YASKAWA

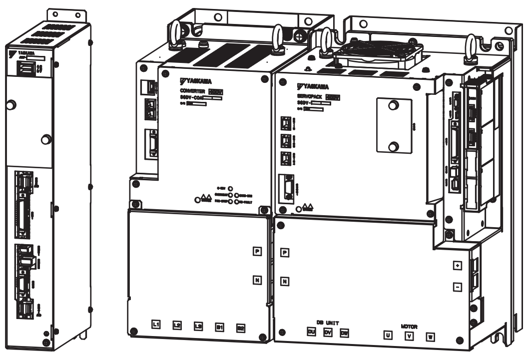
AC Servo Drives

Σ-V Series

USER'S MANUAL
For Use with Large-Capacity Models
Design and Maintenance

Multi-Winding Drive Unit
Rotational Motor
Analog Voltage and Pulse Train References

Multi-Winding Drive Unit Model: JUSP-MD□D01A
SERVOPACK Model: SGDV-□□□J
Converter Model: SGDV-COA
Servomotor Model: SGMVV



MANUAL NO. SIEP S800001 68B

About this Manual

This manual describes information required for designing, testing, adjusting, and maintaining large-capacity models of servo systems in the Σ-V series.

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

■ Description of Technical Terms

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

Term	Meaning
Servomotor	A Σ-V-series SGMVV servomotor
Multi-winding drive unit	A Σ-V-series JUSP-MD□D multi-winding drive unit
SERVOPACK	A Σ-V-series SGDV-□□□J servo amplifier
Converter	A Σ-V-series SGDV-COA converter
Servo Drive	A set that includes a servomotor, a SERVOPACK, and a converter
Multi-winding drive system	A set that includes a servomotors, multi-winding drive unit, SERVOPACK, and converter
Servo System	A servo control system that includes the combination of a servo drive with a host controller and peripheral devices
Analog pulse model	A multi-winding drive unit with an analog voltage or pulse train reference interface
M-II model	A multi-winding drive unit with a MECHATROLINK-II communications reference 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 SERVOPACK.
Main circuit	The circuit related to the main circuit power supply and control power supply
Main circuit power supply	The power supply input to the SERVOPACK (P and N terminals) and converter (L1, L2, and L3 terminals)
Control power supply	The power supply input to the multi-winding drive unit (CN7A/B), SERVOPACK (CN103, CN104), and converter (CN101)
Cursor	Input position indicated by Digital Operator

■ IMPORTANT Explanations

The following icon is displayed for explanations requiring special attention.

IMPORTANT

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

■ Notation Used in this Manual

• Notation for Reverse Signals

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

Notation Example

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

• Notation for Parameters

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

• Parameters for Numeric Settings

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

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

Parameter number

Indicates the setting range for the parameter.

Indicates the minimum setting unit for the parameter.

Indicates the parameter setting before shipment.

Indicates when a change to the parameter will be effective.

Indicates the parameter classification.

• Parameters for Selecting Functions

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

Parameter number

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

This section explains the selections for the function.

Notation Example

Digital Operator Display (Display Example for Pn002)

n.0000

	Digit Notation		Setting Notation	
	Notation	Meaning	Notation	Meaning
1st digit	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.
2nd digit	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.
3rd digit	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.
4th digit	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 Large-Capacity Models

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 For Use with Large-Capacity Models Setup Multi-Winding Drive System Rotational Motors (No. SIEP S800001 85)				✓	✓		
Σ-V Series User's Manual For Use with Large-Capacity Models Design and Maintenance Multi-Winding Drive System Rotational Motor/ Analog Voltage and Pulse Train References (this manual)			✓		✓	✓	✓
Σ-V Series User's Manual Operation of Digital Operator (No.: SIEP S800000 55)					✓	✓	✓
AC Servomotor Safety Precautions (No.: TOBP C230200 00)				✓			✓
AC SERVOPACK and Converter Σ-V Series Safety Precautions For Use with Large-Capacity Models (No.: TOBP C710829 07)	✓			✓			✓
Σ Series Safety Precautions Digital Operator (No.: TOBP C730800 00)							✓

■ Trademarks

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■ 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

These safety precautions are very important. Read them before performing any procedures such as checking products on delivery, storage and transportation, installation, wiring, operation and inspection, or disposal. Be sure to always observe these precautions thoroughly.

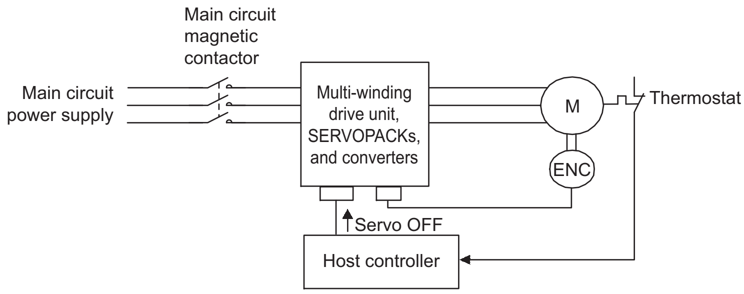
⚠ WARNING

- Never touch any rotating motor parts while the motor is running.
  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 product.
- Never touch the inside of a multi-winding drive unit, SERVOPACK, or converter.
  Failure to observe this warning may result in electric shock.
- Do not remove the front cover of the power supply terminals while the power is ON.
  Failure to observe this warning may result in electric shock.
- Do not touch any terminals while the CHARGE lamp on the SERVOPACK or converter is lit either immediately after the main circuit power supply is turned OFF or after a dielectric strength test. Refer to *3.1.5 Discharging Time of the Main Circuit's Capacitor* for the discharge time of the main circuit capacitor.
  Residual voltage may cause electric shock.
- Follow the procedures and instructions provided in this manual for 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 absolute position detecting system used for Σ-V large-capacity servo drives 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 servo drives must be changed for use with Σ-V large-capacity servo drives. Be sure to make the system modifications.
- The multi-turn 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 multi-winding drive unit 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 front cover, cables, connectors, or optional items from the front of the SERVOPACK and the converter while the power is ON.
  Failure to observe this warning may result in electric shock or damage to the product.
- Do not damage, press, 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, fire, or damage to the product.
- Provide an appropriate braking device 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 a momentary power loss. The machine may restart unexpectedly. Take appropriate measures to ensure safety against an unexpected restart.
  Failure to observe this warning may result in injury.
- Do not wire the regenerative resistor unit incorrectly. Never short-circuit the B1 and B2 terminals.
  Failure to observe this warning may result in fire or damage to the product.
- Always connect the ground terminals (⏚) on the multi-winding drive unit, SERVOPACKs, and converters to ground poles (10 Ω or less.).
  Improper grounding may result in electric shock or fire.

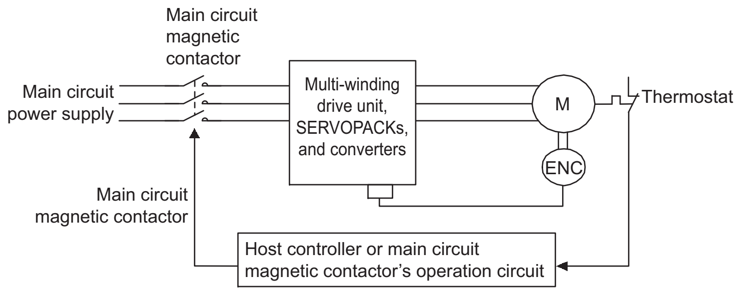
⚠ WARNING

- Be sure to connect the servomotor's built-in thermostat to the host controller or to the main circuit magnetic contactor's operation circuit.

  Failure to observe this warning may result in injury, fire, or damage to the product.
  - Usage Example 1:
    In this example, the output signal from the thermostat is received by the host controller if the thermostat is activated and the host controller turns OFF the servo.



  - Usage Example 2:
    In this example, the main circuit magnetic contactor's operation circuit is activated or the output signal from the thermostat is received by the host controller if the thermostat is activated and the main circuit magnetic contactor is turned OFF.



- 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 product.

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 product.
  - 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 terminal box 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, inflammable gases, or combustibles.
  Failure to observe this caution may result in electric shock or fire.
- Do not step on or place a heavy object on the product.
  Failure to observe this caution may result in injury 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 multi-winding drive unit, SERVOPACKs, converters, control panel, and 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 for the multi-winding drive unit, SERVOPACKs, or converters together with the I/O signal cables or the encoder cables in the same duct. Keep them separated by at least 30 cm.
  Failure to do so may result in malfunction.
- Use shielded twisted-pair wires or multi-core shielded twisted-pair wires for I/O signal cables and encoder cables.
- Use the bus bars that are included with the converter, and connect the P and N terminals on the SERVOPACK and converter securely.
- The maximum wiring length is 3 m for I/O signal cables, 50 m for servomotor main circuit cables and encoder cables, and 10 m for the control power supply cables (+24 V and 0 V).
- Be sure to observe the following precautions when wiring the main circuit terminals and connectors on a multi-winding drive unit, SERVOPACK, or converter.
  - Do not turn ON the power to a multi-winding drive unit, SERVOPACK, or converter until all wiring, including the wiring to the main circuit terminals, has been completed.
  - Remove detachable main circuit terminals from the multi-winding drive unit, SERVOPACK, and converter 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 multi-winding drive unit but not both.
  It is dangerous to install batteries at both ends simultaneously, because that sets up a loop circuit between the batteries.
- Always use the specified power supply voltage.
  An incorrect voltage may result in fire or malfunction.
- Always use the correct polarity (P and N) between the SERVOPACK and converter.
  Incorrect polarity may cause ruptures or damage.
- Take appropriate measures to ensure that the input power supply is supplied within the specified voltage fluctuation range. Be particularly careful in places where the power supply is unstable.
  An incorrect power supply may result in damage to the product.
- 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 product.
- Do not reverse the polarity of the battery when connecting it.
  Failure to observe this caution may damage the battery, multi-winding drive unit, or servomotor, or cause an explosion.
- Wiring or inspection must be performed by a technical expert.
- Use a 24-VDC control power supply with double insulation or reinforced insulation.

■ Operation

⚠ CAUTION

- Always use the servomotor, multi-winding drive unit, SERVOPACK, and converter in one of the specified combinations.
  Failure to observe this caution may result in fire or malfunction.
- Conduct trial operations 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.
  Failure to observe this caution may result in injury or damage to the product.
- Before starting operation with a machine connected, change the settings to match the parameters of the machine.
  Starting operation without matching the proper settings may cause the machine to run out of control or malfunction.
- Do not frequently turn power ON and OFF.
  - Frequently turning power ON and OFF causes elements inside the multi-winding drive unit, SERVOPACKs, and converters to deteriorate. Do not use the system with an application that requires frequently turning power ON and OFF.
  - After the actual operation starts, the allowable interval for turning power ON and OFF is one hour or longer.
- When using JOG operations (Fn002) origin search operations (Fn003), or EasyFFT operations (Fn206), the dynamic brake function does not work for reverse overtravel or forward overtravel. Take necessary precautions.
  Failure to observe this caution may result in damage to the product.
- 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.
- Before you start operation, always set the moment of inertia ratio (Pn103) correctly.
  Setting to an incorrect moment of inertia ratio may cause vibration.
- Do not touch the SERVOPACK or converter heat sink, regenerative resistor, or motor 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 product 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 product, 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

- Never disassemble a multi-winding drive unit, SERVOPACK, or converter.
  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 multi-winding drive unit, resume operation only after copying the previous multi-winding drive unit parameters to the new multi-winding drive unit.
  Failure to observe this caution may result in damage to the product.
- Be sure to eliminate static electricity before operating buttons and switches inside the plastic cover.
  Failure to observe this caution may result in damage to the product.

■ Disposal

⚠ CAUTION

- When disposing of the products, treat them as ordinary industrial waste.

■ General Precautions

Observe the following general precautions to ensure safe application.

- The products shown in illustrations in this manual are sometimes shown without covers or protective guards. Always replace the cover or protective guard as specified first, and then operate the products in accordance with the manual.
- The drawings presented in this manual are typical examples and may not match the product you received.
- If the manual must be ordered due to loss or damage, inform your nearest Yaskawa representative or one of the offices listed on the back of this manual.

Warranty

(1) Details of Warranty

■ Warranty Period

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

■ Warranty Scope

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

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

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

(2) Limitations of Liability

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

(3) Suitability for Use

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

(4) Specifications Change

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

Harmonized Standards

■ North American Safety Standards (UL)

Name (Model)	UL Standards (UL File No.)	Mark
SERVOPACKs (SGDV-□□□J), converters (SGDV-COA)	UL508C (E147823)	
Multi-winding drive units (JUSP-MD□D)	UL508C (E147823)	
Servomotors (SGMVV)	UL1004 (E165827)	

■ European Directives

Name (Model)	European Directives	Harmonized Standards
Multi-winding drive units (JUSP-MD□D), SERVOPACKs (SGDV-□□□J), converters (SGDV-COA)	Machinery Directive 2006/42/EC	EN ISO13849-1: 2008, EN 954-1
	EMC Directive 2004/108/EC	EN 55011 group 1 class A, EN 61000-6-2, EN 61800-3
	Low Voltage Directive 2006/95/EC	EN 50178, EN 61800-5-1
Servomotors (SGMVV)	EMC Directive 2004/108/EC	EN 55011 group 1 class A, EN 61000-6-2, EN 61800-3
	Low Voltage Directive 2006/95/EC	EN 60034-1, EN 60034-5/A1

■ Safety Standards

Name (Model)	Safety Standards	Standards
SERVOPACKs (SGDV-□□□J)	Safety of Machinery	EN ISO13849-1: 2008, EN 954-1, IEC 60204-1
	Functional Safety	IEC 61508 series, IEC 62061, IEC 61800-5-2
	EMC	IEC 61326-3-1

■ Safe Performance

Items	Standards	Performance Level
Safety Integrity Level	IEC 61508	SIL2
	IEC 62061	SILCL2
Probability of Dangerous Failure per Hour	IEC 61508, IEC 62061	PFH ≤ 1.7×10^{-9} [1/h] (0.17% of SIL2)
Category	EN 954-1	Category 3
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	DCave: Low
Stop Category	IEC 60204-1	Stop category 0
Safety Function	IEC 61800-5-2	STO
Proof test Interval	IEC 61508	10 years

Contents

1

Outline

1.1 Σ-V Large-Capacity Multi-Winding Drive Unit, SERVOPACKs and Converters

The Σ-V-series servo drives were designed for applications that require high-speed, high-frequency positioning. They can quickly maximize machine performance to help improve productivity.

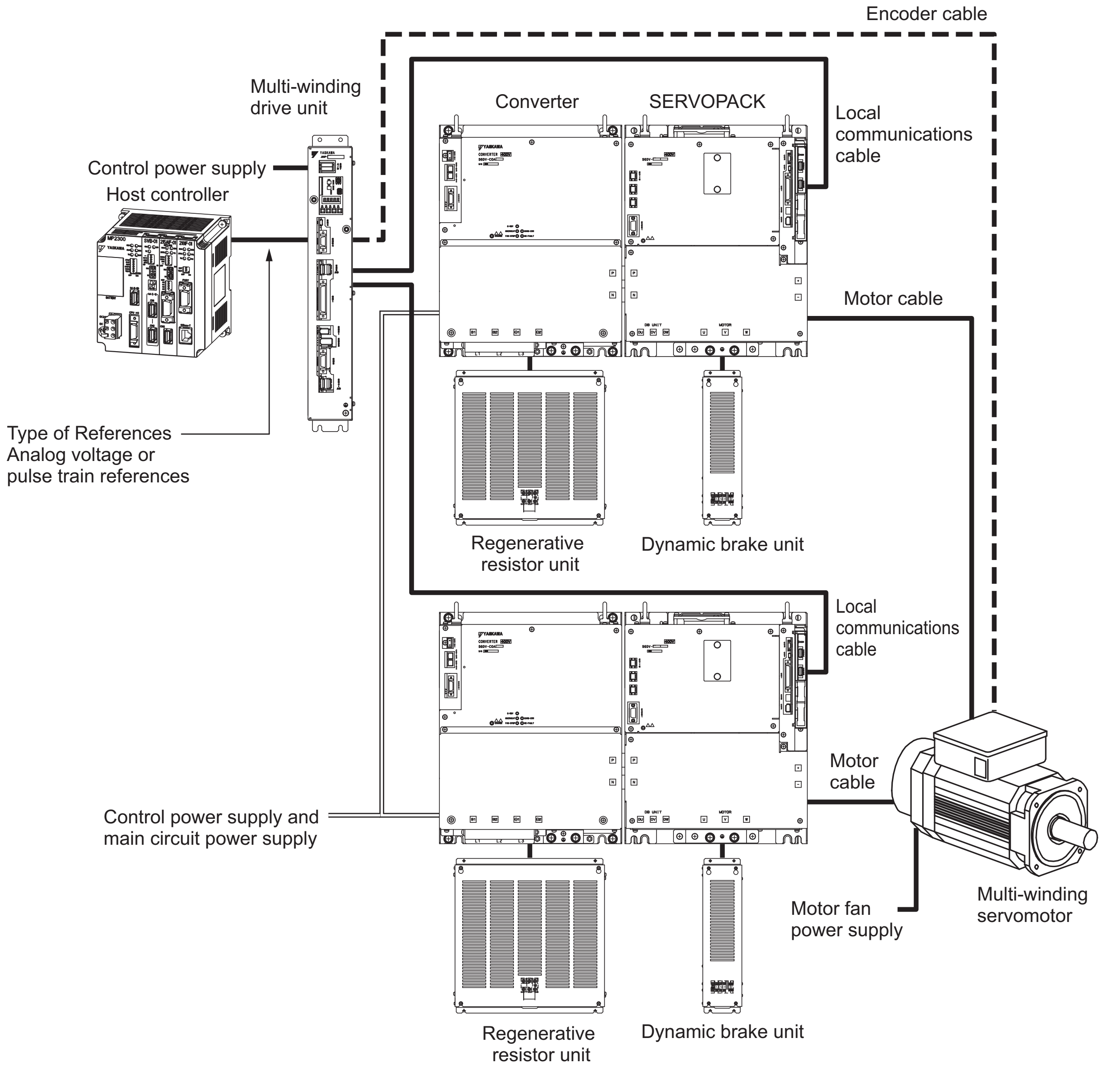
1.2 System Configuration Diagram

A multi-winding drive system consists of a multi-winding drive unit, SERVOPACKs, converters, and a multi-winding servomotor.

The functions of the multi-winding drive unit, SERVOPACKs, and converters are described below.

- Multi-winding Drive Unit
  The multi-winding drive unit is connected to the encoder of a servomotor and it performs position, speed, or torque control.
  It controls the SERVOPACKs through local communications cables.
- SERVOPACKs and Converters
  The SERVOPACKs and converters drive the servomotor based on references they receive from the multi-winding drive unit.

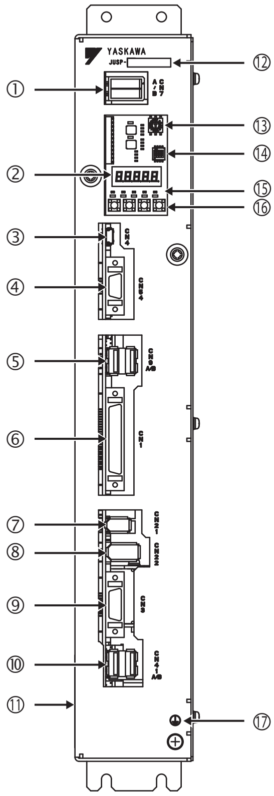
The following figure shows a system configuration example.



1.3 Part Names

1.3.1 Multi-Winding Drive Unit Part Names

The part names of the multi-winding drive unit are given below.



No.	Name	Description	Reference
①	Control power supply input connectors (CN7A and CN7B)	CN7A is the 24 VDC (±15%) input connector. CN7B takes the same input, but it is normally not necessary to connect it.	–
②	Panel display	Shows the status of the multi-winding drive system with a seven-segment LED display.	–
③	Personal computer connector (CN4)	A USB connector used to connect a personal computer. Use the special personal computer cable to make the connection.	–
④	Digital operator connector (CN54)	Used to connect to a digital operator or personal computer (RS422).	–
⑤	Connectors (CN9A and CN9B)	Do not connect anything to these connectors.	–
⑥	Connector for I/O signals (CN1)	Used to connect sequence I/O signals.	–
⑦	Encoder connector (CN21)	Connects to the encoder cable.	–
⑧	CN22 connector	Do not connect anything to this connector.	–
⑨	CN3 connector	Do not connect anything to this connector.	–
⑩	Local communications connectors (CN41A and CN41B)	Used to connect the SERVOPACKs.	–
⑪	Nameplate	Gives the product model number and ratings. It is attached to the side of the unit.	–
⑫	Model number	Gives the model number of the multi-winding drive unit.	–

(cont'd)

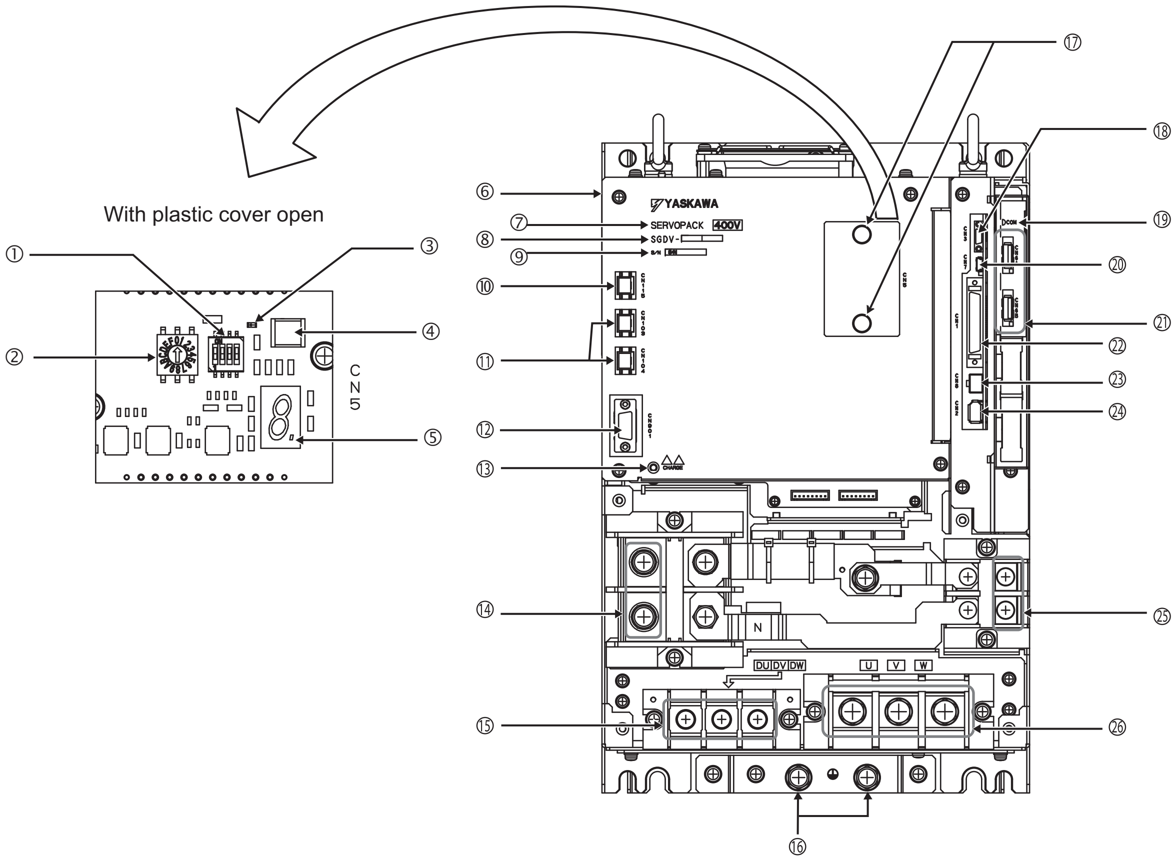
No.	Name	Description	Reference
⑬	Rotary switch (S1001)	Do not use this switch.	–
⑭	DIP switch (S1002)	Do not use this switch.	–
⑮	MS1 LED indicator	This indicator cannot be used.	–
	MMA, MM2, MM3, and MM4 LED indicators	Lights green when local communications are ready.	–
⑯	Panel operator keys	Used to set parameters.	*2.1 Overview*
⑰	Ground terminal	Used to protect against electrical shock. Be sure to ground this terminal.	*3.1 Main Circuit Wiring*

1.3.2 SERVOPACK Part Names

This section describes the part names of SERVOPACKs.

Use a SERVOPACK together with a converter. For details, refer to *1.7 Combinations for Multi-Winding Drive Systems*.

Note: For the purpose of this description, the SERVOPACK is shown with the front cover removed. Always keep the front cover attached when using the SERVOPACK.



No.	Name	Description	Reference
①	DIP switch (S3)	Do not use this switch.	–
②	Rotary switch (S2)	Do not use this switch.	–
③	Power LED indicator (POWER)	Indicates that the control power is being supplied (green).	–
④	CN5 connector	Do not use this connector.	–

(cont'd)

No.	Name	Description	Reference
⑤	Panel display	Indicates the servo status with a seven-segment LED display.	–
⑥	Nameplate	Indicates the SERVOPACK model and ratings. Located on the side of the SERVOPACK.	–
⑦	Input voltage	–	–
⑧	SERVOPACK model	Indicates the model number of the SERVOPACK.	*1.6 Model Designations*
⑨	Serial number	–	–
⑩	Dynamic brake unit connector (CN115)	Used for ON/OFF control of the magnetic contactor in the dynamic brake unit. Connect this connector to terminals DBON and DB24 on the dynamic brake unit.	–
⑪	Control power input connectors (CN103 and CN104)	Used to input 24 VDC (±15%). CN103 and CN104 are equivalent inputs. It is normally not necessary to connect CN104.	–
⑫	SERVOPACK-converter I/O connector (CN901)	Connect this connector to CN901 on the converter.	–
⑬	Charge indicator	Lights (orange) when the main circuit power supply is ON and stays lit as long as the internal capacitor remains charged. Therefore, do not touch the SERVOPACK even after the power supply is turned OFF if the indicator is lit. It may result in electric shock.	–
⑭	Main circuit DC voltage input terminals (P and N)	Connect these terminals to P and N on the converter.	–
⑮	Dynamic brake unit connection terminals (DU, DV, and DW)	Use these terminals to connect the dynamic brake unit. Do not connect servomotors to these terminals.	–
⑯	Ground terminal	Be sure to connect to protect against electrical shock.	*3.1 Main Circuit Wiring*
⑰	Plunger	Do not use this plunger.	–
⑱	CN3 connector	Do not use this connector.	–
⑲	Communications LED indicator (COM)	Lights green during local bus communications.	–
⑳	CN7 connector	Do not use this connector.	–
㉑	Local communications connectors (CN6A and CN6B)	CN6A: Connect this connector to the multi-winding drive unit. CN6B: Connect this connector to terminating resistance.	–
㉒	I/O signal connector (CN1)	Used for sequence I/O signals.	*3.3 I/O Signal Connections*
㉓	Connector for safety function devices (CN8)	Connect a safety function device. Note: When not using the safety function, use the SERVOPACK with the safety function's jumper connector (provided as an accessory) inserted.	*3.3.2 SERVOPACK Safety Function Signal (CN8) Names and Functions* *5.11 Safety Function*
㉔	CN2 connector	Do not use this connector.	–
㉕	+, - terminals	Do not connect anything to these terminals.	–
㉖	Servomotor terminals (U, V, W)	Connect the main circuit cable (power line) for servomotor.	*3.1 Main Circuit Wiring*

Outline

1

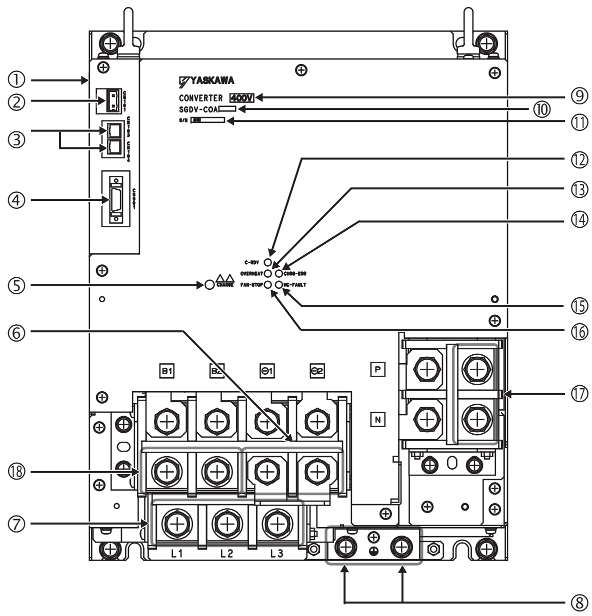
1.3.3 Converter Part Names

This section describes the parts of a converter.

Use a converter together with a SERVOPACK. For details, refer to *1.7 Combinations for Multi-Winding Drive Systems*.

Note: For the purpose of this description, the converter is shown with the front cover removed. Always keep the front cover attached when using the converter.

Converter
SGDV-COA5EDA



No.	Name	Description	Reference
①	Nameplate	Indicates the converter model and ratings. Located on the side of the converter.	–
②	Control power input connector (CN101)	Used to connect the control power input.	*3.1 Main Circuit Wiring*
③	Control power output connectors (CN103 and CN104)	These connectors output 24 VDC to the SERVOPACK. CN103 and CN104 are equivalent outputs. It is normally not necessary to connect CN104.	–
④	SERVOPACK-converter I/O connector (CN901)	Connect this connector to CN901 on the SERVOPACK.	–
⑤	Charge indicator	Lights (orange) when the main circuit power supply is ON and stays lit as long as the internal capacitor remains charged. Therefore, do not touch the converter even after the power supply is turned OFF if the indicator is lit. It may result in electric shock.	–
⑥	DC reactor terminals for harmonic suppression (⊖1 and ⊖2)	Connect a DC reactor for harmonic suppression.	*3.10.3 Connecting a Reactor for Harmonic Suppression*
⑦	Main circuit power supply terminals (L1, L2, and L3)	Used for main circuit power supply input.	*3.1 Main Circuit Wiring*
⑧	Ground terminals	Be sure to connect to protect against electrical shock.	*3.1 Main Circuit Wiring*
⑨	Input voltage	–	–
⑩	Converter model	Indicates the model number of the converter.	–
⑪	Serial number	–	–

(cont'd)

No.	Name	Description	Reference
⑫	Converter LED indicator (C-RDY)	Lights (green) when the converter is ready to be used for operations.	–
⑬	Converter LED indicator (OVERHEAT)	Lights (red) when the converter's heat sink is overheated.	–
⑭	Converter LED indicator (CHRG-ERR)	Lights (red) when the voltage between the main circuit's DC voltage output terminals P and N is abnormal.	–
⑮	Converter LED indicator (FANSTOP)	Lights (red) when an error occurs while the converter fan is running.	–
⑯	Converter LED indicator (MC-FAULT)	Lights (red) when an error occurs when the inrush current limit relay is used.	–
⑰	Main circuit DC voltage output terminals (P and N)	Connect these terminals to P and N on the SERVOPACK.	–
⑱	Regenerative resistor connecting terminals (B1 and B2)	Connect external regenerative resistors.	*3.8 Selecting and Connecting a Regenerative Resistor Unit*

1.4 Ratings and Specifications of a Multi-Winding Drive System

This section gives the ratings and specifications of a multi-winding drive system.

1.4.1 Ratings

(1) Multi-Winding Drive Unit Ratings

The ratings of the multi-winding drive unit are given below.

Model (JUSP-MD□D)	3D
Control Power Supply	24 VDC (+15% to -15%), 0.6 A
Overvoltage Category	III

(2) Ratings of SERVOPACKs and Converters

Ratings of SERVOPACKs and converters are as shown below.

SERVOPACK Model	SGDV-□□□□	101J
Converter Model	SGDV-COA□□□□	5EDA
Continuous Output Current [Arms]		98
Instantaneous Max. Output Current [Arms]		230
Regenerative Resistor Unit*		External
Dynamic Brake Unit		External
Main Circuit Power Supply		Three-phase, 380 to 480 VAC, -15% to 15%, 50/60 Hz
Control Power Supply		24 VDC, ±15%
Overvoltage Category		III

* Refer to *3.8 Selecting and Connecting a Regenerative Resistor Unit* for details.

1.4.2 Basic Specifications

(1) Multi-Winding Drive Unit Specifications

Feedback			Encoder: 20-bit (incremental or absolute)	
Operating Conditions	Surrounding Air Temperature		0°C to +55°C	
	Storage Temperature		-10°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	The environment must satisfy 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		1,000 m or less	
	Others		Free of static electricity, strong electromagnetic fields, magnetic fields or exposure to radioactivity	
Mounting			Base-mounted	
Approximate Mass			2.6 kg	
Connectable SERVOPACKs			Two, large-capacity Σ-V SERVOPACKs	
Connection Method with SERVOPACKs			Two serial communications ports (Each SERVOPACK is connected 1:1.)	
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 Pulses			Phases A, B, and C: Line driver Encoder output pulses: User specified.
	Sequence Inputs	Fixed Input		Encoder absolute data request (SEN)
		Input Signals That Can Be Allocated	Number of Channels	7
			Functions	• Servo ON (/S-ON) • Proportional control (/P-CON) • Forward run prohibited (P-OT) and reverse run prohibited (N-OT) • Alarm reset (/ALM-RST) • Forward external torque limit (/P-CL) and reverse external torque limit (/N-CL) • Internal set speed control (/SPD-D, /SPD-A, /SPD-B) • Control selection (/C-SEL) • Zero clamping (/ZCLAMP) • Reference pulse inhibit (/INHIBIT) • Gain selection (/G-SEL) • Reference pulse input multiplication switching (/PSEL) Signal allocations can be performed, and positive and negative logic can be changed.
		Fixed Outputs		Servo alarm (ALM) and alarm code (ALO1, ALO2, ALO3)
		Output Signals That Can Be Allocated	Number of Channels	3
			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) • Reference pulse input multiplication switching output (/PSELA) Signal allocations can be performed, and positive and negative logic can be changed.
Communications Function	RS422A Communications (CN54)	Interface		Digital operator (Model: JUSP-OP05A-E), personal computer (can be connected with SigmaWin+)
		1:N Communications		N = Up to 15 stations possible at RS422A port
		Axis Address Setting		Set by parameter
	USB Communications (CN4)	Interface		Personal computer (can be connected with SigmaWin+)
		Communications Standard		Complies with standard USB 1.1. (12 Mbps).
Indicators				MS1, MN1, MN2, MN3, and MN4 LED indicators
Panel Operator Functions		Display Unit		Five, 7-segment LED digits
		Switches		Four push switches
Analog Monitor (CN1)				Number of points: 2 Output voltage: ±10 VDC (linearity effective range: ±8 V) Resolution: 16 bits Accuracy: ±20 mV (Typ) Max. output current: ±10 mA Settling time (±1%): 1.2 ms (Typ)

(cont'd)

Dynamic Brake (DB)*2	Included. External dynamic brake units are required for the SERVOPACKs.
Regenerative Processing	Included. External regenerative resistor units are required for the converters
Overtravel Prevention (OT)	Dynamic brake stop, deceleration to a stop, or coasting to a stop at P-OT or N-OT
Protective Functions	Overcurrent, overvoltage, insufficient voltage, overload, regeneration error, etc.
Utility Functions	Gain adjustment, alarm history, JOG operation, origin search, etc.

∗1. Speed 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. Set Pn001 to n.□□□2 if you will not use the dynamic brake.

(2) Basic Specifications of SERVOPACKs and Converters

Basic specifications of SERVOPACKs and converters are shown below.

<table>
<tr><td colspan="3">Drive Method</td><td colspan="2">Sine-wave current drive with PWM control of IGBT</td></tr>
<tr><td rowspan="10">Operating Conditions</td><td colspan="2">Surrounding Air Temperature</td><td colspan="2">0°C to +55°C</td></tr>
<tr><td colspan="2">Storage Temperature</td><td colspan="2">-20°C to +85°C</td></tr>
<tr><td colspan="2">Ambient Humidity</td><td>90% RH or less</td><td rowspan="2">With no freezing or condensation</td></tr>
<tr><td colspan="2">Storage Humidity</td><td>90% RH or less</td></tr>
<tr><td colspan="2">Vibration Resistance</td><td colspan="2">4.9 m/s²</td></tr>
<tr><td colspan="2">Shock Resistance</td><td colspan="2">19.6 m/s²</td></tr>
<tr><td colspan="2">Protection Class</td><td>IP10</td><td rowspan="2">The environment must satisfy the following conditions:
• Free of corrosive or flammable gases
• Free of exposure to water, oil, or chemicals
• Free of dust, salts, or iron dust</td></tr>
<tr><td colspan="2">Pollution Degree</td><td>2</td></tr>
<tr><td colspan="2">Altitude</td><td colspan="2">1000 m or less</td></tr>
<tr><td colspan="2">Others</td><td colspan="2">Free of static electricity, strong electromagnetic fields, magnetic fields or exposure to radioactivity</td></tr>
<tr><td colspan="3">Harmonized Standards
(Application pending)</td><td colspan="2">UL508C
EN 50178, EN 55011 group 1 class A, EN 61000-6-2,
EN 61800-3, EN 61800-5-1, EN 954-1, IEC 61508-1 to 4</td></tr>
<tr><td colspan="3">Mounting</td><td colspan="2">Standard: Base-mounted
Optional: Duct-ventilated</td></tr>
<tr><td rowspan="2">I/O Signals</td><td>Sequence Input</td><td>Fixed Inputs</td><td colspan="2">DB answer (/DBANS)</td></tr>
<tr><td>Sequence Output</td><td>Fixed Output</td><td colspan="2">Servo alarm (ALM) output</td></tr>
<tr><td colspan="3">LED Display</td><td colspan="2">Panel display (seven-segment), CHARGE, POWER, and COM indicators, one 7-segment LED</td></tr>
<tr><td colspan="3">Dynamic Brake (DB)*1</td><td colspan="2">Included
An external dynamic brake unit is required.</td></tr>
<tr><td colspan="3">Regenerative Processing</td><td colspan="2">Included
An external regenerative resistor unit is required.</td></tr>
<tr><td colspan="3">Protective Function</td><td colspan="2">Overcurrent, overvoltage, insufficient voltage, overload, regeneration error, and so on.</td></tr>
<tr><td colspan="3">Utility Function</td><td colspan="2">Current detection offset adjustment and alarm history</td></tr>
<tr><td colspan="2" rowspan="2">Safety Function *2</td><td>Input</td><td colspan="2">/HWBB1, /HWBB2: Baseblock signal for power module</td></tr>
<tr><td>Output</td><td colspan="2">EDM1: Monitoring status of internal safety circuit (fixed output)</td></tr>
</table>

*1. Set Pn001 to □□□2 in the multi-winding drive unit parameters if you will not use the dynamic brake.
*2. Implement risk assessment and confirm that the safety requirements of the machine have been met.

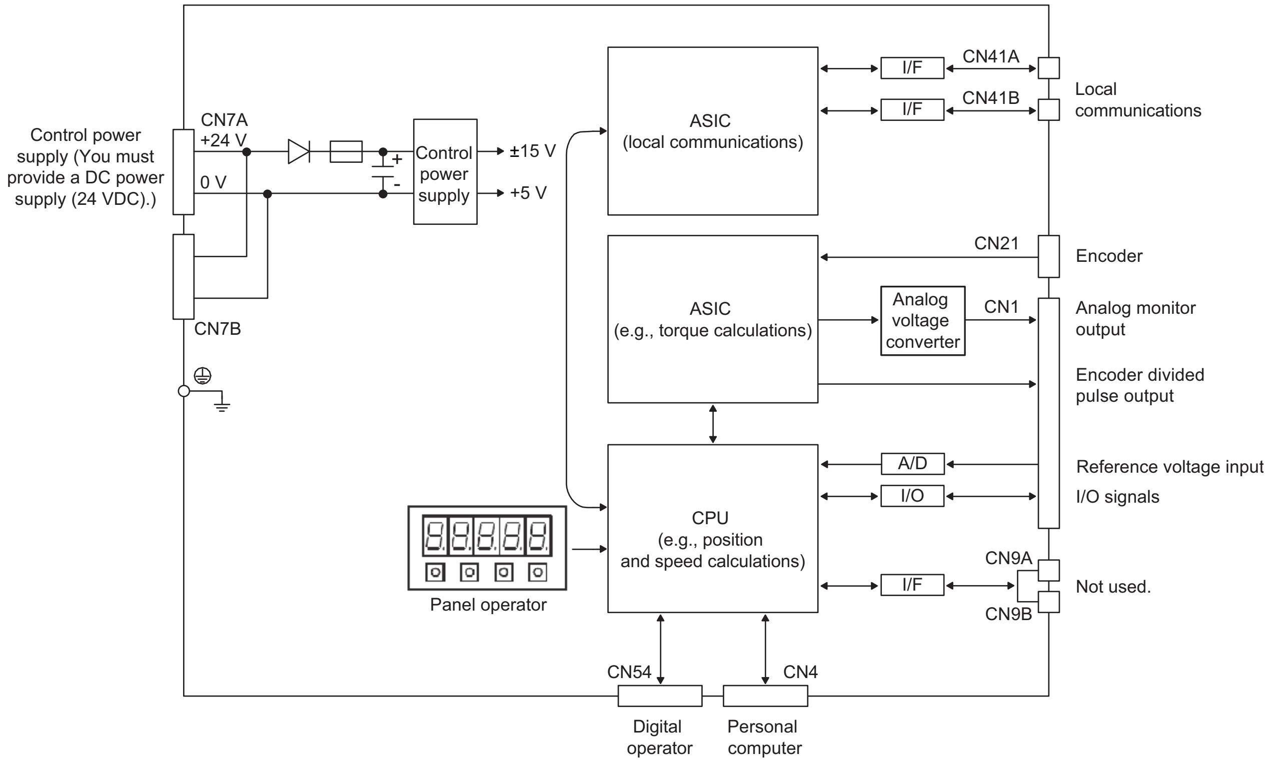
1.4.3 Speed/Position/Torque Control

The following table shows the basic specifications of the multi-winding drive unit at speed/position/torque control.

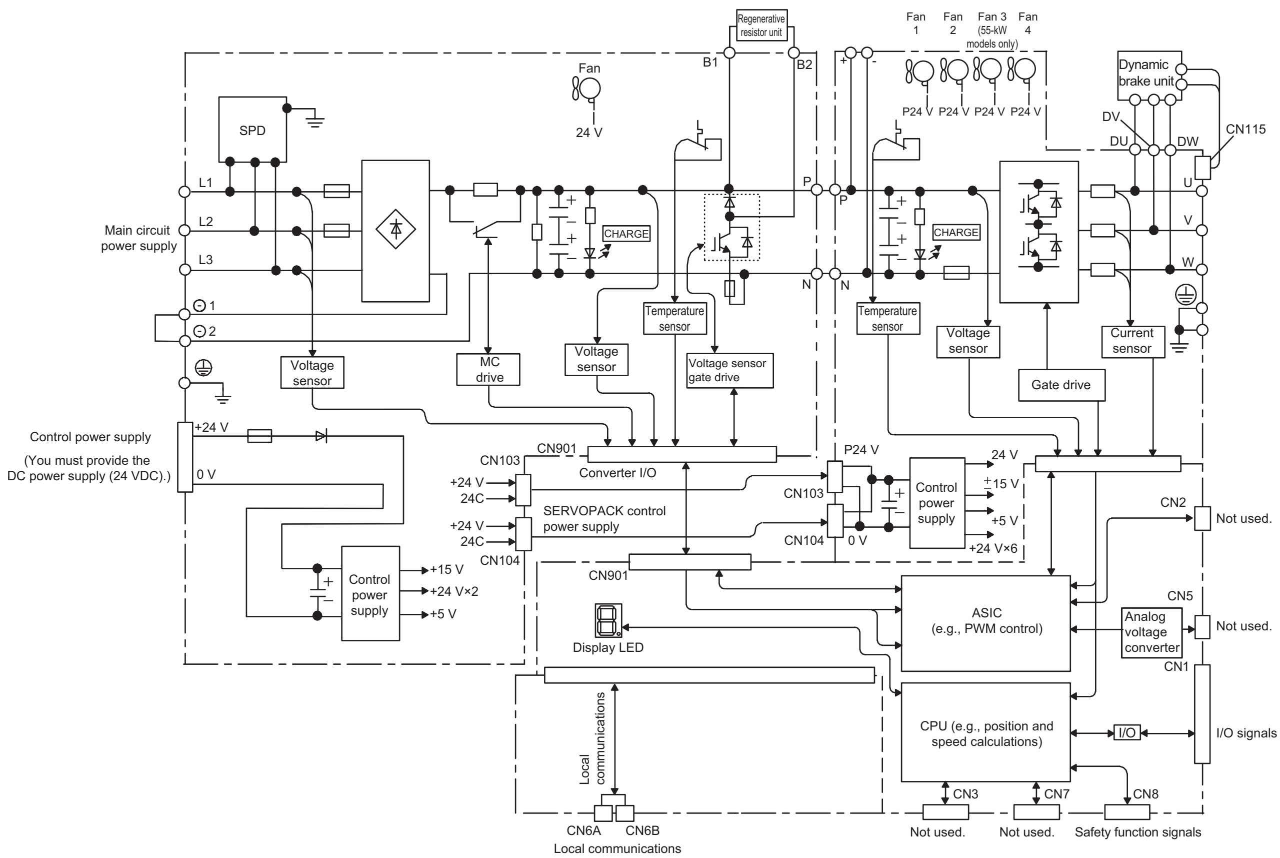
Control Method				Specifications
Speed Control	Performance	Soft Start Time Setting		0 to 10 s (Can be set individually for acceleration and deceleration.)
Speed Control	Input Signals	Reference Voltage		• Max. input voltage: ±12 V (forward speed reference with positive reference) • Factory setting: 6 VDC at rated speed Input gain setting can be varied.
Speed Control	Input Signals	Input Impedance		Approx. 14 kΩ
Speed Control	Input Signals	Circuit Time Constant		30 μs
Speed Control	Internal Set Speed Control	Rotation Direction Selection		With P control signal
Speed Control	Internal Set Speed Control	Speed Selection		With forward/reverse external torque limit signal (speed 1 to 3 selection). Servomotor stops or another control method is used when both are OFF.
Position Control	Performance	Feedforward Compensation		0% to 100%
Position Control	Performance	Positioning Completed Width Setting		0 to 1073741824 reference units
Position Control	Input Signals	Reference Pulse	Type	Select one of them: Sign + pulse train, CW + CCW pulse train, or two-phase pulse train with 90° phase differential
Position Control	Input Signals	Reference Pulse	Form	For line driver, open collector
Position Control	Input Signals	Reference Pulse	Max. Input Pulse Frequency	Line driver Sign + pulse train, CW + CCW pulse train: 4 Mpps Two-phase pulse train with 90° phase differential: 1 Mpps Open Collector Sign + pulse train, CW + CCW pulse train: 200 kpps Two-phase pulse train with 90° phase differential: 200 kpps
Position Control	Input Signals	Reference Pulse	Reference Pulse Input Multiplication Switching	1 to 100 times
Position Control	Input Signals	Clear Signal		Position error clear For line driver, open collector
Torque Control	Input Signals	Reference Voltage		• Max. input voltage: ±12 V (forward torque reference with positive reference) • Factory setting: 3 VDC at rated torque Input gain setting can be varied.
Torque Control	Input Signals	Input Impedance		Approx. 14 kΩ
Torque Control	Input Signals	Circuit Time Constant		16 μs

1.5 Internal Block Diagrams

1.5.1 Internal Block Diagram of the Multi-Winding Drive Unit



1.5.2 Internal Block Diagram for SERVOPACK and Converter



1.6 Model Designations

1.6.1 Multi-Winding Drive Unit Model Designation

This section shows the multi-winding drive unit model designation.

	1st + 2nd digits	3rd digit	4th digit	5th + 6th digits	7th digit	8th + 9th + 10th digits	11th + 12th digits	13th digit
JUSP –	MD	3	D	01	A	000	00	0

Series	
JUSP	Servo peripheral devices

1st + 2nd digits	
MD	Multi-winding drive unit

3rd digit: Power Supply Capacity (Maximum Applicable Motor)	
3	75 kW

4th digit: Main Circuit Power Supply Voltage

Code	Voltage
D	DC power input from separate 400-VAC converter

5th + 6th digits: Interface Specifications

Code	Interface
01	Analog voltage and pulse train reference, rotational servomotor

7th digit: Design Revision Order

8th + 9th + 10th digits: Hardware Specifications

Code	Specification
000	Base-mounted (standard)
001	Duct-ventilated
002	Varnished
003	Duct-ventilated and varnished

11th + 12th digits: Software Specification

Code	Specification
00	Standard

13th digit: Parameter Specification

Code	Specification
0	Standard

Note: When digits 8 to 13 are all zeros (0) in the model designation, the zeros are not shown.

1.6.2 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 digits	13th digit
SGDV –	101	J	F1	A	000	00	0

Series	
SGDV	Σ-V Series

7th digit: Design Revision Order

1st + 2nd + 3rd digits: Current		
Voltage	Code	Max. Allowable Motor Capacity
400 V	101	37.5 kW

4th digit: Main Circuit Power Supply Voltage	
Code	Voltage
J	DC power input from separate 400-VAC converter

5th + 6th digits: Interface Specifications	
Code	Interface
F1	Multi-winding drive type, rotational servomotor

8th + 9th + 10th digits: Hardware Specifications	
Code	Specifications
000	Base-mounted (standard)
001	Duct-ventilated
002	Varnished
003	Duct-ventilated and Varnished

11th + 12th digits: Software Specification	
Code	Specification
00	Standard

13th digit: Parameter Specification	
Code	Specification
0	Standard

Note: When digits 8 to 13 are all zeros (0) in the model designation, the zeros are not shown.

1.6.3 Converter Model Designation

This section shows converter model designation.

	1st + 2nd + 3rd digits	4th + 5th + 6th digits	7th digit	8th + 9th + 10th + 11th + 12th + 13th digits
SGDV –	COA	5ED	A	000000

Series	
SGDV	Σ-V Series

7th digit: Design Revision Order

1st + 2nd + 3rd digits: Product group	
Code	Specifications
COA	Resistive regenerative converter

4th + 5th + 6th digits: Power Supply Capacity and Voltage Specifications		
Code	Power Supply Capacity	Voltage
5ED	55 kW	400 V

8th + 9th + 10th + 11th + 12th +13th digits: Hardware Specifications	
Code	Specifications
000000	Base-mounted (standard)
001000	Dust-ventilated
002000	Varnished
003000	Dust-ventilated and Varnished

Note: When digits 8 to 13 are all zeros (0) in the model designation, the zeros are not shown.

1.7 Combinations for Multi-Winding Drive Systems

This section gives the combinations for a multi-winding drive system.

Main Circuit Power Supply Voltage	Servomotor			SERVOPACKs	Converters	Multi-Winding Drive Unit
	Motor Speed	Model: SGMVV-	Capacity	Model: SGDV-	Model: SGDV-COA	Model: JUSP-
Three-phase, 400 VAC	1500 min^{-1}	7ED□B	75 kW	101J	5EDA	MD3D□□A

1.8 Inspection and Maintenance of a Multi-Winding Drive System

This section describes the inspection and maintenance of a multi-winding drive system.

(1) Inspections for a Multi-Winding Drive System

The multi-winding drive unit, SERVOPACKs, and converters do not need to be inspected every day. Perform the following inspections at least once every year. Other routine inspections are not required.

Item	Frequency	Procedure	Comments
Exterior	At least once a year	Check for dust, dirt, and oil on the surfaces.	Clean with compressed air.
Loose Screws		Check for loose terminal block and connector screws.	Tighten any loose screws.

(2) Parts Replacement Schedule for a Multi-Winding Drive System

The following electric or electronic parts in the multi-winding drive unit, SERVOPACKs, and converters are subject to mechanical wear or deterioration over time. Refer to the following tables for the standard replacement periods.

■ Multi-Winding Drive Unit

Part	Standard Replacement Period	Operating Conditions
Electrolytic Capacitor	10 years	• Surrounding air temperature: Annual average of 30°C • Operation rate: 20 hours/day max.

■ SERVOPACKs and Converters

Part	Standard Replacement Period
Cooling Fan	4 to 5 years
Smoothing Capacitor	7 to 8 years
Other Aluminum Electrolytic Capacitor	5 years
Relays	–
Fuses	10 years

Note: The standard replacement period is given for usage under the following operating conditions.
- Surrounding air temperature: Annual average of 30°C
- Load factor: 80% max.
- Operation rate: 20 hours/day max.

IMPORTANT

The parameters of any multi-winding drive unit overhauled by Yaskawa are reset to the factory settings before shipping. Be sure to confirm that the parameters are properly set before starting operation.

2

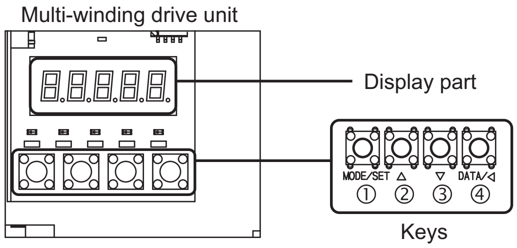
Panel Operator

2.1 Overview

2.1.1 Names and Functions

Panel operator consists of display part and keys.
Setting parameters, displaying status, executing utility functions, and monitoring multi-winding drive unit or converter operation are possible with the panel operator.

The names and functions of the keys on the panel operator are as follows.

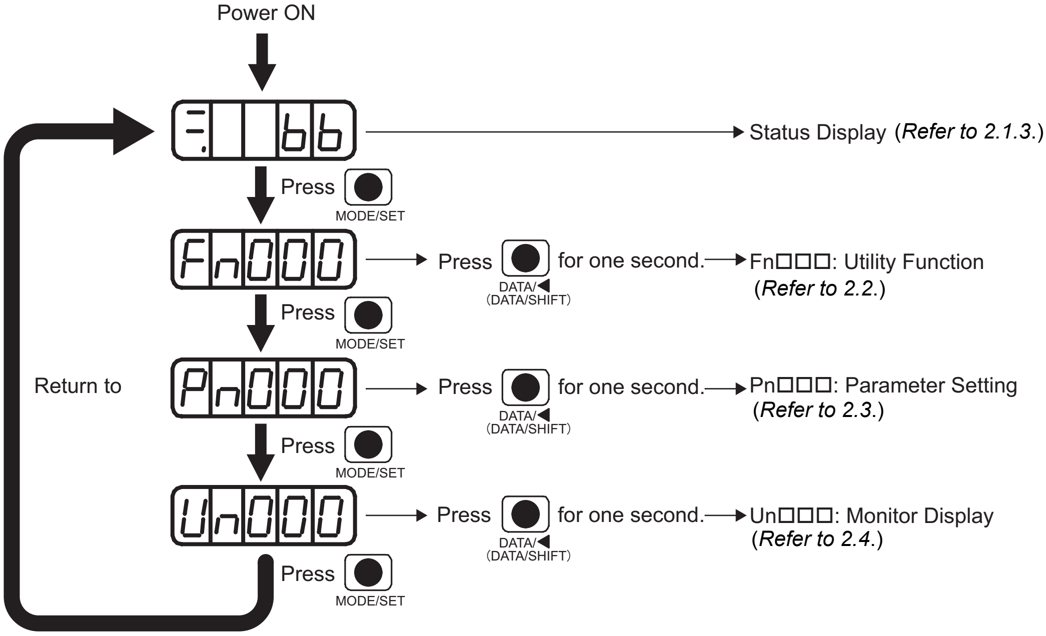


Note: To reset the servo alarm, press the UP Key and the DOWN Key simultaneously. Be sure to remove the cause and then reset the alarm.

Key No.	Key Name	Function
①	MODE/SET Key	• To select a display. • To set the set value.
②	UP Key	To increase the set value.
③	DOWN Key	To decrease the set value.
④	DATA/SHIFT Key	• To display the set value by pressing this key for one second. • To move to the next digit on the left when flashing.

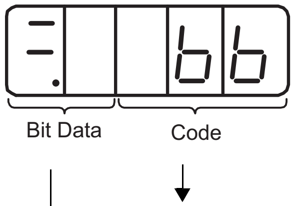
2.1.2 Display Selection

Press the MODE/SET Key to make a selection in the following order.

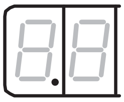
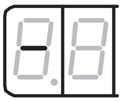
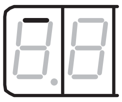
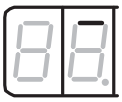
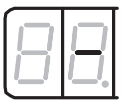
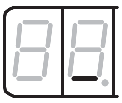
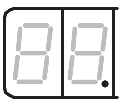


2.1.3 Status Display

The display shows the following status.



Code	Meaning	Code	Meaning
bb	Baseblock Servo OFF (servomotor power OFF)	not	Reverse Run Prohibited N-OT is OFF.
run	Run Servo ON (servomotor power ON)	Hbb	Safety Function The SERVOPACK and converter are baseblocked by the safety function.
Pot	Forward Run Prohibited P-OT is OFF.	020	Alarm Flashes the alarm number.

Display	Meaning
	Control Power ON Lit while the control power supply to the multi-winding drive unit is ON. Not lit while the control power supply to the multi-winding drive unit is OFF.
	Baseblock Lights when the servomotor is OFF.
	In speed control: Speed Coincidence (/V-CMP) Lights when the difference between the servomotor speed and reference speed is the same as or less than the value set in Pn503. (Factory setting: 10 min^{-1}) ∗ Always lights in torque control. Note: If there is noise in the reference voltage during speed control, the horizontal line (-) at the far left edge of the panel operator display may flash. Refer to *3.10.1 Wiring for Noise Control* and take a preventive measures. In position control: Positioning Completion (/COIN) Lights if error between position reference and actual motor position is less than the value set in Pn522. (Factory setting: 7 reference units)
	Rotation Detection (/TGON) Lights if motor speed exceeds the value set in Pn502. (Factory setting: 20 min^{-1})
	In speed control: Speed Reference Input Lights if input speed reference exceeds the value set in Pn502. (Factory setting: 20 min^{-1}) In position control: Reference Pulse Input Lights if reference pulse is input.
	In torque control: Torque Reference Input Lights if input torque reference exceeds preset value (10% of the rated torque). In position control: Clear Signal Input Lights when clear signal is input.
	Power Ready Lights when main circuit power supply is ON.

2.2 Utility Functions (Fn□□□)

The utility functions are related to the setup and adjustment of the multi-winding drive unit.

In this case, the panel operator displays numbers beginning with Fn.

Fn003

Display Example for Origin Search

The following table outlines the procedures necessary for an origin search (Fn003).

Step	Display after Operation	Keys	Operation
1	Fn000	MODE/SET	Press the MODE/SET Key to select the utility function.
2	Fn003	▲ ▼	Press the UP or DOWN Key to select Fn003.
3	-. .CSr	DATA/◀	Press the DATA/SHIFT Key for approximately one second, and the display shown on the left appears.
4	. .CSr	MODE/SET	Press the MODE/SET Key to turn the servomotor power ON. The display shown on the left appears.
5	. .CSr	▲ ▼	Pressing the UP Key will rotate the servomotor in the forward direction. Pressing the DOWN Key will rotate the servomotor in the reverse direction. The rotation direction of the servomotor changes according to the setting of Pn000.0 as shown in the following table. <table><tr><th colspan="2">Parameter</th><th>UP Key</th><th>DOWN Key</th></tr><tr><td rowspan="2">Pn000</td><td>n.□□□0</td><td>CCW</td><td>CW</td></tr><tr><td>n.□□□1</td><td>CW</td><td>CCW</td></tr></table>Note: Direction when viewed from the load of the servomotor.
6	. .CSr Display flashes.	–	When the servomotor origin search is completed, the display flashes. At this moment, the servomotor is servo-locked at the origin pulse position.
7	Fn003	DATA/◀	Press the DATA/SHIFT Key for approximately one second. "Fn003" is displayed again.
8	To enable the change in the setting, turn the control power supply OFF and ON again.		

2.3 Parameters (Pn□□□)

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

2.3.1 Parameter Classification

There are two types of multi-winding drive unit parameters. One type of parameter is required to set up the basic conditions for operation and the other type is required for tuning to adjust servo characteristics.

Classification	Meaning	Display Method	Setting Method
Setup Parameters	Parameters required for setup.	Always displayed (Factory setting: Pn00B.0 = 0)	Set each parameter individually.
Tuning Parameters	Parameters for tuning control gain and other parameters.	Set Pn00B.0 to 1.	There is no need to set each parameter individually.

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

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

2.3.2 Notation for Parameters

(1) Parameters for Numeric Settings

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

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

Parameter number

Indicates the setting range for the parameter.

Indicates the minimum setting unit for the parameter.

Indicates the parameter setting before shipment.

Indicates when a change to the parameter will be effective.

Indicates the parameter classification.

(2) Parameters for Selecting Functions

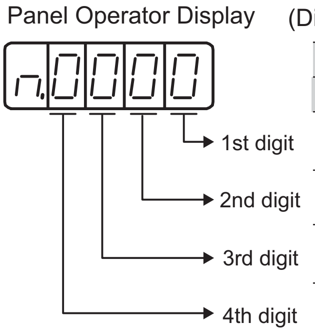
Parameter		Meaning	When Enabled	Classification
Pn002	n.□0□□ [Factory setting]	Uses the absolute encoder as an absolute encoder.	After restart	Setup
	n.□1□□	Uses the absolute encoder as an incremental encoder.		

Parameter number

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

This section explains the selections for the function.

• Notation Example



(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.

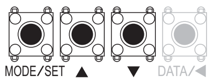
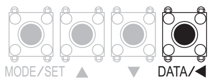
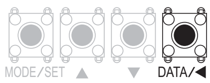
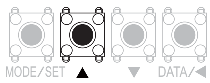
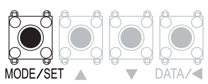
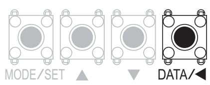
2.3.3 Setting Parameters

(1) How to Make Numeric Settings Using Parameters

This section describes how to make numeric settings using parameters.

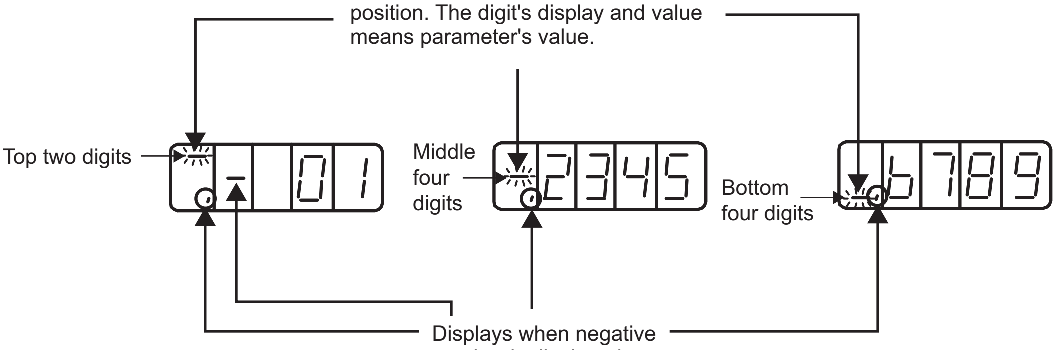
■ Parameters with Setting Ranges of Up to Five Digits

The example below shows how to change the speed loop gain (Pn100) from "40.0" to "100.0."

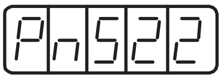
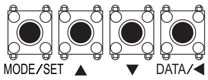
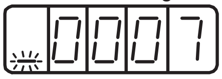
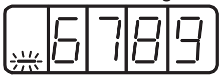
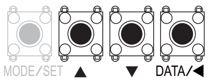
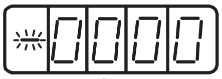
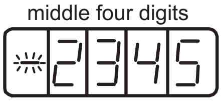
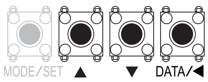
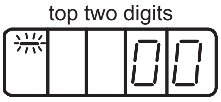
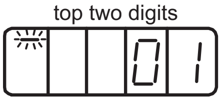
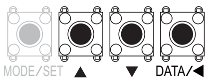
Step	Display after Operation	Keys	Operation
1	Pn100		Press the MODE/SET Key to select the parameter setting. If Pn100 is not displayed, press the UP or the DOWN Key to select Pn100.
2	0040.0		Press the DATA/SHIFT Key for approximately one second. The current data of Pn100 is displayed.
3	0040.0		Press the DATA/SHIFT Key to select "4". "4" will flash and be able to be changed.
4	0100.0		Keep pressing the UP Key until "0100.0" is displayed.
5	0100.0 Display flashes.		Press the MODE/SET Key. The value flashes and is saved. The data for the speed loop gain (Pn100) is changed from "40.0" to "100.0."
6	Pn100		Press the DATA/SHIFT Key for approximately one second. "Pn100" is displayed again.

■ Parameters with Setting Ranges of Six Digits or More

Panel operator displays five digits. When the parameter number is more than six digits, values are displayed and set as shown below.



The example below shows how to set the positioning completed width (Pn522) to "0123456789."

Step	Display after Operation	Keys	Operation
1			Press the MODE/SET Key to select the parameter setting. If Pn522 is not displayed, press the DATA/SHIFT Key, the UP Key, or the DOWN Key to select Pn522.
2	Before changing bottom four digits  After changing bottom four digits 		Press the DATA/SHIFT Key for approximately one second. The current data for bottom four digits of Pn522 are displayed. (In this case, "0007" is displayed.) Press the DATA/SHIFT Key to move to other digits, and change the value by pressing the UP/DOWN Key. (In this case, "6789" is set.)
3	Before changing middle four digits  After changing middle four digits 		Press the DATA/SHIFT Key. The middle four digits will be displayed. (In this case, "0000" is displayed.) Press the DATA/SHIFT Key to move to other digits, and change the value by pressing the UP/DOWN Key. (In this case, "2345" is set.)
4	Before changing top two digits  After changing top two digits 		Press the DATA/SHIFT Key. The top two digits will be displayed. (In this case, "00" is displayed.) Press the DATA/SHIFT Key to move to other digit, and change the value by pressing the UP/DOWN Key. (In this case, "01" is set.) The value "0123456789" is set.

Panel Operator

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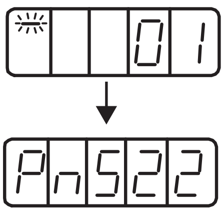
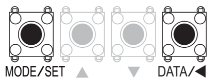
(cont'd)

Step	Display after Operation	Keys	Operation
5			Press the MODE/SET Key to write the value set here (0123456789 in this example) to the multi-winding drive unit. After the saving is completed, press the DATA/SHIFT Key for approximately one second. "Pn522" is displayed again.

<Note>

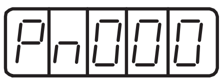
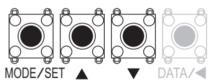
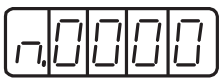
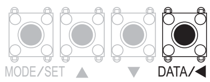
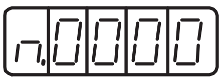
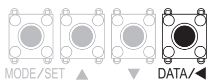
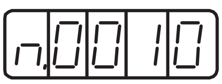
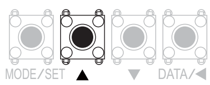
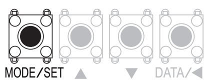
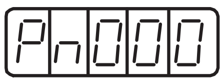
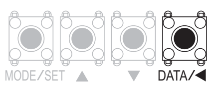
Setting negative numbers

- For the parameters that accept a negative value setting, display "0000000000" and then press the DOWN Key to set negative numbers.
- When setting negative numbers, the value increases by pressing the DOWN Key and decreases by pressing the UP Key.
- Press the DATA/SHIFT Key to move to other digits.
- A - (minus) sign is displayed when the top two digits are displayed.

(2) How to Select Functions Using Parameters

The parameter setting for selecting functions is used to select and set the function allocated to each digit displayed on the panel operator.

The example below shows how to change the setting of Pn000.1 (control method selection) of the Pn000 (basic function select switch 0) from speed control to position control.

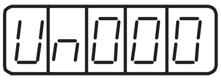
Step	Display after Operation	Keys	Operation
1			Press the MODE/SET Key to select the parameter setting. If Pn000 is not displayed, press the UP or the DOWN Key to select Pn000.
2			Press the DATA/SHIFT Key for approximately one second. The current data of Pn000 is displayed.
3			Press the DATA/SHIFT Key once to select the second digit of current data. "0" on the second digit will flash and be able to be changed.
4			Press the UP Key once to change to "n.0010." (Set the control method to position control.)
5	 Display flashes.		Press the MODE/SET Key. The value flashes and is saved. The control method is changed from speed control to position control.
6			Press the DATA/SHIFT Key for approximately one second. "Pn000" is displayed again.
7	To enable the change in the setting, turn the control power supply OFF and ON again.		

2.4 Monitor Displays (Un□□□)

You can monitor (display) the reference values set in the multi-winding drive unit, the I/O signal status, and the internal status of the multi-winding drive unit.

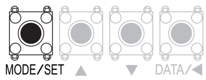
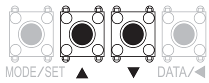
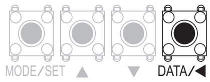
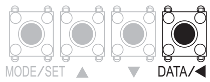
For details, refer to *8.2 Viewing Monitor Displays*.

The panel operator displays numbers beginning with Un.



Display Example for Motor Rotating Speed

The following table outlines the procedures necessary to view the motor rotating speed (Un000).

Step	Display after Operation	Keys	Operation
1	Un000		Press the MODE/SET Key to select the monitor display.
2	Un000		If Un000 is not displayed, press the UP or the DOWN Key to select Un000.
3	1500		Press the DATA/SHIFT Key for approximately one second to display the data of Un000.
4	Un000		Press the DATA/SHIFT Key for approximately one second to return to the display of monitor number (step 1).

Panel Operator

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3

Wiring and Connection

3.1 Main Circuit Wiring

The names and specifications of the main circuit terminals are given below.

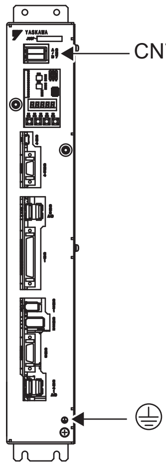
Also this section describes the general precautions for wiring and precautions under special environments.

3.1.1 Main Circuit Terminals

The names and specifications of the main circuit terminals are given below.

Note: For the purpose of this description, the SERVOPACK is shown with the front cover removed. Always keep the front cover attached when using the SERVOPACK.

(1) Multi-Winding Drive Unit

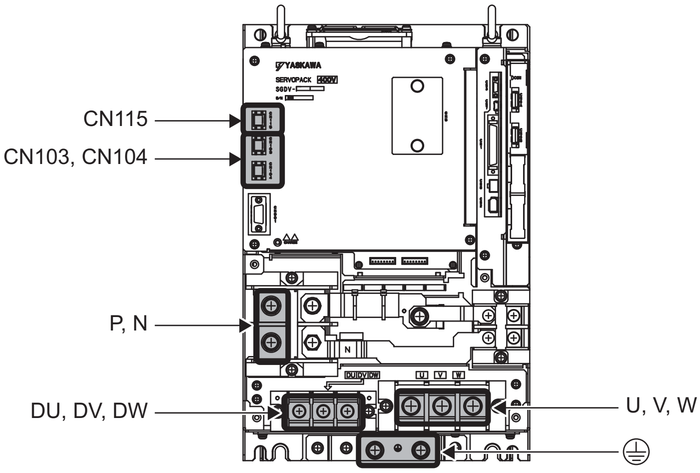


Connectors/ Terminal	Name	Specifications
CN7A/B	Control power supply input connector	CN7A is the 24-VDC (−15% to +15%) input connector. CN7B takes the same input, but it is normally not necessary to connect it.
⏚	Ground terminal	Connect this terminal to the power supply ground terminal and then ground it.

The pin arrangements of the control power supply connectors (CN7A/CN7B) are given below.

CN7A			CN7B		
Pin No.	Signal Name	Function	Pin No.	Signal Name	Function
B1	N24 V	Control power supply 0 V	B2	N24 V	Control power supply 0 V
A1	P24 V	Control power supply 24 V	A2	P24 V	Control power supply 24 V

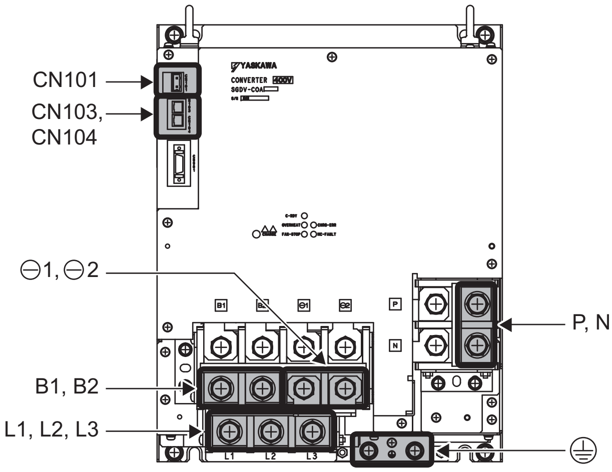
■ SERVOPACK

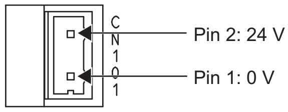


Connectors/ Terminals	Name	Specifications
P, N	Main circuit DC voltage input terminals	Connect these terminals to the P and N terminals on the converter.
U, V, W	Servomotor terminals	Connect these terminals to the Servomotor terminals.
CN103, CN104	Control power input connectors	CN103 is the 24 VDC (±15%) input. CN104 takes the same input, but it is normally not necessary to connect it.
DU, DV, DW	Dynamic brake unit terminals	Connect these terminals to the dynamic brake unit.
CN115	Dynamic brake unit connector	Connect this connector to the DBON and DB24 terminals on the dynamic brake unit.
+, -	NC	Do not connect these terminals.
⏚	Ground terminal	Connect this terminal to the power supply ground terminal and the Servomotor ground terminal, and then ground it.

■ Converter

Converter
SGDV-COA5EDA



Connectors/ Terminals	Name	Specifications
L1, L2, L3	Main circuit power input terminals	Three-phase, 380 to 480 VAC, +10% to -15%, 50/60 Hz
CN101	Control power input connector	24 VDC, ±15% Mating connector model: 231-202/026-000 (Manufactured by Wago Company of Japan, Ltd) 
P, N	Main circuit DC voltage output terminals	Connect these terminals to the P and N terminals on the SERVOPACK.
⏚	Ground terminal	Connect this terminal to the power supply ground terminal and then ground it.
B1, B2	Regenerative resistor connection terminals	Connect these terminals to the regenerative resistor unit.
⊖1, ⊖2	DC reactor connection terminals	Remove the short bar before you connect a DC reactor.
CN103, CN104	Control power output connectors	CN103 and CN104 output 24 VDC to the SERVOPACK. The 24-VDC (±15%) input is output unaltered from CN103. CN104 provides the same output, but it is normally not necessary to connect it.

3.1.2 Main Circuit Wire

This section describes wires used in the main circuit.

IMPORTANT

- The specified wire sizes are for use when the three lead cables are bundled and when the rated electric current is applied with a surrounding air temperature of 40°C.
- Use a wire with a minimum withstand voltage of 600 V for the main circuit.
- If cables are bundled in PVC or metal ducts, take into account the reduction of the allowable current.
- Use a heat-resistant wire under high surrounding air or panel temperatures, where polyvinyl chloride insulated wires will rapidly deteriorate.

(1) Wire Types

Use the following type of wire for main circuit.

Cable Type		Allowable Conductor Temperature (°C)
Symbol	Name	
IV	600 V polyvinyl chloride insulated wire	60
HIV	600 V grade heat-resistant polyvinyl chloride insulated wire	75

The following table shows the wire sizes and allowable currents for three wires.
Use wires with specifications equal to or less than those shown in the table.

Nominal Cross Section Diameter (mm^2)	AWG Size	Configuration (Number of Wires/ mm)	Conductive Resistance (Ω/ km)	Allowable Current at Surrounding Air Temperature (A)		
				30°C	40°C	50°C
0.5	(20)	19/0.18	39.5	6.6	5.6	4.5
0.75	(19)	30/0.18	26	8.8	7	5.5
0.9	(18)	37/0.18	24.4	9	7.7	6
1.25	(16)	50/0.18	15.6	12	11	8.5
2	(14)	7/0.6	9.53	23	20	16
3.5	(12)	7/0.8	5.41	33	29	24
5.5	(10)	7/1.0	3.47	43	38	31
8	(8)	7/1.2	2.41	55	49	40
14	(6)	7/1.6	1.35	79	70	57
22	(4)	7/2.0	0.85	91	81	66
38	(1)	7/2.6	0.49	124	110	93
60	(2/0)	19/2.0	0.30	170	150	127
100	(4/0)	19/2.6	0.18	240	212	179

Note: These are reference values for 600-V-grade, heat-resistant, PVC-insulated wire.

(2) Wire Sizes

The following tables give the symbols for the power supply input terminals, screw sizes for ground terminals, tightening torques, wire sizes, crimp terminals, and crimping tools for the multi-winding drive unit, SERVOPACKs, and converters.

■ Wire Sizes for the Multi-Winding Drive Unit

Name	Terminal Symbol	Screw Size for Terminal	Tightening Torque (N・m)	HIV Wire Size in mm² (AWG)	Crimp Terminal Model (Made by J.S.T. Mfg. Co., Ltd.)*
Ground terminal	⏚	M4	1.2 to 1.4	2.0 (14)	R2-4

* Use the crimp terminals that are recommended by Yaskawa or an equivalent.

Name	Connector Symbols	HIV Wire Size in mm² (AWG)	Connector Model (Made by Tyco Electronics Japan G.K.)	Connector Model (Made by Tyco Electronics Japan G.K.)	Connector Model (Made by Tyco Electronics Japan G.K.)
Control power supply connector	CN7A/B	1.25 (16)	175362-1 2P	353717-2 (loose contacts)	91561-1

■ Wire Sizes for SERVOPACKs and Converters

Combination of SERVOPACK and Converter*1		Terminal/ Connector Symbols	Screw Size for Terminals	Tightening Torque (N・m)	HIV Wire Size in mm² (AWG)	Crimp Terminal Model (Made by J.S.T. Mfg. Co., Ltd.) *2
SGDV-101J SGDV-COA5EDA	SERVOPACKs	P, N	M8	15.0	Bus bar attached to converter	–
		U, V, W	M8	3.0	38 (1)	R38-8
		DU, DV, DW	M6	3.0	3.5 (12)	3.5-6
		⏚	M8	9.0 to 11.0	38 (1)	R38-8
	Converters	P, N	M10	12 to 20	Bus bar attached to converter	–
		L1, L2, L3	M10	12 to 20	38 (1)	R38-10
		⊖1, ⊖2	M10	12 to 20	38 (1)	R38-10
		CN101 (24 V, 0 V)	– (Connector)	–	1.25 (16)	–
		B1, B2	M10	12 to 20	8 (8)	R8-10
		⏚	M8	9.0 to 11.0	38 (1)	R38-8

*1. Use the SERVOPACK and converter in a specified combination.
*2. Use the crimp terminals that are recommended by Yaskawa or an equivalent.

■ Tools for Crimp Terminals

Model	Tools (Made by J.S.T. Mfg Co., Ltd.)		
	Body	Head	Dies
3.5-6	YHT-2210	–	–
R8-10	YPT-150-1	–	TD-221, TD-211
R14-10	Body only: YPT-150-1 or Body: YF-1; Head: YET-150-1		TD-222, TD-211
R38-8 R38-10			TD-224, TD-212
R60-8 R60-10			TD-225, TD-213

(3) Wire Size (UL Standard)

To comply with the UL standard, use the recommended wires.
The following table shows the wire sizes (AWG) at a rating of 75°C.

■ Wire Sizes for SERVOPACKs and Converters

Combination of SERVOPACK and Converter[*]		Terminal Symbols	Screw Size for Terminals	Tightening Torque (N·m)	Wire Size AWG
SGDV-101J SGDV-COA5EDA	SERVOPACK	P, N	M8	15.0	Bus bar attached to the converter
		U, V, W	M8	3.0	1
		DU, DV, DW	M6	3.0	10
		⏚	M8	9.0 to 11.0	1
	Converter	P, N	M10	12 to 20	Bus bar attached to the converter
		L1, L2, L3	M10	12 to 20	2
		⊖1, ⊖2	M10	12 to 20	2
		CN101 (24 V, 0 V)	– (Connector)	–	14
		B1, B2	M10	12 to 20	8
		⏚	M8	9.0 to 11.0	2

* Use SERVOPACKs and converters in the specified combinations.

■ Crimp Terminals, Sleeves, Terminal Kits for SERVOPACKs and Converters

Combination of SERVOPACK and Converter		Terminal Symbols	Crimp Terminal Model (Made by J.S.T. Mfg Co., Ltd.)[*1]	Sleeve Model (Made by Tokyo Dip Co., Ltd.)[*2]	Terminal Kit Model[*3]
SGDV-101J SGDV-COA5EDA	SERVOPACK	U, V, W	R60-8	TP-060 (black)	JZSP-CVT9-101J-E
		DU, DV, DW	R5.5-6	TP-006 (black)	
		⏚	R60-8	–	
	Converter	L1, L2, L3	R38-10	TP-038 (black)	JZSP-CVT9-5ED1-E
		⊖1, ⊖2	R38-10	TP-038 (white)	
		B1, B2	R8-10	TP-014 (white)	
		⏚	R38-8	–	

*1. Use SERVOPACKs and converters in the specified combinations.
*2. Use sleeves for the crimped section of the terminals.
*3. A terminal kit includes the crimp terminals and sleeves required for one SERVOPACK or converter.

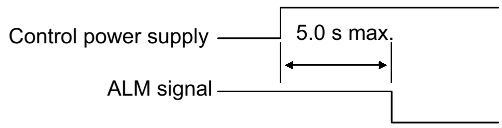
■ Crimp Terminal Tools for SERVOPACKs and Converters

Model	Tools by J.S.T. Mfg Co., Ltd.		
	Body	Head	Dies
R5.5-6	YHT-2210	–	–
R22-10	Body only: YPT-150-1 or Body: YF-1; Head: YET-150-1		TD-223, TD-212
R38-8 R38-10			TD-224, TD-212
R60-8			TD-225, TD-213
70-8 70-10			TD-226, TD-213

3.1.3 Typical Main Circuit Wiring Examples

Note the following points when designing the power ON sequence.

- Design the power ON sequence so that main power is turned OFF when a servo alarm signal (ALM) is output.
- The ALM signal is output (1Ry: OFF) for a maximum of five seconds when the control power is turned ON. Take this into consideration when designing the power ON sequence and use this relay to turn OFF the main circuit power supplies to the multi-winding drive unit, SERVOPACKs, and converters.



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

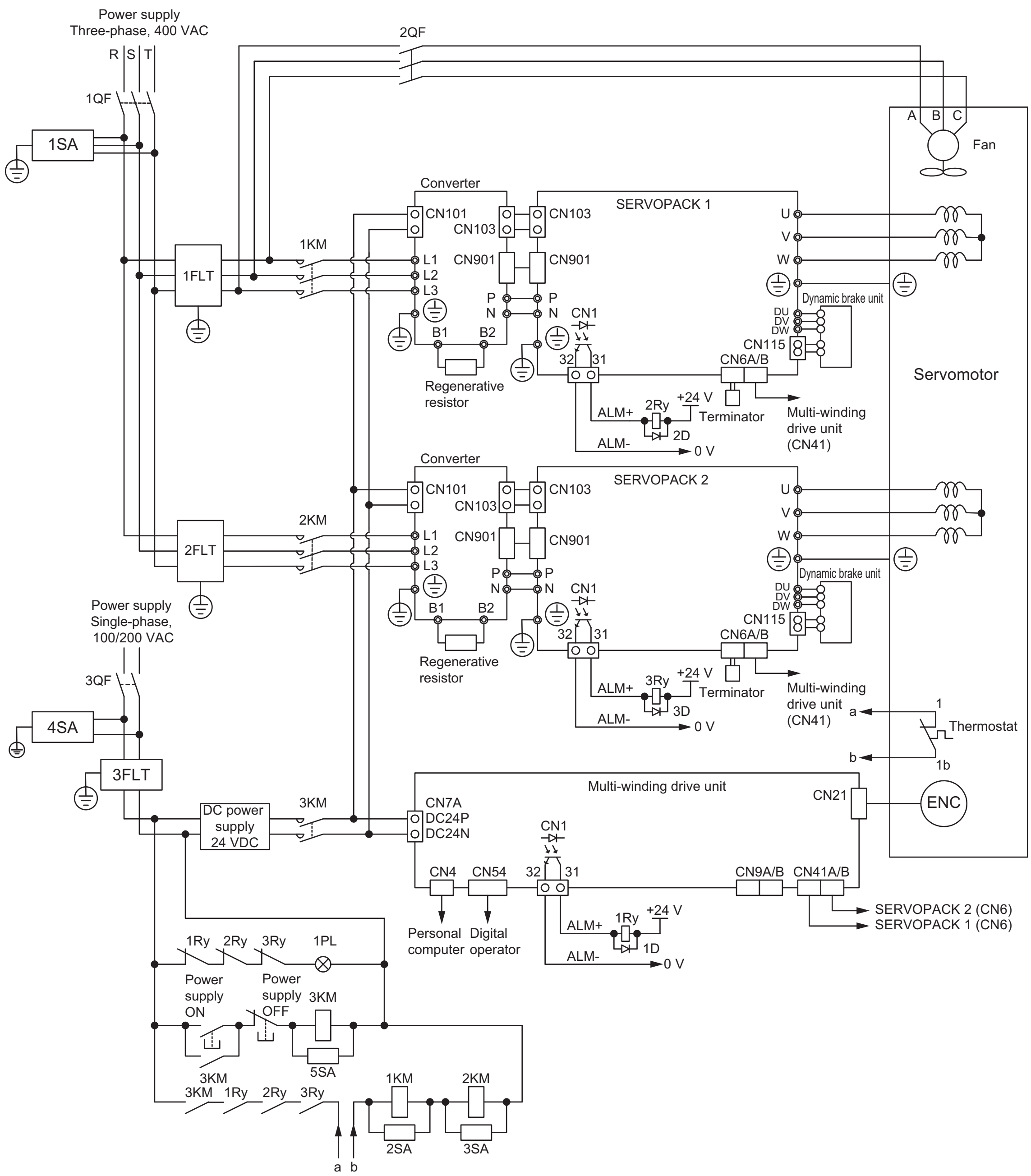
IMPORTANT

- When you turn ON the control power supply and the main circuit power supply, turn them ON at the same time or turn ON the main circuit power supply after the control power supply.
  When you turn OFF the power, first turn OFF the power for the main circuit and then turn OFF the control power.
- Configure the system so that the control power supply to the multi-winding drive unit, SERVOPACKs, and converters turns ON and OFF at the same time.
  If the control power supply does not turned ON at the same time, the following alarms will occur. If these alarms occur, turn the control power supply OFF and ON again.
  - A.045: Multi-winding drive unit setting parameter error (Occurs in the multi-winding drive unit.)
  - A.CA0: Encoder parameter error (Occurs in the SERVOPACKs.)
- If the control power supply does not turned OFF at the same time, the following alarms will occur.
  These alarms, which occur when the power supply is turned OFF, do not require any corrective action.
  - A.EE6: Local communications disconnection error (Occurs in the multi-winding drive unit.)
  - A.E60: Local communications error (Occurs in the SERVOPACKs.)

The typical main circuit wiring examples are shown below.

⚠ WARNING

- High voltage may still remain in the SERVOPACKs and converters even after you turn OFF the main circuit power supplies. To prevent electric shock, do not touch the power supply terminals. When the voltage is discharged, the charge indicator will turn OFF. Make sure the charge indicator is OFF before starting wiring or inspections.



1QF : Molded-case circuit breaker
2QF : Molded-case circuit breaker
3QF : Molded-case circuit breaker
1FLT : Noise filter
2FLT : Noise filter
3FLT : Noise filter
1KM : Magnetic contactor for main circuit power supply
2KM : Magnetic contactor for main circuit power supply
3KM : Magnetic contactor for control power supply
1Ry : Relay
2Ry : Relay
3Ry : Relay

1PL : Indicator lamp
1SA : Surge absorber
2SA : Surge absorber
3SA : Surge absorber
4SA : Surge absorber
5SA : Surge absorber
1D : Flywheel diode
2D : Flywheel diode
3D : Flywheel diode

3.1.4 General Precautions for Wiring

IMPORTANT

- Use a molded-case circuit breaker (1QF) or fuse to protect the main circuit.
  The SERVOPACKs and converters connect directly to a commercial power supply; They are not isolated through a transformer or other device.
  Always use a molded-case circuit breaker (1QF) or fuse to protect the servo system from accidents involving different power system voltages or other accidents.
- Install a ground fault detector.
  The multi-winding drive unit, SERVOPACKs, and converters do not have a built-in protective circuit for grounding.
  To configure a safer system, install a ground fault detector against overloads and short-circuiting, or install a ground fault detector combined with a molded-case circuit breaker.
- Do not turn the power ON and OFF more than necessary.
  - Do not use a multi-winding drive unit, SERVOPACK, or converter for applications that require the power to turn ON and OFF frequently. Such applications will cause elements in the multi-winding drive unit, SERVOPACK, or converter to deteriorate.
  - As a guideline, at least one hour should be allowed between the power being turned ON and OFF once actual operation has been started.

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

- Use the cables specified in the multi-winding drive unit catalog. Design and arrange the system so that each cable will be as short as possible.
- Use shielded twisted-pair cables or screened unshielded twisted-pair cables for I/O signal cables and encoder cables.
- Use the busbars that are included with the converter and connect the P and N terminals on the SERVOPACK and converter securely.
- The maximum wiring length is 3 m for I/O signal cables, 50 m for servomotor main circuit cables and encoder cables, and 10 m for the control power supply cables (+24 V and 0 V).
- Observe the following precautions when wiring the ground.
  - Use a cable as thick as possible (at least 2.0 mm^2).
  - Ground the SERVOPACKs and converters to a resistance of 10 Ω or less.
  - Be sure to ground at only one point.
  - Ground the servomotor directly if the servomotor is insulated from the machine.
- The signal cable conductors are as thin as 0.2 mm^2 or 0.3 mm^2. Do not impose excessive bending force or tension.

(1) Power Supply Capacities and Power Losses

The following tables show the power supply capacities and power losses of the multi-winding drive unit, SERVOPACKs, and converters.
The values are for two pairs of a SERVOPACK and converter.

■ Multi-Winding Drive Unit

Control Power Supply	Model JUSP-	Control Circuit Power Loss [W]
24 VDC	MD□D□□	14.4

■ SERVOPACKs and Converters

Main Circuit Power Supply	Maximum Applicable Servomotor Capacity [kW]	Combination of SERVOPACK and Converter		Power Supply Capacity for Two SERVO-PACK-Converter Sets [kVA]	Output Current [Arms]	Main Circuit Power Loss [W]	Regenerative Resistor Power Loss [W]	Control Circuit Power Loss [W]	Total Power Loss [W]
		SERVO-PACK	Converter						
		Model: SGDV-	Model: SGDV-COA						
Three-phase 400 V	75	101J	5EDA	128	196	2480	(1920)*	192	2672

* This is the value for the JUSP-RA14-E regenerative resistor unit.

(2) How to Select Molded-case Circuit Breaker and Fuse Capacities

The following tables show the current capacities and inrush current of the multi-winding drive unit, SERVO-PACKs, and converters.
Use these values as a basis for selecting the molded-case circuit breaker and fuse. The values are for two pairs of a SERVOPACK and converter.

■ Multi-winding Drive Unit

Control Power Supply	Model JUSP-	Current Capacity Control Circuit [Arms]
24 VDC	MD□D□□	0.6

■ SERVOPACKs and Converters

Main Circuit Power Supply	Maximum Applicable Servomotor Capacity [kW]	Combination of SERVOPACK and Converter		Power Supply Capacity for Two SERVO-PACK-Converter Sets [kVA]	Current Capacity		Inrush Current		Rated voltage	
		SERVOPACK	Converter		Main Circuit [Arms]	Control Circuit [Arms]	Main Circuit [A0-p]	Control Circuit [A0-p]	Fuse [V]	Circuit Breaker [V]
		Model: SGDV-	Model: SGDV-COA							
Three-phase 400 V	75	101J	5EDA	128	128	8*	340	–	600	480

* Input voltage of 24 VDC

Note 1. The rated input current of the SERVOPACK is the nominal value at the rated load.
Select the appropriate capacity in accordance with the specified derating.

Cutoff characteristics (25°C): 300% five seconds min.

2. To comply with the low voltage directive, connect a fuse to the input side. Select the fuse or molded-case circuit breaker for the input side from among models that are compliant with UL standards.
The table above also provides the nominal values of current capacity and inrush current. Select a fuse and a molded-case circuit breaker which meet the cutoff characteristics shown below.
- Main circuit, control circuit: No breaking at three-times the current values of the table for 5 s.
- Inrush current: No breaking at the same current values of the table for 20 ms.

3.1.5 Discharging Time of the Main Circuit's Capacitor

The following table shows the discharging time of the main circuit's capacitor for the SERVOPACKs and converters.

Input Voltage	Combinations		Discharging Time [min.]
	SERVOPACK Model: SGDV-	Converter Model: SGDV-COA	
Three-phase 400 VAC	101J	5EDA	10

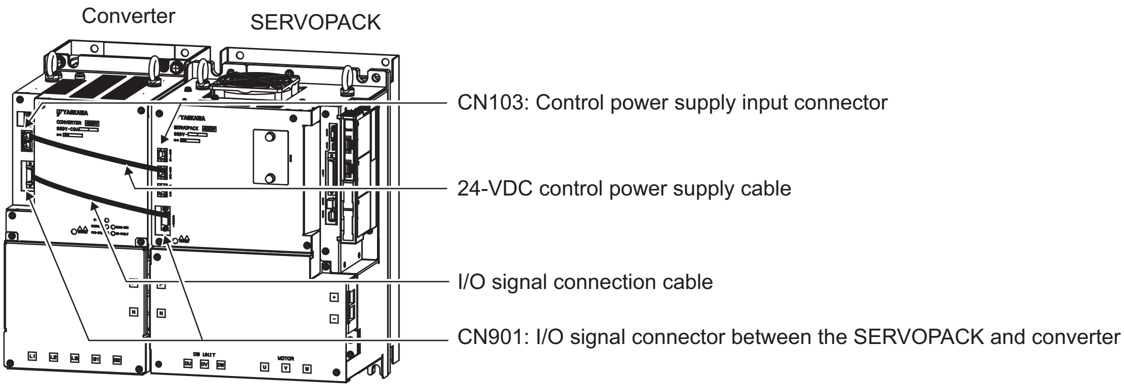
⚠ WARNING

- High voltage may still remain in the SERVOPACKs and converters even after you turn OFF the main circuit power supplies. To prevent electric shock, do not touch the power supply terminals. When the voltage is discharged, the charge indicator will turn OFF. Make sure the charge indicator is OFF before starting wiring or inspection.

3.2 Connecting the Converter to the SERVOPACK

3.2.1 Connecting the Connectors

Connect CN901 and CN103 on the SERVOPACK and converter as shown in the following figure.

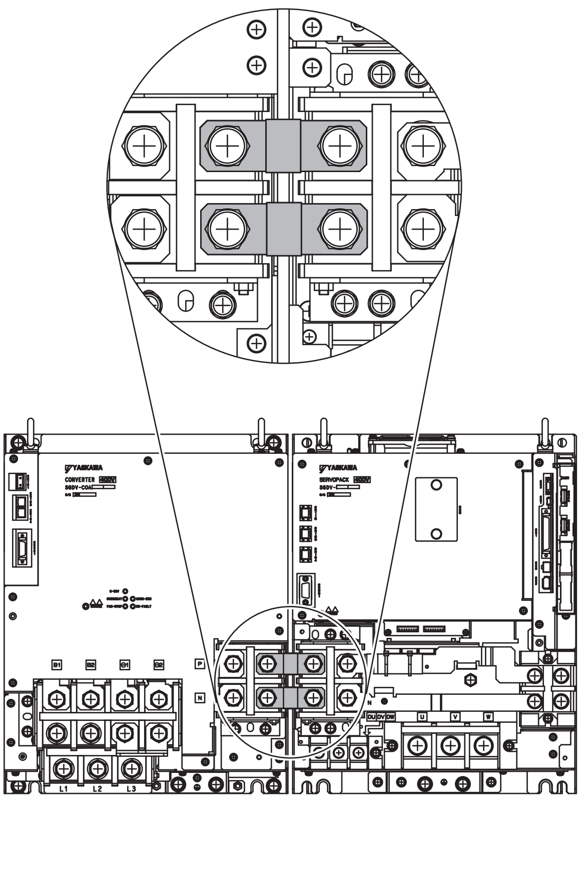


Cable Name	Cable Model	Cable Length	Description
IO signal connection cable	JZSP-CVI02-A4-E	0.4 m	This cable connects the CN901 connectors on the SERVOPACK and converter.
24-VDC control power supply cable	JZSP-CVG00-A4-E	0.4 m	This cable connects the CN103(CN104) connectors on the SERVOPACK and converter.

3.2.2 Interconnecting Terminals

Use the busbars that are provided with the converter to connect the P and N terminals between the SERVOPACK and the converter.

The bus bars can be connected in any direction.



3.3 I/O Signal Connections

This section describes the names and functions of I/O signals (CN1) on the multi-winding drive unit and the safety function signals (CN8) on the SERVOPACK. Also connection examples are provided for different control methods.

3.3.1 Names and Functions for Multi-Winding Drive Unit I/O Signals (CN1)

The following tables give the names and functions of the I/O signals (CN1) on the multi-winding drive unit.

(1) Input Signals

Control Method	Signal Name	Pin No.	Function		Reference Section
Common	/S-ON	40	Servo ON/OFF: Turns ON/OFF the servomotor.		5.2.1
	/P-CON	41	Proportional control reference	Switches the speed control loop from PI (proportional/integral) to P (proportional) control when ON.	6.7.4
			Rotation Direction reference	With internal set speed control selected: Switches the servomotor rotation direction.	5.6.1
			Control switching	Position ↔ speed Position ↔ torque Torque ↔ speed Enables control switching.	5.7.2
			Zero-clamp reference	With speed control with zero-clamp function selected: Reference speed is zero when ON.	5.3.5
			Reference pulse block	With position control with reference pulse stop selected: Stops reference pulse input when ON.	5.4.8
	P-OT N-OT	42 43	Forward run prohibited, Reverse run prohibited	With overtravel prevention: Stops servomotor when movable part travels beyond the allowable range of motion.	5.2.3
	/P-CL /N-CL	45 46	Forward external torque limit, Reverse external torque limit	Activates/deactivates external torque limit function.	5.8.2 5.8.4
			Internal set speed switching	With internal set speed control selected: Switches the internal set speed settings.	5.6.1
	/ALM-RST	44	Alarm reset: Releases the servo alarm state.		–
	+24VIN	47	Control power supply input for sequence signals. Allowable voltage range: 11 to 25 V Note: The 24 VDC power supply is not included.		3.5.2
	SEN	4 (2)	Initial data request signal when using an absolute encoder.		5.9.2
	BAT (+) BAT (-)	21 22	Connecting pin for the absolute encoder backup battery. Do not connect when the encoder cable with the battery case is used.		3.7.2 5.9.1
	/SPD-D /SPD-A /SPD-B /C-SEL /ZCLAMP /INHIBIT /G-SEL /PSELA	Signals that can be allocated	The following input signals can be changed to allocate functions: /S-ON, /P-CON, P-OT, N-OT, /P-CL, /N-CL, and /ALM-RST.		3.4.1 5.3.5 5.4.3 5.4.8 5.6.1 5.7.1 6.6.1 3.9.4
Speed	V-REF	5 (6)	Inputs speed reference. Input voltage range: ± 12 V max.		5.3.1 5.5.4

(cont'd)

Control Method	Signal Name	Pin No.	Function	Reference Section
Position	PULS /PULS SIGN /SIGN	7 8 11 12	Input pulse modes: Select one of them. • Sign + pulse train • CW + CCW pulse train • Two-phase pulse train with 90° phase differential	5.4.1
	CLR /CLR	15 14	Clears position error during position control.	5.4.2
Torque	T-REF	9 (10)	Inputs torque reference. Input voltage range: ± 12 V max.	5.5.1 5.8.3 5.8.5

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

(2) Output Signals

Control Method	Signal Name	Pin No.	Function	Reference Section
Common	ALM+ ALM-	31 32	Servo alarm: Turns OFF when an error is detected.	5.10.1
	/TGON+ /TGON-	27 28	Detection during servomotor rotation: Turns ON when the servomotor is rotating at a speed higher than the motor speed setting.	5.10.3
	/S-RDY+ /S-RDY-	29 30	Servo ready: Turns ON when the SERVOPACK is ready to accept the servo ON (/S-ON) signal.	5.10.4
	PAO /PAO	33 34	Phase-A signal Encoder output pulse signals for two-phase pulse train with 90° phase differential	5.3.6 5.9.5
	PBO /PBO	35 36	Phase-B signal	
	PCO /PCO	19 20	Phase-C signal Origin pulse output signal	
	ALO1 ALO2 ALO3	37 (1) 38 (1) 39 (1)	Alarm code output: Outputs 3-bit alarm codes.	5.10.1
	TMON	16	Analog monitor outputs.	–
	VTG-M	17		
	SG	1, 2, 6, 10	Connects to the 0 V pin on the control circuit of the host controller.	–
	FG	Shell	Connected to frame ground if the shielded wire of the I/O signal cable is connected to the connector shell.	–
	/CLT /VLT /BK /WARN /NEAR /PSELA	Signals that can be allocated	The following output signals can be changed to allocate functions: /TGON, /S-RDY, and /V-CMP (/COIN).	5.4.3 5.4.7 5.5.4 5.8.5 5.10.2
Speed	/V-CMP+ /V-CMP-	25 26	If speed control is selected, the signal turns ON when the motor speed is within the setting range and it matches the reference speed value.	5.3.8
Position	/COIN+ /COIN-	25 26	If position control is selected, the signal turns ON when the number of position error reaches the value set.	5.4.6
	PL1 PL2 PL3	3 13 18	Output signals of power supply for open-collector reference	3.5.1
Reserved	–	23 24 48 49 50	Do not use these pins.	–

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

2. The functions allocated to /TGON, /S-RDY, and /V-CMP (/COIN) output signals can be changed by using the parameters. Refer to *3.4.2 Output Signal Allocations* for details.

3.3.2 SERVOPACK Safety Function Signal (CN8) Names and Functions

The following table shows the names and functions of safety function signals (CN8) on the SERVOPACKs.

Note: The safety function signals can be connected only to a SERVOPACK.

Signal Name	Pin No.	Function	
/HWBB1+	4	Hard wire baseblock input 1	For hard wire baseblock input. Baseblock (motor current off) when OFF.
/HWBB1-	3		
/HWBB2+	6	Hard wire baseblock input 2	
/HWBB2-	5		
EDM1+	8	Monitored circuit status output 1	ON when the /HWBB1 and the /HWBB2 signals are input and the SERVOPACK enters a baseblock state.
EDM1-	7		
–	1*	–	
–	2*	–	

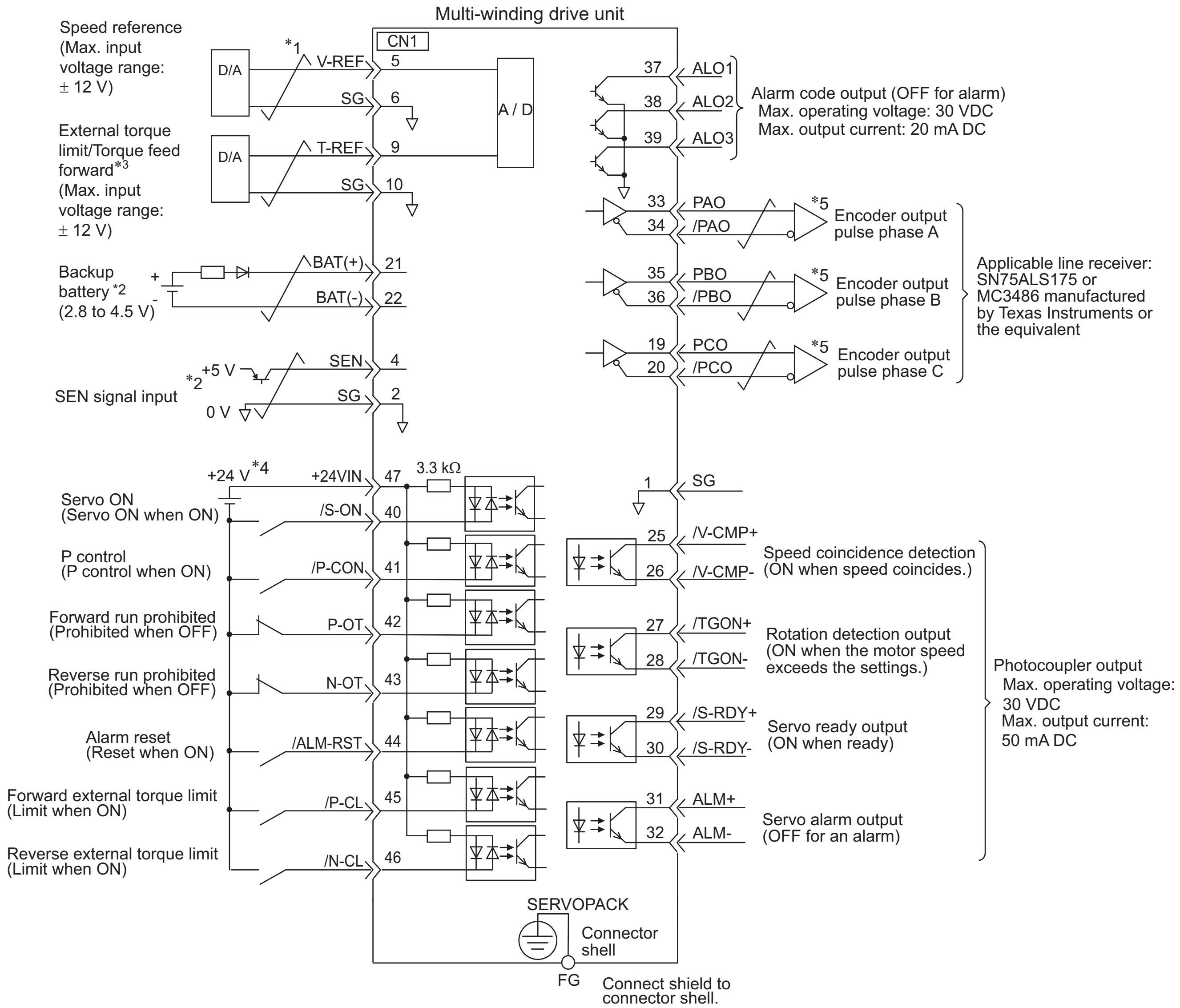
* Do not use pins 1 and 2 because they are connected to the internal circuits.

Wiring and Connection

3

3.3.3 Example of I/O Signal Connections in Speed Control

Connection example in speed control is as shown below.



∗1. represents twisted-pair wires.

∗2. Connect when using an absolute encoder. When the encoder cable with the battery case is connected, do not connect a backup battery.

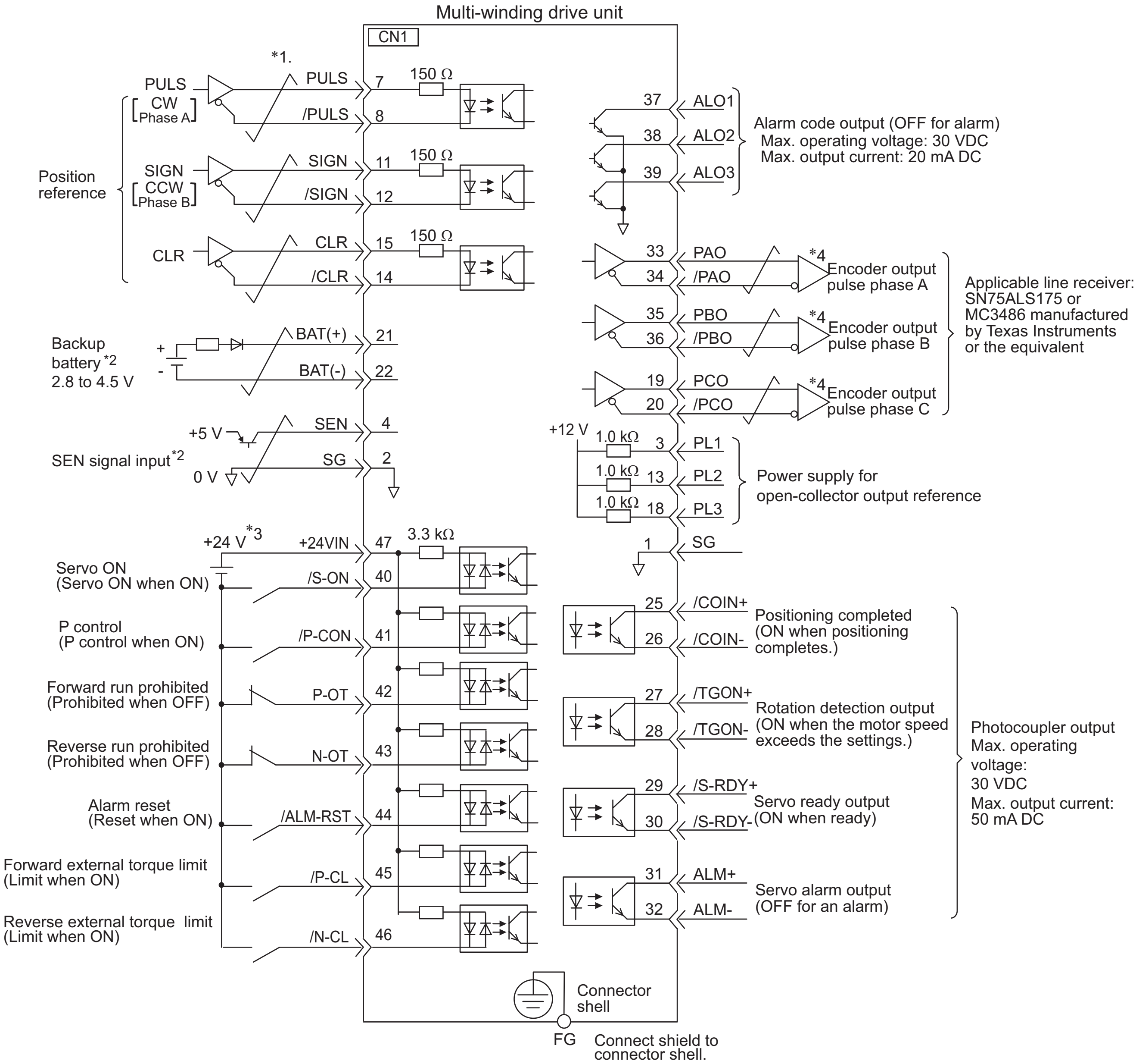
∗3. Enabled by the parameter setting.

∗4. The 24-VDC power supply is not included. Use a 24-VDC power supply with double insulation or reinforced insulation.

∗5. Always use line receivers to receive the output signals.

3.3.4 Example of I/O Signal Connections in Position Control

Connection example in position control is as shown below.



∗1. represents twisted-pair wires.

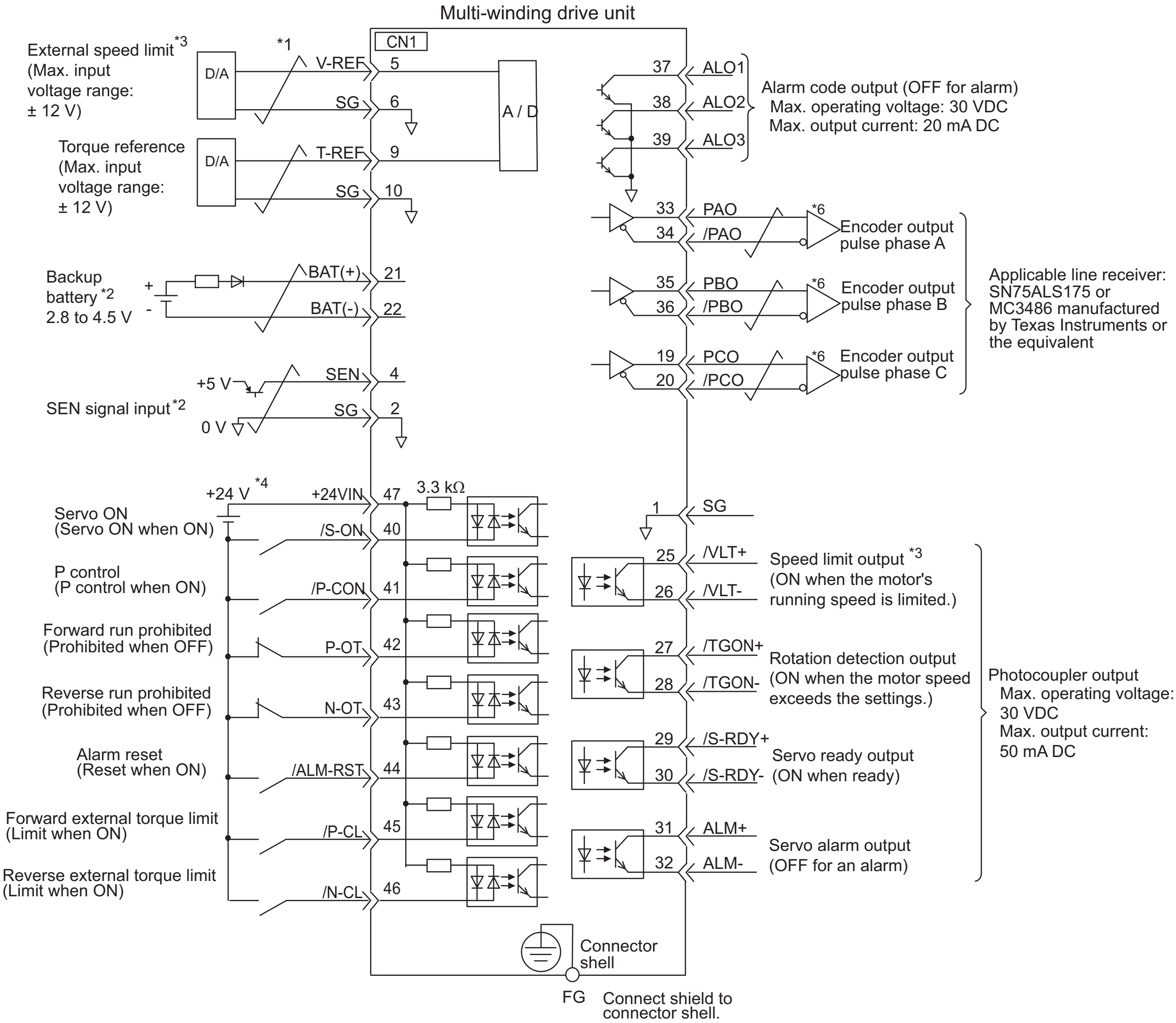
∗2. Connect when using an absolute encoder. When the encoder cable with the battery case is connected, do not connect a backup battery.

∗3. The 24-VDC power supply is not included. Use a 24-VDC power supply with double insulation or reinforced insulation.

∗4. Always use line receivers to receive the output signals.

3.3.5 Example of I/O Signal Connections in Torque Control

Connection example in torque control is as shown below.



∗1. (twisted-pair symbol) represents twisted-pair wires.
∗2. Connect when using an absolute encoder. When the encoder cable with the battery case is connected, do not connect a backup battery.
∗3. Enabled by the parameter setting.
∗4. The 24-VDC power supply is not included. Use a 24-VDC power supply with double insulation or reinforced insulation.
∗5. Always use line receivers to receive the output signals.

3.4 I/O Signal Allocations

This section describes the I/O signal allocations.

3.4.1 Input Signal Allocations

In most cases, input signals can be used at the factory settings. Input signals can also be allocated as required.

(1) Using Factory Settings

Items in cells with bold lines in the following table are the factory-set signal allocations.

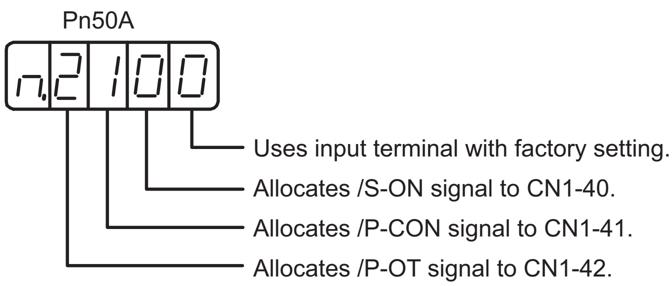
If the control method is changed in Pn000.1, the signals will function as required for the control method. The factory-set signal allocations will remain unchanged.

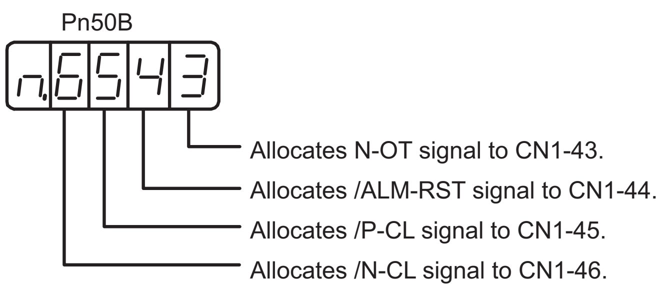
<Example>

When the control method is set to internal set speed control with a contact reference, i.e., when Pn000.1 is set to 3, signal /P-CON (CN1-41) will function as /SPD-D, signal /P-CL (CN1-45) as /SPD-A, and signal /N-CL (CN1-46) as /SPD-B.

<table>
<tr><th rowspan="2">Pn000.1 Setting</th><th rowspan="2">Control Method Selection</th><th colspan="7">CN1 Pin No.</th></tr>
<tr><th>40</th><th>41</th><th>42</th><th>43</th><th>44</th><th>45</th><th>46</th></tr>
<tr><td>0</td><td>Speed control</td><td rowspan="12">/S-ON</td><td rowspan="3">Uses as /P-CON</td><td rowspan="12">P-OT</td><td rowspan="12">N-OT</td><td rowspan="12">/ALM-RST</td><td rowspan="3">/P-CL</td><td rowspan="3">/N-CL</td></tr>
<tr><td>1</td><td>Position control</td></tr>
<tr><td>2</td><td>Torque control</td></tr>
<tr><td>3</td><td>Internal set speed control</td><td rowspan="4">Uses as /SPD-D</td><td rowspan="4">Uses as /SPD-A</td><td rowspan="4">Uses as /SPD-B</td></tr>
<tr><td>4</td><td>Internal set speed control ↔ Speed control</td></tr>
<tr><td>5</td><td>Internal set speed control ↔ Position control</td></tr>
<tr><td>6</td><td>Internal set speed control ↔ Torque control</td></tr>
<tr><td>7</td><td>Position control ↔ Speed control</td><td rowspan="3">Uses as /C-SEL</td><td rowspan="5">Uses as /P-CL</td><td rowspan="5">Uses as /N-CL</td></tr>
<tr><td>8</td><td>Position control ↔ Torque control</td></tr>
<tr><td>9</td><td>Torque control ↔ Speed control</td></tr>
<tr><td>A</td><td>Speed control ↔ Speed control with zero clamp function</td><td>Uses as /ZCLAMP</td></tr>
<tr><td>B</td><td>Position control ↔ Position control with reference pulse inhibit function</td><td>Uses as /INHIBIT</td></tr>
</table>

Input signal allocation at factory setting can be checked using the parameters Pn50A, Pn50B, Pn50C, Pn50D, and Pn515.





Wiring and Connection

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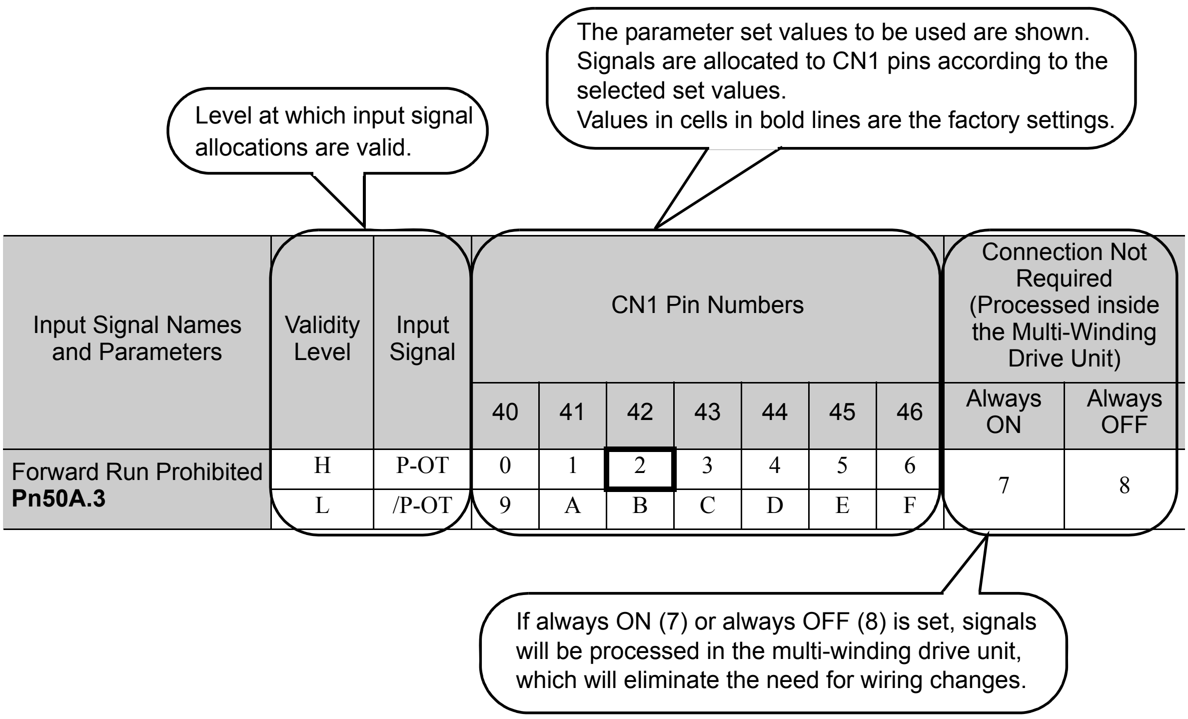
(2) Changing Input Signal Allocations

> **IMPORTANT**
> - Inverting the polarity of the Servo ON, forward run prohibited, and reverse run prohibited signals from the factory setting will prevent the main circuit's power supply from being turned OFF or the overtravel function from working in case of signal line disconnections or other failures.
>   If this setting is absolutely necessary, check the operation and confirm that there are no safety problems.
> - When two or more signals are allocated to the same input circuit, input signal level is valid for all allocated signals, resulting in an unexpected machine operation.

When changing input signal allocations, set Pn50A.0 to 1 to enable making the changes.
Input signals are allocated as shown in the following table.

Refer to the *Interpreting the Input Signal Allocation Tables* and change the allocations accordingly.

<Interpreting the Input Signal Allocation Tables>



Input Signal Names and Parameters	Validity Level	Input Signal	CN1 Pin Numbers							Connection Not Required (Processed inside the Multi-Winding Drive Unit)	
			40	41	42	43	44	45	46	Always ON	Always OFF
Servo ON **Pn50A.1**	L	/S-ON	**0**	1	2	3	4	5	6	7	8
	H	S-ON	9	A	B	C	D	E	F		
Proportional Operation Reference **Pn50A.2**	L	/P-CON	0	**1**	2	3	4	5	6	7	8
	H	P-CON	9	A	B	C	D	E	F		
Forward Run Prohibited **Pn50A.3**	H	P-OT	0	1	**2**	3	4	5	6	7	8
	L	/P-OT	9	A	B	C	D	E	F		

(cont'd)

Input Signal Names and Parameters	Validity Level	Input Signal	CN1 Pin Numbers 40	41	42	43	44	45	46	Connection Not Required (Processed inside the Multi-Winding Drive Unit) Always ON	Always OFF
Reverse Run Prohibited **Pn50B.0**	H	N-OT	0	1	2	3	4	5	6	7	8
	L	/N-OT	9	A	B	C	D	E	F		
Alarm Reset **Pn50B.1**	L	/ARM-RST	0	1	2	3	4	5	6	–	8
	H	ARM-RST	9	A	B	C	D	E	F		
Forward External Torque Limit **Pn50B.2**	L	/P-CL	0	1	2	3	4	5	6	7	8
	H	P-CL	9	A	B	C	D	E	F		
Reverse External Torque Limit **Pn50B.3**	L	/N-CL	0	1	2	3	4	5	6	7	8
	H	N-CL	9	A	B	C	D	E	F		
Switching Servomotor Rotation Direction **Pn50C.0**	L	/SPD-D	0	1	2	3	4	5	6	7	8
	H	SPD-D	9	A	B	C	D	E	F		
Internal Set Speed Control **Pn50C.1**	L	/SPD-A	0	1	2	3	4	5	6	7	8
	H	SPD-A	9	A	B	C	D	E	F		
Internal Set Speed Control **Pn50C.2**	L	/SPD-B	0	1	2	3	4	5	6	7	8
	H	SPD-B	9	A	B	C	D	E	F		
Control Method Selection **Pn50C.3**	L	/C-SEL	0	1	2	3	4	5	6	7	8
	H	C-SEL	9	A	B	C	D	E	F		
Zero Clamp **Pn50D.0**	L	/ZCLAMP	0	1	2	3	4	5	6	7	8
	H	ZCLAMP	9	A	B	C	D	E	F		
Reference Pulse Inhibit **Pn50D.1**	L	/INHIBIT	0	1	2	3	4	5	6	7	8
	H	INHIBIT	9	A	B	C	D	E	F		
Gain Changeover **Pn50D.2**	L	/G-SEL	0	1	2	3	4	5	6	7	8
	H	G-SEL	9	A	B	C	D	E	F		
Reference Pulse Input Multiplication Switching **Pn515.1**	L	/PSEL	0	1	2	3	4	5	6	7	8
	H	PSEL	9	A	B	C	D	E	F		

Wiring and Connection

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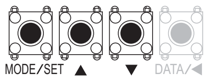
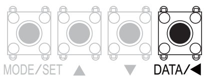
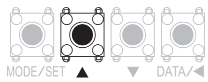
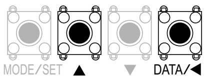
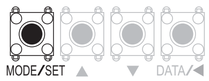
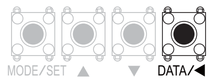
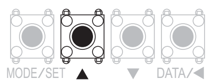
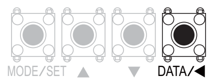
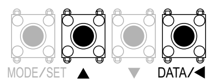
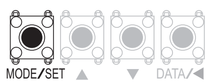
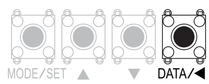
(3) Example of Input Signal Allocation

The procedure to replace Servo ON (/S-ON) signal allocated on CN1-40 and Forward External Torque Limit (/P-CL) allocated on CN1-45 is shown below.

Pn50A	Pn50B	
n.2100	n.6543	Before
↓	↓	
n.2151	n.6043	After

Step	Display after Operation	Keys	Operation
1	Pn50A		Press the MODE/SET Key to select the parameter setting. If a parameter other than Pn50A is displayed, press the UP or DOWN Key to set Pn50A.
2	n.2100		Press the DATA/SHIFT Key for approximately one second to display the current data of Pn50A. (/S-ON is allocated on CN1-40.)
3	n.2101		Press the UP key to set to the value on the far right "1" (Pn50A.0 = 1). (Sequence input signals can be freely set.)
4	n.2151		Press the DATA/SHIFT Key to select the second digit from the right. Press the UP key to set to "5." (Changes the allocation of /S-ON from CN1-40 to CN1-45.)
5	n.2151 Display flashes.		Press the MODE/SET Key. The data flashes and is saved.
6	Pn50A		Press the DATA/SHIFT Key for approximately one second to return to the display Pn50A.
7	Pn50b		Press the UP key to display Pn50B.
8	n.6543		Press the DATA/SHIFT Key for approximately one second to display the current data of Pn50B. (/P-CL is allocated on CN1-45.)
9	n.6043		Press the DATA/SHIFT Key to select the third digit from the right. Press the UP Key to set "0." (Changes the allocation of /P-CL from CN1-45 to CN1-40.)
10	n.6043 Display flashes.		Press the MODE/SET Key. The value flashes and is saved.
11	Pn50b		Press the DATA/SHIFT Key for approximately one second to return to the display Pn50B. /S-ON is mapped on CN1-45, and /P-CL is mapped on CN1-40.
12	To enable the change in the setting, turn the control power supply OFF and ON again.		

<Input signal polarities>

Input signal polarities are as follows when sequence input circuit is connected to a sink circuit. If connected to a source circuit, polarities are reversed. For details, refer to *3.5.2 Sequence Input Circuit*.

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

(4) Checking Input Signals

Input signal status can be checked using the input signal monitor (Un005). As for the input signal monitor (Un005), refer to *8.4 Monitoring Input Signals.*

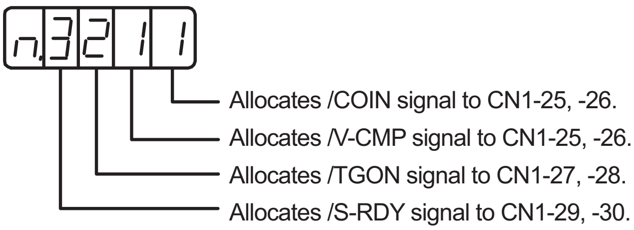
3.4.2 Output Signal Allocations

Output signals can be allocated to the I/O signal connector (CN1) with the settings of the following parameters: Pn50E, Pn50F, Pn510, Pn512, and Pn514.

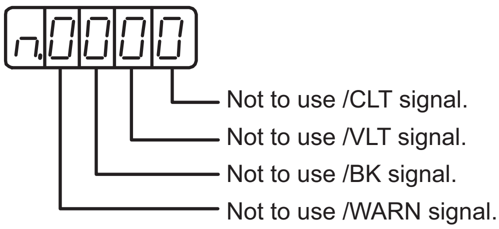
(1) Checking Factory Settings

Factory settings can be checked using the following parameters.

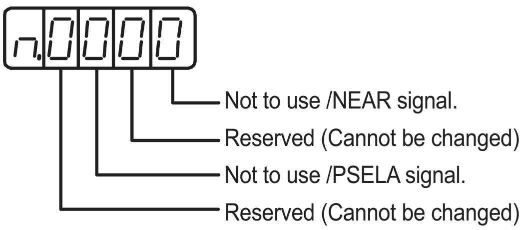
Pn50E



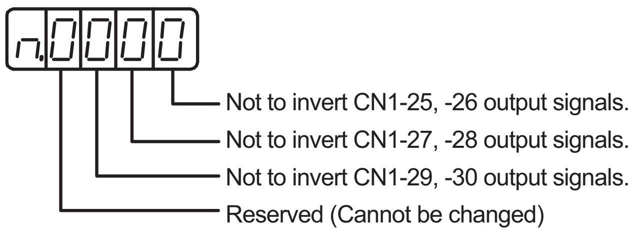
Pn50F



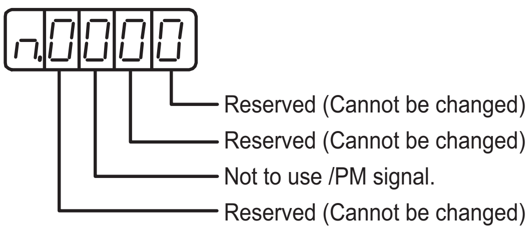
Pn510



Pn512



Pn514



(2) Changing Output Signal Allocations

IMPORTANT

- The signals not detected are considered as "Invalid." For example, Positioning Completion (/COIN) signal in speed control is "Invalid."
- Inverting the polarity of the brake signal (/BK), i.e. positive logic, will prevent the holding brake from working in case of its signal line disconnection.
  If this setting is absolutely necessary, check the operation and confirm that there are no safety problems.
- When two or more signals are allocated to the same output circuit, a signal is output with OR logic circuit.

Output signals are allocated as shown in the following table.

Refer to the *Interpreting the Output Signal Allocation Tables* and change the allocations accordingly.

<Interpreting the Output Signal Allocation Tables>

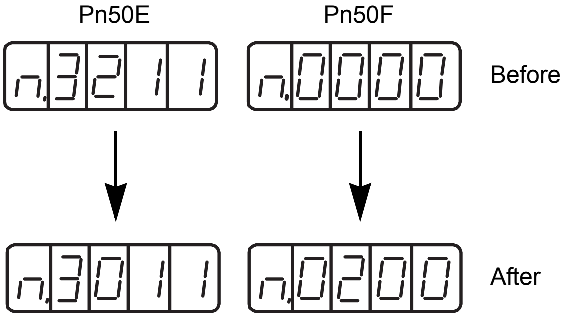
The parameter set values to be used are shown.
Signals are allocated to CN1 pins according to the selected set values.
Values in cells in bold lines are the factory settings.

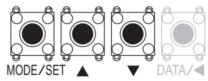
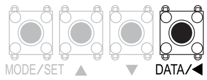
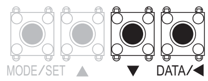
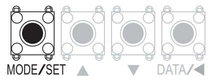
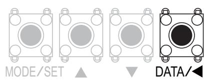
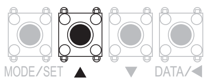
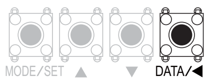
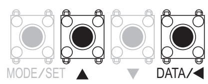
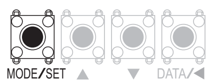
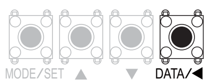
Output Signal Names and Parameters	Output Signal	CN1 Pin Numbers			Invalid (not use)
		25 (26)	27 (28)	29 (30)	
Positioning Completion **Pn50E.0**	/COIN	1	2	3	0

Output Signal Names and Parameters	Output Signal	CN1 Pin Numbers			Invalid (not use)
		25 (26)	27 (28)	29 (30)	
Positioning Completion **Pn50E.0**	/COIN	1	2	3	0
Speed Coincidence Detection **Pn50E.1**	/V-CMP	1	2	3	0
Rotation Detection **Pn50E.2**	/TGON	1	2	3	0
Servo Ready **Pn50E.3**	/S-RDY	1	2	3	0
Torque Limit Detection **Pn50F.0**	/CLT	1	2	3	0
Speed Limit Detection **Pn50F.1**	/VLT	1	2	3	0
Brake **Pn50F.2**	/BK	1	2	3	0
Warning **Pn50F.3**	/WARN	1	2	3	0
Near **Pn510.0**	/NEAR	1	2	3	0
Reference Pulse Input Multiplication Switching Output **Pn510.2**	/PSELA	1	2	3	0
Pn512.0=1	Polarity inversion of CN1-25 (26)				0 (Not invert at factory setting)
Pn512.1=1	Polarity inversion of CN1-27 (28)				
Pn512.2=1	Polarity inversion of CN1-29 (30)				

(3) Example of Output Signal Allocation

The procedure to set Rotation Detection (/TGON) signal of factory setting to "Invalid" and allocate Brake Interlock (/BK) signal is shown below.



Step	Display after Operation	Keys	Operation
1	Pn50E		Press the MODE/SET Key to select the parameter setting. If a parameter other than Pn50E is displayed, press the UP or DOWN Key to select Pn50E.
2	n.3211		Press the DATA/SHIFT Key for approximately one second to display the current data of Pn50E. (/TGON is allocated on CN1-27 (28).)
3	n.3011		Press the DATA/SHIFT Key to select the third digit from the right. Press the DOWN Key to set "0." (Sets /TGON "Invalid.")
4	n.3011 Display flashes.		Press the MODE/SET Key. The data flashes and is saved.
5	Pn50E		Press the DATA/SHIFT Key for approximately one second to return to the display Pn50E.
6	Pn50F		Press the UP Key to display Pn50F.
7	n.0000		Press the DATA/SHIFT Key for approximately one second to display the current data of Pn50F. (/BK is set to "Invalid.")
8	n.0200		Press the DATA/SHIFT Key to select the third digit from the right. Press the UP Key to set "2." (Allocates /BK to CN1-27 (28).)
9	n.0200 Display flashes.		Press the MODE/SET Key. The value flashes and is saved.
10	Pn50F		Press the DATA/SHIFT Key for approximately one second to return to the display Pn50F. /TGON is set as "Invalid" and /BK is allocated on CN1-27 (28).
11	To enable the change in the setting, turn the control power supply OFF and ON again.		

(4) Checking Output Signals

Output signal status can be checked using the output signal monitor (Un006). As for the output signal monitor (Un006), refer to *8.5 Monitoring Output Signals.*

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3.5 Examples of Connection to Host Controller

This section provides examples of multi-winding drive unit and I/O signal connections to the host controller.

3.5.1 Reference Input Circuit

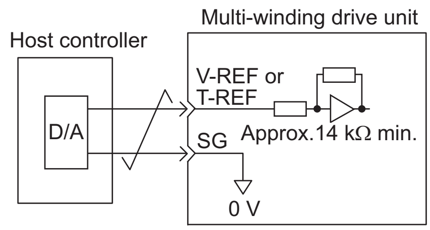
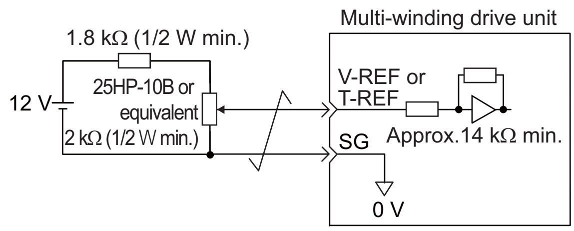
(1) Analog Input Circuit

CN1 connector pins 5 and 6 (speed reference input) and pins 9 and 10 (torque reference input) on the multi-winding drive unit are explained below.

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

- Reference speed input: Approx. 14 kΩ
- Reference torque input: Approx. 14 kΩ

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

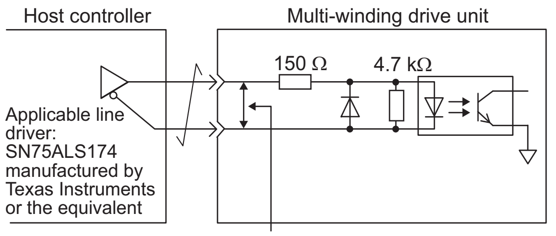
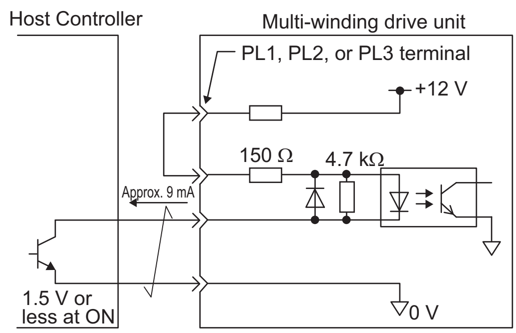
Analog Voltage Input Circuit (D/A)	Analog Voltage Input Circuit (Wiring Example)*
	

* This wiring example is for forward operation.

(2) Position Reference Input Circuit

CN1 connector pins 7 and 8 (reference pulse input), pins 11 and 12 (reference sign input), and 14 and 15 (clear input) on the multi-winding drive unit are explained below.

The output circuits for the reference pulse and position error clear signal from the host controller can be either a line-driver output or open-collector output. The position reference input circuits are shown below by output type.

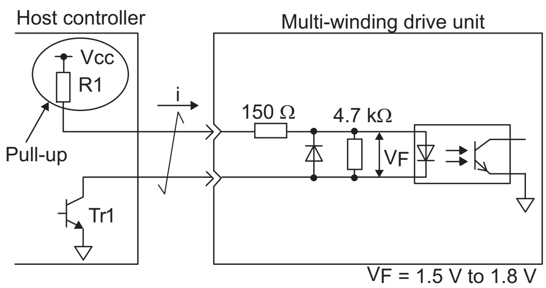
Line-driver Output Circuit	Open-collector Output Circuit (Built-in 12-V power supply)
 2.8 V ≤ (H level) – (L level) ≤ 3.7 V If the above formula is not satisfied, the inputs to the multi-winding drive unit will be unstable. Pulses may be missed from the reference pulse input, reference inversion may occur for the reference sign input, and the clear signal may be OFF for the clear input.	

IMPORTANT

- Precaution when host controller uses open collectors with customer-supplied power.
  The multi-winding drive unit may malfunction depending on the relationship between the pull-up voltage (Vcc) and the pull-up resistance (R1).
  Before wiring, confirm that the specifications of the host controller satisfy the values shown in the following table.

Pull-up voltage (Vcc)	Pull-up resistance (R1)
24 V	1.8 kΩ to 2.7 kΩ
12 V or less	820 Ω to 1.5 kΩ
5 V or less	180 Ω to 470 Ω

Circuit example of open-controller output



Wiring and Connection

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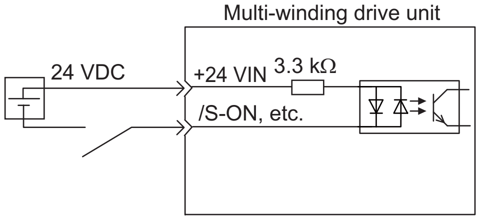
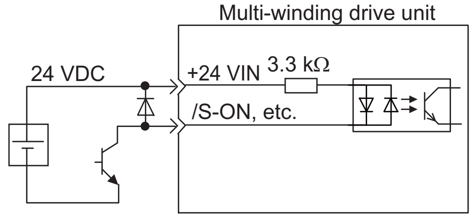
3.5.2 Sequence Input Circuit

(1) Photocoupler Input Circuit

Multi-winding drive unit CN1 connector pins 40 to 47 are explained below.

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

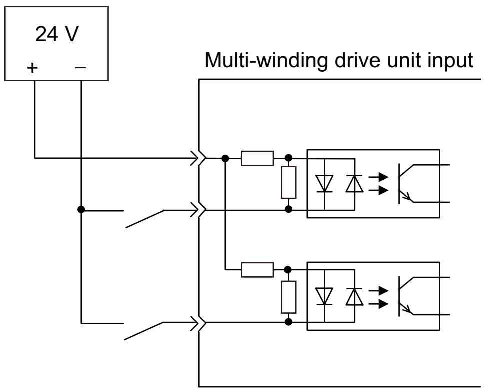
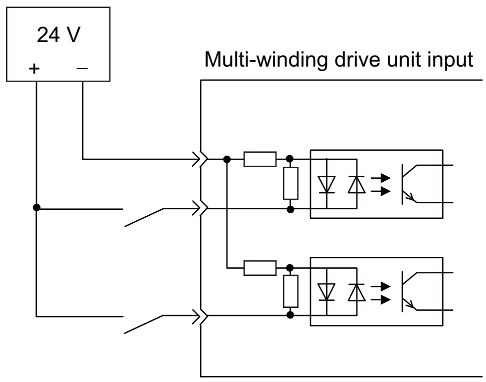
Relay Circuit Example	Open-collector Circuit Example
	

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

For SEN input signal circuit, refer to *5.9.2 Absolute Data Request Signal (SEN)*.

The input circuit of the multi-winding drive unit uses bidirectional photocoupler. Select either the sink circuit or the source circuit according to the specifications required for each machine.

Note: • The connection examples in *3.3.3* to *3.3.5* show sink circuits.
• The ON/OFF polarity differs between when a sink circuit is connected and when a source circuit is connected.

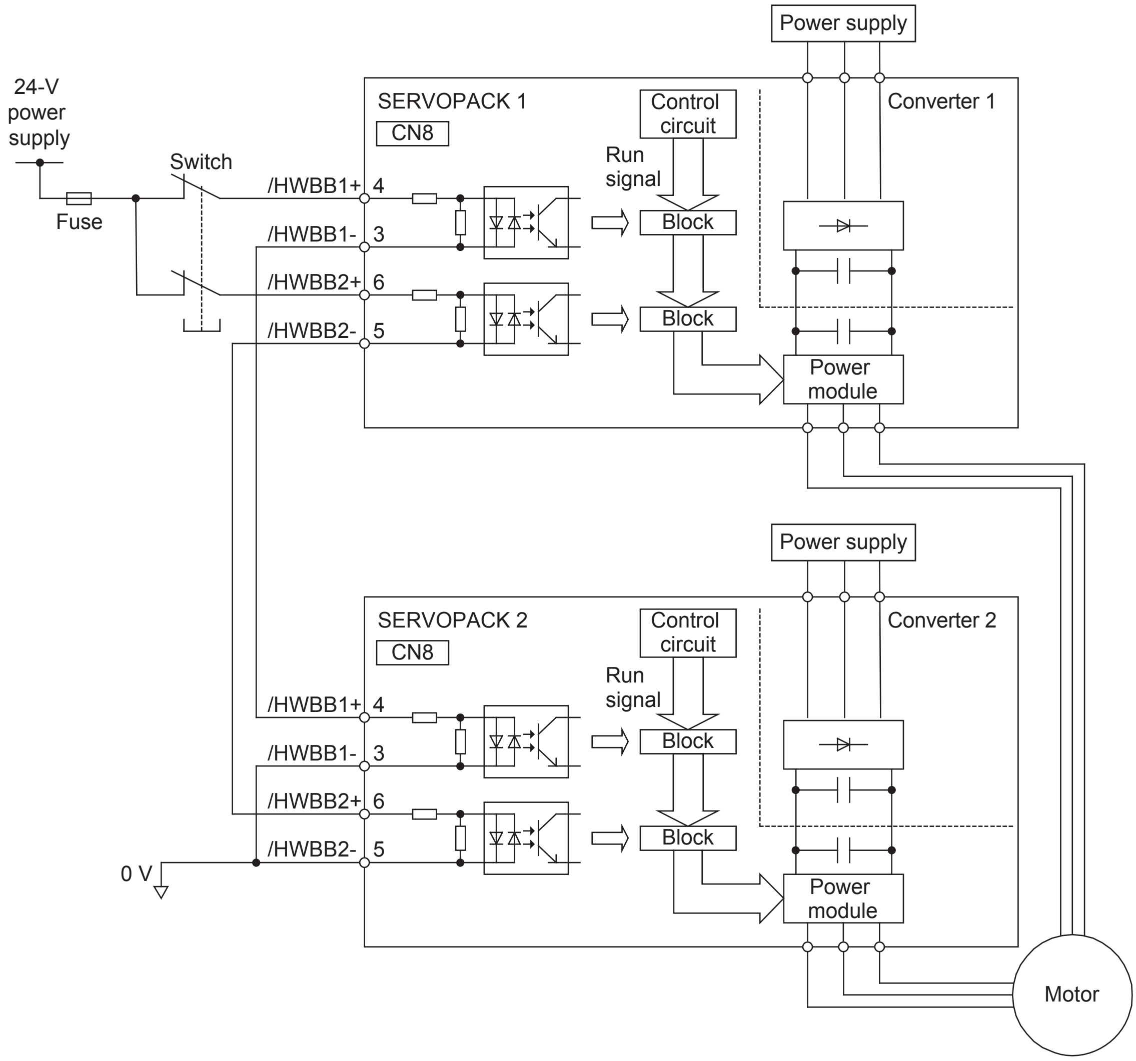
Sink Circuit	Source Circuit
	

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

(2) Safety Input Circuit

The input signals for the SERVOPACK safety function have a 0-V common. It is necessary to make an input signal redundant.

Input Signal Connection Example



3.5.3 Sequence Output Circuit

Three types of multi-winding drive unit sequence output circuits to a SERVOPACK are available and one type of SERVOPACK sequence output circuit is available.

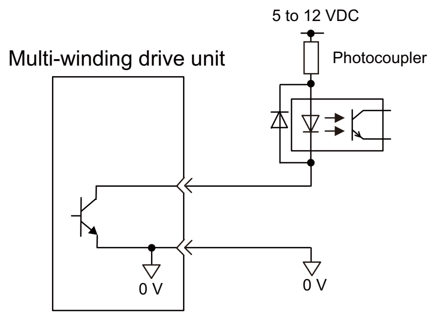
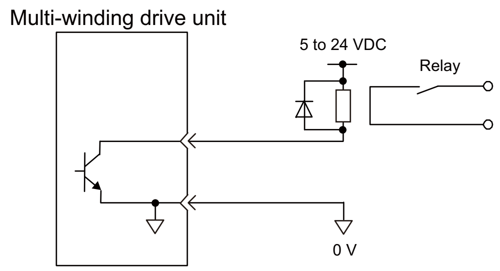
> **IMPORTANT**
>
> Incorrect wiring or incorrect voltage application to the output circuit may cause short-circuit.
>
> If a short-circuit occurs as a result of any of these causes, the holding brake will not work. This could damage the machine or cause an accident resulting in death or injury.

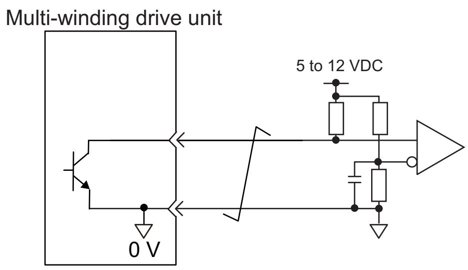
(1) Multi-Winding Drive Unit Sequence Output Circuits

■ Open-collector Output Circuit

CN1 connector pins 37 to 39 (alarm code output) on the multi-winding drive unit are explained below.

Alarm code signals (ALO1, ALO2, ALO3) are output from open-collector transistor output circuits. Connect an open-collector output circuit through a photocoupler, relay or line receiver circuit.

Photocoupler Circuit Example	Relay Circuit Example
	

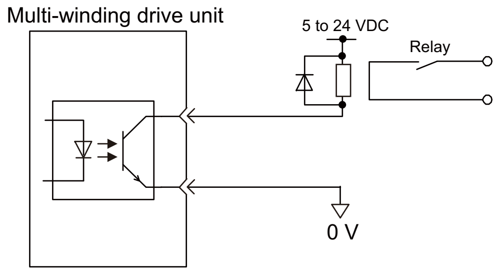
Line Receiver Circuit Example


Note: The maximum allowable voltage and maximum current capacity for open-collector output circuits are as follows.
- Voltage: 30 VDC
- Current: 20 mA DC

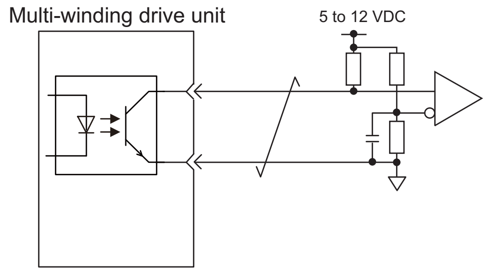
■ Photocoupler Output Circuit

Photocoupler output circuits are used for the multi-winding drive unit's servo alarm (ALM), servo ready (/S-RDY), and other sequence output signal circuits. Connect a photocoupler output circuit through a relay or line receiver circuit.

Relay Circuit Example



Line Receiver Circuit Example



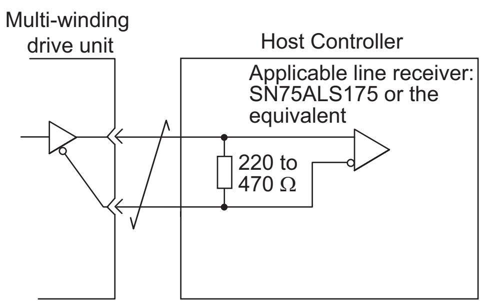
Note: The maximum allowable voltage and the allowable range of current capacity for photocoupler output circuits are as follows.
- Voltage: 30 VDC
- Current: 5 to 50 mA DC

■ Line Driver Output Circuit

CN1 connector pins 33 and 34 (phase-A signal), 35 and 36 (phase-B signal), and 19 and 20 (phase-C signal) on the multi-winding drive unit are explained below.

The following signals are output on the line-driver output circuit: 1) 0utput signals for which encoder serial data is converted to two-phase (phases A and B) pulses (PAO, /PAO, PBO, and /PBO) and 2) origin pulse signals (PCO and /PCO). Receive these outputs with a line receiver circuit at the host controller.

Line Receiver Circuit Example



Wiring and Connection

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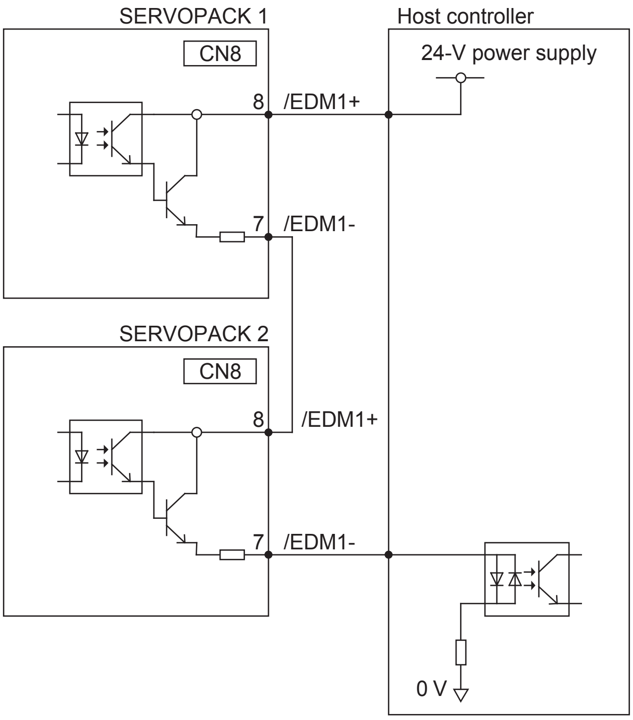
(2) SERVOPACK Safety Output Circuit

The external device monitor (EDM1) for safety output signals is explained below.
A configuration example for the EDM1 output signal is shown in the following diagram.

Note: The safety function signals can be connected only to a SERVOPACK.



■ Specifications

Type	Signal Name	Pin No.	Output Status	Meaning
Output	EDM1	CN8-8 CN8-7	ON	Both the /HWBB1 and /HWBB2 signals are working normally.
			OFF	The /HWBB1 signal, the /HWBB2 signal, or both are not working normally.

Electrical characteristics of EDM1 signal are as follows.

Items	Characteristic	Remarks
Maximum Allowable Voltage	30 VDC	–
Maximum Current	50 mADC	–
Maximum Voltage Drop at ON	1.0 V	Voltage between EDM1+ to EDM1- at current is 50 mA.
Maximum Delay Time	20 ms	Time from the change in /HWBB1 or /HWBB2 until the change in EDM1.

3.6 Local Communications Cable Connections

The local communications connector (CN41A/CN41B) connections from the multi-winding drive unit are explained below.

Use the special cable for local communications.

Connections between the multi-winding drive unit and SERVOPACK are 1:1, so two communications ports are provided on the multi-winding drive unit.

Multi-winding Drive Unit	SERVOPACK	
Connector	SERVOPACK No.	Connector
CN41A	1	CN6A
CN41B	2	CN6A

Note 1. Attach a terminator to the CN6B connector on the SERVOPACK.
2. The CN41A/CN41B connectors are the same connectors as the CN9A/CN9B connectors for MECHATROLINK-II communications.
Make sure you connect them correctly.
3. The maximum length of a local communications cable is 3 m.

3.7 Encoder Connection

This section describes the multi-winding drive unit's encoder signal (CN21) names, functions, and connection examples.

3.7.1 Encoder Signal (CN21) Names and Functions

The following table shows the names and functions of encoder signals (CN21).

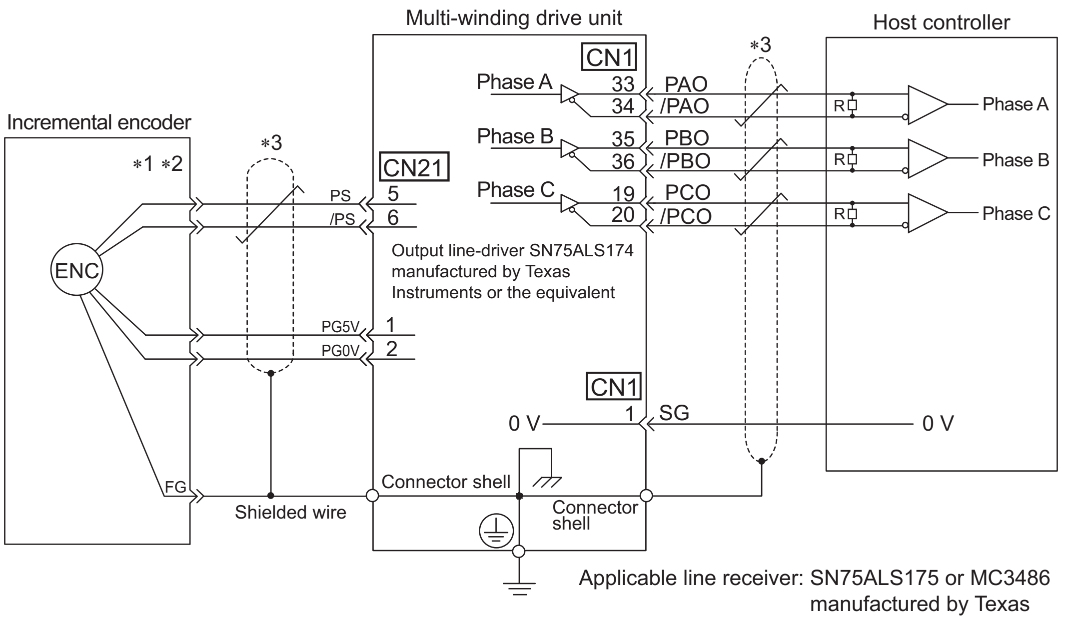
Signal Name	Pin No.	Function
PG 5 V	1	Encoder power supply +5 V
PG 0 V	2	Encoder power supply 0 V
BAT (+)*	3	Battery (+)
BAT (-)*	4	Battery (-)
PS	5	Serial data (+)
/PS	6	Serial data (-)
Shield	Shell	–

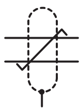
* These do not need to be connected for an incremental encoder.

3.7.2 Encoder Connection Examples

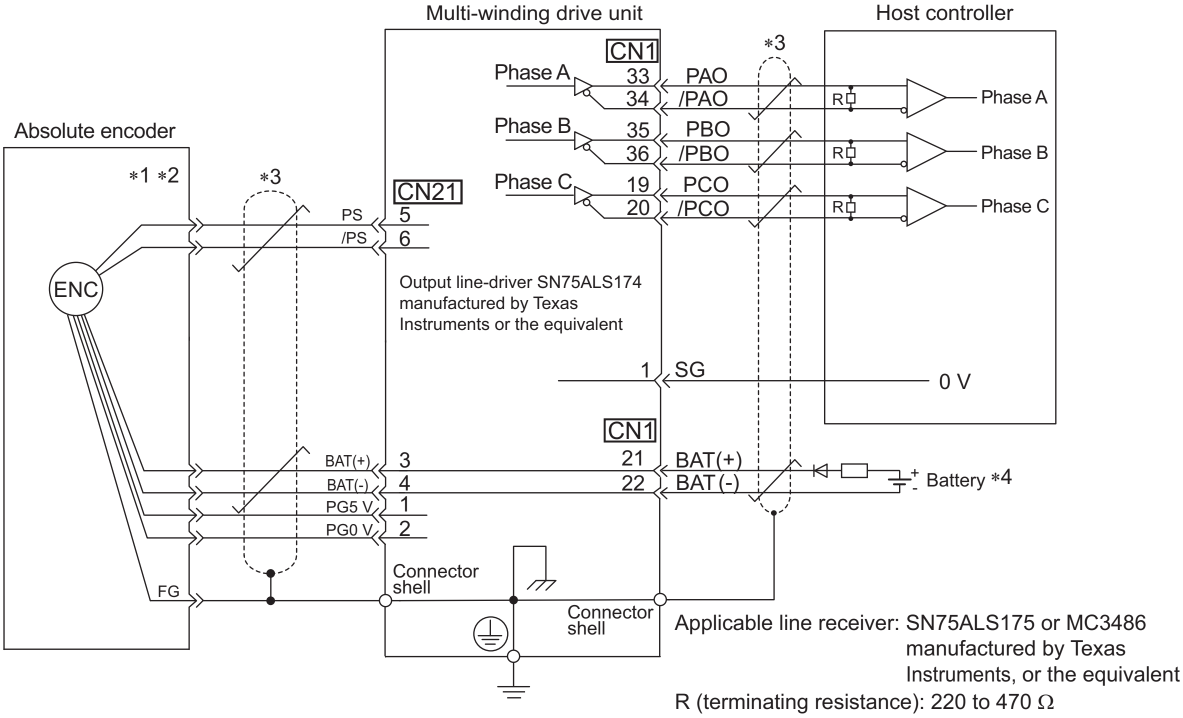
The following diagrams show connection examples of the encoder, the multi-winding drive unit, and the host controller.

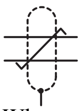
(1) Incremental Encoder



∗1. The pin arrangement for wiring connectors varies in accordance with the servomotor that is used.
∗2. To prevent the influence of external noise, we recommend you connect a ferrite core on the motor end of the encoder cable using two turns.
∗3.  : represents shielded twisted-pair wires.

(2) Absolute Encoder

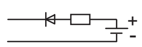


∗1. The pin arrangement for wiring connectors varies in accordance with the servomotor that is used.
∗2. To prevent the influence of external noise, we recommend you connect a ferrite core on the motor end of the encoder cable using two turns.
∗3.  : represents shielded twisted-pair wires.
∗4. When using an absolute encoder, provide power by installing an encoder cable with a JUSP-BA01-E Battery Case or install a battery on the host controller.

IMPORTANT

- When Installing a Battery on the Encoder Cable
  Use the encoder cable with a battery case that is specified by Yaskawa.
  Refer to the multi-winding drive system catalog for details.
- When Installing a Battery on the Host Controller
  Insert a diode near the battery to prevent reverse current flow.

Circuit Example



Wiring and Connection

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3.8 Selecting and Connecting a Regenerative Resistor Unit

The multi-winding drive unit, SERVOPACKs, and converters do not contain a regenerative resistor. Select and connect a regenerative resistor unit and set the regenerative resistor capacity in Pn600 as described in this section.

IMPORTANT

Set Pn600 to the allowable capacity of the regenerative unit for one SERVOPACK-converter pair (i.e., for one winding).

Refer to the multi-winding drive system catalog for detailed specifications of regenerative resistor unit.

WARNING

- Be sure to connect the regenerative resistor unit correctly. Do not short-circuit between B1 and B2.
  Doing so may result in fire or damage to the regenerative resistor unit, SERVOPACK, or converter or other devices.

3.8.1 Selecting a Regenerative Resistor Unit

(1) Using a Regenerative Resistor Unit Specified by Yaskawa

The regenerative resistor units specified by Yaskawa are listed in the following table. You must acquire the regenerative resistor units separately.

If you use a regenerative resistor unit specified by Yaskawa, use it only in one of the combinations that are given in the following table.

Main Circuit Power Supply Voltage	SERVOPACK Model SGDV-	Converter Model SGDV-COA	Model of Applicable Regenerative Resistor Unit	Resistance (Ω)	Specifications
Three-phase 400 V	101J	5EDA	JUSP-RA14-E	5	Four sets of two 10-Ω (600-W) resistors connected in series are connected in parallel.

(2) Using a Non-Specified Regenerative Resistor Unit

If you use non-specified regenerative resistor units, contact your Yaskawa representative or the sales department for more details.

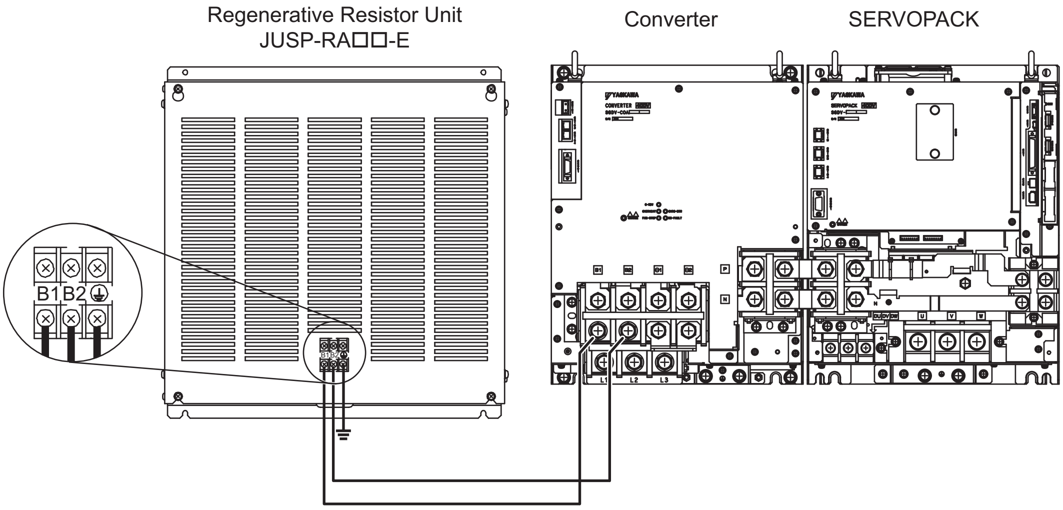
Main Circuit Power Supply Voltage	SERVOPACK Model: SGDV-	Converter Model: SGDV-COA	Minimum Allowable Resistance (Ω)
Three-phase 400 V	101J	5EDA	2

IMPORTANT

If you use a non-specified regenerative resistor unit, we recommend that you use a regenerative resistor unit with a thermal switch for safety.

3.8.2 Connecting a Regenerative Resistor Unit

Connect the B1 terminals and connect the B2 terminals between the converter and regenerative resistor unit. Connect them as shown in the following figures.



3.8.3 Setting Regenerative Resistor Capacity

(1) Using a Regenerative Resistor Unit Specified by Yaskawa

■ Using a Specified Combination

If you use a regenerative resistor unit specified by Yaskawa in one of the specified combinations, use the factory setting for Pn600.

■ Using a Non-Specified Combination

If you use a non-specified combination, refer to *(2) Using a Non-Specified Regenerative Resistor Unit*.

(2) Using a Non-Specified Regenerative Resistor Unit

If you use a non-specified regenerative resistor unit or if you use a regenerative resistor unit specified by Yaskawa but do not use it in the specified combination, set the capacity of the resistor in Pn600 (Regenerative Resistor Capacity).

⚠ WARNING

- If you set Pn600 to 0 when a non-specified regenerative resistor unit is connected or when a regenerative resistor unit specified by Yaskawa is connected in a non-specified combination, regenerative overload alarms (A.320) may not be detected. If the regenerative overload alarm (A.320) is not detected correctly, the regenerative resistor may be damaged and an injury or fire may result. Always set Pn600 to a suitable value.

Pn600	Regenerative Resistor Capacity [Speed] [Position] [Torque]				Classification
	Setting Range	Unit	Factory Setting	When Enabled	
	0 to SERVOPACK capacity	10 W	0	Immediately	Setup

Be sure to set the regenerative resistor capacity (Pn600) to a value that is in accordance with the allowable capacity of the actual regenerative resistor unit being used.

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

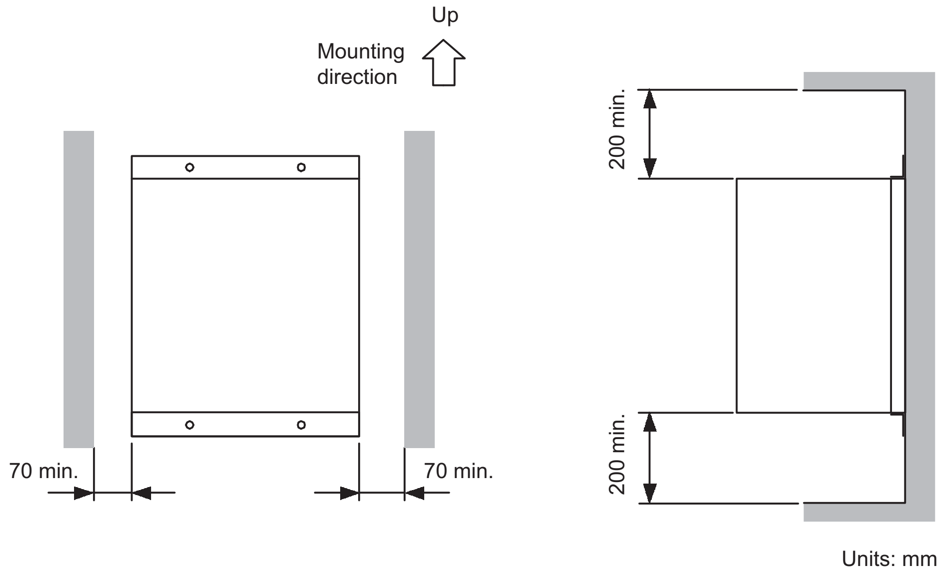
Example: Set 20 W (100 W × 20%) for the 100-W regenerative resistor unit with natural convection cooling method:
Pn600 = 2 (unit: 10 W)

IMPORTANT

- When the regenerative resistor unit for power are used at the rated load ratio, the resistor temperature increases to between 200°C and 300°C. The resistors must be used at or below the rated values. Check with the manufacturer for the resistor's load characteristics.
- Set the regenerative resistor capacity in parameter Pn600 of the multi-winding drive unit. Do not mistakenly change the SERVOPACK parameter.

3.8.4 Installation Standards

Observe the following installation standards when you use a regenerative resistor unit specified by Yaskawa. Provide at least 70 mm on each side of the unit and at least 200 mm at both the top and bottom of the unit to enable fan and natural convection cooling.



If you use a non-specified regenerative resistor unit, follow the specifications of the regenerative resistor unit when you install it.

3.9 Selecting and Connecting a Dynamic Brake Unit

To use the dynamic brake (DB), externally connect a dynamic brake unit or dynamic brake resistor to the SERVOPACK to process the dynamic braking energy.
Set Pn001 to n.□□□2 if you do not use the dynamic brake. In this case, it is not necessary to connect a dynamic brake unit.

IMPORTANT

- A dynamic brake unit is required for each SERVOPACK.
- Set the dynamic brake in parameter Pn001 of the multi-winding drive unit. Do not mistakenly change the SERVOPACK parameter. To enable a new parameter setting, turn the control power supply OFF and ON again.

3.9.1 Selection

Use the following tables to select a dynamic brake unit or dynamic brake resistor.

(1) Using a Yaskawa Dynamic Brake Unit

Main Circuit Power Supply Voltage	SERVOPACK Model: SGDV-	Dynamic Brake Unit Model	Resistance Specifications (Star Wiring 人)	Dynamic Brake Contactor and Surge Absorption Unit
Three-phase 400 V	101J	JUSP-DB04-E	180 W, 0.8 Ω × 3	Built into dynamic brake unit.

(2) Using a Dynamic Brake Resistor from Another Company

To order a dynamic brake unit, contact the manufacturer directly.

Main Circuit Power Supply Voltage	Model	Manufacturer	Required Resistance
Three-phase 400 V	GR series	Japan Resistor Mfg. Co., Ltd.	0.8 Ω or greater

Use the following dynamic brake contactors and surge absorption units.

Name		Model	Manufacturer
Contactor		SC-4-1/G Coil: 24 VDC	Fuji Electric Co., Ltd.
Main circuit surge absorption unit*	Head-on type	SZ-ZM1	
	Side-on type	SZ-ZM2	
Coil surge absorption unit		SZ-Z4	

* Use either a head-on or side-on main circuit surge absorption unit.

3.9.2 Selecting the Cable for the Dynamic Brake Unit

Use one of the following cables to connect the dynamic brake unit or dynamic brake contactor to CN115 on the SERVOPACK.

Cable Model	Cable length	Cable End Processing on Contact Coil End of Cable	Remarks	Manufacturer
JZSP-CVD00-1A5-E	1.5 m	Crimp terminals are attached (M3.5).	Red: Pin 1 (DB24) Black: Pin 3 (DBON)	Yaskawa Controls Co., Ltd.
JZSP-CVD00-03-E	3 m			

3.9.3 Setting the Dynamic Brake Unit

Use the parameters shown in the tables here to make the settings for the following: the servomotor stopping method when the servo is turned OFF, the output signals used to control the dynamic brake contactor, and the capacity of the dynamic brake resistor in relation to whether or not a dynamic brake has been connected.

The servomotor stopping method when the servo is turned OFF is set with parameter Pn001.0.

Parameter		Meaning	When Enabled	Classification
Pn001	n.□□0□ [Factory setting]	Stops servomotor by applying DB (dynamic brake).	After restart	Setup
	n.□□□1	Stops servomotor by applying DB and then releases DB.		
	n.□□□2	Stops servomotor without applying DB by coasting to a stop.		

When using a dynamic brake resistor from a company other than Yaskawa, set Pn00D.1 (second digit) to 0 or 1 in accordance with the following table depending if an NO or NC contact is used.

Parameter		Meaning	When Enabled	Classification
Pn00D	n.□□0□ [Factory setting]	Enables the control of an NO contactor (The dynamic brake is activated when current is supplied to the contactor coil.)	After restart	Setup
	n.□□1□	Enables the control of an NC contactor (The dynamic brake is activated when current is not supplied to the contactor coil.)		

The dynamic brake resistor capacity is set with Pn601.

Pn601	Dynamic Brake Resistor Capacity Speed Position Torque				Classification
	Setting Range	Unit	Factory setting	When Enabled	
	0 to SERVOPACK capacity	10 W	0	Immediately	Setup

(1) Using a Yaskawa Dynamic Brake Unit

- Set Pn001 to n.□□□0.
- Not necessary to set Pn00D
- Set Pn601 to 0.

(2) Using a Dynamic Brake Resistors from Another Company

- Set Pn001 to n.□□□0.
- Set Pn00D to either n.□□0D or n.□□1□ depending on your system.
- Set Pn601 to 20% of the resistor capacity of your dynamic brake.

IMPORTANT

If the setting of Pn601 is not correct, A.730 or A.731 (dynamic brake overloads) will not be detected correctly and there is a risk of equipment damage or fire. The Pn601 parameter is for the multi-winding drive unit. Do not mistakenly change the SERVOPACK parameter.

(3) Not Using a Dynamic Brake

- Set Pn001 to n.□□□2.
- Not necessary to set Pn00D
- Set Pn601 to 0.

3.9.4 Setting the Dynamic Brake Answer Function

With the dynamic brake answer function, you can use auxiliary contacts of the contactor that is used in the dynamic brake circuit and the dynamic brake answer signal (/DBANS) to detect welding or failure to operation.
To use the dynamic brake answer function, select a contactor that has auxiliary contacts.

Note: The dynamic brake answer function cannot be used with a Yaskawa dynamic brake unit because there are no auxiliary contacts on the contactor.

IMPORTANT

Connect the dynamic brake answer signal (/DBANS) to the SERVOPACK's I/O connector (CN1).

The dynamic brake answer signal is assigned with Pn515.2.

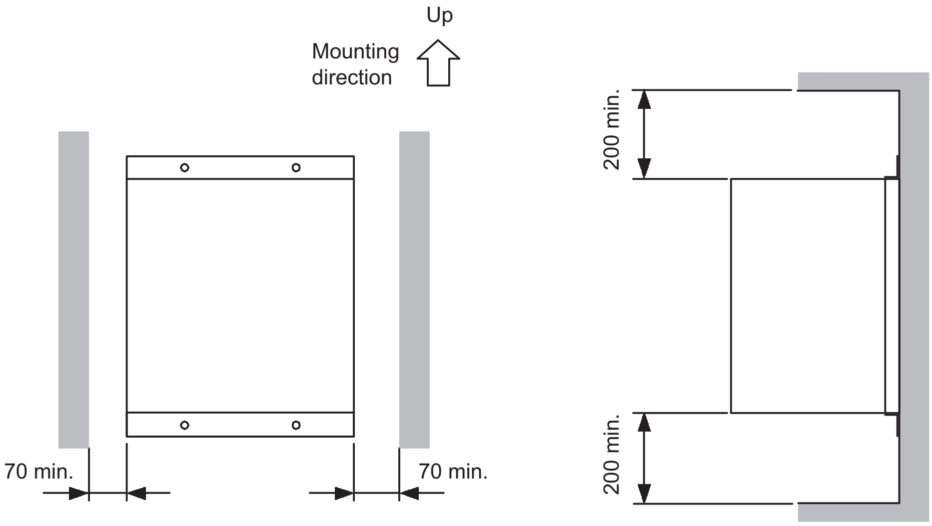
Parameter		Meaning	When Enabled	Classification
Pn515	n.□0□□	Detects dynamic brake (DB) contactor errors when the input signal of CN1-40 is ON (closed) while the DB is applied.	After restart	Setup
	n.□1□□	Detects DB contactor errors when the input signal of CN1-41 is ON (closed) while the DB is applied.		
	n.□2□□	Detects DB contactor errors when the input signal of CN1-42 is ON (closed) while the DB is applied.		
	n.□3□□	Detects DB contactor errors when the input signal of CN1-43 is ON (closed) while the DB is applied.		
	n.□4□□	Detects DB contactor errors when the input signal of CN1-44 is ON (closed) while the DB is applied.		
	n.□5□□	Detects DB contactor errors when the input signal of CN1-45 is ON (closed) while the DB is applied.		
	n.□6□□	Detects DB contactor errors when the input signal of CN1-46 is ON (closed) while the DB is applied.		
	n.□7□□ n.□8□□ [Factory setting]	Disables DB contactor error detection of DB answer signal.		
	n.□9□□	Detects DB contactor errors when the input signal of CN1-40 is OFF (open) while the DB is applied.		
	n.□A□□	Detects DB contactor errors when the input signal of CN1-41 is OFF (open) while the DB is applied.		
	n.□B□□	Detects DB contactor errors when the input signal of CN1-42 is OFF (open) while the DB is applied.		
	n.□C□□	Detects DB contactor errors when the input signal of CN1-43 is OFF (open) while the DB is applied.		
	n.□D□□	Detects DB contactor errors when the input signal of CN1-44 is OFF (open) while the DB is applied.		
	n.□E□□	Detects DB contactor errors when the input signal of CN1-45 is OFF (open) while the DB is applied.		
	n.□F□□	Detects DB contactor errors when the input signal of CN1-46 is OFF (open) while the DB is applied.		

Example

If you use a dynamic brake contactor with NO contacts, input the dynamic brake answer signal (a signal from NO auxiliary contacts) to CN1-45 and set Pn515 to n.□E□□.

3.9.5 Installation Standards

Observe the following installation standards when you use a Yaskawa dynamic brake unit. Provide at least 70 mm on each side of the unit and at least 200 mm at both the top and bottom of the unit to enable fan and natural convection cooling.



Units: mm

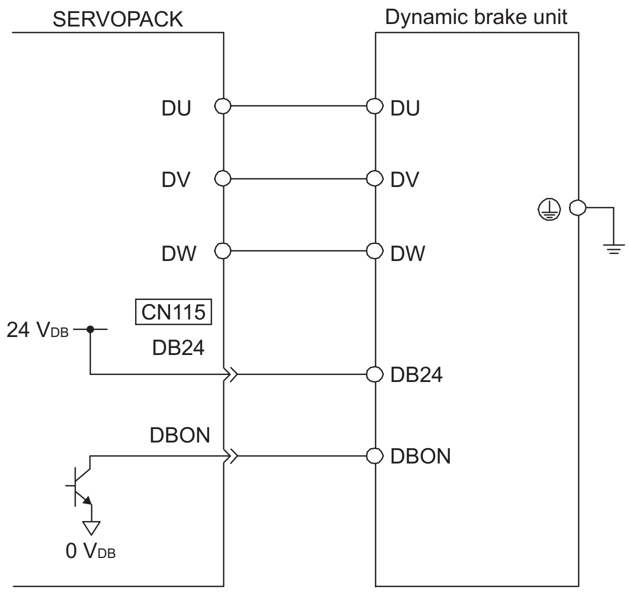
If you use a dynamic brake resistor from a company other than Yaskawa, follow the specifications of the dynamic brake resistor when you install it.

3.9.6 Connections

(1) Using a Yaskawa Dynamic Brake Unit

A dynamic brake contactor is built into a Yaskawa dynamic brake unit.
The connections are shown in the following figure.

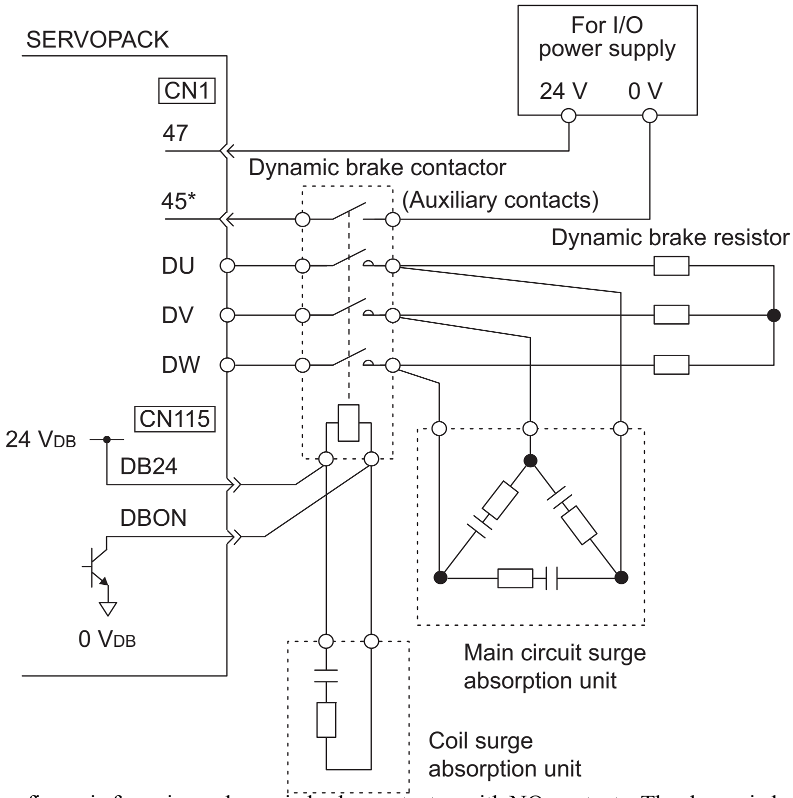
Note: The dynamic brake answer function (Pn515.2) cannot be used because there are no auxiliary contacts on the contactor.



(2) Using a Dynamic Brake Resistor from Another Company

■ Using NO Contacts for the Dynamic Brake Contactor

The following example shows connecting dynamic brake resistors for the SERVOPACK for one winding. When connecting dynamic brake resistors for actual operation, refer to the following figure and connect resistors for two windings.



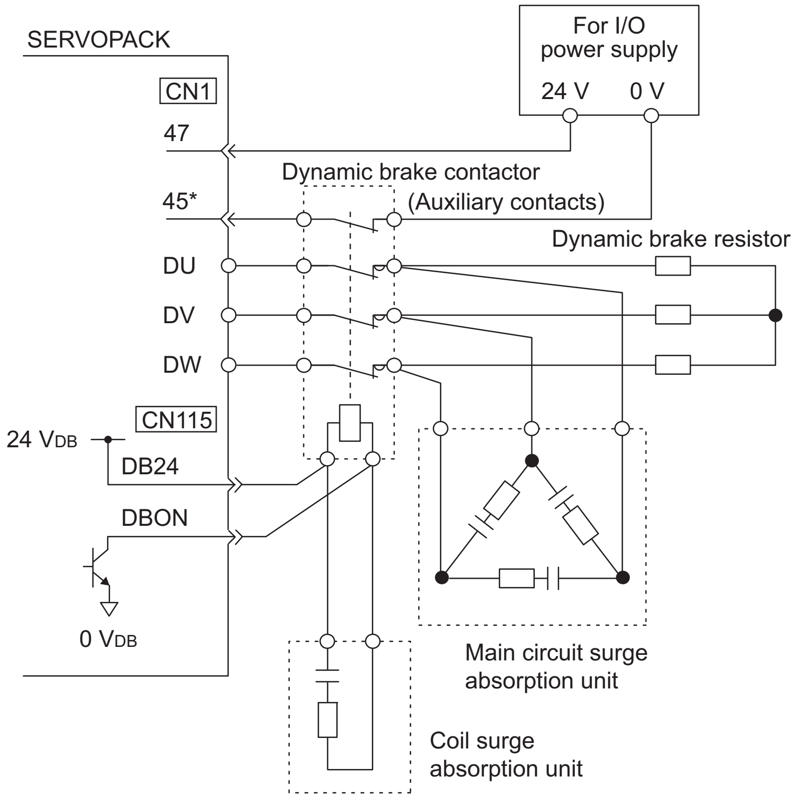
* The above figure is for using a dynamic brake contactor with NO contacts. The dynamic brake answer signal (a signal from NO auxiliary contacts) is input to CN1-45. To indicate an error if the input signal to CN1-45 turns OFF (open) while the dynamic brake is activated, the Pn515 parameter in the multi-winding drive unit must be set to n.□E□□. If the dynamic brake answer signal is not used, Pn515 is set to n.□8□□ (default setting).

Note 1. If you assign more than one signal to the same input circuit, OR logic will be used and any of the input signals will cause the circuit to operate. This may result in unexpected operation.

2. The maximum current for DB24 and DBON is 300 mA.

■ Using NC Contacts for the Dynamic Brake Contactor

The following example shows connecting dynamic brake resistors for the SERVOPACK for one winding. When connecting dynamic brake resistors for actual operation, refer to the following figure and connect resistors for two windings.



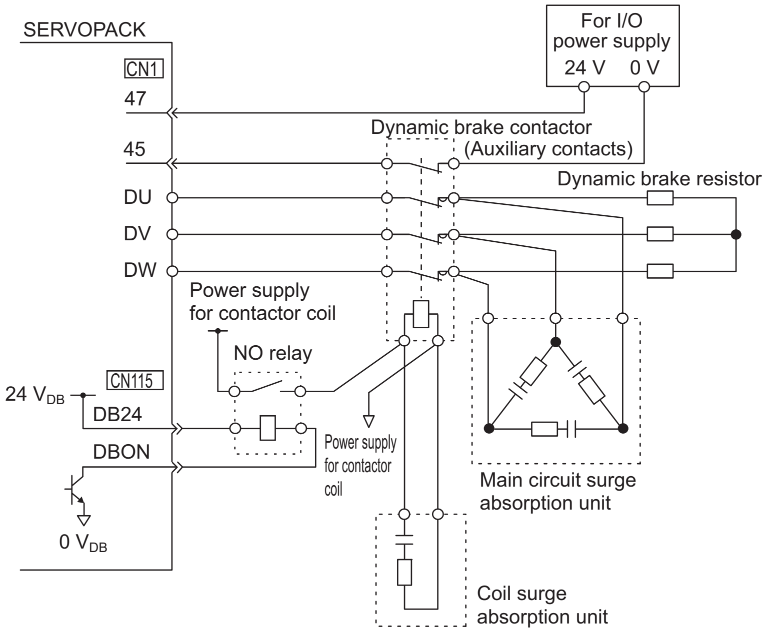
* The above figure is for using a dynamic brake contactor with NC contacts. The dynamic brake answer signal (a signal from NC auxiliary contacts) is input to CN1-45. To indicate an error if the input signal to CN1-45 turns OFF (open) while the dynamic brake is activated, the Pn515 parameter in the multi-winding drive unit must be set to n.□E□□. If the dynamic brake answer signal is not used, Pn515 is set to n.□8□□ (default setting).

Note 1. If you assign more than one signal to the same input circuit, OR logic will be used and any of the input signals will cause the circuit to operate. This may result in unexpected operation.

2. The maximum current for DB24 and DBON is 300 mA.

■ If the coil current of NC dynamic brake contactors is 300 mA or higher, obtain an NO relay that can switch the contactor coil current and voltage and a power supply for the contactor coil.

The following example shows connecting dynamic brake resistors for the SERVOPACK for one winding. When connecting dynamic brake resistors for actual operation, refer to the following figure and connect resistors for two windings.



3.10 Noise Control and Measures for Harmonic Suppression

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

3.10.1 Wiring for Noise Control

IMPORTANT

- Because the multi-winding drive unit, SERVOPACKs, and converters are designed as industrial devices, they provide no mechanism to prevent noise interference.
- The SERVOPACKs and converters use high-speed switching elements in the main circuit. Therefore peripheral devices may receive switching noise. If the equipment is to be used near private houses or if radio interference is a problem, take countermeasures against noise.
- If installation conditions by the EMC directive must be met, refer to *2.4 EMC Installation Conditions in Σ-V User's Manual for Use with Large-Capacity Models Setup Rotational Motor* (No.: SIEP S800000 85).

The multi-winding drive unit, SERVOPACKs, and converters use microprocessors. Therefore, noise influence may be received from the multi-winding drive unit, SERVOPACK, and converter peripheral devices.

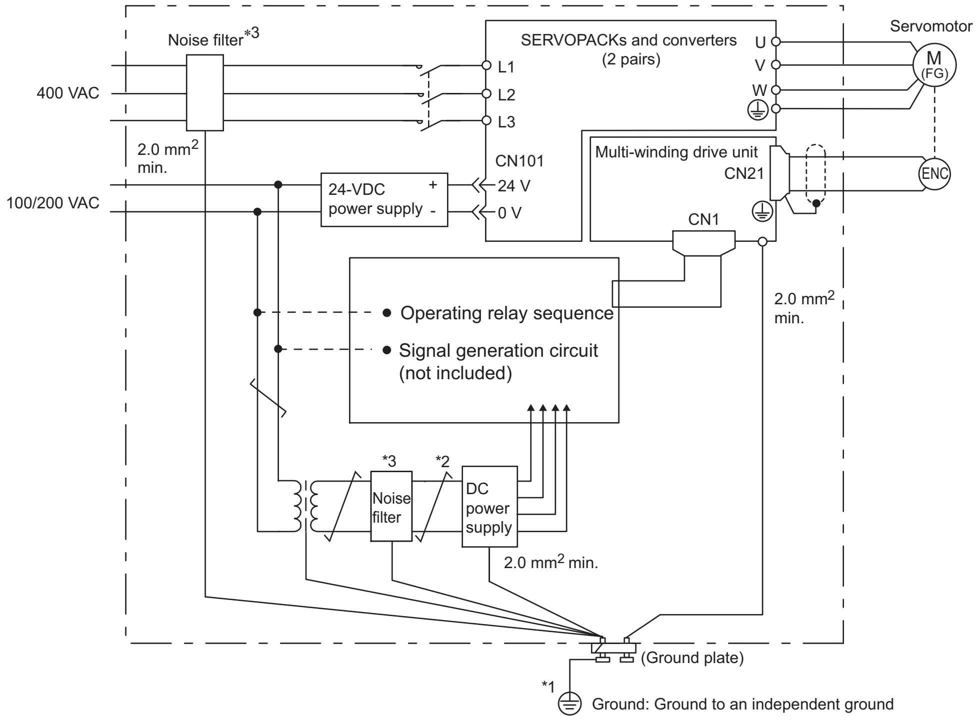
To suppress the influence of noise between peripheral devices and the multi-winding drive unit, SERVOPACKs, and converters, implement the following noise measures as required.

- Position the input reference device and noise filter as close to the multi-winding drive unit, SERVOPACK, or converter as possible.
- Always install a surge absorber in the relay, solenoid and electromagnetic contactor coils.
- 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.
- Do not share the power supply with an electric welder or electrical discharge machine. If the SERVOPACK is placed near equipment that generates high-frequency noise, install a noise filter on the input side of the main circuit power supply cables and control power supply cables, even if the same power supply is not used. As for the wiring of noise filter, refer to *(1) Noise Filter* shown below.
- Take the grounding measures correctly. As for the grounding, refer to *(2) Correct Grounding.*

(1) Noise Filter

The multi-winding drive unit, SERVOPACKs, and converters have built-in microprocessors, so protect them from external noise as much as possible by installing noise filters in the appropriate places.

The following is an example of wiring for noise control.



∗1. For ground wires connected to the ground plate, use a thick wire with a thickness of at least 2.0 mm^2 (preferably, plain stitch cooper wire).

∗2. should be twisted-pair wires.

∗3. When using a noise filter, follow the precautions in *3.10.2 Precautions on Connecting Noise Filter*.

(2) Correct Grounding

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

■ Grounding the Motor

Always connect servomotor frame terminal FG to the SERVOPACK ground terminal ⏚. Also be sure to ground the ground terminal ⏚.

If the servomotor is grounded via the machine, a switching noise current will flow from the main circuit of the SERVOPACK and converter through the stray capacitance of the servomotor. To prevent the adverse effects of switching noise, always connect the ground terminal ⏚ in the motor terminal box on the servomotor to the ground terminal ⏚ on the SERVOPACK.

■ Noise on the I/O Signal Cable

If the I/O signal cable receives noise, ground the 0 V line (SG) of the I/O signal cable. If the servomotor main circuit cable is accommodated in a metal conduit, ground the conduit and its junction box. For all grounding, ground at one point only.

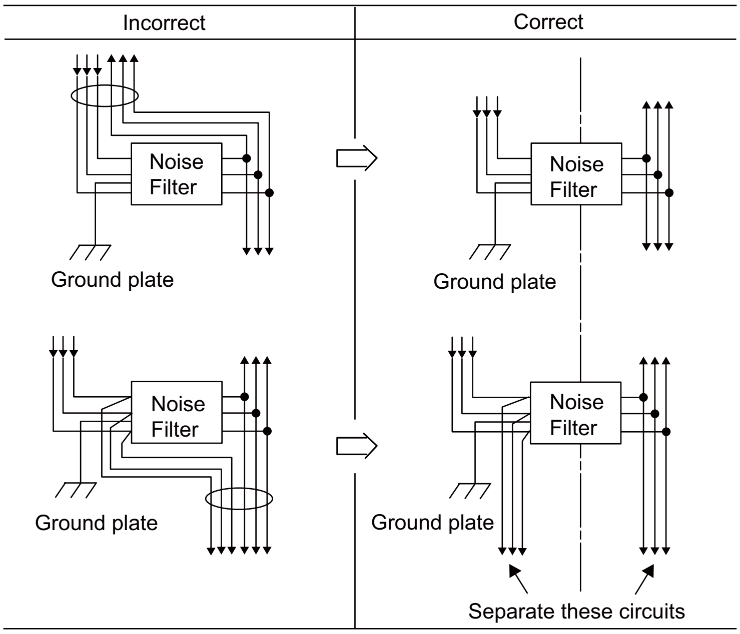
3.10.2 Precautions on Connecting Noise Filter

Always observe the following installation and wiring instructions.

IMPORTANT

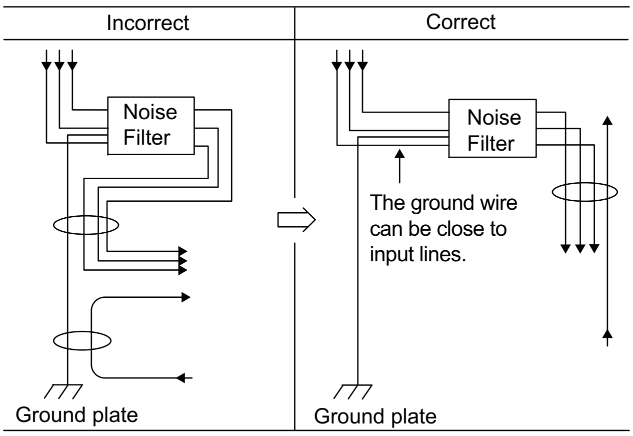
Some noise filters have large leakage currents. The grounding measures taken also affects the extent of the leakage current. If necessary, select an appropriate leakage current detector or leakage current breaker taking into account the grounding measures that are used and leakage current from the noise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

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

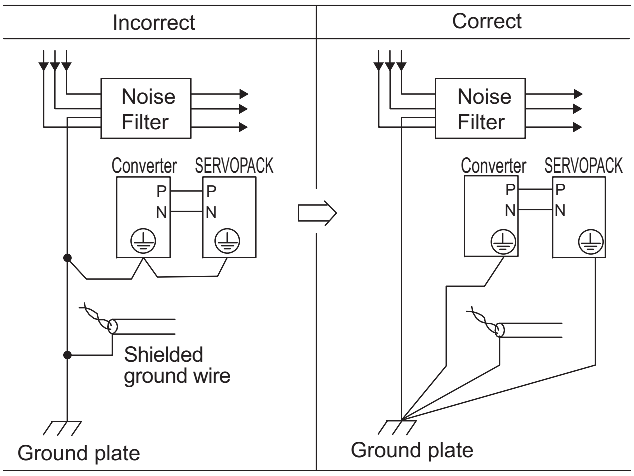


Separate the noise filter ground wire from the output lines.

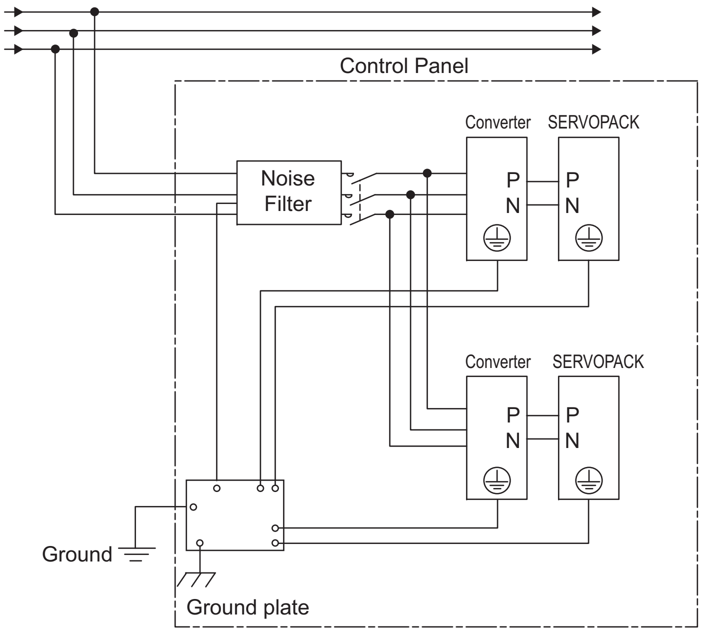
Do not accommodate the noise filter ground wire, output lines and other signal lines in the same duct or bundle them together.



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



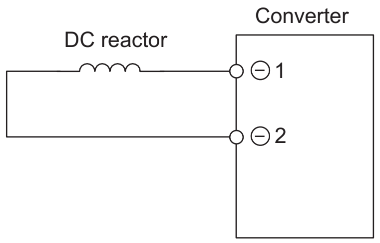
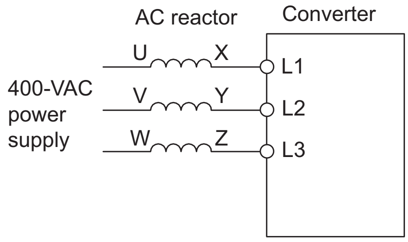
If a noise filter is located inside a control panel, first connect the noise filter ground wire and the ground wires from other devices inside the control panel to the ground plate for the control panel, then ground the plates.



3.10.3 Connecting a Reactor for Harmonic Suppression

The converters have reactor connection terminals for power supply harmonic suppression that can be used as required.

Connect a reactor as shown in the following figure.

DC Reactor	AC Reactor
	

Note 1. Connection terminals for DC reactor ⊖1 and ⊖2 are short-circuited at shipment. Remove the lead wire for short-circuit, and connect a DC reactor.
2. Reactors are not included. (Sold separately.)
3. The multi-winding drive unit and SERVOPACKs do not have connection terminals for reactors.

4

Trial Operation

4.1 Inspection and Checking before Trial Operation

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

(1) Servomotors

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

- Are all wiring and connections correct?
- Are all nuts and bolts securely tightened?
- If the servomotor has an oil seal, is the seal undamaged and is the servomotor oiled?

Note: When performing trial operation on a servomotor that has been stored for a long period of time, perform the inspection according to the procedures described in *1.8 Inspection and Maintenance of a Multi-Winding Drive System*.

(2) Multi-Winding Drive System Status

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

- Are all wiring and connections correct?
- Are the correct power supply voltages being supplied to the multi-winding drive unit, SERVOPACKs, and converters?

4.2 Trial Operation for Servomotor without Load

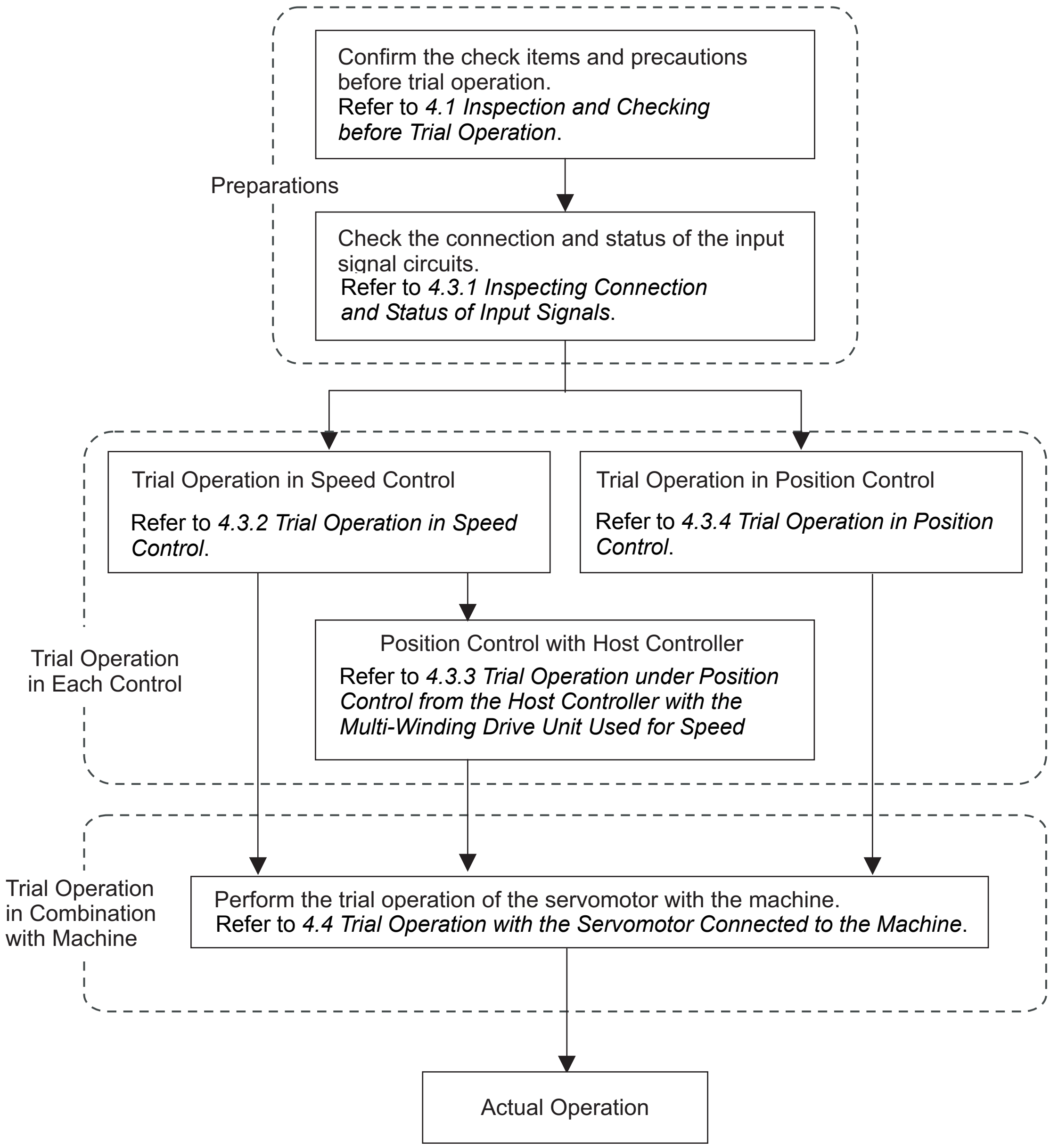
For information on trial operation on the servomotor without a load, refer to the *Σ-V Series User's Manual For Use with Large-Capacity Models Setup Rotational Motors Multi-Winding Drive System* (No. SIEP S800001 85).

4.3 Trial Operation for Servomotor without Load from Host Reference

Check the following items before performing trial operation of the servomotor without load from host reference.

- Check that servomotor operation reference input from the host controller to the multi-winding drive unit and I/O signals are set properly.
- Check that the wiring between the host controller and multi-winding drive unit and the polarity of the wiring are correct.
- Check that all operation settings for the multi-winding drive unit, SERVOPACKs, and converters are correct.

Perform the trial operation using the following procedure.



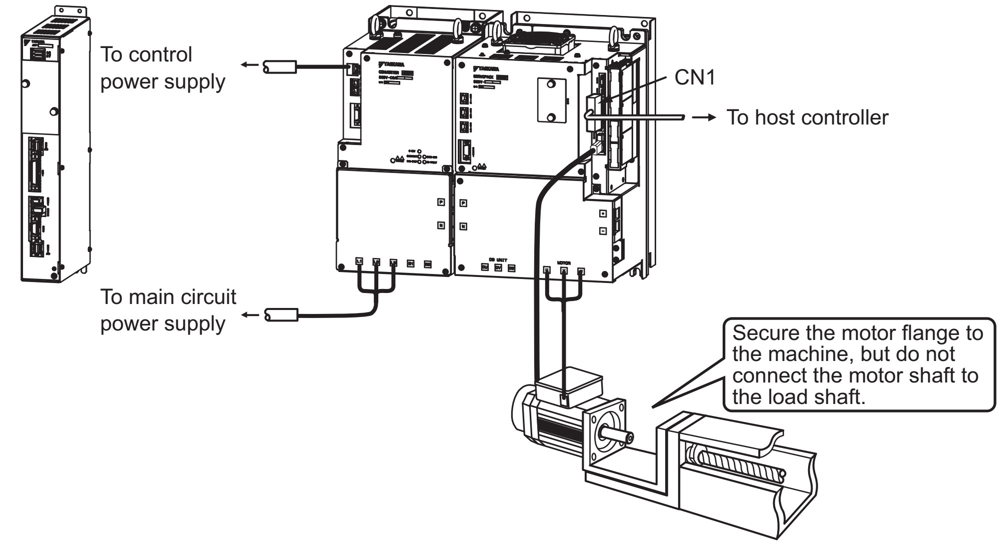
Note: To perform trial operation of a servomotor with a brake, refer to *4.5 Trial Operation of Servomotor with Brakes*.

Trial Operation

4

⚠ CAUTION

Before performing trial operation of the servomotor alone under references from the host controller, be sure that the servomotor has no load (i.e., the coupling and belt are removed from the servomotor) to prevent unexpected accidents.



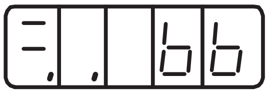
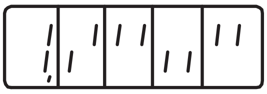
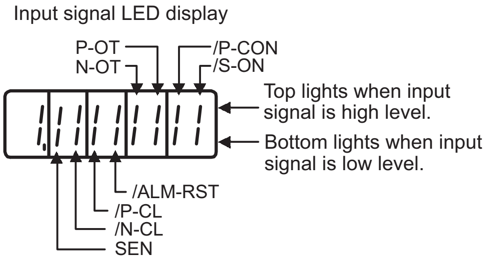
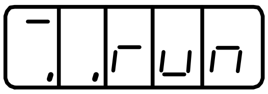
4.3.1 Inspecting Connection and Status of Input Signals

Check the items in step 1 before trial operation of the servomotor under speed control and position control references from the host controller.

Check the connection and status of input signals using the following procedure.

Step	Operation	Reference
1	Connect the necessary input signals to the I/O signal connector (CN1) under the following conditions. • It must be possible to input servo ON signal (/S-ON). • The forward run prohibited (P-OT) and reverse run prohibited (N-OT) input signals must be ON (L level) (i.e., the servomotor must be able to run in forward and reverse). Settings: CN1-42 and CN1-43 must be ON (low) or Pn50A.3 and Pn50B.0 must be set to 8 to disable the forward and reverse run prohibited function. Note: Return the settings to the previous ones after completing trial operation. • Make sure that no reference is being input. • If Pn002.2 is set to 1, the absolute encoder can temporarily be used as an incremental encoder, which makes it possible to perform trial operation of the servomotor without Fn008 and SEN signal settings. Connect a safety function device to CN8 when using the safety function. For the connecting method, refer to *(1) Connecting a Safety Function Device.*	Refer to the following connection diagrams. *3.3.3 Example of I/O Signal Connections in Speed Control* *3.3.4 Example of I/O Signal Connections in Position Control* *3.3.5 Example of I/O Signal Connections in Torque Control* *5.9 Absolute Encoders* *5.11 Safety Function* *3.3.2 SERVOPACK Safety Function Signal (CN8) Names and Functions*
2	Connect the connector of the host controller to the I/O signal connector (CN1) on the multi-winding drive unit.	–

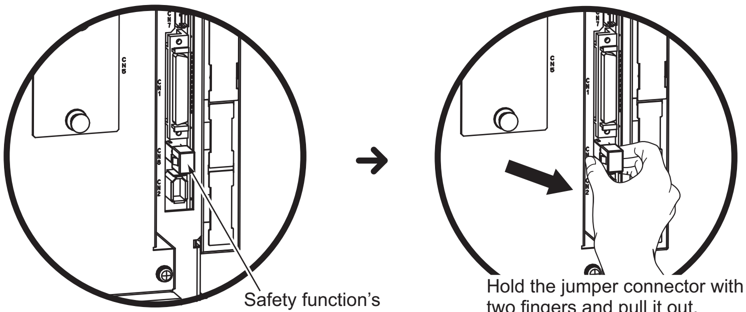
(cont'd)

Step	Operation	Reference
3	Turn ON the control power supply. Make sure that the panel operator display is as shown below.  Check the input signal using the input signal monitor (Un005) from the panel operator. If the display is not the same as shown below, correct the input signal setting.   Note: • If an absolute encoder is being used, turn ON the SEN signal. The servomotor will not turn ON when only the servo ON signal (/S-ON) is input. • When the SEN signal is checked using the monitor display, the top of the LED will light because the SEN signal is high when ON. • Input signals can be also checked using wiring check function of SigmaWin+.	*8.4 Monitoring Input Signals* *3.4.1 Input Signal Allocations*
4	Input the /S-ON signal, then make sure that the display of the panel operator is as shown below.  If an alarm display appears, correct it according to *9.1 Alarm Displays*. If the cause of alarm is not corrected, the servo ON signal cannot be input and the servomotor cannot be turned on.	*9.1 Alarm Displays*
5	This completes all preparations for trial operation. Perform trial operation in each control method.	*4.3.2 Trial Operation in Speed Control* *4.3.3 Trial Operation under Position Control from the Host Controller with the Multi-Winding Drive Unit Used for Speed Control* *4.3.4 Trial Operation in Position Control*

(1) Connecting a Safety Function Device

Connect a safety function device using the following procedure.

1. Remove the safety function’s jumper connector from CN8.



2. Connect a safety function device to CN8.

Note: When not using the safety function, use the SERVOPACK with the safety function’s jumper connector (JZSP-CVH05-E provided as an accessory) inserted in CN8. If the SERVOPACK is used without the jumper connector inserted into CN8, no current will flow to the servomotor and no torque will be output. In this case, the multi-winding drive unit and SERVOPACKs will enter a hard wire base block state.

4.3.2 Trial Operation in Speed Control

Perform the following steps for trial operation in speed control. The steps are specified on the condition that input signal wiring for the speed control has been completed according to *4.3.1 Inspecting Connection and Status of Input Signals*.

Step	Operation	Reference
1	Recheck the power supply and the input signal circuits, and turn ON the control power supply to the multi-winding drive system.	*3.3.3 Example of I/O Signal Connections in Speed Control*
2	Adjust the speed reference input gain (Pn300).	*5.3.1 Basic Settings for Speed Control*
3	Turn ON the main circuit power supply of the SERVOPACK and converter.	–
4	Check that speed reference input (the voltage between V-REF and SG) is 0 V, and turn ON the servo ON (/S-ON) input signal. Note: If the servomotor rotates at a very low speed with the speed reference input at 0 V, adjust the reference offset so that the servomotor will not rotate.	*5.3.2 Reference Offset Adjustment*
5	Gradually increase the voltage of the speed reference input (i.e., the voltage between V-REF and SG) from 0 V. Note: The factory setting is 6 V at the rated speed.	*5.3.1 Basic Settings for Speed Control*
6	Check the speed reference value using the monitor display (Un001).	*8.1 List of Monitor Displays*
7	Check the motor rotating speed using the monitor display (Un000).	*8.1 List of Monitor Displays*
8	Check that the values in step 6 and step 7 (Un001 and Un000) are equal to each other.	–
9	Check the motor rotation direction. Note: To switch the motor rotation direction without changing the polarity of the analog speed reference, refer to *5.2.2 Servomotor Rotation Direction*	*5.2.2 Servomotor Rotation Direction*
10	Return the speed reference input to 0 V.	–
11	Turn OFF the servo ON signal (/S-ON).	–

4.3.3 Trial Operation under Position Control from the Host Controller with the Multi-Winding Drive Unit Used for Speed Control

To operate the multi-winding drive unit in speed control under the position control from the host controller, check the operation of the servomotor after finishing the trial operation explained in *4.3.2 Trial Operation in Speed Control.*

Step	Operation	Reference
1	Recheck the power supply and the input signal circuits, and turn ON the control power supply to the multi-winding drive system.	*3.3.3 Example of I/O Signal Connections in Speed Control*
2	Adjust the speed reference input gain (Pn300).	*5.3.1 Basic Settings for Speed Control*
3	Set the encoder output pulses (Pn212).	*5.3.7 Setting Encoder Output Pulse*
4	Turn ON the main circuit power supply of the SERVOPACK and converter.	–
5	Check that speed reference input (the voltage between V-REF and SG) is 0 V, and turn ON the servo ON (/S-ON) input signal. Note: If the servomotor rotates at a very low speed with the speed reference input at 0 V, adjust the reference offset so that the servomotor will not rotate.	*5.3.2 Reference Offset Adjustment*
6	To check the speed of the servomotor, execute a constant speed reference at a low speed through the host controller. Example: Visually check that the servomotor rotates once per second with a speed reference of 60 min^{-1}. Note: If the speed of the servomotor is not correct, check the reference sent by the host controller.	*8.1 List of Monitor Displays*
7	To check the rotation of the servomotor, execute a simple positioning reference through the host controller. Example: Input a reference that is equivalent to a single rotation of the servomotor. To confirm that the servomotor moved a single rotation, do a visual check or check the rotational angle 1 (Un003 [pulse]). Note: If the rotation of the servomotor is not correct, check the reference sent by the host controller.	*8.1 List of Monitor Displays*
8	Return the speed reference input to 0 V.	–
9	Turn OFF the servo ON signal (/S-ON).	–

4.3.4 Trial Operation in Position Control

Perform the following steps for trial operation in position control. The steps are specified on the condition that input signal wiring for the position control has been completed according to *4.3.1 Inspecting Connection and Status of Input Signals.*

Step	Operation	Reference
1	Recheck the power supply and the input signal circuits, and turn ON the control power supply to the multi-winding drive system.	*3.3.4 Example of I/O Signal Connections in Position Control*
2	Set the reference pulse form with Pn200.0 according to the output pulse form of the host pulse reference form.	*5.4.1 Basic Settings for Position Control*
3	Set the reference unit, and then set the electronic gear ratio according to the host controller. The electronic gear ratio is set in Pn20E and Pn210.	*5.4.4 Electronic Gear*
4	Turn ON the main circuit power supply of the SERVOPACK and converter.	–
5	Turn ON the servo ON (/S-ON) input signal.	–
6	Output a low-speed pulse reference for an easy-to-check number of rotations (e.g., one rotation) from the host controller. Note: To ensure safety, set the reference pulse speed so that the motor speed will be around 100 min^{-1}.	–
7	Check the number of reference pulses input to the SERVOPACK from the changes in the input reference pulse monitor before and after the reference. The input reference pulse can be checked with Un00C.	–

(cont'd)

Step	Operation	Reference
8	Check the actual number of motor rotations from the changes in the feedback pulse monitor before and after the reference. The feedback pulse can be checked with Un00D.	–
9	Check that step 7 and step 8 satisfy the following formula. Un00D = Un00C × (Pn20E/Pn210)	–
10	Check that the servomotor is rotating in the direction specified by the reference. Note: To switch the motor rotation direction without changing the polarity of the input pulse, refer to *5.2.2 Servomotor Rotation Direction.*	*5.2.2 Servomotor Rotation Direction*
11	Input a pulse reference for a comparatively large number of motor rotations from the host controller so that the servomotor will rotate at a constant speed.	–
12	Check the reference pulse speed input to the SERVOPACK from the input reference pulse speed monitor (min^{-1}). The input reference pulse speed can be checked with Un007. Note: Obtain Un007 from the following formula (if the model uses a 20-bit encoder). $\mathrm{Un007} = \underbrace{\text{input reference pulse speed [pulses/s]} \times 60}_{\text{Reference input pulse speed}} \times \underbrace{\frac{\mathrm{Pn20E}}{\mathrm{Pn210}}}_{\text{Electronic gear ratio}} \times \underbrace{\frac{1}{2^{20}(=1048576)}}_{\text{Encoder pulse}}$	
13	Check the motor rotating speed (min^{-1}). The motor rotating speed can be checked with Un000.	–
14	Check that the values in step 12 and step 13 (Un007 and Un000) are equal to each other.	–
15	Stop the pulse reference and turn OFF the servo ON signal (/S-ON).	–

4.4 Trial Operation with the Servomotor Connected to the Machine

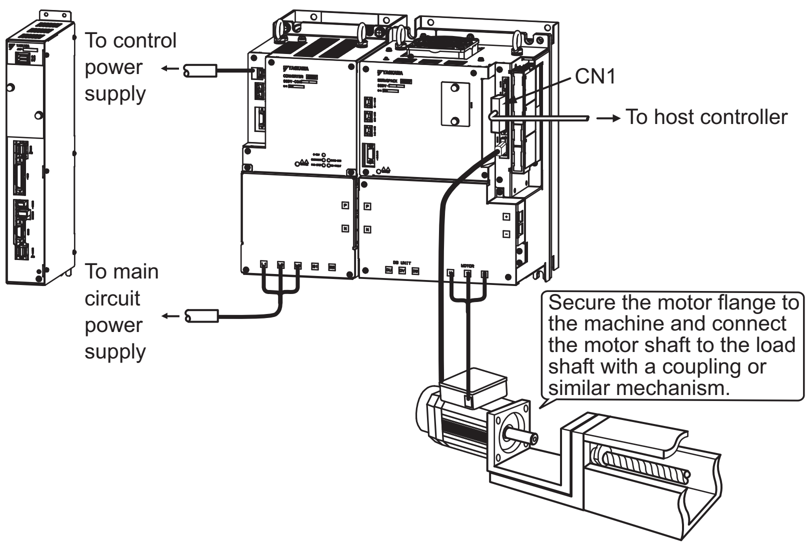
Perform the following steps for trial operation when the servomotor is connected to the machine.
The steps are specified on the condition that trial operation for servomotor without load has been completed in each control method.

⚠ WARNING

- Malfunctions that occur after the servomotor is connected to the machine may not only damage the machine, but may also cause an accident resulting in death or injury.

IMPORTANT

Always make sure that the overtravel signals (P-OT and N-OT) are enabled for trial operation with the servomotor connected to the machine to provide a protective function.

Step	Operation	Reference
1	Turn ON the control power and main circuit power supplies and make the settings for mechanical configuration related to protective function such as safety function, overtravel, and brake. When using the safety function, connect a safety function device to CN8. Note: • When not using the safety function, use the SERVOPACK with the safety function jumper connector (provided as an accessory) inserted into CN8. If the SERVOPACK is used without the jumper connector inserted into CN8, no current will flow to the servomotor and no torque will be output. In this case, "Hbb" will be displayed on the panel operator or the digital operator. • When a servomotor with brake is used, take advance measures to prevent vibration due to gravity acting on the machine or external forces before checking the brake operation. Check that both servomotor and brake operations are correct.	*5.11 Safety Function* *3.3.2 SERVOPACK Safety Function Signal (CN8) Names and Functions* *5.2.3 Overtravel* *5.2.4 Holding Brakes*
2	Set the necessary parameters for control method used.	*5.3 Speed Control* *5.4 Position Control* *5.5 Torque Control*
3	Connect the servomotor to the machine with coupling, etc., while the power is turned OFF.  	–
4	Turn ON the power to the machine (host controller) and then check that the multi-winding drive system is servo OFF status. Check again that the protective function in step 1 operates normally. Note: For steps 4 to 8, take advance measures for emergency stop so that the servomotor can stop safely when an error occurs during operation.	*5.2.5 Stopping Servomotors after /S-ON Turned OFF or Alarm Occurrence*

Trial Operation

4

(cont'd)

Step	Operation	Reference
5	Perform trial operation with the servomotor connected to the machine, following each section in *4.3 Trial Operation for Servomotor without Load from Host Reference*. Check that the trial operation is completed with as the trial operation for servomotor without load. Also check the settings for machine such as reference unit.	*4.3 Trial Operation for Servomotor without Load from Host Reference*
6	Check the settings of parameters for control method used set in step 2 again. Check that the servomotor rotates matching the machine operating specifications.	–
7	Adjust the servo gain and improve the servomotor response characteristics, if necessary. Note: The servomotor will not be broken in completely during the trial operation. Therefore, let the system run for a sufficient amount of additional time to ensure that it is properly broken in.	*6 Adjustments*
8	Write the parameters set for maintenance in *10.4 Parameter Recording Table*. Then the trial operation with the servomotor connected to the machine is completed. Note: If the optional digital operator is used, parameters can be saved. SigmaWin+, which is a tool for supporting the servo drive, can then manage the saved parameters in files.	*10.4 Parameter Recording Table*

4.5 Trial Operation of Servomotor with Brakes

Observe the following precautions when performing a trial operation of servomotor with brake.

- When checking the brake operation, take advance measures to prevent vibration due to gravity acting on the machine or external forces.
- Check the servomotor operation and holding brake operation with the servomotor separated from the machine. If both operations are correct, connect the servomotor to the machine and perform trial operation.

Holding brake operation of the servomotor with brake can be controlled with the brake signal (/BK) of the SERVOPACK.

For wiring on a servomotor with brakes and setting parameters, refer to *5.2.4 Holding Brakes*.

IMPORTANT

Failures caused by incorrect wiring or wrong voltage application in the brake circuit may damage the multi-winding drive system or cause an accident resulting in death or injury. Follow the procedures and instructions for wiring and trial operation precisely as described in this manual.

5

Operation

5.1 Control Method Selection

The control methods supported by the multi-winding drive unit are described below.

The control method can be selected with parameter Pn000.1.

Control Method Selection			
Pn.000.1	**Control**	**Description**	**Reference Section**
n.□□0□ [Factory setting]	Speed Control	Controls servomotor speed by means of an analog voltage speed reference. Use in the following instances. • To control speed • For position control using the encoder pulse output from the multi-winding drive unit to form a position loop in the host controller.	*5.3 Speed Control*
n.□□1□	Position Control	Controls the position of the machine by means of a pulse train position reference. Controls the position with the number of input pulses, and controls the speed with the input pulse frequency. Use when positioning is required.	*5.4 Position Control*
n.□□2□	Torque Control	Controls the servomotor's output torque by means of an analog voltage torque reference. Use to output the required amount of torque for operations such as stopping on contact.	*5.5 Torque Control*
n.□□3□	Internal Set Speed Control	Uses three operating speeds set in advance in the multi-winding drive unit as references to preform speed control. When selecting this control, an analog reference is not necessary.	*5.6 Internal Set Speed Control*
n.□□4□	Internal Set Speed Control ↔ Speed Control	These are switching modes for using the four control methods given above in combination. Select the control switching method that best suits the application.	*5.7 Combination of Control Methods*
n.□□5□	Internal Set Speed Control ↔ Position Control		
n.□□6□	Internal Set Speed Control ↔ Torque Control		
n.□□7□	Position Control ↔ Speed Control		
n.□□8□	Position Control ↔ Torque Control		
n.□□9□	Torque Control ↔ Speed Control		
n.□□A□	Speed Control ↔ Speed Control with Zero Clamp Function	The zero clamp function can be used in speed control.	*5.3.5 Zero Clamp Function*
n.□□B□	Position Control ↔ Position Control with Reference Pulse Inhibit Function	The reference pulse inhibit function can be used in position control.	*5.4.8 Reference Pulse Inhibit Function*

5.2 Basic Functions Settings

5.2.1 Servo ON Signal

This sets the servo ON signal (/S-ON) that determines whether the servomotor power is ON or OFF.

(1) Signal Setting

Type	Name	Connector Pin Number	Setting	Meaning
Input	/S-ON	CN1-40 [Factory setting]	ON	Servomotor power is ON. Servomotor can be operated.
			OFF	Servomotor power is OFF. Servomotor cannot be operated.

Note: Use parameter Pn50A.1 to allocate the /S-ON signal to another terminal. For details, refer to *3.4.1 Input Signal Allocations* for details.

IMPORTANT

Always input the servo ON signal before inputting the speed/position/torque reference to start or stop the servomotor. Do not input the references first and then use the servo ON signal or turn ON/OFF the AC power supply to start or stop. Doing so will degrade internal elements and lead to accident. Input the servo ON signal while the servomotor stops. While the servomotor is rotating, the servo ON signal cannot be input.

(2) Settings for Continuous Servo ON Signal

Parameter Pn50A.1 can be used to enable the Servo ON condition constantly.

Parameter		Meaning	When Enabled	Classification
Pn50A	n.□□0□ [Factory setting]	Inputs the servo ON signal from the input terminal CN1-40.	After restart	Setup
	n.□□7□	Constantly enables the servo ON signal.		

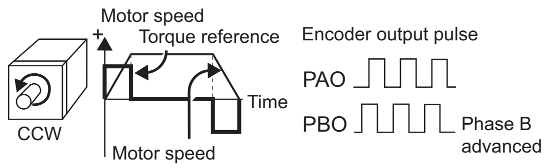
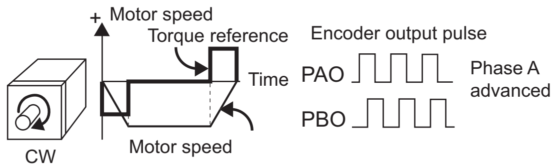
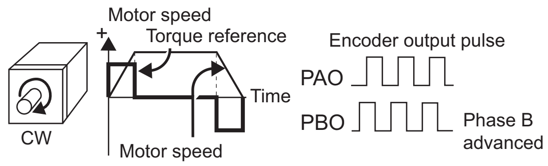
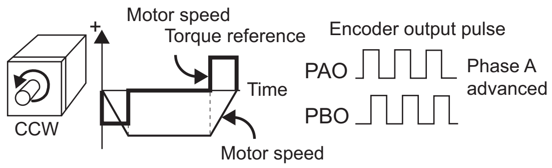
IMPORTANT

Operation of the SERVOPACK and converter will be possible (i.e., power will be supplied) when the main circuit power supply is turned ON if the servo ON signal is set to be always enabled. When inputting speed/position/torque reference, be sure to implement safety measures for unexpected operation of the servomotor and machine.
Operation of the SERVOPACK and converter will be possible (i.e., power will be supplied) when an alarm is reset after an alarm occurs. The servomotor or machine may operate unexpectedly if an alarm is reset while a reference is being input.

5.2.2 Servomotor Rotation Direction

The servomotor rotation direction can be reversed with parameter Pn000.0 without changing the polarity of the speed/position reference. This causes the rotation direction of the servomotor to change, but the polarity of the signals, such as encoder output pulses, output from the multi-winding drive unit does not change. (Refer to *5.3.6 Encoder Output Pulses*)

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

Parameter		Forward/ Reverse Reference	Direction of Motor Rotation and Encoder Output Pulse	Applicable Overtravel (OT)
Pn000	n.□□□0 Sets CCW as forward direction. [Factory setting]	Forward Reference		P-OT
		Reverse Reference		N-OT
	n.□□□1 Sets CW as forward direction. (Reverse Rotation Mode)	Forward Reference		P-OT
		Reverse Reference		N-OT

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

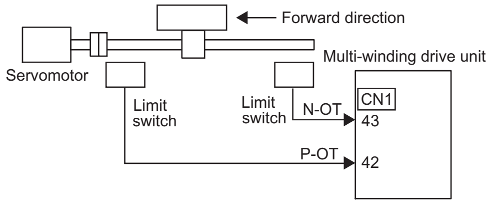
Operation

5

5.2.3 Overtravel

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

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

> **⚠ CAUTION**
>
> - Installing limit switches
>   For machines that move using linear motion, connect limit switches to P-OT and N-OT of CN1 as shown below to prevent machine damage. To prevent a contact fault or disconnection from causing accidents, make sure that the limit switches are normally closed.
>
> 
>
>
> - Axes to which external force is applied in overtravel
>   Vertical axes:
>   Occurrence of overtravel may cause a workpiece to fall, because the /BK signal is on, that is when the brake is released. Set the parameter (Pn001 = n.□□1□) to bring the servomotor to zero clamp state after stopping to prevent a workpiece from falling.
>   Other axes to which external force is applied:
>   Overtravel will bring about a baseblock state after the servomotor stops, which may cause the servomotor to be pushed back by the load's external force. To prevent this, set the parameter (Pn001 = n.□□1□) to bring the servomotor to zero clamp state after stopping.
>   For details on how to set the parameter, refer to *(3) Servomotor Stopping Method When Overtravel is Used*.

(1) Signal Setting

Type	Name	Connector Pin Number	Setting	Meaning
Input	P-OT	CN1-42	ON	Forward run allowed. Normal operation status.
			OFF	Forward run prohibited. Forward overtravel.
	N-OT	CN1-43	ON	Reverse run allowed. Normal operation status.
			OFF	Reverse run prohibited. Reverse overtravel.

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

> **IMPORTANT**
> When the servomotor stops due to overtravel during position control, the position errors are held. A clear signal (CLR) input is required to clear the error pulses.
> For the clear signal, refer to *5.4.2 Clear Signal Setting*.

(2) Overtravel Function Setting

Parameters Pn50A and Pn50B can be set to enable or disable the overtravel function.

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

Parameter		Meaning	When Enabled	Classification
Pn50A	n.2□□□ [Factory setting]	Inputs the Forward Run Prohibited (P-OT) signal from CN1-42.	After restart	Setup
	n.8□□□	Disables the Forward Run Prohibited (P-OT) signal. Allows constant forward rotation.		
Pn50B	n.□□□3 [Factory setting]	Inputs the Reverse Run Prohibited (N-OT) signal from CN1-43.		
	n.□□□8	Disables the Reverse Run Prohibited (N-OT) signal. Allows constant reverse rotation.		

A parameter can be used to re-allocate input connector number for the P-OT and N-OT signals. Refer to *3.4.1 Input Signal Allocations* for details.

(3) Servomotor Stopping Method When Overtravel is Used

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

- Dynamic brake
  By short-circuiting the electric circuits, the servomotor comes to a quick stop.
- Decelerate to a stop
  Stops by using emergency stop torque.
- Coast to a stop
  Stops naturally, with no control, by using the friction resistance of the servomotor in operation.

After servomotor stopping, there are two modes.

- Coast mode
  Stopped naturally, with no control, by using the friction resistance of the servomotor in operation.
- Zero clamp mode
  A mode forms a position loop by using the position reference zero.

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

Parameter		Stop Method	Mode After Stopping	When Enabled	Classification
Pn001	n.□□00 [Factory setting]	DB	DB	After restart	Setup
	n.□□01*		Coast		
	n.□□02	Coast			
	n.□□1□	Deceleration to a stop	Zero clamp		
	n.□□2□		Coast		

* Always connect a dynamic brake circuit for these settings.

- A servomotor under torque control cannot be decelerated to a stop. The servomotor is stopped with the dynamic braking (DB) or coasts to a stop according to the setting of Pn001.0. After the servomotor stops, the servomotor will enter a coast state.
- For details on servomotor stopping methods after the /S-ON (Servo ON) signal turns OFF or an alarm occurs, refer to *5.2.5 Stopping Servomotors after /S-ON Turned OFF or Alarm Occurrence*.

■ When Servomotor Stopping Method is Set to Decelerate to Stop

Emergency stop torque can be set with Pn406.

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

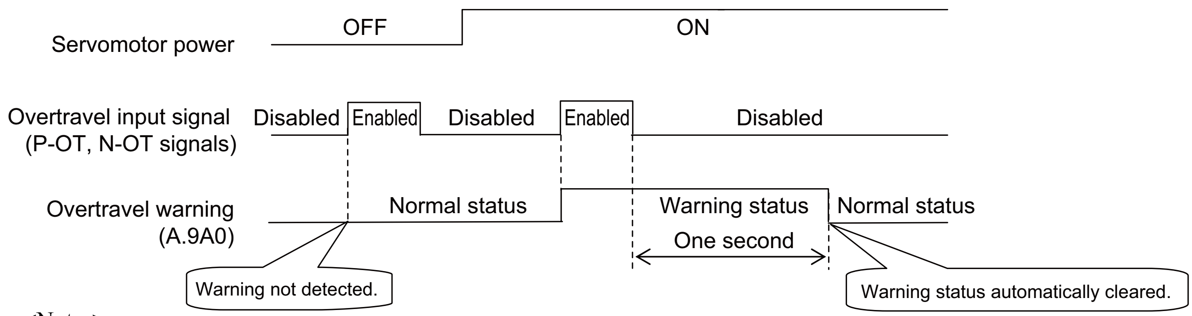
• The setting unit is a percentage of the rated torque.
• The factory setting is 800% so that the setting is large enough a value to operate the servomotor at maximum torque. The maximum value of emergency stop torque that is actually available, however, is limited to the maximum torque of the servomotor.

(4) Overtravel Warning Function

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

To use the overtravel warning function, set digit 4 of Pn00D to 1 (detects overtravel warning).

■ Warning Output Timing



<Notes>

• Warnings are detected for overtravel in the same direction as the reference.
• Warnings are not detected for overtravel in the reverse direction from the reference.
  Example:A warning will not be output for a forward reference even if the N-OT signal (reverse run prohibited) turns ON.
• A warning can be detected in either the forward or reverse direction, when there is no reference.
• A warning will not be detected when the servomotor power is OFF even if overtravel occurs.
• A warning will not be detected when the servomotor power changes from OFF to ON even if overtravel status exists.
• The warning output will be held for one second after the overtravel status no longer exists and it will then be cleared automatically.

⚠ CAUTION

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

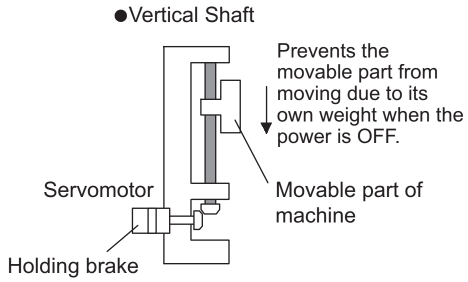
■ Related Parameter

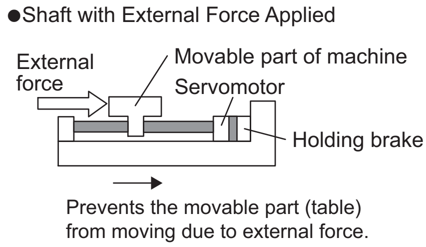
Parameter		Meaning	When Enabled	Classification
Pn00D	n.0□□□ [Factory setting]	Does not detect overtravel warning.	Immediately	Setup
	n.1□□□	Detects overtravel warning.		

5.2.4 Holding Brakes

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

The holding brake is used in the following cases.

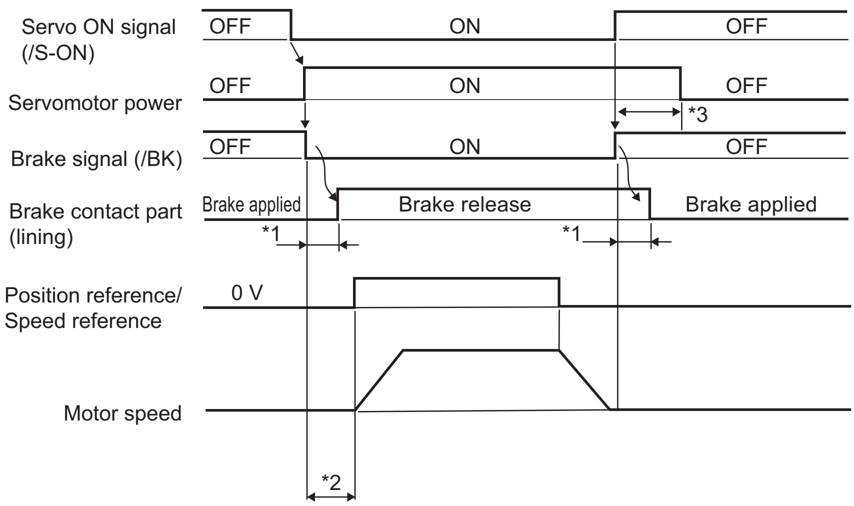




IMPORTANT

- The brake built into the servomotor with brakes is a de-energization brake, which is used only to hold and cannot be used for braking. Use the holding brake only to hold a stopped servomotor.

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



∗1. The operation delay time of the brake is shown in the following table. The operation delay time is an example when the power supply is turned ON and OFF on the DC side. Be sure to evaluate the above times on the actual equipment before using the application.

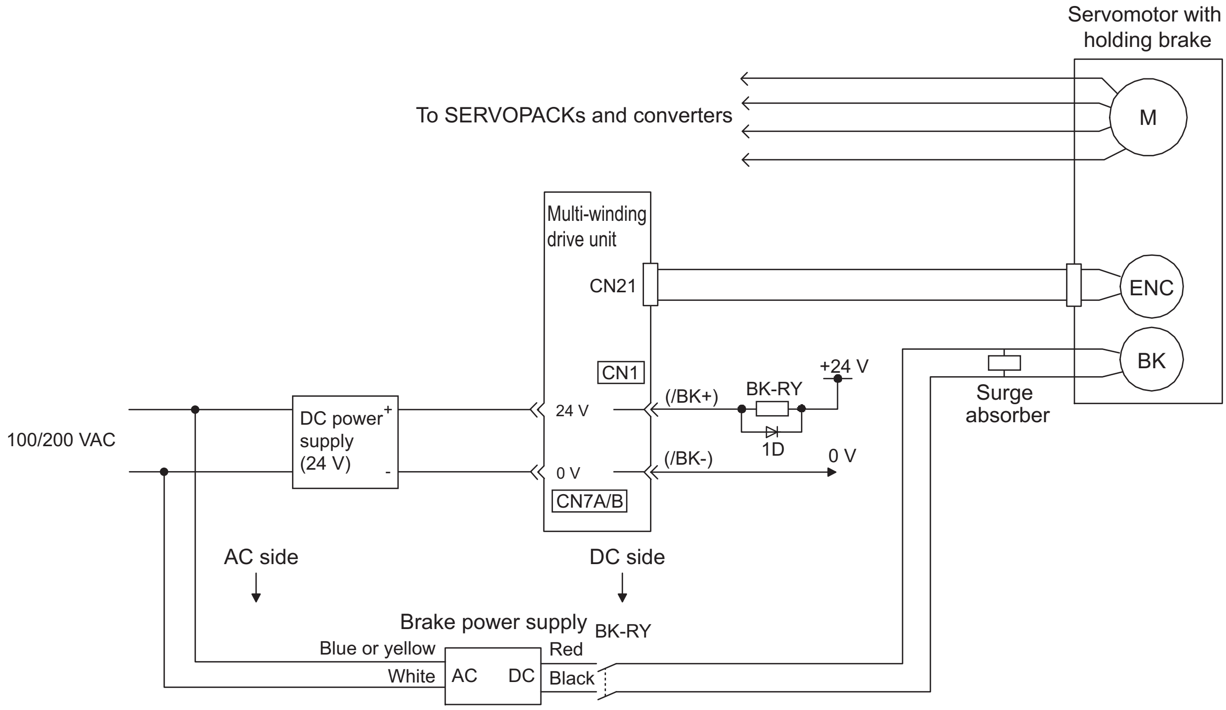
Main Circuit Power Supply Voltage	Servomotor Model: SGMVV-	Rated Speed	Voltage	Brake Open Time	Brake Operation Time
Three-phase 400 VAC	7ED□B	1500 min^{-1}	24 VDC or 90 VDC	500 ms max.	150 ms max.

∗2. After the /S-ON signal turns ON and then 50 ms has passed since the brake was released, output the reference from the host controller to the multi-winding drive unit.
∗3. Use Pn506, Pn507, and Pn508 to set the timing of when the brake will be activated and when the servomotor power will be turned OFF.

(1) Wiring Example

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

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

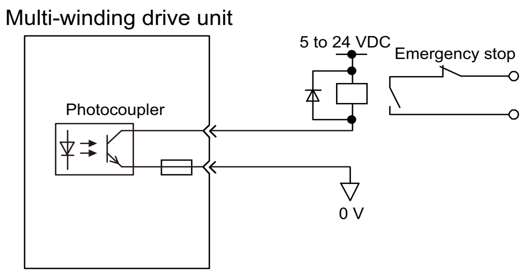


BK-RY: Brake control relay
90-V brake power supply: For 200-V input voltage: LPSE-2H01-E
For 100-V input voltage: LPDE-1H01-E
You must provide a 24-VDC power supply for the 24-V brake.

IMPORTANT

- Select the optimum surge absorber in accordance with the applied brake current and brake power supply.
  When using the LPSE-2H01-E power supply: Z10D471 (Made by SEMITEC Corporation)
  When using the LPDE-1H01-E power supply: Z10D271 (Made by SEMITEC Corporation)
  When using the 24-V power supply: Z15D121 (Made by SEMITEC Corporation)
- After the surge absorber is connected, check the total time the brake is applied for the system. Depending on the surge absorber, the total time the brake is applied can be changed.
- Configure the relay circuit to apply the holding brake by the emergency stop.

Relay Circuit Example



- The brake signal (/BK) cannot be used with factory settings. The output signal must be allocated. Refer to *(3) Brake Signal (/BK) Allocation* to set the parameter Pn50F.
- When using a 24-V brake, separate the 24-VDC power supply from other power supplies, such as the one used for the I/O signals of CN1 connectors. Always install the 24-VDC power supply separately. If the power supply is shared, the I/O signals might malfunction.

(2) Brake Signal (/BK) Setting

This output signal controls the brake. The output signal must be allocated with Pn50F. Refer to *(3) Brake Signal (/BK) Allocation* for allocation.

The /BK signal turns OFF (applies the brake) when an alarm is detected or the /S-ON signal is turned OFF. The brake OFF timing can be adjusted with Pn506.

Type	Name	Connector Pin Number	Setting	Meaning
Output	/BK	Must be allocated	ON (closed)	Releases the brake.
			OFF (open)	Applies the brake.

IMPORTANT

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

(3) Brake Signal (/BK) Allocation

The brake signal (/BK) is not allocated at shipment. Use parameter Pn50F.2 to allocate the /BK signal.

Parameter		Connector Pin Number + Terminal	Connector Pin Number - Terminal	Meaning	When Enabled	Classification
Pn50F	n.□0□□ [Factory setting]	–	–	The /BK signal is not used.	After restart	Setup
	n.□1□□	CN1-25	CN1-26	The /BK signal is output from output terminal CN1-25, 26.		
	n.□2□□	CN1-27	CN1-28	The /BK signal is output from output terminal CN1-27, 28.		
	n.□3□□	CN1-29	CN1-30	The /BK signal is output from output terminal CN1-29, 30.		

IMPORTANT

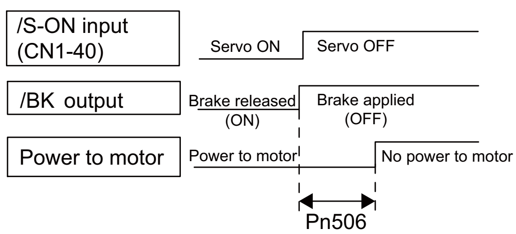
When multiple signals are allocated to the same output terminal, the signals are output with OR logic. For the /BK signal, do not use the output terminal that is already being used for another signal.

(4) Brake ON Timing after the Servomotor Stops

When the servomotor stops, the /BK signal turns OFF at the same time as the /S-ON signal is turned OFF. Use parameter Pn506 to change the timing to turn OFF the servomotor power after the /S-ON signal has turned OFF.

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

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



IMPORTANT

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

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

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

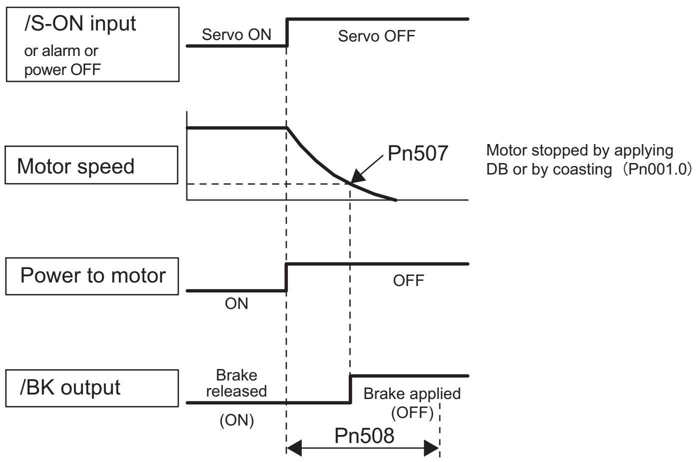
Note: If the servomotor is set so that it comes to a zero-speed stop for an alarm, follow the information in *(4) Brake ON Timing after the Servomotor Stops* after the servomotor comes to a stop for a zero position reference.

Pn507	Brake Reference Output Speed Level (Speed, Position, Torque)				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 10000	1 min^{-1}	100	Immediately	Setup
Pn508	Waiting Time for Brake Signal When Motor Running (Speed, Position, Torque)				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	10 to 100	10 ms	50	Immediately	Setup

/BK Signal Output Conditions When Servomotor Rotating

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

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



IMPORTANT

- The servomotor will be limited to its maximum speed even if the value set in Pn507 is higher than the maximum speed.
- Do not allocate the rotation detection signal (/TGON) and the brake signal (/BK) to the same terminal. The /TGON signal will otherwise be turned ON by the falling speed on a vertical axis, and the brake may not operate.
  For the /BK signal, do not use the terminal that is already being used for another signal.

5.2.5 Stopping Servomotors after /S-ON Turned OFF or Alarm Occurrence

The servomotor stopping method can be selected after the /S-ON (Servo ON) signal turns OFF or an alarm occurs.

IMPORTANT

- Dynamic braking (DB) is used for emergency stops. The DB circuit will operate frequently if the power is turned ON and OFF or the /S-ON signal is ON and OFF with a reference input applied to start and stop the servomotor, which may result in deterioration of the internal elements in the SERVOPACK and converter.
  Use speed input references or position references to start and stop the servomotor.
- If you turn OFF the control power supply during operation without turning OFF the servo, the servomotor will coast to a stop. In this case, you cannot set the stop method in a parameter.
- To minimize the coasting distance of the servomotor to come to a stop when an alarm occurs, the zero-speed stopping method is factory-set for alarms to which the zero-speed stop method is applicable. The DB stopping method may be more suitable than the zero-speed stopping method, however, depending on the application.
  For example, for multiple axes coupling operation (a twin-drive operation), machinery damage may result if a zero-speed stop alarm occurs for one of the coupled shafts and the other shaft stops by dynamic brake. In such cases, change the method to the DB stopping method.

(1) Stopping Method for Servomotor after /S-ON Signal is Turned OFF

Use Pn001.0 to select the stopping method for the servomotor after the /S-ON signal is OFF.

Parameter		Stop Mode	Mode After Stopping	When Enabled	Classification
Pn001	n.□□□0* [Factory setting]	DB	DB	After restart	Setup
	n.□□□1*		Coast		
	n.□□□2	Coast	Coast		

* Always connect a dynamic brake circuit for these settings.
Note: Similar to the Coast Mode, the n.□□□0 setting (which stops the servomotor by dynamic braking and then holds it in Dynamic Brake Mode) does not generate any braking force when the servomotor stops or when it rotates at very low speed.

(2) Stopping Method for Servomotor When an Alarm Occurs

There are two types of alarms (Gr.1 and Gr.2) that depend on the stopping method when an alarm occurs. Select the stopping method for the servomotor when an alarm occurs using Pn001.0 and Pn00B.1.

The stopping method for the servomotor for a Gr.1 alarm is set to Pn001.0.

The stopping method for the servomotor for a Gr.2 alarm is set to Pn00B.1.

Refer to the information on alarm stopping methods in *9.1.1 List of Alarms*.

■ Stopping Method for Servomotor for Gr.1 Alarms

The stopping method of the servomotor when a Gr.1 alarm occurs is the same as that in *(1) Stopping Method for Servomotor after /S-ON Signal is Turned OFF*.

Parameter		Stop Mode	Mode After Stopping	When Enabled	Classification
Pn001	n.□□□0* [Factory setting]	DB	DB	After restart	Setup
	n.□□□1*		Coast		
	n.□□□2	Coast	Coast		

* Always connect a dynamic brake circuit for these settings.

■ Stopping Method for Servomotor for Gr.2 Alarms

Parameter		Stop Mode	Mode After Stopping	When Enabled	Classification
Pn00B	Pn001				
n.□□0□ [Factory setting]	n.□□□0*1 [Factory setting]	Zero-speed stopping*2	DB	After restart	Setup
	n.□□□1*1		Coast		
	n.□□□2				
n.□□1□	n.□□□0*1 [Factory setting]	DB	DB		
	n.□□□1*1		Coast		
	n.□□□2	Coast			

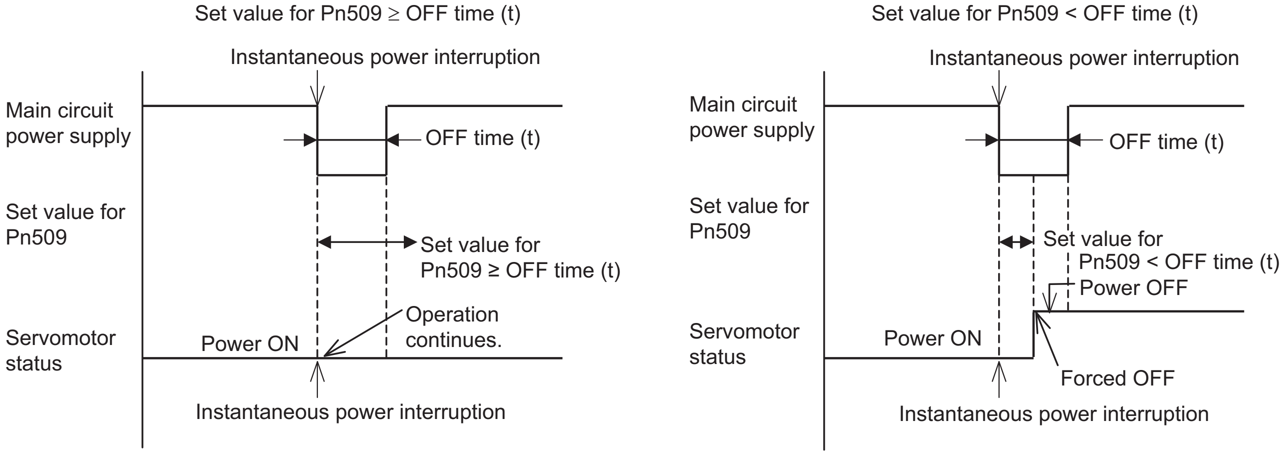
*1. Always connect a dynamic brake circuit for these settings.
*2. Zero-speed stopping: The speed reference is set to 0 to stop quickly.
Note: The setting of Pn00B.1 is effective for position control and speed control. Pn00B.1 will be ignored for torque control and only the setting of Pn001.0 will be valid.

5.2.6 Instantaneous Power Interruption Settings

Determines whether to continue operation or turn OFF the servomotor's power when the power supply voltage to the main circuit power supply of the SERVOPACK and converter is interrupted.

Pn509	Instantaneous Power Cut Hold Time Speed Position Torque				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	20 to 50000	1 ms	20	Immediately	Setup

If the power interruption time is shorter than the set value in Pn509, the servomotor will continue operation. If it is longer than the set value, the servomotor's power will be turned OFF during the power interruption. The servomotor is turned ON when power supply to the main circuit recovers.



Note: If the instantaneous power interruption is longer than the set value of Pn509, the /S-RDY signal turns OFF.

IMPORTANT

- If the control power supply makes control impossible during an instantaneous power interruption, the same operation will be performed as for normally turning OFF the power supply, and the setting of Pn509 will be ignored.
- The holding time of the main circuit power supply varies with the output of the SERVOPACK. If the load on the servomotor is large and an undervoltage alarm (A.410) occurs, the setting of Pn509 will be ignored.
- The holding time of the control power supply (24 VDC) depends on the capability of the power supply (not provided by Yaskawa). Check the power supply before using the application.

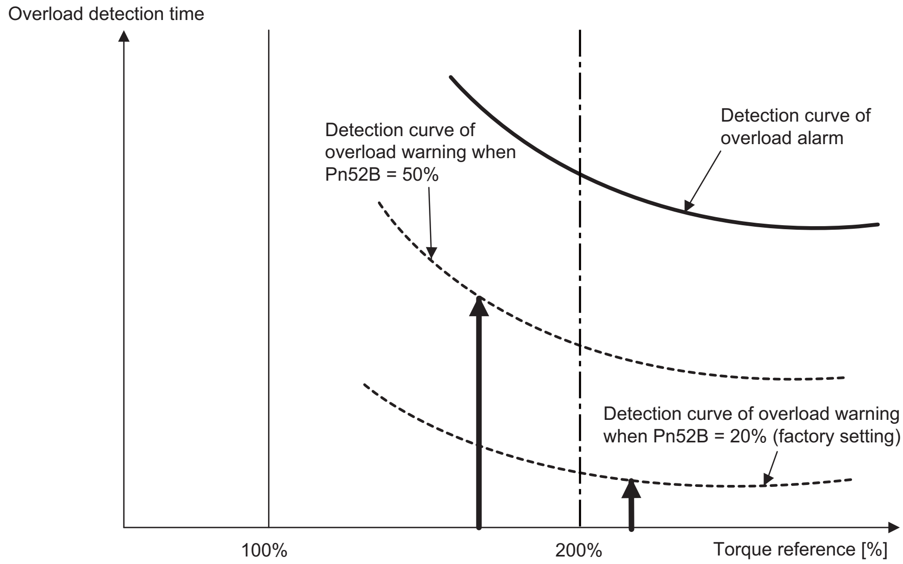
If the uninterruptible power supplies are used for the control power supply and main circuit power supply, the SERVOPACK can withstand an instantaneous power interruption period of 50,000 ms max.

5.2.7 Setting Motor Overload Detection Level

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

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

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



Note: For details, refer to *SERVOPACK Overload Characteristics* in the multi-winding drive system catalog.

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

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

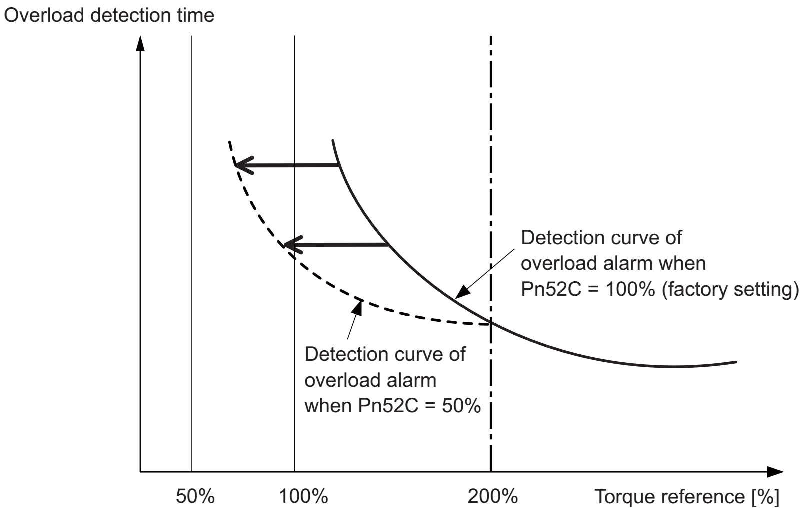
An overload (low load) alarm (A.720) can be detected earlier to protect the servomotor from overloading. The time required to detect an overload alarm can be shortened by using the derated motor base current obtained with the following equation.

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

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

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

The following graph shows an example of the detection of an overload alarm when Pn52C is set to 50%. The calculation for the overload of motors starts at 50% of the motor base current and then an overload alarm will be detected earlier.
Changing the setting of Pn52C will change the detection timing of the overload alarm, so the time required to detect the overload warning will also be changed.



Note: For details, refer to *SERVOPACK Overload Characteristics* in the multi-winding drive system catalog.

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

5.3 Speed Control

This section describes operation with speed control.

Select the speed control with parameter Pn000.1.

Parameter		Meaning	When Enabled	Classification
Pn000	n.□□0□ [Factory setting]	Speed control	After restart	Setup

5.3.1 Basic Settings for Speed Control

This section describes the basic settings for speed control.

(1) Signal Setting

Input the speed reference to the multi-winding drive unit using the analog voltage reference to control the servomotor speed in proportion to the input voltage.

Type	Signal Name	Connector Pin Number	Name
Input	V-REF	CN1-5	Speed reference input
	SG	CN1-6	Signal ground for speed reference input

Maximum input voltage: ±12 VDC

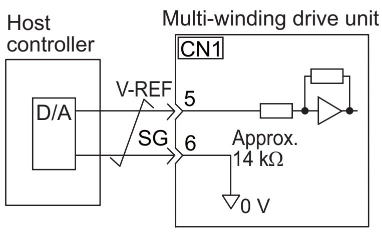
■ Input Circuit Example

Example:
Rated motor speed with Pn300 = 006.00: 6.00 V [Factory setting]

Note: The setting value is 600, but it will be displayed on the operator as 006.00.

Speed Reference Input	Rotation Direction	Motor Speed	SGMVV-□□D□□B Servomotor (Motor Speed: 1500 min^{-1})
+6 V	Forward	Rated motor speed	1500 min^{-1}
–3 V	Reverse	1/2 rated motor speed	-750 min^{-1}
+1 V	Forward	1/6 rated motor speed	250 min^{-1}

Connect the pins for the V-REF signal and SG to the speed reference output terminal on the host controller when using a host controller, such as a programmable controller, for position control.

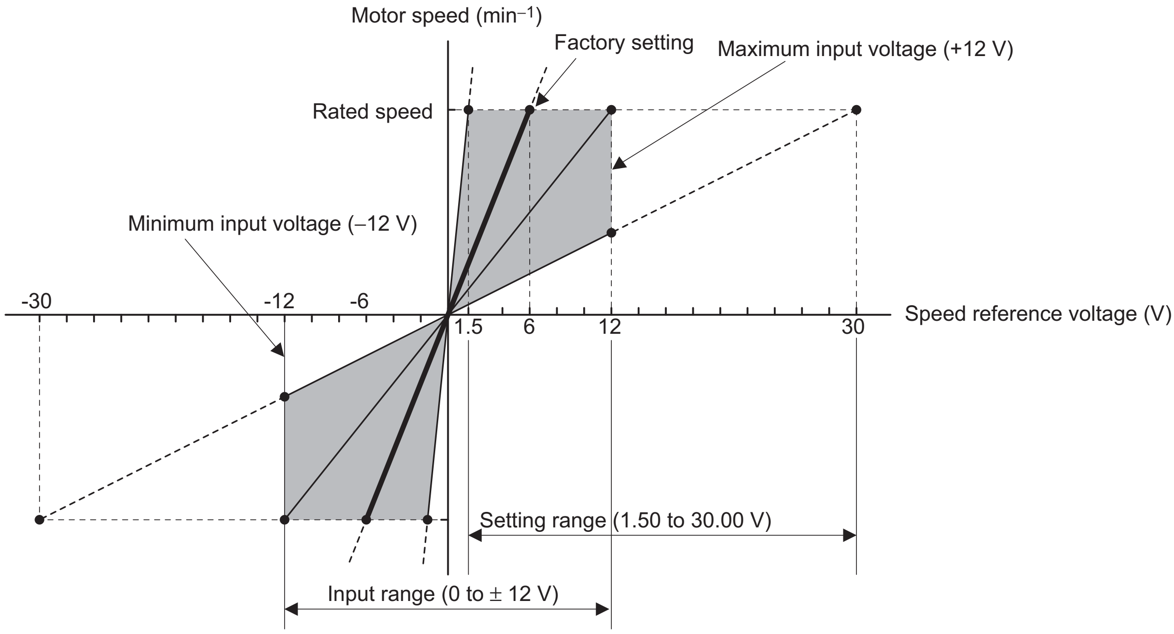


Note: Always use twisted-pair cable to control noise.

(2) Parameter Setting

Using Pn300, set the analog voltage level for the speed reference (V-REF) necessary to operate the servomotor at the rated speed.

Pn300	Speed Reference Input Gain [Speed] [Position] [Torque]				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	150 to 3000	0.01 V/rated speed	600 (Rated speed at 6.00 V)	Immediately	Setup

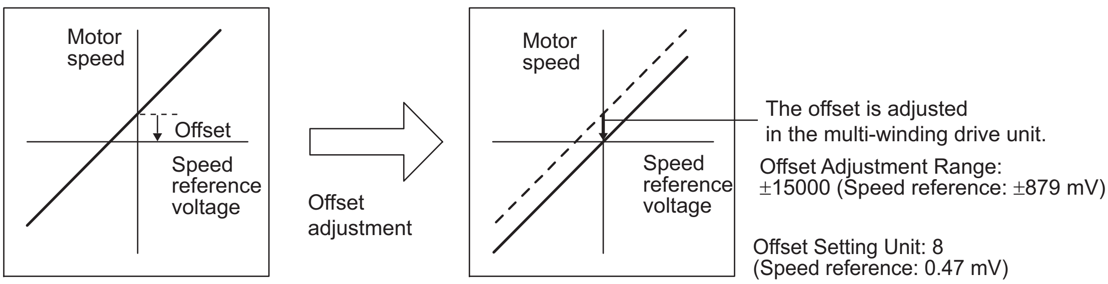


5.3.2 Reference Offset Adjustment

In speed control, the servomotor may rotate at a very low speed with a voltage reference of 0 V. This occurs because the internal reference in the multi-winding drive unit has a slight offset. It is called "offset".

If the servomotor rotates at a very low speed, the offset needs to be eliminated using the offset adjustment function.

Use either automatic adjustment or manual adjustment. Automatic adjustment uses the automatic adjustment parameter for reference offset (Fn009). Manual adjustment uses the manual adjustment parameter for reference offset (Fn00A).



(1) Automatic Adjustment of Reference Offset (Fn009)

The automatic adjustment of reference offset measures the amount of offset and adjusts the reference voltage automatically. After completion of the automatic adjustment, the amount of offset measured is saved in the multi-winding drive unit.

> **IMPORTANT**
> The servomotor power must be OFF when automatically adjusting the reference offset.

Note: The adjusted value is not initialized by executing the Fn005 function (Initializing Parameter Settings).

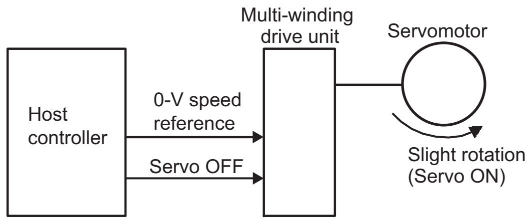
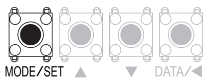
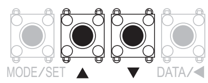
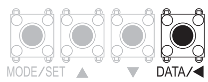
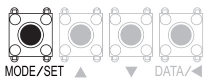
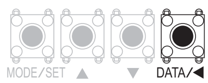
■ Preparation

The following conditions must be met to adjust the offsets of speed reference automatically. The message "NO-OP" indicating that the settings are not appropriate will be displayed, if the following conditions are not met.

- The write prohibited setting parameter (Fn010) must be set to Write permitted (P.0000).
- The servomotor power must be OFF.

■ Operating Procedure

Adjust the reference offset automatically with the panel operator using the following steps.

Step	Display after Operation	Keys	Operation
1	–	–	Turn OFF the servo ON signal (/S-ON), and input the 0-V reference voltage from the host controller or external circuit. 
2	Fn000		Press the MODE/SET Key to select the utility function.
3	Fn009		Press the UP or the DOWN Key to select Fn009.
4	rEF_o		Press the DATA/SHIFT Key for approximately one second. "rEF_o" is displayed.
5	rEF_o		Press the MODE/SET Key. After "donE" flashes for approximately one second, "rEF_o" is displayed again.
6	Fn009		Press the DATA/SHIFT Key for approximately one second. "Fn009" is displayed again.

Note: The automatic adjustment of reference offset (Fn009) cannot be used when a position loop has been formed with a host controller. Use the manual adjustment of reference offset described in *(2) Manual Adjustment of Reference Offset (Fn00A)*.

(2) Manual Adjustment of Reference Offset (Fn00A)

This method adjusts the offset inputting the amount of reference offset directly.

Use the manual adjustment of the reference offset (Fn00A) in the following cases:

- To adjust the position error to zero when a position loop is formed with the host controller and the servomotor is stopped by servolock.
- To deliberately set the offset amount to some value.
- To check the offset amount set in the automatic adjustment mode of reference offset.

Note: The adjusted value is not initialized by executing the Fn005 function (Initializing Parameter Settings).

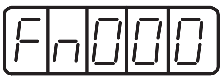
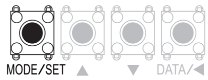
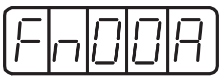
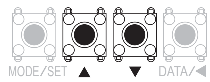
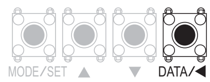
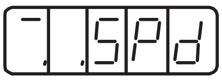
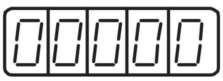
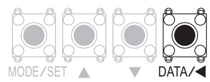
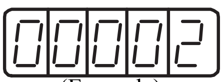
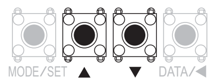
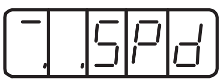
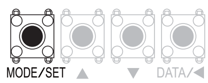
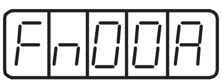
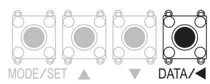
■ Preparation

The following conditions must be met to adjust the offsets of speed reference manually.

- The write prohibited setting parameter (Fn010) must be set to Write permitted (P.0000).
- The main circuit power supply must be ON. (Refer to *5.10.4*.)

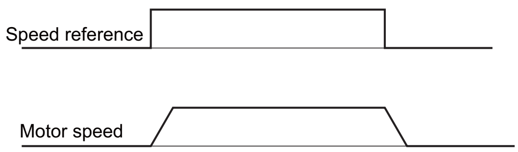
■ Operating Procedure

Adjust the reference offset manually with the panel operator using the following steps.

Step	Display after Operation	Keys	Operation
1			Press the MODE/SET Key to select the utility function.
2			Press the UP or the DOWN Key to select Fn00A.
3			Press the DATA/SHIFT Key for approximately one second. The display shown on the left appears. Note: When "no_oP" flashes for approximately one second, the write prohibited setting has been set in Fn010. Change the setting in Fn010 and press the key again to enable writing. (Refer to *7.10*.)
4		–	Turn ON the servo ON signal (/S-ON) from an external device. The display shown on the left appears.
5			Press the DATA/SHIFT Key for approximately one second. The present offset amount is displayed.
6	 (Example)		Press the UP or the DOWN Key to stop the motor. The displayed value is the amount of the offset after adjustment.
7			Press the MODE/SET Key. After "donE" flashes for approximately one second, the display shown on the left appears.
8			Press the DATA/SHIFT Key for approximately one second. "Fn00A" is displayed again.

5.3.3 Soft Start

The soft start is a function to convert stepped speed reference input into constant acceleration and deceleration. The time can be set for acceleration and deceleration.



Use this function to smooth speed control (including selection of internal set speeds).

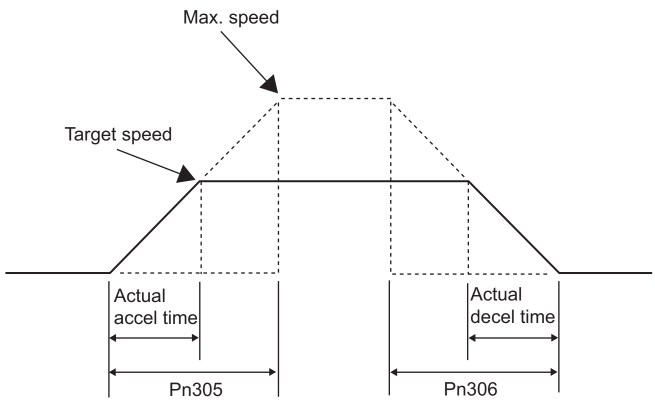
Note: Set both parameters Pn305 and Pn306 to "0" (factory setting) for normal speed control.

Pn305	Soft Start Acceleration Time Speed				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 10000	1 ms	0	Immediately	Setup
Pn306	Soft Start Deceleration Time Speed				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 10000	1 ms	0	Immediately	Setup

Pn305: The time interval from the time the servomotor starts until the maximum motor speed is reached.
Pn306: The time interval from the time the servomotor is operating at the maximum motor speed until it stops.

Actual accel/decel time can be calculated with the following equation.

- Actual accel time = $\dfrac{\text{Target speed}}{\text{Max. speed}}$ × Soft start time (accel time Pn305)
- Actual decel time = $\dfrac{\text{Target speed}}{\text{Max. speed}}$ × Soft start time (decel time Pn306)



5.3.4 Speed Reference Filter

This smooths the speed reference by applying a first order lag filter to the analog speed reference (V-REF) input.

Note: The user need not usually change the setting. A setting value that is too large, however, will slow down response. Check the response characteristics when setting this parameter.

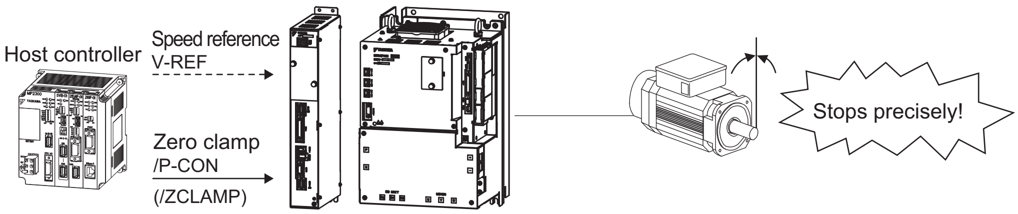
Pn307	Speed Reference Filter Time Constant Speed Position Torque				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 65535	0.01 ms	40	Immediately	Setup

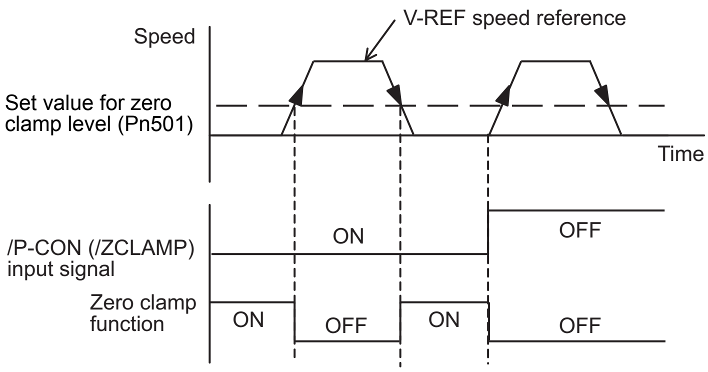
5.3.5 Zero Clamp Function

The zero clamp function locks the servo when the input voltage of the speed reference (V-REF) drops below the speed set in the zero clamp level (Pn501) while the zero clamp signal (/P-CON or /ZCLAMP) is ON. The multi-winding drive unit internally forms a position loop, ignoring the speed reference.

The zero clamp function is used for systems in which the host controller does not form a position loop for the speed reference input.

The servomotor is clamped within one pulse of the position when the zero clamp function is turned ON, and will still return to the zero clamp position even if it is forcibly rotated by external force.





Adjust the position loop gain (Pn102) if the servomotor oscillates in the zero clamp state. If the gain switching function is used, adjusting the 2nd position loop gain (Pn106) is required as well. For details, refer to *6.6.1 Switching Gain Settings*.

(1) Factory-set Input Signal Allocations (Pn50A.0 = 0)

When Pn000.1 is set to A, the control method becomes "speed control ↔ speed control with zero clamp function" and the /P-CON signal is used as a zero clamp signal.

Type		Connector Pin Number	Setting	Meaning
Input	/P-CON	CN1-41 [Factory setting]	ON (closed)	The zero clamp function will be turned ON if the input voltage of the speed reference (V-REF) drops below the set speed in the zero clamp level (Pn501).
			OFF (open)	Turns OFF the zero clamp function.

Parameter		Control Method	When Enabled	Classification
Pn000	n.□□A□	Speed control ↔ speed control with zero clamp function	After restart	Setup

(2) Changing Input Signal Allocations (Pn50A.0 = 1)

Use the /ZCLAMP signal when switching to zero clamp function.

Type		Connector Pin Number	Setting	Meaning
Input	/ZCLAMP	Must be allocated	ON (closed)	The zero clamp function will be turned ON if the input voltage of the speed reference (V-REF) drops below the set speed in the zero clamp level (Pn501).
			OFF (open)	Turns OFF the zero clamp function.

Note: Use parameter Pn50D.0 to allocate the /ZCLAMP signal for use. For details, refer to *3.4.1 Input Signal Allocations*.

To use the zero clamp function, set Pn000.1 to 0, 3, 4, 5, 6, 7, 9 or A.

Parameter		Control Method	Input Signal Used	When Enabled	Classification
Pn000	n.□□0□	Speed control	/ZCLAMP	After restart	Setup
	n.□□3□	Internal set speed control	/ZCLAMP, SPD-A, SPD-B, SPD-D, C-SEL		
	n.□□4□	Internal set speed control ↔ Speed control	/ZCLAMP, SPD-A, SPD-B, SPD-D, C-SEL		
	n.□□5□	Internal set speed control ↔ Position control	/ZCLAMP, SPD-A, SPD-B, SPD-D, C-SEL		
	n.□□6□	Internal set speed control ↔ Torque control	/ZCLAMP, SPD-A, SPD-B, SPD-D, C-SEL		
	n.□□7□	Position control ↔ Speed control	/ZCLAMP, C-SEL		
	n.□□9□	Torque control ↔ Speed control	/ZCLAMP, C-SEL		
	n.□□A□	Speed control ↔ Speed control with zero clamp function	/ZCLAMP, C-SEL		

Note: If Pn000.1 is set to 5, 6, 7, or 9, the zero clamp function will become invalid when the control is changed to any methods other than speed control and internal set speed control.

For speed control, the zero clamp function locks the servomotor when the speed reference drops below the set speed in the zero clamp level by setting Pn50D.0 to 7 (zero clamp function is always valid). The input signals (/ZCLAMP, /P-CON) are not necessary.

(3) Related Parameter

Set the motor speed at which to enter zero clamp operation.

Pn501	Zero Clamp Level		Speed		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 10000	1 min^{-1}	10	Immediately	Setup

Note: Even if a value that exceeds the maximum speed of the servomotor is set, the actual speed will be limited to the maximum speed of the servomotor.

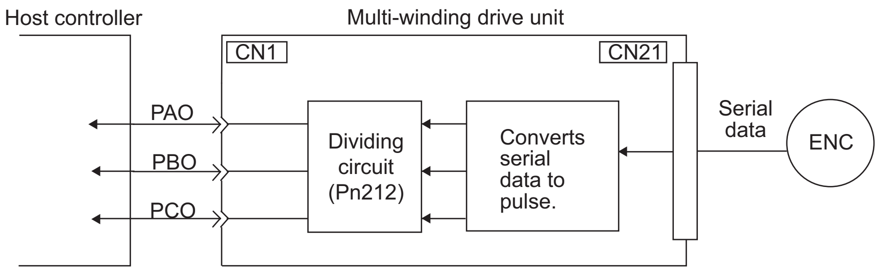
5.3.6 Encoder Output Pulses

The encoder pulse output is a signal that is output from the encoder and processed inside the multi-winding drive unit. It is then output externally in the form of a two-phase pulse signal (phases A and B) with a 90° phase differential. It is used as the position feedback to the host controller.

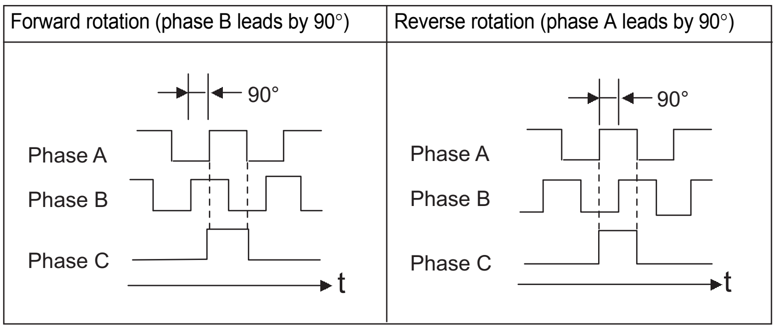
Signals and output phase form are as shown below.

(1) Signals

Type	Signal Name	Connector Pin Number	Name	Remarks
Output	PAO	CN1-33	Encoder output pulse: phase A	These encoder pulse output pins output the number of pulses per motor revolution that is set in Pn212. Phase A and phase B are different from each other in phase by an electric angle of 90°.
	/PAO	CN1-34		
	PBO	CN1-35	Encoder output pulse: phase B	
	/PBO	CN1-36		
	PCO	CN1-19	Encoder output pulse: phase C	One pulse is output per motor rotation.
	/PCO	CN1-20		



(2) Output Phase Form



Note: The pulse width for phase C (origin pulse) changes according to the setting of the encoder output pulses (Pn212) and becomes the same as that for phase A.
Even in reverse rotation mode (Pn000.0 = 1), the output phase form is the same as that for the standard setting (Pn000.0 = 0) above.

IMPORTANT

If you use the multi-winding drive unit's phase-C pulse output for a zero point return, rotate the servomotor two or more times before starting a zero point return. If the servomotor cannot be rotated two or more times, perform a zero point return at a motor speed of 600 min^{-1} or below. If the motor speed is faster than 600 min^{-1}, the phase-C pulse may not be output correctly.

5.3.7 Setting Encoder Output Pulse

Set the encoder output pulse using the following parameter.

Pn212	Encoder Output Pulses		Speed Position Torque		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	16 to 1073741824	1 P/rev	2048	After restart	Setup

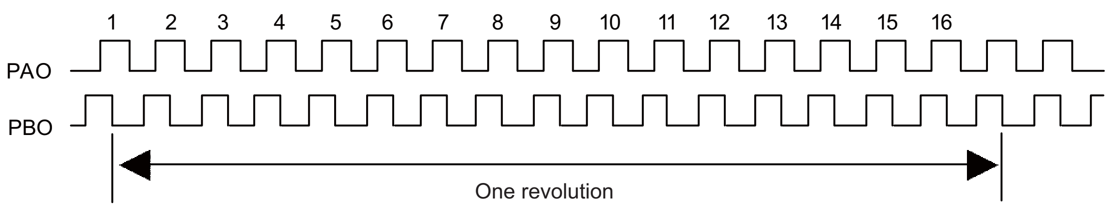
Pulses from the encoder per revolution are divided inside the multi-winding drive unit by the number set in this parameter before being output.
Set the number of encoder output pulses according to the system specifications of the machine or host controller.

Setting Range of Encoder Output Pulses (P/Rev)	Setting Unit	Upper Limit of Servomotor Speed for Set Encoder Output Pulses [min^{-1}]
16 to 16384	1	6000
16386 to 32768	2	3000
32772 to 65536	4	1500
65544 to 131072	8	750
131088 to 262144	16	375

Note 1. An encoder output pulse setting error (A.041) will occur if the setting does not satisfy the required conditions listed in the table.
Pn212 = 25000 (P/Rev) is accepted, but
Pn212 = 25001 (P/Rev) is not accepted. The alarm A.041 is output because the setting unit differs from that in the above table.
2. The upper limit of the pulse frequency is approximately 1.6 Mpps.
The servomotor speed is limited if the setting value of the encoder output pulses (Pn212) is large.
An overspeed of encoder output pulse rate alarm (A.511) will occur if the motor speed exceeds the upper limit specified in the above table.

Output Example: When Pn212 = 16 (16-pulse output per one revolution), PAO and PBO are output as shown below.

Preset value: 16



5.3.8 Setting Speed Coincidence Signal

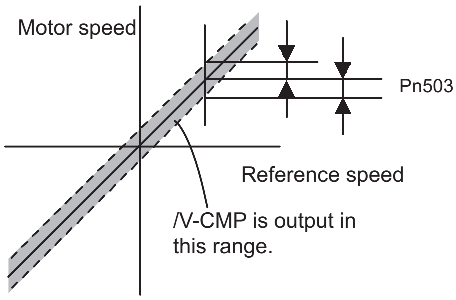
The speed coincidence output signal (/V-CMP) is output when the actual servomotor speed is the same as the reference speed. The host controller uses the signal as an interlock. This signal is the output signal during speed control.

Type	Signal Name	Connector Pin Number	Setting	Meaning
Output	/V-CMP	CN1-25, 26 [Factory Setting]	ON (closed)	Speed coincides.
			OFF (open)	Speed does not coincide.

Note: Use parameter Pn50E.1 to allocate the /V-CMP signal to another terminal. Refer to *3.4.2 Output Signal Allocations* for details.

Pn503	Speed Coincidence Signal Output Width Speed				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 100	1 min^{-1}	10	Immediately	Setup

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



<Example>

The /V-CMP signal is output at 1900 to 2100 min^{-1} if the Pn503 is set to 100 and the reference speed is 2000 min^{-1}.

5.4 Position Control

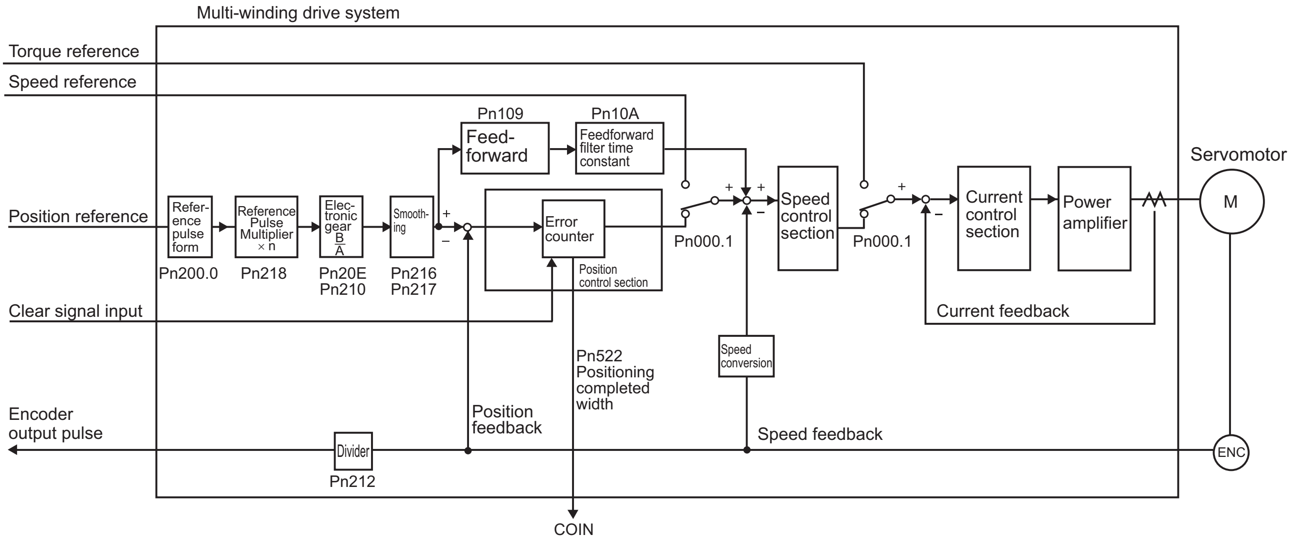
This section describes operation with position control.

Select position control with Pn000.1.

Parameter		Meaning	When Enabled	Classification
Pn000	n.□□1□	Position Control	After restart	Setup

■ Block Diagram for Position Control

A block diagram for position control is shown below.



5.4.1 Basic Settings for Position Control

This section describes the basic settings for position control.

(1) Reference Pulse Form

Set the reference pulse form using Pn200.0.

Parameter		Reference Pulse Form	Input Pulse Multiplier	Forward Run Reference	Reverse Run Reference
Pn200	n.□□□0 [Factory setting]	Sign + pulse train (Positive logic)	–	PULS (CN1-7) SIGN (CN1-11) H level	PULS (CN1-7) SIGN (CN1-11) L level
	n.□□□1	CW + CCW pulse train (Positive logic)	–	CW (CN1-7) L level CCW (CN1-11)	CW (CN1-7) CCW (CN1-11) L level
	n.□□□2	Two-phase pulse train with 90° phase differential	×1	90° Phase A (CN1-7) Phase B (CN1-11)	90° Phase A (CN1-7) Phase B (CN1-11)
	n.□□□3		×2		
	n.□□□4		×4		
	n.□□□5	Sign + pulse train (Negative logic)	–	PULS (CN1-7) SIGN (CN1-11) L level	PULS (CN1-7) SIGN (CN1-11) H level
	n.□□□6	CW + CCW pulse train (Negative logic)	–	CW (CN1-7) H level CCW (CN1-11)	CW (CN1-7) CCW (CN1-11) H level

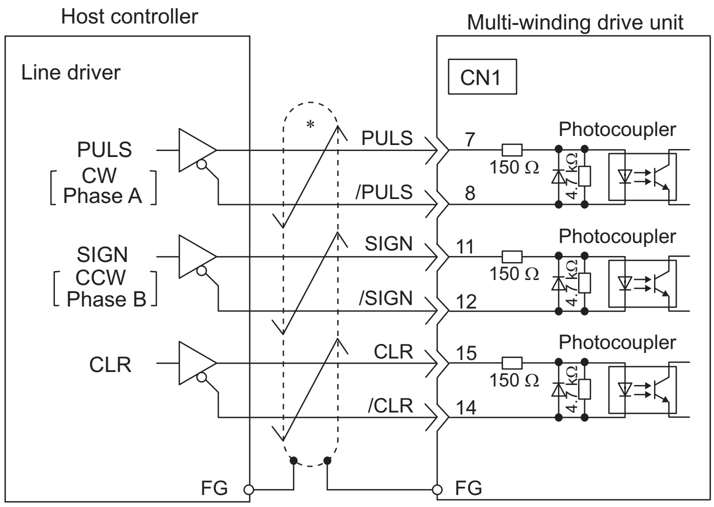
(2) Input Filter Selection

Parameter		Meaning	When Enabled	Classification
Pn200	n.0□□□ [Factory setting]	Uses the reference input filter for line driver signal. (Up to 1 Mpps)	After restart	Setup
	n.1□□□	Uses the reference input filter for open-collector signal. (Up to 200 kpps)		
	n.2□□□	Uses the reference input filter 2 for line driver signal. (1 Mpps to 4 Mpps)		

(3) Connection Example

The following diagram shows a connection example. Use an SN75ALS174 or MC3487 manufactured by Texas Instruments Inc., or equivalent for the line driver.

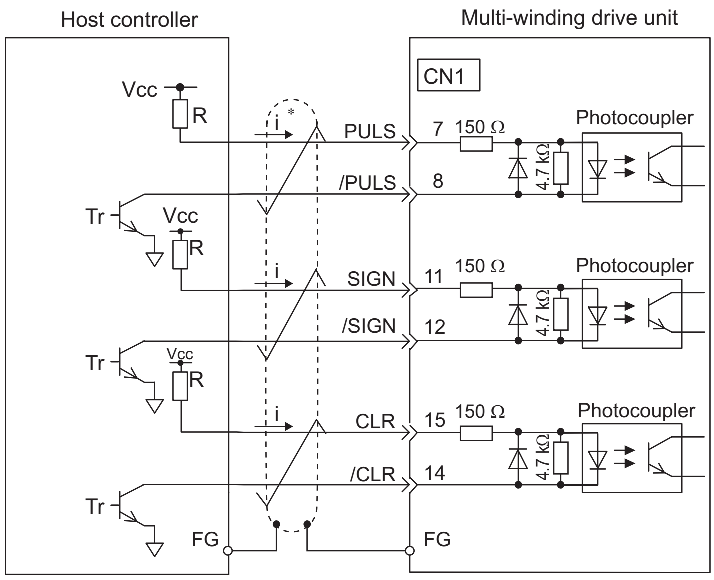
■ Line Driver Output



* represents twisted-pair wires.

■ Open-collector Output

Set limit resistor R so the input current, i, falls between 7 mA to 15 mA.



■ Example

- When Vcc is +24 V: R = 2.2 kΩ
- When Vcc is +12 V: R = 1 kΩ
- When Vcc is +5 V: R = 180 Ω

Note: In case of open-collector outputs, the signal logic is as follows.

When Tr is ON	High level input or equivalent
When Tr is OFF	Low level input or equivalent

* represents twisted-pair wires.

IMPORTANT

- Use a shielded cable for I/O signals and ground both ends of the shield.
- Connect the shield of the cable on the multi-winding drive unit side to the connector shell so that the shield will be connected to the frame ground (FG) through the connector.

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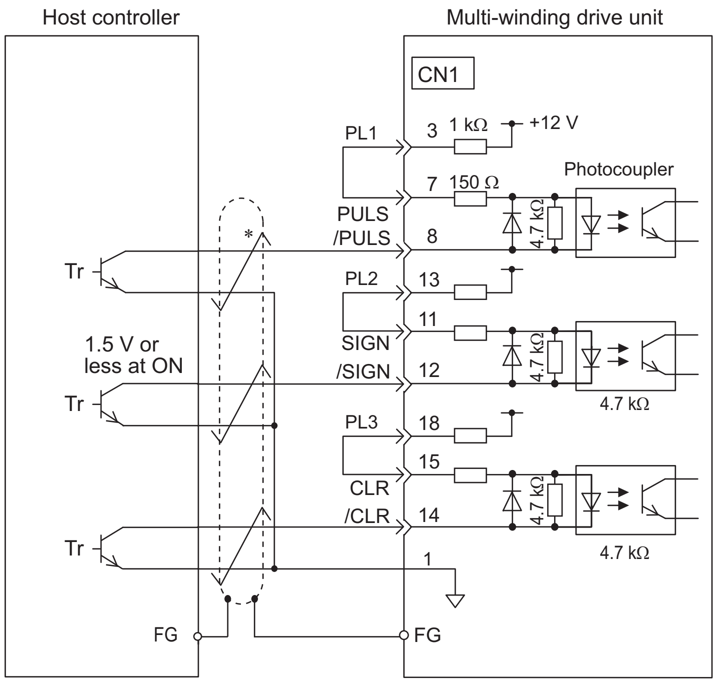
The built-in power supply of the multi-winding drive unit can be used. With an external power supply, a photocoupler isolation circuit will be used. A non-isolated circuit will be used if the built-in power supply is used.

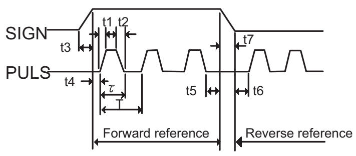
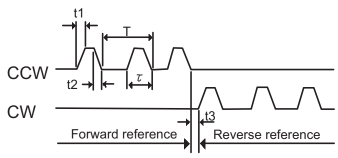
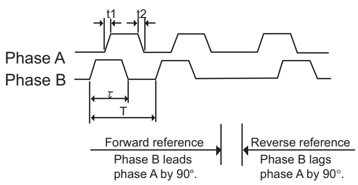


* represents twisted-pair wires.

IMPORTANT	• Use a shielded cable for I/O signals and ground both ends of the shield. • Connect the shield of the cable on the multi-winding drive unit side to the connector shell so that the shield will be connected to the frame ground (FG) through the connector.

(4) Electrical Specifications for Pulse Train Reference

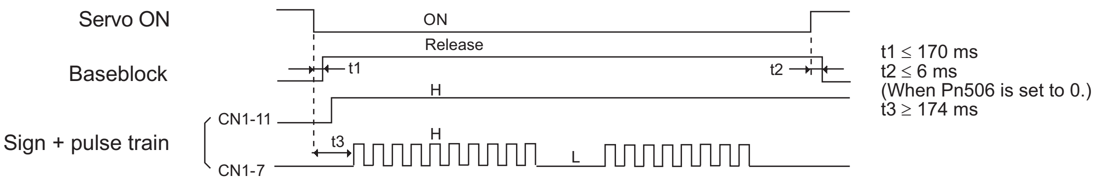
Forms of pulse train references are as shown below.

Pulse Train Reference Form	Electrical Specifications		Remarks
Sign + pulse train input (SIGN + PULS signal) Maximum reference frequency: 4 Mpps (Maximum reference frequency in case of open-collector output: 200 kpps)		t1, t2, t3, t7 ≤ 0.025 μs t4, t5, t6 ≥ 0.5 μs τ ≥ 0.125 μs T-τ ≥ 0.125 μs	Sign (SIGN) H = Forward reference L = Reverse reference
CW + CCW pulse train Maximum reference frequency: 4 Mpps (Maximum reference frequency in case of open-collector output: 200 kpps)		t1, t2 ≤ 0.025 μs t3 ≥ 0.5 μs τ ≥ 0.125 μs T-τ ≥ 0.125 μs	–
Two-phase pulse train with 90° phase differential (phase A + phase B) Maximum reference frequency: 1 Mpps* (Maximum reference frequency in case of open-collector output: 200 kpps)		t1 ≤ 0.1 μs t2 ≤ 0.1 μs τ ≥ 0.5 μs T-τ ≥ 0.5 μs	Reference pulse form is set with Pn200.0.

* Each multiplier's maximum reference frequency before multiplication is 1 Mpps.
×1 input pulse multiplier: 1 Mpps
×2 input pulse multiplier: 1 Mpps
×4 input pulse multiplier: 1 Mpps

(5) I/O Signal Timing Example

I/O signal timing example is as shown below.



Note: The interval from the time the servo ON signal is turned ON until a reference pulse is input (t3) must be at least 174 ms. Otherwise the reference pulse may not be received by the multi-winding drive unit.

5.4.2 Clear Signal Setting

The clear input signal sets the error counter in the multi-winding drive unit to zero.

(1) Connecting the Clear Signal

Type	Signal Name	Connector Pin Number	Name
Input	CLR	CN1-15	Clear input
	/CLR	CN1-14	

(2) Clear Input Signal Form

Set the clear input signal form using Pn200.1.

Parameter		Description	Clear Timing	When Enabled	Classification
Pn200	n.□□0□ [Factory setting]	Clears at ON. Position errors do not accumulate while the signal is ON.	CLR (CN1-15) Clears at ON.	After restart	Setup
	n.□□1□	Clears at the rising edge.	CLR (CN1-15) ON Clears here just once.		
	n.□□2□	Clears at OFF. Position errors do not accumulate while the signal is OFF.	CLR (CN1-15) Clears at OFF.		
	n.□□3□	Clears at the falling edge.	CLR (CN1-15) OFF Clears here just once.		

The following items will be changed in the multi-winding drive unit after the error counter has been reset to zero.

- The error counter in the multi-winding drive unit is set to 0.
- The position loop operation is disabled.

Note: Holding the clear status may cause the servolock to stop functioning and the servomotor to rotate slowly due to drift in the speed loop.

■ Pulse Width of Clear Signal

When parameter Pn200.1 is set to 0 or 2, the width of the clear signal must be at least 250 μs to reset the error counter.
When parameter Pn200.1 is set to 1 or 3, the width of the clear signal must be at least 20 μs to reset the error counter.

(3) Clear Operation

This parameter determines when the position error should be set to zero according to the condition of the multi-winding drive unit. Any of three clearing modes can be selected with Pn200.2.

Parameter		Description	When Enabled	Classification
Pn200	n.□0□□ [Factory setting]	Sets the position error to zero during a baseblock when an alarm occurs or when the servo ON signal (/S-ON) turns OFF.	After restart	Setup
	n.□1□□	Does not set the error counter to zero. Clears the position error only with the CLR signal.		
	n.□2□□	Sets the position error to zero when an alarm occurs.		

5.4.3 Reference Pulse Input Multiplication Switching Function

The input multiplier for the position reference pulses can be switched between 1 and n (n = 1 to 100) by turning the Reference Pulse Input Multiplication Switching Input signal (/PSEL) ON and OFF. The Reference Pulse Input Multiplication Switching Output signal (/PSELA) can be used to confirm that the multiplier has been switched.

To use this function, set the multiplier in Pn218.

Switch the multiplier of the reference pulse only when the position reference pulse is 0. If the position reference pulse is not 0 when the multiplier is switched, the servomotor position may shift.

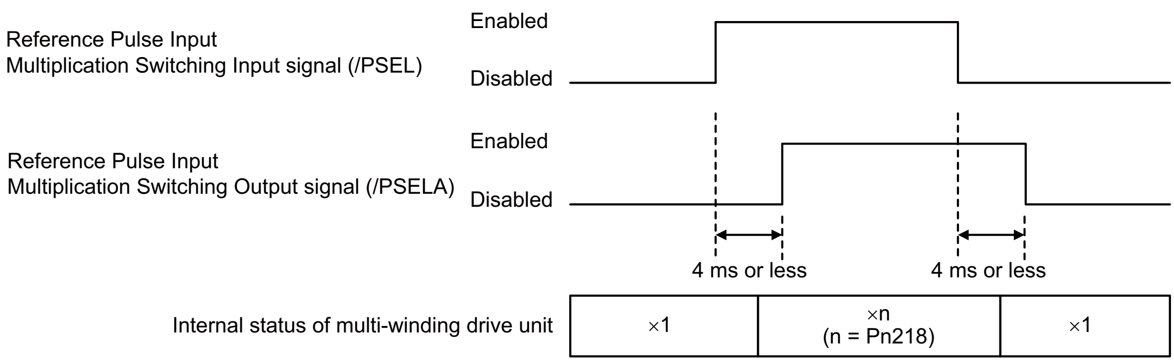
⚠ CAUTION

- Unexpected operation may occur if a position reference pulse is input before the multiplier changes. Always use the /PSELA signal to confirm that the multiplier has been switched before inputting a position reference pulse.
- If changing the setting of Pn218, disconnect the servomotor shaft from the machine and perform trial operation. Be sure that no problems will occur before connecting the shaft to the machine again.

(1) Related Parameter

Pn218	Reference Pulse Input Multiplication			Position	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	1 to 100	1 time	1	Immediately	Setup

(2) Timing Chart for Reference Pulse Input Multiplication Switching



(3) Input Signal Setting

Use the /PSEL signal when switching to the multiplier of the input reference pulse that is set in Pn218.

Type	Signal Name	Connector Pin Number	Setting	Meaning
Input	/PSEL	Must be allocated	ON (closed)	Enables the multiplier of the input reference pulse.
			OFF (open)	Disables the multiplier of the input reference pulse.

Note: Use parameter Pn515.1 to allocate the /PSEL signal for use. For details, refer to *3.4.1 Input Signal Allocations to Input Terminals*.

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(4) Output Signal Setting

This output signal indicates when the multiplier of the input reference pulse has been switched for the Reference Pulse Input Multiplication Switching Input signal (/PSEL).

Type	Signal Name	Connector Pin Number	Setting	Meaning
Output	/PSELA	Must be allocated	ON (closed)	The multiplier of the input reference pulse is enabled.
			OFF (open)	The multiplier of the input reference pulse is disabled.

Note: Use parameter Pn510.2 to allocate the /PSELA signal for use. For details, refer to *3.4.2 Output Signal Allocations*.

(5) Restriction

When using the following utility functions, the reference pulse input multiplication switching function is disabled.

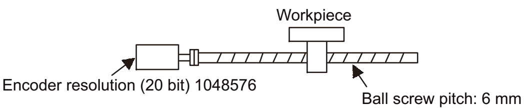
Parameter No.	Function
Fn004	Program JOG operation
Fn201	Advanced autotuning

5.4.4 Electronic Gear

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

Note: If the multiplier of the input reference pulse is switched, the input reference pulse from the host controller will be multiplied by n and defined as the reference unit of the position data. ("n" is the multiplier of the reference pulse.)

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



When the Electronic Gear is Not Used:

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

② Calculate the required reference pulses.
1048576 pulses is 1 revolution. Therefore, 10/6 × 1048576 = 1747626.66 pulses.

③ Input 1747627 pulses as reference pulses.

Reference pulses must be calculated per reference. → complicated

When the Electronic Gear is Used:

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

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

(1) Electronic Gear Ratio

Set the electronic gear ratio using Pn20E and Pn210.

Pn20E	Electronic Gear Ratio (Numerator)			Position	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	1 to 1073741824	1	4	After restart	Setup

Pn210	Electronic Gear Ratio (Denominator)			Position	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	1 to 1073741824	1	1	After restart	Setup

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

$$\text{Electronic gear ratio: } \frac{B}{A} = \frac{\text{Pn20E}}{\text{Pn210}} = \frac{\text{Encoder resolution}}{\text{Travel distance per load shaft revolution (reference units)}} \times \frac{m}{n}$$

■ Encoder Resolution

Encoder resolution can be checked with servomotor model designation.

SGMVV −□□□□□□□

Symbol	Specification	Encoder Resolutions
3	20-bit absolute	1048576
D	20-bit incremental	1048576

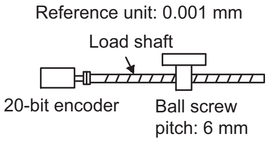
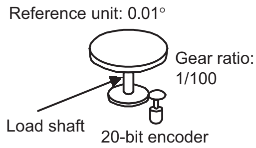
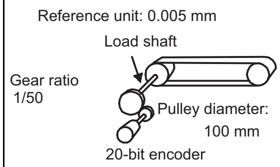
IMPORTANT

Electronic gear ratio setting range: 0.001 ≤ Electronic gear ratio (B/A) ≤ 4000

If the electronic gear ratio is outside this range, a parameter setting error 1 (A.040) will be output.

(2) Electronic Gear Ratio Setting Examples

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

<table>
<tr><th rowspan="3">Step</th><th rowspan="3">Operation</th><th colspan="3">Load Configuration</th></tr>
<tr><th>Ball Screw</th><th>Disc Table</th><th>Belt and Pulley</th></tr>
<tr><td>
</td><td>
</td><td>
</td></tr>
<tr><td>1</td><td>Check machine specifications.</td><td>· Ball screw pitch: 6 mm
· Gear ratio: 1/1</td><td>Rotation angle per revolution: 360°
Gear ratio: 1/100</td><td>Pulley diameter: 100 mm (pulley circumference: 314 mm)
• Gear ratio: 1/50</td></tr>
<tr><td>2</td><td>Check the encoder resolution.</td><td>1048576 (20-bit)</td><td>1048576 (20-bit)</td><td>1048576 (20-bit)</td></tr>
<tr><td>3</td><td>Determine the reference unit used.</td><td>Reference unit: 0.001 mm (1 µm)</td><td>Reference unit: 0.01°</td><td>Reference unit: 0.005 mm (5 µm)</td></tr>
<tr><td>4</td><td>Calculate the travel distance per load shaft revolution. (Reference unit)</td><td>6 mm/0.001 mm = 6000</td><td>360°/0.01° = 36000</td><td>314 mm/0.005 mm = 62800</td></tr>
<tr><td>5</td><td>Calculate the electronic gear ratio.</td><td>$\frac{B}{A} = \frac{1048576}{6000} \times \frac{1}{1}$</td><td>$\frac{B}{A} = \frac{1048576}{36000} \times \frac{100}{1}$</td><td>$\frac{B}{A} = \frac{1048576}{62800} \times \frac{50}{1}$</td></tr>
<tr><td rowspan="2">6</td><td rowspan="2">Set parameters.</td><td>Pn20E: 1048576</td><td>Pn20E: 104857600</td><td>Pn20E: 52428800</td></tr>
<tr><td>Pn210: 6000</td><td>Pn210: 36000</td><td>Pn210: 62800</td></tr>
</table>

5.4.5 Smoothing

Applying a filter to a reference pulse input, this function provides smooth servomotor operation in the following cases.

- When the host controller that outputs a reference cannot perform acceleration/deceleration processing.
- When the reference pulse frequency is too low.

Note: This function does not affect the travel distance (i.e., the number of reference pulses).

■ Related Parameters

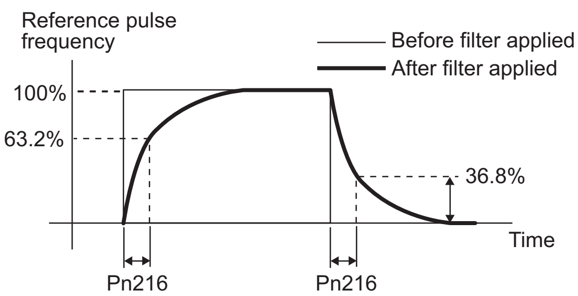
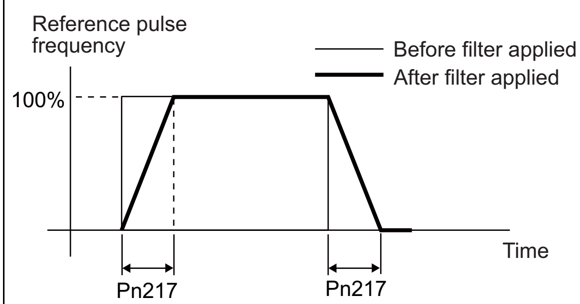
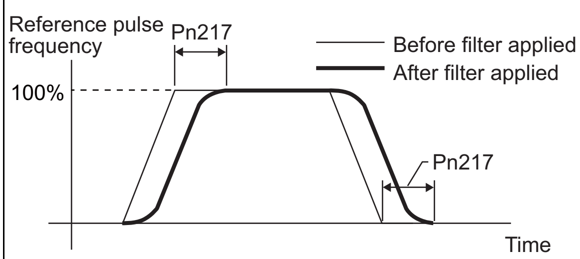
Set the following filter-related parameters.
Change the setting while there is no reference pulse input and the servomotor stops.

Pn216	Position Reference Acceleration/Deceleration Time Constant			Position	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 65535	0.1 ms	0*	Immediately after the servomotor stops	Setup
Pn217	Average Movement Time of Position Reference			Position	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 10000	0.1 ms	0*	Immediately after the servomotor stops	Setup

* When set to 0, a filter becomes ineffective.

> IMPORTANT
>
> While the servomotor is rotating, changes in Pn216 or Pn217 will not be reflected. The changes will be effective after the servomotor comes to a stop with no reference pulse input.

Note: The difference between the position reference acceleration/deceleration time constant (Pn216) and the average movement time of position reference (Pn217) is shown below.

Acceleration/Deceleration Filter (Pn216)	Average Movement Time Filter (Pn217)
	
–	

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5.4.6 Positioning Completed Signal

This signal indicates that servomotor movement has been completed during position control.

When the difference between the number of reference pulses output by the host controller and the travel distance of the servomotor (position error) drops below the set value in the parameter, the positioning completion signal will be output.

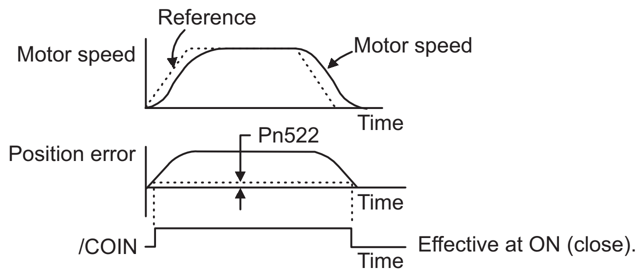
Use this signal to check the completion of positioning from the host controller.

Type	Signal Name	Connector Pin Number	Setting	Meaning
Output	/COIN	CN1-25, 26 [Factory setting]	ON (closed)	Positioning has been completed.
			OFF (open)	Positioning is not completed.

Note: Use parameter Pn50E.0 to allocate the /COIN signal to another terminal. Refer to *3.4.2 Output Signal Allocations* for details.

Pn522	Positioning Completed Width			Position	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 1073741824	1 reference unit	7	Immediately	Setup

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



Note: If the parameter is set to a value that is too large, a positioning completed signal might be output if the position error is low during a low speed operation. This will cause the positioning completed signal to be output continuously. If this signal is output unexpectedly, reduce the set value until it is no longer output.

If the position error is kept to a minimum when the positioning completed width is small, use Pn207.3 to change output timing for the /COIN signal.

Parameter		Name	Meaning	When Enabled	Classification
Pn207	n.0□□□ [Factory setting]	/COIN Output Timing	When the absolute value of the position error is below the positioning completed width (Pn522).	After restart	Setup
	n.1□□□		When the absolute value of the position error is below the positioning completed width (Pn522), and the reference after applying the position reference filter is 0.		
	n.2□□□		When the absolute value of the position error is below the positioning completed width (Pn522), and the position reference input is 0.		

5.4.7 Positioning Near Signal

Before confirming that the positioning completed signal has been received, the host controller first receives a positioning near signal and can prepare the operating sequence after positioning has been completed. The time required for this sequence after positioning can be shortened.

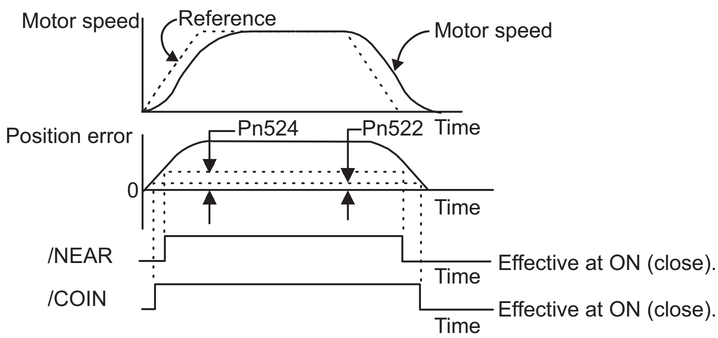
This signal is generally used in combination with the positioning completed output signal.

Type	Signal Name	Connector Pin Number	Setting	Meaning
Output	/NEAR	Must be allocated	ON (closed)	The servomotor has reached a point near to positioning completed.
			OFF (open)	The servomotor has not reached a point near to positioning completed.

Note: Use parameter Pn510.0 to allocate the /NEAR signal for use. Refer to *3.4.2 Output Signal Allocations* for details.

Pn524	NEAR Signal Width			Position	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	1 to 1073741824	1 reference unit	1073741824	Immediately	Setup

The positioning near signal (/NEAR) is output when the difference between the number of reference pulses output by the host controller and the travel distance of the servomotor (position error) is less than the set value.



Note: Normally, the value of Pn524 should be larger than that for the positioning completed width (Pn522).

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5.4.8 Reference Pulse Inhibit Function

This function inhibits the multi-winding drive unit from counting input pulses during position control. When this function is enabled, the multi-winding drive unit does not accept the reference pulse input.

(1) Factory-set Input Signal Allocations (Pn50A.0 = 0)

Use Pn000.1=B and the /P-CON signal to use the reference pulse inhibit function while the input signal allocations are still in the factory settings.

Type	Signal Name	Connector Pin Number	Setting	Meaning
Input	/P-CON	CN1-41 [Factory setting]	ON (closed)	Stops counting the reference pulses.
			OFF (open)	Counts the reference pulses.

Parameter		Control Method	Input Signal Used	When Enabled	Classification
Pn000	n.□□B□	Position Control ↔ Position Control with Reference Pulse Inhibit Function	/P-CON	After restart	Setup

Note: If Pn000.1 is set to B, the /P-CON signal cannot be used for any function other than the reference pulse inhibit function.

(2) Changing Input Signal Allocations (Pn50A.0 = 1)

Allocate the /INHIBIT signal as the reference pulse inhibit signal to use the reference pulse inhibit function while the Pn000.1 (control method) is set to 1, 5, 7, or 8.

Type	Signal Name	Connector Pin Number	Setting	Meaning
Input	/INHIBIT	Must be allocated.	ON (closed)	Stops counting the reference pulses.
			OFF (open)	Counts the reference pulses.

Note: Use parameter Pn50D.1 to allocate the /INHIBIT signal for use. For details, refer to *3.4.1 Input Signal Allocations to Input Terminals*.

To use the reference pulse inhibit function, set Pn000.1 to 1, 5, 7 or 8.

Parameter		Control Method	Input Signal Used	When Enabled	Classification
Pn000	n.□□1□	Position Control	/INHIBIT	After restart	Setup
	n.□□5□	Internal Set Speed Control ↔ Position Control	/INHIBIT /SPD-A /SPD-B /SPD-D /C-SEL		
	n.□□7□	Position Control ↔ Speed Control	/INHIBIT /C-SEL		
	n.□□8□	Position Control ↔ Torque Control	/INHIBIT /C-SEL		

Note: Reference pulse inhibit function is effective only with position control.

5.5 Torque Control

This section describes operation with torque control.

Input the torque reference to the multi-winding drive unit using an analog reference and control the servomotor operation with the torque in proportion to the input voltage.

Select the torque control with parameter Pn000.1.

Parameter		Meaning	When Enabled	Classification
Pn000	n.□□2□	Torque control	After restart	Setup

5.5.1 Basic Settings for Torque Control

This section describes the basic settings for torque control.

(1) Signal Setting

Set the following input signals.

Type	Signal Name	Connector Pin Number	Name
Input	T-REF	CN1-9	Torque reference input
	SG	CN1-10	Signal ground for torque reference input

Maximum input voltage: ±12 VDC

■ Input Circuit Example

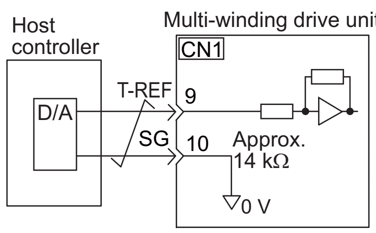
Example
Pn400 = 0003.0 : Motor rated torque at 3.0 V [Factory setting]

Note: The value is 30, but it will be displayed on the operator as 0003.0.

Speed Reference Input	Rotation Direction	Torque
+3 V	Forward	Rated torque
+1 V	Forward	1/3 rated torque
-1.5 V	Reverse	1/2 rated torque

Connect the pins for the T-REF signal and SG to the analog reference output terminal on the host controller when using a host controller, such as a programmable controller, for torque control.

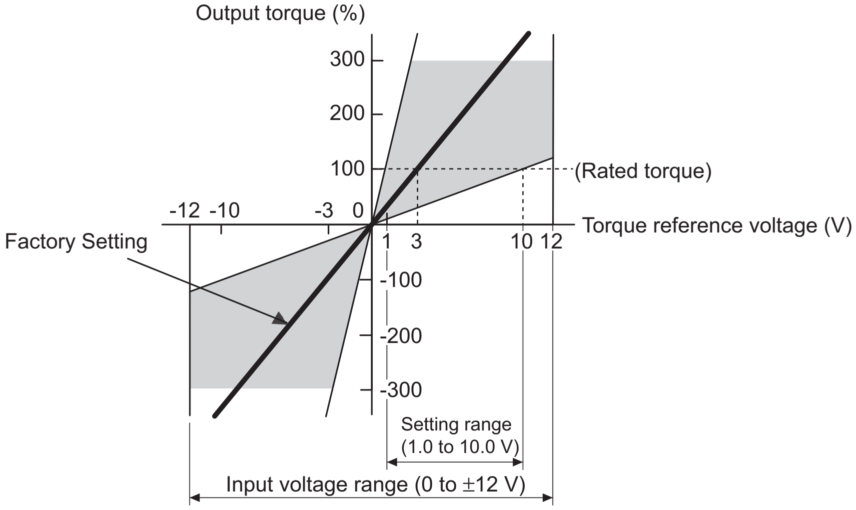
Note: Always use twisted-pair cables to control noise.



(2) Parameter Setting

Using Pn400, set the analog voltage level for the torque reference (T-REF) that is necessary to operate the servomotor at the rated torque.

Pn400	Torque Reference Input Gain \[Speed\] \[Position\] \[Torque\]				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	10 to 100	0.1 V/rated torque	30 (Rated torque at 3.0 V)	Immediately	Setup



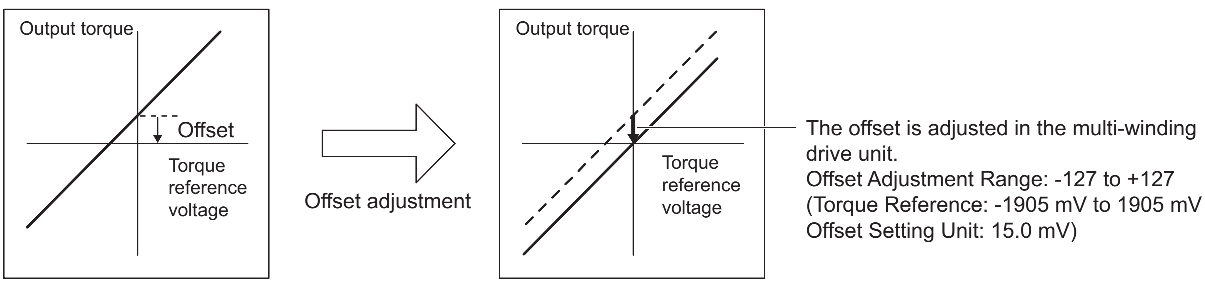
Note: A torque reference above the rated torque can be applied but it may cause an overload (high load) alarm (A.710) or overload (low load) alarm (A.720) if excessive torque is output for a long time. Refer to *9.1.2 Troubleshooting of Alarms*.

5.5.2 Reference Offset Adjustment

In torque control, the servomotor may rotate at a very low speed with a voltage reference of 0 V. This occurs because the internal reference in the multi-winding drive unit has a slight offset of a few millivolts. It is called "offset."

If the servomotor rotates at a very low speed, the offset needs to be eliminated with the offset adjustment function.

Use either automatic adjustment or manual adjustment. Automatic adjustment uses the automatic adjustment parameter for reference offset (Fn009). Manual adjustment uses the manual adjustment parameter for reference offset (Fn00B).



(1) Automatic Adjustment of Reference Offset (Fn009)

The automatic adjustment of reference offset measures the amount of offset and adjusts the reference voltage automatically.
After completion of the automatic adjustment, the amount of offset measured is saved in the multi-winding drive unit.

IMPORTANT	The servomotor power must be OFF when automatically adjusting the reference offset.

Note: The adjusted value is not initialized by executing the Fn005 function (Initializing Parameter Settings).

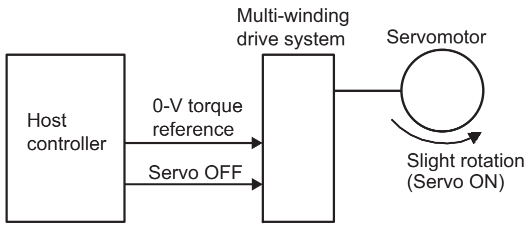
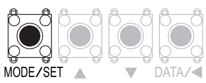
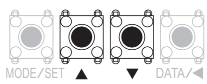
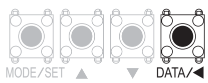
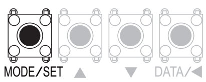
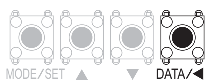
■ Preparation

The following conditions must be met to adjust the offsets of torque analog reference automatically. The message “NO-OP” indicating that the settings are not appropriate will be displayed, if the following conditions are not met.

- The write prohibited setting parameter (Fn010) must be set to Write permitted (P.0000).
- The servomotor power must be OFF.

■ Operating Procedure

Adjust the reference offset automatically with the panel operator using the following steps.

Step	Display after Operation	Keys	Operation
1	–	–	Turn OFF the servo ON signal (/S-ON), and input the 0-V reference voltage from the host controller or external circuit. 
2	Fn000		Press the MODE/SET Key to select the utility function.
3	Fn009		Press the UP or the DOWN Key to select Fn009.
4	rEF_o		Press the DATA/SHIFT Key for approximately one second. "rEF_o" is displayed.
5	rEF_o		Press the MODE/SET key. After "donE" flashes for approximately one second, "rEF_o" is displayed again.
6	Fn009		Press the DATA/SHIFT Key for approximately one second. "Fn009" is displayed again.

Note: The automatic adjustment of reference offset (Fn009) cannot be used when a position loop has been formed with the host controller. Use the manual adjustment of reference offset described in *(2) Manual Adjustment of Reference Offset (Fn00B)*.

Operation

5

(2) Manual Adjustment of Reference Offset (Fn00B)

This mode adjusts the offset by inputting the amount of torque reference offset directly.

Use the manual adjustment of the torque reference offset (Fn00B) in the following cases:

- To deliberately set the offset amount to some value.
- To check the offset amount set in the automatic adjustment mode of reference offset.

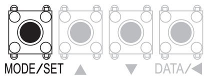
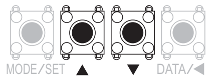
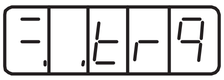
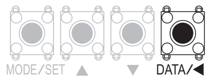
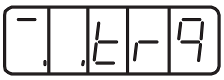
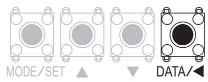
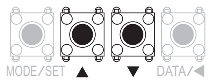
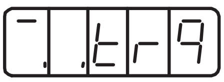
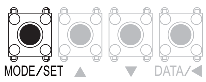
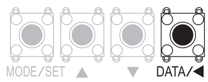
Note: The adjusted value is not initialized by executing the Fn005 function (Initializing Parameter Settings).

■ Preparation

The following conditions must be met to adjust the offsets of torque reference manually.
- The write prohibited setting parameter (Fn010) must be set to Write permitted (P.0000).
- The main circuit power supply must be ON. (Refer to *5.10.4*.)

■ Operating Procedure

Adjust the reference offset manually with the panel operator using the following steps.

Step	Display after Operation	Keys	Operation
1	Fn000		Press the MODE/SET Key to select the utility function.
2	Fn00b		Press the UP or the DOWN Key to select Fn00b.
3			Press the DATA/SHIFT Key for approximately one second. The display shown on the left appears. Note: When "no_oP" flashes for approximately one second, the write prohibited setting has been set in Fn010. Change the setting in Fn010 to enable writing. set (Refer to *7.10*.)
4		–	Turn ON the servo ON signal (/S-ON) from an external device. The display shown on the left appears.
5	00000		Press the DATA/SHIFT Key for approximately one second. The present offset amount is displayed.
6	00002 (Example)		Press the UP or the DOWN Key to adjust the amount of off-set.
7			Press the MODE/SET Key. After "donE" flashes for approximately one second, the display shown on the left appears.
8	Fn00b		Press the DATA/SHIFT Key for approximately one second. "Fn00b" is displayed again.

5.5.3 Torque Reference Filter

This smooths the torque reference by applying a first order lag filter to the torque reference (T-REF) input.

Note: A setting value that is too large, however, will slow down response.
Check the response characteristics when setting this parameter.

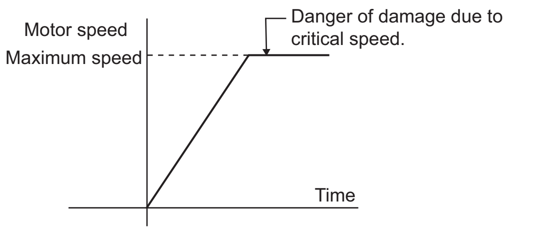
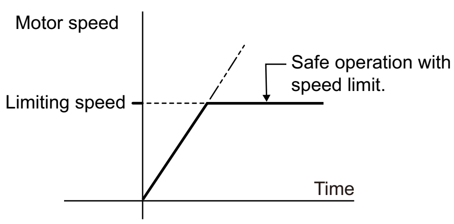
Pn415	T-REF Filter Time Constant [Speed] [Position] [Torque]				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 65535	0.01 ms	0	Immediately	Setup

5.5.4 Speed Limit in Torque Control

This function limits the speed of the servomotor to protect the machine.

A servomotor in torque control is controlled to output the specified torque, but the motor speed is not controlled. Therefore, if an excessive reference torque is set for the load torque on the machinery side, the speed of the servomotor may increase greatly. If that may occur, use this function to limit the speed.

Note: The actual limit value of motor speed depends on the load conditions of the servomotor.

With No Speed Limit	With Speed Limit
	

Refer to the following parameters for speed limit.

(1) Signals Output during Servomotor Speed Limit

The following signal is output when the motor speed reaches the limit speed.

Type	Signal Name	Connector Pin Number	Setting	Meaning
Output	/VLT	Must be allocated	ON (closed)	Servomotor speed limit being applied.
			OFF (open)	Servomotor speed limit not being applied.

Note: Use parameter Pn50F.1 to allocate the /VLT signal for use. For details, refer to *3.4.2 Output Signal Allocations*.

(2) Speed Limit Setting

Select the speed limit mode with Pn002.1.

Parameter		Meaning	When Enabled	Classification
Pn002	n.□□0□ [Factory setting]	Uses the value set in Pn407 as the speed limit (internal speed limit function).	After restart	Setup
	n.□□1□	Uses V-REF (CN1-5, 6) as an external speed limit input. Applies a speed limit using the input voltage of V-REF and the setting in Pn300 (external speed limit function).		

■ Internal Speed Limit Function

If the internal speed limit function is selected in Pn002.1, set the limit of the maximum speed of the servomotor in Pn407. The limit of the speed in Pn408.1 can be either the maximum speed of the servomotor or the overspeed alarm detection speed. Select the overspeed alarm detection speed to limit the speed to the maximum speed of the servomotor or the equivalent.

Pn407	Speed Limit During Torque Control (Torque)				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 10000	1 min^{-1}	10000	Immediately	Setup

Note: The servomotor's maximum speed or the overspeed alarm detection speed will be used when the setting in this parameter exceeds the maximum speed of the servomotor used.

Parameter		Meaning	When Enabled	Classification
Pn408	n.□□0□ [Factory setting]	Uses the smaller value of the maximum motor speed and the value of Pn407 as the speed limit value.	After restart	Setup
	n.□□1□	Uses the smaller value of the overspeed alarm detection speed and the value of Pn407 as speed limit value.		

■ External Speed Limit Function

If the external speed limit function is selected in Pn002.1, set the V-REF input signal and Pn300.

Type	Signal Name	Connector Pin Number	Name
Input	V-REF	CN1-5	External speed limit input
	SG	CN1-6	Signal ground for external speed limit input

Inputs an analog voltage reference as the servomotor speed limit value during torque control.

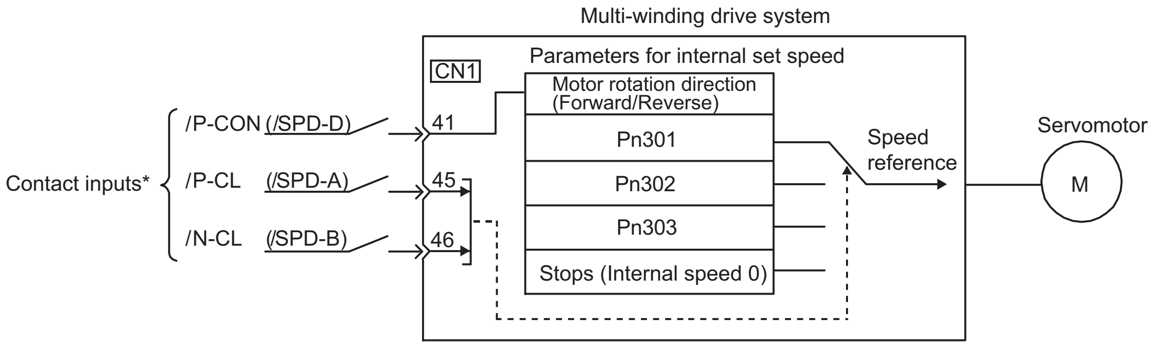
Notes:

- The smaller value of the speed limit input from the V-REF and the value of Pn407 is enabled when Pn002.1 is set to 1.
- The setting in Pn300 determines the voltage level to be input as the limit value. Polarity has no effect.
- When Pn300 is set to 6.00 (factory setting) and 6 V is input to V-REF (CN1-5, 6), the speed is limited to the rated speed of the servomotor used.

Pn300	Speed Reference Input Gain (Speed) (Position) (Torque)				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	150 to 3000	0.01 V/rated speed	600	Immediately	Setup

5.6 Internal Set Speed Control

This section describes operation using speed control with the internal set speeds.
This function enables an operation to be executed at a controlled speed. The speed and direction are selected in accordance with a combination of input signals from an external source. Servomotor speed settings are made in advance using the parameters in the multi-winding drive unit. Because the speed is controlled with a parameter in the multi-winding drive unit, an external pulse generator or a reference generator that controls speed is not needed.



* When using the external input signal pins as factory settings, the functions of /P-CON, /P-CL, and /N-CL change to the functions of /SPD-D, /SPD-A, and /SPD-B, respectively.

5.6.1 Basic Settings for Speed Control with an Internal Set Speed

This section describes the basic settings for the internal set speeds.

(1) Signal Setting

The following input signals are used to switch the operating speed.

■ Factory-set Input Signal Allocations: /P-CON, /P-CL, and /N-CL

Type	Signal Name	Connector Pin Number	Meaning
Input	/P-CON	CN1-41	Switches the servomotor rotation direction.
	/P-CL	CN1-45	Selects the internal set speed.
	/N-CL	CN1-46	Selects the internal set speed.

■ Changing Input Signal Allocations: /SPD-D, /SPD-A, and /SPD-B

Type	Signal Name	Connector Pin Number	Meaning
Input	/SPD-D	CN1-41	Switches the servomotor rotation direction.
	/SPD-A	CN1-45	Selects the internal set speed.
	/SPD-B	CN1-46	Selects the internal set speed.

(2) Parameter Setting

Select the speed control with an internal set speed with Pn000.1.

Parameter		Meaning	When Enabled	Classification
Pn000	n.□□3□	Internal set speed control	After restart	Setup

(3) Related Parameters

Set the internal set speed with Pn301, Pn302, and Pn303.

Pn301	Internal Set Speed 1		Speed		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 10000	1 min^{-1}	100	Immediately	Setup
Pn302	Internal Set Speed 2		Speed		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 10000	1 min^{-1}	200	Immediately	Setup
Pn303	Internal Set Speed 3		Speed		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 10000	1 min^{-1}	300	Immediately	Setup

Note: The maximum speed of the servomotor is used whenever the value which exceeds the maximum speed is set in the Pn301 to Pn303.

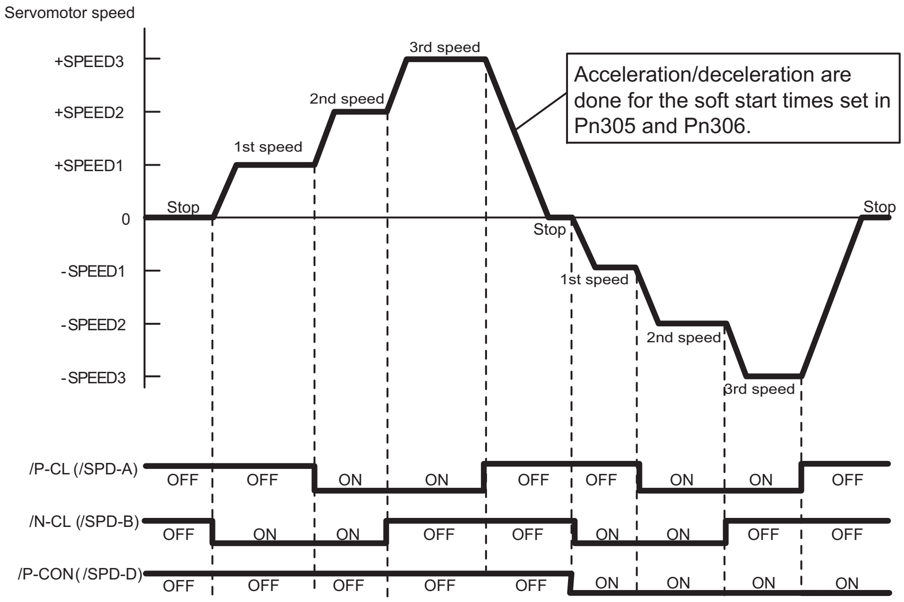
(4) Operating Using an Internal Set Speed

Use ON/OFF combinations of the following input signals to operate with the internal set speeds.

Input Signal			Motor Rotation Direction	Speed
/P-CON /SPD-D	/P-CL /SPD-A	/N-CL /SPD-B		
OFF	OFF	OFF	Forward	Stops at 0 of the internal set speed.
	OFF	ON		Pn301: Internal Set Speed 1
	ON	ON		Pn302: Internal Set Speed 2
	ON	OFF		Pn303: Internal Set Speed 3
ON	OFF	OFF	Reverse	Stops at 0 of the internal set speed.
	OFF	ON		Pn301: Internal Set Speed 1
	ON	ON		Pn302: Internal Set Speed 2
	ON	OFF		Pn303: Internal Set Speed 3

5.6.2 Example of Operating with Internal Set Speeds

An operating example of speed control with the internal set speeds is as shown below.
This example combines speed control with the internal set speeds with the soft start function.
The shock that results when the speed is changed can be reduced by using the soft start function.



5.7 Combination of Control Methods

The multi-winding drive unit can switch between a combination of two control methods. Select the control method with Pn000.1.

Parameter		Combination of Control Methods	When Enabled	Classification
Pn000	n.□□4□	Internal Set Speed Control ↔ Speed Control	After restart	Setup
	n.□□5□	Internal Set Speed Control ↔ Position Control		
	n.□□6□	Internal Set Speed Control ↔ Torque Control		
	n.□□7□	Position Control ↔ Speed Control		
	n.□□8□	Position Control ↔ Torque Control		
	n.□□9□	Torque Control ↔ Speed Control		
	n.□□A□	Speed Control ↔ Speed Control with Zero Clamp Function		
	n.□□B□	Position Control ↔ Position Control with Reference Pulse Inhibit Function		

5.7.1 Switching Internal Set Speed Control (Pn000.1 = 4, 5, or 6)

Conditions for switching internal set speed control are as shown below.

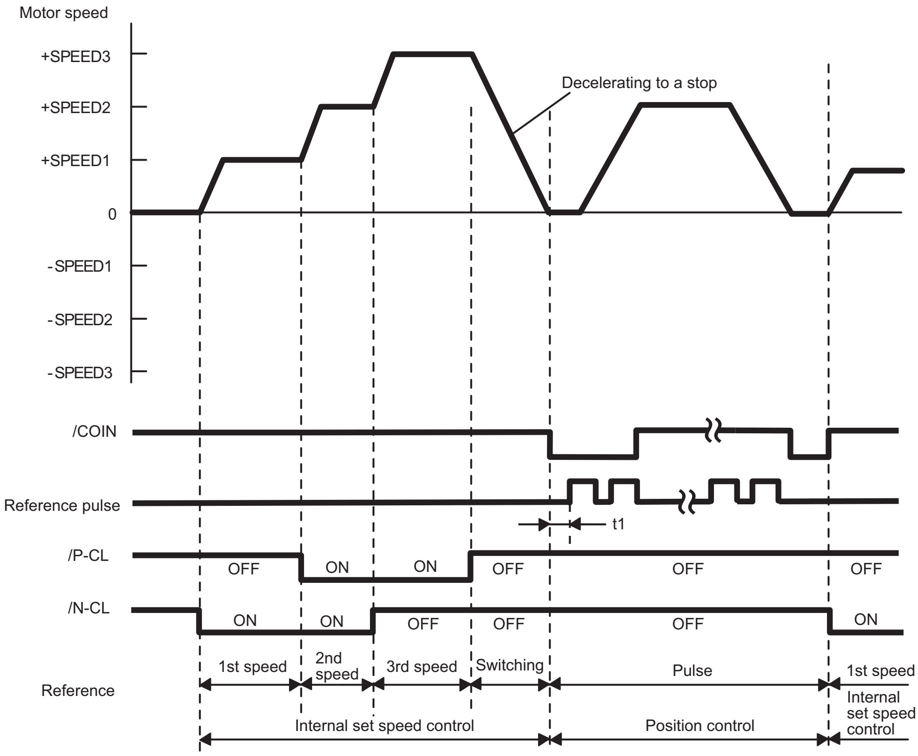
(1) Factory-set Input Signal Allocations (Pn50A.0 = 0)

The control method and internal set speed can be switched using /P-CL and /N-CL signals.

Input Signal			Pn000.1 Settings and Operations		
/P-CON (CN1-41)	/P-CL (CN1-45)	/N-CL (CN1-46)	n.□□4□	n.□□5□	n.□□6□
OFF	OFF	OFF	Speed control	Position control	Torque control
	OFF	ON	Forward rotation at internal set speed 1 set in Pn301.		
	ON	ON	Forward rotation at internal set speed 2 set in Pn302.		
	ON	OFF	Forward rotation at internal set speed 3 set in Pn303.		
ON	OFF	OFF	Speed control	Position control	Torque control
	OFF	ON	Reverse rotation at internal set speed 1 set in Pn301.		
	ON	ON	Reverse rotation at internal set speed 2 set in Pn302.		
	ON	OFF	Reverse rotation at internal set speed 3 set in Pn303.		

It is possible to switch from speed control, position control, or torque control to the internal set speed control even while the servomotor is rotating.

The following diagram describes an operation example for internal set speed control + soft start ↔ position control.



Note 1. The t1 value is not affected by whether the soft start function is used.
A maximum delay of 2 ms occurs in loading /P-CL and /N-CL.
2. The speed is decelerated for the time set in Pn306, and the internal set speed control will be changed to the position control after the servomotor comes to a stop.

(2) Changing Input Signal Allocations (Pn50A.0 = 1)

The control method can be switched by turning the /C-SEL signal ON/OFF.

Type	Signal Name	Connector Pin Number	Setting	Pn000 Setting and Control Method		
				n.□□4□	n.□□5□	n.□□6□
Input	/C-SEL	Must be allocated	ON (closed)	Speed	Position	Torque
			OFF (open)	Internal set speed	Internal set speed	Internal set speed

Note: Use parameter Pn50C.3 to allocate the /C-SEL signal for use. For details, refer to *3.4.1 Input Signal Allocations*.

The following table shows the speed and direction in accordance with settings for the input signals for the setting for internal set speed control when the /C-SEL signal is OFF.

Input Signal			Speed and Direction
/SPD-D	/SPD-A	/SPD-B	
OFF	OFF	OFF	Stops at internal set speed 0.
	OFF	ON	Forward rotation at internal set speed 1 set in Pn301.
	ON	ON	Forward rotation at internal set speed 2 set in Pn302.
	ON	OFF	Forward rotation at internal set speed 3 set in Pn303.
ON	OFF	OFF	Stops at internal set speed 0.
	OFF	ON	Reverse rotation at internal set speed 1 set in Pn301.
	ON	ON	Reverse rotation at internal set speed 2 set in Pn302.
	ON	OFF	Reverse rotation at internal set speed 3 set in Pn303.

Note: Use parameter Pn50C.0 to 2 to allocate the /SPD-D, /SPD-A, and /SPD-B signals for use. For details, refer to *3.4.1 Input Signal Allocations*.

5.7.2 Switching Other Than Internal Set Speed Control (Pn000.1 = 7, 8 or 9)

Use the following signals to switch control methods when Pn000.1 is set to 7, 8, or 9. The control methods switch depending on the signal status as shown below.

(1) Factory-set Input Signal Allocations (Pn50A.0 = 0)

Type	Signal Name	Connector Pin Number	Setting	Pn000.1 Setting and Control Method		
				n.□□7□	n.□□8□	n.□□9□
Input	/P-CON	CN1-41	ON (closed)	Speed	Torque	Speed
			OFF (open)	Position	Position	Torque

(2) Changing Input Signal Allocations (Pn50A.0 = 1)

Type	Signal Name	Connector Pin Number	Setting	Pn000.1 Setting and Control Method		
				n.□□7□	n.□□8□	n.□□9□
Input	/C-SEL	Must be allocated	ON (closed)	Speed	Torque	Speed
			OFF (open)	Position	Position	Torque

5.7.3 Switching Other Than Internal Set Speed Control (Pn000.1 = A or B)

Use the following signals to switch control methods when Pn000.1 is set to A or B. The control methods switch depending on the signal status as shown below.

(1) Factory-set Input Signal Allocations (Pn50A.0 = 0)

Type	Signal Name	Connector Pin Number	Setting	Pn000.1 Setting and Control Method	
				n.□□A□	n.□□B□
Input	/P-CON	CN1-41	ON (closed)	Speed control with zero clamp function	Position control with reference pulse inhibit function
			OFF (open)	Speed	Position

(2) Changing Input Signal Allocations for Each Signal (Pn50A.0 = 1)

Type	Signal Name	Connector Pin Number	Setting	Pn000.1 Setting and Control Method	
				n.□□A□	n.□□B□
Input	/ZCLAMP	Must be allocated	ON (closed)	Speed control with zero clamp function	–
			OFF (open)	Speed	–
	/INHIBIT		ON (closed)	–	Position control with reference pulse inhibit function
			OFF (open)	–	Position

5.8 Limiting Torque

The multi-winding drive unit provides the following four methods for limiting output torque to protect the machine.

Limiting Method	Description	Reference Section
Internal torque limit	Always limits torque by setting the parameter.	5.8.1
External torque limit	Limits torque by input signal from the host controller.	5.8.2
Torque limiting by analog voltage reference	Assigns a torque limit by analog voltage reference.	5.8.3
External torque limit + Torque limiting by analog voltage reference	Combines torque limiting by an external input and by analog voltage reference.	5.8.4

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

5.8.1 Internal Torque Limit

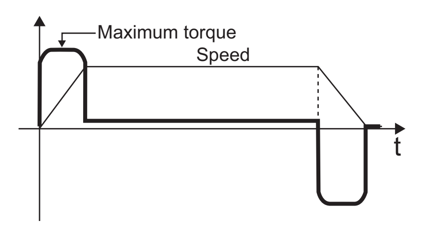
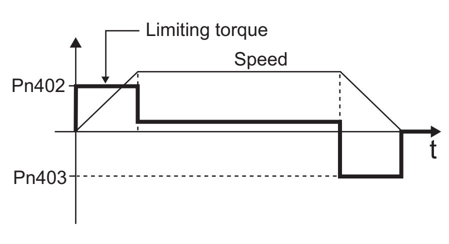
This function always limits maximum output torque by setting values of following parameters.

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

The setting unit is a percentage of the rated torque.

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

Torque waveform

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

5.8.2 External Torque Limit

Use this function to limit torque by inputting a signal from the host controller at specific times during machine operation. For example, some pressure must continually be applied (but not enough to damage the workpiece) when the robot is holding a workpiece or when a device is stopping on contact.

(1) Input Signals

Use the following input signals to limit a torque by external torque limit.

Type	Signal Name	Connector Pin Number	Setting	Meaning	Limit value
Input	/P-CL	CN1-45 [Factory setting]	ON (closed)	Forward external torque limit ON	The smaller value of these settings: Pn402 or Pn404
			OFF (open)	Forward external torque limit OFF	Pn402
Input	/N-CL	CN1-46 [Factory setting]	ON (closed)	Reverse external torque limit ON	The smaller value of these settings: Pn403 or Pn405
			OFF (open)	Reverse external torque limit OFF	Pn403

Note: Use parameter Pn50B.2 and Pn50B.3 to allocate the /P-CL signal and the /N-CL signal to another terminal. For details, refer to *3.4.1 Input Signal Allocations*.

(2) Related Parameters

Set the following parameters for external torque limit.

Parameter	Name / Setting Range	Setting Unit	Factory Setting	When Enabled	Classification
Pn402	Forward Torque Limit	Speed	Position	Torque	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 800	1%	800	Immediately	Setup
Pn403	Reverse Torque Limit	Speed	Position	Torque	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 800	1%	800	Immediately	Setup
Pn404	Forward External Torque Limit	Speed	Position	Torque	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 800	1%	100	Immediately	Setup
Pn405	Reverse External Torque Limit	Speed	Position	Torque	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 800	1%	100	Immediately	Setup

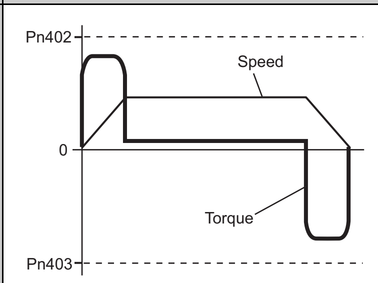
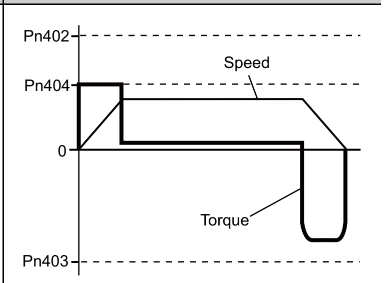
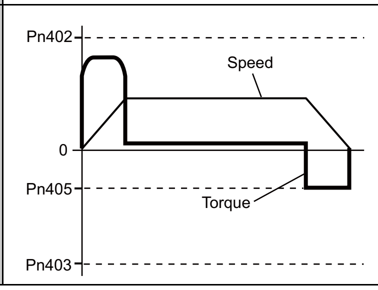
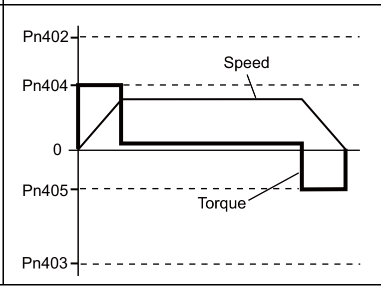
The setting unit is a percentage of the rated torque.

Note: If the settings of Pn402, Pn403, Pn404, and Pn405 are too low, the torque may be insufficient for acceleration or deceleration of the servomotor.

(3) Changes in Output Torque during External Torque Limiting

The following diagrams show the change in output torque when the internal torque limit is set to 800%.

In this example, the servomotor rotation direction is Pn000.0 = 0 (Sets CCW as forward direction).

		/P-CL	
		OFF	ON
/N-CL	OFF		
	ON		

5.8.3 Torque Limiting Using an Analog Voltage Reference

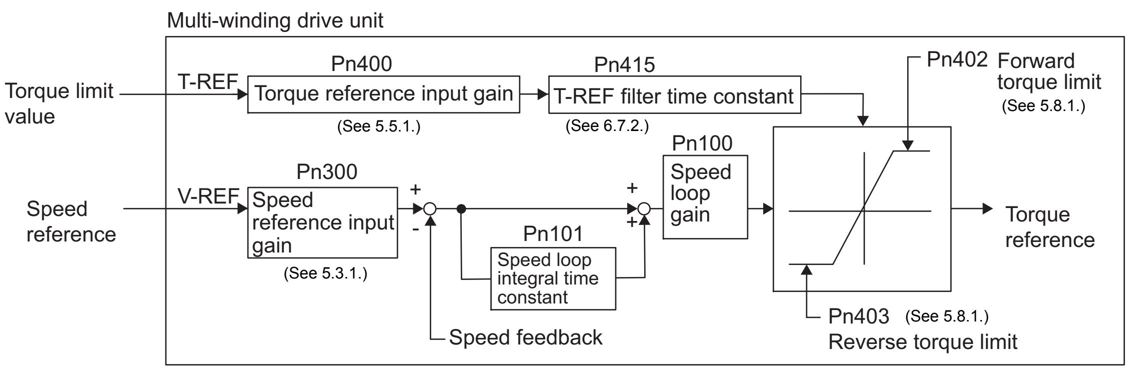
For torque limiting by analog voltage reference, the torque is limited by using the analog voltage at the T-REF terminals for CN1-9 and CN1-10.

From the torque limit value by analog reference and torque limit value by Pn402 and Pn403, whichever is smaller will be applied.

Parameter		Meaning	When Enabled	Classification
Pn002	n.□□□1	Uses the T-REF terminal as an external torque limit input.	After restart	Setup

This function can be used only during speed or position control, not during torque control.

The following chart shows when the torque limiting using an analog voltage reference is performed in the speed control.



There is no polarity in the input voltage of the analog voltage reference for torque limiting. The absolute values of both + and - voltages are input, and a torque limit value corresponding to that absolute value is applied in the forward and reverse direction.

Operation

5

(1) Input Signals

Use the following input signals to limit a torque by analog voltage reference.

Type	Signal Name	Connector Pin Number	Name
Input	T-REF	CN1-9	Torque reference input
	SG	CN1-10	Signal ground for torque reference input

Refer to *5.5.1 Basic Settings for Torque Control*.

(2) Related Parameters

Set the following parameters for torque limit by analog voltage reference.

Pn400	Torque Reference Input Gain		Speed Position Torque		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	10 to 100	0.1 V	30 (Rated torque at 3.0 V)	Immediately	Setup
Pn402	Forward Torque Limit		Speed Position Torque		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 800	1%	800	Immediately	Setup
Pn403	Reverse Torque Limit		Speed Position Torque		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 800	1%	800	Immediately	Setup
Pn415	T-REF Filter Time Constant		Speed Position Torque		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 65535	0.01 ms	0	Immediately	Setup

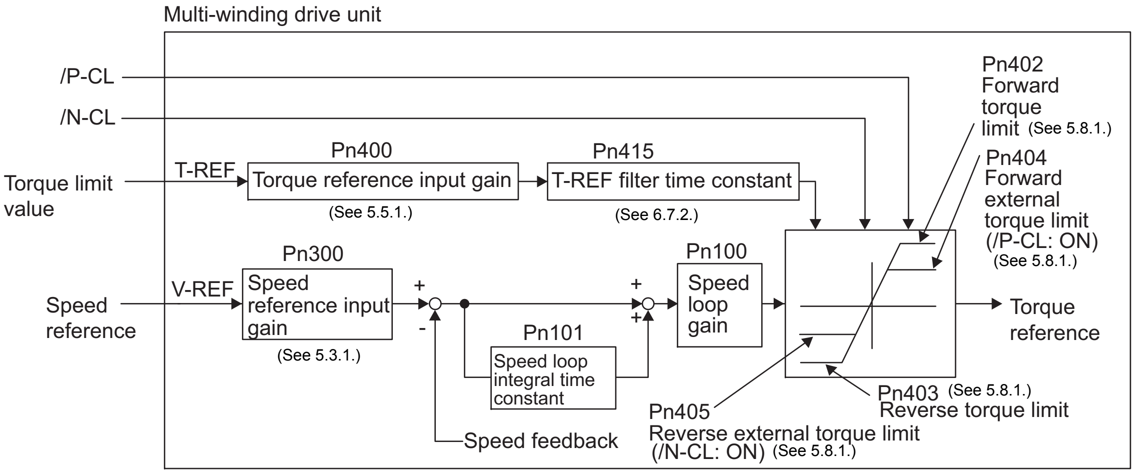
5.8.4 Torque Limiting Using an External Torque Limit and Analog Voltage Reference

This function can be used to combine torque limiting by an external input and by analog voltage reference.

When /P-CL (or /N-CL) is ON, either the torque limit by analog voltage reference or the setting in Pn404 (or Pn405) will be applied as the torque limit, whichever is smaller.

Parameter		Meaning	When Enabled	Classification
Pn002	n.□□□3	When /P-CL or /N-CL is enabled, the T-REF terminal is used as the external torque limit input.	After restart	Setup

The following chart shows the external torque limiting using an analog voltage reference.



Note: This function cannot be used during torque control since the torque limit by analog voltage reference is input from T-REF (CN1-9, 10).

(1) Input Signals

Use the following input signals to limit a torque by external torque limit and analog voltage reference.

Type	Signal Name	Connector Pin Number	Name
Input	T-REF	CN1-9	Torque reference input
	SG	CN1-10	Signal ground for torque reference input

Refer to *5.5.1 Basic Settings for Torque Control*.

Type	Signal Name	Connector Pin Number	Setting	Meaning	Limit Value
Input	/P-CL	CN1-45 [Factory setting]	ON	Forward external torque limit ON	The smallest value of these settings: the analog voltage reference limit, Pn402, or Pn404
			OFF	Forward external torque limit OFF	Pn402
Input	/N-CL	CN1-46 [Factory setting]	ON	Reverse external torque limit ON	The smallest value of these settings: the analog voltage reference limit, Pn403, or Pn405
			OFF	Reverse external torque limit OFF	Pn403

Operation

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(2) Related Parameters

Set the following parameters for torque limit by external torque limit and analog voltage reference.

Pn400	Torque Reference Input Gain		Speed Position Torque		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	Setup
	10 to 100	0.1 V	30 (Rated torque at 3.0 V)	Immediately	

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

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

Pn404	Forward External Torque Limit		Speed Position Torque		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	Setup
	0 to 800	1%	100	Immediately	

Pn405	Reverse External Torque Limit		Speed Position Torque		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	Setup
	0 to 800	1%	100	Immediately	

The setting unit is a percentage of the rated torque.

Pn415	T-REF Filter Time Constant		Speed Position Torque		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 65535	0.01 ms	0	Immediately	Setup

5.8.5 Checking Output Torque Limiting during Operation

The following signal can be output to indicate that the servomotor output torque is being limited.

Type	Signal Name	Connector Pin Number	Setting	Meaning
Output	/CLT	Must be allocated	ON (closed)	Servomotor output torque is being limited.
			OFF (open)	Servomotor output torque is not being limited.

Note: Use parameter Pn50F.0 to allocate the /CLT signal for use. For details, refer to *3.4.2 Output Signal Allocations*.

5.9 Absolute Encoders

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

A battery case is required to save position data in the absolute encoder.
The battery is attached to the battery case of the encoder cable.
If an encoder cable with a battery case is not used, install a battery to the host controller.

PROHIBITED

- Do not install batteries in both the host controller and battery case. It is dangerous because that sets up a loop circuit between the batteries.

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

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

The SEN signal and battery are not required when using the absolute encoder as an incremental encoder.

IMPORTANT

The rotational serial data output range for a large-capacity Σ-V-series absolute position detecting system is different from the range for previous Σ-series systems. As a result, the infinite-length positioning system of the Σ servo drives must be changed for use with Σ-V large-capacity servo drives. Be sure to make the following system modifications.

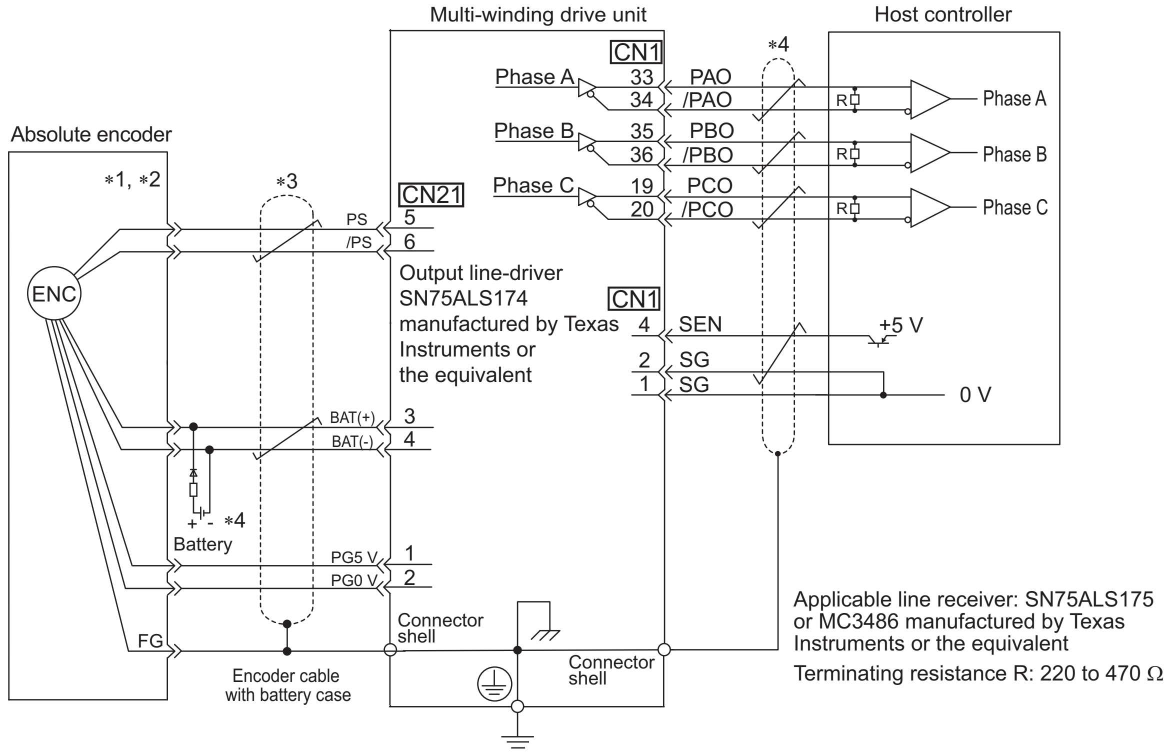
Series (Models)	Absolute Encoder Resolution*	Output Range of Rotational Serial Data	Action when Limit Is Exceeded
Σ Series (SGDB)	12-bit 15-bit	-99999 to + 99999	• When the upper limit (+99999) is exceeded in the forward direction, the rotational serial data will be 0. • When the lower limit (-99999) is exceeded in the reverse direction, the rotational serial data will be 0.
Σ-II Series (SGDM/SGDH) or large-capacity Σ-V Series (SGDV)	17-bit 20-bit	-32768 to + 32767	• When the upper limit (+32767) is exceeded in the forward direction, the rotational serial data will be -32768. • When the lower limit (-32768) is exceeded in the reverse direction, the rotational serial data will be +32767. Note: If you change the multiturn limit setting (Pn205), the operation will be different for both forward and reverse rotation. (Refer to *5.9.6 Multiturn Limit Setting*.)

* This is the resolution for a motor capacity of 22 kW or higher.

5.9.1 Connecting the Absolute Encoder

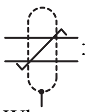
The following diagram shows the connection between a servomotor with an absolute encoder, the multi-winding drive unit, and the host controller.

(1) Using an Encoder Cable with a Battery Case



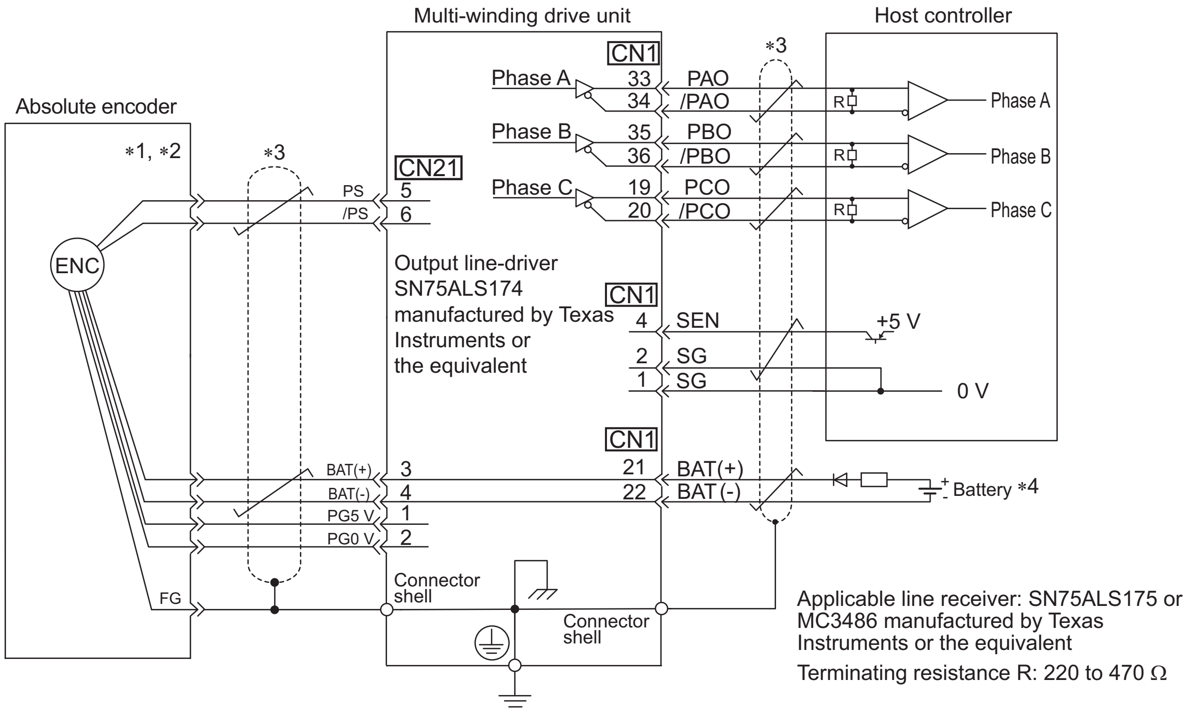
∗1. The absolute encoder pin numbers for the connector wiring depend on the servomotors.

∗2. To prevent the influence of external noise, we recommend you connect a ferrite core on the motor end of the encoder cable using two turns.

∗3.  : represents shielded twisted-pair wires.

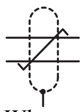
∗4. When using an absolute encoder, provide power by installing an encoder cable with a JUSP-BA01-E Battery Case or install a battery on the host controller.

(2) Installing the Battery in the Host Controller



∗1. The absolute encoder pin numbers for the connector wiring depend on the servomotors.

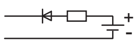
∗2. To prevent the influence of external noise, we recommend you connect a ferrite core on the motor end of the encoder cable using two turns.

∗3.  : represents shielded twisted-pair wires.

∗4. When using an absolute encoder, provide power by installing an encoder cable with a JUSP-BA01-E Battery Case or install a battery on the host controller.

IMPORTANT

- When Installing a Battery on the Encoder Cable
  Use the encoder cable with a battery case that is specified by Yaskawa.
  Refer to the multi-winding drive system catalog for details.
- When Installing a Battery on the Host Controller
  Insert a diode near the battery to prevent reverse current flow.

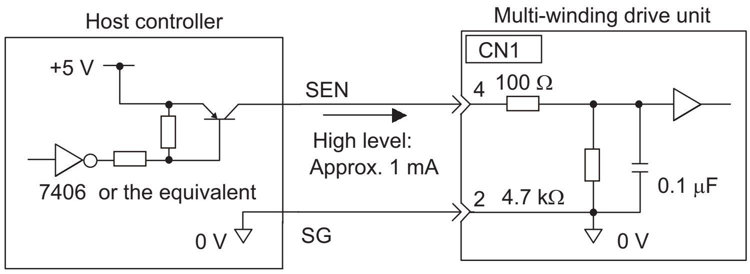
Circuit Example


5.9.2 Absolute Data Request Signal (SEN)

The absolute data request signal (SEN) must be input to obtain absolute data as an output from the multi-winding drive unit.

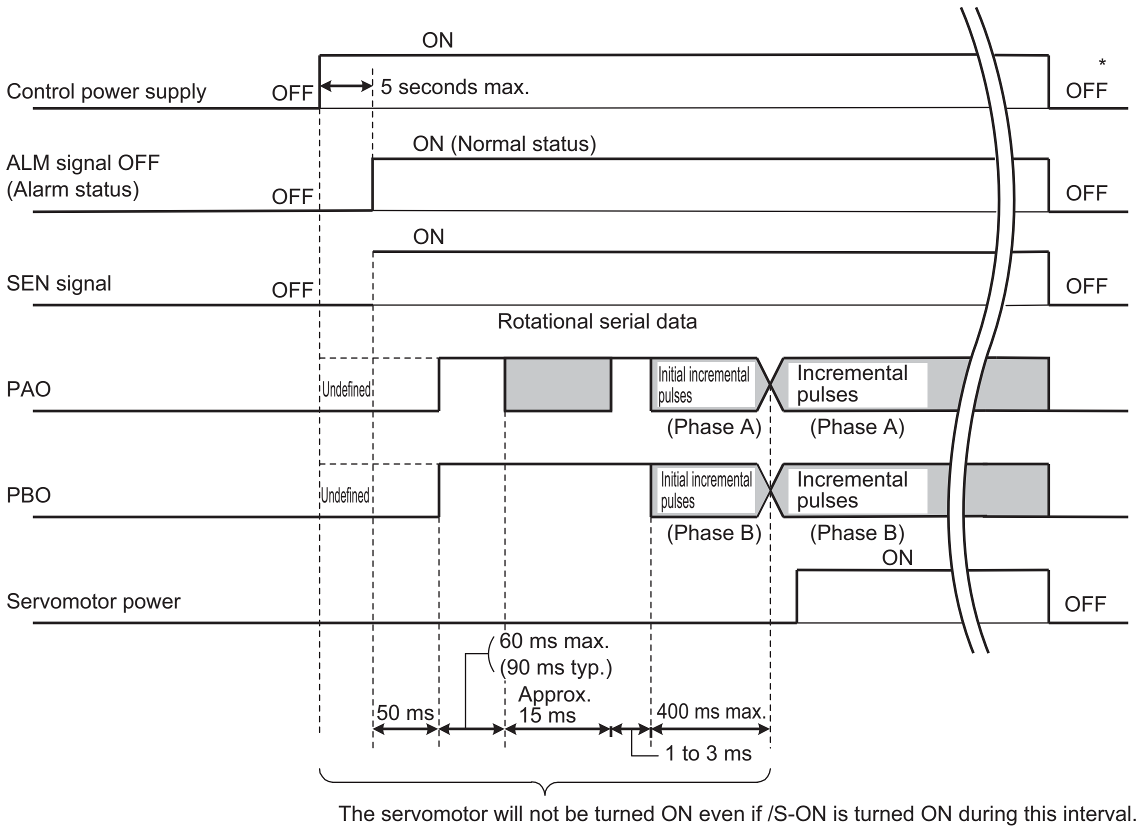
The following table describes the SEN signal.

Type	Signal Name	Connector Pin Number	Setting	Meaning
Input	SEN	CN1-4	OFF (low level)	Disabled
			ON (high level)	The host controller sends a request to the multi-winding drive unit for the absolute data.



We recommend a PNP transistor.

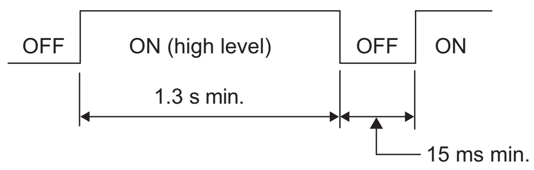
The SEN signal is input at the following timing.



* Turn OFF the SEN signal to turn OFF the control power supply.

IMPORTANT

- Maintain the high level for at least 1.3 seconds when the SEN signal is turned OFF and then ON, as shown in the figure below.



- SEN Signal cannot be OFF while the servomotor power is ON.

For the details of the absolute data reception sequence, refer to *5.9.5 Absolute Data Reception Sequence*.

5.9.3 Battery Replacement

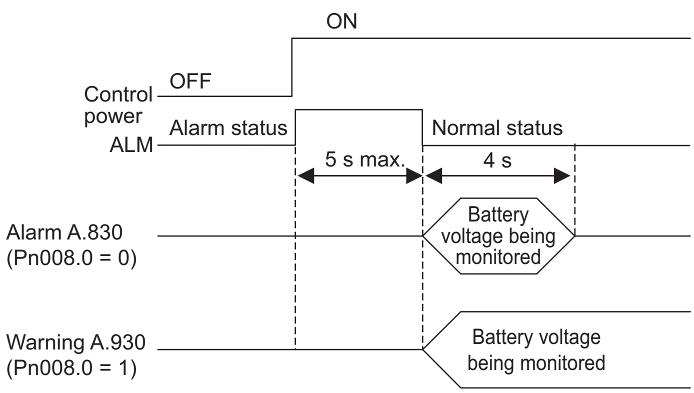
If the battery voltage drops to approximately 2.7 V or less, an absolute encoder battery error alarm (A.830) or an absolute encoder battery error warning (A.930) will be displayed.

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

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

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

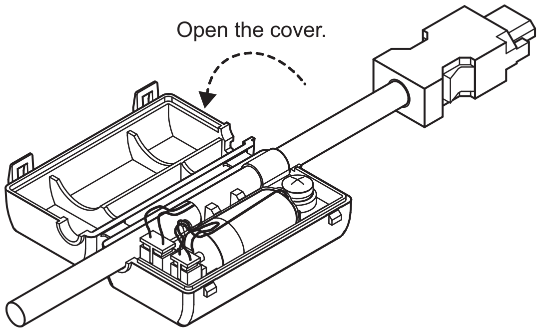
- If Pn008.0 is set to 0, alarm detection will be enabled for 4 seconds after the ALM signal outputs max. 5 seconds when the control power is turned ON.
  No battery-related alarm will be displayed even if the battery voltage drops below the specified value after these 4 seconds.
- If Pn008.0 is set to 1, alarm detection will be always enabled after the ALM signal outputs max. 5 seconds when the control power supply is turned ON.



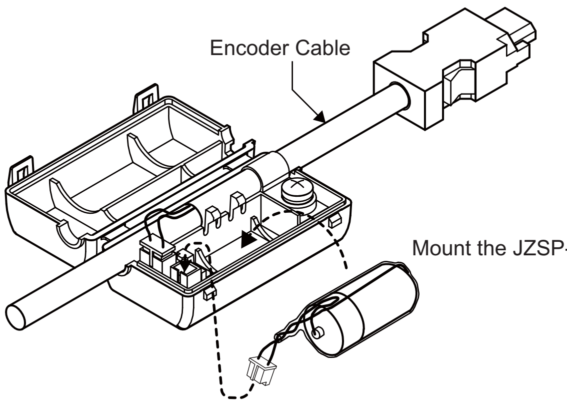
(1) Battery Replacement Procedure

■ Using an Encoder Cable with a Battery Case

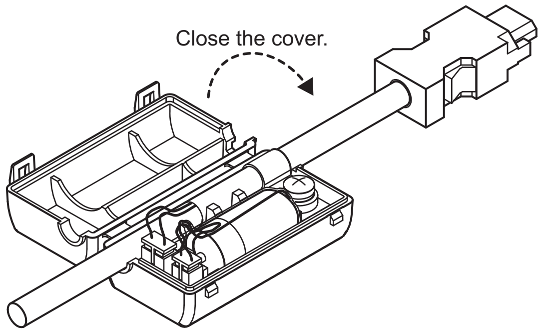
1. Turn ON only the control power supply.
2. Open the battery case cover.



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



4. Close the battery case cover.



5. After replacing the battery, turn OFF the control power supply to clear the absolute encoder battery error alarm (A.830).
6. Turn ON the control power supply.
7. Check that the alarm display has been cleared and that the multi-winding drive unit, SERVOPACKs, and converters operate normally.

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

■ Installing a Battery in the Host Controller

1. Turn ON only the control power supply.
2. Remove the old battery and mount the new battery.
3. After replacing the battery, turn OFF the control power supply to clear the absolute encoder battery error alarm (A.830).
4. Turn ON the control power supply again.
5. Check that the alarm display has been cleared and that the multi-winding drive unit, SERVOPACKs, and converters operate normally.

5.9.4 Absolute Encoder Setup and Reinitialization

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

Setting up and reinitialization of the absolute encoder are necessary in the following cases.

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

Set up the absolute encoder with Fn008.

(1) Precautions on Setup and Reinitialization

- The write prohibited setting parameter (Fn010) must be set to Write permitted (P.0000).
- Set up or reinitialize the encoder when the servomotor power is OFF.
- The encoder backup error alarm (A.810) and encoder checksum error alarm (A.820) cannot be canceled with the multi-winding drive unit's alarm reset (/ALM-RST) input signal. Always use Fn008 for the setup (initializing).
  - Encoder backup error alarm (A.810)
  - Encoder checksum error alarm (A.820)
- Any other alarms (A.8☐☐) that monitor the inside of the encoder should be canceled by turning OFF the power.

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(2) Procedure for Setup and Reinitialization

Follow the steps below to setup or reinitialize the absolute encoder.

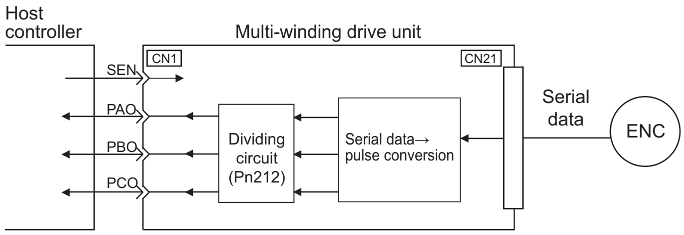
Step	Display after Operation	Keys	Operation
1	Fn000	MODE/SET	Press the MODE/SET Key to select the utility function.
2	Fn008	▲ ▼	Press the UP or the DOWN Key to select Fn008.
3	PGCL1	DATA/◀	Press the DATA/SHIFT Key for approximately one second. The display shown on the left appears.
4	PGCL5	▲	Continue pressing the UP Key until "PGCL5" is displayed. Note: If the wrong key is pressed, "no-oP" will flash for about one second and it will return to the utility function. Start the operation from the beginning.
5	donE	MODE/SET	Press the MODE/SET Key. The absolute encoder is initialized. When completed, "donE" flashes for approximately one second.
6	PGCL5	–	Then, "donE" changes to "PGCL5".
7	Fn008	DATA/◀	Press the DATA/SHIFT Key for approximately one second. "Fn008" is displayed again.
8	To enable the new setting, turn the control power supply OFF and ON again.		

5.9.5 Absolute Data Reception Sequence

The sequence in which the multi-winding drive unit receives the output from the absolute encoder and transmits it to host controller is shown below.

(1) Outline of Absolute Data

The serial data, pulses, etc., of the absolute encoder that are output from the multi-winding drive unit are output from the PAO, PBO, and PCO signals as shown below.



Signal Name	Status	Contents
PAO	At initialization	Rotational serial data Initial incremental pulses
	Normal Operations	Incremental pulses
PBO	At initialization	Initial incremental pulses
	Normal Operations	Incremental pulses
PCO	Always	Origin pulses

■ Phase-C Output Specifications

The pulse width of phase C (origin pulse) changes depending on the encoder output pulse (Pn212), becoming the same width as phase A.

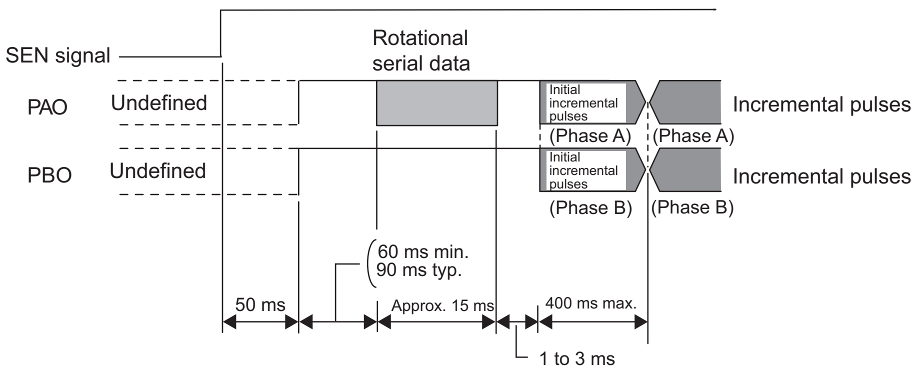
The output timing is one of the following.

- Synchronized with the rising edge of phase A
- Synchronized with the falling edge of phase A
- Synchronized with the rising edge of phase B
- Synchronized with the falling edge of phase B

Note: When host controller receives the data of absolute encoder, do not perform counter reset using the output of PCO signal.

(2) Absolute Data Reception Sequence

1. Set the SEN signal at ON (high level).
2. After 100 ms, the system is set to rotational serial data reception standby and the incremental pulse up/down counter is cleared to zero.
3. Eight characters of rotational serial data is received.
4. The system enters a normal incremental operation state about 400 ms after the last rotational serial data is received.



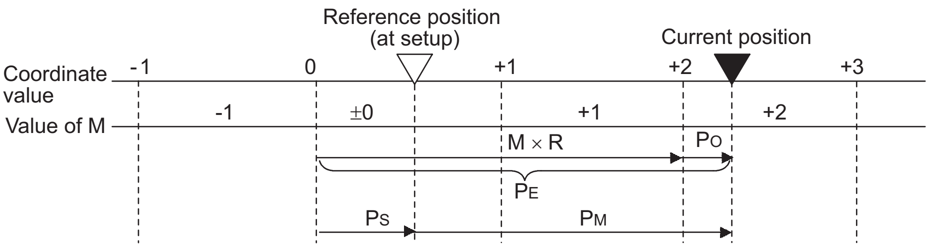
Note: The output pulses are phase-B advanced if the servomotor is turning forward regardless of the setting in Pn000.0.

Rotational serial data:
Indicates how many turns the motor shaft has made from the reference position, which was the position at setup.

Initial incremental pulses:
The initial incremental pulses that provide absolute data is the number of pulses required to rotate the motor shaft from the servomotor origin to the present position. Just as with normal incremental pulses, these pulses are divided by the dividing circuit inside the multi-winding drive unit and then output.

The initial incremental pulse speed depends on the setting of the encoder output pulses (Pn212). Use the following formula to obtain the initial incremental pulse speed.

Setting of the Encoder Output Pulses (Pn212)	Formula of the Initial Incremental Pulse Speed
16 to 16384	$\frac{680 \times Pn212}{16384}$ [kpps]
16386 to 32768	$\frac{680 \times Pn212}{32768}$ [kpps]
32772 to 65536	$\frac{680 \times Pn212}{65536}$ [kpps]
65544 to 131072	$\frac{680 \times Pn212}{131072}$ [kpps]
131088 to 262144	$\frac{680 \times Pn212}{262144}$ [kpps]



Final absolute data P_M is calculated by following formula.

$P_E = M \times R + P_O$

$P_S = M_S \times R + P_S'$

$P_M = P_E - P_S$

Signal	Meaning
P_E	Current value read by encoder
M	Rotational serial data
P_O	Number of initial incremental pulses
P_S	Absolute data read at setup (This is saved and controlled by the host controller.)
M_S	Rotational serial data read at setup
P_S'	Number of initial incremental pulses read at setup
P_M	Current value required for the user’s system
R	Number of pulses per encoder revolution (pulse count after dividing, value of Pn212)

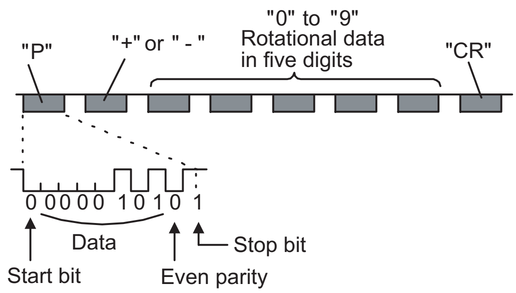
Note: The following formula applies in reverse mode. (Pn000.0 = 1)

$P_E = -M \times R + P_O$
$P_S = M_S \times R + P_S'$
$P_M = P_E - P_S$

(3) Rotational Serial Data Specifications and Initial Incremental Pulses

■ Rotational Serial Data Specifications

The rotational serial data is output from PAO signal.

Data Transfer Method	Start-stop Synchronization (ASYNC)
Baud rate	9600 bps
Start bits	1 bit
Stop bits	1 bit
Parity	Even
Character code	ASCII 7-bit code
Data format	8 characters, as shown below.  Note 1. Data is "P+00000" (CR) or "P-00000" (CR) when the number of revolutions is zero. 2. The revolution range is "-32768" to "+32767". When this range is exceeded, the data changes from "+32767" to "-32678" or from "-32678" to "+32767". When changing multiturn limit, the range changes. For details, refer to *5.9.6 Multiturn Limit Setting*.

■ Initial Incremental Pulses

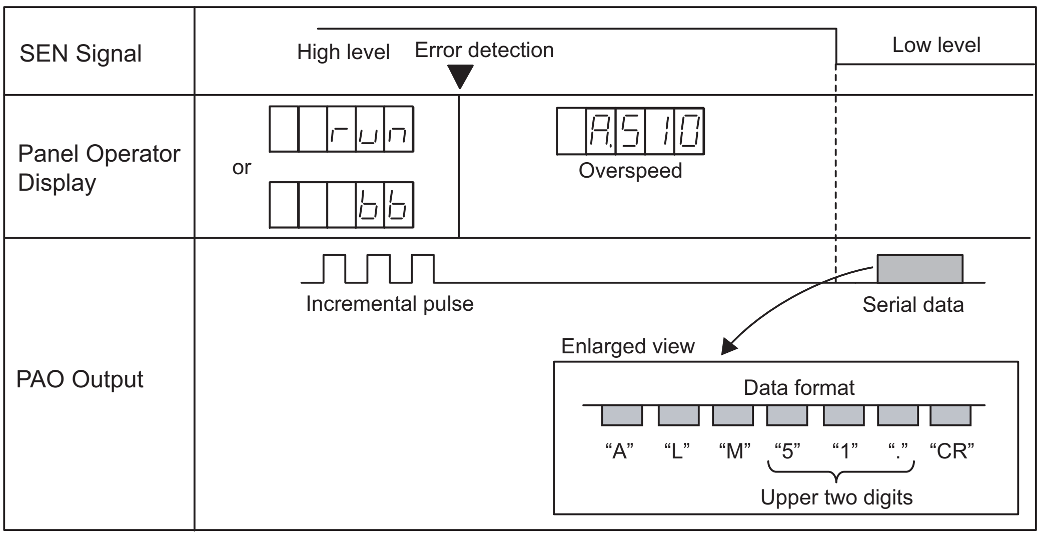
The initial incremental pulses are output after division inside the multi-winding drive unit in the same way as for normal incremental pulses. Refer to *5.3.6 Encoder Output Pulses* for details.

(4) Transferring Alarm Contents

If an absolute encoder is used, the contents of alarms detected by the multi-winding drive unit are transmitted in serial data to the host controller from the PAO output when the SEN signal changes from high level to low level.

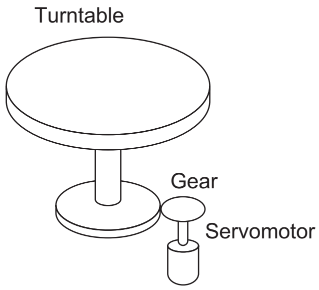
Note: The SEN signal cannot be OFF while the servomotor power is ON.

Output example of alarm contents are as shown below.



5.9.6 Multiturn Limit Setting

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



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

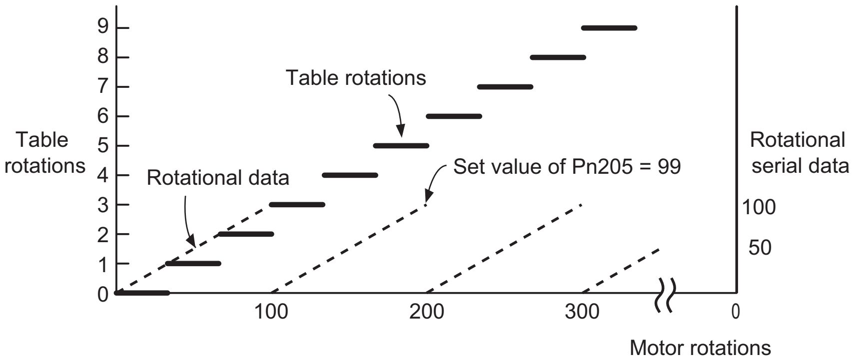
For a machine with a gear ratio of n:m, as shown above, the value of m minus 1 will be the setting for the multiturn limit setting (Pn205).

Multiturn limit setting (Pn205) = m-1

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

Pn205 is set to 99.

Pn205 = 100 – 1 = 99



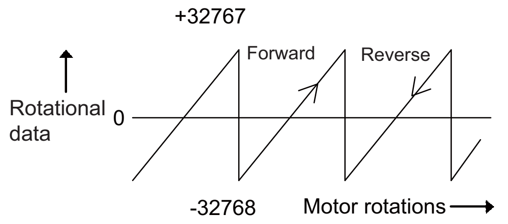
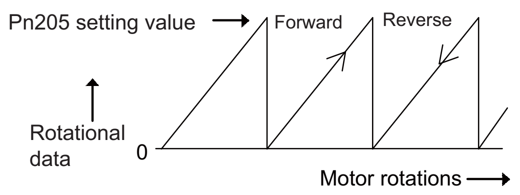
Pn205	Multiturn Limit Setting Speed Position Torque				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 65535	1 Rev	65535	After restart	Setup

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

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

1. When the motor rotates in the reverse direction with the rotational data at 0, the rotational data will change to the setting of Pn205.
2. When the motor rotates in the forward direction with the rotational data at the Pn205 setting, the rotational data will change to 0.

Set the value, the desired rotational amount -1, to Pn205.

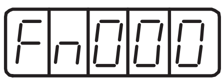
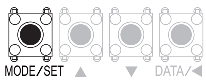
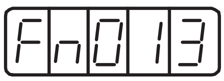
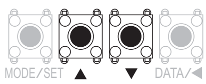
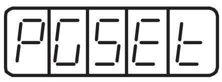
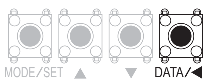
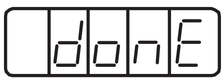
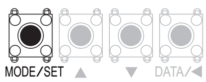
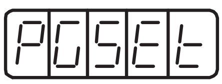
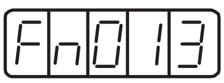
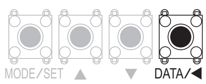
Factory Setting (= 65535)	Other Setting (≠65535)
	

5.9.7 Multiturn Limit Disagreement Alarm (A.CC0)

When the multiturn limit set value is changed with parameter Pn205, a multiturn limit disagreement alarm (A.CC0) will be displayed because the value differs from that of the encoder.

Alarm Display	Alarm Name	Alarm Code Output			Meaning
		ALO1	ALO2	ALO3	
A.CC0	Multiturn Limit Disagreement	ON (L)	OFF (H)	ON (L)	Different multiturn limits have been set in the encoder and the multi-winding drive unit.

If this alarm is displayed, perform the operation described below and change the multiturn limit value in the encoder to the value set in Pn205.

Step	Display after Operation	Keys	Operation
1			Press the MODE/SET Key to select the utility function.
2			Press the UP or DOWN Key to select Fn013.
3			Press the DATA/SHIFT Key for approximately one second. "PGSEt" appears.
4			Press the MODE/SET Key. The value of the multiturn limit setting in the absolute encoder will be the same as the value of Pn205. When the setting is completed, "donE" flashes for approximately one second.
5		–	Then, "donE" changes to "PGSEt".
6			Press the DATA/SHIFT Key for approximately one second. "Fn013" is displayed again.
7	To enable the new setting, turn the control power supply OFF and ON again.		

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5.10 Other Output Signals

This section explains other output signals.

Use these signals according to the application needs, e.g., for machine protection.

5.10.1 Servo Alarm Output Signal (ALM) and Alarm Code Output Signals (ALO1, ALO2, and ALO3)

This section describes signals that are output when the multi-winding drive unit detects errors and the resetting methods for those errors.

(1) Servo Alarm Output Signal (ALM)

This signal is output when the multi-winding drive unit detects an error.

IMPORTANT

Configure an external circuit so that this alarm output turns OFF the main circuit power supply to the SERVOPACK and converter whenever an error occurs.

Type	Signal Name	Connector Pin Number	Setting	Meaning
Output	ALM	CN1-31, 32	ON (closed)	Normal status
			OFF (open)	Alarm status

(2) Alarm Code Output Signals (ALO1, ALO2, and ALO3)

The ON/OFF combination of these signals specifies the type of alarm detected by the multi-winding drive unit.

Use these signals as required to display the contents of the alarm at the host controller.

For details, refer to *9.1.1 List of Alarms*.

Type	Signal Name	Connector Pin Number	Meaning
Output	ALO1	CN1-37	Alarm code output
	ALO2	CN1-38	Alarm code output
	ALO3	CN1-39	Alarm code output
	SG	CN1-1	Signal ground for alarm code output

(3) Alarm Reset Method

If a servo alarm (ALM) occurs, use one of the following methods to reset the alarm after eliminating the cause of the alarm.

The /ALM-RST signal will not always reset encoder-related alarms. If an alarm cannot be reset with /ALM-RST, cycle the control power supply.

IMPORTANT

Be sure to eliminate the cause of the alarm before resetting it.

If the alarm is reset and operation continued without eliminating the cause of the alarm, it may result in damage to the equipment or fire.

■ Resetting Alarms by Turning ON the /ALM-RST Signal

Type	Signal Name	Connector Pin Number	Meaning
Input	/ALM-RST	CN1-44	Alarm reset

■ Resetting Alarms Using the Panel Operator

Simultaneously press the UP and the DOWN Keys on the panel operator. For details, refer to *2.1.1 Names and Functions*.

■ Resetting Alarms Using the Digital Operator

Press the ALARM RESET Key on the digital operator. For details, refer to *Σ-V Series User's Manual, Operation of Digital Operator* (No.: SIEP S800000 55).

5.10.2 Warning Output Signal (/WARN)

This signal is for a warning issued before the occurrence of an alarm.
Refer to *9.2.1 List of Warnings*.

(1) Signal Specifications

Type	Signal Name	Connector Pin Number	Setting	Meaning
Output	/WARN	Must be allocated	ON (closed)	Warning status
			OFF (open)	Normal status

Note: Use parameter Pn50F.3 to allocate the /WARN signal for use. For details, refer to *3.4.2 Output Signal Allocations*.

(2) Related Parameters

Set the output method for alarm codes in Pn001.3.

For details on alarm codes, refer to *(2) Alarm Code Output Signals (ALO1, ALO2, and ALO3)* of *5.10.1 Servo Alarm Output Signal (ALM) and Alarm Code Output Signals (ALO1, ALO2, and ALO3)*.

Parameter		Meaning	When Enabled	Classification
Pn001	n.0□□□	Outputs alarm codes alone for alarm codes ALO1, ALO2, and ALO3.	After restart	Setup
	n.1□□□	Outputs both alarm and warning codes for alarm codes ALO1, ALO2, and ALO3, and outputs an alarm code when an alarm occurs.		

For details on warning codes, refer to *9.2.1 List of Warnings*.

5.10.3 Rotation Detection Output Signal (/TGON)

This output signal indicates that the servomotor is rotating at the speed set for Pn502 or a higher speed.

(1) Signal Specifications

Type	Signal Name	Connector Pin Number	Setting	Meaning
Output	/TGON	CN1-27, 28 [Factory setting]	ON (closed)	Servomotor is rotating with the motor speed above the setting in Pn502.
			OFF (open)	Servomotor is rotating with the motor speed below the setting in Pn502.

Note: Use parameter Pn50E.2 to allocate the /TGON signal to another terminal. For details, refer to *3.4.2 Output Signal Allocations*.

(2) Related Parameter

Set the range in which the /TGON signal is output using the following parameter.

Pn502	Rotation Detection Level Speed Position Torque				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	1 to 10000	1 min^{-1}	20	Immediately	Setup

5.10.4 Servo Ready Output Signal (/S-RDY)

This signal is turned ON when the multi-winding drive unit is ready to accept the servo ON (/S-ON) signal.

The /S-RDY signal is turned ON under the following conditions.

- The main circuit power supply is ON.
- No hard wire base block state
- No servo alarms
- The SEN signal is ON at a high level. (When an absolute encoder is used.)

If an absolute encoder is used, the output of absolute data to the host controller must have been completed when the SEN signal is ON (high level) before /S-RDY is output.

For details on the hard wire base block function, refer to *5.11.1 Hard Wire Base Block (HWBB) Function*.

(1) Signal Specifications

Type	Signal Name	Connector Pin Number	Setting	Meaning
Output	/S-RDY	CN1-29, 30 [Factory setting]	ON (closed)	The multi-winding drive unit is ready to accept the servo ON signal.
			OFF (open)	The multi-winding drive unit is not ready to accept the servo ON signal.

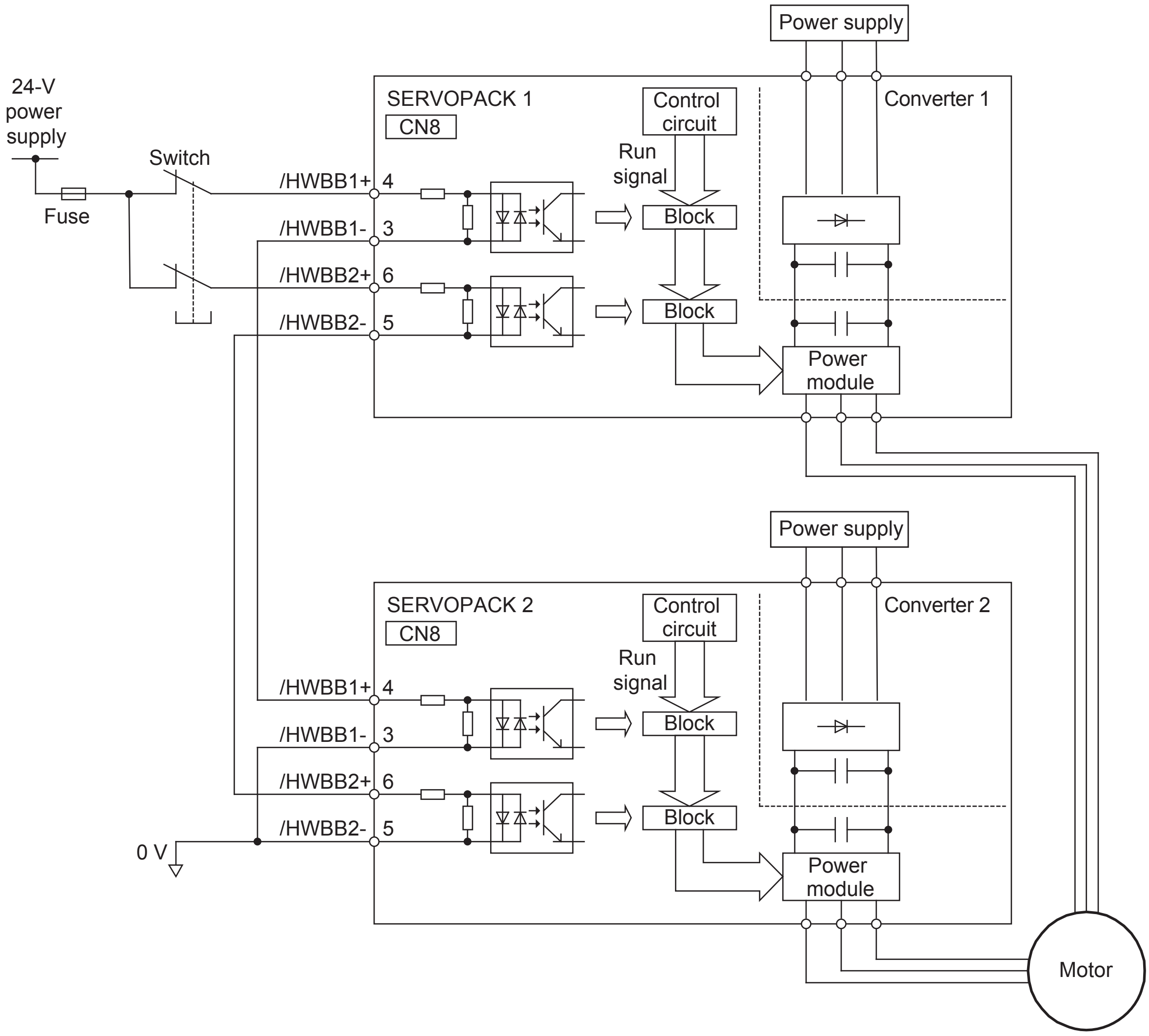
Note 1. Use parameter Pn50E.3 to allocate the /S-RDY signal to another terminal. For details, refer to *3.4.2 Output Signal Allocations*.
2. For details on the hard wire base block function and the servo ready output signal, refer to *5.11.1 Hard Wire Base Block (HWBB) Function*.

5.11 Safety Function

The safety function is incorporated in the multi-winding drive unit to reduce the risk associated with the machine by protecting workers from injury and by securing safe machine operation. Especially when working in hazardous areas inside the safeguard, as for machine maintenance, it can be used to avoid adverse machine movement.

5.11.1 Hard Wire Base Block (HWBB) Function

The Hard Wire Base Block function (hereinafter referred to as HWBB function) is a safety function designed to baseblock the servomotor (shut off the motor current) by using the hardwired circuits. Each circuit for two channel input signals blocks the run signal to turn off the power module that controls the motor current, and the motor current is shut off. (Refer to the diagram below.)



Note: For safety function signal connections, the input signal is the 0 V common and the output signal is the source output. This is the opposite of other signals described in this manual. To avoid confusion, the ON and OFF status of signals for safety functions are defined as follows:
ON: The state in which the relay contacts are closed or the transistor is ON and current flows into the signal line.
OFF: The state in which the relay contacts are open or the transistor is OFF and no current flows into the signal line.

(1) Risk Assessment

When using the HWBB function, be sure to perform a risk assessment of the servo system in advance. Make sure that the safety level of the standards is met. For details about the standards, refer to *Harmonized Standards* at the front of this manual.

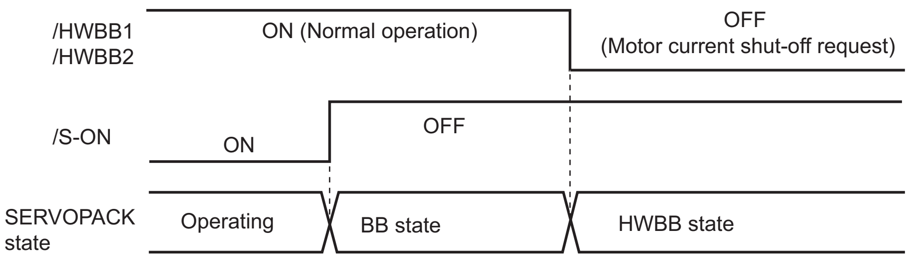
Note 1. Applications for certification are pending to show that SERVOPACKs comply with rules and regulations for North American and other safety standards, including those for safe performance.
2. To meet the performance level d (PLd) in EN ISO 13849-1, the EDM signal must be monitored by a host controller. If the EDM signal is not monitored by a host controller, the system only qualifies for the performance level c (PLc).

The following risks can be estimated even if the HWBB function is used. These risks must be included in the risk assessment.

- The servomotor will move in an application where external force is applied to the servomotor (for example, gravity on the vertical axis). Take measures to secure the servomotor, such as installing a mechanical brake.
- The servomotor may move within the electric angle of 180 degrees in case of the power module failure, etc. Make sure that safety is ensured even in that situation.
  The maximum motor rotation angle is 1/6 of a rotation (This is the converted rotation angle for the motor shaft).
- The HWBB function does not shut off the power to the SERVOPACK and converter or electrically isolate them. Take measures to shut off the power to the SERVOPACK and converter before performing maintenance on them.

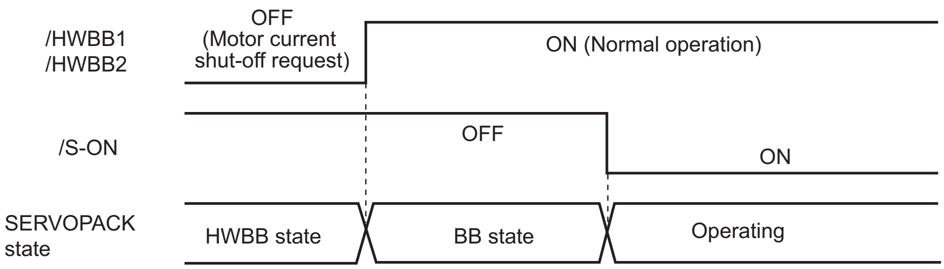
(2) Hard Wire Base Block (HWBB) State

The SERVOPACK will be in the following state if the HWBB function operates. If the /HWBB1 or /HWBB2 signal is OFF, the HWBB function will operate and the SERVOPACK will enter a hard wire baseblock (HWBB) state.



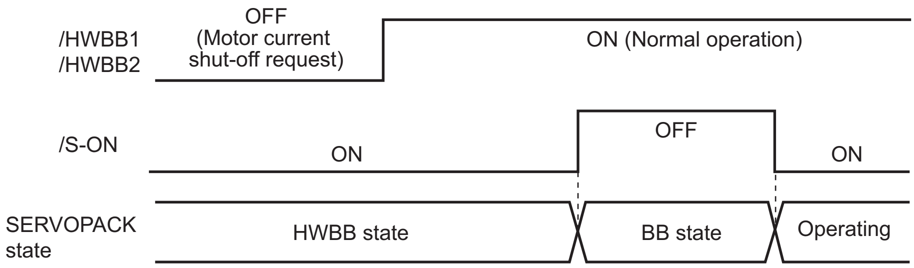
(3) Resetting the HWBB State

Usually after the servo ON signal (/S-ON) is turned OFF, the SERVOPACK will then enter a hard wire baseblock (HWBB) state with the /HWBB1 and /HWBB2 signals turned OFF. By then turning the /HWBB1 and /HWBB2 signals ON in this state, the SERVOPACK will enter a baseblock (BB) state and can accept the servo ON signal.



If the /HWBB1 and /HWBB2 signals are OFF and the servo ON signal is ON, the HWBB state will be maintained after the /HWBB1 and /HWBB2 signals are turned ON.

Turn OFF the servo ON signal, and the SERVOPACK is placed in a BB state. Then turn ON the servo ON signal again.



Note 1. If the SERVOPACK is placed in a BB state with the main power supply turned OFF, the HWBB state will be maintained until the servo ON signal is turned OFF.
2. The HWBB state cannot be reset if the servo ON signal is set to be constantly enabled in the servo ON signal allocation (Pn50A.1). Do not make this setting if the HWBB function is being used.

(4) Error Detection in HWBB Signal

If only the /HWBB1 or /HWBB2 signal is input, an A.Eb1 alarm (Safety Function Signal Input Timing Error) will occur unless the other signal is input within 10 seconds. This makes it possible to detect failures, such as disconnection of the HWBB signals.

⚠ CAUTION

- The safety function signal input timing error alarm (A.Eb1) is not a safety-related part of a control system. Keep this in mind in the system design.

(5) Connection Example and Specifications of Input Signals (HWBB Signals)

The input signals must be redundant. A connection example and specifications of input signals (HWBB signals) are shown below.

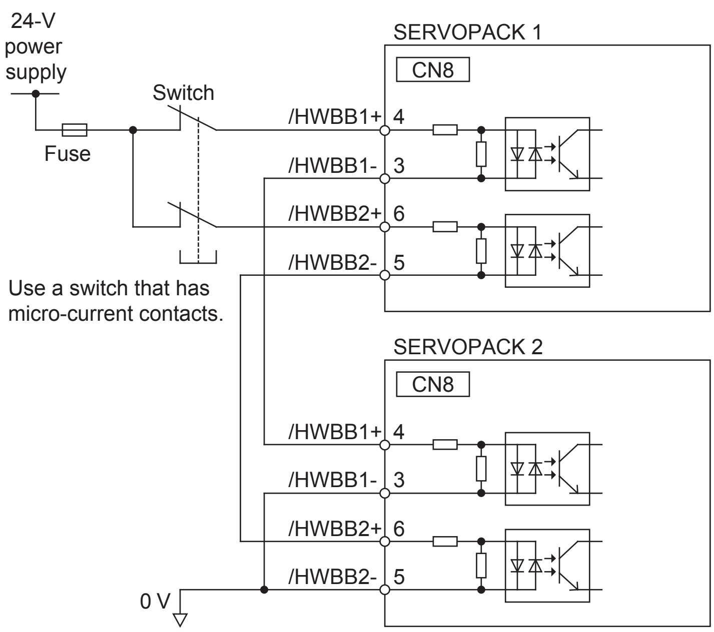
IMPORTANT

For safety function signal connections, the input signal is the 0 V common and the output signal is the source output. This is opposite to other signals described in this manual. To avoid confusion, the ON and OFF status of signals for safety functions are defined as follows:

ON: The state in which the relay contacts are closed or the transistor is ON and current flows into the signal line.

OFF: The state in which the relay contacts are open or the transistor is OFF and no current flows into the signal line.

■ Connection Example



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■ Specifications

Type	Signal Name	Connector Pin Number	Setting	Meaning
Input	/HWBB1	CN8-4 CN8-3	ON (closed)	Does not use the HWBB function. (normal operation)
			OFF (open)	Uses the HWBB function. (motor current shut-off request)
	/HWBB2	CN8-6 CN8-5	ON (closed)	Does not use the HWBB function. (normal operation)
			OFF (open)	Uses the HWBB function. (motor current shut-off request)

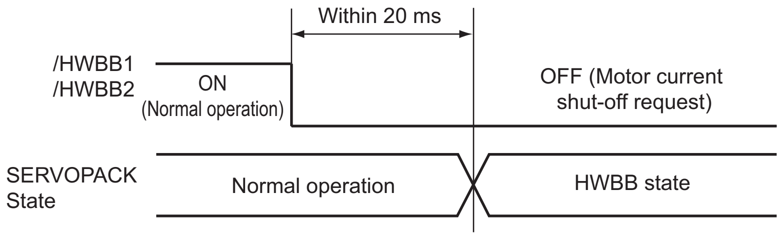
The input signals (HWBB signals) have the following electrical characteristics.

Items	Characteristics	Remarks
Internal Impedance	3.3 kΩ	–
Operation Movable Voltage Range	+11 V to + 25 V	–
Maximum Delay Time	20 ms	Time from the /HWBB1 and /HWBB2 signals are OFF to the HWBB function operates.

IMPORTANT

When using the HWBB function, always use a 24-VDC power supply for the DC power.

If the HWBB function is requested by turning OFF the /HWBB1 and /HWBB2 input signals on the two channels, the power supply to the servomotor will be turned OFF within 20 ms (see below).



Note 1. The OFF status is not recognized if the total OFF time of the /HWBB1 and /HWBB2 signals is 0.5 ms or shorter.
2. The status of the input signals can be checked using monitor displays. Refer to *8.6 Monitoring Safety Input Signals*.

(6) Operation with Utility Functions

The HWBB function works while the SERVOPACK operates in the utility function.

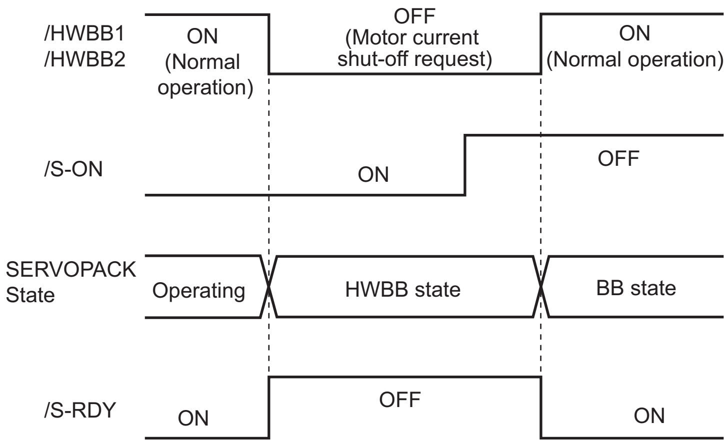
If any of the following utility functions is being used with the /HWBB1 and /HWBB2 signals turned OFF, the SERVOPACK cannot be operated by turning ON the /HWBB1 and /HWBB2 signals. Cancel the utility function first, and then set the SERVOPACK to the utility function again and restart operation.

- JOG operation (Fn002)
- Origin search (Fn003)
- Program JOG operation (Fn004)
- Advanced autotuning (Fn201)
- EasyFFT (Fn206)
- Automatic offset-signal adjustment of motor current detection signal (Fn00E)

(7) Servo Ready Output (/S-RDY)

The servo ON (/S-ON) signal will not be accepted in the HWBB state. Therefore, the servo ready output will turn OFF. The servo ready output will turn ON if the servo ON signal is turned OFF (set to BB state) when both the /HWBB1 and /HWBB2 signals are ON.

The following diagram shows an example where the main circuit power supply is turned ON, the SEN signal is turned ON (with an absolute encoder), and no servo alarm occurs.



(8) Brake Signal (/BK)

When the /HWBB1 or /HWBB2 signal is OFF and the HWBB function operates, the brake signal (/BK) will turn OFF. At that time, Pn506 (brake reference - servo OFF delay time) will be disabled. Therefore, the servomotor may be moved by external force until the actual brake becomes effective after the brake signal (/BK) turns OFF.

⚠ CAUTION

- The brake signal is not a safety-related part of a control system. Be sure to design the system so that the system will not be put into danger if the brake signal fails in the HWBB state. Moreover, if a servomotor with a brake is used, keep in mind that the brake for the servomotor is used only to prevent the movable part from being moved by gravity or an external force and it cannot be used to brake the servomotor.

(9) Dynamic Brake

If the dynamic brake is enabled in Pn001.0 (Stopping Method for Servomotor after /S-ON Signal is Turned OFF), the servomotor will come to a stop under the control of the dynamic brake when the HWBB function works while the /HWBB1 or /HWBB2 signal is OFF.

⚠ CAUTION
• The dynamic brake is not a safety-related part of a control system. Be sure to design the system so that the system will not be put into danger if the servomotor coasts to a stop in the HWBB state. Usually, use a sequence in which the HWBB state occurs after the servomotor is stopped using the reference. • If the application frequently uses the HWBB function, do not use the dynamic brake to stop the servomotor. Otherwise element deterioration in the SERVOPACK and converter may result. To prevent internal elements from deteriorating, use a sequence in which the HWBB state occurs after the servomotor has come to a stop.

(10) Position Error Clear Setting

A position error in the HWBB state is cleared according to the setting in Pn200.2 for the clear operation selection.

If Pn200.2 is set to 1 (i.e., the position error is not cleared for position control), the position errors will be accumulated unless the position reference from the host controller is canceled in the HWBB state, and the following conditions may result.

- A position error overflow alarm (A.d00) occurs.
- If the servo is turned ON after changing from HWBB state to BB state, the servomotor will move for the accumulated position error.

Therefore, stop the position reference through the host controller while in HWBB state. If Pn200.2 is set to 1 (i.e., the position error is not cleared), input the clear (CLR) signal while in HWBB or BB state to clear the position error.

(11) Servo Alarm Output Signal (ALM) and Alarm Code Output Signals (ALO1, ALO2, and ALO3)

In the HWBB state, the servo alarm output signal (ALM) and alarm code output signals (AOL1, AOL2, and AOL3) are not sent.

5.11.2 External Device Monitor (EDM1)

The external device monitor (EDM1) functions to monitor failures in the HWBB function. Connect the monitor to feedback signals to the safety function device.

Note: To meet the performance level d (PLd) in EN ISO13849-1, the EDM signal must be monitored by a host controller. If the EDM signal is not monitored by a host controller, the system only qualifies for the performance level c (PLc).

■ Failure Detection Signal for EDM1 Signal

The relation of the EDM1, /HWBB1, and /HWBB2 signals is shown below.

Detection of failures in the EDM1 circuit can be checked using the following four status of the EDM1 signal in the table. Failures can be detected if the failure status can be confirmed, e.g., when the control power supply is turned ON.

Signal Name	Logic			
/HWBB1	ON	ON	OFF	OFF
/HWBB2	ON	OFF	ON	OFF
EDM1	OFF	OFF	OFF	ON

⚠ WARNING

- The EDM1 signal is not a safety output. Use it only for monitoring a failure.

(1) Connection Example and Specifications of EDM1 Output Signal

Connection example and specifications of EDM1 output signal are explained below.

IMPORTANT

For safety function signal connections, the input signal is the 0 V common and the output signal is the source output. This is opposite to other signals described in this manual. To avoid confusion, the ON and OFF status of signals for safety functions are defined as follows:

ON: The state in which the relay contacts are closed or the transistor is ON and current flows into the signal line.

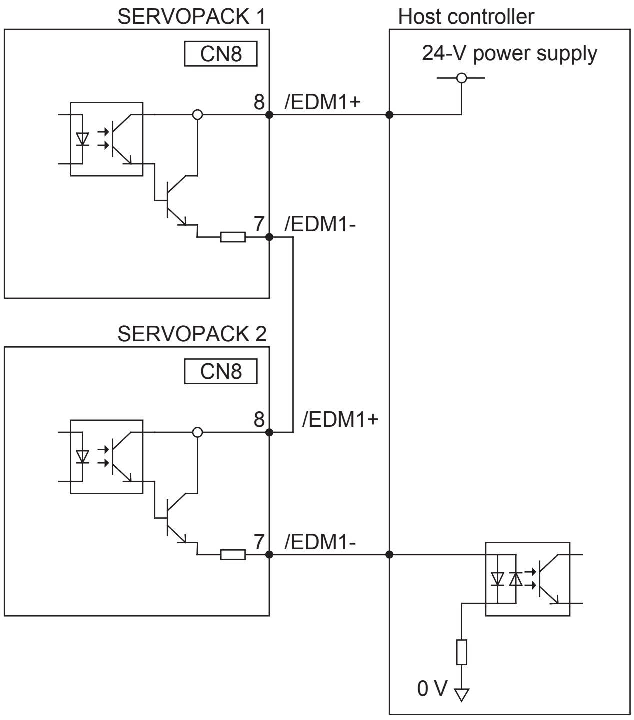
OFF: The state in which the relay contacts are open or the transistor is OFF and no current flows into the signal line.

Operation

5

■ Connection Example

EDM1 output signal is used for source circuit.



■ Specifications

Type	Signal Name	Connector Pin Number	Setting	Meaning
Output	EDM1	CN8-8 CN8-7	ON (closed)	Both the /HWBB1 and the /HWBB2 signals are working normally.
			OFF (open)	The /HWBB1 signal, the /HWBB2 signal or both are not working normally.

Electrical characteristics of EDM1 signal are as follows.

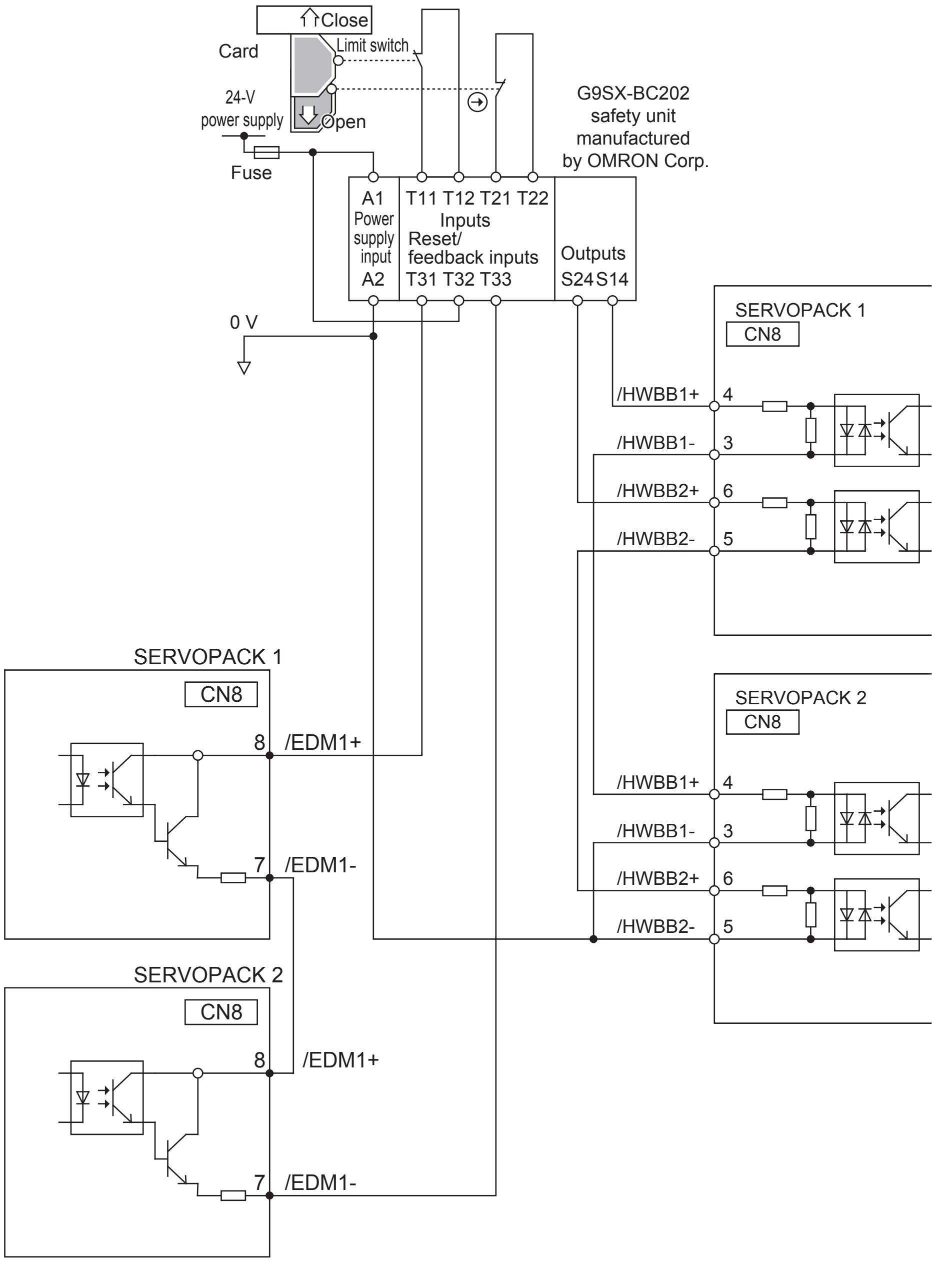
Items	Characteristics	Remarks
Maximum Allowable Voltage	30 VDC	–
Maximum Current	50 mADC	–
Maximum Voltage Drop at ON	1.0 V	Voltage between EDM1+ and EDM1- when current is 50 mA
Maximum Delay Time	20 ms	Time from the change in /HWBB1 or /HWBB2 until the change in EDM1

5.11.3 Application Example of Safety Functions

An example of using safety functions is shown below.

(1) Connection Example

In the following example, a safety unit is used and the HWBB function operates when the guard opens.



When a guard opens, both of signals, the /HWBB1 and the /HWBB2, turn OFF, and the EDM1 signal turns ON. Since the feedback is ON when the guard closes, the safety unit is reset, and the /HWBB1 and the / HWBB2 signals turn ON, and the operation becomes possible.

Note: The EDM1 signal is used as a sourcing output. Connect the EDM1 so that the current flows from EMD1+ to EMD1-.

(2) Failure Detection Method

In case of a failure such as the /HWBB1 or the /HWBB2 signal remains ON, the safety unit is not reset when the guard closes because the EDM1 signal keeps OFF. Therefore starting is impossible, then the failure is detected.

In this case, an error in the external device, disconnection or short-circuiting of the external wiring, or a failure in the SERVOPACK or converter must be considered. Find the cause and correct the problem.

Operation

5

(3) Procedure

1	Request to open the guard.
2	When the servomotor is operating, the host controller stops the servomotor and turns OFF the Servo ON signal (/S-ON).
3	Open the guard and enter.
4	The /HWBB1 and /HWBB2 signals are OFF and HWBB function operates. (The operation in the guard is available.)
5	After completing the operation, leave and close the guard.
6	Turn ON the /S-ON signal from the host controller.

5.11.4 Confirming Safety Functions

When starting the equipment or replacing the SERVOPACK or converter for maintenance, be sure to conduct the following confirmation test on the HWBB function after wiring.

- When the /HWBB1 and /HWBB2 signals turn OFF, check that the panel operator or digital operator displays "Hbb" and that the servomotor does not operate.
- Check the ON/OFF states of the /HWBB1 and /HWBB2 signals with Un015.
  → If the ON/OFF states of the signals do not coincide with the display, an error in the external device, disconnection or short-circuiting of the external wiring, or a failure in the SERVOPACK or converter must be considered. Find the cause and correct the problem. For details, refer to *8.7 Monitor Display at Power ON*.
- Check with the display of the feedback circuit input of the connected device to confirm that the EDM1 signal is OFF while in normal operation.

5.11.5 Precautions for Safety Functions

⚠ WARNING

- To check that the HWBB function satisfies the safety requirements of the system, be sure to conduct a risk assessment of the system.
  Incorrect use of the machine may cause injury.
- The servomotor rotates if there is external force (e.g., gravity in a vertical axis) when the HWBB function is operating. Therefore, use an appropriate device independently, such as a mechanical brake, that satisfies safety requirements.
  Incorrect use of the machine may cause injury.
- While the HWBB function is operating, the motor may rotate within an electric angle of 180° or less as a result of failure of the SERVOPACK or converter. Use the HWBB function for applications only after checking that the rotation of the motor will not result in a dangerous condition.
  Incorrect use of the machine may cause injury.
- The dynamic brake and the brake signal are not safety-related parts of a control system. Be sure to design the system that these failures will not cause a dangerous condition when the HWBB function operates.
  Incorrect use of the machine may cause injury.
- Connect devices meeting safety standards for the signals for safety functions.
  Incorrect use of the machine may cause injury.
- The HWBB function does not shut off the power to the SERVOPACK and converter or electrically isolate it. Take measures to shut off the power to the SERVOPACK and converter when performing maintenance on it.
  Failure to observe this warning may cause an electric shock.

6

Adjustments

6.1 Type of Adjustments and Basic Adjustment Procedure

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

6.1.1 Adjustments

Adjustments (tuning) are performed to optimize the responsiveness of the multi-winding drive unit.

The responsiveness is determined by the servo gain that is set in the multi-winding drive unit.

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 cases, it is possible to suppress the vibration with a variety of vibration suppression functions in the multi-winding drive unit.

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.

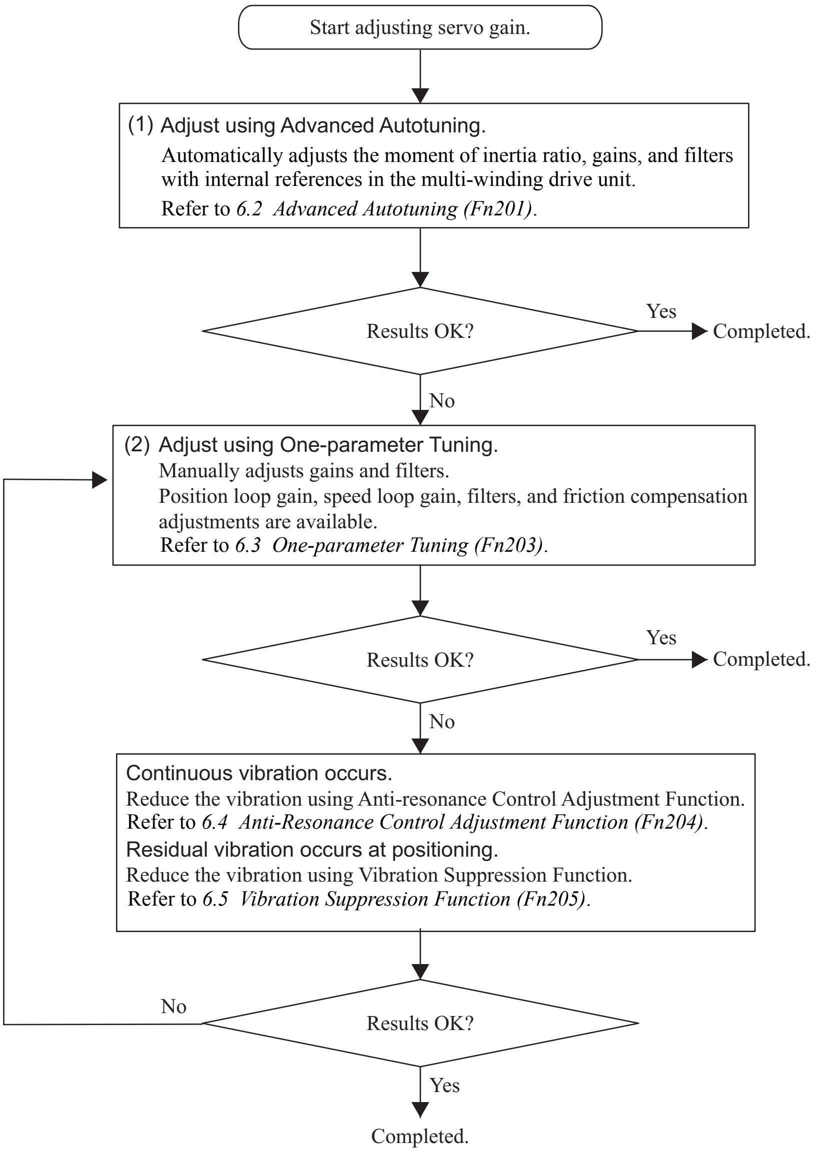
This section describes the following utility adjustment functions.

Utility Function for Adjustment	Outline	Applicable Control Method	Tool*		
			Digital Operator	Panel Operator	SigmaWin+
Advanced Autotuning (Fn201)	Automatic operation is performed with internal references in the multi-winding drive unit to automatically adjust the moment of inertia ratio.	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	○	Δ	○
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	○	×	○

* ○: Available
Δ: Can be used but functions are limited.
×: Not available

6.1.2 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.



6.1.3 Monitoring Operation during Adjustment

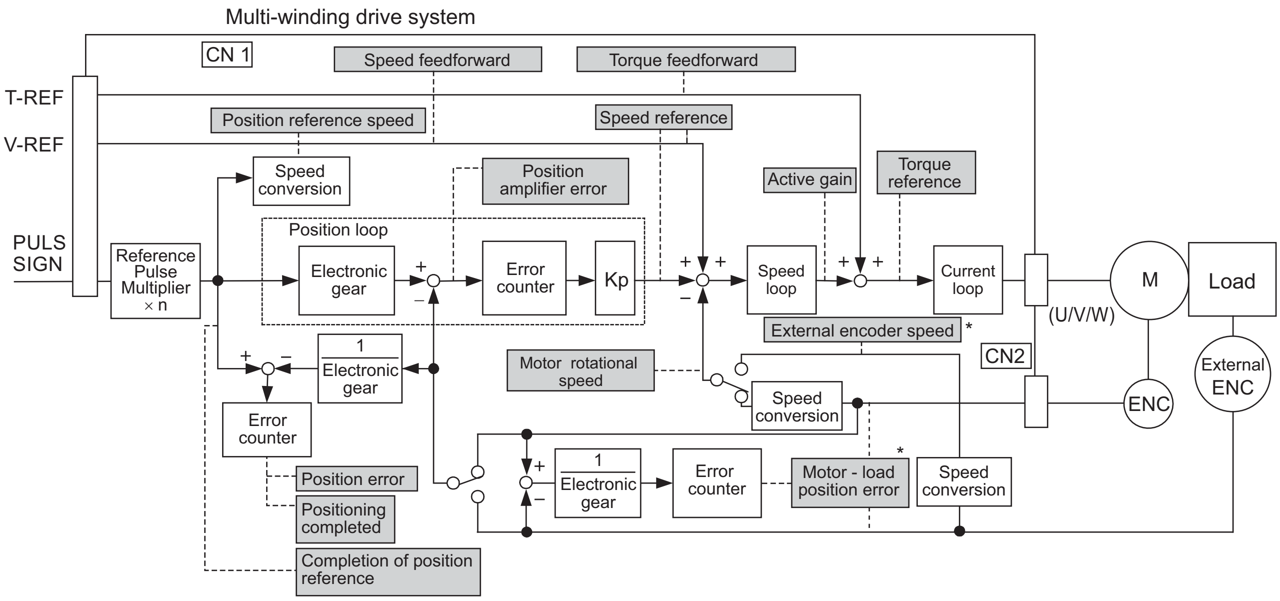
Check the operating status of the machine and signal waveform when adjusting the servo gain. Connect a measuring instrument, such as a memory recorder, to an analog monitor connector on the multi-winding drive unit to monitor the analog signal waveform.
The settings and parameters for monitoring analog signals are described in the following sections.

(1) Analog Monitor Connector Connections

Connector Pin No.	Signal Name	Factory Setting
CN1-16	Analog monitor 1 (TMON)	Torque reference: 1 V/100% rated torque
CN1-17	Analog monitor 2 (VTG-M)	Motor speed: 1 V/1000 min^{-1}
CN1-1	Signal ground (SG)	Analog monitor GND: 0 V

(2) Monitor Signal

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



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}	–
	n.□□01	Speed reference	1 V/1000 min^{-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}	The input reference pulses will be multiplied by n to output the position reference speed.
	n.□□06	Reserved (Do not use.)	–	–
	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}	–
	n.□□0A	Torque feedforward	1 V/100% rated torque	–
	n.□□0B	Active gain *	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

* Refer to *6.6.1 Switching Gain Settings* for details.

(3) Setting Monitor Factor

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

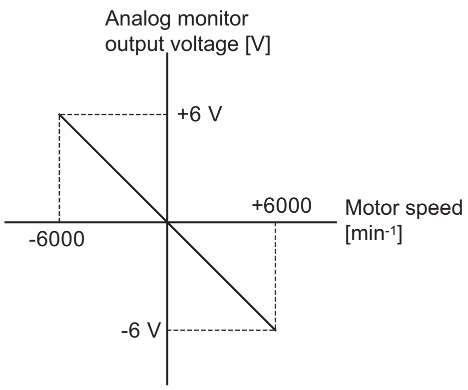
Analog monitor 1 output voltage = (-1) × (Signal selection (Pn006=n.00□□) × Multiplier (Pn552) + Offset voltage [V] (Pn550))

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

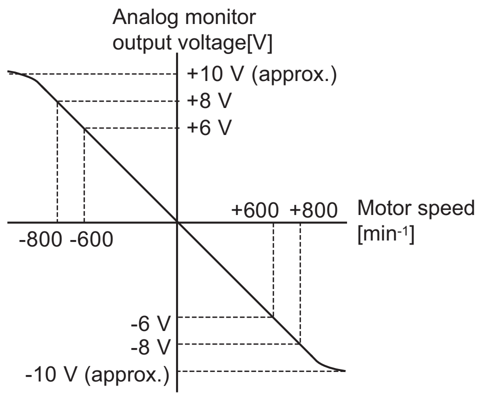
<Example>

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

6.1.4 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 multi-winding drive unit 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 multi-winding drive unit 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 *5.2.3 Overtravel*.

(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 *5.8 Limiting Torque*.

(3) Excessive Position Error Alarm Level

The excessive position error alarm is a protective function that will be enabled when the multi-winding drive unit is used in position control.

If this alarm level is set to a suitable value, the multi-winding drive unit 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 *5.4.4 Electronic Gear*.
∗2. When model following control is enabled (Pn140 is set to n.□□□1), use the set value of Pn141 and not that of Pn102.
∗3. To check the Pn102 setting, change the parameter display setting to display all parameters (Pn00B.0 = 1).
∗4. At the end of the equation, a coefficient is shown as "× (1.2 to 2)." This coefficient is used to add a margin that prevents a position error overflow alarm (A.d00) from occurring in actual operation of the servomotor.

Set the level to a value that satisfies these equations, and no position error overflow alarm (A.d00) will be generated during normal operation.

The servomotor will be stopped, however, if it does not operate according to the reference and the multi-winding drive unit detects an excessive position error.

The following calculation example is for a motor with a maximum motor speed of 2,000 and an encoder resolution of 1,048,576 (20 bits). The following settings are used: Pn102 = 400 and Pn210/Pn20E = 1/1.

$$\text{Pn520} = \frac{2000}{60} \times \frac{1048576}{400/10} \times \frac{1}{1} \times 2$$

$$= 873813.3 \times 2$$

$$= 1747627$$

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 *7.13 Vibration Detection Level Initialization (Fn01B)*.

(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* and take the corrective actions.

6.2 Advanced Autotuning (Fn201)

With advanced tuning for the multi-winding drive system, adjustment is performed only for moment of inertia calculation.

6.2.1 Calculating the Moment of Inertia

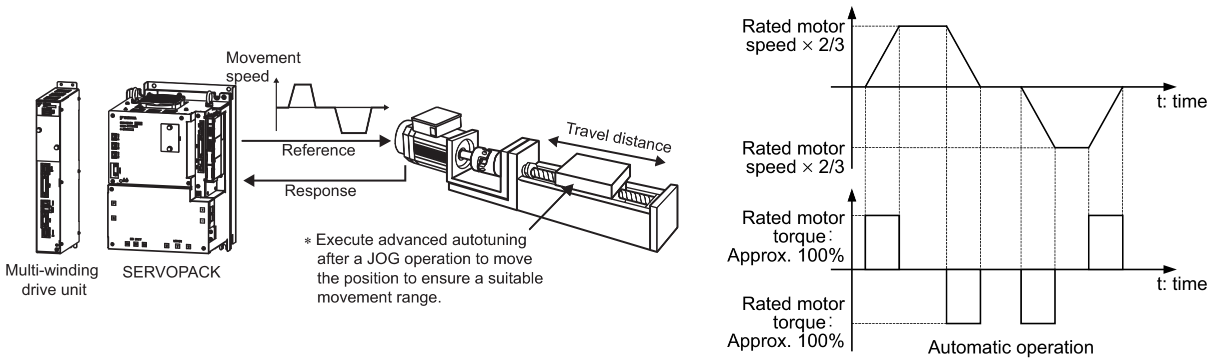
To calculate the load moment of inertia, the multi-winding drive unit and SERVOPACKs perform automatic operation (reciprocal forward and reverse operation) and the moment of inertia is calculated during operation.

The parameter that sets the moment of inertia ratio (ratio of the load moment of inertia to the motor moment of inertia) forms a standard for adjusting the gain, and therefore must be set as accurately as possible.

The load moment of inertia can be calculated from the mass and composition of the mechanical section, but doing so is troublesome and accurate calculation has become difficult with the complexity of current mechanical compositions. You can use this calculation function to get a highly accurate load moment of inertia simply by driving the actual motor in forward and reverse a few times.

The following automatic operation specifications apply.

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



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

(1) Preparation

Check the following settings before performing advanced autotuning.
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 servo ON signal (/S-ON) must be OFF.
- The control method must not be set to torque control.
- The gain selection switch must be in manual switching mode (Pn139.0 = 0).
- Gain setting 1 must be selected.
- All alarms and warning must be cleared.
- The hardwire baseblock (HWBB) must be disabled.
- The write prohibited setting parameter (Fn010) must be set to Write permitted (P.0000).

(2) When Advanced Autotuning Cannot Be Performed

Advanced autotuning cannot be performed normally under the following conditions. Make adjustments using one-parameter tuning (Fn203).

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

One-parameter Tuning (Fn203): Refer to *6.3 One-parameter Tuning (Fn203)*.

(3) When Advanced Autotuning Cannot Be Performed Successfully

The moment of inertia cannot be calculated successfully under the following conditions. Make adjustments using one-parameter tuning (Fn203).

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

  Note: If a setting is made for calculating the moment of inertia, an error will result when P control operation is selected using /P-CON signal while the moment of inertia is being calculated.
- The mode switch is used.

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

One-parameter Tuning (Fn203): Refer to *6.3 One-parameter Tuning (Fn203)*.

6.2.2 Procedure for Calculating the Moment of Inertia

The procedure to calculate the moment of inertia is given below.

Moment of inertia calculation is performed from the digital operator (optional) or SigmaWin+.

The procedure from the digital operator is described here.

During execution, you cannot change Pn103 (Moment of Inertia Ratio) from the SigmaWin+ or by any other means.

(1) Operating Procedure

Step	Display after Operation	Keys	Operation
1	BB —FUNCTION— Fn01E:SvMotOp ID Fn201:Jcalc Fn203:OnePrm Tun Fn204:A−Vib Sup	MODE/SET ∧ ∨	Press the MODE/SET Key to view the main menu for the utility function mode. Use the ∧ or ∨ Key to move through the list, and select Fn201.
2	Status Display BB Advanced AT Stroke=+00800000 (0003.0)rev	DATA	Press the DATA Key to display the initial setting screen for Fn201 (Advanced Autotuning). Only the moment of inertia calculation can be used.
3	BB Advanced AT Stroke=+00800000 (0003.0)rev	∧ ∨	Press the ∧ or ∨ Key and set the items in step 3-1.

(cont'd)

Step	Display after Operation	Keys	Operation
3-1	■ STROKE (Travel Distance) Setting The travel distance setting range is from -99,990,000 to +99,990,000 [reference units]. Specify the STROKE (travel distance) in increments of 1,000 reference units. The negative (-) direction is for reverse rotation, and the positive (+) direction is for forward rotation. Initial value: About 3 rotations Note 1. Set the number of motor rotations to at least 0.5. If you do not, "Error" will be displayed and the travel distance cannot be set. 2. To calculate the moment of inertia accurately, it is recommended to set the number of motor rotations to around 3.		
4	RUN Advanced AT Pn103=00100	DATA	Press the DATA Key. The moment of inertia ratio calculation execution screen will be displayed.
5	RUN Advanced AT Pn103=00100	JOG SVON	Press the JOG SVON Key. The servomotor power will be turned ON and the display will change from "BB" to "RUN."
6	ADJ —FUNCTION— Pn103=00300 Display example: After the moment of inertia is calculated.	∧ ∨	The moment of inertia is calculated. 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 will be displayed. The servomotor will remain ON, but the auto run operation will be stopped temporarily. Note: • If the wrong key (i.e., ∧ or ∨ Key) is pressed for the set STROKE (travel direction), 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	BB —FUNCTION— Fn01E:SvMotOp ID Fn201:AAT Fn203:OnePrm Tun Fn204:A-Vib Sup	DATA MODE/SET	After the servomotor is temporarily stopped, press the DATA Key to save the calculated moment of inertia ratio in the multi-winding drive unit. "DONE" will flash for one second, and "ADJ" will be displayed again. Press the MODE/SET Key to end the operation.
8	Turn the control power supply OFF and ON again.		

(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 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 multi-winding drive unit 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 and execute the calculation with the Jcalc set to OFF.
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 with the /P-CON input.	Operate the multi-winding drive unit with PI control while calculating the moment of inertia.

6.3 One-parameter Tuning (Fn203)

Adjustments with one-parameter tuning are described below.

6.3.1 One-parameter Tuning

One-parameter tuning is used to manually make tuning level adjustments during operation with a position reference or speed reference input from the host controller.

One-parameter tuning enables automatically setting related servo gain settings to balanced conditions by adjusting one or two tuning levels.

One-parameter tuning performs the following adjustments.

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

Refer to *6.3.4 Related Parameters* for parameters used for adjustments.

Perform one-parameter tuning if satisfactory response characteristics is not obtained with advanced autotuning or advanced autotuning by reference.

To fine-tune each servo gain after one-parameter tuning, refer to *6.6 Additional Adjustment Function*.

⚠ CAUTION
• Vibration or overshooting may occur during adjustment. To ensure safety, perform one-parameter tuning in a state where the multi-winding drive unit can come to an emergency stop at any time.

■ Preparation

Check the following settings before performing one-parameter tuning.
The message “NO-OP” indicating that the settings are not appropriate will be displayed, if all of the following conditions are not met.

- The test without a motor function must be disabled (Pn00C.0 = 0).
- The write prohibited setting parameter (Fn010) must be set to Write permitted (P.0000).
- The tuning-less function must be disabled (Pn170.0 = 0).
- The tuning mode must be set to 0 or 1 when performing speed control.
- The main circuit power must be ON.
- All alarms must be cleared.
- The hardwire baseblock (HWBB) must be disabled.

6.3.2 One-parameter Tuning Procedure

The following procedure is used for one-parameter tuning.

There are the following two operation procedures depending on the tuning mode being used.

• When the tuning mode is set to 0 or 1, the model following control will be disabled and one-parameter tuning will be used as the tuning method for applications other than positioning.
• When the tuning mode is set to 2 or 3, the model following control will be enabled and it can be used for tuning for positioning.

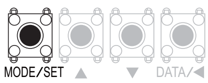
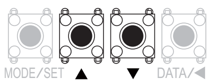
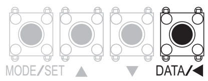
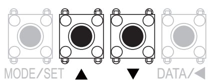
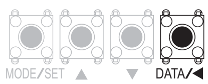
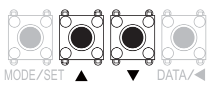
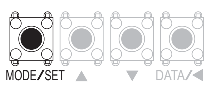
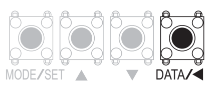
One-parameter tuning is performed from the panel operator, digital operator (option), or SigmaWin+.

Only tuning modes 0 and 1 can be selected from the panel operator. Make sure that the moment of inertia ratio (Pn103) is set correctly using advance autotuning before beginning operation.

The following section provides the operating procedure from the panel operator and digital operator.

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.

(1) Panel Operator Operating Procedure

Step	Display after Operation	Keys	Operation
1	Fn000		Press the MODE/SET Key to select the utility function mode.
2	Fn203		Press the UP or DOWN Key to move through the list and select Fn203.
3	d 0		Press the DATA/SHIFT Key for approximately one second. The screen shown on the left will be displayed.
4	d 0 ↓ ↑ d 1		Press the UP or DOWN Key to move through the list and select Tuning Mode. TUNING MODE 0: Makes adjustments giving priority to stability. 1: Makes adjustments giving priority to responsiveness. Note: TYPE (rigidity type) is fixed to 2.
5	d 0	–	If the servomotor power is OFF, input a servo ON signal (/S-ON) from the host controller. If the servomotor power is ON, go to step 6.
6	L0040		Press the DATA/SHIFT Key for less than one second. The one parameter gain data shown on the left will be displayed.
7	L0055		Press the UP or DOWN Key to change the one parameter gain value and change the actual servo gain (Pn100, Pn101, Pn102, and Pn401) at the same time. This tuning function terminates when you decide that the response output is satisfactory.
8	L0055		Press the MODE/SET Key to save the calculated four gains to the parameter. When tuning is finished, "donE" will flash before returning to the screen shown on the left. Note: To end operation without saving the calculated gain, go to step 9.
9	Fn203		Press the DATA/SHIFT Key for approximately one second. The display will return to Fn203.

(2) Digital Operator Operating Procedure

■ Setting the Tuning Mode 0 or 1

Step	Display after Operation	Keys	Operation
1	BB —FUNCTION— Fn202:Ref-AAT Fn203:OnePrmTun Fn204:A-Vib Sup Fn205:Vib Sup	MODE/SET ∧ ∨	Press the MODE/SET Key to view the main menu for the utility function. Press the ∧ or ∨ Key to move through the list and select Fn203.
2	Status Display BB —OnePrmTun— Pn103=00300	DATA	Press the DATA Key to display the moment of inertia ratio set in Pn103 at present. Move the digit with the < or > Key and change the value with the ∧ or ∨ Key.
3	BB —OnePrmTun— Setting Tuning Mode = 0 Type = 2	DATA	Press the DATA Key to display the initial setting screen for one-parameter tuning.
4	BB —OnePrmTun— Setting Tuning Mode = 0 Type = 2	∧ ∨ SCROLL	Press the ∧ , ∨, or SCROLL Key and set the items in steps 4-1 and 4-2.
4-1	■Tuning Mode Select the tuning mode. Select the tuning mode 0 or 1. Tuning Mode = 0: Makes adjustments giving priority to stability. Tuning Mode = 1: Makes adjustments giving priority to responsiveness.		
4-2	■Type Selection Select the type according to the machine element to be driven. If there is noise or the gain does not increase, better results may be obtained by changing the rigidity type. Type = 1: For belt drive mechanisms Type = 2: For ball screw drive mechanisms [Factory setting] Type = 3: For rigid systems in which the servomotor is directly coupled to the machine (without gear or other transmissions).		
5	RUN —OnePrmTun— Setting Tuning Mode = 0 Type = 2	–	If the servomotor power is OFF, input a servo ON signal (/S-ON) from the host controller. The display will change from "BB" to "RUN." If the servomotor power is ON, go to step 6.
6	RUN —OnePrmTun— Pn100=0040.0 Pn101=0020.00 Pn102=0040.0	DATA	Press the DATA Key to display the set value.
7	RUN —OnePrmTun— LEVEL = 0050 NF1 NF2 ARES	DATA	Press the DATA Key again to display the LEVEL setting screen.

Note: The status display will always be RUN when the servomotor power is ON.

Adjustments

6

(cont'd)

Step	Display after Operation	Keys	Operation
8	RUN —OnePrmTun— LEVEL = 0050 NF1 NF2 ARES	< > ∧ ∨	If readjustment is required, select the digit with the < or > Key or change the LEVEL with the ∧ or ∨ Key. Check the response. If readjustment is not required, go to step 9. Note: The higher the level, the greater the responsiveness will be. If the value is too large, however, vibration will occur. • If vibration occurs, press the JOG SVON Key. The multi-winding drive unit will automatically detect the vibration frequencies and make notch filter or an anti-resonance control settings. When the notch filter is set, "NF1" or "NF2" will be displayed on the bottom row. When the anti-resonance control is set, "ARES" will be displayed in the lower right corner. RUN —OnePrmTun— LEVEL=0070 NF1 NF2 ARES • If the vibration is great, the vibration frequency will be detected automatically even if the JOG SVON Key is not pressed and a notch filter or an anti-resonance control will be set.
9	RUN —OnePrmTun— Pn100=0050.0 Pn101=0016.0 Pn102=0050.0	DATA	Press the DATA Key. A confirmation screen will be displayed after LEVEL adjustment.
10	RUN —OnePrmTun— Pn100=0050.0 Pn101=0016.0 Pn102=0050.0	DATA	• Press the DATA Key to save the adjusted values. After the data is saved, "DONE" will flash for approximately two seconds and then "RUN" will be displayed. • To return to the previous value, press the MODE/SET Key. • Press the < Key to readjust the level without saving the values.
11	RUN —FUNCTION— Fn202:Ref-AAT Fn203:OnePrmTun Fn204:A-Vib Sup Fn205:Vib Sup	MODE/SET	Press the MODE/SET Key to complete the one-parameter tuning operation. The screen in step 1 will appear again.

■ Setting the Tuning Mode 2 or 3

Step	Display after Operation	Keys	Operation
1	BB —FUNCTION— Fn202:Ref-AAT Fn203:OnePrmTun Fn204:A-Vib Sup Fn205:Vib Sup	MODE/SET ∧ ∨	Press the MODE/SET Key to view the main menu for the utility function. Press the ∧ or ∨ Key to move through the list and select Fn203.
2	Status Display BB —OnePrmTun— Pn103=00300	DATA	Press the DATA Key to display the moment of inertia ratio set in Pn103 at present. Move the digit with the < or > Key and change the value with the ∧ or ∨ Key.
3	BB —OnePrmTun— Setting Tuning Mode = 2 Type = 2	DATA	Press the DATA Key to display the initial setting screen for one-parameter tuning.
4	BB —OnePrmTun— Setting Tuning Mode = 2 Type = 2	∧ ∨ SCROLL	Press the ∧ , ∨, or SCROLL Key and set the items in steps 4-1 and 4-2.
4-1	■Tuning Mode Select the tuning mode. Select the tuning mode 2 or 3. Tuning Mode = 2: Enables model following control and makes adjustments for positioning. Tuning Mode = 3: Enables model following control, makes adjustments for positioning, and suppresses over-shooting.		
4-2	■Type Selection Select the type according to the machine element to be driven. If there is noise or the gain does not increase, better results may be obtained by changing the rigidity type. Type = 1: For belt drive mechanisms Type = 2: For ball screw drive mechanisms [Factory setting] Type = 3: For rigid systems in which the servomotor is directly coupled to the machine (without gear or other transmissions).		
5	RUN —OnePrmTun— Setting Tuning Mode=2 Type=2	–	If the servomotor power is OFF, input a servo ON signal (/S-ON) from the host controller. The display will change from "BB" to "RUN." If the servomotor power is ON, go to step 6.
6	RUN —OnePrmTun— Pn100=0040.0 Pn101=0020.00 Pn141=0050.0	DATA	Press the DATA Key to display the set value.
7	RUN —OnePrmTun— FF LEVEL=0050. 0 FB LEVEL=0040. 0	DATA	Press the DATA Key again to display FF LEVEL and FB LEVEL setting screens.

(cont'd)

<table>
<tr><th>Step</th><th>Display after Operation</th><th>Keys</th><th>Operation</th></tr>
<tr><td>8</td><td>RUN —OnePrmTun—
FF LEVEL=0050. 0
FB LEVEL=0040. 0</td><td>< >
∧ ∨</td><td>If readjustment is required, select the digit with the < or > Key or change the FF LEVEL and FB LEVEL with the ∧ or ∨ Key. Check the response.
If readjustment is not required, go to step 9.
Note: The higher the FF LEVEL, the positioning time will be shorter and the response will be better. If the level is too high, however, overshooting or vibration may occur. Overshooting will be reduced if the FB LEVEL is increased.
■ If Vibration Occurs
• If vibration occurs, press the JOG SVON Key. The multi-winding drive unit will automatically detect the vibration frequencies and make notch filter or an anti-resonance control settings. When the notch filter is set, "NF1" and "NF2" are displayed on the bottom row. When the anti-resonance control is set, "ARES" will be displayed on the bottom low.
RUN —OnePrmTun—
FF LEVEL=0050. 0
FB LEVEL=0040. 0
NF1 NF2 ARES
■ If Vibration Is Large
• Even if the JOG SVON Key is not pressed, the multi-winding drive unit will automatically detect the vibration frequencies and make notch filter or anti-resonance control settings.
Notes:
• If the FF LEVEL is changed when the servomotor is in operation, it will not be reflected immediately. The changes will be effective after the servomotor comes to a stop with no reference input and then the servomotor starts operation If the FF LEVEL is changed too much during operation, vibration may occur because the responsiveness is changed rapidly when the settings become effective.
• The message "FF LEVEL" flashes until the machine reaches the effective FF LEVEL. If the servomotor does not stop within approximately 10 seconds after changing the setting, a timeout will occur. The setting will be returned to the previous value.</td></tr>
<tr><td>9</td><td>RUN —OnePrmTun—
Pn100=0040.0
Pn101=0020.00
Pn141=0050.0
NF1</td><td>DATA</td><td>Press the DATA Key to display the confirmation screen after level adjustment.</td></tr>
<tr><td>10</td><td>RUN —OnePrmTun—
Pn100=0040.0
Pn101=0020.00
Pn141=0050.0
NF1</td><td>DATA</td><td>• Press the DATA Key to save the adjusted values. After the data is saved, "DONE" will flash for approximately two seconds and then "RUN" will be displayed.
• To return to the previous value, press the MODE/SET Key.
• Press the < Key to readjust the level without saving the values.</td></tr>
<tr><td>11</td><td>RUN —FUNCTION—
Fn202:Ref-AAT
Fn203:OnePrmTun
Fn204:A-Vib Sup
Fn205:Vib Sup</td><td>MODE/SET</td><td>Press the MODE/SET Key to complete the one-parameter tuning operation. The screen in step 1 will appear again.</td></tr>
</table>

Note: The status display will always be RUN when the servomotor power is ON.

(3) Related Functions on One-parameter Tuning

This section describes functions related to one-parameter tuning.

■ Notch Filter

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

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

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

■ Anti-Resonance Control Adjustment

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

Usually, set this function to Auto Setting. (The anti-resonance control is factory-set to Auto Setting.)
When this function is set to Auto Setting, vibration will be automatically detected during one-parameter tuning and anti-resonance control will be automatically adjusted and set.

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

"ARES" will flash on the digital operator when anti-resonance control adjustment function is set.

```
RUN     —OnePrmTun—
FF  LEVEL  =  0050
FB  LEVEL  =  0040

 NF1  NF2    ARES
```

■ Friction Compensation

This function compensates for changes in the following conditions.

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

Conditions to which friction compensation is applicable depend on the tuning mode. The friction compensation setting in F408.3 applies when the mode is 0 or 1. Tuning Mode = 2 and Tuning Mode = 3 are adjusted with the friction compensation function regardless of the friction compensation setting in P408.3.

Friction Compensation Selecting \ Mode		Tuning Mode = 0	Tuning Mode = 1	Tuning Mode = 2	Tuning Mode = 3
Pn408	n.0□□□ [Factory setting]	Adjusted without the friction compensation function	Adjusted without the friction compensation function	Adjusted with the friction compensation function	Adjusted with the friction compensation function
	n.1□□□	Adjusted with the friction compensation function	Adjusted with the friction compensation function		

■ Feedforward

If Pn140 is set to the factory setting and the tuning mode setting is changed to 2 or 3, the feedforward gain (Pn109), speed feedforward (V-REF) input, and torque feedforward (T-REF) input will be disabled.

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

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

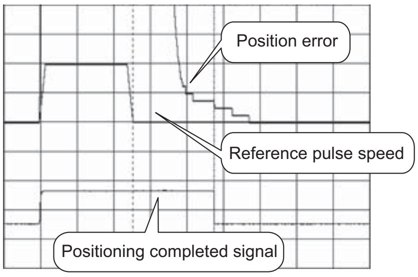
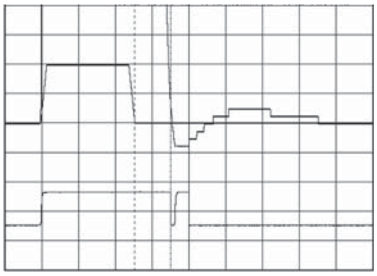
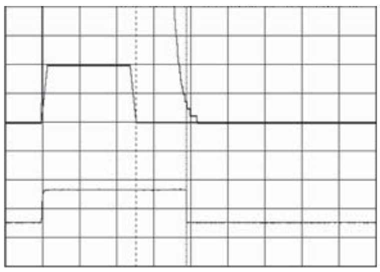
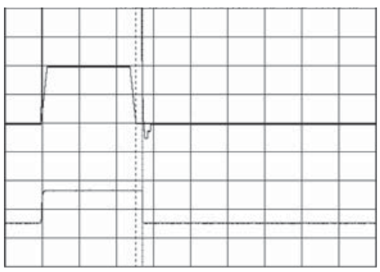
Refer to *6.7.2 Torque Feedforward* and *6.7.3 Speed Feedforward* for details.

IMPORTANT

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

6.3.3 One-parameter Tuning Example

The following procedure is used for one-parameter tuning on the condition that the tuning mode is set to 2 or 3. This mode is used to reduce positioning time.

Step	Measuring Instrument Display Example	Operation
1		Measure the positioning time after setting the moment of inertia ratio (Pn103) correctly. Tuning will be completed if the specifications are met here. The tuning results will be saved in the multi-winding drive unit.
2		The positioning time will become shorter if the FF level is increased. The tuning will be completed if the specifications are met. The tuning results will be saved in the multi-winding drive unit. If overshooting occurs before the specifications are met, go to step 3.
3		Overshooting will be reduced if the FB level is increased. If the overshooting is eliminated, go to step 4.
4		The graph shows overshooting generated with the FF level increased after step 3. In this state, the overshooting occurs, but the positioning settling time is shorter. The tuning will be completed if the specifications are met. The tuning results will be saved in the multi-winding drive unit. If overshooting occurs before the specifications are met, repeat steps 3 and 4. If vibration occurs before the overshooting is eliminated, the vibration will be suppressed by the automatic notch filter and anti-resonance control. Note: The vibration frequencies may not be detected if the vibration is too small. If that occurs, press the JOG/SVON Key to forcibly detect the vibration frequencies.
5	–	The tuning results will be saved in the multi-winding drive unit.

6.3.4 Related Parameters

The following table lists parameters related to this function and their possibility of being changed while executing this function or of being changed automatically after executing this function.

- Parameters related to this function
  These are parameters that are used or referenced when executing this function.

- Allowed changes during execution of this function
  Yes : Parameters can be changed using SigmaWin+ while this function is being executed.
  No : Parameters cannot be changed using SigmaWin+ while this function is being executed.

- Automatic changes after execution of this function
  Yes : Parameter set values are automatically set or adjusted after execution of this function.
  No : Parameter set values are not automatically set or adjusted after execution of this function.

Parameter	Name	Mid-execution changes	Automatic changes
Pn100	Speed Loop Gain	No	Yes
Pn101	Speed Loop Integral Time Constant	No	Yes
Pn102	Position Loop Gain	No	Yes
Pn103	Moment of Inertia Ratio	No	No
Pn121	Friction Compensation Gain	No	Yes
Pn123	Friction Compensation Coefficient	No	Yes
Pn124	Friction Compensation Frequency Correction	No	No
Pn125	Friction Compensation Gain Correction	No	Yes
Pn401	Torque Reference Filter Time Constant	No	Yes
Pn408	Torque Related Function Switch	Yes	Yes
Pn409	1st Notch Filter Frequency	No	Yes
Pn40A	1st Notch Filter Q Value	No	Yes
Pn40C	2nd Notch Filter Frequency	No	Yes
Pn40D	2nd Notch Filter Q Value	No	Yes
Pn140	Model Following Control Related Switch	Yes	Yes
Pn141	Model Following Control Gain	No	Yes
Pn142	Model Following Control Gain Compensation	No	Yes
Pn143	Model Following Control Bias (Forward Direction)	No	Yes
Pn144	Model Following Control Bias (Reverse Direction)	No	Yes
Pn145	Vibration Suppression 1 Frequency A	No	No
Pn146	Vibration Suppression 1 Frequency B	No	No
Pn147	Model Following Control Speed Feedforward Compensation	No	Yes
Pn160	Anti-Resonance Control Related Switch	Yes	Yes
Pn161	Anti-Resonance Frequency	No	Yes
Pn163	Anti-Resonance Damping Gain	No	Yes

6.4 Anti-Resonance Control Adjustment Function (Fn204)

This section describes the anti-resonance control adjustment function.

6.4.1 Anti-Resonance Control Adjustment Function

The anti-resonance control adjustment function increases the effectiveness of the vibration suppression after one-parameter tuning. This function is effective in supporting anti-resonance control adjustment if the vibration frequencies are from 100 to 1000 Hz.

This function rarely needs to be used because it is automatically set by the advanced autotuning or advanced autotuning by reference input. Use this function only if fine-tuning is required, or vibration detection is failed and readjustment is required.

Perform one-parameter tuning (Fn203) or use another method to improve the response characteristics after performing this function. If the anti-resonance gain is increased with one-parameter tuning performed, vibration may result again. If that occurs, perform this function again to fine-tune the settings.

⚠ CAUTION

- If this function is executed, related parameters will be set automatically. Therefore, there will be a large response change after this function is executed. Enable the function in a state where the machine can come to an emergency stop at any time to ensure the safety operation of the machine.
- Be sure to set a suitable value for the moment of inertia ratio (Pn103) using advanced autotuning before executing the anti-resonance control adjustment function. If the setting greatly differs from the actual moment of inertia ratio, normal control of the machine may not be possible, and vibration may result.

IMPORTANT

- This function detects vibration between 100 and 1000 Hz. Vibration will not be detected for frequencies outside of this range, and instead, "F----" will be displayed. If that occurs, use one-parameter tuning with tuning mode 2 selected to automatically set a notch filter or use the vibration suppression function (Fn205).
- Vibration can be reduced more effectively by increasing the anti-resonance damping gain (Pn163). The amplitude of vibration may become larger if the damping gain is excessively high. Increase the damping gain from about 0% to 200% in 10% increments while checking the effect of vibration reduction. If the effect of vibration reduction is still insufficient at a gain of 200%, cancel the setting, and lower the control gain using a different method, such as one-parameter tuning.

(1) Before Performing Anti-Resonance Control Adjustment Function

Check the following settings before performing anti-resonance control adjustment function.
The message “NO-OP” indicating that the settings are not appropriate will be displayed, if all of the following conditions are not met.

- The tuning-less function must be disabled (Pn170.0 = 0).
- The control must not be set to torque control.
- The write prohibited setting parameter (Fn010) must be set to Write permitted (P.0000).

6.4.2 Anti-Resonance Control Adjustment Function Operating Procedure

With this function, an operation reference is sent, and the function is executed while vibration is occurring.

Anti-resonance control adjustment function is performed from the digital operator (option) or SigmaWin+. The function cannot be performed from the panel operator.
The following methods can be used for the anti-resonance control adjustment function.

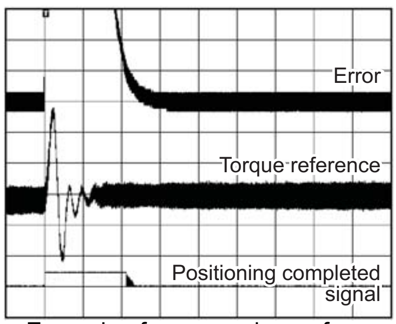
- Using anti-resonance control for the first time
  - With undetermined vibration frequency
  - With determined vibration frequency
- For fine-tuning after adjusting the anti-resonance control

The following describes the operating procedure from the digital operator.

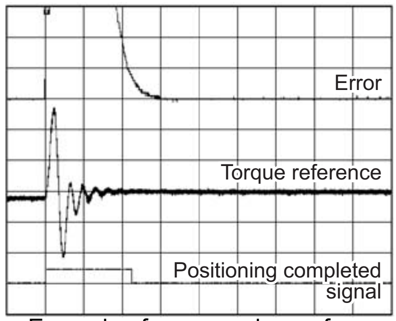
Refer to the *Σ-V Series User's Manual, Operation of Digital Operator* (No.: SIEP S800000 55) for basic key operations of the digital operator.

(1) Using Anti-Resonance Control for the First Time

■ With Undetermined Vibration Frequency

Step	Display after Operation	Keys	Operation
1	RUN —FUNCTION— Fn203:OnePrmTun Fn204:A-Vib Sup Fn205:Vib Sup Fn206:Easy FFT	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 Fn204.
2	Status Display RUN —Vib Sup— Tuning Mode = 0	DATA	Press the DATA Key to display the initial setting screen for tuning mode.
3	RUN —Vib Sup— Tuning Mode = 0	∧ ∨	Press the ∧ or ∨ Key and set the tuning mode "0."
4	RUN —Vib Sup— freq = ---- Hz damp = 0000	DATA	Press the DATA Key while "Tuning Mode = 0" is displayed. The screen shown on the left will appear. The detection of vibration frequencies will start and "freq" will flash. Return to step 3 if vibration is not detected. Note: If vibration is not detected even when vibration is occurring, lower the vibration detection sensitivity (Pn311). When this parameter is lowered, the detection sensitivity will be increased. Vibration may not be detected accurately if too small value is set.
5	RUN —Vib Sup— freq = 0400 Hz damp = 0000	–	The vibration frequency will be displayed in "freq" if vibration is detected.  Example of measured waveform

(cont'd)

Step	Display after Operation	Keys	Operation
6	RUN —Vib Sup— freq = 0400 Hz damp = 0000	DATA	Press the DATA Key. The cursor will move to "damp," and the flashing of "freq" will stop.
7	RUN —Vib Sup— freq = 0400 Hz damp = 0120	< > ∧ ∨	Select the digit with the < or > Key, and press the ∧ or ∨ Key to set the damping gain.  Example of measured waveform Note: Increase the damping gain from about 0% to 200% in 10% increments while checking the effect of vibration reduction. If vibration reduction is still insufficient at a gain of 200%, cancel the setting, and lower the control gain by using a different method, such as one-parameter tuning.
8	RUN —Vib Sup— freq = 0400 Hz damp = 0120	SCROLL	If fine tuning of the frequency is necessary, press the SCROLL Key. The cursor will move from "damp" to "freq." If fine-tuning is not necessary, skip step 9 and go to step 10.
9	RUN —Vib Sup— freq = 0420 Hz damp = 0120	< > ∧ ∨	Select the digit with the < or > Key, and press the ∧ or ∨ Key to fine-tune the frequency.
10	RUN —Vib Sup— freq = 0420 Hz damp = 0120	DATA	Press the DATA Key to save the settings. "DONE" will flash for approximately two seconds and "RUN" will be displayed.
11	RUN —FUNCTION— Fn203:OnePrmTun Fn204:A-Vib Sup Fn205:Vib Sup Fn206:Easy FFT	MODE/SET	Press the MODE/SET Key to complete the anti-resonance control adjustment function. The screen in step 1 will appear again.

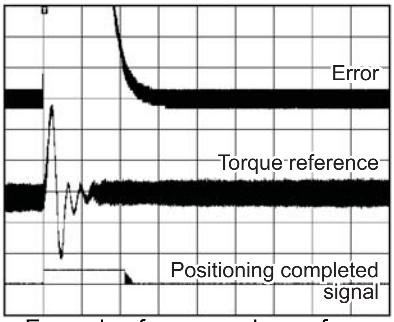
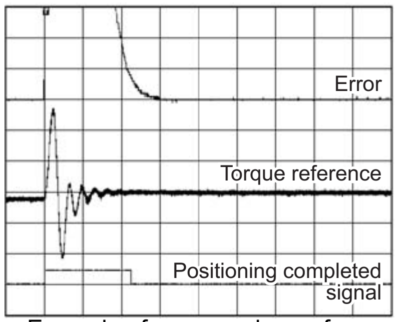
■ With Determined Vibration Frequency

Step	Display after Operation	Keys	Operation
1	RUN —FUNCTION— Fn203:OnePrmTun Fn204:A-Vib Sup Fn205:Vib Sup Fn206:Easy FFT	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 Fn204.
2	RUN —Vib Sup— Tuning Mode = 0	DATA	Press the DATA Key to display the initial setting screen for tuning mode.

Adjustments

6

(cont'd)

Step	Display after Operation	Keys	Operation
3	RUN —FUNCTION— Tuning Mode = 1	∧ ∨	Press the ∧ or ∨ Key and set the tuning mode "1."
4	RUN — Vib Sup— freq = 0100 Hz damp = 0000	DATA	Press the DATA Key while "Tuning Mode = 1" is displayed. The screen shown on the left will appear and "freq" will flash.  Example of measured waveform
5	RUN — Vib Sup— freq = 0100 Hz damp = 0000	< > ∧ ∨	Select the digit with the < or > Key, and press the ∧ or ∨ Key to adjust the frequency.
6	RUN — Vib Sup— freq = 0400 Hz damp = 0000	SCROLL	Press the SCROLL Key. The cursor will move to "damp."
7	RUN — Vib Sup— freq = 0400 Hz damp = 0020	< > ∧ ∨	Select the digit with the < or > Key, and press the ∧ or ∨ Key to adjust the damping gain.  Example of measured waveform Note: Increase the damping gain from about 0% to 200% in 10% increments while checking the effect of vibration reduction. If vibration reduction is still insufficient at a gain of 200%, cancel the setting, and lower the control gain by using a different method, such as one-parameter tuning.
8	RUN — Vib Sup— freq = 0400 Hz damp = 0120	SCROLL	If fine tuning of the frequency is necessary, press the SCROLL Key. The cursor will move from "damp" to "freq." If fine-tuning is not necessary, skip step 9 and go to step 10.
9	RUN — Vib Sup— freq = 0400 Hz damp = 0120	< > ∧ ∨	Select the digit with the < or > Key, and press the ∧ or ∨ Key to fine-tune the frequency.

(cont'd)

Step	Display after Operation	Keys	Operation
10	RUN — Vib Sup— freq = 0400 Hz damp = 0120	DATA	Press the DATA Key to save the settings. "DONE" will flash for approximately two seconds and "RUN" will be displayed.
11	RUN —FUNCTION— Fn203:OnePrmTun Fn204:A-Vib Sup Fn205:Vib Sup Fn206:Easy FFT	MODE/SET	Press the MODE/SET Key to complete the anti-resonance control adjustment function. The screen in step 1 will appear again.

(2) For Fine-tuning After Adjusting the Anti-Resonance Control

Step	Display after Operation	Keys	Operation
1	RUN —FUNCTION— Fn203:OnePrmTun Fn204:A-Vib Sup Fn205:Vib Sup Fn206:Easy FFT	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 Fn204.
2	RUN —FUNCTION— Tuning Mode = 1	DATA	Press the DATA Key to display the "Tuning Mode = 1" as shown on the left.
3	RUN — Vib Sup— freq = 0400 Hz damp = 0120	DATA	Press the DATA Key while "Tuning Mode = 1" is displayed. The screen shown on the left will appear and "damp" will flash.
4	RUN — Vib Sup— freq = 0400 Hz damp = 0150	< > ∧ ∨	Select the digit with the < or > Key, and press the ∧ or ∨ Key to set the damping gain. Note: Increase the damping gain from about 0% to 200% in 10% increments while checking the effect of vibration reduction. If vibration reduction is still insufficient at a gain of 200%, cancel the setting, and lower the control gain by using a different method, such as one-parameter tuning.
5	RUN — Vib Sup— freq = 0400 Hz damp = 0150	SCROLL	If fine tuning of the frequency is necessary, press the SCROLL Key. The cursor will move from "damp" to "freq." If fine-tuning is not necessary, skip step 6 and go to step 7.
6	RUN — Vib Sup— freq = 0420 Hz damp = 0150	< > ∧ ∨	Select the digit with the < or > Key, and press the ∧ or ∨ Key to fine-tune the frequency.
7	RUN — Vib Sup— freq = 0420 Hz damp = 0150	DATA	Press the DATA Key to save the settings. "DONE" will flash for approximately two seconds and "RUN" will be displayed.
8	RUN —FUNCTION— Fn203:OnePrmTun Fn204:A-Vib Sup Fn205:Vib Sup Fn206:Easy FFT	MODE/SET	Press the MODE/SET Key to complete the anti-resonance control adjustment function. The screen in step 1 will appear again.

6.4.3 Related Parameters

The following table lists parameters related to this function and their possibility of being changed while executing this function or of being changed automatically after executing this function.

• Parameters related to this function
These are parameters that are used or referenced when executing this function.

• Allowed changes during execution of this function
Yes : Parameters can be changed using SigmaWin+ while this function is being executed.
No : Parameters cannot be changed using SigmaWin+ while this function is being executed.

• Automatic changes after execution of this function
Yes : Parameter set values are automatically set or adjusted after execution of this function.
No : Parameter set values are not automatically set or adjusted after execution of this function.

Parameter	Name	Mid-execution changes	Automatic changes
Pn160	Anti-Resonance Control Related Switch	Yes	Yes
Pn161	Anti-Resonance Frequency	No	Yes
Pn162	Anti-Resonance Gain Compensation	Yes	No
Pn163	Anti-Resonance Damping Gain	No	Yes
Pn164	Anti-Resonance Filter Time Constant 1 Compensation	Yes	No
Pn165	Anti-Resonance Filter Time Constant 2 Compensation	Yes	No

6.5 Vibration Suppression Function (Fn205)

The vibration suppression function is described in this section.

6.5.1 Vibration Suppression Function

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

This function is set automatically when advanced autotuning or advanced autotuning by reference is executed. In most cases, this function is not necessary. Use this function only if fine-tuning is required or readjustment is required as a result of a failure to detect vibration.

Perform one-parameter tuning (Fn203) if required to improve the response characteristics after performing this function.

⚠ CAUTION

- If this function is executed, related parameters will be set automatically. Therefore, there will be a large response change after this function is enabled or disabled. Enable the function in a state where the machine can come to an emergency stop at any time to ensure the safety operation of the machine.
- Be sure to set a suitable value for the moment of inertia ratio (Pn103) using advanced autotuning before executing the vibration suppression function. If the setting greatly differs from the actual moment of inertia ratio, normal control of the multi-winding drive unit may not be possible, and vibration may result.

IMPORTANT

- This function detects vibration frequency between 1 to 100 Hz. Vibration will not be detected for frequencies outside of this range, and instead, "F-----" will be displayed.
- Frequency detection will not be performed if no vibration results from position error or the vibration frequencies are outside the range of detectable frequencies. If so, use a device, such as a displacement sensor or vibration sensor, to measure the vibration frequency.
- If vibration frequencies automatically detected are not suppressed, the actual frequency and the detected frequency may differ. Fine-tune the detected frequency if necessary.

(1) Preparation

Check the following settings before performing the vibration suppression function.
The message “NO-OP” indicating that the settings are not appropriate will be displayed, if all of the following conditions are not met.

- The control must be set to position control.
- The tuning-less function must be disabled (Pn170.0 = 0).
- The write prohibited setting parameter (Fn010) must be set to Write permitted (P.0000).

(2) Items Influencing Performance

If continuous vibration occurs when the servomotor is not rotating, the vibration suppression function cannot be used to suppress the vibration effectively. If the result is not satisfactory, perform anti-resonance control adjustment function (Fn204) or one-parameter tuning (Fn203).

(3) Detection of Vibration Frequencies

Frequency detection may not be possible if there is not enough vibration to affect the position error.

The detection sensitivity can be adjusted by changing the setting for the remained vibration detection width (Pn560) which is set as a percentage of the positioning completed width (Pn522). Perform the detection of vibration frequencies again after adjusting the remained vibration detection width (Pn560).

Pn560	Remained Vibration Detection Width Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	1 to 3000	0.1%	400	Immediately	Setup

Note: As a guideline, change the setting 10% at a time. The smaller the set value is, the higher the detection sensitivity will be. If the value is too small, however, the vibration may not be detected accurately.

The vibration frequencies that are automatically detected may vary somewhat with each positioning operation. Perform positioning several times and make adjustments while checking the effect of vibration suppression.

6.5.2 Vibration Suppression Function Operating Procedure

The following procedure is used for vibration suppression function.

Vibration suppression function is performed from the digital operator (option) or SigmaWin+. This function cannot be performed from the panel operator.

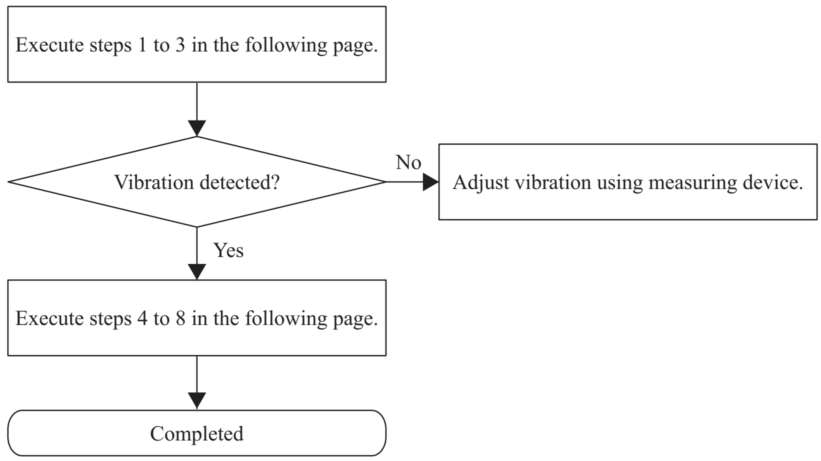
The operating procedure from the digital operator is described here.

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.

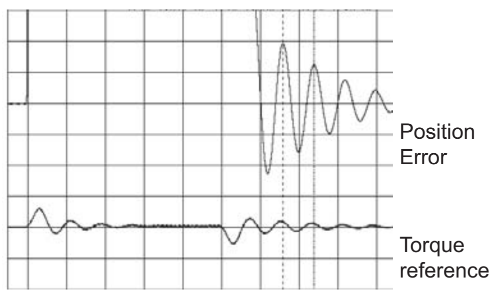
Note: If this function is aborted by pressing the MODE/SET Key, the multi-winding drive unit will continue operating until the servomotor comes to a stop. After the servomotor stops, the set value will return to the previous value.

The operating flow of the vibration suppression function is shown below.

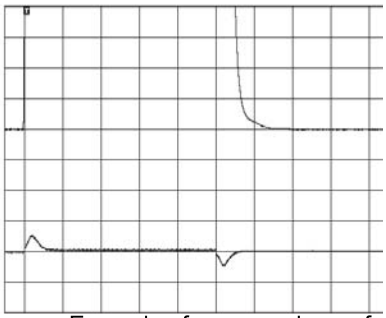
(1) Operating Flow



(2) Operating Procedure

Step	Display after Operation	Keys	Operation
1	Input a operation reference and take the following steps while repeating positioning.		
2	RUN —FUNCTION— Fn204:A−Vib Sup Fn205:Vib Sup Fn206:Easy FFT Fn207:V−Monitor	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 Fn205.
3	RUN —Vib Sup— Measure f=010.4Hz Setting f=050.4Hz	DATA	Press the DATA Key. The display shown on the left will appear. Measure f: Measurement frequency Setting f: Setting frequency [Factory-set to the set value for Pn145] If the setting frequency and actual operating frequency are different, "Setting" will flash. Note: Frequency detection will not be performed if there is no vibration or the vibration frequency is outside the range of detectable frequencies. The following screen will be displayed if vibration is not detected. If the vibration frequencies are not detected, prepare a means of detecting and measuring the vibration. When the vibration frequencies are measured, go to step 5 and manually set the measured vibration frequency to “Setting f.” RUN —Vib Sup— Measure f =−−−−−Hz Setting f =050.0Hz
4	RUN —Vib Sup— Measure f=010.4Hz Setting f=010.4Hz	SCROLL	Press the SCROLL Key. The displayed “Measure f” value will be displayed as the “Setting f” value as well.  Example of measured waveform
5	RUN —Vib Sup— Measure f=010.4Hz Setting f=012.4Hz	< > ∧ ∨	If the vibration is not completely suppressed, select the digit with the < or > Key, and press the ∧ or ∨ Key to fine-tune the frequency “setting f.” Skip this step and go to step 7 if the fine-tuning of the frequency is not necessary. Note: If the setting frequency and actual operating frequency are different, "Setting" will flash.

(cont'd)

Step	Display after Operation	Keys	Operation
6	RUN —Vib Sup— Measure f=010.4Hz Setting f=012.4Hz	DATA	Press the DATA Key. The "Setting f" will change to usual display and the frequency currently displayed will be set for the vibration suppression function.  Example of measured waveform
7	RUN —Vib Sup— Measuref =-----Hz Settingf =012.4Hz	DATA	Press the DATA Key to save the adjusted settings in the multi-winding drive unit. “DONE” will flash for approximately two seconds and “RUN” will be displayed.
8	RUN —FUNCTION— Fn204 Fn205 Fn206 Fn207	MODE/SET	Press the MODE/SET Key to complete the vibration suppression function. The screen in step 1 will appear again.

> **IMPORTANT**
>
> No settings related to the vibration suppression function will be changed during operation.
>
> If the servomotor does not stop approximately 10 seconds after the setting changes, a timeout error will result and the previous setting will be automatically enabled again.
>
> The vibration suppression function will be enabled in step 6. The motor response, however, will change when the servomotor comes to a stop with no reference input.

(3) Related Function on Vibration Suppression Function

This section describes functions related to vibration suppression function.

■ Feedforward

The feedforward gain (Pn109), speed feedforward (V-REF) input, and torque feedforward (T-REF) input will be disabled in the factory setting.

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

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

Refer to *6.7.2 Torque Feedforward* and *6.7.3 Speed Feedforward* for details.

IMPORTANT

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

6.5.3 Related Parameters

The following table lists parameters related to this function and their possibility of being changed while executing this function or of being changed automatically after executing this function.

- Parameters related to this function
  These are parameters that are used or referenced when executing this function.

- Allowed changes during execution of this function
  Yes : Parameters can be changed using SigmaWin+ while this function is being executed.
  No : Parameters cannot be changed using SigmaWin+ while this function is being executed.

- Automatic changes after execution of this function
  Yes : Parameter set values are automatically set or adjusted after execution of this function.
  No : Parameter set values are not automatically set or adjusted after execution of this function.

Parameter	Name	Mid-execution changes	Automatic changes
Pn140	Model Following Control Related Switch	Yes	Yes
Pn141	Model Following Control Gain	No	Yes
Pn142	Model Following Control Gain Compensation	No	No
Pn143	Model Following Control Bias (Forward Direction)	No	No
Pn144	Model Following Control Bias (Reverse Direction)	No	No
Pn145	Vibration Suppression 1 Frequency A	No	Yes
Pn146	Vibration Suppression 1 Frequency B	No	Yes
Pn147	Model Following Control Speed Feedforward Compensation	No	No
Pn14A	Vibration Suppression 2 Frequency	No	No
Pn14B	Vibration Suppression 2 Compensation	No	No

6.6 Additional Adjustment Function

This section describes the functions that can be used for additional fine tuning after making adjustments with advanced autotuning, advanced autotuning by reference, or one-parameter tuning.

- Switching gain settings
- Friction compensation
- Current control mode selection
- Current gain level setting
- Speed detection method selection

6.6.1 Switching Gain Settings

Two gain switching functions are available, manual switching and automatic switching. The manual switching function uses an external input signal to switch gains, and the automatic switching function switches gains automatically.

By using the gain switching function, the positioning time can be shortened by increasing the gain during positioning and vibration can be suppressed by decreasing the gain while it is stopped.

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

Note: n.□□□1 is reserved. Do not use.

For the gain combinations for switching, refer to *(1) Gain Combinations for Switching*.

For the manual gain switching, refer to *(2) Manual Gain Switching*.

For the automatic gain switching, refer to *(3) Automatic Gain Switching*.

(1) Gain Combinations for Switching

Setting	Speed Loop Gain	Speed Loop Integral Time Constant	Position Loop Gain	Torque Reference Filter	Model Following Control Gain	Model Following Control Gain Compensation	Friction Compensation Gain
Gain Setting 1	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
Gain Setting 2	Pn104 2nd Speed Loop Gain	Pn105 2nd Speed Loop Integral Time Constant	Pn106 2nd Position Loop Gain	Pn412 1st Step 2nd Torque Reference Filter Time Constant	Pn148* 2nd Model Following Control Gain	Pn149* 2nd Model Following Control Gain Compensation	Pn122 2nd Gain for Friction Compensation

* The switching gain settings for the model following control gain and the model following control gain compensation are available only for manual gain switching. To enable the gain switching of these parameters, a gain switching input signal must be sent, and the following conditions must be met.
- No command being executed.
- Motor having been completely stopped.

If these conditions are not satisfied, the applicable parameters will not be switched although the other parameters shown in this table will be switched.

(2) Manual Gain Switching

Manual gain switching uses an external input signal (/G-SEL) to switch between gain setting 1 and gain setting 2.

Type	Signal Name	Connector Pin Number	Setting	Meaning
Input	/G-SEL	Must be allocated	OFF	Switches to gain setting 1.
			ON	Switches to gain setting 2.

(3) Automatic Gain Switching

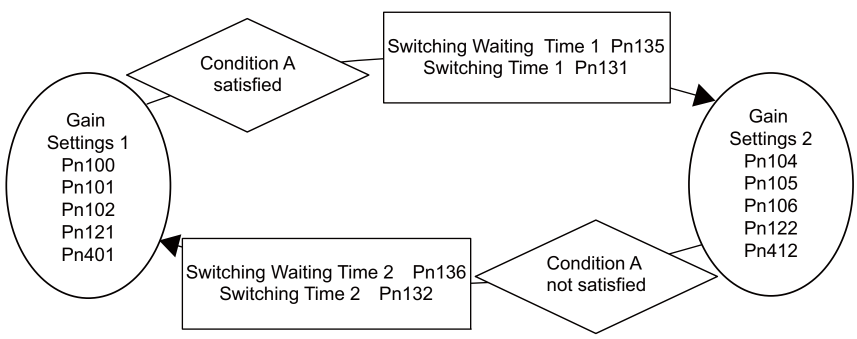
Automatic gain switching is enabled only in position control. The switching conditions are specified using the following settings.

Parameter Setting		Switching Condition	Setting	Switching Wait Time	Switching Time
Pn139	n.□□□2	Condition A satisfied.	Gain setting 1 to gain setting 2	Pn135 Gain Switching Waiting Time 1	Pn131 Gain Switching Time 1
		Condition A not satisfied.	Gain setting 2 to gain setting 1	Pn136 Gain Switching Waiting Time 2	Pn132 Gain Switching Time 2

Select one of the following settings for switching condition A.

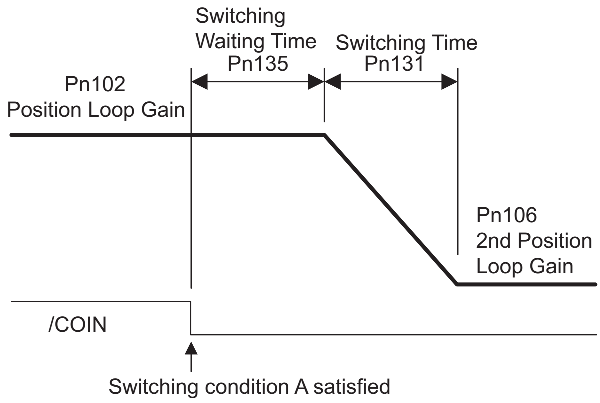
Parameter		Switching Condition A for Position Control	For Other than Position Control (No Switching)	When Enabled	Classification
Pn139	n.□□0□ [Factory setting]	Positioning completed signal (/COIN) ON	Fixed in gain setting 1	Immediately	Tuning
	n.□□1□	Positioning completed signal (/COIN) OFF	Fixed in gain setting 2		
	n.□□2□	Positioning near signal (/NEAR) ON	Fixed in gain setting 1		
	n.□□3□	Positioning near signal (/NEAR) OFF	Fixed in gain setting 2		
	n.□□4□	No output for position reference filter and reference pulse input OFF	Fixed in gain setting 1		
	n.□□5□	Position reference pulse input ON	Fixed in gain setting 2		

Automatic switching pattern 1 (Pn139.0 = 2)



■ Relationship between the Waiting and Switching Times for Gain Switching

In this example, the "positioning completed signal (/COIN) ON" condition is set as condition A for automatic gain switching. The position loop gain is switched from the value in Pn102 (position loop gain) to the value in Pn106 (2nd position loop gain). When the /COIN signal goes ON, the switching operation begins after the waiting time set in Pn135. The switching operation changes the position loop gain linearly from Pn102 to Pn106 within the switching time set in Pn131.



Note: Automatic gain switching is available in the PI and I-P controls (Pn10B).

(4) Related Parameters

Pn100	Speed Loop Gain (Speed, Position)				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	10 to 20000	0.1 Hz	400	Immediately	Tuning

Pn101	Speed Loop Integral Time Constant (Speed, Position)				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	15 to 51200	0.01 ms	2000	Immediately	Tuning

Pn102	Position Loop Gain (Position)				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	10 to 20000	0.1/s	400	Immediately	Tuning

Pn401	Torque Reference Filter Time Constant (Speed, Position, Torque)				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 65535	0.01 ms	100	Immediately	Tuning

Pn141	Model Following Control Gain (Position)				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	10 to 20000	0.1/s	500	Immediately	Tuning

Pn142	Model Following Control Gain Compensation (Position)				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	500 to 2000	0.1%	1000	Immediately	Tuning

Pn121	Friction Compensation Gain (Speed, Position)				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	10 to 1000	1%	100	Immediately	Tuning

Pn104	2nd Speed Loop Gain (Speed, Position)				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	10 to 20000	0.1 Hz	400	Immediately	Tuning

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(cont'd)

Pn105	2nd Speed Loop Integral Time Constant Speed Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	15 to 51200	0.01 ms	2000	Immediately	Tuning
Pn106	2nd Position Loop Gain Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	10 to 20000	0.1/s	400	Immediately	Tuning
Pn412	1st Step 2nd Torque Reference Filter Time Constant Speed Position Torque				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 65535	0.01 ms	100	Immediately	Tuning
Pn148	2nd Model Following Control Gain Position				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 Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	500 to 2000	0.1%	1000	Immediately	Tuning
Pn122	2nd Gain for Friction Compensation Speed Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	10 to 1000	1%	100	Immediately	Tuning

(5) Parameters for Automatic Gain Switching

Pn131	Gain Switching Time 1 Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 65535	1 ms	0	Immediately	Tuning
Pn132	Gain Switching Time 2 Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 65535	1 ms	0	Immediately	Tuning
Pn135	Gain Switching Waiting Time 1 Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 65535	1 ms	0	Immediately	Tuning
Pn136	Gain Switching Waiting Time 2 Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 65535	1 ms	0	Immediately	Tuning

(6) Related Monitor

Monitor No. (Un)	Name	Value	Remarks
Un014	Effective gain monitor	1	For gain setting 1
		2	For gain setting 2

Note: When using the tuning-less function, gain setting 1 is enabled.

Parameter No.	Analog Monitor	Name	Output Value	Remarks
Pn006 Pn007	n.□□0B	Effective gain monitor	1 V	Gain setting 1 is enabled.
			2 V	Gain setting 2 is enabled.

6.6.2 Manual Adjustment of Friction Compensation

Friction compensation rectifies the viscous friction change and regular load change.

The friction compensation function can be automatically adjusted with advanced autotuning (Fn201), advanced autotuning by reference input (Fn202), or one-parameter tuning (Fn203). This section describes the steps to follow if manual adjustment is required.

(1) Required Parameter Settings

The following parameter settings are required to use friction compensation.

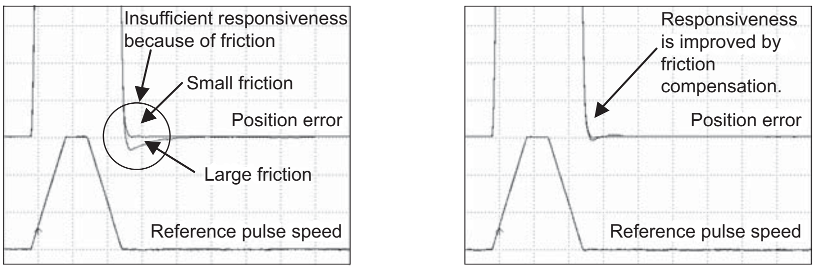
Parameter		Function	When Enabled	Classification
Pn408	n.0□□□ [Factory setting]	Does not use friction compensation.	Immediately	Setup
	n.1□□□	Uses friction compensation.		

Parameter	Name / Setting Range	Setting Unit	Factory Setting	When Enabled	Classification
Pn121	Friction Compensation Gain (Speed, Position)				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	10 to 1000	1%	100	Immediately	Tuning
Pn123	Friction Compensation Coefficient (Speed, Position)				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 100	1%	0	Immediately	Tuning
Pn124	Friction Compensation Frequency Correction (Speed, Position)				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	-10000 to 10000	0.1 Hz	0	Immediately	Tuning
Pn125	Friction Compensation Gain Correction (Speed, Position)				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	1 to 1000	1%	100	Immediately	Tuning

(2) Operating Procedure for Friction Compensation

The following procedure is used for friction compensation.

⚠ CAUTION
• Before using friction compensation, set the moment of inertia ratio (Pn103) as accurately as possible. If the wrong moment of inertia ratio is set, vibration may result.

Step	Operation
1	Set the following parameters for friction compensation to the factory setting as follows. Friction compensation gain (Pn121): 100 Friction compensation coefficient (Pn123): 0 Friction compensation frequency correction (Pn124): 0 Friction compensation gain correction (Pn125): 100 Note: Always use the factory-set values for friction compensation frequency correction (Pn124) and friction compensation gain correction (Pn125).
2	To check the effect of friction compensation, gradually increase the friction compensation coefficient (Pn123). Note: Usually, set the friction compensation coefficient value to 95% or less. If the effect is insufficient, increase the friction compensation gain (Pn121) by 10% increments until it stops vibrating. Effect of Parameters for Adjustment Pn121: Friction Compensation Gain This parameter sets the responsiveness for external disturbance. The higher the set value is, the better the responsiveness will be. If the equipment has a resonance frequency, however, vibration may result if the set value is excessively high. Pn123: Friction Compensation Coefficient This parameter sets the effect of friction compensation. The higher the set value is, the more effective friction compensation will be. If the set value is excessively high, however, the vibration will occur easily. Usually, set the value to 95% or less.
3	Effect of Adjustment The following graph shows the responsiveness with and without proper adjustment.  Without friction compensation With friction compensation

6.6.3 Current Control Mode Selection Function

This function reduces high-frequency noises while the servomotor is being stopped. This function is enabled by default.

Parameter		Meaning	When Enabled	Classification
Pn009	n. □□0□	Selects the current control mode 1.	After restart	Tuning
	n. □□1□ [Factory setting]	Selects the current control mode 2 (low noise).		

IMPORTANT

- If current control mode 2 is selected, the load ratio may increase while the servomotor is being stopped.

6.6.4 Current Gain Level Setting

This function reduces noises by adjusting the parameter value for current control inside the multi-winding drive unit according to the speed loop gain (Pn100). You can reduce the noise level by reducing the current gain level (Pn13D) from its factory setting of 2000% (disabled). Adjust the current gain level within the allowable range at which multi-winding drive unit response characteristics can be secured. This function is always disabled in torque control (Pn000.1 = 2).

Pn13D	Current Gain Level		Speed Position		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	100 to 2000	1%	2000	Immediately	Tuning

IMPORTANT

- If the parameter setting of the current gain level is changed, the responses characteristics of the speed loop will also change. The multi-winding drive unit must, therefore, be readjusted again.

6.6.5 Speed Detection Method Selection

This function can ensure smooth movement of the servomotor while the servomotor is running. Set the value of Pn009.2 to 1 and select speed detection 2 to smooth the movement of the servomotor while the servomotor is running.

Parameter		Meaning	When Enabled	Classification
Pn009	n. □0□□ [Factory setting]	Selects speed detection 1.	After restart	Tuning
	n. □1□□	Selects speed detection 2.		

IMPORTANT

- If the speed detection method is changed, the response characteristics of the speed loop will change and the multi-winding drive unit must be readjusted again.

6.6.6 Position Integral

The position integral is the integral function of the position loop. It is used for the electronic cams and electronic shafts when using the multi-winding drive unit with Yaskawa MP900/2000 machine controllers.

Pn11F	Position Integral Time Constant			Position	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 50000	0.1 ms	0	Immediately	Tuning

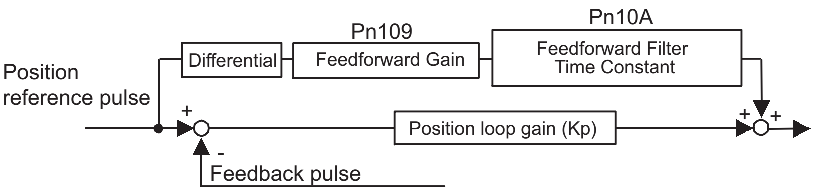
6.7 Compatible Adjustment Function

With the multi-winding drive unit, you can use the adjustment functions described in section *6.1* to *6.6* to adjust the machine.

This section explains compatible functions provided by earlier models, such as the Σ-II large-capacity SERVOPACK.

6.7.1 Feedforward Reference

This function applies feedforward compensation to position control and shortens positioning time.



Pn109	Feedforward Gain			Position	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 100	1%	0	Immediately	Tuning
Pn10A	Feedforward Filter Time Constant			Position	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 6400	0.01 ms	0	Immediately	Tuning

Note: Too high value may cause the machine to vibrate. For ordinary machines, set 80% or less in this parameter.

6.7.2 Torque Feedforward

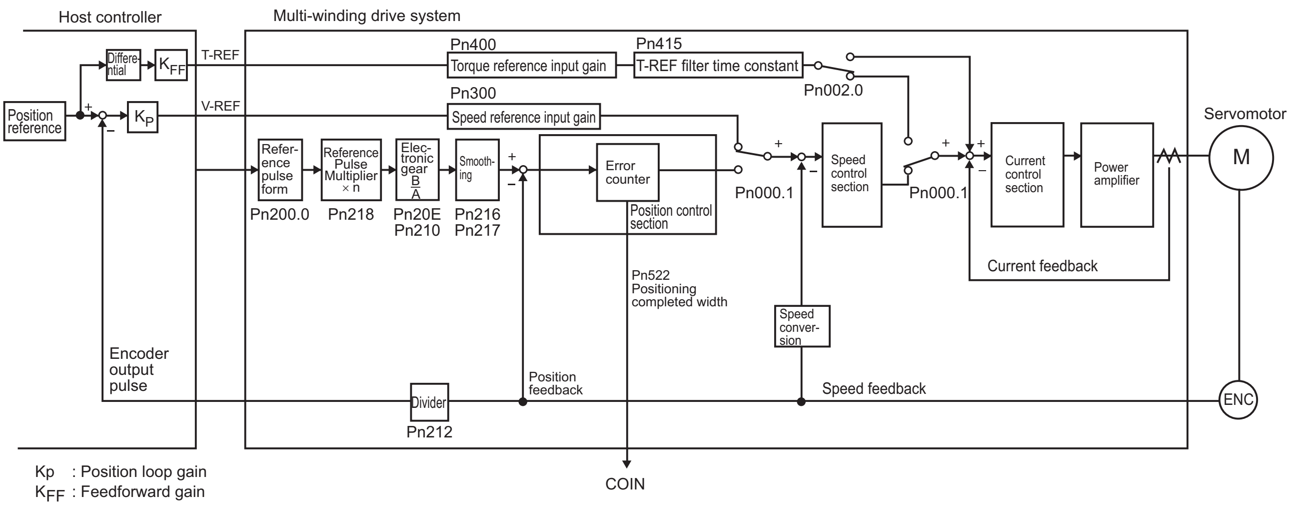
The torque feedforward function shortens positioning time.

The host controller finds the difference from the position reference to generate a torque feedforward reference. This reference and the speed reference are sent to the multi-winding drive unit.

(1) Example of Connection with Host Controller

Connect a speed reference to V-REF (CN1-5 and -6) and a torque feedforward reference to T-REF (CN1-9 and -10) from the host controller.

■ When the Multi-winding Drive Unit Performs Speed Control



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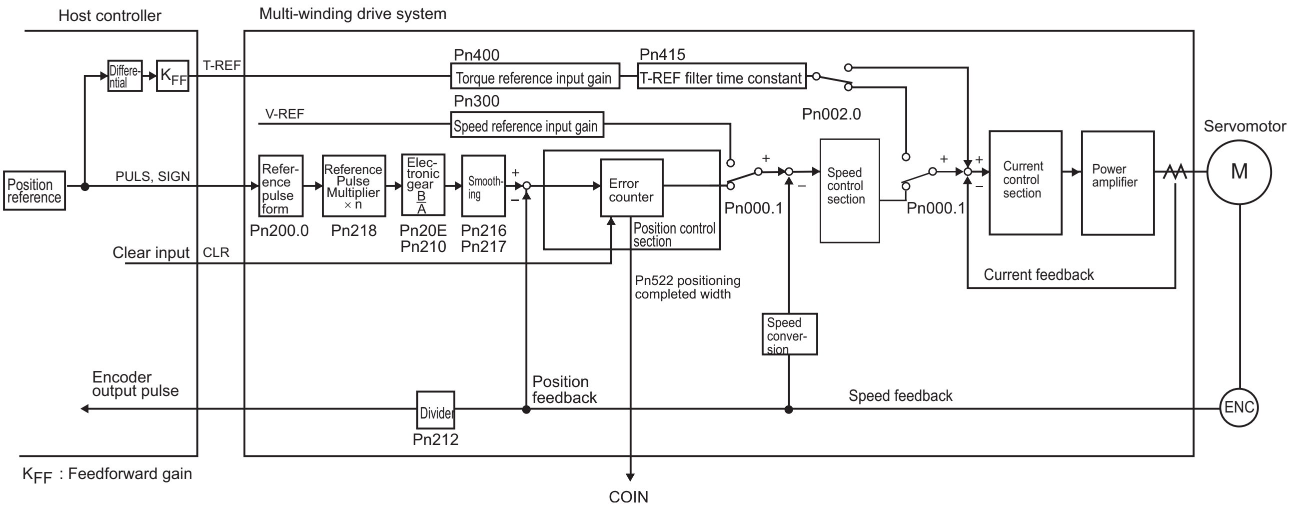
■ When the Multi-winding Drive Unit Performs Position Control



(2) Related Parameters

Torque feedforward is set using the parameters Pn002, Pn400, and Pn415.

The factory setting is Pn400 = 3.0 V/rated torque.
For example, the torque feedforward value is ±3 V, then, the torque is limited to ±100% of the rated torque.

Parameter		Meaning	When Enabled	Classification
Pn002	n.□□□0 [Factory setting]	Disabled	After restart	Setup
	n.□□□2	Uses T-REF terminal for torque feedforward input.		

Pn400	Torque Reference Input Gain	Speed Position Torque			Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	10 to 100	0.1 V/rated torque	30	Immediately	Setup

Note 1. Too high a torque feedforward value will result in overshooting. To prevent such troubles, set the optimum value while observing the system responsiveness.
2. The torque feedforward function cannot be used with torque limiting by analog voltage reference.

Pn415	T-REF Filter Time Constant	Speed Position Torque			Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 65535	0.01 ms	0	Immediately	Setup

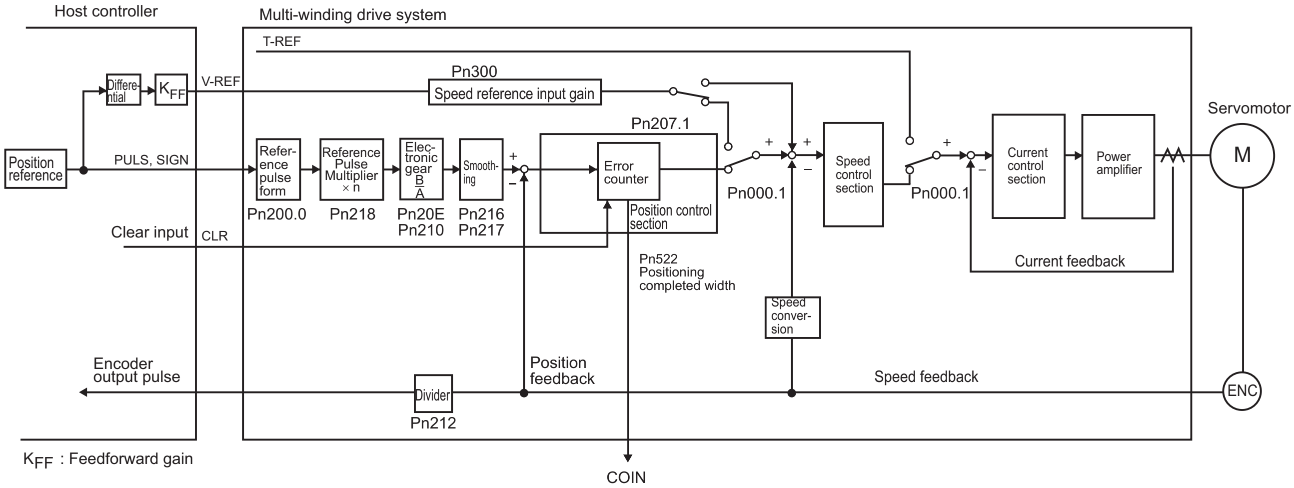
6.7.3 Speed Feedforward

The speed forward function shortens positioning time.
This function is enabled only when the multi-winding drive unit performs position control.

The host controller finds the difference from the position reference to generate a speed feedforward reference, and inputs the speed feedforward reference together with the position reference to the multi-winding drive unit.

(1) Example of Connection with Host Controller

Connect a position reference to PULS and SIGN (CN1-7, -8, -11, and -12) and a speed feedforward reference to V-REF (CN1-5 and -6) from the host controller.



(2) Related Parameters

Speed feedforward value is set using the parameters Pn207 and Pn300.

The factory setting is Pn300 = 6.00 V/rated speed.
For example, the speed feedforward value is ±6 V, then the speed is limited to the rated speed.

Parameter		Meaning	When Enabled	Classification
Pn207	n.□□0□ [Factory setting]	Disabled	After restart	Setup
	n.□□1□	Uses V-REF terminal for speed feedforward input.		

Pn300	Speed Reference Input Gain		Speed / Position / Torque		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	150 to 3000	0.01 V/rated speed	600	Immediately	Setup

Note: Too high a speed feedforward value will result in overshooting. To prevent such troubles, set the optimum value while observing the system responsiveness.

6.7.4 Proportional Control

The /P-CON signal can be sent from the host control to select proportional control.

The speed control section uses a PI control if the reference stays zero in the speed control. This integral effect may cause the servomotor to move. Switch the PI control to a proportional control to prevent this from occurring.

If the speed control is set with a zero clamp function, however, a position loop will be formed so there is no need to use this function. The speed control is set to proportional control if the /P-CON signal is ON.

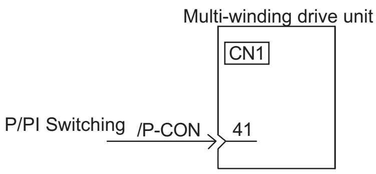
Proportional control operation is set using parameter Pn000.1 and input signal /P-CON.

(1) /P-CON Input Signal

Input signal /P-CON is used to switch between PI control and P control.

Type	Signal Name	Connector Pin Number	Setting	Meaning
Input	/P-CON	CN1-41 [Factory setting]	OFF (High level)	Switches to PI control (proportional-integral control).
			ON (Low level)	Switches to P control (proportional control).

Example: Factory-set Input Signal Allocations



Note: This is an example when the input signal allocations are at the default factory settings.

(2) Control Method and Proportional Control Input Signal

Proportional control operation is enabled when the control method is set to speed or position control.

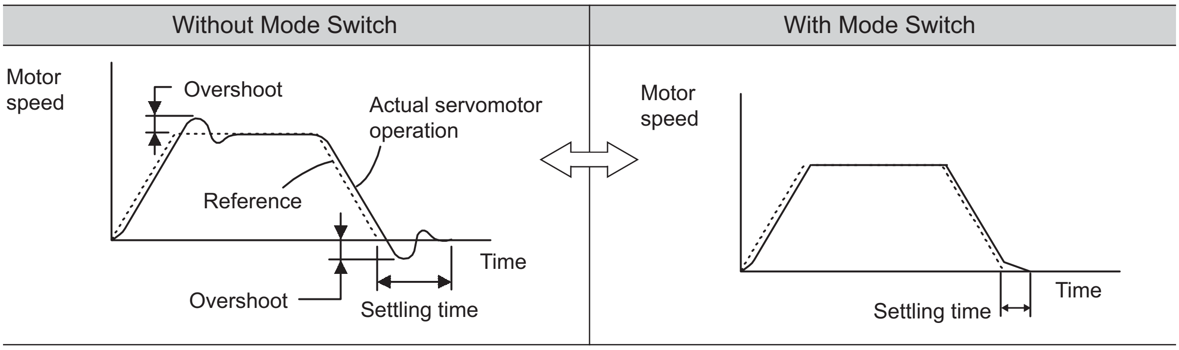
Parameter		Contents	Switching to the Proportional Control
Pn000	n.□□0□ [Factory setting]	Speed control	Can be switched with the factory setting (CN1-41=/P-CON). /P-CON signal can be allocated to other terminals as required.
	n.□□1□	Position control	
	n.□□2□	Torque control	Cannot switch to proportional control.
	n.□□3□	Internal set speed control	Allocation of /P-CON to one of terminals CN1-40 to 46 are needed.
	n.□□4□	Internal set speed control ↔ Speed control	
	n.□□5□	Internal set speed control ↔ Position control	
	n.□□6□	Internal set speed control ↔ Torque control	
	n.□□7□	Position control ↔ Speed control	
	n.□□8□	Position control ↔ Torque control	
	n.□□9□	Torque control ↔ Speed control	
	n.□□A□	Speed control ↔ Speed control with zero clamp function	
	n.□□B□	Position control ↔ Position control with reference pulse inhibit function	

Note: Refer to *5.7 Combination of Control Methods* for how to switch control methods.

6.7.5 Mode Switch (P/PI Switching)

The mode switch automatically switches between proportional and PI control. Set the switching condition with Pn10B.0 and set the level of detection points with Pn10C, Pn10D, Pn10E, and Pn10F.

Overshooting caused by acceleration and deceleration can be suppressed and the settling time can be reduced by setting the switching condition and detection points.



(1) Related Parameters

Select the switching condition of the mode switch with Pn10B.0.

Parameter		Mode Switch Selection	Parameter Containing Detection Point Setting	When Enabled	Classification
Pn10B	n.□□□0 [Factory setting]	Uses an internal torque reference level for the switching conditions.	Pn10C	Immediately	Setup
	n.□□□1	Uses a speed reference level for the switching conditions.	Pn10D		
	n.□□□2	Uses an acceleration level for the switching conditions.	Pn10E		
	n.□□□3	Uses a position error level for the switching conditions.	Pn10F		
	n.□□□4	Does not use mode switch function.	–		

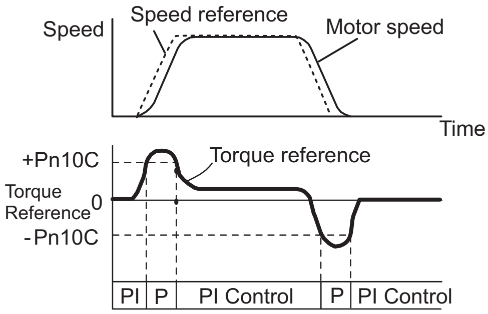
■ Parameters to Set the Level of Detection Points

Pn10C	Mode Switch (Torque Reference) Speed Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 800	1%	200	Immediately	Tuning
Pn10D	Mode Switch (Speed Reference) Speed Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 10000	1 min^{-1}	0	Immediately	Tuning
Pn10E	Mode Switch (Acceleration) Speed Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 30000	1 min^{-1}/s	0	Immediately	Tuning
Pn10F	Mode Switch (Position Error) Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 10000	1 reference unit	0	Immediately	Tuning

(2) Operating Examples for Different Switching Conditions

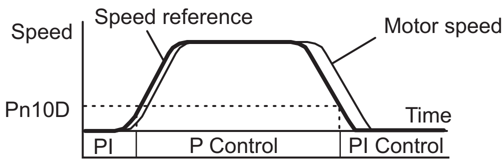
■ Using the Torque Reference [Factory Setting]

With this setting, the speed loop is switched to P control when the value of torque reference input exceeds the torque set in Pn10C. The factory setting for the torque reference detection point is 200% of the rated torque.



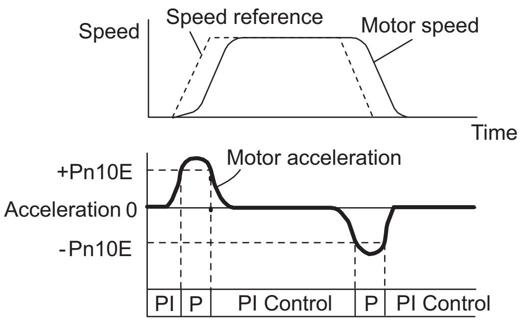
■ Using the Speed Reference

With this setting, the speed loop is switched to P control when the value of speed reference input exceeds the speed set in Pn10D.



■ Using Acceleration

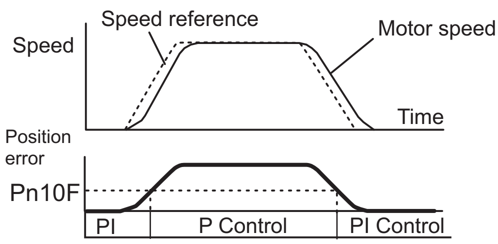
With this setting, the speed loop is switched to P control when the speed reference exceeds the acceleration set in Pn10E.



■ Using the Position Error

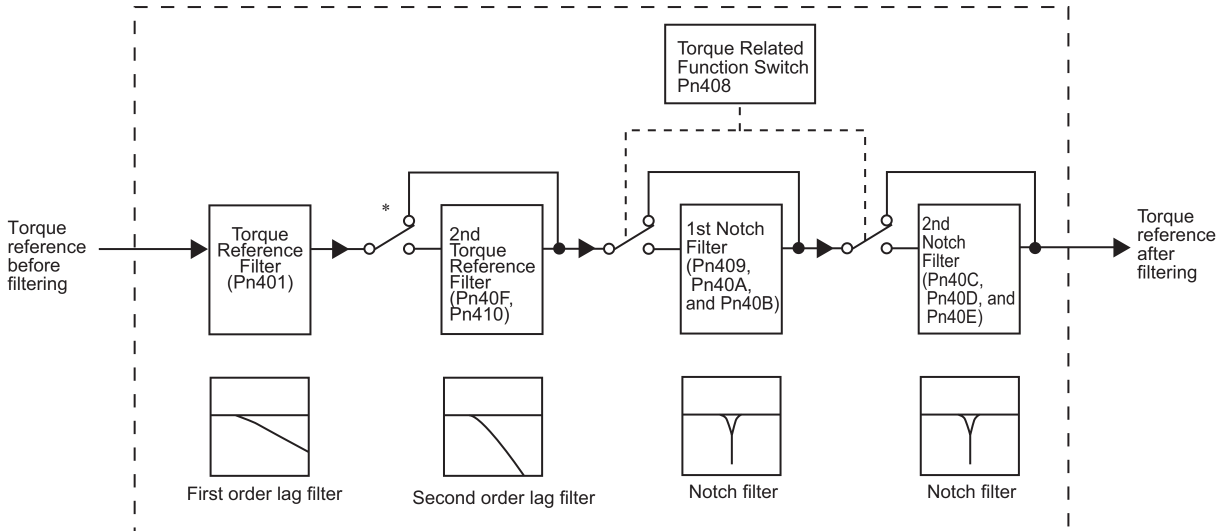
With this setting, the speed loop is switched to P control when the position error exceeds the value set in Pn10F.

This setting is effective with position control only.



6.7.6 Torque Reference Filter

As shown in the following diagram, the torque reference filter contains first order lag filter and notch filters arrayed in series, and each filter operates independently. The notch filters can be enabled and disabled with the Pn408.



* The 2nd torque reference filter is enabled when Pn40F is set to a value less than 5000 and disabled when Pn40F is set to 5000 (factory setting).

(1) Torque Reference Filter

If you suspect that machine vibration is being caused by the servo drive, try adjusting the filter time constants with Pn401. This may stop the vibration. The lower the value, the better the response will be, but there may be a limit that depends on the machine conditions.

Pn401	Torque Reference Filter Time Constant (Speed, Position, Torque)				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 65535	0.01 ms	100	Immediately	Tuning

■ Torque Reference Filter Setting Guide

Use the speed loop gain (Pn100 [Hz]) and the torque filter time constant (Pn401 [ms]) to set the torque reference filter.

Adjusted value for stable control: Pn401 [ms] $\leq$ 1000/ ($2\pi \times$ Pn100 [Hz] $\times$ 4)
Critical gains: Pn401 [ms] < 1000/ ($2\pi \times$ Pn100 [Hz] $\times$ 1)

Pn40F	2nd Step 2nd Torque Reference Filter Frequency (Speed, Position, Torque)				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	100 to 5000	1 Hz	5000*	Immediately	Tuning
Pn410	2nd Step 2nd Torque Reference Filter Q Value (Speed, Position, Torque)				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	50 to 100	0.01	50	Immediately	Tuning

* The filter is disabled if 5000 is set.

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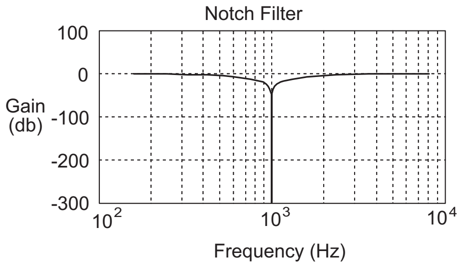
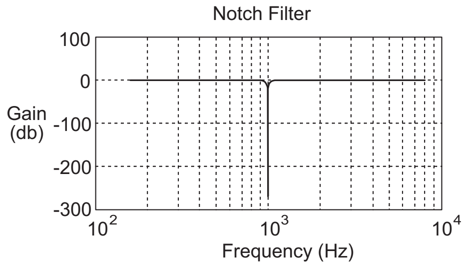
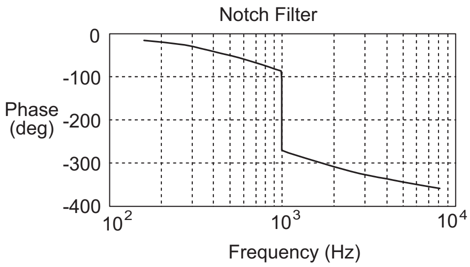
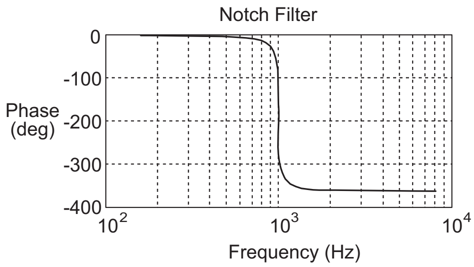
(2) Notch Filter

The notch filter can eliminate specific frequency elements generated by the vibration of sources such as resonance of the shaft of a ball screw. The notch filter puts a notch in the gain curve at the specific vibration frequency. The frequency characteristics near the notch can be reduced or removed with this filter. A higher Q value produces a sharper notch and phase delay.

Q value = 0.7	Q value = 1.0
	
	

The notch filter can be enabled or disabled with Pn408.

Parameter		Meaning	When Enabled	Classification
Pn408	n.□□□0 [Factory setting]	Disables 1st notch filter.	Immediately	Setup
	n.□□□1	Enables 1st notch filter.		
	n.□0□□ [Factory setting]	Disables 2nd notch filter.		
	n.□1□□	Enables 2nd notch filter.		

Set the machine's vibration frequency as a parameter of the notch filter.

Pn409	1st Notch Filter Frequency		Speed Position Torque		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	50 to 5000	1 Hz	5000	Immediately	Tuning

Pn40A	1st Notch Filter Q Value		Speed Position Torque		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	50 to 1000	0.01	70	Immediately	Tuning

Pn40B	1st Notch Filter Depth		Speed Position Torque		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 1000	0.001	0	Immediately	Tuning

Pn40C	2nd Notch Filter Frequency		Speed Position Torque		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	50 to 5000	1 Hz	5000	Immediately	Tuning

Pn40D	2nd Notch Filter Q Value		Speed Position Torque		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	50 to 1000	0.01	70	Immediately	Tuning

(cont'd)

Pn40E	2nd Notch Filter Depth	Speed Position Torque			Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 1000	0.001	0	Immediately	Tuning

IMPORTANT

- Sufficient precautions must be taken when setting the notch filter frequencies. Do not set the notch filter frequencies (Pn409 or Pn40C) that is close to the speed loop's response frequency. Set the frequencies at least four times higher than the speed loop's response frequency. Setting the notch filter frequency too close to the response frequency may cause vibration and damage the machine.
- Change the notch filter frequencies (Pn409 or Pn40C) only when the servomotor is stopped. Vibration may occur if the notch filter frequency is changed when the servomotor is rotating.

7

Utility Functions (Fn□□□)

7.1 List of Utility Functions

Utility functions are used to execute the functions related to servomotor operation and adjustment.
Each utility function has a number starting with Fn.

The following table lists the utility functions and reference section.

Function No.	Function	Operation from the Panel Operator	Operation from the Digital Operator or SigmaWin+	Reference Section
Fn000	Alarm history display	○	○	7.2
Fn002	JOG operation	○	○	7.3
Fn003	Origin search	○	○	7.4
Fn004	Program JOG operation	○	○	7.5
Fn005	Initializing parameter settings	○	○	7.6
Fn006	Clearing alarm history	○	○	7.7
Fn008	Absolute encoder multiturn reset and encoder alarm reset	○	○	5.9.4
Fn009	Automatic tuning of analog (speed, torque) reference offset	○	○	5.3.2 5.5.2
Fn00A	Manual servo tuning of speed reference offset	○	○	5.3.2
Fn00B	Manual servo tuning of torque reference offset	○	○	5.5.2
Fn00C	Offset adjustment of analog monitor output	○	○	7.8
Fn00D	Gain adjustment of analog monitor output	○	○	7.9
Fn010	Write prohibited setting	○	○	7.10
Fn011	Servomotor model display	○	○	7.11
Fn012	Software version display	○	○	7.12
Fn013	Multiturn limit value setting change when a multiturn limit disagreement alarm occurs	○	○	5.9.7
Fn01B	Vibration detection level initialization	○	○	7.13
Fn01E	Display of multi-winding drive unit and servomotor ID	×	○	7.14
Fn201	Advanced autotuning	×	○	6.2.2
Fn203	One-parameter tuning	○*	○	6.3.2
Fn204	Anti-resonance control adjustment function	×	○	6.4.2
Fn205	Vibration suppression function	×	○	6.5.2
Fn206	EasyFFT	○	○	7.15
Fn207	Online vibration monitor	○	○	7.16

○: Available ×: Not available

* There are functional limitations if the function is executed on the panel operator.

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

7.2 Alarm History Display (Fn000)

This function displays the last ten alarms that have occurred in the servo drive.
The latest ten alarm numbers and time stamps* can be checked.

* Time Stamps

A function that measures the ON times of the control power supply and main circuit power supply in 100-ms units and displays the total operating time when an alarm occurs. The time stamp operates around the clock for approximately 13 years.

<Example of Time Stamps>

If 36000 is displayed,

3600000 [ms] = 3600 [s] = 60 [min] = 1 [h]

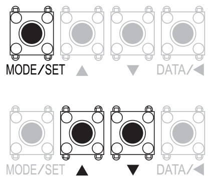
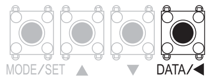
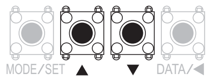
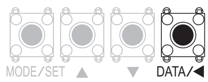
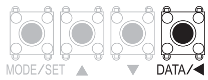
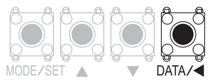
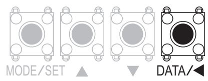
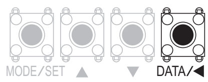
Therefore, the total number of operating hours is 1 hour.

(1) Preparation

There are no tasks that must be performed before displaying the alarm history.

(2) Operating Procedure

Use the following procedure.

Step	Display after Operation	Keys	Operation
1	Fn000		Press the MODE/SET Key to select the utility function. If a number other than Fn000 is displayed, press the UP Key or DOWN Key to select Fn000.
2	0. 810		Press the DATA/SHIFT Key for approximately one second. The latest alarm data is displayed.
3	1. C90 Alarm Sequence Number The higher the number, the older the alarm data. Alarm Code See the alarm table.		Press the DOWN Key to display one older alarm data. (To display one newer alarm data, press the UP Key.) The higher the far-left digit, the older the alarm data.
4	_3456		Press the DATA/SHIFT Key. The lower four digits of Time Stamp are displayed.
5	-7890		Press the DATA/SHIFT Key. The middle four digits of Time Stamp are displayed.
6	‾ 00		Press the DATA/SHIFT Key. The higher two digits of Time Stamp are displayed.
7	1. C90		Press the DATA/SHIFT Key. The alarm number is displayed again.
8	Fn000		Press the DATA/SHIFT Key for approximately one second. "Fn000" is displayed again.

Note:

- If the same alarm occurs after more than one hour, the alarm will be saved. If it occurs in less than one hour, it will not be saved.
- The display "□.---" means no alarm occurs.
- Delete the alarm history using the parameter Fn006. The alarm history is not deleted when the alarm reset is executed or the control power supply of the multi-winding drive unit is turned OFF.

7.3 JOG Operation (Fn002)

JOG operation is used to check the operation of the servomotor under speed control without connecting the multi-winding drive unit to the host controller.

⚠ CAUTION
• While the multi-winding drive unit is in JOG operation, the overtravel function will be disabled. Consider the operating range of the machine when performing JOG operation for the multi-winding drive unit.

(1) Preparation

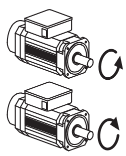
The following conditions must be met to perform a jog operation.

- The write prohibited setting parameter (Fn010) must be set to Write permitted (P.0000).
- The main circuit power supply must be ON.
- All alarms must be cleared.
- The hardwire baseblock (HWBB) must be disabled.
- The servo ON signal (/S-ON) must be OFF.
- The JOG speed must be set considering the operating range of the machine.
  Set the jog speed in Pn304.

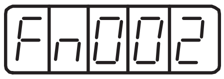
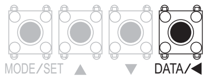
Pn304	Jog Speed		Speed Position Torque		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 10000	1 min^{-1}	500	Immediately	Setup

(2) Operating Procedure

Use the following procedure. The following example is for when Pn000.0 is set to 0 (CCW is forward direction) as the rotation direction of the motor.

Step	Display after Operation	Keys	Operation
1	Fn000	MODE/SET	Press the MODE/SET Key to select the utility function.
2	Fn002	▲ ▼	Press the UP or DOWN Key to select Fn002.
3	JoG	DATA/◄	Press the DATA/SHIFT Key for approximately one second. The display shown on the left appears.
4	JoG	MODE/SET	Press the MODE/SET Key to turn the servomotor power ON.
5	JoG	▲ ▼	The servomotor will rotate at the speed set in Pn304 while the UP Key (for forward rotation) or DOWN Key (for reverse rotation) is pressed.  Forward Reverse
6	JoG	MODE/SET DATA/◄	Press the MODE/SET Key to turn the servomotor power OFF. Note: The servomotor power can be turned OFF by pressing the DATA/SHIFT Key for approximately one second.

(cont'd)

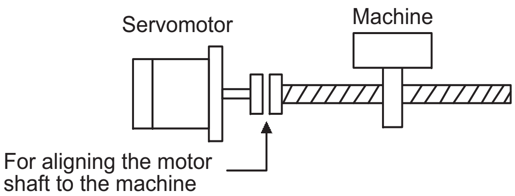
Step	Display after Operation	Keys	Operation
7			Press the DATA/SHIFT Key for approximately one second. "Fn002" is displayed again.
8	When you finish the JOG operation, turn the control power supply OFF and ON again.		

7.4 Origin Search (Fn003)

The origin search is designed to position the origin pulse position of the incremental encoder (phase C) and to clamp at the position.

⚠ CAUTION
• Perform origin searches without connecting the coupling. The forward run prohibited (P-OT) and reverse run prohibited (N-OT) signals are not effective in origin search mode.

This function is used when the motor shaft needs to be aligned to the machine.
Motor speed at the time of execution: 60 min^{-1}



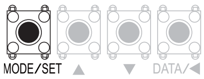
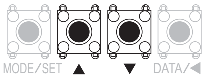
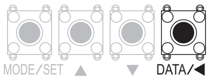
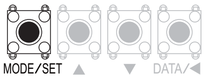
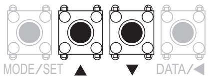
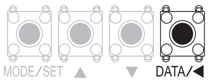
(1) Preparation

The following conditions must be met to perform the origin search.

- The write prohibited setting parameter (Fn010) must be set to Write permitted (P.0000).
- The main circuit power supply must be ON.
- All alarms must be cleared.
- The hardwire baseblock (HWBB) must be disabled.
- The servo ON signal (/S-ON) must be OFF.

(2) Operating Procedure

Use the following procedure.

Step	Display after Operation	Keys	Operation
1	Fn000		Press the MODE/SET Key to select the utility function.
2	Fn003		Press the UP or DOWN Key to select Fn003.
3	-. .CSr		Press the DATA/SHIFT Key for approximately one second, and the display shown on the left appears.
4	. .CSr		Press the MODE/SET Key to turn the servomotor power ON. The display shown on the left appears.
5	. .CSr		Pressing the UP Key will rotate the servomotor in the forward direction. Pressing the DOWN Key will rotate the servomotor in the reverse direction. The rotation direction of the servomotor changes according to the setting of Pn000.0 as shown in the following table. Parameter / UP Key / DOWN Key Pn000 n.□□□0: CCW / CW Pn000 n.□□□1: CW / CCW Note: Direction when viewed from the load of the servomotor.
6	. .CSr Display flashes.	–	When the servomotor origin search is completed, the display flashes. At this moment, the servomotor is servo-locked at the origin pulse position.
7	Fn003		Press the DATA/SHIFT Key for approximately one second. "Fn003" is displayed again.
8	When you finish the origin search, turn the control power supply OFF and ON again.		

Step 5 table:

Parameter		UP Key	DOWN Key
Pn000	n.□□□0	CCW	CW
	n.□□□1	CW	CCW

7.5 Program JOG Operation (Fn004)

The program JOG operation is a utility function, that allows continuous operation determined by the preset operation pattern, movement distance, movement speed, acceleration/deceleration time, waiting time, and number of times of movement.
This function can be used to move the servomotor without it having to be connected to a host controller for the machine as a trial operation in JOG operation mode. Program JOG operation can be used to confirm the operation and for simple positioning operations.

(1) Preparation

The following conditions must be met to perform the program JOG operation.

- The write prohibited setting parameter (Fn010) must be set to Write permitted (P.0000).
- The main circuit power supply must be ON.
- All alarms must be cleared.
- The hardwire baseblock (HWBB) must be disabled.
- The servo ON signal (/S-ON) must be OFF.
- The travel distance and speed must be set correctly considering the machine operation range and safe operation speed.
- There must be no overtravel.

(2) Additional Information

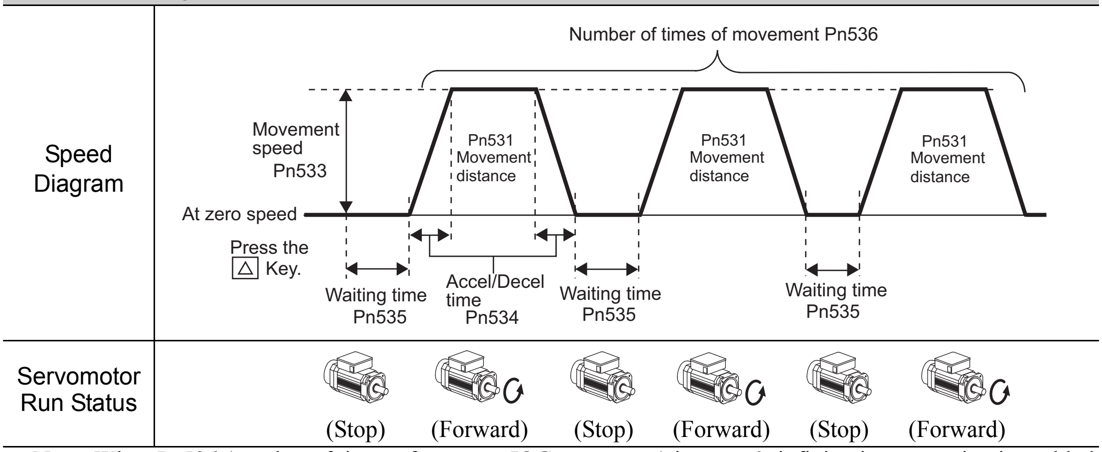
- The program JOG operation is carried out in position control. However, the pulse reference input to the multi-winding drive unit cannot be used.
- The functions that are applicable for position control, such as position reference filter, can be used.
- The overtravel function is enabled in this function.
- When using an absolute encoder, the SEN signal needs not be input since it is always enabled.
- The reference pulse input multiplication switching function is disabled.

(3) Program JOG Operation Patterns

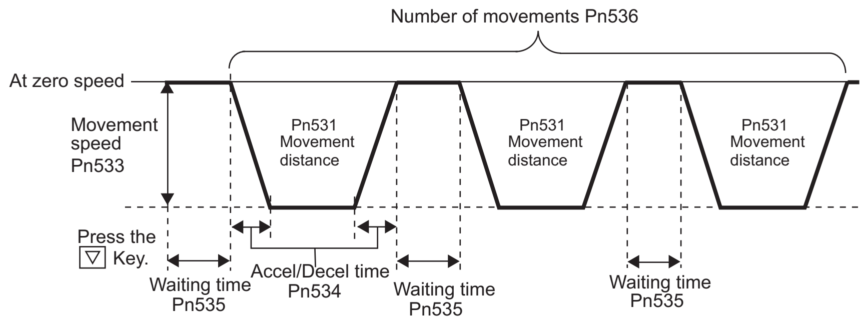
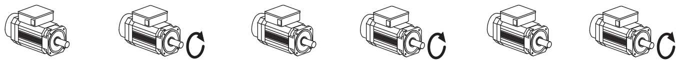
The following describes an example of program JOG operation pattern. The following example is given when the rotating direction of the servomotor is set as Pn000.0 = 0 (Forward rotation by forward reference).

Pn530.0 = 0

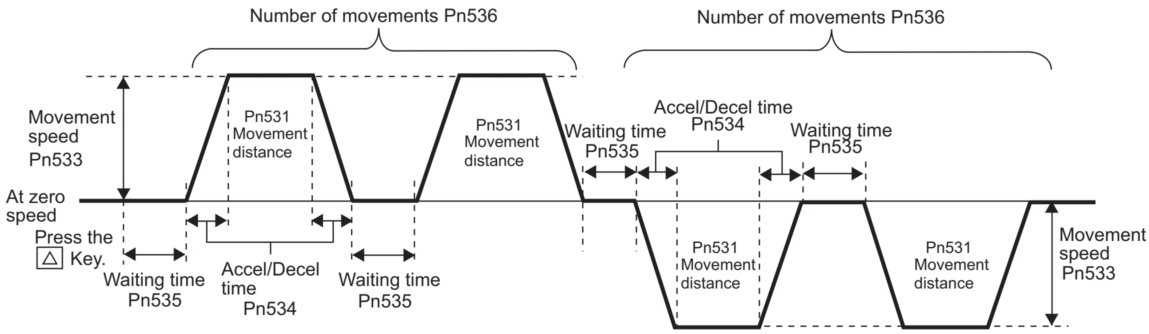
(Waiting time Pn535 → Forward movement Pn531) × Number of movements Pn536



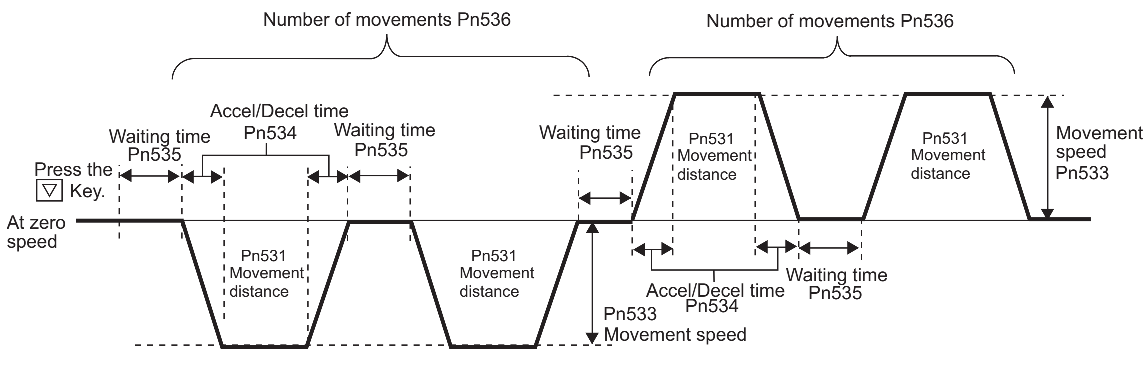
Note: When Pn536 (number of times of program JOG movement) is set to 0, infinite time operation is enabled. To stop infinite time operation, press the MODE/SET Key (or JOG/SVON Key of digital operator) to turn OFF the servomotor power.

Pn530.0 = 1	
(Waiting time Pn535 → Reverse movement Pn531) × Number of movements Pn536	
Speed Diagram	
Servomotor Run Status	 (Stop) (Reverse) (Stop) (Reverse) (Stop) (Reverse)

Note: When Pn536 (Number of Times of Program JOG Movement) is set to 0, infinite time operation is enabled. To stop infinite time operation, press the MODE/SET Key (or JOG/SVON Key of digital operator) to turn the servomotor power OFF.

Pn530.0 = 2	
(Waiting time Pn535 → Forward movement Pn531) × Number of movements Pn536 (Waiting time Pn535 → Reverse movement Pn531) × Number of movements Pn536	
Speed Diagram	
Servomotor Run Status	 (Stop) (Forward) (Stop) (Forward) (Stop) (Reverse) (Stop) (Reverse)

Note: When Pn530.0 is set to 2, infinite time operation is disabled.

Pn530.0 = 3	
(Waiting time Pn535 → Reverse movement Pn531) × Number of movements Pn536 (Waiting time Pn535 → Forward movement Pn531) × Number of movements Pn536	
Speed Diagram	
Servomotor Run Status	 (Stop) (Reverse) (Stop) (Reverse) (Stop) (Forward) (Stop) (Forward)

Note: When Pn530.0 is set to 3, infinite time operation is disabled.

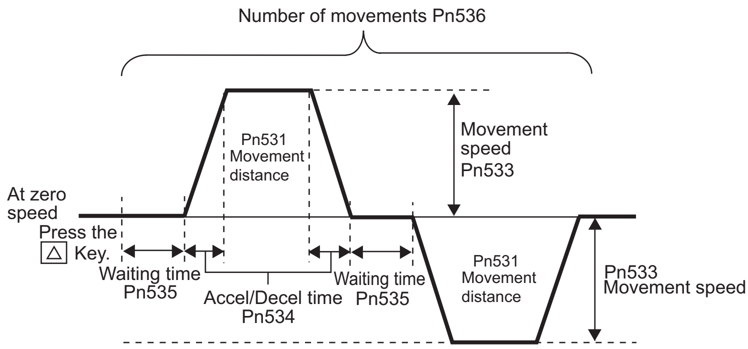
Utility Functions (Fn□□□)

7

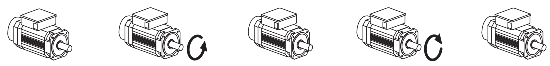
Pn530.0 = 4

(Waiting time Pn535 → Forward movement Pn531 → Waiting time Pn535 → Reserve movement Pn531) × Number of movements Pn536

Speed Diagram



Servomotor Run Status



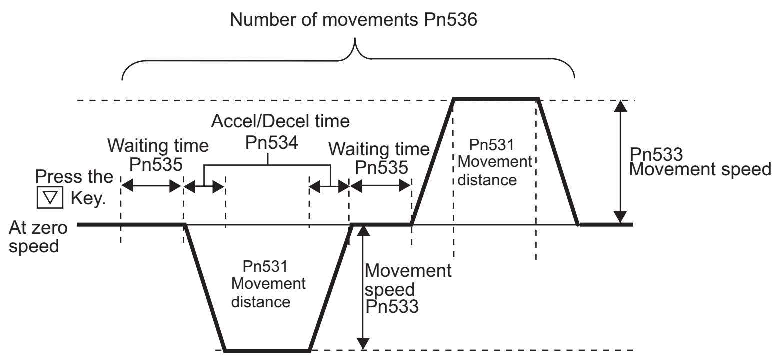
(Stop) (Forward) (Stop) (Reverse) (Stop)

Note: When Pn536 (number of times of program JOG movement) is set to 0, infinite time operation is enabled. To stop infinite time operation, press the MODE/SET Key (or JOG/SVON Key of digital operator) to turn OFF the servomotor power.

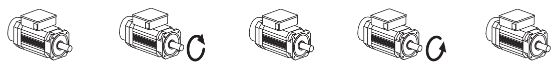
Pn530.0 = 5

(Waiting time Pn535 → Reverse movement Pn531 → Waiting time Pn535 → Forward movement Pn531) × Number of movements Pn536

Speed Diagram



Servomotor Run Status



(Stop) (Reverse) (Stop) (Forward) (Stop)

Note: When Pn536 (number of times of program JOG movement) is set to 0, infinite time operation is enabled. To stop infinite time operation, press the MODE/SET Key (or JOG/SVON Key of digital operator) to turn the servomotor power OFF.

(4) Related Parameters

The following parameters set the program JOG operation pattern. Do not change the settings while the program JOG operation is being executed.

Pn530	Program JOG Operation Related Switch		Speed Position Torque		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0000 to 0005	–	0000	Immediately	Setup
Pn531	Program JOG Movement Distance		Speed Position Torque		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	1 to 1073741824	1 reference unit	32768	Immediately	Setup

(cont'd)

Pn533	Program JOG Movement Speed		Speed Position Torque		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	1 to 10000	1 min^{-1}	500	Immediately	Setup
Pn534	Program JOG Acceleration/Deceleration Time		Speed Position Torque		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	2 to 10000	1 ms	100	Immediately	Setup
Pn535	Program JOG Waiting Time		Speed Position Torque		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 10000	1 ms	100	Immediately	Setup
Pn536	Number of Times of Program JOG Movement		Speed Position Torque		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 1000	1 time	1	Immediately	Setup

(5) Operating Procedure

Use the following procedure to perform the program JOG operation after setting a program JOG operation pattern.

Step	Display after Operation	Keys	Operation
1	Fn000	MODE/SET	Press the MODE/SET Key to select the utility function.
2	Fn004	▲ ▼	Press the UP or DOWN Key to select Fn004.
3	-.P.JOG	DATA/◀	Press the DATA/SHIFT Key for approximately one second. The display shown on the left appears.
4	‾.P.JOG	MODE/SET	Press the MODE/SET Key to turn the servomotor power ON. The display shown on the left appears.
5	.PJOG	MODE/SET ▲ ▼ DATA/◀	Press the UP or DOWN Key according to the first movement direction of the operation pattern. After the preset waiting time, the movement starts. Notes: • Press the MODE/SET Key during operation, and the servomotor power will turn OFF and the servomotor stops. • Press the DATA/SHIFT Key for approximately one second during operation, and the display of step 2 appears.
6	‾.P.JOG	–	"End" flashes when the program JOG operation has been completed, and the screen returns to the display as shown on the left. Notes: • Press the MODE/SET Key, and the servomotor power will turn OFF and the display of step 3 appears. • Press the DATA/SHIFT Key for approximately one second, and the display of step 2 appears.
7	When you finish program operation, turn the control power supply OFF and ON again.		

7.6 Initializing Parameter Settings (Fn005)

This function is used when returning to the factory settings after changing parameter settings.

IMPORTANT

- Be sure to initialize the parameter settings while the servo ON (/S-ON) signal is OFF.
- After initialization, always turn the control power supply OFF and ON again to validate the settings.

Note: Any value adjusted with Fn009, Fn00A, Fn00B, Fn00C, Fn00D, Fn00E, and Fn00F cannot be initialized by Fn005.

(1) Preparation

The following conditions must be met to initialize the parameter values.

- The write prohibited setting parameter (Fn010) must be set to Write permitted (P.0000).
- The servo ON signal (/S-ON) must be OFF.

(2) Operating Procedure

Use the following procedure.

Step	Display after Operation	Keys	Operation
1	Fn000	MODE/SET	Press the MODE/SET Key to select the utility function.
2	Fn005	▲ ▼	Press the UP or DOWN Key to select Fn005.
3	P.Init	DATA/◄	Press the DATA/SHIFT Key for approximately one second. The display shown on the left appears.
4	P.Init	MODE/SET	Press the MODE/SET Key. Then, the parameters will be initialized. When the initialization has been completed, "donE" flashes on the display and returns to the screen as shown on the left.
5	When you finish initializing the parameter settings, turn the control power supply OFF and ON again.		

7.7 Clearing Alarm History (Fn006)

The clear alarm history function deletes all of the alarm history recorded in the multi-winding drive unit.

Note: The alarm history is not deleted when the alarm reset is executed or the control power supply of the multi-winding drive unit is turned OFF.

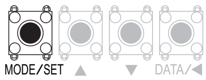
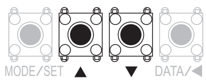
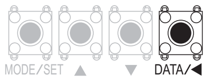
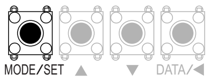
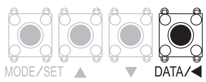
(1) Preparation

The follow conditions must be met to clear the alarm history.

• The write prohibited setting parameter (Fn010) must be set to Write permitted (P.0000).

(2) Operating Procedure

Use the following procedure.

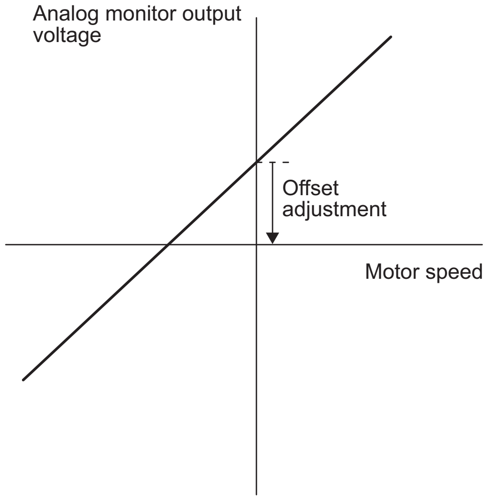
Step	Display after Operation	Keys	Operation
1	Fn000		Press the MODE/SET Key to select the utility function.
2	Fn006		Press the UP or DOWN Key to select Fn006.
3	trCLr		Press the DATA/SHIFT Key for approximately one second. The display shown on the left appears.
4	trCLr		Press the MODE/SET Key to clear the alarm history. When the data is cleared, "donE" flashes on the display and returns to the screen as shown on the left.
5	Fn006		Press the DATA/SHIFT Key for approximately one second. "Fn006" is displayed again.

7.8 Offset Adjustment of Analog Monitor Output (Fn00C)

This function is used to manually adjust the offsets for the analog monitor outputs (torque reference monitor output and motor speed monitor output). The offset values are factory-set before shipping. Therefore, the user need not usually use this function.

(1) Adjustment Example

An example of offset adjustment to the motor speed monitor is shown below.



Item	Specifications
Offset Adjustment Range	-2.4 V to + 2.4 V
Adjustment Unit	18.9 mV/LSB

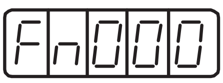
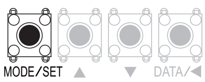
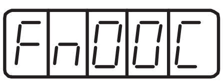
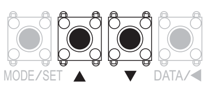
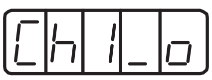
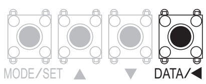
Note:
- The adjustment value will not be initialized when parameter settings are initialized using Fn005.
- Make offset adjustment with a measuring instrument connected, so that the analog monitor output is zero. An example of settings for a zero analog monitor output is shown below.
  - While the servomotor is not turned ON, set the monitor signal to the torque reference.
  - In speed control, set the monitor signal to the position error.

(2) Preparation

The following condition must be met to adjust the offsets of the analog monitor output.
- The write prohibited setting parameter (Fn010) must be set to Write permitted (P.0000).

(3) Operating Procedure

Use the following procedure to perform the offset adjustment of analog monitor output.

Step	Display after Operation	Keys	Operation
1			Press the MODE/SET Key to select the utility function.
2			Press the UP or DOWN Key to select Fn00C.
3			Press the DATA/SHIFT Key for approximately one second. The display shown on the left appears.

(cont'd)

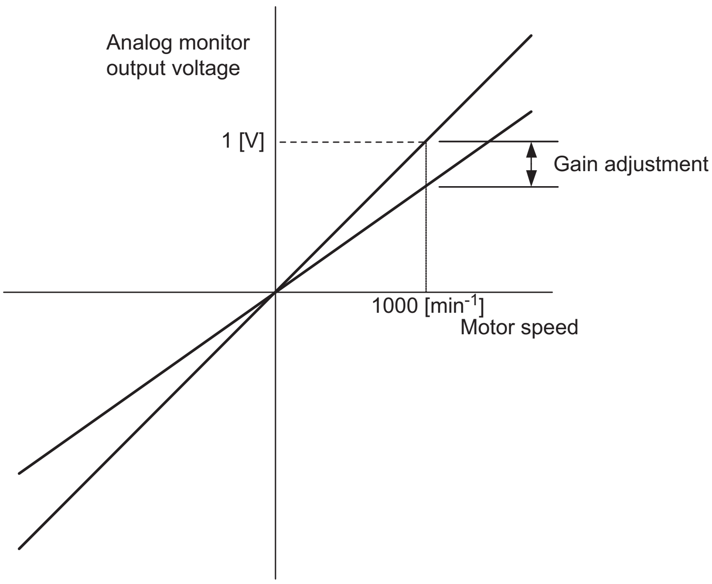
Step	Display after Operation	Keys	Operation
4	0000	DATA/◀	Press the DATA/SHIFT Key. Offset data will be displayed as shown on the left.
5	-0001	▲ ▼	Press the UP or DOWN Key to change the data.
6	Ch1_o	DATA/◀	Press the DATA/SHIFT Key to return to the screen as shown on the left.
7	Ch2_o	MODE/SET	Press the MODE/SET Key to switch to channel 2 (analog monitor 2) monitor output.
8	0000	DATA/◀	Press the DATA/SHIFT Key. Offset data will be displayed as shown on the left.
9	-0001	▲ ▼	Press the UP or DOWN Key to change the data.
10	Fn00C	DATA/◀	Press the DATA/SHIFT Key for approximately one second. "Ch2-o" is displayed, and then "Fn00C" is displayed again.

7.9 Gain Adjustment of Analog Monitor Output (Fn00D)

This function is used to manually adjust the gains for the analog monitor outputs (torque reference monitor output and motor rotating speed monitor output). The gain values are factory-set before shipping. Therefore, the user need not usually use this function.

(1) Adjustment Example

An example of gain adjustment to the motor rotating speed monitor is shown below.



Item	Specifications
Gain-adjustment Range	100±50%
Adjustment Unit	0.4%/LSB

The gain adjustment range is made with a 100% output set as a center value (adjustment range: 50% to 150%). The following is a setting example.

<Setting the Set Value to -125>

100% + (–125 × 0.4) = 50%

Therefore, the monitor output voltage is 0.5 time as high.

<Setting the Set Value to 125>

100% + (125 × 0.4) = 150%

Therefore, the monitor output voltage is 1.5 times as high.

Note: The adjustment value will not be initialized when parameter settings are initialized using Fn005.

(2) Preparation

The following condition must be met to adjust the gain of the analog monitor output.

- The write prohibited setting parameter (Fn010) must be set to Write permitted (P.0000).

(3) Operating Procedure

Use the following procedure to perform the gain adjustment of analog monitor output.

Step	Display after Operation	Keys	Operation
1	Fn000	MODE/SET	Press the MODE/SET Key to select the utility function.
2	Fn00d	▲ ▼	Press the UP or DOWN Key to select Fn00D.
3	Ch1_G	DATA/◀	Press the DATA/SHIFT Key for approximately one second. The screen shown on the left will be displayed.
4	0000	DATA/◀	Press the DATA/SHIFT Key. Gain adjustment data will be displayed as shown on the left.
5	-0001	▲ ▼	Press the UP or DOWN Key to change the gain.
6	Ch1_G	DATA/◀	Press the DATA/SHIFT Key to return to the screen as shown on the left.
7	Ch2_G	MODE/SET	Press the MODE/SET Key to switch to channel 2 (analog monitor 2) monitor output.
8	0000	DATA/◀	Press the DATA/SHIFT Key. Gain adjustment data will be displayed as shown on the left.
9	-0001	▲ ▼	Press the UP or DOWN Key to change the gain.
10	Fn00d	DATA/◀	Press the DATA/SHIFT Key for approximately one second. "Ch2-G" is displayed, and then "Fn00D" is displayed again.

7.10 Write Prohibited Setting (Fn010)

This function prevents changing parameters by mistake and sets restrictions on the execution of the utility function.

Parameter changes and execution of the utility function become restricted in the following manner when Write prohibited (P.0001) is assigned to the write prohibited setting parameter (Fn010).

- Parameters: Cannot be changed. If you attempt to change it, "NO-OP" will flash on the display and the screen will return to the main menu.
- Utility Function: Some functions cannot be executed. (Refer to the following table.) If you attempt to execute these utility functions, "NO-OP" will flash on the display and the screen will return to the main menu.

Parameter No.	Function	Write Prohibited Setting	Reference Section
Fn000	Alarm history display	Executable	7.2
Fn002	JOG operation	Cannot be executed	7.3
Fn003	Origin search	Cannot be executed	7.4
Fn004	Program JOG operation	Cannot be executed	7.5
Fn005	Initializing parameter settings	Cannot be executed	7.6
Fn006	Clearing alarm history	Cannot be executed	7.7
Fn008	Absolute encoder multiturn reset and encoder alarm reset	Cannot be executed	5.9.4
Fn009	Automatic tuning of analog (speed, torque) reference offset	Cannot be executed	5.3.2 5.5.2
Fn00A	Manual servo tuning of speed reference offset	Cannot be executed	5.3.2
Fn00B	Manual servo tuning of torque reference offset	Cannot be executed	5.5.2
Fn00C	Offset adjustment of analog monitor output	Cannot be executed	7.8
Fn00D	Gain adjustment of analog monitor output	Cannot be executed	7.9
Fn010	Write prohibited setting	–	7.10
Fn011	Servomotor model display	Executable	7.11
Fn012	Software version display	Executable	7.12
Fn013	Multiturn limit value setting change when a multiturn limit disagreement alarm occurs	Cannot be executed	5.9.7
Fn01B	Vibration detection level initialization	Cannot be executed	7.13
Fn01E	Display of multi-winding drive unit and servomotor ID	Executable	7.14
Fn201	Advanced autotuning	Cannot be executed	6.2.2
Fn203	One-parameter tuning	Cannot be executed	6.3.2
Fn204	Anti-resonance control adjustment function	Cannot be executed	6.4.2
Fn205	Vibration suppression function	Cannot be executed	6.5.2
Fn206	EasyFFT	Cannot be executed	7.15
Fn207	Online vibration monitor	Cannot be executed	7.16

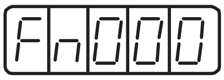
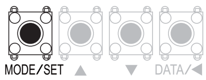
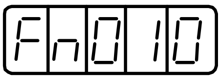
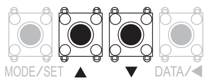
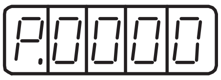
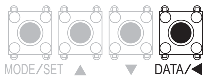
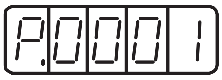
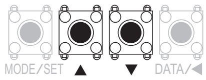
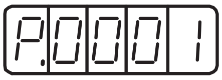
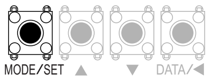
(1) Preparation

There are no tasks that must be performed before the execution.

(2) Operating Procedure

Follow the steps to set enable or disable writing.
Setting values are as follows:

- "P.0000": Write permitted (Releases write prohibited mode.) [Factory setting]
- "P.0001": Write prohibited (Parameters become write prohibited from the next time the control power supply is turned ON.)

Step	Display after Operation	Keys	Operation
1			Press the MODE/SET Key to select the utility function.
2			Press the UP or DOWN Key to select Fn010.
3			Press the DATA/SHIFT Key for approximately one second. The display shown on the left appears.
4			Press the UP or DOWN Key to set a value: P.0000: Write permitted [Factory setting] P.0001: Write prohibited
5			Press the MODE/SET Key to register the value. When the setting has been completed, "donE" flashes on the display and the screen returns to the state shown on the left. Note: If any value other than P.0000 or P.0001 is set, "Error" will be displayed on the screen.
6	To enable the change in the setting, turn the control power supply OFF and ON again.		

7.11 Servomotor Model Display (Fn011)

This function is used to check the model, voltage, capacity, encoder type, and encoder resolution of the servomotor connected to the multi-winding drive unit. If the multi-winding drive unit has a special specification, the specification number is also displayed.

(1) Preparation

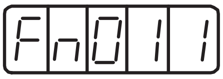
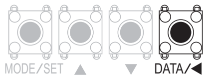
There are no tasks that must be performed before the execution.

(2) Operating Procedure

Use the following procedure.

<table>
<tr><th>Step</th><th>Display after Operation</th><th>Keys</th><th>Operation</th></tr>
<tr><td>1</td><td>Fn000</td><td>MODE/SET</td><td>Press the MODE/SET Key to select the utility function.</td></tr>
<tr><td>2</td><td>Fn011</td><td>▲ ▼</td><td>Press the UP or DOWN Key to select Fn011.</td></tr>
<tr><td>3</td><td>F.0160</td><td>DATA/◀</td><td>Press the DATA/SHIFT Key for approximately one second to display the servomotor voltage and model codes.
F.0271
<table>
<tr><th colspan="2">Servomotor Voltage</th></tr>
<tr><th>Code</th><th>Type</th></tr>
<tr><td>01</td><td>200 VAC,
280 VDC</td></tr>
<tr><td>02</td><td>400 VAC,
560 VDC</td></tr>
</table>
<table>
<tr><th colspan="2">Servomotor Model</th></tr>
<tr><th>Code</th><th>Model</th></tr>
<tr><td>71</td><td>SGMVV-□□□□B</td></tr>
<tr><td>73</td><td>SGMVV-□□□□D</td></tr>
</table>
</td></tr>
<tr><td>4</td><td>P.0010</td><td>MODE/SET</td><td>Press the MODE/SET Key to display the servomotor capacity.
P.2200
Servomotor capacity in units of 10 W
The above example indicates 22 kW.</td></tr>
<tr><td>5</td><td>E.0020</td><td>MODE/SET</td><td>Press the MODE/SET Key to display the encoder type and resolution codes.
E.0020
<table>
<tr><th colspan="2">Encoder Type</th></tr>
<tr><th>Code</th><th>Type</th></tr>
<tr><td>00</td><td>Incremental</td></tr>
<tr><td>01</td><td>Multiturn absolute value</td></tr>
</table>
<table>
<tr><th colspan="2">Encoder Resolution</th></tr>
<tr><th>Code</th><th>Resolution</th></tr>
<tr><td>20</td><td>20-bit</td></tr>
</table>
</td></tr>
<tr><td>6</td><td>y.0000</td><td>MODE/SET</td><td>Press the MODE/SET Key to display the multi-winding drive unit's special specification number.
The display "y.0000" means standard model.
If anything other than "y.0000" is displayed, a customized device is being used.
y.0000
Code for custom orders</td></tr>
</table>

(cont'd)

Step	Display after Operation	Keys	Operation
7			Press the DATA/SHIFT Key for approximately one second. "Fn011" is displayed again.

7.12 Software Version Display (Fn012)

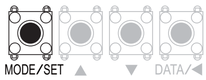
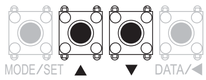
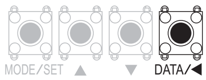
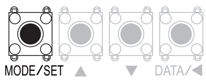
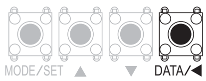
Select Fn012 to check the multi-winding drive unit and encoder software version numbers.

(1) Preparation

There are no tasks that must be performed before the execution.

(2) Operating Procedure

Use the following procedure.

Step	Display after Operation	Keys	Operation
1	Fn000		Press the MODE/SET Key to select the utility function.
2	Fn012		Press the UP or DOWN Key to select Fn012.
3	r.0001		Press the DATA/SHIFT Key for approximately one second to display the multi-winding drive unit software version number.
4	E.0001		Press the MODE/SET Key to display the encoder software version number. Note: If the MODE/SET Key is pressed again, a pre-programmed display will appear. The display will change as follows: 0.0000 → S.FFFF → F.FFFF.
5	Fn012		Press the DATA/SHIFT Key for approximately one second. "Fn012" is displayed again.

7.13 Vibration Detection Level Initialization (Fn01B)

This function detects vibration when servomotor is connected to a machine in operation and automatically adjusts the vibration detection level (Pn312) to output more exactly the vibration alarm (A.520) and the vibration warning (A.911).

The vibration detection function detects vibration elements according to the motor speed.

Parameter		Meaning	When Enabled	Classification
Pn310	n.□□□0 [Factory setting]	Does not detect vibration.	Immediately	Setup
	n.□□□1	Outputs the warning (A.911) when vibration is detected.		
	n.□□□2	Outputs the alarm (A.520) when vibration is detected.		

If the vibration exceeds the detection level calculated by the following formula, the alarm or warning will be output according to the setting of vibration detection switch (Pn310).

$$\text{Detection level} = \frac{\text{Vibration detection level (Pn312 [min}^{-1}\text{])} \times \text{Vibration detection sensitivity (Pn311 [\%])}}{100}$$

- Use this function if the vibration alarm (A.520) or the vibration warning (A.911) is not output correctly when a vibration at the factory setting of the vibration detection level (Pn312) is detected. In other cases, it is not necessary to use this function.
- The vibration alarm or warning detection sensibility differs depending on the machine conditions. In this case, fine-tune the setting of the vibration detection sensitivity (Pn311) using the above detection level formula as a guide.

Pn311	Vibration Detection Sensitivity (Speed, Position, Torque)				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	50 to 500	1%	100	Immediately	Tuning

IMPORTANT

- The vibration may not be detected because of improper servo gains. Also, not all kinds of vibrations can be detected. Use the detection result as a guideline.
- Set a proper moment of inertia ratio (Pn103). Improper setting may result in the vibration alarm, warning misdetection, or non-detection.
- The references that are used to operate your system must be input to execute this function.
- Execute this function under the operating condition for which the vibration detection level should be set.
- Execute this function while the motor speed reaches at least 10% of its maximum.

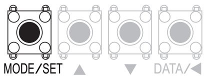
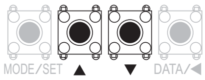
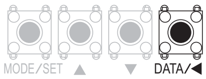
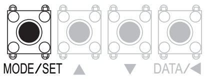
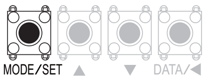
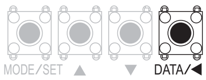
(1) Preparation

The following conditions must be met to initialize the vibration detection level.

- The write prohibited setting parameter (Fn010) must be set to Write permitted (P.0000).

(2) Operating Procedure

Use the following procedure.

Step	Display after Operation	Keys	Operation
1	Fn000		Press the MODE/SET Key to select the utility function.
2	Fn01b		Press the UP or DOWN Key to select Fn01b.
3	d.InIt		Press the DATA/SHIFT Key for approximately one second. The display shown on the left appears.
4	d.InIt Display flashes.		Press the MODE/SET Key for approximately one second. The display shown on the left will flash and the vibration level will be detected and refreshed. Notes: • Operate the multi-winding drive unit with the references that will be used for actual operation. • If the servomotor is rotating at 10% or less of the maximum speed, "Error" will be displayed.
5	donE		Press the MODE/SET Key again after a suitable time to complete vibration detection and refreshing the setting. This will enable the setting. If the setting has been completed normally, "donE" will be displayed. If there was a setting failure, "Error" will be displayed.
6	Fn01b		Press the DATA/SHIFT Key for approximately one second. "Fn01b" is displayed again.

(3) Related Parameters

The following table lists parameters related to this function and their possibility of being changed while executing this function or of being changed automatically after executing this function.

• Parameters related to this function
These are parameters that are used or referenced when executing this function.

• Allowed changes during execution of this function
Yes : Parameters can be changed using SigmaWin+ while this function is being executed.
No : Parameters cannot be changed using SigmaWin+ while this function is being executed.

• Automatic changes after execution of this function
Yes : Parameter set values are automatically set or adjusted after execution of this function.
No : Parameter set values are not automatically set or adjusted after execution of this function.

Parameter	Name	Mid-execution changes	Automatic changes
Pn311	Vibration Detection Sensitivity	Yes	No
Pn312	Vibration Detection Level	No	Yes

7.14 Display of Multi-Winding Drive Unit and Servomotor ID (Fn01E)

This function displays ID information for the multi-winding drive unit and the servomotor, encoder, and option modules connected to the SERVOPACKs. The ID information of some option modules (SGDV-OFA01A) is not stored in the multi-winding drive unit. "Not available" will be displayed for these option modules.

This function cannot be executed from the panel operator of the multi-winding drive unit.
To use this function, the digital operator (JUSP-OP05A-1-E) or SigmaWin+ is needed.

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

The following items can be displayed.

ID	Items to be Displayed
Multi-Winding Drive Unit ID	• Multi-winding drive unit model • Multi-winding drive unit serial number • Multi-winding drive unit manufacturing date • Multi-winding drive unit input voltage • Maximum applicable motor capacity [W] • Maximum applicable motor rated current [Arms]
Servomotor ID	• Servomotor model • Servomotor order number • Servomotor manufacturing date • Servomotor input voltage (V) • Servomotor capacity (W) • Servomotor rated current (Arms)
Encoder ID	• Encoder model • Encoder serial number • Encoder manufacturing date • Encoder type/resolution
Safety Option Module ID*	• Safety Option Module model • Safety Option Module serial number • Safety Option Module manufacturing date • Safety Option Module ID number
Feedback Option Module ID*	• Feedback Option Module model • Feedback Option Module serial number (Reserved area) • Feedback Option Module manufacturing date • Feedback Option Module ID

* If the option module is not connected, "Not connect" will be displayed after the module name.

(1) Preparation

There are no tasks that must be performed before the execution.

(2) Operating Procedure

Use the following procedure.

Step	Display after Operation	Keys	Operation
1	RUN –FUNCTION– Fn01B:Viblvl Init Fn01E:SvMotOp ID Fn01F:FBOpMot ID Fn020:S–Orig Set	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 and select Fn01E.
2	Serial number Multi-winding drive unit model BB –SvMotOp ID– Driver SGDV–750J01A D0024123459001 12. 07 400V, 22000W Manufacturing date / SERVOPACK input voltage / SERVOPACK capacity	DATA < >	Press the DATA Key. The display changes to the Fn01E (multi-winding drive unit and motor ID check) execution display. The multi-winding drive unit ID information is displayed. Use the < or > Key to scroll left and right and to view other information.
3	Servomotor order number Servomotor model BB –SvMotOp ID– Motor SGMVV–7EDDB 123456–1–BK1 12. 07 400V, 75000W Manufacturing date / Servomotor voltage / Servomotor capacity	DATA < >	Press the DATA Key. The servomotor ID information is displayed. Use the < or > Key to scroll left and right and to view other information.
4	Encoder serial number Encoder model BB –SvMotOp ID– Encoder UTTIH–B20FN Q12345–001–BK6 12. 07 20bit–INC Manufacturing date / Encoder resolution / Encoder type	DATA < >	Press the DATA Key. The encoder ID information is displayed. Use the < or > Key to scroll left and right and to view other information.
5	RUN –FUNCTION– Fn01B:Viblvl Init Fn01E:SvMotOp ID Fn01F:FBOpMot ID Fn020:S–Orig Set	MODE/SET	Press the MODE/SET Key. The display returns to the main menu of the utility function.

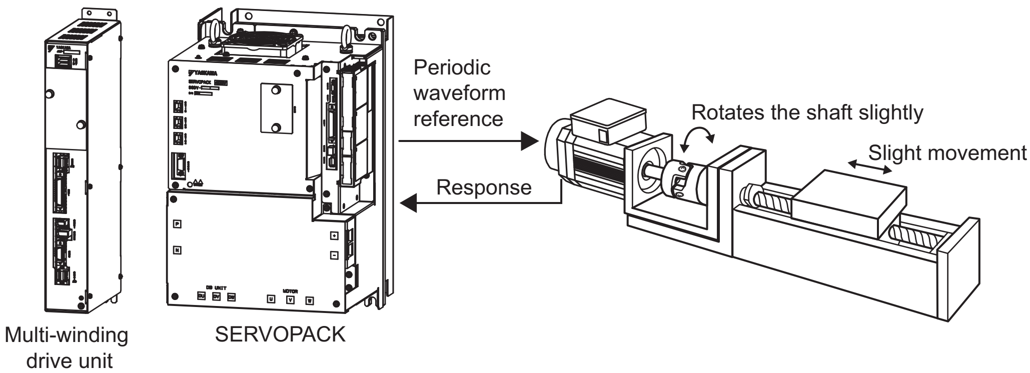
7.15 EasyFFT (Fn206)

EasyFFT sends a frequency waveform reference from the SERVOPACK to the servomotor and slightly rotates the servomotor several times over a certain period, thus causing machine vibration. The multi-winding drive unit detects the resonance frequency from the generated vibration and makes notch filter settings according to the resonance frequency detection.. The notch filter is effective for the elimination of high-frequency vibration and noise.

Execute this function after the servo ON signal (/S-ON) is turned OFF if operation of the SERVOPACK results in high-frequency vibration and noise.

⚠ WARNING
• The servomotor rotates slightly when EasyFFT is executed. Do not touch the servomotor or machine during execution of EasyFFT, otherwise injury may result.

⚠ CAUTION
• Use the EasyFFT when the servo gain is low, such as in the initial stage of servo adjustment. If EasyFFT is executed after increasing the gain, the servo system may vibrate depending on the machine characteristics or gain balance.



In addition to this function, online vibration monitor (Fn207) can be used to detect machine vibration and automatically make notch filter settings.

If a multi-winding drive unit is used to make adjustments, it is recommended that you use advanced autotuning. This built-in EasyFFT function is used to maintain interchangeability with previous models. There is normally no need to use it.

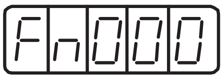
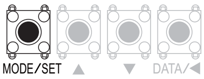
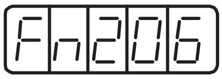
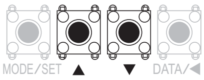
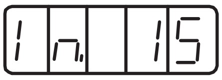
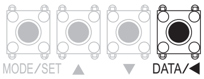
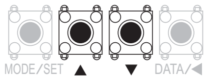
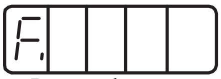
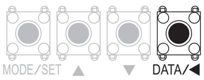
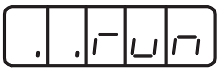
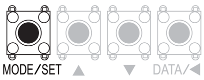
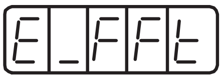
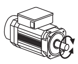
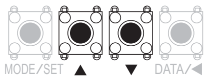
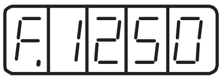
(1) Preparation

The following conditions must be met to perform EasyFFT.

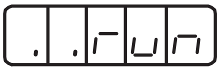
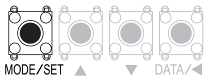
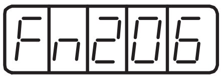
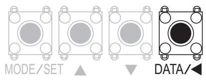
- The write prohibited setting parameter (Fn010) must be set to Write permitted (P.0000).
- The main circuit power supply must be ON.
- All alarms must be cleared.
- The hardwire baseblock (HWBB) must be disabled.
- The servo ON signal (/S-ON) must be OFF.
- There must be no overtravel.
- An external reference must not be input.

(2) Operating Procedure

Use the following procedure.

Step	Display after Operation	Keys	Operation
1			Press the MODE/SET Key to select the utility function.
2			Press the UP or DOWN Key to select Fn206.
3	 Setting reference amplitude		Press the DATA/SHIFT Key for approximately one second. The display shown on the left appears. The panel operator is in the reference amplitude setting mode.
4			Press the UP or DOWN Key to set a reference amplitude. Reference amplitude setting range: 1 to 800 Notes: • At the initial execution of Fn206, do not change the reference amplitude setting, but start from the initial value 15. Though increasing reference amplitude increases the detection accuracy, the vibration and noise occurring on the machine will increase momentarily. Increase the amplitude value little by little, observing the result. • The set value of reference amplitude is stored in Pn456.
5	 Run ready status		Press the DATA/SHIFT Key for approximately one second to enter the run ready status.
6			Press the MODE/SET Key to enter Servo ON status (the servomotor power ON). Note: Press the MODE/SET Key again to turn the servomotor power OFF. "F" is displayed to indicate the run ready status (step 5).
7	 Display flashes.  Servomotor slight movement		In the Servo ON status (the servomotor power ON), press the UP Key (forward) or the DOWN Key (reverse). The servomotor oscillates (within 1/4 rotation) in automatic operation. The servomotor performs such movements for approximately 2 seconds. During this operation, the display shown on the left flashes. Notes: • Press the MODE/SET Key to stop the servomotor. No detection is executed. "F." is displayed to indicate the run ready status (step 5). • Do not enter the machine's working area, because the servomotor rotates. Some noise may result.
8	 Detection result example	–	At normal completion of the detection, "E_FFt" stops flashing and the detected resonance frequency is displayed. When failing to detect, "F----" is displayed. To set the detection result, proceed to step 9. To monitor the resonance frequency without setting the detection result, press the DATA/SHIFT Key for approximately one second to return to step 2. <IMPORTANT> If the operation ended normally but it took two seconds or more, the detection accuracy may not be good. Set the reference amplitude little higher than 15 in step 4 and re-execute the operation. A higher detection accuracy may be obtained. Though increasing reference amplitude increases the detection accuracy, the vibration and noise occurring on the machine will increase momentarily. Increase the amplitude value little by little, observing the result.

(cont'd)

Step	Display after Operation	Keys	Operation
9			After the detection completes normally, press the MODE/SET Key. The optimum notch filter for the detected resonance frequency will automatically be set. When the notch filter is set correctly, the "donE" flashes and then the display shown on the left appears. When the 1st notch filter frequency is already set (Pn408.0=1), the 2nd notch filter frequency will be automatically set (Pn40C). Press the MODE/SET Key to return to step 5. Notes: • If both the 1st and 2nd notch filter frequencies are already set (Pn408 = n.□1□1), no more notch filter frequencies can be set. • Set Pn408.0 to 0 (disables notch filter) not to use the notch filter frequency detected by executing the EasyFFT function.
10			Press the DATA/SHIFT Key for approximately one second. "Fn206" is displayed again.
11	When you finish the EasyFFT operation, turn the control power supply OFF and ON again.		

(3) Related Parameters

The following table lists parameters related to this function and their possibility of being changed while executing this function or of being changed automatically after executing this function.

• Parameters related to this function

These are parameters that are used or referenced when executing this function.

• Allowed changes during execution of this function

Yes : Parameters can be changed using SigmaWin+ while this function is being executed.
No : Parameters cannot be changed using SigmaWin+ while this function is being executed.

• Automatic changes after execution of this function

Yes : Parameter set values are automatically set or adjusted after execution of this function.
No : Parameter set values are not automatically set or adjusted after execution of this function.

Parameter	Name	Mid-execution changes	Automatic changes
Pn408	Torque Related Function Switch	Yes	Yes
Pn409	1st Notch Filter Frequency	No	Yes
Pn40A	1st Notch Filter Q Value	No	No
Pn40C	2nd Notch Filter Frequency	No	Yes
Pn40D	2nd Notch Filter Q Value	No	No
Pn456	Sweep Torque Reference Amplitude	No	No

7.16 Online Vibration Monitor (Fn207)

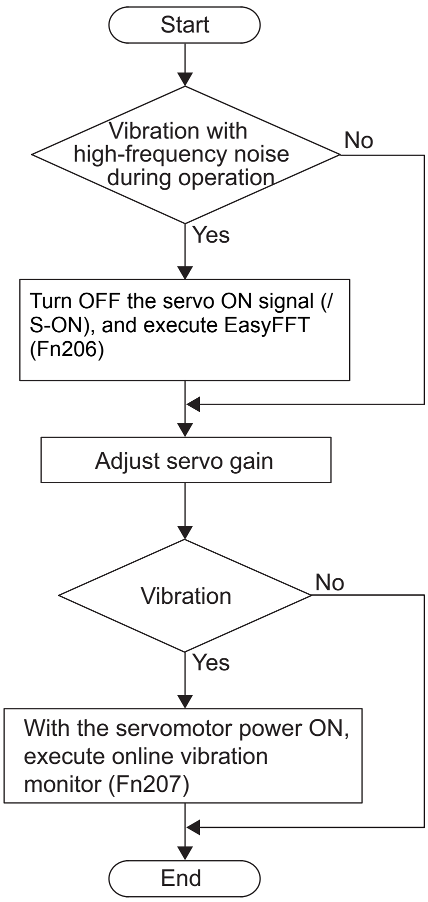
If vibration is generated during operation and this function is executed while the servo ON signal (/S-ON) is still ON, the machine vibration can sometimes be suppressed by setting a notch filter or torque reference filter for the vibration frequencies.

When online, vibration frequency caused by machine resonance will be detected and the frequency that has the highest peak will be displayed on the panel operator. The effective torque reference filter or notch filter frequency for the vibration frequencies will be automatically selected and the related parameters will be automatically set.

In addition to this function, EasyFFT (Fn206) can be used to detect machine vibration and automatically make notch filter settings. Use the following flowchart to determine how these functions should be used.

If a multi-winding drive unit is used to make adjustments, it is recommended that you use advanced autotuning. This built-in function is used to maintain interchangeability with previous models. There is normally no need to use it.

How to use EasyFFT (Fn206) and online vibration monitor (Fn207), when they are mainly used for servo gain adjustment.



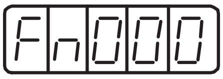
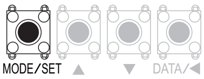
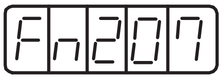
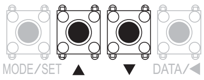
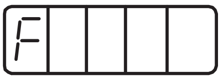
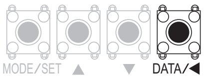
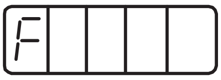
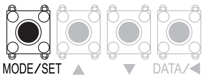
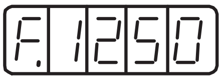
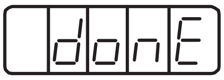
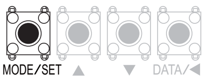
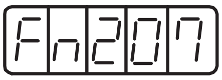
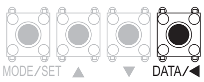
(1) Preparation

The following conditions must be met to perform online vibration monitoring.

- The write prohibited setting parameter (Fn010) must be set to Write permitted (P.0000).
- The servo ON signal (/S-ON) must be ON.
- There must be no overtravel.
- The correct moment of inertia (Pn103) must be set.

(2) Operating Procedure

Use the following procedure.

Step	Display after Operation	Keys	Operation
1			Press the MODE/SET Key to select the utility function.
2			Press the UP or DOWN Key to select the Fn207.
3			Press the DATA/SHIFT Key for approximately one second. The display shown on the left appears.
4	 Display flashes.		Press the MODE/SET Key. "F" will flash, and the detection of frequencies will start automatically.
5	 Detection result example	–	When "F" stops flashing, detection has been completed. If detection has been performed normally, the results of detection will be displayed. The displayed value is the frequency of the highest peak of vibration. To set the detection result, proceed to step 6. To monitor the vibration frequency without setting the detection result, press the DATA/SHIFT Key for approximately one second to return to step 2. Notes: • If a frequency is not detected, "F----" will be displayed. • If detection processing is not completed normally for some reason, "no_oP" will be displayed.
6			If the MODE/SET Key is pressed, the optimum notch filter frequency or torque reference filter time constant for the frequency value will be set automatically, and "donE" will flash if the setting is completed normally.
7			Press the DATA/SHIFT Key for approximately one second. "Fn207" is displayed again.

(3) Related Parameters

The following table lists parameters related to this function and their possibility of being changed while executing this function or of being changed automatically after executing this function.

- Parameters related to this function
  These are parameters that are used or referenced when executing this function.

- Allowed changes during execution of this function
  Yes : Parameters can be changed using SigmaWin+ while this function is being executed.
  No : Parameters cannot be changed using SigmaWin+ while this function is being executed.

- Automatic changes after execution of this function
  Yes : Parameter set values are automatically set or adjusted after execution of this function.
  No : Parameter set values are not automatically set or adjusted after execution of this function.

Parameter	Name	Mid-execution changes	Automatic changes
Pn401	Torque Reference Filter Time Constant	No	Yes
Pn408	Torque Related Function Switch	Yes	Yes
Pn409	1st Notch Filter Frequency	No	Yes
Pn40A	1st Notch Filter Q Value	No	No
Pn40C	2nd Notch Filter Frequency	No	No
Pn40D	2nd Notch Filter Q Value	No	No

8

Monitor Displays (Un□□□)

8.1 List of Monitor Displays

The monitor displays can be used for monitoring the I/O signal status, and the multi-winding drive unit internal status.

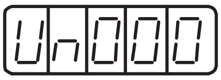
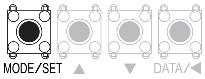
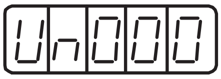
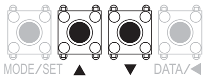
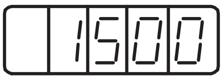
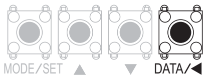
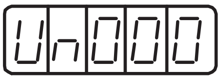
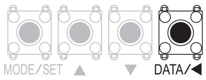
Refer to the following table.

Parameter No.	Description	Unit
Un000	Motor rotating speed	min^{-1}
Un001	Speed reference	min^{-1}
Un002	Internal torque reference (percentage of the rated torque)	%
Un003*3	Rotational angle 1 (encoder pulses from the phase-C origin: decimal display)	encoder pulse*4
Un004	Rotational angle 2 (from polarity origin (electric angle))	deg
Un005*1	Input signal monitor	–
Un006*2	Output signal monitor	–
Un007*5	Input reference pulse speed (valid only in position control)	min^{-1}
Un008*5	Position error amount (valid only in position control)	reference unit
Un009	Accumulated load ratio (in percentage to the rated torque: effective torque in cycle of 10 seconds)	%
Un00A	Regenerative load ratio (as a percentage of the processable regenerative power: regenerative power consumption in cycle of 10 seconds)	%
Un00B	Power consumed by DB resistance (in percentage to the processable power at DB activation: displayed in cycle of 10 seconds)	%
Un00C*3, *5	Input reference pulse counter	reference unit
Un00D*3	Feedback pulse counter	encoder pulse*4
Un012	Total operation time	100 ms
Un013*3	Feedback pulse counter	reference unit
Un014	Effective gain monitor (gain settings 1 = 1, gain settings 2 = 2)	–
Un015	Safety I/O signal monitor	–
Un020	Motor rated speed	min^{-1}
Un021	Motor maximum speed	min^{-1}

∗1. For details, refer to *8.4 Monitoring Input Signals*.
∗2. For details, refer to *8.5 Monitoring Output Signals*.
∗3. For details, refer to *8.3 Reading 32-bit Data in Decimal Displays*.
∗4. For details, refer to *5.4.4 Electronic Gear*.
∗5. If the reference pulse input multiplication switching function is enabled, the reference pulse will be multiplied by n to obtain the reference.

8.2 Viewing Monitor Displays

The example below shows how to view the contents of monitor number Un000 (when the servomotor rotates at 1500 min^{-1}).

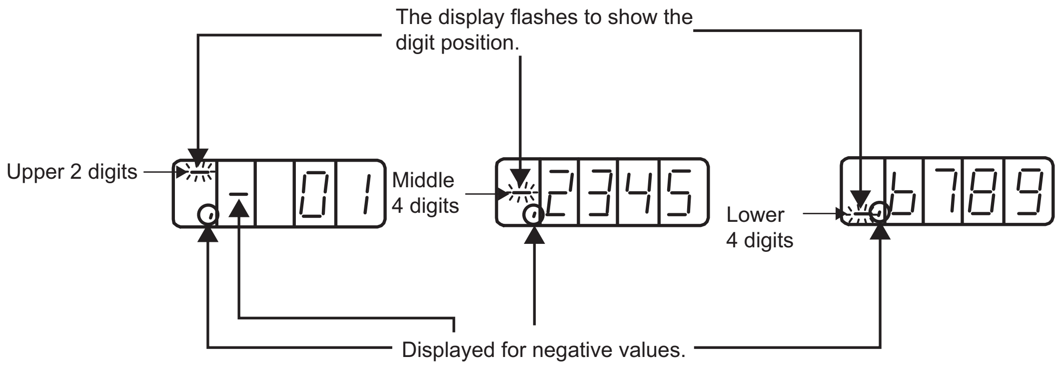
Step	Display after Operation	Keys	Operation
1			Press the MODE/SET Key to select the monitor display.
2			If Un000 is not displayed, press the UP or DOWN Key to select Un000.
3			Press the DATA/SHIFT Key for approximately one second to display the motor rotating speed (Un000).
4			Press the DATA/SHIFT Key for approximately one second to return to the display of step 1.

8.3 Reading 32-bit Data in Decimal Displays

The 32-bit data is displayed in decimal format. This section describes how to read the display.

Step	Display after Operation	Keys	Operation
1	Un000	MODE/SET ▲ ▼ DATA/◀	Press the MODE/SET Key to select the monitor display.
2	Un00d	MODE/SET ▲ ▼ DATA/◀	Press the UP or DOWN Key to display the parameter to be displayed in 32-bit decimal. In this example, "Un00D" is selected.
3	Lower 4 digits 7890	MODE/SET ▲ ▼ DATA/◀	Press the DATA/SHIFT Key for approximately one second. The lower 4 digits of the setting of the selected parameter are displayed.
4	Middle 4 digits 3456	MODE/SET ▲ ▼ DATA/◀	After checking the displayed digits, press the DATA/SHIFT Key. The middle 4 digits of the setting of the selected parameter are displayed.
5	Upper 2 digits 12	MODE/SET ▲ ▼ DATA/◀	Press the DATA/SHIFT Key again. The upper 2 digits of the setting of the selected parameter are displayed. Note: If the DATA/SHIFT Key is pressed after the upper 2 digits are displayed, the lower 4 digits of the setting will be displayed again.
6	Un00d	MODE/SET ▲ ▼ DATA/◀	Press the DATA/SHIFT Key for approximately one second to return to the display of step 2.

The method for reading the display is summarized below.



The number of pulses between -2147483648 and 2147483647 is displayed continuously. When the number of pulses is outside this range, the display will change as follows:

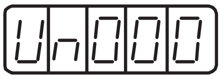
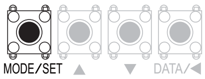
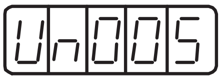
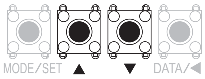
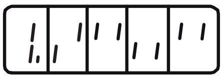
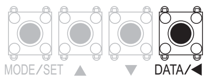
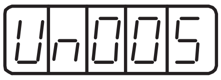
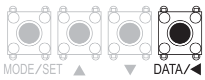
- The displayed value will change to 2147483647 when the number of pulses decreases by one from -2147483648. Thereafter, the displayed value will decrease according to the number of pulses.
- The displayed value will change to -2147483648 when the number of pulses increases by one from 2147483647. Thereafter, the displayed value will increase according to the number of pulses.

8.4 Monitoring Input Signals

The status of input signals can be checked with the input signal monitor (Un005). The procedure for displaying the status, the method of interpreting the display, and a display example are shown below.

8.4.1 Displaying Input Signal Status

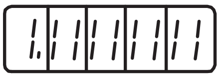
Use the following steps to display the input signal status.

Step	Display after Operation	Keys	Operation
1			Press the MODE/SET Key to select the monitor display.
2			Press the UP or DOWN Key to select Un005.
3	 Input signal display status		The present status can be displayed on the 7-segment display on the panel operator by pressing the DATA/SHIFT Key for approximately one second. Refer to *8.4.2 Interpreting Input Signal Display Status.*
4			Press the DATA/SHIFT Key for approximately one second to return to the display of step 2.

8.4.2 Interpreting Input Signal Display Status

The status of allocated signals is displayed on the 7-segment display on the panel operator.

Input terminals correspond to LED numbers as shown in the following table.



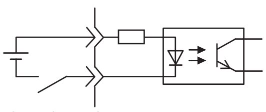
Top: OFF
Bottom: ON
8 7 6 5 4 3 2 1 Number

- When the input signal is in OFF status, the top segment (LED) is lit.
- When the input signal is in ON status, the bottom segment (LED) is lit.

Display LED Number	Input Terminal Name	Signal Name (Factory Setting)
1	CN1-40	/S-ON
2	CN1-41	/P-CON
3	CN1-42	P-OT
4	CN1-43	N-OT
5	CN1-44	/ALM-RST
6	CN1-45	/P-CL
7	CN1-46	/N-CL
8	CN1-4	SEN

Note: Input signals use the following circuit configuration.
- OFF: Open
- ON: Short-circuited

Example

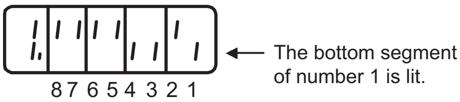


OFF (open)

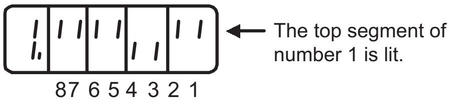
8.4.3 Input Signal Display Example

Input signals are displayed as shown below.

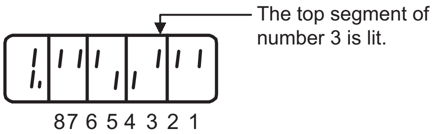
• When the /S-ON signal is ON



• When the /S-ON signal is OFF



• When the P-OT signal operates

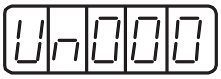
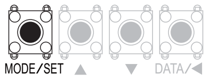
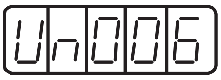
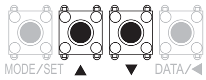
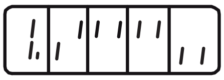
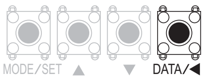
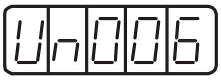
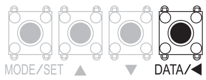


8.5 Monitoring Output Signals

The status of output signals can be checked with the output signal monitor (Un006). The procedure for displaying the status, the method of interpreting the display, and a display example are shown below.

8.5.1 Displaying Output Signal Status

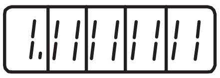
Use the following steps to display the output signal status.

Step	Display after Operation	Keys	Operation
1			Press the MODE/SET Key to select the monitor display.
2			Press the UP or DOWN Key to select Un006.
3	 Output signal display status		The present status can be displayed on the 7-segment display on the panel operator by pressing the DATA/SHIFT Key for approximately one second. Refer to *8.5.2 Interpreting Output Signal Display Status*.
4			Press the DATA/SHIFT Key for approximately one second to return to the display of step 2.

8.5.2 Interpreting Output Signal Display Status

The status of allocated signals is displayed on the 7-segment display on the panel operator.

Output terminals correspond to LED numbers as shown in the following table.



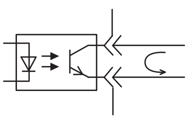
Top: OFF
Bottom: ON
8 7 6 5 4 3 2 1 Number

- When the output signal is in OFF status, the top segment (LED) is lit.
- When the output signal is in ON status, the bottom segment (LED) is lit.

Display LED Number	Output Terminal Name	Signal Name (Factory Setting)
1	CN1-31, -32	ALM
2	CN1-25, -26	/COIN or /V-CMP
3	CN1-27, -28	/TGON
4	CN1-29, -30	/S-RDY
5	CN1-37	ALO1
6	CN1-38	ALO2
7	CN1-39	ALO3
8	–	Reserved

Note: Output signals use the following circuit configuration.
- OFF: Transistor OFF
- ON: Transistor ON

Example

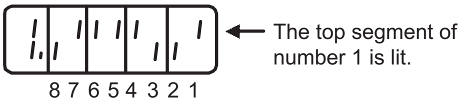


ON: Transistor ON

8.5.3 Output Signal Display Example

Output signals are displayed as shown below.

• When the ALM signal is OFF

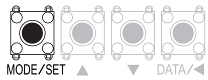
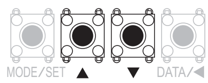
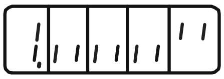
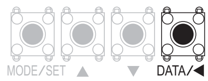
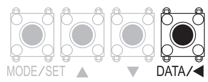


8.6 Monitoring Safety Input Signals

The status of safety input signals can be checked with the safety I/O signal monitor (Un015). The procedure for displaying the status, the method of interpreting the display, and a display example are shown below.

8.6.1 Displaying Safety Input Signals

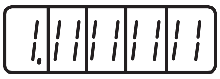
Use the following procedure to display the input signal.

Step	Display after Operation	Keys	Operation
1	Un000		Press the MODE/SET Key to select the monitor display.
2	Un015		Press the UP or DOWN Key to select Un015.
3	 Input signal display status		The present status can be displayed on the 7-segment display on the panel operator by pressing the DATA/SHIFT Key for approximately one second. Refer to *8.6.2 Interpreting Safety Input Signal Display Status* for how to read the display.
4	Un015		Press the DATA/SHIFT Key for approximately one second to return to the display of step 2.

8.6.2 Interpreting Safety Input Signal Display Status

The status of allocated signals is displayed on the 7-segment display on the panel operator.

Input terminals correspond to LED numbers as shown in the following table.

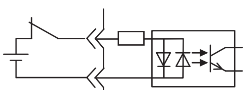


- When the safety input signal is in ON status, the top segment (LED) is lit.
- When the safety input signal is in OFF status, the bottom segment (LED) is lit.

Display LED Number	Input Terminal Name	Signal Name
1	CN8-3, -4	/HWBB1
2	CN8-5, -6	/HWBB2
3	–	Reserved
4	–	Reserved
5	–	Reserved
6	–	Reserved
7	–	Reserved
8	–	Reserved

Note: Input signals use the following circuit configuration.
- OFF: Open
- ON: Short-circuited

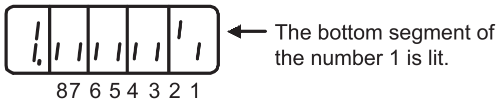
Example



8.6.3 Safety Input Signal Display Example

Safety input signals are displayed as shown below.

- When the /HWBB1 signal turns OFF to activate the HWBB function



8.7 Monitor Display at Power ON

When Un number is set using Pn52F, the data of Un□□□ that was specified in the panel operator is displayed when the power is turned ON.

When 0FFF is set (factory setting), the status display mode (bb, run) is selected at power ON.

Pn52F	Monitor Display at Power ON Speed Position Torque				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0000 to 0FFF	–	0FFF	Immediately	Setup

9

Troubleshooting

9.1 Alarm Displays

The following sections describe troubleshooting in response to alarm displays.

The alarm name, alarm meaning, alarm stopping method, alarm code output, and alarm reset capability are listed in order of the alarm numbers in *9.1.1 List of Alarms*.

The causes of alarms and troubleshooting methods are provided in *9.1.2 Troubleshooting of Alarms*.

9.1.1 List of Alarms

This section provides list of alarms.

■ Servomotor Stopping Method

If an alarm occurs, the servomotor can be stopped by doing either of the following operations.

Gr.1: The servomotor is stopped according to the setting in Pn001.0 if an alarm occurs. Pn001.0 is factory-set to stop the servomotor by applying the DB.

Gr.2: The servomotor is stopped according to the setting in Pn00B.1 if an alarm occurs. Pn00B.1 is factory-set to stop the servomotor by setting the speed reference to "0." The servomotor under torque control will always use the Gr.1 method to stop. By setting Pn00B.1 to 1, the servomotor stops using the same method as Gr.1. When coordinating a number of servomotors, use this stopping method to prevent machine damage that may result due to differences in the stop method.

■ Alarm Reset

Available: Removing the cause of alarm and then executing the alarm reset can clear the alarm.
N/A: Executing the alarm reset cannot clear the alarm.

Alarm Number	Alarm Name	Meaning	Servomotor Stopping Method	Alarm Reset	Alarm Code Output		
					ALO1	ALO2	ALO3
A.020	Parameter Checksum Error 1	The data of an internal parameter in the multi-winding drive unit is incorrect.	Gr.1	N/A	H	H	H
A.021	Parameter Format Error 1	The data type of an internal parameter in the multi-winding drive unit is incorrect.	Gr.1	N/A	H	H	H
A.022	System Checksum Error 1	The data of an internal parameter in the multi-winding drive unit is incorrect.	Gr.1	N/A	H	H	H
A.030*	Main Circuit Detector Error	Detection data for main circuit is incorrect.	Gr.1	Available	H	H	H
A.040	Parameter Setting Error 1	The parameter setting is outside the setting range.	Gr.1	N/A	H	H	H
A.041	Encoder Output Pulse Setting Error	The encoder output pulse (Pn212) is outside the setting range or does not satisfy the setting conditions.	Gr.1	N/A	H	H	H
A.042	Parameter Combination Error	Combination of some parameters exceeds the setting range.	Gr.1	N/A	H	H	H
A.045	Multi-winding Drive Unit Parameter Setting Error	The parameter setting does not match the number of SERVOPACK axes that are connected.	Gr.1	N/A	H	H	H
A.050	Combination Error	The SERVOPACK and the servomotor capacities do not match each other.	Gr.1	Available	H	H	H
A.051	Unsupported Device Alarm	The device unsupported was connected.	Gr.1	N/A	H	H	H
A.0b0	Cancelled Servo ON Command Alarm	The servo ON signal (/S-ON) was sent from the host controller after executing a utility function that turns ON servomotor.	Gr.1	Available	H	H	H
A.100*	Overcurrent or Heat Sink Overheated	An overcurrent flowed through the IGBT or the heat sink of the SERVOPACK was overheated.	Gr.1	N/A	L	H	H

(cont'd)

Alarm Number	Alarm Name	Meaning	Servomotor Stopping Method	Alarm Reset	Alarm Code Output		
					ALO1	ALO2	ALO3
A.150	Motor Winding Current Unbalance	The currents in the motor windings are not correct.	Gr.1	Available			
A.300	Regeneration Error	Regenerative circuit or regenerative resistor is faulty.	Gr.1	Available	L	L	H
A.320	Regenerative Overload	Regenerative energy exceeds regenerative resistor capacity.	Gr.2	Available	L	L	H
A.330*	Main Circuit Power Supply Wiring Error	• Setting of AC input/DC input is incorrect. • Power supply wiring is incorrect.	Gr.1	Available	L	L	H
A.400*	Overvoltage	Main circuit DC voltage is excessively high.	Gr.1	Available	H	H	L
A.410*	Undervoltage	Main circuit DC voltage is excessively low.	Gr.2	Available	H	H	L
A.42A	Converter error	One of the following was detected by the converter. • An operation error occurred when using the limit relay for inrush current • PN voltage error • Regeneration operation error • The converter's heat sink overheated • An operation error occurred when using the converter and fan	Gr.1	Available	H	H	L
A.450*	Main-Circuit Capacitor Overvoltage	The capacitor of the main circuit has deteriorated or is faulty.	Gr.1	N/A	H	H	L
A.510	Overspeed	The servomotor speed is above the maximum rotational speed.	Gr.1	Available	L	H	L
A.511	Overspeed of Encoder Output Pulse Rate	The pulse output speed upper limit of the set encoder output pulse (Pn212) is exceeded.	Gr.1	Available	L	H	L
A.520	Vibration Alarm	Incorrect vibration at the motor speed was detected.	Gr.1	Available	L	H	L
A.710	Overload: High Load	The servomotor was operating for several seconds to several tens of seconds under a torque largely exceeding ratings.	Gr.2	Available	L	L	L
A.720	Overload: Low Load	The servomotor was operating continuously under a torque exceeding ratings.	Gr.1	Available	L	L	L
A.730* **A.731**	Dynamic Brake Overload	When the dynamic brake was applied, rotational energy exceeded the capacity of dynamic brake resistor.	Gr.1	Available	L	L	L
A.740*	Overload of Surge Current Limit Resistor	The main circuit power was frequently turned ON and OFF.	Gr.1	Available	L	L	L
A.7A0*	Heat Sink Overheated	The heat sink of the SERVOPACK or converter exceeded 100°C.	Gr.2	Available	L	L	L
A.7Ab*	Built-in Fan in SERVOPACK Stopped	The fan inside the SERVOPACK stopped.	Gr.1	Available	L	L	L
A.810	Encoder Backup Error	The power supplies to the encoder all failed and position data was lost.	Gr.1	N/A	H	H	H
A.820	Encoder Checksum Error	The checksum results of encoder memory is incorrect.	Gr.1	N/A	H	H	H
A.830	Absolute Encoder Battery Error	The battery voltage was lower than the specified value after the control power supply was turned ON.	Gr.1	Available	H	H	H
A.840	Encoder Data Error	Data in the encoder is incorrect.	Gr.1	N/A	H	H	H
A.850	Encoder Overspeed	The encoder was rotating at high speed when the power was turned ON.	Gr.1	N/A	H	H	H

(cont'd)

Alarm Number	Alarm Name	Meaning	Servomotor Stopping Method	Alarm Reset	Alarm Code Output		
					ALO1	ALO2	ALO3
A.860	Encoder Overheated	The internal temperature of encoder is too high.	Gr.1	N/A	H	H	H
A.b10	Speed Reference A/D Error	The A/D converter for speed reference input is faulty.	Gr.2	Available	H	H	H
A.b11	Speed Reference A/D Data Error	A/D conversion data of speed reference input is incorrect.	Gr.2	Available	H	H	H
A.b20	Reference Torque Input Read Error	The A/D converter for torque reference input is faulty.	Gr.2	Available	H	H	H
A.b31*	Current Detection Error 1	The current detection circuit for phase U is faulty.	Gr.1	N/A	H	H	H
A.b32*	Current Detection Error 2	The current detection circuit for phase V is faulty.	Gr.1	N/A	H	H	H
A.b33*	Current Detection Error 3	The detection circuit for the current is faulty.	Gr.1	N/A	H	H	H
A.bF0	System Alarm 0	Internal program error 0 occurred.	Gr.1	N/A	H	H	H
A.bF1	System Alarm 1	Internal program error 1 occurred.	Gr.1	N/A	H	H	H
A.bF2	System Alarm 2	Internal program error 2 occurred.	Gr.1	N/A	H	H	H
A.bF3	System Alarm 3	Internal program error 3 occurred.	Gr.1	N/A	H	H	H
A.bF4	System Alarm 4	Internal program error 4 occurred.	Gr.1	N/A	H	H	H
A.C10	Servo Overrun Detected	The servomotor ran out of control.	Gr.1	Available	L	H	L
A.C80	Absolute Encoder Clear Error and Multiturn Limit Setting Error	The multiturn for the absolute encoder was not properly cleared or set.	Gr.1	N/A	L	H	L
A.C90	Encoder Communications Error	Communications between the multi-winding drive unit and the encoder are not possible.	Gr.1	N/A	L	H	L
A.C91	Encoder Communications Position Data Error	An encoder position data calculation error occurred.	Gr.1	N/A	L	H	L
A.C92	Encoder Communications Timer Error	An error occurred in the communications timer between the encoder and the multi-winding drive unit.	Gr.1	N/A	L	H	L
A.CA0	Encoder Parameter Error	Encoder parameters are faulty.	Gr.1	N/A	L	H	L
A.Cb0	Encoder Echoback Error	Contents of communications with encoder are incorrect.	Gr.1	N/A	L	H	L
A.CC0	Multiturn Limit Disagreement	Different multiturn limits have been set in the encoder and the multi-winding drive unit.	Gr.1	N/A	L	H	L
A.d00	Position Error Overflow	Position error exceeded the value of excessive position error alarm level (Pn520) when the servomotor power is ON.	Gr.1	Available	L	L	H
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.	Gr.1	Available	L	L	H
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).	Gr.2	Available	L	L	H
A.Eb1*	Safety Function Signal Input Timing Error	The safety function signal input timing is faulty.	Gr.1	N/A	H	L	L

(cont'd)

Alarm Number	Alarm Name	Meaning	Servomotor Stopping Method	Alarm Reset	Alarm Code Output		
					ALO1	ALO2	ALO3
A.EE0	Local Communications Servo OFF Operation Error 1	The servo was not turned OFF within 1 second after the servo OFF request.	Gr.1	Available	H	L	L
A.EE1	Local Communications Servo ON Operation Error 1	The servo was not turned ON within 1 second after the servo ON request.	Gr.1	Available	H	L	L
A.EE2	Local Communications Servo ON Operation Error 2	Servo ON status could not be detected during servo ON status.	Gr.1	Available	H	L	L
A.EE3	Local Communications Servo OFF Operation Error 2	Servo OFF status could not be detected during servo OFF status.	Gr.1	Available	H	L	L
A.EE4	Local Communications Connection Failure	The local communications connection command was not completed.	Gr.1	Available	H	L	L
A.EE5	Local Communications ASIC Initialization Failure	Initialization processing of the local communications ASIC failed.	Gr.1	N/A	H	L	L
A.EE6	Local Communications Disconnection Error	Local communications was disconnected.	Gr.1	Available	H	L	L
A.F10	Main Circuit Cable Open Phase	With the main circuit power supply ON, voltage was low for more than 1 second in phase R, S, or T.	Gr.2	Available	H	L	H
A.F30	Dynamic Brake Contactor Error	An error occurred in the operation of the dynamic brake contactor.	Gr.2	Available	H	L	H
CPF00	Digital Operator Transmission Error 1	Digital operator (JUSP-OP05A-1-E) fails to communicate with the multi-winding drive unit (e.g., CPU error).	–	N/A	Undefined		
CPF01	Digital Operator Transmission Error 2		–	N/A	Undefined		
A.– –	Not an error	Normal operation status	–	–	H	H	H

* These alarms occur only for the SERVOPACKs or converters.

9.1.2 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.020: Parameter Checksum Error 1 (The data of the internal parameter is incorrect.)	The power supply voltage suddenly dropped.	Measure the power supply voltage.	Set the power supply voltage within the specified range, and set Fn005 to initialize the parameter.
	The power supply went OFF while changing a parameter setting.	Check the circumstances when the power supply went OFF.	Set Fn005 to initialize the parameter and then set the parameter again.
	The number of times that parameters were written exceeded the limit.	Check to see if the parameters were frequently changed through the host controller.	The multi-winding drive unit may be faulty. Replace the multi-winding drive unit. Correct the procedure for writing parameters.
	Malfunction caused by noise from the AC power supply or grounding line, static electricity noise, etc.	Turn the power supply ON and OFF several times. If the alarm still occurs, there may be noise interference.	Take countermeasures against noise.
	Gas, water drops, or cutting oil entered the multi-winding drive unit and caused internal components to fail.	Check the installation conditions.	The multi-winding drive unit may be faulty. Replace the multi-winding drive unit.
	A fault occurred in the multi-winding drive unit.	Turn the power supply ON and OFF several times. If the alarm still occurs, the multi-winding drive unit may be faulty.	The multi-winding drive unit may be faulty. Replace the multi-winding drive unit.
A.021: Parameter Format Error 1 (The data type of the internal parameter is incorrect.)	The software version of the multi-winding drive unit that caused the alarm is older than that of the written parameters.	Check Fn012 to see if the set software version agrees with that of the multi-winding drive unit. If not, an alarm may occur.	Write the parameters of another multi-winding drive unit of the same model with the same software version. Then turn the control power OFF and ON again.
	A fault occurred in the multi-winding drive unit.	–	The multi-winding drive unit may be faulty. Replace the multi-winding drive unit.
A.022: System Checksum Error 1 (The data of the internal parameter is incorrect.)	The power supply voltage suddenly dropped.	Measure the power supply voltage.	The multi-winding drive unit may be faulty. Replace the multi-winding drive unit.
	The power supply went OFF while setting an utility function.	Check the circumstances when the power supply went OFF.	The multi-winding drive unit may be faulty. Replace the multi-winding drive unit.
	A fault occurred in the multi-winding drive unit.	Turn the power supply ON and OFF again. If the alarm still occurs, the multi-winding drive unit may be faulty.	The multi-winding drive unit may be faulty. Replace the multi-winding drive unit.
A.030: Main Circuit Detector Error	A fault occurred in the SERVOPACK or converter.	–	The SERVOPACK or converter may be faulty. Replace the SERVOPACK or converter.

(cont'd)

Alarm Number: Alarm Name (Alarm Description)	Cause	Investigative Actions	Corrective Actions
A.040: Parameter Setting Error 1 (The parameter setting was out of the setting range.)	The SERVOPACK capacity, converter capacity, and the servomotor capacity do not match each other.	Check the combination of SERVOPACK, converter, and servomotor capacities.	Select the proper combination of capacities.
	A fault occurred in the multi-winding drive unit.	–	The multi-winding drive unit may be faulty. Replace the multi-winding drive unit.
	The parameter setting is out of the setting range.	Check the setting ranges of the parameters that have been changed.	Set the parameter to a value within the setting range.
	The electronic gear ratio is out of the setting range.	Check the electronic gear ratio. The ratio must satisfy: 0.001< (Pn20E/Pn210) < 4000.	Set the electronic gear ratio in the range: 0.001< (Pn20E/Pn210) < 4000.
A.041: Encoder Output Pulse Setting Error	The encoder output pulse (Pn212) is out of the setting range and does not satisfy the setting conditions.	Check the parameter Pn212.	Set Pn212 to a correct value.
A.042: Parameter Combination Error	The speed of program JOG operation (Fn004) is lower than the setting range after having changed the electronic gear ratio (Pn20E/Pn210) or the servomotor.	Check if the detection conditions* are satisfied.	Decrease the setting of the electronic gear ratio (Pn20E/Pn210).
	The speed of program JOG operation (Fn004) is lower than the setting range after having changed the setting of the program JOG movement speed (Pn533).	Check if the detection conditions* are satisfied.	Increase the setting of the program JOG movement speed (Pn533).
	The moving speed of advanced autotuning is lower than the setting range after having changed the electronic gear ratio (Pn20E/Pn210) or the servomotor.	Check if the detection conditions* are satisfied.	Decrease the setting of the electronic gear ratio (Pn20E/Pn210).
A.045: Multi-winding Drive Unit Parameter Setting Error	The parameter setting does not match the number of SERVOPACK axes that are connected.	Check the setting of Pn002.3.	Make sure the setting of Pn002.3 agrees with the fully-closed module.
A.050: Combination Error (The SERVOPACK and servomotor capacities do not correspond.)	The SERVOPACK and servomotor capacities do not match each other.	Check the capacities to see if they satisfy the following condition: $\frac{1}{4} \leq \frac{\text{Servomotor capacity}}{\text{SERVOPACK capacity}} \leq 4$	Select the proper combination of SERVOPACK and servomotor capacities.
	An encoder fault occurred.	Replace the servomotor and see if the alarm occurs again.	Replace the servomotor (encoder).
	A fault occurred in the SERVOPACK or converter.	–	The SERVOPACK or converter may be faulty. Replace the SERVOPACK or converter.
A.051: Unsupported Device Alarm	An unsupported serial converter unit, encoder, or external encoder is connected to the multi-winding drive unit.	Check the product specifications, and select the correct model.	Select the correct combination of units.

* Detection conditions
If one of the following conditions detected, an alarm occurs.

- $\text{Pn533 [min}^{-1}] \times \frac{\text{Encoder resolution}}{6 \times 10^5} \leq \frac{\text{Pn20E}}{\text{Pn210}}$
- $\text{Max Motor Speed [min}^{-1}] \times \frac{\text{Encoder resolution}}{\text{About } 3.66 \times 10^{12}} \geq \frac{\text{Pn20E}}{\text{Pn210}}$

(cont'd)

Alarm Number: Alarm Name (Alarm Description)	Cause	Investigative Actions	Corrective Actions
A.0b0: Cancelled Servo ON Command Alarm	After executing the utility function to turn ON the power to the motor, the servo ON signal (/S-ON) was sent from the host controller.	–	Turn the control power supply OFF and ON again. Or, execute a software reset.
A.100: Overcurrent or Heat Sink Overheated (An overcurrent flowed through the IGBT or heat sink of SERVOPACK overheated.)	Incorrect wiring or contact fault of main circuit cables.	Check the wiring. Refer to *3.1 Main Circuit Wiring*.	Correct the wiring.
	Short-circuit or ground fault of main circuit cables.	Check for short-circuits across the servomotor terminal phases U, V, and W, or between the grounding and servomotor terminal phases U, V, or W. Refer to *3.1 Main Circuit Wiring*.	The cable may be short-circuited. Replace the cable.
	Short-circuit or ground fault inside the servomotor.	Check for short-circuits across the servomotor terminal phases U, V, and W, or between the grounding and servomotor terminal phases U, V, or W. Refer to *3.1 Main Circuit Wiring*.	The servomotor may be faulty. Replace the servomotor.
	Short-circuit or ground fault inside the SERVOPACK.	Check for short-circuits across the servomotor connection terminals U, V, and W on the SERVOPACK, or between the grounding and terminal U, V, or W. Refer to *3.1 Main Circuit Wiring*.	The SERVOPACK may be faulty. Replace the SERVOPACK.
	The dynamic brake (DB: Emergency stop executed from the SERVOPACK) was frequently activated, or the DB overload alarm occurred.	Check the power consumed by DB resistance (Un00B) to see how many times the DB has been used. Or, check the alarm history display Fn000 to see if the DB overload alarm A.730 or A.731 was reported.	Change the SERVOPACK model, operating conditions, or the mechanism so that the DB does not need to be used so frequently.
	A heavy load was applied while the servomotor was stopped or running at a low speed.	Check to see if the operating conditions are outside servo drive specifications.	Reduce the load applied to the servomotor or increase the operating speed.
	Malfunction caused by noise interference.	Improve the wiring or installation environment, such as by reducing noise, and check to see if the alarm recurs.	Take countermeasures for noise, such as correct wiring of the FG. Use an FG wire size equivalent to the main circuit wire size of the SERVOPACK and converter.
	The setting of Pn515.2 (dynamic brake answer signal (/DBANS) input signal mapping) does not agree with the contacts of the dynamic brake contactor that is connected.	Check the setting of Pn515.2 and the contacts of the dynamic brake contactor.	Set Pn515.2 to agree with the contacts of the dynamic brake contactor.
	Current flowed to the dynamic brake resistor when power to the servomotor was ON due to welding or other failure of the dynamic brake contacts.	Check the contactor to see if it is welded.	The dynamic brake contactor may have failed. Replace the dynamic brake contactor.
	A fault occurred in the SERVOPACK or converter.	–	Turn the control power supply OFF and ON again. If the alarm still occurs, the SERVOPACK or converter may be faulty. Replace the SERVOPACK or converter.
A.150: Motor Winding Current Unbalance	The motor wiring is faulty.	Check the wiring.	Make sure that the motor is correctly wired.
	A fault occurred in the SERVOPACK or converter.	–	The SERVOPACK or converter may be faulty. Replace the SERVOPACK or converter.

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Alarm Number: Alarm Name (Alarm Description)	Cause	Investigative Actions	Corrective Actions
A.300: Regeneration Error	An external regenerative resistor unit is not connected.	Check the external regenerative resistor unit connection.	Connect the external regenerative resistor unit.
	The regenerative resistor unit is incorrectly wired, or is removed or disconnected.	Check the regenerative resistor unit connection.	Correctly connect the regenerative resistor unit.
	The connection of the I/O signals (CN901) between the SERVOPACK and converter is faulty.	Check the connection of CN901.	Correctly connect CN901.
	A fault occurred in the SERVOPACK or converter.	–	While the main circuit power supply is OFF, turn the control power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK or converter may be faulty. Replace the SERVOPACK or converter.
A.320: Regenerative Overload	The power supply voltage exceeds the specified limit.	Measure the power supply voltage.	Set the power supply voltage within the specified range.
	Insufficient regenerative resistance, regenerative resistor capacity. Or, regenerative power has been continuously flowing back.	Check the operating condition or the capacity using the capacity selection Software SigmaJunmaSize+, etc.	Change the regenerative resistance, regenerative resistor capacity. Reconsider the operating conditions using the capacity selection software SigmaJunmaSize+, etc.
	Regenerative power continuously flowed back because negative load was continuously applied.	Check the load applied to the servomotor during operation.	Reconsider the system including servo, machine, and operating conditions.
	The setting of parameter Pn600 is smaller than the regenerative resistor's capacity.	Check the regenerative resistor unit connection and the value of the Pn600.	Set the Pn600 to a correct value.
	The regenerative resistance is too high.	Check the regenerative resistance.	Change the regenerative resistance to a correct value or use an external regenerative resistor of appropriate capacity.
	The connection of the I/O signals (CN901) between the SERVOPACK and converter is faulty.	Check the connection of CN901.	Correctly connect CN901.
	A fault occurred in the SERVOPACK or converter.	–	The SERVOPACK or converter may be faulty. Replace the SERVOPACK or converter.
A.330: Main Circuit Power Supply Wiring Error (Detected when the power to the main circuit is turned ON.)	The regenerative resistor unit was disconnected when the power supply voltage to the SERVOPACK and converter was high.	Measure the resistance of the regenerative resistor unit using a measuring instrument.	Replace the regenerative resistor unit.
	DC power was supplied.	Check the power supply to see if it is a AC power supply.	Use an AC power supply.
	An regenerative resistor unit is not connected.	Check the regenerative resistor unit connection.	Connect the regenerative resistor unit.
	The ⊖1 and ⊖2 terminals of the converter are open.	Check the ⊖1 and ⊖2 terminals on the converter.	Correctly connect the ⊖1 and ⊖2 terminals on the converter.
	The connection of the I/O signals (CN901) between the SERVOPACK and converter is faulty.	Check the connection of CN901.	Correctly connect CN901.
	A fault occurred in the SERVOPACK or converter.	–	The SERVOPACK or converter may be faulty. Replace the SERVOPACK or converter.

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Alarm Number: Alarm Name (Alarm Description)	Cause	Investigative Actions	Corrective Actions
A.400: Overvoltage (Detected in the SERVOPACK main circuit power supply section.)	A power supply voltage of 580 VAC or higher was detected.	Measure the power supply voltage.	Set AC power supply voltage within the specified range.
	The power supply is unstable, or was influenced by a lightning surge.	Measure the power supply voltage.	Improve the power supply conditions by installing a surge absorber, etc. Then, turn the power supply OFF and ON again. If the alarm still occurs, the SERVOPACK or converter may be faulty. Replace the SERVOPACK or converter.
	Voltage for AC power supply was too high during acceleration or deceleration.	Check the power supply voltage and the speed and torque during operation.	Set AC power supply voltage within the specified range.
	The regenerative resistance is too high for the actual operating conditions.	Check the operating conditions and the regenerative resistance.	Select a regenerative resistance value appropriate for the operating conditions and load.
	The moment of inertia ratio exceeded the allowable value.	Confirm that the moment of inertia ratio is within the allowable range.	Increase the deceleration time, or reduce the load.
	The fuse in the converter's regeneration circuit is blown out.	Check for a Regeneration Error alarm (A.300) and check the CHARGE indicator on the converter to see if it remains lit for more than a few seconds immediately after the main circuit power supply is turned OFF.	The converter may be faulty. Replace the converter.
	The connection of the I/O signals (CN901) between the SERVOPACK and converter is faulty.	Check the connection of CN901.	Correctly connect CN901.
	A fault occurred in the SERVOPACK or converter.	–	Turn the control power OFF and then ON again while the main circuit power supply is OFF. If the alarm still occurs, the SERVOPACK or converter may be faulty. Replace the SERVOPACK or converter.
A.410: Undervoltage (Detected in the SERVOPACK main circuit power supply section.)	The AC power supply voltage dropped to 240 V or less for a 400-VAC SERVOPACK.	Measure the power supply voltage.	Set the power supply voltage within the specified range.
	The power supply voltage dropped during operation.	Measure the power supply voltage.	Increase the power supply capacity.
	Occurrence of instantaneous power interruption.	Measure the power supply voltage.	When the instantaneous power cut hold time (Pn509) is set, decrease the setting.
	The converter fuse is blown out.	–	Replace the converter, connect a reactor, and run the SERVOPACK and converter.
	The ⊖1 and ⊖2 terminals of the converter are open.	Check the ⊖1 and ⊖2 terminals on the converter.	Correctly connect the ⊖1 and ⊖2 terminals on the converter.
	A fault occurred in the SERVOPACK or converter.	–	The SERVOPACK or converter may be faulty. Replace the SERVOPACK or converter.

(cont'd)

Alarm Number: Alarm Name (Alarm Description)	Cause	Investigative Actions	Corrective Actions
A.42A: Converter error	The Converter fan stopped (The FAN STOP indicator on the converter is lit.).	Check for foreign matter or debris inside the converter.	Remove foreign matter or debris from the converter. If the alarm still occurs, the SERVOPACK or converter may be faulty. Replace the SERVOPACK or converter.
	An error was detected in the magnetic contactor inside the converter. (The CHRG-ERR indicator on the converter lights when the power supply is turned ON.)	Check to see if you can hear the magnetic contactor operate when the main circuit power supply is turned ON.	If the power supply voltage is correct but no sound is heard when the power supply is turned ON, the converter may be faulty. Replace the converter.
	Overheating was detected in the heat sink in the converter (The OVERHEAT indicator on the converter is lit.).	Check the ambient temperature, check for an overload, and check the installation method.	Review the ambient temperature, load conditions, and installation conditions.
	The DC output voltage from the converter is not correct. (The CHRG-ERR indicator on the converter is lit.)	Measure the power supply voltage and the output voltage.	If the output voltage is not consistent with the power supply voltage, the converter may be faulty. Replace the converter.
		Measure the main circuit power supply voltage waveform when the power supply is turned ON and OFF.	If the voltage waveform is not stable, take suitable measures to make it stable.
	The timing of inputting the control power supply to the SERVOPACK and converter is incorrect.	Check the timing of inputting the control power supply to the SERVOPACK and converter.	Input the control power supply simultaneously to the SERVOPACK and converter.
	The wiring between the SERVOPACK and converter is incorrect or the connection is faulty.	Check the wiring.	Correctly connect the SERVOPACK and converter to each other.
	The connection of the I/O signals (CN901) between the SERVOPACK and converter is faulty.	Check the connection of CN901.	Correctly connect CN901.
	A fault occurred in the converter.	–	Replace the converter.
A.450: Main-Circuit Capacitor Overvoltage	The fuse in the SERVOPACK is blown out.	Check to see if this alarm occurs when the main circuit power supply is turned ON.	The SERVOPACK may be faulty. Replace the SERVOPACK.
	A fault occurred in the SERVOPACK or converter.	–	Replace the SERVOPACK or converter.
A.510: Overspeed (The servomotor speed exceeds the maximum.)	The order of phases U, V, and W in the servomotor wiring is incorrect.	Check the motor wiring.	Confirm that the servomotor is correctly wired.
	A reference value exceeding the overspeed detection level was input.	Check the input value.	Reduce the reference value or adjust the gain.
	The motor speed exceeded the maximum.	Check the motor speed waveform.	Reduce the speed reference input gain, adjust the servo gain, or reconsider the operating conditions.
	A fault occurred in the multi-winding drive unit, SERVOPACK, or converter.	–	A fault may have occurred in the multi-winding drive unit, SERVOPACK, or converter. Replace the multi-winding drive unit, SERVOPACK, or converter.
A.511: Overspeed of Encoder Output Pulse Rate	The encoder output pulse frequency exceeded the limit.	Check the encoder output pulse setting.	Decrease the setting of the encoder output pulse (Pn212).
	The encoder output pulse output frequency exceeded the limit because the motor speed was too high.	Check the encoder output pulse output setting and motor speed.	Decrease the motor speed.

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Alarm Number: Alarm Name (Alarm Description)	Cause	Investigative Actions	Corrective Actions
A.520: Vibration Alarm	Abnormal vibration was detected at the motor speed.	Check for abnormal noise from the servomotor, and check the speed and torque waveforms during operation.	Reduce the motor speed or reduce the speed loop gain (Pn100).
	The moment of inertia ratio (Pn103) value is greater than the actual value or is greatly changed.	Check the moment of inertia ratio.	Set the moment of inertia ratio (Pn103) to an appropriate value.
A.710: A.720: Overload A.710: High Load A.720: Low Load	Incorrect wiring or contact fault of servomotor and encoder.	Check the wiring.	Confirm that the servomotor and encoder are correctly wired.
	Operation beyond the overload protection characteristics.	Check the servomotor overload characteristics and executed run command.	Reconsider the load conditions and operating conditions. Or, increase the motor capacity.
	Excessive load was applied during operation because the servomotor was not driven due to mechanical problems.	Check the executed operation reference and motor speed.	Remove the mechanical problems.
	A fault occurred in the SERVOPACK or converter.	–	The SERVOPACK or converter may be faulty. Replace the SERVOPACK or converter.
A.730: A.731: Dynamic Brake Overload (An excessive power consumption of dynamic brake was detected.)	The servomotor rotates because of external force.	Check the operation status.	Take measures to ensure the servomotor will not rotate because of external force.
	The rotating energy at a DB stop exceeds the DB resistance capacity.	Check the power consumed by DB resistance (Un00B) to see how many times the DB has been used.	Reconsider the following: • Reduce the motor reference speed. • Reduce the moment of inertia ratio. • Reduce the number of times of the DB stop operation.
	The setting of Pn001.0 (Servomotor Power OFF or Alarm Gr.1 Stop Mode) is not correct.	Check the setting of Pn001.0.	To not use the dynamic brake, set Pn001.0 to 2. (The dynamic brake will not be used and the motor will coast to a stop.)
	The setting of Pn601 does not agree with the dynamic brake resistance that is connected.	Check the setting of Pn601.	Set Pn601 correctly.
	The connection of the dynamic brake unit is faulty.	Check the wiring between the dynamic brake unit and DU, DV, DW, and CN115 is correct and securely connected.	Correctly wire and securely connect the dynamic brake unit with DU, DV, DW, and CN115.
	A fault occurred in the SERVOPACK.	–	The SERVOPACK may be faulty. Replace the SERVOPACK.
A.740: Overload of Surge Current Limit Resistor (The main circuit power is turned ON/OFF too frequently.)	The inrush current limit resistor operation frequency at the main circuit power supply ON/OFF operation exceeds the allowable range.	–	Reduce the frequency of turning the main circuit power supply ON/OFF.
	A fault occurred in the SERVOPACK or converter.	–	The SERVOPACK or converter may be faulty. Replace the SERVOPACK or converter.

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Alarm Number: Alarm Name (Alarm Description)	Cause	Investigative Actions	Corrective Actions
A.7A0: Heat Sink Overheated (Detected when the SERVOPACK's heat sink temperature exceeds 100°C.)	The surrounding air temperature is too high.	Check the surrounding air temperature using a thermostat.	Decrease the surrounding air temperature by improving the installation conditions of the SERVOPACK.
	The overload alarm has been reset by turning OFF the power too many times.	Check the alarm history display (Fn000) to see if the overload alarm was reported.	Change the method for resetting the alarm.
	Excessive load or operation beyond the regenerative energy processing capacity.	Check the accumulated load ratio (Un009) to see the load during operation, and the regenerative load ratio (Un00A) to see the regenerative energy processing capacity.	Reconsider the load and operating conditions.
	Incorrect installation orientation of the SERVOPACK or/and insufficient space around the SERVOPACK.	Check the installation conditions of the SERVOPACK.	Install the SERVOPACK correctly as specified.
	A fault occurred in the SERVOPACK.	–	The SERVOPACK may be faulty. Replace the SERVOPACK.
A.7AB: Built-in Fan in SERVOPACK Stopped	The fan inside the SERVOPACK stopped.	Check for foreign matter or debris inside the SERVOPACK.	Remove foreign matter or debris from the SERVOPACK. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.
A.810: Encoder Backup Error (Only when an absolute encoder is connected.) (Detected on the encoder side.)	Alarm occurred when the control power supply to the absolute encoder was turned ON for the first time.	Check to see if the control power supply was turned ON for the first time.	Set up the encoder (Fn008).
	The encoder cable disconnected, and connected again.	Check to see if the control power supply was turned ON for the first time.	Confirm the connection and set up the encoder (Fn008).
	The power from both the control power supply (+5 V) from the multi-winding drive unit and the battery power supply is not being supplied.	Check the encoder connector battery or the connector contact status.	Replace the battery or take similar measures to supply power to the encoder, and set up the encoder (Fn008).
	An absolute encoder fault occurred.	–	If the alarm cannot be reset by setting up the encoder again, replace the servomotor.
	A fault occurred in the multi-winding drive unit.	–	The multi-winding drive unit may be faulty. Replace the multi-winding drive unit.
A.820: Encoder Checksum Error (Detected on the encoder side.)	An encoder fault occurred.	–	• Absolute encoder Set up the encoder again using Fn008. If the alarm still occurs, the servomotor may be faulty. Replace the servomotor. • Absolute encoder that shows values for a single rotation or incremental encoder The servomotor may be faulty. Replace the servomotor.
	A fault occurred in the multi-winding drive unit.	–	The multi-winding drive unit may be faulty. Replace the multi-winding drive unit.

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Alarm Number: Alarm Name (Alarm Description)	Cause	Investigative Actions	Corrective Actions
A.830: Absolute Encoder Battery Error (The absolute encoder battery voltage is lower than the specified value.)	The battery connection is incorrect.	Check the battery connection.	Reconnect the battery.
	The battery voltage is lower than the specified value 2.7 V.	Measure the battery voltage.	Replace the battery.
	A fault occurred in the multi-winding drive unit.	–	The multi-winding drive unit may be faulty. Replace the multi-winding drive unit.
A.840: Encoder Data Error (Detected on the encoder side.)	An encoder malfunctioned.	–	Turn the control power supply OFF and ON again. If the alarm still occurs, the servomotor may be faulty. Replace the servomotor.
	Malfunction of encoder because of noise interference, etc.	–	Correct the wiring around the encoder by separating the encoder cable from the servomotor main circuit cable or by checking the grounding and other wiring.
A.850: Encoder Overspeed (Detected when the control power supply was turned ON.) (Detected on the encoder side.)	The servomotor speed is higher than 200 min^{-1} when the control power supply was turned ON.	Check the motor rotating speed (Un000) to confirm the servomotor speed when the power is turned ON.	Reduce the servomotor speed to a value less than 200 min^{-1}, and turn ON the control power supply.
	An encoder fault occurred.	–	Turn the control power supply OFF and ON again. If the alarm still occurs, the servomotor may be faulty. Replace the servomotor.
	A fault occurred in the multi-winding drive unit.	–	Turn the control power supply OFF and ON again. If the alarm still occurs, the multi-winding drive unit may be faulty. Replace the multi-winding drive unit.
A.860: Encoder Overheated (Only when an absolute encoder is connected.) (Detected on the encoder side.)	The ambient operating temperature around the servomotor is too high.	Measure the ambient operating temperature around the servomotor.	The ambient operating temperature must be 40°C or less.
	The motor load is greater than the rated load.	Check the accumulated load ratio (Un009) to see the load.	The motor load must be within the specified range.
	An encoder fault occurred.	–	Turn the control power supply OFF and ON again. If the alarm still occurs, the servomotor may be faulty. Replace the servomotor.
	A fault occurred in the multi-winding drive unit.	–	Turn the control power supply OFF and ON again. If the alarm still occurs, the multi-winding drive unit may be faulty. Replace the multi-winding drive unit.
A.b10: Speed Reference A/D Error (Detected when the servo is ON.)	A malfunction occurred in the speed reference input section.	–	Clear and reset the alarm and restart the operation.
	A fault occurred in the SERVOPACK.	–	Turn the control power supply OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.
A.b11: Speed Reference A/D Data Error	A malfunction occurred in the speed reference input section.	–	Clear and reset the alarm and restart the operation.
	A fault occurred in the SERVOPACK.	–	Turn the control power supply OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.

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Alarm Number: Alarm Name (Alarm Description)	Cause	Investigative Actions	Corrective Actions
A.b20: Reference Torque Input Read Error (Detected when the servo is ON.)	A malfunction occurred in the reading section of the torque reference input.	–	Clear and reset the alarm and restart the operation.
	A fault occurred in the SERVOPACK.	–	Turn the control power supply OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.
A.b31: Current Detection Error 1	The current detection circuit for phase U is faulty.	–	Turn the main circuit power supply OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.
A.b32: Current Detection Error 2	The current detection circuit for phase V is faulty.	–	Turn the main circuit power supply OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.
A.b33: Current Detection Error 3	The detection circuit for the current is faulty.	–	Turn the main circuit power supply OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.
	The servomotor main circuit cable is disconnected.	Check for disconnection of the servomotor main circuit cable.	Correct the servomotor wiring.
A.bF0: System Alarm 0	A fault occurred in the multi-winding drive unit.	–	Turn the control power supply OFF and ON again. If the alarm still occurs, the multi-winding drive unit may be faulty. Replace the multi-winding drive unit.
A.bF1: System Alarm 1	A fault occurred in the multi-winding drive unit.	–	Turn the control power supply OFF and ON again. If the alarm still occurs, the multi-winding drive unit may be faulty. Replace the multi-winding drive unit.
A.bF2: System Alarm 2	A fault occurred in the multi-winding drive unit.	–	Turn the control power supply OFF and ON again. If the alarm still occurs, the multi-winding drive unit may be faulty. Replace the multi-winding drive unit.
A.bF3: System Alarm 3	A fault occurred in the multi-winding drive unit.	–	Turn the control power supply OFF and ON again. If the alarm still occurs, the multi-winding drive unit may be faulty. Replace the multi-winding drive unit.
A.bF4: System Alarm 4	A fault occurred in the multi-winding drive unit.	–	Turn the control power supply OFF and ON again. If the alarm still occurs, the multi-winding drive unit may be faulty. Replace the multi-winding drive unit.

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Alarm Number: Alarm Name (Alarm Description)	Cause	Investigative Actions	Corrective Actions
A.C10: Servo Overrun Detected (Detected when the servomotor power is ON.)	The order of phases U, V, and W in the servomotor wiring is incorrect.	Check the motor wiring.	Confirm that the servomotor is correctly wired.
	An encoder fault occurred.	–	If the alarm still occurs after turning the control power supply OFF and ON again even though the servomotor is correctly wired, the servomotor may be faulty. Replace the servomotor.
	A fault occurred in the multi-winding drive unit, SERVOPACK, or converter.	–	Turn the control power supply OFF and ON again. If the alarm still occurs, the multi-winding drive unit, SERVOPACK or converter may be faulty. Replace the multi-winding drive unit, SERVOPACK, or converter.
A.C80: Absolute Encoder Clear Error and Multi-turn Limit Setting Error	An encoder fault occurred.	–	Turn the control power supply OFF and ON again. If the alarm still occurs, the servomotor may be faulty. Replace the servomotor.
	A fault occurred in the multi-winding drive unit.	–	Turn the control power supply OFF and ON again. If the alarm still occurs, the multi-winding drive unit may be faulty. Replace the multi-winding drive unit.
A.C90: Encoder Communications Error	Contact fault of connector or incorrect wiring for encoder cable.	Check the connector contact status for encoder cable.	Re-insert the connector and confirm that the encoder is correctly wired.
	Cable disconnection for encoder cable or short-circuit. Or, incorrect cable impedance.	Check the encoder cable.	Use the cable with the specified rating.
	Corrosion caused by improper temperature, humidity, or gas, short-circuit caused by intrusion of water drops or cutting oil, or connector contact fault caused by vibration.	Check the operating environment.	Improve the operating environmental conditions, and replace the cable. If the alarm still occurs, replace the multi-winding drive unit.
	Malfunction caused by noise interference.	–	Correct the wiring around the encoder by separating the encoder cable from the servomotor main circuit cable or by checking the grounding and other wiring.
	A fault occurred in the multi-winding drive unit.	–	Connect the servomotor to another multi-winding drive unit, and turn ON the control power supply. If no alarm occurs, the multi-winding drive unit may be faulty. Replace the multi-winding drive unit.
A.C91: Encoder Communications Position Data Error	Noise interference occurred on the I/O signal line because the encoder cable is bent and the sheath is damaged.	Check the encoder cable and connector.	Confirm that there is no problem with the cable layout.
	The encoder cable is bundled with a high-current line or near a high-current line.	Check the cable layout for encoder cable.	Confirm that there is no surge voltage on the cable.
	The FG potential varies because of influence from machines on the servomotor side, such as the welder.	Check the cable layout for encoder cable.	Properly ground the machines to separate from the encoder FG.

(cont'd)

Alarm Number: Alarm Name (Alarm Description)	Cause	Investigative Actions	Corrective Actions
A.C92: Encoder Communications Timer Error	Noise interference occurred on the I/O signal line from the encoder.	–	Take countermeasures against noise for the encoder wiring.
	Excessive vibration and shocks were applied to the encoder.	Check the operating environment.	Reduce the machine vibration or correctly install the servomotor.
	An encoder fault occurred.	–	Turn the control power supply OFF and ON again. If the alarm still occurs, the servomotor may be faulty. Replace the servomotor.
	A fault occurred in the multi-winding drive unit.	–	Turn the control power supply OFF and ON again. If the alarm still occurs, the multi-winding drive unit may be faulty. Replace the multi-winding drive unit.
A.CA0: Encoder Parameter Error	An encoder fault occurred.	–	Turn the control power supply OFF and ON again. If the alarm still occurs, the servomotor may be faulty. Replace the servomotor.
	A fault occurred in the multi-winding drive unit.	–	Turn the control power supply OFF and ON again. If the alarm still occurs, the multi-winding drive unit may be faulty. Replace the multi-winding drive unit.
A.Cb0: Encoder Echoback Error	The wiring and contact for encoder cable are incorrect.	Check the wiring.	Correct the wiring.
	Noise interference occurred due to incorrect cable specifications of encoder cable.	–	Use tinned annealed copper shielded twisted-pair or screened unshielded twisted-pair cable with a core of at least 0.12 mm^2.
	Noise interference occurred because the wiring distance for the encoder cable is too long.	–	The wiring distance must be 50 m max.
	The FG potential varies because of influence from machines on the servomotor side, such as the welder.	Check the cable layout for encoder cable.	Properly ground the machines to separate from encoder FG.
	Excessive vibration and shocks were applied to the encoder.	Check the operating environment.	Reduce the machine vibration or correctly install the servomotor.
	An encoder fault occurred.	–	Turn the control power supply OFF and ON again. If the alarm still occurs, the servomotor may be faulty. Replace the servomotor.
	A fault occurred in the multi-winding drive unit.	–	Turn the control power supply OFF and ON again. If the alarm still occurs, the multi-winding drive unit may be faulty. Replace the multi-winding drive unit.
A.CC0: Multiturn Limit Disagreement	The multiturn limit value of the encoder is different from that of the multi-winding drive unit. Or, the multiturn limit value of the multi-winding drive unit has been changed.	Check the value of the Pn205 of the multi-winding drive unit.	Execute Fn013 at the occurrence of alarm.
	A fault occurred in the multi-winding drive unit.	–	Turn the control power supply OFF and ON again. If the alarm still occurs, the multi-winding drive unit may be faulty. Replace the multi-winding drive unit.

(cont'd)

Alarm Number: Alarm Name (Alarm Description)	Cause	Investigative Actions	Corrective Actions
A.d00: Position Error Overflow (Position error exceeded the value set in the excessive position error alarm level (Pn520).)	The servomotor U, V, and W wirings is faulty.	Check the servomotor main circuit cable connection.	Confirm that there is no contact fault in the motor wiring or encoder wiring.
	The frequency of the position reference pulse is too high.	Reduce the reference pulse frequency, and operate the multi-winding drive unit.	Reduce the position reference pulse frequency or acceleration of position reference. Or, reconsider the electronic gear ratio.
	The acceleration of the position reference is too high.	Reduce the reference acceleration, and operate the multi-winding drive unit.	Apply the smoothing function, such as using position reference acceleration/deceleration time constant (Pn216).
	Setting of the excessive position error alarm level (Pn520) is low against the operating condition.	Check the alarm level (Pn520) to see if it is set to an appropriate value.	Set the Pn520 to proper value.
	A fault occurred in the multi-winding drive unit.	–	Turn the control power supply OFF and ON again. If the alarm still occurs, the multi-winding drive unit may be faulty. Replace the multi-winding drive unit.
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.	Check the position error amount (Un008) while the servomotor power is OFF.	Set position error to be cleared while the servomotor power is OFF. Or, correct the excessive position error alarm level at servo ON (Pn526).
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 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).	–	Set position error to be cleared while the servomotor power is OFF. Or, correct the excessive position error alarm level (Pn520). Or, adjust the speed limit level at servo ON (Pn529).
A.d10: Motor-load Position Error Overflow	Motor rotation direction and external encoder installation direction are opposite.	Check the servomotor rotation direction and the external encoder installation direction.	Install the external encoder in the opposite direction, or change the setting of the external encoder usage method (Pn002.3) to reverse the direction.
	Mounting of the load (e.g., stage) and external encoder joint installation are incorrect.	Check the external encoder mechanical connection.	Check the mechanical joints.
A.Eb1: Safety Function Signal Input Timing Error	The lag between activations of the input signals /HWBB1 and /HWBB2 for the HWBB function is ten second or more.	Measure the time lag between the /HWBB1 and /HWBB2 signals.	The output signal circuits or devices for /HWBB1 and /HWBB2 or the multi-winding drive unit input signal circuits may be faulty. Alternatively, the input signal cables may be disconnected. Check if any of these items are faulty or have been disconnected.
A.EE0: Local Communications Servo OFF Operation Error 1	The servo was not turned OFF for all axes within 1 second after the servo OFF request.	–	Perform an alarm reset and restart operation.
A.EE1: Local Communications Servo ON Operation Error 1	The servo was not turned ON for all axes within 1 second after the servo ON request.	Check to see if the multi-winding drive unit is in ready status.	Perform an alarm reset and restart operation.
		Check to see if the motor is stopped.	Perform an alarm reset and restart operation.

(cont'd)

Alarm Number: Alarm Name (Alarm Description)	Cause	Investigative Actions	Corrective Actions
A.EE2: Local Communications Servo ON Operation Error 2	Servo ON status could not be detected for all axes during servo ON status.	Check to see if the multi-winding drive unit is in ready status.	Perform an alarm reset and restart operation.
A.EE3: Local Communications Servo OFF Operation Error 2	Servo OFF status could not be detected for all axes during servo OFF status.	–	Perform an alarm reset and restart operation.
A.EE4: Local Communications Connection Failure	The connection command for local bus communications was not completed.	Check to see if the multi-winding drive unit is in ready status.	Perform an alarm reset and restart operation.
		Check the multi-winding drive unit parameters.	Set the multi-winding drive unit parameters again.
A.EE5: Local Communications ASIC Initialization Failure	Initialization processing of the local bus communications ASIC failed.	–	Turn the control power supply OFF and ON again. Replace the multi-winding drive unit.
A.EE6: Local Communications Disconnection Error	The wiring for local bus communications is not correct.	Check the wiring of local bus communications.	Wire the local bus communications cable correctly. Install the terminator correctly.
	A reception error occurred in the local bus communications data due to noise.	–	Take countermeasures against noise. (For example, correct the cable and field ground wiring. Or, place a ferrite core on the local bus communications cable.)
A.F10: Main Circuit Cable Open Phase (With the main circuit power supply ON, voltage was low for more than 1 second in an R, S, or T phase.) (Detected when the main power supply was turned ON.)	The three-phase power supply wiring is incorrect.	Check the power supply wiring.	Confirm that the power supply is correctly wired.
	The three-phase power supply is unbalanced.	Measure the voltage at each phase of the three-phase power supply.	Balance the power supply by changing phases.
	The connection of the I/O signals (CN901) between the SERVOPACK and converter is faulty.	Check the connection of CN901.	Correctly connect CN901.
	A fault occurred in the SERVOPACK or converter.	–	Turn the main circuit power supply OFF and ON again. If the alarm still occurs, the SERVOPACK or converter may be faulty. Replace the SERVOPACK or converter.
A.F30: Dynamic Brake Contactor Error	The contactor is faulty in the dynamic brake circuit.	Check the contacts to see if they are welded or not.	The contactor may be faulty. Replace the contactor.
	Incorrect wiring of the dynamic brake answer signal.	Check the wiring of the dynamic brake answer signal.	Correctly wire the dynamic brake answer signal.
	A fault occurred in the SERVOPACK.	–	Turn the control power supply OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.
CPF00: Digital Operator Transmission Error 1	The contact between the digital operator and the SERVOPACK is faulty.	Check the connector contact.	Insert securely the connector or replace the cable.
	Malfunction caused by noise interference.	–	Keep the digital operator or the cable away from noise sources.

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Alarm Number: Alarm Name (Alarm Description)	Cause	Investigative Actions	Corrective Actions
CPF01: Digital Operator Transmission Error 2	A digital operator fault occurred.	–	Disconnect the digital operator and then re-connect it. If the alarm still occurs, the digital operator may be faulty. Replace the digital operator.
	A fault occurred in the multi-winding drive unit and SERVOPACK.	–	Turn the control power supply OFF and ON again. If the alarm still occurs, the multi-winding drive unit and SERVOPACK may be faulty. Replace the multi-winding drive unit and SERVOPACK.

9.2 Warning Displays

The following sections describe troubleshooting in response to warning displays.

The warning name, warning meaning, and warning code output are listed in order of the warning numbers in *9.2.1 List of Warnings*.

The causes of warnings and troubleshooting methods are provided in *9.2.2 Troubleshooting of Warnings*.

9.2.1 List of Warnings

This section provides list of warnings.

Warning Number	Warning Name	Meaning	Warning Code Output		
			ALO1	ALO2	ALO3
A.900	Position Error Overflow	Position error exceeded the parameter setting (Pn520×Pn51E/100).	H	H	H
A.901	Position Error Overflow Alarm at Servo ON	When the servomotor power is ON, the position error exceeded the parameter setting (Pn526×Pn528/100).	H	H	H
A.910	Overload	This warning occurs before the overload alarms (A.710 or A.720) occur. If the warning is ignored and operation continues, an overload alarm may occur.	L	H	H
A.911	Vibration	Abnormal vibration at the motor speed was detected. The detection level is the same as A.520. Set whether to output an alarm or warning by the vibration detection switch (Pn310).	L	H	H
A.920	Regenerative Overload	This warning occurs before the regenerative overload alarm (A.320) occurs. If the warning is ignored and operation continues, a regenerative overload alarm may occur.	H	L	H
A.921	Dynamic Brake Overload	This warning occurs before dynamic brake overload alarm (A.731) occurs. If the warning is ignored and operation continues, a dynamic brake overload alarm may occur.	H	L	H
A.930	Absolute Encoder Battery Error	This warning occurs when the voltage of absolute encoder’s battery is lowered.	L	L	H
A.941	Change of Parameters Requires Restart	Parameters that require the restart have been changed.	H	H	L
A.971	Undervoltage	This warning occurs before undervoltage alarm (A.410) occurs. If the warning is ignored and operation continues, an undervoltage alarm may occur.	L	L	L
A.9A0	Overtravel	Overtravel is detected while the servomotor power is ON.	H	L	L

Note 1. Warning code is not output without setting Pn001.3 =1 (outputs both alarm codes and warning codes).
2. If Pn008.2 = 1 (does not detect warning) is selected, no warnings will be detected except for an undervoltage warning (A.971).

9.2.2 Troubleshooting of Warnings

Refer to the following table to identity the cause of a warning and the action to be taken. Contact your Yaskawa representative if the problem cannot be solved by the described corrective action.

Warning Number: Warning Name (Warning Description)	Cause	Investigative Actions	Corrective Actions
A.900: Position Error Overflow	The servomotor U, V, and W wirings is faulty.	Check the servomotor main circuit cable connection.	Confirm that there is no contact fault in the motor wiring or encoder wiring.
	The multi-winding drive unit gain is too low.	Check the multi-winding drive unit gain to see if it is low.	Increase the servo gain by using the function such as advanced autotuning.
	The frequency of the position reference pulse is too high.	Reduce the reference pulse frequency, and operate the multi-winding drive unit.	Reduce the position reference pulse frequency or acceleration of position reference. Or, reconsider the electronic gear ratio.
	The acceleration of the position reference is too high.	Reduce the reference acceleration, and operate the multi-winding drive unit.	Apply the smoothing function, such as using the position reference acceleration/deceleration time constant (Pn216).
	Setting of the excessive position error alarm level (Pn520) is low against the operating condition.	Check the alarm level (Pn520) to see if it is set to an appropriate value.	Set the Pn520 to proper value.
	A fault occurred in the multi-winding drive unit.	–	Turn the control power supply OFF and ON again. If the alarm still occurs, the multi-winding drive unit may be faulty. Replace the multi-winding drive unit.
A.901: Position Error Overflow Alarm at Servo ON	When the servomotor power is ON, the position error exceeded the parameter setting (Pn526×Pn528/100).	–	Set Pn200.2 to 0 to clear the number of position error while the servomotor power is OFF. Or set an appropriate value for the excessive position error warning level at servo ON (Pn528).
A.910: Overload (Warning before alarm A.710 or A.720 occurs)	Incorrect wiring or contact fault of servomotor and encoder.	Check the wiring.	Confirm that the servomotor and encoder are correctly wired.
	Operation beyond the overload protection characteristics.	Check the motor overload characteristics and executed run command.	Reconsider the load conditions and operating conditions. Or, increase the motor capacity.
	Excessive load was applied during operation because the servomotor was not driven due to mechanical problems.	Check the executed operation reference and motor speed.	Remove the mechanical problems.
	A fault occurred in the multi-winding drive unit.	–	The multi-winding drive unit may be faulty. Replace the multi-winding drive unit.

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Warning Number: Warning Name (Warning Description)	Cause	Investigative Actions	Corrective Actions
A.911: Vibration	Abnormal vibration was detected at the motor speed.	Check for abnormal noise from the servomotor, and check the speed and torque waveforms during operation.	Reduce the motor speed or reduce the servo gain by using the function such as one-parameter tuning.
	The moment of inertia ratio (Pn103) value is greater than the actual value or is greatly changed.	Check the moment of inertia ratio.	Set the moment of inertia ratio (Pn103) to an appropriate value.
A.920: Regenerative Overload (Warning before the alarm A.320 occurs)	The power supply voltage exceeds the specified limit.	Measure the power supply voltage.	Set the power supply voltage within the specified range.
	Insufficient regenerative resistance, regenerative resistor capacity, SERVOPACK capacity, or converter capacity. Or, regenerative power has been continuously flowing back.	Check the operating condition or the capacity using the capacity selection Software SigmaJunmaSize+, etc.	Change the regenerative resistance, regenerative resistor capacity, SERVOPACK capacity, or converter capacity. Reconsider the operating conditions using the capacity selection software SigmaJunmaSize+, etc.
	Regenerative power continuously flowed back because negative load was continuously applied.	Check the load to the servomotor during operation.	Reconsider the system including servo drives, machine, and operating conditions.
A.921: Dynamic Brake Overload (Warning before the alarm A.731 occurs)	The servomotor rotates because of external force.	Check the operation status.	Take measures to ensure the servomotor will not rotate because of external force.
	The rotating energy at a DB stop exceeds the DB resistance capacity.	Check the power consumed by DB resistance (Un00B) to see how many times the DB has been used.	Reconsider the following: • Reduce the motor reference speed. • Reduce the moment of inertia ratio. • Reduce the number of times of the DB stop operation.
	A fault occurred in the SERVOPACK or converter.	–	The SERVOPACK or converter may be faulty. Replace the SERVOPACK or converter.
A.930: Absolute Encoder Battery Error (The absolute encoder battery voltage is lower than the specified value.) * Only when an absolute encoder is connected.	The battery connection is incorrect.	Check the battery connection.	Reconnect the battery.
	The battery voltage is lower than the specified value 2.7 V.	Measure the battery voltage.	Replace the battery.
	A fault occurred in the multi-winding drive unit.	–	The multi-winding drive unit may be faulty. Replace the multi-winding drive unit.
A.941: Change of Parameters Requires Restart	Parameters that require the restart have been changed.	–	Turn the control power supply OFF and ON again.

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Warning Number: Warning Name (Warning Description)	Cause	Investigative Actions	Corrective Actions
A.971: Undervoltage	The AC power supply voltage dropped to 280 V or less for a 400-VAC SERVOPACK.	Measure the power supply voltage.	Set the power supply voltage within the specified range.
	The power supply voltage dropped during operation.	Measure the power supply voltage.	Increase the power supply capacity.
	Occurrence of instantaneous power interruption.	Measure the power supply voltage.	When the instantaneous power cut hold time (Pn509) is set, decrease the setting.
	A fault occurred in the SERVOPACK or converter.	–	The SERVOPACK or converter may be faulty. Replace the SERVOPACK or converter.
A.9A0: Overtravel (Overtravel status is detected.)	When the servomotor power is ON, overtravel status is detected.	Check the input signal monitor (Un005) to check the status of the overtravel signals.	Refer to *9.3 Troubleshooting Malfunction Based on Operation and Conditions of the Servomotor*. Even if overtravel signals were not shown by the input signal monitor (Un005), momentary overtravel may have been detected. Take the following precautions. • Do not specify movements that would cause overtravel from the host controller. • Check the wiring of the overtravel signals. • Take countermeasures for noise.

9.3 Troubleshooting Malfunction Based on Operation and Conditions of the Servomotor

Troubleshooting for the malfunctions based on the operation and conditions of the servomotor is provided in this section.

Be sure to turn OFF the servo system before troubleshooting items shown in bold lines in the table.

Problem	Probable Cause	Investigative Actions	Corrective Actions
Servomotor Does Not Start	The control power supply is not ON.	Check voltage between control power terminals.	Correct the wiring so that the control power supply turns ON.
	The main circuit power supply is not ON.	Check the voltage between main circuit power terminals.	Correct the wiring so that the main circuit power supply turns ON.
	Wiring of I/O signal connector CN1 is faulty or disconnected.	Check if the connector CN1 is properly inserted and connected.	Correct the connector CN1 connection.
	Wiring for servomotor main circuit cable or encoder cable is disconnected.	Check the wiring.	Correct the wiring.
	Overloaded	Run under no load and check the load status.	Reduce load or replace with larger capacity servomotor.
	Encoder type differs from parameter setting (Pn002.2).	Check the settings for parameter Pn002.2.	Set parameter Pn002.2 to the encoder type being used.
	Speed/position references not input	Check the allocation status of the input signals.	Allocate input signals so that the speed/position reference is input correctly.
	Settings for the input signal selections (Pn50A to Pn50D) is incorrect.	Check the settings for parameters Pn50A to Pn50D.	Correct the settings for parameter Pn50A to Pn50D.
	Servo ON signal (/S-ON) stays OFF.	Check the settings for parameters Pn50A.0 and Pn50A.1.	Set the parameters Pn50A.0 and Pn50A.1 to turn the /S-ON signal ON.
	/P-CON input function setting is incorrect.	Check the settings for parameter Pn000.1.	Set parameters to match the application.
	SEN input is OFF.	Check the ON/OFF status of the SEN input.	If using an absolute encoder, turn the SEN input signal ON.
	Reference pulse mode selection is incorrect.	Check the Pn200.0 setting and the reference pulse form.	Match the Pn200.0 setting and the reference pulse form.
	Speed control: Speed reference input is incorrect.	Check V-REF and SG to confirm if the control method and the input are agreed.	Correct the control method selection parameter, and the input signal.
	Torque control: Torque reference input is incorrect.	Check V-REF and SG to confirm if the control method and the input are agreed.	Correct the control method selection parameter, and the input signal.
	Position control: Reference pulse input is incorrect.	Check Pn200.0 reference pulse form and sign + pulse signal.	Correct the control method selection parameter, and the input signal.
	Position error clear (/CLR) input has not been turned OFF.	Check /CLR input signals (CN1-14 and -15).	Turn /CLR input signals OFF.
	The forward run prohibited (P-OT) and reverse run prohibited (N-OT) input signals are turned OFF.	Check P-OT or N-OT input signal.	Turn P-OT or N-OT input signal ON.
	The safety input signal (/HWBB1 or /HWBB2) remains OFF.	Check the /HWBB1 and /HWBB2 input signal.	Set the /HWBB1 and /HWBB2 input signal to ON. When not using the safety function, mount the safety function jumper connector (provided as an accessory) on the CN8.
	The brake is not released.	Check the operation of the brake.	Release the brake.
	A fault occurred in the multi-winding drive unit, SERVOPACK, or converter.	–	Replace the multi-winding drive unit, SERVOPACK, or converter.

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Problem	Probable Cause	Investigative Actions	Corrective Actions
Servomotor Moves Instantaneously, and then Stops	Servomotor wiring is incorrect.	Check the wiring.	Correct the wiring.
	Encoder wiring is incorrect.	Check the wiring.	Correct the wiring.
Servomotor Speed Unstable	Wiring connection to servomotor is defective.	Check connections of power line (phases U, V, and W) and encoder connectors.	Tighten any loose terminals or connectors and correct the wiring.
Servomotor Rotates Without Reference Input	Speed control: Speed reference input is incorrect.	Check V-REF and SG to confirm if the control method and the input are agreed.	Correct the control method selection parameter, and the input signal.
	Torque control: Torque reference input is incorrect.	Check V-REF and SG to confirm if the control method and the input are agreed.	Correct the control method selection parameter, and the input signal.
	Speed reference offset is incorrect.	The offset in the multi-winding drive unit is adjusted incorrectly.	Adjust the offset in the multi-winding drive unit.
	Position control: Reference pulse input is incorrect.	Check the reference pulse form (Pn200.0) and sign + pulse signal.	Correct the control method selection parameter, and the input signal.
	A fault occurred in the multi-winding drive unit.	–	Replace the multi-winding drive unit.
Dynamic Brake Does Not Operate	Improper Pn001.0 setting	Check the setting for parameter Pn001.0.	Correct the setting for parameter Pn001.0.
	DB resistor disconnected	Check if excessive moment of inertia, motor overspeed, or DB frequently activated occurred.	Replace the dynamic brake unit or change the external dynamic brake circuit. And reduce the load.
	DB drive circuit fault	–	A defective component is in the dynamic brake circuit inside SERVOPACK. Replace the SERVOPACK.
	Wiring of the dynamic brake unit is incorrect.	Check the wiring.	Correct the wiring.
Abnormal Noise from Servomotor	The servomotor largely vibrated during execution of tuning-less function.	Check the motor speed waveform.	Reduce the load so that the moment of inertia ratio becomes within the allowable value, or increase the load level or lower the tuning level for the tuning-less levels setting (Fn200).
	Mounting is not secured.	Check if there are any loose mounting screws.	Tighten the mounting screws.
		Check if there is misalignment of couplings.	Align the couplings.
		Check if there are unbalanced couplings.	Balance the couplings.
	Bearings are defective.	Check for noise and vibration around the bearings.	Replace the servomotor.
	Vibration source at the driven machine.	Check for any foreign matter, damage, or deformations on the machinery's movable parts.	Contact the machine manufacturer.
	Noise interference due to incorrect I/O signal cable specifications.	The I/O signal cable must be tinned annealed copper shielded twisted-pair or screened unshielded twisted-pair cable with a core of 0.12 mm^2 min.	Use the specified I/O signal cable.
	Noise interference due to length of I/O signal cable.	Check the length of the I/O signal cable.	The I/O signal cable length must be no more than 3 m.

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Problem	Probable Cause	Investigative Actions	Corrective Actions
Abnormal Noise from Servomotor (Continued from previous page.)	Noise interference due to incorrect cable specifications of encoder cable.	The encoder cable must be tinned annealed copper shielded twisted-pair or screened unshielded twisted-pair cable with a core of 0.12 mm^2 min.	Use the specified encoder cable.
	Noise interference due to length of encoder cable.	Check the length of the encoder cable.	The encoder cable must be no more than 50 m.
	Noise interference due to damaged encoder cable.	Check if the encoder cable is bent and the sheath is damaged.	Replace the encoder cable and correct the cable layout.
	Excessive noise to the encoder cable.	Check if the encoder cable is bundled with a high-current line or near a high-current line.	• Correct the cable layout so that no surge is applied. • Use a double-shielded encoder cable.
	The FG potential varies because of influence from machines on the servomotor side, such as the welder.	Check if the machines are correctly grounded.	Properly ground the machines to separate from the encoder FG.
	A multi-winding drive unit pulse counting error occurred due to noise interference.	Check if there is noise interference on the I/O signal line from the encoder.	Take measures against noise in the encoder wiring.
	Excessive vibration and shock to the encoder	Check if vibration from the machine occurred or servomotor installation is incorrect (mounting surface accuracy, fixing, alignment, etc.).	Reduce vibration from the machine, or secure the servomotor installation.
	An encoder fault occurred.	–	Replace the servomotor.
Servomotor Vibrates at Frequency of Approx. 200 to 400 Hz.	Unbalanced servo gains	Check to see if the servo gains have been correctly adjusted.	Execute the advanced autotuning.
	Speed loop gain value (Pn100) too high.	Check the speed loop gain (Pn100). Factory setting: Kv = 40.0 Hz	Reduce the speed loop gain (Pn100).
	Position loop gain value (Pn102) too high.	Check the position loop gain (Pn102). Factory setting: Kp = 40.0/s	Reduce the position loop gain (Pn102).
	Incorrect speed loop integral time constant (Pn101)	Check the speed loop integral time constant (Pn101). Factory setting: Ti = 20.0 ms	Correct the speed loop integral time constant (Pn101).
	Incorrect moment of inertia ratio (Pn103)	Check the moment of inertia ratio (Pn103).	Correct the moment of inertia ratio (Pn103).
High Motor Speed Overshoot on Starting and Stopping	Unbalanced servo gains	Check to see if the servo gains have been correctly adjusted.	Execute the advanced autotuning.
	Speed loop gain value (Pn100) too high	Check the speed loop gain (Pn100). Factory setting: Kv = 40.0 Hz	Reduce the speed loop gain (Pn100).
	Position loop gain value (Pn102) too high	Check the position loop gain (Pn102). Factory setting: Kp = 40.0/s	Reduce the position loop gain (Pn102).
	Incorrect speed loop integral time constant (Pn101)	Check the speed loop integral time constant (Pn101). Factory setting: Ti = 20.0 ms	Correct the speed loop integral time constant (Pn101).
	Incorrect moment of inertia ratio data (Pn103)	Check the moment of inertia ratio (Pn103).	Correct the moment of inertia ratio (Pn103).
	The torque reference is saturated.	Check the torque reference waveform.	Use a mode switch.

(cont'd)

Problem	Probable Cause	Investigative Actions	Corrective Actions
Absolute Encoder Position Difference Error (The position saved in the host controller when the power was turned OFF is different from the position when the power was next turned ON.)	Noise interference due to incorrect cable specifications of encoder cable.	The encoder cable must be tinned annealed copper shielded twisted-pair or screened unshielded twisted-pair cable with a core of 0.12 mm^2 min.	Use the specified encoder cable.
	Noise interference due to length of encoder cable.	Check the length of the encoder cable.	The encoder cable must be no more than 50 m.
	Noise interference due to damaged encoder cable.	Check if the encoder cable is bent and the sheath is damaged.	Replace the encoder cable and correct the cable layout.
	Excessive noise to the encoder cable.	Check if the encoder cable is bundled with a high-current line or near a high-current line.	• Correct the cable layout so that no surge is applied. • Use a double-shielded encoder cable.
	FG potential varies because of influence of machines such as welders at the servomotor.	Check if the machines are correctly grounded.	Ground machines correctly, and prevent diversion to the FG on the encoder side.
	A multi-winding drive unit pulse counting error occurred due to noise interference.	Check if there is noise interference on the I/O signal line from the encoder.	Take measures against noise in the encoder wiring.
	Excessive vibration and shock to the encoder	Check if vibration from the machine occurred or servomotor installation is incorrect (mounting surface accuracy, fixing, alignment, etc.).	Reduce vibration from the machine, or secure the servomotor installation.
	An encoder fault occurred.	–	Replace the servomotor.
	A fault occurred in the multi-winding drive unit.	–	Replace the multi-winding drive unit.
	Host controller multiturn data reading error	Check the error detection section of the host controller.	Correct the error detection section of the host controller.
		Check if the host controller is executing data parity checks.	Execute a multiturn data parity check.
		Check noise in the cable between the SERVOPACK and the host controller.	Take measures against noise, and again execute a multiturn data parity check.
Overtravel (OT)	Forward or reverse run prohibited signal is input.	Check the external power supply (+24 V) voltage for the input signal.	Correct the external power supply (+24 V) voltage.
		Check if the overtravel limit switch operates properly.	Correct the overtravel limit switch.
		Check if the overtravel limit switch is wired correctly.	Correct the overtravel limit switch wiring.
		Check the settings for parameters Pn50A and Pn50B.	Correct the settings for parameters Pn50A and Pn50B.
	Forward or reverse run prohibited signal malfunctioning.	Check the fluctuation of the external power supply (+24 V) voltage for the input signal.	Stabilize the external power supply (+24 V) voltage.
		Check if the overtravel limit switch operates correctly.	Correct the overtravel limit switch.
		Check if the overtravel limit switch wiring is correct. (check for damaged cables or loose screws.)	Correct the overtravel limit switch wiring.
	Incorrect forward or reverse run prohibited signal (P-OT/N-OT) allocation (parameters Pn50A.3, Pn50B.0)	Check if the P-OT signal is allocated in Pn50A.3.	If another signal is allocated in Pn50A.3, allocate P-OT.
		Check if the N-OT signal is allocated in Pn50B.0.	If another signal is allocated in Pn50B.0, allocate N-OT.

(cont'd)

Problem	Probable Cause	Investigative Actions	Corrective Actions
Overtravel (OT) (Continued from previous page.)	Incorrect servomotor stop method selection	Check the settings for parameters Pn001.0 and Pn001.1 when the servomotor power is OFF.	Select a servomotor stop method other than "coast to stop."
		Check the settings for parameters Pn001.0 and Pn001.1 when in torque control.	Select a servomotor stop method other than "coast to stop."
Improper Stop Position by Overtravel (OT) Signal	Improper limit switch position and dog length	–	Install the limit switch at the appropriate position.
	The overtravel limit switch position is too short for the coasting distance.	–	Install the overtravel limit switch at the appropriate position.
Position Error (Without Alarm)	Noise interference due to incorrect encoder cable specifications	The encoder cable must be tinned annealed copper shielded twisted-pair or screened unshielded twisted-pair cable with a core of 0.12 mm^2 min.	Use the specified encoder cable.
	Noise interference due to length of encoder cable.	Check the length of the encoder cable.	The encoder cable must be no more than 50 m.
	Noise influence due to damaged encoder cable.	Check if the encoder cable is bent and the sheath is damaged.	Replace the encoder cable and modify the cable layout.
	Excessive noise to encoder cable.	Check if the encoder cable is bundled with a high-current line or near a high-current line.	• Change the cable layout so that no surge is applied. • Use a double-shielded encoder cable.
	The FG potential varies because of influence from machines on the servomotor side such as the welder.	Check if the machines are correctly grounded.	Properly ground the machines encoder FG.
	SERVOPACK pulse count error due to noise	Check if the I/O signal line from the encoder is influenced by noise.	Take measures against noise in the encoder wiring.
	Excessive vibration and shock to the encoder	Check if vibration from the machine occurred or servomotor installation is incorrect (mounting surface accuracy, fixing, alignment, etc.).	Reduce the machine vibration or mount the servomotor securely.
	Unsecured coupling between machine and servomotor	Check if a position error occurs at the coupling between machine and servomotor.	Secure the coupling between the machine and servomotor.
	Noise interference due to improper I/O signal cable specifications	The I/O signal cable must be tinned annealed copper shielded twisted-pair or screened unshielded twisted-pair cable with a core of 0.12 mm^2 min.	Use input signal cable with the specified specifications.
	If the reference pulse input multiplication switching function is being used, noise may be causing the I/O signals (/PSEL and /PSELA) used for this function to be falsely detected.	The I/O signal cable must be tinned annealed copper shielded twisted-pair or screened unshielded twisted-pair cable with a core of 0.12 mm^2 min.	Use input signal cable that satisfy specifications.
	Noise interference due to length of I/O signal cable	Check the I/O signal cable length.	The I/O signal cable length must be no more than 3 m.
	An encoder fault occurred. (The pulse count does not change.)	–	Replace the servomotor.
	A fault occurred in the multi-winding drive unit.	–	Replace the multi-winding drive unit.

(cont'd)

Problem	Probable Cause	Investigative Actions	Corrective Actions
Servomotor Overheated	Ambient operating temperature too high	Measure the servomotor ambient operating temperature.	Reduce the ambient operating temperature to 40°C or less.
	Servomotor surface dirty	Visually check the surface.	Clean dust and oil from the surface.
	Servomotor overloaded	Check the load status with monitor.	If an overload occurs, reduce the load or replace the SERVOPACK, converter, and servomotor with models with higher capacities.
	A fault occurred in the fan.	Check if the fan is rotating or not.	Replace the servomotor.
	Incorrect wiring of the fan.	Check if the fan is rotating backward.	Correct the wiring.
		Check the wiring.	
	The brake is not released.	Check the operation of the brake.	Release the brake.

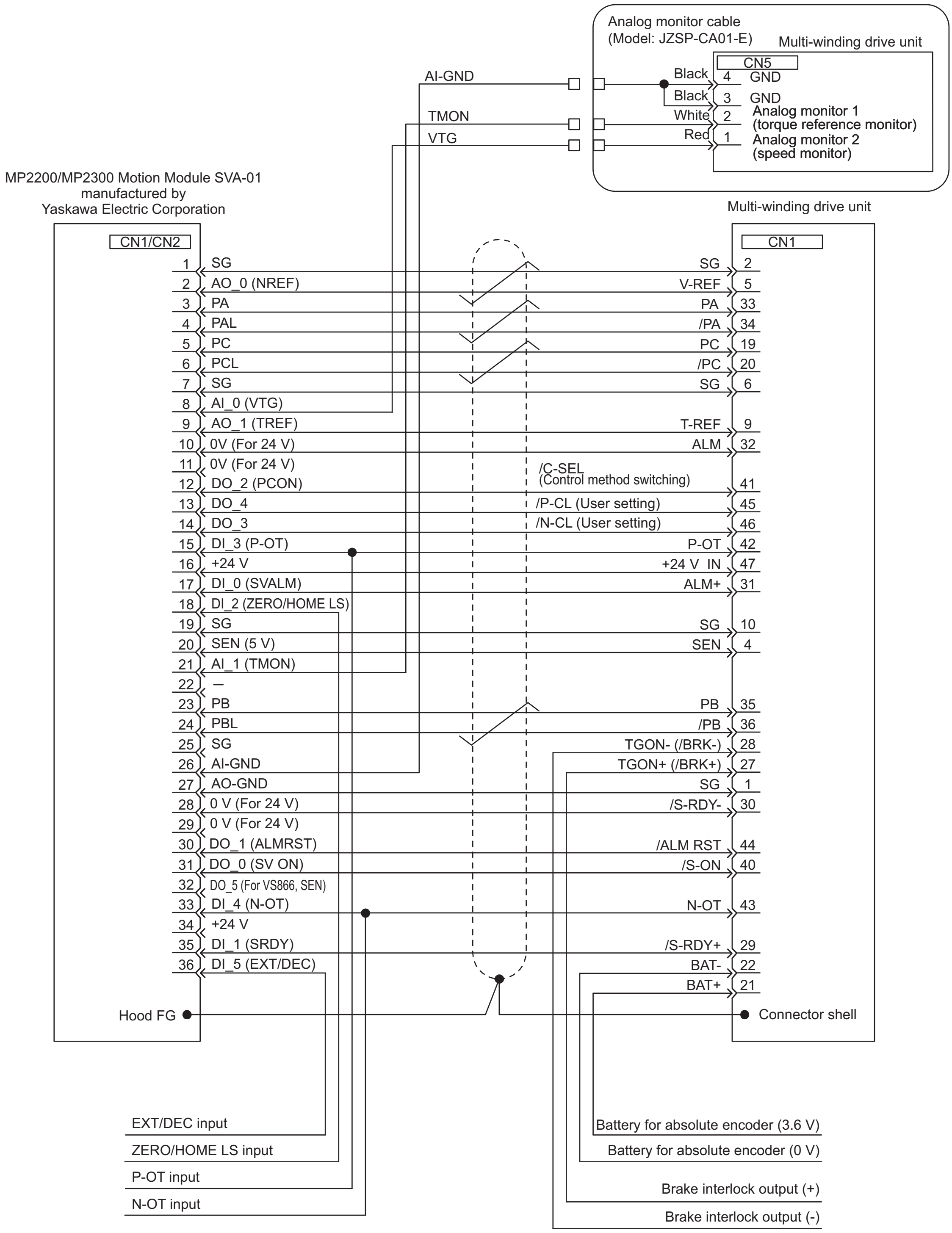
10

Appendix

10.1 Connection to Host Controller

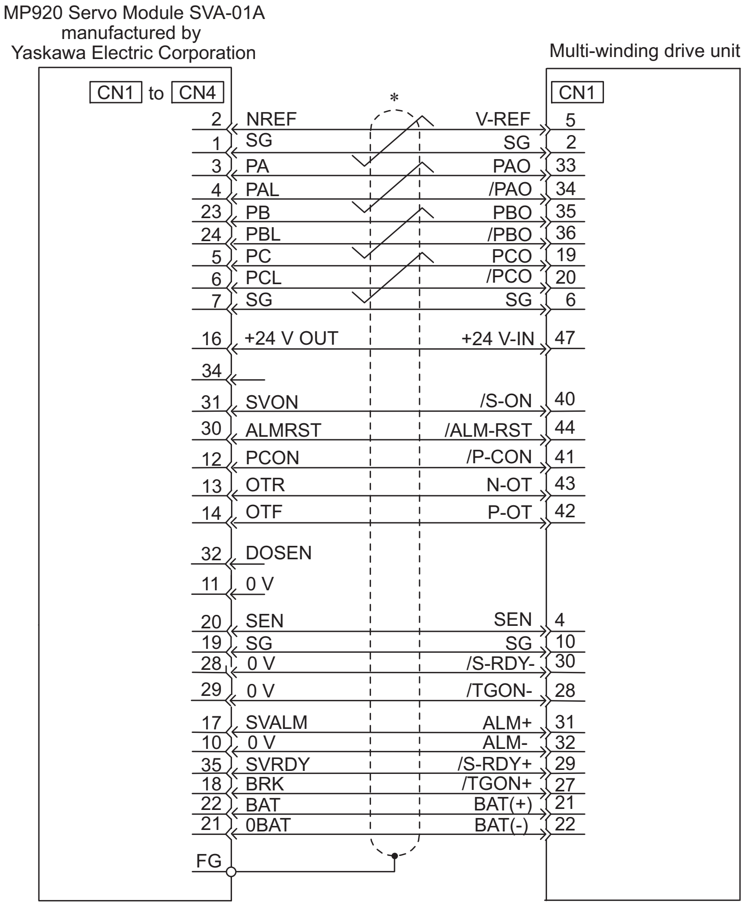
This section provides examples of multi-winding drive unit connections to the host controller.

10.1.1 Connection to MP2200/MP2300 Motion Module SVA-01



Note 1. Connection cables (model: JEPMC-W2040-□□) to connect the multi-winding drive unit to the MP2200/MP2300 are prepared by Yaskawa. For details, refer to *Machine Controller MP2200/2300 Motion Module User's Manual* (No.: SIEP C880700 16).
2. Only the signals that are related to the multi-winding drive unit and MP2200/2300-series SVA-01 are given in this example.
3. Incorrect signal connections may damage the machine controller, multi-winding drive unit, SERVOPACKs, and converters.
4. Open the signal lines not to be used.
5. The above connection diagram shows the connections for only one axis. When using other axes, make connections to the SERVOPACK in the same way.
6. Short-circuit the normally closed (NC) input terminals that are not used at the I/O connector section of the machine controller.
7. Make the settings so that the servomotor can be turned ON/OFF by the Servo ON signal (/S-ON).
8. The SERVOPACK incorporates safety functions to protect people from the hazardous operation of the movable parts of the machines, reduce the risk, and ensure the safety of the machine in operation. Necessary circuits and settings are required in CN8 to use these functions. If these functions are not used, use the SERVOPACK with the enclosed safety function jumper connector connected to CN8. For details, refer to *5.11 Safety Function.*

10.1.2 Connection to MP920 Servo Module SVA-01A

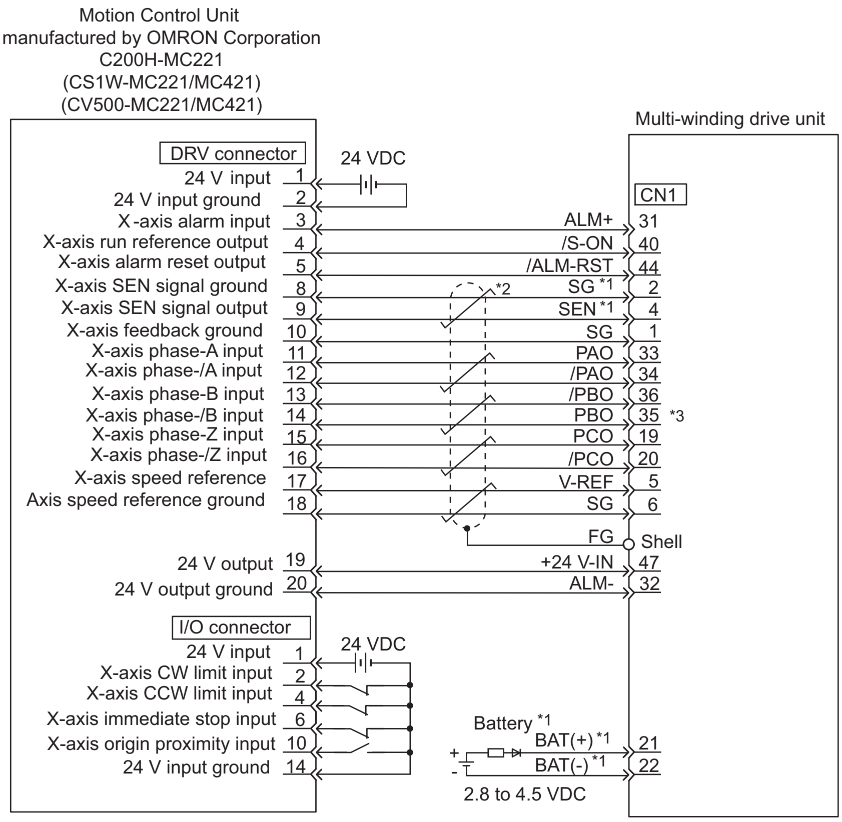


*  represents twisted-pair wires.

Note 1. Connection cables (model: JEPMC-W6050-□□) to connect the multi-winding drive unit to the MP920 are prepared by Yaskawa. For details, refer to *Machine Controller MP920 User's Manual design and maintenance* (No.: SIEZ-C887-2.1).

2. Only the signals that are related to the multi-winding drive unit and MP920-series SVA-01A are given in this example.
3. Incorrect signal connections may damage the machine controller, multi-winding drive unit, SERVOPACKs, and converters.
4. Open the signal lines not to be used.
5. The above connection diagram shows the connections for only one axis. When using other axes, make connections to the SERVOPACK in the same way.
6. Short-circuit the normally closed (NC) input terminals that are not used at the I/O connector section of the machine controller.
7. Make the settings so that the servomotor can be turned ON/OFF by the Servo ON signal (/S-ON).
8. The SERVOPACK incorporates safety functions to protect people from the hazardous operation of the movable parts of the machines, reduce the risk, and ensure the safety of the machine in operation. Necessary circuits and settings are required in CN8 to use these functions. If these functions are not used, use the SERVOPACK with the enclosed safety jumper connected to CN8. For details, refer to *5.11 Safety Function.*

10.1.3 Connection to OMRON's Motion Control Unit



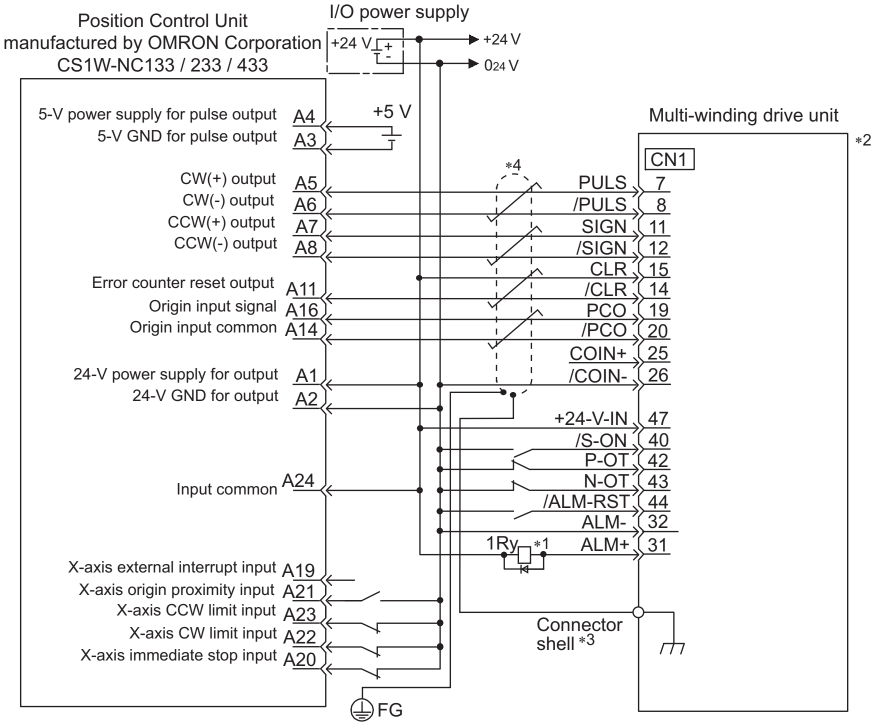
∗1. Connect when an absolute encoder is used.
When the encoder cables with a battery case JUSP-BA01 are used, no battery is required for CN1 (between 21 and 22).
- For CN1: ER6VC3N (3.6 V, 2000 mA)
- Battery case: JUSP-BA01 (3.6 V, 1000 mA)

∗2.  represents twisted-pair wires.

∗3. This connection is to adjust the phase of the encoder output pulse.

Note 1. Only the signals that are related to the multi-winding drive unit and the OMRON Motion Control Unit are given in this example.
2. Incorrect signal connections may damage the Motion Control Unit, multi-winding drive unit, SERVOPACKs, and converters.
3. Open the signal lines not to be used.
4. The above connection diagram shows the connections for only one axis. When using other axes, make connections to the SERVOPACK in the same way.
5. Short-circuit the normally closed (NC) input terminals that are not used at the I/O connector section of the motion control unit.
6. Make the settings so that the servomotor can be turned ON/OFF by the Servo ON signal (/S-ON).
7. The SERVOPACK incorporates safety functions to protect people from the hazardous operation of the movable parts of the machines, reduce the risk, and ensure the safety of the machine in operation. Necessary circuits and settings are required in CN8 to use these functions. If these functions are not used, use the SERVOPACK with the enclosed safety jumper connected to CN8. For details, refer to *5.11 Safety Function*.

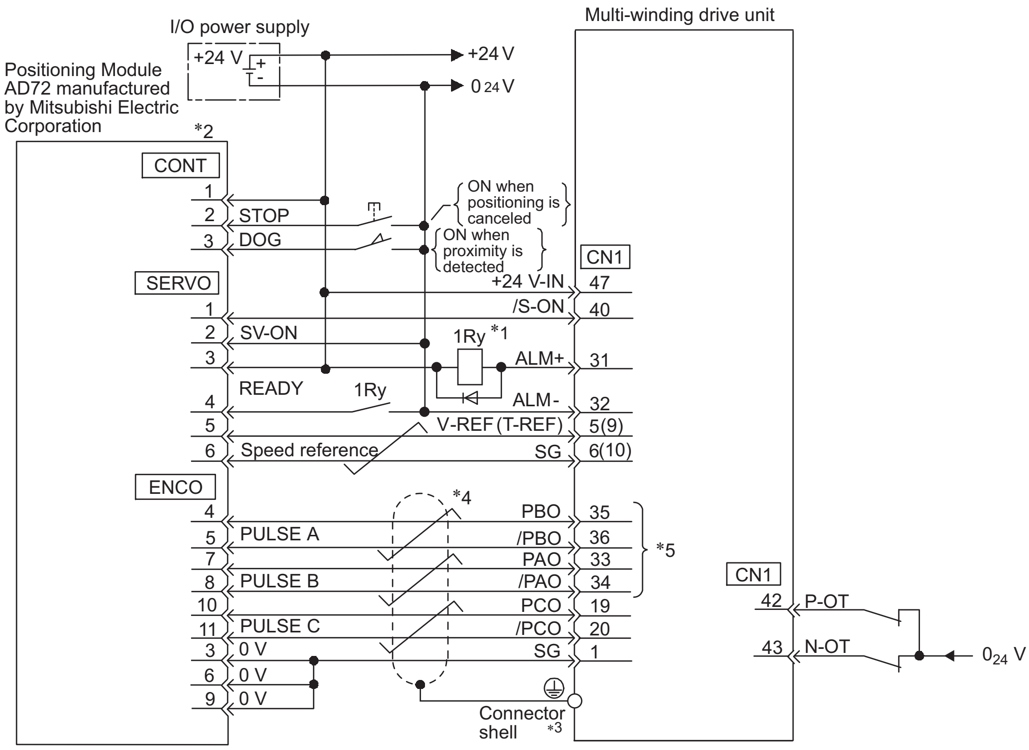
10.1.4 Connection to OMRON's Position Control Unit



∗1. The ALM signal is output for about five seconds after the control power is turned ON. Take this into consideration when designing the power ON sequence. Also, use the ALM signal to actuate the alarm detection relay 1Ry to stop the main circuit power supply to the SERVOPACK and converter.
∗2. Set parameter Pn200.0 to "1."
∗3. Connect the shielded wire to the connector shell.
∗4. represents twisted-pair wires.

Note 1. Only the signals that are related to the multi-winding drive unit and the OMRON Position Control Unit are given in this example.
2. Incorrect signal connections may damage the Position Control Unit, multi-winding drive unit, SERVOPACKs, and converters.
3. Open the signal lines not to be used.
4. The above connection diagram shows only X-axis connections. When using other axes, make connections to the SERVOPACK in the same way.
5. Short-circuit the normally closed (NC) input terminals that are not used at the I/O connector section of the position control unit.
6. Make the settings so that the servomotor can be turned ON/OFF by the Servo ON (/S-ON) signal.
7. The SERVOPACK incorporates safety functions to protect people from the hazardous operation of the movable parts of the machines, reduce the risk, and ensure the safety of the machine in operation. Necessary circuits and settings are required in CN8 to use these functions. If these functions are not used, use the SERVOPACK with the enclosed safety jumper connected to CN8. For details, refer to *5.11 Safety Function.*

10.1.5 Connection to MITSUBISHI's AD72 Positioning Module (Multi-Winding Drive Unit in Speed Control)



∗1. The ALM signal is output for about five seconds after the control power is turned ON. Take this into consideration when designing the power ON sequence. Also, use the ALM signal to actuate the alarm detection relay 1Ry to stop the main circuit power supply to the SERVOPACK and converter.

∗2. Pin numbers are the same both for X axis and Y axis.

∗3. Connect the shielded wire to the connector shell.

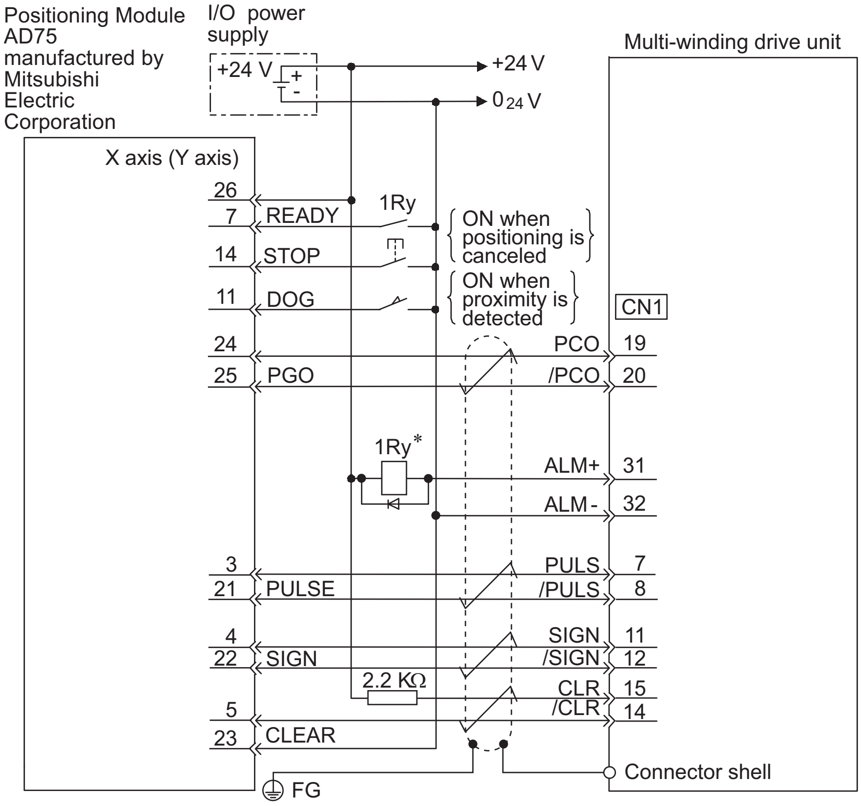
∗4.  represents twisted-pair wires.

∗5. This connection is to adjust the phase of the encoder pulse output.

Note 1. Only the signals that are related to the multi-winding drive unit and Mitsubishi's AD72 Positioning Module are given in this example.

2. Incorrect signal connections may damage the Positioning Unit, multi-winding drive unit, SERVOPACKs, and converters.
3. Open the signal lines not to be used.
4. The above connection diagram shows the connections for only one axis. When using other axes, make connections to the SERVOPACK in the same way.
5. Short-circuit the normally closed (NC) input terminals that are not used at the I/O connector section of the positioning module.
6. Make the settings so that the servo can be turned ON/OFF by the Servo ON (/S-ON) signal.
7. The SERVOPACK incorporates safety functions to protect people from the hazardous operation of the movable parts of the machines, reduce the risk, and ensure the safety of the machine in operation. Necessary circuits and settings are required in CN8 to use these functions. If these functions are not used, use the SERVOPACK with the enclosed safety jumper connected to CN8. For details, refer to *5.11 Safety Function.*

10.1.6 Connection to MITSUBISHI's AD75 Positioning Module (Multi-Winding Drive Unit in Position Control)

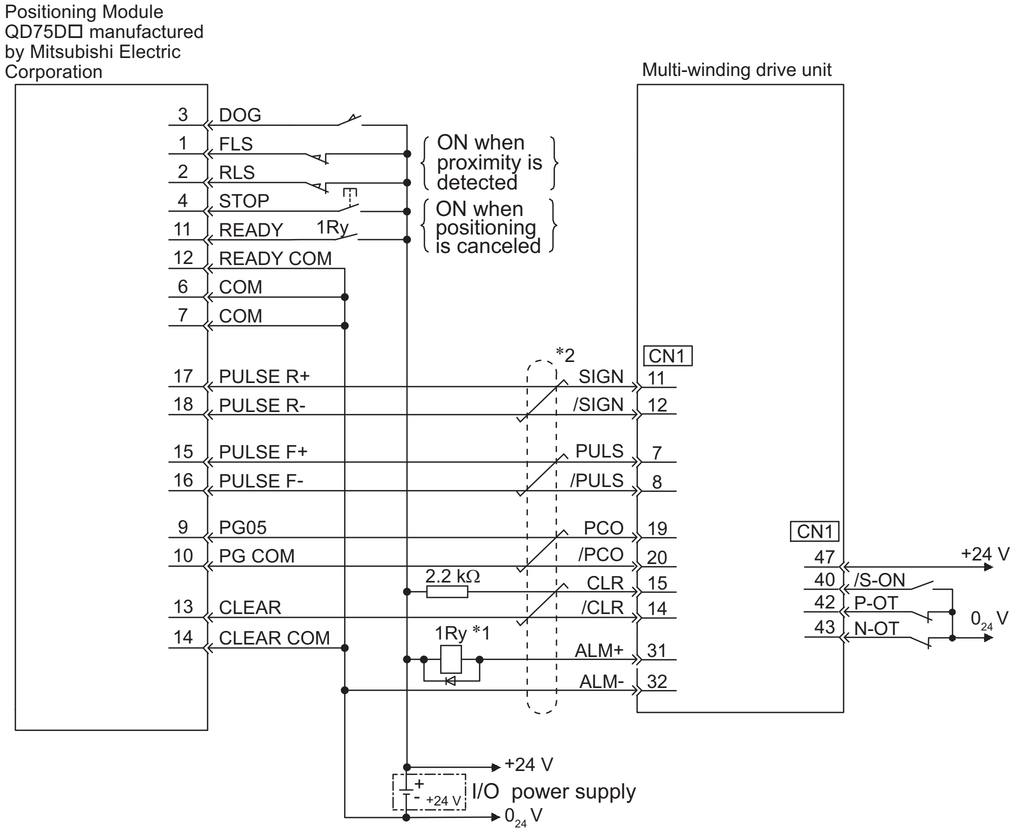


* The ALM signal is output for about five seconds when the control power is turned ON. Take this into consideration when designing the power ON sequence. Also, use the ALM signal to actuate the alarm detection relay 1Ry to stop the main circuit power supply to the SERVOPACK and converter.

Note 1. Only the signals that are related to the multi-winding drive unit and Mitsubishi's AD75 Positioning Module are given in this example.

2. Incorrect signal connections may damage the Positioning Unit, multi-winding drive unit, SERVOPACKs, and converters.
3. Open the signal lines not to be used.
4. The above connection diagram shows the connections for only one axis. When using other axes, make connections to the SERVOPACK in the same way.
5. Short-circuit the normally closed (NC) input terminals that are not used at the I/O connector section of the positioning module.
6. Make the settings so that the servomotor can be turned ON/OFF by the Servo ON (/S-ON) signal.
7. The SERVOPACK incorporates safety functions to protect people from the hazardous operation of the movable parts of the machines, reduce the risk, and ensure the safety of the machine in operation. Necessary circuits and settings are required in CN8 to use these functions. If these functions are not used, use the SERVOPACK with the enclosed safety jumper connected to CN8. For details, refer to *5.11 Safety Function.*

10.1.7 Connection to MITSUBISHI's QD75D☐ Positioning Module (Multi-Winding Drive Unit in Position Control)



∗1. The ALM signal is output for about five seconds when the control power is turned ON. Take this into consideration when designing the power ON sequence. Also, use the ALM signal to actuate the alarm detection relay 1Ry to stop the main circuit power supply to the SERVOPACK and converter.

∗2.  represents twisted-pair wires.

Note 1. Only the signals that are related to the multi-winding drive unit and Mitsubishi's QD75D☐ Positioning Module are given in this example.
2. Incorrect signal connections may damage the Positioning Unit, multi-winding drive unit, SERVOPACKs, and converters.
3. Open the signal lines not to be used.
4. The above connection diagram shows the connections for only one axis. When using other axes, make connections to the SERVOPACK in the same way.
5. Short-circuit the normally closed (NC) input terminals that are not used at the I/O connector section of the positioning module.
6. Make the settings so that the servo can be turned ON/OFF by the Servo ON (/S-ON) signal.
7. The SERVOPACK incorporates safety functions to protect people from the hazardous operation of the movable parts of the machines, reduce the risk, and ensure the safety of the machine in operation. Necessary circuits and settings are required in CN8 to use these functions. If these functions are not used, use the SERVOPACK with the enclosed safety jumper connected to CN8. For details, refer to *5.11 Safety Function.*

10.2 List of Parameters

10.2.1 Utility Functions

The following list shows the available utility functions.

Parameter No.	Function	Operation from the Panel Operator	Operation from the Digital Operator or SigmaWin+	Reference Section
Fn000	Alarm history display	○	○	7.2
Fn002	JOG operation	○	○	7.3
Fn003	Origin search	○	○	7.4
Fn004	Program JOG operation	○	○	7.5
Fn005	Initializing parameter settings	○	○	7.6
Fn006	Clearing alarm history	○	○	7.7
Fn008	Absolute encoder multiturn reset and encoder alarm reset	○	○	5.9.4
Fn009	Automatic tuning of analog (speed, torque) reference offset	○	○	5.3.2 5.5.2
Fn00A	Manual servo tuning of speed reference offset	○	○	5.3.2
Fn00B	Manual servo tuning of torque reference offset	○	○	5.5.2
Fn00C	Offset adjustment of analog monitor output	○	○	7.8
Fn00D	Gain adjustment of analog monitor output	○	○	7.9
Fn010	Write prohibited setting	○	○	7.10
Fn011	Servomotor model display	○	○	7.11
Fn012	Software version display	○	○	7.12
Fn013	Multiturn limit value setting change when a multiturn limit disagreement alarm occurs	○	○	5.9.7
Fn01B	Vibration detection level initialization	○	○	7.13
Fn01E	Display of multi-winding drive unit and servomotor ID	×	○	7.14
Fn201	Advanced autotuning	×	○	6.2.2
Fn203	One-parameter tuning	○*	○	6.3.2
Fn204	Anti-resonance control adjustment function	×	○	6.4.2
Fn205	Vibration suppression function	×	○	6.5.2
Fn206	EasyFFT	○	○	7.15
Fn207	Online vibration monitor	○	○	7.16

○: Available ×: Not available

* The following functional restrictions apply to the panel operator.

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

10.2.2 Parameters

This section contains a tables of parameters.

Note: Do not change the following parameters from the factory settings.
- Reserved parameters
- Parameters not described in this manual

IMPORTANT

When you turn the power supplies OFF and ON again to enable new settings, turn the control power supplies to the multi-winding drive unit, SERVOPACKs, and converters OFF and ON again at the same time.

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn000	2	Basic Function Select Switch 0	0000 to 00B3	–	0000	After restart	Setup	–

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

n.□□□□

1st digit:

Direction Selection		Reference Section
0	Sets CCW as forward direction.	5.2.2
1	Sets CW as forward direction. (Reverse Rotation Mode)	
2 and 3	Reserved (Do not use.)	

2nd digit:

Control Method Selection		Reference Section
0	Speed control (analog reference)	5.7
1	Position control (pulse train reference)	
2	Torque control (analog reference)	
3	Internal set speed control (contact reference)	
4	Internal set speed control (contact reference) ↔ Speed control (analog reference)	
5	Internal set speed control (contact reference) ↔ Position control (pulse train reference)	
6	Internal set speed control (contact reference) ↔ Torque control (analog reference)	
7	Position control (pulse train reference) ↔ Speed control (analog reference)	
8	Position control (pulse train reference) ↔ Torque control (analog reference)	
9	Torque control (analog reference) ↔ Speed control (analog reference)	
A	Speed control (analog reference) ↔ Speed control with zero clamp function	
B	Position control (pulse train reference) ↔ Position control with reference pulse inhibit function	

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn001	2	Application Function Select Switch 1	0000 to 1122	–	0000	After restart	Setup	–

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

1st digit:

Servomotor Power OFF or Alarm Gr.1 Stop Mode		Reference Section
0	Stops the servomotor by applying DB (dynamic brake).	5.2.5
1	Stops the servomotor by applying DB and then releases DB.	
2	Makes the servomotor coast to a stop state without using the DB.	

2nd digit:

Overtravel (OT) Stop Mode		Reference Section
0	Stops in accordance with the setting of Pn001.0.	5.2.3
1	Sets the torque of Pn406 to the maximum value, decelerates the servomotor to a stop, and then sets it to servolock state.	
2	Sets the torque of Pn406 to the maximum value, decelerates the servomotor to a stop, and then sets it to coasting state.	

3rd digit: Reserved (Do not change.)

4th digit:

Warning Code Output Selection		Reference Section
0	ALO1, ALO2, and ALO3 output only alarm codes.	5.10.2
1	ALO1, ALO2, and ALO3 output both alarm codes and warning codes. While warning codes are output, ALM signal output remains ON (normal state).	

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn002	2	Application Function Select Switch 2	0000 to 4113	–	0000	After restart	Setup	–

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

1st digit:

Speed/Position Control Option (T-REF Terminal Allocation)		Reference Section
0	T-REF not allocated	–
1	Uses T-REF as an external torque limit input.	5.8.3
2	Uses T-REF as a torque feedforward input.	6.7.2
3	Uses T-REF as an external torque limit input when /P-CL and /N-CL are ON.	5.8.4

2nd digit:

Torque Control Option (V-REF Terminal Allocation)		Reference Section
0	V-REF not allocated	5.5.4
1	Uses V-REF as an external speed limit input.	

3rd digit:

Absolute Encoder Usage		Reference Section
0	Uses absolute encoder as an absolute encoder.	5.9
1	Uses absolute encoder as an incremental encoder.	

4th digit: Reserved (Do not change.)

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classifi-cation	Reference Section
Pn006	2	Application Function Select Switch 6	0000 to 005F	–	0002	Immediately	Setup	6.1.3

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

n.□□□□

Analog Monitor 1 Signal Selection	
00	Motor rotating speed (1 V/1000 min^{-1})
01	Speed reference (1 V/1000 min^{-1})
02	Torque reference (1 V/100% rated torque)
03	Position error (0.05 V/1 reference unit)
04	Position amplifier error (after electronic gears) (0.05 V/1 encoder pulse unit)
05	Position reference speed (1 V/1000 min^{-1})
06	Reserved (Do not use.)
07	Motor-load position error (0.01 V/1 reference unit)
08	Positioning completion (positioning completed: 5 V, positioning not completed: 0 V)
09	Speed feedforward (1 V/1000 min^{-1})
0A	Torque feedforward (1 V/100% rated torque)
0B	Active gain (1st gain: 1 V, 2nd gain: 2 V)
0C	Completion of position reference (completed: 5 V, not completed: 0 V)
0D	External encoder speed (1 V/1000 min^{-1}: Values at motor shaft)

Reserved (Do not change.)

Reserved (Do not change.)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classifi-cation	Reference Section
Pn007	2	Application Function Select Switch 7	0000 to 005F	–	0000	Immediately	Setup	6.1.3

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

n.□□□□

Analog Monitor 2 Signal Selection	
00	Motor rotating speed (1 V/1000 min^{-1})
01	Speed reference (1 V/1000 min^{-1})
02	Torque reference (1 V/100% rated torque)
03	Position error (0.05 V/1 reference unit)
04	Position amplifier error (after electronic gears) (0.05 V/1 encoder pulse unit)
05	Position reference speed (1 V/1000 min^{-1})
06	Reserved (Do not use.)
07	Motor-load position error (0.01 V/1 reference unit)
08	Positioning completion (positioning completed: 5 V, positioning not completed: 0 V)
09	Speed feedforward (1 V/1000 min^{-1})
0A	Torque feedforward (1 V/100% rated torque)
0B	Active gain (1st gain: 1 V, 2nd gain: 2 V)
0C	Completion of position reference (completed: 5 V not completed: 0 V)
0D	External encoder speed (1 V/1000 min^{-1}: Values at motor shaft)

Reserved (Do not change.)

Reserved (Do not change.)

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn008	2	Application Function Select Switch 8	0000 to 7121	–	0000	After restart	Setup	–

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

1st digit:

Lowered Battery Voltage Alarm/Warning Selection		Reference Section
0	Outputs alarm (A.830) for lowered battery voltage.	5.9.3
1	Outputs warning (A.930) for lowered battery voltage.	

2nd digit: Reserved (Do not change.)

3rd digit:

Warning Detection Selection		Reference Section
0	Detects warning.	9.2.1
1	Does not detect warning (except for A.971, A.9b0, and A.9b1).	

4th digit: Reserved (Do not change.)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn009	2	Application Function Select Switch 9	0000 to 0111	–	0010	After restart	Tuning	–

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

1st digit:

Automatic Offset Adjustment of Motor Current Detection Signals		Reference Section
0	Does not execute automatic adjustment.	–
1	Executes automatic adjustment when the main circuit power supply is turned ON.	

2nd digit:

Current Control Method Selection		Reference Section
0	Current control method 1	6.6.3
1	Current control method 2	

3rd digit:

Speed Detection Method Selection		Reference Section
0	Speed detection 1	6.6.5
1	Speed detection 2	

4th digit: Reserved (Do not change.)

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classifi-cation	Reference Section
Pn00B	2	Application Function Select Switch B	0000 to 1111	–	0000	After restart	Setup	–

Pn00B: n.□□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit:

Parameter Display Selection		Reference Section
0	Setup parameters	2.3.1
1	All parameters	

2nd digit:

Alarm Gr.2 Stop Method Selection		Reference Section
0	Stops the motor by setting the speed reference to "0".	5.2.5
1	Same setting as Pn001.0 (Stops the motor by applying DB or by coasting).	

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classifi-cation	Reference Section
Pn00D	2	Application Function Select Switch D	0000 to 1011	–	0000	–	Setup	–

Pn00D: n.□□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: Reserved (Do not change.)

2nd digit:

Dynamic Brake Signal Selection		When Enabled	Classification	Reference Section
0	Enables the control of an NO contactor (The dynamic brake is activated when current is supplied to the contactor coil.)	After restart	Setup	3.9.3
1	Enables the control of an NC contactor (The dynamic brake is activated when current is not supplied to the contactor coil.)			

3rd digit: Reserved (Do not change.)

4th digit:

Overtravel Warning Detection Selection		When Enabled	Classification	Reference Section
0	Does not detect overtravel warning.	Immediately	Setup	5.2.3
1	Detects overtravel warning.			

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classifi-cation	Reference Section
Pn010	2	Axis Address Selection (for UART/USB communications)	0000 to 007F	–	0001	After restart	Setup	–

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classifi-cation	Reference Section
Pn081	2	Application Function Select Switch 81	0000 to 1111	–	0000	After restart	Setup	–

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

1st digit: Phase-C Pulse Output Selection

0	Outputs phase-C pulse only in forward direction.
1	Outputs phase-C pulse in forward and reverse direction.

2nd digit: Reserved (Do not change.)

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classifi-cation	Reference Section
Pn100	2	Speed Loop Gain	10 to 20000	0.1 Hz	400	Immediately	Tuning	6.6.1
Pn101	2	Speed Loop Integral Time Constant	15 to 51200	0.01 ms	2000	Immediately	Tuning	6.6.1
Pn102	2	Position Loop Gain	10 to 20000	0.1/s	400	Immediately	Tuning	6.6.1
Pn103	2	Moment of Inertia Ratio	0 to 20000	1%	100	Immediately	Tuning	6.6.1
Pn104	2	2nd Speed Loop Gain	10 to 20000	0.1 Hz	400	Immediately	Tuning	6.6.1
Pn105	2	2nd Speed Loop Integral Time Constant	15 to 51200	0.01 ms	2000	Immediately	Tuning	6.6.1
Pn106	2	2nd Position Loop Gain	10 to 20000	0.1/s	400	Immediately	Tuning	6.6.1
Pn109	2	Feedforward Gain	0 to 100	1%	0	Immediately	Tuning	6.7.1
Pn10A	2	Feedforward Filter Time Constant	0 to 6400	0.01 ms	0	Immediately	Tuning	6.7.1

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classifi-cation	Reference Section
Pn10B	2	Application Function for Gain Select Switch	0000 to 5334	–	0000	–	–	–

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

1st digit:

Mode Switch Selection		When Enabled	Classification	Reference Section
0	Uses internal torque reference as the condition (Level setting: Pn10C).	Immediately	Setup	6.7.5
1	Uses speed reference as the condition (Level setting: Pn10D).			
2	Uses acceleration as the condition (Level setting: Pn10E).			
3	Uses position error as the condition (Level setting: Pn10F).			
4	No mode switch function available.			

2nd digit:

Speed Loop Control Method		When Enabled	Classification	Reference Section
0	PI control	After restart	Setup	–
1	I-P control			
2 and 3	Reserved (Do not use.)			

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classifi-cation	Reference Section
Pn10C	2	Mode Switch (torque reference)	0 to 800	1%	200	Immediately	Tuning	6.7.5
Pn10D	2	Mode Switch (speed reference)	0 to 10000	1 min^{-1}	0	Immediately	Tuning	6.7.5
Pn10E	2	Mode Switch (acceleration)	0 to 30000	1 min^{-1}/ s	0	Immediately	Tuning	6.7.5
Pn10F	2	Mode Switch (position error)	0 to 10000	1 reference unit	0	Immediately	Tuning	6.7.5
Pn11F	2	Position Integral Time Constant	0 to 50000	0.1 ms	0	Immediately	Tuning	6.6.6
Pn121	2	Friction Compensation Gain	10 to 1000	1%	100	Immediately	Tuning	6.6.2
Pn122	2	2nd Gain for Friction Compensation	10 to 1000	1%	100	Immediately	Tuning	6.6.2
Pn123	2	Friction Compensation Coefficient	0 to 100	1%	0	Immediately	Tuning	6.6.2
Pn124	2	Friction Compensation Frequency Correction	-10000 to 10000	0.1 Hz	0	Immediately	Tuning	6.6.2
Pn125	2	Friction Compensation Gain Correction	1 to 1000	1%	100	Immediately	Tuning	6.6.2
Pn131	2	Gain Switching Time 1	0 to 65535	1 ms	0	Immediately	Tuning	6.6.1
Pn132	2	Gain Switching Time 2	0 to 65535	1 ms	0	Immediately	Tuning	6.6.1
Pn135	2	Gain Switching Waiting Time 1	0 to 65535	1 ms	0	Immediately	Tuning	6.6.1
Pn136	2	Gain Switching Waiting Time 2	0 to 65535	1 ms	0	Immediately	Tuning	6.6.1

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn139	2	Automatic Gain Changeover Related Switch 1	0000 to 0052	–	0000	Immediately	Tuning	6.6.1

Pn139

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

Gain Switching Selection Switch (1st digit)	
0	Manual gain switching Changes gain manually using external input signal (/G-SEL) .
1	Reserved (Do not use.)
2	Automatic gain switching pattern 1 Changes automatically 1st gain to 2nd gain when the switching condition A is satisfied. Changes automatically 2nd gain to 1st gain when the switching condition A is not satisfied.

Gain Switching Condition A (2nd digit)	
0	Positioning completion signal (/COIN) ON
1	Positioning completion signal (/COIN) OFF
2	Positioning near signal (/NEAR) ON
3	Positioning near signal (/NEAR) OFF
4	Position reference filter output = 0 and reference pulse input OFF
5	Position reference pulse input ON

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn13D	2	Current Gain Level	100 to 2000	1%	2000	Immediately	Tuning	6.6.4
Pn140	2	Model Following Control Related Switch	0000 to 1121	–	0100	Immediately	Tuning	–

Pn140

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

Model Following Control Selection (1st digit)	
0	Does not use model following control.
1	Uses model following control.

Vibration Suppression Selection (2nd digit)	
0	Does not perform vibration suppression.
1	Performs vibration suppression over the specified frequency.
2	Performs vibration suppression over two different kinds of frequencies.

Vibration Suppression Adjustment Selection (3rd digit)		Reference Section
0	Does not adjust vibration suppression automatically using utility function.	6.2.1, 6.4.1, 6.3.1, 6.5.1
1	Adjusts vibration suppression automatically using utility function.	

Selection of Speed Feedforward (VFF) / Torque Feedforward (TFF) (4th digit)		Reference Section
0	Does not use model following control and speed/torque feedforward together.	6.2.1, 6.4.1
1	Uses model following control and speed/torque feedforward together.	

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn141	2	Model Following Control Gain	10 to 20000	0.1/s	500	Immediately	Tuning	–
Pn142	2	Model Following Control Gain Compensation	500 to 2000	0.1%	1000	Immediately	Tuning	–
Pn143	2	Model Following Control Bias (Forward Direction)	0 to 10000	0.1%	1000	Immediately	Tuning	–

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn144	2	Model Following Control Bias (Reverse Direction)	0 to 10000	0.1%	1000	Immediately	Tuning	–
Pn145	2	Vibration Suppression 1 Frequency A	10 to 2500	0.1 Hz	500	Immediately	Tuning	–
Pn146	2	Vibration Suppression 1 Frequency B	10 to 2500	0.1 Hz	700	Immediately	Tuning	–
Pn147	2	Model Following Control Speed Feedforward Compensation	0 to 10000	0.1%	1000	Immediately	Tuning	–
Pn148	2	2nd Model Following Control Gain	10 to 20000	0.1/s	500	Immediately	Tuning	–
Pn149	2	2nd Model Following Control Gain Compensation	500 to 2000	0.1%	1000	Immediately	Tuning	–
Pn14A	2	Vibration Suppression 2 Frequency	10 to 2000	0.1 Hz	800	Immediately	Tuning	–
Pn14B	2	Vibration Suppression 2 Compensation	10 to 1000	1%	100	Immediately	Tuning	–
Pn14F	2	Control Related Switch	0000 to 0011	–	0011	After restart	Tuning	–

Pn14F

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

1st digit:

Model Following Control Type Selection		Reference Section
0	Model Following Control 1	6.2.1, 6.4.1, 6.3.1
1	Model Following Control 2	

2nd digit: Reserved (Do not change.)

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn160	2	Anti-Resonance Control Related Switch	0000 to 0011	–	0010	Immediately	Tuning	6.2.1, 6.4.1, 6.3.1, 6.5.1

Pn160

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

1st digit:

Anti-Resonance Control Selection	
0	Does not use anti-resonance control.
1	Uses anti-resonance control.

2nd digit:

Anti-Resonance Control Adjustment Selection	
0	Does not adjust anti-resonance control automatically using utility function.
1	Adjusts anti-resonance control automatically using utility function.

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn161	2	Anti-Resonance Frequency	10 to 20000	0.1 Hz	1000	Immediately	Tuning	–
Pn162	2	Anti-Resonance Gain Compensation	1 to 1000	1%	100	Immediately	Tuning	–

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classifi-cation	Reference Section
Pn163	2	Anti-Resonance Damping Gain	0 to 300	1%	0	Immediately	Tuning	–
Pn164	2	Anti-Resonance Filter Time Constant 1 Compensation	-1000 to 1000	0.01 ms	0	Immediately	Tuning	–
Pn165	2	Anti-Resonance Filter Time Constant 2 Compensation	-1000 to 1000	0.01 ms	0	Immediately	Tuning	–
Pn170	2	Reserved	–	–	0000	–	–	–
Pn200	2	Position Control Reference Form Selection Switch	0000 to 2236	–	0000	After restart	Setup	–
Pn205	2	Multiturn Limit Setting	0 to 65535	1 rev	65535	After restart	Setup	5.9.6

Pn200

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

1st digit:

Reference Pulse Form		Reference Section
0	Sign + Pulse train, positive logic	5.4.1
1	CW + CCW pulse train, positive logic	
2	Two-phase pulse train with 90° phase differential (phase A + phase B) ×1, positive logic	
3	Two-phase pulse train with 90° phase differential (phase A + phase B) ×2, positive logic	
4	Two-phase pulse train with 90° phase differential (phase A + phase B) ×4, positive logic	
5	Sign + Pulse train, negative logic	
6	CW + CCW pulse train, negative logic	

2nd digit:

Clear Signal Form		Reference Section
0	Clears position error when the signal is at high level.	5.4.2
1	Clears position error at the rising edge of the signal.	
2	Clears position error when the signal is at low level.	
3	Clears position error at the falling edge of the signal.	

3rd digit:

Clear Operation		Reference Section
0	Clears position error at the baseblock (servomotor power OFF or alarm occurred).	5.4.2
1	Does not clear position error (possible to clear error counter only with CLR signal).	
2	Clears position error when an alarm occurs.	

4th digit:

Filter Selection		Reference Section
0	Uses reference input filter 1 for line driver signal (to 1 Mpps).	5.4.1
1	Uses reference input filter for open collector signal (to 200 kpps).	
2	Uses reference input filter 2 for line driver signal (1 Mpps to 4 Mpps).	

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classifi-cation	Reference Section
Pn207	2	Position Control Function Switch	0000 to 2210	–	0000	After restart	Setup	–

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

n.□ □ □ □

1st digit: Reserved (Do not change.)

2nd digit:

Position Control Option		Reference Section
0	V-REF not allocated	6.7.3
1	Uses V-REF as a speed feedforward input.	

3rd digit: Reserved (Do not change.)

4th digit:

/COIN Output Timing		Reference Section
0	Outputs when the position error absolute value is the same or less than the positioning completed width (Pn522).	5.4.6
1	Outputs when the position error absolute value is the same or less than the positioning completed width (Pn522), and the reference after position reference filtering is 0.	
2	Outputs when the position error absolute value is the same or less than the positioning completed width (Pn522), and the position reference input is 0.	

Pn20A	4	Number of External Scale Pitch	4 to 1048576	1 pitch/rev	32768	After restart	Setup	9.3
Pn20E	4	Electronic Gear Ratio (Numerator)	1 to 1073741824	1	4	After restart	Setup	5.4.4
Pn210	4	Electronic Gear Ratio (Denominator)	1 to 1073741824	1	1	After restart	Setup	5.4.4
Pn212	4	Encoder Output Pulses	16 to 1073741824	1 P/rev	2048	After restart	Setup	5.3.7
Pn216	2	Position Reference Acceleration/ Deceleration Time Constant	0 to 65535	0.1 ms	0	Immediately after the servomotor stops	Setup	5.4.5
Pn217	2	Average Movement Time of Position Reference	0 to 10000	0.1 ms	0	Immediately after the servomotor stops	Setup	5.4.5
Pn218	2	Reference Pulse Input Multiplication	1 to 100	1 time	1	Immediately	Setup	5.4.3
Pn22A	2	Reserved (Do not change.)	–	–	0000	–	–	–
Pn281	2	Reserved (Do not change.)	–	–	20	–	–	–
Pn300	2	Speed Reference Input Gain	150 to 3000	0.01V /rated speed	600	Immediately	Setup	5.3.1 5.5.4 6.7.3
Pn301	2	Internal Set Speed 1	0 to 10000	1 min^{-1}	100	Immediately	Setup	5.6.1
Pn302	2	Internal Set Speed 2	0 to 10000	1 min^{-1}	200	Immediately	Setup	5.6.1
Pn303	2	Internal Set Speed 3	0 to 10000	1 min^{-1}	300	Immediately	Setup	5.6.1
Pn304	2	JOG Speed	0 to 10000	1 min^{-1}	500	Immediately	Setup	7.3
Pn305	2	Soft Start Acceleration Time	0 to 10000	1 ms	0	Immediately	Setup	5.3.3
Pn306	2	Soft Start Deceleration Time	0 to 10000	1 ms	0	Immediately	Setup	5.3.3
Pn307	2	Speed Reference Filter Time Constant	0 to 65535	0.01 ms	40	Immediately	Setup	5.3.4

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classifi-cation	Reference Section
Pn310	2	Vibration Detection Switch	0000 to 0002	–	0000	Immediately	Setup	–

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

n. □ □ □ □

1st digit:

Vibration Detection Selection		Reference Section
0	Does not detect vibration.	7.13
1	Outputs warning (A.911) when vibration is detected.	
2	Outputs alarm (A.520) when vibration is detected.	

2nd digit: Reserved (Do not change.)

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classifi-cation	Reference Section
Pn311	2	Vibration Detection Sensibility	50 to 500	1%	100	Immediately	Tuning	7.13
Pn312	2	Vibration Detection Level	0 to 5000	1 min^{-1}	50	Immediately	Tuning	7.13
Pn324	2	Moment of Inertia Calculating Start Level	0 to 20000	1%	300	Immediately	Setup	6.3.2
Pn400	2	Torque Reference Input Gain	10 to100	0.1 V/ rated torque	30	Immediately	Setup	5.5.1 6.7.2
Pn401	2	Torque Reference Filter Time Constant	0 to 65535	0.01 ms	100	Immediately	Tuning	6.7.6
Pn402	2	Forward Torque Limit	0 to 800	1%	800	Immediately	Setup	5.8.1
Pn403	2	Reverse Torque Limit	0 to 800	1%	800	Immediately	Setup	5.8.1
Pn404	2	Forward External Torque Limit	0 to 800	1%	100	Immediately	Setup	5.8.2, 5.8.4
Pn405	2	Reverse External Torque Limit	0 to 800	1%	100	Immediately	Setup	5.8.2, 5.8.4
Pn406	2	Emergency Stop Torque	0 to 800	1%	800	Immediately	Setup	5.2.3
Pn407	2	Speed Limit during Torque Con-trol	0 to 10000	1 min^{-1}	10000	Immediately	Setup	5.5.4

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classifi-cation	Reference Section
Pn408	2	Torque Related Function Switch	0000 to 1111	–	0000	–	–	–

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

n.□ □ □ □

1st Step Notch Filter Selection		When Enabled	Classification	Reference Section
0	N/A	Immediately	Setup	6.7.6
1	Uses 1st step notch filter for torque reference.			

Speed Limit Selection		When Enabled	Classification	Reference Section
0	Uses the smaller of the maximum motor speed and the value of Pn407 as the speed limit value.	After restart	Setup	5.5.4
1	Uses the smaller of the overspeed detection speed and the value of Pn407 as the speed limit value.			

2nd Step Notch Filter Selection		When Enabled	Classification	Reference Section
0	N/A	Immediately	Setup	6.7.6
1	Uses 2nd step notch filter for torque reference.			

Friction Compensation Function Selection		When Enabled	Classification	Reference Section
0	Disables friction compensation function.	Immediately	Setup	6.6.2
1	Enables friction compensation function.			

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classifi-cation	Reference Section
Pn409	2	1st Notch Filter Frequency	50 to 5000	1 Hz	5000	Immediately	Tuning	6.7.6
Pn40A	2	1st Notch Filter Q Value	50 to 1000	0.01	70	Immediately	Tuning	6.7.6
Pn40B	2	1st Notch Filter Depth	0 to 1000	0.001	0	Immediately	Tuning	6.7.6
Pn40C	2	2nd Notch Filter Frequency	50 to 5000	1 Hz	5000	Immediately	Tuning	6.7.6
Pn40D	2	2nd Notch Filter Q Value	50 to 1000	0.01	70	Immediately	Tuning	6.7.6
Pn40E	2	2nd Notch Filter Depth	0 to 1000	0.001	0	Immediately	Tuning	6.7.6
Pn40F	2	2nd Step 2nd Torque Reference Filter Frequency	100 to 5000	1 Hz	5000	Immediately	Tuning	6.7.6
Pn410	2	2nd Step 2nd Torque Reference Filter Q Value	50 to 100	0.01	50	Immediately	Tuning	6.7.6
Pn412	2	1st Step 2nd Torque Reference Filter Time Constant	0 to 65535	0.01 ms	100	Immediately	Tuning	6.6.1
Pn415	2	T-REF Filter Time Constant	0 to 65535	0.01 ms	0	Immediately	Setup	5.5.3
Pn423	2	Reserved (Do not change.)	–	–	0000	–	–	–
Pn424	2	Reserved (Do not change.)	–	–	50	–	–	–
Pn425	2	Reserved (Do not change.)	–	–	100	–	–	–
Pn456	2	Reserved (Do not change.)	–	–	15	–	–	–

(cont'd)

<table>
<tr><th>Parameter No.</th><th>Size</th><th>Name</th><th>Setting Range</th><th>Units</th><th>Factory Setting</th><th>When Enabled</th><th>Classifi-cation</th><th>Reference Section</th></tr>
<tr><td rowspan="2">Pn460</td><td>2</td><td>Notch Filter Adjustment Switch</td><td>0000 to 0101</td><td>–</td><td>0101</td><td>Immediately</td><td>Tuning</td><td>6.2.1
6.2.1
6.3.1</td></tr>
<tr><td colspan="8">4th digit 3rd digit 2nd digit 1st digit
n.□□□□

1st digit: Notch Filter Adjustment Selection 1
0: Does not adjust 1st step notch filter automatically using utility function.
1: Adjust 1st step notch filter automatically using utility function.

2nd digit: Reserved (Do not change.)

3rd digit: Notch Filter Adjustment Selection 2
0: Does not adjust 2nd step notch filter automatically using utility function.
1: Adjust 2nd step notch filter automatically using utility function.

4th digit: Reserved (Do not change.)</td></tr>
<tr><td>Pn501</td><td>2</td><td>Zero Clamp Level</td><td>0 to 10000</td><td>1 min^{-1}</td><td>10</td><td>Immediately</td><td>Setup</td><td>5.3.5</td></tr>
<tr><td>Pn502</td><td>2</td><td>Rotation Detection Level</td><td>1 to 10000</td><td>1 min^{-1}</td><td>20</td><td>Immediately</td><td>Setup</td><td>5.10.3</td></tr>
<tr><td>Pn503</td><td>2</td><td>Speed Coincidence Signal Output Width</td><td>0 to 100</td><td>1 min^{-1}</td><td>10</td><td>Immediately</td><td>Setup</td><td>5.3.8</td></tr>
<tr><td>Pn506</td><td>2</td><td>Brake Reference - Servo OFF Delay Time</td><td>0 to 50</td><td>10 ms</td><td>0</td><td>Immediately</td><td>Setup</td><td>5.2.4</td></tr>
<tr><td>Pn507</td><td>2</td><td>Brake Reference Output Speed Level</td><td>0 to 10000</td><td>1 min^{-1}</td><td>100</td><td>Immediately</td><td>Setup</td><td>5.2.4</td></tr>
<tr><td>Pn508</td><td>2</td><td>Waiting Time for Brake Signal When Motor Running</td><td>10 to 100</td><td>10 ms</td><td>50</td><td>Immediately</td><td>Setup</td><td>5.2.4</td></tr>
<tr><td>Pn509</td><td>2</td><td>Instantaneous Power Cut Hold time</td><td>20 to 50000</td><td>1 ms</td><td>20</td><td>Immediately</td><td>Setup</td><td>5.2.6</td></tr>
</table>

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn50A	2	Input Signal Selection 1	0000 to FFF1	–	2100	After restart	Setup	–

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

1st digit:

Input Signal Allocation Mode		Reference Section
0	Uses the sequence input signal terminals with the factory-set allocations.	3.4.1
1	Changes the sequence input signal allocation for each signal.	

2nd digit:

Servo ON (/S-ON) Signal Mapping Signal Polarity: Normal; Servomotor power ON when ON (closed) Signal Polarity: Reverse; Servomotor power OFF when OFF (open)		Reference Section
0	Active when CN1-40 input signal is ON (closed).	5.2.1
1	Active when CN1-41 input signal is ON (closed).	
2	Active when CN1-42 input signal is ON (closed).	
3	Active when CN1-43 input signal is ON (closed).	
4	Active when CN1-44 input signal is ON (closed).	
5	Active when CN1-45 input signal is ON (closed).	
6	Active when CN1-46 input signal is ON (closed).	
7	Always active (fixed).	
8	Not active (fixed).	
9	Active when CN1-40 input signal is OFF (open).	
A	Active when CN1-41 input signal is OFF (open).	
B	Active when CN1-42 input signal is OFF (open).	
C	Active when CN1-43 input signal is OFF (open).	
D	Active when CN1-44 input signal is OFF (open).	
E	Active when CN1-45 input signal is OFF (open).	
F	Active when CN1-46 input signal is OFF (open).	

3rd digit:

/P-CON Signal Mapping (P control when ON (closed))		Reference Section
0 to F	Same as Servo ON Signal (/S-ON) Mapping.	6.7.4

4th digit:

P-OT Signal Mapping (Forward run prohibited when OFF (open))		Reference Section
0	Forward run allowed when CN1-40 input signal is ON (closed).	5.2.3
1	Forward run allowed when CN1-41 input signal is ON (closed).	
2	Forward run allowed when CN1-42 input signal is ON (closed).	
3	Forward run allowed when CN1-43 input signal is ON (closed).	
4	Forward run allowed when CN1-44 input signal is ON (closed).	
5	Forward run allowed when CN1-45 input signal is ON (closed).	
6	Forward run allowed when CN1-46 input signal is ON (closed).	
7	Forward run prohibited.	
8	Forward run allowed.	
9	Forward run allowed when CN1-40 input signal is OFF (open).	
A	Forward run allowed when CN1-41 input signal is OFF (open).	
B	Forward run allowed when CN1-42 input signal is OFF (open).	
C	Forward run allowed when CN1-43 input signal is OFF (open).	
D	Forward run allowed when CN1-44 input signal is OFF (open).	
E	Forward run allowed when CN1-45 input signal is OFF (open).	
F	Forward run allowed when CN1-46 input signal is OFF (open).	

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn50B	2	Input Signal Selection 2	0000 to FFFF	–	6543	After restart	Setup	–

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

1st digit:

N-OT Signal Mapping (Reverse run prohibited when OFF (open))		Reference Section
0	Reverse run allowed when CN1-40 input signal is ON (closed).	5.2.3
1	Reverse run allowed when CN1-41 input signal is ON (closed).	
2	Reverse run allowed when CN1-42 input signal is ON (closed).	
3	Reverse run allowed when CN1-43 input signal is ON (closed) .	
4	Reverse run allowed when CN1-44 input signal is ON (closed).	
5	Reverse run allowed when CN1-45 input signal is ON (closed).	
6	Reverse run allowed when CN1-46 input signal is ON (closed).	
7	Reverse run prohibited.	
8	Reverse run allowed.	
9	Reverse run allowed when CN1-40 input signal is OFF (open).	
A	Reverse run allowed when CN1-41 input signal is OFF (open).	
B	Reverse run allowed when CN1-42 input signal is OFF (open).	
C	Reverse run allowed when CN1-43 input signal is OFF (open).	
D	Reverse run allowed when CN1-44 input signal is OFF (open).	
E	Reverse run allowed when CN1-45 input signal is OFF (open).	
F	Reverse run allowed when CN1-46 input signal is OFF (open).	

2nd digit:

/ALM-RST Signal Mapping (Alarm reset when OFF (open) to ON (closed))		Reference Section
0	Active on the falling edge of CN1-40 input signal.	5.10.1
1	Active on the falling edge of CN1-41 input signal.	
2	Active on the falling edge of CN1-42 input signal.	
3	Active on the falling edge of CN1-43 input signal.	
4	Active on the falling edge of CN1-44 input signal.	
5	Active on the falling edge of CN1-45 input signal.	
6	Active on the falling edge of CN1-46 input signal.	
7	Reserved (Do not use.)	
8	Not active (fixed).	
9	Active on the rising edge of CN1-40 input signal.	
A	Active on the rising edge of CN1-41 input signal.	
B	Active on the rising edge of CN1-42 input signal.	
C	Active on the rising edge of CN1-43 input signal.	
D	Active on the rising edge of CN1-44 input signal.	
E	Active on the rising edge of CN1-45 input signal.	
F	Active on the rising edge of CN1-46 input signal.	

3rd digit:

/P-CL Signal Mapping (Torque Limit when ON (closed))		Reference Section
0 to F	Same as Servo ON Signal (/S-ON) Mapping.	5.8.2

4th digit:

/N-CL Signal Mapping (Torque Limit when ON (closed)		Reference Section
0 to F	Same as Servo ON Signal (/S-ON) Mapping.	5.8.2

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classifi-cation	Reference Section
Pn50C	2	Input Signal Selection 3	0000 to FFFF	–	8888	After restart	Setup	–

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

1st digit:

/SPD-D Signal Mapping (Refer to *5.6 Internal Set Speed Control*.)		Reference Section
0	Active when CN1-40 input signal is ON (closed).	5.6.1
1	Active when CN1-41 input signal is ON (closed).	
2	Active when CN1-42 input signal is ON (closed).	
3	Active when CN1-43 input signal is ON (closed).	
4	Active when CN1-44 input signal is ON (closed).	
5	Active when CN1-45 input signal is ON (closed).	
6	Active when CN1-46 input signal is ON (closed).	
7	Reserved (Do not use.)	
8	Not active (fixed).	
9	Active when CN1-40 input signal is OFF (open).	
A	Active when CN1-41 input signal is OFF (open).	
B	Active when CN1-42 input signal is OFF (open).	
C	Active when CN1-43 input signal is OFF (open).	
D	Active when CN1-44 input signal is OFF (open).	
E	Active when CN1-45 input signal is OFF (open).	
F	Active when CN1-46 input signal is OFF (open).	

2nd digit:

/SPD-A Signal Mapping (Refer to *5.6 Internal Set Speed Control*.)		Reference Section
0 to F	Same as /SPD-D Signal Mapping.	5.6.1

3rd digit:

/SPD-B Signal Mapping (Refer to *5.6 Internal Set Speed Control*.)		Reference Section
0 to F	Same as /SPD-D Signal Mapping.	5.6.1

4th digit:

/C-SEL Signal Mapping (Control method change when ON (closed))		Reference Section
0 to F	Same as /SPD-D Signal Mapping.	5.7.1

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn50D	2	Input Signal Selection 4	0000 to FFFF	–	8888	After restart	Setup	–

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

1st digit:

/ZCLAMP Signal Mapping (Zero clamp when ON (closed))		Reference Section
0	Active when CN1-40 input signal is ON (closed).	5.3.5
1	Active when CN1-41 input signal is ON (closed).	
2	Active when CN1-42 input signal is ON (closed).	
3	Active when CN1-43 input signal is ON (closed).	
4	Active when CN1-44 input signal is ON (closed).	
5	Active when CN1-45 input signal is ON (closed).	
6	Active when CN1-46 input signal is ON (closed).	
7	Always active (fixed).	
8	Not active (fixed).	
9	Active when CN1-40 input signal is OFF (open).	
A	Active when CN1-41 input signal is OFF (open).	
B	Active when CN1-42 input signal is OFF (open).	
C	Active when CN1-43 input signal is OFF (open).	
D	Active when CN1-44 input signal is OFF (open).	
E	Active when CN1-45 input signal is OFF (open).	
F	Active when CN1-46 input signal is OFF (open).	

2nd digit:

/INHIBIT Signal Mapping (Reference pulse inhibit when ON (closed))		Reference Section
0 to F	Same as /ZCLAMP Signal Mapping.	5.4.8

3rd digit:

/G-SEL Signal Mapping (Gain change when ON (closed))		Reference Section
0 to F	Same as /ZCLAMP Signal Mapping.	6.7.6

4th digit: Reserved (Do not change.)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn50E	2	Output Signal Selection 1	0000 to 3333	–	3211	After restart	Setup	–

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

1st digit:

Positioning Completion Signal Mapping (/COIN)		Reference Section
0	Disabled (the above signal is not used.)	5.4.6
1	Outputs the signal from CN1-25, -26 output terminal.	
2	Outputs the signal from CN1-27, -28 output terminal.	
3	Outputs the signal from CN1-29, -30 output terminal.	

2nd digit:

Speed Coincidence Detection Signal Mapping (/V-CMP)		Reference Section
0 to 3	Same as /COIN Signal Mapping.	5.3.8

3rd digit:

Servomotor Rotation Detection Signal Mapping (/TGON)		Reference Section
0 to 3	Same as /COIN Signal Mapping.	5.10.3

4th digit:

Servo Ready Signal Mapping (/S-RDY)		Reference Section
0 to 3	Same as /COIN Signal Mapping.	5.10.4

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classifi-cation	Reference Section
Pn50F	2	Output Signal Selection 2	0000 to 3333	–	0000	After restart	Setup	–
Pn510	2	Output Signal Selection 3	0000 to 0333	–	0000	After restart	Setup	–
Pn511	2	Reserved (Do not change.)	–	–	8888	–	–	–

Pn50F

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

1st digit:

Torque Limit Detection Signal Mapping (/CLT)		Reference Section
0	Disabled (the above signal is not used.)	5.8.5
1	Outputs the signal from CN1-25, -26 output terminal.	
2	Outputs the signal from CN1-27, -28 output terminal.	
3	Outputs the signal from CN1-29, -30 output terminal.	

2nd digit:

Speed Limit Detection Signal Mapping (/VLT)		Reference Section
0 to 3	Same as /CLT Signal Mapping.	5.5.4

3rd digit:

Brake Signal Mapping (/BK)		Reference Section
0 to 3	Same as /CLT Signal Mapping.	5.2.4

4th digit:

Warning Signal Mapping (/WARN)		Reference Section
0 to 3	Same as /CLT Signal Mapping.	5.10.2

Pn510

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

1st digit:

Near Signal Mapping (/NEAR)		Reference Section
0	Disabled (the above signal is not used.)	5.4.7
1	Outputs the signal from CN1-25, -26 output terminal.	
2	Outputs the signal from CN1-27, -28 output terminal.	
3	Outputs the signal from CN1-29, -30 output terminal.	

2nd digit: Reserved (Do not change.)

3rd digit:

Reference Pulse Input Multiplication Switching Output Signal Mapping (/PSELA)		Reference Section
0 to 3	Same as /NEAR Signal Mapping.	5.4.3

4th digit: Reserved (Do not change.)

Appendix

10

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classifi-cation	Reference Section
Pn512	2	Output Signal Inverse Setting	0000 to 0111	–	0000	After restart	Setup	3.4.2
Pn513	2	Reserved (Do not change.)	–	–	0000	–	–	–

Pn512:

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

1st digit: Output Signal Inversion for CN1-25 or -26 Terminal

0	Does not inverse outputs.
1	Inverses outputs.

2nd digit: Output Signal Inversion for CN1-27 or -28 Terminal

0	Does not inverse outputs.
1	Inverses outputs.

3rd digit: Output Signal Inversion for CN1-29 or -30 Terminal

0	Does not inverse outputs.
1	Inverses outputs.

4th digit: Reserved (Do not change.)

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn515	2	Input Signal Selection 6	0000 to FFFF	–	8888	After restart	Setup	–

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

1st digit: Reserved (Do not change.)

2nd digit:

Reference Pulse Input Multiplication Switching Input Signal Mapping (/PSEL)		Reference Section
0	Active when CN1-40 input signal is ON (closed).	5.4.3
1	Active when CN1-41 input signal is ON (closed).	
2	Active when CN1-42 input signal is ON (closed).	
3	Active when CN1-43 input signal is ON (closed).	
4	Active when CN1-44 input signal is ON (closed).	
5	Active when CN1-45 input signal is ON (closed).	
6	Active when CN1-46 input signal is ON (closed).	
7	Always active (fixed).	
8	Not active (fixed).	
9	Active when CN1-40 input signal is OFF (open).	
A	Active when CN1-41 input signal is OFF (open).	
B	Active when CN1-42 input signal is OFF (open).	
C	Active when CN1-43 input signal is OFF (open).	
D	Active when CN1-44 input signal is OFF (open).	
E	Active when CN1-45 input signal is OFF (open).	
F	Active when CN1-46 input signal is OFF (open).	

3rd digit:

Dynamic Brake Answer Signal Input Signal Mapping (/DBANS)		Reference Section
0	Detects dynamic brake (DB) contactor errors when the input signal of CN1-40 is ON (closed) while the DB is applied.	3.9.4
1	Detects DB contactor errors when the input signal of CN1-41 is ON (closed) while the DB is applied.	
2	Detects DB contactor errors when the input signal of CN1-42 is ON (closed) while the DB is applied.	
3	Detects DB contactor errors when the input signal of CN1-43 is ON (closed) while the DB is applied.	
4	Detects DB contactor errors when the input signal of CN1-44 is ON (closed) while the DB is applied.	
5	Detects DB contactor errors when the input signal of CN1-45 is ON (closed) while the DB is applied.	
6	Detects DB contactor errors when the input signal of CN1-46 is ON (closed) while the DB is applied.	
7, 8	Disables DB contactor error detection of DB answer signal.	
9	Detects DB contactor errors when the input signal of CN1-40 is OFF (open) while the DB is applied.	
A	Detects DB contactor errors when the input signal of CN1-41 is OFF (open) while the DB is applied.	
B	Detects DB contactor errors when the input signal of CN1-42 is OFF (open) while the DB is applied.	
C	Detects DB contactor errors when the input signal of CN1-43 is OFF (open) while the DB is applied.	
D	Detects DB contactor errors when the input signal of CN1-44 is OFF (open) while the DB is applied.	
E	Detects DB contactor errors when the input signal of CN1-45 is OFF (open) while the DB is applied.	
F	Detects DB contactor errors when the input signal of CN1-46 is OFF (open) while the DB is applied.	

4th digit: Reserved (Do not change.)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn517	2	Reserved (Do not change.)	–	–	0000	–	–	–
Pn51B	4	Reserved (Do not change.)	–	–	1000	–	–	–
Pn51E	2	Excessive Position Error Warning Level	10 to 100	1%	100	Immediately	Setup	9.2.1
Pn520	4	Excessive Position Error Alarm Level	1 to 1073741823	1 reference unit	5242880	Immediately	Setup	6.1.4 9.1.1

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn522	4	Positioning Completed Width	0 to 1073741824	1 reference unit	7	Immediately	Setup	5.4.6
Pn524	4	NEAR Signal Width	1 to 1073741824	1 reference unit	1073741824	Immediately	Setup	5.4.7
Pn526	4	Excessive Position Error Alarm Level at Servo ON	1 to 1073741823	1 reference unit	5242880	Immediately	Setup	6.1.4
Pn528	2	Excessive Position Error Warning Level at Servo ON	10 to 100	1%	100	Immediately	Setup	6.1.4
Pn529	2	Speed Limit Level at Servo ON	0 to 10000	1 min^{-1}	10000	Immediately	Setup	6.1.4
Pn52A	2	Reserved (Do not change.)	–	–	20	–	–	–
Pn52B	2	Overload Warning Level	1 to 100	1%	20	Immediately	Setup	5.2.7
Pn52C	2	Derating of Base Current at Detecting Overload of Motor	10 to 100	1%	100	After restart	Setup	5.2.7
Pn52D	2	Reserved (Do not change.)	–	–	50	–	–	–
Pn52F	2	Monitor Display at Power ON	0000 to 0FFF	–	0FFF	Immediately	Setup	8.7
Pn530	2	Program JOG Operation Related Switch	0000 to 0005	–	0000	Immediately	Setup	7.5
Pn531	4	Program JOG Movement Distance	1 to 1073741824	1 reference unit	32768	Immediately	Setup	7.5
Pn533	2	Program JOG Movement Speed	1 to 10000	1 min^{-1}	500	Immediately	Setup	7.5
Pn534	2	Program JOG Acceleration/ Deceleration Time	2 to 10000	1 ms	100	Immediately	Setup	7.5
Pn535	2	Program JOG Waiting Time	0 to 10000	1 ms	100	Immediately	Setup	7.5
Pn536	2	Number of Times of Program JOG Movement	0 to 1000	1 time	1	Immediately	Setup	7.5
Pn550	2	Analog Monitor 1 Offset Voltage	-10000 to 10000	0.1 V	0	Immediately	Setup	6.1.3

Pn530: n.□□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: Program JOG Operation Switch

0	(Waiting time Pn535 → Forward movement Pn531) × Number of movements Pn536
1	(Waiting time Pn535 → Reverse movement Pn531) × Number of movements Pn536
2	(Waiting time Pn535 → Forward movement Pn531) × Number of movements Pn536 (Waiting time Pn535 → Reverse movement Pn531) × Number of movements Pn536
3	(Waiting time Pn535 → Reverse movement Pn531) × Number of movements Pn536 (Waiting time Pn535 → Forward movement Pn531) × Number of movements Pn536
4	(Waiting time Pn535 → Forward movement Pn531 → Waiting time Pn535 → Reverse movement Pn531) × Number of movements Pn536
5	(Waiting time Pn535 → Reverse movement Pn531 → Waiting time Pn535 → Forward movement Pn531) × Number of movements Pn536

2nd digit: Reserved (Do not change.)

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classifi-cation	Reference Section
Pn551	2	Analog Monitor 2 Offset Voltage	-10000 to 10000	0.1 V	0	Immediately	Setup	6.1.3
Pn552	2	Analog Monitor Magnification (×1)	-10000 to 10000	×0.01	100	Immediately	Setup	6.1.3
Pn553	2	Analog Monitor Magnification (×2)	-10000 to 10000	×0.01	100	Immediately	Setup	6.1.3
Pn560	2	Remained Vibration Detection Width	1 to 3000	0.1%	400	Immediately	Setup	6.5.1
Pn561	2	Overshoot Detection Level	0 to 100	1%	100	Immediately	Setup	6.2.1 6.4.1
Pn600	2	Regenerative Resistor Capacity *1	Depends on SERVOPACK Capacity*2	10 W	0	Immediately	Setup	3.8.3
Pn601	2	Dynamic brake resistor capacity	0 or higher (Max. value depends on model.)*2	10 W	0	Immediately	Setup	3.9.2
Pn612	2	SERVOPACK Ambient Tem-perature	0 to 55	1ºC	30	After restart	Setup	–
Pn614	2	Servomotor Service Life 1	0 to 65535	10 hours	500	After restart	Setup	–
Pn615	2	Servomotor Service Life 2	0 to 65535	10 hours	2000	After restart	Setup	–
Pn621 to Pn628*3	–	SERVOPACK: Safety Module Parameters	–	–	–	–	–	–

*1. Normally set to "0." When using an external regenerative resistor, set the capacity (W) of the regenerative resistor unit.
*2. The upper limit is the maximum output capacity (W) of the SERVOPACK.
*3. These parameters can be set in SERVOPACKs with safety modules. For details, refer to *Σ-V Series User's Manual, Safety Module* (No.: SIEP C720829 06).

10.3 List of Monitor Displays

The following list shows the available monitor displays.

Parameter No.	Description	Unit
Un000	Motor rotating speed	min^{-1}
Un001	Speed reference	min^{-1}
Un002	Internal torque reference (percentage of the rated torque)	%
Un003*3	Rotational angle 1 (encoder pulses from the phase-C origin: decimal display)	encoder pulse*4
Un004	Rotational angle 2 (from polarity origin (electric angle))	deg
Un005*1	Input signal monitor	–
Un006*2	Output signal monitor	–
Un007*6	Input reference pulse speed (valid only in position control)	min^{-1}
Un008*6	Position error amount (valid only in position control)	reference unit
Un009	Accumulated load ratio (in percentage to the rated torque: effective torque in cycle of 10 seconds)	%
Un00A	Regenerative load ratio (as a percentage of the processable regenerative power: regenerative power consumption in cycle of 10 seconds)	%
Un00B	Power consumed by DB resistance (in percentage to the processable power at DB activation: displayed in cycle of 10 seconds)	%
Un00C*3,*5	Input reference pulse counter	reference unit
Un00D*3	Feedback pulse counter	encoder pulse*4
Un012	Total operation time	100 ms
Un013*3	Feedback pulse counter	reference unit
Un014	Effective gain monitor (gain settings 1 = 1, gain settings 2 = 2)	–
Un015	Safety I/O signal monitor	–
Un020	Motor rated speed	min^{-1}
Un021	Motor maximum speed	min^{-1}

∗1. For details, refer to *8.4 Monitoring Input Signals*.
∗2. For details, refer to *8.5 Monitoring Output Signals*.
∗3. For details, refer to *8.3 Reading 32-bit Data in Decimal Displays*.
∗4. For details, refer to *5.4.4 Electronic Gear*.
∗5. If the reference pulse input multiplication switching function is enabled, the reference pulse will be multiplied by n to obtain the reference.

10.4 Parameter Recording Table

Use the following table for recording parameters.

Parameter	Factory Setting						Name	When Enabled
Pn000	0000						Basic Function Select Switch 0	After restart
Pn001	0000						Application Function Select Switch 1	After restart
Pn002	0000						Application Function Select Switch 2	After restart
Pn006	0002						Application Function Select Switch 6	Immediately
Pn007	0000						Application Function Select Switch 7	Immediately
Pn008	0000						Application Function Select Switch 8	After restart
Pn009	0010						Application Function Select Switch 9	After restart
Pn00B	0000						Application Function Select Switch B	After restart
Pn00C	0000						Application Function Select Switch C	After restart
Pn00D	0000						Application Function Select Switch D	*
Pn010	0001						Axis Address Selection (for UART/ USB communications)	After restart
Pn081	0000						Application Function Select Switch 81	After restart
Pn100	400						Speed Loop Gain	Immediately
Pn101	2000						Speed Loop Integral Time Constant	Immediately
Pn102	400						Position Loop Gain	Immediately
Pn103	100						Moment of Inertia Ratio	Immediately
Pn104	400						2nd Speed Loop Gain	Immediately
Pn105	2000						2nd Speed Loop Integral Time Constant	Immediately
Pn106	400						2nd Position Loop Gain	Immediately
Pn109	0						Feedforward Gain	Immediately
Pn10A	0						Feedforward Filter Time Constant	Immediately
Pn10B	0000						Application Function for Gain Select Switch	*
Pn10C	200						Mode Switch (torque reference)	Immediately
Pn10D	0						Mode Switch (speed reference)	Immediately
Pn10E	0						Mode Switch (acceleration)	Immediately
Pn10F	0						Mode Switch (position error)	Immediately
Pn11F	0						Position Integral Time Constant	Immediately
Pn121	100						Friction Compensation Gain	Immediately
Pn122	100						2nd Gain for Friction Compensation	Immediately
Pn123	0						Friction Compensation Coefficient	Immediately
Pn124	0						Friction Compensation Frequency Correction	Immediately
Pn125	100						Friction Compensation Gain Correction	Immediately
Pn131	0						Gain Switching Time 1	Immediately
Pn132	0						Gain Switching Time 2	Immediately
Pn135	0						Gain Switching Waiting Time 1	Immediately
Pn136	0						Gain Switching Waiting Time 2	Immediately

* The timing varies in accordance with the digit changed in a parameter (1st digit, 2nd digit, and so on). For details, refer to *10.2.2 Parameters*.

(cont'd)

Parameter	Factory Setting						Name	When Enabled
Pn139	0000						Automatic Gain Changeover Related Switch 1	Immediately
Pn13D	2000						Current Gain Level	Immediately
Pn140	0100						Model Following Control Related Switch	Immediately
Pn141	500						Model Following Control Gain	Immediately
Pn142	1000						Model Following Control Gain Compensation	Immediately
Pn143	1000						Model Following Control Bias (Forward Direction)	Immediately
Pn144	1000						Model Following Control Bias (Reverse Direction)	Immediately
Pn145	500						Vibration Suppression 1 Frequency A	Immediately
Pn146	700						Vibration Suppression 1 Frequency B	Immediately
Pn147	1000						Model Following Control Speed Feedforward Compensation	Immediately
Pn148	500						2nd Model Following Control Gain	Immediately
Pn149	1000						2nd Model Following Control Gain Compensation	Immediately
Pn14A	800						Vibration Suppression 2 Frequency	Immediately
Pn14B	100						Vibration Suppression 2 Compensation	Immediately
Pn14F	0011						Control Related Switch	After restart
Pn160	0010						Anti-Resonance Control Related Switch	Immediately
Pn161	1000						Anti-Resonance Frequency	Immediately
Pn162	100						Anti-Resonance Gain Compensation	Immediately
Pn163	0						Anti-Resonance Damping Gain	Immediately
Pn164	0						Anti-Resonance Filter Time Constant 1 Compensation	Immediately
Pn165	0						Anti-Resonance Filter Time Constant 2 Compensation	Immediately
Pn170	1400						Reserved	–
Pn200	0000						Position Control Reference Form Selection Switch	After restart
Pn205	65535						Multiturn Limit Setting	After restart
Pn207	0000						Position Control Function Switch	After restart
Pn20A	32768						Number of External Scale Pitch	After restart
Pn20E	4						Electronic Gear Ratio (Numerator)	After restart
Pn210	1						Electronic Gear Ratio (Denominator)	After restart
Pn212	2048						Encoder Output Pulses	After restart
Pn216	0						Position Reference Acceleration/ Deceleration Time Constant	Immediately after the motor stops
Pn217	0						Average Movement Time of Position Reference	Immediately after the motor stops
Pn218	1						Reference Pulse Input Multiplication	Immediately

(cont'd)

Parameter	Factory Setting						Name	When Enabled
Pn22A	0000						Reserved	–
Pn281	20						Reserved	–
Pn300	600						Speed Reference Input Gain	Immediately
Pn301	100						Internal Set Speed 1	Immediately
Pn302	200						Internal Set Speed 2	Immediately
Pn303	300						Internal Set Speed 3	Immediately
Pn304	500						JOG Speed	Immediately
Pn305	0						Soft Start Acceleration Time	Immediately
Pn306	0						Soft Start Deceleration Time	Immediately
Pn307	40						Speed Reference Filter Time Constant	Immediately
Pn310	0000						Vibration Detection Switch	Immediately
Pn311	100						Vibration Detection Sensibility	Immediately
Pn312	50						Vibration Detection Level	Immediately
Pn324	300						Moment of Inertia Calculating Start Level	Immediately
Pn400	30						Torque Reference Input Gain	Immediately
Pn401	100						Torque Reference Filter Time Constant	Immediately
Pn402	800						Forward Torque Limit	Immediately
Pn403	800						Reverse Torque Limit	Immediately
Pn404	100						Forward External Torque Limit	Immediately
Pn405	100						Reverse External Torque Limit	Immediately
Pn406	800						Emergency Stop Torque	Immediately
Pn407	10000						Speed Limit during Torque Control	Immediately
Pn408	0000						Torque Related Function Switch	*
Pn409	5000						1st Notch Filter Frequency	Immediately
Pn40A	70						1st Notch Filter Q Value	Immediately
Pn40B	0						1st Notch Filter Depth	Immediately
Pn40C	5000						2nd Notch Filter Frequency	Immediately
Pn40D	70						2nd Notch Filter Q Value	Immediately
Pn40E	0						2nd Notch Filter Depth	Immediately
Pn40F	5000						2nd Step 2nd Torque Reference Filter Frequency	Immediately
Pn410	50						2nd Step 2nd Torque Reference Filter Q Value	Immediately
Pn412	100						1st Step 2nd Torque Reference Filter Time Constant	Immediately
Pn415	0						T-REF Filter Time Constant	Immediately
Pn423	0000						Reserved	–
Pn424	50						Reserved	–
Pn425	100						Reserved	–
Pn456	15						Reserved	–
Pn460	0101						Notch Filter Adjustment Switch	Immediately
Pn501	10						Zero Clamp Level	Immediately

* The timing varies in accordance with the digit changed in a parameter (1st digit, 2nd digit, and so on). For details, refer to *10.2.2 Parameters*.

(cont'd)

Parameter	Factory Setting						Name	When Enabled
Pn502	20						Rotation Detection Level	Immediately
Pn503	10						Speed Coincidence Signal Output Width	Immediately
Pn506	0						Brake Reference - Servo OFF Delay Time	Immediately
Pn507	100						Brake Reference Output Speed Level	Immediately
Pn508	50						Waiting Time for Brake Signal When Motor Running	Immediately
Pn509	20						Instantaneous Power Cut Hold Time	Immediately
Pn50A	2100						Input Signal Selection 1	After restart
Pn50B	6543						Input Signal Selection 2	After restart
Pn50C	8888						Input Signal Selection 3	After restart
Pn50D	8888						Input Signal Selection 4	After restart
Pn50E	3211						Output Signal Selection 1	After restart
Pn50F	0000						Output Signal Selection 2	After restart
Pn510	0000						Output Signal Selection 3	After restart
Pn511	8888						Reserved	–
Pn512	0000						Output Signal Inverse Setting	After restart
Pn513	0000						Reserved	–
Pn515	8888						Input Signal Selection 6	After restart
Pn517	0000						Reserved	–
Pn51B	1000						Reserved	–
Pn51E	100						Excessive Position Error Warning Level	Immediately
Pn520	5242880						Excessive Position Error Alarm Level	Immediately
Pn522	7						Positioning Completed Width	Immediately
Pn524	1073741824						NEAR Signal Width	Immediately
Pn526	5242880						Excessive Position Error Alarm Level at Servo ON	Immediately
Pn528	100						Excessive Position Error Warning Level at Servo ON	Immediately
Pn529	10000						Speed Limit Level at Servo ON	Immediately
Pn52A	20						Reserved	–
Pn52B	20						Overload Warning Level	Immediately
Pn52C	100						Derating of Base Current at Detecting Overload of Motor	After restart
Pn52D	50						Reserved	–
Pn52F	0FFF						Monitor Display at Power ON	Immediately
Pn530	0000						Program JOG Operation Related Switch	Immediately
Pn531	32768						Program JOG Movement Distance	Immediately
Pn533	500						Program JOG Movement Speed	Immediately
Pn534	100						Program JOG Acceleration/Deceleration Time	Immediately
Pn535	100						Program JOG Waiting Time	Immediately
Pn536	1						Number of Times of Program JOG Movement	Immediately

(cont'd)

Parameter	Factory Setting						Name	When Enabled
Pn550	0						Analog Monitor 1 Offset Voltage	Immediately
Pn551	0						Analog Monitor 2 Offset Voltage	Immediately
Pn552	100						Analog Monitor Magnification (×1)	Immediately
Pn553	100						Analog Monitor Magnification (×2)	Immediately
Pn560	400						Remained Vibration Detection Width	Immediately
Pn561	100						Overshoot Detection Level	Immediately
Pn600	0						Regenerative Resistor Capacity	Immediately
Pn601	0						Dynamic Brake Resistor Capacity	Immediately
Pn612	30						SERVOPACK Ambient Temperature	After restart
Pn614	500						Servomotor Service Life 1	After restart
Pn615	2000						Servomotor Service Life 2	After restart

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Revision History

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

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July 2016	<1>	Front cover	Deletion: SERVOPACK model SGDV-□□□H
		Introduction	Revision: Harmonized Standards
		1.4.1 (1), 3.1.4 (1), 3.1.4 (2)	Revision: Current value of the control power supply and value of the control circuit power loss.
		10.2.2	Revision: Explanation of the parameter list.
October 2015	–	–	First edition

AC Servo Drives

Σ-V Series

USER'S MANUAL
For Use with Large-Capacity Models
Design and Maintenance

Multi-Winding Drive Unit
Rotational Motor
Analog Voltage and Pulse Train References

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In the event that the end user of this product is to be the military and said product is to be employed in any weapons systems or the manufacture thereof, the export will fall under the relevant regulations as stipulated in the Foreign Exchange and Foreign Trade Regulations. Therefore, be sure to follow all procedures and submit all relevant documentation according to any and all rules, regulations and laws that may apply.

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

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