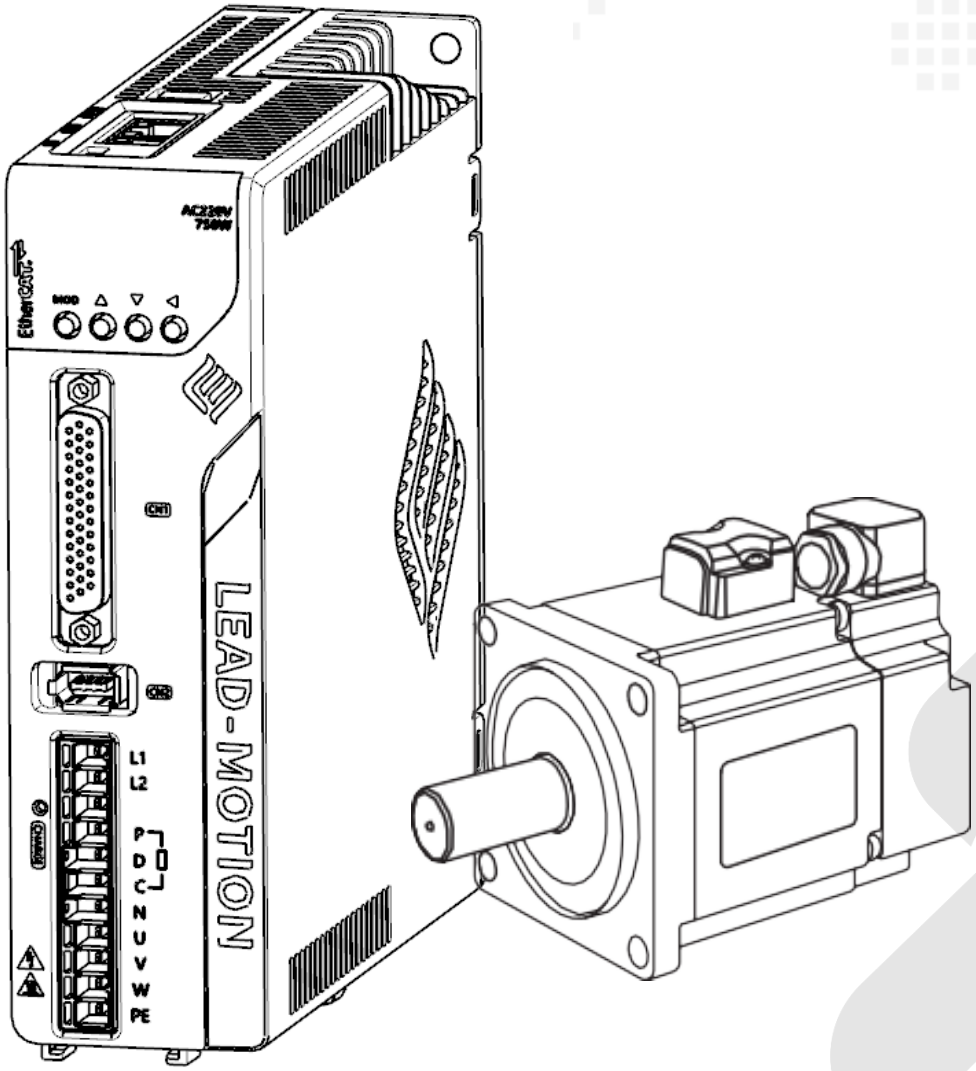
LEAD-MOTION

User Manual for M1 Series Servo

(V1.12)



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Changzhou Lead-motion Intelligent Technology Co., Ltd.

Preface

Thank you for using the M1 Series servo drive!

M1 series servo product is a high-performance AC servo product developed by Lead-motion, which has a power range of 0.1kW-7.5kW and supports communication protocols such as EtherCAT. The product adopts a new algorithm to make the product present higher dynamic response, higher positioning accuracy and higher reliability. The product has a comprehensive range of functions (free adjustment, inertia identification, vibration suppression, advanced tuning), making commissioning easier and more convenient

This product is suitable for equipment in multiple industries such as 3C/semiconductor, robotics, new energy, laser, textile, packaging, etc., and provides value to user equipment with excellent product performance.

This manual provides information about the M1 series drivers and motors. Refer to this manual for the installation, commissioning and maintenance of M1 series products. The wrong use method and treatment method will not only affect the product performance, the service life of the product, but also lead to accidents.

Please keep this manual safe so that you can consult it if necessary.

If there is any doubt about the contents of this manual, you can contact our technical staff.

More information

Document name	Description
M1 Series EtherCAT User Manual	Introduces the installation, commissioning, function description, troubleshooting, and parameter description of EtherCAT products.

Manual acquisition

Access to the electronic manual is available in the following ways:
Log on to the official website of Lead-motion (www.lead-motion.com), and download from the download center.
Consult with our technical staff.

Safety precautions

Before the storage, installation, wiring, operation, inspection or repair of the product, users are required to get familiar with and abide by the following important matters, to ensure the safe and correct use of the product.

This symbol indicates that improper operation may cause danger or even personal injury.

This symbol indicates that improper operations may cause danger, personal injury, and possibly damage the device.

This symbol indicates "operation forbidden" (absolutely cannot do).

This symbol indicates mandatory operation (must be done).

Danger

Storage and usage environment

- It is prohibited to store and use the product in the environment with water, corrosive gas and flammable gas.
- It is forbidden to store and use the products in the environment with direct sunlight, dust, salt and metal powder.
- It is prohibited to store and use products in the presence of water, oil and dangerous materials.

Installation and Wiring

- It is prohibited to connect the UVW terminal of the motor to the three-phase power supply.
- It is forbidden to install this product near the combustible materials.

- Installation and wiring must be done by professional electrical personnel.
- It must be installed in the correct installation way.
- The Ground terminal must be reliably grounded.
- The power supply must be disconnected before wiring.
- The wiring material must be properly selected.
- An emergency stop circuit must be installed externally to ensure that the power supply can be stopped and cut off in case of emergency.

Operation and Running

- Do not touch the driver and motor in operation.
- Do not frequently turn on or off the power supply.

- It is prohibited to damage the cable, withstand excessive external forces, exert heavy pressure, or get caught in the cable.
- Reasonable parameter values must be set before running.
- Wear safety equipment before performing operations.

Maintenance and Repair	
Maintenance and repair must be conducted by professional electrical personnel.	
Equipment maintenance must be carried out in a non-powered state.	
The power supply must be cut off for a period of time (more than 5 minutes) before maintenance and repair operations.	

Caution	
Installation and Wiring	
Please follow the correct installation direction.	
Install the product in a place that can support the weight of the product.	
Do not place heavy objects on this product.	
Do not touch the wiring terminals.	
Do not block the heat sink device.	
Operation and Running	
Please match the drive and the motor as required.	
Please test the motor in the no-load state.	
Do not use the motor holding brake for mechanical braking.	
Do not make the motor and motor shaft subject to strong impact.	
Do not set unreasonable parameters to drive.	
Maintenance and Repair	
Do not remove the drive or motor.	
Do not change the wiring while the power is on.	

Meet certification and standard requirements.

	Model	Low-voltage standard	EMC standard
Servo drive	M1	EN 61800-5-1	EN 61800-3

Contents

01 Chapter I

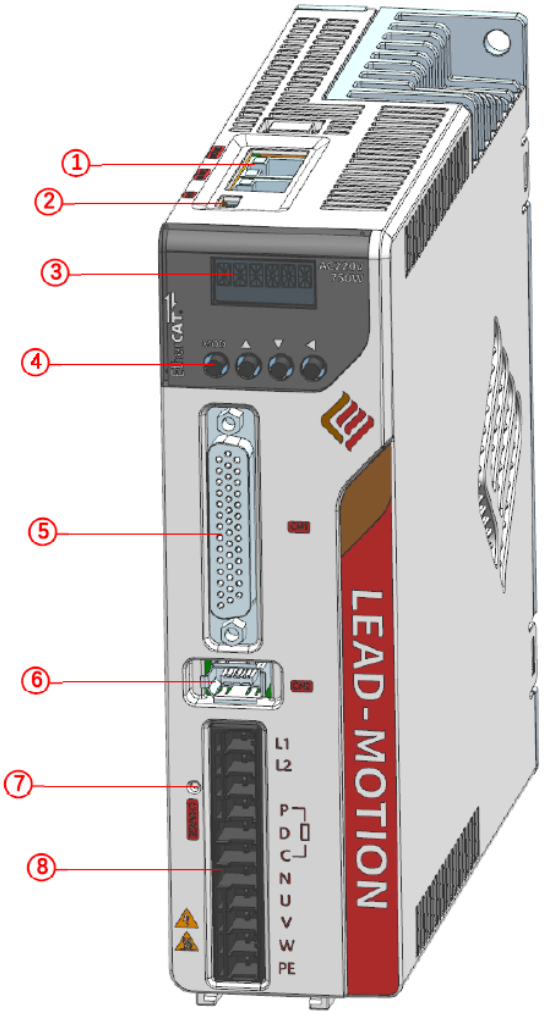
Summary

1.1 Description of the M1 series nameplate

The M1 series is mainly used in situations that require "high speed and positioning accuracy". This series of servo drives can maximize machine performance in the shortest possible time, helping to improve production efficiency.

1.2 Description of each part of the servo drive

(1) Size-A: M1-01B□/M1-02B□/M1-04B□/M1-08B□ servo drive



① Communication reference driver: **EtherCAT**; Pulse/analog driver

② ② **Micro USB: M1** servo backend software interface

③ **6-digit LCD** display

④ Operation buttons

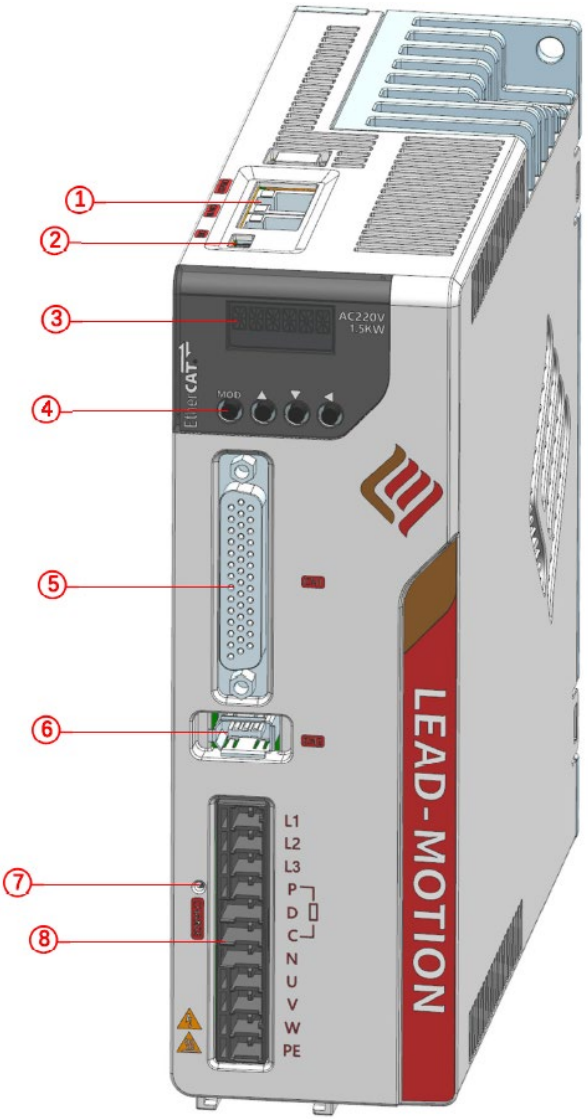
⑤ **I/O** signal interface

⑥ Encoder interface

⑦ **CHARGE** indicator

⑧ **AC** power input; Motor interface; External regenerative resistor

(2) Size-B: M1-10B□/M1-15B□ servo drive



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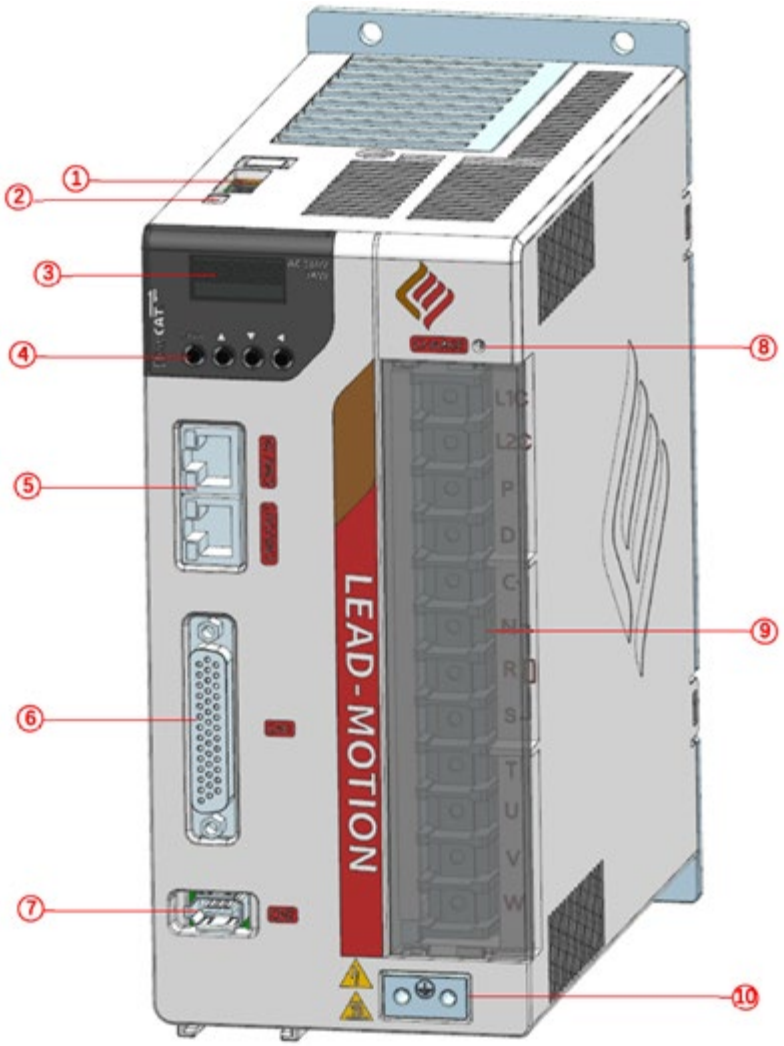
(3) Size-C: M1-20B□/M1-30B□/M1-20C□/M1-30C□ servo drive



① Safety function terminal

② **Micro USB: M1** servo backend software interface

③ **6-digit LCD** display

④ Operation buttons

⑤ Communication reference driver: **EtherCAT**; Pulse/analog driver

⑥ **I/O** signal interface

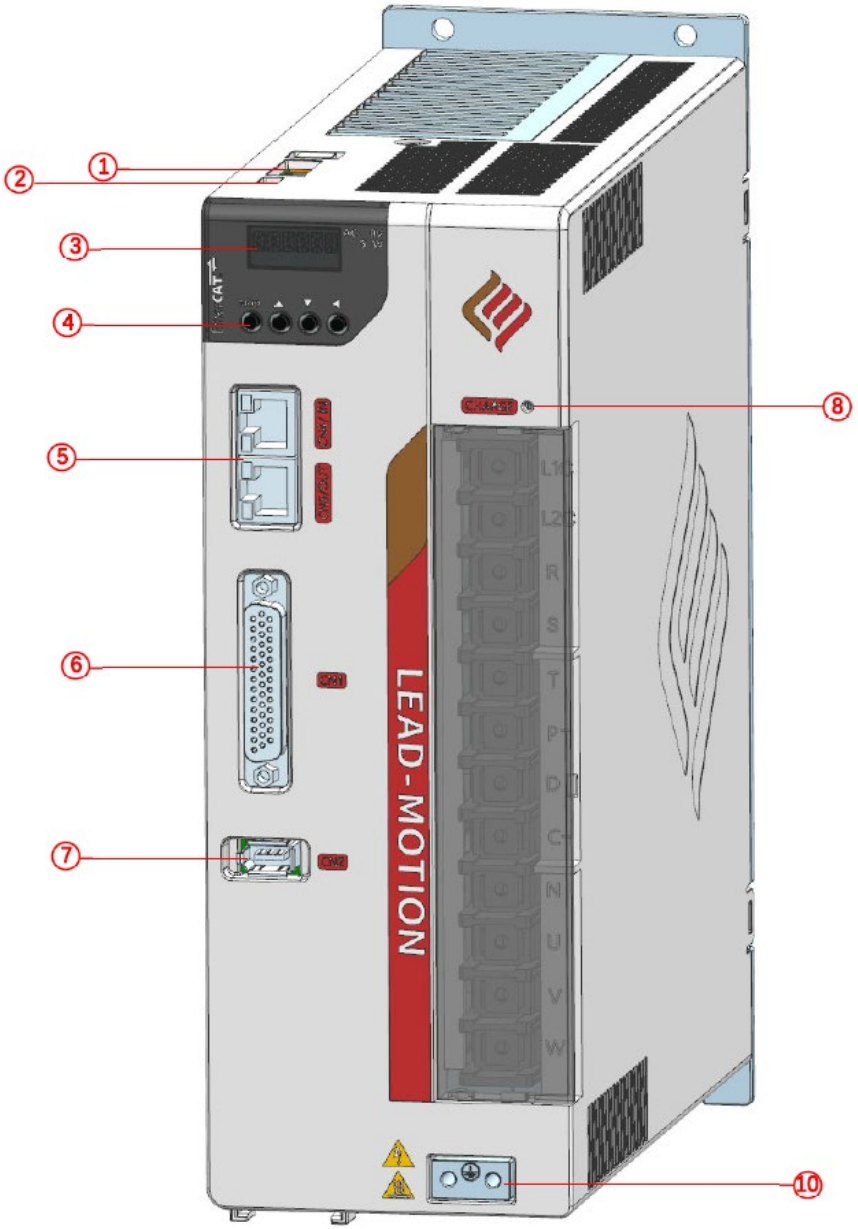
⑦ Encoder interface

⑧ **CHARGE** indicator

⑨ **AC** power input; Motor interface; External regenerative resistor

⑩ Ground terminal

(4) Size-D: **M1-45C□/M1-55C□/M1-75C□ servo drive**



① Safety function terminal

② **Micro USB: M1** servo backend software interface

③ **6-digit LCD** display

④ Operation buttons

⑤ Communication reference driver: **EtherCAT**; Pulse/analog driver

⑥ **I/O** signal interface

⑦ Encoder interface

⑧ **CHARGE** indicator

⑨ **AC** power input; Motor interface; External regenerative resistor

⑩ Ground terminal

1.3 Product specifications of the server driver

1.3.1 Electrical specifications

(1) Electrical specifications for M1 type (AC220V)

Driver model	M1-01B□	M1-02B□	M1-04B□	M1-08B□
Rated Power (W)	**100**	**200**	**400**	**750**
Rated continuous output current [Arms]	**1.1**	**1.6**	**2.8**	**5.5**
Instantaneous maximum output current [Arms]	**3.3**	**5.8**	**8.8**	**16.9**
Main circuit power supply	Single-phase AC200 ~ 230V ±20% 50/60Hz			
Control circuit power	Bus power supply (sharing main circuit power input and rectification)			
Overload capability	200%, 10s; Maximum output current, 3s			200%, 100s; Maximum output current, 5s
Dynamic brake	Standard			
Regenerative resistor	External (min. 38) Ω			Internal/external (min. 38) Ω

Driver model	M1-10B□	M1-15B□
Rated Power (W)	**1000**	**1500**
Rated continuous output current [Arms]	**7.6**	**12.0**
Instantaneous maximum output current [Arms]	**23.0**	**32.0**
Main circuit power supply	Single-phase/three-phase AC200 ~ 230V ±20% 50/60Hz	
Control circuit power	Bus power supply (sharing main circuit power input and rectification)	
Overload capability	200%, 100s; Maximum output current, 5s	
Dynamic brake	Standard	
Regenerative resistor	Internal/external (min. 18) Ω	

Driver model	M1-20B□	M1-30B□
Rated Power (W)	**2000**	**3000**
Rated continuous output current [Arms]	**18.5**	**19.6**
Instantaneous maximum output current [Arms]	**42.0**	**44.0**
Main circuit power supply	Three-phase AC200 ~ 230V ±20% 50/60Hz	
Control circuit power	Single-phase AC200 ~ 230V ±20% 50/60Hz	
Overload capability	200%, 100s; Maximum output current, 5s	
Dynamic brake	Standard	
Regenerative resistor	Internal/external (min. 28) Ω	

(2) Electrical specifications for M1 type (AC380V)

Driver model	M1-20C□	M1-30C□	M1-45C□	M1-55C□
Rated Power (W)	2000	3000	4500	5500
Rated continuous output current [Arms]	8.4	12.0	16.5	21.0
Instantaneous maximum output current [Arms]	20	28.0	42.0	47.0
Main circuit power supply	Three-phase AC380～480V ±20% 50/60Hz			
Control circuit power	Single-phase AC380～480V ±20% 50/60Hz			
Overload capability	200%, 100s; Maximum output current, 5s			
Dynamic brake	Standard			
Regenerative resistor	Internal/external (min. 28) Ω			

Driver model	M1-75C□
Rated Power (W)	7500
Rated continuous output current [Arms]	26.0
Instantaneous maximum output current [Arms]	65.0
Main circuit power supply	Three-phase AC380～480V ±20% 50/60Hz
Control circuit power	Single-phase AC380～480V ±20% 50/60Hz
Overload capability	200%, 100s; Maximum output current, 5s
Dynamic brake	Standard
Regenerative resistor	Internal/external (min. 28) Ω

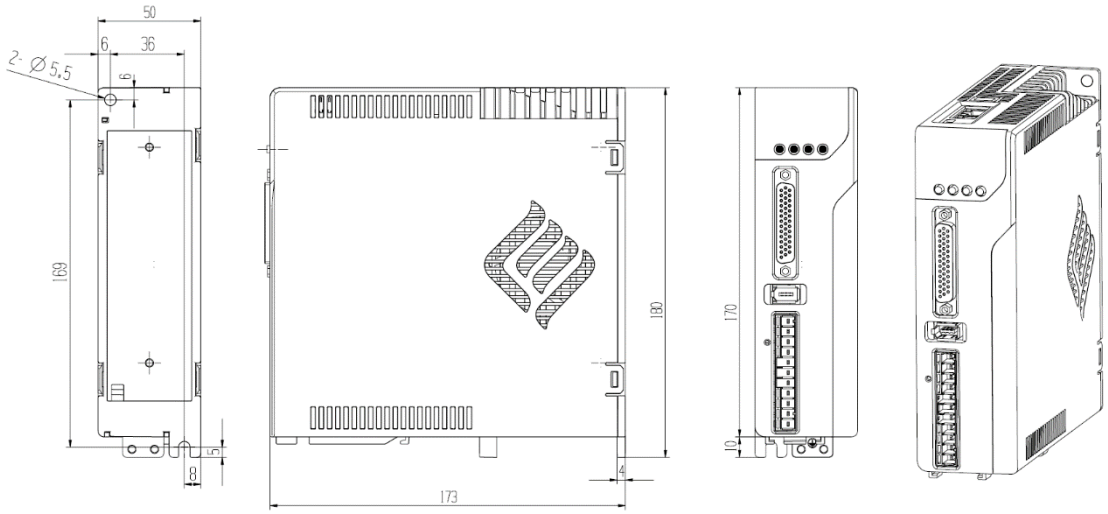
1.3.2 Basic specifications

Basic specifications	Control mode		IGBT PIGBT PWM control, Sine-wave current drive mode, WM mode, Sinusoidal motion	
	Encoder feedback		Encoder: 23 Photoelectric encoder (incremental type / absolute value type) 17-bit magnetic encoder	
	Operating ambient temperature		0 ~ 55°C (If the ambient temperature exceeds 45°C, derate 2% for every additional 1°C)	
	Storage temperature		-20 ~ 85°C	
	Ambient humidity		Below 90%RH	Non condensing
	Storage humidity		Below 90%RH	
	Vibration strength		4.9m/s2	
	Impact strength		19.6m/s2	
	Protection level		IP20	No corrosive gas or no combustible gas No water, oil or medicine splash In environments with less dust, dust, salt, and metal powder
	Altitude		1000m or less	
	Other		No electrostatic interference, strong electric field, strong magnetic field, radiation, etc.	
Performance	Speed control range		1:5000 (The lower limit of the speed control range is the value under the condition of not stopping at rated torque load)	
	Speed adjustment rate	Load fluctuation	At 0 ~ 100% load: ± 0.01% below (at rated speed)	
		Voltage fluctuation	Rated voltage ±10%: ± 0.01% below (at rated speed)	
		Temperature fluctuation	25 ± 25°C: ± 0.1% below (at rated speed)	
	Speed fluctuation coefficient		0.1% below (at no-load rated speed)	
	Torque control precision		± 1%	
	Soft start time setting		0 ~ 10s (Acceleration and deceleration can be set respectively)	
Position control	Feedforward compensation		0 ~ 100%	
	Positioning completed width setting		0 ~ 1073741824 reference unit	
	Pulse input	Input pulse type	Direction + pulse, CW + CCW, AB Orthogonal pulse	
		Input pulse pattern	Support for differential input, open collector	
		Input pulse frequency	Difference input: Direction + pulse, CW + CCW: 4Mpps AB Orthogonal pulses: 1Mpps Open collector: Direction + pulse, CW + CCW: 200kpps AB Orthogonal pulses: 200kpps	
		Reference pulse input magnification switching	1 ~ 100 times	
	Location output	Output pattern	A phase, B phase, C phase: Difference output	
Speed Control	Control mode		External analog input	
	Analog input		Maximum input voltage range: ± 12V Default DC6V corresponds to rated speed	
	Torque limiting function		Parameter setting, parameter setting+I/O control, analog input	
Internal velocity	Control mode		I/O control	
	Speed selection		Select three types through parameter settings and the arrangement and combination of I/O Different speeds	
Torque control	Control mode		External analog input	
	Analog input		Maximum input voltage range: ± 12V Default DC3V corresponds to rated torque	
	Speed limit function		Parameter setting, parameter setting+I/O control, analog input	

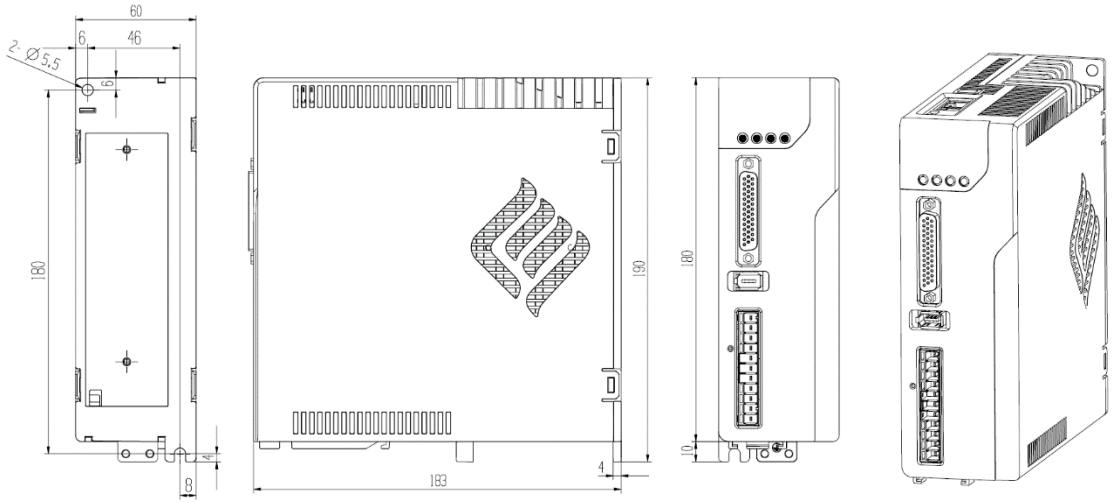
Input signal	Fixed input		SEN signal
	Programmable output		Servo ON (/S-ON) P action (/P-CON) No forward drive (P-OT), No reverse drive (N-OT) Alarm Reset (/ALM-RST) External torque limit on the positive side (/P-CL), External torque limit on the reverse side (/N-CL) internal set speed switch (/SPD-D, /SPD-A, /SPD-B) Control mode switching (/C-SEL) Zero position fixed (/ZCLAMP) reference pulse prohibition (/INHIBIT) Gain switch (/G-SEL) reference pulse input magnification switching (/PSEL) Encoder absolute value data requires input (SEN) signal Emergency stop alarm input (FSTP) signal
Output signal	Fixed output		Servo alarm (ALM)
	Programmable output		Positioning completed (/COIN) Speed consistent detection (/V-CMP) Rotation detection (/TGON) Servo ready (/S-RDY) Torque limit detection (/CLT) Speed limit detection (/VLT) Brake (/BK) Warning (/WARN) positioning near (/NEAR) reference pulse input magnification switching (/PSELA)
Communication function	USB communication	Connecting device	Computer (install DriveKey)
		Communication specification	USB1.1 Specification (12Mbps)
Dynamic brake (DB) (optional)			Acting during the main circuit power OFF, servo alarm, servo OFF and overtravel (OT)
Regeneration treatment			Built-in regeneration and discharge processing function
Overtravel (OT) prevention function			Dynamic brake (DB) stops, deceleration stops, or free running stops when P-OT and N-OT input actions occur
Protection function			Over-current, over-voltage, under-voltage, overload, regeneration fault, encoder fault, etc.

1.4 Installation dimensions of the servo drive

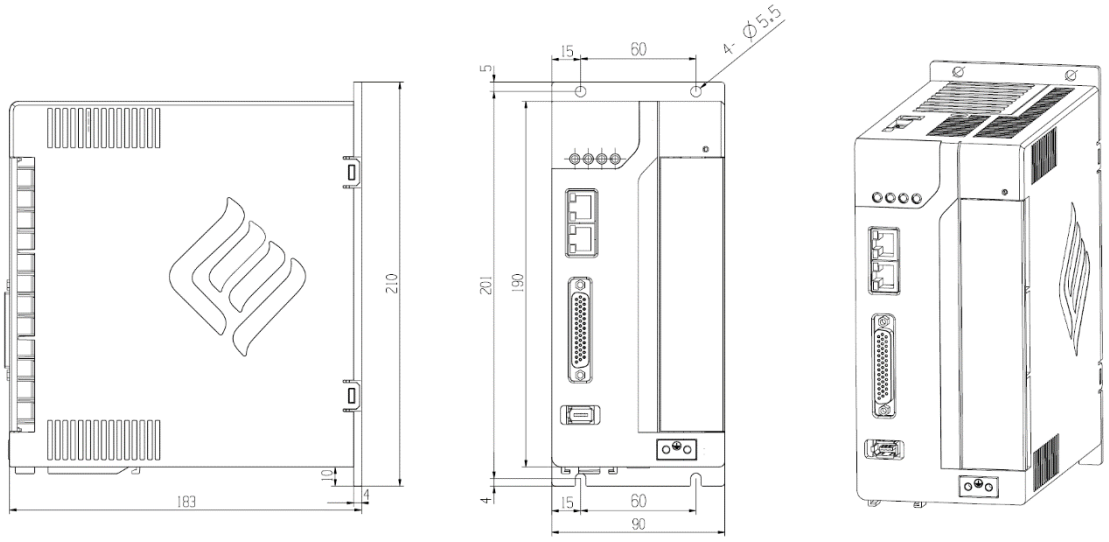
(1) Size-A: M1-01B□ / M1-02B□ / M1-04B□ / M1-08B□ servo drive



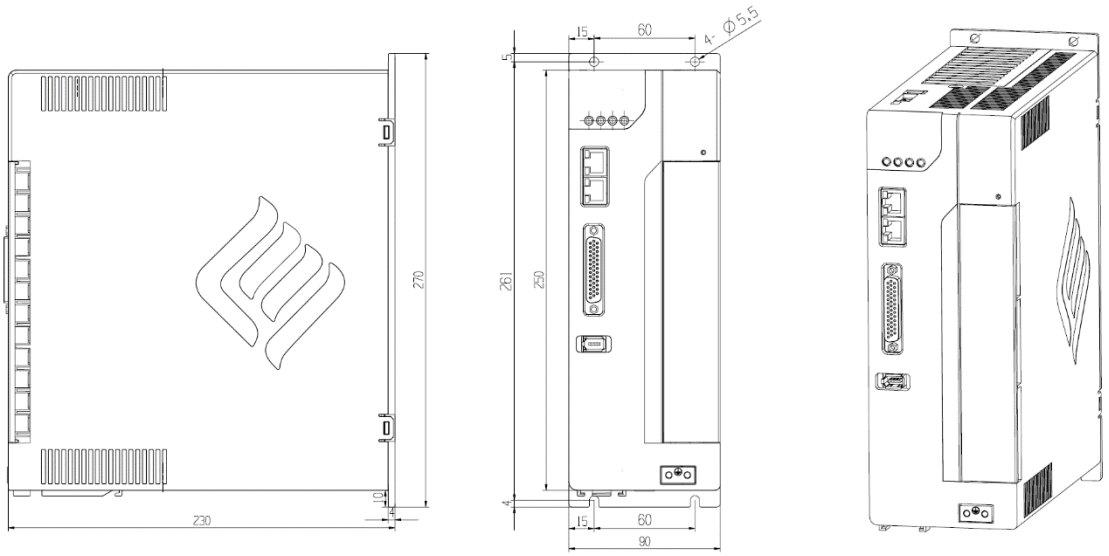
(2) Size-B: M1-10B□ / M1-15B□ servo drive



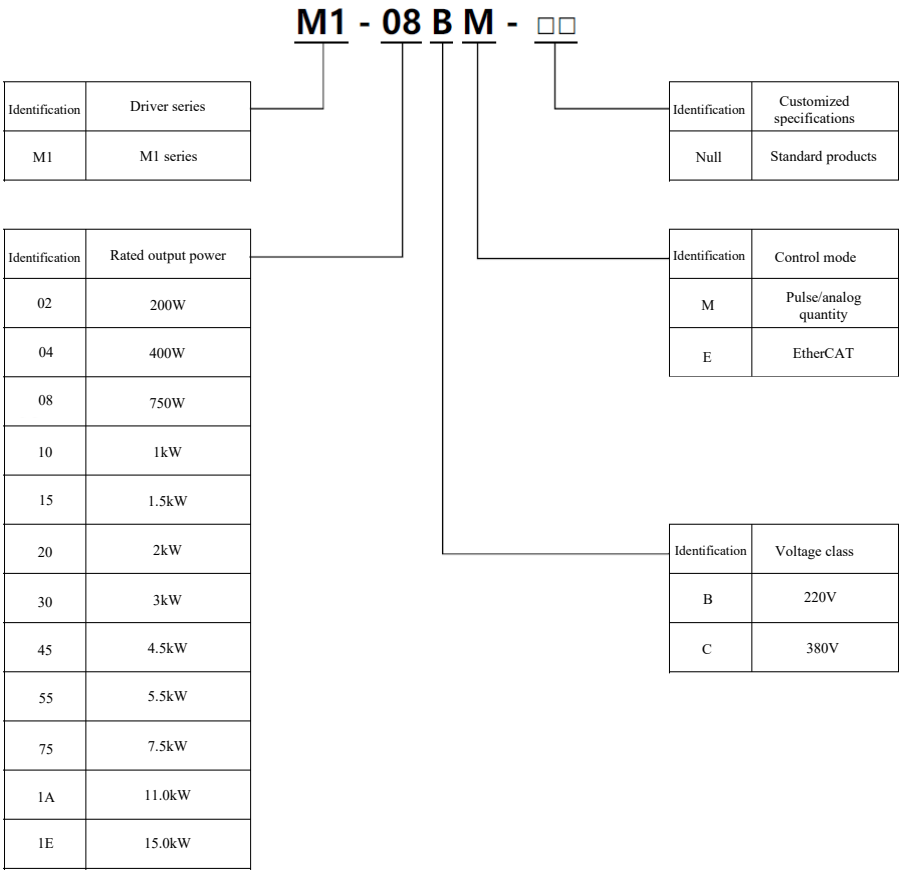
(3) Size-C: M1-20B□/ M1-30B□ / M1-20C□ /M1-30C□ servo drive



(4) Size-D: M1-45C□/M1-55C□/M1-75C□ servo drive



1.5 Servo drive model description (as described below)



Identification	Driver series
M1	M1 series

Identification	Rated output power
02	200W
04	400W
08	750W
10	1kW
15	1.5kW
20	2kW
30	3kW
45	4.5kW
55	5.5kW
75	7.5kW
1A	11.0kW
1E	15.0kW

Identification	Customized specifications
Null	Standard products

Identification	Control mode
M	Pulse/analog quantity
E	EtherCAT

Identification	Voltage class
B	220V
C	380V

1.6 Maintenance and inspection of servo drive

The following describes the maintenance and inspection of the servo drive

(1) Maintenance of the servo motor

The servo drive does not require daily inspection, but the following items need to be inspected at least once a year.

Inspection items	Inspection interval	Inspection essentials	Troubleshooting
Check appearance	At least once a year	No garbage, dust, oil, etc.	Please wipe with cloth or clean with air gun.
Loose screws		The mounting screws of terminal block and connectors must not be loosened.	Please tighten them.

(2) General standard for servo drive component replacement

The electrical and electronic components inside the servo drive will undergo mechanical wear and aging. In order to prevent and maintain the servo drive, please replace the standard replacement years in the following table to the approximate standard. When replacing, please contact the agent or the company. We will determine whether replacement parts are necessary after an investigation.

Component name	Standard service life
Cooling fan	4 ~ 5 Years
Smoothing capacitor	7 ~ 8 Years
Other aluminum electrolytic capacitors	5 years
Relays	-
Fuse	10 years

(Note) The standard number of replacement years is the number of years when used under the following conditions/

· Operating ambient temperature Annual average 30°C

· Load rate: Below 80%

· Operating ratio: Less than 20 hours / day

02 Chapter II

Operation Panel

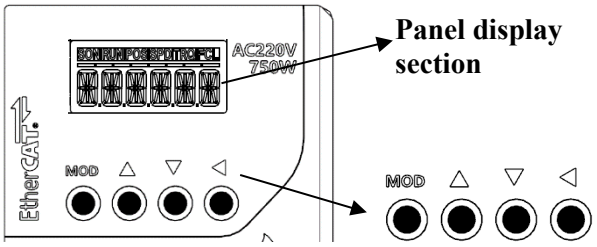
2.1 Panel references

2.1.1 Panel composition

The panel consists of the panel display section and the key section.

Through the panel, you can set the parameters, status display, perform AIDS, and monitor the action of the servo drive.

The names and functions of the panel keys are shown below.



How to reset the drive alarm
Press UP△ key and DOWN▽ key,
To reset the drive alarm.
(Note: Please exclude the alarm reason before the alarm is reset)

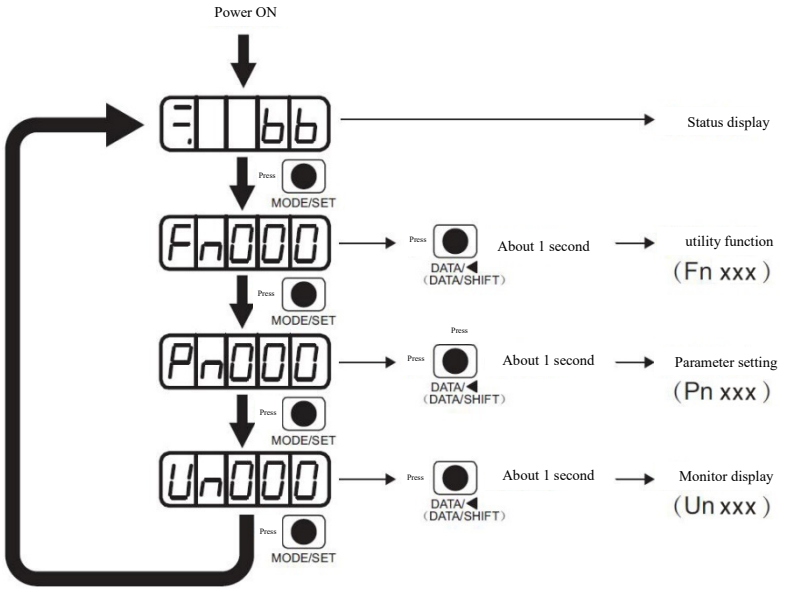
Panel key

Key No.	Key name	Function
①	MOD key	Mode switch: utility functions, parameter setting, monitor display. Confirm the set value: After changing the parameters, long press this key for more than 1s to confirm the setting value.
②	UP △ key	Increase the setting value.
③	DOWN ▽ key	Decrease the setting value.
④	DATA/SHIFT◁ Key	Display settings: Long press DATA/SHIFT key for about 1s. Displacement: When the digit is blinking, press this key to move the digit one bit to the left.

2.1.2 Mode switch

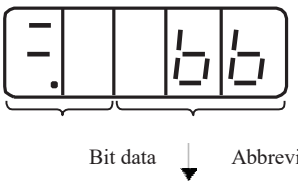
Press the MOD key, and the mode will switch as shown in the following figure.

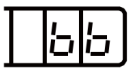
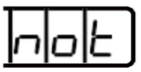
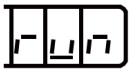
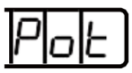
For the usage methods of each mode, please refer to the introduction of relevant content.

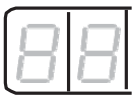
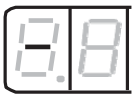
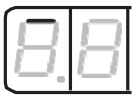
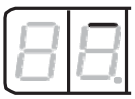
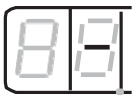
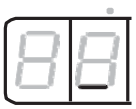
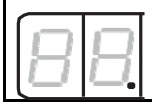


2.1.3 Status display

The discriminant method for the status display is shown below.

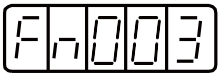


Symbol	Description	Symbol	Description
	**Base locking** Servo OFF state, that is, the motor is not powered on.		**Disable the reverse drive state** N-OT signal input in the positive limit valid state
	**In operation** Servo ON state, that is, the motor powers up.		**Safety function** When the safety function is activated, the servo drive is in the base locking state
	**Disable the forward drive state** P-OT signal input in the positive limit valid state		**Alarm state** Display alarm code

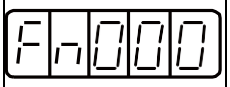
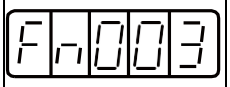
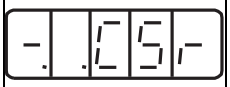
Display	Description
	**Control power ON sign** Display when the control power supply is ON No display when the control power is OFF
	**Base locking sign** Display when the servo is off. Not displayed when the servo is ON
	**Speed consistency (/V-CMP) sign (effective during speed control)** When the difference between the actual speed and the speed reference is within the set value (set through Pn503), it is displayed; when it exceeds the set value, it is not displayed. * Always displayed at torque control. **Positioning completed (/COIN) sign (effective during position control)** When the deviation between the reference position and the actual position of the motor is within the set value (set by Pn522), it is not displayed when it is beyond the set value
	**Rotation detection (/TGON) sign** When the speed of the servo motor is higher than the set value (set by Pn502), it is displayed; when it is lower than the set value, it is not displayed.
	**Speed reference input sign (valid for speed control)** When the input speed reference is larger than the set value (set by Pn502), it is displayed; when it is lower than the set value, it is not displayed. **reference pulse input sign (valid for position control)** Display when there is a reference pulse input. Not displayed when there is no clear signal input.
	**torque reference input sign (valid for torque control)** When the input torque reference is larger than the set value (10% of rated torque), it is displayed; when it is lower than the set value, it is not displayed. **Clear signal input sign (valid for position control)** Display when there is a clear signal input. Not displayed when there is no clear signal input.
	**Power ready sign** Display when the main circuit power supply is ON. Not displayed when the main circuit power supply is OFF.

2.2 Description of utility function (Fnxxx)

Utility functions are used to perform functions related to the servo drive setting and adjustment. Display as a number starting with Fn on the panel operator.



The following uses origin search (Fn003) as an example to explain the operation of the utility function.

Steps	Panel display	Key	Operating reference
1			Press the MOD key to switch to the utility function menu.
2			Press UP or DOWN key and switch to "Fn003".
3			Press (DATA/SHIFT) key about 1s and the panel is displayed on the left.
4			Press MOD key and servo ON, and the panel is displayed on the left.
5			Press the UP key, and the motor turns forward. Press the DOWN key, and the motor reverses. The rotation direction of the motor can be changed by modifying the parameter values of Pn000.0.
6	 (Flashing display)		When the origin search is complete, it will turn into a flashing display. The motor will also enter the servo-locked state at the origin pulse position.
7			Press the (DATA/SHIFT) key for about 1 second to return to "Fn003".
8	After the origin search ends, please turn off and restart.		

2.3 Parameter setting description (Pnxxx)

The following content is used to explain the parameter classification and parameter setting method.

2.3.1 Parameter classification

The parameters of M1 series servo drive are divided into two categories: one is the setting parameters required for servo operation and basic settings, and the other is the adjustable parameters used to adjust servo performance.

Type	Description	Setting method
Setting	Parameters required for the basic setting	Set the parameters separately
Adjustable	Adjustable parameters for adjusting performance	In principle, users do not need to set it up.

2.3.2 Parameter setting method

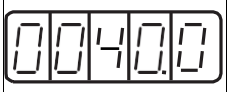
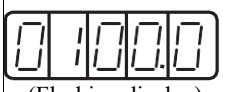
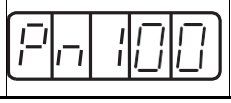
(1) Setting method of "numerical setting"

The following describes the setting method of "numerical setting".

The method for setting the numerical values

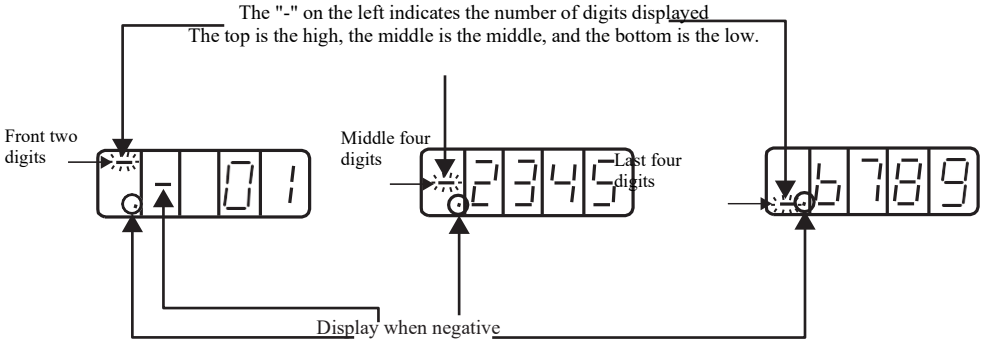
■ Set when the range is within 5 bits

Taking adjusting the speed loop gain as an example, the speed loop gain is adjusted from 40.0 to 100.0.

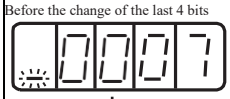
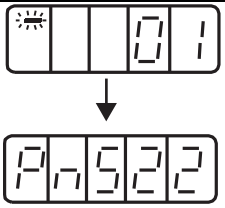
Steps	Panel display	Key	Operating reference
1			Press the MOD key to switch to Pn000 (parameter setting mode). Press UP or DOWN key and switch to Pn100.
2			Press the DATA/SHIFT key for about 1 second, and the panel will display the current value of Pn100.
3			Press the DATA/SHIFT key to move the flashing digits left and right, causing 4 to flash.
4			Press the UP key 6 times and the setting value becomes 100.0.
5	 (Flashing display)		Press the MOD key, the numerical value will flash and the parameter setting will be successful.
6			Press the DATA/SHIFT key for about 1 second, and return to the display of Pn100.

■When the setting range is more than 6 bits,

the panel can only display 5 digits. The setting method of above 6 bits is as follows.



Taking the setting of Pn522 (positioning completion width) as an example, the setting method for setting Pn522 to 0123456789 is as follows.

Steps	Panel display	Key	Operating reference
1			Press the MOD key to switch to Pn000 (parameter setting mode). Press DATA/SHIFT key, UP or DOWN key to Pn522.
2	Before the change of the last 4 bits  After the change of the last 4 bits 		Press the DATA/SHIFT key for about 1 second to display the last 4 digits of the current value of Pn522. Press the DATA/SHIFT key to shift and set the numerical values for each digit.
3	Before the change of middle four digits  After the change of middle four digits 		Press the DATA/SHIFT key to display the middle 4 digits of the current value of Pn522. Press the DATA/SHIFT key to shift and set the numerical values for each digit.
4	Before the change of front two digits  After the change of front two digits 		Press the DATA/SHIFT key to display the first two digits. Press the DATA/SHIFT key to shift and set the numerical values for each digit. Set Pn522 to 0123456789 successfully.
5			Press the mod key, and the current value is written to the drive. When writing parameters, the display of the first two digits will flash. After completing the parameter writing, press the DATA/SHIFT key for about 1 second and return to the display of Pn522.

< Supplement >

About the negative number (-) setting

· When setting negative numbers in the parameters that can be set to negative numbers (-), start with "0000000000" and press the DOWN key to set as negative numbers.

· When the number is negative, press the DOWN key to increase the value, and press the UP key to decrease the value.

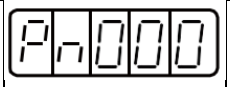
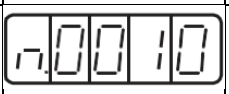
· Press the DATA/SHIFT key to move the digit.

· When the first two digits are displayed, a - (negative sign) will be displayed. ·

(2) Setting method of function selection type

The function selection type selects from the functions assigned to each digit of the panel operator display number, in order to set various functions.

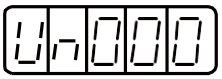
The following is an introduction to the setting method for changing the control mode (Pn000.1) of the basic switch 0 (Pn000) for function selection from speed control to position control.

Steps	Panel display	Key	Operating reference
1			Press the MOD key to switch to Pn000 (parameter setting mode).
2			Press the DATA/SHIFT key for about 1 second, and the panel will display the current value of Pn000.
3			Press the DATA/SHIFT key to move the blinking digit one bit to the left
4			Press the UP key and the current value becomes n.0010.
5	 (Flashing display)		Press MOD key and the value display will blink (indicating successful operation).
6			Press the DATA/SHIFT key for about 1 second, and return to the display of Pn000.
7	After modifying the parameters, power off the driver and restart it.		

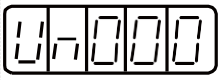
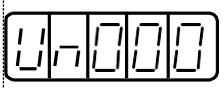
2.4 Status monitoring (Unxxx)

State monitoring is the monitoring of the internal information of the servo unit, including the set reference value, the input and output signal, and the internal state of the servo drive.

A number starting with Un is displayed on the panel.



The following takes monitoring Un000(motor speed) as an example to explain the operation method.

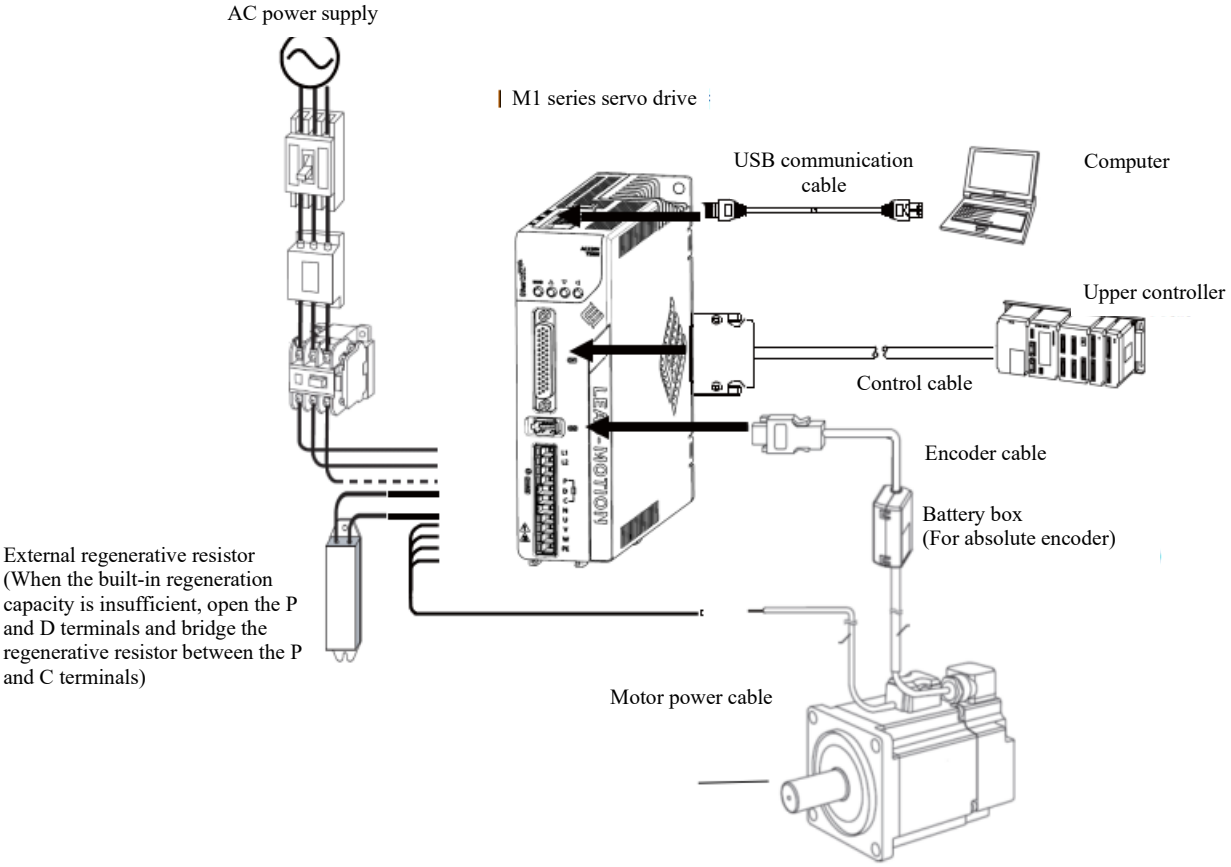
Steps	Panel display	Key	Operating reference
1			Press the MODE/SET key to select the monitor display.
2			Press the MOD key to switch to Un000 (status monitoring mode).
3			Press the DATA/SHIFT key for about 1S to display the actual motor speed.
4			Press the DATA/SHIFT key again for about 1S to return a display of Pn000.

03 Chapter III

Servo System Composition and Wiring

3.1 Servo system composition

The typical servo system composition is shown below.



3.2 Wiring of the main circuit

The main circuit wiring terminals are described as follows.

The precautions for wiring are also described.

3.2.1 Main circuit terminal

Terminal	Name	Model M1-□□□□	Specification
L1, L2	Control/main circuit Power input terminal	01B□,02B□, 04B□, 08B□	Single-phase 200 ~ 230V, +20% ~ -20% (50/60Hz)
L1, L2, L3		10B□,15B□	Three-phase 200 ~ 230V, +20% ~ -20% (50/60Hz)
R, S, T	main circuit power supply Input terminal	20B□, 30B□	Three-phase 200 ~ 230V, +20% ~ -20% (50/60Hz)
		20C□,30C□, 45C□, 55C□, 75C□	Three-phase 380 ~ 480V, +20% ~ -20% (50/60Hz)
L1C, L2C	Control power input terminal	20B□, 30B□	Single-phase 200 ~ 230V, +20% ~ -20% (50/60Hz)
		20C□,30C□, 45C□, 55C□, 75C□	Single-phase 380 ~ 480V, +20% ~ -20% (50/60Hz)
P, D, C	Forward-side terminal of the main circuit, external regenerative resistor connection terminal	01B□,02B□, 04B□	No internal regenerative resistor When regenerative processing capacity is insufficient, an external regenerative resistor is connected between P and C
		08B□, 10B□, 15B□ 20B□, 30B□, 20C□, 30C□ 45C□, 55C□, 75C□	With internal regenerative resistor When the regeneration processing capacity is insufficient, remove the short circuit or connector between P and D, and connect an external regenerative resistor between P and C.
N	Negative-side terminal of the main circuit	□□□□	Use with DC power supply.
U, V, W	Servo motor connection terminal	Used to connect servo motors.	
⏚	Ground terminal (2)	Driver Ground terminal and motor Ground terminal	

3.2.2 Recommended cable for the main circuit

The following types of main circuit cables are required.

Cable type		Conductor allowable temperature (℃)
Symbol	**Name**	
PVC	General PVC cable	**-**
IV	600V PVC insulated cable	**60**
HIV	600V Type II PVC insulated cable	**75**

For the relationship between the cable diameter and the allowable current, refer to the value in the table below, and do not exceed the value in the table when using.

AWG	**mm²**	Allowable currents at different ambient temperatures (A)		
		30 ℃	40 ℃	50℃
20	**0.519**	**8**	**7**	**6**
19	**0.653**	**9**	**8**	**7**
18	**0.823**	**13**	**11**	**9**
16	**1.31**	**18**	**15**	**12**
14	**2.08**	**26**	**23**	**20**
12	**3.31**	**32**	**28**	**26**
10	**5.26**	**48**	**43**	**38**
8	**8.37**	**70**	**65**	**55**
6	**13.3**	**95**	**85**	**75**

The data in the above table are the reference value of the 600V type II PVC insulated wire.

3.2.3 Cable used for the servo drive main circuit

The cable requirements for the main circuit of the servo drive are as follows:

■ Single-phase 220V

Terminal	Name	Wire diameter mm² (AWG)					
		Driver model M1-□□B					
		01	02	04	08	10	15
L1, L2	Input terminal of control/ main circuit power supply	**1.25(AWG16)**		**2.0(AWG14)**			**3.5(AWG12)**
U, V, W	Motor connection terminal	**1.25(AWG16)**			**2.0(AWG14)**		
P, C	External regenerative resistor connection terminal	**1.25(AWG16)**					
⏚	Ground terminal	**Above 2.0(AWG14)**					

■ Three-phase 220V

Terminal	Name	Wire diameter mm² (AWG)			
		Driver model M1-□□B			
		10	**15**	**20**	**30**
L1, L2, L3	Input terminal of control/ main circuit power supply	2.0(AWG14)		/	
R, S, T	Input terminal of main circuit power supply	/		3.5(AWG12)	
L1C, L2C	Control power input terminal	/		1.25(AWG16)	
P, C	External regenerative resistor connection terminal	1.25(AWG16)		2.0(AWG14)	3.5(AWG12)
U, V, W	Motor connection terminal	2.0(AWG14)		3.5(AWG12)	5.5(AWG10)
⏚	Ground terminal	Above 2.0(AWG14)			

■ Three-phase 380V

Terminal	Name	Wire diameter mm²(AWG)				
		Driver model M1-□□C□				
		20	30	45	55	75
R, S, T	Input terminal of main circuit power supply	2.0(AWG14)		3.5(AWG12)		5.5(AWG10)
L1C, L2C	Control power input terminal	1.25(AWG16)				
P, C	External regenerative resistor connection terminal	1.25 (AWG16)		2.0 (AWG14)	3.5 (AWG12)	
U, V, W	Motor connection terminal	2.0 (AWG14)		3.5 (AWG12)	5.5 (AWG10)	
⏚	Ground terminal	Above 2.0(AWG14)				

Important notes are as follows:

·The main circuit should use voltage resistant cables above **600V**.

· When the wiring harness is bundled and placed in a hard PVC or metal conduit, the allowable current attenuation rate of the wire needs to be considered.

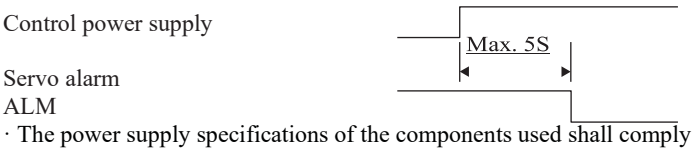
·When the ambient temperature of the cable is too high, use heat-resistant wires as required.

3.2.4 Examples of the main circuit wiring

Regarding the design of the power connection, the following points need to be considered.

·Design for power connection: When there is a servo alarm signal output, the main circuit power supply should be in the OFF state

·After the control power is turned on, the servo alarm signal will be output for a maximum of 5 seconds. The design of the power connection sequence should consider this point, by disconnecting the main circuit power supply connected to the servo drive through a relay.



· The power supply specifications of the components used shall comply with the input power supply.

Important notes are as follows:

· When connecting the control power supply and the main circuit power supply, connect them simultaneously or first connect the control power supply before connecting the main circuit power supply. When the power is disconnected,

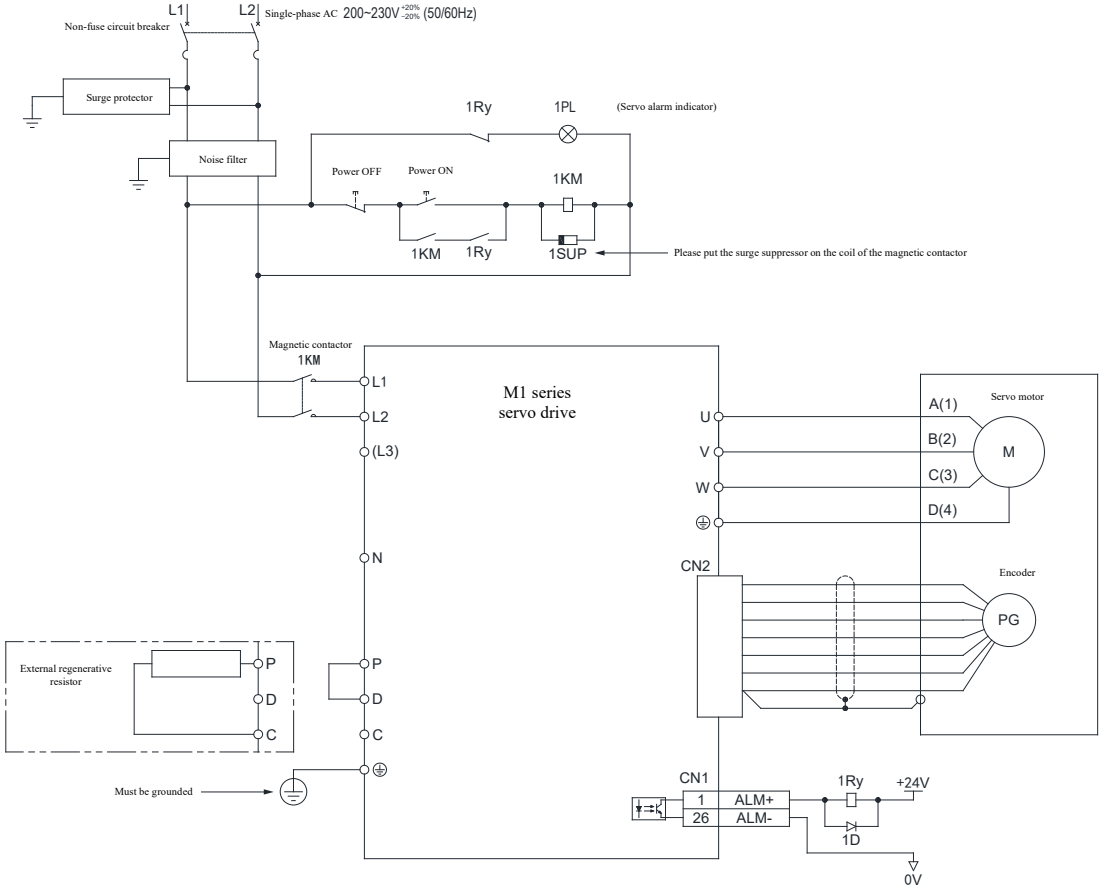
Disconnect the main circuit power supply and then the control power supply.

· After the main power is turned off, there may be residual high voltage inside the servo drive, which poses a risk of electric shock. Do not touch the power terminal. After the driver is discharged, the CHARGE indicator will turn off. It is necessary to connect and check again after the CHARGE indicator is off.

The wiring example of the main circuit is as follows:

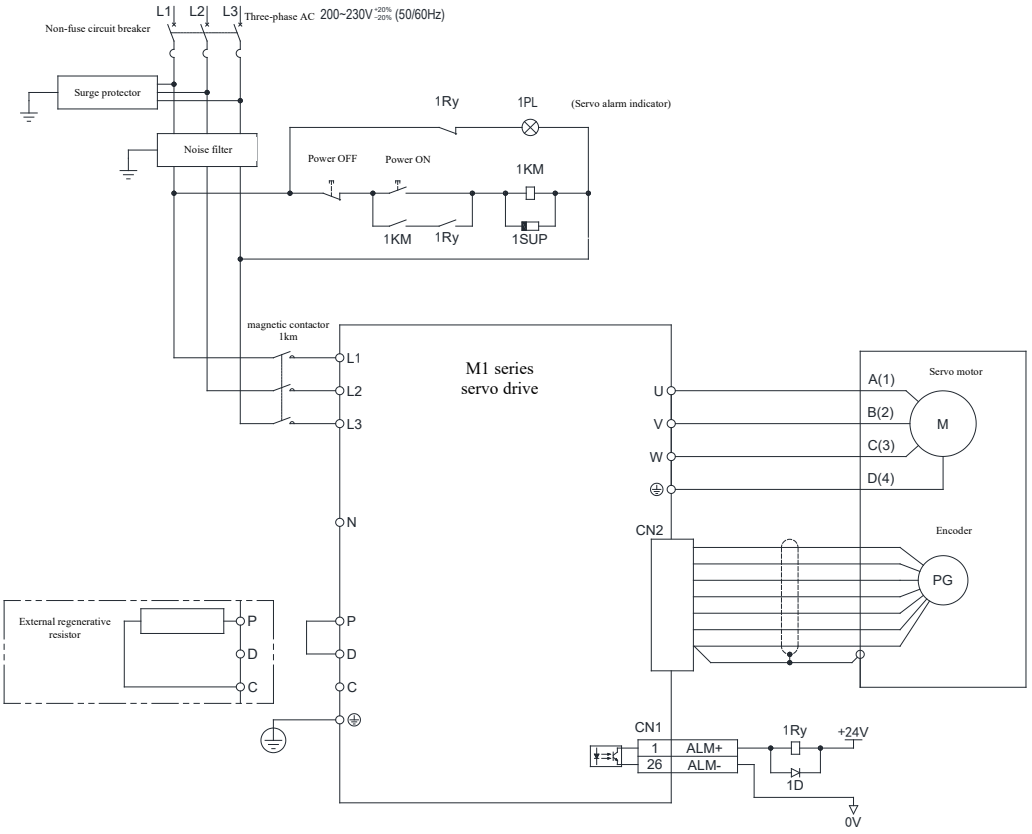
■ Connect to single-phase 220V

·M1-01B,M1-02B, M1-04B, M1-08B, M1-10B, M1-15B

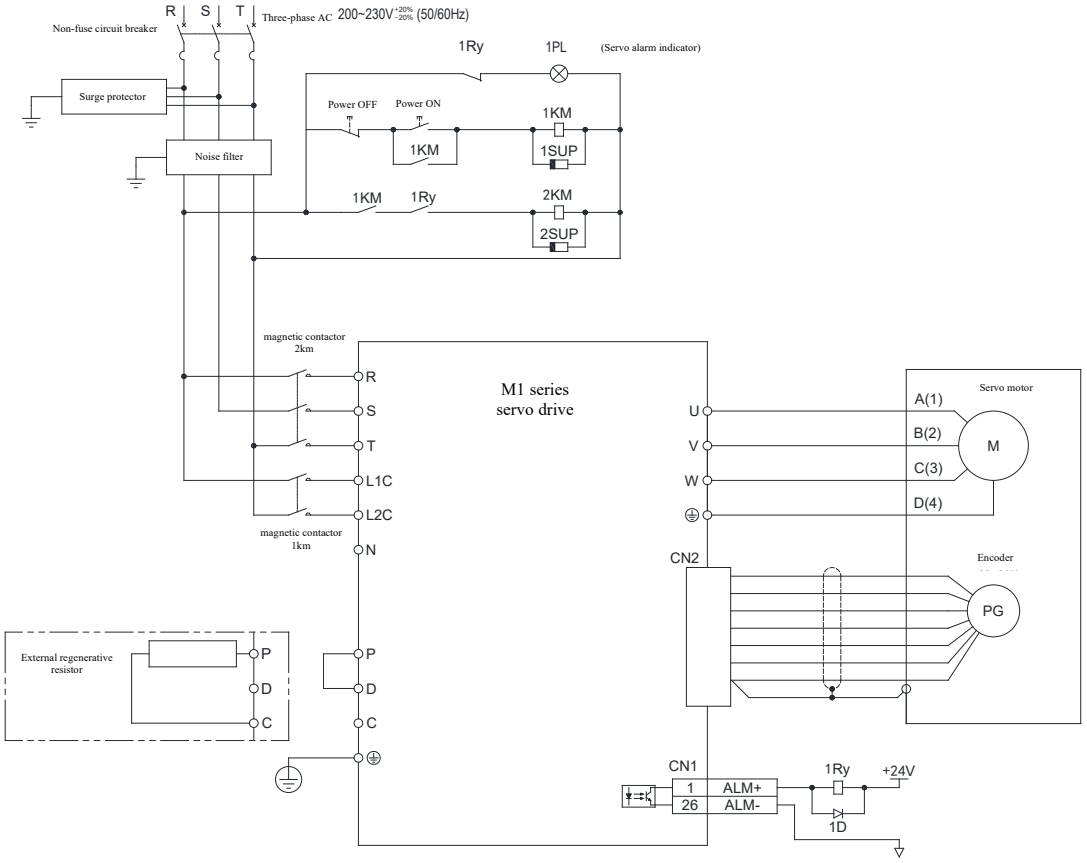


■ Connect to three-phase 220V

·M1-10B, M1-15B

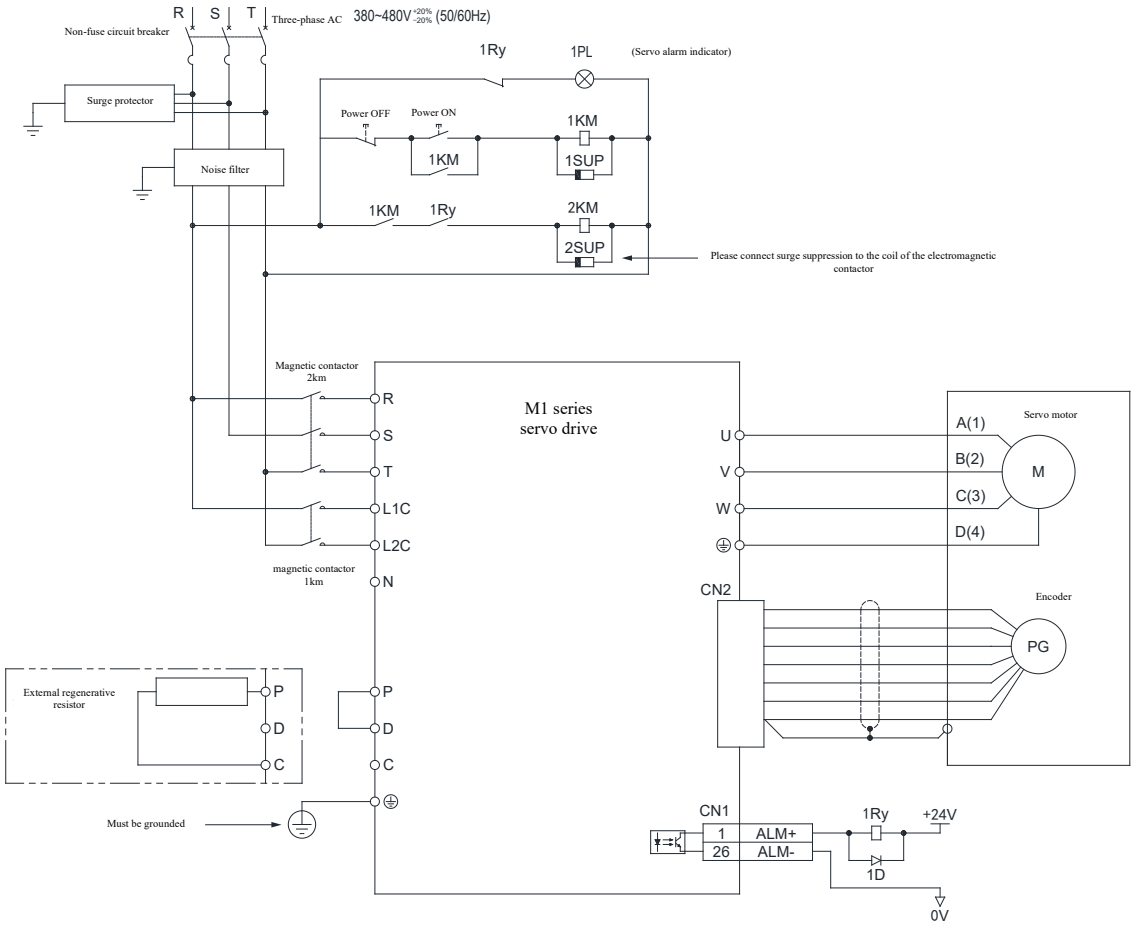


·M1-20B, M1-30B



■ Connect to three-phase 380V

·M1-20C, M1-30C, M1-45C, M1-55C, M1-75C



3.2.5 Power supply capacity

The power supply capacity of the servo drive is shown below.

main circuit power supply	Maximum applicable motor capacity [kW]	servo drive model M1-	Power capacity of servo drive [kVA]
Single-phase 220V	**0.1**	**01B□**	**0.3**
	0.2	**02B□**	**0.6**
	0.4	**04B□**	**1.2**
	0.75	**08B□**	**1.9**
	1.0	**10B□**	**2.8**
	1.5	**15B□**	**4.0**
Three-phase 220V	**1.0**	**10B□**	**2.3**
	1.5	**15B□**	**3.2**
	2.0	**20B□**	**4.0**
	3.0	**30B□**	**6.0**
Three-phase 380V	**2.0**	**20C□**	**6.2**
	3.0	**30C□**	**7.1**
	4.5	**45C□**	**11.7**
	5.5	**55C□**	**12.4**
	7.5	**75C□**	**14.4**

3.2.6 Precautions for wiring

Precautions for wiring are as follows:

- Encoder cables and IO signal cables should use twisted pair wires or multi-core twisted pair shielded wires.
- The length of IO signal cable should not exceed 3m, and the length of servo motor main circuit cable and encoder cable should not exceed 30m.
- When wiring, install the circuit breaker or the fuse for protection.
- To prevent mixed contact accidents between the servo system and the outside world, please install circuit breakers or fuses.
- In order to use servo drive safely, install a leakage protector that combines overload and short circuit protection.
- Do not frequently turn on/off the power supply, or it may cause aging of internal components in the driver. Do not use the driver in situations where the power supply is frequently turned on/off.

Precautions for grounding cables are as follows:

- The grounding cable should use the thick wire (above 2.0mm^2).
- The grounding resistance of the Ground terminal for servo drives powered by 220V power supply should be below 100 Ω.
- The grounding resistance of the Ground terminal for servo drives powered by 380V power supply should be below 10 Ω Single-point grounding is required.
- When the servo motor is insulated from the machinery, the servo motor needs to be grounded directly and separately.

3.3 Connection of the input/output signals

The input and output signal terminals (CN1) are described as follows.

Examples of wiring for different control modes are described below.

3.2.1 Name and function of the input/output signals (CN1)

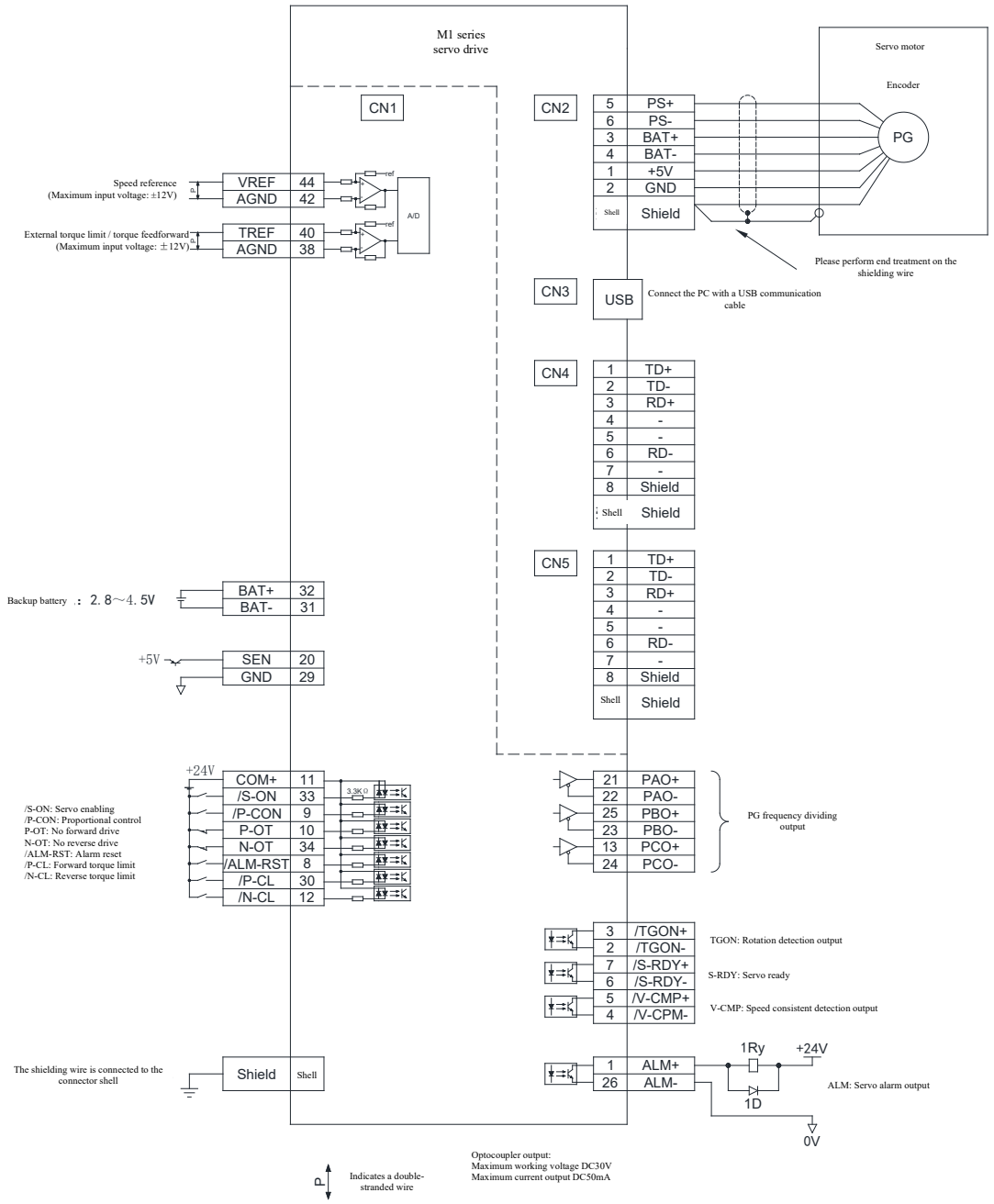
(1) Input signal

Control mode	Signal name	Pin number	Function description	
General	**/S-ON**	**33**	Control servo motor ON/OFF	
	/P-CON	**9**	P-action reference	When the signal is ON, the speed control loop switches from PI (proportional, integral) control to P (proportional) control.
			Rotation direction reference	Switch the rotation direction of the motor when selecting the internal set speed control.
			Control mode switching	Switch the control mode in the form of position-speed, position-torque and torque-speed.
			Speed control with zero clamping	When selecting speed control with zero clamping, the speed reference will be considered as zero when the signal is ON.
			Position control with the reference pulse suppression function	When the position control with reference pulse suppression function is selected, the input of reference pulses will be inhibited when the signal is ON.
	P-OT N-OT	**10** **34**	No forward drive, no reverse drive	When the mechanical movement exceeds the movable range, stop the drive of the servo motor (overtravel prevention function).
	/ALM-RST	**8**	Alarm clearing	
	/P-CL **/N-CL**	**30** **12**	External torque limit on the forward side External torque limit on the reverse side	Valid / invalid switching of the external torque limit function.
			Internal speed switching	When selecting the internal set speed control, switch to the internal set speed.
	COM+	**11**	The I/O signal power supply needs to be provided by the user with a DC power supply. Operating voltage range: +11VDC ~ +25VDC	
	SEN **GND**	**20** **29**	Enter a signal that requires initial data when using an absolute encoder.	
	BAT+ **BAT-**	**32** **31**	Backup battery connector pins for the absolute encoder. (Note) Do not connect encoder cables with battery cells.	
	/SPD-D **/SPD-A** **/SPD-B** **/C-SEL** **/ZCLAMP** **/INHIBIT** **/G-SEL** **/PSEL** **/FSTP**	**Assignable signal**	Changeable /S-ON, /P-CON, P-OT, N-OT, /P-CL, /N-CL, /ALM-RST input signal Assign functions	
Speed	**V-REF** **AGND**	**44** **42**	Input speed reference Maximum input voltage: ± 12V	
Position	**PULS** **/PULS SIGN** **/SIGN**	**41** **43** **37** **39**	Set any of the following input pulse patterns. · Symbol + pulse trains · CW+CCW pulse · 90° phase differential	
	CLR **/CLR**	**16** **18**	Clear position deviation during position control.	
	PPI-P	**35**	Power input for collector open circuit reference (using signals from pins 35 and 43)	
	PPI-S	**36**	Power input for collector open circuit reference (using signals from pins 36 and 39)	
	V-CLR	**19**	Power input for collector open circuit reference (using signals from pins 16 and 18)	
Torque	**T-REF** **AGND**	**40** **38**	Enter the torque reference. Maximum input voltage: ± 12V	

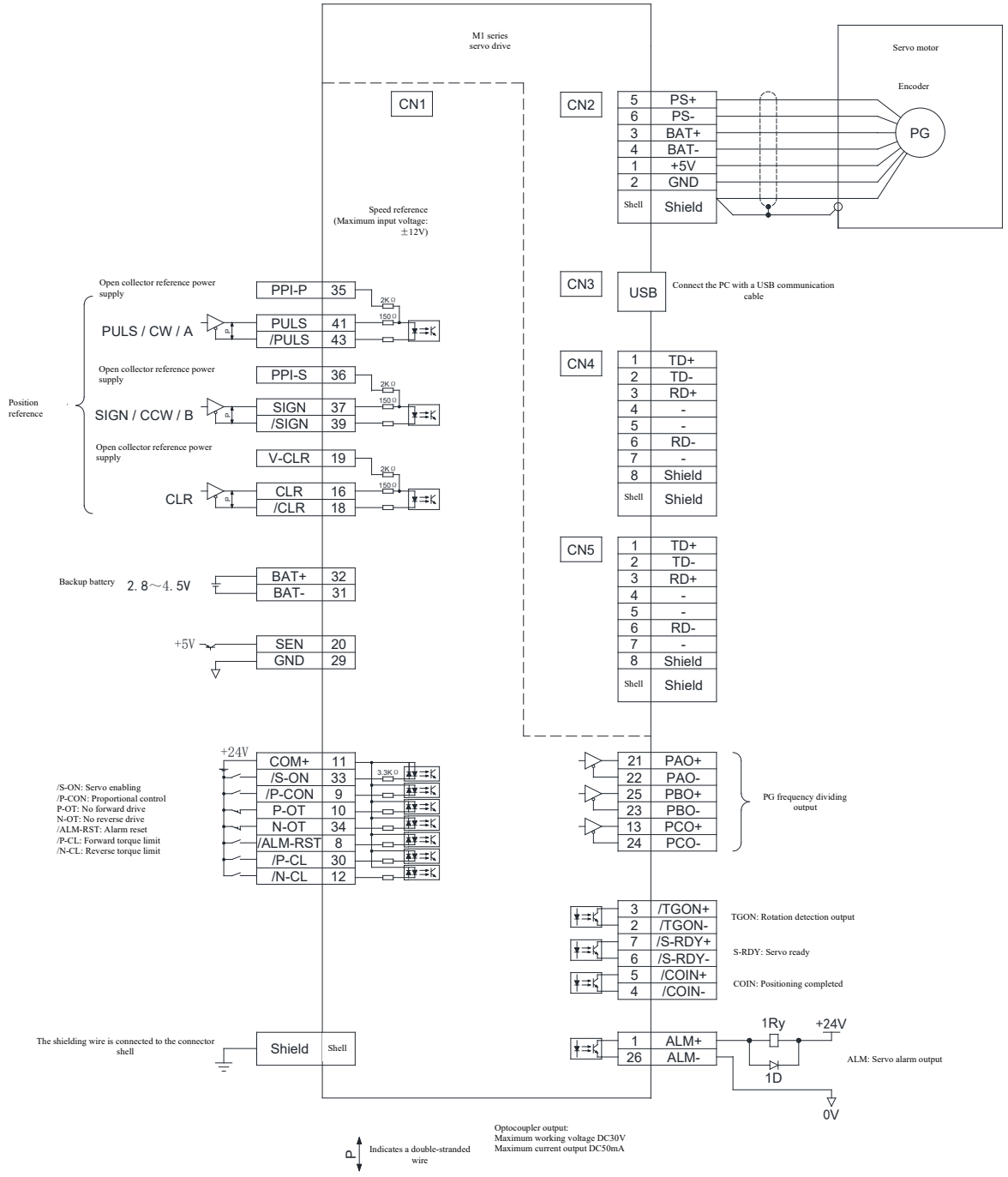
(2) Output signal

Control mode	Signal name	Pin number	Function description	
General	**ALM+ ALM-**	**1 26**	OFF in case of a driver alarm	
	/TGON+ /TGON-	**3 2**	ON when the motor speed is higher than the set value	
	/S-RDY+ /S-RDY-	**7 6**	ON in the condition that the servo ON (/S-ON) signal can be received	
	PAO /PAO	**21 22**	A-phase signal	Encoder divided pulse output signal with a 90 degree phase differential.
	PBO /PBO	**25 23**	B-phase signal	
	PCO /PCO	**13 24**	C-phase signal	Origin pulse output signal
	/CLT /VLT /BK /WARN /NEAR /PSELA	**Assignable signal**	Changeable /TGON, /S-RDY, /V-CMP (/COIN) output signal allocations	
	+24V COM-	**17 14**	Internal 24VDC output power supply and ground	
	FG	**Shell**	If the shielding layer of the input and output signals is connected to the connector housing using a cable, it means that the frame grounding has been carried out.	
Speed	**/V-CMP+ /V-CMP-**	**5 4**	When controlling the speed, the motor speed is ON when it is within the set range and consistent with the speed reference value.	
Position	**/COIN+ /COIN-**	**5 4**	ON when the position deviation is within the set value during the position control.	

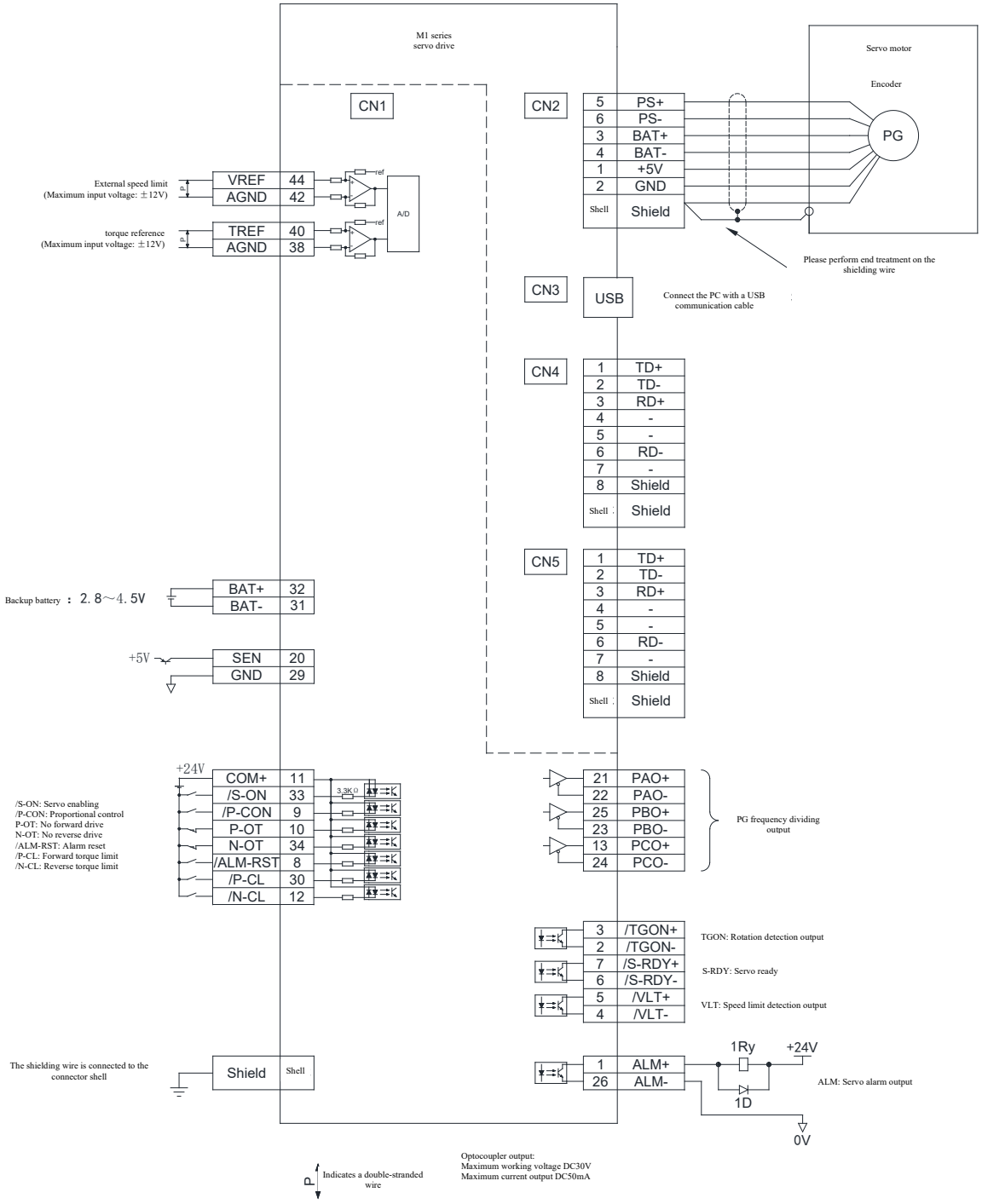
3.3.2 Speed control wiring diagram



3.3.3 Position control wiring diagram



3.3.4 Torque control wiring diagram



3.4 Input / output signal allocations

3.4.1 Input signal allocations

The input signal can be used directly in the factory set state or after arbitrary allocation.

(1) Use as default Settings

The allocations of signals in the factory state is shown in the table below. The ▭ section in the table is the default setting.

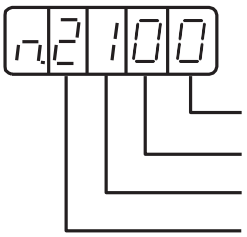
Different control methods result in different factory settings for each signal, as shown in the table below.

Control mode can be switched by setting Pn000.1.

Setting of Pn000.1	Control mode selection	CN1 pin number						
		33	9	10	34	8	30	12
0	Speed Control	/S-ON	Used as /P-CON	P-OT	N-OT	/ALM-RST	/P-CL	/N-CL
1	Position control							
2	Torque control							
3	internal set speed control		Used as /SPD-D				Used as /SPD-A	Used as /SPD-B
4	internal set speed control ⇔ speed control							
5	internal set speed control ⇔ position control							
6	internal set speed control ⇔ torque control							
7	Position control ⇔ speed control		Used as /C-SEL				Used as /P-CL	Used as /N-CL
8	Position control ⇔ torque control							
9	Torque control ⇔ speed control							
A	Speed control ⇔ speed control with zero clamping		Used as /ZCLAMP, used as /INHIBIT					
B	Position control ⇔ position control with reference pulse suppression function							
C	EtherCAT	-	-	-	-	-	-	-

The factory allocation status of the input signal can be confirmed through parameters Pn50A and Pn50B.

Pn50A



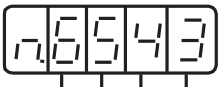
Use the input terminal according to the factory setting status

Distribute /S-ON signal to CN1-33

Distribute /P-CON signal to CN1-9

Distribute P-OT signal to CN1-10

Pn50B



Distribute /N-OT signal to CN1-34

Distribute / ALM-RST signal to CN1-8

Distribute / P-CL signal to CN1-30

Distribute / N-CL signal to CN1-12

(2) Used after changing the allocations of input signals

Important precautions for changing the input signal are as follows:

·After changing the polarity of the factory settings for servo ON, prohibiting forward drive, and prohibiting reverse drive signals, if abnormal situations such as signal line disconnection occur, the main circuit power supply may not be able to be turned off and the overtravel will not operate. Before performing this operation, ensure that there are no security problems.

·When multiple signals are assigned to the same input circuit, it becomes XOR logic, and all the input signals will act. Unexpected movements may occur.

At Pn50A.0 = 1, the input signal can be arbitrarily assigned.

The allocations of input signals is shown in the table below:

Name and setting parameters of input signal	Active level	Input signal	CN1 terminal number							No external connection required (handled inside the servo drive)	
			33	9	10	34	8	30	12	Always valid	Always invalid
Servo ON Setting of 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 action reference Setting of Pn50A.2	L	/P-CON	0	1	2	3	4	5	6	7	8
	H	P-CON	9	A	B	C	D	E	F		
Forbid forward drive Setting of Pn50A.3	H	P-OT	0	1	2	3	4	5	6	7	8
	L	/P-OT	9	A	B	C	D	E	F		
Forbid reverse drive Setting of 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 Setting of Pn50B.1	L	/ARM-RST	0	1	2	3	4	5	6	□	8
	H	ARM-RST	9	A	B	C	D	E	F		
External torque limit on the forward side Setting of Pn50B.2	L	/P-CL	0	1	2	3	4	5	6	7	8
	H	P-CL	9	A	B	C	D	E	F		
External torque limit on the reverse side Setting of Pn50B.3	L	/N-CL	0	1	2	3	4	5	6	7	8
	H	N-CL	9	A	B	C	D	E	F		
Motor rotation direction switching Setting of 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 Setting of 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 Setting of 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 mode selection Setting of 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 fixation Setting of Pn50D.0	L	/ZCLAMP	0	1	2	3	4	5	6	7	8
	H	ZCLAMP	9	A	B	C	D	E	F		
Reference pulse suppression Setting of Pn50D.1	L	/INHIBIT	0	1	2	3	4	5	6	7	8
	H	INHIBIT	9	A	B	C	D	E	F		
Gain switching Setting of 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 magnification switching Setting of Pn515.1	L	/PSEL	0	1	2	3	4	5	6	7	8
	H	PSEL	9	A	B	C	D	E	F		
reference pulse input magnification switching Setting of Pn515.2	L	/FSTP	0	1	2	3	4	5	6	7	8
	H	FSTP	9	A	B	C	D	E	F		

(3) Confirm input signal

The status of the input signal can be confirmed by monitoring Un005.

3.4.2 Output signal allocations

The allocations of the output signal can be confirmed by Pn50E, Pn50F, Pn510, and Pn512.

(1) Confirm the allocations status at delivery

The allocations status of the output signal at the delivery is as follows

Pn50E

Distribute / COIN signal to CN1-5 and 4
Distribute / V-CMP signal to CN1-5 and 4
Distribute / TGON signal to CN1-3 and 2
Distribute / S-RDY signal to CN1-7 and 6

Pn50F

Disable / CLT signal
Disable / VLT signal
Disable / BK signal
Disable / WARN signal

Pn510

Disable / NEAR signal
Reserved parameters (cannot be changed)
Disable / PSELA signal
Reserved parameters (cannot be changed)

Pn512

Reverse CN1-5 and 4 output signal
Reverse CN1-3 and 2 output signal
Reverse CN1-7 and 6 output signal
Reserved parameters (cannot be changed)

(2) Used after changing the allocations of output signals

Important precautions for changing the output signal are as follows:

·The signal without the detected output is in an invalid state. For example, at the speed control, the positioning completed (/COIN) signal is invalid.

·If the polarity of the braking signal (/BK) is reversed and used with positive logic, the brake will not operate when the signal line is disconnected.

Before performing this operation, ensure that there are no security problems.

·When multiple signals are assigned on the same output circuit, they are output with XOR logic.

The allocations of output signals is shown in the table below:

Name and parameters of output signal	Output signal	CN1 terminal number			Invalid (disabled)
		5 (4)	3 (2)	7 (6)	
Setting of positioning completed Pn50E.0	/COIN	1	2	3	0
Setting of speed consistency detection Pn50E.1	/V-CMP	1	2	3	0
Setting of rotation detection Pn50E.2	/TGON	1	2	3	0
Setting of servo ready Pn50E.3	/S-RDY	1	2	3	0
Setting of torque limit detection Pn50F.0	/CLT	1	2	3	0
Setting of speed limit detection Pn50F.1	/VLT	1	2	3	0
Setting of controller Pn50F.2	/BK	1	2	3	0
Setting of warning Pn50F.3	/WARN	1	2	3	0
Setting of positioning near Pn510.0	/NEAR	1	2	3	0
Setting of reference pulse input magnification switching Pn510.2	/PSELA	1	2	3	0
Setting of Pn512.0 = 1	Polarity reversal of CN1-5 (4)				Polarity not reversing of 0 factory setting
Setting of Pn512.1 = 1	Polarity reversal of CN1-3 (2)				
Setting of Pn512.2 = 1	Polarity reversal of CN1-7 (6)				

(3) Confirm the output signal status

The status of the output signal can be confirmed by monitoring Un006.

3.5 Description of CN1 terminal interface

3.5.1 Reference input interface

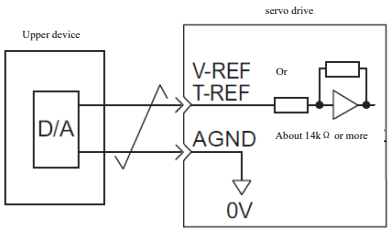
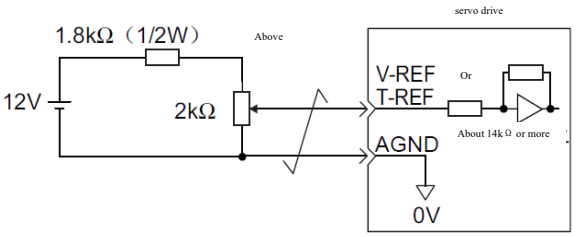
(1) Analog input interface

Speed references and torque references are analog signals.

Explain the speed reference input interface (pin numbers 44-42) and torque reference input interface (pin numbers 40-38). The input impedance is shown as follows:

- **Speed reference input: About 14k Ω**
- **torque reference input: About 14k Ω**

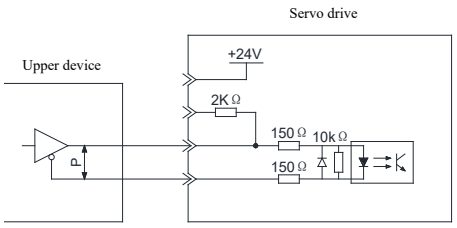
The maximum voltage allowed for analog signals is 12V.

Analog voltage reference input loop (D/A example)	Analog voltage reference input loop	(Wiring example)
		

(2) Position reference input interface

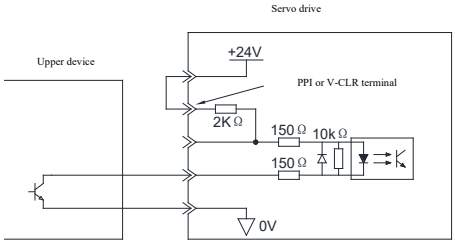
Explain the reference pulse input interface (pin numbers 41-43), reference symbol input interface (pin numbers 37-39), and deviation clearing input (pin numbers 16-18). There are two connection methods for the output circuit of reference pulses and position deviation clearance signals, one is the linear driver output, and the other is the open collector output.

Linear drive output loop

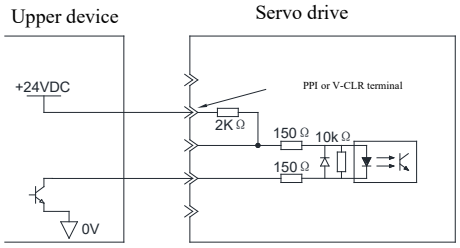


Applicable linear drivers, such as TI AM26LS31 similar products

Open collector output (using the built-in 24V output power supply of the servo drive)



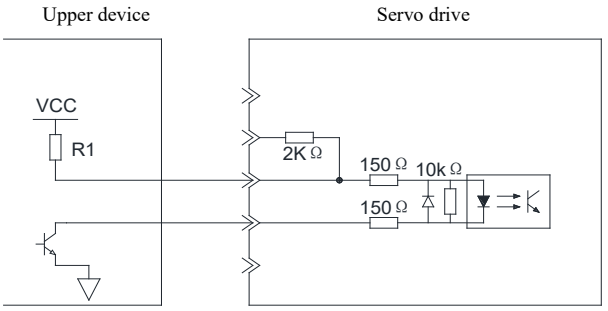
Open collector output (external 24V power supply)



When the upper control device is an open collector output, the following precautions should be taken when using an external power supply:

- The pull-up voltage (Vcc) and pull-up resistance value (R1) should be corresponding to the following table, otherwise, the driver may be damaged.
- Before wiring, please confirm that the specifications of the upper device are within the range shown in the table below. Set the resistance R1 (optocoupler VF: 1.45-1.7V) within the range of input current i=7.5-14mA.
- Generally, the input method of the open collector reference is susceptible to interference. The shielding layer of the control cable connected to CN1 can be grounded on the upper device side (such as a 24V power supply, the shielding layer can be connected to 24V ground), and the shielding layer of the control line can be suspended on the driver side.

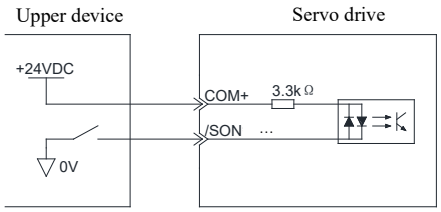
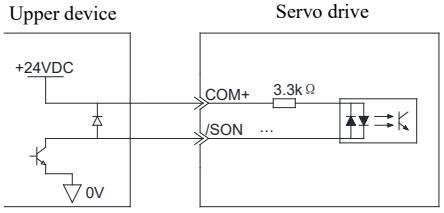
Pull-up voltage (Vcc)	Pull-up resistance value (R1)
24V	1.6k ～ 3.0k Ω
12V	820 ～ 1.2k Ω
5V	240 ～ 470 Ω



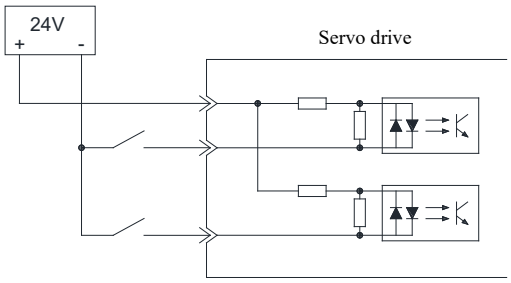
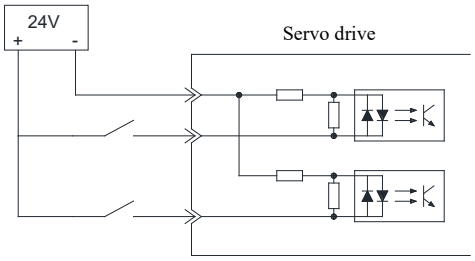
3.5.2 Digital input interface

Below is an explanation of terminals 8, 9, 10, 11, 12, 30, 33, and 34 of the CN1 interface.

The digital input interface can be controlled by connection of relays or transistors with open collector. The relay needs to select a low current relay to prevent poor contact.

Example of the relay circuit	Example of the collector open circuit
	

Note: When the external power supply is (+24VDC), the power current should be larger than 50mA.
Additional note:
The digital input interface uses a bidirectional optical coupling. The leaking circuit connection or source circuit connection can be selected according to the actual use.

Common emitter loop	Source type circuit
	

Polarity of input signal				Polarity of input signal			
Signal	Active level	Power value	Switch	Signal	Active level	Power value	Switch
ON	L level	0V	OFF	ON	H level	24V	OFF
OFF	H level	24V	ON	OFF	L level	0V	ON

3.5.3 Digital output interface

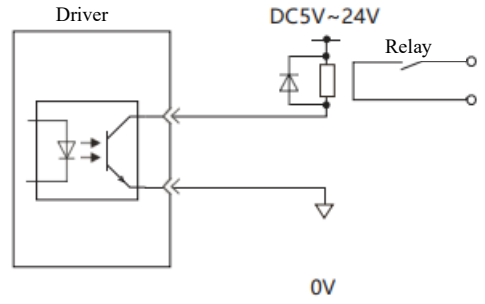
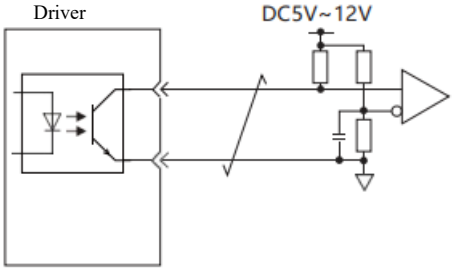
Important notes are as follows:

·If the wiring is incorrect or the input voltage is high, the output port will be short-circuited.

·When the above fault occurs, the brake may not act, leading to mechanical damage or personal accident.

(1) Photoelectric coupler output interface

Servo alarm (ALM), servo ready (/S-RDY), and other output signals belong to the photoelectric coupler output. Connection control may be carried out through the relay loop or line receiver loop.

Example of the relay circuit	Example of linear receiver loop
	

The specifications of the optocoupler output interface are as follows:

- Maximum voltage: DC30V
- Operating current range: DC5mA ~ DC50mA

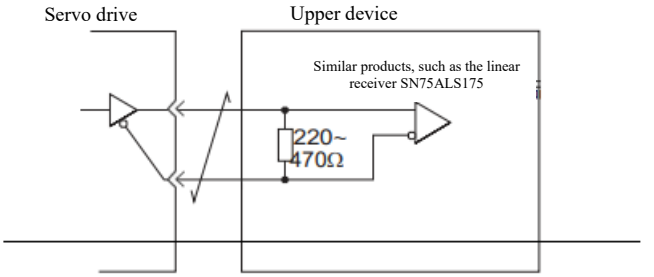
(2) Linear drive output interface

Explain the interfaces of A-phase signal (pin numbers 21-22), B-phase signal (pin numbers 25-23), and C-phase signal (pin numbers 13-24).

Convert the serial data of the encoder into 2-phase (A phase, B phase) pulse output signals (PAO, /PAO, PBO, /PBO) and origin pulse signals (PCO, /PCO).

Output to the upper device through the wire driver output circuit.

Example of linear receiver loop



3.6 Encoder interface specification

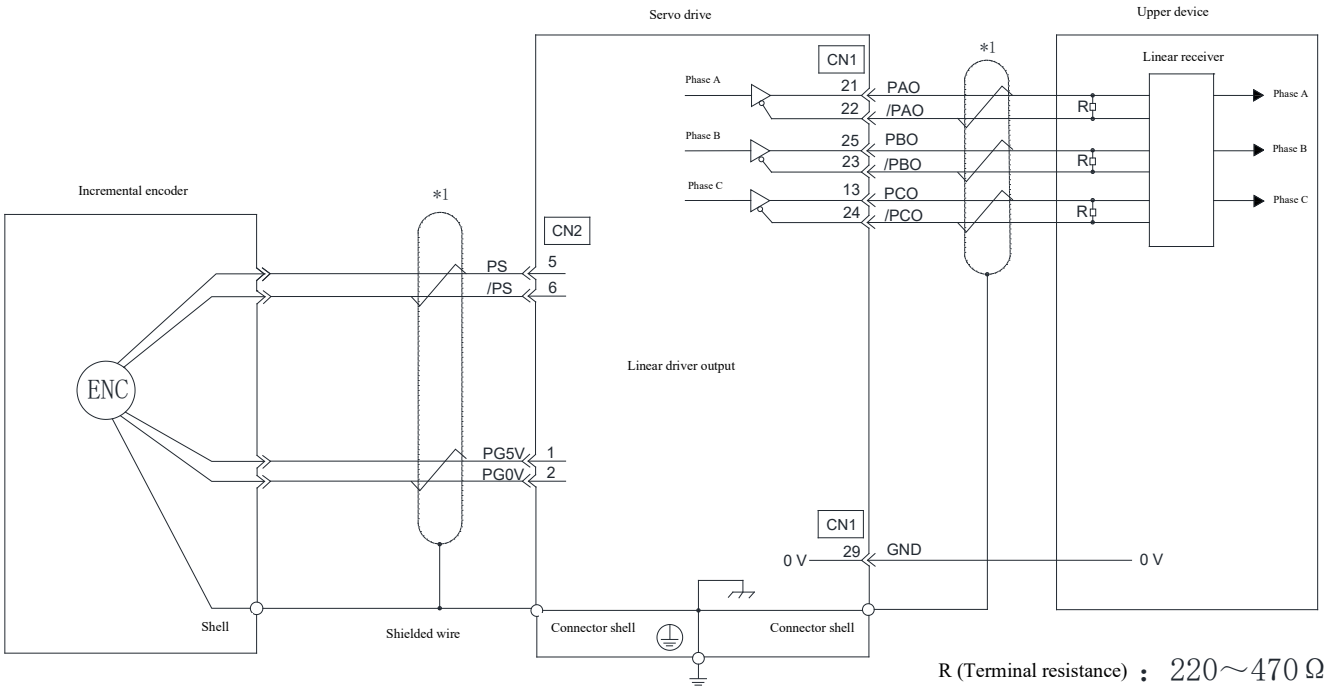
3.6.1 Name and function of encoder interface (CN2)

Name and function of encoder interface (CN2) are shown as below.

Signal name	Pin number	Function description
PG5V	**1**	Encoder power supply +5V
PG0V	**2**	Encoder power supply 0V
BAT (+)	**3**	Battery (+) [No connection if required for an incremental encoder]
BAT (-)	**4**	Battery (-) [No connection if required for an incremental encoder]
PS	**5**	Serial data (+)
/PS	**6**	Serial data (-)
Shielding	Shell	-

3.6.2 Examples of connections for encoder

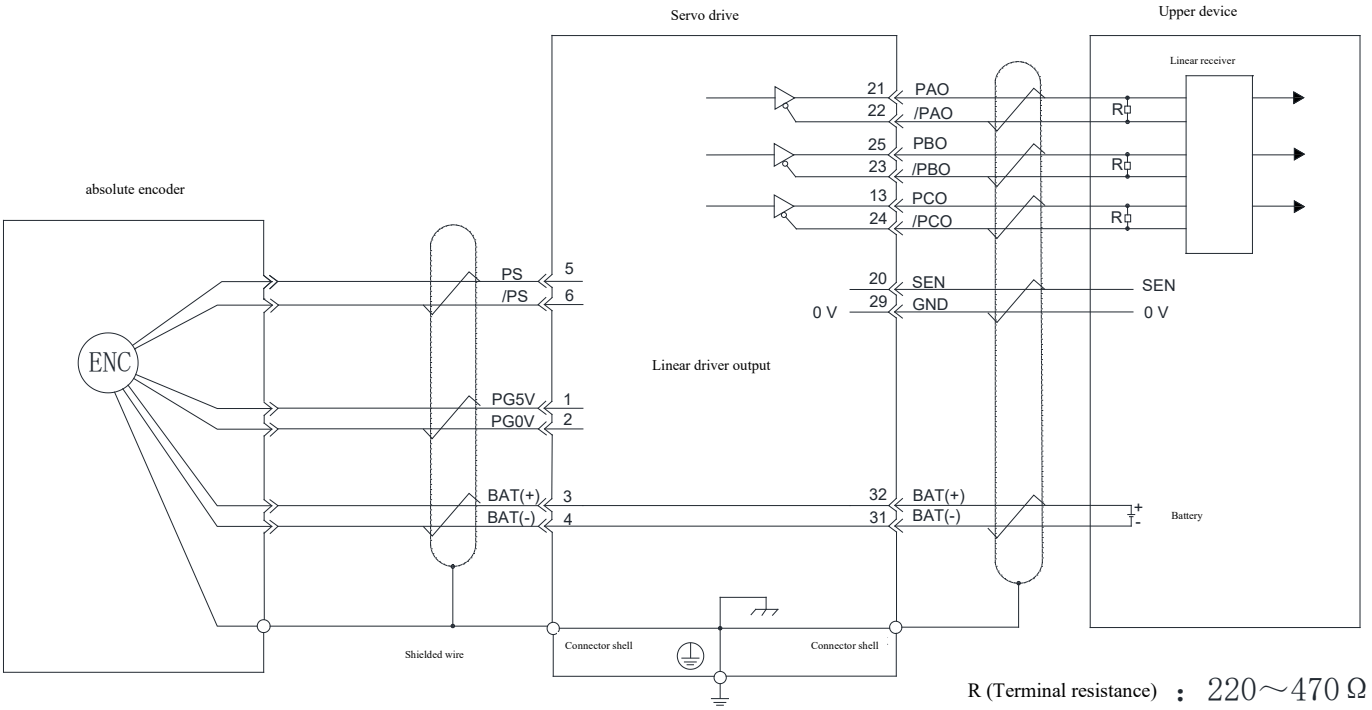
(1) Incremental encoder



R (Terminal resistance) : 220～470 Ω

*1. Indicates a twisted shielded cable.

(2) Absolute encoder



R (Terminal resistance) ： 220～470 Ω

Indicates a twisted shielded cable.

When using the absolute encoder, install the battery on either side of the encoder cable or the upper device side.

3.7 Connection of regenerative resistor

When the regenerative energy is too high and the built-in regenerative resistor is not enough, the following method can be used to connect the external regenerative resistor. The regenerative resistor capacity is set by the parameter Pn600. Please wire the regenerative resistor correctly. Incorrect wiring may cause damage to the regenerative resistor or servo drive, and even cause a fire.

3.7.1 Connection of regenerative resistor

The connection of regenerative resistor is performed as follows.

(1) Model M1-02B and 04B servo drive

No internal regenerative resistor When regenerative processing capacity is insufficient, an external regenerative resistor is connected between P and C

After connection, set the regenerative resistor capacity (Pn 600).

(2) There is an internal regenerative resistor inside M1-08B, 10B, 15B, 20B, 30B, 30C, 45C, 55C and 75C servo drives. When the regeneration processing capacity is insufficient, remove the short circuit or connector between P and D, and connect an external regenerative resistor between P and C. After connection, set the regenerative resistor capacity (Pn 600).

3.7.2 Set the regenerative resistor capacity

When connecting the external regenerative resistor, be sure to set the regenerative resistor capacity through Pn600.

If Pn600=0 is set when an external regenerative resistor is connected, it may cause the regeneration overload alarm (A.320) to not appear.

If the regeneration overload alarm (A.320) cannot occur, the external regenerative resistor may be damaged, leading to personal injury, fire, and other accidents. Therefore, it is necessary to set an appropriate value for Pn600.

Pn600				
Regenerative resistor capacity				Category
Setting range	Setting unit	Factory setting	Effective time	
0 ～Maximum applicable motor capacity for the servo drive	10W	0	With immediate effect	Basic setting

The regenerative resistor capacity is set according to the actual external regenerative resistor value.

The setting value varies according to the cooling condition of the external regenerative resistor.

- When natural cooling: Set to less than 20% of the regenerative resistor capacity (W).
- When forced air cooling: Set to less than 50% of the regenerative resistor capacity (W).

Example: Under natural cooling mode, when the capacity of the external regenerative resistor is 100W, the set value is 100W × 20%=20W, so Pn600=2 (set unit: 10W) should be set.

Important notes are as follows:

·When the setting is inappropriate, a regenerative overload alarm will appear (A.320).

·The factory setting "0" is the setting when using the internal regenerative resistor of servo drive.

·When using an external regenerative resistor at the usual rated load rate, the temperature of the resistor will reach 200 ° C to 300 ° C. Please make sure to lower the rated value before use.

3.8 Noise and higher harmonics treatment methods

The treatment method of noise and higher harmonic is described below.

3.8.1 Noise and its treatment

The main circuit of the servo drive uses high-speed switch components. After the servo drive is processed through peripheral wiring and grounding, the noise of the switch components may affect the peripheral equipment. As the servo drive is industrial equipment, there is no corresponding radio interference protection measure. If the radio interference is to be avoided, the corresponding anti-noise interference measures can be taken.

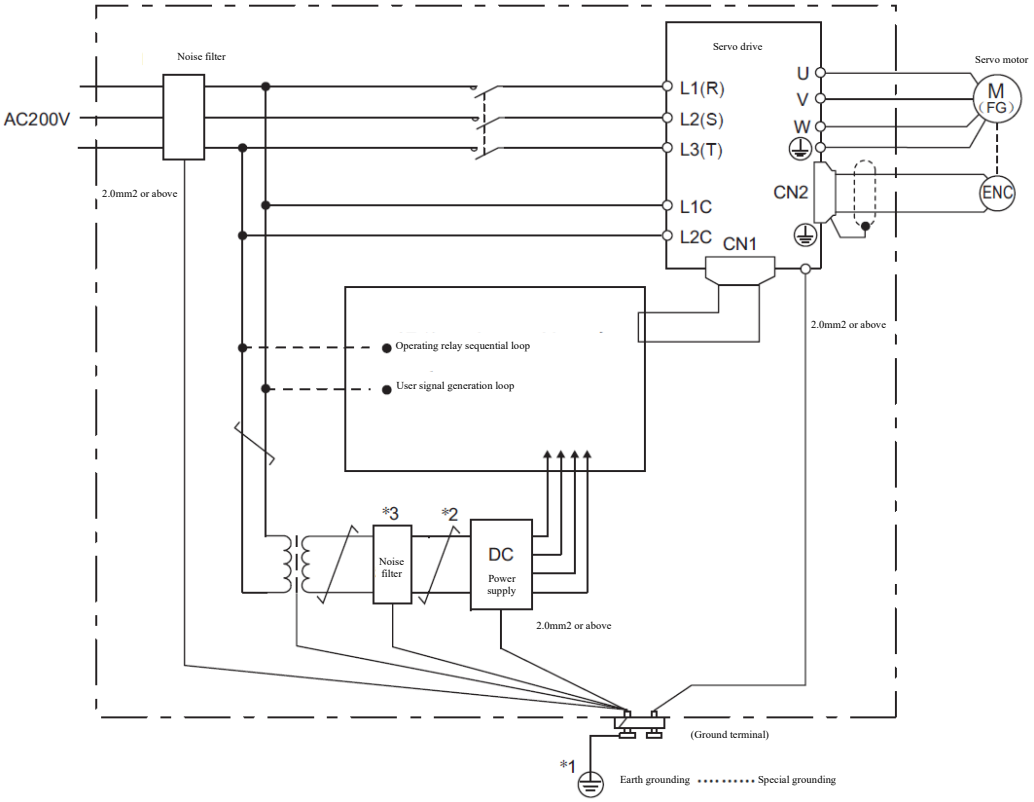
To avoid the mutual noise interference between the servo drive and the peripheral equipment, the following noise interference processing method can be adopted.

- Reference input device and noise filter should be placed near the servo drive.
- The coil of the relay and the magnetic contactor shall be connected to the surge protector.
- The main circuit cables and IO signal cables/encoder cables should not be placed in the same conduit, nor should they be bundled together. The distance between the main circuit cable and the IO signal cable/encoder cable should be maintained at least 30cm.
- It can not be powered with the same power supply as welding machine, spark machine and other equipment. When not powered by the same power source and there are high-frequency devices nearby, noise filters should also be installed on the input side of the main circuit power supply cable and control power cable.
- Ensure proper grounding

(1) Noise filter

The noise filter is installed in the right place to avoid the noise effects on the servo drive.

Examples of noise disposal methods are as follows:



Use a thick ground cable larger than 2.0mm2.

Use twisted shielded cable as much as possible.

Regarding the use of noise filters, please follow the "precautions when connecting noise filters".

(2) Proper grounding treatment

In order to prevent the misaction caused by the noise, the grounding treatment method is described below.

■ Grounding of motor frame

When the servo motor is mechanically grounded, the switching interference current in the main circuit of the servo drive will flow out through the parasitic capacitance of the servo motor. To prevent this from happening, the motor frame terminal (FG) of the servo motor must be connected to the Ground terminal ⏚ of the servo drive. At the same time, the Ground terminal ⏚ must be grounded

■ Noise occurs in the cable for the input and output signal

When there is noise in the input and output signal cable, a single point can grounding the input and output signal with the 0V line (GND) of the cable.

When the main circuit cable of the servo motor is covered with a metal sleeve, the metal sleeve and the ground box must be grounded in a single point.

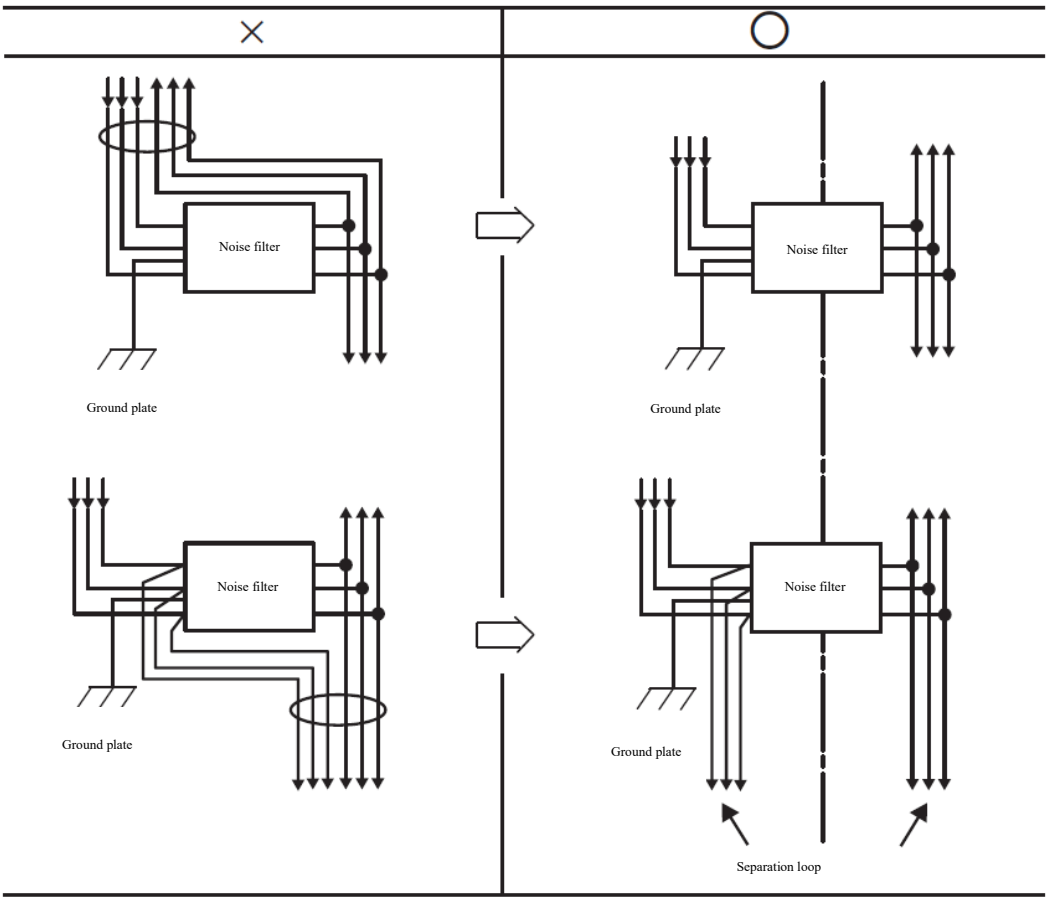
3.7.2 Precautions for connecting noise filters

Precautions for connecting noise filters are shown below.

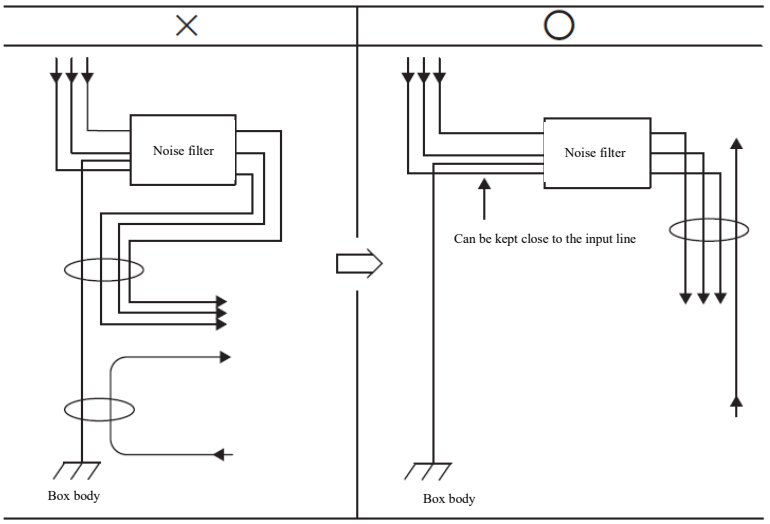
(1) Precautions for the installation and wiring of the noise filter

Please observe the following precautions when installing and wiring noise filters.

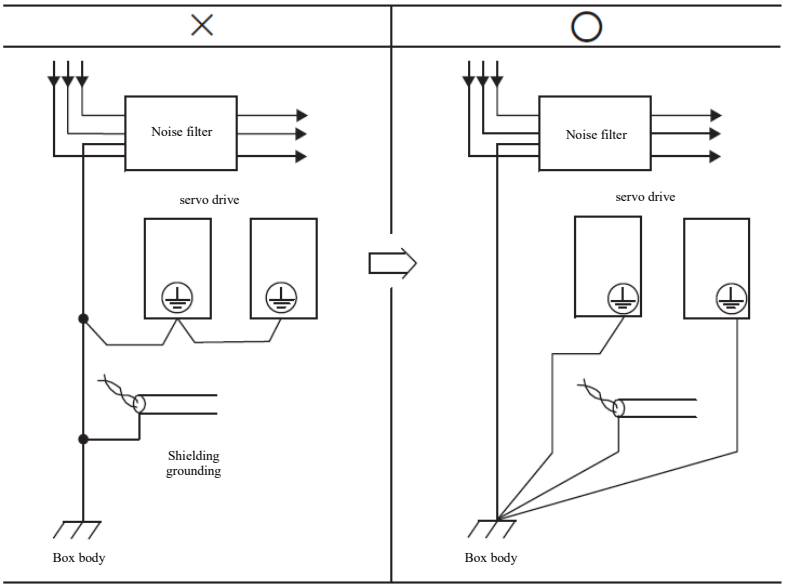
Input and output cables should be separated. Input/output cables cannot be used in the same tube, nor can they be bundled together.



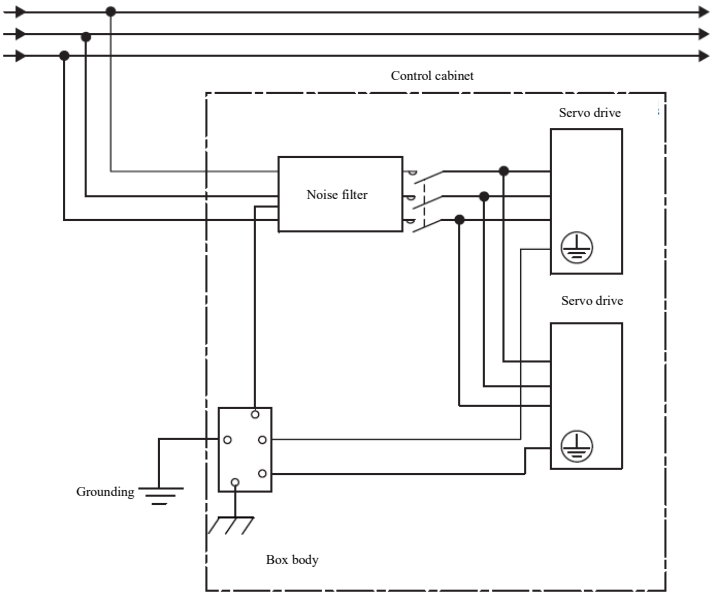
The ground wire of the noise filter should be separated from the output wire. The grounding wire and the output wire of the noise filter and other signal wires should not be placed in the same tube, nor should they be bundled together.



The ground wire of the noise filter should be connected separately.



When there is a noise filter inside the electrical cabinet, the grounding wire of the noise filter and the grounding wire of other equipment in the control cabinet are separately connected to the ground bar. After connecting to the ground bar, they are uniformly grounded.



04 Chapter IV

Test Run

4.1 Inspection and precautions before test run

For a correct and safe test, the following items should be checked and confirmed in advance.

Item	Content
Servo motor	Is the motor load switched off?
	Is the wiring and connection correct?
	Are the fastening parts loose?
	Has the brake been lifted when used for a servo motor with a hold brake? When removing the brake, supply voltage to the brake (generally DC24V)
servo drive	Is the wiring and connection correct?
	Is the voltage of the servo drive power supply normal?

4.2 JOG running through the panel

The following describes the execution steps for running JOG through the panel.

● JOG running refers to the function of confirming the correct action of the servo motor through internal speed control, without connecting to the upper device.

● During JOG running, the P-OT and N-OT overtravel prevention functions are ineffective. The operating range of the machinery used must be considered.

(1) Settings before running

To run JOG, the following settings must be made in advance.

● When S-ON input signal is ON, switch it to OFF.

● Please set JOG speed after considering the operating range of the machine used. JOG running speed is set through Pn304.

(2) Operating steps of JOG

For the operations, see " 7.3 JOG running"

4.3 Test run of servo motor according to upper reference

Please confirm the following items in advance for the test run of servo motor according to upper reference

Item	Content
1	Confirm that the servo motor movement references and input and output signals from the upper device to the servo drive are correctly set.
2	Check that the wiring between the upper device and the servo drive is correct and the polarity setting is correct.
3	Confirm if the action settings of the servo drive are correct.

4.3.1 Connection and status confirmation of the input signal

For the test run of speed control or position control through the upper reference, connection confirmation as shown in step 1.
The connection and status of the input signal are confirmed by the following steps.

Steps	Operation
1	The input signal required for test run shall be connected to the CN1 interface. The following conditions must be met when connecting: ● Servo ON input signal (S-ON) is in a input state ● No forward drive (POT) and No reverse drive (NOT) input signal ON (L level) (i.e.: forward rotation and reverse drive)
2	The control signal of the upper device is connected to the CN1 interface of the driver.
3	Power on the servo drive. Make sure the "power ready light" on the driver panel is on Confirm the status of the input signal by input monitoring (Un005).
4	Enter S-ON signal, so that the servo drive enters the servo ON status. Verify that the "Run Sign" on the driver panel appears correctly.
5	Ready for test run. Continue to perform the test run under each control mode.

4.3.2 Test run during position control

The following describes the test run method for position control.

Steps	Operation
1	Confirm the power supply and input signal loop again, and then switch on the control power of the servo drive.
2	According to the pulse output form of the upper device, the corresponding reference pulse form is set by Pn 200.0.
3	Set the reference unit, and set the electronic tooth ratio and frequency division number Pn212 by Pn20E and Pn210 according to the upper device.
4	Power on again to make the parameter changes in step 3 effective. And then connect the main circuit power supply of servo drive.
5	Turn on the servo (ON) (S-ON) input signal.
6	Output low-speed pulse reference from the upper device with an identifiable motor rotation amount (e.g. 1 turn).
7	By inputting the reference pulse counter (Un00C), monitor the pulse changes before and after the reference is issued to confirm whether the driver has received the correct reference pulses.
8	By using a feedback pulse counter (Un00D), monitor the pulse variation before and after the reference is issued to confirm whether the actual rotation of the motor is correct.
9	Verify that the servo motor rotates in the instructed direction.
10	If the driver has a feedback pulse, check that the number of feedback pulses is consistent with the desired value. Feedback pulse number = Un00D*Pn212*4 / encoder resolution
11	Stop sending the pulse reference to make the servo OFF.

4.4 Test run after connecting the servo motor to the machine

After the monomer test run is normal, connect the servo motor with the machine, and test run after the mechanical connection.

Steps	Item	Content
1	Parameter setting 1	Turn on the control power supply and the main circuit power supply and set up protection functions related to overtravel and braking.
2	Parameter setting 2	Set the necessary parameters according to the control mode used
3	Installation	In the state of power supply off, connect the servo motor and machinery through coupling.
4	Check	After connecting the upper device power supply and setting the servo drive to OFF, confirm whether the protection function set in step 1 is normal.
5	Running	Test run according to "Test run of servo motor according to upper reference" and make sure that the test run results are the same as the test run of the servo motor unit. And confirm that the setting of the reference unit is consistent with the machinery.
6	Tuning	Adjust the servo gain as needed to improve the response characteristics of the servo motor. (Note) During the test run, the servo motor and the machinery may not adapt to the situation, please fully implement the run-in operation.

4.5 Test run of servo motor with brake

Follow the following precautions for the test run of servo motor with brake.

Item	Content
1	When conducting a test run of a servo motor with a brake, before confirming the action of the brake, take measures to prevent mechanical natural falling or vibration caused by external forces.
2	When running a servo motor with a brake, please confirm the servo motor and hold the brake action first when the servo motor and the machine are not connected. In case of no problem, please connect the servo motor to the machine and then test run again.
3	Please use the brake interlock output (/BK) signal of the servo drive to control the holding brake action of the servo motor with brake.

05 Chapter V

Running

5.1 Selection of the control mode

By setting the Pn000.1 parameter, the control mode can be changed. The control mode supported by the servo drive is described in the following table.

Selection of the control mode		
Pn000.1	Control mode	Description
n.□□0□ [Factory setting]	Speed control (analog reference)	The speed of the servo motor is controlled by simulating the voltage speed reference.
n.□□1□	Position control (pulse train reference)	The position of machine is controlled through the pulse trains position reference. Enter the number of pulses to control the position, and enter the frequency of pulses to control the speed.
n.□□2□	Torque control (analog reference)	The output torque of the servo motor is controlled by simulating the analog voltage torque reference.
n.□□3□	internal set speed control	The speed is controlled by the 3 internal set speeds set by the driver.
n.□□4□	internal set speed control ⇔ speed control	Four control modes can be combined. It can be used in any combination according to the purpose.
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 clamping	The zero clamping can be used at the speed control.
n.□□B□	Position control ⇔ position control with reference pulse suppression function	The reference pulse suppression function can be used at the position control.
n.□□C□	EtherCAT	Control servo drive operation with EtherCAT Industrial Ethernet.

5.2 Setting of basic operation functions

The following explains the setting of running basic functions.

5.2.1 Servo ON

Servo ON (/S-ON) signal controlling the servo motor ON/OFF.

(1) Signal setting

Type	Signal name	Pin number	Setting	Description
Input	/S-ON	CN1-33 [Factory setting]	ON(closed)	Turn the servo ON and enter the running state.
			OFF (open)	Turn the servo OFF and enter the non-running state.

Additional note:

·By setting the parameter Pn50A. 1, the/S-ON signal can be assigned to other terminals.

·The speed reference/ position reference/ torque reference must be input after the servo ON (/S-ON) signal is connected to control the start or stop of the servo motor.

· If a reference is inputted first, and then the servo ON (/S-ON) signal is turned on or off, or the AC power is turned on again, causing the servo motor to start or stop. It may cause rapid aging of internal components in the driver, leading to faults.

·Please input the servo ON (/S-ON) signal while the servo motor is stopped. When the servo motor rotates, it can not turn the servo ON.

(2) Setting to enable the servo ON

By setting the parameter Pn50A.1, the servo motor can always be in the servo ON state.

Pn50A		
Parameter	Description	Effective time
n.□□0□ [factory setting]	Enter the servo ON (/S-ON) signal from CN1-33.	After power on again
n.□□7□	Fix the servo ON (/S-ON) signal to always be "valid".	

Additional note:

·When the servo ON is set to always valid, when the main circuit power supply of the servo drive is turned on, it will directly enter the operable state (powered state).

·When the speed reference position reference/ torque reference is entered, unexpected actions may occur in the servo motor or mechanical system. Safety measures must be taken.

·Even if it enters an inoperable state (non-powered state) due to a resettable alarm, as long as the alarm reset is performed, it will automatically return to the operable state (powered state).

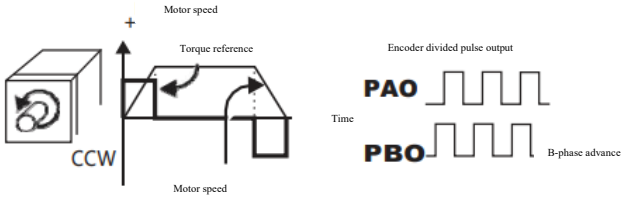
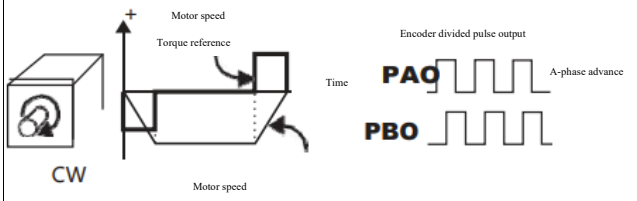
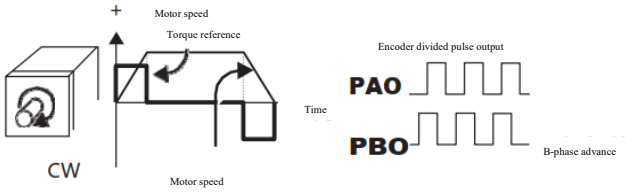
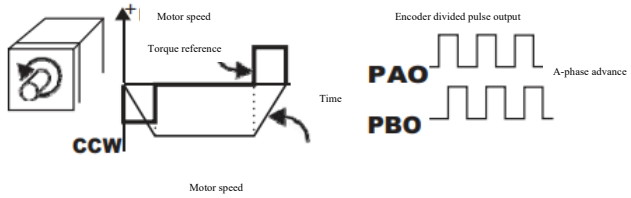
·If the alarm reset is performed during the reference input, the servo motor or the mechanical system may act unexpectedly.

5.2.2 Selection of motor rotation direction

The polarity of the speed reference/ position reference does not change, and the rotation direction of the servo motor can be changed by setting Pn000.0.

After changing the rotation direction of the motor by setting Pn000.0, the polarity of the encoder's divided pulse output will not change.

From the load side of the servo motor, counterclockwise rotation (CCW) indicates forward rotation, and clockwise rotation (CW) indicates reverse rotation. (Factory setting)

<table>
<tr><th colspan="4">Pn000</th></tr>
<tr><th>Parameter</th><th>Forward/reverse reference</th><th>Motor rotation direction and encoder divided pulse output</th><th>Effective overtravel (OT)</th></tr>
<tr><td rowspan="2">n.□□□0
The direction of CCW is forward.
[Factory setting]</td><td>Forward reference</td><td> 
</td><td>P-OT</td></tr>
<tr><td>Reverse reference</td><td> 
</td><td>N-OT</td></tr>
<tr><td rowspan="2">n.□□□1
The direction of CW is forward.
(Reverse mode)</td><td>Forward reference</td><td> 
</td><td>P-OT</td></tr>
<tr><td>Reverse reference</td><td> 
</td><td>N-OT</td></tr>
</table>

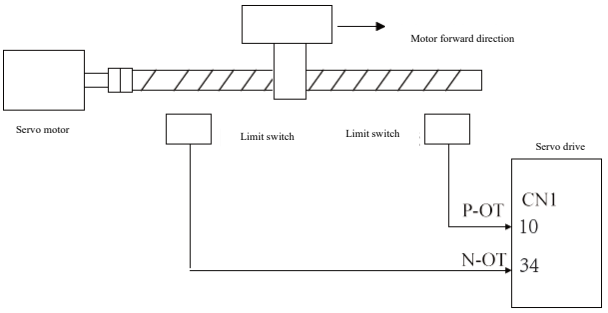
5.2.3 Overtravel

The overtravel function of the servo drive is to prevent the triggering of limit switch signals when the mechanical movement exceeds the safe range of movement, which is a safety function that forces the servo motor to stop.

Users can freely choose whether to use the overtravel function, and when disabled, the input signal line of the overtravel can be left unconnected.

Installation of limit switch

Please refer to the following figure for the installation method of the limit switch.
To prevent accidents caused by poor contact or wire breakage at the contact point, please use normally closed contacts for limit switches.



(1) Signal setting

Type	Signal name	Pin number	Setting	Description
Input	P-OT	CN1-10	ON	Forward drive (normal operation)
			OFF	Disable the forward drive (forward overtravel)
	N-OT	CN1-34	ON	Reverse drive (normal operation)
			OFF	No reverse drive (reverse overtravel)

Additional note:
·Even if the overtravel signal is triggered, the motor can still be driven in the opposite direction by the input references.
· In position control, when the servo motor stops due to overtravel, the position deviation value will not change.
·To clear the positional deviation, enter the clear signal (clr). Please refer to section 5.4.2 for the clear signal description.

(2) Selection of valid/invalie overtravel prevention function

Whether the overtravel prevention function is effective can be set by Pn50A and Pn50B
If the selection is invalid, the input signal connection for overtravel prevention is not connected.

Parameter		Description	Effective time
Pn50A	n.2□□□ [Factory setting]	Input "no forward drive signal" from CN1-10 (P-OT)	After power on again
	n.8□□□	"No forward drive signal" is invalid, always allowing the forward drive.	
Pn50B	n.□□□3 [Factory setting]	Input "no reverse drive signal" from CN1-34 (N-OT)	
	n.□□□8	"No reverse drive signal" is invalid, always allowing the reverse drive.	

· P-OT and N-OT can be freely assigned to CN1 pin numbers.

(3) Selection of motor stop method when the overtravel prevention function works

When overtravel occurs, there are three ways to stop the motor, which can be chosen at will

· Dynamic brake (DB) stop: The electrical circuit is shorted to stop the servo motor in an emergency.
· Deceleration stop: Deceleration stop via the emergency stop of torque
· Free stop: The friction stops naturally through the motor rotation.

There are two following states after the servo motor stops:

· Free running state: Natural stop due to friction when the motor rotates (the motor is not energized).

· Zero fixed state: The state that holds the zero position in the position ring

The servo motor stop method caused by overtravel can be selected through the setting of Pn001

Pn001				
Parameter	Motor stop method	State after the motor is stopped	Description	Effective time
n.□□00 [factory setting]	DB stop	Free running state	Stop the motor quickly through DB (dynamic brake) and enter the free running state after stopping.	After power on again
n.□□01				
n.□□02	Free stop		During the free running stop, the motor enters a free running state.	
n.□□1□	Deceleration stop	Zero fixed state	Decelerate and stop by emergency stop torque (Pn406), and enter the zero position fixed (servo locked) state after stopping.	
n.□□2□		Free running state	Decelerate and stop by emergency stop torque (Pn406), and enter the free running state after the motor stops.	

· Deceleration stop is ineffective at the torque control. During the DB stops or the free running stop, the motor will enter the free running state after stopping.

· For the stopping method when the servo is turned off or an alarm occurs, please refer to Chapter 5.2.5.

■ Set the motor stop method to the deceleration stop

The value of the emergency stop torque is set by Pn406

Pn406			
Emergency stop torque		Speed Position	
Setting range	Setting unit	Factory setting	Effective time
0 ~ 800	1%	800%	With immediate effect

· Set the unit as the percentage of the relative rated torque.

· The factory setting is 800%, but the actual effective emergency stop torque is the maximum torque of the servo motor.

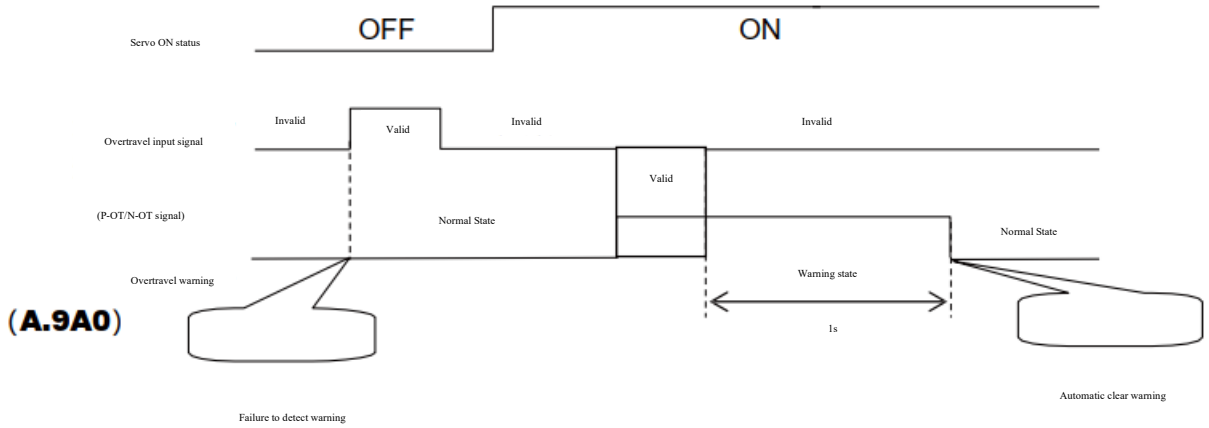
(4) Overtravel warning function

When the servo is ON, if an overtravel occurs, an overtravel warning will be given (A.9A0).

After setting this function, when an instantaneous overtravel occurs, the servo drive can also transmit the information of the overtravel to the upper device.

In case of Pn00D.3 = 1, the overtravel warning function turns on.

■ Warning detection time



When an overtravel occurs in the same direction as the reference, a warning is detected; when an overtravel occurs in the opposite direction of the reference, a warning is not detected.

When there is no reference, a certain overtravel warning in the forward or reverse direction will be detected.

When the servo is in the OFF state, even if it enters the overtravel state, no warning will be detected.

In overtravel mode, no warning is detected when changing from servo OFF state to servo ON state.

After the overtravel state is released, the warning I/O output will remain for 1 second, after which it will automatically clear.

Notes:

· The overtravel warning function is only for the action of detecting the warning. It will not affect the overtravel stop processing. When the overtravel warning occurs, the action of the motion control reference can still be executed.

·The upper device can decide how to handle overtravel warnings, and when an overtravel warning occurs, the upper device can cause subsequent actions to change (Movement control stops or motor control does not stop).

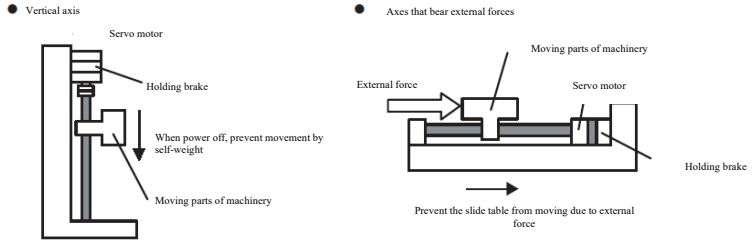
■ Related parameters

Pn00D		
Parameter	Description	Effective time
n.0□□□ [Factory setting]	Overtravel warning is not detected.	With immediate effect
n.1□□□	Overtravel warning is detected.	

5.2.4 Holding brake (for fixing)

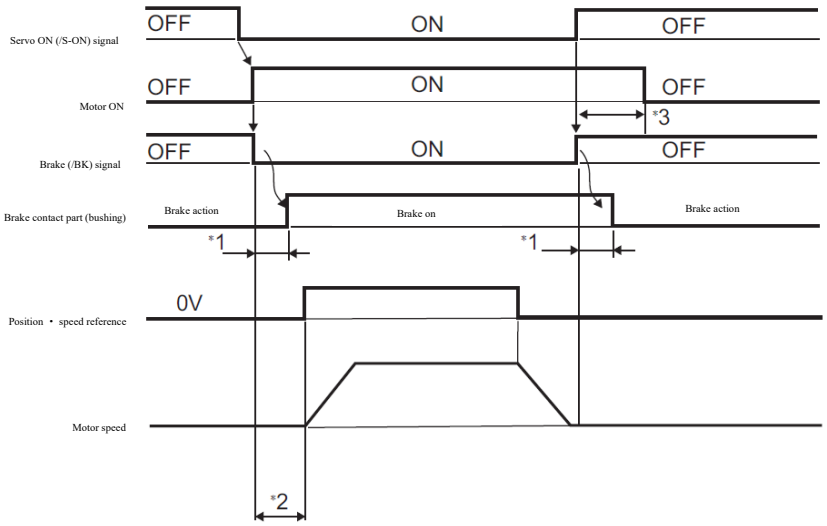
The function of the holding brake is to keep the position fixed. When the power supply of the servo drive is OFF, the holding brake can make the moving part of the machine not move because of its own weight or external force.

A servo motor with a holding brake shall be used in the following situations.



Note: The holding brake cannot be used for braking purposes and is only used to keep the servo motor in a stopped state.

The brake action will be delayed, and the timing diagram of the action is shown below.

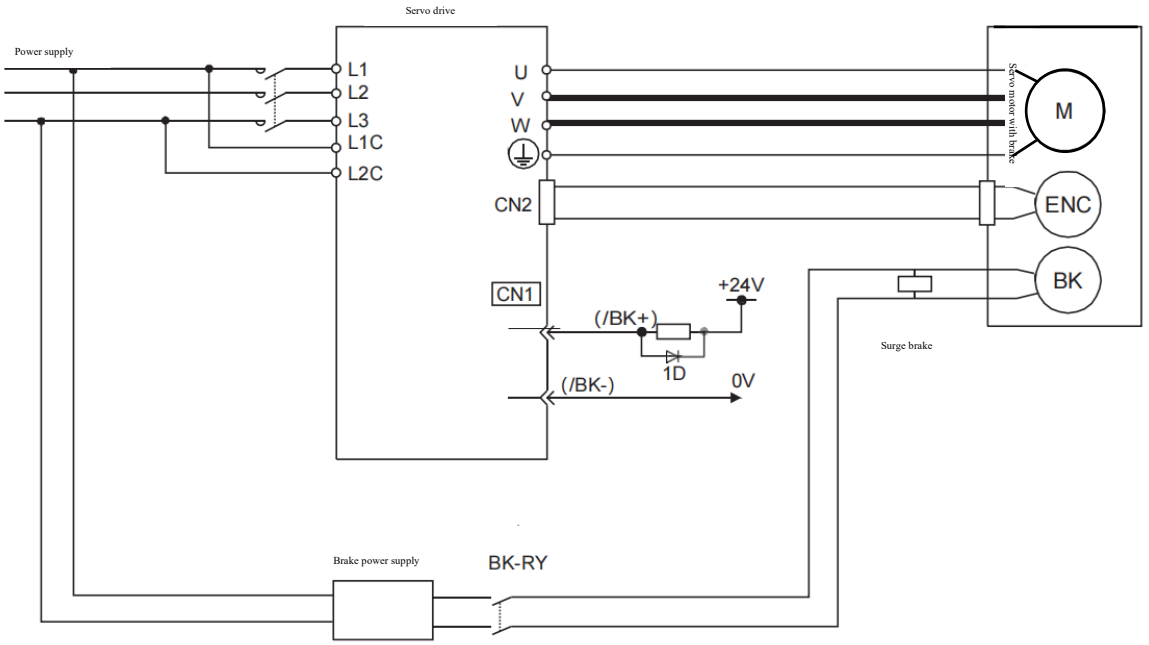


Different brake types will have different action delay time.

After turning on /S-ON signal and the brake opens for above +50ms, the upper device will send references to the servo drive.
Set the time of brake action and servo OFF through Pn506, Pn507 and Pn508.

(1) Connection example

Below is an example of the standard wiring of the brake signal (/BK) and the brake power supply.



BK-RY: Brake control relay

When using 24V servo motor with brake, the user needs to bring DC24V power supply.

Important notes:

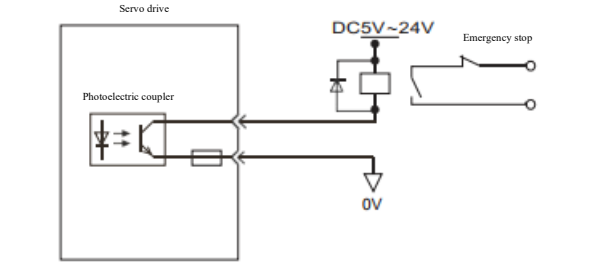
·Select the surge protector based on the applicable brake current and brake power supply.

· Design the relay circuit so that the brake will operate in case of an emergency stop.

·The brake signal (/BK) needs to be assigned the output signal, which is not set in the factory.

·When using the 24V brake, the DC24V power supply of the brake should be used separately from the power supply used for the input and output signal (CN1) to prevent the wrong actions.

Example of the relay circuit



(2) Brake signal

When servo OFF or alarm occurs, /BK signal will OFF, and the brake acts.

The time of the brake signal OFF can be changed through the Pn506.

Type	Signal name	Pin number	Output state	Description
Output	/BK	Allocations is required	ON(closed)	Remove the brake.
			OFF (open)	Actuate the brake.

When an overtravel alarm occurs, the/BK signal remains in the ON state and the brake remains in the released state.

(3) allocations of brake signal (/BK)

When leaving the factory, the brake signal (/BK) is not assigned and can be assigned by setting Pn50F.2.

Pn50F				
Parameter	Pin number		Description	Effective time
	+terminal	-terminal		
n.□0□□ [Factory setting]	-	-	Disable /BK signal	After power on again
n.□1□□	CN1-5	CN1-4	Output /BK signal from CN1-5/CN1-4.	
n.□2□□	CN1-3	CN1-2	Output /BK signal from CN1-3/CN1-2.	
n.□3□□	CN1-7	CN1-6	Output /BK signal from CN1-7/CN1-6.	

When multiple output signals are assigned to the same output terminal, the output signal will be output as OR logic. Do not repeat the allocations of /BK signal.

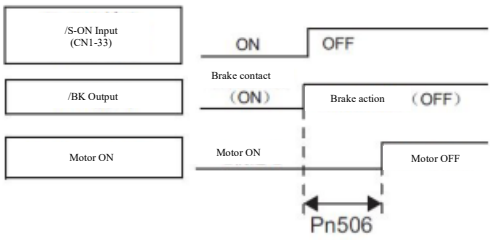
(4) Output time of the brake signal (/BK) when the servo motor stops

When the motor is stopped, the brake (/BK) signal and the servo ON (/S-ON) signal are OFF at the same time.

The time from when the servo ON (/S-ON) signal is turned off to when the motor actually enters a power-off state can be set through Pn506.

Pn506			
Brake reference - Servo OFF delay time			
Setting range	Setting unit	Factory setting	Effective time
0 ~ 50	10ms	0	With immediate effect

· When the servo motor is used in the vertical axis, the mechanical moving part may move slightly due to self-weight or external force. The Pn506 can be set so that the motor is in a non-energized state after the brake action to eliminate slight mechanical movement.



Important notes:

·When the driver alarm occurs, the setting of Pn506 is invalid, and the servo motor will immediately enter the non-power state.

·Due to the dead weight or external force of the mechanical movement part, the machine may move before the brake moves.

(5) Output time of the brake signal (/BK) when the servo motor rotates

When an alarm occurs during the rotation of the servo motor, the servo motor will stop moving and the brake signal (/BK) will be OFF.

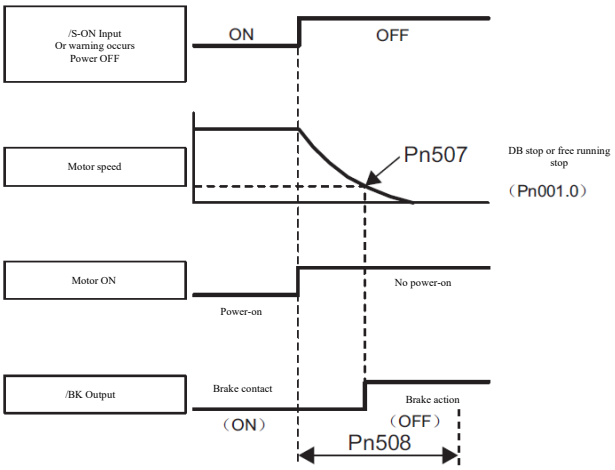
To adjust the brake signal (/BK) output time, you can change the brake reference output speed value (Pn507) or the servo OFF - brake reference waiting time (Pn508).

Pn507			
Brake reference output speed value			
Setting range	Setting unit	Factory setting	Effective time
0 ～ 10000	1min-1	100	With immediate effect
Pn508			
Servo OFF - brake reference waiting time			
Setting range	Setting unit	Factory setting	Effective time
10 ～ 100	10ms	50	With immediate effect

When an alarm occurs, the stopping method is to stop at zero speed. After stopping the motor through the zero speed reference, please refer to "(4) Output time of the brake signal (/BK) when the servo motor stops".

During the rotation of the servo motor, when any of the following conditions are established, the brake will act.

1. After the motor enters the non-energized state, the motor speed is lower than the set value of Pn507.
2. After the motor enters the non-energized state, it exceeds the setting time of Pn508.



Important notes:

·When the set value of Pn 507 exceeds the maximum speed of the motor, the set value is limited to the maximum speed of the servo motor.

·The rotation detection signal (/TGON) and the brake signal (/BK) cannot be assigned to the same terminal.

5.2.5 Motor stop method in case of server OFF and alarm

Important notes:

·DB (dynamic brake) is used for an emergency stop. The power supply can not be ON/OFF in the state of input reference, and the servo motor can not be started and stopped by the servo ON/OFF.

This causes the DB loop to move frequently, resulting in the aging or damage of the components inside the driver.

· When the main circuit power supply or control power supply is OFF during servo operation, the stopping method of the servo motor cannot be set by parameters. The default stopping method is as follows:

When the servo is running and the main circuit power supply is turned off, the servo motor will stop the DB.

When the servo is running and the control power is OFF, different types of servo drive implement different stop methods.

· When the servo is running and the main circuit power supply or the control power supply is OFF, and DB stop cannot be implemented, but the free running stop is required.

external combination of sequential control signals is required to disconnect the wiring of the servo motor (U, V, W).

· As for the alarm stop method, the zero speed stop alarm can be performed, and the factory setting is the zero speed stop.

This can shorten the inertial movement distance when there is an alarm. There are occasions when a DB stop is more appropriate than a zero speed stop.

(1) Motor stop method at servo-off

By setting Pn001.0, you can select the motor stop method when the servo is OFF

Pn001			
Parameter	Servo motor stop method	State after the servo motor is stopped	Effective time
n.□□□0 [factory setting]	DB stop	DB state	After power on again
n.□□□1		Free running state	
n.□□□2	Free running stop	Free running state	

Pn001 = n.□□□0. When the servo motor is in a stopped state or rotating at a low speed, it will not produce braking force as it is in a free running state.

(2) Motor stop method when an alarm occurs

There are two types of alarms, i.e. Ws.1 alarm and Ws.2 alarm.

Stop method for different types of alarms may be selected through Pn001.0 and Pn00B.1.

When Ws.1 alarms, the motor stop method is Pn001.0.

When Ws.2 alarms, the motor stop method is Pn00B.1.

When the alarm is Ws.1 or Ws.2, please refer to the description in chapter 9.1.1.

■ Motor stop method when Ws.1 alarms

Pn001			
Parameter	Servo motor stop method	State after the servo motor is stopped	Effective time
n.□□□0 [Factory setting]	DB stop	DB state	After power on again
n.□□□1		Free running state	
n.□□□2	Free running stop	Free running state	

■ Motor stop method when Ws.2 alarms

Parameter		Servo motor stop method	State after the servo motor is stopped	Effective time
Pn00B	**Pn001**			
n.□□0□ [Factory setting]	n.□□□0 [Factory setting]	Zero speed stop	DB state	After power on again
	n.□□□1		Free running state	
	n.□□□2			
n.□□1□	n.□□□0 [Factory setting]	DB stop	DB state	
	n.□□□1		Free running state	
	n.□□□2	Free running stop		

Valid when the parameter Pn00B.1 is at position control and speed control. Invalid at torque control.

5.2.6 Operation in case of momentary power interruption

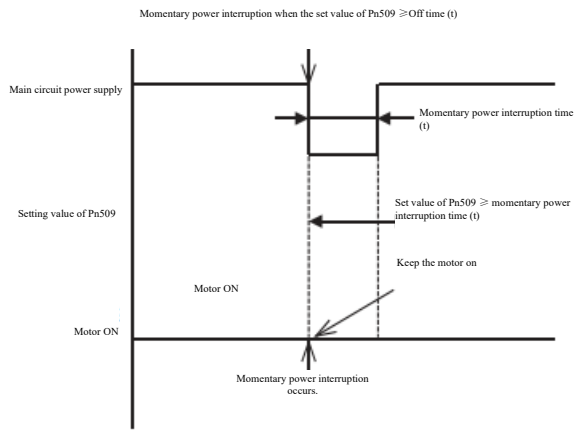
When the main circuit power supply of the servo drive suddenly turns off, the motor can continue to be powered on for the time set by Pn509 (Insient power outage holding time).

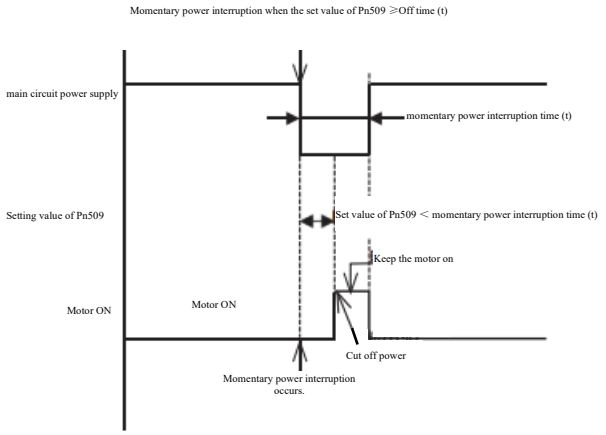
Pn509			
momentary power interruption holding time			
Setting range	Setting unit	Factory setting	Effective time
20 ~ 1000	1ms	20	With immediate effect

When the momentary power interruption time is below the set value of pn509, continue to energize the motor.

When the instantaneous power outage time is above the set value of Pn509, the motor is no longer energized.

After the main circuit power supply is restored, the motor is restored to power,





Additional note:

·When the momentary power interruption time exceeds the set value of Pn509, the /S-RDY output signal becomes OFF.

·When the control power supply and the main circuit power supply use no power failure equipment, it can deal with the momentary power interruption of more than 1000ms.

·The servo drive powered by AC220V has a holding time of approximately 100ms for the control power supply.

·The setting of Pn 509 is valid for the main circuit power supply and is not valid for the control power supply.

·The holding time of the main circuit power supply will be different for different types of drivers.

· When an undervoltage alarm (A.410) occurs during A momentary power interruption, the Pn509 settings do not take effect.

5.2.7 Setting of the drive overload detection value

The detection time of overload warning A.910 can be modified.

The detection time of overload alarm A.720 (continuous maximum) can be modified.

The detection time of the overload alarm A.710 (instantaneous maximum) cannot be modified.

(1) Change to the overload warning (A.910) detection time

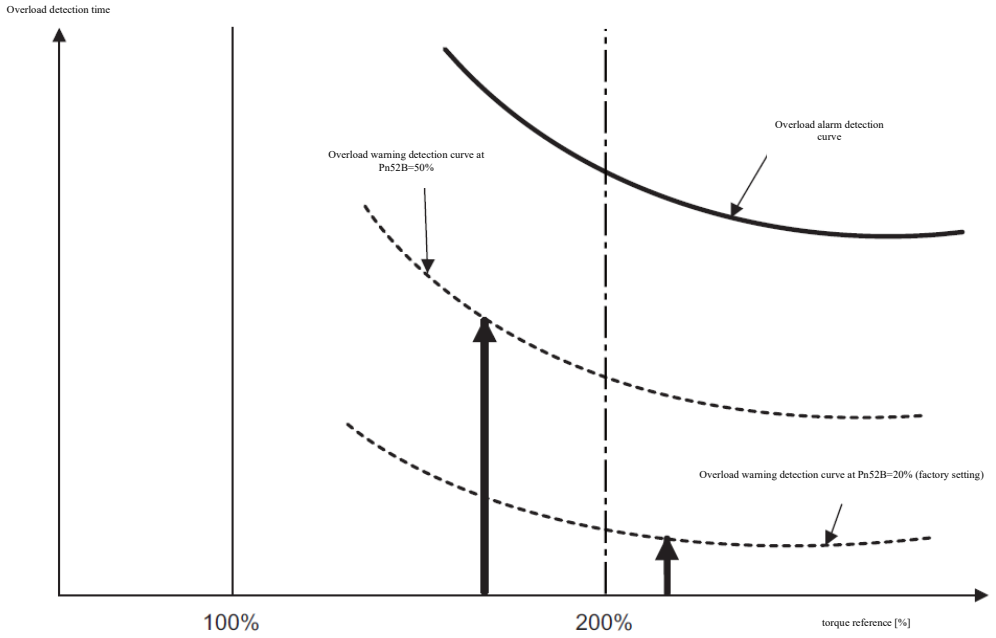
The overload warning detection time at the factory is 20% of the overload alarm detection time.

To modify the overload warning detection time, please set the parameter Pn52B.

The alarm warning can be used as the corresponding overload protection function of the used system to improve the security of the system.

Examples are given below:

The overload warning value (Pn 52 B) changes from 20% to 50%, and the overload warning detection time becomes 50% of the overload alarm detection time.



Pn52B			
Overload warning value			
Setting range	Setting unit	Factory setting	Effective time
1 ~ 100	1%	20	With immediate effect

(2) Change to the overload alarm (A.720) detection time

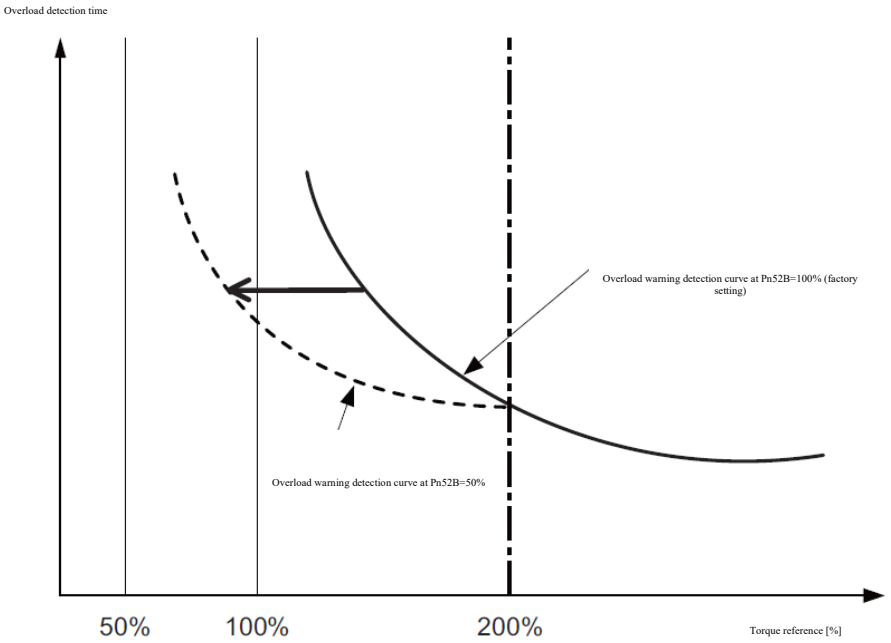
By modifying the overload alarm detection time, the A.720 overload alarm (continuous maximum) can be detected in advance.

Detecting overload alarms in advance can prevent motor overload and achieve overload protection for the motor.

After changing the value of parameter Pn52C, the overload alarm detection time will be changed, and the overload warning detection time will also be correspondingly changed.

Examples are given below:

After changing Pn52C to 50%, overload alarms can be detected faster.



Pn52C			
Motor overload detection base current reduction rated value			
Setting range	Setting unit	Factory setting	Effective time
10 ～ 100	1%	100	After power on again

5.3 Speed control (analog reference)

The speed control (analog reference) is selected through changing Pn000.1.

Pn000		
Parameter	Description	Effective time
n.□□0□ [factory setting]	The control mode is selected as the speed control	After power on again

5.3.1 Basic settings for speed control

(1) Specification of the speed reference input signal

The motor speed is proportional to the voltage, with the maximum input voltage DC±12V.

Type	Signal name	Pin number	Description
Input	V-REF	CN1-44	Speed reference input signal
	AGND	CN1-42	Grounding of speed reference input signal

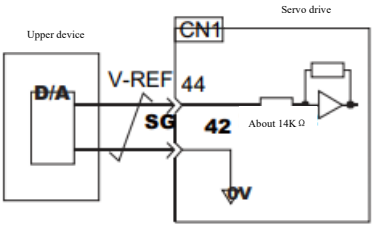
Examples of the speed reference input are given as follows:

When Pn300 is set to 006.00, it represents the rated speed of the motor corresponding to the 6.00V voltage (factory setting)

If the value is 600, 006.00 is displayed on the panel

Speed reference input	Rotation direction	Speed	LMG servo motor
+6V	Forward	Rated speed	3000r/min
-3V	Reverse	1/2 rated speed	-1500r/min
+1V	Forward	1/6 rated speed	500r/min

For position control through the upper device, connect it to the speed reference output terminal of the upper device.

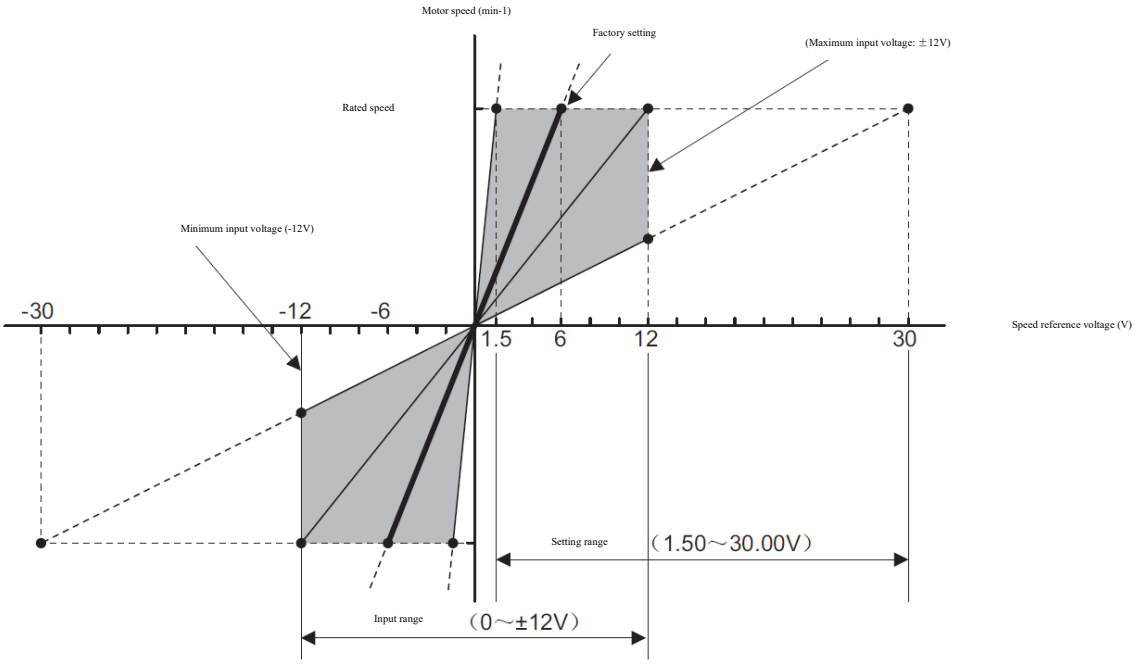


The cable for speed reference input signal may apply the twisted shielded cable to suppress noise.

(2) Setting of speed reference input gain

By setting Pn300, the corresponding relationship between the analog voltage of the speed reference (V-REF) and the rated speed of the motor can be changed.

Pn300			
Speed reference input gain			
Setting range	Setting unit	Factory setting	Effective time
150 ~ 3000	0.01V	600 (Rated speed at 6.00v)	With immediate effect



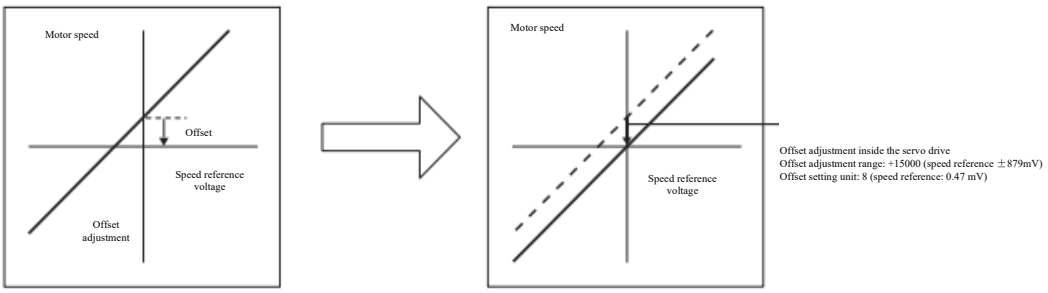
5.3.2 Tuning of the reference offset

During speed control, the servo motor may rotate at microspeed even if the speed reference input signal is 0v.

The reason for this is that the simulation reference sampled inside the servo drive has a minor deviation, which is called a bias.

When the motor rotates slightly, the reference offset function is used to eliminate the bias.

There are two ways of bias tuning, automatic (Fn 009) and manual (Fn 00A).



(1) Autotuning of reference offset (Fn009)

The autotuning of reference offset is to automatically measure the amount of bias and then automatically adjust the reference voltage.

The measured bias is saved in the servo drive.

Additional note:

·autotuning of reference offset is performed in the servo OFF state.

·After parameter initialization (Fn005) is performed, the bias tuning level will not be initialized.

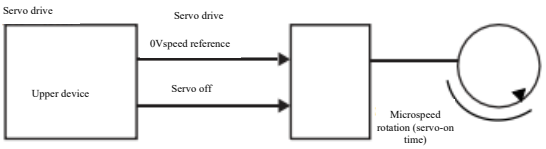
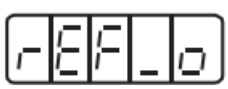
·When the parameter writing forbid function (Fn010) is set to prohibit writing, Fn009 cannot be executed and the panel will display NO-OP.

When executing Fn009 in a non servo OFF state, Fn009 cannot be executed and the panel will display NO-OP.

· When the upper device has already constructed a position loop, the autotuning of reference offset is invalid. Please manually adjust the reference offset (Fn00A).

■ Operating steps

The steps to perform the autotuning of the reference offset through the panel are as follows.

Steps	Panel display	Key	Description
1			Turn the servo OFF and input 0V reference voltage from the upper device or external loop. 
2			Press the MOD key to select utility function.
3			Press UP or DOWN key to display Fn009 on the panel.
4			Press DATA/SHIFT key for about 1S to display "rEF_o".
5			Press the MOD key, "donE" will flash for about 1 second, and the panel will display as shown in the left.
6			Press the DATA/SHIFT key again for about 1S to return a display of Pn009.

(2) Manual tuning of reference offset (Fn00A)

Manual tuning of reference offset is the tuning by directly inputting the reference offset value.

Manual tuning of reference offset applies to the following occasions:

· The upper device has constructed a position loop and set the position deviation when the servo is locked and stopped to zero.

· A bias quantity needs to be set.

· To confirm the bias set by autotuning.

Notes:

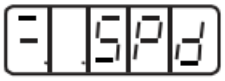
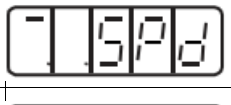
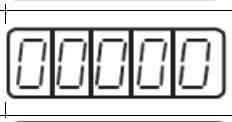
· After parameter initialization (Fn005) is performed, the tuning level will not be initialized.

· When the parameter writing forbid function (Fn010) is set to prohibit writing, Fn00A cannot be executed and the panel will display NO-OP.

· The servo should be in the servo-ready state during the execution

■ Operating steps

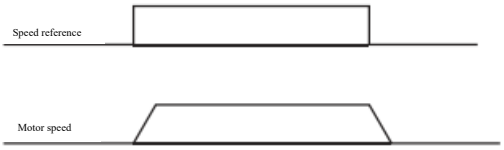
The steps to perform the manual tuning of the reference offset through the panel are as follows.

Steps	Panel display	Key	Description
1			Press the MOD key to select utility function.
2			Press UP or DOWN key to display Fn00A on the panel.
3			Press (DATA/SHIFT) key about 1s and the panel is displayed on the left.
4			Externally turn the servo ON, and the panel display is shown in the left.
5			Press the DATA/SHIFT key for about 1S to display the current amount of bias.
6	 (Example)		Press the UP or DOWN key to stop the motor. This value is the bias quantity.
7			Press the MOD key, "donE" will flash for about 1 second, and the panel will display as shown in the left.
8			Press the DATA/SHIFT key again for about 1S to return a display of Fn00A.

5.3.3 Soft start

The soft start function turns the speed reference into a smooth speed reference with constant acceleration and deceleration. The acceleration and deceleration time of the soft start can be set separately.

This function can be used for speed control, including internal set speed control.



Pn305			
Soft start acceleration time		Speed	
Setting range	Setting unit	Factory setting	Effective time
0 ～ 10000	1ms	0	With immediate effect
Pn306			
Soft start deceleration time		Speed	
Setting range	Setting unit	Factory setting	Effective time
0 ～ 10000	1ms	0	With immediate effect

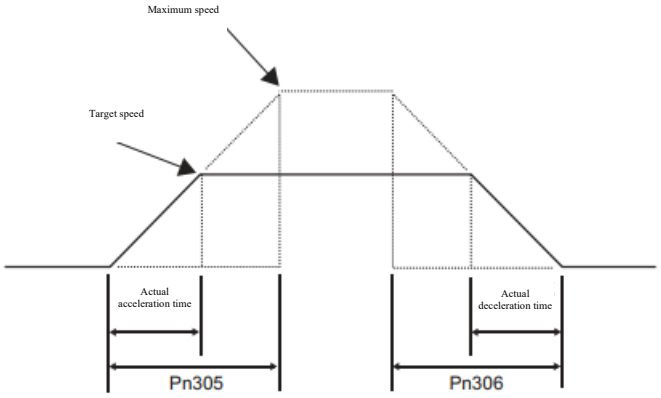
Pn305: The time required for the motor to reach its maximum speed

Pn306: The time required from maximum motor speed to motor stop

The actual acceleration and deceleration time is calculated by the following formula:

Actual acceleration time =(target speed/maximum speed) soft start acceleration time Pn305

Actual deceleration time = (target speed/maximum speed) soft start deceleration time Pn306



5.3.4 Speed reference filter

The speed reference filter is a delay filter applied to the input of the analog speed reference (V-REF), making the speed reference smoother.

The speed reference filter parameter Pn307 usually does not need to be changed. If the set value of Pn307 is too large, the responsiveness may be reduced.

Pn307			
Speed reference filtering time constant		Speed Position Torque	
Setting range	Setting unit	Factory setting	Effective time
0 ～ 65535	0.01ms	40	With immediate effect

5.3.5 Zero clamping

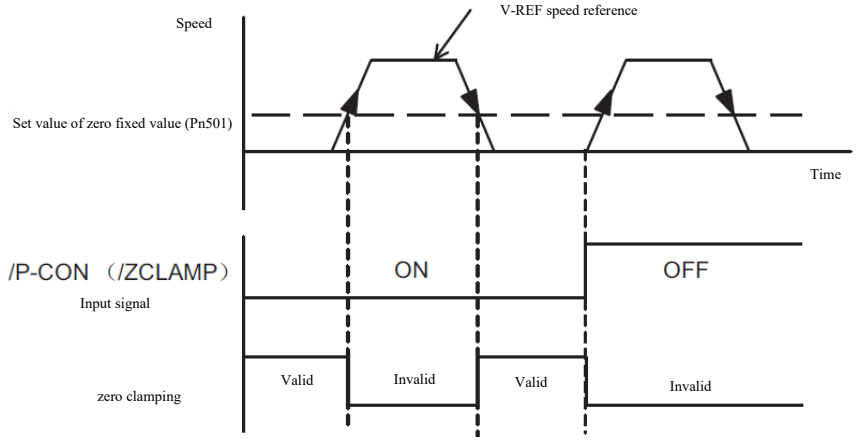
When the zero fixed signal (/P-CON, /ZCLAMP) is ON, if the input voltage of the speed input reference (V-REF) corresponds to a speed lower than the speed set value of Pn501,

the servo enters a locked state, and the servo drive forms a position loop internally, rendering the input speed reference invalid.

The zero clamping is used for speed control, and the upper device does not build a position loop.

After the zero clamping takes effect, the motor position will automatically return to the zero fixed position even if there is a change

The motor position is fixed within ± 1 pulse of the effective position.



(1) When the input signal is assigned in the factory setting state (Pn50A.0 = 0)

If using the zero clamping in the factory setting, please set Pn000.1=A and use the/P-CON signal as the zero fixed signal.

Type	Signal name	Pin number	Setting	Description
Input	/P-CON	CN1-9 [Factory setting]	ON (connected)	When the input voltage of the speed reference(V-REF) is lower than the speed set by the zero fixed value (Pn501), the zero clamping is effective.
			OFF (disconnected)	The zero clamping is invalid.

Pn000		
Parameter	Description	Effective time
n.□□A□	Speed control * speed control with zero clamping	After power on again

(2) When the allocations of input signals should be changed (Pn50A.0 = 1),

the zero clamping is switched through /ZCLAMP signal.

Type	Signal name	Pin number	Setting	Description
Input	/ZCLAMP	Allocations is required	ON	When the input voltage of the speed reference(V-REF) is lower than the speed set by the zero fixed value (Pn501), the zero clamping is effective.
			OFF (disconnected)	The zero clamping is invalid.

The /ZCLAMP signal can be assigned to the terminal by setting the Pn50D.0.

When using the zero clamping, Pn000.1 can be set to any one of 0,3,4,5,6,7,9, and A.

Pn000			
Parameter	Control mode	Input signal used	Effective time
n.□□0□	Speed Control	/ZCLAMP	After power on again
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 clamping	/ZCLAMP, C-SEL	

Additional note:

· When Pn000.1 = 5, 6, 7 and 9, the zero clamping takes effect when the control mode is switched to speed control.

·When Pn50D.0 = 7, the zero clamping always takes effect, without the input signal (/ZCLAMP, /P-CON).

(3) Related parameters

Set the effective speed of the zero clamping through Pn501.

Pn501			
Zero fixed value		Speed	
Setting range	Setting unit	Factory setting	Effective time
0 ~ 10000	1min-1	10	With immediate effect

When the setting value exceeds the maximum speed of the motor, the maximum speed of the motor is the upper limit.

5.3.6 Encoder divided pulse output

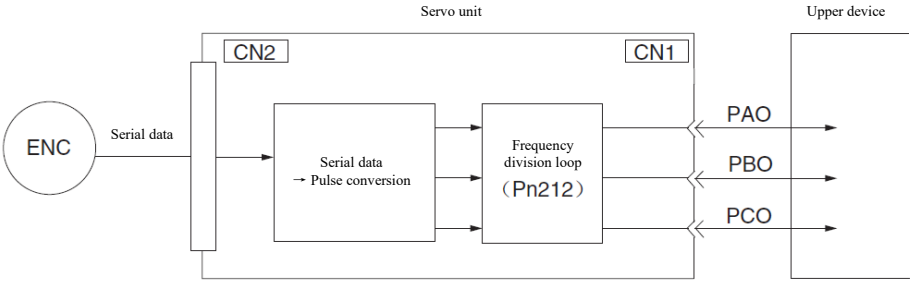
After the encoder signal is processed internally in the servo drive, it is output to the outside in the form of 2-phase pulses (A phase, B phase) with a 90 ° phase differential, which is called encoder divided pulse output.

The signal output of the encoder divided pulse can be output to the upper device as position feedback.

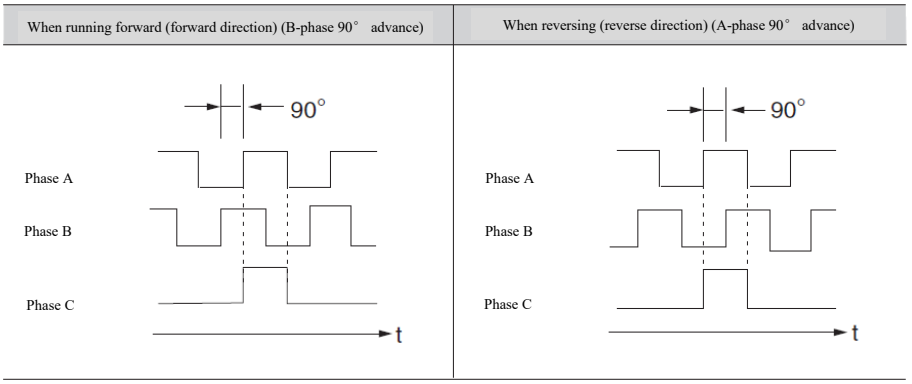
The shape of the signal and the output phase is shown below.

(1) Signal

Type	Signal name	Pin number	Name	Description
Output	PAO	CN1-21	Encoder divided pulse output A phase	Pn212 can set the pulse amount of the motor per 1 turn of rotation.
	/PAO	CN1-22		
	PBO	CN1-25	Encoder divided pulse output B phase	The phase differential between phase A and phase B is an electrical angle of 90 °.
	/PBO	CN1-23		
	PCO	CN1-13	Encoder divided pulse output C phase	The motor outputs 1 pulse per rotation.
	/PCO	CN1-24		



(2) Output phase pattern



Additional note:

·The pulse width of phase C will vary according to the variation of Pn212 (encoder divided pulse number), which is the same as the pulse width of phase A.

·When Pn000.0 = 1 (the rotation direction changes), the output phase pattern is the same as the figure above.

·The phase relationship between the frequency division output A and B pulses can be reversed by setting Pn605.1.

·When performing origin regression through the C-phase pulse of the servo drive, first let the servo motor run for more than 2 cycles before proceeding. If this operation cannot be performed, set the speed of the servo motor to below 600min-1, and then perform origin regression. ·When the speed is above 600min-1, the C-phase pulse may not output normally.

5.3.7 Setting of the encoder divided pulse output

After the encoder signal is processed internally in the servo drive, it is output to the outside in the form of 2-phase pulses (A phase, B phase) with a 90 ° phase differential, which is called encoder divided pulse output. The signal output of the encoder divided pulse can be output to the upper device as position feedback.

The setting method of the encoder divided pulse output is shown below.

Pn212				
Encoder divided pulse output		Speed Position Torque		Category
Setting range	Setting unit	Factory setting	Effective time	
16 ～ 16383	1P/Rev	2500	After power on again	Basic setting

The encoder signal is processed inside the servo drive, and then output by dividing the set value of Pn212.

Encoder resolution limits the number of encoder divided pulse number.

Setting range of encoder divided pulse number (P/Rev)	Setting value Scale	Encoder resolution		Upper motor speed limit corresponding to the encoder divided pulse number (min-1)
		17-bit (131072 pulses)	23-bit (8388608 pulses)	
16 ～ 16383	1	O	O	6000

Additional note:

·The setting range of Pn212 is related to the encoder resolution of the motor. If the set value does not meet the requirements, an A.041 alarm will appear.

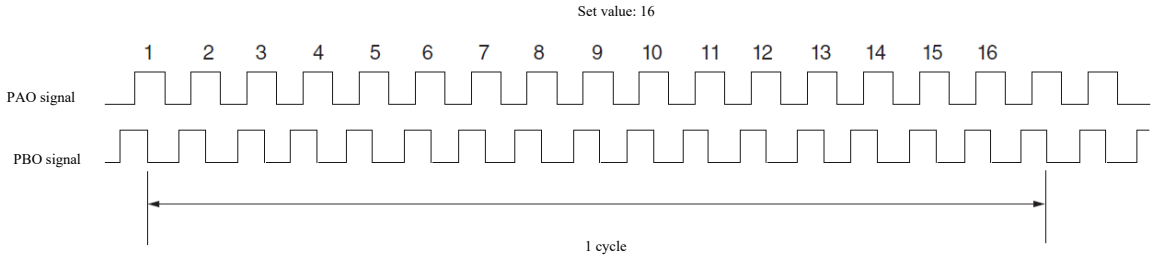
·The upper limit of the pulse frequency is about 1.6Mpps. The speed of the servo motor will be limited if the encoder divided pulse number is set too high.

If the motor speed limit in the table above is exceeded, an A.511 alarm will appear.

Examples are given below:

When Pn212 = 16 (Output 16 pulses per turn),

The output of phase A (PAO) signal and phase B(PBO) signal of encoder divided pulse are shown in the figure below.



5.3.8 Speed consistency output (/V-CMP) signal

When the actual speed of the motor is consistent with the speed reference, the output speed is the same signal (/V-CMP) signal.

The output speed consistency signal can be used for interlocking with the upper device and other occasions.

The output consistency speed signal is only effective for speed control.

Type	Signal name	Pin number	Output state	Description
Output	/V-CMP	CN1-25, 26 [Factory setting]	ON(closed)	Speed consistency state
			OFF (open)	Speed inconsistency state

The /V-CMP signal can be assigned to the terminal by setting the Pn50E.1.

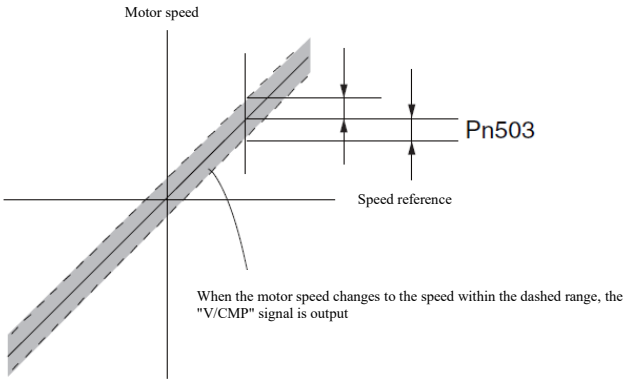
Change the speed detection range of /V-CMP signal through Pn503 settings

Pn503			
Speed consistency signal output range		Speed	
Setting range	Setting unit	Factory setting	Effective time
0 ~ 100	1min-1	10	With immediate effect

When the speed difference between the actual speed of the motor and the speed reference is lower than the set value of Pn503, the speed consistency signal is output.

Examples are given below:

At Pn503 = 100, output signal when the speed reference is 2000min-1 and the motor speed is 1900min-1 ~ 2100min-1.



5.4 Position control

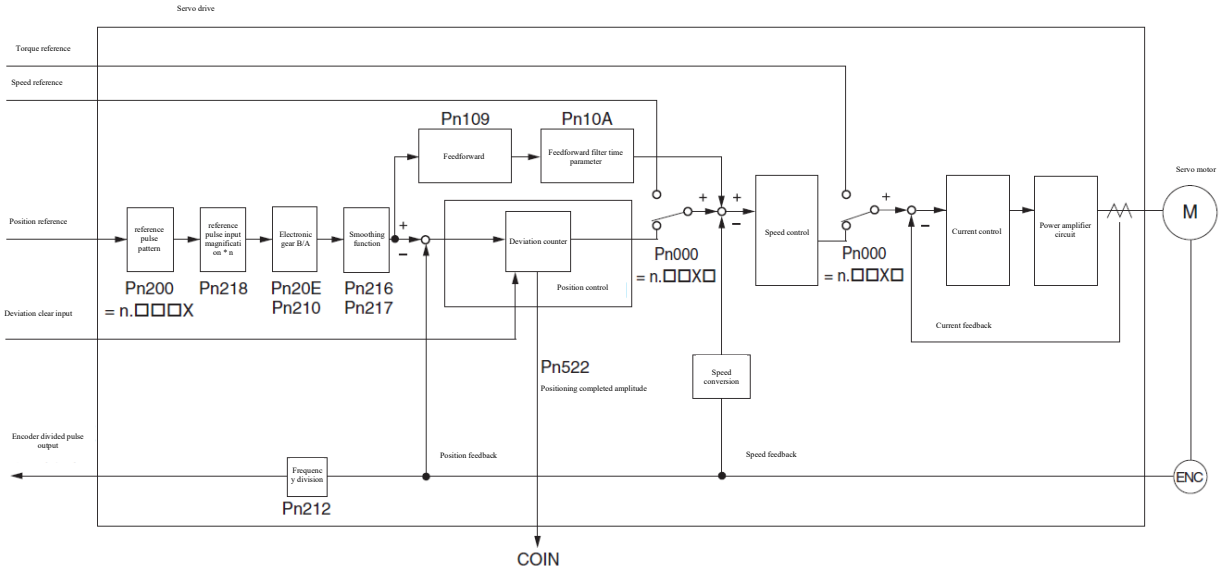
Position control is the function of positioning by pulse reference.

The amount of position movement is controlled by the number of input pulses, and the speed is controlled by the frequency of input pulses.

Select the position control mode by changing Pn000.1.

Pn000		
Parameter		Effective time
n.□□1□	Position control	After power on again

□ The control block diagram is as follows



5.4.1 Basic settings of position control

(1) Setting of the reference pulse form

At the position control, the reference pulse form of the upper device and servo drive should correspond, and the reference pulse form of the driver can be changed through parameter Pn200.

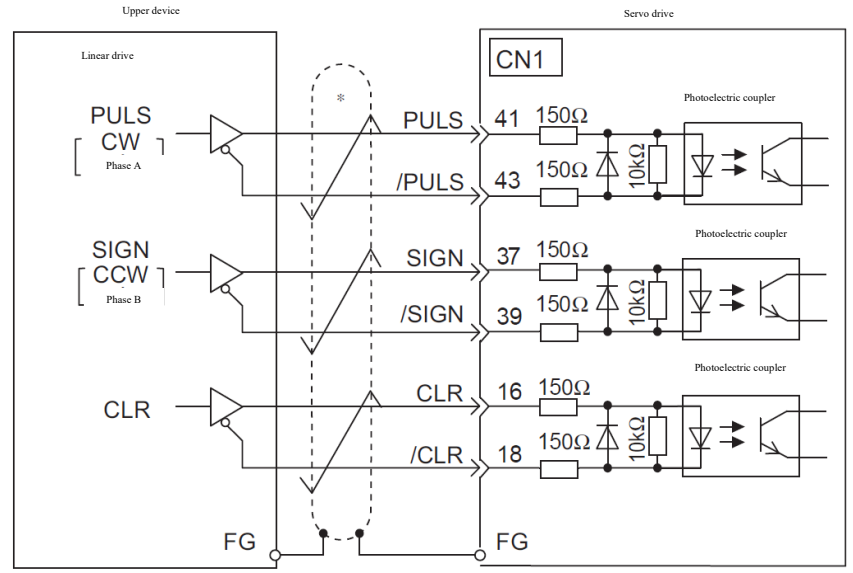
Parameter		reference pulse pattern	Input multiplication	Forward reference	Reverse reference
Pn200	n.□□□0 [Factory setting]	Symbol + pulse series (positive logic)	—	PULS (CN1-41) / SIGN (CN1-37) H Level	PULS (CN1-41) / SIGN (CN1-37) L Level
	n.□□□1	CW+CCW pulse series (Positive logic)	—	CW (CN1-41) L Level / CCW (CN1-37)	CW (CN1-41) / CCW (CN1-37) L Level
	n.□□□2	90° phase differential two-phase pulse	1 time	90° Phase A (CN1-41) / Phase B (CN1-37)	90° Phase A (CN1-41) / Phase B (CN1-37)
	n.□□□3		2 times		
	n.□□□4		4 times		
	n.□□□5	Symbol + pulse series (negative logic)	—	PULS (CN1-41) / SIGN (CN1-37) L Level	PULS (CN1-41) / SIGN (CN1-37) H Level
	n.□□□6	CW+CCW pulse series (Negative logic)	—	CW (CN1-41) H Level / CCW (CN1-37)	CW (CN1-41) / CCW (CN1-37) H Level

(2) Selection of the input filter

Pn605		
Parameter	Description	Effective time
n.□0□□ [Factory setting]	Use the high-speed reference input filter. (~ 4Mpps)	After power on again
n.□1□□	Use the low-speed reference input filter. (~ 800kpps)	

(3) Connection example

■ Example of connection for linear drive output



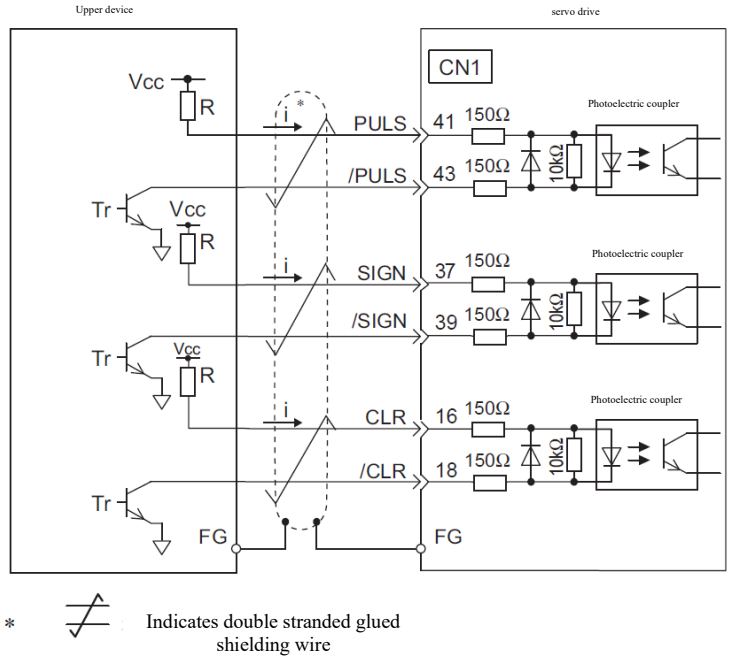
* Indicates double stranded glued shielding wire

■ Example of connection for open collector output

The resistance value of the current-limiting resistor R needs to be reasonably selected, and the input current should be controlled between 7-15mA.

Input and output signals should be shielded with cables, and both ends of the shielded wire should be grounded.

The shielding layer on the servo drive side should be connected to the metal casing of the plug and connected to the frame ground wire (FG).



* Indicates double stranded glued shielding wire

■

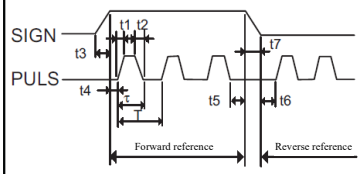
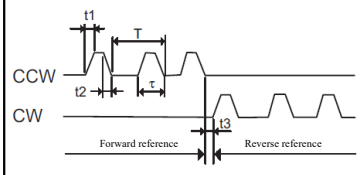
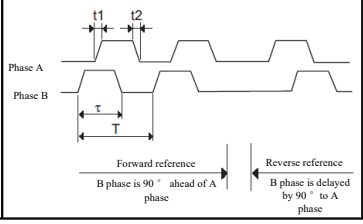
Example
- Vcc is +24V: R=2kΩ
- Vcc is +12V: R=1kΩ
- Vcc is +5V: R=100Ω

(Note) When the collector has an open circuit output, the signal logic is as shown below.

Tr is On	Equivalent to H-level input
Tr is Off	Equivalent to L-level input

(4) Electrical specifications for pulse references

Below is the shape of the pulse reference.

pulse trains reference signal pattern	Electrical specifications		Remarks
Symbol + pulse trains reference (SIGN+PULS signal) Maximum reference frequency: 4Mpps (Maximum frequency at the collector open circuit output is 200kpps)		t1、t2、t3、t7 ≤ 0.025μs t4、t5、t6 ≥ 0.5μs τ ≥ 0.125μs T- τ ≥ 0.125μs	The sign is a forward rotation reference at level H and a reverse rotation reference at level L.
CW+CCW pulse trains Maximum reference frequency: 4Mpps (Maximum frequency at the collector open circuit output is 200kpps)		t1、t2 ≤ 0.025μs t3 ≥ 0.5μs τ ≥ 0.125μs T- τ ≥ 0.125μs	
90 ° phase differential two-phase pulse (A phase +B phase) Maximum reference frequency: 1Mpps* (Maximum frequency at the collector open circuit output is 200kpps)		t1 ≤ 0.1μs t2 ≤ 0.1μs τ ≥ 0.5μs T- τ ≥ 0.5μs	Reference pulse pattern is set through Pn200.0.

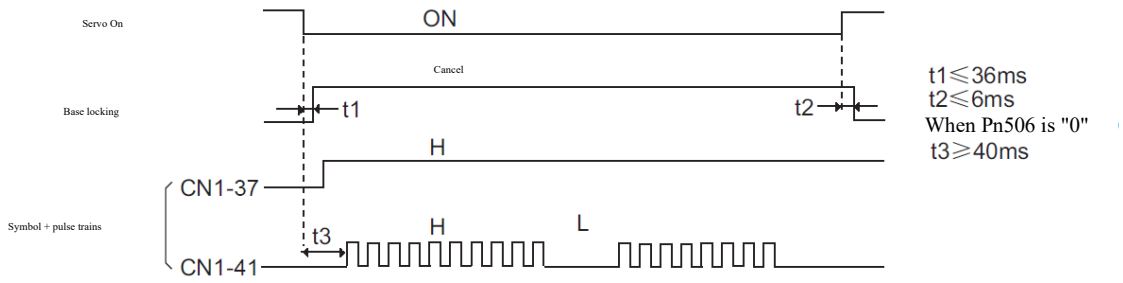
* The maximum reference frequency of each multiple (before doubling) is shown below.

X1 time: 1Mpps

X2 times: 1Mpps

X4 times: 1Mpps

(5) Time example of input and output signals



Additional note:

·t3 should be larger than 40ms. If less than 40ms, the pulse reference may not be received normally.

5.4.2 Position deviation clearing input (CLR) signal

The difference between the reference input pulse and the encoder feedback pulse is counted by the deviation counter.

When the positional deviation clearance signal is triggered, the value of the differential counter is cleared.

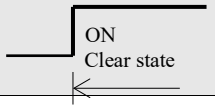
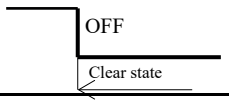
With the CLR signal on, the value of the deviation counter is always 0, leading to no positional ring construction.

(1) Clear the wiring of the signal

Type	Signal name	Pin number	Name
Input	CLR	CN1-16	Position deviation clearing input
	/CLR	CN1-18	

(2) Setting of the positional deviation clearing input (CLR) signal form

Clear deviation counter by setting Pn200.1.

Pn200			
Parameter	Reference form	Clear time	Effective time
n.□□0□ [Factory setting]	Clear deviation counter at ON.	CLR (CN1-16) 	After power on again
n.□□2□	Clear deviation counter at OFF.	CLR (CN1-16) 	

Additional note:

· If the position deviation clearing signal remains effective, it will result in the servo locking function being ineffective. After the servo locking function is ineffective, the speed loop may be affected by drift pulses, causing the motor to rotate at a slight speed.

■ About the pulse amplitude of the clear signal

When Pn200.1=0 or 2, in order to effectively clear the signal, the pulse width for clearing the signal should be above 250us.

(3) Clear action selection

By setting Pn200.2, select when to clear the position deviation.

Pn200		
Parameter	Description	Effective time
n.□0□□ [Factory setting]	Clear deviation counter in case of base locking (servo OFF and issue alarm).	After power on again
n.□1□□	Do not clear the position deviations. Clear deviation counter through the CLR signal when clearing.	
n.□2□□	Clear deviation counter when an alarm occurs	

5.4.3 Reference pulse input magnification switching function

By switching the ON/OFF of the input signal (/PSEL) through the reference pulse input magnification, the input magnification of the position reference pulse can be switched to 1 and n times (n=1-100).

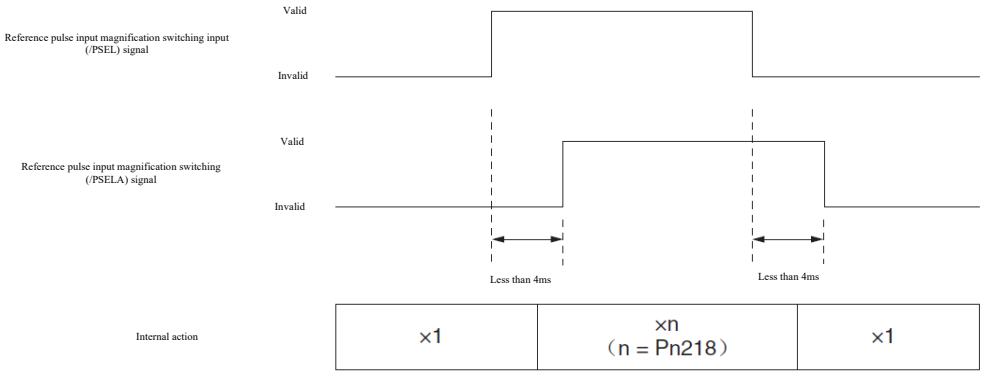
The switching of multiplication can be confirmed by the output signal (/PSELA) of the reference pulse input multiplication switch.

When there is a position reference pulse input, it is not possible to switch the pulse rate, which can lead to unexpected situations.

(1) Setting of the reference pulse input magnification (Pn218)

Pn218			
reference pulse input magnification		Position	
Setting range	Setting unit	Factory setting	Effective time
1 ~ 100	1 time	1	With immediate effect

(2) Reference pulse input rate switching time graph



(3) Reference pulse input magnification switching input (/PSEL) signal

Use the /PSEL signal when using the reference pulse input magnification switching function

Type	Signal name	Pin number	Output state	Description
Input	/PSEL	To be assigned	ON(closed)	The reference pulse input magnification is valid.
			OFF (open)	The reference pulse input magnification is invalid. The multiplier is 1 times.

/PSE/PSEL signal needs to be manually assigned to the terminals as follows:
1. Set Pn50A.0=1 so that the input signal can be freely assigned.

2. By setting Pn515.1, the /PSEL signal is freely assigned to the terminal.

(4) Reference pulse input magnification switching (/PSELA) signal

This signal indicates that the reference pulse input rate switching function is effective.

Type	Signal name	Pin number	Output state	Description
Output	/PSELA	To be assigned	ON(closed)	The reference pulse input magnification is valid.
			OFF (open)	The reference pulse input magnification is invalid.

/PSELA signal needs to be manually assigned to the terminals as follows:

1. By setting Pn510.2, the /PSELA signal is freely assigned to the terminal.

(5) Restrictions

When running the JOG program or during autotuning (without upper reference), the input pulse switching function does not take effect when running the following functions.

5.4.4 Setting of the electronic gear

The electronic gear is set by parameters Pn20E and Pn210.

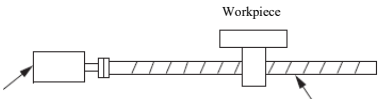
The electronic gear is a function that sets the movement amount of the workpiece by inputting a reference of 1 pulse unit to the upper device.

The number of reference pulses of each reference can be simply calculated.

If the electronic gear is set by the upper device, the electronic gear ratio of the driver is typically set to 1:1.

When the reference pulse input magnification switching function is effective, the number of input reference pulses needs to be multiplied by the multiplier before being converted to the corresponding reference unit.

Take the workpiece moving 10mm to illustrate the difference between using / not using electronic gear:



Encoder resolution: 8388608 (23 bits)

Ball screw lead: 6mm

When the single gear is not used

When moving the workpiece by 10mm
(1) Calculate the number of turns The servo motor rotates 6mm every 1 turn, so when moving the workpiece 10mm, the number of rotations is 10/6
(2) Calculate the number of reference pulses 8388608 pulses make 1 turn, therefore, the required number of pulses is "10/6*8388608=13981013.33... pulses"
(3) Input the reference of 13981013 pulses

The number of reference pulses must be calculated according to different references

When the single gear is used

When using the "reference unit" to move the workpiece 10mm, use 1 μm as the reference unit, and the movement of each pulse is 1 μm. When moving 10mm(10000um), "10000-1=10000 pulses", so input 10000 pulses.

There is no need to calculate the number of reference pulses according to different references

(1) Setting of the electronic gear ratio

Pn20E			
Electronic gear ratio (molecular)		Position	
Setting range	Setting unit	Factory setting	Effective time
1 ~ 1073741824	1	4	After power on again
Pn210			
Electronic gear ratio (denominator)		Position	
Setting range	Setting unit	Factory setting	Effective time
1 ~ 1073741824	1	1	After power on again

When the machine reduction ratio between the motor shaft and the load side is n/m (when the motor rotates m times, the load shaft rotates n times),

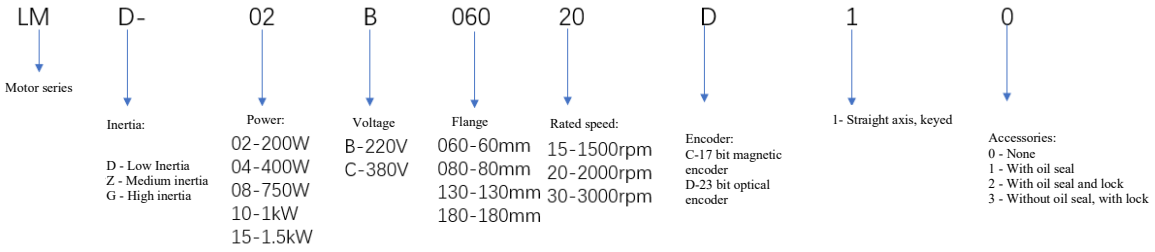
the electronic gear ratio is calculated by the following formula.

$$\text{Electronic gear ratio } \frac{B}{A} = \frac{Pn20E}{Pn210} = \frac{\text{Encoder resolution}}{\text{Movement of the load shaft in 1 turn (reference unit)}} \times \frac{m}{n}$$

■ Encoder resolution

The resolution of the encoder can be confirmed by the type of servo motor.

The naming rules for motor models are as follows:

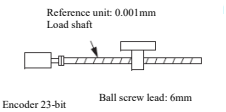
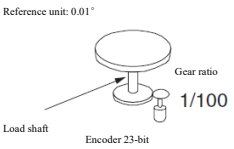
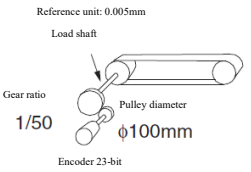


The setting range of the electronic gear ratio is as follows:

0.001 ≤ electronic gear ratio (B/A) ≤ 4000

When the setting of the electronic gear ratio exceeds this range, the driver will have an A. 040 alarm.

(2) Example of setting of electronic gear ratio

Steps	Content	Mechanical composition		
		Ball screw	Circular table	Belt + pulley
				
1	Machinery specifications	• Ball screw lead: 6mm • Gear ratio: 1/1	• Rotation angle of 1 turn: 360° • Gear ratio: 1/100	• Pulley diameter: 100mm (Girth of pulley: 314mm) • Gear ratio: 1/50
2	Encoder resolution	8388608 (23 bits)	8388608 (23 bits)	8388608 (23 bits)
3	Reference unit	0.001mm （1μm）	0.01°	0.005mm （5μm）
4	Movement of the load shaft in 1 turn (reference unit)	6mm/0.001mm = 6000	360°/0.01° =36000	314mm/0.005mm = 62800
5	Electronic gear ratio	$\frac{B}{A} = \frac{8388608}{6000} \times \frac{1}{1}$	$\frac{B}{A} = \frac{8388608}{36000} \times \frac{100}{1}$	$\frac{B}{A} = \frac{8388608}{62800} \times \frac{50}{1}$
6	Parameter	Pn20E：8388608 Pn210：6000	Pn20E：83886080 Pn210：3600	Pn20E：419430400 Pn210：62800

5.4.5 Setting of the smoothing function

The smoothing function is to filter the position reference to make the rotation of the motor smoother. The smoothing function has no effect on the number of input reference pulses received.

Smoothing function is recommended to apply in the following situations:

1. The position references entered do not speed up or down.
2. The reference pulse frequency is too low.

■ Related parameters

Change the parameters if the motor is stopped without the reference pulse input.

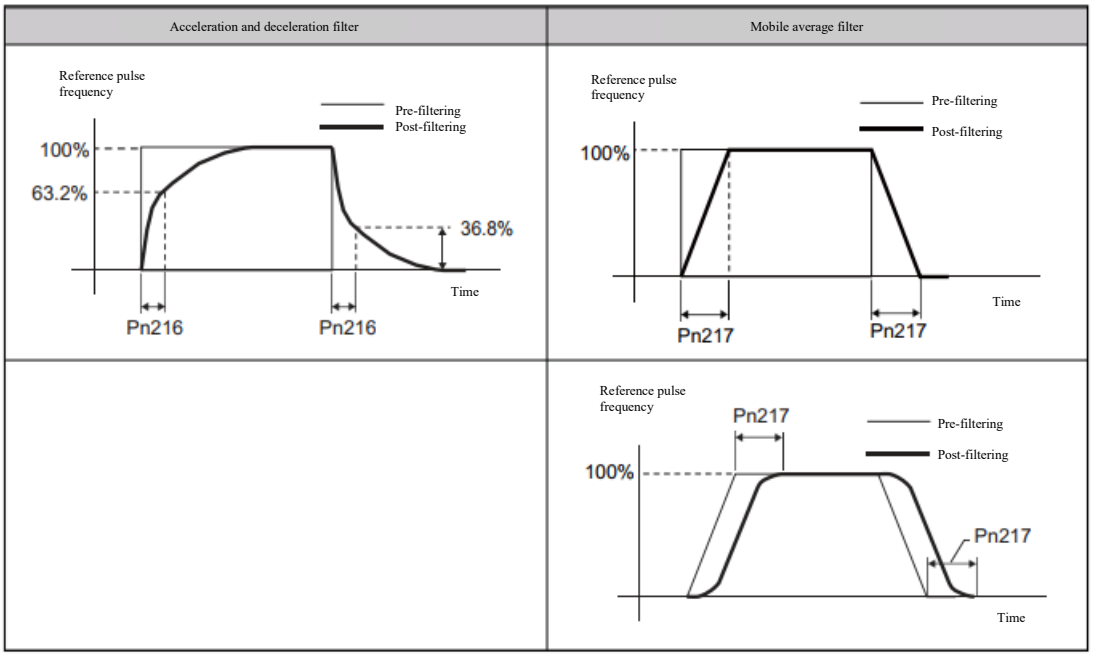
Pn216			
Position reference acceleration and deceleration time parameter		Position	
Setting range	Setting unit	Factory setting	Effective time
0 ~ 65535	0.1ms	0	After the change and motor stop
Pn217			
Average time of position reference movement		Position	
Setting range	Setting unit	Factory setting	Effective time
0 ~ 10000	0.1ms	0	After the change and motor stop

Additional note:

·The parameters do not take effect when Pn216 and Pn217 values are 0.

·The change of Pn216 and Pn217 during the motor rotation is also not effective, but only when the motor stops.

The filtering effects of Pn216 and Pn217 are shown below the figure.



5.4.6 Positioning completed output (/COIN) signal

When the deviation between the given position and the actual position of the motor is less than the Pn522 set value during position control, the driver outputs a positioning completion signal.

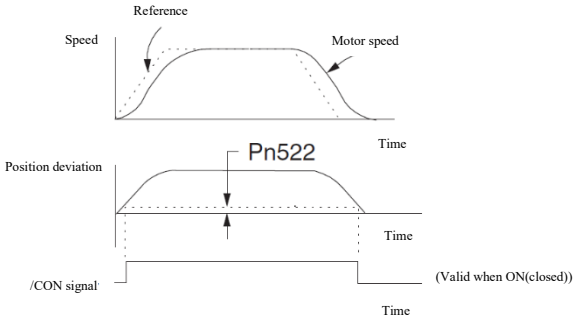
The upper device can confirm whether the positioning is complete by using this signal.

The positioning completed signal has no effect on the positioning accuracy.

Type	Signal name	Pin number	Output state	Description
Output	/COIN	CN1-5, 4 [Factory setting]	ON(closed)	Positioning completed
			OFF (open)	Positioning not completed

Positioning completed amplitude setting

Pn522			
Positioning completed width		Position	
Setting range	Setting unit	Factory setting	Effective time
0 ~ 1073741824	1 reference unit	7	With immediate effect



When the motor speed is low, the position deviation value will be small. If Pn522 is set too much, it will cause the positioning completed signal to be continuously outputted.

Set the output time for the positioning completed output (/COIN) signal

By setting Pn207.3, the conditions for the output of positioning completed signal can be changed, as shown in the following figure:

Pn207			
Parameter	Description		Effective time
n.0□□□ [Factory setting]	/COIN signal Output time	When the absolute value of position deviation is lower than Pn522, the positioning completed signal is output.	After power on again
n.1□□□		When the absolute value of the position deviation is lower than Pn522 and the position reference becomes 0 after filtering, the positioning completed signal is output.	
n.2□□□		When the absolute value of the position deviation is lower than Pn522 and the position reference input becomes 0, the positioning completed signal is output.	

5.4.7 Positioning near output (/NEAR) signal

positioning near output signal is generally used together with the positioning completed output signal.

When positioning in position mode, the upper device first confirms the positioning near signal, and then confirms the positioning completion signal. This can allow the upper device to be adequately prepared for positioning completion and reduce the positioning completion time.

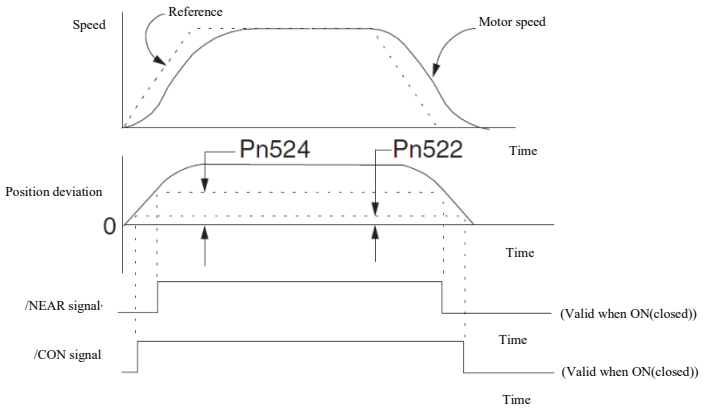
Type	Signal name	Pin number	Output state	Description
Output	/NEAR	To be assigned	ON(closed)	Output when the positioning completion approach point is reached.
			OFF (open)	Positioning completion approach point has not been reached.

Setting of positioning near output (/NEAR) amplitude

When the deviation between the given position and the actual position of the motor is less than the Pn524 set value, the driver outputs a positioning near signal.

Usually the value of Pn 524 is greater than that of Pn 522.

Pn524			
NEAR signal range		**Position**	
Setting range	Setting unit	Factory setting	Effective time
1 ~ 1073741824	1 reference unit	1073741824	With immediate effect



5.4.8 Reference pulse prohibition function

When the reference pulse suppression function is in effect during position control, the driver cannot receive the input of the reference pulse.

(1) When the input signal is assigned according to the factory settings (Pn50A = n.□□□0)

When Pn000 = n.□□B□, /P-CON signal is the reference pulse prohibition signal (factory setting)

Type	Signal name	Pin number	Setting	Description
Input	/P-CON	CN1-9 [Factory setting]	ON(closed)	Stop the counting of reference pulses.
			OFF (open)	Count the reference pulses.

Pn000			
Parameter	Control mode	Input signal used	Effective time
n.□□B□	Position control * position control with reference pulse suppression function	/P-CON	After power on again

(2) When the allocations of input signals should be changed (Pn50A = n.□□□1)

When Pn000.1 is set to 1/ 5/ 7/ 8, assign the /INHIBIT signal as reference pulse prohibition signal.

Assign /INHIBIT signals to the terminal through Pn50D.1 setting.

Type	Signal name	Pin number	Output state	Description
Input	/INHIBIT	allocations is required	ON(closed)	Stop the counting of reference pulses.
			OFF (open)	Count the reference pulses.

(3) Setting of the reference pulse suppression function

The reference pulse suppression function may be used when Pn000.1 is set to 1, 5, 7, 8 and B.

Pn000			
Parameter	Control mode	Input signal used	Effective time
n.□□1□	Position control	/INHIBIT	After power on again
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	
n.□□B□	Position control ⇔ position control with reference pulse suppression function	/INHIBIT	

5.5 Torque control

The torque control (analog reference) is selected through changing Pn000.1.

Pn000		
Parameter	Description	Effective time
n.□□2□	Torque control	After power on again

5.5.1 Basic settings of torque control

(1) torque reference input signal (T-REF)

The motor torque is proportional to the voltage, with the maximum input voltage DC±12V.

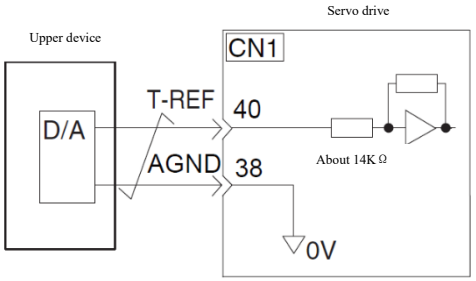
Type	Signal name	Pin number	Description
Input	T-REF	CN1-40	Torque reference input signal
	AGND	CN1-38	Signal grounding for torque reference input signal

Examples of the torque reference input are given as follows:

When Pn400 is set to 30, it represents the rated torque of the motor corresponding to the 3.0V voltage (factory setting)

Speed reference input	Rotation direction	Torque
+3V	Forward	Rated torque
+1V	Forward	1/3 rated torque
-1.5V	Reverse	1/2 rated torque

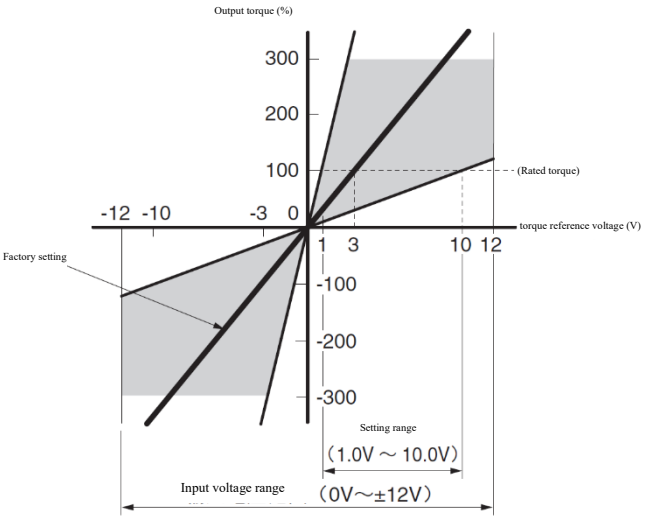
For position control through the upper device, connect it to the torque reference output terminal of the upper device.



(2) Setting of torque reference input gain (Pn400)

By setting Pn400, the corresponding relationship between the analog voltage of the torque reference (V-REF) and the rated torque of the motor can be changed.

Pn400			
torque reference input gain		Speed Position Torque	
Setting range	Setting unit	Factory setting	Effective time
10 ~ 100	0.1V	30 (Rated torque at 3.0V)	With immediate effect



When the output torque exceeds the rated output torque for a long time, an overload alarm of A.710 (instantaneous maximum) or A.720 (continuous maximum) will occur.

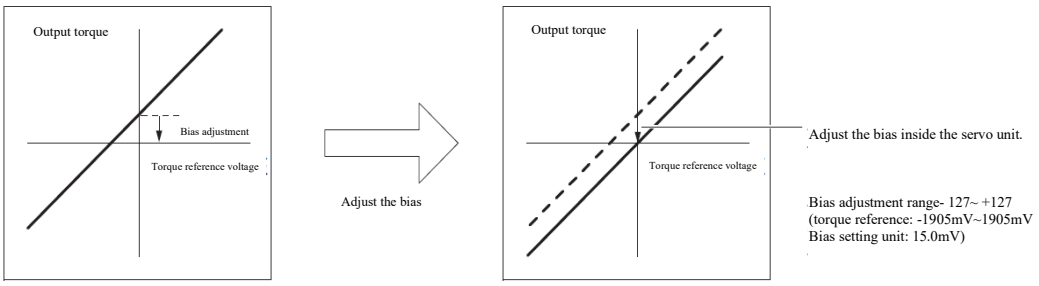
5.5.2 Tuning of the torque reference offset

During torque control, the servo motor may rotate at microspeed even if the torque reference input signal is 0v.

The reason for this is that the simulation reference sampled inside the servo drive has a minor deviation, which is called a bias.

When the motor rotates slightly, the reference offset function is used to eliminate the bias.

There are two ways of bias tuning, automatic (Fn009) and manual (Fn00B).



(1) Autotuning of torque reference offset

The autotuning of reference offset is to automatically measure the amount of bias and then automatically adjust the reference voltage.

The measured bias is saved in the servo drive.

Additional note:

·autotuning of reference offset is performed in the servo OFF state.

·After parameter initialization (Fn005) is performed, the bias tuning level will not be initialized.

·When the parameter writing forbid function (Fn010) is set to prohibit writing, Fn009 cannot be executed and the panel will display NO-OP.

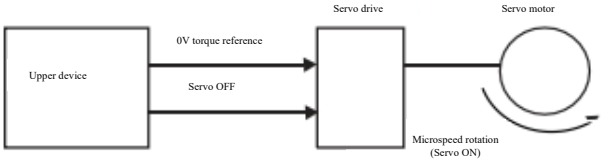
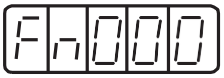
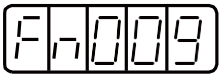
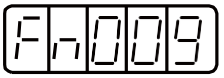
· When executing Fn009 in a non servo OFF state, Fn009 cannot be executed and the panel will display NO-OP.

· When the upper device has already constructed a position loop, the autotuning of reference offset is invalid. Please manually adjust the reference offset (Fn00B).

■ Operating steps

The steps to perform the autotuning of the reference offset through the panel are as follows.

(1) Manual tuning of torque reference offset

Steps	Panel display	Key	Operating reference
1			Turn the servo OFF and input 0V reference voltage from the upper device or external loop. 
2			Press the MOD key to select utility function.
3			Press UP or DOWN key to display Fn009 on the panel.
4			Press DATA/SHIFT key for about 1S to display "rEF_o".
5			Press the MOD key, "donE" will flash for about 1 second, and the panel will display as shown in the left.
6			Press the DATA/SHIFT key again for about 1S to return a display of Fn009.

(2) Manual tuning of torque reference offset (Fn00B)

Manual tuning of reference offset is the tuning by directly inputting the reference offset value.

Manual tuning of reference offset applies to the following occasions:

- A bias quantity needs to be set.
- To confirm the bias set by autotuning.

Notes:

·After parameter initialization (Fn005) is performed, the tuning level will not be initialized.

· When the parameter writing forbid function (Fn010) is set to prohibit writing, Fn00B cannot be executed and the panel will display NO-OP.

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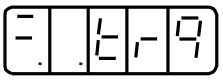
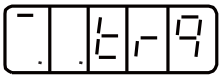
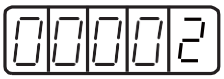
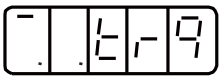
■ Operating steps

The steps to perform the manual tuning of the reference offset through the panel are as follows.

Steps	Panel display	Key	Operating reference
1			Press the MOD key to select utility function.
2			Press UP or DOWN key to display Fn00b on the panel.
3			Press (DATA/SHIFT) key about 1s and the panel is displayed on the left.
4			Turn the servo ON, and the panel display is shown in the left.
5			Press the DATA/SHIFT key for about 1S to display the current amount of bias.
6	 (Example)		Press UP or DOWN to adjust the bias.
7			Press the MOD key, "donE" will flash, and the panel will display as shown in the left.
8			Press the DATA/SHIFT key again for about 1S to return a display of Fn00b.

5.5.3 Setting of the torque reference input filter

The torque reference filter is a first-order delay filter applied to the input of the torque reference (T-REF) to make the torque reference smoother.

The torque reference input filter is set through Pn415 (T-REF filter time parameter).

When the set value of Pn415 is too large, it will reduce the responsiveness of torque references.

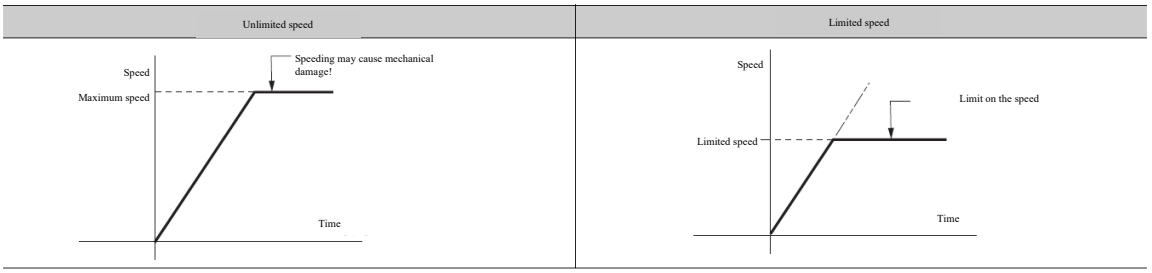
Pn415			
T-REF filtering time constant		Speed Position Torque	
Setting range	Setting unit	Factory setting	Effective time
0 ～ 65535	0.01ms	0	With immediate effect

5.5.4 Speed-limiting function during torque control

During torque control, the motor outputs a constant torque and does not control the motor speed.

If speed limitation is not applied, when the output torque of the motor is greater than the load torque, the motor speed will increase significantly, which may have adverse effects on the load end.

The actual limit speed of the motor will be different from the set limit speed of the motor.



(1) Speed limit detection output (/VLT) signal

The speed limit detection signal is output after the motor speed is limited.

/VLT signal needs to be freely allocated, and by setting Pn50F.1, the/VLT signal can be allocated to the terminals.

Type	Signal name	Pin number	Output state	Description
Output	/VLT	To be assigned	ON(closed)	Motor speed is limited.
			OFF (open)	Motor speed is not limited.

(2) Selection of the speed limit value

By setting Pn002.1, you can select the speed limit mode.

Pn002		
Parameter	Description	Effective time
n.□□0□ [Factory setting]	Pn407 setting value is used as the speed limit value. (Internal speed limit function)	After power on again
n.□□1□	Speed is limited by the input voltage of the V-REF and the set value of the Pn300. (External speed limit function)	

□ Internal speed limit function

At Pn002.1 = 0, limit the motor speed by Pn407.

By setting the Pn408.1, you can choose whether to limit the speed by checking the maximum motor speed or the overspeed alarm speed.

When the limit speed setting value is equal to the maximum speed, select the overspeed alarm detection speed to limit the speed.

Pn408		
Parameter	Description	Effective time
n.□□0□ [Factory setting]	The speed limit value uses the smaller value between the maximum motor speed and the Pn407 set value.	After power on again
n.□□1□	The speed limit value uses the smaller value between the overspeed detection speed and the Pn407 set value.	

Pn407			
Speed-limiting during torque control		Torque	
Setting range	Setting unit	Factory setting	Effective time
0 ~ 10000	1min-1	10000	With immediate effect

When the set value of Pn407 exceeds the maximum speed of the motor, the speed will be limited to the maximum speed of the motor or the speed detected by the overspeed alarm.

■ External speed limit function

At Pn002.1= 1, speed is limited by the input voltage of the V-REF and the set value of the Pn300.

The smaller value between the speed limit value of V-REF input voltage and the setting value of Pn407 is effective.

The speed limit value of the V-REF input voltage is not affected by the voltage polarity.

Type	Signal name	Pin number	Description
Input	V-REF	CN1-41	External speed limit input
	AGND	CN1-42	Signal grounding for external speed limit input

At Pn300 = 6.00, and when the input voltage of V-REF is 6V, the speed limit value is the rated speed of the motor.

Pn300			
Speed reference input gain		Speed Position Torque	
Setting range	Setting unit	Factory setting	Effective time
150 ~ 3000	0.01V	600	With immediate effect

5.6 internal set speed control

Internal speed control is the function of setting three motor speeds through the driver parameters, and then inputting external IO signals to control the speed and rotation direction.

(1) Input signal related to the internal set speed control

■ When the input signal is assigned in the factory setting state (Pn50A.0 = 0)

Type	Signal name	Pin number	Description
Input	/SPD-D	CN1-9	Switch the rotation direction of the servo motor.
	/SPD-A	CN1-30	Select the internal set speed.
	/SPD-B	CN1-12	Select the internal set speed.

■ Change the allocations of input signals (Pn50A.0 = 1)

Through the Pn50C settings, assign /SPD-A, /SPD-B and /SPD-D signals to each terminal.

Type	Pin number	Description
Input	To be assigned	Switch the rotation direction of the servo motor.
	To be assigned	Select the internal set speed.
	To be assigned	Select the internal set speed.

(2) Set the control mode into an internal set speed control

Set Pn000.1 to 3, and set the control mode to internal set speed control.

Pn000		
Parameter		Effective time
n.□□3□	The control mode selects the speed control using the internal set speed control.	After power on again

(3) Setting of internal speed control

The internal speed is set using parameters Pn301, Pn302, and Pn303.

Pn301			
Internal set speed 1		Speed	
Setting range	Setting unit	Factory setting	Effective time
0 ~ 10000	1min-1	100	With immediate effect
Pn302			
Internal set speed 2		Speed	
Setting range	Setting unit	Factory setting	Effective time
0 ~ 10000	1min-1	200	With immediate effect
Pn303			
Internal set speed 3		Speed	
Setting range	Setting unit	Factory setting	Effective time
0 ~ 10000	1min-1	300	With immediate effect

(4) Switch the internal set speed through the input signal

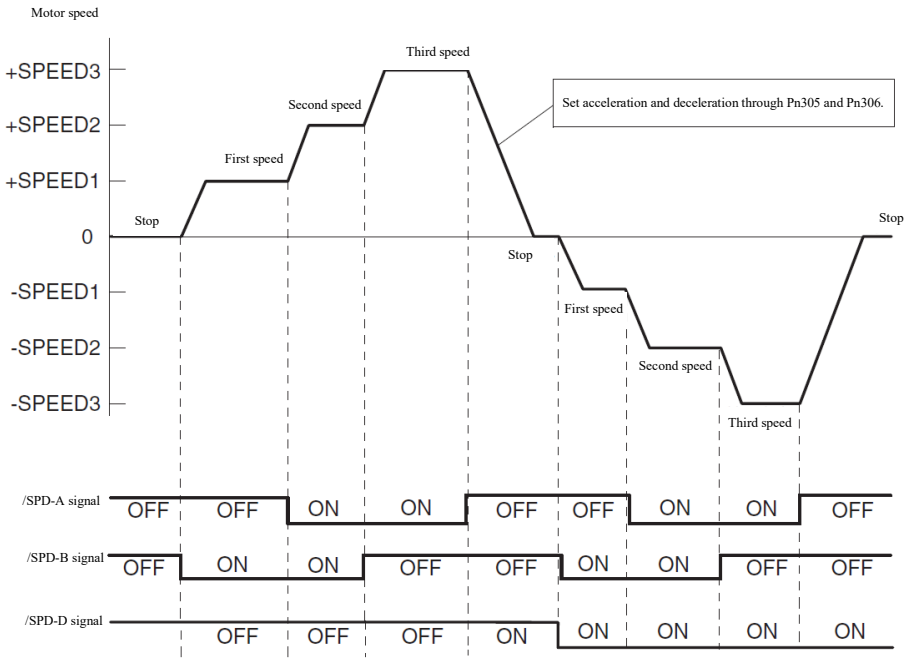
The internal set speed is selected by switching the /SPD-A and /SPD-B signal ON/OFF.

The direction of motor rotation is controlled by ON/OFF switching of the /SPD-D signal.

Input signal			Motor rotation direction	Running speed
/SPD-D	/SPD-A	/SPD-B		
OFF	OFF	OFF	Forward	Stop by internal speed 0.
	OFF	ON		Run at the internal set speed 1 set by Pn301.
	ON	ON		Run at the internal set speed 2 set by Pn302.
	ON	OFF		Run at the internal set speed 3 set by Pn303.
ON	OFF	OFF	Reverse	Stop by internal speed 0.
	OFF	ON		Run at the internal set speed 1 set by Pn301.
	ON	ON		Run at the internal set speed 2 set by Pn302.
	ON	OFF		Run at the internal set speed 3 set by Pn303.

(5) A running example of the internal set speed control

This example is used with a soft start function, which reduces the impact of speed switching.



5.7 Selection of the control mode combination

Two different control methods can be combined and switched for use.

The combination of control modes can be selected by the setting of Pn000.1.

Pn000		
Parameter	Control mode combination	Effective time
n.□□4□	Internal set speed control ⇔speed control	After power on again
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 clamping	
n.□□B□	Position control ⇔ position control with reference pulse suppression function	

5.7.1 When Pn000.1 is set to 4/ 5/ 6

(1) When the input signal is assigned in the factory setting state (Pn50A.0 = 0)

Switch the control mode and internal set speed via the /SPD-A and /SPD-B signal

During the rotation of the motor, position control, speed control and torque control can also be switched to internal speed control.

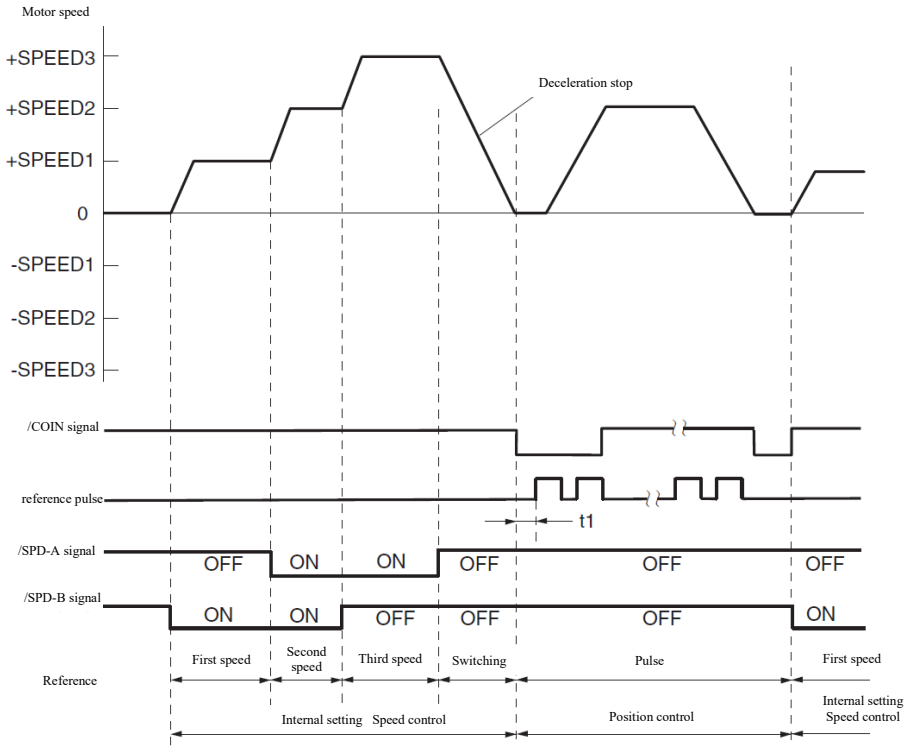
Input signal			Setting and action of Pn000.1		
/SPD-D (CN1-9)	/SPD-A (CN1-30)	/SPD-B (CN1-12)	n.□□4□	n.□□5□	n.□□6□
OFF	OFF	OFF	Speed Control	Position control	Torque control
	OFF	ON	Turn forward at the internal set speed 1 set by Pn301.		
	ON	ON	Turn forward at the internal set speed 2 set by Pn302.		
	ON	OFF	Turn forward at the internal set speed 3 set by Pn303.		
ON	OFF	OFF	Speed Control	Position control	Torque control
	OFF	ON	Turn reversely at the internal set speed 1 set by Pn301.		
	ON	ON	Turn reversely at the internal set speed 2 set by Pn302.		
	ON	OFF	Turn reversely at the internal set speed 3 set by Pn303.		

When switching from internal set speed control to position control, the motor first slows down and stops at the deceleration time set by Pn306, and then switches to position control.

When switching from internal set speed control to position control, please enter a pulse reference after successfully switching to position control.

At Pn000.1=5, the operating example for switching between internal set speed control and position control is shown below.

This example is used with a soft start function, which reduces the impact of speed switching.



Additional note:
·The t1 time should be greater than 2ms, and the t1 value is not affected by the soft start function.

·/The reading of SPD-A and/SPD-B signals will generate a maximum delay of 2ms.

(2) Change the allocations of input signals (Pn50A.0 = 1)

Switch control mode by ON/OFF of /C-SEL signal.

The /C-SEL signal can be assigned to the terminal by setting the Pn50C.3.

Type	Signal name	Plug pin number	Setting	Setting and control methods of Pn000		
				n.□□4□	n.□□5□	n.□□6□
Input	/C-SEL	To be assigned	ON(closed)	Speed Control	Position control	Torque control
			OFF (open)	internal set speed control	internal set speed control	internal set speed control

/The operation mode of internal set speed control is as follows when the /C-SEL signal is in the OFF state.

Input signal			Running speed
/SPD-D	/SPD-A	/SPD-B	
OFF	OFF	OFF	Stop by internal speed 0.
	OFF	ON	Turn forward at the internal set speed 1 set by Pn301.
	ON	ON	Turn forward at the internal set speed 2 set by Pn302.
	ON	OFF	Turn forward at the internal set speed 3 set by Pn303.
ON	OFF	OFF	Stop by internal speed 0.
	OFF	ON	Turn reversely at the internal set speed 1 set by Pn301.
	ON	ON	Turn reversely at the internal set speed 2 set by Pn302.
	ON	OFF	Turn reversely at the internal set speed 3 set by Pn303.

Through the Pn50C settings, assign /SPD-A, /SPD-B and /SPD-D signals to each terminal.

5.7.2 When Pn000.1 is set to 7/ 8/ 9

(1) When the input signal is assigned in the factory setting state (Pn50A.0 = 0)

Type	Signal name	Connector pin number	Setting	Setting and control methods of Pn000.1		
				n.□□7□	n.□□8□	n.□□9□
Input	/P-CON	CN1-9	ON(closed)	Speed Control	Torque control	Speed Control
			OFF (open)	Position control	Position control	Torque control

(2) Change the allocations of input signals (Pn50A.0 = 1)

The /C-SEL signal can be assigned to the terminal by setting the Pn50C.3.

Type	Signal name	Connector pin number	Setting	Setting and control methods of Pn000.1		
				n.□□7□	n.□□8□	n.□□9□
Input	/C-SEL	To be assigned	ON(closed)	Speed Control	Torque control	Speed Control
			OFF (open)	Position control	Position control	Torque control

5.7.3 When Pn000.1 is set to A or B

(1) When the input signal is assigned in the factory setting state (Pn50A.0 = 0)

Type	Signal name	Connector pin number	Setting	Setting and control methods of Pn000.1	
				n.□□A□	n.□□B□
Input	/ZCLAMP	CN1-9	ON(closed)	Speed control with zero clamping	-
			OFF (open)	Speed Control	-
	/INHIBIT		ON(closed)	-	Position control with the reference pulse suppression function
			OFF (open)	-	Position control

(2) Change the allocations of input signals (Pn50A.0 = 1)

The /ZCLAMP signal can be assigned to the terminal by setting the Pn50D.0.

Assign /INHIBIT signals to the terminal through Pn50D.1 setting.

Type	Signal name	Connector pin number	Setting	Setting and control methods of Pn000.1	
				n.□□A□	n.□□B□
Input	/ZCLAMP	To be assigned	ON(closed)	Speed control with zero clamping	-
			OFF (open)	Speed Control	-
	/INHIBIT		ON(closed)	-	Position control with the reference pulse suppression function
			OFF (open)	-	Position control

5.8 Selection of the torque limit

Torque limit is a function that limits the output torque of the servo motor.

When the set value exceeds the maximum torque of the motor, the actual torque is limited to the maximum torque of the motor.

There are four ways to limit torque:

Control mode	Description
Internal torque limit	Torque is always constrained by the parameters.
External torque limit	The torque is limited by the input signal from the upper device.
Torque limit based on analog reference	Torque is arbitrarily limited by analog reference.
Torque limit based on external torque limit + analog reference	Simultaneously use external input signal torque limit and analog reference torque limit.

5.8.1 Internal torque limit

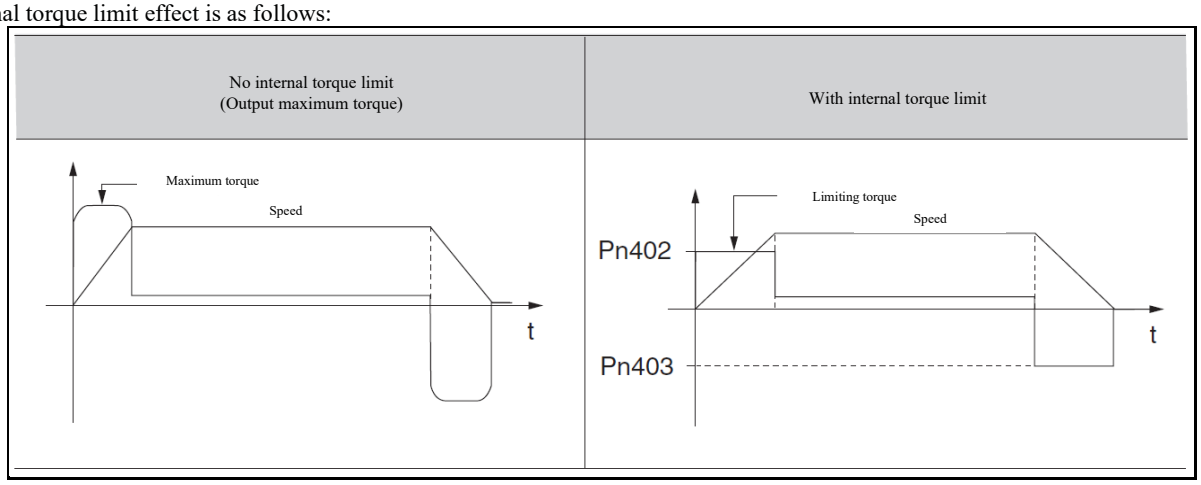
The internal torque limit limits the maximum output torque through the torque limit values set by Pn402 and Pn403.

Setting the values of Pn402 and Pn403 too small can result in insufficient torque during acceleration and deceleration.

Set the unit as the percentage of the relative motor rated torque.

Pn402			
Forward torque limit		Speed Position Torque	
Setting range	Setting unit	Factory setting	Effective time
0 ~ 800	1%	800	With immediate effect
Pn403			
Reverse torque limit		Speed Position Torque	
Setting range	Setting unit	Factory setting	Effective time
0 ~ 800	1%	800	With immediate effect

The internal torque limit effect is as follows:



5.8.2 External torque limit

External torque limit is the limitation of torque through external input signals.

(1) A reference signal for external torque limit

External torque limit signals include forward external torque limit input signal (/P-CL) and reverse external torque limit input signal (/N-CL).

The /P-CL signal can be assigned to the terminal by setting the Pn50B.2.

The /N-CL signal can be assigned to the terminal by setting the Pn50B.3.

Type	Signal name	Pin number	Setting	Description
Input	/P-CL	CN1-30 [Factory setting]	ON(closed)	The forward external torque limit is ON. Limiting value: The smaller value in the set values of Pn402 and Pn404
			OFF (open)	The forward external torque limit is OFF. Limiting value: Pn402
Input	/N-CL	CN1-12 [Factory setting]	ON(closed)	The reverse external torque limit is ON. Limiting value: The smaller value in the set values of Pn403 and Pn405
			OFF (open)	The reverse external torque limit is OFF. Limiting value: Pn403

(2) Setting of torque limits

Set the unit as the percentage of the relative motor rated torque.

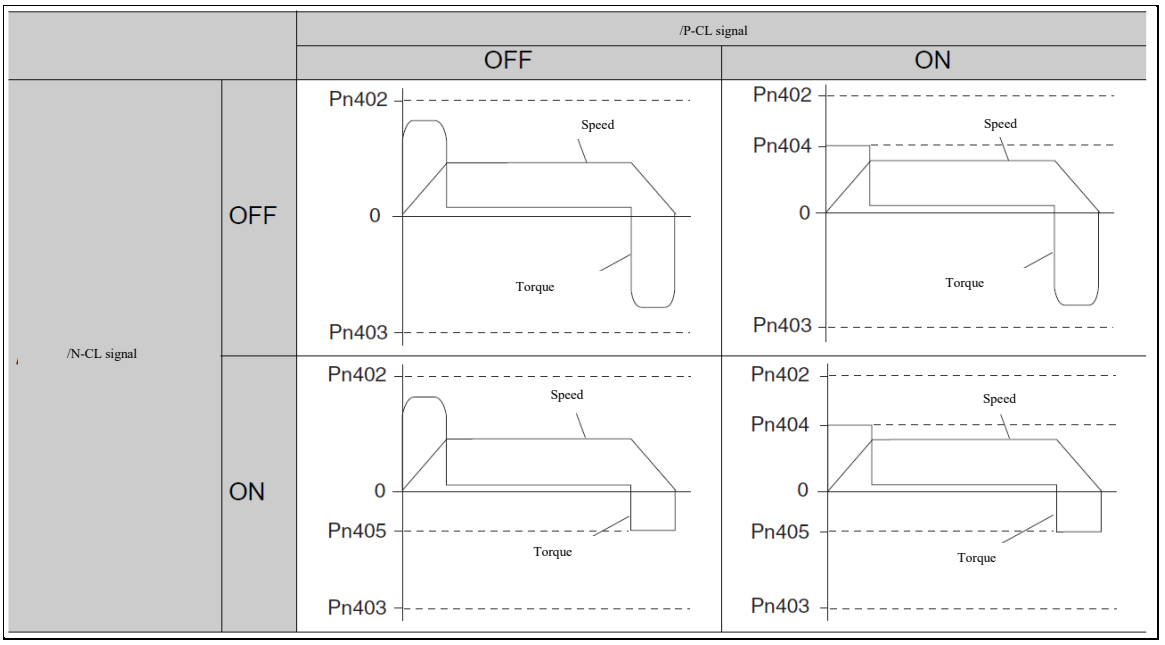
The values of Pn402, Pn403, Pn404, and Pn405 are set too small, resulting in insufficient torque during acceleration and deceleration.

Pn402	**Forward torque limit**		Speed	Position	Torque
	Setting range	Setting unit	Factory setting	Effective time	
	0 ~ 800	1%	800	With immediate effect	
Pn403	Reverse torque limit		Speed	Position	Torque
	Setting range	Setting unit	Factory setting	Effective time	
	0 ~ 800	1%	800	With immediate effect	
Pn404	External torque limit on the forward side		Speed	Position	Torque
	Setting range	Setting unit	Factory setting	Effective time	
	0 ~ 800	1%	100	With immediate effect	
Pn405	External torque limit on the reverse side		Speed	Position	Torque
	Setting range	Setting unit	Factory setting	Effective time	
	0 ~ 800	1%	100	With immediate effect	

(3) Output torque change at the external torque limit

The direction of motor rotation is taken as the direction when Pn000.0=0 (CCW is forward rotation).

The external torque limit effect is as follows:



5.8.3 Torque limit based on analog reference

The torque limit based on analog reference is achieved by inputting analog voltage through T-REF (CN1-40, 38) and limiting the torque through voltage magnitude.

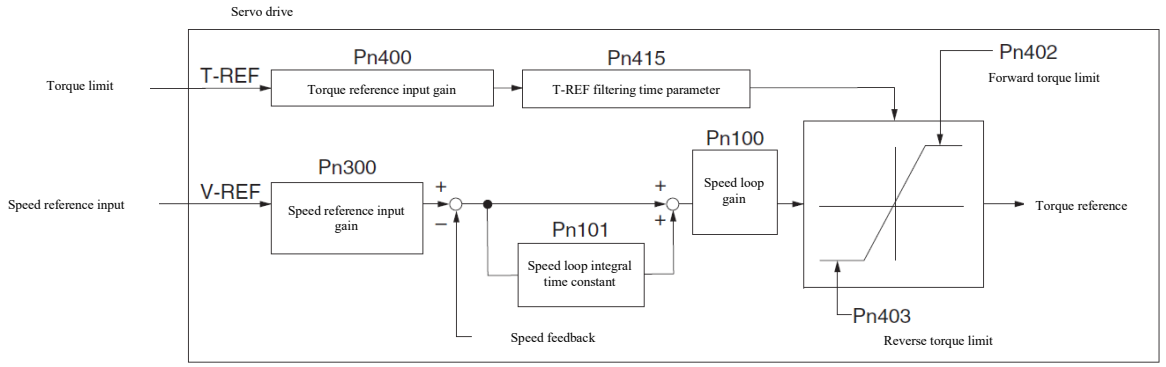
The torque limit based on analog reference is effective for speed control position control, but not for torque control.

The analog input voltage for torque limiting is non-polar, and the voltage acts on both forward and reverse directions.

The smaller torque limit value of the analog reference compared to the torque limit values of Pn402 and Pn403 is used as the limit value.

Pn002		
Parameter	Description	Effective time
n.□□□1	Use the T-REF terminal as an external torque limiting input terminal.	After power on again

The limit block diagram under speed control is as follows.



(1) Torque reference input (T-REF) signal

Type	Signal name	Pin number	Description
Input	T-REF	CN1-40	torque reference input signal
	AGND	CN1-38	Signal grounding for torque reference input signal

(2) Setting of external torque limits

At Pn002.0=1, T-REF (CN1-40, 38) is used as the input terminal for torque limit.

Pn002		
Parameter	Description	Effective time
n.□□□1	Use the T-REF terminal as an external torque limiting input terminal.	After power on again

(3) Setting of the analog voltage reference torque limit

The relevant parameters of analog voltage reference torque limit are divided into input gain of analog voltage reference, time parameter of reference filter, and internal torque limit value.

Pn400	Torque reference input gain		Speed	Position	Torque
	Setting range	Setting unit	Factory setting	Effective time	
	10 ~ 100	0.1V	30 (Rated torque at 3.0V)	With immediate effect	
Pn402	Forward torque limit		Speed	Position	Torque
	Setting range	Setting unit	Factory setting	Effective time	
	0 ~ 800	1%	800	With immediate effect	
Pn403	Reverse torque limit		Speed	Position	Torque
	Setting range	Setting unit	Factory setting	Effective time	
	0 ~ 800	1%	800	With immediate effect	
Pn415	T-REF filtering time constant		Speed	Position	Torque
	Setting range	Setting unit	Factory setting	Effective time	
	0 ~ 65535	0.01ms	0	With immediate effect	

5.8.4 Torque limit based on external torque limit + analog reference

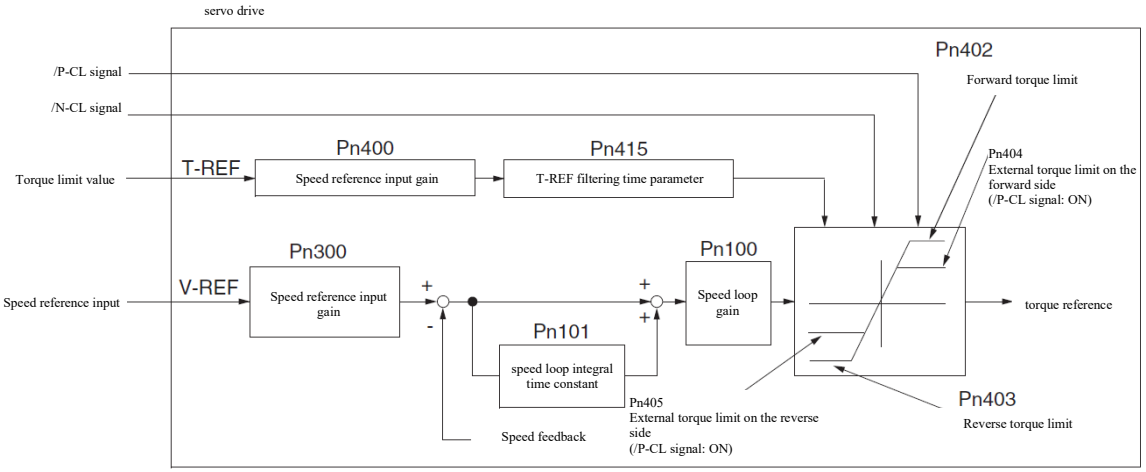
This torque limit mode uses both external input signals and analog voltage references.

The torque limit based on analog reference is effective for speed control position control, but not for torque control.

When the /P-CL or /N-CL signal is ON, the smaller torque limit value of the analog reference compared to the torque limit values of Pn404 and Pn405 is used as the limit value.

Pn002		
Parameter	Description	Effective time
n.□□□3	When /P-CL and N-CL are effective, use the T-REF terminal as an external torque limiting input terminal.	After power on again

The limit block diagram of the external torque limit + analog voltage reference is shown below.



(1) Forward/reverse external torque limit input (/P-CL /N-CL) signal and torque reference input (T-REF)
Signal torque reference input (T-REF) signal

Type	Signal name	Pin number	Description
Input	T-REF	CN1-40	Torque reference input signal
	AGND	CN1-38	Signal grounding for torque reference input signal

Forward/reverse the external torque limit input (/P-CL /N-CL) signal

Type	Signal name	Pin number	Setting	Description
Input	/P-CL	CN1-30 [Factory setting]	ON	The forward external torque limit is ON. Limiting value: The smaller value in the set values of analog reference, Pn402 and Pn404
			OFF	The forward external torque limit is OFF. Limiting value: Pn402
Input	/N-CL	CN1-12 [Factory setting]	ON	The reverse external torque limit is ON. Limiting value: The smaller value in the set values of analog reference, Pn403 and Pn405
			OFF	The reverse external torque limit is OFF. Limiting value: Pn403

(2) Torque limit setting based on external torque limit + analog voltage reference

When Pn002.0=3, both the torque limit of the external input signal and the torque limit of the analog voltage reference are used simultaneously.

Pn002	
Parameter	Effective time
When /P-CL and N-CL are effective, use the T-REF terminal as an external torque limiting input terminal.	After power on again

(3) Related parameters

The internal torque limit is always effective. To make the internal torque limit invalid, the corresponding parameters (Pn402, Pn403, Pn483, Pn484) can be set to the maximum value.

Pn400	torque reference input gain		Speed	Position	Torque
	Setting range	Setting unit	Factory setting	Effective time	
	10 ~ 100	0.1V	30 (Rated torque at 3.0V)	With immediate effect	
Pn402	Forward torque limit		Speed	Position	Torque
	Setting range	Setting unit	Factory setting	Effective time	
	0 ~ 800	1%	800	With immediate effect	
Pn403	Reverse torque limit		Speed	Position	Torque
	Setting range	Setting unit	Factory setting	Effective time	
	0 ~ 800	1%	800	With immediate effect	
Pn404	External torque limit on the forward side		Speed	Position	Torque
	Setting range	Setting unit	Factory setting	Effective time	
	0 ~ 800	1%	100	With immediate effect	
Pn405	External torque limit on the reverse side		Speed	Position	Torque
	Setting range	Setting unit	Factory setting	Effective time	
	0 ~ 800	1%	100	With immediate effect	
Pn415	T-REF filtering time constant		Speed	Position	Torque
	Setting range	Setting unit	Factory setting	Effective time	
	0 ~ 65535	0.01ms	0	With immediate effect	

5.8.5 Torque limit detection output (/CLT) signal

This signal is output when the motor is in a torque limit state.

The /CLT signal can be assigned to the terminal by setting the Pn50F.0.

Type	Signal name	Pin number	Output state	Description
Output	/CLT	To be assigned	ON(closed)	Motor output torque is limited.
			OFF (open)	Motor output torque is not limited.

5.9 Absolute encoder

The absolute encoder will still remember the current position of the stop position even after the power is turned off.

In the absolute encoder system, the current position can be obtained through the upper controller, without the need to perform the origin return action when the system is powered on.

In order to save the position data of the absolute encoder, a battery needs to be installed.

Install the battery on the battery cell of the encoder cable with the cell or directly to the encoder cable.

If the battery is not installed on the driver side, install the battery in the upper device.

Do not install batteries on both sides of the upper unit and battery unit. (If the battery is installed on both the upper device and the encoder cable, a cycle loop will form between the batteries, causing product damage or burn.)

At Pn002.2 = 0, use the absolute encoder.

At Pn002.2 = 1, the absolute encoder is used as an incremental encoder, without the need of SEN signal or battery.

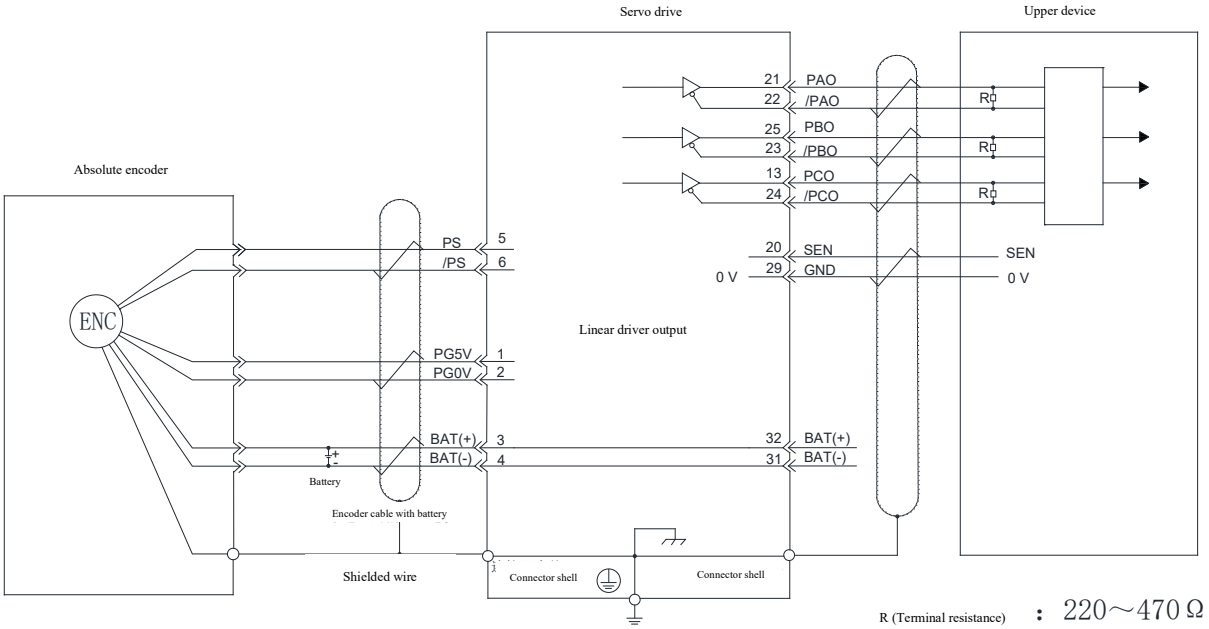
Pn002		
Parameter	Description	Effective time
n.□0□□ [Factory setting]	absolute encoders are used normally	After power on again
n.□1□□	Use the absolute encoder as an incremental encoder.	

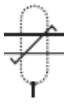
The multi-turn data output range of the absolute encoder is as follows:

Resolution	Output range of multi-turn data	Operation when exceeding the limit
17-bit 23-bit	-32768 ~ +32767	When higher than the upper limit in the forward direction (+32767): Multiturn data = -32768 When lover than the lower limit in the reverse direction (- 32768): Multiturn data = +32767 When the maximum number of turns (Pn205) is changed, the forward and reverse movements will change.

5.9.1 Connection of the absolute encoder

(1) When using an encoder cable with batteries

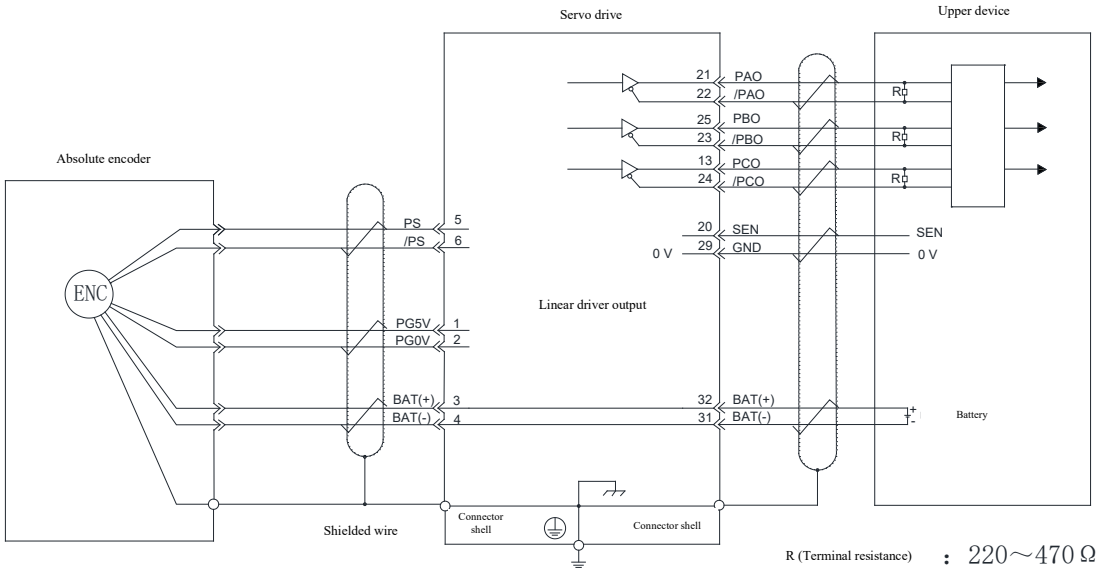


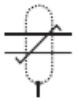


Indicates a twisted shielded cable.

When installing the battery on the encoder cable, do not install the battery on the upper device.

(2) When the battery is mounted on the upper device





It indicates a twisted shielded cable.

When installing the battery in the upper device, do not install the battery on the encoder cable again.

5.9.2 Replace the battery

When the battery voltage is below 2.7V, the driver will display encoder battery alarm (A.830) or absolute encoder battery exception warning (A.930).

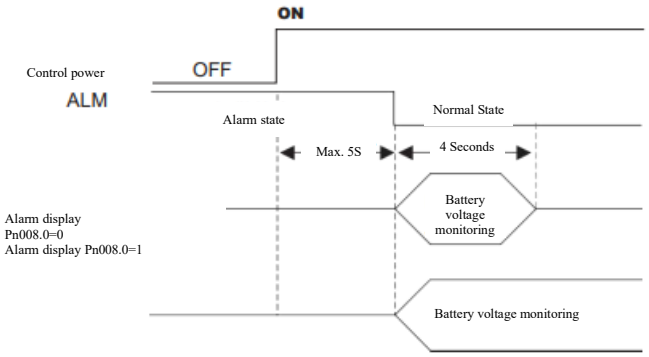
When A.830 or A.930 alarm occurs, the battery needs to be replaced.

The Pn008.0 Settings can be used to select whether to display an alarm (A.830) or A warning (A.930) when the battery is under voltage.

Pn008		
Parameter	Description	Effective time
n.□□□0 [Factory setting]	Display an alarm when the battery is undervoltage (A.830)	After power on again
n.□□□1	Display a warning when the battery is undervoltage (A.930)	

At Pn008.0 = 0: After the control power is turned on, an ALM signal of up to 5 seconds is output, and the battery voltage is monitored for 4 seconds. After 4 seconds, the battery voltage is no longer monitored, and even if the battery voltage drops below the specified value, no alarm is displayed.

At Pn008.0 = 1: After the control power is connected, output the ALM signal for 5S at most and monitor the battery voltage.



5.9.3 Setting of the absolute encoder (initialization)

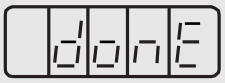
Initialize the absolute encoder in the following situations:

1. The driver motor is used for the frist time.
2. An encoder backup alarm occurs (A.810).
3. An encoder and number check alarm occurs (A.820).
4. To clear the absolute encoder multi-turn data.

The considerations for performing the absolute encoder initialization are as follows:

1. The parameter writing forbid function (Fn010) cannot be set to "no writing".
2. Perform initialization in the server OFF state.
3. The encoder backup alarm (A.810) and encoder sum check alarm (A.820) cannot be restored by the alarm reset signal and must be removed by the operation of Fn008.
4. When the encoder internal monitoring alarm (A.8XX) occurs, do not disable the alarm by restarting the servo.
5. After initializing the encoder, the multi-turn data ranges from -2 turns to+2 turns. The reference position of the machine will change due to the initialization operation, and it is necessary to reset the reference position of the machine.
6. Running the machine without positioning the upper device may result in unexpected mechanical movements, leading to personal accidents or mechanical damage. Please run the machine carefully.

(1) Basic setup (initialization) steps

Steps	Panel display	Key	Operating reference
1			Press the MOD key to select utility function.
2			Press UP or DOWN key to display Fn008 on the panel.
3			Press the DATA/SHIFT key again for about 1S and the panel displays PGCL1.
4			Hold down the UP key until the panel displays PGCL5.
5			Press MOD key to initialize the absolute encoder. After initialization, the panel flashes donE for about 1S.
6			After donE is displayed, the PGCL5 display is returned.
7			Press the DATA/SHIFT key again for about 1S to return a display of Fn008.
8	To make the setting effective, please restart the power supply.		

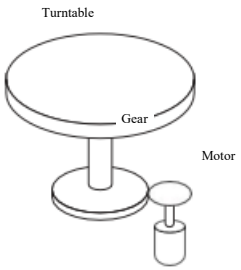
5.9.4 Setting the upper limit of multiturn

When controlling the position of the turntable such as the rotary table, the upper limit of multiturn can be set

For example, the turntable in the following figure is always rotating in one direction.

Because of the one-way rotation, the multiturn will eventually exceed the upper limit of multiturn of the absolute encoder.

In order to maintain an integer ratio between the multiturn of the motor and the turntable, the upper limit of multiturn can be set.



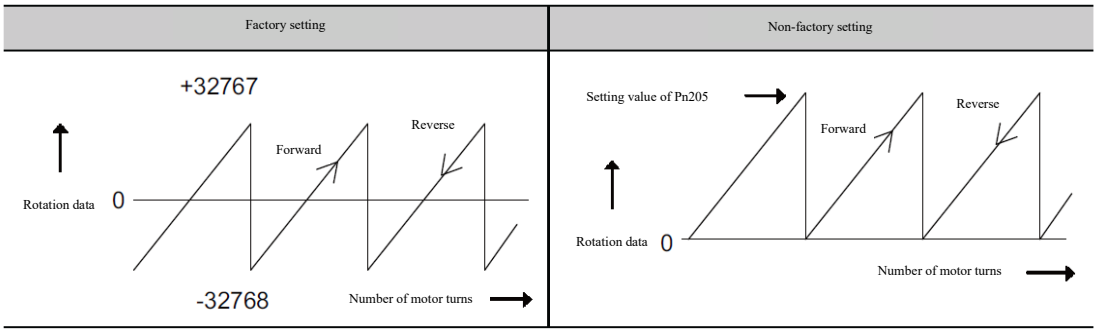
Assuming that the gear ratio between the turntable and the motor in the figure above is n:m, then the upper limit of multiturn is set to M-1, that is, Pn205 = M-1

Pn205			
Upper limit of multiturn		Speed Position Torque	
Setting range	Setting unit	Factory setting	Effective time
0 ~ 65535	1Rev	65535	After power on again

This setting is only valid when using absolute encoder.

After the value of Pn205 is changed, the changes in multiturn data are explained as follows:

1. If the number of rotations is 0 and the motor starts to reverse, the rotation amount data becomes the set value of Pn205.
2. If the rotation data is the set value of Pn205 and the motor starts to rotate forward, then the rotation data becomes 0.

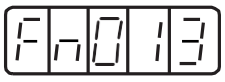
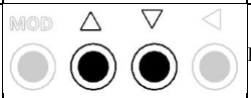
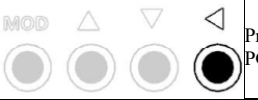
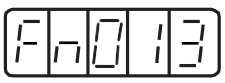


5.9.5 When there is an alarm (A.CC0) indicating that the upper limit of multiturn is inconsistent

After the value of Pn205 is modified, the upper limit of multiturn will not correspond to the actual upper limit of the encoder's rotations, resulting in an alarm for the driver's inconsistent upper limit of rotations.

Display	Name	Alarm code output			Description
		AL01	AL02	AL03	
A.CC0	The upper limit of multiturn is inconsistent	ON (L)	OFF (H)	ON (L)	The upper limit of multiturn of the encoder and the servo drive is inconsistent.

The upper limit of multiturn inside the encoder can be set in line with the Pn205 by following steps.

Steps	Panel display	Key	Operating reference
1			Press the MOD key to select utility function.
2			Press UP or DOWN key to display Fn013 on the panel.
3			Press the DATA/SHIFT key again for about 1S and the panel displays PGSEt.
4			Press MOD key. The upper limit of the internal multiturn of the encoder is set to be consistent with Pn205. After the operation is completed, donE flashes for about 1 second.
5			After donE is displayed, the PGSEt display is returned.
6			Press the DATA/SHIFT key again for about 1S to return a display of Fn013.
7	To make the setting effective, please restart the power supply.		

5.10 Other output signals

5.10.1 Warning output signal (/WARN)

(1) Signal specification

The /WARN signal is assigned through the Pn50F.3 setting.

Type	Signal name	Pin number	Output state	Description
Output	/WARN	To be assigned	ON(closed)	Abnormal warning state (warning state)
			OFF (open)	Normal State

5.10.2 Rotation detection output signal (/TGON)

When the actual speed of the motor exceeds the Pn502 set value, output the rotation detection signal.

(1) Signal specification

/TGON signal is assigned to other terminals by setting the Pn50E.2.

Type	Signal name	Connector pin number	Output state	Meaning
Output	/TGON	CN1-3, 2 [Factory setting]	ON(closed)	The servo motor is rotating at a speed above the Pn502 setting value
			OFF (open)	The servo motor is rotating at a speed below the Pn502 setting value

(2) Related parameters

Pn502			
Rotation detection		Speed Position Torque	
Setting range	Setting unit	Factory setting	Effective time
1 ~ 10000	1min-1	20	With immediate effect

5.10.3 Servo-ready output signal (/S-RDY)

When the /S-ON signal is ON, the driver outputs the /S-RDY signal.

The output /S-RDY signal needs to meet the following conditions:

1. main circuit power supply ON
2. The driver has no alarm.
3. When using an absolute encoder, the SEN signal is ON After the SEN signal is turned on, the/S-RDY signal can only be output after outputting absolute value data to the upper device.

(1) Signal specification

/S-RDY signal is assigned to other terminals by setting the Pn50E.3.

Type	Signal name	Pin number	Setting	Description
Output	/S-RDY	CN1-7, 6 [Factory setting]	ON(closed)	Able to receive the servo ON (/S-ON) signal status
			OFF (open)	Unable to receive the servo ON (/S-ON) signal status

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06 Chapter VI

Tuning

6.1 Adjust functions and processes

Tuning refers to tuning the servo gain of a servo drive, such as speed loop gain, position loop gain, filter, friction compensation, moment of inertia ratio, etc., through a combination of multiple parameters to optimize system responsiveness. The parameters will affect each other, so when setting, it is necessary to consider that the balance responsiveness between the set values of each parameter depends on the servo gain set in the servo drive.

The factory setting of the servo gain is stable. The user can further improve the responsiveness by tuning the servo gain according to the state of the machine using the following utility functions, all of which are related to the servo tuning. If advanced autotuning without reference is used, the related multiple parameters are automatically adjusted, so there is no need to adjust them separately.

In general, for machinery with high rigidity, increasing servo gain can improve responsiveness; However, for machinery with low rigidity, increasing servo gain may cause vibration, and therefore cannot improve responsiveness. At this time, the vibration can be suppressed by various vibration suppression functions of the servo drive.

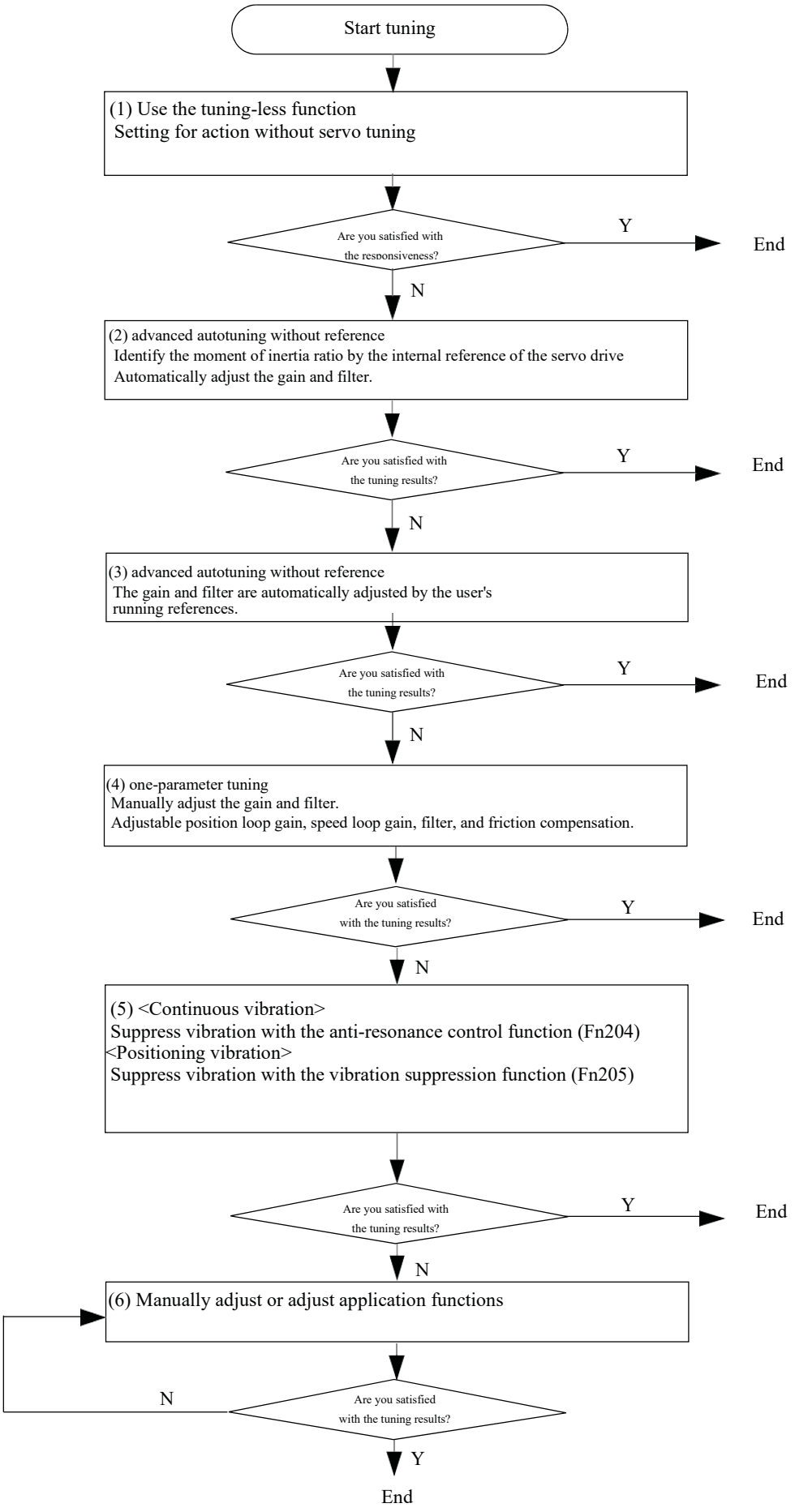
6.1.1 Tuning function

Tuning function	Summary	Usable Control mode	Operating tool	
			Panel	DriveKey
Self-tuning (Fn200)	Autotuning function that stabilizes the motion without servo tuning. Regardless of the type of machine and load fluctuations, stable response can be achieved. The factory setting is invalid for this function.	Speed Control Position control	○	○
Advanced autotuning without reference (Fn201)	The servo drive runs automatically according to the internal references, along with the following autotunings. · Moment of inertia ratio · Gain (position loop gain, speed loop gain, etc.) · Filter (torque reference filter, notch filter) · Friction compensation · anti-resonance control · Vibration suppression	Speed Control Position control	×	○
Advanced autotuning without reference (Fn202)	The servo drive runs following the external input references, along with the following autotunings. · Gain (position loop gain, speed loop gain, etc.) · Filter (torque reference filter, notch filter) · Friction compensation · anti-resonance control · Vibration suppression	Position control	×	○
one-parameter tuning (Fn203)	The servo drive operates in accordance with externally input position references or speed references while making the following tunings. · Gain (position loop gain, speed loop gain, etc.) · Filter (torque reference filter, notch filter) · Friction compensation · anti-resonance control	Speed Control Position control	△	○
Anti-resonance control function (Fn204)	This function is used to suppress the continuous vibration.	Speed Control Position control	×	○
Vibration suppression function (Fn205)	This function is used to suppress residual vibration during positioning.	Position control	×	○
Adjust application functions	Functions used in combination with autotuning and single-parameter tuning. Can improve the tuning results	It varies by function	△	○
Manual tuning	Manually adjust the servo gain and adjust the response characteristics.	Speed control, position control	○	○

○: Operability
△: Operable, but limited in some functions
×: Inoperable

6.1.2 Tuning process

The following is the flow chart of the tuning. Please adjust the machine according to the state and operating conditions.



6.1.3 Safety precautions during tuning

When making tunings, be sure to comply with the following requirements:

- Do not touch the motor rotation axis when the servo is ON or the motor is rotating.
- When the servo motor is running, it can be in a state of emergency stop at any time.
- Verify that the test run is normal, and then adjust it.
- Set the stop device on the mechanical side to ensure safety.

When tuning, please correctly set the following servo drive protection function.

(1) Overtravel setting

Please refer to "5.2.3 overtravel" to set the overtravel.

(2) Torque limit setting

The torque limiting function is the function of calculating the maximum torque required for normal mechanical operation, and limiting the output torque to ensure that the actual torque does not exceed this value, in order to achieve the purpose of reducing the impact of mechanical interference or collision failure. If the torque is set below the value required for normal operation, overshooting or vibration may occur.

Refer to the "5.8 Selection of the torque limit".

(3) Set the alarm value of position deviation overflow

The alarm with position deviation overflow takes effect when using the servo drive for position control, and can play an effective protection function.

By setting the appropriate position deviation overflow alarm level, the anomaly can be detected when the motor action is inconsistent with the reference, so that the motor can stop running. Position deviation refers to the difference between the position reference value and the actual position.

Position deviation can be represented by position ring gain (Pn 102) and motor speed.

$$\text{Position deviation [reference unit]} = \frac{\text{Motor speed (min-1)}}{60} \times \frac{\text{Encoder resolution}}{\text{Pn102 [0.1/s] /10}} \times \frac{\text{Pn210}}{\text{Pn20E}}$$

(Pn520) Alarm value of position deviation overflow[Set unit: 1 reference unit]

$$\text{Pn520} > \frac{\text{Maximum motor speed [min-1]}}{60} \times \frac{\text{Encoder resolution}}{\text{Pn102 [0.1/s] /10}} \times \frac{\text{Pn210}}{\text{Pn20E}} \times \underline{\underline{(1.2 \sim 2)}}$$

The "x (1.2-2)" in the double underlined section is a redundancy factor to avoid frequent occurrence of position deviation overflow alarms (A.d00).

Under normal circumstances, as long as the above relationship is maintained for setting, there will be no position deviation overflow alarm during operation.

When the position deviation occurs because the motor action does not conform to the reference, the abnormal situation will be detected and the motor will stop running.

Example:

Maximum motor speed: 6000, encoder resolution: 8388608 (23-bit), when Pn102 = 400 and electronic gear ratio is 1

$$\text{Pn520} = \frac{6000}{60} \times \frac{8388608}{400/10} \times \frac{1}{1} \times 2$$

$$= 20971520 \times 2$$

$$= 41943040$$ Factory setting of Pn520

When the acceleration and deceleration of the position reference exceed the response capability of the servo motor, the following will lag greatly, resulting in position deviation that cannot meet the above relationship. Please reduce the speed of the position reference to a value that the servo motor can respond to, or increase the position deviation overflow alarm level.

■ Related parameters

Pn520			
Alarm value of position deviation overflow		Position	
Setting range	Setting unit	Factory setting	Effective time
1 ~ 1073741823	1 reference unit	41943040	With immediate effect

■ Related alarm

Alarm number	Alarm name	Alarm content
A.d00	position deviation overflow alarm	The position deviation exceeds the alarm value of position deviation overflow(Pn520)

(4) Vibration detection function setting

Initialize the detection value through vibration detection (Fn01B) and set an appropriate value for the vibration detection function. Refer to " 7.16 Initialize the vibration detection values (Fn01B)"

(5) Set the alarm value of position deviation overflow when the servo is ON

When the servo is set to ON in the state of accumulated position deviation, the motor will return to its initial position to make the position deviation "0", which may cause danger. To avoid such situations, set an alarm value of position deviation overflow when the servo is turned on, and limit the action.

The relevant parameters and alarms are shown below.

■ Related parameters

Pn526			
Alarm value of position deviation overflow when the servo is on		Position	
Setting range	Setting unit	Factory setting	Effective time
1 ~ 1073741823	1 reference unit	**41943040**	With immediate effect

Pn528			
Warning value of position deviation overflow when the servo is ON		Position	
Setting range	Setting unit	Factory setting	Effective time
10 ~ 100	**1%**	**100**	With immediate effect

Pn529			
Speed limit value when the servo is on		Position	
Setting range	Setting unit	Factory setting	Effective time
0 ~ 10000	1min-1	**10000**	With immediate effect

■ Related alarms and warnings

Alarm number	Alarm name	Alarm content
A.d01	Warning value of position deviation overflow when the servo is on	In servo OFF, when the position deviation is above the set value of Pn526, the alarm is displayed when the servo ON is attempted
A.d02	Alarm for position deviation overflow caused by speed limit during servo ON	If the servo is ON in the state of accumulated position deviation, the speed limit value will be set when the servo is ON Execute the speed limit at (Pn529). The alarm displayed when the position reference is entered in this state and exceeds the setting alarm value of position deviation overflow(Pn520).
A.900	Warning of position deviation overflow	Warning displayed when position deviation exceeds the value set by ((Pn520 Pn51E)/100).

Refer to "Chapter 10 Failure Diagnosis" for handling alarm.

6.2 Self-tuning function

The self-tuning function is set to invalid at factory.

When the self-tuning function is set to "effective", if resonance or vibration occurs, please change the rigidity level (Pn170.2) and load value (Pn170.3) through the "6.2.2 Self-tuning value setting (Fn200) procedure".

Notes:

The motor may vibrate when exceeding the motor allowable load inertia. At this point, please set Mode=2 through Fn200 or reduce the tuning level

6.2.1 Summary

No matter what type of machinery, and no matter how the load fluctuates, the self-tuning function can achieve stable response. Automatically start tuning at servo ON

(1) Select self-tuning valid/invalid

The valid / invalid self-tuning function can be selected by the following parameters.

Pn170		
Parameter	Meaning	Effective time
n.□□□0	The self-tuning function is invalid.	After power on again
n.□□□1 [Factory setting]	The self-tuning function is effective.	
n.□□0□ [Factory setting]	Used as speed control	
n.□□1□	Used as speed control and the upper device as position control.	

(2) Use limit

The self-tuning function is effective in position control and speed control. Invalid at torque control.

In addition, the control function shown in the following table will be partially limited when the self-tuning function is effective.

Function name	Executable/unexecutable	Executable conditions and remarks
Vibration detection value initialization (Fn01B)	○	-
advanced autotuning without reference (Fn201)	△	□ Can be selected only if the moment of inertia is inferred □ The self-tuning function is invalid when Fn201 is executed. It is restored after the execution.
advanced autotuning without reference (Fn202)	×	-
one-parameter tuning (Fn203)	×	-
anti-resonance control function (Fn204)	×	-
Vibration suppression function (Fn205)	×	-
EasyFFT (Fn206)	○	The self-tuning function is invalid when Fn206 is executed. It is restored after the execution.
Friction compensation	×	-
Gain switching	×	-

○: Executable △: Conditional execution ×: Unexecutable

(3) About setting up automatic notch filters

The factory setting is "autotuning" and usually does not require any changes.

When set to "autotuning", vibration will be automatically detected and a notch filter will be set when the self-tuning function is effective.

Only set the notch filter setting to "no autotuning" before executing this function without changing it.

Pn460		
Parameter	Meaning	Effective time
n.□0□□	Automatically adjust the second notch filter without using utility functions.	With immediate effect
n.□1□□ [Factory setting]	Automatically adjust the second notch filter using utility functions.	

(4) About self-tuning level

self-tuning levels are "rigidity level" and "load value". The tuning levels can be selected by setting utility function (Fn 200) or parameters (Pn 170).

■ rigidity level

a) Changes in the utility functions

When changing the settings, please refer to "6.2.2 self-tuning level setting (Fn200) procedure".

Operation panel display	Content
Level0	Rigidity level 0
Level1	Rigidity level 1
Level2	Rigidity level 2
Level3	Rigidity level 3
Level4 [factory setting]	Rigidity level 4

b) Changes in parameters

Pn170		
Parameter	Content	Effective time
n.□0□□	Rigidity level 0 (Level0)	With immediate effect
n.□1□□	Rigidity level 1 (Level1)	
n.□2□□	Rigidity level 2 (Level2)	
n.□3□□	Rigidity level 3 (Level3)	
n.□4□□ [Factory setting]	Rigidity level 4 (Level4)	

■ Load value

a) Changes in the utility functions

When changing the settings, please refer to "6.2.2 self-tuning level setting (Fn200) procedure".

Operation panel display	Content
Mode0	Low load value
Mode1[factory setting]	Medium load value
Mode2	High load value

b) Changes in parameters

Pn170		
Parameter	Content	Effective time
n.0□□□	Low load value (Mode0)	With immediate effect
n.1□□□ [Factory setting]	Medium load value (Mode1)	
n.2□□□	High load value (Mode2)	

6.2.2 Self-tuning level setting (Fn200) procedure

To ensure operation safety, perform the self-tuning function with emergency stop available at any time.

self-tuning level setting procedure is shown as below.

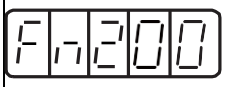
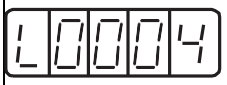
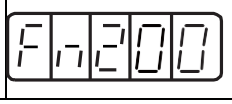
The operation of self-tuning level setting can be performed through the panel operator and DriveKey.

(1) Confirmation matters before execution

Please confirm the following settings before performing the self-tuning level setting. If the setting is not satisfied, "NO-OP" is displayed in the operation.

- Self-tuning selection is "valid" (Pn170.0 = 1)
- The parameter writing forbid function (Fn010) is not set to "no writing".

(2) Steps to operate through the panel operator

Steps	Panel display	Key	Description
1			Press the MOD key to select utility function.
2			Press the UP or DOWN key to display "Fn200".
3	 Load value		Press DATA/SHIFT key for about 1s. switch to the load setting screen of the self-tuning level. (Note) If an overshooting occurs in the response waveform, Or when used above the load inertia (outside the product guarantee object), press the UP key to change the load value to "2".
4			Press the MOD key to switch to the rigidity level setting screen of the self-tuning level.
5	 rigidity level		Press the UP or DOWN key to select a rigidity level. Select a rigidity level in the range of "0 to 4". The larger the number, the higher the gain, and the higher the responsiveness. (Factory setting :4) (Note) When the rigidity level is too large, the vibration may occur. In this case, lower the rigidity level. When the high-frequency sound occurs, please press the DATA/SHIFT key to automatically adjust the frequency of the notch filter to the vibration frequency.
6			Press the MOD key, the status display will change to "donE" and flash for about 1s, Then "L0004" is displayed. The settings are saved in the servo drive.
7			Press the DATA/SHIFT key again for about 1S to return a display of Fn200.

(3) Alarm and handling methods

Resonance or significant vibration during position control may cause an autotuning alarm (A.521). Please proceed as follows

■

Reduce the setting of Mode or Level by Fn200 or parameter.

■ When large vibration occurs in position control

Increase the Mode or Level Settings using Fn200. You can also increase the set value of Pn170.3 or decrease the set value of Pn170.2 through parameter settings.

(4) Parameter that becomes invalid when the self-tuning function is valid

The parameters that become invalid when the self-tuning function is effective (Pn170=n. □ □ □ 1) are shown in the table below.

Parameter that becomes invalid when the self-tuning function is valid			Performed functions and valid parameters		
Item	Parameter	Parameter number	Torque control	Easy FFT	Mechanical analysis (Vertical axis mode)
Gain class	Speed loop gain Second speed loop gain	**Pn100 Pn104**	○	○	○
	Speed loop integral time constant Second speed loop integral time constant	**Pn101 Pn105**	□□	○	○
	Position loop gain Second position loop gain	**Pn102 Pn106**	□□	○	○
	Moment of inertia ratio	**Pn103**	○	○	○
Advanced control class	Friction compensation function selection	**Pn408.3**	□□	□	□
	anti-resonance control selection	**Pn160.0**	□□	□	□
Gain switching	Switch of gain switching function	**Pn139.0**	□	□	□

○: Parameter Settings are valid: Parameter Settings are invalid
* If torque control, EasyFFT, and mechanical analysis (vertical axis mode) are performed, self tuning is invalid during the execution process.

The gain-related parameters (for torque control, only Pn100, Pn103, Pn104) in the above parameters are switched to be effective during the execution of torque control, EasyFFT, and mechanical analysis (vertical axis mode).

(5) Select the self-tuning type

Pn14F		
Parameter	Meaning	Effective time
n.□□0□	Self-tuning Type 1	After power on again
n.□□1□ [Factory setting]	Self-tuning Type 2	

6.2.3 Related parameters

The following table shows the parameters related to the three items.

- Whether the parameter settings can be changed when this function is executed

  "No": Parameters cannot be changed when this function is executed.

  "Yes": Parameters can be changed when this function is executed.

- Whether parameters are automatically set after this function is performed
- "Yes": After this function is performed, the parameter settings will be automatically set or adjusted.
- "No": After this function is performed, the parameter settings will not be automatically set or adjusted.

Parameter	Name	Whether the settings can be changed	Whether there are automatic settings
Pn170	Self-adjusted switch	No	Yes
Pn401	Filter time constant for the first torque reference in the first section	No	Yes
Pn40C	Frequency of the second notch filter	No	Yes
Pn40D	Q value of the second notch filter	No	Yes

6.3 Advanced autotuning without reference (Fn201)

This section details the advanced autotuning without references.

Important notes:

·**Advanced autotuning without reference starts with the current set speed loop gain (Pn100) as the benchmark for tuning.** If vibration occurs at the beginning of the tuning, it will not be possible to make the correct tuning. At this point, reduce the speed loop gain (Pn100) until the vibration is gone, and then adjust it.

· When performing advanced autotuning without reference while the self-tuning function is active (Pn170.0=1: factory setting), please set "Inferred Moment of Inertia (Jcalc=ON)". At this point, the self-tuning function will be automatically set to invalid, and the gain will be set through advanced autotuning without reference.

If advanced autotuning without reference is performed without "Inferred Moment of Inertia (Jcalc=OFF)", "Error" will be displayed and advanced autotuning without reference cannot be performed.

· **After performing advanced autotuning without reference, if the load status and transmission mechanism of the machine are changed, and the advanced autotuning without reference with "Inferring Load Moment of Inertia (Jcalc=ON)" is performed again, please change the following parameters and set all the settings after the last tuning to invalid.**

If advanced autotuning without reference is performed without changing the parameters, mechanical vibration and mechanical damage.

Pn00B.0 = 1 (displaying all parameters)

Pn140.0 = 0 (disabled model following control)

Pn160.0 = 0 (disabled anti-resonance control)

Pn408 = n.00 (disabled friction compensation, first or second trapped wave)

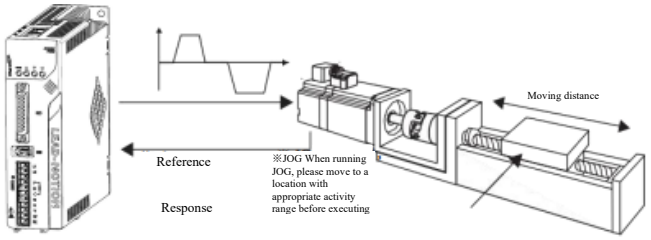
6.3.1 Summary

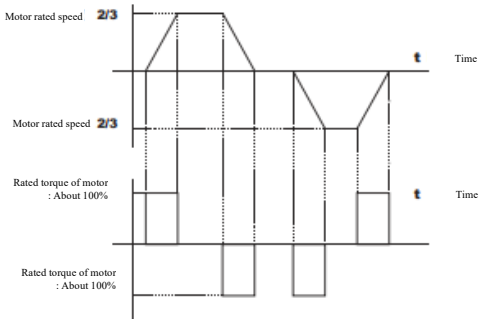
Advanced autotuning without reference refers to the function of the servo drive automatically tuning according to mechanical characteristics When performing automatic operation (forward and reverse reciprocating motion) within a set range. advanced autotuning without reference can be performed without connecting the upper device. The action specifications for the automatic operation are as follows.

· Maximum speed: 2/3 of motor rated speed

· Acceleration torque: The rated torque of the motor is about 100%. Depending on the setting of the moment of inertia ratio (Pn103), mechanical friction, and external interference, the acceleration torque will fluctuate.

· Moving distance: Optionally set the factory setting is equivalent to 3 turns of the motor.





Advanced autotuning without reference will adjust the following items.

1. Moment of inertia ratio
2. Gain tuning (speed loop gain position loop gain, etc.)
3. Filter tuning (torque reference filter, notch filter)
4. Friction compensation
5. anti-resonance control
6. Vibration suppression (limited to Mode = 2 or 3)

Notes: advanced autotuning without reference is made in automatic operation mode, so vibration or overshooting may occur during operation.

(1) The following items shall be confirmed before execution.

If set improperly, the operation panel will display "NO-OP", indicating that the function cannot be executed.
The items required to be confirmed are as follows:

- Main circuit power supply ON
- Servo OFF
- Torque control
- No alarm or warning occurred
- No overtravel occurred
- The gain switching selection switch is manual gain switching (Pn139.0=0)
- The first gain is selected
- The parameter writing forbid function (Fn010) is not set to "no writing".
- Set to "Inferred Moment of Inertia (Jcalc=ON)" when the self-tuning function is effective (Pn170.0=1: factory setting), or set the self-tuning function to invalid (Pn170.0=0)

< Supplement >

- When performing advanced autotuning without reference in speed control mode, it will automatically switch to position control to execute the tuning, and return to speed control after the tuning is completed.
- When executing in speed control mode, please set mode Pn000.1 to "1".
- During the process of performing advanced autotuning without reference, the reference pulse input multiplier switching function will be ineffective.

(2) Example of where the tuning cannot be performed

The advanced autotuning without reference cannot be performed in the following scenarios. Please adjust through advanced autotuning without reference (Fn202) or one-parameter tuning (Fn203).

- When the mechanical system can only operate in one direction
- When the range of motion is less than 0.5 laps

(3) Example where the tuning cannot be made smoothly

In the following cases, the tuning cannot be made through advanced autotuning without reference. Please adjust through advanced autotuning without reference (Fn202) or one-parameter tuning (Fn203).

- When proper range of motion is not available
- When the moment of inertia changes within the set operating range
- When the dynamic friction of the machinery is large
- When the rigidity of the machinery is low, and the vibration occurs in the positioning action
- When using the position integration function
- At the P (proportional) control

- When using the mode switch
- When the speed feedforward and the torque feedforward are input
- When the positioning completed width (Pn522) is narrow

Advanced autotuning without reference refers to "Positioning completed width (Pn522)" for tuning.
When running with "position control (Pn000.1=1)", please set the "electronic gear (Pn20E/Pn210)" and " positioning completed width (Pn522)" as the value used at the actual running time.
When running with speed control (Pn000.1 = 0), adjust by Mode = 1.
When tuning the overshooting without changing the positioning completed width (Pn522), use the overshooting detection value (Pn561).
Due to the factory setting of Pn561 being 100%, it is allowed to adjust up to the same overshooting as the positioning completed width.
If it is changed to 0%, the tuning can be made without overshooting within the positioning completed width. But after changing this value, the positioning time may be extended.

Pn561			
overshooting detection value		Speed Position Torque	
Setting range	Setting unit	Factory setting	Effective time
0 ~ 100	1%	100	With immediate effect

6.3.2 Related parameters

The following 3 items are shown in the following below. The parameters related to this function are used or referenced when executing this function.

· Whether the parameter settings can be changed when this function is executed

"No": Parameters cannot be changed through DriveKey when performing this function.

"Yes": Parameters cannot be changed through DriveKey when performing this function.

· Whether parameters are automatically set after the function is performed

· "Yes": After this function is performed, the parameter settings will be automatically set or adjusted.

· "No": After this function is performed, the parameter settings will not be automatically set or adjusted.

Parameter number	Meaning	Whether the settings can be changed	Whether to set automatically
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	None
Pn121	Friction compensation gain	No	Yes
Pn123	Friction compensation coefficient	No	Yes
Pn124	Friction compensation Frequency compensation	No	None
Pn125	Friction compensation gain compensation	No	Yes
Pn401	Filter time constant for the first torque reference in the first section	No	Yes
Pn408	Torque-type function switch	Yes	Yes
Pn409	Frequency for the first notch filter	No	Yes
Pn40A	Q value of the first notch filter	No	Yes
Pn40C	Frequency of the second notch filter	No	Yes
Pn40D	Q value of the second notch filter	No	Yes
Pn140	Model following control switch	Yes	Yes
Pn141	model following control gain	No	Yes
Pn142	Model following control gain correction	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	Yes
Pn146	Vibration suppression 1 frequency B	No	Yes
Pn147	Model following control speed feedforward compensation	No	Yes
Pn160	Vibration suppression control switch	Yes	Yes
Pn161	anti-resonance frequency	No	Yes
Pn163	Vibration anti-resonance gain	No	Yes
Pn531	Program JOG movement distance	No	None
Pn533	Program JOG movement speed	No	None
Pn534	Program JOG acceleration and deceleration time	No	None
Pn535	Programs JOG waiting time	No	None
Pn536	Program JOG movement times	No	None

6.4 Advanced autotuning without reference (Fn202)

This section illustrates the method of tuning through advanced autotuning without reference.

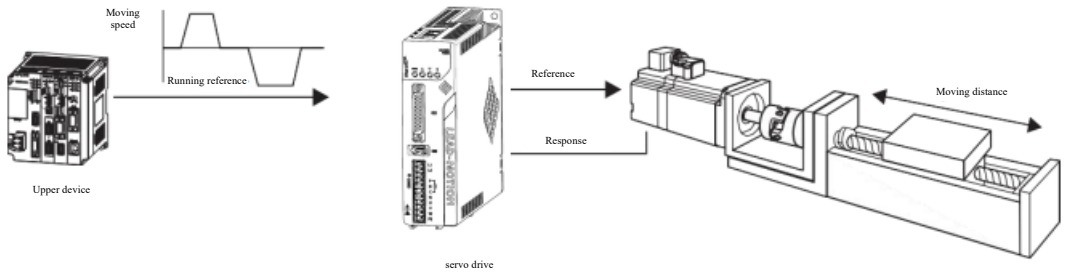
Important notes:

Advanced autotuning without reference starts with the current speed loop gain (Pn100) as the benchmark for tuning. If vibration occurs at the beginning of the tuning, it will not be possible to make the correct tuning. At this point, reduce the speed loop gain (Pn100) until the vibration is gone, and then adjust it.

6.4.1 Summary

- The advanced autotuning without reference is a method to automatically and optimally adjust the running references (pulse trains references) from the upper device.
- The advanced autotuning without reference (Fn202) can also be used for additional tunings after the advanced autotuning without reference (Fn201).

If the correct moment of inertia ratio has been set in Pn103, the advanced autotuning without reference (Fn201) can be omitted and only the advanced autotuning without reference (Fn202) can be performed.



Advanced autotuning without reference adjusts the following items.

- Gain tuning (speed loop gain position loop gain, etc.)
- Filter tuning (torque reference filter, notch filter)
- Friction compensation
- anti-resonance control
- Vibration suppression

Notes:

The advanced autotuning without reference performs an autotuning, so vibration or overshooting may occur during action.

(1) Confirmation matters before execution

Before performing advanced autotuning without reference, be sure to confirm the following settings. If set improperly, the operation panel will display "NO-OP", indicating that the function cannot be executed.

- In the servo-ready state
- Overtravel must not occur
- In servo OFF state
- The motor power on (in servo on) must be position control
- The gain switching selection switch is manual gain switching (Pn139.0=0)
- The first gain must be selected
- No warning may occur
- The parameter writing forbid function (Fn010) cannot be set to "no writing".
- Self-tuning selection must be invalid (Pn170.0 = 0)

(2) Example where the tuning cannot be made smoothly

In the following cases, the correct tuning cannot be made through the advanced autotuning without reference. In this case, perform the one-parameter tuning (Fn203).

- When the movement indicated by the upper device reference is the set value of the positioning completed width (Pn522) or below
- When the movement speed indicated by the upper device reference is the set value of the rotation detection value (Pn502) or below
- When the stop time (the time when the positioning completion signal (/COIN) is in the OFF state) is 10ms or less
- When the rigidity of the machinery is low, and the vibration occurs in the positioning action
- When using the position integration function
- **At the P (proportional) control**
- When using the mode switch
- When the positioning completed width (Pn522) is narrow

Important notes:

advanced autotuning without reference refers to "Positioning completed width (Pn522)" for tuning. Please set the "Electronic Gear (Pn20E/Pn210)" and "Positioning Completed Amplitude (Pn522)" to the actual operating values.

When tuning the overshooting without changing the positioning completed width (Pn522), use the overshooting detection value (Pn561). Due to the factory setting of Pn561 being 100%, it is allowed to adjust up to the same overshooting as the positioning completed width. If it is changed to 0%, the tuning can be made without overshooting within the positioning completed width. But after changing this value, the positioning time may be extended.

Pn561			
Overshooting detection value		Speed Position Torque	
Setting range	Setting unit	Factory setting	Effective time
0 ~ 100	**1%**	**100**	With immediate effect

6.4.2 Related parameters

The following 3 items are shown in the following below. Whether the parameter settings can be changed when this function is executed

"No": Parameters cannot be changed through DriveKey when performing this function.

"Yes": Parameters cannot be changed through DriveKey when performing this function.

· Whether to automatically set parameters after executing this function

· "Yes": After this function is performed, the parameter settings will be automatically set or adjusted.

· "No": After this function is performed, the parameter settings will not be automatically set or adjusted.

Parameter	Name	Whether the settings can be changed	Whether to set automatically
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	None
Pn121	Friction compensation gain	No	Yes
Pn123	Friction compensation coefficient	No	Yes
Pn124	Friction compensation Frequency compensation	No	None
Pn125	Friction compensation gain compensation	No	Yes
Pn401	Filter time constant for the first torque reference in the first section	No	Yes
Pn408	Torque-type function switch	Yes	Yes
Pn409	Frequency for the first notch filter	No	Yes
Pn40A	Q value of the first notch filter	No	Yes
Pn40C	Frequency of the second notch filter	No	Yes
Pn40D	Q value of the second notch filter	No	Yes
Pn140	Model following control switch	Yes	Yes
Pn141	model following control gain	No	Yes
Pn142	Model following control gain correction	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	Yes
Pn146	Vibration suppression 1 frequency B	No	Yes
Pn147	Model following control speed feedforward compensation	No	Yes
Pn160	Vibration suppression control switch	Yes	Yes
Pn161	anti-resonance frequency	No	Yes
Pn163	Vibration anti-resonance gain	No	Yes

6.5 One-parameter tuning (Fn203)

6.5.1 Summary

One-parameter tuning is a method of manually tuning the speed reference or position reference input from the upper device while running. When fine-tuning is required on top of autotuning, use one-parameter tuning.

By tuning one or two values through a single parameter, the set value of the relevant servo gain can be automatically adjusted.

Single-parameter tuning adjusts the following items.

- Speed loop gain, position loop gain, etc.
- torque reference filter, notch filter
- Friction compensation, anti-resonance control

Additional note:

After tuning the single parameter, if you want to further fine tune the gain of each servo, please refer to "6.8 Tuning Application Function" and "6.9 Manual Tuning" to perform manual tuning.

Notes: · Vibration or overshooting may occur during tuning.

(1) Matters to be confirmed before execution

If set improperly, the operation panel will display "NO-OP", indicating that the function cannot be executed.

Before performing one-parameter tuning, be sure to confirm the following settings.

- The parameter writing forbid function (Fn010) cannot be set to "no writing".
- Self-tuning selection must be invalid (Pn170.0 = 0)
- When performing tunings through speed control, the tuning mode is set to 0 or 1

(2) Model following control type selection

Model following control switch parameters (Pn14F) Model following control type 2 can suppress overshooting of position deviation compared with type 1

Pn14F		
Parameter	Function	Effective time
n.□□□0	Model following control Type 1	After power on again
n.□□□1 [Factory setting]	Model following control Type 2	

6.5.2 Operation steps for the single-parameter tuning

According to the selected tuning mode, there are two following single-parameter adjustment methods.

① When Tuning Mode = 0 (Set the stability-priority servo gain) or 1 (Set a high-response-priority servo gain), the model following control is "invalid" and perform tuning beyond positioning purpose.

Operate one Tuning level to change multiple servo gains in a stable controlled state. It has the function of automatically setting "notch filter and anti-resonance" after detecting vibration. In addition, the customized vibration function can be manually set in the adjustment.

② When Tuning Mode = 2(Set the servo gain suitable for positioning purposes) or 3 (Set the servo gain without overshooting), the model following control is "valid" and make positioning specific tuning.

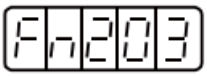
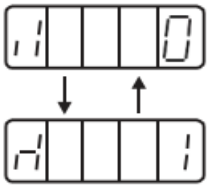
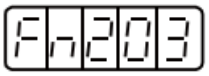
Operate two tuning levels (feedforward value FF and feedback value FB) to shorten the positioning time and change multiple servo gains. The "model following control" is used to shorten the positioning time. It has the function of automatically setting "notch filter, anti-resonance and friction compensation" after detecting vibration. In addition, the anti-resonance function and vibration suppression function can be customized manually during the tuning.

The operation of single parameter adjustment can be performed through either the panel operator or DriveKey. But the panel operator can only operate when the tuning mode is set to "Tuning Mode=0" or "Tuning Mode=1".

Please set the moment of inertia ratio (Pn103) correctly using advanced autotuning without reference (Fn201) and other methods before proceeding with the operation.

The following describes the steps to using the panel operator.

(1) Steps for using the Panel operator

Steps	Panel display	Key	Description
1			Press the MOD key to select utility function.
2			Press the UP or DOWN key to display "Fn203".
3			Press the DATA/SHIFT key for about 1S, and the display content is shown in the left figure.
4			Press UP or DOWN to set the tuning mode. TUNING MODE (weak tuning setting) 0: Focus on the adjustment of stability. 1: Focus on responsive adjustment. (Note) TYPE (rigid type) is fixed to "2".
5			In the non-servo ON(power ON) state, input the servo ON(/S-ON) signal from the upper device. In the servo-on (power-on) state, proceed to step 6.
6			Press DATA/SHIFT key (less than 1s) to display the single-parameter gain data as shown on the left.
7			The actual servo gain (Pn100, Pn101, Pn102, Pn401) also changes when the value of the single parameter gain is changed by the UP or DOWN key. This function is determined by the customer's response effect, and the tuning ends when the effect is satisfied.
8			Press MOD key to save the four calculated gains into the parameter. After normal tuning, "donE" flashes and returns to the display in the left figure. (Note) To end without saving the calculated gain, go to Step 9.
9			Press the DATA/SHIFT key for about 1S to return the display of Fn203

(2) Supplementary description of one-parameter tuning

■ Automatic notch filtering

Usually set to "autotuning" (Factory Settings are "autotuning")

When set to "autotuning", vibration will be automatically detected through one-parameter tuning and the relevant parameters of the notch filter will be automatically tuned.

Only set the notch filter setting to "no autotuning" before executing this function without changing it.

Pn460		
Parameter	Function	Effective time
n.□□□0	Automatically adjust the first notch filter without using utility functions.	With immediate effect
n.□□□1 [Factory setting]	Automatically adjust the first notch filter using utility functions.	
n.□0□□	Automatically adjust the second notch filter without using utility functions.	
n.□1□□ [Factory setting]	Automatically adjust the second notch filter using utility functions.	

■ Anti-resonance control

Anti-resonance control mainly acts on low-frequency vibration, and the notch filter is not applicable.

Usually set to "autotuning" (Set to "autotuning" at factory)

When set to "autotuning", vibration is automatically detected in one-parameter tuning, and customized anti-resonance control parameters are automatically adjusted and set.

Pn160		
Parameter	Function	Effective time
n.□□0□	autotuning of anti-resonance control without using the utility function	With immediate effect
n.□□1□ [Factory setting]	The anti-resonance control is automatically adjusted through the utility functions.	

■ Friction compensation

Friction compensation function is the compensation function for the following state changes.

- Change in viscous resistance of the sliding part of the machine
- Friction resistance change caused by mechanical assembly deviation
- Changes in friction resistance caused by aging

The application conditions of friction compensation under different tuning modes are also different.

When "Tuning Mode = 0" or "Tuning Mode = 1", follow the setting of "friction compensation function selection (Pn408.3)".

"Tuning Mode = 2" or "Tuning Mode = 3" is irrelevant to the setting of "Friction compensation function selection" (Pn408.3) and is adjusted through "friction compensation function is effective".

Tuned Mode / Friction compensation function selection		"Tuning mode=0"	"Tuning mode=1"	"Tuning mode=2"	"Tuning mode=3"
Pn408	N.0□□□ [Factory setting]	Ineffective time adjustment for friction compensation	Ineffective time adjustment for friction compensation	Effective time adjustment for friction compensation	Effective time adjustment for friction compensation
	N.1□□□	Effective time adjustment for friction compensation	Effective time adjustment for friction compensation		

Feedforward

In the factory-setting mode (Pn140.3 = 0)

When executing the adjustment mode through "Tuning Mode=2" or "Tuning Mode=3", the "feedforward (Pn109)", "speed feedforward (V-REF) input", and "torque feedforward (T-REF) input" will become invalid.

To use both the "Speed Feedforward (V-REF) input", "Torque Feedforward (T-REF) input", and Model following control from the upper device, please set Pn140.3 to 1.

Pn140		
Parameter	Function	Effective time
n.0□□□ [Factory setting]	Not using both model following control and speed / torque feedforward.	With immediate effect
n.1□□□	Using both model following control and speed / torque feedforward.	

Important notes:

When using the model following control, the model following control will set the best feedforward inside the servo

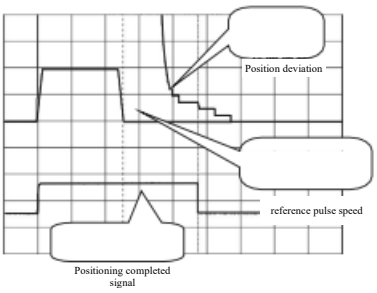
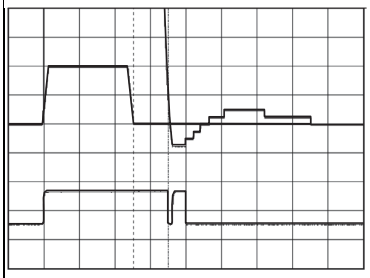
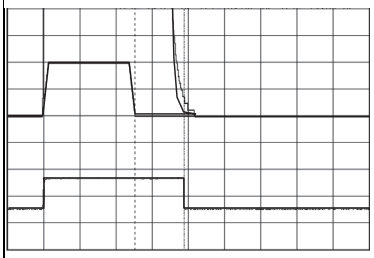
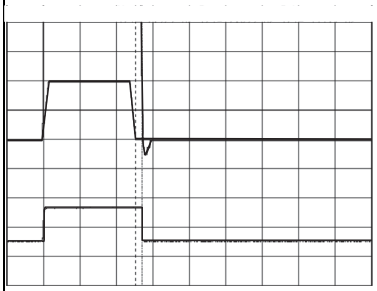
Therefore, it is usually not necessary to use both "velocity feedforward (V-REF) input" and "torque feedforward (T-REF) input" from the upper device simultaneously.

But model following control and "velocity feedforward (V-REF) input" and "torque feedforward (T-REF) input" can be used simultaneously as needed.

At this point, if the input feedforward is inappropriate, it may cause overshooting.

6.5.3 Example of one-parameter tuning

The following is an example of adjusting when tuning mode is selected as "Tuning Mode=2" or "Tuning Mode=3". This tuning mode is used to shorten the positioning time.

Steps	Oscilloscope diagram	Description
1		Measure the positioning time after correctly setting the moment of inertia ratio (Pn103). If the requirements are met, the tuning ends. The adjustment results are saved in the servo drive.
2		When the feedforward value (FF LEVEL) is increased, the positioning time will be shortened. If the requirements are met after the tuning, the tuning ends. The adjustment results are saved in the servo drive. When the overshooting occurs before the specification is met, proceed to step 3.
3		After increasing the feedback value (FB LEVEL), the overshooting will decrease. If the overshooting is eliminated after the above adjustment, then proceed to step 4.
4		This is the state where overshooting occurs when FF LEVEL is further increased after step 3. In this state, overshooting occurs, but the positioning time is shortened. If the requirements are met, the tuning ends. The adjustment results are saved in the servo drive. Repeat steps 3 and 4 when the overshooting occurs before meeting the requirements. If the vibration occurs before overshooting elimination, suppress the vibration through the notch filter and anti-resonance control.
5		The adjustment results are saved in the servo drive.

6.5.4 Related parameters

- Whether the parameter settings can be changed when this function is executed
- "No": Parameters cannot be changed through DriveKey when performing this function.
- "Yes": Parameters cannot be changed through DriveKey when performing this function.
- Whether parameters are automatically set after the function is performed
- "Yes": After this function is performed, the parameter settings will be automatically set or adjusted.
- "No": After this function is performed, the parameter settings will not be automatically set or adjusted.

Parameter	Name	Whether the settings can be changed	Whether to set automatically
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	None
Pn121	Friction compensation gain	No	Yes
Pn123	Friction compensation coefficient	No	Yes
Pn124	Friction compensation Frequency compensation	No	None
Pn125	Friction compensation gain compensation	No	Yes
Pn401	Filter time constant for the first torque reference in the first section	No	Yes
Pn408	Torque-type function switch	Yes	Yes
Pn409	Frequency for the first notch filter	No	Yes
Pn40A	Q value of the first notch filter	No	Yes
Pn40C	Frequency of the second notch filter	No	Yes
Pn40D	Q value of the second notch filter	No	Yes
Pn140	Model following control switch	Yes	Yes
Pn141	model following control gain	No	Yes
Pn142	Model following control gain correction	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	None
Pn146	Vibration suppression 1 frequency B	No	None
Pn147	Model following control speed feedforward compensation	No	Yes
Pn160	Vibration suppression control switch	Yes	Yes
Pn161	anti-resonance frequency	No	Yes
Pn163	Vibration anti-resonance gain	No	Yes

6.6 Anti-resonance control (Fn204)

6.6.1 Summary

After adjustment by one-parameter tuning, the effect of anti-resonance control function on vibration suppression will be further improved.

The anti-resonance control function can effectively suppress the continuous vibration occurring around 100 hZ ~ 1000 hZ when increasing the control gain.

After automatic detection or manually setting of the vibration frequency, the vibration can be eliminated by adjusting the anti-resonance gain Please enter the action reference to perform this function in the state of vibration.

This function is automatically set through the advanced autotuning without reference (Fn201) or the advanced autotuning without reference (Fn202).

Please only set it when further minor adjustments are needed or when readjustment is required due to vibration detection failure.

After performing this function, to improve the response characteristics, perform one-parameter tuning (Fn203), etc.

After improving the control gain through one-parameter tuning, it is possible to vibrate again. In this case, perform the function again to fine-tune.

The anti-resonance control function cannot be operated through the panel operator. anti-resonance control function is the only possible through DriveKey operation.

Notes:

· After performing this function, the relevant parameters are then automatically set. Therefore, the system response may change greatly before and after performing this function.

·Before performing the anti-resonance control function, please correctly set the moment of inertia ratio (Pn 103) through the advanced autotuning without reference.

Otherwise, normal control may not be possible, resulting in vibration.

Important notes:

·Using this function, the vibration frequency can be detected from 100Hz to 1000Hz. If "F--" is displayed, vibration outside the detected range is indicated. When the vibration frequency is not within this range, please set the tuning mode for one-parameter tuning to "2", automatically set the notch filter, or use the vibration suppression function (Fn205).

·Increasing the anti-resonance gain (Pn163) can improve the vibration suppression effect, but excessive anti-resonance gain can actually increase the vibration.

While confirming the anti-resonance effect, gradually increase the set value of the anti-resonance gain by 10% in the range of 0% to 200%. If the anti-resonance gain reaches 200% and still can not obtain the vibration suppression effect, please stop the setting and reduce the control gain by one-parameter tuning.

(1) Confirmation matters before execution

If set improperly, the operation panel will display "NO-OP", indicating that the function cannot be executed. Before performing the anti-resonance control function, be sure to confirm the following settings.

- Self-tuning selection must be invalid (Pn170.0 = 0)
- Not for torque control
- The parameter writing forbid function (Fn010) cannot be set to "no writing".

6.6.2 Related parameters

- Whether the parameter settings can be changed when this function is executed
- "No": Parameters cannot be changed through DriveKey when performing this function.
- "Yes": Parameters cannot be changed through DriveKey when performing this function.
- Whether parameters are automatically set after the function is performed
- "Yes": After this function is performed, the parameter settings will be automatically set or adjusted.
- "No": After this function is performed, the parameter settings will not be automatically set or adjusted.

Parameter	Name	Whether the settings can be changed	Whether to set automatically
Pn160	Vibration suppression control switch	Yes	Yes
Pn161	anti-resonance frequency	No	Yes
Pn162	anti-resonance gain compensation	Yes	None
Pn163	Vibration anti-resonance gain	No	Yes
Pn164	anti-resonance filtering time constant 1 compensation	Yes	None
Pn165	anti-resonance filtering time constant 2 compensation	Yes	None

6.7 Vibration suppression (Fn205)

6.7.1 Summary

The vibration suppression function is mainly used to suppress the low-frequency vibration (shaking) of about 1Hz ~ 100Hz caused by the vibration of the machine during positioning.

It is effective against vibration frequencies that cannot be suppressed by notch filters or anti-resonance functions. Automatically set this function through advanced autotuning without reference (Fn201)

or advanced autotuning without reference (Fn202).

Please only set it when further minor adjustments are needed or when readjustment is required due to vibration detection failure. When using this function, please enter an action reference to perform this function when the vibration occurs. After performing this function, to improve the response characteristics, perform one-parameter tuning (Fn203).

Notes:

· After performing this function, the relevant parameters are then automatically set. Therefore, the system response may change greatly before and after performing this function.

·Before performing the function, please correctly set the moment of inertia ratio (Pn103) through the advanced autotuning without reference. Otherwise, normal control may not be possible, resulting in vibration.

Important notes:

·Using this function, the vibration frequency range can be detected from 1 to 100Hz. If "F--" is displayed, vibration outside the detected range is indicated.

· If there is no vibration caused by positional deviation, or if the vibration frequency is outside the detection frequency range, the vibration cannot be detected.

· When the vibration cannot be eliminated using the automatically detected vibration frequency, there may be an error between the actual vibration frequency and the detected frequency. Please make slight adjustments to the vibration frequency

(1) Confirmation matters before execution

If set improperly, the operation panel will display "NO-OP", indicating that the function cannot be executed.

Before performing the vibration suppression function, be sure to confirm the following settings.

- Position control
- Self-tuning selection must be invalid (Pn170.0 = 0)
- The parameter writing forbid function (Fn010) is not set to "no writing".

(2) Items that affect the performance

When the vibration occurs continuously during the stop, the full vibration suppression effect cannot be obtained by the vibration suppression function.

Adjust through the anti-resonance control function (Fn204) or the one-parameter tuning (Fn203).

(3) Detection of the vibration frequency

The vibration frequency may not be detected if there is no vibration in the position deviation or if the vibration is small.

By changing the ratio of positioning completed width (Pn522), i.e. the setting of residual vibration detection width (Pn560), the detection sensitivity can be adjusted. Therefore, please adjust the residual vibration detection width (Pn560) and perform vibration frequency detection again.

Please change the setting value by roughly standard using 10%. The smaller the set value, the higher the detection sensitivity. However, the too small set value may not be able to detect the vibration correctly.

Additional note:

The automatic detection of vibration frequency may result in some differences in the detected frequency during each positioning action. Please perform several positioning actions, and confirm the vibration suppression effect while adjusting.

Pn560			
Residual vibration detection amplitude		Position	
Setting range	Setting unit	Factory setting	Effective time
1 ~ 3000	**0.1%**	**400**	With immediate effect

6.7.2 Related parameters

· Whether the parameter settings can be changed when this function is executed

"No": Parameters cannot be changed through DriveKey when performing this function.

"Yes": Parameters cannot be changed through DriveKey when performing this function.

· Whether parameters are automatically set after the function is performed

"Yes": After this function is performed, the parameter settings will be automatically set or adjusted.

"No": After this function is performed, the parameter settings will not be automatically set or adjusted.

Parameter	Name	Whether the settings can be changed	Whether to set automatically
Pn140	Model following control switch	Yes	Yes
Pn141	model following control gain	No	Yes
Pn142	Model following control gain correction	No	None
Pn143	Model following control bias (forward direction)	No	None
Pn144	Model following control bias (reverse direction)	No	None
Pn145	Vibration suppression 1 frequency A	No	Yes
Pn146	Vibration suppression 1 frequency B	No	Yes
Pn147	Model following control speed feedforward compensation	No	None
Pn14A	Frequency of vibration suppression 2	No	None
Pn14B	Compensation of vibration suppression 2	No	None

6.8 Adjustment application

The following is an explanation of the functions that need to be further adjusted separately after advanced autotuning without reference, advanced autotuning without reference of reference input type and one-parameter tuning.

Function name	Available control methods
Gain switching	Position control, speed control, torque control
Friction compensation function	Position control, speed control
Current control mode selection	Position control, speed control, torque control
Current gain value setting function	Position control, speed control
Speed detection method selection function	Position control, speed control, torque control

6.8.1 Switching gain

The gain switching function includes both manual gain switching using external input signals and automatic gain switching.
By using the gain switching function, we can improve the gain and shorten the positioning time; **It stops to reduce the gain and suppress the vibration.**

Pn139		
Parameter	Function	Effective time
n.□□□0 [Factory setting]	Manual gain switching	With immediate effect
n.□□□1	Reserve (do not set up)	
n.□□□2	Automatic gain switching	

(1) Combination of the switching gains

Switching Gain	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
First gain	Speed loop gain (Pn100)	Speed loop integral time constant (Pn101)	Position loop gain (Pn102)	Section 1 The first torque reference filtering time constant (Pn401)	model following control gain (Pn141)	model following control gain compensation (Pn142)	Friction compensation gain (Pn121)
Second gain	Second speed loop gain (Pn104)	Second speed loop integral time constant (Pn105)	Second position loop gain (Pn106)	Section 1 Second moment reference filtering time constant (Pn412)	Second model following control gain (Pn148)	Second model following control gain compensation (Pn149)	Second friction compensation gain (Pn122)

Additional note:

The gain switching between model following control gain and Model following control gain correctionis only suitable for "manual gain switching".

Of these parameters, the gain is switched only when the following conditions are simultaneously met and the gain switching signal is input. If the condition is not met, these parameters will not be switched even if other parameters in the table above are switched.

- No reference
- Motor stop

(2) manual gain switching

"manual gain switching" switches the first and second gains through an external input signal (/G-SEL).

Type	Signal name	Connector pin number	Setting	Description
Input	**/G-SEL**	To be assigned	**OFF**	Switch to the first gain.
			ON	Switch to the second gain.

(3) Automatic switching gain

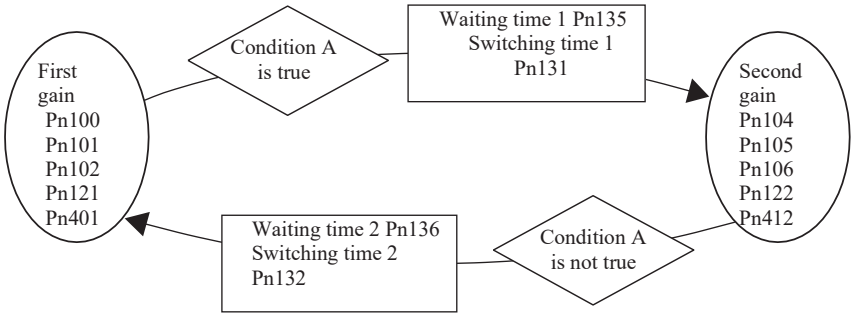
The automatic switch gain is valid only when under position control. The switching conditions are set as follows.

Pn139				
Parameter	Switching condition	Switching gain	Switching waiting time	Switching time
n.□□□ 2	Condition A is true	First gain Second gain	Waiting time 1 Pn135	Switching time 1 Pn131
	Condition A is not true	Second gain First gain	Waiting time 2 Pn136	Switching time 2 Pn132

Please select "switching condition A" for automatic switching gain from the settings below.

Pn139			
Parameter	Position control switching condition A	Outside position control (no switching)	Effective time
n.□□0□ [Factory setting]	Positioning completed signal (/COIN)ON	Fixed at first gain	With immediate effect
n.□□1□	Positioning completed signal (/COIN)OFF	Fixed at second gain	
n.□□2□	positioning near signal (/NEAR)ON	Fixed at first gain	
n.□□3□	positioning near signal (/NEAR)OFF	Fixed at second gain	
n.□□4□	Position reference filter output = 0 and reference pulse input OFF	Fixed at first gain	
n.□□5□	Position reference pulse input ON	Fixed at second gain	

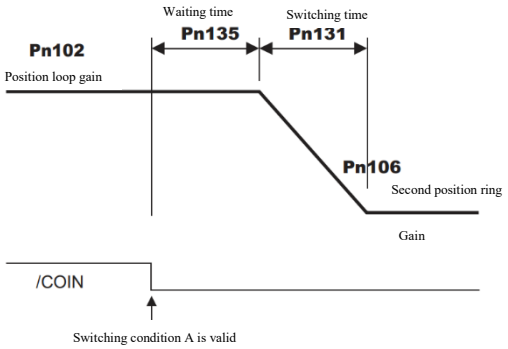
Automatic switching mode (Pn139.0=2)



■ The relationship between the waiting time and the switching time when switching gain

Example: In the automatic switching gain mode with the positioning completion signal (/COIN) ON as the condition, it is assumed to switch from the position loop gain Pn102 to the second position loop gain Pn106.

The/COIN signal of the switching condition is ON, and after waiting for the waiting time Pn135 from the time when the switching condition has been established, the gain is linearly changed from Pn102 to Pn106 during the switching time Pn131.



Additional note:

Gain switching can be performed in either PI or I-P control modes (Pn10B=n. □ □ 0 □, □ □ 1 □).

(3) Related parameters

Pn100	Speed loop gain		Speed	Position
	Setting range	Setting unit	Factory setting	Effective time
	10 ～ 20000	0.1Hz	400	With immediate effect
Pn101	Speed loop integral time constant		Speed	Position
	Setting range	Setting unit	Factory setting	Effective time
	15 ～ 51200	0.01ms	2000	With immediate effect
Pn102	Position loop gain			Position
	Setting range	Setting unit	Factory setting	Effective time
	10 ～ 20000	0.1/s	400	With immediate effect
Pn401	Filter time constant for the first torque reference in the first section		Speed	Position Torque
	Setting range	Setting unit	Factory setting	Effective time
	0 ～ 65535	0.01ms	100	With immediate effect
Pn141	model following control gain			Position
	Setting range	Setting unit	Factory setting	Effective time
	10 ～ 20000	0.1/s	500	With immediate effect
Pn142	model following control gain compensation			Position
	Setting range	Setting unit	Factory setting	Effective time
	500 ～ 2000	0.1%	1000	With immediate effect
Pn121	Friction compensation gain		Speed	Position
	Setting range	Setting unit	Factory setting	Effective time
	10 ～ 1000	1%	100	With immediate effect
Pn104	Second speed loop gain		Speed	Position
	Setting range	Setting unit	Factory setting	Effective time
	10 ～ 20000	0.1Hz	400	With immediate effect
Pn105	Second speed loop integral time constant		Speed	Position
	Setting range	Setting unit	Factory setting	Effective time
	15 ～ 51200	0.01ms	2000	With immediate effect

Pn106	Second position loop gain			Position
	Setting range	Setting unit	Factory setting	Effective time
	10 ～ 20000	0.1/s	400	With immediate effect
Pn412	Filter time constant for the second torque reference in the first section			Speed Position Torque
	Setting range	Setting unit	Factory setting	Effective time
	0 ～ 65535	0.01ms	100	With immediate effect
Pn148	Second model following control gain			Position
	Setting range	Setting unit	Factory setting	Effective time
	10 ～ 20000	0.1/s	500	With immediate effect
Pn149	Second model following control gain compensation			Position
	Setting range	Setting unit	Factory setting	Effective time
	500 ～ 2000	0.1%	1000	With immediate effect
Pn122	Second friction compensation		Speed	Position
	Setting range	Setting unit	Factory setting	Effective time
	10 ～ 1000	1%	100	With immediate effect

(4) Related parameters of automatic gain switching

Pn131	Gain switching time 1			Position
	Setting range	Setting unit	Factory setting	Effective time
	0 ～ 65535	1ms	0	With immediate effect
Pn132	Gain switching time 2			Position
	Setting range	Setting unit	Factory setting	Effective time
	0 ～ 65535	1ms	0	With immediate effect
Pn135	Gain switching waiting time 1			Position
	Setting range	Setting unit	Factory setting	Effective time
	0 ～ 65535	1ms	0	With immediate effect
Pn136	Gain switching waiting time 2			Position
	Setting range	Setting unit	Factory setting	Effective time
	0 ～ 65535	1ms	0	With immediate effect

(5) Correlation monitoring

Un014	
Display value	Content
1	Displays when the first gain is active
2	Displays when the second gain is active

Note: "1" is displayed when the self-tuning function is valid.

6.8.2 Manual tuning of friction compensation

Friction compensation function is the function of compensating for viscosity friction change and fixed load change.

Friction compensation function may be performed through the advanced autotuning without reference (Fn201), advanced autotuning without reference (Fn202), one-parameter tuning (Fn203) autotuning friction compensation function.

To manually adjust the parameters, perform the following steps.

(1) Parameters to be set

To use the friction compensation function, set the following parameters.

Pn408		
Parameter	Function	Effective time
n.0□□□ [Factory setting]	The friction compensation function is not used.	With immediate effect
n.1□□□	Use the friction compensation function.	

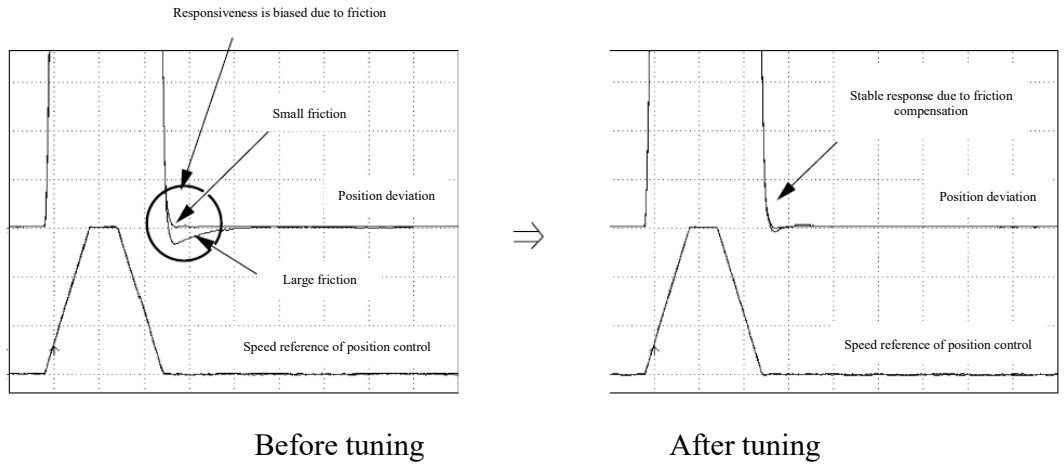
Pn121	Friction compensation gain		Speed	Position
	Setting range	Setting unit	Factory setting	Effective time
	10 ～ 1000	1%	100	With immediate effect
Pn123	Friction compensation coefficient			
	Setting range	Setting unit	Factory setting	Effective time
	0 ～ 100	1%	0	With immediate effect
Pn124	Friction compensation Frequency compensation		Speed	Position
	Setting range	Setting unit	Factory setting	Effective time
	-10000～10000	0.1Hz	0	With immediate effect
Pn125	Friction compensation gain compensation		Speed	Position
	Setting range	Setting unit	Factory setting	Effective time
	1 ～ 1000	1%	100	With immediate effect

(2) Operation procedure of friction compensation function

The following describes the procedure for friction compensation function.

Notes:

When using the friction compensation function, set the moment of inertia ratio as correctly as possible (Pn103). If the moment of inertia ratio is set correctly, it may cause vibration.

Steps	Description
1	Restore the following friction compensation parameters to factory settings. Friction compensation gain (Pn121) →Factory setting: 100 Friction compensation gain (Pn123) →Factory setting: 0 Friction compensation Frequency compensation (Pn124) → Factory setting 0 Friction compensation Frequency compensation (Pn125) → Factory setting 100 Note: Please ensure that the friction compensation frequency compensation (Pn124) and friction compensation gain compensation (Pn125) are always set at the factory.
Steps	Description
2	To verify the effect of the friction compensation function, gradually increase the friction compensation coefficient (Pn123). Note: Generally, the friction compensation coefficient (Pn123) should be set below 95%. If the effect is not significant enough, increase the friction compensation gain (Pn121) set by 10% to the extent that no vibration is generated. Effect of adjusting parameters **Pn121:** Friction compensation gain Set the parameters for the responsiveness to the external interference. The higher the set value, the better the responsiveness to external interference, but when the device has a resonance frequency, a set value that is too high may cause vibration. **Pn123:** Friction compensation coefficient Set parameters for friction compensation effect the higher the setting value, the better the effect, but the higher the setting value, the more likely the response to vibration. In general, please set the setting value below 95%.
3	Tuning effect The tuning result is shown as an example of the waveforms before and after tuning.  Before tuning After tuning

6.8.3 Current control mode selection function

The current control mode selection function reduces the high-frequency noise when the motor stops. This function is valid in factory setting mode and is set to work in many occasions. When using this function, please set Pn009 = n.□□1□.

Input voltage	Servo drive model that can use this function M1-
220V	**15B, 20B, 30B**
380V	**20C, 30C, 45C, 55C, 75C**

Pn009		
Parameter	Meaning	Effective time
n.□□0□	Select the current control mode 1.	After power on again
n.□□1□ [Factory setting]	Select the current control mode 2 (Low Noise).	

6.8.4 Current gain value setting function

The current gain value setting function adjusts the internal current control parameters of the servo drive based on the speed loop gain (Pn100) to reduce noise.

By reducing the current gain value (Pn13D) to the factory set value (2000%, ineffective function), the noise level can be reduced. At the same time, the response characteristics of the servo drive will become worse. Therefore, adjust to the extent that you can ensure response characteristics. In addition, this function is invalid at the torque control (Pn000 = n.□□2□).

Pn13D			
Current gain value	Speed	Position	
Setting range	Setting unit	Factory setting	Effective time
100 ~ 2000	**1%**	**2000**	With immediate effect

Important notes:

With this change, the response characteristics of the speed loop will also change, thus requiring a new servo tuning.

6.8.5 Speed detection method selection function

The speed detection method selection function smooths the speed of the running motor. Please set Pn009.2 to 1 and select speed detection 2 to make the running motor speed smoother.

Pn009		
Parameter	Meaning	Effective time
n.□0□□ [Factory setting]	Select the speed detection 1.	After power on again
n.□1□□	Select the speed detection 2.	

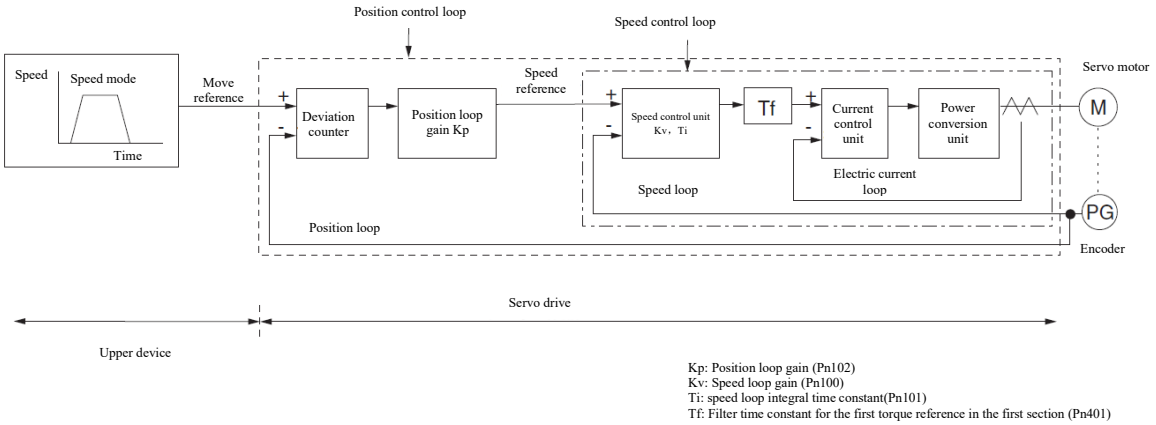
Important notes:

After the speed detection method is changed, the response characteristics of the speed ring will also change, thus requiring a new servo tuning.

6.9 Manual tuning

6.9.1 Tuning servo gain

Description of the servo gain



Kp: Position loop gain (Pn102)
Kv: Speed loop gain (Pn100)
Ti: speed loop integral time constant(Pn101)
Tf: Filter time constant for the first torque reference in the first section (Pn401)

To manually adjust the servo gain, please adjust the servo gain one by one, on the basis of understanding the composition and characteristics of the servo drive.

In most cases, if one parameter shows large changes, the other parameters must be adjusted again.

The servo drive is composed of three control loops (position, speed and current). The more inner the loop, the more it needs to improve its responsiveness. Failure to follow this principle results in poor responsiveness or vibration.

Because the current ring algorithm of this driver ensures sufficient responsiveness, the user does not need to adjust the current ring parameters.

Summary

The response characteristics of the servo drive can be improved by manually adjusting the servo gain. For example, position control can shorten the positioning time. Use manual adjustments in the following situations.

When it cannot be performed smoothly through the advanced autotuning without reference and advanced autotuning without reference

When the servo gain needs to be further improved compared to the result of advanced autotuning without reference and advanced autotuning without reference

When users have to decide the servo gain and moment of inertia ratio themselves

Start from the factory setting state of servo gain parameters or the gain setting state at the end of advanced autotuning without reference and advanced autotuning without reference

Notes:

Vibration sometimes occurs when adjusting the servo gain. It is recommended to set the vibration detection vibration alarm as valid (Pn310 = n.□□□2)

Example of tuning steps (for position control and speed control)

Steps	Content
1	Adjust the filter time constant for the first torque reference in the first section (Pn401) and set it as no vibration.
2	Increase the speed loop gain as much as possible in a range where the machinery does not vibrate (Pn100) Also reduce the speed loop integral time constant (Pn101).
3	Repeat steps 1 and 2 to restore 10% to 20% of the changed values
4	During position control, the position loop gain is increased in the range where the machinery does not vibrate (Pn102).

Additional note:
In the servo gain adjustment, if one parameter is changed, the other parameters also need to be readjusted. Do not make large changes to only one parameter.
Please use about 5% as a rough standard to slightly adjust each servo gain. Generally, follow the following steps for changing the servo parameters.

◆ **When improving the response**

(1) Reduce the torque reference filter time parameter
(2) Increase the speed loop gain
(3) Reduce the speed loop integral time constant
(4) Increase the position loop gain

◆ **Reduce the response and prevent vibration and overshooting**

(1) Reduce the position loop gain
(2) Increase the speed loop integral time constant
(3) Reduce the speed loop gain
(4) Increase the torque filter time parameter

Servo gain to be adjusted

The response characteristics of the servo drive can be adjusted by setting the following servo gains.

◆ **Pn100:** Speed loop gain

Parameters that determine the speed loop responsiveness. Due to the low responsiveness of the speed loop, it becomes a delay factor of the outer position loop, so overshooting occurs or the speed reference vibrates. Therefore, within the range of no vibration of the mechanical system, the larger the set value of the speed loop gain, the greater the stability of the servo system and the better the responsiveness.

◆ **Pn101:** speed loop integral time constant

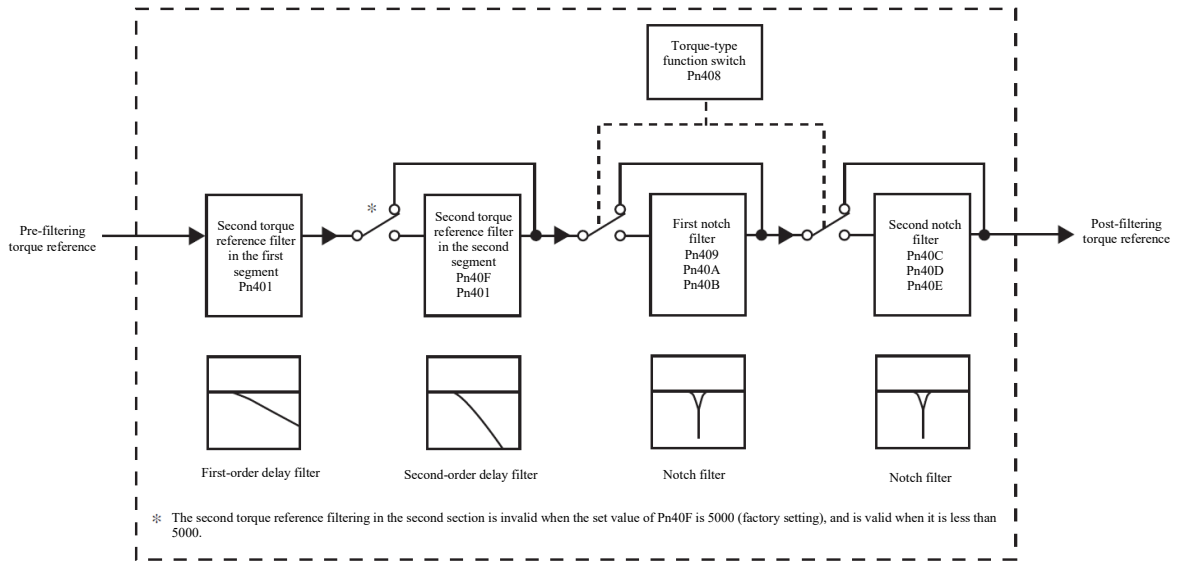
To make the driver responsive to tiny inputs, the speed loop contains an integral link. Since this integral link is a delay link for the servo system, when the integral time parameter is set too large, overshooting or extended positioning time will occur, making the responsiveness worse.

◆ **Pn102:** Position loop gain

The responsiveness of the servo drive position loop is determined by the position loop gain. The higher the setting of the position loop gain, the higher the responsiveness and the shorter the positioning time. In general, the position loop gain cannot be increased to a range beyond the intrinsic vibration frequencies of the mechanical system. Therefore, to set the position loop gain to a larger value, it is necessary to improve the machine rigidity and increase the inherent vibration frequency of the machine.

◆ **Pn401:** Filter time constant for the first torque reference in the first section

In the torque reference filter, there is a serial delay filter and a notch filter, each acting independently.
The notch filter uses Pn408 to switch valid / invalid.



(1) Torque reference filter

When the machine may vibrate due to the servo drive, the vibration may be eliminated if the following torque reference filtering time parameters are adjusted. The smaller the value, the more responsive the control, but subject to machine conditions.

Pn401	Filter time constant for the first torque reference in the first section			
	Setting range	Setting unit	Factory setting	Effective time
	0 ~ 65535	**0.01ms**	**100**	With immediate effect
Pn40F	Second torque reference filter frequency in the second section			
	Setting range	Setting unit	Factory setting	Effective time
	100 ~ 5000	**1Hz**	**5000***	With immediate effect
Pn410	Q value of second torque reference filter in the second section			
	Setting range	Setting unit	Factory setting	Effective time
	50 ~ 100	**0.01**	**50**	With immediate effect

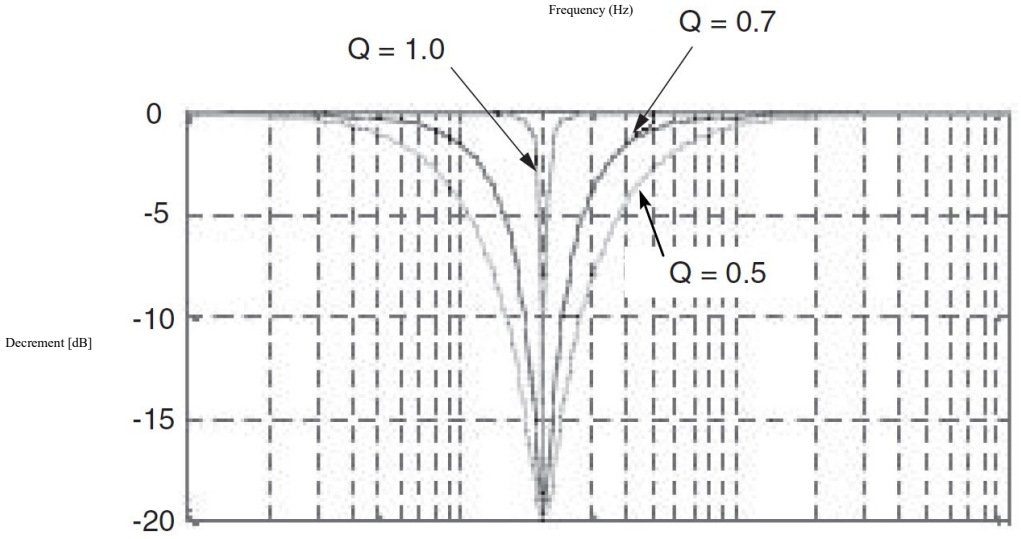
*When set to 5000, the filter becomes invalid

(2) Notch filter

Notch filter is a filter used to remove the specific vibration frequency components caused by the resonance of the ball screw shaft.
The gain curve is shown in the figure below, with a specific frequency (hereinafter called the notch frequency) in a notch shape. Through this characteristic, the frequency component near the notch frequency can be eliminated or reduced.
The notch filter is set by three parameters: notch filter frequency, notch filter q-value and notch filter depth. The Q value of notch filter and the depth of notch filter are described below.

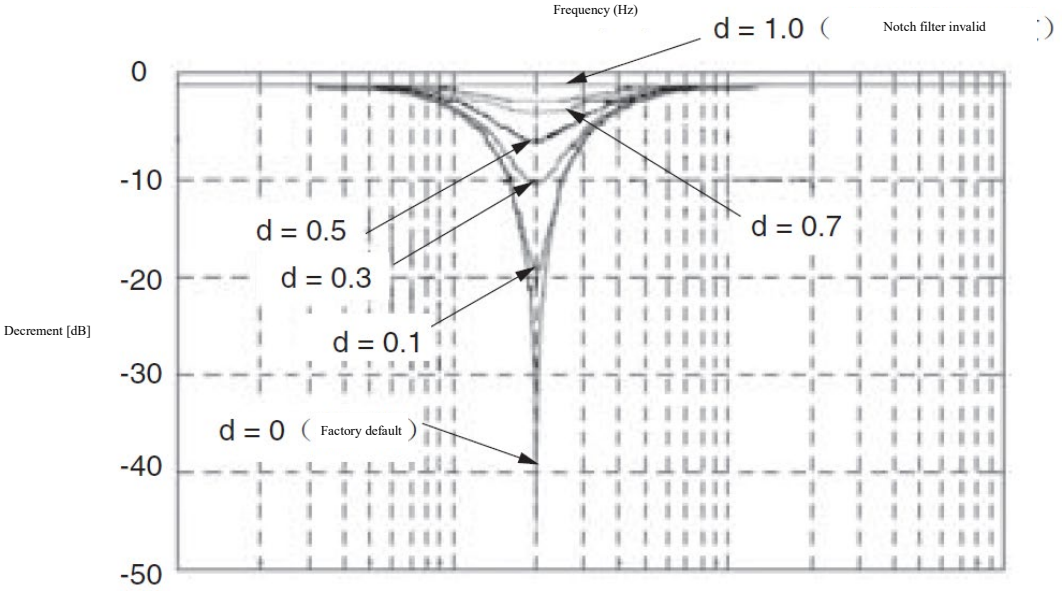
• Q value of notch filter

The Q value of the notch filter refers to the set value that determines the width of the filter frequency relative to the notch filter frequency. The width of the depression varies depending on the Q value of notch filter. The larger the value of the notch filter Q value, the stronger the depression, and the narrower the width of the filter frequency.
The frequency characteristics of the notch filter change due to the Q value of the notch filter, as shown below.



• Notch filter depth

The notch filter depth refers to the set value of the filter frequency depth relative to the notch filter frequency. The depth of the depression varies with the notch filter depth. The smaller the depth value of the notch filter is, the deeper the depression is, and the higher the vibration suppression effect is. But being too small will actually increase the vibration.
When the depth of notch filter is set to d = 1.0, the notch filter becomes invalid. The frequency characteristics of the notch filter change due to the notch filter depth, as show



Important notes:

·Do not set the notch filter frequency (Pn409 or Pn 40 C) to the response frequency close to the speed loop. The frequency should be set at least 4 times the speed loop gain (Pn100) (but Pn103 should be set correctly). If the setting is incorrect, mechanical damage may occur due to vibration.
· Be sure to change the notch filter frequency when the motor stops (Pn409 or Pn40C). If changes are made during motor operation, vibration may occur.

Approximate standard for manual tuning of servo gain

When manually adjusting parameters, please fully understand the contents of the user manual and use the following formula as the general standard. Even if the state is stable in the servo motor stop, it may become unstable if the operation reference is entered Therefore, when adjusting the servo gain, you must input the operation reference to make the servo motor run while making the adjustment.

Stable tuning level: A well-balanced set value between parameters.
When the load rotational inertia is large and the mechanical system contains vibration factors, if the set value is not increased to some extent, the machine vibration will occur.

Critical tuning level: A set value that influences the interaction between parameters.
Depending on the machine conditions, overshooting and vibration may occur, leading to movement instability.
When the critical tuning level is exceeded, the action will be more unstable, and there is a danger of abnormal vibration of the motor shaft and large reciprocating movement.
Therefore, do not exceed the critical tuning level when setting.
When using torque reference filters, secondary torque reference filters, and notch filters simultaneously, the interference between each filter and the speed loop gain will overlap, so greater margin must be left when adjusting.

Important notes:
·For the approximate standard of the following tuning level, Pn103(moment of inertia ratio) must be set correctly according to the actual machine.

◆Pn10B = n.□□0□ (PI control)
• Speed loop gain (Pn100 [Hz]) and position loop gain (Pn102 [/s])
Stable tuning level Pn102 ≤ 2×Pn100/4
Critical tuning level Pn102 < 2×Pn100
• Speed loop gain (Pn100 [Hz]) and speed loop integral time constant(Pn101 [ms])
Stable tuning level Pn101 ≥ 4000/ (2×Pn100)
Critical tuning level Pn101 > 1000/ (2×Pn100)
• Speed loop gain and (Pn100 [Hz]) Filter time constant for the first torque reference in the first section (Pn401 [ms])
Stable tuning level Pn401 ≤ 1000/ (2×Pn100×4)
Critical tuning level Pn401 < 1000/(2×Pn100)
• speed loop gain (Pn100 [Hz]) and Second torque reference filter frequency in the second section (Pn40F [Hz])
Critical tuning level Pn40F > 4×Pn100
(Note) Please use the Q value of the second torque reference filter in the second section (Pn410) = 0.70.
• Speed loop gain (Pn100 [Hz]) and frequency for the first notch filter (Pn409 [Hz])
Critical tuning level Pn409 [Hz] > 4×Pn100 [Hz]

◆ Upon I-P control during Pn10B = n.□□1□ (I-P control),
the relationship between the speed loop integral time constantand the speed loop gain and position loop gain is different from that of PI control, while the relationship between other servo gains is the same as that of PI control.
• Speed loop gain (Pn100 [Hz]) and speed loop integral time constant(Pn101 [ms])
Stable tuning level Pn100 [Hz] ≥ 320/Pn101 [ms]
• Position loop gain (Pn102 [Hz]) and speed loop integral time constant(Pn101 [ms])
Stable tuning level Pn102 [/s] ≤ 320/Pn101 [ms]

Additional note: About the selection of the speed loop control method (PI control /I-P control)
Usually, I-P control is effective for high-speed positioning and high-speed, high-precision machining applications. Through I-P control, you can use a lower position loop gain than PI control to shorten positioning time and reduce the reduction of arc radius. However, if you convert from mode switching (such as input signal/P-CON) to proportional control (P control) to achieve the desired application, then PI control is usually used.

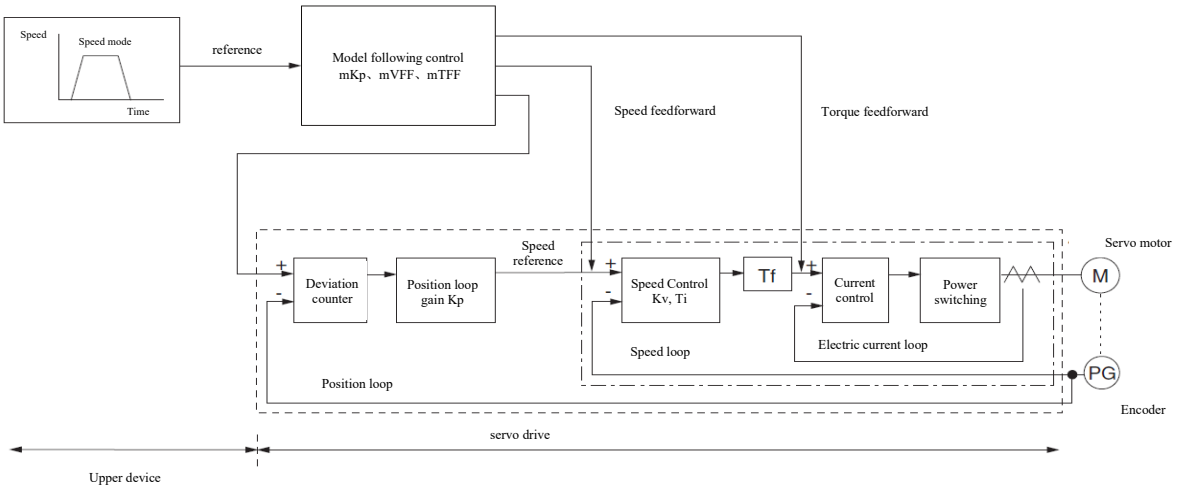
◆ Representation of the decimal points about the parameter
For M1 series servo drive, the parameters are indicated with decimal points in the panel operator and manual.
For example, Pn100 (speed loop gain) is represented as Pn100=40.0, indicating a set value of 40.0 [Hz]. The general criteria for the following tuning level also include
decimal point. Example: Speed loop gain (Pn100 [Hz]), speed loop integral time constant(Pn101 [ms]), Stable tuning level Pn101 ≥ 4000/(2×Pn100), and when Pn100 = 40.0 [Hz], Pn101 = 4000/(2×40.0) ≈ 15.92 [ms].

• Model following control

Using model following control can improve responsiveness and shorten positioning time. Model following controls can be used for only position control.
Typically, the parameters used in this function are automatically set at the same time as the servo gain, either by autotuning or one-parameter tuning.

In the following cases, please manually tune:
• When you are not satisfied with the tuning result of autotuning or one-parameter tuning
• When further responsiveness is needed compared to the tuning results of autotuning or one-parameter tuning
• When the user has to decide the servo gain or model following control parameters

The block diagram of model following control is shown below:



Kp: Position loop gain (Pn102)
Kv: Speed loop gain (Pn100)
Ti: speed loop integral time constant(Pn101)
Tf: torque reference filter time parameter (Pn401)
mKp: model following control gain (Pn141)
mTFF: Model following control bias (forward direction) (Pn143)
Model following control bias (reverse direction) (Pn144)
mVFF: Model following control speed feedforward compensation (Pn147)

◆ Example of manual adjustment steps
An example of the tuning steps when using the model following control is shown below.
(1) Considering the simultaneous use of the friction compensation function, the parameters of the friction compensation function must be set.
(2) Adjust the servo gain.
Set the inertia ratio correctly, refer to the general manual adjustment standard of servo gain, and set the position loop gain within the range of stable tuning level (Pn 102).
(3) Improve the following control gain in a range where no overshooting and vibration occurs (Pn141).
(4) When overshooting occurs, or when the response to forward and reverse is different, fine tuning is performed through model following control bias (forward direction) (Pn143),
model following control bias (reverse direction) (Pn144), and model following control speed feedforward compensation (Pn147).
◆ Related parameters
• **Pn140:** Model following control switch
• **Pn141:** model following control gain
• **Pn143:** Model following control bias (forward direction)
• **Pn144:** Model following control bias (reverse direction)
• **Pn147:** Model following control speed feedforward compensation
• When the model following control switch uses the vibration suppression function (Pn140 = n.□□1☑or Pn140 = n.□□2□), be sure to set it as Pn140 = n.□□□1.

Pn140		
Parameter	Meaning	Effective time
n.□□□0 [Factory setting]	Model following control is not used.	With immediate effect
n.□□□1	Model following control is used.	
n.□□0□ [Factory setting]	No vibration suppression	
n.□□1□	Use vibration suppression function for the specific frequency	
n.□□2□	Use vibration suppression function for two different frequencies	

• Model following control gain

The model following control gain determines the responsiveness of the servo system. If the model following control gain is improved, the responsiveness is enhanced and the positioning time is shortened.

Pn141			
Model following control gain	Position		
Setting range	Setting unit	Factory setting	Effective time
10 ～ 20000	0.1/s	500	With immediate effect

The responsiveness of the servo system depends on this parameter, but not on Pn 102 (position loop gain).
For the machine whose model following control gain cannot be set too large, the position deviation depends on the model following control gain. For the less rigid machinery whose model following control gain cannot be set too large, position deviation overflow alarm may occur during high-speed operation. At this time, if the value of the Pn520 parameter is set too large, the detection of the alarm will become difficult.
Pn520 shall be set up as follows:

$$Pn520 \geqslant \frac{\text{Maximum feed speed [reference unit /s]}}{Pn\,141/10\ [1/s]} \times 2.0$$

Pn520			
Alarm value of position deviation overflow	Position		
Setting range	Setting unit	Factory setting	Effective time
1 ~ 1073741823	**1 reference unit**	**41943040**	With immediate effect

• Model following control bias (forward direction), model following control bias (reverse direction)
For different forward and reverse responses, please fine-tune with the following parameters. If the set point is reduced, although the responsiveness is slower, it is not easy to produce overshooting.

Pn143			
Model following control bias (forward direction)	Position		
Setting range	Setting unit	Factory setting	Effective time
1 ~ 10000	**0.1%**	**1000**	With immediate effect
Pn144			
Model following control bias (forward and reverse direction)	Position		
Setting range	Setting unit	Factory setting	Effective time
1 ~ 10000	**0.1%**	**1000**	With immediate effect

• Model following control speed feedforward compensation
Even if the model following control gain, model following control bias (forward direction), and model following control bias (reverse direction) are adjusted, overshooting still occurs. Improvement can be achieved by adjusting the following parameters.
If the set point is reduced, although the responsiveness is slower, it is not easy to produce overshooting.

Pn147			
Model following control speed feedforward compensation	Position		
Setting range	Setting unit	Factory setting	Effective time
1 ~ 10000	**0.1%**	**1000**	With immediate effect

• Model following control type selection tracking

Pn14F		
Parameter	Meaning	Effective time
n.□□□0	Select Model following control Type 1.	After power on again
n.□□□1[factory setting]	Select Model following control Type 2.	

6.9.2 General function for tuning

General function for tuning is a function used in combination with the manual tuning. With this function, you can improve the tuning result.

Feedforward

Feedforward is the function of performing feedforward compensation to shorten the positioning time during position control.

Pn109			
Feedforward		Position	
Setting range	Setting unit	Factory setting	Effective time
0 ～ 100	1%	0	With immediate effect
Pn10A			
Feedforward filter time constant		Position	
Setting range	Setting unit	Factory setting	Effective time
0 ～ 6400	0.01ms	0	With immediate effect

(Note) If the feedforward set value is too large, it may cause mechanical vibration. Please drop the settings to below 80%.

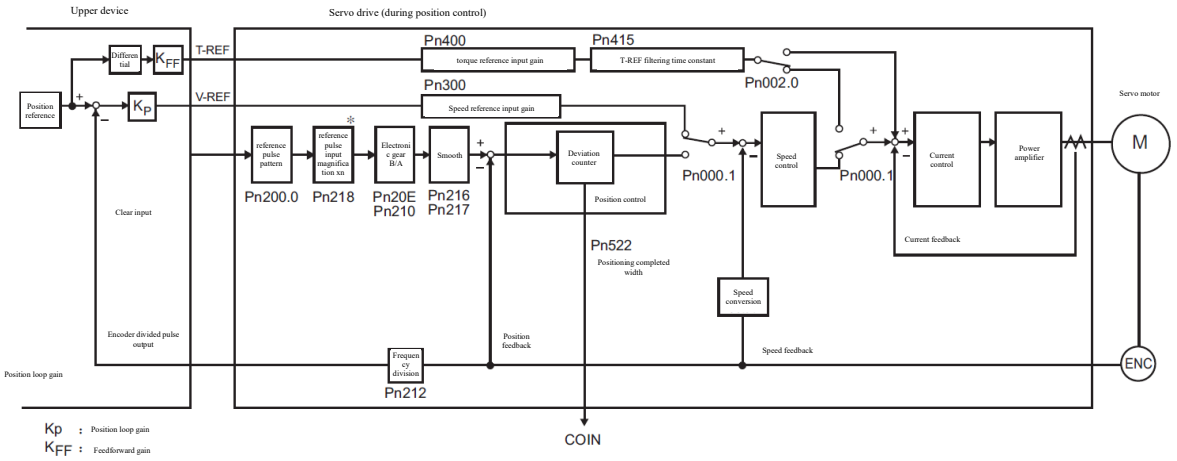
Torque feedforward

Torque feedforward can be used to reduce positioning time. The position reference on the upper device side is differentiated to generate a reference, which is sent together with the speed reference to the servo drive.

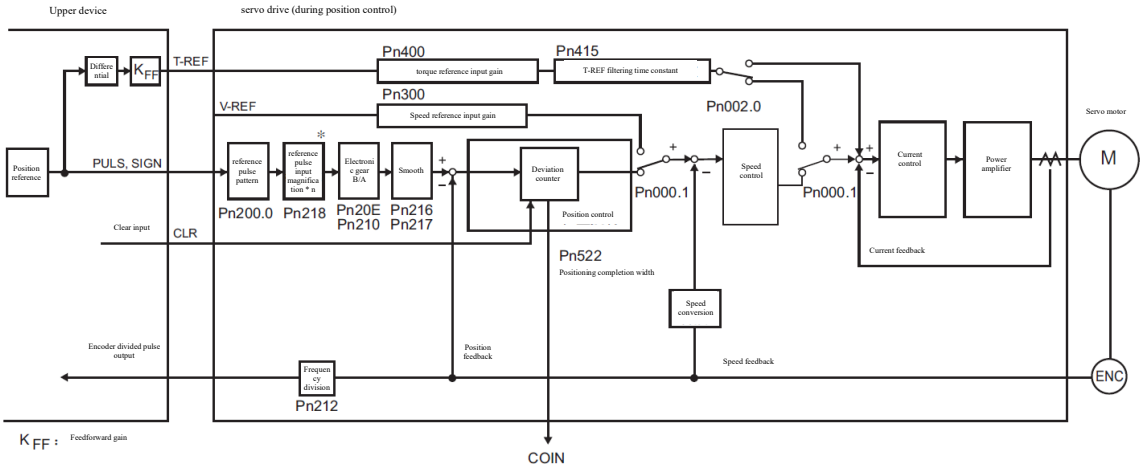
(1) Example of connection to the upper device

The speed reference from the upper device is connected to V-REF (CN1-44, 42), and the torque feedforward reference is connected to T-REF (CN1-40, 38).

When the servo drive performs the speed control:



When the servo drive performs the position control:



(2) Related parameters

The torque feedforward is set through Pn002, torque reference input gain (Pn400), and T-REF filtering time constant (Pn415).
At the factory, Pn400 is set to "Pn400=30", so when the torque feedforward value is set to "± 3V", it is "± 100% torque (rated torque)".

Pn002		
Parameter	Meaning	Effective time
n.□□□0 [Factory setting]	T-REF no allocations	After power on again
n.□□□2	Use T-REF as a torque feedforward input.	

Pn400			
Torque reference input gain	Speed	Position	Torque
Setting range	Setting unit	Factory setting	Effective time
10 ~ 100	**0.1V**	**30**	With immediate effect

Notes:
1. When the torque feedforward reference is too large, the overshooting will occur. Please observe the response while setting appropriately.
2. Cannot be used simultaneously with "torque limit using analog voltage reference".

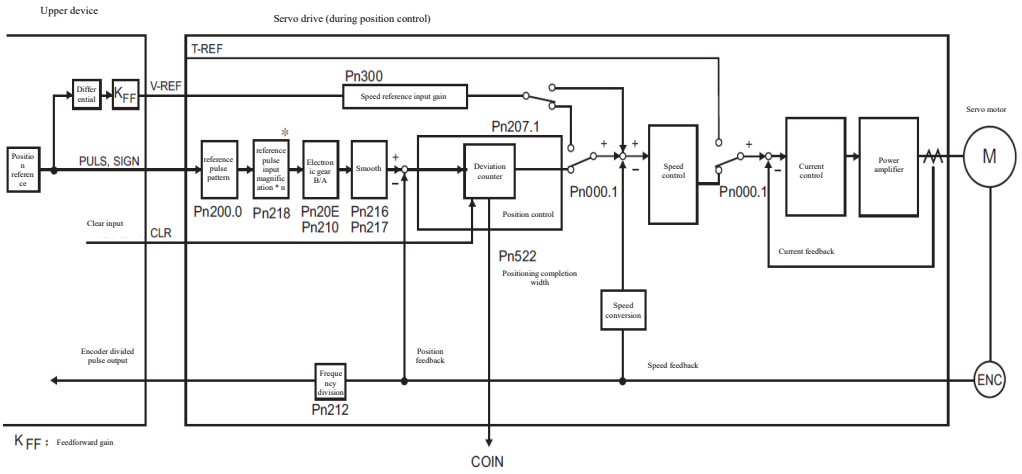
T-REF filtering time constant	Speed	Position	Torque
Setting range	Setting unit	Factory setting	Effective time
0 ~ 65535	**0.01ms**	**0**	With immediate effect

Speed feedforward

Speed feedforward is a function that shorten the positioning time, which is effective when the servo drive performs position control.
The reference generated by differentiating the position reference on the upper device side is sent together with the position reference to the servo drive.

(1) Example of connection to the upper device

The position reference from the upper device is connected to PULS and SIGN (CN1-41, 43, 37, 39), while the speed reference is connected to V-REF (CN1-44, 42).



(2) Related parameters

The speed feedforward is set through Pn207.1 and the speed reference input gain (Pn300).
At the factory, Pn300 is set to Pn300 = 600, so when the speed feedforward value is set to 6V, it is the rated speed

Pn207		
Parameter	Meaning	Effective time
n.□□0□ [Factory setting]	V-REF no allocations	After power on again
n.□□1□	Use V-REF as a speed feedforward input.	

Pn300			
Input gain speed reference		Speed Position Torque	
Setting range	Setting unit	Factory setting	Effective time
150 ~ 3000	**0.01V**	**600**	With immediate effect

Notes:
When the feedforward reference is too large, the overshooting occurs. Please observe the response while setting appropriately.

At the P (proportional) control

Select the P-controlled action from the upper device by using the input signal (/P-CON).

If the "0" reference continues in the speed control mode, the speed control section will become PI control, and the motor may act due to the integration effect. To prevent this from happening, switch the PI control to the P control.

However, when set to the speed control with zero clamping, this function is usually not required because of the position loop.
When /P-CON signal is turned on, it becomes P control. The P control action is set through Pn000.1 and input signal (/P-CON).

(1) /P-CON input signal

Use /P-CON for the switching signal of PI control /P control.

Type	Signal name	Connector pin number	Setting	Meaning
Input	**/P-CON**	CN1-9 [Factory setting]	**OFF (H level)**	Change to PI control (proportional/integral control)
			ON (L-level)	Change to P control (proportional control)

(2) Control mode

(2) Control mode and P control input signal

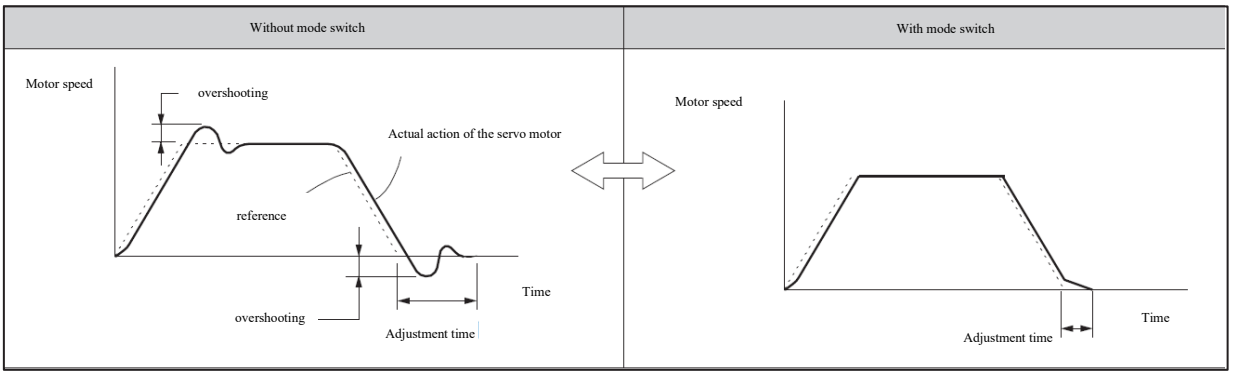
When the control mode is speed control or position control, it can be switched to P control.

Pn000		
Parameter	Control mode selection	Switch to P control
n.□□0□ [Factory setting]	Speed Control	It can be switched by factory settings (CN1-9 = /P- CON) Assign /P-CON to other terminals as required.
n.□□1□	Position control	
n.□□2□	Torque control	It cannot be switched
n.□□3□	internal set speed control	Please assign /P-CON to any terminal in CN1-8, 9, 10, 12, 30, 33 and 34.
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 clamping	
n.□□B□	Position control ⇔ position control with reference pulse suppression function	

Setting of the mode switch (P control / PI control switch)

Mode switch is the function of automatic P control and PI control switch.
The switching condition is set by Pn10B.0, and the switching condition value is set by Pn10C, Pn10D, Pn10E, and Pn10F.

After setting the switching conditions with the parameters, the overshooting during acceleration and deceleration can be suppressed and the setting time can be shortened.



(1) Related parameters
Select the switching condition of the mode switch by Pn10B.0.

Pn10B			
Parameter	Select the mode switch	Parameters that set conditional values	Effective time
n.□□□0 [Factory setting]	Conditional on internal torque references	**Pn10C**	With immediate effect
n.□□□1	Conditional on the speed reference.	**Pn10D**	
n.□□□2	Conditional on the acceleration.	**Pn10E**	
n.□□□3	Conditional on the position deviation	**Pn10F**	
n.□□□4	The mode switch is not selected	-	

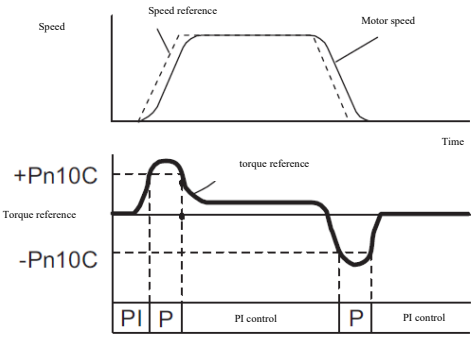
■ Set parameters for switching condition values

Pn10C	Mode switch (torque reference)		Speed	Position
	Setting range	Setting unit	Factory setting	Effective time
	0 ~ 800	**1%**	**200**	With immediate effect
Pn10D	Mode switch (speed reference)		Speed	Position
	Setting range	Setting unit	Factory setting	Effective time
	0 ~ 10000	**1min-1**	**0**	With immediate effect
Pn10E	Mode Switch (acceleration)		Speed	Position
	Setting range	Setting unit	Factory setting	Effective time
	0 ~ 30000	**1min-1/s**	**0**	With immediate effect
Pn10F	Mode switch (position deviation)			Position
	Setting range	Setting unit	Factory setting	Effective time
	0 ~ 10000	**1 reference unit**	**0**	With immediate effect

(2) When the internal torque reference is used as the switching condition of the mode switch [factory setting]

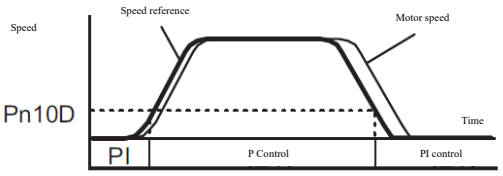
When the torque reference exceeds the torque set in Pn10C, the speed loop will switch to P control.

The factory torque reference value is set to 200% at the factory.



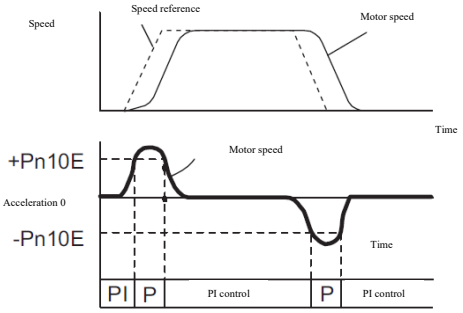
(3) When the speed reference is used as a switching condition for the mode switch

When the speed reference exceeds the torque set in Pn10D, the speed loop will switch to P control.



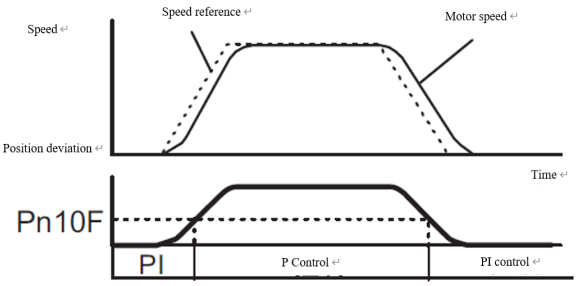
(4) When acceleration is used as the switching condition of mode switch

When the speed reference exceeds the torque set in Pn10E, the speed loop will switch to P control.



(5) When the position deviation is used as the switching condition of the mode switch.

When the position deviation exceeds the torque set in Pn10F, the speed loop will switch to P control. This setting is only valid for position control.



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07 Chapter VII

Utility function (Fnxxx)

7.1 List of utility functions

Utility function refers to the functions related to the operation and tuning of the servo motor.
Utility functions are displayed on the panel beginning with Fn
Below is a list of utility functions.

Fn number	Function description
Fn000	Display alarm record
Fn002	JOG Run
Fn003	Origin search
Fn004	Program JOG run
Fn005	Initialization of parameter settings
Fn006	Delete alarm record
Fn008	Initialization of absolute encoder, encoder alarm reset
Fn009	Autotuning of analog speed/analog torque reference offset
Fn00A	Manual adjustment of speed reference offset
Fn00B	Manual tuning of torque reference offset
Fn00C	Adjust the bias of analog volume monitoring output
Fn00D	Adjust the gain of analog volume monitoring output
Fn00E	Bias tuning of the motor current detection signal - automatic
Fn00F	Bias tuning of the motor current detection signal - manual
Fn010	Parameter write disabled
Fn012	Display MCU and FPGA software versions, driver power levels
Fn013	Set the upper limit of multiturn in case of "inconsistent alarm of upper limit of multiturn (A.CC0)"
Fn015	Inertia ratio identification
Fn01B	Initialization of the detection value for the vibration detection
Fn030	Software reset
Fn200	Set a self-tuning level
Fn201	Advanced autotuning without reference
Fn202	Advanced autotuning without reference
Fn203	One-parameter tuning
Fn204	Anti-resonance control function
Fn205	Vibration suppression function
Fn206	EasyFFT
Fn207	Online vibration monitoring

7.2 Display alarm record (Fn000)

The servo drive alarm recording function can record 10 alarms that have occurred recently

Alarm numbers and time stamps can be viewed through alarm records.

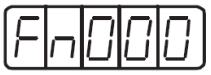
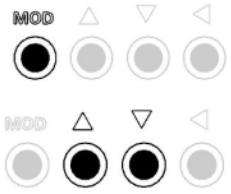
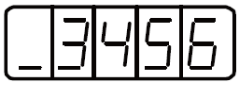
When the same alarm occurs continuously, if the interval between alarms is less than 1 hour, it will not be saved, and if it exceeds 1 hour, all alarms will be saved.

The timestamp refers to the duration measured in 100ms units after the control power supply and main circuit power supply are connected, and displays the total running time when an alarm occurs.

The alarm record cannot be cleared by resetting the alarm or cutting off the main circuit power supply of the servo drive.

The alarm record can be cleared by Fn006 (Clear Alarm Record).

(1) Operating steps

Steps	Panel display	Key	Description
1			Press the MOD key to select utility function. Press the UP or DOWN key until the panel displays Fn000.
2			Press the DATA/SHIFT key again for about 1S and the panel displays the latest alarm.
3			Pressing the DOWN key once will display an old alarm back. Press the UP key once to display a new alarm. The larger the number on the left, the older the alarm is displayed.
4			Press the DATA/SHIFT key and the panel displays the last 4 digits of the timestamp.
5			Press the DATA/SHIFT key and the panel displays the middle 4 digits of the timestamp.
6			Press the DATA/SHIFT key and the panel displays the first 2 digits of the timestamp.
7			Press the DATA/SHIFT key to return the display of the alarm number.
8			Press the DATA/SHIFT key again for about 1S to return a display of Fn000.

7.3 JOG run (Fn002)

JOG operation is to execute speed control function through panel buttons. The servo motor action can be confirmed by JOG running.

The overtravel prevention function is invalid during JOG running. Please perform JOG running within the operating range of the machine.

（1） Confirmation matters before JOG execution

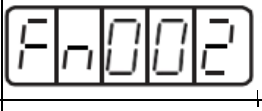
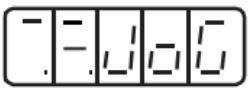
Before JOG run, confirm the following:

- The parameter writing forbid function (Fn010) is not set to "no writing".
- Main circuit power supply ON
- No alarm
- The servo is OFF

JOG speed is set through the parameter Pn304.

Pn304			
JOG speed	Speed Position Torque		
Setting range	Setting unit	Factory setting	Effective time
0 ~ 10000	1min-1□	500	With immediate effect

（2） Operating steps

Steps	Panel display	Key	Description
1			Press the MOD key to select utility function.
2			Press UP or DOWN key to display Fn002 on the panel.
3			Press (DATA/SHIFT) key about 1s and the panel is displayed on the left.
4			Press MOD to enter the servo ON state.
5			Press the UP key, and the motor turns forward. Press the DOWN key, and the motor reverses. The motor rotates at the speed set by Pn304.
6			Press MOD to enter the servo OFF state. Press the DATA/SHIFT key for about 1 second to turn the servo OFF. Press MOD to enter the servo OFF state.
7			Press the DATA/SHIFT key for about 1S to return the display of Fn002
8	After the JOG run is completed, reconnect the power supply to the servo drive.		

7.4 Origin search (Fn003)

Origin search is a function that determines the origin within 1 turn and stops at that position.

This function is used when the motor shaft and mechanical position are required.

The origin search is performed in the unbound coupling state.

"No forward drive" (P-OT) and "no reverse drive" (N-OT) are invalid when the origin search is executed.

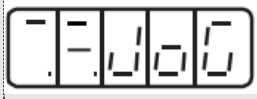
The motor speed for the origin search execution is 60min-1.

(1) Confirmation matters before execution

Before origin search run, confirm the following:

- The parameter writing forbid function (Fn010) is not set to "no writing".
- No alarm
- The servo is OFF

(2) Operating steps

Steps	Panel display	Key	Description
1			Press the MOD key to select utility function.
2			Press UP or DOWN key to display Fn003 on the panel.
3			Press (DATA/SHIFT) key about 1s and the panel is displayed on the left.
4			Press MOD key and servo ON, and the panel is displayed on the left.
5			Press the UP key and the motor will turn forward. Press the DOWN key to reverse the motor. The motor rotation direction can be changed by setting Pn000.0.
6	 (Flashing display)		The servo motor will turn into a blinking display after the origin search is completed. The servo motor will enter the servo lock state at the origin pulse position.
7			Press the DATA/SHIFT key again for about 1S to return a display of Fn003.
8	When the origin search is complete, reconnect the power to the servo drive.		

7.5 Program JOG run (Fn004)

The program JOG run is the function of continuous operation in a preset operation mode.

The program JOG can set the movement distance, movement speed, acceleration and deceleration time, waiting time, movement number.

The program JOG is the same as JOG (Fn002), without the need to connect the upper device, and can confirm the action of the servo motor and perform simple positioning action.

(1) Confirmation matters before execution

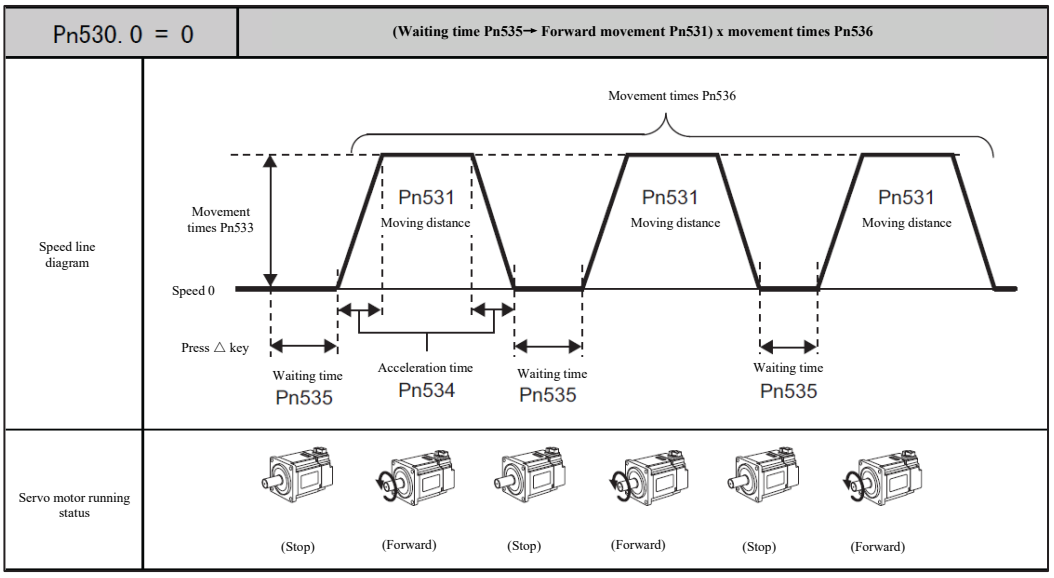
Before program JOG run, confirm the following:

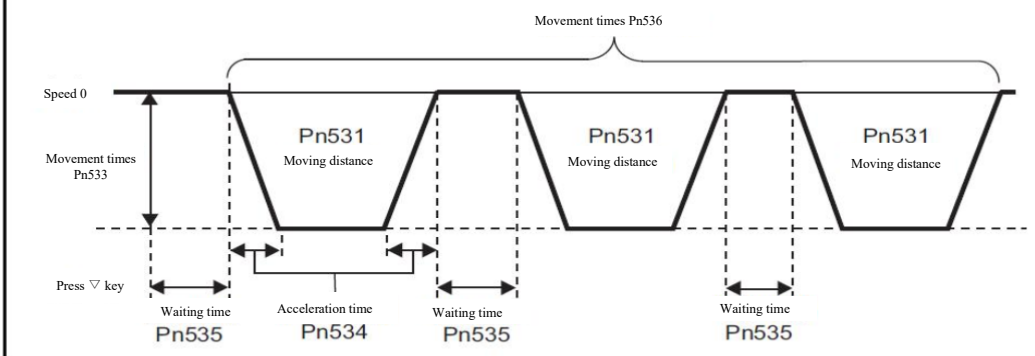
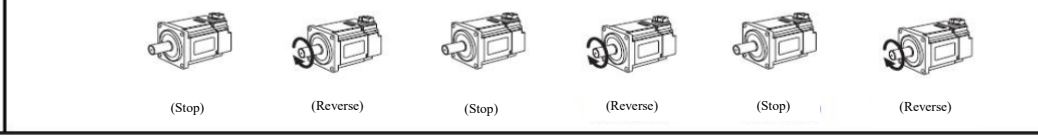
- The parameter writing forbid function (Fn010) is not set to "no writing".
- No alarm
- The servo is OFF
- Within the safe operating range and safe operating speed of the machine, set the moving distance and moving speed.
- No overtravel occurred

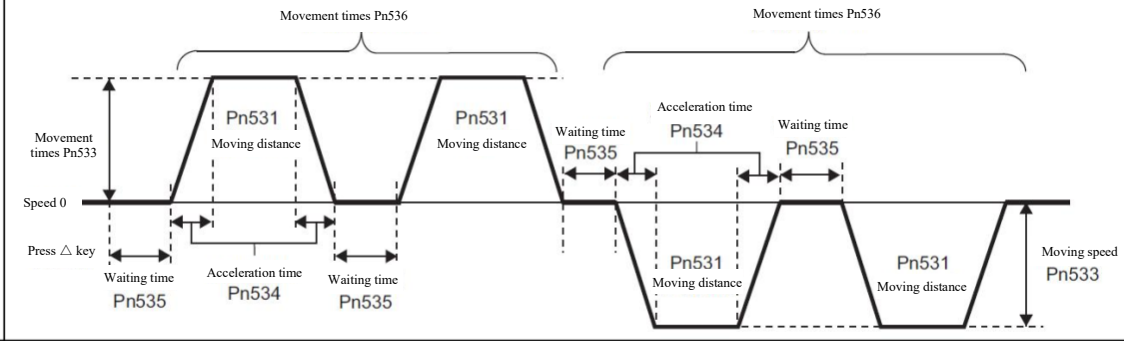
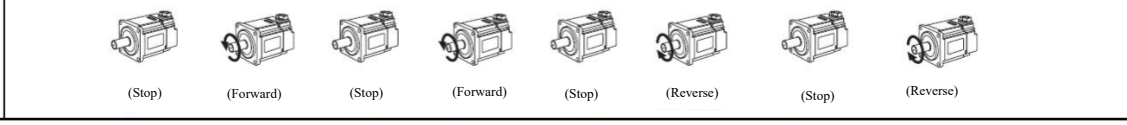
(2) Supplementary item

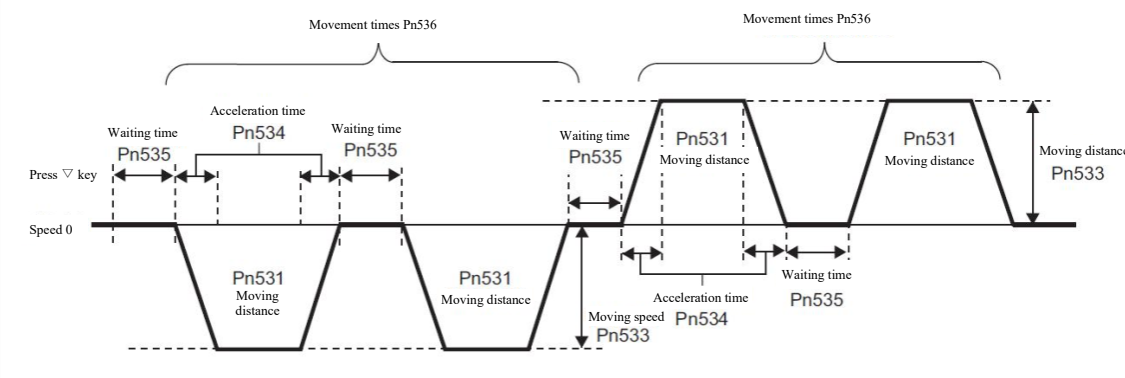
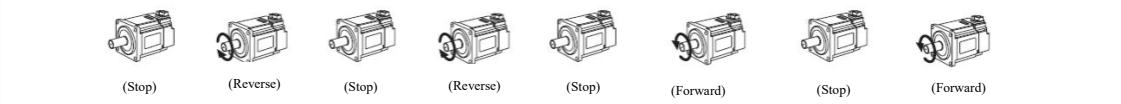
- No external input pulse references are received during program JOG run.
- The overtravel prevention function takes effect
- When using the absolute encoder, SEN signal is always valid, so no input is required.
- The reference pulse input magnification switching function is invalid.

(3) Program JOG running mode



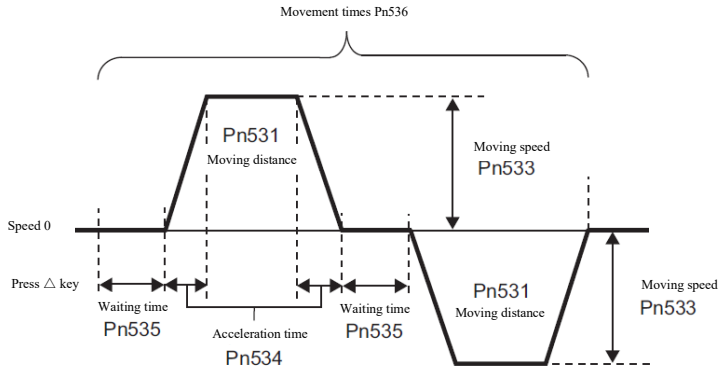
Pn530. 0 = 1	(Waiting time Pn535→ Forward movement Pn531) x movement times Pn536
Speed line diagram	
Servo motor running status	

Pn530. 0 = 2	(Waiting time Pn535→ Forward movement Pn531) x movement times Pn536 (Waiting time Pn535→ Forward movement Pn531) x movement times Pn536
Speed line diagram	
Servo motor running status	

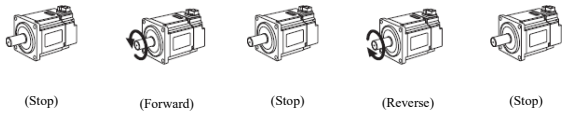
Pn530. 0 = 3	(Waiting time Pn535→ Forward movement Pn531) x movement times Pn536 (Waiting time Pn535→ Forward movement Pn531) x movement times Pn536
Speed line diagram	
Servo motor running status	

Pn530.0 = 4	(Waiting time Pn535 → Forward movement Pn531 → waiting time Pn535 → Reverse movement Pn531) Movement times Pn536 X

Speed line diagram

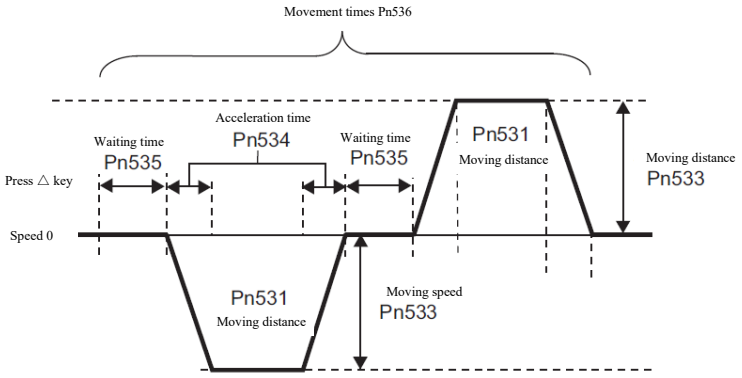


Servo motor running status

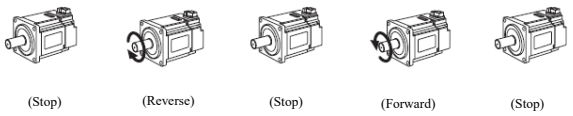


Pn530.0 = 5	(Waiting time Pn535 → Reverse movement Pn531 → waiting time Pn535 → Forward movement Pn531) * Movement times Pn536

Speed line diagram



Servo motor running status



Additional note:
·When Pn530.0 = 0/1/4/5, Pn536 is set to 0, which can run for unlimited times.
·When Pn530.0 = 2, it cannot run for unlimited times.

(4) Related parameters

Pn530	Program JOG run switch		Speed Position Torque	
	Setting range	Setting unit	Factory setting	Effective time
	0000 ~ 0005	□	**0000**	With immediate effect
Pn531	Program JOG movement distance		Speed Position Torque	
	Setting range	Setting unit	Factory setting	Effective time
	1 ~ 1073741824	**1 reference unit**	**32768**	With immediate effect
Pn533	Program JOG movement speed		Speed Position Torque	
	Setting range	Setting unit	Factory setting	Effective time
	1 ~ 10000	**1min-1□**	**500**	With immediate effect

Pn534	Program JOG acceleration and deceleration time		Speed Position Torque	
	Setting range	Setting unit	Factory setting	Effective time
	2 ~ 10000	**1ms**	**100**	With immediate effect
Pn535	Programs JOG waiting time		Speed Position Torque	
	Setting range	Setting unit	Factory setting	Effective time
	0 ~ 10000	**1ms**	**100**	With immediate effect
Pn536	Program JOG movement times		Speed Position Torque	
	Setting range	Setting unit	Factory setting	Effective time
	0 ~ 1000	**1 time**	**1**	With immediate effect

(2) Operating steps

Steps	Panel display	Key	Description
1			Press the MOD key to select utility function.
2			Press UP or DOWN to switch to Fn004
3			Press (DATA/SHIFT) key about 1s and the panel is displayed on the left.
4			Press MOD key and servo ON, and the panel is displayed on the left.
5			Press the UP key or DOWN key that conforms to the initial action direction of the running mode, and the action starts after the set waiting time. Press MOD key during operation, and the servo enters OFF state, and the motor stops running. During operation, press the DATA/SHIFT key for about 1 second to return to step 2.
6			The program JOG ends, and the display returns to the left image after flashing "End". Press MOD during operation, and the servo enters OFF state and returns to Step 3. During operation, press the DATA/SHIFT key for about 1 second to return to step 2.
7	After finishing the program, reconnect the power to the servo drive.		

7.6 Initialization of parameter settings (Fn005)

This function can restore parameters to factory settings.

Parameter setting initialization must be performed when the server is OFF and cannot be performed when the server is ON.

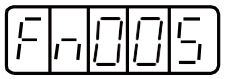
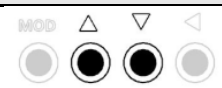
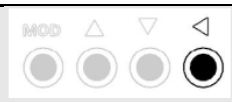
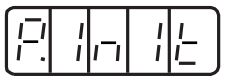
After initialization, reconnect the power to the servo drive.

(1) Confirmation matters before execution

Before initializing parameters, confirm the following items:

- The parameter writing forbid function (Fn010) is not set to "no writing".
- The servo is OFF

(2) Operating steps

Steps	Panel display	Key	Description
1			Press the MOD key to select utility function.
2			Press UP or DOWN key to display Fn005 on the panel.
3			Press (DATA/SHIFT) key about 1s and the panel is displayed on the left.
4			Press MOD key to initialize parameters. After the initialization is finished, "donE" flashes and returns to the display on the left.
5	After the initialization of the parameter settings ends, power on the servo drive again.		

7.7 Delete alarm record (Fn006)

This function can clear the alarm record of the driver.

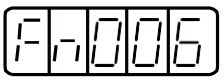
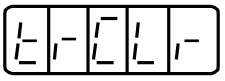
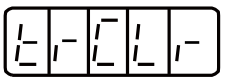
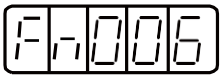
The alarm record can only be deleted by executing Fn006. The alarm record cannot be deleted even if the alarm is reset or the power supply of the driver is cut off.

(1) Confirmation matters before execution

Before clearing the alarm record, confirm the following:

· The parameter writing forbid function (Fn010) is not set to "no writing".

(2) Operating steps

Steps	Panel display	Key	Description
1			Press the MOD key to select utility function.
2			Press UP or DOWN key to display Fn006 on the panel.
3			Press (DATA/SHIFT) key about 1s and the panel is displayed on the left.
4			Press MOD key to clear alarm record. After the clearing is finished, "donE" flashes and returns to the display on the left.
5			Press the DATA/SHIFT key again for about 1S to return a display of Fn006.

7.8 Bias tuning of the motor current detection signal - automatic (Fn00E)

This function is used to further reduce torque pulsation and higher precision adjustment, generally without adjustment.

This function can be performed when the torque pulse generated is significantly larger compared with other servo drives of the same model.

This function must be performed in the state of the servo OFF.

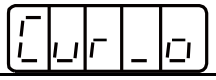
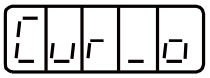
The offset is not a parameter and will not be initialized even after parameter initialization (Fn005) is performed.

(1) Confirmation matters before execution

Before performing autotuning of the offset of the motor current detection signal, the following items need to be confirmed:

- The parameter writing forbid function (Fn010) is not set to "no writing".
- The servo is in the ready state.
- The servo is OFF

(2) Operating steps

Steps	Panel display	Key	Description
1			Press the MOD key to select utility function.
2			Press UP or DOWN key to display Fn00E on the panel.
3			Press (DATA/SHIFT) key about 1s and the panel is displayed on the left.
4			Press MOD key to adjust the bias automatically. After the tuning is finished, "donE" flashes and returns to the display on the left.
5			Press the DATA/SHIFT key again for about 1S to return a display of Fn00E.

7.9 Bias tuning of the motor current detection signal - manual (Fn00F)

After performing the automatic bias tuning of the motor current detection signal (Fn00E), if the torque ripple is still large, this function can be executed.

If this function is incorrectly performed during manual tuning, the feature may deteriorate.

The offset is not a parameter and will not be initialized even after parameter initialization (Fn005) is performed.

For manual tuning, follow the following precautions:

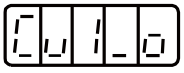
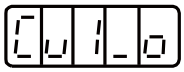
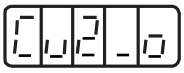
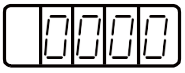
· The rotating speed of servo motor is 100min-1.

·Observe the torque reference under the simulated quantity monitoring state and adjust the pulse to the minimum.

(1) Confirmation matters before execution

· The parameter writing forbid function (Fn010) is not set to "no writing".

(2) Operating steps

Steps	Panel display	Key	Description
1			Press the MOD key to select utility function.
2			Press UP or DOWN key to display Fn00F on the panel.
3			Adjust the U-phase bias. Press (DATA/SHIFT) key about 1s and the panel is displayed on the left.
4			Press the DATA/SHIFT key to display the U-phase bias.
5			Press the UP or DOWN key to change the bias. The torque reference must be carefully adjusted while observing the monitoring signal. Tuning range: -512 ~ +511
6			Press the DATA/SHIFT key to return to the display on the left.
7			Adjust the V-phase bias. Press the MOD key for about 1S, and the panel is displayed on the left.
8			Press the DATA/SHIFT key to display the V-phase bias.
9			Press the UP or DOWN key to change the bias. The torque reference must be carefully adjusted while observing the monitoring signal. Tuning range: -512 ~ +511
10			Press the DATA/SHIFT key for about 1S to display Cu2-o and then return the Fn00F display.

7.10 Parameter write disabled (Fn010)

This function is to prohibit the use of the panel to change parameters, but it is possible to use DriveKey to change parameters.

When this function is enabled, parameter changes and utility functions will be subject to the following restrictions:

Parameters: Cannot be changed. When changing, the panel flashes NO-OP.

Utility function: The following table lists the non-executable utility functions, When unexecutable utility functions are performed, NO-OP is displayed.

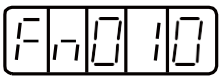
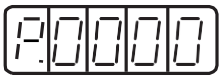
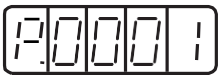
Fn number	Function	Set as "no writing"
Fn000	Display alarm record	Executable
Fn002	JOG Run	Unexecutable
Fn003	Origin search	Unexecutable
Fn004	Program JOG run	Unexecutable
Fn005	Initialization of parameter settings	Unexecutable
Fn006	Delete alarm record	Unexecutable
Fn008	Initialization of absolute encoder, encoder alarm reset	Unexecutable
Fn009	autotuning of analog speed/analog torque reference offset	Unexecutable
Fn00A	Manual adjustment of speed reference offset	Unexecutable
Fn00B	Manual tuning of torque reference offset	Unexecutable
Fn00C	Adjust the bias of analog volume monitoring output	Unexecutable
Fn00D	Adjust the gain of analog volume monitoring output	Unexecutable
Fn00E	Bias tuning of the motor current detection signal - automatic	Unexecutable
Fn00F	Bias tuning of the motor current detection signal - manual	Unexecutable
Fn010	Parameter write disabled	-
Fn012	Display software version	Executable
Fn013	Set the upper limit of multiturn in case of "inconsistent alarm of upper limit of multiturn (A.CC0)"	Unexecutable
Fn01B	Initialization of the detection value for the vibration detection	Unexecutable
Fn030	Software reset	Executable
Fn200	Set a self-tuning level	Unexecutable
Fn201	advanced autotuning without reference	Unexecutable
Fn202	advanced autotuning without reference	Unexecutable
Fn203	one-parameter tuning	Unexecutable
Fn204	anti-resonance control function	Unexecutable
Fn205	Vibration suppression function	Unexecutable
Fn206	EasyFFT	Unexecutable
Fn207	Online vibration monitoring	Unexecutable

(1) Operating steps

The settings for whether to allow writing parameters are as follows:

P.0000: Writing allowed

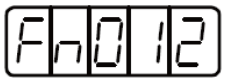
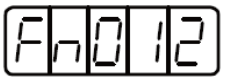
P.0001: Writing prohibited

Steps	Panel display	Key	Description
1			Press the MOD key to select utility function.
2			Press UP or DOWN key to display Fn010 on the panel.
3			Press (DATA/SHIFT) key about 1s and the panel is displayed on the left.
4			Press the UP or DOWN key to set it to P.0000 or P.0001
5			Press the MOD key to confirm the settings. After the setting is finished, "donE" flashes and returns to the display on the left. If it is set to a value other than P.0000 and P.0001, the panel displays Error.
6	After the setting of "parameter writing forbid" ends, turn on the power of the servo drive again.		

7.11 Display software version (Fn012)

This function is the software version that displays the servo drive.

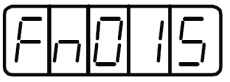
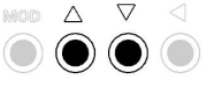
(1) Operating steps

Steps	Panel display	Key	Description
1			Press the MOD key to select utility function.
2			Press UP or DOWN key to display Fn012 on the panel.
3			Press the DATA/SHIFT key for about 1S to display the MCU software version of the driver.
4			Press MOD to display the FPGA software version of the servo drive.
5			Press the DATA/SHIFT key for about 1S to return the display of Fn012

7.12 Inertia ratio identification (Fn015)

(1) Operating steps

The following describes the procedures.

Steps	Panel display	Key	Description
1			Press the MOD key to select utility function.
2			Press UP or DOWN key to display Fn015 on the panel.
3			Press (DATA/SHIFT) key about 1s and the panel displays JRT.
4			Press the MOD key, and the panel is displayed on the left.
5			Press the UP or DOWN key to rotate the motor 2 turns forward or reversely, and start inertia identification. The inertia ratio of the load to the motor is displayed when the motor stops (unit: 1%).
6			Press the DATA/SHIFT key for about 1S to return the display of Fn015

Additional note:

1. Before inertia identification, please ensure that the motor displacement travel in the positive/reverse direction has at least 2 turns.
2. The inertia ratio identification result will not automatically update the parameter Pn103, and the user needs to manually set Pn103 based on the identification result.

7.13 Initialization of the vibration detection value (Fn01B)

In the running state, after the machine vibrates, the vibration detection function automatically sets the vibration detection value (Pn312) in order to more accurately detect vibration alarms (A.520) or vibration warnings (A.911).

Part of the vibration component of the motor speed can be detected by vibration detection function.
When the vibration exceeds the detection value, the alarm or warning will be displayed through the setting of the vibration detection switch (Pn 310).
The calculation formula of the detected value is as follows:

Detection value = vibration detected value (Pn312[min-1]) Vibration detection sensitivity (Pn311[%])/1

Pn310		
Parameter	Description	Effective time
N.□□□0 [factory setting]	No vibration detected	With immediate effect
n.□□□1	A warning is issued when vibration is detected (A.911).	
n.□□□2	Alarm is issued when vibration is detected (A.520).	

The vibration detection value (Pn312) is the factory default setting. This function can be set when there is no effective vibration alarm (A520) or vibration warning (A.911) detected. Because of the different mechanical state, the detection sensitivity of vibration alarm and vibration warning will be different, and the vibration detection sensitivity (Pn311) can be fine-tuned at this time.

Important notes:

·It may be difficult to detect vibration when the servo gain is not set properly. The moment of inertia ratio needs to be set properly (Pn103).

In case of improper setting, vibration alarm or vibration warning may be misdetected or may not be detected. To set this function, you must control the operation with the actual references.

Please execute after entering the running state where the vibration detection value is to be set.

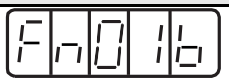
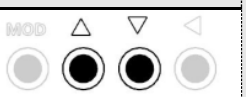
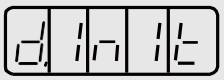
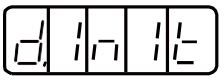
Please set the motor speed to be at least 10% of the maximum speed, otherwise an Error will be displayed.

(1) Confirmation matters before execution

Before initializing the detected value of the vibration detection, confirm the following:

· The parameter writing forbid function (Fn010) is not set to "no writing".

(2) Operating steps

Steps	Panel display	Key	Description
1			Press the mod key to end the inspection and update and make the setting take effect. Display donE after the setting is completed normally, and the display Error cannot be completed normally.
2			
3			
4			
5			
6			Press the DATA/SHIFT key for about 1S to return the display of Fn01b

(3) Related parameters

Parameter	Description	Whether the settings can be changed	Whether there are automatic settings
Pn311	Vibration detection sensitivity	Yes	None
Pn312	Vibration detection value	No	Yes

A description of whether the set value can be changed:

No: Parameters cannot be changed through DriveKey when performing this function.

Yes: Parameters cannot be changed through DriveKey when performing this function.

Description of automatic setting:

Yes: After this function is performed, the parameter settings will be automatically set or adjusted.

No: After this function is performed, the parameter settings will not be automatically set or adjusted.

7.14 Software reset (Fn030)

The function o reset the servo drive internally via software.

For parameters or alarm resets that take effect after power outage and restart, software reset can be used to take effect and reset.

The software reset function must operate in the servo OFF state or in the motor stop state.

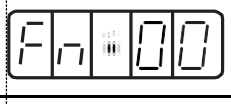
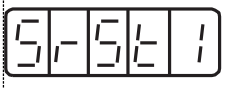
The reset effect of software reset is the same as that of power outage restart. The output signal of the driver changes due to the software reset.

(1) Confirmation matters before execution

Before performing a software reset, confirm the following:

· The servo is OFF

(2) Operating steps

Steps	Panel display	Key	Description
1			Press the MOD key to select utility function.
2			Press UP or DOWN key to display Fn030 on the panel.
3			Press (DATA/SHIFT) key about 1s and the panel is displayed on the left.
4			Press the UP key until the panel displays as shown in the left image. If the wrong key operation occurs in the middle of the process, the no oP will flash for about 1S.
5			Press MOD key, and the panel displays the status display screen after power on

7.15 EasyFFT (Fn206)

This function is to make the machine produce vibration, detect the resonance frequency according to the vibration generated by the machine, and then set the corresponding notch filter through the detected resonance frequency, so as to remove the high frequency vibration and abnormal sound.

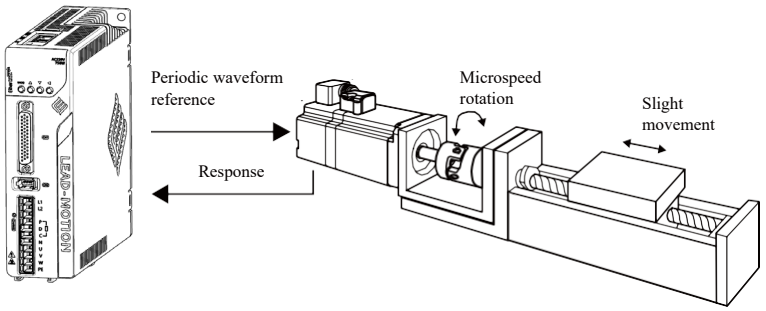
When EasyFFT is executed, the periodic waveform references from the servo unit are transmitted to the servo motor.

The motor automatically rotates several times in the 1/4 turn to vibrate the machine. This function is performed in the servo OFF state when the vibration is accompanied by a large abnormal sound.

Important notes:

Do not touch the motor or machine during EasyFFT to prevent danger.

Please use EasyFFT function at a lower gain. If EasyFFT function is implemented at a higher gain, the machine may vibrate.



servo drive

When using the M1 series servo drive for adjustment (tuning), it is recommended to use the advanced autotuning without reference (no upper input reference) function for adjustment.

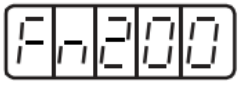
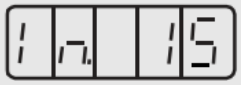
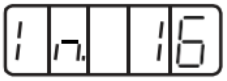
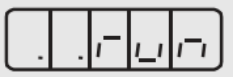
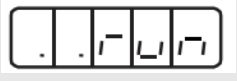
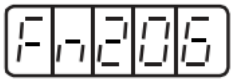
Although the servo drive has this function, it is generally not needed.

(1) Confirmation matters before execution

Before executing EasyFFT, you need to confirm the following:

- The parameter writing forbid function (Fn010) is not set to "no writing".
- Main circuit power supply ON
- No alarm
- The servo is OFF
- No overtravel occurred
- No references were entered from outside.
-

(2) Operating steps

Steps	Panel display	Key	Description
1			Press the MOD key to select utility function.
2			Press UP or DOWN key to display Fn206 on the panel.
3	 (Set reference amplitude)		Press (DATA/SHIFT) key about 1s and the panel is displayed on the left. Enter the reference amplitude setting mode.
4			Press the UP or DOWN key to set the reference amplitude and amplitude setting range: 1- 800 When setting EasyFFT for the first time, start with the initial setting. By increasing the amplitude of the reference, the detection accuracy will be improved, and the vibration and noise generated by the machinery will correspondingly increase. Please gradually increase the amplitude value, and modify it while observing. The parameter Pn456 is used to save the reference amplitude value.
5	 (Running ready state)		Press the DATA/SHIFT key for about 1 second to enter the ready state.
6			Press MOD to enter the servo ON state. To turn the servo OFF, press the MODE/SET key. Return to step 5.
7	 (Flashing display)		In the servo ON state, press the UP or Down key, and the motor will rotate forward and backward with a maximum amplitude of 1/4 turn. The running time is about 2 seconds, and the panel will flash during operation. To abort the action, please press the MODE/SET key to return to step 5.
8	 (Example of detection results)		After successful detection, the E_FFt stops flashing and displays the detected resonance frequency. If the detection fails, it will display F--. To confirm the resonance frequency without setting the detection result, press the DATA/SHIFT key for about 1 second to return to step 2. If the detection is successful, but the running time exceeds 2 seconds, it may be due to insufficient detection accuracy. You can slightly increase the amplitude of the reference and execute it again, which may improve the detection accuracy.
9			Press the MOD key to automatically set the detected resonance frequency to the optimal notch filter frequency. After setting the notch filter, donE flashes and returns to the display in the left figure. The frequency of the first notch filter has been set and automatically set to the frequency of the second notch filter (Pn40C). Press the MODE/SET key again to return to Step 5.
10			Press the DATA/SHIFT key again for about 1S to return a display of Fn206.
11	After executing EasyFFT, power on the servo drive again.		

(3) Related parameters

Parameter	Name	Whether the settings can be changed	Whether there are automatic settings
Pn408	Torque-type function switch	Yes	Yes
Pn409	Frequency for the first notch filter	No	Yes
Pn40A	Q value of the first notch filter	No	None
Pn40C	Frequency of the second notch filter	No	Yes
Pn40D	Q value of the second notch filter	No	None
Pn456	Scan the torque reference amplitude	No	None

A description of whether the set value can be changed:

No: Parameters cannot be changed through DriveKey when performing this function.

Yes: Parameters cannot be changed through DriveKey when performing this function.

Description of automatic setting:

Yes: After this function is performed, the parameter settings will be automatically set or adjusted.

No: After this function is performed, the parameter settings will not be automatically set or adjusted.

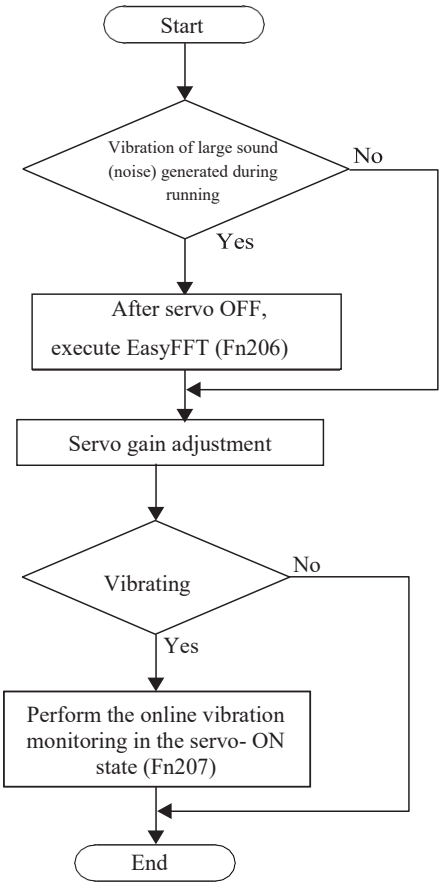
7.16 Online vibration monitoring (Fn207)

During the operation of the machine, the servo is in the ON state. When vibration occurs, this function is executed, and the current vibration frequency is set to the notch filter or torque reference filter, which can eliminate vibration.

The vibration frequency generated during mechanical resonance will show the vibration frequency with large peak on the drive panel. For this frequency, select the effective torque reference filter or notch filter frequency automatically, and automatically set the relevant parameters.

When using the xx series servo drive for adjustment (tuning), it is recommended to use the advanced autotuning without reference (no upper input reference) function for adjustment. Although the servo drive has this function, it is generally not normally required.

It is mainly used to adjust the servo gain when the vibration produces a loud sound (noise)

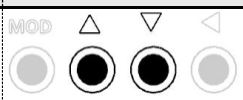
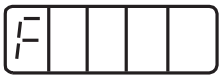
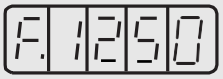
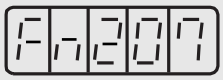
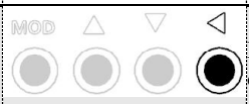


(1) Confirmation matters before execution

Before performing the online vibration monitoring, the following needs to be confirmed:

- The parameter writing forbid function (Fn010) is not set to "no writing".
- The servo is ON.
- No overtravel occurred
- The correct moment of inertia ratio is set (Pn103).

(2) Operating steps

Steps	Panel display	Key	Description
1			Press the MOD key to select utility function.
2			Press UP or DOWN key to display Fn207 on the panel.
3			Press the DATA/SHIFT key for about 1 second and the panel displays F.
4	 (Flash)		Press the MOD key, then the F display flashes, and the automatic detection starts.
5	 (Example of detection results)		F display stops flashing and ends the detection. If detected as normal, the detection result is displayed and the vibration frequency displayed is the frequency at the maximum peak. To confirm the vibration frequency without setting the detection result, press the DATA/SHIFT key for about 1 second to return to step 2. If the frequency detection fails, it will display F--. no_oP is displayed when the detection process does not end properly.
6			Press MOD key to automatically set the detected resonance frequency to the optimal notch filter frequency or the torque reference filtering time constant. It flashes donE during the normal setting.
7			Press the DATA/SHIFT key for about 1S to return the display of Fn207

(3) Related parameters

Parameter	Name	Whether the settings can be changed	Whether there are automatic settings
Pn401	Filter time constant for the first torque reference in the first section	No	Yes
Pn408	Torque-type function switch	Yes	Yes
Pn409	Frequency for the first notch filter	No	Yes
Pn40A	Q value of the first notch filter	No	None
Pn40C	Frequency of the second notch filter	No	None
Pn40D	Q value of the second notch filter	No	None

A description of whether the set value can be changed:

No: Parameters cannot be changed through DriveKey when performing this function.

Yes: When performing this function, you can change the parameters through DriveKey and other references on whether the parameters are automatically set:

Yes: After this function is performed, the parameter settings will be automatically set or adjusted.

No: After this function is performed, the parameter settings will not be automatically set or adjusted.

08 Chapter VIII

Monitoring Function (Unxxx)

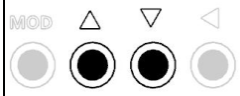
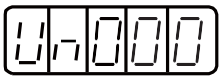
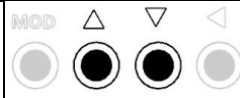
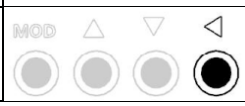
8.1 List of monitoring functions

Monitoring function is the monitoring of the internal information of the servo unit, including the set reference value, the input and output signal, and the internal state of the servo drive.

Un number	Display content	Unit
Un000	Motor speed	min-1
Un001	Speed reference	min-1
Un002	Internal torque reference (value relative to rated torque)	%
Un003	Rotation angle 1 (Number of encoder pulses starting from the origin of phase C: displayed in decimal format)	Encoder pulse
Un004	Rotation angle 2 (Angle from the origin of the magnetic pole (electrical angle))	deg
Un005	Input signal monitoring	-
Un006	Output signal monitoring	-
Un007	Input reference pulse speed (valid only for position control)	min-1
Un008	Position deviation amount (valid only for position control)	reference unit
Un009	Cumulative load rate (Value of rated torque at 100%: display effective torque for a 10s period)	%
Un00A	Regenerative load rate (Value at 100% of treatable renewable electrical energy: display regenerative power consumption for a 10s period)	%
Un00B	DB Resistance power consumption (The value of 100% processable electrical energy when the dynamic brake is applied: display the DB power consumption for a 10s period)	%
Un00C	Input reference pulse counter	reference unit
Un00D	Feedback pulse counter	Encoder pulse
Un012	Total driver run time	100ms
Un013	Feedback pulse counter	reference unit
Un020	Rated motor speed (motor parameters)	min-1
Un021	Maximum motor speed (motor parameters)	min-1
Un10A	Driver radiator temperature	°C
Un10F	Internal temperature of absolute encoder	°C
Un140	main circuit bus voltage	V
Un14A	Input reference pulse frequency	PPS (pulse count/second)

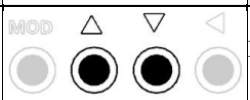
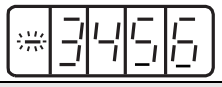
8.2 Example of the monitoring function

Taking Un000 as an example, an operational example of the monitoring function is shown below. The following is the display when the servo motor speed is 1500min-1.

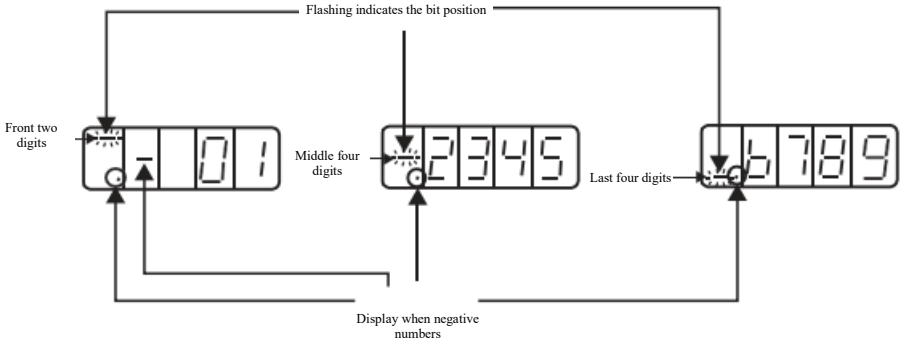
Steps	Panel display	Key	Description
1			Press MOD to select Monitor Display
2			If the parameter number does not display "Un000", press the UP or Down key to display "Un000".
3			Press the DATA/SHIFT key for about 1S to display the motor speed.
4			Press the DATA/SHIFT key again for about 1S to return a display of step 1.

8.3 Read methods for the 32-bit length data

The 32-bit length data are shown in 10-decimal form.

Steps	Panel display	Key	Description
1			Press MOD and select Monitor Display Un000.
2			Press UP or DOWN key to display Un00D on the panel.
3	Last four digits 		Press the DATA/SHIFT key for about 1 second and the last 4 digits of the data are displayed on the panel.
4	Middle four digits 		After confirmation, press the DATA/SHIFT key. The panel displays the middle 4 digits of the time.
5	Front two digits 		Press the DATA/SHIFT key again to display the first two digits of the data. < Supplement > After the first two digits are displayed, press the DATA/SHIFT key again to restore the last four digits.
6			Press the DATA/SHIFT key for about 1 second to return to the display shown in Step 2.

The 32-bit length data is viewed as follows:



8.4 Monitoring of input signals (Un005)

The display steps and the discriminant methods of Un005 are described as follows.

8.4.1 Display step

Steps	Panel display	Key	Description
1			Press MOD to select Monitor Display
2			Press UP or DOWN key to display Un005 on the panel.
3	 Input signal display status		Press the DATA/SHIFT key for about 1 second to enter the input signal state.
4			Press the DATA/SHIFT key again for about 1S to return a display of Un005.

8.4.2 Discrimination method displayed

The assigned input signal is displayed through the SEG on state of the panel. The corresponding relationship between the input signal and the number is as follows

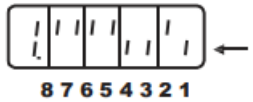
Up: OFF
Down: ON
No.

- When the input signal is OFF, the upper half of the SEG lights up.
- When the input signal is ON, the lower half of the SEG lights up.

No.	Pin number	Signal name (Factory setting)
1	CN1-33	/S-ON
2	CN1-9	/P-CON
3	CN1-10	P-OT
4	CN1-34	N-OT
5	CN1-8	/ALM-RST
6	CN1-30	/P-CL
7	CN1-12	/N-CL
8	CN1-20	SEN

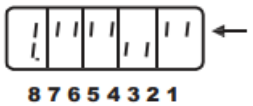
8.4.3 Example of the input signal display

· When /S-ON signal is ON



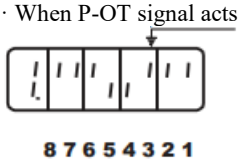
Light on the upper side of number 1 is ON

· When /S-ON signal is OFF



Light on the upper side of number 1 is ON

· When P-OT signal acts

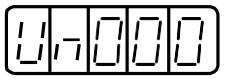
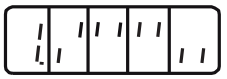


Light on the upper side of number 3 is ON

8.5 Monitoring of the output signal (Un006)

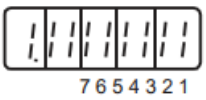
The display steps and the discriminant methods of Un006 are described as follows.

8.5.1 Display step

Steps	Panel display	Key	Description
1			Press MOD to select Monitor Display
2			Press UP or DOWN key to display Un006 on the panel.
3	 Output signal display status		Press the DATA/SHIFT key for about 1 second to display the current status of the output signal.
4			Press the DATA/SHIFT key again for about 1S to return a display of Un006.

8.5.2 Discrimination method displayed

The assigned output signal is displayed through the SEG on state of the panel. The corresponding relationship between the output signal and the number is as follows.



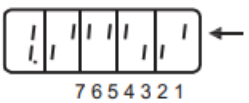
Up: OFF
Down: ON
Light on the upper side of number 7 is ON

- When the output signal is OFF, the upper half of the SEG lights up.
- When the output signal is ON, the lower half of the SEG lights up.

No.	Pin number	Signal name (factory setting)
1	CN1-1, 26	ALM
2	CN1-5, 4	/COIN or /V-CMP
3	CN1-3, 2	/TGON
4	CN1-7, 6	/S-RDY
5	-	Reserved
6	-	Reserved
7	-	Reserved
8	-	Reserved

8.5.3 Example of the output signal display

- When ALM signal is OFF (when alarm occurs)



Light on the upper side of number 1 is ON

8.6 Monitoring content setting for the initial power-up

If you want to modify the monitoring content on the driver panel during initial power-on, you can set the parameter Pn52F.

Pn52F			
Monitor display during power on		Speed Position Torque	
Setting range	Setting unit	Factory setting	Effective time
0000 ~ 0FFF	-	0FFF	With immediate effect

Examples are given below:

To display the actual motor speed when the driver is initially powered on, change the value of Pn52F to 0000.

09 Chapter IX

Failure Diagnosis

9.1 When a alarm is displayed

This chapter introduces the alarm list of the driver and the cause and treatment measures of the alarm.

9.1.1 Alarm list

Stop method for the alarm:

Ws.1: The stop method for the alarm is set by the parameter Pn001.0. Ws.2: The stop method for the alarm is set by the parameter Pn00B.1.

Whether the alarm can be reset:

Yes: The alarm can be deactivated by alarm reset No: The alarm cannot be deactivated by alarm reset

Alarm code	Alarm name	Alarm content	Stop method for the alarm	Whether the alarm can be reset
A.001	Driver model identification alarm	The servo drive model identified is inconsistent with the driver model present in the EEPROM.	Ws.1	No
A.002	Motor model parameters are not set	Driver parameter Pn604 does not set the motor model.	Ws.1	No
A.003	Emergency stop alarm	FSTP emergency stop alarm input signal is valid.	Ws.1	No
A.004	The function does not match the model	Pn000.1 has selected the control mode of speed control (analog reference), but the driver does not have analog input function.	Ws.1	No
A.020	Parameter and calibration exceptions	Data exception for the parameters internal to the driver.	Ws.1	No
A.021	Parameter formatting exception	Data format exception for the parameters internal to the driver.	Ws.1	No
A.022	System and calibration exceptions	Data exception for the parameters internal to the driver.	Ws.1	No
A.030	Part exception detected in the main circuit	The detection data of the main circuit is abnormal.	Ws.1	Yes
A.040	Parameter setting exception	The parameter is outside the set range.	Ws.1	No
A.041	Divided pulse output setting exception	The number of encoder divided pulses (Pn212) does not meet the set range or set conditions.	Ws.1	No
A.042	Parameter combination exception	The combination of multiple parameters is out of the set range.	Ws.1	No
A.050	Combination error	Outside the range of combined motor capacity.	Ws.1	Yes
A.052	Exception of power matching	The driver power is less than the motor power	Ws.1	No
A.0b0	Servo ON reference invalid alarm	After the motor power-on utility function is performed, the servo ON (/S-ON) signal is input from the outside.	Ws.1	Yes
A.100	Overcurrent detection	Overcurrent flows through the power transistor.	Ws.1	No
A.101	Overcurrent detection	Overcurrent flows through the power transistor. [VCE saturation]	Ws.1	No
A.300	Regeneration fault	Regenerative fault	Ws.1	Yes
A.320	Regeneration overload	Regeneration overload occurred	Ws.2	Yes
A.330	Incorrect wiring of main circuit power supply	Wrong setting of AC /DC input Power supply wiring error	Ws.1	Yes
A.400	Overvoltage	The main circuit bus voltage is too high.	Ws.1	Yes
A.410	Undervoltage	The main circuit bus voltage is undervoltage.	Ws.2	Yes
A.510	Overspeed	Motor speed exceeds maximum speed	Ws.1	Yes
A.511	Divided pulse output overspeed	Exceed the pulse output speed limit of the set encoder divided pulse number (Pn212)	Ws.1	Yes
A.512	Speed deviation fault	The speed reference and the feedback speed deviate too much	Ws.1	Yes
A.513	Locking fault	Motor locking (overlarge torque at a low speed)	Ws.1	Yes
A.514	Galloping fault	The actual speed of the motor is reversed to the speed reference or the reference torque	Ws.1	Yes

Alarm code	Alarm name	Alarm content	Stop method for the alarm	Whether the alarm can be reset
A.520	Vibration alarm	Abnormal motor speed vibration is detected	Ws.1	Yes
A.521	autotuning alarm	Vibration was detected in the autotuning	Ws.1	Yes
A.710	Drive overload (instantaneous maximum load)	Run for a few seconds to tens of seconds at a torque that substantially exceeds the rated value.	Ws.2	Yes
A.711	Motor overload (instantaneous maximum load)	Run for a few seconds to tens of seconds at a torque that substantially exceeds the rated value.	Ws.1	Yes
A.720	Drive overload (continuous maximum load)	Continuous operation with torque exceeding the rated value	Ws.1	Yes
A.721	Motor overload (continuous maximum load)	Continuous operation with torque exceeding the rated value	Ws.1	Yes
A.730 A.731	DB overload	Due to the DB (dynamic brake) action, the rotation energy exceeds the capacity of the DB resistance.	Ws.1	Yes
A.740	inrush current limits the resistance overload	The switching frequency of the main circuit power supply is too high.	Ws.1	Yes
A.7A0	Heat sink overheating	The heat sink temperature of the servo drive exceeds 90°C.	Ws.2	Yes
A.810	Encoder backup alarm	The encoder is running out of power and the location data is cleared.	Ws.1	No
A.820	Encoder sumcheck alarm	The sum check result of the encoder memory is abnormal.	Ws.1	No
A.830	Encoder battery alarm	After switching on the control power supply, the battery voltage is below the specified value.	Ws.1	Yes
A.840	Encoder data alarm	Data in the encoder is abnormal.	Ws.1	No
A.850	Encoder overspeed	When powered on, the encoder rotates at high speed	Ws.1	No
A.860	Encoder overheating	The internal temperature of the encoder is too high.	Ws.1	No
A.b10	Speed reference A/D exception	A/D converter for speed reference input is faulty	Ws.2	Yes
A.b11	Speed reference A/D conversion data exception	Speed reference A/D conversion data exception	Ws.2	Yes
A.b20	torque reference A/D exception	A/D converter for torque reference input is faulty	Ws.2	Yes
A.b31	Current detection fault 1	U-phase current detection circuit fault.	Ws.1	No
A.b32	Current detection fault 2	V-phase current detection circuit fault.	Ws.1	No
A.b33	Current detection fault 3	Current detection circuit fault	Ws.1	No
A.C10	Prevent out of control detection	Servo motor is out of control.	Ws.1	Yes
A.C80	Encoder clear fault (Abnormal setting of upper limit of multiturn)	The multi-turn value of the absolute encoder is not cleared or set correctly.	Ws.1	No
A.C90	Encoder communication failure	Unable not communicate between the encoder and the servo drive.	Ws.1	No
A.C91	The acceleration of the encoder communication position data is abnormal	The encoder location data has failed in the calculation.	Ws.1	No
A.C92	Encoder communication timer is abnormal	The timer used for the communication between the encoder and the servo drive has failed.	Ws.1	No
A.CA0	Encoder parameter exception	The parameters of the encoder are corrupted	Ws.1	No
A.Cb0	Encoder check exception	Wrong communication content with the encoder.	Ws.1	No
A.CC0	The upper limit of multiturn is inconsistent	The upper limit of multiturn of the encoder and the servo drive is inconsistent.	Ws.1	No
A.d00	position deviation overflow	In the servo-ON state, the position deviation exceeds the alarm value of position deviation overflow (Pn520)	Ws.1	Yes
A.d01	Warning value of position deviation overflow when the servo is on	In servo OFF, when the position deviation is above the set value of Pn526, the servo is ON.	Ws.1	Yes

Alarm code	Alarm name	Alarm content	Stop method for the alarm	Whether the alarm can be reset
A.d02	Alarm for position deviation overflow caused by speed limit during servo ON	When the servo is ON in the position deviation accumulation state, the speed is limited by the speed limit value (Pn529) when the servo is ON. Enter the reference pulse in this state and exceed the set value of the alarm value of position deviation overflow (Pn520) without lifting the limit.	Ws.2	Yes
A.d10	Excessive deviation between motor and load position	Excessive deviation between motor and load position	Ws.2	Yes
A.F10	Phase loss of power line	When the main power supply is ON, the low voltage state of one phase in R, S, T lasts for 1 second or more.	Ws.2	Yes

9.1.2 Cause of alarm and treatment measures

Alarm code and name	Cause	Confirmation method	Treatment measures
A.001: Driver model identification alarm	The type recognized by the driver is different from the type of the driver present in the EEPROM	Check through Fn012 if the driver model (power and voltage levels) is consistent with the model on the driver nameplate.	1. If it is confirmed that the identified driver model is correct, the alarm is eliminated by the following method: (1) Set Pn602.2=1 and power off the driver (2) Execute Fn005 and restore to the factory value. 2. If it is confirmed that the driver model is incorrect, the reason for the hardware identification ID error needs to be investigated.
A.002: Motor model parameters are not set	Driver parameter Pn604 does not set the motor model.	Check the value of the driver parameter Pn604. If it is 50, an alarm A.002 will be triggered.	According to the actual motor model, set the value of Pn604 against the motor parameter list.
A.003: Emergency stop alarm	The emergency stop alarm input signal is valid	-	Remove the emergency stop input signal.
A.004: The function does not match the model	The function does not match the driver model	-	Reset the Pn000.1 control mode Replace the driver with analog input function.
A.020: Parameter and calibration exceptions	The power supply voltage drops instantaneously.	Measure the supply voltage.	Set the power supply voltage within the specified range and initialize the parameter settings (Fn005).
	The power is turned off during parameter writing.	Confirm the time of power outage.	After initialization of the parameter Settings (Fn005), enter the parameters again.
	The number of times the parameter has been written exceeds the maximum value.	Confirm whether parameter changes are frequently made from the upper device.	It could be a servo drive failure. Replace the servo drive. Change the parameter writing method.
	Misoperation is caused by noise from AC power, grounding and static electricity.	When the alarm still occurs after the power is connected many times, it may be the noise.	Take measures to prevent noise interference.
	The components inside the servo drive fail due to gas, water droplets or cutting oil, etc.	Confirm the installation environment.	It could be a servo drive failure. Replace the servo drive.
	Servo drive fault	If the alarm still occurs after the power supply is turned on several times, the failure may occur.	It could be a servo drive failure. Replace the servo drive.
A.021: Parameter formatting exception	Software version update for the writing parameter compared to the software version of the servo drive in which the alarm occurred	Verify that the software version is the same using Fn012. If the version is different, it may cause an alarm.	Write the parameters of other servo drives with the same software version and model, and then power on.
	Servo drive fault	-	It could be a servo drive failure. Replace the servo drive.
A.022: System and calibration exceptions	The power supply voltage drops instantaneously.	Measure the supply voltage.	It could be a servo drive failure. Replace the servo drive.
	Power off during utility function settings.	Confirm the time of power outage.	It could be a servo drive failure. Replace the servo drive.
	Servo drive fault	If the alarm still occurs after the power supply is turned on several times, the failure may occur.	It could be a servo drive failure. Replace the servo drive.
A.030: Part failure detected in the main circuit	Servo drive fault	-	It could be a servo drive failure. Replace the servo drive.
A.040: Parameter setting exception	The servo drive capacity does not match the servo motor capacity.	Confirm the capacity and combination of the servo drive and the servo motor.	Make the servo drive and servo motor capacity match each other.
	Servo drive fault	-	It could be a servo drive failure. Replace the servo drive.
	Outside of the parameter setting range.	Confirm the settings range of the changed parameters	Make the changed parameter the value within the set range
	The set value of the electronic gear ratio is outside the set range.	Verify that the electronic gear ratio is 0.001 ＜ Pn20E/Pn210 ＜4000.	Set the electronic gear ratio as 0.001 ＜ (Pn20E/Pn210) ＜4000.
A.041: Divided pulse output Setting exception	The number of encoder divided pulses (Pn212) does not meet the set range or set conditions.	Confirm Pn212.	Set Pn212 to the appropriate value.

Alarm code and name	Cause	Confirmation method	Treatment measures
A.042*1: Parameter combination exception	Due to changes in the electronic gear ratio (Pn20E/Pn210) or servo motor, the speed of program JOG operation (Fn004) does not meet the set range.	Verify that the detection condition formula *1 is valid.	Reduce the value of electronic gear ratio (Pn20E/Pn210).
	Due to a change in the movement speed of program JOG (Pn533), the speed of program JOG operation (Fn004) did not meet the set range.	Verify that the detection condition formula *1 is valid.	Increase the value of the program JOG movement speed (Pn533).
	Due to changes in electronic gear ratios (Pn20E/Pn210) or servo motors, the movement speed of advanced autotuning without reference does not meet the set range.	Verify that the detection condition formula *1 is valid.	Reduce the value of electronic gear ratio (Pn20E/Pn210).
A.050: Combination error	The servo drive capacity does not match the servo motor capacity.	Confirmed to be $1/4 \leqslant \frac{\text{Unit capacity}}{\text{Servo unit capacity}} \leqslant 4$	Make the servo drive and servo motor capacity match each other.
	Encoder fault	Replace with other servo motor to confirm that the alarm does not occur again.	Replace servo motor (encoder)
	Servo drive fault	-	It could be a servo drive failure. Replace the servo drive.
A.052: Exception of power matching	The servo drive set power is lower than the motor power	Confirm the servo drive power via the Fn012	Make the servo drive and servo motor power match each other.
A.0b0: Servo ON reference invalid alarm	After the motor power-on utility function is performed, the servo ON (/S-ON) signal is input from the outside.	-	Power on the servo drive again. Or perform a software reset.

*1 When any of the following two conditional formulas are true, an alarm will be detected.

$$\bullet\ \text{Pn533 [min}^{-1}] \times \frac{\text{Encoder resolution}}{6\times10^{5}} \leqslant \frac{\text{Pn20E}}{\text{Pn210}}$$

$$\bullet\ \text{Maximum motor speed [min-1]} \times \frac{\text{Encoder resolution}}{\text{About 3.66*1012}} \geqslant \frac{\text{Pn20E}}{\text{Pn210}}$$

Alarm code and name	Cause	Confirmation method	Treatment measures
A.100/A.101 Overcurrent detection	The main circuit cable is incorrectly connected or in poor contact.	Confirm that the wiring is correct.	Modify the wiring.
	A short circuit or a ground fault occurs within the main circuit cable.	Check whether there is a short circuit between the UVW phase of the cable, between UVW and the ground.	The cable may be short-circuit. Replace cable
	A short circuit or ground short circuit occurs inside the servo motor.	Check whether there is a short circuit between the UVW phase of the motor terminal, between UVW and the ground.	It may be a servo motor fault. Replace the servo motor.
	A short circuit or ground occurs inside the servo drive.	Verify that there is a short circuit between the UVW phase of the servo motor connection terminal of the servo drive and the ground. Refer to "3.1 main circuit wiring" for details.	It could be a servo drive failure. Replace the servo drive.
	The regenerative resistor is incorrectly connected or in poor contact.	Confirm that the wiring is correct. Refer to "3.6 Connection of regenerative resistor" for details.	Modify the wiring.
	Dynamic brake (emergency stop due to DB and servo drive) is used frequently or DB overload alarm occurs.	The use frequency of DB is confirmed by the DB resistance power consumption (Un00B). Or use the display of the alarm record (Fn000) to confirm whether the DB overload alarm A.730 and A.731 has occurred.	Change the selection, operation method and mechanism of the servo drive to reduce the frequency of DB use.
	The regenerative resistance value is too high, exceeding the regenerative processing capacity.	The regenerative load factor (Un00A) is used to determine the frequency of use of the regenerative resistor.	Considering the operating conditions and load, the regenerative resistance value is discussed again.
	The regenerative resistance value of the servo drive is too small.	The regenerative load factor (Un00A) is used to determine the frequency of use of the regenerative resistor.	Change the regenerative resistance value to a value above the minimum allowable resistance value of the servo drive.
	High load is borne when the servo motor is stopped or running at low speed.	Verify that the operating conditions are outside the specifications of the servo drive.	Reduce the load on the servo motor. Or run at a higher operating speed
	Misaction due to noise.	Improve the noise environment such as wiring and installation to confirm whether there is no effect.	Take noise prevention measures, such as proper FG wiring, etc. In addition, the size of the FG wire should be the same as the "servo drive main circuit wire dimensions".
	Servo drive fault	-	After power on again If the alarm still occurs, a servo drive failure is possible. Replace the servo drive.
A.300: Regeneration fault	The regeneration and discharge IGBT inside the servo drive is faulty.	-	Replace the servo drive.

Alarm code and name	Cause	Confirmation method	Treatment measures
A.320: Regeneration overload	The power supply voltage exceeds the specification range.	Measure the supply voltage.	Set the power supply voltage within the specification range.
	The jumper wire of the power terminal P-D of the servo drive with built-in regenerative resistor falls off.	Confirm the wiring of the power supply terminal jumper wire.	Connect the jumper wire correctly.
	Poor wiring, shedding, or disconnection of the external regenerative resistor.	Confirm the wiring of the external regenerative resistor.	Connect the external regenerative resistor correctly.
	The external regenerative resistance value or regenerative resistor capacity is insufficient, or it is in a continuous regeneration state.	Reconfirm the operating conditions or capacity.	Change the regenerative resistance value and the regenerative resistor capacity. Adjust the operating conditions again.
	Continuous bearing load, in a state of continuous regeneration.	Confirm the load applied to the running servo motor.	The system including servo, machinery and operating conditions are discussed again.
	The capacity set in the parameter Pn600 is less than the capacity of the external regenerative resistor.	Confirm the connection of regenerative resistor and Pn600.	Correct the set value of parameter Pn600.
	The external regenerative resistance value is too large	Verify that the regenerative resistance value is correct.	Change it to the correct resistance value and capacity.
	Servo drive fault	-	It could be a servo drive failure. Replace the servo drive.
A.330: main circuit power supply Incorrect wiring	The power supply voltage inside the servo drive is too high, and the regenerative resistor is disconnected.	Measure the resistance value of the regenerative resistor with a measuring instrument.	Replace the servo drive when using the regenerative resistor built in the servo drive. When using an external regenerative resistor, replace the regenerative resistor.
	DC power was input when AC power input was set.	Confirm that the power supply is a DC power supply.	Make the set value of the power supply consistent with the power supply used.
	AC power was input when DC power input was set.	Confirm that the power supply is a AC power supply.	Make the set value of the power supply consistent with the power supply used.
	Use M1-01B, 02B and 04B The regenerative resistance capacity (Pn600) is set to a value beyond "0" without an external regenerative resistor.	Confirm the wiring of the external regenerative resistor and Pn600.	Connect an external regenerative resistor, or set the Pn600 to 0 when an external regenerative resistor is not required
	The jumper wire of the power terminal P-D for servo drives with capacities other than M1-01B, 02B, and 04B has fallen off.	Confirm the wiring of the power supply terminal jumper wire.	Connect the jumper wire correctly.
	Servo drive fault	-	It could be a servo drive failure. Replace the servo drive.

Alarm code and name	Cause	Confirmation method	Treatment measures
A.400: Overvoltage	The AC supply voltage of the AC220V servo drive is detected to be above 310V. The AC supply voltage of the AC380V servo drive is detected to be above 580V.	Measure the supply voltage.	Adjust the power supply voltage to the product specification range.
	The power supply is unstable or affected by lightning strikes.	Measure the supply voltage.	Improve the power supply condition, set the surge repressor, and then connect the power supply again. When the alarm still occurs, the servo drive failure may occur. Replace the servo drive.
	Acceleration and deceleration are performed when the AC supply voltage is above the specification range.	Confirm the supply voltage and the speed and torque in operation.	Adjust the AC supply voltage to the product specification range.
	External regenerative resistance value is larger than the operating conditions.	Confirm the operating conditions and the regenerative resistance values.	Considering the operating conditions and load, the regenerative resistance value is discussed again.
	Run above the moment of inertia ratio.	Confirm that the moment of inertia ratio is within the allowable moment of inertia ratio.	Extend the deceleration time, or reduce the load.
	Servo drive fault	-	If the control power is reconnected without the main circuit power supply, and an alarm still occurs, it is possible that the servo drive has malfunctioned. Replace the servo drive.
A.410: Undervoltage	The AC supply voltage of the AC220V servo drive is detected to be below 120V. The AC supply voltage of the AC380V servo drive is detected to be below 230V.	Measure the supply voltage.	Adjust the power supply voltage to the normal range.
	Power supply voltage drops during operation.	Measure the supply voltage.	Increase the power supply capacity.
	Momentary power interruption occurs.	Measure the supply voltage.	If the momentary power interruption retention time is changed (Pn509), it is set to a smaller value.
	The fuse of the servo drive has blown.	-	Replace the servo drive and connect the reactor before using the servo drive.
	Servo drive fault	-	It could be a servo drive failure. Replace the servo drive.
A.510: Overspeed	The U, V and W phase sequence of the motor wiring is incorrect.	Confirm the wiring of the servo motor.	Verify that the motor wiring is faulty.
	The reference input value exceeds the excessive value.	Confirm the input references.	Lower the reference value, or adjust the gain.
	Motor speed exceeds maximum speed	Confirm the waveform of the motor speed.	Reduce the speed reference input gain, adjust the servo gain, or adjust the operating conditions.
	Servo drive fault	-	It could be a servo drive failure. Replace the servo drive.
A.511: Divided pulse output overspeed	The output frequency of the divided pulse is too large and exceeds the limit value.	Confirm the output setting of divided pulse.	Reduce the setting of encoder divided pulses (Pn212).
	The motor speed is too high, and the output frequency of the divided pulse exceeds the limit value	Confirm the output setting of the divided pulse and the motor speed	Reduce motor speed.
A.512: Excessive speed deviation fault	The deviation between speed reference and feedback speed exceeds the limit value	Confirm the speed reference and the feedback speed	Confirm whether there is a problem with the motor wiring, confirm whether there is a mechanical problem, confirm whether the rigidity is too low
A.513: Locking fault	The low speed torque exceeds the limit value for a certain time	Confirm feedback speed and output torque	Confirm whether there is a problem with the motor wiring, confirm whether there is a mechanical problem, confirm whether the rigidity is too large
A.514: Galloping fault	The feedback speed is reversed from the speed reference in position or speed mode or from the reference torque in torque mode	Confirm the feedback speed, speed reference and reference torque	Confirm whether there is a problem with the motor wiring, confirm whether there is a mechanical problem, confirm whether the rigidity is too large

Alarm code and name	Cause	Confirmation method	Treatment measures
A.520: Vibration alarm	Abnormal motor speed vibration is detected	Confirm the abnormal sound of the motor and the speed and torque waveform during operation.	Reduce motor speed. Or reduce the speed loop gain (Pn100).
	The value of the moment of inertia ratio (Pn103) is larger than the actual value or has undergone a large change.	Confirm the moment of inertia ratio.	Set the moment of inertia ratio correctly (Pn103)
A.521: advanced autotuning without reference alarm	The motor will vibrate greatly when using the self-tuning function.	Confirm the waveform of the motor speed.	Reduce the load to below the allowable moment of inertia ratio, or increase the load value of the self-tuning level setting(Fn200), or reduce the rigidity level.
	The motor will vibrate greatly when executing one-parameter tuning and in the process of EasyFFT	Confirm the waveform of the motor speed.	Implement the handling measures in each functional operation step.
A.710: Drive overload (Instantaneous maximum load) A.711: Motor overload (Instantaneous maximum load) A.720: Drive overload (Maximum continuous load) A.721: Motor overload (Maximum continuous load)	The motor wiring and encoder wiring is poorly connected.	Confirm wiring.	Confirm whether there is any problem with motor wiring and encoder wiring.
	Motor operation exceeds the overload protection characteristics.	Confirm the overload characteristics and operation references of the motor.	Discuss load conditions and operating conditions. Or rediscuss the motor capacity.
	Mechanical factors that do not drive the motor, resulting in excessive load during operation.	Confirm the operation reference and the motor speed.	Improve mechanical factors.
	Servo drive fault	-	It could be a servo drive failure. Replace the servo drive.
A.730: A.731: DB overload (Excessive power consumption of the dynamic brake is detected)	The motor is being driven by external forces.	Confirm the running status.	Do not drive the motor by an external force.
	The rotational energy when the DB stops exceeds the capacity of the DB resistor.	The use frequency of DB is confirmed by the DB resistance power consumption (Un00B).	Try the following measures: Reduce the speed reference of the servo motor. Reduce the moment of inertia ratio. Reduce the number of DB stops.
	Servo drive fault	-	It could be a servo drive failure. Replace the servo drive.
A.740: inrush current limitation Resistance overload	The allowable number of times the inrush current limiting resistor exceeds the limit during the ON/OFF of the main circuit power supply	-	Reduce the ON/OFF times of the main circuit power supply
	Servo drive fault	-	It could be a servo drive failure. Replace the servo drive.
A.7A0: Heat sink overheating	The ambient temperature is too high.	Measure the ambient temperature with a thermometer.	Improve the installation conditions of the servo drive and reduce the ambient temperature.
	Reset the overload alarm by turning off the power supply too many times	Confirm the overload alarm through the display of alarm record (Fn000).	Change the reset method of the alarm.
	Excessive load or exceeding regeneration capacity during operation	Confirm the operating load by accumulating the load rate (Un009), and confirm the regeneration processing capacity by regenerating the load rate (Un00A).	Discuss load conditions and operating conditions.
	The installation direction and unreasonable interval from other servo drives.	Confirm the installation status of the servo drive.	Install according to the installation standards of the servo drive.
	Servo drive fault	-	It could be a servo drive failure. Replace the servo drive.

Alarm code and name	Cause	Confirmation method	Treatment measures
A.810: Encoder backup alarm	Power on the absolute encoder for the first time.	Verify that the power is switched on for the first time.	Set up the encoder (Fn008)
	Connect the encoder cable after removing it.	Verify that the power is switched on for the first time.	Confirm the wiring of the encoder and set the encoder (Fn008)
	Fault occurs in the control power for servo drive (+5V) and battery power	Verify that the battery and plug status of the encoder plug is correct.	After restoring the power supply to the encoder (replacing the battery, etc.), perform the encoder setting operation (Fn008).
	absolute encoder fault.	-	Replace the servo motor when the alarm cannot be lifted even if the setting operation is performed again.
	Servo drive fault	-	It could be a servo drive failure. Replace the servo drive.
A.820: Encoder and number check alarm	Encoder fault	-	For the absolute encoder, set the (Fn008) encoder again. If the alarm still occurs, a servo drive failure is possible. Replace the servo motor. 1. Rotary absolute encoder or incremental encoder may be a servo motor failure. Replace the servo motor.
	Servo drive fault	-	It could be a servo drive failure. Replace the servo drive.
A.830: Encoder battery alarm	The battery is improperly connected or is not connected.	Confirm the connection of the battery.	Connect the battery correctly.
	The battery voltage is below the specified value (2.7V).	Measure the battery voltage.	Replace battery
	Servo drive fault	-	It could be a servo drive failure. Replace the servo drive.
A.840: Encoder data alarm	Encoder misoperation	-	After power on again If the alarm still occurs, a servo motor failure is possible. Replace the servo motor.
	The encoder misfunctions due to the interference of the noise.	-	Proper wiring around the encoder (Separation of encoder cable and servo motor main circuit cable, grounding processing, etc.)
A.850: Encoder overspeed	On the control power supply, the servo motor rotates at a speed above 200min-1.	Confirm the motor speed when power is turned on by monitoring the motor rotation speed (Un000).	Adjust the servo motor speed to less than 200min-1, and then turn on the control power.
	Encoder fault	-	After power on again If the alarm still occurs, a servo motor failure is possible. Replace the servo motor.
	Servo drive fault	-	After power on again If the alarm still occurs, a servo drive failure is possible. Replace the servo drive.
A.860: Encoder overheating	The ambient temperature of the servo motor is too high	Measure the ambient temperature of the servo motor.	Adjust the ambient temperature of the servo motor to below 40°C.
	The servo motor operates with a load exceeding the rating.	Confirm the motor load by cumulative load rate (Un009).	Adjust the load of the servo motor within the rated value before running.
	Encoder fault	-	After power on again If the alarm still occurs, a servo motor failure is possible. Replace the servo motor.
	Servo drive fault	-	After power on again If the alarm still occurs, a servo drive failure is possible. Replace the servo drive.

Alarm code and name	Cause	Confirmation method	Treatment measures
A.b10: Speed reference A/D exception	The speed reference input unit misoperates.	-	Run again after the reset of the alarm.
	Servo drive fault	-	After power on again If the alarm still occurs, a servo drive failure is possible. Replace the servo drive.
A.b11: Speed reference A/D conversion data exception	The speed reference input unit misoperates.	-	Run again after the reset of the alarm.
	Servo drive fault	-	After power on again If the alarm still occurs, a servo drive failure is possible. Replace the servo drive.
A.b20: torque reference A/D is abnormal	torque reference input and reading misoperates.	-	Run again after the reset of the alarm.
	Servo drive fault	-	After power on again If the alarm still occurs, a servo drive failure is possible. Replace the servo drive.
A.b31: Current detection fault 1	U-phase current detection circuit fault.	-	After power on again If the alarm still occurs, a servo drive failure is possible. Replace the servo drive.
A.b32: Current detection fault 2	V-phase current detection circuit fault.	-	After power on again If the alarm still occurs, a servo drive failure is possible. Replace the servo drive.
A.b33: Current detection fault 3	Current detection circuit fault	-	After power on again If the alarm still occurs, a servo drive failure is possible. Replace the servo drive.
	The main circuit cable of the servo motor is disconnected.	Make whether the main circuit cable of servo motor is disconnected.	Repair the motor cable.

Alarm code and name	Cause	Confirmation method	Treatment measures
A.C10: Prevent out of control detection	The U, V and W phase sequence of the motor wiring is incorrect.	Confirm the motor wiring.	Verify that the motor wiring is faulty.
	Encoder fault	-	If there is no problem with the motor wiring and the alarm still occurs after reconnecting the power, it may be a fault of the servo motor. Replace the servo motor.
	Servo drive fault	-	After power on again If the alarm still occurs, a servo drive failure is possible. Replace the servo drive.
A.C80: Encoder clear exception	Encoder fault	-	After power on again If the alarm still occurs, a servo motor failure is possible. Replace the servo motor.
	Servo drive fault	-	After power on again If the alarm still occurs, a servo drive failure is possible. Replace the servo drive.
A.C90: Encoder communication failure	Poor contact of the encoder connection port or incorrect plug wiring.	Confirm the status of the encoder connection port.	Insert the encoder plug again to confirm the encoder wiring.
	The encoder cable is broken or short-circuited or the cables with impedance exceeding the specified limit are used.	Confirm the status of the encoder cable.	Use the encoder cable required by the specification.
	Corrosion caused by temperature, humidity and gas; Short circuit caused by water droplets and cutting oil; Poor plug contact caused by vibration.	Confirm the use environment.	Improve the use environment and replace the cable. Even if there is no improvement, replace the servo drive.
	Misaction due to noise.	-	Proper wiring around the encoder (Separation of encoder cable and servo motor main circuit cable, grounding processing, etc.)
	Servo drive fault	-	When the servo motor is connected to other servo drives and the control power is turned on, if no alarm occurs, it is possible that the servo drive is faulty. Replace the servo drive.
A.C91: The acceleration of the encoder communication position data is abnormal	The encoder cable is engaged, the cladding is damaged, and the signal line is interfered with.	Confirm the status of the encoder cable and the connecting ports.	Verify that there is a problem with the encoder cable laying.
	The encoder cable is tied together or too close to the high current line.	Confirm the setting status of the encoder cable.	Lay the encoder cable in a position not subject to surge voltage.
	The potential of FG changes due to the influence of the motor side device (welding machine, etc.).	Confirm the setting status of the encoder cable.	Ground the machine to prevent the diversion to the encoder side FG.
A.C92: Encoder communication timer is abnormal	The signal lines of the encoder are disturbed.	-	Implement the anti-interference countermeasures of the encoder wiring.
	The encoder bears excessive vibration impact.	Confirm the uses.	Reduce the vibration of the machinery. Or install the servo motor correctly.
	Encoder fault	-	After power on again If the alarm still occurs, a servo motor failure is possible. Replace the servo motor.
	Servo drive fault	-	After power on again If the alarm still occurs, a servo drive failure is possible. Replace the servo drive.
A.C93: FPGA working exception	FPGA fault		Power on the driver after running Fn01C If the alarm still occurs, consider replacing the driver

Alarm code and name	Cause	Confirmation method	Treatment measures
A.CA0: Encoder parameter exception	The motor model parameters are incorrectly set	Verify that the motor model corresponding to the value set in Pn604 is consistent with the actual motor model	Reset Pn604 and power on again.
	Servo drive fault	-	After power on again If the alarm still occurs, a servo drive failure is possible. Replace the servo drive.
A.Cb0: Encoder return check exception	Encoder has wrong wiring and poor contact.	Confirm the encoder wiring.	Verify for the encoder wiring is faulty.
	Encoder cables have different specifications and are disturbed by noise.	-	Change the cable specifications to double stranded wire or double stranded overall shielded wire, with a core wire of 0.12mm2 or more, and tinned soft copper stranded wire.
	The wiring distance of the encoder cable is too long, which is disturbed by noise.	-	The longest wiring distance is 50m.
	The potential of FG changes due to the influence of the motor side device (welding machine, etc.).	Confirm the status of the encoder cable and the connecting ports.	Ground the machine to prevent the diversion to the encoder side FG.
	The encoder bears excessive vibration impact.	Confirm the uses.	Reduce the vibration of the machinery. Or install the servo motor correctly.
	Encoder fault	-	After power on again If the alarm still occurs, a servo motor failure is possible. Replace the servo motor.
	Servo drive fault	-	After power on again If the alarm still occurs, a servo drive failure is possible. Replace the servo drive.
A.CC0: The upper limit of multiturn is inconsistent	The upper limit of the multiturn of the DD motor (Pn205) is different from the encoder.	Confirm Pn205.	Set the Pn205 correctly (0 ～ 65535).
	The upper limit of the encoder's multiturn is different from the servo drive, or the upper limit of multiturn has been changed.	Confirm the value of the servo drive Pn205.	Change the setting to Fn013 in case of an alarm.
	Servo drive fault	-	After power on again If the alarm still occurs, a servo drive failure is possible. Replace the servo drive.
A.d00: position deviation overflow (In the servo-ON state, the position deviation exceeds the alarm value of position deviation overflow(Pn520))	The U, V and W wiring of the servo motor is incorrect.	Make whether the main circuit cable of servo motor is wired.	Check whether the motor cable or the encoder cable has poor contact.
	The frequency of position references is higher	Try to reduce the reference pulse frequency before running.	Reduce the position reference pulse frequency or reference acceleration, or adjust the electronic gear ratio.
	Position reference acceleration is too large.	Try to slow down the reference acceleration before running.	Add the smoothing function of position reference acceleration and deceleration time constant (Pn 216), etc.
	Alarm value of position deviation overflow(Pn 520) is low relative to operating conditions.	Confirm whether the alarm value of position deviation overflow(Pn520) is appropriate.	Set the value of parameter Pn520 correctly.
	Servo drive fault	-	After power on again If the alarm still occurs, a servo drive failure is possible. Replace the servo drive.

Alarm code and name	Cause	Confirmation method	Treatment measures
A.d01: When servo-ON position deviation overflow alarm	In servo OFF, when the position deviation is above the set value of Pn526, the servo is ON.	Confirm the position deviation amount when servo is OFF (Un008).	Set up to clear position deviation during servo OFF. Or set the correct alarm value of position deviation overflow (Pn526) during the servo-ON.
A. d02: Alarm for position deviation overflow caused by speed limit during servo ON	When the servo is ON in the position deviation accumulation state, the speed limit (Pn529) is set to limit the speed. Entering a position reference in this state exceeds the setting alarm value of position deviation overflow (Pn520).	-	Set up to clear position deviation during servo OFF. Or set the correct alarm value of position deviation overflow (Pn520). Or set the speed limit value (Pn529) during the servo-ON as a correct value.
A.d10: Excessive deviation between motor and load position	The motor rotates in the opposite direction to the external encoder mounting direction.	Confirm the motor rotation direction and the external encoder mounting direction.	Reverse the installation direction of the external encoder or set the rotation direction of the "Usage of External Encoder (Pn002.3)" to the opposite direction.
	Load position of work table and installation fault of external encoder junction.	Confirm the external encoder junction.	Perform the mechanical binding again.
A.F10: Phase loss of power line	Poor wiring of the three-phase power supply.	Confirm the power supply wiring.	Verify for the power wiring is faulty.
	Three-phase power supply imbalance.	Measure the voltage of each phase of the three-phase power supply.	Correct the imbalance of the power supply.
	The single-phase power supply is directly input without the parameter setting of single-phase input (Pn00B.2 = 1).	Confirm the power supply and parameter settings.	Set the power input and parameters correctly.
	Servo drive fault	-	After power on again If the alarm still occurs, a servo drive failure is possible. Replace the servo drive.

9.2 When a warning is displayed

This chapter introduces the warning list of the driver and the cause and treatment measures of the warning.

9.2.1 Warning list

Warning code	Warning name	Warning content
A.900	position deviation overflow	The accumulated positional deviation exceeds the value of (Pn520 Pn51E)/100.
A.901	position deviation overflow during the servo-ON.	The accumulated positional deviation exceeds the value of (Pn526 Pn528E)/100 during the servo-ON.
A.910	Overload	The warning displays before the A.710 or A.720 alarm is about to be reached. If the operation continues, an alarm may occur.
A.911	Vibration	Abnormal vibration in motor operation is detected. Same as the detection value of A.520, set whether it is an alarm or a warning through the vibration detection switch (Pn310).
A.920	Regeneration overload	Warning display before the regenerative overload (A.320) alarm is about to be reached. If the operation continues, an alarm may occur.
A.921	DB overload	Warning display before DB overload (A.731) alarm is about to be reached. If the operation continues, an alarm may occur.
A.930	Battery failure of absolute encoder	Is the warning display of the battery undervoltage of the absolute encoder.
A.941	Parameter changes that require reconnecting the power supply	Changed the parameters that require reconnecting the power.
A.971	Undervoltage	Warning display before undervoltage (A.410) alarm is reached. If the operation continues, an alarm may occur.
A.9A0	Overtravel	Overtravel detected during the servo-ON

9.2.2 Cause of warning and treatment measures

Warning code & warning name	Cause	Confirmation method	Treatment measures
A.900: Position deviation overflow	The U, V and W wiring of the servo motor is incorrect.	Make whether the main circuit cable of servo motor is wired.	Check whether the motor cable or the encoder cable has poor contact.
	The servo drive has a low gain.	Verify that the servo drive gain is too low.	Improve the servo gain through advanced autotuning without reference.
	The frequency of the position reference pulse is higher.	Try to reduce the reference pulse frequency before running.	Reduce the position reference pulse frequency or reference acceleration, or adjust the electronic gear ratio.
	Position reference acceleration is too large.	Try to slow down the reference acceleration before running.	Add the smoothing function of position reference acceleration and deceleration time constant (Pn216)
	Relative to the running conditions, the alarm value of position deviation overflow (Pn520) is lower.	Confirm whether the alarm value of position deviation overflow (Pn520) is appropriate.	Set the value of parameter Pn520 correctly.
	Servo drive fault	-	When the power is turned on again and the alarm still occurs, it is possible that the servo drive is faulty. Replace the servo drive.
A.901: Position deviation overflow during the servo-ON	The accumulated positional deviation exceeds the value of (Pn526 × Pn528)/100 during the servo-ON.	-	Set up to clear position deviation during servo OFF. Or set the correct warning value of position deviation overflow (Pn528) during the servo-ON.
A.910: Overload (Warning before becoming overload alarm A.710 A.720)	The motor wiring and encoder wiring is poorly connected.	Confirm wiring.	Confirm whether there is any problem with motor wiring and encoder wiring.
	Motor operation exceeds the overload protection characteristics.	Confirm the overload characteristics and operation references of the motor.	Discuss load conditions and operating conditions. Or rediscuss the motor capacity.
	Mechanical factors that do not drive the motor, resulting in excessive load during operation.	Confirm the operation reference and the motor speed.	Improve mechanical factors.
	Servo drive fault	-	It could be a servo drive failure. Replace the servo drive.
A.911: Vibration	Abnormal vibration in motor operation is detected.	Confirm the abnormal sound of the motor and the speed and torque waveform during operation.	Reduce motor speed. Or reduce the servo gain by a one-parameter tuning.
	The value of the moment of inertia ratio (Pn103) is larger than the actual value or has undergone a large change.	Confirm the moment of inertia ratio.	Set the moment of inertia ratio correctly (Pn103).
A.920: Regeneration overload (Warning before becoming regenerative overload (A.320))	The power supply voltage exceeds the specification range.	Measure the supply voltage.	Set the power supply voltage within the specification range.
	Insufficient external regenerative resistance value, servo drive capacity or regenerative resistor capacity, or in a continuous regeneration state.	Reconfirm the operating conditions or capacity.	Change the regenerative resistance value, regenerative resistor capacity, or servo drive capacity.
	Continuous bearing load, in a state of continuous regeneration.	Confirm the load applied to the running servo motor.	The system including servo, machinery and operating conditions are discussed again.
A.921: DB overload (Warning before becoming DB overload (A.731))	The motor is being driven by external forces.	Confirm the running status.	Do not drive the motor by an external force.
	The rotational energy when the DB stops exceeds the capacity of the DB resistor.	Confirm the use frequency of DB through DB resistance power consumption (Un00B).	Try the following measures: · Reduce the speed reference of the servo motor. · Reduce the moment of inertia. · Reduce the number of DB stops.
	Servo drive fault	-	It could be a servo drive failure. Replace the servo drive.

Warning code & warning name	Cause	Confirmation method	Treatment measures
A.930: absolute encoder (The absolute encoder battery voltage is below the specified value) * Detected when connecting the absolute encoder	The battery is improperly connected or is not connected.	Confirm the connection of the battery.	Connect the battery correctly.
	The battery voltage is below the specified value (2.7V)	Measure the battery voltage.	Replace battery
	Servo drive fault	-	It could be a servo drive failure. Replace the servo drive.
A.941: Changed the parameters that require reconnecting the power.	Changed the parameters that require reconnecting the power.	-	After power on again
A.971: Undervoltage	The AC supply voltage of the 220V servo drive is detected to be below 140V. The AC supply voltage of the 380V servo drive is detected to be below 280V.	Measure the supply voltage.	Adjust the power supply voltage to the normal range.
	Power supply voltage drops during operation.	Measure the supply voltage.	Increase the power supply capacity.
	momentary power interruption occurs.	Measure the supply voltage.	If the hold time (Pn509) of momentary power interruption is changed, set it to a smaller value.
	The fuse of the servo drive has blown.	-	Replace the servo drive and connect the reactor before using the servo drive.
	Servo drive fault	-	It could be a servo drive failure. Replace the servo drive.
A.9A0: Overtravel (overtravel state detected)	Overtravel detected during the servo-ON	Confirm the status of the overtravel signal using the input signal monitor (Un005).	Refer to section 9.3 to determine the fault cause and treatment measures. Monitor for overtravel signal input by Un005. If there is no input overtravel signal, a transient overtravel may have occurred. Take the following measures: · No references are sent from the upper device to the overtravel · Confirm the signal wiring for the overtravel signal. · Take anti-interference countermeasures.

9.3 Judge the cause and treatment measures of the fault from the action and condition of the servo motor

The inspection and treatment methods in the thick wire frame need to be carried out in the case of power failure.

Fault content	Cause	Confirmation method	Treatment measures
Servo motor does not start	The control power supply is not connected.	Measure the voltage between the power control supply terminals.	Connect the cables correctly so that the control power supply is ON.
	The main circuit power supply is not connected.	Measure the voltage between the main circuit power supply terminals.	Connect the cables correctly so that the main circuit power supply is ON.
	The input and output terminals (CN1) have wiring errors and omissions.	Confirm the connection status of the input / output terminal (CN1).	Connect the input and output terminals (CN1) correctly.
	The wiring of servo motor main circuit and encoder cable falls off.	Confirm the wiring status.	Wire correctly.
	The servo motor bears too much load.	Try the no-load operation to confirm the load status.	Reduce the load, or replace it with a servo motor with a larger capacity.
	The type of encoder used is different from the settings for Pn002.2.	Confirm the type of encoder used and the setting of Pn002.2.	Set Pn002.2 according to the encoder used.
	No input of speed/ position reference.	Confirm the allocations status of the input signal.	Assign input signals so that speed / position references are input correctly.
	The allocations of input signal (Pn50A ～ Pn50D) is wrong.	Confirm the allocations status of input signal (Pn50A ～ Pn50D).	Correctly assign the input signal (Pn50A ～Pn50D).
	/S-ON input is OFF.	Confirm the setting of Pn50A.0 and Pn50A.1.	Correctly set Pn50A.0 and Pn50A.1 to make /S-ON input is ON.
	Function setting error of /P-CON input.	Confirm Pn000.1 settings.	Set it correctly according to the function purpose.
	SEN input is OFF.	Confirm through ON/OFF of SEN signal.	When using an absolute encoder, set the SEN signal to ON.
	Wrong mode selection for the reference pulse	Confirm the settings of Pn200.0 and the pattern of the reference pulse.	Make the setting of Pn200.0 consistent with the pattern of the reference pulse.
	Incorrect input of speed reference (During speed control)	Confirm whether the control mode is consistent with the input between V-REF and SG.	Set the control mode and the input method correctly.
	Incorrect input of torque reference (During torque control)	Confirm whether the control mode is consistent with the input between V-REF and SG.	Set the control mode and the input method correctly.
	Incorrect input of reference pulse (During position control)	Confirm Pn200.0 reference pulse pattern and symbol + pulse signal.	Set the control mode and the input method correctly.
	Position deviation clear (/CLR) input remains ON.	Confirm input signal /CLR (CN1-14, 15).	Make /CLR input signal OFF.
	Remain "No forward drive (P-OT)" and "No reverse drive (N-OT)" input signal OFF.	Confirm P-OT or N-OT input signal.	Turn on P-OT or N-OT input signal.
	Servo drive fault	-	Replace the servo drive.
The servo motor stops still after instantaneous operation	Servo motor wiring error.	Confirm wiring.	Wire correctly.
	Incorrect wiring of the encoder	Confirm wiring.	Wire correctly.
Unstable action of the servo motor	Poor wiring of servo motor	The plug connection of the power line (U, V, W phase) and the encoder may be unstable. Confirm wiring.	Tighten loose terminals or plugs for proper wiring.

Fault content	Cause	Confirmation method	Treatment measures
The servo motor rotates without giving references	Incorrect input of speed reference (During speed control)	Confirm whether the control mode is consistent with the input between V-REF and SG.	Set the control mode and the input method correctly.
	Incorrect input of torque reference (During torque control)	Confirm whether the control mode is consistent with the input between V-REF and SG.	Set the control mode and the input method correctly.
	There is a bias deviation in the speed reference	Inappropriate position adjustment of the servo drive.	Adjust the bias of the servo drive.
	Incorrect input of reference pulse (During position control)	Confirm Pn200.0 reference pulse pattern and symbol + pulse signal.	Set the control mode and the input method correctly.
	Servo drive fault	-	Replace the servo drive.
The dynamic brake (DB) does not act	The set value of parameter Pn001.0 is incorrect	Confirm the settings of parameter Pn001.0	Correctly set Pn001.0.
	DB resistance disconnects.	Confirm the use frequency of the moment of inertia, speed, and DB. It may be due to excessive moment of inertia, speed, excessive frequency of DB usage, or DB resistor disconnection.	Replace the servo drive. In addition, in order to prevent line breaking, measures can be taken to reduce the load state.
	Fault in DB drive circuit	-	Fault in DB drive components Replace the servo drive.
The servo motor makes an abnormal sound	The servo motor vibrates greatly when using the self-tuning function (factory setting).	Confirm the waveform of the motor speed.	Reduce the load to below the allowable moment of inertia ratio, or increase the load value of the self-tuning level setting (Fn200), or reduce the rigidity level.
	Poor mechanical installation.	Confirm the installation status of the servo motor.	Re-tighten the mounting screws.
		Confirm whether the coupling is off-core.	Align the core of the coupling.
		Confirm the equilibrium state of the coupling.	Keep the coupling in balance.
	Fault in bearing.	Confirm the sound and vibration near the bearing.	Replace the servo motor.
	Vibration comes from the supporting machinery.	Confirm if there are any foreign objects entering, damaging, or deforming the moving parts on the mechanical side.	Contact with the manufacturer of the machinery.
	Noise interference occurred due to the wrong specification of the cable used for the input and output signal.	Confirm that the input / output signal cables meet the specifications. Cable specifications: Double stranded wire or double stranded overall shielded wire, with a core wire of 0.12mm2 or more, and tinned soft copper stranded wire.	Use cables that meet specifications.
	Noise interference occurred due to the too long cable for the input and output signal.	Confirm the length of the cable used for the input and output signal.	Make the length of cable used for the input/ output signal within 3m.
	Noise interference occurred due to the wrong specification of the encoder cable.	Verify that the encoder cable meets specifications. Cable specifications: Double stranded shielded wire or double stranded overall shielded wire (core wire of 0.12mm2 or more, tin-coated soft copper stranded wire)	Use cables that meet specifications.
	Noise interference occurred because the encoder cable was too long.	Confirm the length of the encoder cable.	Set the length of the encoder cable within 50m.
	Noise interference occurred due to the encoder cable damage.	Make whether the encoder cable is clamped and the envelope is damaged.	Replace the encoder cable and change the laying environment of the encoder cable.
	There is excessive noise interference on the encoder cable.	Confirm whether the encoder cable is tied together or too close to the high current line.	Change the laying environment of the encoder cable to avoid the surge voltage of the high current wire.
	The potential of FG changes due to the influence of the servo motor device (welding machine, etc.).	Check the grounding status of the servo motor side device (Forget grounding, incomplete grounding)	Properly ground the servo motor side device to prevent shunt to encoder side FG.
	The pulse count of the servo drive is wrong due to noise interference.	Check for noise interference between the encoder and the signal line.	Take anti-interference countermeasures to the encoder wiring.
	The encoder is affected by the excessive vibration impact.	Confirm whether mechanical vibration occurs and confirm the installation state of the servo motor (Precision, fixed state, and partial core of the mounting surface).	Reduce the mechanical vibration, and improve the installation state of the servo motor.
	Encoder fault	-	Replace the servo motor.

(continued)

Fault content	Cause	Confirmation method	Treatment measures
The motor vibrates when the frequency is about 200 ～ 400Hz.	Poor balance of the servo gain	Confirm that the tuning of the servo gain is performed.	Perform the advanced autotuning without reference.
	The setting value of speed loop gain (Pn100) is too high.	Confirm the setting value of speed loop gain (Pn100). Factory setting Kv = 40.0Hz	Set correct value of speed loop gain (Pn100).
	The setting value of position loop gain (Pn102) is too high.	Confirm the setting value of position loop gain (Pn102). Factory setting Kp = 40.0/s	Set correct value of position loop gain (Pn102).
	Improper setting of speed loop integral time constant (Pn101)	Confirm the setting value of speed loop integral time constant (Pn101). Factory setting Ti = 20.0ms	Set correct value of speed loop integral time constant (Pn101).
	Incorrect setting of moment of inertia ratio (Pn103)	Confirm the setting value of moment of inertia ratio (Pn103).	Set the correct value of moment of inertia ratio (Pn103).
Excessive speed overshooting when starting and stopping	Poor balance of the servo gain	Confirm that the tuning of the servo gain is performed.	Perform the advanced autotuning without reference.
	The setting value of speed loop gain (Pn100) is too high.	Confirm the setting value of speed loop gain (Pn100). Factory setting Kv = 40.0Hz	Set correct value of speed loop gain (Pn100).
	The setting value of position loop gain (Pn102) is too high.	Confirm the setting value of position loop gain (Pn102). Factory setting Kp = 40.0/s	Set correct value of position loop gain (Pn102).
	Improper setting of speed loop integral time constant (Pn101)	Confirm the setting value of speed loop integral time constant (Pn101) Factory setting Ti = 20.0ms	Set correct value of speed loop integral time constant (Pn101).
	Incorrect setting of moment of inertia ratio (Pn103)	Confirm the setting value of moment of inertia ratio (Pn103).	Set the correct value of moment of inertia ratio (Pn103).
Position deviation error of absolute encoder (The deviation between the position stored by the upper device during power OFF and the position during power ON)	Noise interference occurred due to the wrong specification of the encoder cable.	Verify that the encoder cable meets specifications. Cable specifications: Double stranded wire or double stranded overall shielded wire, with a core wire of 0.12mm2 or more, and tinned soft copper stranded wire.	Use cables that meet specifications.
	Noise interference occurred because the encoder cable was too long.	Confirm the length of the encoder cable.	Set the length of the encoder cable within 50m.
	Noise interference occurred due to the encoder cable damage.	Make whether the encoder cable is clamped and the envelope is damaged.	Replace the encoder cable and change the laying environment of the encoder cable.
	There is excessive noise interference on the encoder cable.	Confirm whether the encoder cable is tied together or too close to the high current line.	Change the laying environment of the encoder cable to avoid the surge voltage of the high current wire.
	The potential of FG changes due to the influence of the servo motor device (welding machine, etc.).	Check the grounding status of the servo motor side device (Forget grounding, incomplete grounding)	Properly ground the servo motor side device to prevent shunt to encoder side FG.
	The pulse count of the servo drive is wrong due to noise interference.	Check for noise interference between the encoder and the signal line.	Take anti-interference countermeasures to the encoder wiring.
	The encoder is affected by the excessive vibration impact.	Confirm whether mechanical vibration occurs and confirm the installation state of the servo motor (Precision, fixed state, and partial core of the mounting surface).	Reduce the mechanical vibration, and improve the installation state of the servo motor.
	Encoder fault	-	Replace the servo motor.
	Servo drive fault (Pulse does not change)	-	Replace the servo drive.
	Multi-rotation data reading error of the upper device	Confirm the error detection unit of the upper device.	Make the error detection unit of the upper device work properly.
		Use the upper device to confirm whether the parity data has been checked.	Conduct the parity check of the multi-rotation data.
		Verify there is no noise interference on the cable between the servo drive and the upper device.	Take anti-interference measures and check the parity of multi-rotation data again.

9.3 Judge the cause and treatment measures of the fault from the action and condition of the servo motor

(continued)

Fault content	Cause	Confirmation method	Treatment measures
Generated overtravel (OT)	No forward drive /no reverse drive signal entered	Confirm that the input signal is powered by an external power source (+24V).	Set the input signal to the correct value using an external power supply (+24V) voltage.
		Confirm the operating status of the overtravel limit switch.	Make the overtravel limit switch operate normally.
		Confirm the wiring of the overtravel limit switch.	Connect the overtravel limit switch correctly.
		Confirm the settings of Pn50A and Pn50B.	Set parameters correctly.
	Malfunction of "no forward/ reverse drive signal".	Confirm if there is any fluctuation in the voltage of the external power supply (+24V) for the input signal.	Eliminate voltage fluctuations from external power sources (+24V) for input signals.
		Confirm whether the action state of the overtravel limit switch is unstable.	Stabilize the action state of the overtravel limit switch.
		Confirm the wiring of the overtravel limit switch (cable without damage, screw tightening state, etc.).	Connect the overtravel limit switch correctly.
	The no forward/reverse drive signal (P-OT/N-OT) assigned to parameters (Pn50A. 3, Pn50B. 0) is incorrect.	Verify that the P-OT signal is assigned to Pn50A.3.	If other signals are assigned to Pn50A.3, re-assign the P-OT signal to this parameter.
		Verify that the N-OT signal is assigned to Pn50B.0.	If other signals are assigned to Pn50B.0, re-assign the N-OT signal to this parameter.
	Servo motor stop method selection error	Confirm Pn001.0 and Pn001.1 when the servo is OFF.	Select the servo motor stop method beyond the free run stop.
		Confirm Pn001.0 and Pn001.1 during the torque control.	Select the servo motor stop method beyond the free run stop.
Incorrect stop position due to overtravel (OT)	Improper position of the limit switch and improper length of the monitoring device	-	Set the limit switch in place.
	The position of the overtravel limit switch is shorter than the inertia operation.	-	Install the overtravel limit switch in place.
Position deviation occurs (No alarm)	Noise interference occurred due to the wrong specification of the encoder cable.	Verify that the encoder cable meets specifications. Cable specifications: Double stranded wire or double stranded overall shielded wire, with a core wire of 0.12mm2 or more, and tinned soft copper stranded wire.	Use cables that meet specifications.
	Noise interference occurred because the encoder cable was too long.	Confirm the length of the encoder cable.	Set the length of the encoder cable within 50m.
	Noise interference occurred due to the encoder cable damage.	Make whether the encoder cable is clamped and the envelope is damaged.	Replace the encoder cable and change the laying environment of the encoder cable.
	There is excessive noise interference on the encoder cable.	Confirm whether the encoder cable is tied together or too close to the high current line.	Change the laying environment of the encoder cable to avoid the surge voltage of the high current wire.
	The potential of FG changes due to the influence of the servo motor device (welding machine, etc.).	Check the grounding status of the servo motor side device (Forget grounding, incomplete grounding)	Properly ground the servo motor side device to prevent shunt to encoder side FG.
	The pulse count of the servo drive is wrong due to noise interference.	Check for noise interference between the encoder and the signal line.	Take anti-interference countermeasures to the encoder wiring.
	The encoder is affected by the excessive vibration impact.	Confirm whether mechanical vibration occurs and confirm the installation state of the servo motor (Precision, fixed state, and partial core of the mounting surface).	Reduce the mechanical vibration, and improve the installation state of the servo motor.
	The coupling between the machine and the servo motor is faulty	Confirm whether the coupling of the machine and the servo motor is misaligned.	Properly fix the coupling between the machine and the servo motor.
	Noise interference occurred due to the wrong specification of the cable used for the input and output signal.	Confirm that the input / output signal cables meet the specifications. Cable specifications: Double stranded wire or double stranded overall shielded wire, with a core wire of 0.12mm2 or more, and tinned soft copper stranded wire.	Use cables that meet specifications.

9.3 Judge the cause and treatment measures of the fault from the action and condition of the servo motor

(continued)

Fault content	Cause	Confirmation method	Treatment measures
Position deviation occurs (No alarm)	When using the reference pulse input ratio switching function, due to interference, the input and output signals (/PSEL/PSELA) of the reference pulse input ratio switching were incorrectly detected.	Confirm that the input / output signal cables meet the specifications. Cable specifications: Double stranded shielded wire or double stranded overall shielded wire (core wire of 0.12mm2 or more, tin-coated soft copper stranded wire)	Use cables that meet specifications.
	Noise interference occurred due to the too long cable for the input and output signal.	Confirm the length of the cable used for the input and output signal.	Make the length of cable used for the input/ output signal within 3m.
	Encoder fault (Pulse does not change)	-	Replace the servo motor.
	Servo drive fault	-	Replace the servo drive.
Servo motor overheating	The ambient temperature is too high.	Measure the ambient temperature of the servo motor.	Control the ambient temperature below 40°C.
	The servo motor surface is dirty.	Visually confirm dirt on motor surface.	Remove the dirt, dust and oil pollution on the surface of the motor.
	The servo motor bears too much load.	Confirm the load status with a monitor.	If overload, reduce the load, or replace with a large capacity servo drive and servo motor.

10 Chapter X

Parameter List

10 Parameter List

Parameter No.	Size	Name	Setting range	Setting unit	Factory setting	Effective time
Pn000	2	Function selection base switch 0	0000 ～ 00C3	-	0010	After power on again

3rd 2nd 1st 0th

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Rotation direction selection

0	The direction of CCW is forward.
1	The direction of CW is forward. (Reverse mode)
2～3	Reserved

Control mode selection

0	Speed control (analog reference)
1	Position control (pulse trains 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 trains reference)
6	internal set speed control (contact reference) ⇔ Torque control (analog reference)
7	Position control (pulse trains reference) ⇔ Speed control (analog reference)
8	Position control (pulse trains reference) ⇔ Torque control (analog reference)
9	Torque control (analog reference) ⇔ Speed control (analog reference)
A	Speed control (analog reference) ⇔ Speed control with zero clamping
B	Position control (pulse trains reference) ⇔ Position control with reference pulse suppression function
C	EtherCAT bus control

Reserved parameters (do not change)

Reserved parameters (do not change)

Parameter No.	Size	Name	Setting range	Setting unit	Factory setting	Effective time
Pn001	2	Function selection application switch 1	0000 ～ 1122	-	0000	After power on again

3rd 2nd 1st 0th

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Stop method when servo is OFF and Ws.1 alarm occurs

0	The motor is stopped by DB (Dynamic brake).
1	Stop motor through DB, then disarm DB.
2	Without using DB, set the motor to free running state.

Stop method during overtravel (OT)

0	DB stop or free running stop (stop method is the same as Pn001.0).
1	Use the set torque of Pn406 as the maximum value to slow down and stop the motor, and then enter the servo lock state.
2	Use the value of Pn406 as the maximum deceleration torque to stop the motor and then enter the free state.

Selection of AC/DC power input

0	AC power input: Input AC power from L1(R)/ L2(S)/ L3(T) terminals.
1	DC power input: Reserved, not used

Reserved parameters (do not change)

Parameter No.	Size	Name	Setting range	Setting unit	Factory setting	Effective time
Pn002	2	Function selection application switch 2	0000 ～ 4113	-	0100	After power on again

3rd 2nd 1st 0th

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Speed/position control selection (T-REF allocations)

0	No T-REF allocations
1	Use the T-REF as an external torque limiting input.
2	Use T-REF as a torque feedforward input.
3	When /P-CL and N-CL are effective, use the T-REF terminal as an external torque limiting input.

Torque control selection (V-REF allocations)

0	V-REF no allocations
1	Use the V-REF as an external speed limit input.

Use of absolute encoder

0	Absolute value encoding is used normally
1	Use the absolute encoder as an incremental encoder.

Reserved parameters (do not change)

Parameter No.	Size	Name	Setting range	Setting unit	Factory setting	Effective time
Pn006	2	Function selection application switch 6	0000 ～005F	-	0002	With immediate effect

3rd 2rd 1nd 0th

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Analog monitoring 1 Signal selection

00	Motor speed (1V/1000min-1)
01	Speed reference (1V/1000min-1)
02	torque reference (1V/100% rated torque)
03	Position deviation (0.05V/1 reference unit)
04	Position amplifier deviation (behind electronic gear)(0.05V/1 encoder pulse unit)
05	position reference speed (1V/1000min-1)
06	Reserved
07	Position deviation between motor and load (0.01V/1 reference unit)
08	Positioning completed (positioning completed :5V, positioning incomplete :0V)
09	Speed feedforward (1V/1000min-1)
0A	Feedforward torque (1V/100% rated torque)
0B	Effective gain (1st gain :1V, 2nd gain :2V)
0C	Position reference output completed (output completed:5V, output incomplete :0V)
0D	Reserved

Reserved parameters (do not change)

Reserved parameters (do not change)

Parameter No.	Size	Name	Setting range	Setting unit	Factory setting	Effective time
Pn007	2	Function selection application switch 7	0000 ～005F	-	0000	With immediate effect

3rd 2nd 1st 0th

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Analog monitoring 2 Signal selection

00	Motor speed (1V/1000min-1)
01	Speed reference (1V/1000min-1)
02	torque reference (1V/100% rated torque)
03	Position deviation (0.05V/1 reference unit)
04	Position amplifier deviation (behind electronic gear) (0.05V/1 encoder pulse unit)
05	position reference speed (1V/1000min-1)
06	Reserved
07	Position deviation between motor and load (0.01V/1 reference unit)
08	Positioning completed (positioning completed :5V, positioning incomplete :0V)
09	Speed feedforward (1V/1000min-1)
0A	Feedforward torque (1V/100% rated torque)
0B	Effective gain (1st gain :1V, 2nd gain :2V)
0C	Position reference output completed (output completed:5V, output incomplete :0V)
0D	Reserved

Reserved parameters (do not change)

Reserved parameters (do not change)

Parameter No.	Size	Name		Setting range	Setting unit	Factory setting	Effective time
Pn008	2	Function selection application switch	8	0000 ～ 7121	-	0000	After power on again

n. 3rd 2nd 1st 0th □ □ □ □

Battery undervoltage alarm/warning options

0	Set the battery undervoltage to the alarm (A.830)
1	Set the battery undervoltage to the warning (A.930)

Function selection at undervoltage

0	Undervoltage warning not detected
1	An undervoltage warning is detected and torque limits are enforced on the upper device.
2	Detect undervoltage warning and execute torque limit through Pn424 and Pn425.

Warning detection selection

0	Detection warning
1	Failure to detect warning

Reserved parameters (do not change)

Parameter No.	Size	Name		Setting range	Setting unit	Factory setting	Effective time
Pn009	2	Function selection application switch	9	0000 ～ 0111	-	0010	After power on again

n. 3rd 2nd 1st 0th □ □ □ □

Reserved parameters (do not change)

Current control mode selection

0	Select the current control mode 1.
1	Select the current control mode 2.

Speed detection method selection

0	Select the speed detection 1.
1	Select the speed detection 2.

Reserved parameters (do not change)

Parameter No.	Size	Name	Setting range	Setting unit	Factory setting	Effective time
Pn00B	2	Function selection application switch B	0000 ～ 1111	-	0001	After power on again

n. 3rd 2nd 1st 0th □ □ □ □

0th: Operator parameter display selection
- 0: Only settings are displayed
- 1: Displays all parameters.

1st: Ws.2 Alarm stop method selection
- 0: Zero speed stop
- 1: DB stop or free running stop (stop method is the same as Pn001.0).

2nd: Three-phase input specification, power input selection for servo drive
- 0: Use with a three-phase power supply input.
- 1: Use three-phase input specifications with single-phase power input

3rd: Reserved parameters (do not change)

Parameter No.	Size	Name	Setting range	Setting unit	Factory setting	Effective time
Pn00C	2	Function selection application switch C	0000 ～ 0111	-	0000	After power on again

n. 3rd 2nd 1st 0th □ □ □ □

0th: Reserved parameters (do not change)

1st: Reserved parameters (do not change)

2nd: Reserved parameters (do not change)

3rd: Reserved parameters (do not change)

Parameter No.	Size	Name	Setting range	Setting unit	Factory setting	Effective time
Pn00D	2	Function selection application switch D	0000 ～ 1001	-	0000	With immediate effect

n. 3rd 2nd 1st 0th □ □ □ □

0th: Reserved parameters (do not change)

1st: Reserved parameters (do not change)

2nd: Reserved parameters (do not change)

3rd: Overtravel warning detection selection
- 0: Overtravel warning is not detected.
- 1: Detection overtravel warning

Parameter No.	Size	Name	Setting range	Setting unit	Factory setting	Effective time
Pn010	2	Axis address selection (For USB communication)	0000 ～ 007F	-	0001	After power on again
Pn015	2	EtherCAT address (For Omron system)	0000 ～ 007F	-	0000	After power on again
Pn080	2	Reserve (do not change)	-	-	-	-
Pn081	2	Function selection application switch 81	0000 ～ 1111	-	0000	After power on again
Pn100	2	Speed loop gain	10 ～ 20000	0.1Hz	400	With immediate effect
Pn101	2	Speed loop integral time constant	15 ～ 51200	0.01ms	2000	With immediate effect
Pn102	2	Position loop gain	10 ～ 20000	0.1/s	400	With immediate effect
Pn103	2	Moment of inertia ratio	0 ～ 20000	1%	100	With immediate effect
Pn104	2	Second speed loop gain	10 ～ 20000	0.1Hz	400	With immediate effect
Pn105	2	Second speed loop integral time constant	15 ～ 51200	0.01ms	2000	With immediate effect
Pn106	2	Second position loop gain	10 ～ 20000	0.1/s	400	With immediate effect
Pn109	2	Feedforward	0 ～ 100	1%	0	With immediate effect
Pn10A	2	Feedforward filtering time constant	0 ～ 6400	0.01ms	0	With immediate effect

Pn081

3rd 2nd 1st 0th

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Frequency division C-phase output selection	
00	Only the forward frequency division C-phase pulse is output.
01	Output the forward and reverse frequency division C-phase pulses.
Reserved parameters (do not change)	
Reserved parameters (do not change)	
Reserved parameters (do not change)	

<table>
<tr><th>Parameter No.</th><th>Size</th><th>Name</th><th>Setting range</th><th>Setting unit</th><th>Factory setting</th><th>Effective time</th></tr>
<tr><td>Pn10B</td><td colspan="6">
3rd 2nd 1st 0th
n. □ □ □ □
<table>
<tr><td>Mode switch selection</td><td></td><td>Effective time</td></tr>
<tr><td>0</td><td>Conditional on internal torque references (Value setting: Pn10C)</td><td rowspan="5">With immediate effect</td></tr>
<tr><td>1</td><td>Conditional on the speed reference. (Value setting: Pn10D)</td></tr>
<tr><td>2</td><td>Conditional on the acceleration. (Value setting: Pn10E)</td></tr>
<tr><td>3</td><td>Conditional on the position deviation (Value setting: Pn10F)</td></tr>
<tr><td>4</td><td>None dode switch function</td></tr>
</table>
<table>
<tr><td>Speed loop control method</td><td></td><td>Effective time</td></tr>
<tr><td>0</td><td>PI control</td><td rowspan="3">After power on again</td></tr>
<tr><td>1</td><td>I-P control</td></tr>
<tr><td>2～3</td><td>Reserved parameters (do not change)</td></tr>
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<tr><td>Reserved parameters (do not change)</td></tr>
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<tr><td>Reserved parameters (do not change)</td><td></td></tr>
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</td></tr>
<tr><td>Pn10C</td><td>2</td><td>Mode switch (torque reference)</td><td>0 ～ 800</td><td>1%</td><td>200</td><td>With immediate effect</td></tr>
<tr><td>Pn10D</td><td>2</td><td>Mode switch (speed reference)</td><td>0 ～ 10000</td><td>1min-1</td><td>0</td><td>With immediate effect</td></tr>
<tr><td>Pn10E</td><td>2</td><td>Mode Switch (acceleration)</td><td>0 ～ 30000</td><td>1min-1/s</td><td>0</td><td>With immediate effect</td></tr>
<tr><td>Pn10F</td><td>2</td><td>Mode switch (position deviation)</td><td>0 ～ 10000</td><td>1 reference unit</td><td>0</td><td>With immediate effect</td></tr>
<tr><td>Pn11F</td><td>2</td><td>Position integral time constant</td><td>0 ～ 50000</td><td>0.1ms</td><td>0</td><td>With immediate effect</td></tr>
<tr><td>Pn121</td><td>2</td><td>Friction compensation gain</td><td>10 ～ 1000</td><td>1%</td><td>100</td><td>With immediate effect</td></tr>
<tr><td>Pn122</td><td>2</td><td>Second friction compensation gain</td><td>10 ～ 1000</td><td>1%</td><td>100</td><td>With immediate effect</td></tr>
<tr><td>Pn123</td><td>2</td><td>Friction compensation coefficient</td><td>0 ～ 100</td><td>1%</td><td>0</td><td>With immediate effect</td></tr>
<tr><td>Pn124</td><td>2</td><td>Friction compensation Frequency compensation</td><td>-10000 ～ 10000</td><td>0.1Hz</td><td>0</td><td>With immediate effect</td></tr>
<tr><td>Pn125</td><td>2</td><td>Friction compensation gain compensation</td><td>1 ～ 1000</td><td>1%</td><td>100</td><td>With immediate effect</td></tr>
<tr><td>Pn131</td><td>2</td><td>Gain switching time 1</td><td>0 ～ 65535</td><td>1ms</td><td>0</td><td>With immediate effect</td></tr>
<tr><td>Pn132</td><td>2</td><td>Gain switching time 2</td><td>0 ～ 65535</td><td>1ms</td><td>0</td><td>With immediate effect</td></tr>
<tr><td>Pn135</td><td>2</td><td>Gain switching waiting time 1</td><td>0 ～ 65535</td><td>1ms</td><td>0</td><td>With immediate effect</td></tr>
<tr><td>Pn136</td><td>2</td><td>Gain switching waiting time 2</td><td>0 ～ 65535</td><td>1ms</td><td>0</td><td>With immediate effect</td></tr>
</table>

Parameter No.	Size	Name	Setting range	Setting unit	Factory setting	Effective time
Pn139	2	Automatic gain switching switch 1	0000 ～ 0052	-	0000	With immediate effect

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Switch of gain switching selection

0	Manual gain switching Manual gain switching through external input signal (/G-SEL)
1	Reserved parameters (do not change)
2	Automatic switching mode 1 When switching condition A is met, it automatically switches From the first gain to the second gain. When switching condition A does not hold, it automatically switches from the second gain to the first gain.

Switching condition A

0	Positioning completed signal (/COIN)ON
1	Positioning completed signal (/COIN) OFF
2	Positioning near signal (/NEAR)ON
3	Positioning near signal (/NEAR)ON
4	Position reference filter output = 0 and reference pulse input OFF
5	Position reference pulse input ON

Reserved parameters (do not change)

Reserved parameters (do not change)

Pn13A	2	Gain switching speed	0~10000	rpm	0	With immediate effect
Pn13D	2	Current gain value	100 ～ 2000	1%	2000	With immediate effect
Pn140	2	Model following control switch	0000 ～ 1121	-	0100	With immediate effect

n. □ □ □ □ (3rd 2nd 1st 0th)

Model following control selection

0	Model following control is not used.
0	Model following control is used.

Vibration suppression selection

0	No vibration suppression
1	Add vibration suppression function for the specific frequency.
2	Add vibration suppression function for two different frequencies.

Vibration suppression function adjustment selection

0	The vibration suppression function is not automatically adjusted by the utility function.
1	The vibration suppression function is automatically adjusted by the utility function.

Reserved parameters (do not change)

0	Not using both model following control and speed / torque feedforward.
1	Using both model following control and speed / torque feedforward.

Pn141	2	Model following control gain	10 ～ 20000	0.1/s	500	With immediate effect
Pn142	2	Model following control gain correction	500 ～ 2000	0.1%	1000	With immediate effect
Pn143	2	Model following control bias (Forward direction)	0 ～ 10000	0.1%	1000	With immediate effect
Pn144	2	Model following control bias (Reverse direction)	0 ～ 10000	0.1%	1000	With immediate effect
Pn145	2	Vibration suppression 1 frequency A	10 ～ 2500	0.1Hz	500	With immediate effect

Parameter No.	Size	Name	Setting range	Setting unit	Factory setting	Effective time
Pn146	2	Vibration suppression 1 frequency B	10 ～ 2500	0.1Hz	700	With immediate effect
Pn147	2	Model following control speed feedforward compensation	0 ～ 10000	0.1%	1000	With immediate effect
Pn148	2	Second model following control gain	10 ～ 20000	0.1/s	500	With immediate effect
Pn149	2	Second Model following control gain correction	500 ～ 2000	0.1%	1000	With immediate effect
Pn14A	2	Frequency of vibration suppression 2	10 ～ 2000	0.1Hz	800	With immediate effect
Pn14B	2	Compensation of vibration suppression 2	10 ～ 1000	1%	100	With immediate effect
Pn14F	2	Control switch	0000 ～ 0011	-	0011	After power on again

3rd 2nd 1st 0th

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Model following control selection

0	Select Model following control Type 1.
1	Select Model following control Type 2.

Self-tuning type selection

0	Select self-tuning Type 1.
1	Select self-tuning Type 2.

Reserved parameters (do not change)

Reserved parameters (do not change)

Pn160	2	Vibration suppression control switch	0000 ～ 0011	-	0010	With immediate effect

3rd 2nd 1st 0th

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Anti-resonance control selection

0	No anti-resonance control is used.
1	Anti-resonance control is used.

Anti-resonance control adjustment selection

0	Autotuning of anti-resonance control using the utility function
1	The anti-resonance control is automatically adjusted through the utility functions.

Reserved parameters (do not change)

Reserved parameters (do not change)

Pn161	2	Anti-resonance frequency	10 ～ 20000	0.1Hz	1000	With immediate effect
Pn162	2	Anti-resonance gain compensation	1 ～ 1000	1%	100	With immediate effect
Pn163	2	Vibration anti-resonance gain	0 ～ 300	1%	0	With immediate effect
Pn164	2	Anti-resonance filtering time constant 1 compensation	-1000 ～ 1000	0.01ms	0	With immediate effect
Pn165	2	Anti-resonance filtering time constant 2 compensation	-1000 ～ 1000	0.01ms	0	With immediate effect

Parameter No.	Size	Name	Setting range	Setting unit	Factory setting	Effective time
Pn170	2	Self-adjusted switch	0000 ～ 2411	-	1400	With immediate effect

n. 3rd □ 2nd □ 1st □ 0th □

Self-tuning selection	
0	Disables the self-tuning function
1	Enable the self-tuning function.

Control method for speed control	
0	Used as speed control
1	Used as speed control and the upper device as position control.

Self-tuning level	
0~4	Set the self-tuning level.

Reserved parameters (do not change)	
0~2	Set the self-tuning load value.

Pn190	2	Reserve (do not change)	-	-	-	-

Parameter No.	Size	Name	Setting range	Setting unit	Factory setting	Effective time
Pn200	2	Self-adjusted switch	0000 ～ 2236	-	0000	After power on again

3rd 2nd 1st 0th

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Reference pulse pattern

0	Symbol + pulse, positive logic
1	CW+CCW pulse trains, positive logic
2	90 ° phase differential two-phase pulse (A phase + B phase) increases by 1 time, positive logic
3	90 ° phase differential two-phase pulse (A phase + B phase) increases by 2 times, positive logic
4	90 ° phase differential two-phase pulse (A phase + B phase) increases by 4 times, positive logic
5	Symbol pulse trains, negative logic
6	CW+CCW pulse trains, negative logic

Clear signal pattern

0	Clear position deviation at the signal H level.
1	Reserved
2	Clear position deviation at the signal L level.
3	Reserved

Reserved parameters (do not change)

Reserved parameters (do not change)

Pn205	2	Upper limit of multiturn	0 ～ 65535	1rev	65535	After power on again
Pn207	2	Position control function switch	0000 ～ 2210	-	0000	After power on again

3rd 2nd 1st 0th

n. □ □ □ □

Reserved parameters (do not change)

Position control selection

0	No V-REF allocations
1	Use V-REF as a speed feedforward input.

Reserved parameters (do not change)

/COIN Output timing

0	Output when the absolute value of position deviation is less than the positioning completed width (Pn522)
1	When the absolute value of the position deviation is less than the positioning completed width (Pn522) and the filtered position reference is 0, output.
2	When the absolute value of position deviation is less than the positioning completed width (Pn522) and the position reference input is 0, output.

Parameter No.	Size	Name	Setting range	Setting unit	Factory setting	Effective time
Pn20A	4	Reserved parameters (do not change)	-	-	-	
Pn20E	4	Electronic gear ratio (molecular)	1～ 1073741824	1	1	After power on again
Pn210	4	Electronic gear ratio (denominator)	1～ 1073741824	1	1	After power on again
Pn212	4	Encoder divided pulse output	16 ～ 16383	1P/Rev	2500	After power on again
Pn216	2	Position reference acceleration and deceleration time parameter	0 ～ 65535	0.1ms	0	After the change and motor stop
Pn217	2	Average time of position reference movement	0 ～ 10000	0.1ms	0	After the change and motor stop
Pn218	2	reference pulse input magnification	1 ～ 100	1 time	1	With immediate effect
Pn22A	2	Reserved parameters (do not change)	-	-	-	-
Pn230	2	Reserved parameters (do not change)	-	-	-	-
Pn231	2	Reserved parameters (do not change)	-	-	-	-
Pn233	2	Reserved parameters (do not change)	-	-	-	-
Pn240	2	Reserved parameters (do not change)	-	-	-	-
Pn281	2	Reserved parameters (do not change)	-	-	-	-
Pn2D0	2	Reserved parameters (do not change)	-	-	-	-
Pn300	2	Input gain speed reference	150 ～ 3000	0.01V	600	With immediate effect
Pn301	2	Internal set speed 1	0 ～ 10000	1min-1	100	With immediate effect
Pn302	2	Internal set speed 2	0 ～ 10000	1min-1	200	With immediate effect
Pn303	2	Internal set speed 3	0 ～ 10000	1min-1	300	With immediate effect
Pn304	2	JOG speed	0 ～ 10000	1min-1	500	With immediate effect
Pn305	2	Soft start acceleration time	0 ～ 10000	1ms	0	With immediate effect
Pn306	2	Soft start deceleration time	0 ～ 10000	1ms	0	With immediate effect
Pn307	2	Speed reference filtering time constant	0 ～ 65535	0.01ms	40	With immediate effect

Parameter No.	Size	Name	Setting range	Setting unit	Factory setting	Effective time
Pn310	2	Vibration detection switch	0000 ～ 0002	-	0000	With immediate effect

3rd 2nd 1st 0th

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Vibration detection selection

0	No vibration detected
1	A warning is issued when vibration is detected (A.911).
2	Alarm is issued when vibration is detected (A.520).

Reserved parameters (do not change)

Reserved parameters (do not change)

Reserved parameters (do not change)

Parameter No.	Size	Name	Setting range	Setting unit	Factory setting	Effective time
Pn311	2	Vibration detection sensitivity	50 ～ 500	1%	100	With immediate effect
Pn312	2	Vibration detection value	0 ～ 5000	1min-1	50	With immediate effect
Pn324	2	Presumptive starting value of the moment of inertia	0 ～ 20000	1%	300	With immediate effect
Pn400	2	Torque reference input gain	10 ～ 100	0.1V	30	With immediate effect
Pn401	2	Filter time constant for the first torque reference in the first section	0 ～ 65535	0.01ms	100	With immediate effect
Pn402	2	Forward torque limit	0 ～ 800	1%	800	With immediate effect
Pn403	2	Reverse torque limit	0 ～ 800	1%	800	With immediate effect
Pn404	2	External torque limit on the forward side	0 ～ 800	1%	100	With immediate effect
Pn405	2	External torque limit on the reverse side	0 ～ 800	1%	100	With immediate effect
Pn406	2	Emergency stop torque	0 ～ 800	1%	800	With immediate effect
Pn407	2	Speed-limiting during torque control	0 ～ 10000	1min-1	10000	With immediate effect

Parameter No.	Size	Name	Setting range	Setting unit	Factory setting	Effective time
Pn408	2	Torque-type function switch	0000 ～ 1111	-	0000	-

n. 3rd □ 2nd □ 1st □ 0th □

0th □ — Selection of notch filter 1 (Effective time)

		Effective time
0	Make the segment 1 notch filter invalid.	Immediate effect
1	Use the segment 1 notch filter.	

1st □ — Speed limit selection (Effective time)

		Effective time
0	Use the smaller value of the highest motor speed or Pn407 set value as the speed limit value.	After power on again
1	Use the smaller value of the speed alarm detection speed or Pn407 set value as the speed limit value.	

2nd □ — Selection of notch filter 1 (Effective time)

		Effective time
0	The second notch filter is invalid	After power on again
1	The second notch filter is valid	

3rd □ — Friction compensation function selection (Effective time)

		Effective time
0	The friction compensation function is not used.	With immediate effect
1	Use the friction compensation function.	

Parameter No.	Size	Name	Setting range	Setting unit	Factory setting	Effective time
Pn409	2	Frequency for the first notch filter	50 ～ 5000	1Hz	5000	With immediate effect
Pn40A	2	Q value of the first notch filter	50 ～ 1000	0.01	70	With immediate effect
Pn40B	2	Notch depth of the first notch filter	0 ～ 1000	0.001	0	With immediate effect
Pn40C	2	Frequency of the second notch filter	50 ～ 5000	1Hz	5000	With immediate effect
Pn40D	2	Q value of the second notch filter	50 ～ 1000	0.01	70	With immediate effect
Pn40E	2	Notch depth of the second notch filter	0 ～ 1000	0.001	0	With immediate effect
Pn40F	2	Second torque reference filter frequency in the second section	100 ～ 5000	1Hz	5000	With immediate effect
Pn410	2	Q value of second torque reference filter in the second section	50 ～ 100	0.01	50	With immediate effect
Pn412	2	Filter time constant for the second torque reference in the first section	0 ～ 65535	0.01ms	100	With immediate effect
Pn415	2	T-REF filtering time constant	0 ～ 65535	0.01ms	0	With immediate effect
Pn416～ Pn41F	2	Reserved parameters (do not change)	-	-	-	-
Pn423	2	Reserved parameters (do not change)	-	-	-	-
Pn424	2	Torque limit when the main circuit voltage drops	0 ～ 100	1%	50	With immediate effect
Pn425	2	Torque limit removal time when the main circuit voltage drops	0 ～ 1000	1ms	100	With immediate effect
Pn456	2	Scan the torque reference amplitude	1 ～ 800	1%	15	With immediate effect

Parameter No.	Size	Name	Setting range	Setting unit	Factory setting	Effective time
Pn460	2	Notch filter tuning switch	0000 ～ 0101	-	0101	With immediate effect

3rd 2nd 1st 0th

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Selection of notch filter 1

0	The segment 2 notch filter is not automatically adjusted by utility functions.
1	The segment 2 notch filter is automatically adjusted by utility functions.

Reserved parameters (do not change)

Selection of notch filter 1

0	The segment 2 notch filter is not automatically adjusted by utility functions.
1	The segment 2 notch filter is automatically adjusted by utility functions.

Reserved parameters (do not change)

Pn481	2	Reserved parameters (do not change)	-	-	-	-
Pn482	2	Reserved parameters (do not change)	-	-	-	-
Pn486～Pn488	2	Reserved parameters (do not change)	-	-	-	-
Pn490	2	Reserved parameters (do not change)	-	-	-	-
Pn493～Pn495	2	Reserved parameters (do not change)	-	-	-	-
Pn498	2	Reserved parameters (do not change)	-	-	-	-
Pn501	2	Zero fixed value	0 ～ 10000	1min-1	10	With immediate effect
Pn502	2	Rotation detection value	1 ～ 10000	1min-1	20	With immediate effect
Pn503	2	Speed consistency signal output range	0 ～ 100	1min-1	10	With immediate effect
Pn506	2	Brake reference － Servo OFF delay time	0 ～ 50	10ms	0	With immediate effect
Pn507	2	Brake reference output speed value	0 ～ 10000	1min-1	100	With immediate effect
Pn508	2	Brake reference waiting time	10 ～ 100	10ms	50	With immediate effect
Pn509	2	Momentary power interruption holding time	20 ～ 1000	1ms	20	With immediate effect

Parameter No.	Size	Name	Setting range	Setting unit	Factory setting	Effective time
Pn50A	2	Input signal selection 1	0000 ～ FFF1	-	8100	After power on again

3rd 2nd 1st 0th

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Input signal allocations mode

0	Use sequential input signal terminals assigned in factory condition
1	Change the allocations of sequential input signal according to different signals.

Servo ON (/S-ON) signal allocations

0	Valid when CN1-33 input signal is ON(closed).
1	Valid when CN1-9 input signal is ON(closed).
2	Valid when CN1-10 input signal is ON(closed).
3	Valid when CN1-34 input signal is ON(closed).
4	Valid when CN1-8 input signal is ON(closed).
5	Valid when CN1-30 input signal is ON(closed).
6	Valid when CN1-12 input signal is ON(closed).
7	Hold the signal to "valid".
8	Hold the signal to "invalid".
9	Valid when CN1-33 input signal is OFF (open).
A	Valid when CN1-9 input signal is OFF (open).
B	Valid when CN1-10 input signal is OFF (open).
C	Valid when CN1-34 input signal is OFF (open).
D	Valid when CN1-8 input signal is OFF (open).
E	Valid when CN1-30 input signal is OFF (open).
F	Valid when CN1-12 input signal is OFF (open).

/P-CON signal allocations

0~F	Same as the allocations of servo ON input (/S-ON) signals.

P-OT signal allocations

0	When the input signal of CN1-33 is ON(closed), forward drive can be performed.
1	When the input signal of CN1-9 is ON(closed), forward drive can be performed.
2	When the input signal of CN1-10 is ON(closed), forward drive can be performed.
3	When the input signal of CN1-34 is ON(closed), forward drive can be performed.
4	When the input signal of CN1-8 is ON(closed), forward drive can be performed.
5	When the input signal of CN1-30 is ON(closed), forward drive can be performed.
6	When the input signal of CN1-12 is ON(closed), forward drive can be performed.
7	Fixed the signal to "no forward drive".
8	Fixed the signal to "forward drive".
9	When the input signal of CN1-33 is OFF (open), forward drive can be performed.
A	When the input signal of CN1-9 is OFF (open), forward drive can be performed.
B	When the input signal of CN1-10 is OFF (open), forward drive can be performed.
C	When the input signal of CN1-34 is OFF (open), forward drive can be performed.
D	When the input signal of CN1-8 is OFF (open), forward drive can be performed.
E	When the input signal of CN1-30 is OFF (open), forward drive can be performed.
F	When the input signal of CN1-12 is OFF (open), forward drive can be performed.

Parameter No.	Size	Name	Setting range	Setting unit	Factory setting	Effective time
Pn50B	2	Input signal selection 2	0000 ～ FFFF	-	6548	After power on again

3rd 2nd 1st 0th

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N-OT signal allocations

0	When the input signal of CN1-33 is ON(closed), reverse drive can be performed.
1	When the input signal of CN1-9 is ON(closed), reverse drive can be performed.
2	When the input signal of CN1-10 is ON(closed), reverse drive can be performed.
3	When the input signal of CN1-34 is ON(closed), reverse drive can be performed.
4	When the input signal of CN1-8 is ON(closed), reverse drive can be performed.
5	When the input signal of CN1-30 is ON(closed), reverse drive can be performed.
6	When the input signal of CN1-12 is ON(closed), reverse drive can be performed.
7	Fixed the signal to "no reverse drive".
8	Fixed the signal to "reverse drive".
9	When the input signal of CN1-33 is OFF (open), reverse drive can be performed.
A	When the input signal of CN1-9 is OFF (open), reverse drive can be performed.
B	When the input signal of CN1-10 is OFF (open), reverse drive can be performed.
C	When the input signal of CN1-34 is OFF (open), reverse drive can be performed.
D	When the input signal of CN1-8 is OFF (open), reverse drive can be performed.
E	When the input signal of CN1-30 is OFF (open), reverse drive can be performed.
F	When the input signal of CN1-12 is OFF (open), reverse drive can be performed.

/ALM-RST signal allocations (When in EtherCAT control mode, reuse as "Touchprobe1" signal allocations)

0	The input signal of CN1-33 is valid at the edge from OFF (open) to ON(closed).
1	The input signal of CN1-9 is valid at the edge from OFF (open) to ON(closed).
2	The input signal of CN1-10 is valid at the edge from OFF (open) to ON(closed).
3	The input signal of CN1-34 is valid at the edge from OFF (open) to ON(closed).
4	The input signal of CN1-8 is valid at the edge from OFF (open) to ON(closed).
5	The input signal of CN1-30 is valid at the edge from OFF (open) to ON(closed).
6	The input signal of CN1-12 is valid at the edge from OFF (open) to ON(closed).
7	Reserved parameters (do not change)
8	Hold the signal to "invalid".
9	The input signal of CN1-33 is valid at the edge from OFF (open) to ON(closed).
A	The input signal of CN1-9 is valid at the edge from ON(closed) to OFF (open).
B	The input signal of CN1-10 is valid at the edge from ON(closed) to OFF (open).
C	The input signal of CN1-34 is valid at the edge from ON(closed) to OFF (open).
D	The input signal of CN1-8 is valid at the edge from ON(closed) to OFF (open).
E	The input signal of CN1-30 is valid at the edge from ON(closed) to OFF (open).
F	The input signal of CN1-12 is valid at the edge from ON(closed) to OFF (open).

/P-CL signal allocations (When in EtherCAT control mode, reuse as "Touchprobe2" signal allocations)

0～F	Same as the allocations of servo ON input (/S-ON) signals.

/N-CL signal allocations (When in EtherCAT control mode, reuse as "HomeSwitch" signal allocations)

0～F	Same as the allocations of servo ON input (/S-ON) signals.

Parameter No.	Size	Name	Setting range	Setting unit	Factory setting	Effective time
Pn50C	2	Input signal selection 3	0000 ～ FFFF	-	8888	After power on again

3rd 2nd 1st 0th

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/SPD-D signal allocations

0	Valid when CN1-33 input signal is ON(closed).
1	Valid when CN1-9 input signal is ON(closed).
2	Valid when CN1-10 input signal is ON(closed).
3	Valid when CN1-34 input signal is ON(closed).
4	Valid when CN1-8 input signal is ON(closed).
5	Valid when CN1-30 input signal is ON(closed).
6	Valid when CN1-12 input signal is ON(closed).
7	Hold the signal to "valid".
8	Hold the signal to "invalid".
9	Valid when CN1-33 input signal is OFF (open).
A	Valid when CN1-9 input signal is OFF (open).
B	Valid when CN1-10 input signal is OFF (open).
C	Valid when CN1-34 input signal is OFF (open).
D	Valid when CN1-8 input signal is OFF (open).
E	Valid when CN1-30 input signal is OFF (open).
F	Valid when CN1-12 input signal is OFF (open).

/SPD-A signal allocations

/SPD-B signal allocations

0～F	Same as /SPD-D signal allocations

/C-SEL signal allocations

0～F	/C-SEL signal allocations

Parameter No.	Size	Name	Setting range	Setting unit	Factory setting	Effective time
Pn50D	2	Input signal selection 4	0000 ～ FFFF	-	8888	After power on again

3rd 2nd 1st 0th

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/ZCLAMP signal allocations

0	Valid when CN1-33 input signal is ON(closed).
1	Valid when CN1-9 input signal is ON(closed).
2	Valid when CN1-10 input signal is ON(closed).
3	Valid when CN1-34 input signal is ON(closed).
4	Valid when CN1-8 input signal is ON(closed).
5	Valid when CN1-30 input signal is ON(closed).
6	Valid when CN1-12 input signal is ON(closed).
7	Reserved parameters (do not change)
8	Hold the signal to "invalid".
9	Valid when CN1-33 input signal is OFF (open).
A	Valid when CN1-9 input signal is OFF (open).
B	Valid when CN1-10 input signal is OFF (open).
C	Valid when CN1-34 input signal is OFF (open).
D	Valid when CN1-8 input signal is OFF (open).
E	Valid when CN1-30 input signal is OFF (open).
F	Valid when CN1-12 input signal is OFF (open).

/INHIBIT signal allocations

0～F	Same as /ZCLAMP signal allocations

/G-SEL signal allocations

0～F	Same as /ZCLAMP signal allocations

Reserved parameters (do not change)

Parameter No.	Size	Name	Setting range	Setting unit	Factory setting	Effective time
Pn50E	2	Output signal selection 1	0000 ～ FFFF	-	3211	After power on again

3rd 2nd 1st 0th

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Signal allocations signal distribution (/COIN)

0	Invalid (do not use the above signal output)
1	Output the above signal from CN1-5/4 output terminals.
2	Output the above signal from CN1-3/2 output terminals.
3	Output the above signal from CN1-7/6 output terminals.

Speed consistent detection signal allocations (/V-CMP)

0～3	Same as /COIN signal allocations

Rotation detection signal allocations (/TGON)

0～3	Same as /COIN signal allocations

Servo ready signal allocations (/S-RDY)

0～3	Same as /COIN signal allocations

Parameter No.	Size	Name	Setting range	Setting unit	Factory setting	Effective time
Pn50F	2	Output signal selection 2	0000 ～ 3333	-	0000	After power on again

n. 3rd 2nd 1st 0th □ □ □ □

Signal allocations in the torque limit (/CLT)

0	Invalid (do not use the above signal output)
1	Output the above signal from CN1-5/4 output terminals.
2	Output the above signal from CN1-3/2 output terminals.
3	Output the above signal from CN1-7/6 output terminals.

Speed limit detection signal allocations (/VLT)

0～3	Same as /CLT signal allocations

Brake signal allocations (/BK)

0～3	Same as /CLT signal allocations

Warning signal allocations (/WARN)

0～3	Same as /CLT signal allocations

Parameter No.	Size	Name	Setting range	Setting unit	Factory setting	Effective time
Pn510	2	Output signal selection 3	0000 ～ 0333	-	0000	After power on again

n. 3rd 2nd 1st 0th □ □ □ □

Positioning nearby signal allocations (/NEAR)

0	Invalid (do not use the above signal output)
1	Output the above signal from CN1-5/4 output terminals.
2	Output the above signal from CN1-3/2 output terminals.
3	Output the above signal from CN1-7/6 output terminals.

Reserved parameters (do not change)

Reference pulse input magnification switching output signal allocations (/PSELA)

0～3	Same as /NEAR signal allocations

Reserved parameters (do not change)

Parameter No.	Size	Name	Setting range	Setting unit	Factory setting	Effective time
Pn511	2	Input signal selection 5	0000 ～ FFFF	-	8888	After power on again

n. 3rd 2nd 1st 0th □ □ □ □

Reserved parameters (do not change)

Reserved parameters (do not change)

Reserved parameters (do not change)

Reserved parameters (do not change)

Parameter No.	Size	Name	Setting range	Setting unit	Factory setting	Effective time
Pn512	2	Reverse setting of output signal	0000 ～ 0111	-	0000	After power on again

	3rd	2nd	1st	0th
n.	□	□	□	□

- 0th □ — Reverse CN1-5 and 4 terminal output signal
  - 0: Non-reversing signal
  - 1: Reverse the signal.
- 1st □ — Reverse the output signal of CN1-3/ 2 terminal
  - 0: Non-reversing signal
  - 1: Reverse the signal.
- 2nd □ — Reverse the output signal of CN1-7/ 6 terminal
  - 0: Non-reversing signal
  - 1: Reverse the signal.
- 3rd □ — Reverse ALM output signal: Reverse 1

Parameter No.	Size	Name	Setting range	Setting unit	Factory setting	Effective time
Pn513	2	Output signal selection 4	0000 ～ 0333	-	0000	After power on again

	3rd	2nd	1st	0th
n.	□	□	□	□

- 0th □ — Reserved parameters (do not change)
- 1st □ — Reserved parameters (do not change)
- 2nd □ — Reserved parameters (do not change)
- 3rd □ — Reserved parameters (do not change)

Parameter No.	Size	Name	Setting range	Setting unit	Factory setting	Effective time
Pn515	2	Input signal selection 6	0000 ～ FFFF	-	8888	After power on again

n. 3rd □ 2nd □ 1st □ 0th □

Allocations of encoder absolute value data requires input (SEN) signal

0	Valid when CN1-33 input signal is ON(closed)
1	Valid when CN1-9 input signal is ON(closed).
2	Valid when CN1-10 input signal is ON(closed)
3	Valid when CN1-34 input signal is ON(closed)
4	Valid when CN1-8 input signal is ON(closed).
5	Valid when CN1-30 input signal is ON(closed)
6	Valid when CN1-12 input signal is ON(closed)
7	Hold the signal to "valid".
8	Valid when entering 5V in CN1-20
9	Valid when CN1-33 input signal is OFF (open).
A	Valid when CN1-9 input signal is OFF (open).
B	Valid when CN1-10 input signal is OFF (open).
C	Valid when CN1-34 input signal is OFF (open).
D	Valid when CN1-8 input signal is OFF (open).
E	Valid when CN1-30 input signal is OFF (open).
F	Valid when CN1-12 input signal is OFF (open).

Allocations of reference pulse input magnification switching input signal (/PSEL)

0	Valid when CN1-33 input signal is ON(closed)
1	Valid when CN1-9 input signal is ON(closed).
2	Valid when CN1-10 input signal is ON(closed)
3	Valid when CN1-34 input signal is ON(closed)
4	Valid when CN1-8 input signal is ON(closed).
5	Valid when CN1-30 input signal is ON(closed)
6	Valid when CN1-12 input signal is ON(closed)
7	Hold the signal to "valid".
8	Hold the signal to "invalid".
9	Valid when CN1-33 input signal is OFF (open).
A	Valid when CN1-9 input signal is OFF (open).
B	Valid when CN1-10 input signal is OFF (open).
C	Valid when CN1-34 input signal is OFF (open).
D	Valid when CN1-8 input signal is OFF (open).
E	Valid when CN1-30 input signal is OFF (open).
F	Valid when CN1-12 input signal is OFF (open).

Allocations of emergency stop alarm input signal (FSTP)

0～F	Same as /PSEL signal allocations

Reserved parameters (cannot be changed)

Pn517	2	Reserved parameters (do not change)	-	-	0000	-
Pn51B	4	Excessive deviation between motor load	0 ～ 1073741824	1 reference unit	1000	With immediate effect
Pn51E	2	Warning value of position deviation overflow	10 ～ 100	1%	100	With immediate effect
Pn520	4	Warning value of position deviation overflow	1 ～ 1073741823	1 reference unit	41943040	With immediate effect
Pn522	4	Positioning completed width	0 ～ 1073741824	1 reference unit	7	With immediate effect
Pn524	4	NEAR signal range	1 ～ 1073741824	1 reference unit	1073741824	With immediate effect
Pn526	4	When servo-ON Warning value of position deviation overflow	1 ～ 1073741823	1 reference unit	41943040	With immediate effect
Pn528	2	When servo-ON Warning value of position deviation overflow	10 ～ 100	1%	100	With immediate effect
Pn529	2	Speed limit value when the servo is on	0 ～ 10000	1min-1	10000	With immediate effect
Pn52A	2	Reserved parameters (do not change)	-	-	-	-
Pn52B	2	Overload warning value	1 ～ 100	1%	20	With immediate effect
Pn52C	2	Motor overload detection base current reduction rated value	10 ～ 100	1%	100	After power on again
Pn52D	2	Reserved parameters (do not change)	-	-	50	-

Parameter No.	Size	Name	Setting range	Setting unit	Factory setting	Effective time
Pn52F	2	Monitor display during power on	0000 ～ 0FFF	-	0FFF	With immediate effect
Pn530	2	Program JOG run switch	0000 ～ 0005	-	0000	With immediate effect

n. 3rd □ 2nd □ 1st □ 0th □

Program JOG running parameter

0	(Waiting time Pn535→ Forward movement Pn531) x movement times Pn536
1	(Waiting time Pn535→ Forward movement Pn531) x movement times Pn536
2	(Waiting time Pn535→ Forward movement Pn531) x movement times Pn536 (Waiting time Pn535→ Forward movement Pn531) x movement times Pn536
3	(Waiting time Pn535→ Forward movement Pn531) x movement times Pn536 (Waiting time Pn535→ Forward movement Pn531) x movement times Pn536
4	(Waiting time Pn535 → Forward movement Pn531 → waiting time Pn535 → Reverse movement Pn531) × Movement times Pn536
5	(Waiting time Pn535 → Reverse movement Pn531 → waiting time Pn535 → Forward movement Pn531) × Movement times Pn536

Reserved parameters (do not change)

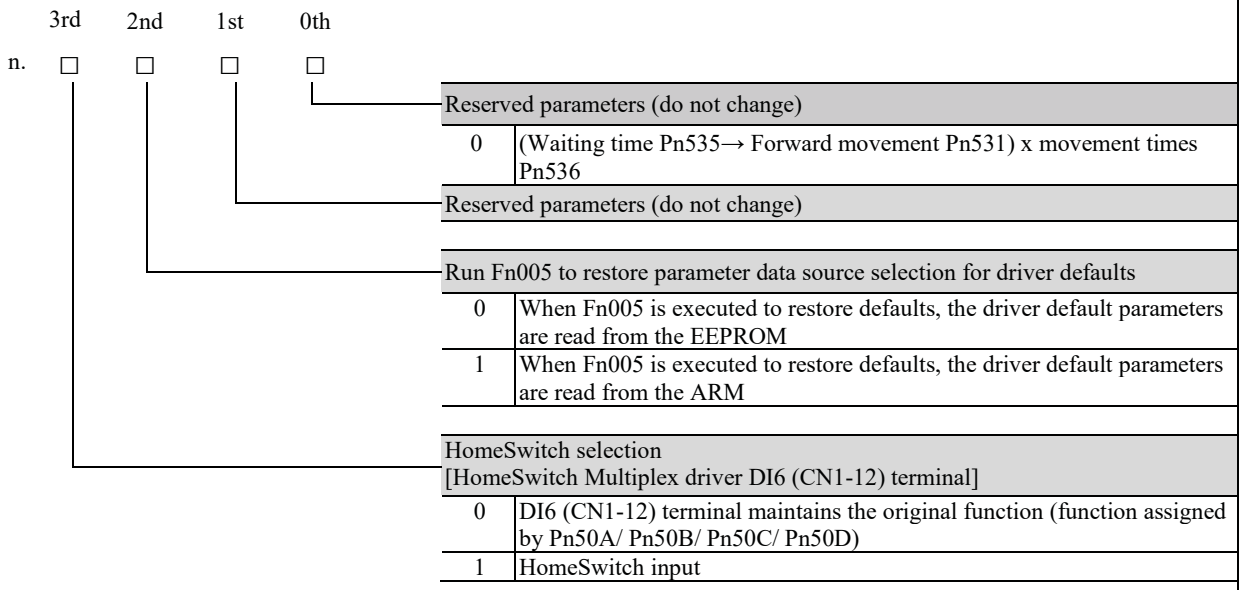
Reserved parameters (do not change)

Reserved parameters (do not change)

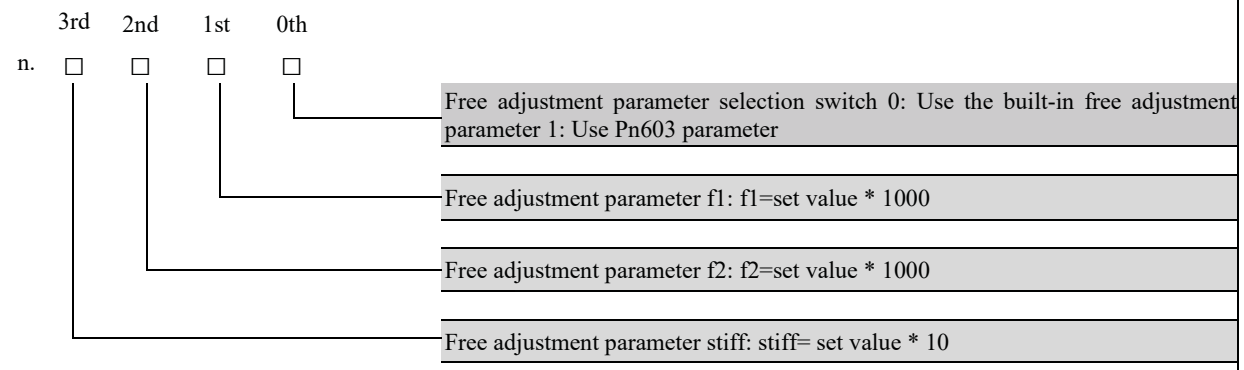
Pn531	4	Program JOG movement distance	1 ～ 1073741824	1 reference unit	32768	With immediate effect
Pn533	2	Program JOG movement speed	1 ～ 10000	1min-1	500	With immediate effect
Pn534	2	Program JOG acceleration and deceleration time	2 ～ 10000	1ms	100	With immediate effect
Pn535	2	Programs JOG waiting time	0 ～ 10000	1ms	100	With immediate effect
Pn536	2	Program JOG movement times	0 ～ 1000	1 time	1	With immediate effect
Pn550	2	Bias voltage of analog monitor 1	-10000 ～ 10000	0.1V	0	With immediate effect
Pn551	2	Bias voltage of analog monitor 2	-10000 ～ 10000	0.1V	0	With immediate effect
Pn552	2	Magnification of analog monitor 1	-10000 ～ 10000	0.01 times	100	With immediate effect
Pn553	2	Magnification of analog monitor 2	-10000 ～ 10000	0.01 times	100	With immediate effect
Pn560	2	Residual vibration detection amplitude	1 ～ 3000	0.1%	400	With immediate effect
Pn561	2	overshooting detection value	0 ～ 100	1%	100	With immediate effect
Pn600	2	Regenerative resistor capacity*1	By model *2	10W	0	With immediate effect
Pn601	2	Reserved parameters (do not change)	-	-	0	-

*1. Generally set to "0". For the external regenerative resistor, set the capacity of the regenerative resistor (W).
*2. The upper limit is the maximum output capacity of the servo drive (W).

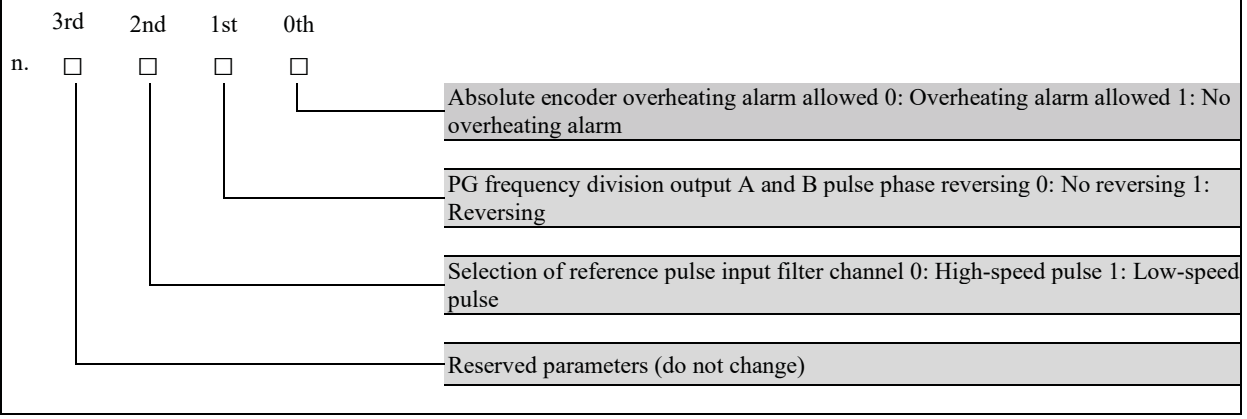
Parameter No.	Size	Name	Setting range	Setting unit	Factory setting	Effective time
Pn602	2	Function selector switch	0000 ～ 1111	-	0000	After power on again



Pn603	2	Free adjustment selection switch	0000 ～ AAA1	-	0000	With immediate effect



Pn604	2	Motor code selection	0 ～ 49	-	0	After power on again
Pn605	2	Function selector switch	0000 ～ 1111	-	0000	After power on again



Parameter No.	Size	Name	Setting range	Setting unit	Factory setting	Effective time
	2	Function selector switch	0000 ～ 1111	-	0000	After power on again
Pn606	n. □ 3rd □ 2nd □ 1st □ 0th Rapid discharge of driver bus bar allowed when powering off 0: Rapid discharge allowed 1: No rapid discharge Reserved parameters (do not change) Reserved parameters (do not change) Reserved parameters (do not change)					
Pn608	2	Predicted torque	-100 ～ 100	1%	0	With immediate effect
Pn609	2	Forward commutation and feedforward compensation torque	0 ～ 100	1%	0	With immediate effect
Pn610	2	Forward commutation and feedforward compensation torque filtering	0 ～ 1000	0.01ms	0	With immediate effect
Pn611	2	Reverse commutation and feedforward compensation torque	0 ～ 100	1%	0	With immediate effect
Pn612	2	Reverse commutation and feedforward compensation torque filtering	0 ～ 1000	0.01ms	0	With immediate effect
Pn613	2	Speed deviation detection threshold	0 ～ 3000	rpm	1000	With immediate effect
Pn614	2	Speed deviation detection time	0 ～ 3000	ms	300	With immediate effect
Pn615	2	Locking torque protection	0 ～ 300	1%	150	With immediate effect
Pn616	2	Locking detection time	0 ～ 3000	ms	300	With immediate effect
n617	2	Locking speed threshold	0 ～ 1000	rpm	50	With immediate effect
Pn61E	4	Zero shift	0 ～ 1073741824	-	0	With immediate effect
Pn630	2	Custom waveform 1	0 ～ 65535	-	0	With immediate effect
Pn631	2	Custom waveform 2	0 ～ 65535	-	0	With immediate effect
Pn700	2	Single-circle digits of serial encoder	0 ～ 100	-	0	After power on again
Pn702	2	Rated power of motor	0 ～ 65535	W	0	After power on again
Pn703	2	Number of motor poles	0 ～ 100	-	0	After power on again
Pn704	2	Rated torque of motor	0 ～ 65535	0.01Nm	0	After power on again
Pn705	2	Maximum torque of motor	0 ～ 65535	1%	300	After power on again
Pn706	2	Peak rated current of the motor	0 ～ 65535	0.1A	0	After power on again
Pn707	2	Maximum current peak of the motor	0 ～ 65535	0.1A	0	After power on again
Pn708	2	Rated motor speed	0 ～ 100	100rpm	0	After power on again

Pn709	2	Maximum motor speed	0 ～ 100	100rpm	0	After power on again
Parameter No.	Size	Name	Setting range	Setting unit	Factory setting	Effective time
Pn70A	2	Motor inertia	0 ～ 65535	0.01*10-4kgm²	0	After power on again
Pn70B	2	Motor phase resistance	0 ～ 65535	0.001Ω	0	After power on again
Pn70C	2	Motor phase inductance	0 ～ 65535	0.01mH	0	After power on again
Pn70D	2	Basic torque	0 ～ 65535	1%	115	After power on again
Pn70E	2	Intermediate torque	0 ～ 65535	1%	200	After power on again
Pn70F	2	Intermediate time	0 ～ 100	10s	1	After power on again
Pn710	2	Intermediate time 2	0 ～ 100	S	3	After power on again
Pn711	2	Intermediate torque 2	0 ～ 65535	1%	300	After power on again
Pn712	2	Rated voltage of motor	0 ～ 1	-	0	After power on again
Pn714	2	Corresponding phase angle of encoder zero	0 ～ 65535	-	0	After power on again
Pn715	2	Motor outlet method	0 ～ 1	-	0	After power on again
Pn716	2	Magnetic marking bit	0 ～ 1	-	0	After power on again
Pn717	2	Motor type configuration	0 ～ 65535	-	0	After power on again
Pn718	2	Opposite potential coefficient of motor	0 ～ 65535	0.1V/1000rpm	0	After power on again
Pn719	2	Motor encoder type	0 ～ 1	-	0	After power on again
	This parameter is used for the encoder type information read only from the motor. 0: absolute encoder 1: Incremental encoder					
PnE05	2	Fault shielding 1	0 ～ 65535	-	0	After power on again
	The shielding positions are as follows: Bit0: A.050 Bit1: A.320 Bit2 ： A.410 Bit3: A.510 Bit4: A.710 Bit5: A.720 Bit6 ： A.730 Bit7: A.740 Bit8: A.C10 Bit9: A.D00 Bit10 ： A.F10 Bit11: A.D10 Bit12: A.B31 Bit13: A.B32 Bit14 ： A.BF2 Bit15: A.B11					
PnE06	2	Fault shielding 2	0 ～ 65535	-	0	After power on again
	The shielding positions are as follows: Bit0: A.051 Bit1: A.B10 Bit2： A.D30 Bit3: A.7AB Bit4: A.810 Bit5: A.820 Bit6： A.7A0 Bit7: A.514					

Data number