DORNA™

AC SERVO SYSTEM

DS2P SERIES USER MANUAL

(V1.04)

http://www.dorna.com.cn/

Safety Notice

This section will introduce the main instructions that users shall follow during the receiving, storage, handling, installation, wiring, operation, inspection and disposal of the products.

DANGER

- **Input power。**
  Input power of the servo drive is 220VAC (- 15%~+10%) or 380VAC (- 15%~+15%).
- **When installed to a machine, the servo motor shall be able to do emergency stop at any moment.**
  Otherwise, there may be personnel injuries and mechanical failure.
- **When the power is on, the power supply terminals must be properly housed.**
  Otherwise, there may be electric shocks.
- **After power off or voltage withstand test, when the charge indication light (CHARGE) is on, do not touch the power supply terminals.**
  Otherwise, there may be electric shocks caused by residual voltage.
- **Please do trial run (JOG) following the procedures and instructions of this user manual.**
  Otherwise, there may be personnel injuries and mechanical failure.
- **Do not make any alterations to this product. Only qualified/designated persons can configure, dismantle or repair this product.**
  Otherwise, there may be personnel injuries, mechanical failure or fire.
- **Please install stop mechanisms on the machine side to ensure safety.**
  The holding brake of the servo motor is not a device designed to ensure safety. Otherwise, there may be injuries.
- **Please ensure to connect the earth terminal of servo drive with the earth electrode (the earth resistance of servo drive for power input is below 100Ω).**
  Otherwise, there may be electric shocks or fire.

ATTENTION: INSTALLATIONS

- **Please do not block the air inlet and outlet and prevent alien matters entering the product.**
  Otherwise, the inner components may be aged and cause failure or fire.
- **Please install at correct directions.**
  Otherwise, there may be failure.
- **During installation, please ensure there is enough space between the servo drive and internal surface of control cabinet and other electrical parts.**
  Otherwise, there may be fire or machine breakdown.
- **Please do not impose too big impacts.**
  Otherwise, there may be machine breakdown.

ATTENTION: WIRING

- **Please connect wires correctly and reliably.**

  Otherwise, there may be out-of-control of motor, personnel injuries or machine fault.

- **Please DO NOT connect commercial power supply to the UVW terminals of the servo drive.**

  Otherwise, there may be personnel injuries or fire.

- **Please connect the UVW terminals with the servo motor firmly.**

  Otherwise, there may be a fire.

- **Please do not house the main circuit cables, input-output signal cables and encoder cables with the same bushing, or tie them together. During wiring, the main circuit cables shall be at least 30cm from the input-output signal cable.**

- **Cables for input-output signal and encoder shall be twin strands or multiple- core twinning bulk shielding strands.**

- **Maximum length of input-output signal cable:3m; Maximum length of encoder cable:30m.**

- **Even when the power is turned off, there may still be residual high voltage inside the servo drive, so when the charge indication light (CHARGE) is on, do not touch the power terminals.**

  Please connect or check wirings after the charge indication light (CHARGE) is off.

- **Please install circuit breakers to prevent external short-circuit.**

  Otherwise, there may be a fire.

- **When used in the following places, please take appropriate measures for shielding:**
  - When there may be interference of static electricity
  - The place with strong electric field or high intensity field
  - The place where there may be radioactive rays

  Otherwise, there may be machinery breakdown.

- **When connecting to batteries, pay attention to the polarity.**

  Otherwise, it may lead to the damage and explosion of batteries, servo drive and servo motor.

ATTENTION: OPERATIONS

- **In order to prevent accidents, please conduct trial run (JOG)**
  before connecting to mechanical parts. Otherwise, there may be injuries.
- **Before running, please set the appropriate parameters.**
  Otherwise, the machine may be out of control or have failure.
- **Please do not turn on/off the power supply frequently.**
  Because the power section of servo drive has capacitors, when the power is on, heavy charging current may flow through them. Therefore, if the power is frequently turned on/off, perseverance of the main circuit components inside the servo drive may decline.
- **During JOG operation (AF 02) or advanced gain tuning(AF 201) , please note that the emergency stop will become ineffective at over-travel.**
  Otherwise, there may be machinery breakdown.
- **When the servo motor is used on the vertical axis, please set a safety device, in case workpiece drops when there is alarm or over-travel. Besides, please set up zero-position fixation when there is over-travel.**
  Otherwise, the workpiece may drop when there is over-travel.
- **Extreme or alternative parameter settings may cause the servo system to be instable.**
  Otherwise, there may be personnel injuries and machinery breakdown.
- **When there are alarms, please reset the alarm after finding out the causes and ensure operation safety, and then start operation again.**
  Otherwise, there may be machinery breakdown, fire or personnel injuries.
- **The holding brake (optional) of the servo motor is designed for maintaining positions, NOT for servo motor braking at deceleration.**
  Otherwise, there may be machine fault.
- **The servo motor and servo drive shall be used in combinations as specified.**
  Otherwise, there may be fire or machine breakdown.

ATTENTION: MAINTENANCE

- **Please do not change the wiring when the power is on.**
  Otherwise, there may be electric shocks or personnel injuries.
- **When replacing the servo drive, please copy parameters to the new servo drive, and then start operation again.**
  Otherwise, there may be machinery breakdown.

ATTENTION: OTHERS

- In order to give explicit explanations, housing or safety protection devices are omitted in some drawings in this user manual. During real operations, please make sure to install the housing or safety protection devices according to the instructions of the user manual.
- Illustrations in this manual are representative graphic symbols, which may be different from the products that you receive.
- During the commissioning and use of servo drive, please install the relevant safety protection devices. Our company will not bear any liability for the special losses, indirect losses and other relevant losses caused by our products.
- This manual is general descriptions or characteristic which may not always be the case in practical use, or may not be completely applicable when the products are further improved.

Contents

Chapter 1 Product Introduction

1.1 Product Inspections

Please check the items listed in the table below carefully, in case there is negligence during the purchase and transportation of the product.

Items to inspect	Reference
Whether the product received is the right one you intend to buy?	Check the product model on the motor and drive nameplate respectively. Please refer to the notes to model in following sections.
Whether the motor shaft runs smoothly?	Rotate the rotor shaft of the motor. If it can rotate smoothly, the rotor shaft is normal. Note that the motor with electro-magnetic brake (holding brake) cannot be rotated with hands!
Check whether there are any appearance damages?	Check visually whether there are any appearance damages.
Whether there are loosened screws?	Check whether the mounting screws of servo drive is loosened with a screw drive.

Please contact your vendor if anything above occurs.

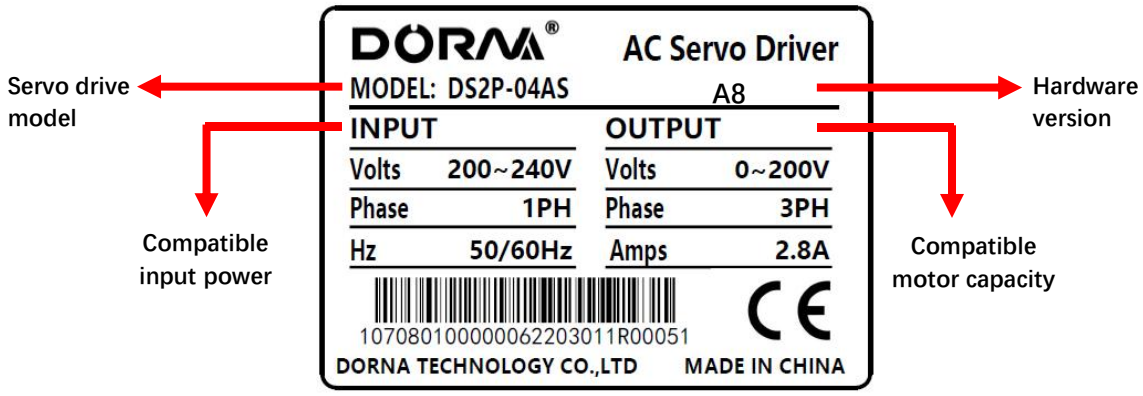
A complete set of servo components shall include the following:

No.	Reference
1	Servo drive and its matching servo motor.
2	CN1: 50-Pin connectors (standard) or complete cable (optional)
3	CN2: 6-Pin connectors (standard) or complete cable (optional)
4	CN4/CN5: RJ45 connector for EtherCAT or RS485 communication (optional)
5	11-Pin quick plug: L1、L2、L3、P、D、C、N、U、V、W 、PE
6	One plastic stick
7	One copy of user manual

1.2 Product Model Identifications

1.2.1 Description of nameplate

■ Description of the nameplates of DS2P series servo drives



1.2.2 Model identifications

■ DS2P series servo drive model description

DS2 P– 08 A S – □ – □□□□

Servo drive name: DS2 【1】 【2】 【3】 【4】 【5】 【6】

Table 1-3

【1】Servo drive series

Mark	Specifications
P	Pulse type

【2】Power

Mark	Specifications
04	400W
08	750W
10	1.0KW
15	1.5KW

【3】Rated input voltage

Mark	Specifications
A	**220V**

【4】Encoder interface

Mark	Specifications
S	**Serial encoder interface**

【5】Non-standard

Mark	Specifications
none	**General specifications**

【6】Factory code

Mark	Specifications
none	**Standard**

Description of the models of DM servo motors

DM1/2 M – 04 A 60 I 8 S -*

Name of servo motors :DM1/2 【1】 【2】 【3】 【4】 【5】 【6】 【7】 【8】

Table 1-4

【1】Type of inertia

Mark	Specifications
U	Ultra-small inertia
S	Small inertia
M	Medium inertia
H	Large inertia
G	Super large inertia

【2】Motor power

Mark	Specifications
01	100W
02	200W
04	400W
08	750W
09	900W
10	1.0KW
13	1.3KW
15	1.5KW
18	1.8KW
20	2.0KW

【3】Input voltage

Mark	Specifications
A	220V

【4】Machine base number

Mark	Specifications
40	40-port machine base
60	60-port base
80	80-port machine base
100	100-port machine base
110	110-port machine base
130	130-port seat

【5】Encoder type

Mark	Specifications
I	17-bit single-turn absolute value
J	17-Bit multi-turn absolute
M	23-bit single-turn absolute value
L	23-Bit multi-turn absolute

【7】Options

Mark	Specifications
N	No option
B	With brake
S	With oil seal
E	With oil seal, brake

【6】Shaft end

Mark	Specifications
0	Flange output
1	Internal tapered shaft without key
2	Internal tapered shaft with key
3	External tapered shaft without key
4	External tapered shaft with key
5	Inner spline shaft
6	External spline shaft
7	Straight shaft without key
8	Straight shaft with key and hole

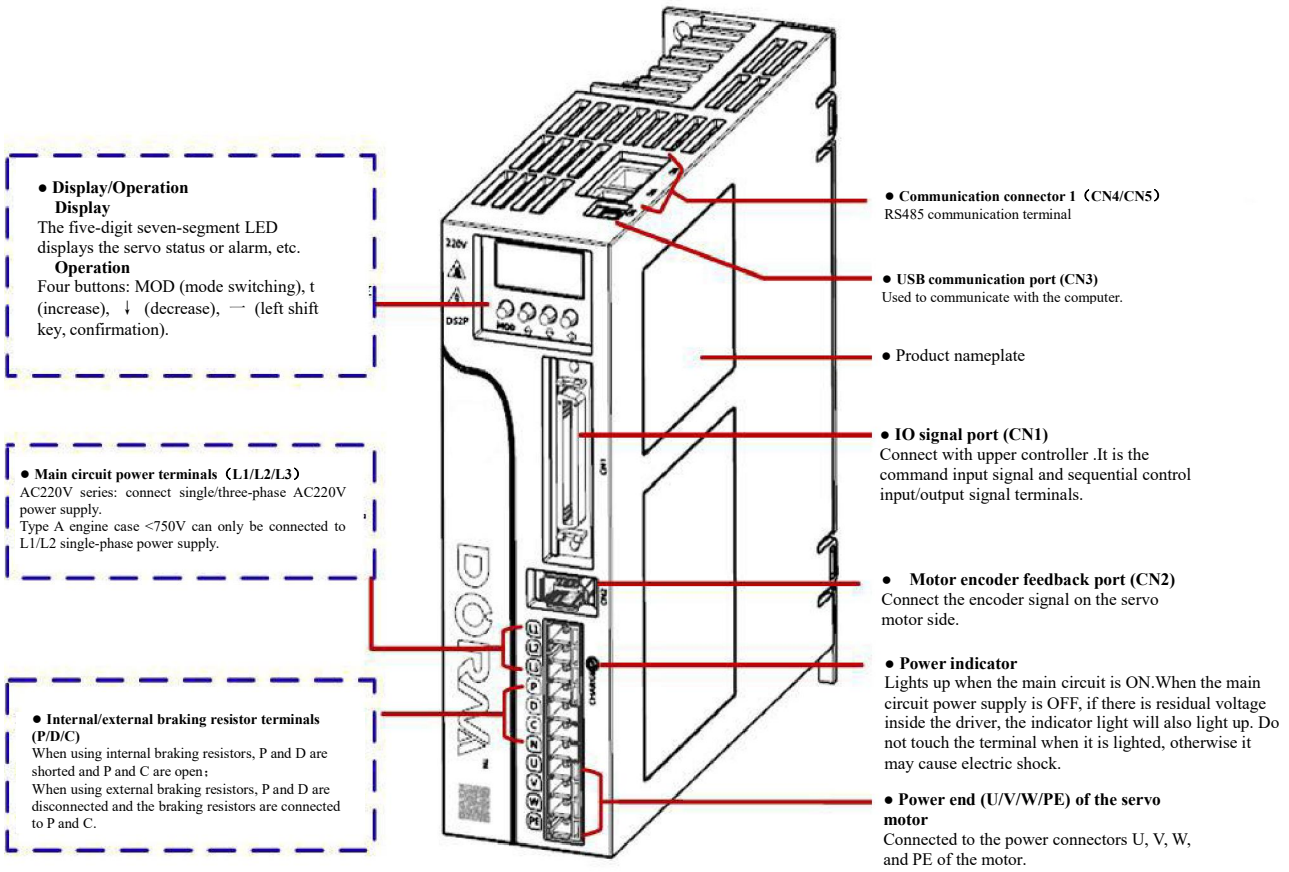
【8】Special specifications

Mark	Specifications
None	Standard
-C	Small capacity IP67 connector type
-**	Customized type

Note:

1、 Drive and motor models may be updated. Please refer to the catalog or consult our company for the corresponding models.

1.3 Servo Drive Part Names



Note

- Model ≤ 750W is powered by L1 and L2 single-phase power supply.
- **Please note that the power off time is longer for models without braking resistor; the power off time will become longer after repeated power up and down for models with resistor.**
- Please note the input power specifications of the drive; 220V series drive input 380V power will cause damage to the drive.
- When using internal braking resistors, P and D are shorted. When using external braking resistors, P and D are disconnected and the braking resistors are connected to P and C.

1.4 Maintenance and Inspections

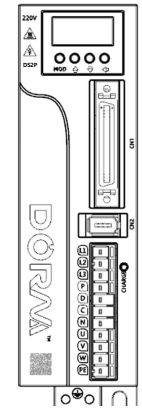
Please make regular maintenance and inspection of the drive and motor for safe and easy use. Routine and periodical inspections shall be carried out according to the following items

Type	Period	Items
Routine inspections	Daily	Whether there are dirt and or substances. Whether there is abnormal vibration and sound Whether the input supply voltage is normal Whether there is abnormal smell Whether there are fiber stubs stuck to the ventilation opening Whether the front end of drive and the connector are clean Whether there the connection with control device and equipment motor is loose and whether the core feet deviates Whether there are foreign matters in the load part
Periodical inspections	Yearly	Whether the fastening parts are loose Whether it is superheated Whether the terminal is damaged or loose

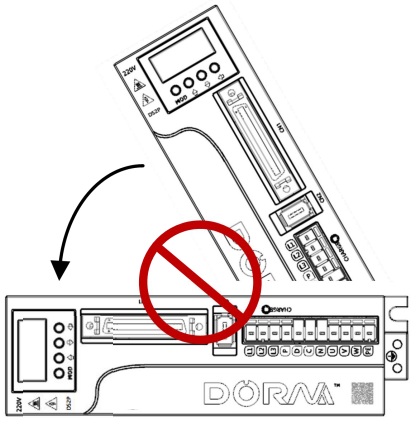
Chapter 2 Installations

2.1 Installation Direction and Space

The installation direction must be in accordance with the regulations, otherwise it will cause malfunctions. In order to make a good cooling effect, the upper and lower, left and right with the adjacent items and baffle (wall) must have enough space, otherwise it will cause malfunctions. The AC servo drive's suction, exhaust hole cannot be sealed, nor placed upside down, otherwise it will cause malfunctions.

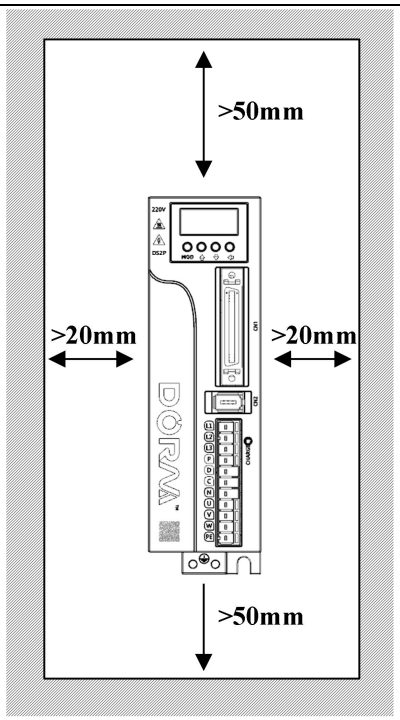


Right



Wrong

In order to lower the wind resistance to the radiator fan and let heat discharge effectively, users shall follow the recommended installation spacing distance of one or several AC servo drives (see the figure below) .



2.2 Recommended Specifications of Circuit-breaker and Fuse

■ 220V class

Servo drive case type	Circuit-breaker	Fuse (class T)
A	20A	40A
B	30A	80A

Note:

1. Strongly recommended: the fuse and circuit-breaker must comply with UL/CSA standards.
2. When an earth leakage circuit breaker (ELCB) is added for leakage protections, please choose ELCB with sensitivity current over 200mA and action time over 0. 1s.

2.3 Countering Noise Interference and Higher Harmonics

The main circuit of servo drive uses a high-speed switching device, so the peripheral wiring and earthing of servo drive may be affected by the noise of the switching device.

In order to prevent noise, the following measures can be taken:

- Please install EMI filter on the main power supply side;
- Connection of AC/DC reactor for suppression of higher harmonic;

- Please install the command input equipment (such as PLC) and EMI filter as close as possible to the servo drive;
- The power cable (cable for power supply from servo drive to servo motor) shall be over 30cm from the input-output signal cable. Do not house them in the same bushing or tie them together.
- Do not use the same power supply with a welding machine or electro spark machine. When there is a high frequency generating device nearby, an EMI filter shall be connected to the input side of the main circuit cable.
- Ensure the earthing is appropriate.

2.3.1 Installation of EMI filter

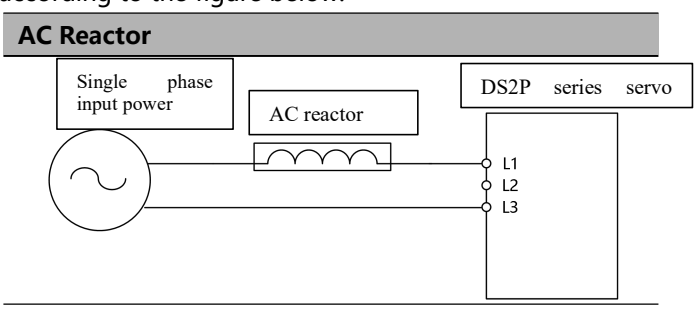
In order to ensure that the EMI filter (EMI Filter) can play a maximum effect to suppress the servo drive interference, in addition to the servo drive need to be able to follow the contents of the manual installation and wiring, but also need to pay attention to the following points.

Item	Reference
1	Servo drives and EMI filters must be installed on the same metal surface.
2	The wiring has to be as short as possible.
3	The metal surface shall be well grounded.
4	The metal housing or earthing of both servo drive and EMI filter shall be reliably fixed to the metal surface, with the contact area as big as possible.
5	Use shielded copper wire for the motor power cable (better if there is a double shielding layer)
6	The shielded copper mesh at both ends of the motor wire should be grounded with the shortest distance and maximum contact area.

2.3.2 Connection of AC/DC reactor for suppression of higher harmonic

An AC/DC reactor can be connected to the servo drive for suppression of higher harmonic.

Please connect the reactor according to the figure below:



2.4 Selection of Regenerative Resistors

When the motor is outputting torque opposite to the rotating direction, energy is regenerated from the load to the drive. DC bus voltage will rise and at a certain level, the regenerated energy can only be consumed by the regenerative resistor. The drive contains an internal regenerative resistor, and users can also connect an external regenerative resistor.

The table below shows the specifications of regenerative resistor contained in DS2 series servo drives.

Servo drive case type	Internal regenerative resistor specs		Minimum allowable resistance value (Ohm)
	Resistance (Ohm)	Capacity (Watt)	
A（<=400W）	--	--	40
A(750W)	40	50	40
B(1/1.5/2KW)	40	55	33

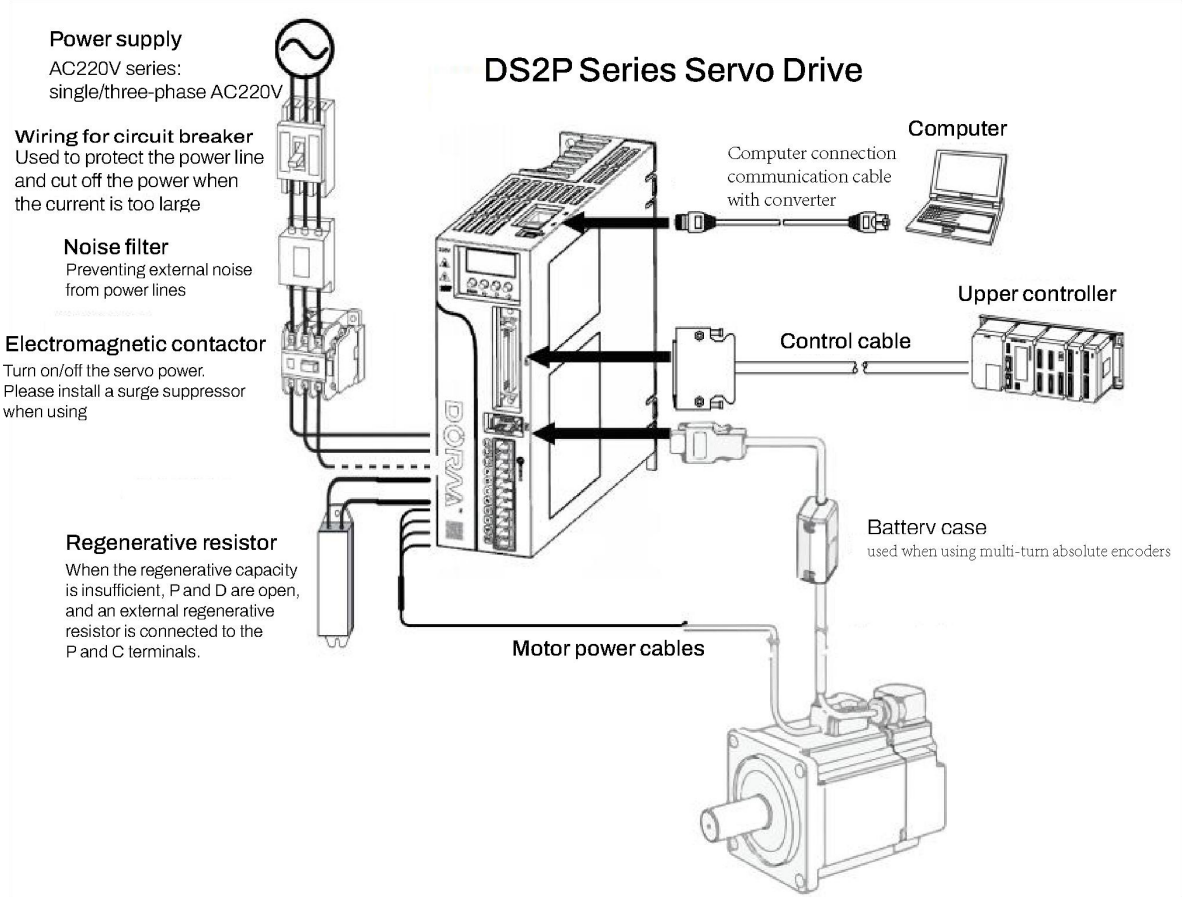
When the regenerative capacity exceeds the disposable capacity of the internal regenerative resistor, an external regenerative resistor shall be connected. Please note:

Item	Reference
1	Please set the external resistor value and capacity correctly
2	The external resistance value shall not be smaller than the minimum allowable resistance value. If parallel connection is to be used to increase the power, please confirm whether the resistance value satisfies the limiting conditions.
3	In natural environment, when the disposable regenerated capacity (mean value) of regenerative resistor is used within the limit of nominal capacity, the temperature of resistor will rise to be above 120˚C (under continual regeneration). In order to ensure safety, it is suggested to use a regenerative resistor with a thermo-switch
4	When external regenerative resistor is used, the resistor shall be connected to P, C end, and P, D end shall be open. External regenerative resistor shall follow the resistance value suggested in the table above.

Chapter 3 Wirings

3.1 System Structure and Wiring

3.1.1 Servo system structure



3.1.2 Servo drive connectors & terminals

Markings	Descriptions	Reference
L1，L2，L3	**Main circuit input**	Connect to 1/3 PH AC power supply. (Please choose correctly)

	power terminals	
P，D，C	**Regenerative resistor terminals**	Internal regenerative resistor: make PD short circuit, PC open. External regenerative resistor: connect PC to external resistor, PD open.
N	**DC bus negative terminal**	DC bus positive terminal is P. P & N terminals can be used for common DC bus scheme.
U，V，W，PE	**Servo motor power supply terminals**	Connect with the servo motor
CN1	**I/O connector**	Connect with upper controller
CN2	**Encoder connector**	Connect with the motor encoder
CN3	**Communication connector 1**	For PC communication.
CN4	**Communication connector 2**	DS2P: Modbus communication connector (optional)
CN5		

3.1.3 Main circuit wirings

1) Cable diameter requirement

Marking	**Name**	**Cable diameter: mm2(AWG)**				
		DS2P-				
		02A	**04A**	**08A**	**10A**	**15A**
Main circuit input power terminals	L1、L2、L3	0.8(AWG-18)		2.0(AWG-14)	2.6(AWG-13)	3.3(AWG-12)
Servo motor power supply terminals	U、V、W、PE	0.8(AWG-18)		2.0(AWG-14)	2.6(AWG-13)	3.3(AWG-12)
Regenerative resistor terminals	P，D，C	0.8(AWG-18)		2.0(AWG-14)	2.6(AWG-13)	3.3(AWG-12)
Earth wire	⏚	Above 2.0 (AWG- 14)				

2) Typical main circuit wiring example

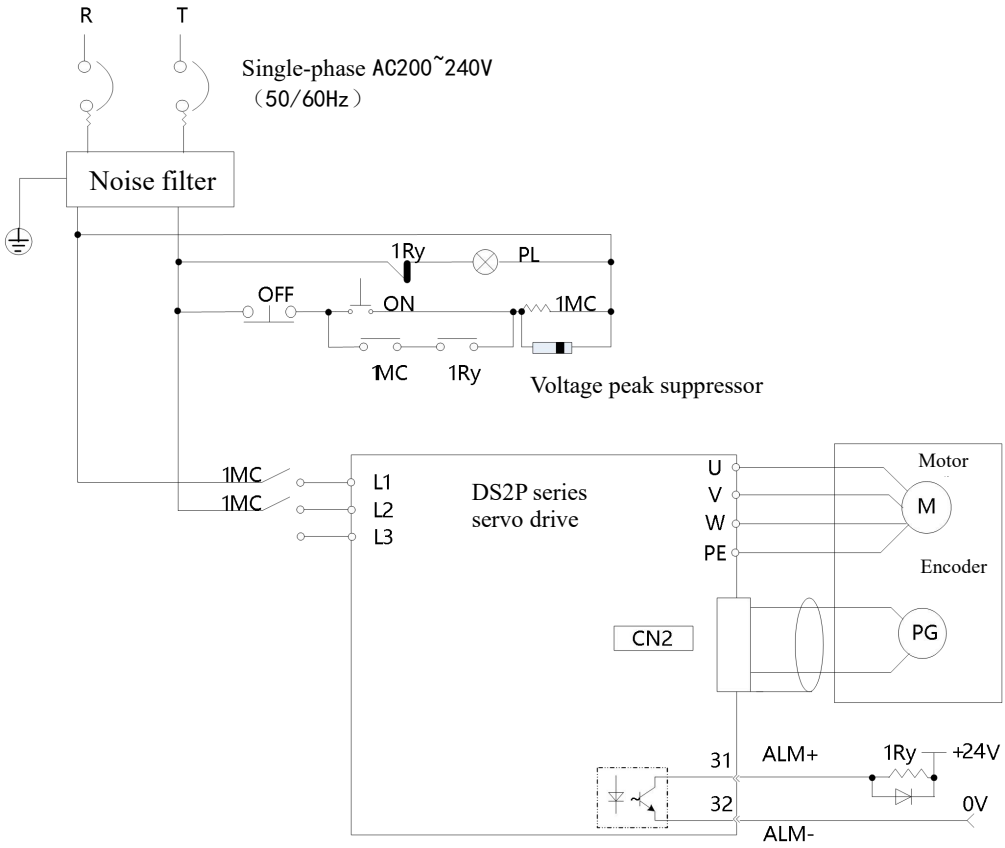
Note:

Consider the following points when designing the power-on sequential control.

Design the power-on sequential control as follows: After the "servo alarm" signal is output, turn the main circuit power OFF.

Please note that the power off time is longer for models without braking resistor.

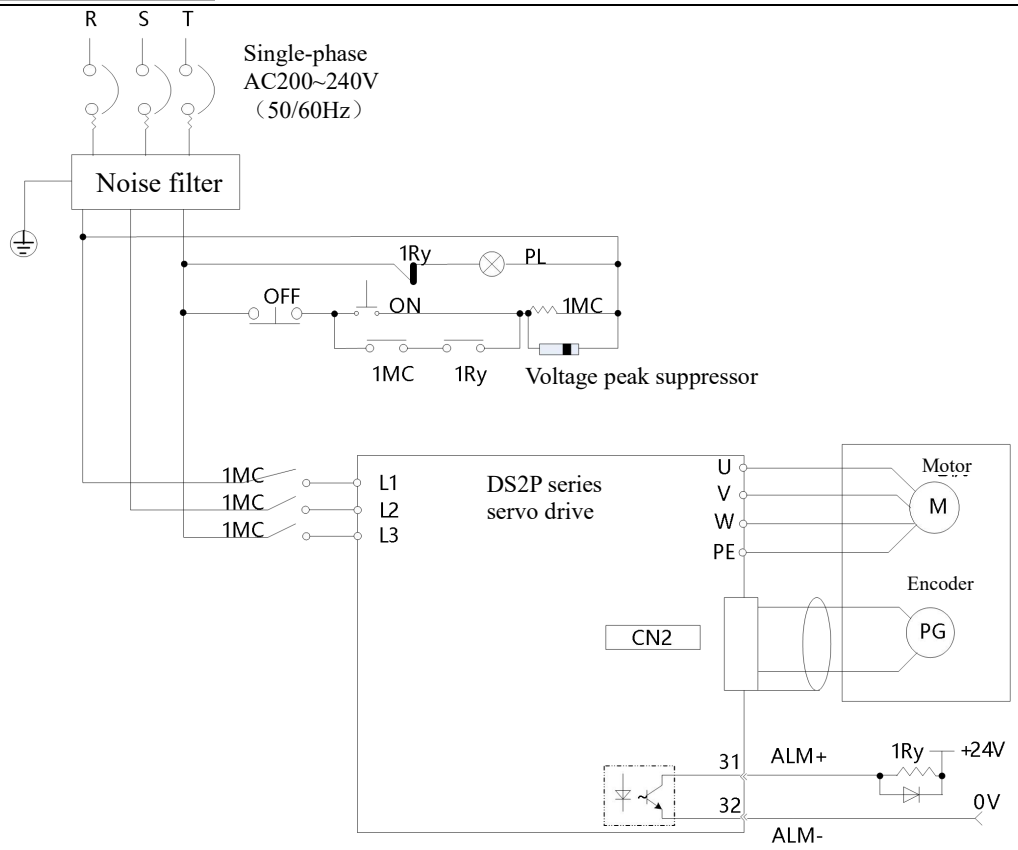
■ **Single-phase AC220V power input**



Note:

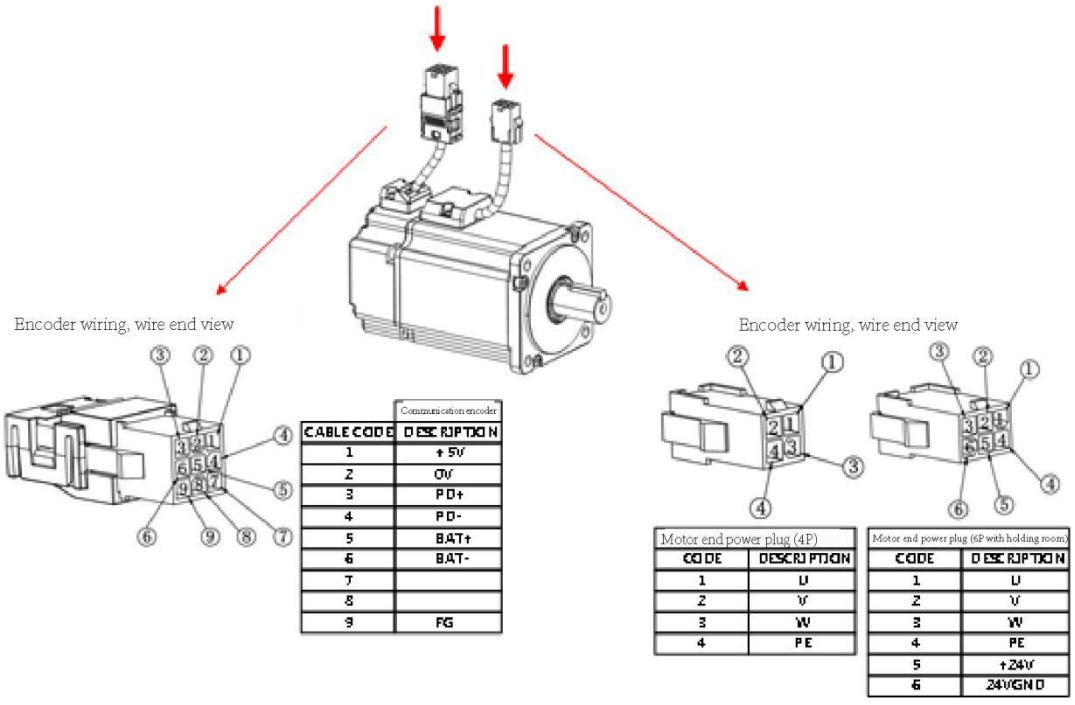
1、 For ≦750W model, single-phase power input only.

■ **Three-phase AC220V power input**



3.2 Wirings Between Servo Drive & Servo Motor

3.2.1 Configurations & definitions of quick plug terminals



Communication encoder

CABLE CODE	DESCRIPTION
1	+5V
2	0V
3	PD+
4	PD-
5	BAT+
6	BAT-
7	
8	
9	FG

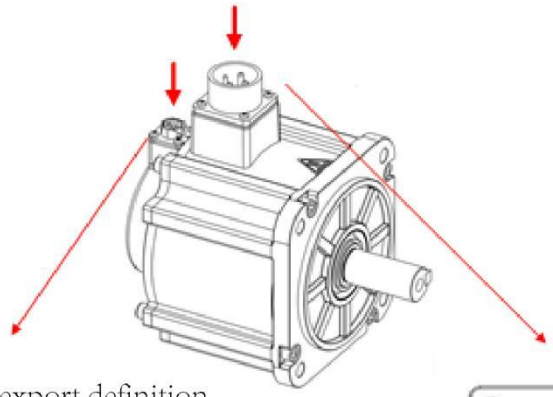
Motor end power plug (4P)

CODE	DESCRIPTION
1	U
2	V
3	W
4	PE

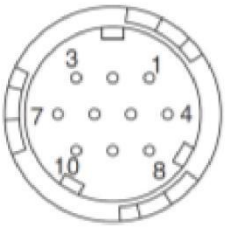
Motor end power plug (6P with holding room)

CODE	DESCRIPTION
1	U
2	V
3	W
4	PE
5	+24V
6	24VGND

3.2.2 Configurations and definitions of aviation plug terminals(general aviation plug)

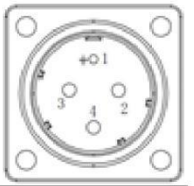


Encoder export definition

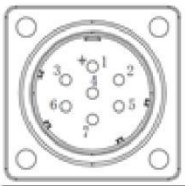


Communication encoder	
CABLECODE	DESCRIPTION
1	PD+
2	PD-
3	
4	+5V
5	BAT-
6	BAT+
7	
8	
9	0V
10	RS

Power outlet definition

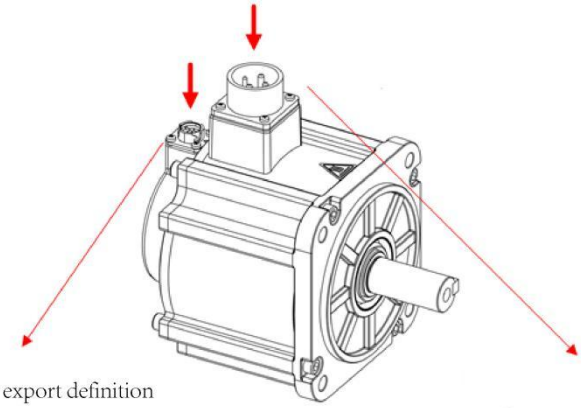


Motor end power plug (4P)	
CODE	DESCRIPTION
1	PE
2	V
3	U
4	W

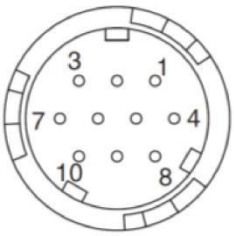


Motor end power plug (7P with holding room)	
CODE	DESCRIPTION
1	PE
2	V
3	U
4	W
5	+24V
6	24VGND
7	

3.2.3 Configurations and definitions of aviation plug terminals(military aviation plug)



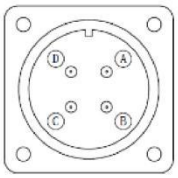
Encoder export definition



Communication encoder

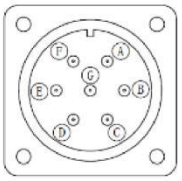
CABLE CODE	DESCRIPTION
1	PD+
2	PD-
3	
4	+5V
5	BAT-
6	BAT+
7	
8	
9	0V
10	FG

Power outlet definition



Motor end power plug (4P)

CODE	DESCRIPTION
A	U
B	V
C	W
D	PE



Motor end power plug (7P with holding room)

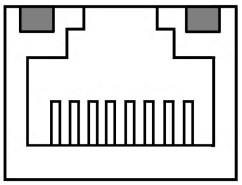
CODE	DESCRIPTION
A	U
B	V
C	W
D	PE
E	+24V
F	24VGND
G	

3.3 Wirings of CN4/CN5 (Communication Connector)

Connector CN4 and CN5 are communication plugs, and DS2P servo drive is used as RS485 communication. Where CN4 is RS485 IN and CN5 is RS485 OUT.

3.3.1 Arrangement of terminals

(一) Terminal appearance

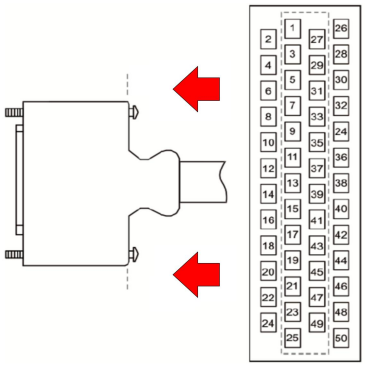


(二) Signal definitions

DS2P		
Pin	**Name**	**Function**
1	RS485+	RS485 positive
2	RS485-	RS485 negative
3	GND	Digital ground
4	NC	Leave open
5	NC	Leave open
6	GND	Digital ground
7	NC	Leave open
8	NC	Leave open
Housing	FG	Shielded cable
Note: NC is not used; do not wire.		

3.4 Wiring of Connector CN1

3.4.1 Pin arrangement of CN1 connector(DS2P type)



2	SG	GND	1	SG	GND	27	DO3+	Digital output 3 (+)	26	DO4 -	Digital output 4 (-)
4			3	PL	Open-collector command Power input	29	DO2+	Digital output 2 (+)	28	DO3 -	Digital output 3 (-)
6			5			31	DO1+	ALM(+)	30	DO2 -	Digital output 2 (-)
8	/PULS	Command pulse input(-)	7	PULS	Command pulse input(+)	33	PAO	Encoder frequency division pulse Output phase A (+)	32	DO1 -	ALM(-)
10			9			35	PBO	Encoder frequency division pulse Output phase B (+)	34	/PAO	Encoder frequency division pulse Output phase A (-)
12	/SIGN	Command sign input(-)	11	SIGN	Command sign input(+)	37			36	/PBO	Encoder frequency division pulse Output phase B (-)
14			13			39			38		
16			15			41	DI2	Digital input 2	40	DI1	Digital input 1
18			17			43	DI4	Digital input 4	42	DI3	Digital input 3
20	/PZO	Encoder frequency division pulse Output phase Z (-)	19	PZO	Encoder frequency division pulse Output phase Z (+)	45	DI6	Digital input 6	44	DI5	Digital input 5
22			21			47	COM+	external 24V power input	46		
24			23			49	+24V	Internal 24V power output	48		
			25	DO4+	Digital output 4 (+)				50	24V GND	Internal 24V power Grounded

(Note)

1) Do not use vacant terminals.
2) Connect the shielding of control line (I/O cable) to the connector housing to achieve FG.
3) All input and output pins can be parameterized to assign signals.
4) The maximum output current of the internal 24V power supply is 200mA. If internal 24V is used, internal 5V will lose power very quickly.

3.4.2 CN1 signal descriptions

■ Name and function of input signals (with default pin allocations)

Control mode	Signal	Pin no.	Function	
Universal	DI1：S-ON	40	Servo ON: The motor is powered on.	
	DI2：C-MOD	41	Control mode switch: Switch between two control modes.	
	DI3：POT DI4：NOT	42 43	Forward rotation prohibited Reverse rotation prohibited	Overtravel prohibited: Stop operation of servo motor when it is on.
	DI5：CLR	44	Clear position deviation pulses counter during position control.	
	DI6：A-RST	45	Reset alarms: Release the servo alarm status.	
	COM+	47	External 24VDC for I/O signals	
Position	PULS	7	Low-speed channel pulse input * Sign+pulse train * CCW+CW Pulse train * A + B Pulse train	
	/PULS	8		
	SIGN	11		
	/SIGN	12		
	PL	3	Open collector pulse signal terminal	

■ Name and function of output signals (with default pin allocations)

Control mode	Signal	Pin no.	Function	
Universal	+24V	49	Internal 24V power supply, can provide for DI and DO signals, can withstand 200mA current	
	24VGND	50	Internal 24V power supply ground	
	PAO	33	phase A signal	Two-phase pulse (phase A and phase B) encoder frequency dividing signal output
	/PAO	34		
	PBO	35	phase B signal	
	/PBO	36		
	PZO	19	phase Z signal	Home (phase Z) signal output
	/PZO	20		
	DO1：ALM+	31	Servo alarm: OFF when abnormal state is detected.	
	ALM-	32		

	DO2：COIN+	29	Positioning completed: Under position control mode, when deviation pulse is smaller than PA522, the signal is active.
	COIN -	30	
	DO3：CZ+	27	Optocoupler phase Z pulse output
	CZ-	28	
	DO4：BK+	25	External brake signal output
	BK -	26	

3.4.3 Allocation of I/O signals

(—) Allocation of input signals

The input signal can be used according to the factory settings or allocated as required.

(1) When used in accordance with the factory settings

■ The input signal allocation status at the factory can be confirmed by PA500~PA505.

PA	Description	Range	Unit	Default	Effective
PA500	**n.××□□: input signal selection** [00] Servo-on (S-ON) [01] Control mode switch (C-MODE) [02] Forward rotation prohibited (POT) [03] Reverse rotation prohibited (NOT) [04] Deviation counter clearance (CLR) [05] Alarm reset (A-RST) [06] Pulse input inhibited (INHIBIT) [07] Reserved [08] Forward torque limitation (PCL) [09] Reverse torque limitation (NCL) [0A] Gain switch (GAIN) [0B] Reserved [0C] Command negated [0E] Reserved [0F] Internal speed register 0 (INSPD0) [10] Internal speed register 1 (INSPD1) [13] Internal torque register 0 (INTor0) [14] Internal torque register 1 (INTor1) [15] Zero signal (HomeSwitch) [16] Back to zero start (HomeStart) [17] Back to zero stop signal (QStop) [1C] Internal position selection 3 (INPos3) [1D] Internal position selection 2 (INPos2) [1E] Internal position selection 1 (INPos1) [1F] Internal position selection 0 (INPos0) [20] Internal position trigger signal (Ptrg) [21] Internal position stop signal (PZero)	n.0000～n.211F	～	n.0000	Immediate

	[23] Second gear ratio switching **n. ×□××: DI 1 signal negation** [0] Not negate [1] Negate **n.□×××: DI 1 signal status** [0] Controlled by external I/O [1] Normally active [2] Normally inactive				
PA501	DI2 input signal selection (CN1-41)	n.0000～n.211F	～	n.0001	Immediate
PA502	DI3 input signal selection (CN1-42)	n.0000～n.211F	～	n.2002	Immediate
PA503	DI4 input signal selection (CN1-43)	n.0000～n.211F	～	n.2003	Immediate
PA504	DI5 input signal selection (CN1-44)	n.0000～n.211F	～	n.0004	Immediate
PA505	DI6 input signal selection (CN1-45)	n.0000～n.211F	～	n.0005	Immediate

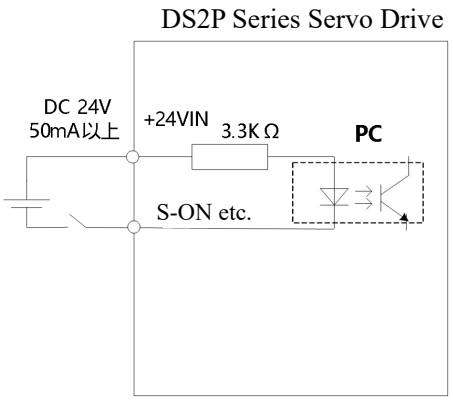
■ Default signals and corresponding pins of DI1～DI6:

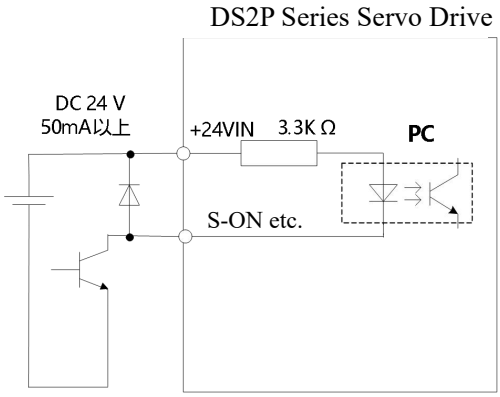
PA	Terminal name	CN1 pin	Default signal
PA500	DI1	40	S-ON
PA501	DI2	41	C-MOD
PA502	DI3	42	POT
PA503	DI4	43	NOT
PA504	DI5	44	CLR
PA505	DI6	45	A-RST

(2) Change level selection of input signals

When signals like S-ON, POT, NOT are used through "polarity inversion" , if there are abnormal states like breakage of signal line, it will cause movement deviating from the safety direction. If such setting has to be adopted, please confirm the action and ensure there are no safety problems.

The typical circuit of input signal is as follows:





Take the above figure as an example. When the optocoupler is conductive, S-ON signal is L level; when the optocoupler is not conductive, S-ON signal is H level. Parameter PA500.2 decides the active level of S-ON. When PA500.0=2, S-ON signal is L level active; when PA500.2=1, S-ON signal is H level active.

The following is an example of the PA500 parameters:

CN1 pin	Description	Signal selection parameters	Signal name	Negate parameter	Signal state
40	DI1	PA500.01=00	Servo-on	PA500.2=0	Signal L is valid
				PA500.2=1	Signal H is valid
		PA500.01=01	Control mode switch (C-MODE)	PA500.2=0	Signal L is valid
				PA500.2=1	Signal H is valid
		PA500.01=02	Forward rotation prohibited (POT)	PA500.2=0	Signal L is valid
				PA500.2=1	Signal H is valid
		PA500.01=03	Reverse rotation prohibited (NOT)	PA500.2=0	Signal L is valid
				PA500.2=1	Signal H is valid
		PA500.01=04	Deviation counter clearance (CLR)	PA500.2=0	Signal L is valid
				PA500.2=1	Signal H is valid
		PA500.01=05	Alarm reset (A-RST)	PA500.2=0	Signal L is valid
				PA500.2=1	Signal H is valid
		PA500.01=06	Pulse input inhibited (INHIBIT)	PA500.2=0	Signal L is valid
				PA500.2=1	Signal H is valid
		PA500.01=07	Reserved	PA500.2=0	Signal L is

					valid
				PA500.2=1	Signal H is valid
		PA500.01=08	Forward torque limitation (PCL)	PA500.2=0	Signal L is valid
				PA500.2=1	Signal H is valid
		PA500.01=09	Reverse torque limitation (NCL)	PA500.2=0	Signal L is valid
				PA500.2=1	Signal H is valid
		PA500.01=0A	Gain switch (GAIN)	PA500.2=0	Signal L is valid
				PA500.2=1	Signal H is valid
		PA500.01=0B	Reserved	PA500.2=0	Signal L is valid
				PA500.2=1	Signal H is valid
		PA500.01=0C	Reserved	PA500.2=0	Signal L is valid
				PA500.2=1	Signal H is valid
		PA500.01=0E	Reserved	PA500.2=0	Signal L is valid
				PA500.2=1	Signal H is valid
		PA500.01=0F	Internal speed register 0 (INSPD0)	PA500.2=0	Signal L is valid
				PA500.2=1	Signal H is valid
		PA500.01=10	Internal speed register 1 (INSPD1)	PA500.2=0	Signal L is valid
				PA500.2=1	Signal H is valid
		PA500.01=13	Internal torque register 0 (INTor0)	PA500.2=0	Signal L is valid
				PA500.2=1	Signal H is valid
		PA500.01=14	Internal torque register 1 (INTor1)	PA500.2=0	Signal L is valid
				PA500.2=1	Signal H is valid
.....					
41	DI2	PA501.01=n	Corresponding signal n	PA501.2=1	Signal H is

					valid
				PA501.2=1	Signal H is valid
42	DI3	PA502.01=n	Corresponding signal n	PA502.2=0	Signal L is valid
				PA502.2=1	Signal H is valid
43	DI4	PA503.01=n	Corresponding signal n	PA503.2=0	Signal L is valid
				PA503.2=1	Signal H is valid
44	DI5	PA504.01=n	Corresponding signal n	PA504.2=0	Signal L is valid
				PA504.2=1	Signal H is valid
45	DI6	PA505.01=n	Corresponding signal n	PA505.2=0	Signal L is valid
				PA505.2=1	Signal H is valid

(3) Confirmation of input signal

The status of the input signal can be confirmed by the input signal monitoring (dP012). For the input signal monitoring (dP012), refer to "5.3 Input Signal Monitoring".

(4) Related precautions

- If two IO pins are allocated to the same signal, the valid status of this signal prevails with the higher labeled DI signal. If both DI1 and DI2 are set to 0 (S-ON signal), the S-ON signal status of the drive is determined by DI2 (CN1-41 pins).

(二) Allocation of output signals

The output signals are allocated to the input and output signal connectors (CN1) according to the settings of PA50A~PA50D.

(1) Confirming the allocation status at the factory

The allocation status of output signals at the factory can be confirmed by the following parameters.

PA	Description	Range	Unit	Default	Effective
PA50A	DO1 output signal configuration (CN1-31, CN1-32)	n.0000～n.211F		n.0000	Immediate
	n.××□□: DO1 output signal selection [00]Alarm signal output (ALM) [01]Positioning completion (COIN): value of position deviation less than the value of PA522 is outputted later				

	[02]Z pulse collector signal (CZ) [03]External brake release signal (BK) [04]Servo ready output (S-RDY) [05]Velocity consistent output (VCMP) [06]Motor rotation detection (TGON) [07]Torque limiting signal (TLC) [08]Velocity limiting center signal (VLC) [09]Warning output (WARN) [0A] Positioning near (NEAR): value of position deviation less than the value of PA522 is outputted later [0D]Torque reaching (TREACH): value of torque feedback reaching the the value of PA43D is outputted later [0E]DB brake output signal (DB) [0F]Home return signal (HOME) [10]Position command completion signal (CMD-OK) [11]Position command execution completion signal (MC-OK) **n.×□××: DO1 output signal negated** [0] Not negate [1] Negate **n.×□××: DO1 output signal status** [0] Controlled by external I/O				
PA50B	DO2 output signal configuration (CN1-29, CN1-30)	n.0000～n.211F		n.0001	Immediate
	Ditto				
PA50C	DO3 output signal configuration (CN1-27, CN1-28)	n.0000～n.211F		n.0002	Immediate
	Ditto				
PA50D	DO4 output signal configuration (CN1-25, CN1-26)	n.0000～n.211F		n.0003	Immediate
	Ditto				

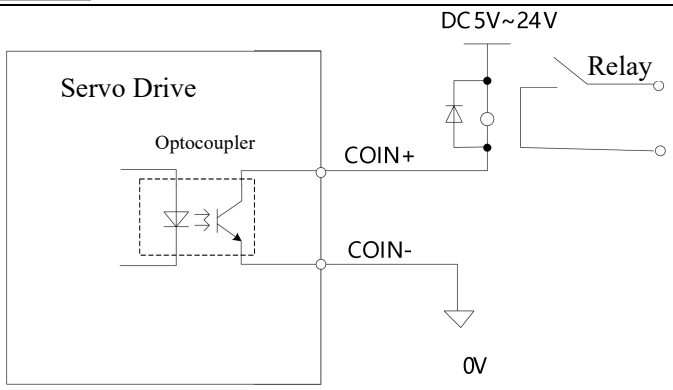
Default signals and corresponding pins of DO1～DO4:

PA	Description	CN1 pin	Default signal
PA50A	DO1	31、32	ALM
PA50B	DO2	29、30	COIN
PA50C	DO3	27、28	CZ
PA50D	DO4	25、26	BK

(2) Change level selection of output signals

If an output signal is not detected, then it is regarded as invalid. For example, COIN is invalid at positioning completion.

Typical output signal circuit is shown in the following diagram:



(Note) The maximum allowable voltage and current capacity of the photocoupler output circuit is as follows:

Take above figure as an example, COIN level is determined by PA50B.2. When PA50B.2=0, L level (conductive) is active; when PA50B.2=1, H level (nonconductive) is active.

CN1 pin	Description	Signal selection parameters	Signal name	Negate parameter	Signal state
31、32	DO1	PA50A.01=00	Alarm signal output (ALM)	PA50A.2=0	L when the signal is valid
				PA50A.2=1	H when the signal is valid
		PA50A.01=01	Positioning completion（COIN）	PA50A.2=0	L when the signal is valid
				PA50A.2=1	H when the signal is valid
		PA50A.01=02	Z pulse collector signal (CZ)	PA50A.2=0	L when the signal is valid
				PA50A.2=1	H when the signal is valid
		PA50A.01=03	External brake release signal (BK)	PA50A.2=0	L when the signal is valid
				PA50A.2=1	H when the signal is valid
		PA50A.01=04	Servo ready output (S-RDY)	PA50A.2=0	L when the signal is valid
				PA50A.2=1	H when the signal is valid
		PA50A.01=05	Velocity consistent output (VCMP)	PA50A.2=0	L when the signal is valid
				PA50A.2=1	H when the signal is valid
		PA50A.01=06	Motor rotation detection (TGON)	PA50A.2=0	L when the signal is valid
				PA50A.2=1	H when the signal is valid
		PA50A.01=07	Torque limiting signal (TLC)	PA50A.2=0	L when the

					signal is valid
				PA50A.2=1	H when the signal is valid
		PA50A.01=08	Zero-speed detection signal (ZSP)	PA50A.2=0	L when the signal is valid
				PA50A.2=1	H when the signal is valid
		PA50A.01=09	Warning output (WARN)	PA50A.2=0	L when the signal is valid
				PA50A.2=1	H when the signal is valid
		PA50A.01=0D	Torque reaching (TREACH)	PA50A.2=0	L when the signal is valid
				PA50A.2=1	H when the signal is valid
		PA50A.01=0E	DB brake output signal (DB)	PA50A.2=0	L when the signal is valid
				PA50A.2=1	H when the signal is valid
			.....		
29、30	DO2	PA50B.01 Ditto	Positioning completion（COIN）	PA50B.2=0	L when the signal is valid
				PA50B.2=1	H when the signal is valid
27、28	DO3	PA50C.01 Ditto	Z pulse collector signal (CZ)	PA50C.2=0	L when the signal is valid
				PA50C.2=1	H when the signal is valid
25、26	DO4	PA50D.01 Ditto	External brake release signal (BK)	PA50D.2=0	L when the signal is valid
				PA50D.2=1	H when the signal is valid

(3) Related precautions

- When a Z-pulse collector output signal is used, its output level state cannot be changed (the corresponding PA50X.2 bit is not used).
- If two IO pins are allocated as Z pulse collector output signals, the valid status of this signal prevails with the higher labeled DO signal. If DO2 and DO3 are both set to 2 (Z pulse collector signal), DO3 (CN1 - pins 27 and 28) outputs the Z pulse signal.
- Note that the alarm signal (ALM) and warning signal (WARN) indicate alarm when valid, and no alarm when invalid.

3.4.4 Examples of connection with upper controllers

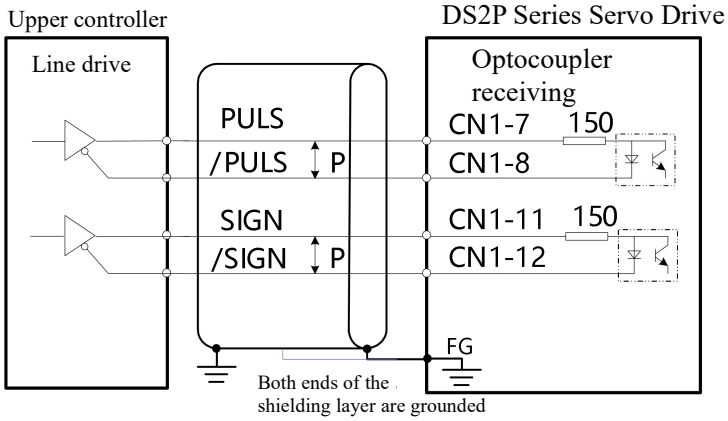
(—) Command input circuit

1) Low-speed position command input circuit

The following explains the 7-8 (command pulse input) and 11-12 (command symbol input) terminals of the CN1 connector.

The output circuit of the command pulse on the upper controller side can be selected from one of three types: linear drive output and open collector output (two types). Each of these is described below.

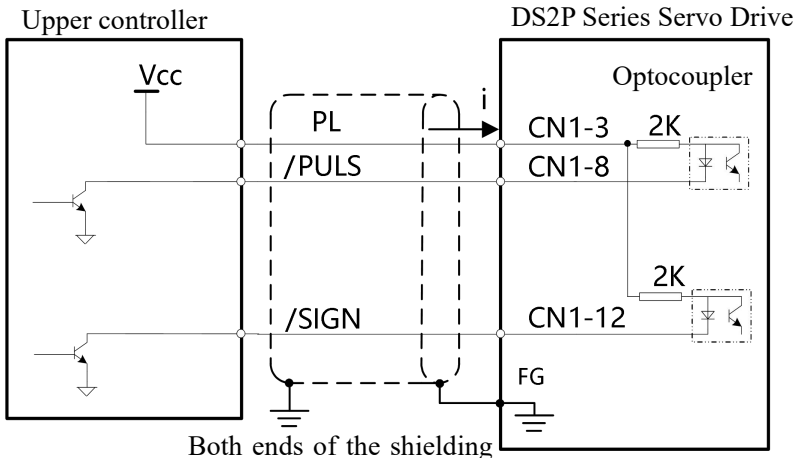
■ Linear drive output



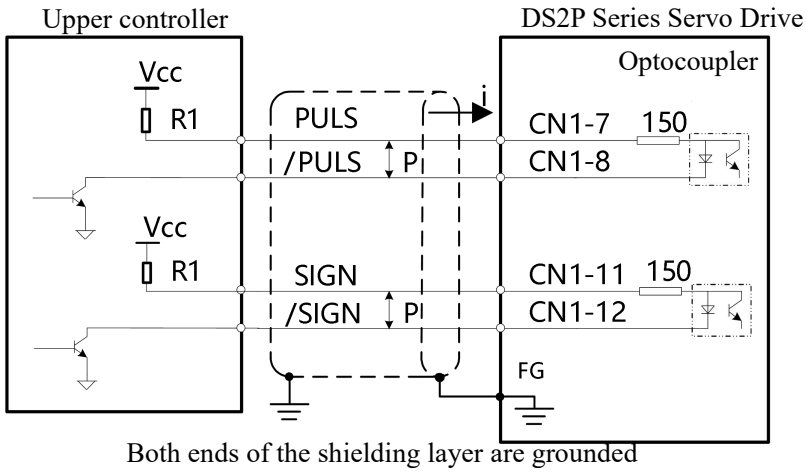
Applicable linear drive, such as the similar product of AM26LS31 from T1 company

■ Open-collector output

a) **If the upper controller is an open collector output and 24VDC signal power is provided, connect method 1**



b) **When the upper controller is an open collector output and 5VDC, 12VDC or 24VDC signal power is provided, connect method 2**



Both ends of the shielding layer are grounded

Note:

◆ Please set the resistor R1 according to the following required input current value range.

Input current i ＝7 to 15mA:

When Vcc is 24V, R1 = 2KΩ

When Vcc is 12V, R1 = 510Ω

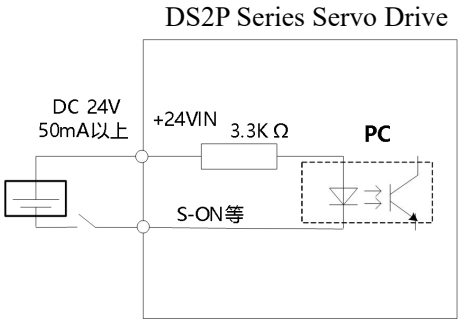
When Vcc is 5V, R1 = 180Ω

◆ Normally, open collector pulses can be easily interfered. To reduce interference:

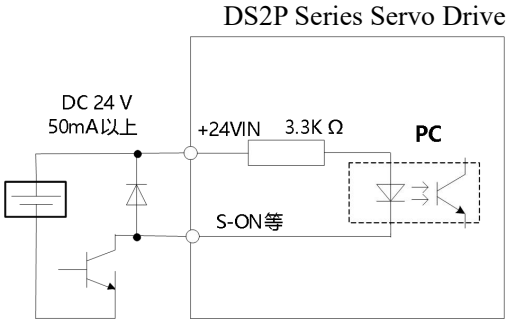
➢ Grounding: control line shielding shall connect to ground of upper controller power supply (such as 24V power supply, the shield is connected to 24V ground); on the drive side, the shielding shall hang in air;

2) Sequential control input circuit

Connected by a relay or an open collector transistor circuit. When using relay connections, select the micro current relay. If you do not use small current relay, it will cause bad contact.



Example of a relay circuit

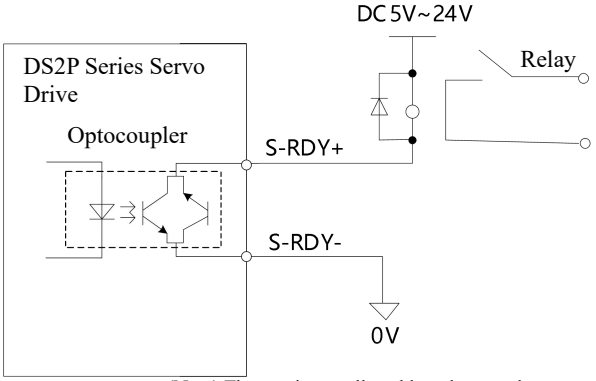


Example of an open-collector

(二) Output circuit

1) Sequential control output circuit

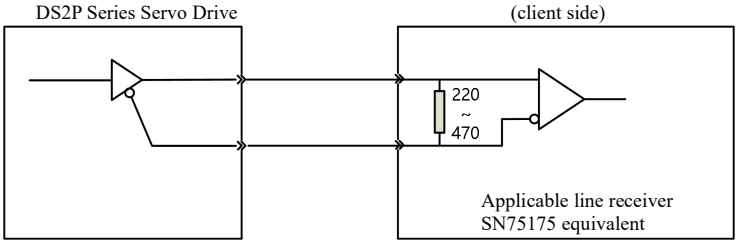
ALM, S-RDY and other sequence of output signals are consisted of optocoupler. Please connect with relays.



(Note) The maximum allowable voltage and current capacity of the photocoupler output circuit is as follows:
Voltage: DC30V (maximum)
Current: DC50mA (maximum)

2) Line drive output circuit

The following explains the 33-34 (A signal), 35-36 (B signal), and 19-20 (Z signal) terminals of the CN1 port.
The serial data from the encoder is converted into 2-phase (A-phase, B-phase) pulse output signals (PAO, /PAO, PBO, /PBO) and home pulse signals (PZO, /PZO), which are output via the linear drive output loop. Normally, the servo drive is used for velocity control when a position control system is formed on the upper controller side. On the upper controller side, use the linear receiver circuit to receive.

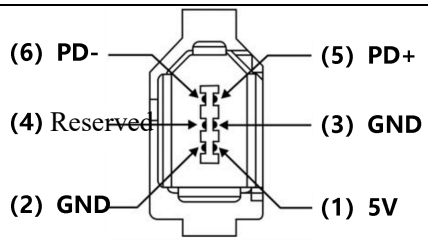


3.5 Wirings of CN2

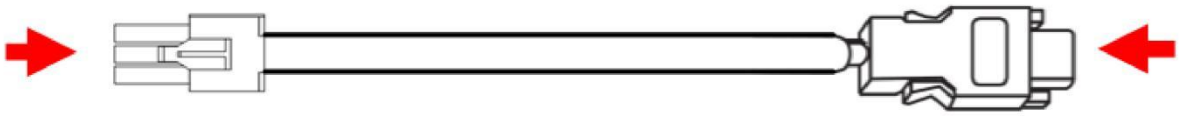
The following is an example of the connection of the encoder, servo drive, and output signals from the servo drive to the controller, and the terminal arrangement of the encoder connection port (CN2).

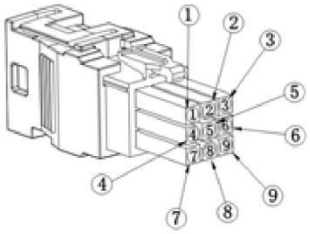
3.5.1 Wiring instructions of CN2

(一) Appearance and signal



(二) Quick plug encoder cable

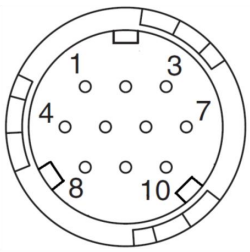




CN4 plug	
6P CODE	DESCRIPTION
1	+ 5V
2	0V
3	
4	
5	PD+
6	PD-

Communication encoder	
CABLE CODE	DESCRIPTION
1	+ 5V
2	0V
3	PD+
4	PD-
5	BAT+
6	BAT-
7	
8	
9	FG

(三) Aviation plug encoder cable



CN4 plug	
6P CODE	DESCRIPTION
1	+5V
2	0V
3	
4	
5	PD+
6	PD-

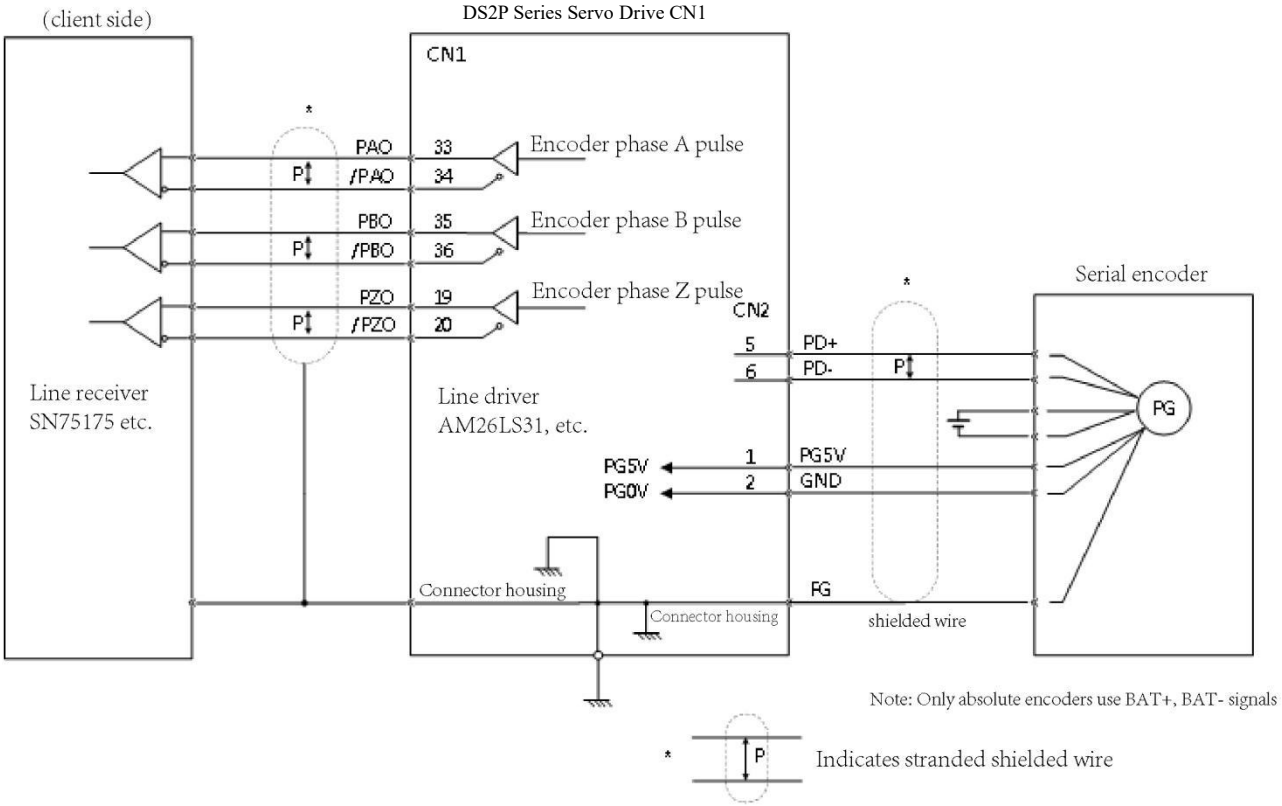
Communication encoder	
CABLE CODE	DESCRIPTION
1	PD+
2	PD-
3	
4	+5V
5	BAT-
6	BAT+
7	
8	
9	0V
10	FG

Note:

1、The communication type encoder uses BAT+ and BAT- to connect external battery if it is absolute value type. If the communication type encoder is incremental type, BAT+ and BAT- signals are not used.

3.5.2 Example of CN2 connection

■ Serial encoder wiring



3.6 Connector CN3(miniUSB)

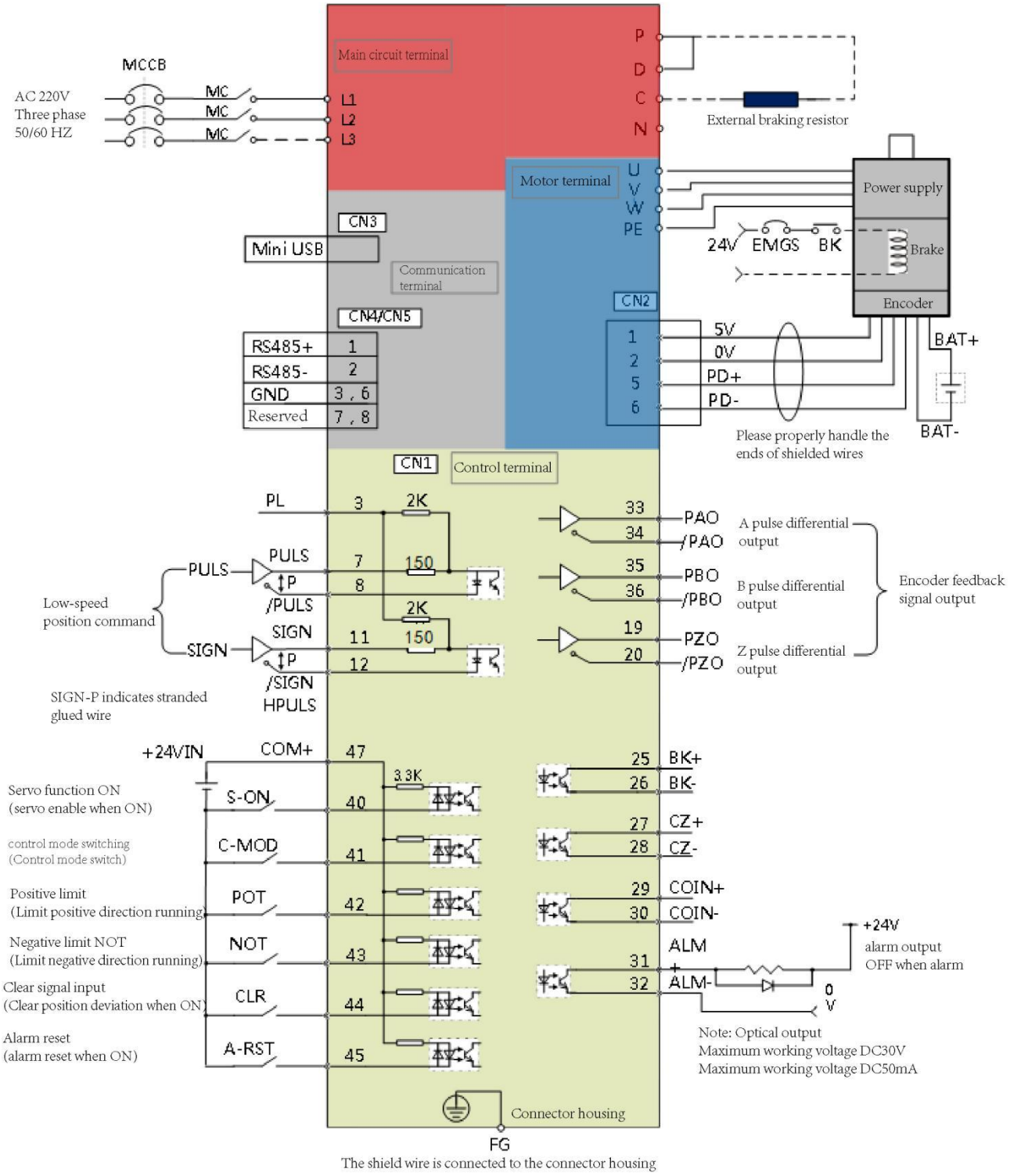
Connector CN3 is a mini USB communication plug. Connect a PC with DorVision/ServoLink software installed to CN3 of the Servo Drive.

Use this port for USB communication and USB program upgrade.

- USB communication must be used in conjunction with the controller software DorVision/ServoLink.
  Its operation is the same as RS485 communication, just selecting the port number of USB.
  The communication parameters of the drive (PA015, PA016) have no effect on USB communication.
  USB communication speed is much faster than RS485.
  If USB communication fails, please restart DorVision/ServoLink software.
- Please refer to the related documentation for USB program upgrade, which will not be elaborated here.

3.7 Standard Wiring Method

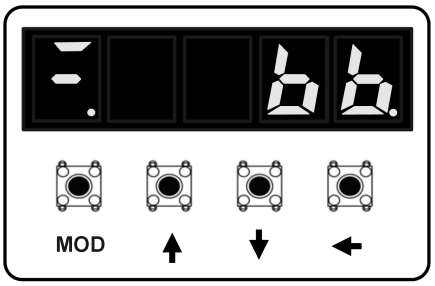
DS2P Series Servo Drive



Chapter 4 Panel Operations

4.1 Panel Operations

Panel operator consists of a panel display and operating keys.
Panel operator is used for displaying status, performing auxiliary functions, setting parameters and monitoring servo drive’ s status.
The names and functions of the panel operator keys are shown below.

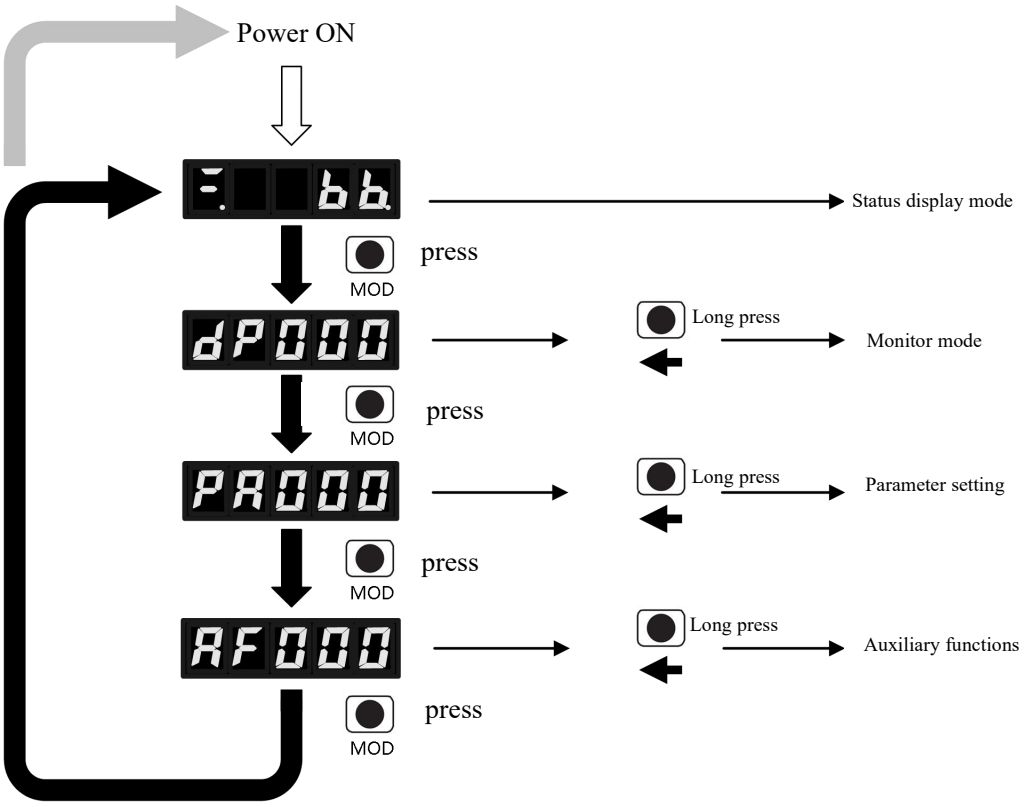


Key	Function description
MOD	Switch between different modes or cancel
↑	Increase value
↓	Decrease value
←	● Long press: Display/set the setting value. At this point, press and hold this key for about 1 second. ● Short press: move the digit one bit to the left (when the data bit is blinking)

How to clear the servo alarm?
Press and hold the UP key and the DOWN key at the same time to clear the servo alarm.(Note) Before clearing the servo alarm, be sure to eliminate the cause of the alarm.

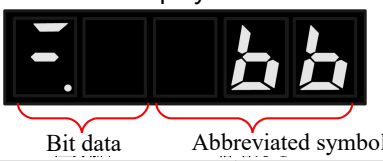
4.2 Switch Between Different Functions

Press the MODE key and the functions will be switched as follows.
For the operation of each function, please read the reference chapter.



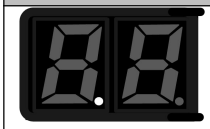
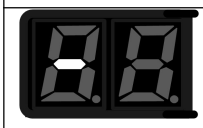
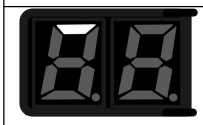
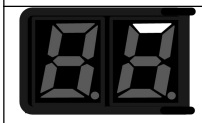
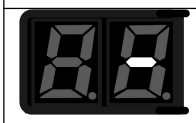
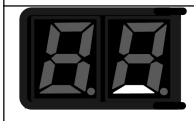
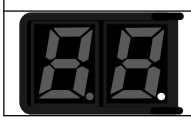
4.3 Status Code Display

The status of the servo drive is indicated by the number of digits in the status display mode.
The status display can be identified as follows.



Display	Meaning	Display	Meaning
	**Base blockade** Indicating the state of the servo OFF (the servo motor is not energized).		**Reverse driving prohibited** Indicating that the input signal (N-OT) is in an open state.
	**Running** Indicating the status of the servo ON (servo motor energization status).		**Warning function** Flashing display warning number.
	**Forward driving prohibited** Indicates that the input		**Alarm status** Flashing display alarm number or warning number.

	signal (P-OT) is in an open state.		

Bit data	Meaning
	**Control power ON display** Lights when the servo drive's control power is turned ON. Off when the servo drive's control power is turned OFF.
	**Base block display** Lights up in the base block (servo OFF state). Off when the servo is turned ON.
	**Velocity and torque control: for velocity consistent (V-CMP) display** When the difference between the servo motor speed and the command velocity is within the specified value (set by PA513, the factory setting is 10 min- 1), it lights up. Off when the specified value is reached. * Always lights up during torque control. <Supplement> When the command voltage is affected by noise, the " -" symbol on the upper left of the panel operator will flash. Please take countermeasures against noise interference. Position control: for positioning completion (COIN) display The deviation between the position command and the actual position of the motor is within the specified value (set by PA522, the factory setting is 7 command units), it lights up; it is extinguished when the specified value is exceeded.
	**Rotation detection (TGON) display** When the rotation velocity of the servo motor is higher than the specified value (set by PA512, the factory setting is 20 min- 1), it lights up; when it is lower than the specified value, it is distinguished.
	**For velocity and torque control: display for velocity command input** Lights when the velocity command in the input is greater than the specified value (set by PA512, the factory setting is 20 min- 1), and turns off when it is less than the specified value. For position control: display for command pulse input Lights when there is a command pulse input. Off when no command pulse is input.
	**For velocity and torque control: display for torque command input** Lights when the torque command in the input is greater than the specified value (10% of rated torque) and turns off when it is less than the specified value. For position control: display for clear signal input Lights when there is a clear signal input. Off when there is no clear signal input.
	**Power ready display** Lights when the main circuit power is turned ON. Off when the main circuit power is OFF.

4.4 Monitoring Display Mode (dP □□)

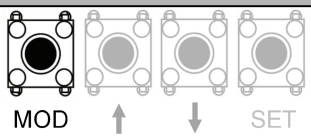
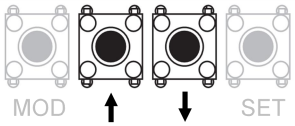
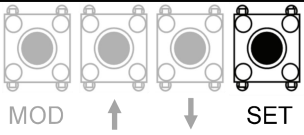
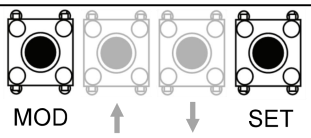
At monitoring display mode, user can monitor the set values, I/O signal status and internal status of the servo drive. On the panel operator, it is displayed as a number beginning with dP.

4.4.1 Contents of monitoring display mode

Please refer to Chapter 5.1 for display contents in monitoring mode

4.4.2 Example of operations at monitoring display mode

The following is an example of how to monitor the motor speed (dP000).

Steps	Panel display	Keys	Operations
1			Press MOD key to choose monitoring display function.
2			If the panel display is not dP000, press "↑" & "↓" until it is dP 00.
3			Press SET for 1s to enter dP000. This shows motor speed is 1600rpm.
4			Press SET for 1s or MOD to return to Step 1.
5	End of operations		

4.5 Parameter Mode

4.5.1 Remarks at parameter mode

Set the parameters of the servo drive. On the panel operator, it is displayed as a number beginning with PA.

■ **Storage setting status**

After parameter editing, press SET to store the setting, and the panel display will blink accordingly.

■ **Data type**

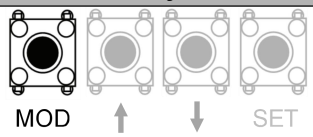
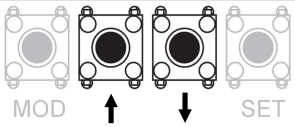
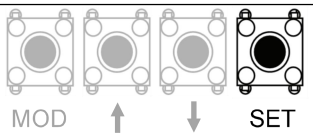
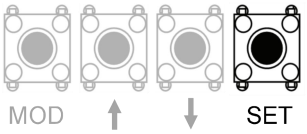
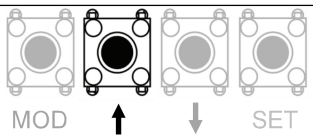
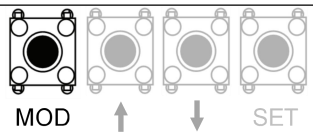
The highest bit of the parameter indicates the value type.

Panel display	Remarks
	Indicating that the parameter is set to decimal and the data is an unsigned number.
	The highest bit is displayed as "n", indicating that the parameter is set to hexadecimal. The setting range of each bit is 0~F.

4.5.2 Example of operations at parameter mode (PA100)

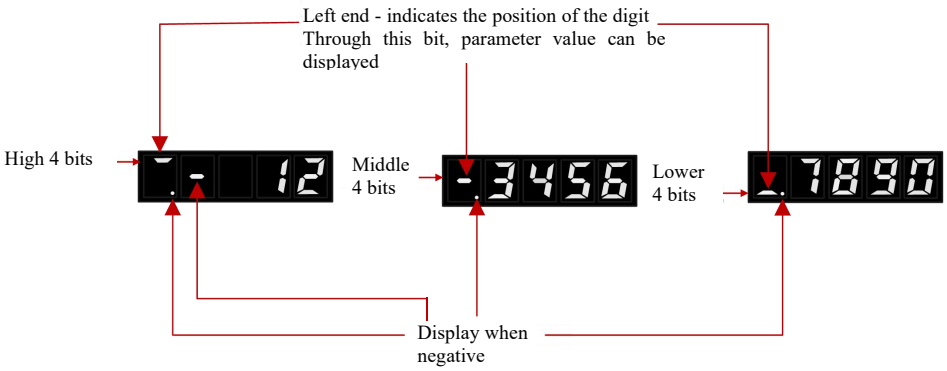
(1) When the setting range is within 5 digits

The following is an example of how to modify the parameter using the first position loop gain (PA100) as an example. Modify the value of PA100 from 40.0 to 80.0.

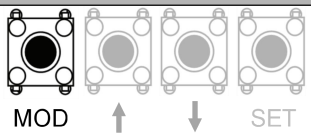
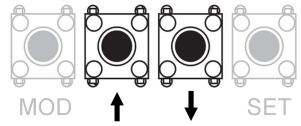
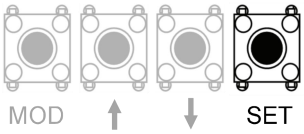
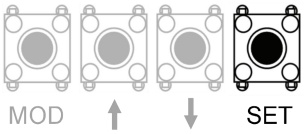
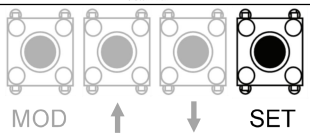
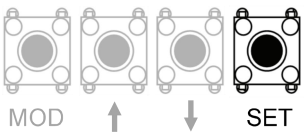
Steps	Panel display	Keys	Operations
1			Press MOD to choose parameter mode.
2			If the panel display is not PA100, press ↑ & ↓ until it is PA100.
3			Press SET for 1s to enter the parameter editing interface; it shows the current value is 40.0.
4			Short press SET to move the flashing digit, and the decimal point under "4" will flash. (The flashing digit indicates the number of digits that can be changed.)
5			Press “↑” and the value becomes 80.0.
6	 (flashing display)		Press SET for 1s and the value display will flash. Thus, the set value changes from 40.0 to 80.0. The display will return to "PA100".
			Press "MOD" to cancel the parameter modification and return to the "PA100" display.
7	End of operations		

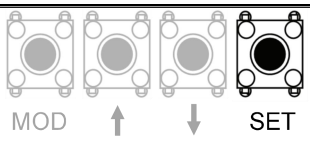
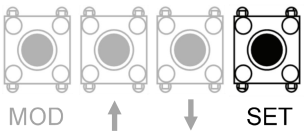
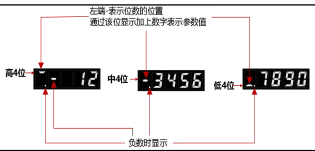
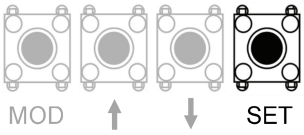
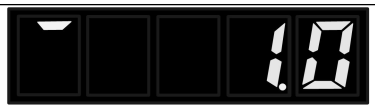
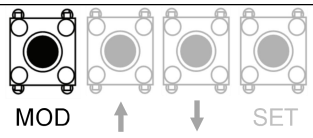
(2) When the setting range is 6 digits or more

Since the panel operator can only display 5 digits, the setting values of 6 digits or more are shown below.



The setting method when the positioning completion range (PA522) is set to "1010001010" is shown below.

Steps	Panel display	Keys	Operations
1			Press MOD to choose parameter mode.
2			If the panel display is not PA522, press ↑ & ↓ until it is PA100.
3			Press SET for 1s to enter the parameter editing low 4-digit interface; the left figure is displayed, indicating that the current value is 10.
4			Short press SET to move the flashing display to the thousands digit. (The flashing digit indicates the number of digits that can be changed.)
5			Press “↑” and the value becomes 1000.
6			Short press SET to enter the parameter editing 4-digit interface.
7			Short press SET to move the flashing display to the thousands digit. (The flashing digit indicates the number of digits that can be changed.)
8			Press “↑” and the value becomes 1000.

9			Short press SET to enter the parameter editing high 2-bit interface.
10			Short press SET to move the flashing display to the tens digit. (The flashing digit indicates the number of digits that can be changed.)
11			Press “↑” and the value becomes 10.
12	 (flashing)		Press SET for 1s and the value display will flash. In this way, the setting value is saved. The display will return to "PA522".
12	 (flashing)		Press "MOD" to cancel the parameter modification and return to the "PA522" display.
13	End of operations		

4.6 Example of Operations at Auxiliary Function Mode (AF □□)

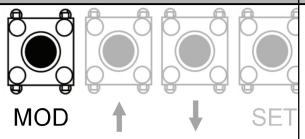
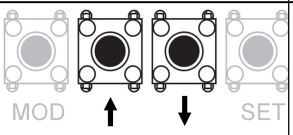
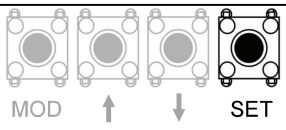
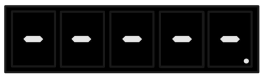
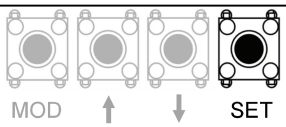
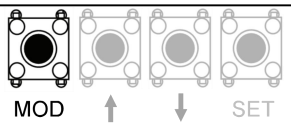
Auxiliary functions are used to perform some additional setting & tuning of the servo drive.
On the panel operator, it is displayed as a number beginning with AF.

4.6.1 Contents of auxiliary function mode

Please refer to Chapter 6.1.

4.6.2 Example of operations at auxiliary function mode (AF005)

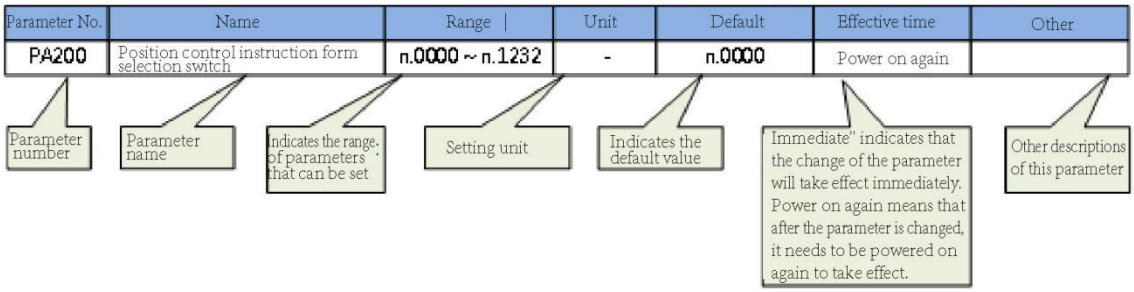
The following is an example of how to operate the auxiliary function by restoring the factory value (AF005).

Steps	Panel display	Keys	Operations
1			Press MOD to choose parameter mode.
2			If the panel display is not AF005, press ↑ & ↓ until it is PA100.
3			If the servo is in S-OFF status, press SET for 1s and the panel will enter the restore factory value interface
			If the servo is running or the panel lock is set, the panel will display the left figure, indicating that this auxiliary function cannot be operated.
4			Press SET for 1s and the panel will enter the restore factory value interface
5			Until the picture on the left is displayed, indicating that the operation is complete.
6			Release the key and the panel displays the left figure.
7			Press MOD to exit from the auxiliary function and return to the display in step 2.
8	End of operations		

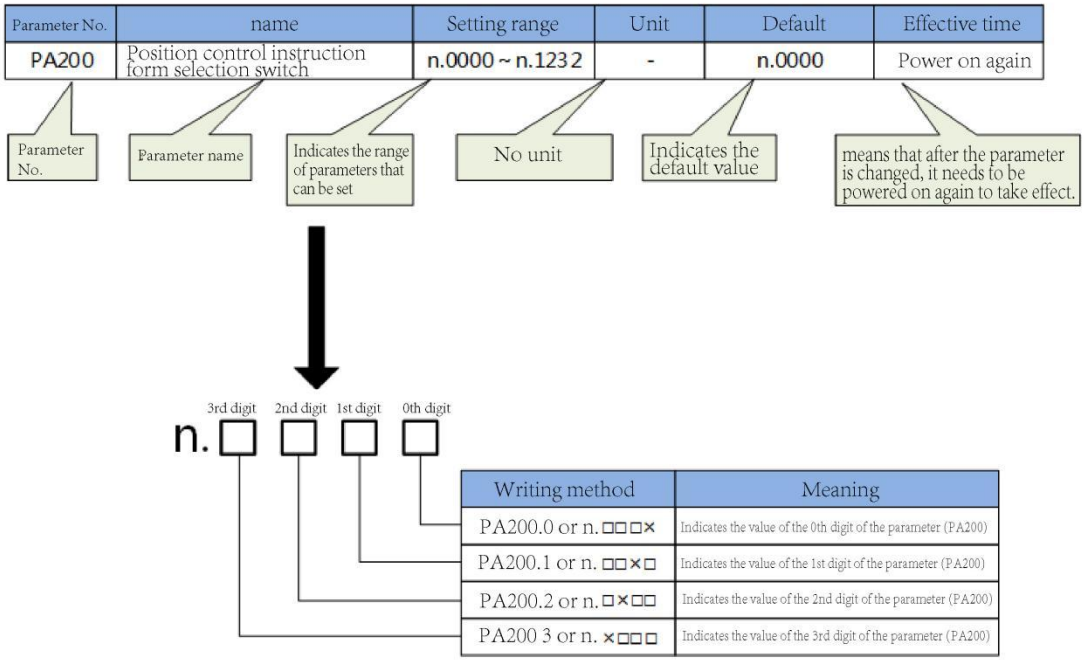
4.7 How to Write the Parameters in This Manual

The following describes how to write the parameters used in this manual.

4.7.1 How to write "Value Setting Type"



4.7.2 How to write “Function Selection Type”



Chapter 5 Monitoring Display

5.1 List of Monitoring Display Parameters

The monitoring display is a function that displays the command value set in the servo drive, the status of the input and output signals, and the internal status of the servo drive.

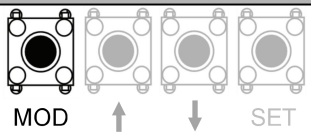
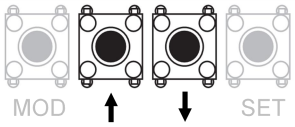
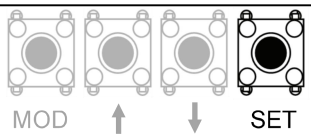
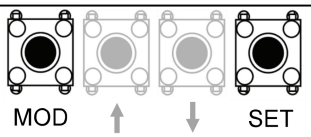
The monitoring display list is shown below.

No.	Content	Unit	Data length	Address
dP000	Motor speed	[r/min]	int16	0xE000
dP001	Motor feedback pulse counter (Encoder unit)	[1 encoder pulse]	int32	0xE001
dP003	Input pulse counter before electronic gear	[1 command pulse]	int32	0xE003
dP005	Deviation pulse counter (Encoder unit)	[1 encoder pulse]	int32	0xE005
dP008	Internal velocity command	[r/min]	int16	0xE008
dP00A	Internal torque command (to rated torque value)	[%]	int16	0xE00A
dP00B	Cumulative load factor (take rated cumulative load as 100%)	[%]	Uint16	0xE00B
dP00C	Driving load factor (take rated regeneration load as 100%)	[%]	Uint16	0xE00C
dP00D	Regeneration load factor (take rated regeneration load as 100%)	[%]	Uint16	0xE00D
dP012	Input signal monitoring	—	Uint16	0xE012
dP013	Output signal monitoring	—	Uint16	0xE013

dP014	Command pulse frequency	[0. 1Khz]	int16	0xE014
dP015	DC bus voltage	[V]	Uint16	0xE015
dP018	Feedback pulse counter	[1 input pulse]	int32	0xE018
dP01A	Deviation pulse counter	[1 input pulse]	int32	0xE01A
dP020	Electrical angle 1 (32-bit decimal)	[1 encoder pulse]	Uint32	0xE020
dP022	Electrical angle 2	[deg]	Uint16	0xE022
dP024	Cumulative running time	[100ms]	Uint32	0xE024
dP030	Effective group of gains (1= 1st group; 2=2nd group)	—	Uint16	0xE030
dP032	Encoder resolution: 17-bit: 131072; 23-bit: 8388608;	pulse	Uint32	0xE032
dP050	Motor rated speed	[r/min]	Uint16	0xE050
dP051	Motor maximum speed	[r/min]	Uint16	0xE051
dP150	Drive type: 1->400W, 2->750W, 3->1KW	—	Uint16	0xE150
dP156	Maximum overload capacity	[%]	Uint16	0xE151
dP158	Motor rated current	[0.1A]	Uint16	0xE158
dP159	Motor maximum current	[0.1A]	Uint16	0xE159
dP160	Encoder single-turn value	[1 encoder pulse]	Uint32	0xE160
dP162	Encoder multi-turn value	[1 turn]	Uint16	0xE162
dP164	Motor absolute position value low 32 place	[encoder unit]	int32	0xE164
dP166	Motor absolute position value low 32 place	[encoder unit]	int32	0xE166
dP168	Motor absolute position value low 32 place	[user unit]	int32	0xE168
dP16A	Motor absolute position value high 32 place	[user unit]	int32	0xE16A
dP30A	Present alarm code	—	Uint16	0xE30A
dPA0A	U-phase zero drift calibration value	——	Uint16	0xEA0A
dPA0B	W-phase zero drift calibration value	——	Uint16	0xEA0B
dPA11	Detects if curing parameters are enabled	——	Uint16	0xEA11
dPA12	Average internal torque command	[%]	Uint16	0xEA12

5.2 Example of Operations at Monitoring

The following is an example of the operation of the monitoring display for the dP000.
The following is an example of the display when the servo motor speed is 1600 rpm.

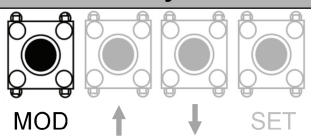
Steps	Panel display	Keys	Operations
1			Press MOD key to choose monitoring display function.
2			If the panel display is not dP000, press “↑” & “↓” until it is dP 00.
3			Press SET for 1s to enter dP000. This shows motor speed is 1600rpm.
4			Press SET for 1s or MOD to return to Step 1.
5	End of operations		

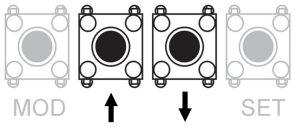
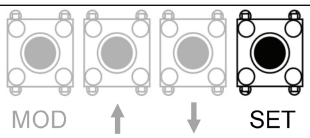
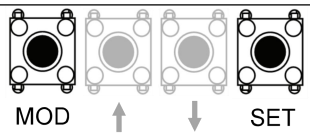
5.3 Input Signal Monitoring

The status of the input signal can be confirmed by the input signal monitoring (dP012).
The display procedure, the distinguishing method , and the display example are shown below.

5.3.1 Steps of display

The steps for displaying the input signal is shown below.

Steps	Panel display	Keys	Operations
1			Press MOD key to choose monitoring display function.

2			If the panel display is not dP012, press “↑” & “↓” until it is dP012.
3			Press and hold SET to enter the input signal monitoring interface, and the left figure is displayed.
4			Press MOD key or hold SET key to return to the display of step 1.
5	End of operations		

5.3.2 Display distinguishing method

The allocated input signal is displayed by the illumination status of the segment (LED) of the panel operator. The correspondence between input pin and LED number is shown in the following table.

Upper: the corresponding input signal is valid
Bottom: the corresponding input signal is invalid

◆The upper (LED) is lit when the input signal is valid.

◆The lower (LED) is lit when the input signal is L level (input optocoupler is on).

Display LED number	CN1 input pin		Signal name (factory setting)
1	40	DI1	S-ON
2	41	DI2	C-MOD
3	42	DI3	POT
4	43	DI4	NOT
5	44	DI5	CLR
6	45	DI6	A-RST

[Note]

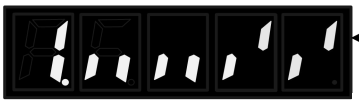
1、In case of no external input, the corresponding IO signal can also be made valid by modifying parameters PA500.2~PA505.2 (input signal form selection). Note that dP012 only displays the external input IO signal level status.

2. In the case that the input signal is not negated, the status when the optocoupler is not on is POT and NOT signal invalid, which means the drive is prohibited (over-travel).

5.3.3 Examples of displays

An example of the input signal display is shown below.

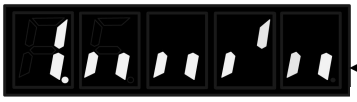
The S-ON signal input is valid when the input optocoupler is on.



The upper LED of number 1 is on

8 7 6 5 4 3 2 1 Number

If the input optocoupler is not on, the S-ON signal input is not valid.



The lower LED of number 1 is on

8 7 6 5 4 3 2 1 Number

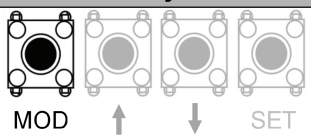
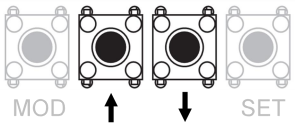
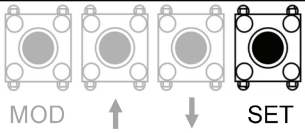
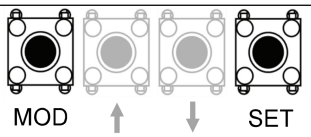
Note that the actual validity of the S-ON signal is also related to the parameter PA500.2 (valid level).

5.4 Output Signal Monitoring

The status of the output signal can be confirmed by the output signal monitoring (dP013). The display procedure, the distinguishing method , and the display example are shown below.

5.4.1 Steps of display

The steps for displaying the output signal is shown below.

Steps	Panel display	Keys	Operations
1			Press MOD key to choose monitoring display function.
2			If the panel display is not dP013, press “↑” & “↓” until it is dP013.
3			Press and hold SET to enter the input signal monitoring interface, and the left figure is displayed.
4			Press MOD key or hold SET key to return to the display of step 1.
5	End of operations		

5.4.2 Display distinguishing method

The allocated output signal is displayed by the illumination status of the segment (LED) of the panel operator. The correspondence between input pin and LED number is shown in the following table.

Upper: the corresponding output signal is valid
Bottom: the corresponding output signal is invalid

4 3 2 1 Number

◆The upper (LED) is lit when the output signal is valid.

◆The lower (LED) is lit when the output signal is L level (output optocoupler is on).

Display LED number	CN1 output pin		Signal name (factory setting)
1	31、32	DO1+, DO1－	ALM
2	29、30	DO2+, DO2－	COIN
3	27、28	DO3+, DO3－	CZ
4	25、26	DO4+, DO4－	BK

[Note]

1. Even in the output signal invalid state, the level polarity of the corresponding output IO can be changed by modifying the parameter PA[50A].2 (output signal form selection). dP013 can display both the output signal level state and the internal signal valid state.

2. Output pins CN1-31,CN1-32 can only be used as ALM signal, and their output polarity can be modified by parameter PA50A.2 (output signal form selection). When the output pin is selected as Z pulse collector output (CZ), the corresponding bit of dP013 is not lit. When more than one pin is selected as Z pulse output, only one Z signal can be output (priority is DO2> DO3> DO4).

5.4.3 Examples of displays

An example of the output signal display is shown below.

ALM signal is invalid, the optocoupler is on (ALM signal is L level)

The upper LED of number 1 is

4 3 2 1 Number

After the ALM signal is valid, the optocoupler is not on (ALM signal is at H level)

The lower LED of number 1 is on

4 3 2 1 Number

Note that the actual output level of the ALM signal is also related to the parameter PA50A.2 (valid level).

5.5 Monitoring Display When Power is On

If the dP number is set by PA52F, the data of the set dP number is displayed on the panel operator when the power is turned on.

However, if 0FFF [factory setting] is set, the status (bb, run, etc.) is displayed when the power is turned on.

PA	Description	Range	Unit	Default	Effective
PA52F	**Initial display status** When the setting is 0FFF, the status code is	0000 ～ 0FFF	～	0FFF	Power on again

	displayed. The corresponding dPXXX is displayed when other values are set.				

Chapter 6 Auxiliary Functions

6.1 List of Auxiliary Functions

The following table shows the list of auxiliary functions and reference chapters for the functions related to the operation and adjustment of the servo motor.

AF number	Function	Reference
AF000	Display of alarm logging	6.2
AF001	Position assignment	6.3
AF002	JOG run	6.4
AF003	Panel lock	6.5
AF004	Clearance of alarm logging	6.6
AF005	Parameter initialization	6.7
AF00A	Programmed JOG run	6.8
AF010	Display of main software version of servo drive	6.9
AF011	Initialization of absolute encoders	8.3.4
AF015	Parameter initialization of all parameters	6.7
AF016	Dragging	/
AF021	Vibration detection value initialization	6.10
AF030	Manual stiffness adjustment	9.2
AF050	Vibration monitoring	6.11
AF060	FFT analysis	6.12
AF105	Vibration suppression control function	9.4

6.2 Display of Alarm Logging (AF000)

The servo drive has a retroactive display of historical alarms, and can retroactively display up to 10 records of alarms that have occurred. Each alarm record can confirm that an alarm occurred with an alarm number and the time (timestamp) of the alarm.

Timestamp:

It is a function that measures the duration of control power and main circuit power on in 1S unit and displays the total running time at the time of alarm occurrence. The time stamp of 32-bit data can be measured continuously for about 13 years if it is operated 24 hours a day, 365 days a year.

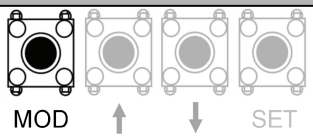
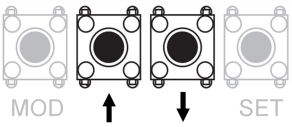
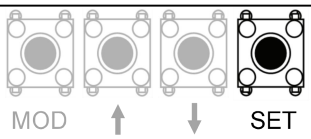
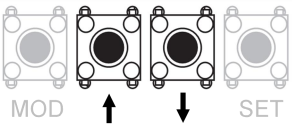
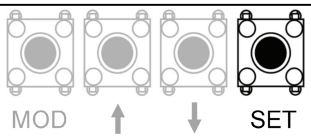
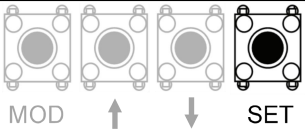
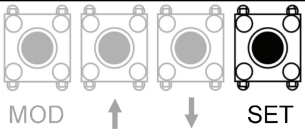
＜Timestamp display example＞

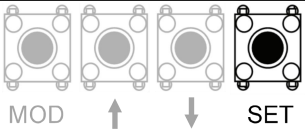
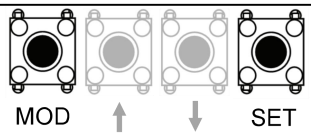
When 3600.0 is displayed,

= 60 [min]

= 1 [h], so the total running time is 1 hour.

The procedure for displaying the alarm log is shown below.

Steps	Panel display	Keys	Operations
1			Press MOD key to choose monitoring display function.
2			If the panel display is not AF000, press ↑ & ↓ until it is AF000.
3			Press SET for 1 second to display the left figure, which is the latest alarm code.
4			Press ↑ once and it will display one previous alarm. Press ↓ once and it will display a new alarm. The bigger the number on the left side, the older the alarm displayed.
5			Short press SET to display the lower 4 digits of the timestamp.
6			Short press SET to display the middle 4 digits of the timestamp.
7			Short press SET to display the high 2 digits of the timestamp. Time stamp data bit 58709.8 seconds.

8			Short press SET to return to the alarm number display.
9			Press SET to exit to Step 2.
10	End of operations		

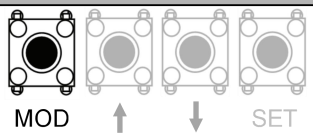
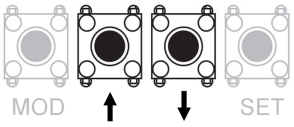
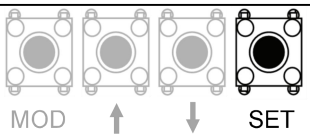
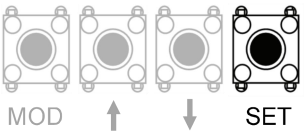
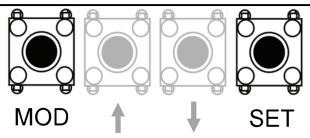
<Supplement>

● When there have been no alarms, the alarm No. is 0.

● The alarm logging can be deleted through Clearance of Alarm Logging (AF004). A-RESTART or power off cannot clear the alarm logging.

6.3 Position Assignment (AF001)

With this function, motor feedback position & command pulse position is allocated by value of 0.

Steps	Panel display	Keys	Operations
1			Press MOD key to choose monitoring display function.
2			Press ↑ & ↓ until it is AF001.
3			Press SET for 1 second to display the left figure.
4	 (flashing display) ↓ 		u Long press SET to execute this auxiliary function. After execting this function, "donE" will flash and return to the display on the left.
5			Press MOD or SET to exit this auxiliary function and return to the display of step 2.
6	End of operations		

6.4 JOG Run (AF002)

JOG run is the function to confirm the servo motor action through velocity control without connecting to the upper controller.

During JOG run, the overtravel prevention function is inactive. User shall pay close attention to mechanical movement of the machinery caused by JOG run.

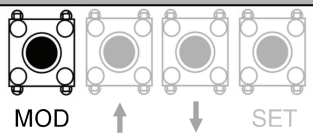
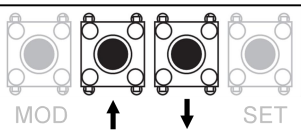
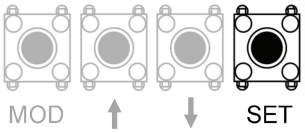
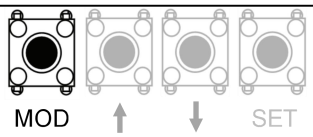
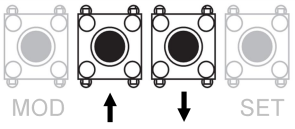
(1) Preparing for JOG run

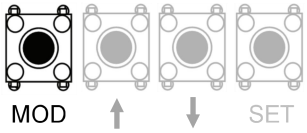
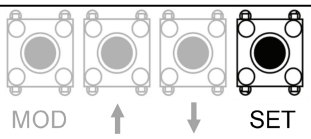
Before JOG run, the following settings are necessary.

- When S-ON input signal is ON, please switch it to OFF.
- Please set the JOG speed after considering mechanical movement of the machinery. JOG speed can be set by PA304.
- Please take necessary safety measures and ensure it can stop at any emergency.
- In order to ensure safety, a stop device shall be set on the machine side.

（2）JOG run procedures

The procedures of JOG run are shown below. The following explains the procedure when the servo motor rotation direction is set to PA000.0=0 (positive rotation at the positive rotation command).

Steps	Panel display	Keys	Operations
1			Press MOD key to choose monitoring display function.
2			If the panel display is not AF002, press ↑ & ↓ until it is AF002.
3			If the servo is in the non-running state and ready, press SET for 1 second to enter the JOG running screen to display the contents as shown in the figure on the left.
4			If the servo is running or the panel lock is set (AF003), the panel will display the left figure, indicating that this auxiliary function cannot be operated.
5			Press MOD to enter the servo ON (motor energized) state.
6			Press the "↑" (forward rotation) or "↓" key (reverse rotation), during the key press, the servo motor rotates at the speed set by PA304.

7			Press the MODE to enter the servo OFF (motor not energized) state. <Supplement> You can also press the SET to exit the JOG run interface, and the servo will also be OFF.
8			Press and hold the SET to exit this auxiliary function and return to the display in step 2.
9	End of operations		

6.5 Panel Lock (AF003)

Function to prevent inadvertent writing of parameters.

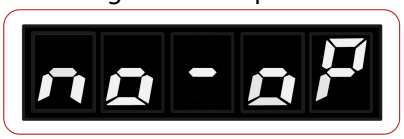
All PAs and the following auxiliary functions (AFs) listed in "(1) List of auxiliary functions to which writing is prohibited" can be set to write prohibition or write permission.

(1) List of auxiliary functions to which writing is prohibited

AF number	Function	Panel lock
AF000	Display of alarm logging	×
AF001	Position assignment	○
AF002	JOG run	○
AF004	Deletion of alarm logging	○
AF005	Initialization of parameter setting values	○
AF00A	Programmed JOG run	○
AF010	Display of software version of servo drive	×

○:Write prohibition can be set ×:Write prohibition cannot be set

When the write prohibition setting (AF00A) of the parameter is valid, if the auxiliary function of the write prohibition setting object is executed, the panel operator will display the following and the corresponding operation cannot be executed. To execute these auxiliary functions, refer to "(2) procedures" on the next page and change to "Write permission".



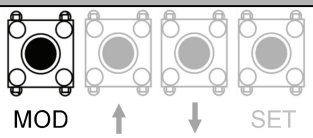
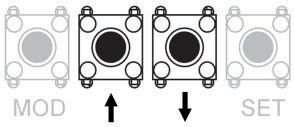
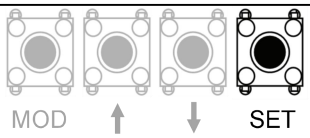
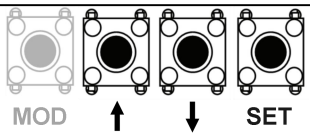
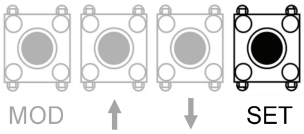
← Flashing indicates the alarm number

（2）JOG run procedures

The setting methods for write prohibition and write permission are shown below.

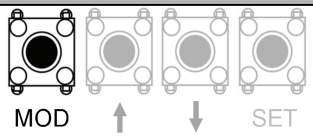
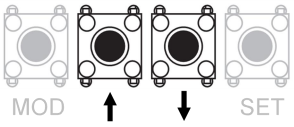
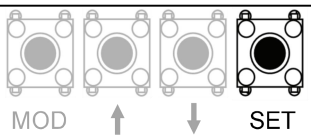
The setting values are as follows.

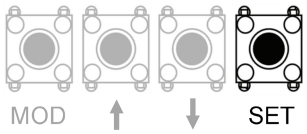
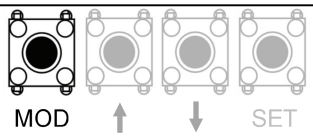
- "P.0000"...Write permission (disable write prohibition) (factory setting)
- "P.0058"...Write prohibition(parameters will not be written from the next power-on.) After setting to 58, parameters and functions cannot be operated.

Steps	Panel display	Keys	Operations
1			Press MOD key to choose monitoring display function.
2			If the panel display is not AF003, press ↑ & ↓ until it is PA100.
3			Press and hold SET to display the left figure.
4			Press "↑" or "↓" or SET to set the password.
5			Long press SET to execute this auxiliary function. After executing this function, "donE" will flash and return to the display on the left.
6			Press MOD to exit this function.
7	To make the setting effective, turn the servo drive power on again.		

6.6 Deleting of Alarm Logging (AF004)

Function to delete all alarm logging in the servo drive.
(Note) Alarm logging can be deleted by this function. A-RESTART or power off cannot clear the alarm logging.
The procedures are shown below.

Steps	Panel display	Keys	Operations
1			Press MOD key to choose monitoring display function.
2			If the panel display is not AF003, press ↑ & ↓ until it is PA100.
3			Press and hold SET to display the left figure.

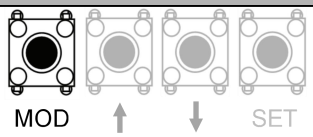
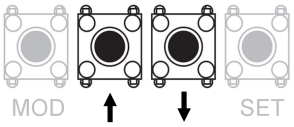
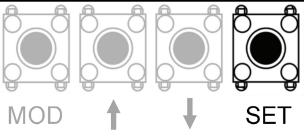
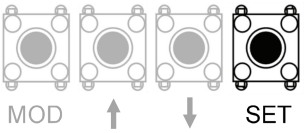
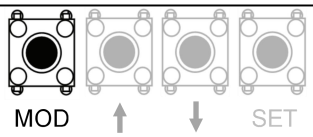
4			Long press SET to execute this auxiliary function. After executing this function, "donE" will flash and return to the display on the left.
5			Press MOD to exit from the auxiliary function and return to the display in step 2.
6	End of operations		

6.7 Initialization of Parameter Setting Values

Function to restore the parameters to the factory settings.

- Parameter setting value initialization should be performed in the servo OFF state. It cannot be executed in the servo ON state.
- To make the setting effective, the power to the servo drive should be turned back on after operation.

The procedures are shown below.

Steps	Panel display	Keys	Operations
1			Press MOD key to choose monitoring display function.
2			If the panel display is not AF005, press ↑ & ↓ until it is PA100.
3			If the servo is not running, press and hold SET to display the figure on the left.
4			If the servo is running or the panel lock is set (AF003), the panel will display the left figure, indicating that this auxiliary function cannot be operated.
5	 (flashing display)		Long press SET to execute this auxiliary function. After executing this function, "donE" will flash and the servo will return to the previous interface.
6			Press MOD to exit from the auxiliary function and return to the display in step 2.
7	Power on again		
8	End of operations		

6.8 Programmed JOG Run (AF00A)

Programmed JOG operation is a function to set and execute continuous operation determined by the pre-set operation mode, travel distance, migration velocity, acceleration/deceleration time, wait time, and number of moves.

This function is the same as JOG run (AF002); it is possible to confirm the movement of the servo motor and execute a simple positioning action without connecting the upper controller when setting.

(1) Preparing for JOG run

Before programmed JOG run, the following settings are necessary.

- Set the correct travel distance and migration velocity, taking into account the operating range of the machine to be used and the safe migration velocity.
- Make the servo drive in servo ready state.
- If the S-ON input signal is ON, switch it to OFF.

(2) Notes and supplementary items

(Note) The programmed JOG run is a position-controlled operation, but it cannot be used because pulse input to the servo drive is prohibited (INHIBIT).

<Supplement>

- The function that can be used by position control, such as position command filtering, can be performed.
- The overtravel prevention function is available.

(3) Related parameters

The parameters that can be set by the programmed JOG run are shown below.

PA5A0	**Programmed JOG run switch**			
	Range	Setting unit	Default	Effective
	0000～0005	--	0000	Immediate
	0000	(Waiting time PA5A5 → forward movement PA5A1) × number of moves PA5A6		
	0001	(Waiting time PA5A5 → reverse movement PA5A1) × number of moves PA5A6		
	0002	(Waiting time PA5A5 → forward movement PA5A1) × number of moves PA5A6 (Waiting time PA5A5 → reverse movement PA5A1) × number of moves PA5A6		
	0003	(Waiting time PA5A5 → reverse movement PA5A1) × number of moves PA5A6 (Waiting time PA5A5 → forward movement PA5A1) × number of moves PA5A6		
	0004	(Waiting time PA5A5 → forward movement PA5A1) × → waiting time PA5A5 → reverse movement PA5A1) × number of moves PA5A6		
	0005	(Waiting time PA5A5 → reverse movement PA5A1) × → waiting time PA5A5 → forward movement PA5A1) × number of moves PA5A6		

PA5A1	Programmed JOG travel distance			
	Range	Setting unit	Default	Effective
	1～1073741824	1 input pulse	32768	Immediate
PA5A3	**Programmed JOG migration velocity**			
	Range	Setting unit	Default	Effective
	1～6000	1rpm	500	Immediate
PA5A4	**Programmed JOG acceleration/deceleration time**			
	Range	Setting unit	Default	Effective
	10～10000	1ms	100	Immediate
PA5A5	**Programmed JOG waiting time**			
	Range	Setting unit	Default	Effective
	0～10000	1ms	100	Immediate
PA5A6	**Programmed JOG number of moves**			
	Range	Setting unit	Default	Effective
	0～1000	1	1	Immediate

(4) Setting method of infinite run

● If PA5A0.0=0, 1, 4, or 5, set the number of moves (PA5A6) of programmed JOG to "0" for infinite run.

● To end the infinite run, press MODE to turn the servo OFF.

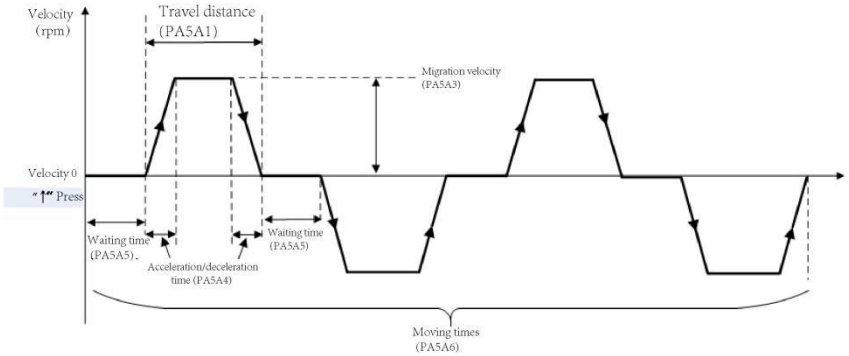
(Note) When PA5A0.0=2,3, infinite run is not possible.

When PA5A0.0=0, 1, only one direction of run is possible continuously. Please pay attention to the operating range.

(5) Programmed JOG run mode

An example of the program JOG run mode is shown below. The following assumes that the motor rotation direction is set to PA000.0=0 (forward rotation at the forward rotation command).

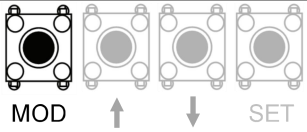
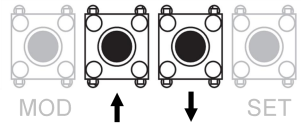
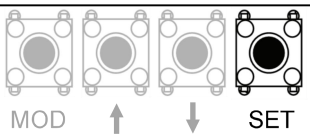
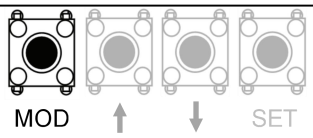
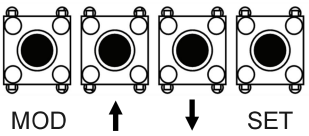
Here, only the setting at PA5A0.0=4 is explained.

PA5A0.0=4	(Waiting time PA5A5 → forward movement PA5A1) × → waiting time PA5A5 → reverse movement PA5A1) × number of moves PA5A6
Velocity graph	

（6）JOG run procedures

After setting the program for JOG run, proceed as follows to run the programmed JOG.

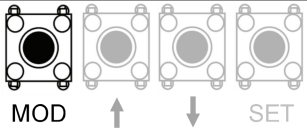
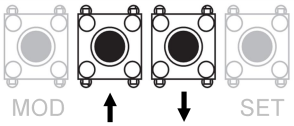
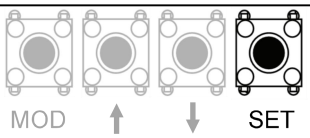
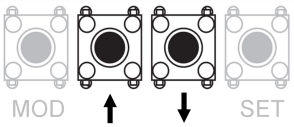
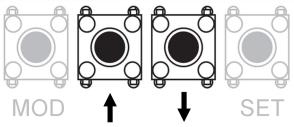
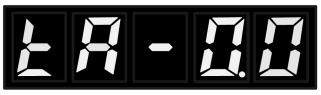
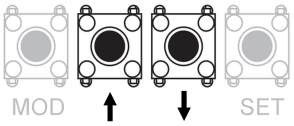
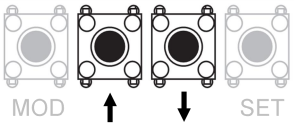
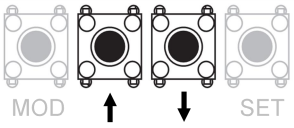
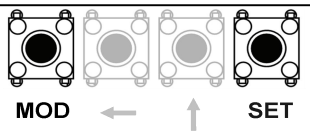
Steps	Panel display	Keys	Operations

1			Press MOD key to choose monitoring display function.
2			If the panel display is not AF00A, press ↑ & ↓ until it is PA100.
3			Press SET to display the left figure.
4			Press MODE to make the servo ON, and the left figure is displayed.
5			Press the ↑ or ↓ that matches the initial action direction of the run mode. then the run starts after the set waiting time. <Supplement> If the MODE is pressed during run, the SOFF state is entered and the motor stops. If the SET is pressed and held for about 1 second during run, it returns to step 2.
6			If the programmed JOG is finished, the display flashes "End" and returns to the step 4. <Supplement> If the MODE is pressed during run, the SOFF state is entered and the display returns to step 3. If the SET is pressed and held for about 1 second during run, it returns to step 2.
7	End of operations		

6.9 Display of Main Software Version of Servo Drive (AF010)

The function to display the software version of the servo drive and encoder.
The procedures are shown below.

Steps	Panel display	Keys	Operations

1			Press MOD key to choose monitoring display function.
2			If the panel display is not AF010, press ↑ & ↓ until it is PA100.
3			Press and hold SET to display the left figure. Then the software version 1.10 of Chip A of the servo drive is displayed.
4			Press "↑" again to display the software version 1.01 of Chip B of the servo drive.
5			Press "↑" again to display the software version 1.02 of Chip C of the servo drive.
6			Press "↑" again to display the software test version 0.0 of Chip A of the servo drive.
7			Press "↑" again to display the software test version 0.1 of Chip B of the servo drive.
8			Press "↑" again to display the software test version 0.1 of Chip B of the servo drive.
9			Press MOD key or hold SET key to exit, and display step 2.
10	End of operations		

6.10 Vibration Detection Value Initialization (AF021)

This function is to automatically set the vibration detection value (PA312) in order to detect the vibration alarm (E.A20) and the vibration warning (A.91A) more accurately after detecting the mechanical vibration in the running state.

Vibration detection switch PA310:

Paramete		Meaning	Effective	Category
PA310	n.□□□0	Vibration is not automatically detected.	Immediate	Setting
	n.□□□1	Warning after detection(A.91A)。		
	n.□□□2	Alarm after detection(E.A20)。		

When the detected value is obtained by the following formula,

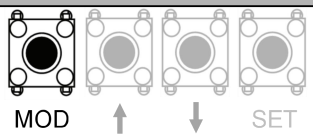
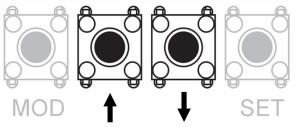
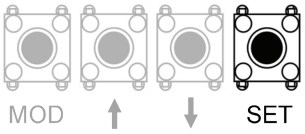
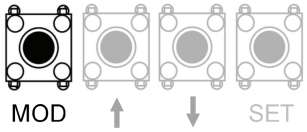
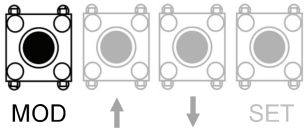
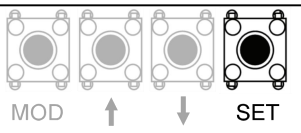
$$\text{Detected value} = \frac{\text{Vibration detected value}(PA312[rpm]) * detection\ sensitivity\ \ (PA311[\%])}{100}$$

Notes:

● This function can only be used when the "Vibration Alarm (E.520)" or "Vibration Warning (A.91A)" is not correctly at the factory setting.

● Depending on the state of the machine used, the detection sensitivity of vibration alarms and vibration warnings may vary. In this case, please refer to the above detection formula to finely adjust the vibration detection sensitivity (PA311).

（1）JOG run procedures

Steps	Panel display	Keys	Operations
1			Press MOD key to choose monitoring display function.
2			If the panel display is not AF021, press ↑ & ↓ until it is PA100.
3			Press and hold SET to display the left figure. (Note) When set to disable writing, "no_oP" will flash for about 1 second. Please set the AF003 to the writable state before operating.
4			Press the MOD button, display on the left will flash, and the vibration value will be detected and updated. This will continue until the MOD button is pressed again. (Note) ● Please control the operation with the actual command used. ● When the servo motor is running at a maximum velocity of 10% or less, "Error" will be displayed.
5	 (flashing display)		Press the MOD button again at the appropriate time to end the checkout and update for the settings to take effect. "donE" is displayed after the setting is completed normally. "Error" is displayed when the setting cannot be completed normally
6			Long press SET to exit to Step 2.
7	End of operations		

(2) Related parameters

PA311	Vibration detection sensitivity				Category
	Range	Setting unit	Factory	Effective	
	50 ～ 500	1 %	100	Immediate	Automati

PA312	Vibration detection value				Category
	Range	Setting unit	Factory	Effective	
	0 ～ 5000	rpm	50	Immediate	Automati

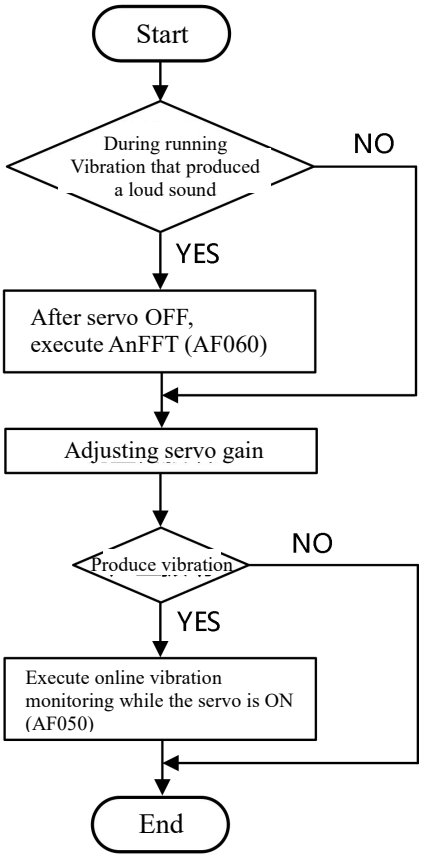
6.11 Vibration Monitoring (AF050)

After the vibration occurs in the machine, if the notch filter or the torque command filter is set according to the vibration frequency, there is a certain effect on eliminating the vibration.

The vibration frequency of the noise generated by mechanical resonance or the like is detected online, and the frequency of the peak large vibration is displayed on the operator. For this frequency, an effective torque command filter or notch filter frequency is automatically selected and the relevant parameters are automatically set.

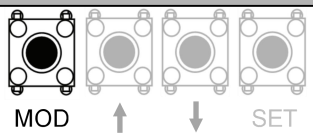
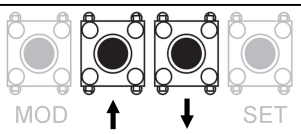
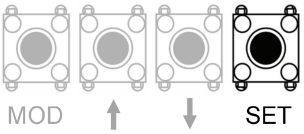
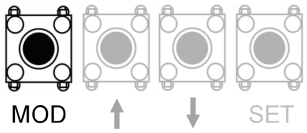
The FFT analysis (AF060) function also detects mechanical vibrations and automatically sets the notch filter. Please judge which function to use according to the flowchart below.

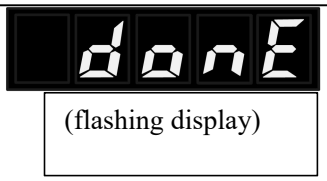
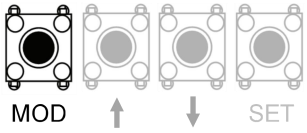
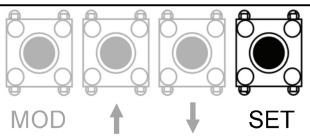
When adjusting servo gain



（1）JOG run procedures

The procedures are shown below.

Steps	Panel display	Keys	Operations
1			Press MOD key to choose monitoring display function.
2			If the panel display is not AF050, press ↑ & ↓ until it is PA100.
3			Press and hold the SET button for about 1 second, and the display will appear as shown in the figure on the left. (Note) When set to disable writing, “no_oP” will flash for about 1 second. Please set the AF003 to the writable state before operating.
4	 Flashing		Press the SET key, then "...." is displayed flashing and the checkout starts automatically.

5			"....." stops flashing and the checkout ends. If the detection is normal, the detection result is displayed. The displayed vibration frequency is the frequency at the maximum peak. If you only check the vibration frequency without setting the detection result, you must press the MOD. When setting the detection result, you must advance to step 6. (Note) If the frequency detection fails, "F----" is displayed. If the checkout process does not finish properly, "no_oP" is displayed.
6	 (flashing display)	 MOD SET	Press the SET button to automatically set the most suitable notch filter frequency or torque command filter time parameter for that frequency. If it is set properly, "donE" is displayed with a flashing light.
7		 MOD SET	Press and hold the SET for about 1 second to return to the display of "AF050".
8	End of operations		

2) Related parameters

The relevant parameters are shown below.

PA401	The first-stage torque command				Category
	Range	Setting unit	Factory setting	Effective	
	0 ～ 65535	0.01 ms	100	Immediate effect	Automatic

Par		Mea	Effective	Cat
PA408	n.□□□0	Invalidate the first-stage notch filter. (Factory	Immediate effect	Setting
	n.□□□1	Validate the first-stage notch filter.		
	n.□0□□	Invalidate the second-stage notch filter.		
	n.□1□□	Validate the second-stage notch filter.		

PA409	The first-stage notch filter frequency				Category
	Range	Setting unit	Factory	Effective	
	50 ～ 5000	1 Hz	5000	Immediate	Aut

6.12 FFT Analysis (AF060)

The AnFFT transmits the periodic waveform command from the servo drive to the servo motor, and the servo motor is slightly rotated a few times for a certain period of time to cause the machine to vibrate. The servo drive detects the resonance frequency based on the vibration generated by the machine, and then sets the corresponding notch filter according to the resonance frequency. The notch filter effectively removes high frequency vibrations and noise.

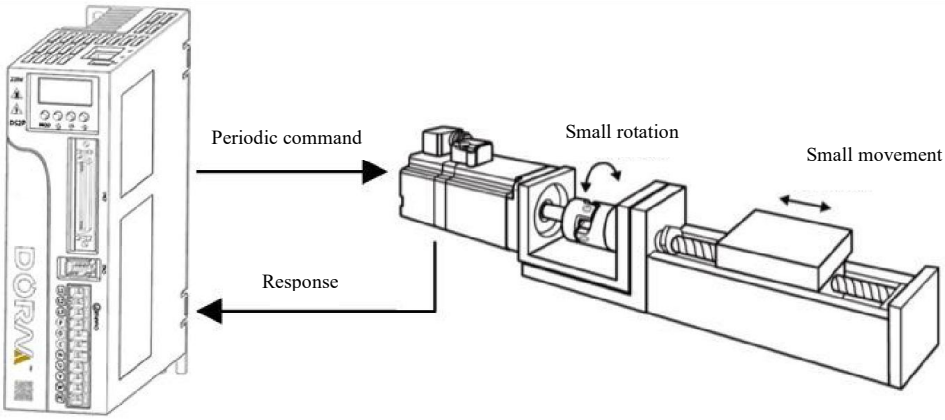
Danger

- The servo motor rotates slightly during the AnFFT. Do not touch the servo motor and machine during execution. Otherwise, there may be injuries.

Important

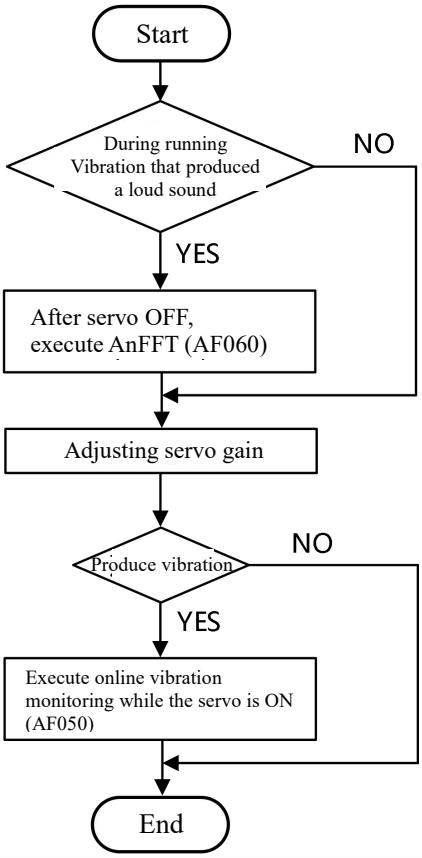
- The AnFFT function must be used in a state where the gain is low in the initial stage of servo adjustment. Execute if a higher gain is set
- AnFFT function, which may be subject to vibration due to mechanical characteristics and gain balance.

When the mechanical vibration occurs, if the notch filter is set according to the vibration frequency, there is a certain effect on eliminating the vibration.



"Online vibration monitoring (AF050) " function also detects mechanical vibrations and automatically sets the notch filter. Please judge which function to use according to the flowchart below.

When adjusting servo gain

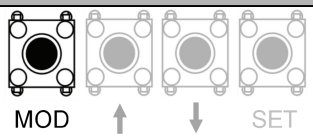
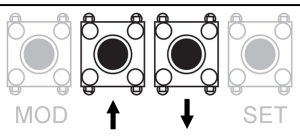
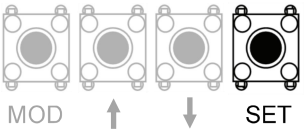


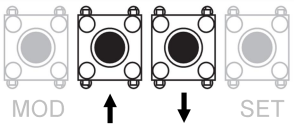
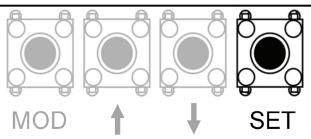
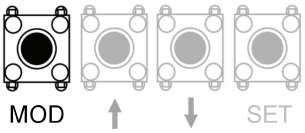
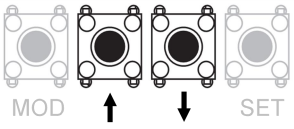
Important

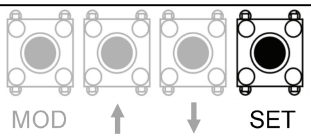
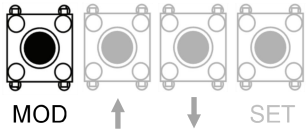
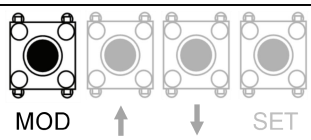
- This function should be operated in the servo OFF state.
- When this function is used, a dedicated command is output from the servo drive. Do not enter commands from the outside.

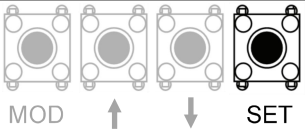
（1）Steps

The procedures are shown below.

Steps	Panel display	Keys	Operations
1			Press MOD key to choose monitoring display function.
2			If the panel display is not AF060, press ↑ & ↓ until it is PA100.
3			Press and hold the SET button for about 1 second, and the display will appear as shown in the figure on the left. Enter the command amplitude setting mode.

			(Note) When set to disable writing, “no_oP” will flash for about 1 second. Please set the AF003 to the writable state before operating.
4			Press the "↑" or "↓" to set the command amplitude. Command amplitude setting range: 1 ~ 800 (Note) ● When setting AnFFT for the first time, the setting of the command amplitude is not changed, starting from the initial setting "12". If the command amplitude is increased, the detection accuracy will increase, but the vibration and noise generated by the machine will increase in a short time. When changing amplitude, the command increase the amplitude value gradually and change it while observing the situation. ● The set command amplitude is saved in PA456.
5			Long press SET to enter ready state.
6			Press the MOD to enter the servo ON state. <Supplement> At this time, to make the servo OFF, press the MODE again. Return to step 5.
7	 **(Flashing display)** **(small motor rotation)**		When the servo is ON, press the “↑” (forward) or “↓” (reverse) button, and the servo motor repeats forward and reverse several times within a maximum of 1/4 turn. The running time is about 2 seconds. The display on the left will flash during operation. (Note) ● When the action is aborted, press the MOD button to return to step 5. ● The servo motor moves slightly and emits an action sound. For safety reasons, do not approach the mechanical range of motion.

8			When the detection processing is completed normally, the "AnFFt" display stops flashing and the detected resonance frequency is displayed. If the checkout fails, "F----" is displayed. If only the resonance frequency is confirmed and the detection result is not set, press the SET button to exit to step 9. When setting the detection result, you must advance to step 10. <important> Even if the detection ends normally, if the run time exceeds 2 seconds, the detection accuracy may not be sufficient. If the command amplitude is increased to a value slightly larger than "15" and then executed again, the detection accuracy may increase. However, after the command amplitude is increased, the vibration and noise generated by the machine become large in a short time. When changing amplitude, the command increase the amplitude value gradually and change it while observing the situation.
9			Long press SET to let servo enter OFF state.
10	 (flashing display) ↓ **PA408=n.□□□ 1** **PA409=615 (Hz)** 		Pressing the MOD key automatically sets the notch filter that is most appropriate for the detected resonant frequency. When the notch filter is normally set, "donE" flashes. When the first-stage notch filter frequency is set, the second-stage notch filter frequency (PA40C) is automatically set at (PA408=n. □ □□1). (Note) If the second-stage notch filter frequency is set, the notch filter frequency can no longer be set at (PA408=n. □1□□). When not using the notch filter frequency detected by this function, set PA408=n. □□□0 (notch filter is invalid).
11	 (Ready to run status)		Press MOD to return to ready state.

12			Press and hold the SET for about 1 second to return to the display of "AF060".
13	At the end of operation, the drive needs to be re-powered in order for the settings to take effect.		

(2) Related parameters

The relevant parameters are shown below. These parameters will be set automatically, so there is no need to set them manually.

Parameter		Meaning	Effective	Category
PA408	n.□□□0	Invalidate the first-stage notch filter. (Factory	Immediate effect	Setting
	n.□□□1	Validate the first-stage notch filter.		
	n.□0□□	Invalidate the second-stage notch filter. (Factory		
	n.□1□□	Validate the second-stage notch filter.		

PA409	**The first-stage notch filter frequency**				
	Range	Setting unit	Factory setting	Effective	Category
	50 ～ 5000	1 Hz	5000	Immediate	Automatic
PA40C	**The second-stage notch filter frequency**				
	Range	Setting unit	Factory setting	Effective	Category
	50 ～ 5000	1 Hz	5000	Immediate	Automatic
PA456	**Scan torque command amplitude**				
	Range	Setting unit	Factory setting	Effective	Category
	1 ～800	1 %	15	Immediate	Automatic

Chapter 7 JOG Run

7.1 Preparations Before JOG Run

To ensure safe and proper JOG run, please check and confirm the following items in advance.

Item	What to check
Servo motor	Whether the motor has been released from load?
	Whether the wiring and connection are correct?
	Whether the fastening parts are loose?
	If the servo motor has a holding brake, whether the brake has been released in advance? When disengaging the brake, a specified voltage (usually DC24V) must be applied to the brake
Servo drive	Whether the wiring and connection are correct?
	Whether the input voltage to the servo drive is stable?

7.2 JOG Run by Panel Operations

The following explains the execution procedure for JOG run via the panel operator.

● JOG run is the function to confirm the servo motor action through velocity control without connecting to the upper controller.

● During JOG run, the overtravel prevention function is inactive. User shall pay close attention to mechanical movement of the machinery caused by JOG run.

(1) Preparing for JOG run

Before JOG run, the following settings are necessary.

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

● Please set the JOG speed after considering mechanical movement of the machinery. JOG speed can be set by PA304.

（2）JOG run procedures

For the procedure of JOG operation, see 6.4.

7.3 Stand-alone JOG Run with Upper Controllers

Please check the following items before JOG run by command from upper controllers:

Item	What to check
1	Whether the servo motor movement command and input and output signals input from the upper controller to the servo drive are set correctly?
2	Whether the connections between upper controller and servo drive is correct and whether the polarities are set correctly?
3	Whether the servo drive action is set correctly?

7.3.1 Wiring & status check of input signal circuit

To perform JOG run of velocity control and position control according to the upper command, you need to perform the connection confirmation as shown in step 1 below.

Follow the steps below to confirm the connection and status of the input signals.

Steps	Operations	Reference
1	Connect the input signal circuit required for the JOG run to the input/output signal connector (CN1). The following conditions must be met when connecting. ● The servo ON input signal (S-ON) is available for input. ● Prohibit forward drive (POT) and prohibit reverse drive (NOT) input signal ON (L level) (Forward and reverse drive available)	3.4
2	Connect the connector of the upper controller to the input/output signal port (CN1).	
3	Turn on the power to the servo drive. Confirm that "Power Ready" on the panel operator is lit. Confirm the status of the input signal by input monitoring (dP012).	4.3
4	Input the S-ON signal to turn the servo ON. Verify that the "Run flag" on the panel operator is displayed correctly.	4.3
5	The JOG run is now ready. Continue with the JOG run for each control mode.	

7.3.2 JOG run in position control mode

The following explains the JOG run method for position control. This section describes the JOG run procedure after the input signal for position control is wired.

Steps	Operations	Reference
1	Reconfirm the power supply and input signal circuit and then switch on the	3.1

	control power supply of servo drive.	
2	Use PA200.0 to set the input pulse form.	8.4.1
3	Set the input pulse; set the electronic gear ratio and the number of divisions PA212 according to the upper controller via PA20E and PA210.	8.4.2 8.5.7
4	Power on again. Make the parameter changes in step 3 effective. Turn on the main circuit power of the servo drive.	
5	Set the servo ON (S-ON) input signal to ON.	
6	Output low velocity pulse command from the upper controller with easily confirmed motor rotation (such as: 1 turn).	
7	Monitor the amount of pulse change before and after the command according to the input command pulse counter (dP003), to confirm the number of command pulses input to the servo drive.	5.1
8	Monitor the amount of pulse change before and after the command according to the feedback pulse counter (dP001) to confirm the actual rotation of the motor.	5.1
9	Confirm whether the servo motor rotates in the direction given by the command.	
10	Check whether the number of feedback pulse corresponds with the expected number. Feedback pulse number = dP001*PA212*4/ encoder resolution (dP032)	5.1
11	Stop the pulse command and make the servo OFF.	

7.4 JOG Run with Mechanical Connections

After stand-alone JOG run, user can then proceed to JOG run with mechanical connections.

Steps	Item	What to check	Reference
1	Parameter setting 1	Power on and conduct the setting related to the safety functions, overtravel and brake protection functions.	3.1 8.2
2	Parameter setting 2	Set the necessary parameters according to the control mode used.	
3	Installations	Power OFF and connect the servo motor with the mechanical parts.	
4	Check	Power on upper controller but keep the servo OFF, and then confirm whether the protection functions set in Step 1 function normally.	
5	Servo operations	Conduct JOG run same way as Chapter 7.3. Confirm the JOG run result is up t expectations with mechanical connections.	—
6	Gain adjustment	Adjust the servo gains (if necessary) to improve the response characteristic of servo motor. (Note) During the JOG run, the servo motor may not adapt to the machine well at the beginning. Please conduct fine tune to make them adapt to each other.	—
7	S-ON signal input	Then, the JOG run is finished.	Command from

			the top

7.5 JOG Run with a Holding Brake

Observe the following precautions for JOG run with a holding brake.

Item	What to check
1	When conducting JOG run of the servo motor with a brake, before confirming the action of brake, measures to prevent the natural fall or vibration due to external force of the machine shall be taken.
2	When conducting the JOG run of servo motor with a brake, please first of all confirm the action of servo motor and holding brake before connecting the servo motor with the machine. If there are no problems, conduct the JOG run again by connecting the servo motor with the machine.
3	Please control the action of the holding brake BK signal.

Chapter 8 Servo Operations

8.1 Control Mode Selections

The following is an explanation of the control methods (control modes) that can be performed by the DS2P series servo drives.

Parameter		Control mode	Reference
PA000	**n.□□0□ [Default]**	**Position control (pulse train command)** The position of servo motor is controlled through the pulse train position command. The position is controlled through the pulse number inputted, and velocity is controlled through the frequency of input pulse. It is used when the action needs to be positioned.	8.4
	n.□□2□	**Torque control** Use 2 input signals, INTor0, INTor1, for velocity control through the 3 preset velocities in the servo drive. When this control mode is used, the analog command is not needed.	8.6

	n.□□3□	**Velocity control (Internal setting velocity selection)** Use 2 input signals, INSPD0, INSPD1, for velocity control through the 3 preset velocities in the servo drive. When this control mode is used, the analog command is not needed.	8.5
	n.□□5□	**Velocity control and position control switching** Use IO to switch between velocity control mode and position control mode.	8.8
	n.□□6□	**Velocity control and torque control switching** Use IO to switch between velocity control mode and torque control mode.	8.8
	n.□□8□	**Position control and torque control switching** Use IO to switch between position control mode and torque control mode.	8.8
	n.□□A□	**Programmed JOG control** Use the same as AF00A.	6.8
	n.□□C□	**Internal position control** Use 4 input signals, INTor0, INTor1, INTor2, INTor3, for position control through the 16 preset velocities in the servo drive. When this control mode is used, the analog command is not needed.	8.7

8.2 Basic Function Settings

8.2.1 S-ON settings

Set the servo ON signal (S-ON) for commanding the servo motor power-on/non-power-on status.

(1) S-ON signal (S-ON)

Type	Signal	Status	Level	Reference
Input	S-ON	ON	CN1-40: L level (default)	Servo is ON & ready for operations.
		OFF	CN1-40: H level	Servo is OFF.

(2) Selection of S-ON level

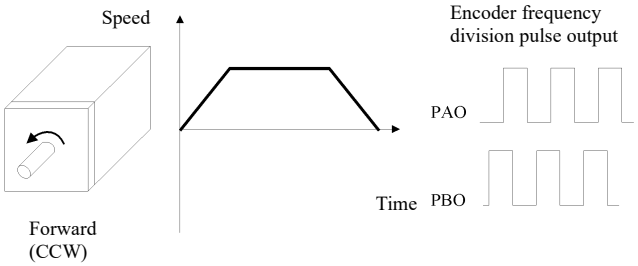
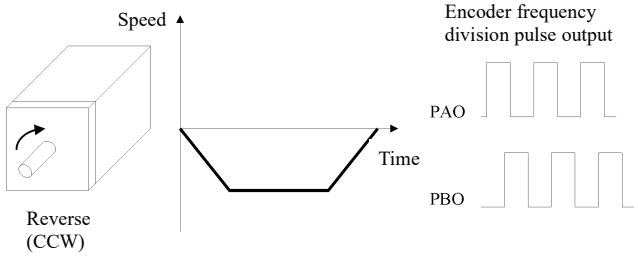
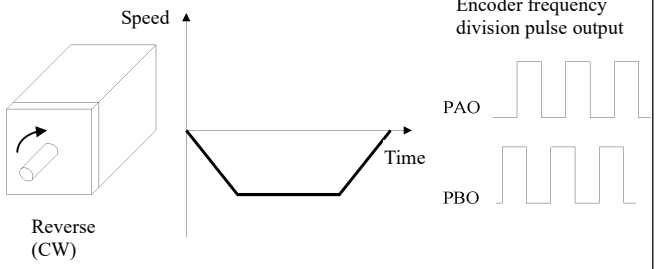
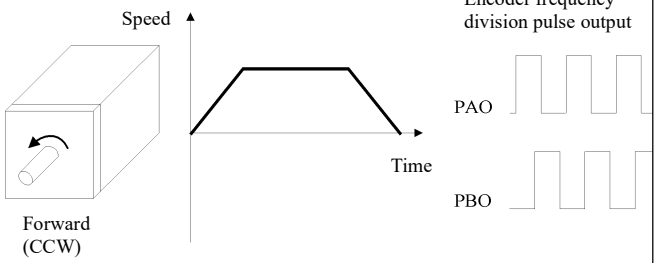
The input level can be selected by user parameters. That is, the valid level of the servo ON signal (CN1-40) is set.

Parameter		Remarks
PA500	n.□0□□	The S-ON signal input from input terminals CN1-40 is active low. (Default)
	n.□1□□	The S-ON signal input from input terminal CN1-40 is active high.

8.2.2 Switch of motor rotational directions

The servo drive can enable the servo motor to rotate reversely (negative rotation mode) without changing the wiring of servo motor.

The standard setting of "positive direction" is "counterclockwise rotation (CCW)" from the load side of the servo motor. In this case, the "positive direction" is "clockwise rotation" from the load side of the servo motor. At this time, the direction of movement of the axis (+, -) reverses, and note that the polarity of the output signal of the servo drive can be modified to reverse the corresponding parameters if it is to remain unchanged.

<table>
<tr><th colspan="2">Parameter</th><th>Commands</th><th>Overtravel (OT)</th></tr>
<tr><td rowspan="2">PA000</td><td rowspan="2">n.□□□0
Standard setting
(Positive rotation command is positive rotation, CCW direction)
(Default)</td><td>■ Action at positive command
 
</td><td>Positive rotation:
Stop by POT</td></tr>
<tr><td>■ Action at negative command
 
</td><td>When negative:
Stop by POT</td></tr>
<tr><td rowspan="2">n.□□□1
Negative mode
(Positive rotation command is negative rotation, CW direction)</td><td>■ Action at positive command
 
</td><td>When negative:
Stop by POT</td></tr>
<tr><td>■ Action at negative command
 
</td><td>Positive rotation:
Stop by POT</td></tr>
</table>

8.2.3 Overtravel settings

Overtravel refers to the safety function which can make the limit switch function (ON) and force the servo motor to stop when the moving parts of a machine go beyond the movable area.

Attention

Installation of limit switches

Limit switches must be installed in applications such as linear motions.

When the limit switch has bad contacts or broken wires, please use 'normally closed nods' to ensure the motor moves to the safer side.

Use of servo motors in vertical axis

Work piece might fall when overtravel. To prevent this, please set the servo into Zero-speed clamp when overtravel.

(1) Wiring for overtravel

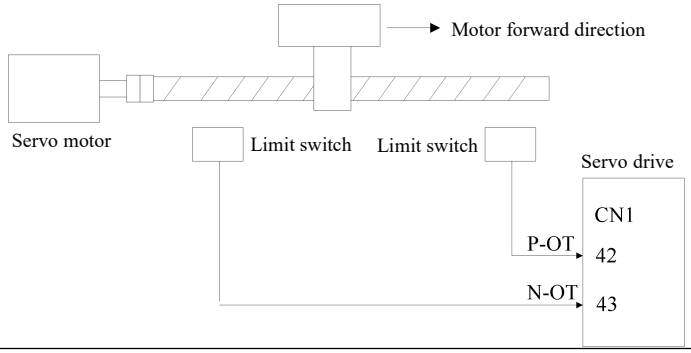
In order to use the overtravel function, connect the input signal of the overtravel limit switch described below correctly to the corresponding pin number of the CN1 connector of the servo drive.

Type	Signal name	Connector pin no.	Setting	Meaning
Input	POT	CN1-42 (Default)	ON=L level	Can forward run (normal run)
			OFF=H level	Forward run prohibited (positive overtravel)
Input	NOT	CN1-43 (Default)	ON=L level	Can reverse run (normal run)
			OFF=H level	Reverse run prohibited (negative overtravel)

In the case of linear drive, etc., be sure to connect the limit switches as shown in the figure below to prevent mechanical damage.

When in overtravel, servo can still move in the opposite direction.

For example, in the state of positive overtravel, it can be driven to the reverse side.



■Important

*There might be position deviation pulse residual at overtravel in position control. To clear the residual, use CLR signal.

*POT, NOT can be allocated to other Pins. For details, refer to "3.4.3 Allocation of I/O signals".

*To use POT and NOT signals, make POT and NOT signals active (configure PA500 to PA505).

(2) Selection of servo stop patterns at overtravel

Set the stop method when the overtravel (POT, NOT) signal is input during the rotation of the servo motor (note that some drive models do not have the DB brake function).

Parameter		During stop	After stop	Meaning
PA001	n.□□□0	DB to stop (hold)	DB state	Quick stop by DB (dynamic brake), and DB status is maintained after the servo motor stops.
	n.□□□1	DB to stop	Coast state	Quick stop by DB (dynamic brake), and the servo motor stops and enters the coast state

				(non-energized).
	n.□□□2	Coast to stop	Free state	Free state stops; servo motor will also change to free state after stopping.
	n.□□□3	Torque to stop	Free state;	Decelerate and stop the motor by using the set torque of PA406 as the maximum value; when the velocity drops to PA666 or the time is greater than PA667, the motor is in the free state.
	n.□□1□	Decelerate to stop	Zero-speed clamp state	Use emergency stop torque (PA406) to decelerate and enter zero-speed clamp state after stop.
	n.□□2□		Coast state	Use emergency stop torque (PA406) to decelerate and enter coast state (non-energized) after stop.

● After changing this user parameter, the power should be restarted to make the setting effective.

● If the servo receives S-ON signal during coast to stop, the servo motor can only be controlled after the velocity has decelerated to 0.

■ Definitions

● DB：dynamic brake (internal short-circuit of servo drive). (Standard servo products do not come with DB)

● Coast to stop: instead of DB braking, natural stopping is performed by the frictional resistance of the motor rotation.

● Decelerate to stop: the stop of torque using a deceleration (brake).

● Zero-speed clamp state: the state when position command is 0 Under the the zero-speed clamp state, the position deviation is cleared.

* Refer to "8.2.5 Selection of servo stop patterns at servo OFF" for the stop method when the servo is turned off and an alarm occurs.

(4) Stop torque setting during overtravel

PA406	Emergency Stop Torque			
	Range	Setting unit	Default	Effective
	0～400	1%	400	Immediate

● Set the torque for motor stop when the overtravel signals (POT, NOT) are valid.

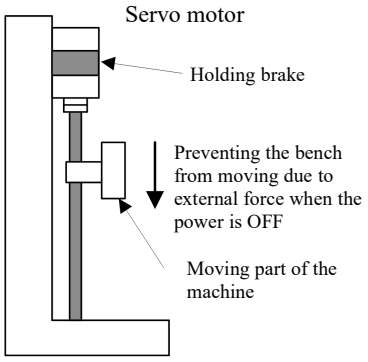
● The setting unit is the % of the rated torque. (the rated torque is 100%)

The factory setting is "400%". This is the value that is large enough to make sure that the servo motor outputs the maximum torque. However, the actual effective emergency stop torque maximum limit is the maximum torque of the servo motor.

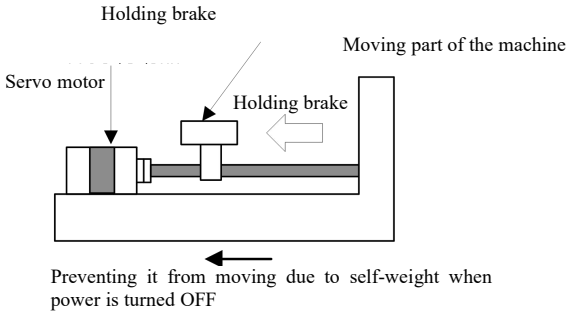
8.2.4 Holding brake settings

The holding brake is often used when the motor is used in the vertical axis. When the power of servo drive is OFF, the servo motor with a brake can keep the moving parts from moving due to gravity. (Please refer to Chapter 7.5 JOG run with a holding brake)

■ Vertical axis



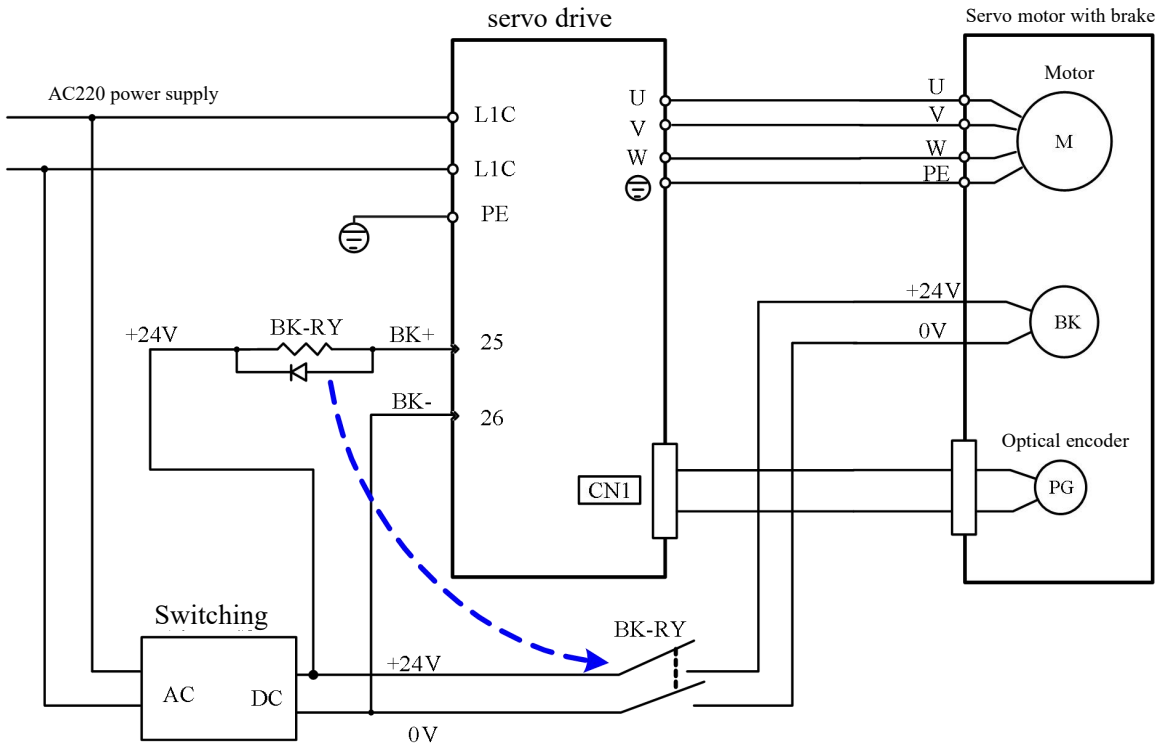
■ Axis receiving external force



1. The holding brake can only be used to maintain the halt state, not braking, of the servo motor. The brake torque is 70% or above of the rated torque of servo motor.
2. If only the velocity loop is used to activate the servo motor, when the brake functions, set the servo OFF and input command to be "0V".
3. When setting the position loop, because the servo motor is under servo locked state at stop, the mechanical brake shall not function.

(1) Example of connection

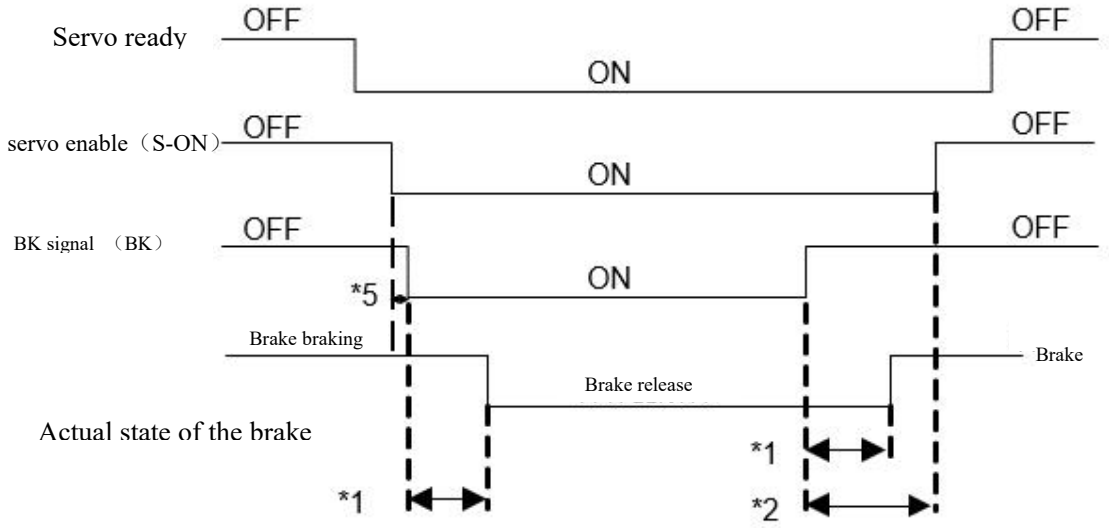
The sequential output signal of servo drive (BK) and brake power supply forms the ON/OFF of the brake. Standard connection of a circuit is illustrated as follows.



1. BK-RY: the relay for brake control.
2. The current provided by switching power supply should be determined by the brake; different brakes have different working currents. Normally, the DC24V of switching power supply shall be provide the current >1A;
3. DC24V input of the brake is not restricted by direction.
4. To control relay (at the circle in the above figure), a relay with a current-continuing diode should be selected, or a reverse diode (PN 1N4002) at the relay coil should be added, otherwise it may cause damage to the drive; also, pay attention to the polarity of the diode, which may also cause damage to the drive if placed in the wrong

position;

The brake has delay action time; please refer to the figure below for the order of ON and OFF of the action.



*1. The time from when the brake signal is valid to when the brake is opened varies depending on the type of brake;
*2. Please set the brake action and servo OFF time through PA516, PA517, and PA518.
3. Please be sure to turn off the brake power supply 1~2S after the motor stops
4. Please wait more than 200ms from turning on the brake power supply to command input.
*5. Please set the delay opening time of the servo enable brake through PA657.

(2) BK interlock output

Type	Signal name	Connector pin no.	Setting	Meaning
Output	BK	Need allocation	ON=L level	Brake release
			ON=H level	Brake holding

Use of the servo motor with a brake needs to control the output signal of brake. In addition, the output signal is not available in factory default setting. Therefore, it is necessary to allocate the output signal (setting of PA50X.01). Do not connect with it when the motor without a brake is used.

■Important

When overtravel, even the servo motor is powered off, no BK signal can output.

(3) Allocation of BK signal

Brake signal (BK) is allocated to DO4 (CN1-25, CN1-26) by default.

Parameter	Connector pin no.		Meaning
	+	-	
PA50A.01=03	CN3-31	CN3-32	BK signal output from CN3-31, CN3-32
PA50B.01=03	CN3-29	CN3-30	BK signal output from CN3-29, CN3-30
PA50C.01=03	CN3-27	CN3-28	BK signal output from CN3-29, CN3-30

PA50D.01=03	CN3-25	CN3-26	BK signal output from CN3-29, CN3-30

■Important

Please refer to "Chapter 3.4.3 Allocation of I/O signals" for the allocation method of other output signals of the servo drive.

(4) BK signal hysteresis time after Servo-OFF

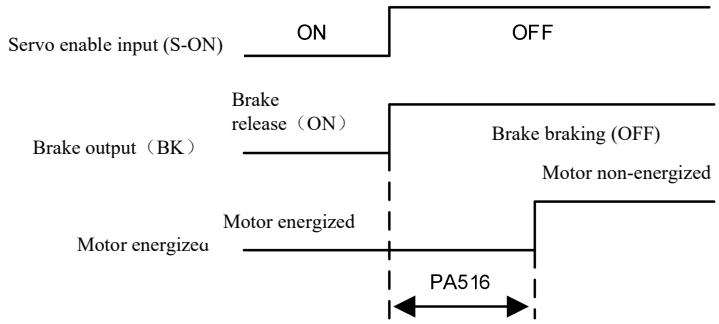
BK signal is normally OFF when servo OFF, but users can change the BK signal hysteresis time after Servo-OFF.

PA516	BK signal hysteresis time after Servo-OFF			
	Range	Setting unit	Default	Effective
	0～500	ms	0	Immediate

When used on a vertical axis, due to the timing of the brake ON, moving parts of the machine sometimes may move slightly due to deadweight or external force.

The slight movement may be eliminated by using the user parameter to delay the actions after the servo OFF.

Refer to "8.2.4(5) Setting of BK signal timing during the rotation of servo motor" for the brake action during the servo motor rotation.



■Important

When an alarm is given out, the servo motor will be immediately powered off, and the setting of this parameter becomes irrelevant.

Owing to the deadweight of machine moving parts or the external force, the machine sometimes may move before the brake functions

(5) Setting of BK signal timing during the rotation of servo motor

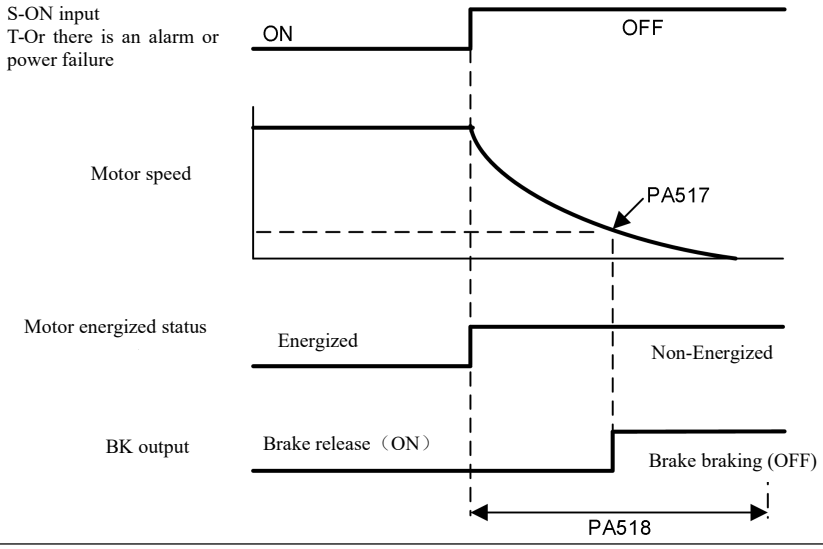
When a halt command is given to the rotating servo motor during servo OFF or an alarm, the output conditions of BK signal can be changed according to the following user parameters.

PA517	BK signal velocity limit			
	Range	Setting unit	Default	Effective
	0～1000	rpm	100	Immediate
PA518	BK signal waiting time at Servo-OFF			
	Range	Setting unit	Default	Effective
	0～5000	1ms	500	Immediate

BK signal output conditions during servo motor rotation

BK signal will be set to H level (BK ON) when any of the following conditions holds.

- The motor speed is below PA517 after servo OFF
- The waiting time exceeds PA518 after servo OFF



■Important

Even PA517 is set to be above the maximum velocity of the servo motor, the servo motor will be restricted by its own maximum velocity.

(6) BK OFF signal - Servo ON signal waiting time setting

If the vertical axis falls down during servo ON, the delayed OFF time of the BK signal can be changed according to the following user parameters.

PA657	BK signal - Servo ON signal waiting time			
	Range	Setting unit	Default	Effective
	0～1000	1ms	0	Immediate

8.2.5 Selection of servo stop patterns at servo OFF

Select the stop method when the servo drive is in the servo OFF state.

Parameter		Servo motor Stop pattern	Servo motor After stop	Meaning
PA001	n.□□□0	DB to stop (hold)	DB state	Quick stop by DB (dynamic brake), and DB status is maintained after the servo motor stops.
	n.□□□1	DB to stop	Coast state	Quick stop by DB (dynamic brake), and the servo motor stops and enters the coast state

				(non-energized).
	n.□□□2	Coast to stop	Free state	Free state stops; servo motor will also change to free state after stopping.
	n.□□□3	Decelerate to stop	Free state	Decelerate and stop the motor by using the set torque of PA406 as the maximum value; when the velocity drops to PA666 or the time is greater than PA667, the motor is in the free state.

This parameter is valid in following situations:

- When S-ON signal is OFF
- When there is an alarm output
- When main power (L1, L2, L3) is OFF

In the above setting "DB state maintenance after DB stops" of "n. □□□0", if the servo motor stops or rotates at a very low velocity, no brake force will be generated.

■ Definitions

● DB to stop：the dynamic brake (internal short-circuit of servo drive) is used to brake or stop.

● Coast to stop：instead of braking, natural stopping is performed by the frictional resistance of the motor rotation.

Dynamic brake (DB) can be used for emergency stop.

When the servo motor is frequently started and stopped through the power ON/OFF or servo ON signal (S-ON), DB circuit will also repeat ON and OFF frequently, which is the main cause for the aging of the interior components of the servo drive. Please start and stop the servo motor through the velocity input command and position control command.

8.2.6 Instantaneous power off settings

This is to set when the main power supply is OFF instantly, whether the motor shall go on operating or set to be servo OFF

PA519	**Instantaneous power off holding time**			
	Range	Setting unit	Default	Effective
	20～1000	1ms	20	Immediate

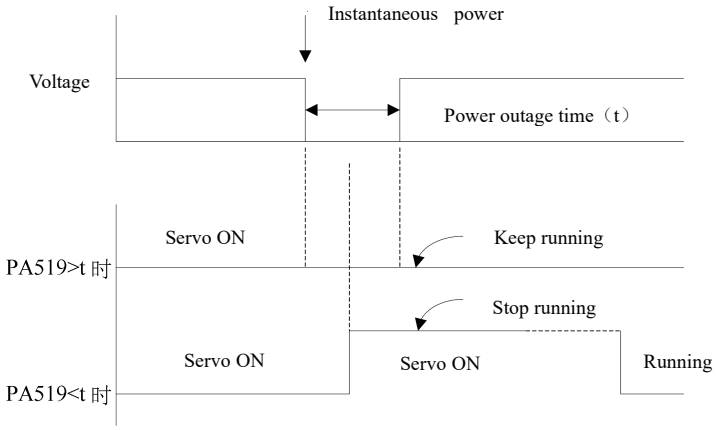
The detection of instantaneous power off is to detect the ON/OFF of the main circuit power supply.

If the OFF→ON resetting time is below the setting value of this parameter, the servo will keep on operating.

But under the following circumstances, the setting of this parameter will not become effective:

● The load of servo motor is too big,
which causes " under voltage alarm (E. 190) " during instantaneous power off;

● When the control power supply is out of control (the same to the usual power OFF operation) during the period of instantaneous power off.



■Important

The maximum holding time setting value is 1000ms during instantaneous power off, but the holding time of control power supply of the servo motor is about 100ms. The holding time of main power supply varies along with the output of servo drive.

Please use a UPS in order to go on controlling the servo drive if instantaneous power off time is beyond the maximum setting value of this parameter.

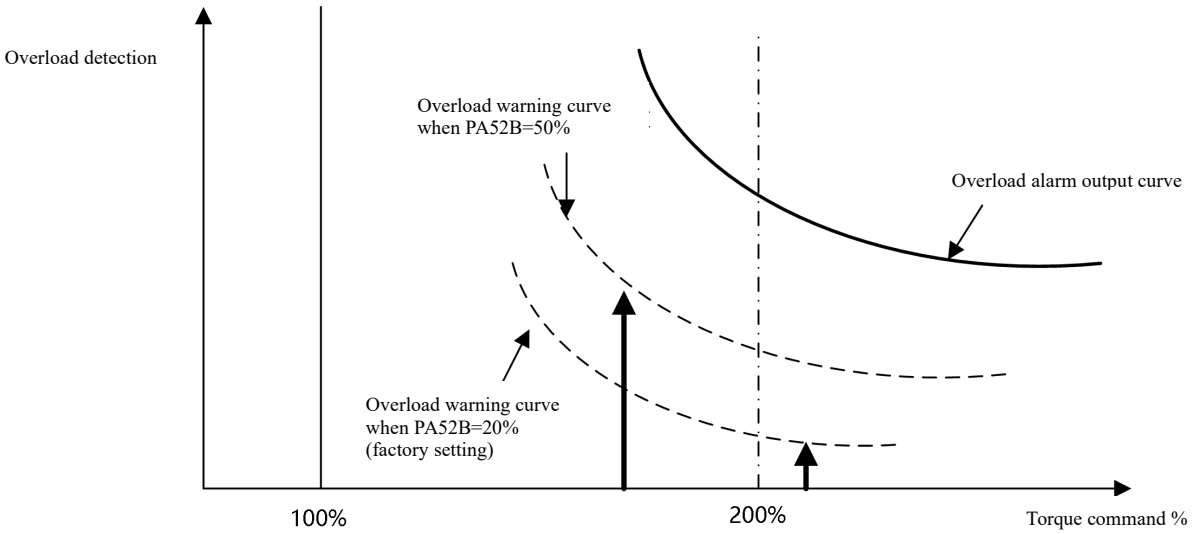
8.2.7 Motor overload detection value setting

This servo drive can change the detection time of overload warning (A.910) and overload alarm (continuous maximum load) (E. 130). However, the overload characteristics and the detection value of the overload alarm (instantaneous maximum load) (E.120) cannot be changed.

(1) Change of detection time of overload warning (A.910)

The overload warning detection time at the factory is 20% of the overload alarm detection time. By changing the overload warning value (PA52B), the overload warning detection time can be changed. Use this function as an overload protection function for your system to improve safety.

For example, as shown in the figure below, after changing the overload warning value (PA52B) from 20% to 50%, the overload warning detection time is half (50%) of the overload alarm detection time.



PA52B	Overload warning value			
	Range	Setting unit	Default	Effective

	1～100	1%	20	Immediate

(2) Change of detection time of overload alarm (E. 130)

Overload alarm (continuous maximum load) can be detected in advance to prevent motor overload.

By using the "base current after reduction of rated value" in the following formula to detect an overload alarm, the time for detecting the overload alarm can be shortened. The detected value of the overload (instantaneous maximum load) alarm (E. 120) cannot be changed.

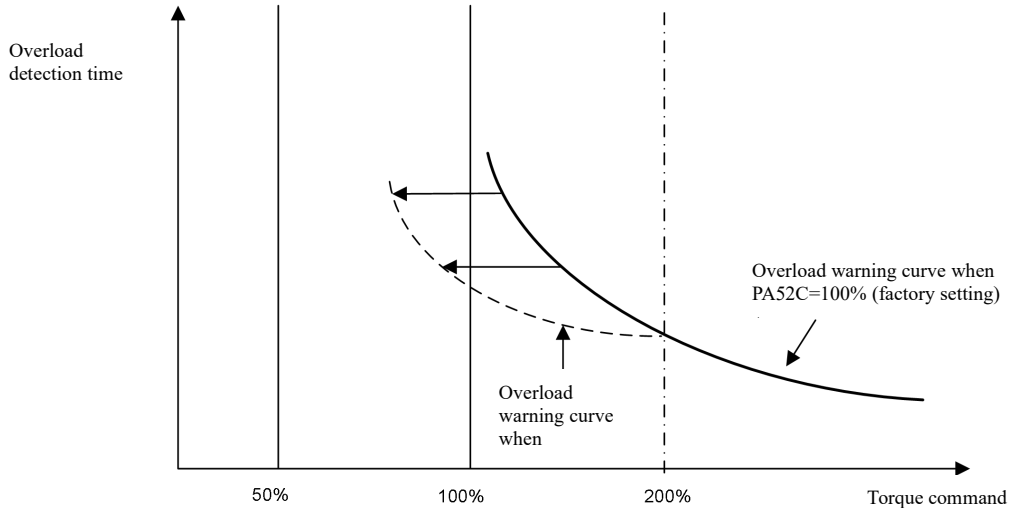
Motor base current × motor overload detection base current reduction rating (PA52C)
= Motor base current after derating

Motor base current: Starting calculation of motor current threshold for overload alarm
Motor overload detection base current rating reduction (PA52C): Rate of motor base current reduction

For example, as shown in the figure below, after setting PA52C to 50%, the motor overload is calculated from 50% of the base current, so an overload alarm can be detected early.

When the value of PA52C is changed, the overload alarm detection time will be changed, so the overload warning detection time will be changed accordingly.

Taking into account the ambient temperature and heat dissipation, etc., setting to PA52C can be changed to a more appropriate overload alarm detection time, thereby achieving motor overload protection.



PA52C	Motor overload detection base current rating reduction			
	Range	Setting unit	Default	Effective
	10～100	1%	100	Power on again

8.3 Using of Absolute Encoders

If the servo motor with an absolute encoder is used, an absolute value detection system can be set in the command control unit. Thus, after power on again, the motor can directly run without zero reset.

Encoder type	Resolution	Multi-turn data Output range	Action when exceed the limit
Absolute encoder with multi-turn memory	17-bit or 23-bit	-32768～ +32767	● When going beyond the upper limit (+32767) of positive rotation direction, the multi-turn data become -32768. ● When going beyond the lower limit (-32768) of reverse rotation direction, the multi-turn data become +32767.

When multi-turn data overflows, E.556 will output. PA007. 1 can disable this alarm.

Parameter		Meaning
PA007	n.□□0□	Multi-turn data overflows will output E.5556 (default). (Default)
	n.□□1□	Multi-turn data overflows will not output alarm.

8.3.1 Absolute encoder selection

Parameter		Meaning
PA002	n.□0□□	Use absolute encoders as multi-turn encoders.
	n.□1□□	Use absolute encoders as single-turn encoders. (Default)

When use absolute encoders as single-turn encoders, no battery is needed.
After modifying this parameter, restart the servo to take effect.

8.3.2 Using battery for absolute encoder

Even the power is OFF, a battery is needed to back up data, so that the absolute encoder can save the position information.

(1) Battery selection

Please make preparations according to the specification of command control unit; the battery shall be the product equivalent to ER3V (3.6V, 1000mA TOSHIBA battery).

(2) Battery installation

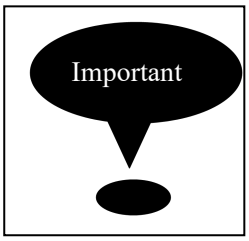
The battery shall be mounted inside the battery case of the encoder cable; pay close attention not to reverse the polarities.

8.3.3 Battery replacement

When the battery voltage drops to be below 3. 1V, the servo drive will output "serial encoder battery warning (A.930)". But this warning only output when the servo drive is ON. If the battery voltage is ultralow when the servo drive is powered on, the servo drive will not give any warning. User can modify warning for ultralow battery voltage.

● Procedures to replace the battery

1. Please replace the battery when the control power of servo drive is ON.
2. After replacing the battery, please make the servo drive power OFF, so as to clear "serial encoder battery warning (A.930) ".
3. Restart the power of servo drive; if there is no abnormal action, the battery is successfully replaced.



When the control power supply of servo drive is OFF and the battery connection has been moved (so has the encoder cable), data inside the absolute value encoder will be lost. Therefore, setting of absolute value encoder is necessary. Please refer to Chapter 8.3.4 Setting up absolute encoders (AF011).

8.3.4 Initialization of absolute encoders (AF011)

Notes:

After the absolute value encoder is initialized, the encoder multi-turn data will become 0, and the reference position of the mechanical system will also change.

If the machine is operated in this state, unexpected actions may occur, resulting in personal accidents or machine damage. Use caution when operating machinery.

In the following cases, you must set the absolute encoder.

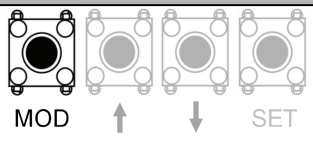
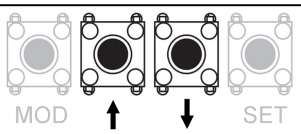
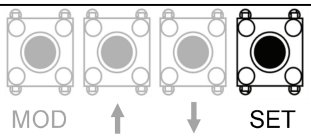
- When starting the machine for the first time
- When "Serial Encoder Battery Warning (A.930)" occurs
- When E.550 ~ E.558 alarm occurs
- When you want to set the multi-rotation data of the absolute encoder to 0

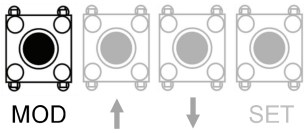
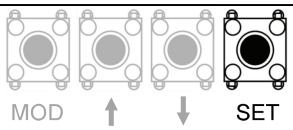
(1) Precautions when setting (initializing)

- Set (initialize) the servo OFF.
- PA002.2 = 0 must be set, otherwise AF011 operation cannot be entered;

(2) Setting (initialization) steps

The setting (initialization) procedure is shown below:

Steps	Panel display	Keys	Operations
1			Press MOD key to choose monitoring display function.
2			If the panel display is not AF011, press ↑ & ↓ until it is PA100.
3			Press and hold SET to display the left figure.

4	 (闪烁显示)		Press the MOD key to clear the multi-turn data of the absolute value encoder and clear the multi-turn encoder related alarms. After the operation is completed, "donE" is displayed for about 2 seconds, and the display returns to the previous interface.
5			Long press SET to exit to Step 2.
6	End of operations		

8.4 Position Control Operations

8.4.1 Parameter settings

When using pulses for position control, please pay attention to following parameters.

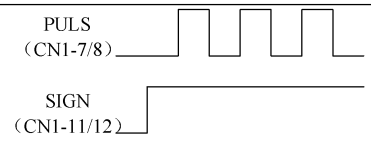
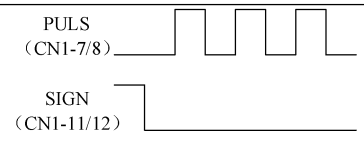
(1) Control mode selection

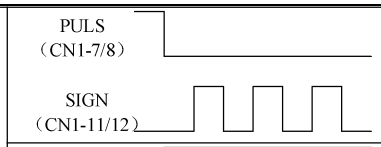
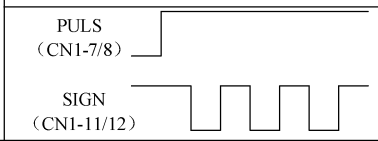
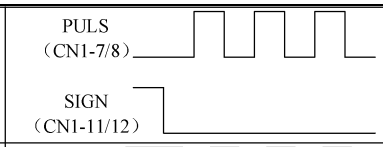
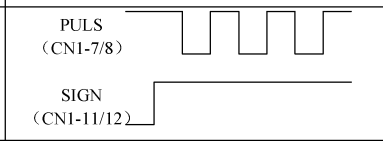
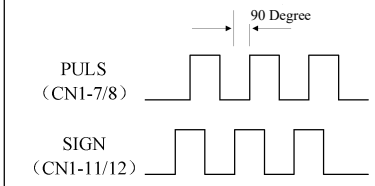
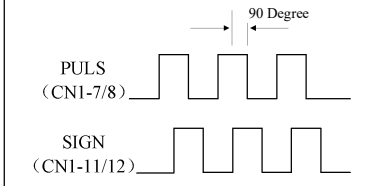
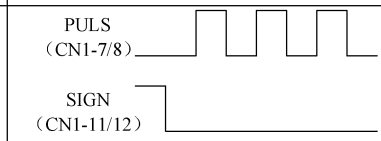
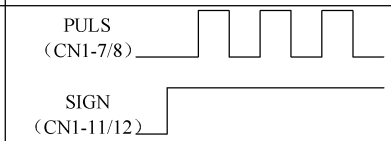
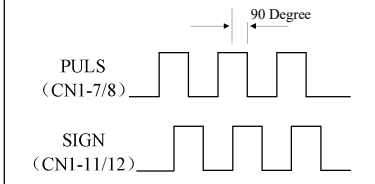
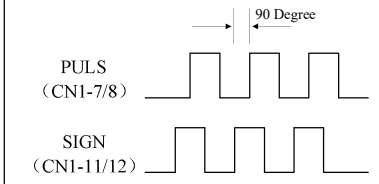
Parameter		Meaning
PA000	n.□□0□	Control mode selection: position control (pulse train)

(2) Pulse form selection

Type		Signal name	Connector pin no.	Definition
Input	Low speed channel	PULS	CN1-7	Command pulse input
		/PULS	CN1-8	Command pulse input
		SIGN	CN1-11	Sign input
		/SIGN	CN1-12	Sign input

Please set the user parameters PA200.0 and PA200.1 according to the specifications of the command controller for the input form on the servo drive.

Parameter		Pulse form	Forward rotation	Reverse rotation
PA200	n.□□00	Sign+pulse train (Positive) (Default)		

	n.□□01	CW+CCW	 	 
	n.□□02	phase A + B phase pulse 4x frequency (Positive)		
	n.□□10	Sign+pulse train (Negative)		
	n.□□12	phase A + B phase pulse 4x frequency (Negative)		

(3) Selection of clearance

Under conditions other than the clear signal (CLR), a timing offset pulse can be selected to clear depending on the state of the servo drive. The action mode of the offset pulse can be selected from the following three types using the user parameter PA200.2.

Parameter		What to check
PA200	n.□0□□	Clear the offset pulse when the basic module is met and the CLR signal is input. (Default) The basic module is the state when the S-ON signal is set to OFF, when the main power is set to OFF, and when an alarm occurs.
	n.□1□□	The offset pulse is not cleared. Only the CLR signal can be used to clear.
	n.□2□□	Clear the offset pulse only when servo has alarm or by CLR signal.

8.4.2 Electronic gear ratio settings

1) Encoder resolutions

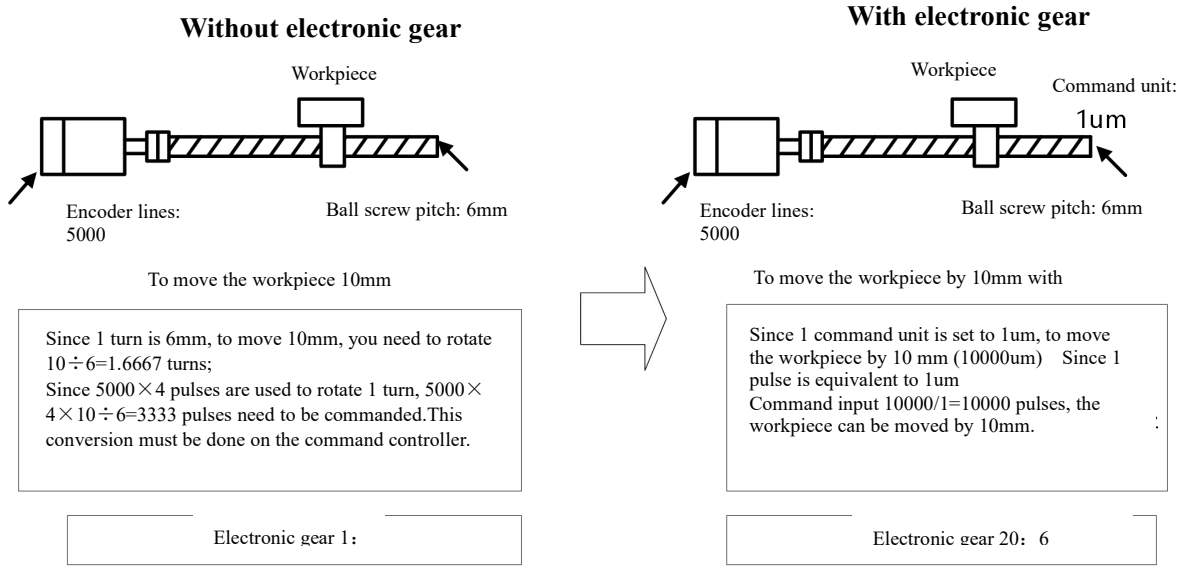
Resolution		Encoder type	Resolution
dP032	131072	17-bit absolute encoder	131072（17bit）
	8388608	23-bit absolute encoder	8388608（23bit）

Remarks: The number of bits indicating the encoder resolution is not the same as the number of pulses in the encoder signal output (phase A, phase B). The number of encoder pulses x 4 (multiplication) is equal to

the number of bits indicating the resolution.

2) Electronic gear

The function of electronic gear is for setting the workpiece travel distance by 1 pulse command (1 command unit).



(3) Relevant user parameters

PA20E	**First electronic gear (numerator)**			
	Range	Setting unit	Default	Effective
	1～1073741824	—	4	Immediate
PA210	**Electronic gear (denominator)**			
	Range	Setting unit	Default	Effective
	0～1073741824	—	1	Immediate

If the mechanical reduction ratio between the motor shaft and the load side is set to n/m, the setting value of the electronic gear ratio can be derived from the following equation.

(When the servo motor rotates m turns and the load axle rotates n turns).

Electronic gear $\frac{B}{A} = \frac{PA20E}{PA210} = \frac{\text{Encoder pulses}}{\text{Travel of 1 turn of load axle}} X \frac{m}{n}$

*If the setting range is exceeded, divide the numerator and denominator approximately into integers within the setting range.

*When PA210 is set to 0, PA20E is the number of pulses given by the upper controller for one rotation of the motor.

That is, PA20E and PA210 have the following relationship.

PA210	Command processing
≠0	Pulse input → PA20E / PA210 → Position command
=0	Pulse input → Encoder resolution / PA20E → Position command

■Important

The recommended setting range of electronic gear ratio: 0.01≤ electronic gear ratio (B/A) ≤ 100

(4) Electronic gear ratio setting procedure

Set the electronic gear ratio according to the following steps

Steps	What to check	Reference
1	Confirm the machine specification	Confirm the reduction ratio, ball screw pitch, pulley diameter, etc.
2	Confirm the number of encoder pulses	Confirm the number of encoder pulses of the servo motor used.
3	Determine the command unit	Determine the command unit of 1 command from the command controller. Decide the command unit taking into account the machine specifications, positioning accuracy, and other factors.
4	Calculate the travel amount for 1 turn of the load axis.	Based on the decided command unit, calculate the amount of command unit required to rotate the load axis by 1 turn.
5	Calculate the electronic gear ratio	Calculate the electronic gear ratio (B/A) based on the electronic gear ratio calculation formula.
6	Set user parameters	Set the calculated value as the electronic gear ratio.

(5) Calculation method of electronic gear ratio

In the position control mode, the actual velocity of the load is:

Command pulse velocity × (B/A) × mechanical reduction ratio

In the case of pulley transmission, etc., the electronic gear ratio (B/A) is calculated as follows.

$$\frac{B}{A} = \frac{P_{pulse} \times M \times i}{L}$$

P_{pulse} : motor encoder resolution. It refers to the number of pulses fed back by the motor feedback element for one turn of the motor. For 5000 lines of incremental encoder, the number of pulses fed back to the drive is 5000 x 4 = 20000.

M: Equivalent for pulse calculation (mm). Refers to the resolution of the upper controller;

L: Screw pitch (mm);

i: Mechanical gear ratio

$$i = \frac{\text{Number of teeth on the driven side pulley (machine side)}}{\text{Number of teeth on the master side pulley (motor side)}}$$

For example: the pulse equivalent of the upper controller is 0.001mm (1um); the mechanical gear ratio is: i = driven wheel/active wheel = 36/24; the screw pitch is 6mm; the motor encoder is 5000P/r, and the number of feedback pulses per turn of the encoder is 5000 × 4 = 20000.

Then, according to the above formula, it is calculated as:

$$\frac{B}{A} = \frac{20000 \times 0.001 \times \frac{36}{24}}{6} = \frac{10}{2} = 5$$

The numerator of the electronic gear needs to be set to 5 and the denominator to 1.

If this example is a direct screw connection, the reduction ratio is 1, and the screw pitch is also 6mm, then we get

$$\frac{B}{A} = \frac{20000 \times 0.001 \times 1}{6} = \frac{10}{3}$$

8.4.3 Position commands

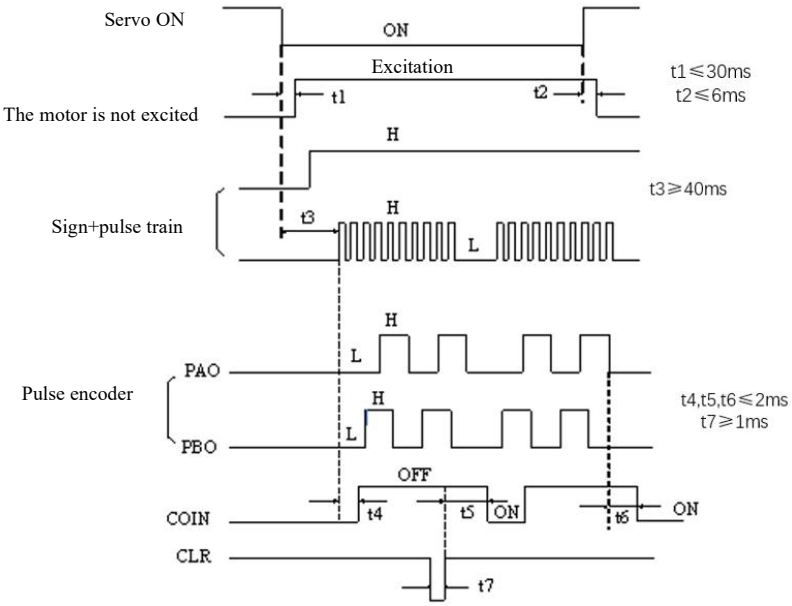
A command in the form of a pulse train is issued to control the position of the servo motor.
The pulse train output form of the command controller includes the following types.

Field-bus output
+24V open-collector output
+12V open-collector output
+5V open-collector output

■ Precautions at the open-collector output

Open-collector output signals can only connect to servo drive's CN1-7, 8, 11, 12.
In case of open-collector pulse input, the interference tolerance for input signal will decrease.
In case of deviation due to interference, changes should be made in the following user parameters.

(1) Example of I/O signal time sequence

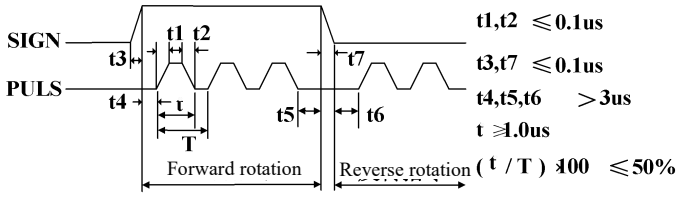
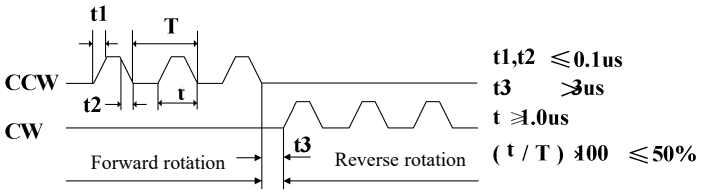
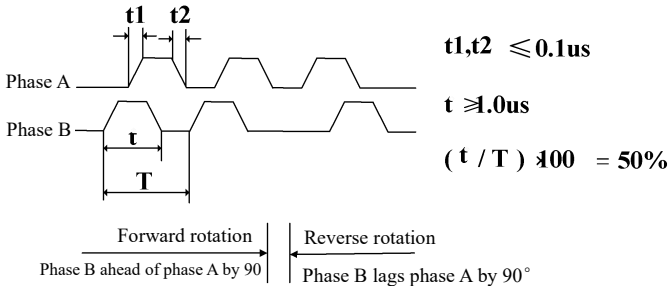


(Note) The interval between S-ON signal and input pulse commands should be above 40ms. If this interval is less than 40ms, servo drive may fail to receive the pulse commands.

Please set CLR signal to be above 20 μs.

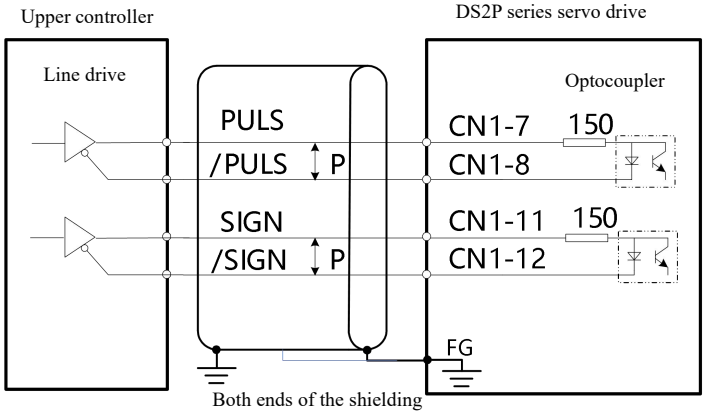
Table 8.1 Timing of command pulse input signal

Pulse forms	Specifications	Remarks:

Sign+pulse train input (SIGN + PULS) Maximum frequency: 500kpps (Open-collector output: 200kpps）		SIGN H=Forward rotation L=Reverse rotation
CW+CCW Maximum frequency: 500kpps (Open-collector output: 200kpps)		
90° Phase difference 2 phase pulse (Phase A + Phase B) Maximum frequency: ×4 multiplier: 200kpps (Open-collector output: 150kpps)		

(2) Connection examples

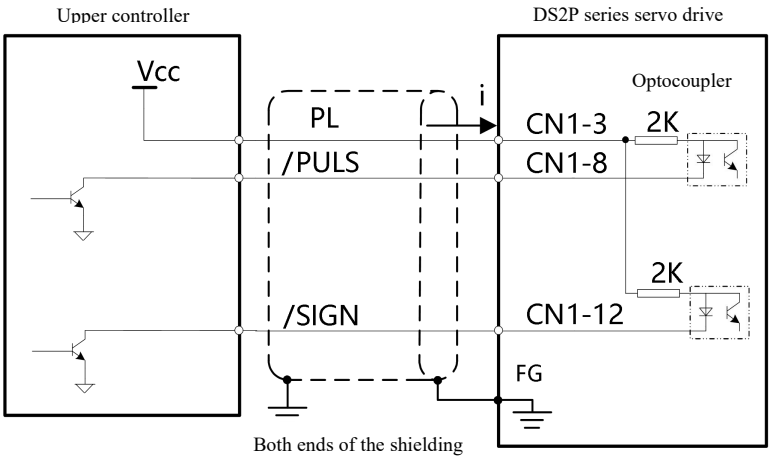
(a) Example of connection of field-bus output



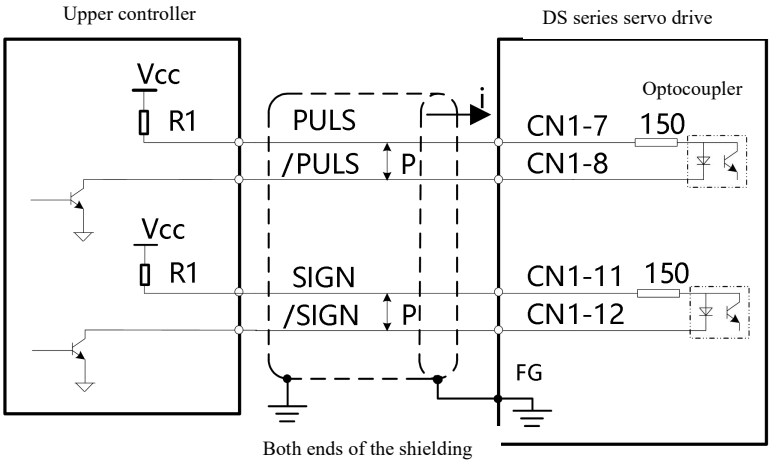
Applicable linear drive, such as the similar product of AM26LS31 from T1 company

(b) Connection example of open-collector output

When the collector power supply is 24V, it can be connected according to the following diagram.



When the collector power supply is 12V or 5V, it can be connected according to the following diagram.



Select the value of limiting resistor R1 to ensure that the input current i enters the following range

Input current i ＝7 to 15mA.

■Important

If the interference tolerance of the input signal is reduced when the command pulse is output through open-collector, increase the setting of the user parameter PA201.0 and pay attention to the connection of the shield wire when the offset occurs due to interference.

8.4.4 Smoothness

The servo drive can filter pulse commands within certain frequency ranges.

PA216	**Position command acceleration/deceleration time constant 1**			
	Range	Setting unit	Default	Effective
	0～32767	0.1ms	0	Immediate
PA217	**Position command average-moving time**			
	Range	Setting unit	Default	Effective
	0～1000	rpm	0	Immediate

■Important

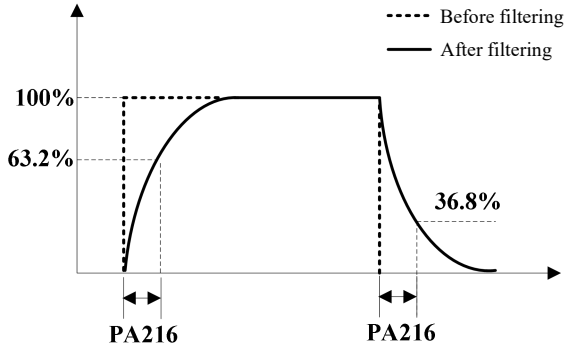
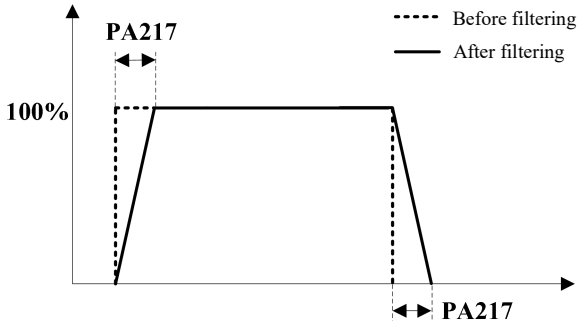
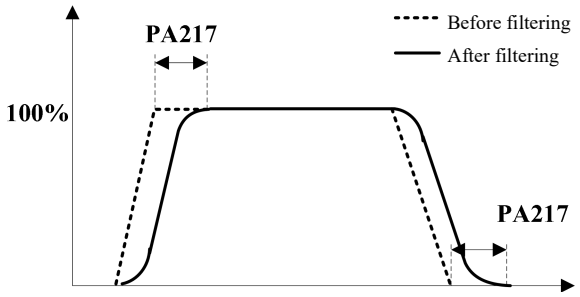
If the position command acceleration/deceleration time parameter (PA216, PA217) is changed, the changed value takes effect when no command pulse is input. To effectively reflect the set value, input CLR to disable the command pulse of the command controller or to clear the offset pulse as a servo ON.

The motor can be operated smoothly even in the following cases; in addition, this setting has no effect on the movement amount (number of command pulses)

- When the command controller that sent the command cannot perform acceleration or deceleration
- When the frequency of the command pulse is low
- When the number of electronic teeth is relatively large (100 times or more)

■ Supplement

The difference between the position command acceleration/deceleration time constant (PA216) and the position command average travel time (PA217) is shown below

Acceleration/deceleration time parameter	Average-moving filter
PA216	PA217
 Response waveform of step command input	 Response waveform of step command input  Response waveform of step command input

8.4.5 Positioning completed signal (COIN)

This signal means that servo motor positioning is completed at position control. Please use it when the position is completed by the command controller.

Type	Signal name	Connector pin no.	Level	Description
Output	COIN	CN1-29, 30 (default)	ON=L level	Positioning completed
			OFF=H level	Positioning not completed

The positioning completed signal can be allocated to the output terminals by the user parameter PA50B, see "3.4.3 3.4.3 Allocation of I/O signals". The factory setting is allocated to CN1-29 and 30.

PA522	Positioning completed width			
	Range	Setting unit	Default	Effective
	0～1073741824	1 input pulse	7	Immediate

If the difference between the upper controller’s command pulse input count and the servo motor’s movement amount (deviation pulse) is lower than the set value of this use parameter, then the COIN signal will output; setting units are command units; this also depends on the electronic gear setting.
If the set value of PA525 is too high and servo is running in low velocity, COIN signal may still output even though positioning is not completed. Please pay close attention to this.
Setting of this user parameter does not affect the final positioning precision.

■ Supplement
The COIN signal is the signal used during position control.

8.4.6 Positioning near signal (NEAR)

The positioning near signal (NEAR) is a signal meaning that the servo motor is near positioning completion. It is usually used in pair with the COIN.
It is used to receive positioning near signal before the command controller’s confirmation of the positioning completion signal to make action sequence preparations after positioning is completed to shorten the time needed for the action when positioning is completed.

Type	Signal name	Connector pin no.	Level	Description
Output	NEAR	To be allocated	ON=L level	Near positioning completion
			OFF=H level	Not near positioning completion

The positioning near signal can be allocated to the output terminals using the user parameters PA50A~PA50D. Please refer to “Chapter 3.4.3 Allocation of I/O signals” for the allocation of input signals.

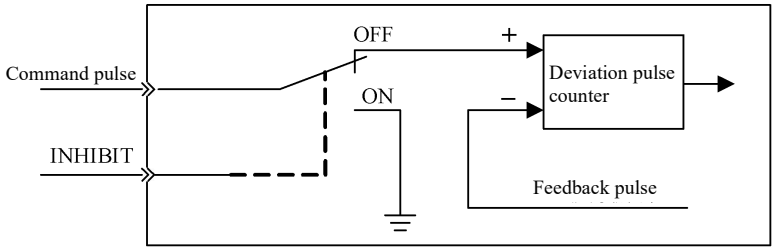
PA524	NEAR signal width			
	Range	Setting unit	Default	Effective
	1～1073741824	1 input pulse	65535	Immediate

If the difference between the upper controller’s command pulse input count and the servo motor’s movement amount (deviation) is lower than the set value of this use parameter PA524, then the positioning near signal (NEAR) will output.
Setting units are command units. This depends on the command units set by the electronic gear
Value of PA524 should be greater than value of PA525. Please refer to “Chapter 3.4.3 Allocation of I/O signals” for the allocation of input signals.

8.4.7 Pulse input inhibited (INHIBIT)

(1) Functional characteristics

This is a function that stops (inhibits) command pulse input counting in case of position control.
It is in servo locking (clamping) state when this function is used.



(2) Input signal setting

Type	Signal name	Connector pin no.	Level	Description
Input	INHIBIT	CN1-46 (Default)	ON=L level	INHIBIT ON (Stopping (prohibiting) the counting of command pulses)
			OFF=H level	INHIBIT OFF (Counting of command pulses)
INHIBIT is only valid in position control mode.				

8.5 Velocity Control (Selection of Internal Setting Velocity)

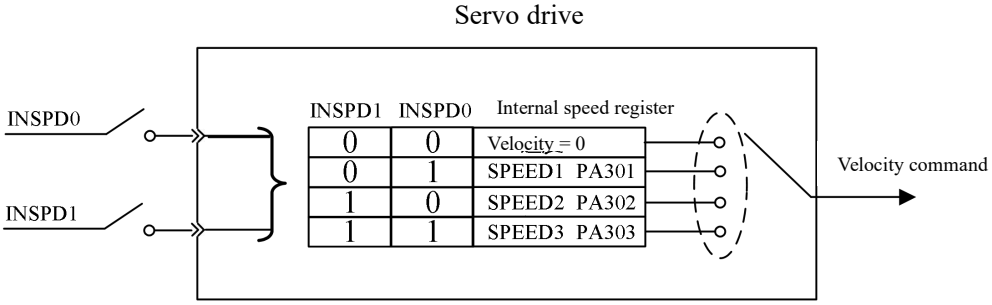
Operation

Meaning of selection of internal setting velocity

Internal velocity control is to set 3 velocities beforehand through parameters inside servo drive. It uses the external input signal selection for the function of velocity control operation, which is effective for the velocity control action where the operation velocity is within 3 motor speeds.

It’ s unnecessary to configure velocity generator or pulse generator outside.

The combination of INSPD1 and INSPD0 selects the internal velocity; INSPD1 is the high bit and INSPD0 is the low bit.



Note: After selecting external input signals as INSPD1 and INSPD0, if there is no input for INSPD1 and INSPD0 signals, the selected velocity is "velocity=0" (00); if INSPD0 signal is valid and INSPD1 is invalid, the selected velocity is " SEEPD1" (01), the velocity value is PA301.

8.5.1 Parameter settings

Parameter		Meaning
PA000	n.□□3□	Control mode selection: Internal setting velocity control (contact command)

PA301	**Internal velocity 1 (velocity1)**			
	Range	Setting unit	Default	Effective
	-6000～6000	rpm	100	Immediate
PA302	**Internal velocity 2 (velocity2)**			
	Range	Setting unit	Default	Effective
	-6000～6000	rpm	200	Immediate
PA303	**Internal velocity 3 (velocity3)**			
	Range	Setting unit	Default	Effective
	-6000～6000	rpm	300	Immediate

■Important

Even if a value exceeding the maximum velocity of the used servo motor is set in PA301 to PA303, the actual value is limited to the maximum velocity of the used servo motor.

8.5.2 Setting of input signals

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

Type	Signal name	Connector pin no.	Description
Input	INSPD0	CN1-□□(To be allocated)	Internal speed register 0
	INSPD1	CN1-□□(To be allocated)	Internal speed register 1

About input signal selection

The combination of the INSPD0 and INSPD1 signals corresponds to 3 velocities.

To operate with INSPD0 and INSPD1, the input signals must be allocated using the user parameters PA500 to PA505. Refer to "Chapter 3.4.3 Allocation of I/O signals".

8.5.3 Soft start

Soft start is the function that phase step velocity command input is transformed to command with certain acceleration/deceleration curves inside servo drive.

PA305	**Soft start acceleration time**			
	Range	Setting unit	Default	Effective

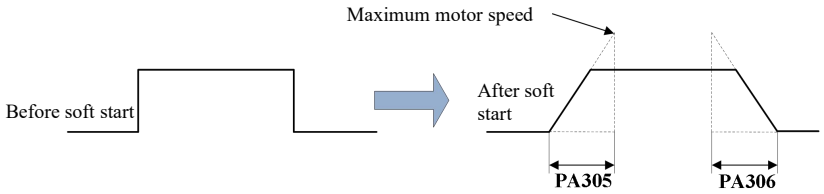
	0～10000	1ms	0	Immediate
PA306	**Soft start deceleration time**			
	Range	Setting unit	Default	Effective
	0～10000	1ms	0	Immediate

Smooth velocity control is possible when a step velocity command is input or an internal set velocity is selected.

(For general velocity control, set to "0")

Each setting value is shown below

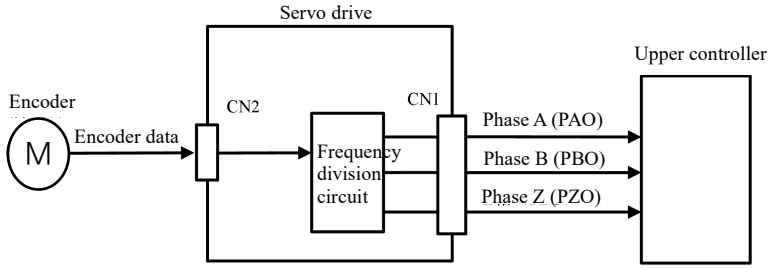
- PA305: The time required to reach the maximum motor speed from the motor stop state
- PA306: Time required from the maximum motor speed to the motor stop



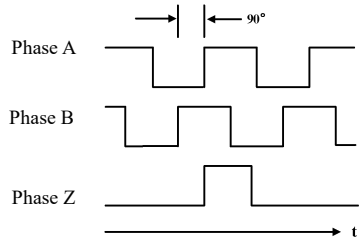
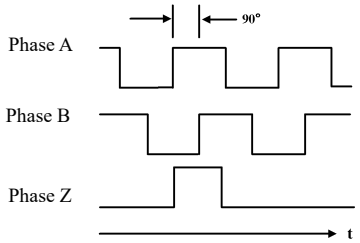
8.5.4 Encoder signal output

Pulse feedbacks from the encoder are processed inside the servo drive before outputting to the upper controller.

Type	Signal name	Connector pin no.	Description
Output	PAO	CN1-33	Encoder Output phase A
	/PAO	CN1-34	Encoder Output /phase A
Output	PBO	CN1-35	Encoder Output phase B
	/PBO	CN1-36	Encoder Output /phase B
Output	PZO	CN1-19	Encoder Output phase Z (reference point)
	/PZO	CN1-20	Encoder Output /phase Z (reference point)



■ Output phase status

Positive rotation (phase B 90° ahead)	Negative rotation (phase A 90° ahead)
	

Please make servo drive rotate by two turns before using servo drive’ s phase Z pulse output for mechanical

reference point reset action.

If this can’ t be done due to the structure of the mechanical system, please implement reference point reset action at velocity below 600rpm (calculated according to servo motor’ s rotating velocity). If a velocity of 600rpm or more is used, Z-phase pulses are sometimes not output correctly.

Frequency division

The pulse data from the encoder installed on the servo motor is converted to the pulse density set by the user parameter (PA212) and output.

The unit is "number of pulses per turn".

Encoder pulse frequency-division ratio setting

PA212	PG frequency-division ratio			
	Range	Setting unit	Default	Effective
	16～65535	1P/ Rev	2500	Immediate

Set the number of output pulses for the PG output signal (PAO,/PAO,PBO,/PBO) sent from the servo drive to the outside.

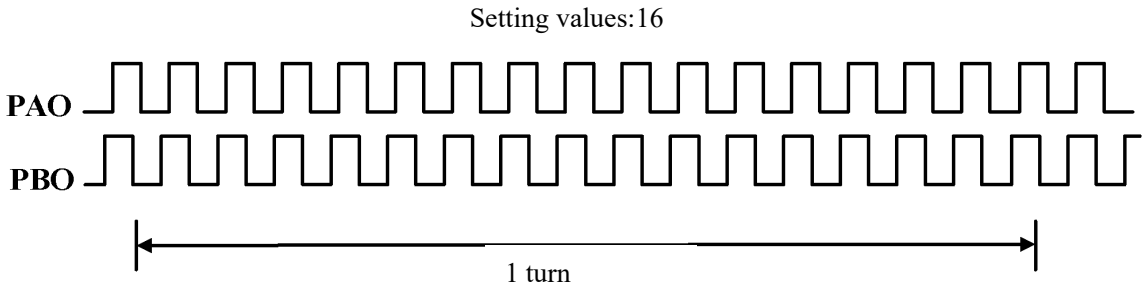
Each 1-turn feedback pulse from the encoder is divided into the set value of PA212 inside the servo drive and output. (Please set according to the system specifications of the machine and command controller.)

Also, the setting range varies depending on the number of encoder pulses of the servo motor used.

Encoder type	Resolution	Number of encoder pulses (P/R)	Range
Absolute encoder	17 bits, 131072 pulses/turn	32768P/R	16～16384

■Example of output

When PA212 = 16 (16 pulses output per turn)



8.5.5 Same velocity detection output

The same velocity detection output (VCMP) signal is output when the velocity of the servo motor is the same as the command velocity, so use it when interlocking with the command controller.

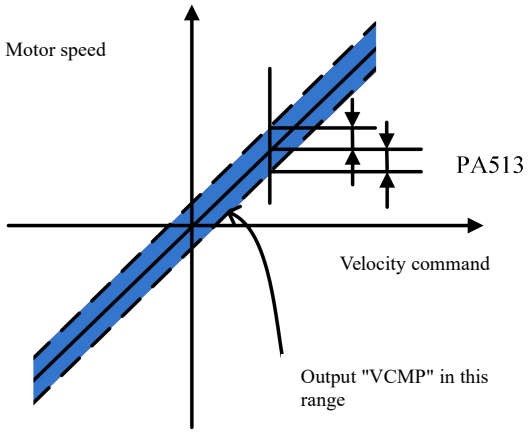
Type	Signal name	Connector pin no.	Setting	Meaning
Output	VCMP	Need allocation	ON=L level	Same velocity status
			OFF=H level	Different velocity status

This output signal needs to be allocated by the parameter.

Refer to "3.4.3 Allocation of I/O signals" for the assignment of output signals.

PA513	Same velocity detection width			
	Range	Setting unit	Default	Effective
	0～100	rpm	10	Immediate

If the difference between the motor speed and the command velocity is lower than the setting value of PA517, the "VCMP" signal is output.



■ Example

If the motor speed is between 1900 and 2100rpm when PA513=100 and the command velocity is 2000rpm, "VCMP" is set to ON.

■ Supplement

The "VCMP" signal is the output signal for velocity control.

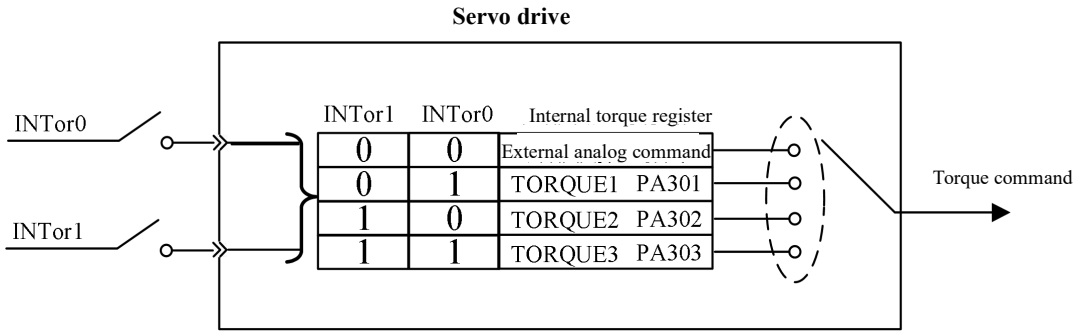
8.6 Torque Control (Selection of Internal Torque) Operation

Meaning of selection of internal setting torque

Internal torque control is to set 3 velocities beforehand through parameters inside servo drive and to select among them by using external input signals. The function of torque control operation is effective for torque control operation up to 3 torques.

It’ s unnecessary to configure torque generator outside.

INTor1, INTor0 combination selects the torque command, with INTor1 as high and INTor0 as low.



Note: After selecting external input signal as INTor1 and INTor0, if there is no input of INTor1 and INTor0 signal, the selected torque is "external analog command" (00); if INTor0 signal is valid and INTor1 is invalid, then select " TORQUE1" (01), the torque value is PA301.

8.6.1 Parameter settings

Parameter		Meaning
PA000	n.□□2□	Control mode selection: Torque control

PA301	**Internal torque 1 (TORQUE1)**			
	Range	Setting unit	Default	Effective
	-6000～6000	0.1%	100	Immediate
PA302	**Internal torque 2 (TORQUE2)**			
	Range	Setting unit	Default	Effective
	-6000～6000	0.1%	200	Immediate
PA303	**Internal torque 3 (TORQUE3)**			
	Range	Setting unit	Default	Effective
	-6000～6000	0.1%	300	Immediate

■Important

Even if a value exceeding the maximum torque of the used servo motor is set in PA301 to PA303, the actual value is limited to the maximum torque of the used servo motor.

8.6.2 Setting of input signals

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

Type	Signal name	Connector pin no.	Description
Input	INTor0	CN1-□□(To be allocated)	Internal torque selection signal 0
	INTor1	CN1-□□(To be allocated)	Internal torque selection signal 1

About input signal selection

The combination of the INTor0 and INSPD1 signals corresponds to 3 torques.

To operate with INTor0 and INTor1, the input signals must be allocated using the user parameters PA500 to PA505. Refer to "Chapter 3.4.3 Allocation of I/O signals".

8.7 Internal Position Control (Contact Command) (Some Models)

In the internal position control (contact command) (PA000.1=C) mode of the servo drive, the drive has a simple single-axis motion function that eliminates the need for complex upper control.
This control mode has 16-segment position control, and each point can be individually set for displacement, running velocity, acceleration/deceleration time constants, and stopping time after being in place. The control mode has a back to zero function (to find the reference point); the velocity of the two segments of the back to zero can be set (the first segment of the back to zero velocity (the velocity before the reference point); the second segment of the back to zero velocity (the velocity after the reference point)), the direction and mode of the back to zero can be set (parameter PA202).
The point switching of the internal position control is as follows (PA700):
1) The external IO port (INPOS0, INPOS1, INPOS2, INPOS3) selects a point position and runs the currently selected position segment by triggering a signal. The trigger method can also be selected as external IO (PTRG) or a variation of the IO port (INPOS0, INPOS1, INPOS2, INPOS3) by the parameter PA701.1.
2) The cycle is triggered by an external IO (PTRG). The cycle start point is PA700.2 and the end point is PA700.3.
3) Timing triggered cycle operation.

■Set displacement amount

The displacement amount of each point corresponds to two parameters, which are the digit and the 10,000 digit, and the two parameters are combined together to form the displacement amount of the point.
Position segment X data = position segment X data 10,000 bits * 10000 + position segment X data single bits.
Example of stored data:
If the 10,000 bits data PA704 of position 0 is 13 and the individual bits data PA703 is 1072, it means that the position 0 data is 131072 pulses.
If the 10,000 bits data PA704 of position 1 is -13 and the individual bits data PA703 is -1072, it means that the position 1 data is -131072 pulses.
*Note:
If the 10,000 bits data PA704 of position 2 is 1 and the individual bits data PA703 is -1, it means that the position 2 data is 9999 pulses.
If the 10,000 bits data PA704 of position 3 is -1 and the individual bits data PA703 is 1, it means that the position 3 data is -9999 pulses.

■ Velocity

Refer to the actual running velocity of the motor, which is consistent with dP000.

■ Position command acceleration/deceleration time constant

This parameter is the same as the position command acceleration/deceleration time PA214 for normal position control, see chapter 8.4.4 for details.

■Step change time after position

For this parameter to be valid, an internal timing cycle must be used, i.e. PA700.0 = 1 or 2.
The change of step time is the time from the output of the current position command completion signal (CMD_OK) until the servo starts executing the next position segment, determined by PA5A5.

8.7.1 Related input signals

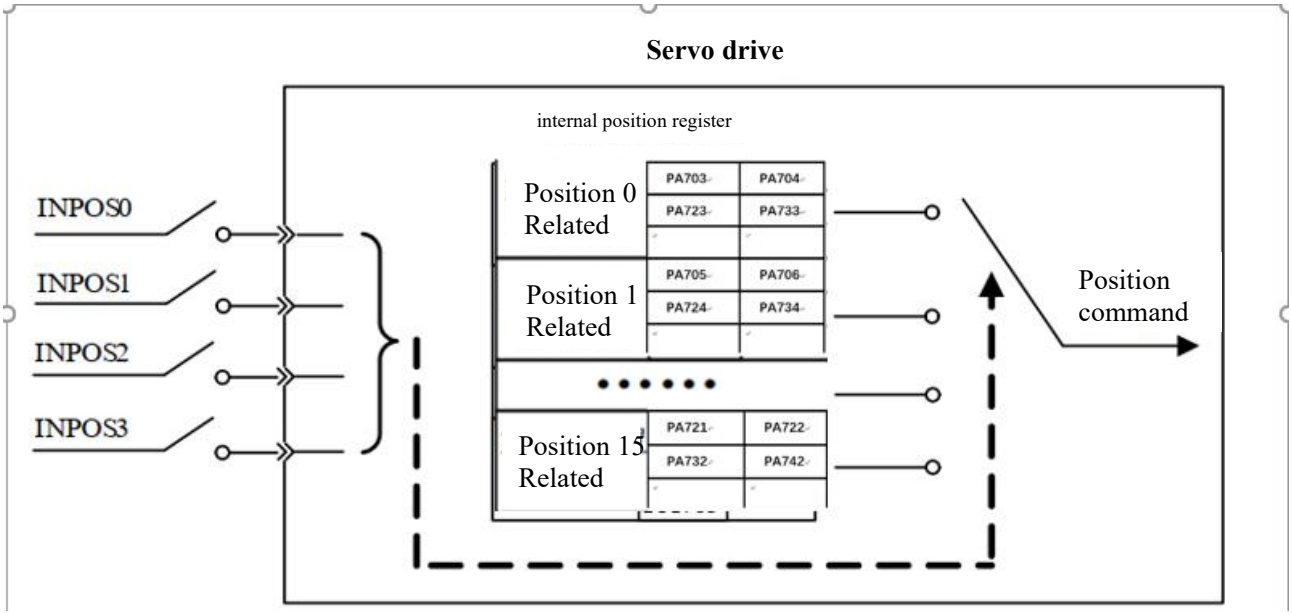
Type	Signal name	Connector pin no.
Input	INPOS0	1F need to be allocated
	INPOS1	1E need to be allocated
	INPOS2	1D need to be allocated
	INPOS3	1C need to be allocated
	PTRG (start)	20 need to be allocated
	PZERO (Stop)	21 need to be allocated
All of the above signals need to be allocated for input signals, which can be controlled by IO, or remote IO of PA65E~PA661 through 485 communication. Refer to "3.4.3 Allocation of I/O signals" for allocation method.		

■ Internal position selection signals (INPOS0, INPOS1, INPOS2, INPOS3)

The 16-segment position selection is done by combining four signals, INPOS0, INPOS1, INPOS2, and INPOS3. The following table shows the INPOS signals.

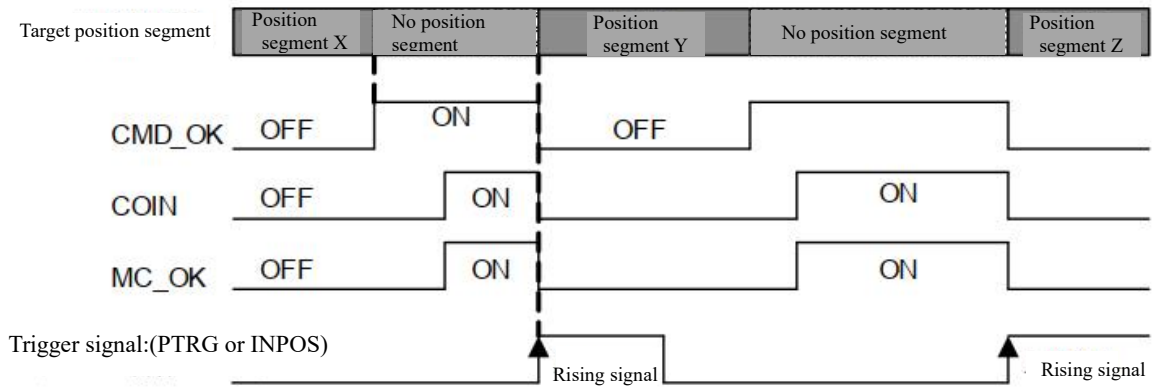
INPOS3	INPOS2	INPOS1	INPOS0	Select position segment
0 (invalid)	0 (invalid)	0 (invalid)	0 (invalid)	Position 0 (PA704 & PA703)
0 (invalid)	0 (invalid)	0 (invalid)	1 (valid)	Position 1 (PA706 & PA705)
0 (invalid)	0 (invalid)	1 (valid)	0 (invalid)	Position 2 (PA708 & PA707)
0 (invalid)	0 (invalid)	1 (valid)	1 (valid)	Position 3 (PA70A & PA709)
0 (valid)	1 (valid)	0 (invalid)	0 (invalid)	Position 4 (PA70C & PA70B)
0 (valid)	1 (valid)	0 (invalid)	1 (valid)	Position 5 (PA70E & PA70D)
0 (valid)	1 (valid)	1 (valid)	0 (invalid)	Position 6 (PA710 & PA70F)
0 (valid)	1 (valid)	1 (valid)	1 (valid)	Position 7 (PA712 & PA711)
1 (valid)	0 (invalid)	0 (invalid)	0 (invalid)	Position 8 (PA714 & PA713)
1 (valid)	0 (invalid)	0 (invalid)	1 (valid)	Position 9 (PA716 & PA715)
1 (valid)	0 (invalid)	1 (valid)	0 (invalid)	Position 10 (PA718 & PA717)
1 (valid)	0 (invalid)	1 (valid)	1 (valid)	Position 11 (PA71A & PA719)
1 (valid)	1 (valid)	0 (invalid)	0 (invalid)	Position 12 (PA71C & PA71B)
1 (valid)	1 (valid)	0 (invalid)	1 (valid)	Position 13 (PA71E & PA71D)
1 (valid)	1 (valid)	1 (valid)	0 (invalid)	Position 14 (PA720 & PA71F)
1 (valid)	1 (valid)	1 (valid)	1 (valid)	Position 15 (PA722 & PA721)

The schematic diagram is shown below



■ Internal position trigger signal (PTRG)

In internal position control, this signal is active on the rising edge when the trigger mode operation is selected (PA700.0 = 0 or 1). The signal input and output timing of the servo when operating in the trigger mode is used, as shown in the following figure.



8.7.2 Related output signals

Type	Signal name	Connector pin no.	Level status	Meaning
Output	**HOME**	0F need to be allocated	Valid status	Home return completed
			Invalid status	Home return not completed
	CMD-OK	10 need to be allocated	Valid status	Position command completed
			Invalid status	Position command not completed

	MC-OK	11 need to be allocated	Valid status	Position command execution completed
			Invalid status	Position command execution not completed
All the above signals need to be allocated as output signals. **Refer to "3.4.3 Allocation of I/O signals" for allocation method.**				

■ Zero return completion signal (HOME) under internal position control

This signal is ON when the home return is completed, which means the position coordinate system is meaningful and the position counter is meaningful. When power is applied, this signal is OFF; and after the home return is completed, this signal is ON. After running a period of position, this signal is OFF. When SHOME triggers the home return command, this signal is OFF; and after the home return is completed, this signal is ON. The back to zero operation can be stopped by the input stop signal SZERO, and this signal is OFF.

■ Position command completion signal under internal position control (CMD-OK)

This signal turns ON when the internal position mode is first entered. This signal is OFF when the command is being executed; and this signal is ON when the position command execution is completed. This signal only indicates the completion of the command, not meaning the motor positioning completed.

■ Position command execution completion signal under internal position control (MC-OK)

This signal represents the completion of position command execution. If both the CMD-OK signal and the COIN (positioning completion) signal are ON, the output is ON; otherwise it is OFF.

8.7.3 Setting of related parameters

Parameter		**Meaning**
PA000	**h.□□C□**	Internal position control (contact command)
PA700	**h.□□□0**	Position step changing method: External IO signal (INPOS) selects the position segment, and external IO signal (PTRG) triggers the motion.
	h.□□□1	Position step changing method: External IO signal (PTRG) triggers the motion and the position segment performs cycle operation
	h.□□□2	Position step changing method: Position segment of internal timing cycle operation
	h.□□0□	Position operation method: Incremental position
	h.□□1□	Position operation method: Absolute position
	h.□□2□	Position operation method: Select the incremental position operation method or the absolute position operation method by PAbs signal at the external IO side.
	h.□X□□	Cycle operation position starting point: Select position starting point 0~F
	h.X□□□	Cycle operation position end point: Select position end point 0~F
PA701	**b.□□□0**	Selection of trigger signal:

		Use external IO signal (PTRG) to trigger operation.		
	b.□□□1	Selection of trigger signal: The operation is triggered when the position selection signal (INPOS0, INPOS1, INPOS2, INPOS3) is changed.		
	b.□□0□	Selection of trigger timing: A new trigger signal is received only after the current segment running position is completed.		
	b.□□1□	Selection of trigger timing: The new next position trigger signal can also be received when the current segment running position is not completed.		
	b.□0□□	PZERO signal function: Operation stops. Under the return to zero or position node, the operation will be stopped immediately after the signal is valid.		
	b.□1□□	PZERO signal function: Pause. Under the return to zero or position node, the operation will be paused after the signal is valid, and the operation will continue after this signal is invalid.		
	b. 0□□□	Software limit enabling: No.		
	b. 1□□□	Software limit enabling: Yes. PA743, PA744 are positive limit distance; PA745, PA746 are negative limit distance.		
PA703	**low 16 bits at internal position 0**			
	Range	Setting unit	Default	Effective
	0x0000～0xFFFF	pulse	0x4E20	Immediate
PA704	**High 16 bits at internal position 0**			
	Range	Setting unit	Default	Effective
	0x0000～0xFFFF	pulse	0x0000	Immediate
PA721	**low 16 bits at internal position 15**			
	Range	Setting unit	Default	Effective
	0x0000～0xFFFF	pulse	0XE200	Immediate
PA722	**High 16 bits at internal position 15**			
	Range	Setting unit	Default	Effective
	0x0000～0xFFFF	pulse	0x0004	Immediate
PA723	**Velocity at internal position 0**			
	Range	Setting unit	Default	Effective
	0～5000	rpm	100	Immediate
PA732	**Velocity at internal position 15**			
	Range	Setting unit	Default	Effective
	0～5000	rpm	100	Immediate
PA733	**Acceleration/deceleration time at internal position 0**			
	Range	Setting unit	Default	Effective

	0～500	ms	0	Immediate
PA742	**Acceleration/deceleration time at internal position 15**			
	Range	Setting unit	Default	Effective
	0～500	ms	0	Immediate
■Important **Even if a value exceeding the maximum velocity of the used servo motor is set in PA723 to PA732, the actual value is limited to the maximum velocity of the used servo motor.**				

8.8 Mode Switching

On the servo unit, you can select two of the various control modes for combination and switch between them. The control mode is selected by IO. The switching mode and switching conditions are explained below.

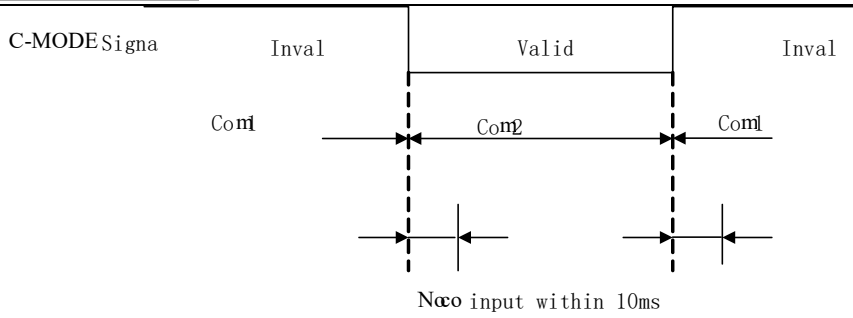
8.8.1 Parameter settings

Parameter		**Control mode combination**
PA000	**n.□□5□**	**Velocity control and position control switching** Use IO to switch between velocity control mode and position control mode.
	n.□□6□	**Velocity control and torque control switching** Use IO to switch between velocity control mode and torque control mode.
	n.□□8□	**Position control and torque control switching** Use IO to switch between position control mode and torque control mode.
	■ Important The external input signal C-MODE must be used to switch the control mode, and the input signal needs to be allocated via the user parameters PA500 to PA505.	

8.8.2 Description of control mode switching

When PA000.1 is set to 5, 6, or 8 for combination control, the input signal (C-MODE) can be selected from either 1 or 2 through the control mode.

When the C-MODE signal is invalid, control mode 1 is selected; and when the C-MODE signal is valid, control mode 2 is selected. Do not input commands within 10ms before and after selection. The process of switching the control mode by C-MODE signal is shown in the figure below.



8.9 Zero Return Function (Home Return)

There is usually a reference point switch on the workbench as the coordinate zero point for point control, which requires a return to zero operation at power-up or after each machining. Under the internal position control, the drive completes the return to zero operation by itself after the upper controller outputs the return to zero start (HOMEStart) signal. The back to zero method, back to zero velocity, offset, etc. can be set by parameters PA202, PA54D, PA54E, PA747, PA748.

PA202	**Position control function switch 2**	n.0000~0022	--	n.0000	Power on again	1

n.×××□: positioning signal (COIN) output condition

0: Output when the absolute value of position deviation is less than the positioning completion amplitude (PA522);

1: output when the absolute value of position deviation is less than the positioning completion amplitude (PA522) and the command after position command filtering is 0

2: output when the absolute value of position deviation is less than the positioning completion amplitude (PA522) and the position command input is 0;

N.××□×: clear signal (CLR) form

0: Clear position deviation pulse at the H level of the signal;

1: Clear position deviation pulse at the rising edge of the signal;

2: Clear position deviation pulse at the L level of the signal;

3: Clear the position deviation pulse at the falling edge of the signal;

N.×□×××: back to zero mode

0: Z pulse searching in negative direction, Z pulse as zero point;

1: Z pulse searching in positive direction, Z pulse as zero point;

2: operation in negative direction; when encountering NOT signal, Z pulse searching in positive direction, the first Z pulse as the zero point;

3: operation in positive direction; when encountering POT signal, Z pulse searching in negative direction, the first Z pulse as the zero point;

4: zero signal is invalid; operation in positive direction, when the zero signal is valid, operation in negative direction, the first Z pulse of the invalid zero signal as zero point; zero signal is valid, operation in negative direction, the first Z pulse of the invalid zero signal as the zero point;

5: zero signal is valid; operation in negative direction, when the zero signal is invalid, operation in positive direction, the first Z pulse of the valid zero signal as zero point; zero signal is invalid, operation in positive direction, the first Z pulse of the valid zero signal as the zero point;

6: operation in negative direction; when encountering NOT signal, operation in positive direction; the NOT signal is used as a zero position where it is invalid;

7: operation in positive direction; when encountering POT signal, operation in negative direction; the POT signal is used as a zero position where it is invalid;

8: zero signal is invalid; operation in positive direction, when the zero signal is valid, operation in negative direction, the zero signal is used as a zero point where it is invalid; zero signal is valid, operation in negative direction, the zero signal is used as a zero point where it is invalid;

9: zero signal is valid; operation in negative direction, when the zero signal is invalid, operation in positive direction, the zero signal is used as a zero point where it is valid; zero signal is invalid, operation in positive direction, the zero signal is used as a zero point where it is valid;

12: Zero signal is invalid; operation in positive direction, when the zero signal is valid, operation in positive direction, the zero signal is used as a zero point where it is invalid; zero signal is valid, operation in positive direction, the zero signal is used as a zero point where it is invalid;

13: Zero signal is invalid; operation in negative direction, when the zero signal is invalid, operation in negative direction, the zero signal is used as a zero point where it is valid; zero signal is invalid, operation in negative direction, the zero signal is used as a zero point where it is invalid;

14: Zero signal is invalid; operation in negative direction, when the zero signal is valid, operation in positive direction, the zero signal is used as a zero point where it is valid; zero signal is valid, operation in positive direction, the zero signal is used as a zero point where it is invalid;

n. □×××:Back to zero start control

0: Off

1: DI (HomeStart) start

2: Start when the SON is valid for the first time after power on

■ Related parameters

PA54D	**Back to zero velocity 1**	0 ～ 3000	1 min-1	500	Immediate	1
PA54E	**Back to zero velocity 2**	0 ～ 3000	1 min-1	10	Immediate	1
PA747	**Home offset low 16-bit data**	0000~FFFF	Pulse	0000	Immediate	1
PA748	**Home offset high 16-bit data**	0000~FFFF	Pulse	0000	Immediate	1

■Important

1. Even if a value exceeding the maximum velocity of the used servo motor is set in PA54D, PA54E, the actual value is limited to the maximum velocity of the used servo motor.

2. The direction of home offset is determined according to the direction of back to zero, which is the offset of motor running direction. Home offset = (Home offset high 16 bits << 16) & Home offset low 16 bits.

3、Back to zero function is applicable to position control (pulse command) and internal position control (contact command).

4、drives will not receive the upper controller pulse during the back to zero operation.

■ Description of back to zero process

In the internal position control mode, when the rising edge of the back to zero start signal (HomeStart) is detected, the motor sets the zero position of the back to zero method with PA202.2. When the offset pulse is reached, the motor stops and outputs the back to zero completion signal (HOME), indicating that the back to zero operation is completed.

Generally, set the back to zero velocity 1 (the velocity that does not touch the home signal) to high velocity, and set the back to zero velocity 2 (the velocity that touches the home signal) to low velocity. Note that setting the back to zero velocity 2 too large will affect the accuracy of the back to zero.

Chapter 9 Adjustment

9.1 Adjustment Summary and Procedures

Tuning (auto tuning) is a function to optimize the response of the servo drive. The response depends on the servo gain set in the servo drive.
The servo gain is set by a combination of multiple parameters (velocity loop gain, position loop gain, filter, disturbance compensation, inertia ratio, etc.), and they affect each other. Therefore, the setting of the servo gain must consider the balance between the setting values of the various parameters.

In general, a high-stiffness machine can improve responsiveness by increasing the servo gain. However, for a machine with low stiffness, when the servo gain is increased, vibration may occur and the responsiveness cannot be improved. At this time, vibration can be suppressed by various vibration reduction control functions of the servo drive.

The factory setting of the servo gain is a stable setting. Depending on the state of the user's machine, the servo gain can be adjusted using the following adjustment-related auxiliary functions to further improve responsiveness.

9.1.1 Description of the auxiliary functions related to the adjustment

Adjustment-related auxiliary functions	Summary	Control mode
Manual stiffness adjustment (AF030)	Manual stiffness adjustment. Automatic modification of gain-related parameters.	Position control Velocity control
Vibration suppression control function (AF105)	A function to suppress the residual vibration generated during positioning.	Position control

9.1.2 Safety precautions during adjustment

Note

During adjustment, make sure to observe the following items.

- Do not touch the rotating part of the motor while the servo is on or the motor is rotating.
- When the servo motor is running, please make it ready for emergency stop at any time.
- Please make adjustments after confirming that the trial operation has completed normally.
- To ensure safety, install a stop device on the machine side.

When making adjustments, set the servo drive protection function shown in (1) to (5) below under appropriate conditions.

(1) 8.2.1 Overtravel setting

Make the overtravel setting. Refer to Chapter 8.2.3 Overtravel setting.

(2) Setting of torque limit

The torque limit function is a function that calculates the torque required for machine operation and limits the output torque so that it does not exceed this value. It can reduce the impact in the event of mechanical interference or collision. If the torque is set lower than the value required for operation, overshoot or vibration may occur.

(3) Setting of excessive position deviation alarm value

Excessive position deviation alarm is an effective protection function when the servo drive is in position control.

When the motor action does not match the command, by setting an appropriate excessive position deviation alarm value, an abnormal situation can be detected and the motor can be stopped. Position deviation is the difference between the position command value and the actual position.

The position deviation can be expressed by the following relationship between the position loop gain and the motor speed.

$$\text{Position deviation} = \frac{\text{motor speed (rpm)}}{60} \times \frac{\text{Encoder resolution (rpm)}}{\text{PA102}}$$

Position deviation too large alarm value (PA520) [Setting unit: 1 command unit]

$$\text{PA520} \times \frac{\text{Encoder resolution}}{10} > \frac{\text{maximum motor speed (rpm)}}{60} \times \frac{\text{Encoder resolution (rpm)} \times 10}{\text{PA102}} \times (1.2\sim2)$$

i.e.

$$\text{PA520} > \frac{\text{maximum motor speed (rpm)} \times 10}{6 \times \text{PA102}} \times (1.2\sim2)$$

(1) Position gain PA102

PA102	Position loop gain				Category
	Range	Setting unit	Factory setting	Effective	
	10 ～ 20000	0.1/s	400	Immediate effect	Automatic adjustment

（2） "×（1.2 ～ 2）"

"×（1.2 ～ 2）" is a surplus coefficient to avoid frequent occurrence of excessive position deviation alarm (E.A30).

As long as the relationship of the above formula is maintained, no excessive position deviation alarm will occur during normal operation. When the position deviation occurs because the motor action does not match the command, an abnormal situation will be detected and the motor will stop running.

(3) Example

When using a motor with a maximum motor speed of 3000 rpm, PA102 = 400, and encoder resolution = 8388608 (23 bits), calculate PA520 with an alarm margin of 2 as follows.

$$\text{PA520} = \frac{3000 \times 10}{6 \times 400} \times 2 = 25$$

When the acceleration/deceleration velocity of the position command exceeds the tracking ability of the motor, the lagging will become larger, resulting in the position deviation cannot satisfy the above-mentioned relationship. Please reduce the acceleration/deceleration velocity of the position command to a value that the motor can track or increase the alarm value of excessive position deviation.

■ Related parameters

PA520	Excessive position deviation alarm				
	Range	Setting unit	Factory setting	Effective	Category
	1～ 500	0.1 turn	50	Immediate effect	Setting

■Related alarm

Alarm No.	Alarm name	Alarm content
E.A30	Excessive position deviation alarm	Alarm displayed when the position deviation exceeds the excessive position deviation alarm value (PA520) in the servo ON state.

(4) Setting of vibration detection function

Initialize the vibration detection value (AF021), and set an appropriate value for the vibration detection function. For details, refer to "6.13 Vibration detection value initialization (AF021)".

(5) Setting of excessive position deviation alarm value when servo ON

When the clear operation (PA200.2) is set to a value other than "0", if the servo is turned on while the position deviation is accumulated, the position will be returned to the original position so that the position deviation becomes 0. This is very dangerous. To avoid this situation, you can set an alarm value for excessive position deviation when the servo is ON to limit its operation.

The related parameters and alarms are shown below.

■ Related parameters

PA526	Excessive position deviation alarm value when servo ON				Category
	Range	Setting unit	Factory setting	Effective	
	1～ 500	0.1 turn	50	Immediate effect	Setting

PA528	Excessive position deviation warning value when servo ON				Category
	Range	Setting unit	Factory	Effective	

			setting		
	10 ～ 100	1%	100	Immediate effect	Setting

PA529	Velocity limit when servo ON				Category
	Range	Setting unit	Factory setting	Effective	
	0 ～ 10000	1 min-1	10000	Immediate	Setting

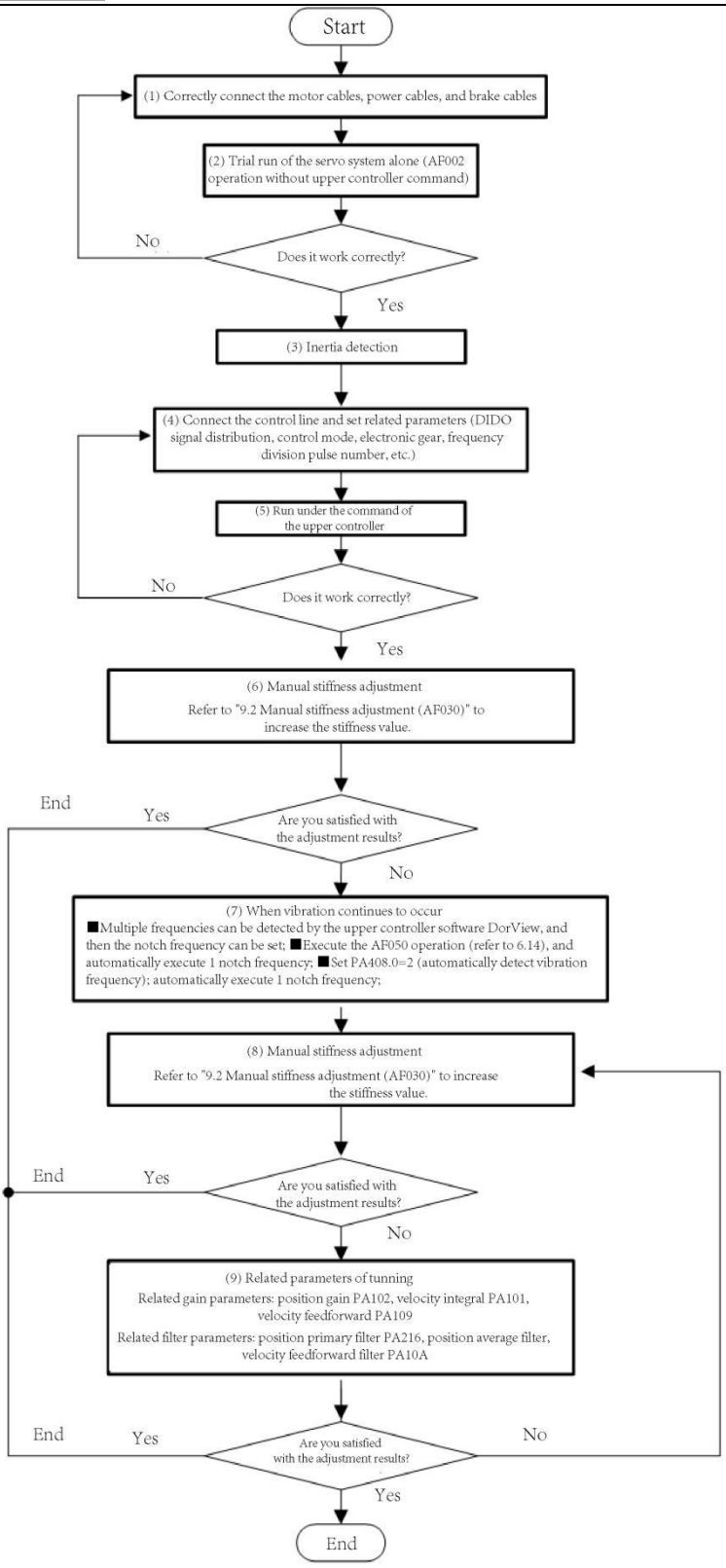
■Related alarm

Alarm No.	Alarm name	Alarm content
E.A31	Excessive position deviation alarm value when servo ON	Alarm displayed during servo OFF when the position deviation pulse exceeds the set value of PA526 and an attempt is made to turn the servo ON in this state.
E.A32	Excessive position deviation alarm due to velocity limit	The velocity limit is executed using the velocity limit value (PA529) while the servo is ON; and the command pulse is input in this state, and the position deviation exceeds the set value of the excessive position deviation alarm (PA520).

Refer to "Chapter 10 Fault diagnosis" for details on how to handle the alarm when it occurs.

9.1.3 Tuning procedures

The DS2P series servo drive can be tuned by the following tuning procedures for servo-related parameters. The figure below shows the flow chart of the simple tuning procedures. Please make appropriate adjustments according to the status and operating conditions of the machine used.

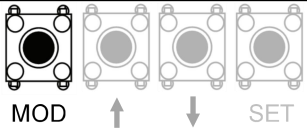
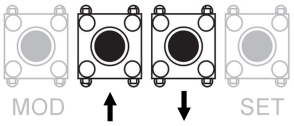
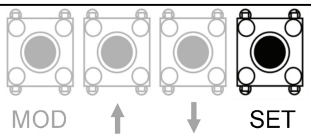
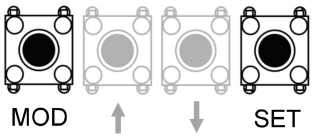
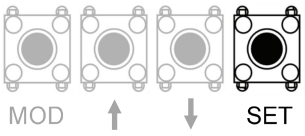
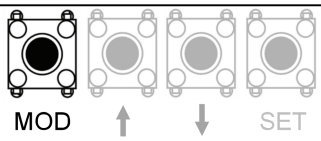

Start
(1) Correctly connect the motor cables, power cables, and brake cables
(2) Trial run of the servo system alone (AF002 operation without upper controller command)
No
Does it work correctly?
Yes
(3) Inertia detection
(4) Connect the control line and set related parameters (DIDO signal distribution, control mode, electronic gear, frequency division pulse number, etc.)
(5) Run under the command of the upper controller
No
Does it work correctly?
Yes
(6) Manual stiffness adjustment
Refer to "9.2 Manual stiffness adjustment (AF030)" to increase the stiffness value.
End
Yes
Are you satisfied with the adjustment results?
No
(7) When vibration continues to occur
■Multiple frequencies can be detected by the upper controller software DorView, and then the notch frequency can be set; ■Execute the AF050 operation (refer to 6.14), and automatically execute 1 notch frequency; ■Set PA408.0=2 (automatically detect vibration frequency); automatically execute 1 notch frequency;
(8) Manual stiffness adjustment
Refer to "9.2 Manual stiffness adjustment (AF030)" to increase the stiffness value.
End
Yes
Are you satisfied with the adjustment results?
No
(9) Related parameters of tunning
Related gain parameters: position gain PA102, velocity integral PA101, velocity feedforward PA109
Related filter parameters: position primary filter PA216, position average filter, velocity feedforward filter PA10A
End
Yes
Are you satisfied with the adjustment results?
No
Yes
End

9.2 Manual Stiffness Adjustment (AF030)

9.2.1 About manual stiffness adjustment

Under non-automatic adjustment, this auxiliary function makes it easy to set the velocity gain PA100, velocity integral PA101, position gain PA102 and torque filter time constant PA401 empirically.

9.2.2 Procedures of manual stiffness adjustment

Steps	Panel display	Keys	Operations
1			Press MOD key to choose monitoring display function.
2			If the panel display is not AF030, press ↑ & ↓ until it is AF030.
3			Press "SET" for about 1 second and "r. XX" displays the current stiffness value of the system.
4			Press the "↑" or "↓" to set the desired stiffness. Note that the stiffness value is valid immediately; observe the adjustment result. If there is a large noise or abnormal phenomenon in operation after increasing stiffness, please reduce the stiffness value. **(Note)** The maximum stiffness value is 23
6			After pressing "SET" for about 1 second, the displayed stiffness value will be set in the corresponding parameter.
8			Press MOD to return to the display of "AF030".
9	End of operations		

9.2.3 Related parameters

The relevant parameters are shown below. These parameters are set automatically, and do not need to be adjusted manually.

Par	Des
PA100	Velocity 1 loop gain
PA101	Velocity 1 loop integration time constant
PA102	Position 1 loop gain
PA401	The first-stage torque command filter time parameter

9.3 Protection Functions during Adjustment

After the general parameters have been set, the relevant protection settings need to be considered and the drive has several protection functions as follows.

1) **Excessive position deviation protection (E.A30)**

   Set the parameter PA520 correctly according to the pulse equivalent of the upper controller and the running velocity.

   For example, if the pulse equivalent of the upper controller is 10000pulse corresponding to 1 turn of the motor, and the dP005 at the highest velocity of operation is the number of pulses of 2 turns of the motor, then PA520 can be set to 3 (turns). That is, when the deviation pulse reaches 3 turns of the motor, E.A30 alarm will be generated.

   i.e. PA520 value = dP005 (when running the highest velocity) * 1.5/PulseNo (dP032 motor encoder resolution)

   Setting this parameter helps to prevent runaway or out of control, etc.

2) **Motor collision protection (E.136)**

   This protection is generated when the servo detects that the load torque has reached a certain threshold and exceeds a specified time, and considers that the motor has collided.

   Parameter PA43D is the torque threshold and parameter PA00D.2 is the time.

   Setting this parameter helps to prevent runaway , out of control or collision, etc.

3) **Vibration alarm (E.A20)**

   Setting the correct PA311 and PA312 helps to prevent damage to the machinery by alarming due to vibration when the parameters are turned up.

9.4 Vibration Reduction Control Function (AF105)

This section explains the vibration reduction control function

9.4.1 About the vibration reduction control function

The vibration reduction control function is mainly used to suppress transient low-frequency vibration of about 1 to 100 Hz caused by vibration of the machine and the like during positioning.

This function is automatically set during internal command type automatic adjustment or external command type automatic adjustment, so it is almost unnecessary to use this function. Only use it if further fine adjustment is needed or readjustment is required due to vibration detection failure.

To improve response characteristics after executing this function, please perform manual modification of the stiffness level.

Note

- After executing this function, related parameters will be set automatically. Therefore, the response may change greatly before and after this function is executed. For safety reasons, please execute this function at any time in an emergency stop state.
- Before executing the vibration reduction control function, please set the correct moment of inertia ratio (PA103) by internal command type automatic adjustment, etc. If the moment of inertia ratio is set improperly, the control may be abnormal and vibration may occur.

Important

- The vibration frequency that can be detected using this function is 1 to 100 Hz. Vibrations outside the detection range cannot be detected, but "F -----" is displayed.
- If vibration due to position deviation does not occur or the vibration frequency is outside the detection frequency range, vibration cannot be detected. In this case, use an instrument that can measure the vibration frequency, such as a displacement or a vibrometer, to measure the vibration.
- When the vibration frequency cannot be eliminated by the automatically detected vibration frequency, there may be an error between the actual vibration frequency and the detected frequency. Please fine-tune the vibration frequency.

(1) Confirmation before performing vibration reduction control function

Before executing this function, please confirm the following items.

A) If the setting is not correct, "NO-OP" will be displayed during operation.

● Position control

● The automatic adjustment function shall not be effective.

b) Check the following items; if not set properly, it will not operate

● Writing prohibited (AF003) is not set to "Writing prohibited"

(2) Items affecting performance

When vibrations continue to occur when stopped, sufficient vibration reduction control effects cannot be obtained with the vibration reduction control function. In this case, please solve it by manually adjusting the relevant gain.

(3) Detection of vibration frequency

If there is no vibration in the position deviation or the vibration of the position deviation is small, the frequency may not be detected. The detection sensitivity can be adjusted by changing the ratio to the positioning completion amplitude (PA522), that is, the setting of the residual vibration detection amplitude (PA560), so please adjust the residual vibration detection amplitude (PA560) and perform the vibration frequency detection again.

PA560	Residual vibration detection amplitude				Category
	Range	Setting unit	Factory setting	Effective	
	1 ～ 3000	0.1 %	400	Immediate effect	Setting

(Note) Please change the setting value to approximately 10%. The smaller the setting value is, the higher the detection sensitivity is. However, if the setting value is too small, vibration may not be detected correctly.

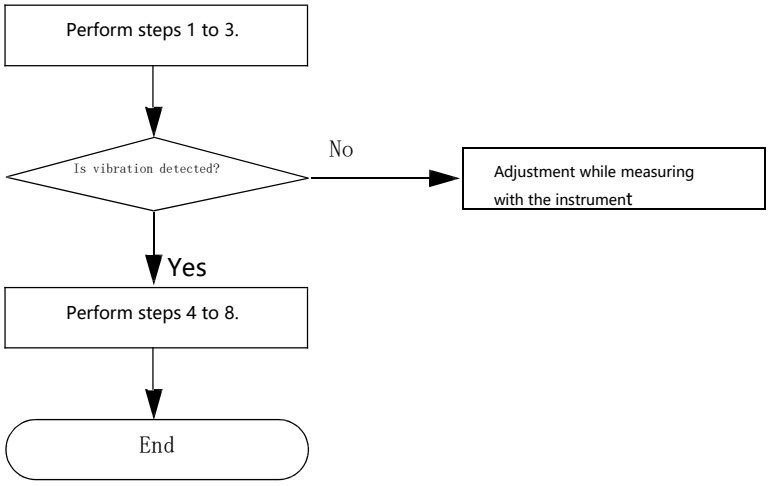
<Supplement> The automatic detection of the vibration frequency will have some differences in the frequency detected during each positioning operation. Perform positioning operation several times, and adjust while confirming the effect of vibration reduction control.

9.4.2 Procedures of vibration reduction control function

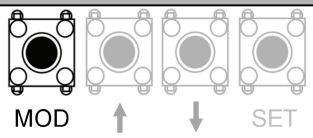
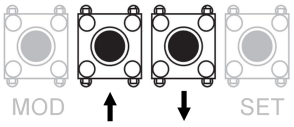
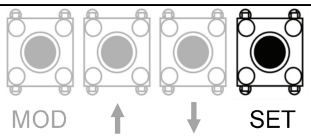
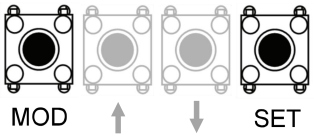
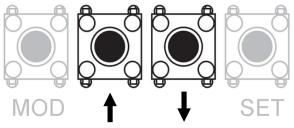
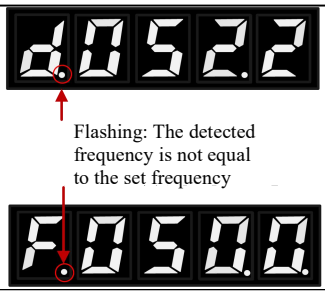
(Note) If you press the "MOD" key to stop the operation during the execution of this function, the motor will run in the set state before the motor stops. After the motor stops, the setting value will return to the state before adjustment.

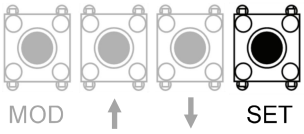
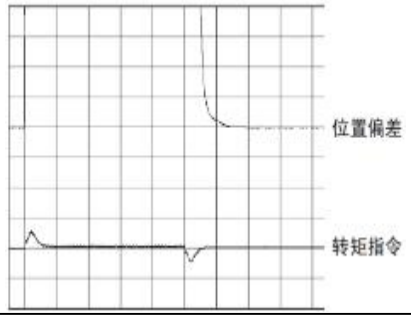
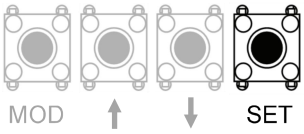
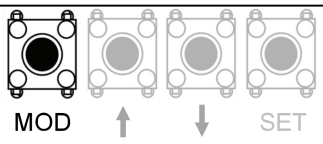
The procedures of vibration reduction control function are as follows.

(1) Procedures:



（2）JOG run procedures

Steps	Panel display	Keys	Operations
1			Press MOD key to choose monitoring display function.
2			If the panel display is not AF105, press ↑ & ↓ until it is AF105.
3			Press SET for about 1 second, the “d.XXXX” displays the detected frequency.
4			Press the "MOD" and "SET" keys at the same time to move the interface from "d.XXXX" to "F.XXXX". Enter the frequency setting interface.
5			Press “↑” or “↓” to set the frequency. [The factory setting is the set value of PA617]. **(Note)** ● When no vibration occurs or the vibration frequency is outside the detection frequency range, the following screen is displayed without performing frequency detection. If vibration frequency cannot be detected, please prepare a tool that can detect vibration and measure the vibration frequency. After measuring the vibration frequency, go to step 5 and manually set the measured vibration frequency.
			When the detected frequency (d.XXXX) is not equal to the set frequency (F.XXXX), the decimal point under d. or F. flashes.

6			After pressing the "SET" key for about 1 second, the displayed frequency will be set to the set frequency of the vibration reduction control function. 
7			After adjustment to meet the requirements; When saving the data, after pressing SET for about 1 second, the adjusted settings will be stored in the servo drive , "DONE" will flash for 2 seconds, and then revert to the previous screen display. When the data is not saved, press the "MOD" key.
8			Press MOD to return to the display of "AF105".
9	End of operations		

Important

- During operation, the settings related to the "vibration reduction control function" do not change.
- If the motor does not stop after about 10 seconds after changing the setting, the change timeout will occur and the setting will be restored to the setting before the change.
- The vibration reduction control function takes effect immediately after setting the parameters in step 6, but the motor's response will only change when there is "no command input" and "motor stopped".

Additional information about the vibration reduction control function is shown below.

■ Feedforward function

Important

- Model tracking control will set the optimal feedforward inside the servo. Therefore, it is usually not possible to use both the "velocity feedforward (V-REF) input" and the "torque feedforward (T-REF) input". If improper "velocity feedforward (V-REF) input" and "torque feedforward (T-REF) input" are input,

overshoot may be caused.

When this function is executed, the "feed forward command (PA109)", "velocity feedforward (V-REF) input" and "torque feedforward (T-REF) input" will become invalid.

To use "velocity feedforward (V-REF)input", "torque feedforward (T-REF) input" and model tracking control simultaneously, set PA610.3=1.

Parameter		Function	Effective	Category
PA610	n.0□□□	Model tracking control and velocity/torque feedforward are not used at the same time. (Factory setting)	Immediate effect	Automatic adjustment
	n.1□□□	Model tracking control and velocity/torque feedforward are used at the same time.		

For "torque feedforward (T-REF) input" and "velocity feedforward (V-REF) input", refer to "9.11.2 Torque feed forward", "9.11.3 Velocity feedforward".

9.4.3 Related parameters

The relevant parameters are shown below. These parameters are set automatically, and do not need to be adjusted manually.

Par	Des
PA610	Model tracking control selection
PA613	Model tracking control gain
PA617	Vibration reduction control 1 frequency A
PA618	Vibration reduction control 1 frequency B

9.5 Adjustment of Application Functions

The following explains the functions when further individual adjustment is required after adjustment by the internal command auto tuning, command input auto tuning, and simple parameter auto tuning.

- Switching gain
- Disturbance compensation function
- Current control mode selection
- Current gain value setting function
- Velocity detection method selection function

9.5.1 Switching gain

The gain switching function includes "Manual Gain Switching" which uses external input signals, and "Auto Gain Switching" which performs switching automatically.

Parameter	Function	Effective	Category

PA139	n.□□□0	Manual gain switching (factory setting)	Immediate effect	Automatic adjustment
	n.□□□2	Automatic switching		

(Note) n.□□□□□1 is the reservation parameter. Please do not set it.

For the combination of switching gain, refer to "(1) Combination of switching gain".

For manual gain switching, refer to "(2) Manual Gain Switching".

For automatic gain switching, refer to "(3) Automatic gain switching".

(1) Combination of switching gain

Switching gain	Velocity loop gain	Velocity loop integration time constant	Position loop gain	Torque command filter	Model tracking control gain	Model tracking control gain correction	Disturbance compensation gain
Gain 1	Velocity loop gain (PA100)	Velocity loop integration time constant (PA101)	Position loop gain (PA102)	Torque command filter (PA401)	Model tracking control gain *(PA613)	Model tracking control gain correction* (PA614)	Disturbance compensation gain (PA121)
Gain 2	Velocity 2 loop gain (PA104)	Velocity 2 loop integration time constant (PA105)	Position 2 loop gain (PA106)	Torque 2 command filter (PA412)	Model 2 tracking control gain* (PA61A)	Model 2 tracking control gain correction* (PA61B)	Disturbance 2 compensation gain (PA122)

* The model tracking control gain and model tracking control gain correction are only available for "Manual gain switching".

In addition, in these parameters, the gain is switched only when the following conditions are satisfied at the same time and the gain switching signal is input. If the conditions are not met, these parameters will not switch even if the other parameters in the table above are switched.

- No command
- Motor is stopped

(2) Manual gain switching

"Manual gain switching" switches the Gain 1 and Gain 2 with the external input signal (G-SEL1).

Type	Signal	Connector pin no.	Setting	Meaning
Input	G-SEL1	Need allocation	OFF	Switch to gain 1 via G-SEL1.
			ON	Switch to gain 2 via G-SEL1.

(3) Automatic gain switching

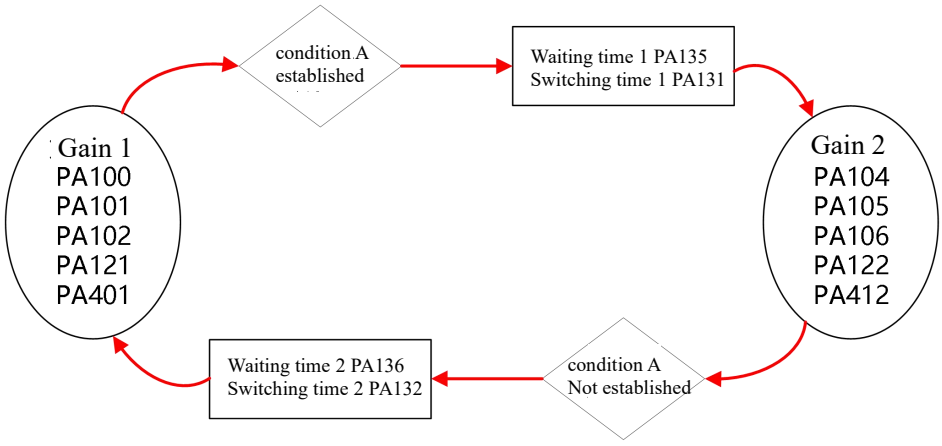
The "Automatic gain switching" is executed under the following settings and conditions.

Parameter setting	Switching conditions	Switching gain	Switching wait time	Switching time
PA139=n.□□□2 (Automatic switching)	Condition A holds	Gain 1 → Gain 2	Waiting time 1 PA135	Switching time 1 PA131
	Condition A does not hold	Gain 2 → Gain 1	Waiting time 2 PA136	Switching time 2 PA132

Select "Switching condition A" for automatic gain switching from the following settings.

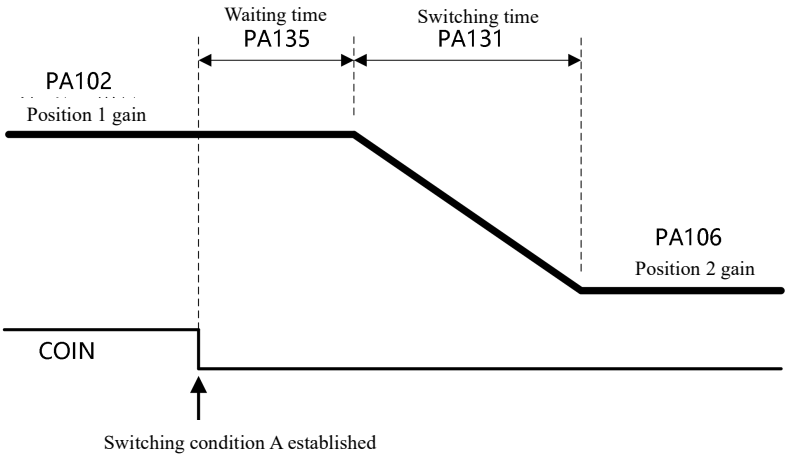
Parameter		Switching condition A		Effective time	Category
		Position	Other than position control		
PA139	n.□□0□	Positioning completed	Fixed at Gain 1	Immediate effect	Automatic adjustment
	n.□□1□	Positioning completed	Fixed at Gain 2		
	n.□□2□	Near signal (NEAR) ON	Fixed at Gain 1		
	n.□□3□	Near signal (NEAR) OFF	Fixed at Gain 2		
	n.□□4□	Position command filter output = 0 and command pulse input OFF	Fixed at Gain 1		
	n.□□5□	Position command pulse	Fixed at Gain 2		

Auto mode 1 (PA139.0=2)



■Relationship between waiting time and switching time parameters for switching gain

For example, in the case of automatic gain switching with the positioning completion signal (COIN) ON, assume that the gain is switched from position loop gain PA102 to position loop 2 gain PA106. After the COIN signal of the switching condition is ON and the waiting time PA135 has been waited from the time the switching condition has been established, the gain is changed linearly from PA102 to PA106 during the switching time PA131.



<Supplement>
Gain switching can be performed in either PI or I-P control mode (PA10B).

(4) Related parameters

PA100	Velocity loop gain				Category
	Range	Setting unit	Factory setting	Effective	
	10 ～ 20000	0.1 Hz	400	Immediate effect	Automatic adjustment
PA101	Velocity loop				Category
	Range	Setting unit	Factory setting	Effective	
	15 ～ 51200	0.01 ms	2000	Immediate effect	Automatic adjustment
PA102	Position loop gain				Category
	Range	Setting unit	Factory setting	Effective	
	10 ～ 20000	0.1/s	400	Immediate effect	Automatic adjustment
PA613	Model tracking				Category
	Range	Setting unit	Factory setting	Effective	
	10 ～ 20000	0.1/s	500	Immediate effect	Automatic adjustment
PA615	Model tracking control gain correction				Category
	Range	Setting unit	Factory setting	Effective	
	500 ～ 2000	0.1%	1000	Immediate effect	Automatic adjustment
PA104	Velocity loop gain				Category
	Range	Setting unit	Factory setting	Effective	
	10 ～ 20000	0.1 Hz	400	Immediate effect	Automatic adjustment
PA105	Velocity loop integration time constant 2				Category
	Range	Setting unit	Factory setting	Effective	
	15 ～ 51200	0.01 ms	2000	Immediate effect	Automatic adjustment
	Position loop gain				Category

	Range	Setting unit	Factory setting	Effective	
	10 ～ 20000	0.1/s	400	Immediate effect	Automatic adjustment

PA121	Disturbance				Category
	Range	Setting unit	Factory setting	Effective	
	10 ～ 1000	0.1%	100	Immediate effect	Automatic adjustment
PA122	Disturbance				Category
	Range	Setting unit	Factory setting	Effective	
	10 ～ 1000	1%	100	Immediate effect	Automatic adjustment
PA61A	Model tracking control gain 2				Category
	Range	Setting unit	Factory setting	Effective	
	10 ～ 20000	0.1/s	500	Immediate effect	Automatic adjustment
PA61B	Model tracking control gain correction 2				Category
	Range	Setting unit	Factory setting	Effective	
	500 ～ 2000	0.1%	1000	Immediate effect	Automatic adjustment
PA412	The first-stage Torque 2 command filter time parameter				Category
	Range	Setting unit	Factory setting	Effective	
	0 ～ 65535	0.01 ms	100	Immediate effect	Automatic adjustment

(5) Automatic gain switching related parameters

PA131	Gain switching				Cate gory
	Range	Setting unit	Factory setting	Effective	
	0 ～ 65535	1 ms	0	Immediate effect	Automa tic
PA132	Gain switching				Category
	Range	Setting unit	Factory setting	Effective	
	0 ～ 65535	1 ms	0	Immediate effect	Automati c
PA135	Gain switching				Cate gory
	Range	Setting unit	Factory setting	Effective	
	0 ～ 65535	1 ms	0	Immediate effect	Automati c
PA136	Gain switching				Cate gory
	Range	Setting unit	Factory	Effective	
	0 ～ 65535	1 ms	0	Immediate effect	Automati c

(6) Related monitoring

Monitoring number	Monitoring name	Display value	What to check
dP030	Effective gain monitoring	1	Displayed when Gain 1 is active.
		2	Displayed when Gain 2 is active.

(Note) "1" is displayed when the auto tuning function is active.

9.5.2 Disturbance compensation function

The disturbance compensation function is a function that compensates for viscous friction fluctuations and stable load fluctuations.

<Supplement> The main causes of load fluctuations are changes in viscosity resistance of lubricants caused by temperature fluctuations, variations in equipment, and changes in viscous friction and stable loads caused by aging.

With the following settings, the disturbance compensation will be adjusted automatically.

① When the mode is set to "Mode = 2" and "Mode = 3" by internal command type automatic adjustment;

② When the automatic adjustment mode is set to "Tuning Mode = 2" or "Tuning Mode = 3" by simple parameter type automatic adjustment. Please refer to the following descriptions only when manual adjustment is required.

(1) Parameters to be set

To use the disturbance compensation function, the following parameters need to be set:

Paramete		Function	Effective	Category
PA408	n.0□□□	The disturbance compensation function is	Immediate effect	Setting
	n.1□□□	The disturbance compensation function is		

PA121	Disturbance compensation gain			Category
	Range	Setting unit	Factory setting	Effective
	10 ～ 1000	1%	100	Immediate effect
PA123	Disturbance compensation coefficient			Category
	Range	Setting unit	Factory setting	Effective
	0 ～ 100	1%	0	Immediate effect
PA124	Disturbance compensation frequency			Category
	Range	Setting unit	Factory setting	Effective
	-10000 ～ 10000	0.1 Hz	0	Immediate effect
PA125	Disturbance compensation gain			Category
	Range	Setting unit	Factory setting	Effective

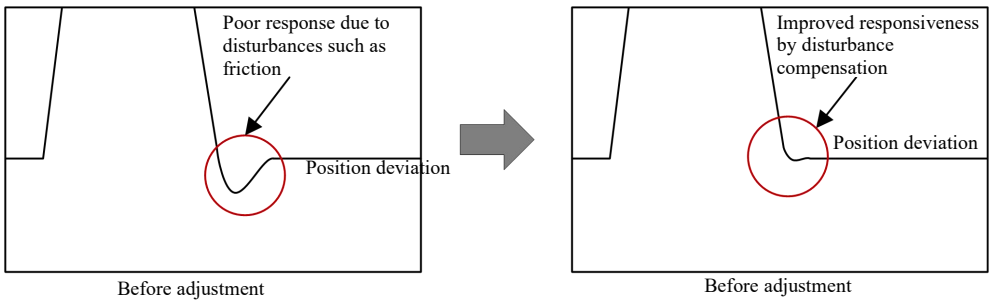
	1 ～ 1000	1%	100	Immediate effect	Automatic

(2) Procedures of disturbance compensation function

The procedures of disturbance compensation function are as follows.

Note

- When using the disturbance compensation function, set the moment of inertia ratio (PA103) as accurately as possible. If the moment of inertia ratio is set incorrectly, vibration may occur.

Steps	Operations
1	Restore the following disturbance compensation related parameters to the factory settings. Disturbance compensation gain (PA121) → Factory setting: 100 Disturbance compensation coefficient (PA123) → Factory setting: 0 Disturbance compensation frequency correction (PA124) → Factory setting: 0 Disturbance compensation gain correction (PA125) → Factory setting: 100 (Note) (Note) Please keep the disturbance compensation frequency correction (PA124) and disturbance compensation gain correction (PA125) at the factory settings.
2	To confirm the effect of the disturbance compensation function, increase the disturbance compensation coefficient (PA123) gradually. (Note) The upper limit value of the disturbance compensation coefficient (PA123) is 95%.
3	If the sufficient disturbance compensation function is still not obtained through step 2, please increase the setting value of PA121 within the range that does not generate vibration. (Note) Setting the PA121 too large may cause vibration. When increasing PA121, adjust it gradually at intervals of about 10%. Adjustment effect The results of the adjustment are shown below as examples of the waveform graphs before and after adjustment. 

	Effect of tuning parameters PA121: disturbance compensation gain Set the parameter of response to external interference. The higher the setting value, the better the response to external interference, but when the device has a resonance frequency, Setting too high may cause vibration. PA123: disturbance compensation coefficient Set the parameters of the disturbance compensation effect. The higher the setting value, the better the effect, but the higher the setting value, the easier the response is to vibrate. Usually please set to 95 [%] of the upper limit of the set value.

9.5.3 Current gain value setting function

The current gain value setting is a function to adjust the current control parameters inside the servo drive according to the velocity loop gain (PA100) to reduce noise. By changing the factory setting (2000%, function disabled) of the current gain value (PA60D), it can be changed to the current control parameter corresponding to the velocity loop gain setting. However, this function is not available in the torque control mode (PA000.1=2).

PA60D	Current gain value				Category
	Range	Setting unit	Factory setting	Effective	
	100 ～ 2000	1%	2000	Immediate	Automatic

Important

- When this function is changed, the response characteristics of the velocity loop will also change, so servo adjustment is required again.

(Note) By reducing the setting value, the noise level can be reduced, but at the same time the response characteristics of the servo drive will be deteriorated. Therefore, reduce the setting value to a level that ensures the response characteristics.

9.6.4 Velocity detection method selection function

The velocity detection method selection function can smooth out the motor speed during operation. This function is not available in the factory setting mode. To use this function, set PA009.2=1.

Para		Mean	Effective	Categ
PA009	n.□0□□	Select velocity checkout 1. (Factory setting)	After power is turned on again	Automatic adjustment
	n.□1□□	Select velocity checkout 2.		

Important

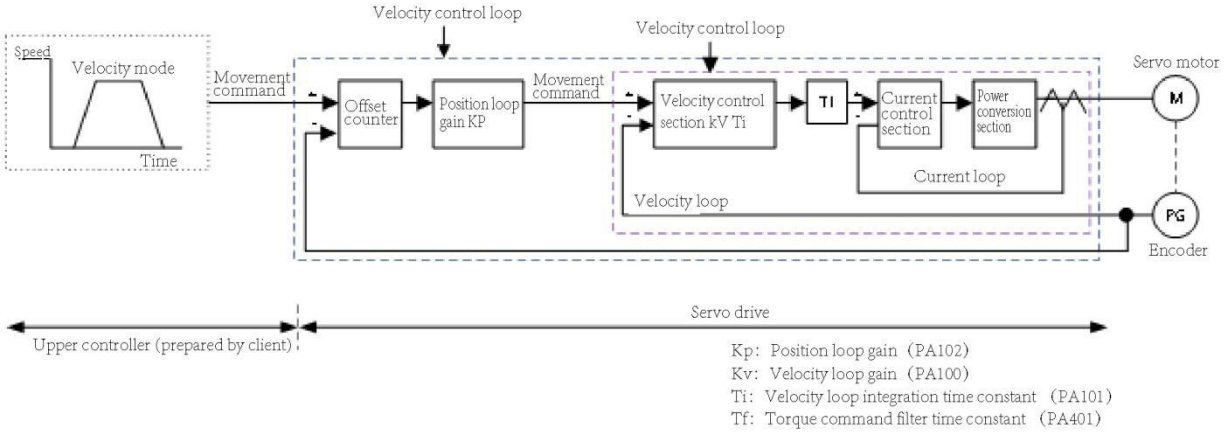
- When this function is changed, the response characteristics of the velocity loop will also change, so servo adjustment is required again.

9.6 Manual Adjustment

The following explains manual adjustment.

9.6.1 Servo gain adjustment

Description of servo gain



To adjust the servo gain manually, adjust each servo gain one by one based on an understanding of the servo drive's composition and characteristics. In most cases, if there is a large change in one parameter, the other parameters should be adjusted accordingly. In order to confirm the response characteristics, it is necessary to be prepared to observe the output waveform of the drive with a measuring instrument, etc.

The servo drive consists of three feedback loops (position loop, velocity loop, and current loop); the more the inner loop is, the more responsiveness it needs to improve. Failure to comply with this principle will result in poor responsiveness or vibration.

Since the current loop ensures adequate responsiveness, it is not necessary for the customer to make adjustments.

Summary

After setting the servo gain of the servo drive manually, the response characteristics of the servo drive can be improved. For example, in position control, the positioning time can be shortened. Please use manual adjustment in the following cases.

• When automatic adjustment (without upper command) or automatic adjustment (with upper command) cannot be performed smoothly

• When the servo gain needs to be increased more than the result of automatic adjustment (without upper command) or automatic adjustment (with upper command)

• When the customer wants to decide the servo gain and inertia ratio by himself

Start from the factory-set state of each servo gain parameter or the gain setting state at the end of automatic adjustment (without upper command) or automatic adjustment (with upper command).

Operable tools

DorVision/ServoLink can be used for monitoring.

Precautions

Vibration may occur sometimes when adjusting the servo gain. It is recommended that the vibration alarm for vibration detection be set to active (PA310 = n.2). For vibration detection, refer to "6.13 Vibration detection value initialization".

The vibration alarm cannot detect all vibrations. An emergency stop device should be installed to safely stop the machine in the event of an alarm. The emergency stop device should be prepared by the customer and it can be activated immediately in case of vibration.

Example of adjustment procedure (for position control and velocity control)

Steps	What to check
1	Adjust the first-stage torque 1 command filter time parameter (PA401) and set it to no vibration.
2	Increase the velocity loop gain (PA100) and decrease the velocity loop integration time constant (PA101) as much as possible within the range of no mechanical vibration.
3	Repeat steps 1 and 2 to restore 10 to 20% of the changed value.
4	For position control, increase the position loop gain (PA102) within the range of no mechanical vibration.

Additional notes:

In the servo gain, if one parameter is changed, the other parameters need to be readjusted as well. Please do not make a large change to only one parameter. Please use about 5% as a general standard and adjust each servo gain slightly.

In general, please observe the following procedure for changing servo parameters.

◆ When improving the response time

1. Decrease the torque command filter time parameter
2. Increase the velocity loop gain.
3. Decrease the velocity loop integration time constant
4. Increase the position loop gain

◆ When reducing the response time to prevent vibration and overshoot

1. Decrease the position loop gain
2. Increase the velocity loop integration time constant
3. Decrease the velocity 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.

- PA100: velocity loop gain
- PA101: velocity loop integration time constant

PA102: Position loop gain

- PA401: The first-stage Torque 1 command filter time parameter

■ Position loop gain

The responsiveness of the servo drive's 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 beyond the inherent vibration number of the mechanical system. Therefore, to set the position loop gain to a larger value, you need to increase the machine stiffness and increase the inherent vibration number of the machine.

PA102	**Position loop gain**				Category
	Range	Setting unit	Factory setting	Effective	
	10 ～ 20000	0.1/s	400	Immediate effect	Automatic adjustment

Additional notes:

Parameter PA520 is the detection value of excessive position deviation alarm. If the position loop gain (PA102) is set too small, the machine may have overflow alarm during high velocity operation. When the value of PA520 is adjusted upward, the detection of overflow will become difficult.

As an approximate standard for the setting value, please refer to the following conditions.

$$\text{PA520} > \frac{\text{Maximum motor speed (rpm)} \times 10}{6 \times \text{PA102}} \times (1.2\sim2)$$

When using the position command filter, the transition deviation will increase depending on the filter time parameter. The set value should take into account the filter signal stacking.

PA520	**Excessive position deviation alarm**				Category
	Range	Setting unit	Factory setting	Effective	

	1～ 500	0.1 turn	50	Immediate effect	Setting

■ Velocity loop gain

A parameter to determine the responsiveness of the velocity loop. Since a low responsiveness of the velocity loop becomes a delay element of the outer position loop, overshoot or vibration of the velocity command may occur. For this reason, the higher the setting value, the more stable the servo system is and the better the responsiveness is, within the range of no mechanical vibration.

PA100	Velocity loop gain				
	Range	Setting unit	Default	Effective	Category
	10～20000	0.1Hz	400	Immediate	Automatic adjustment

▪ Velocity loop integration time constant

In order to respond to small inputs, the velocity loop contains an integration element. Since the integration element is a delay element for the servo system, when the time parameter is set too large, overshoot will occur or the positioning time will be prolonged, resulting in poor responsiveness.

PA101	Velocity loop integration time constant				
	Range	Setting unit	Default	Effective	Category
	15～51200	0.01ms	2000	Immediate	Automatic adjustment

■ Moment of inertia ratio

It is the ratio of load inertia to motor rotor inertia.

The factory setting of PA103 (moment of inertia ratio) is "100". Use the following formula to find the moment of inertia ratio and set it in PA103 before performing servo tuning.

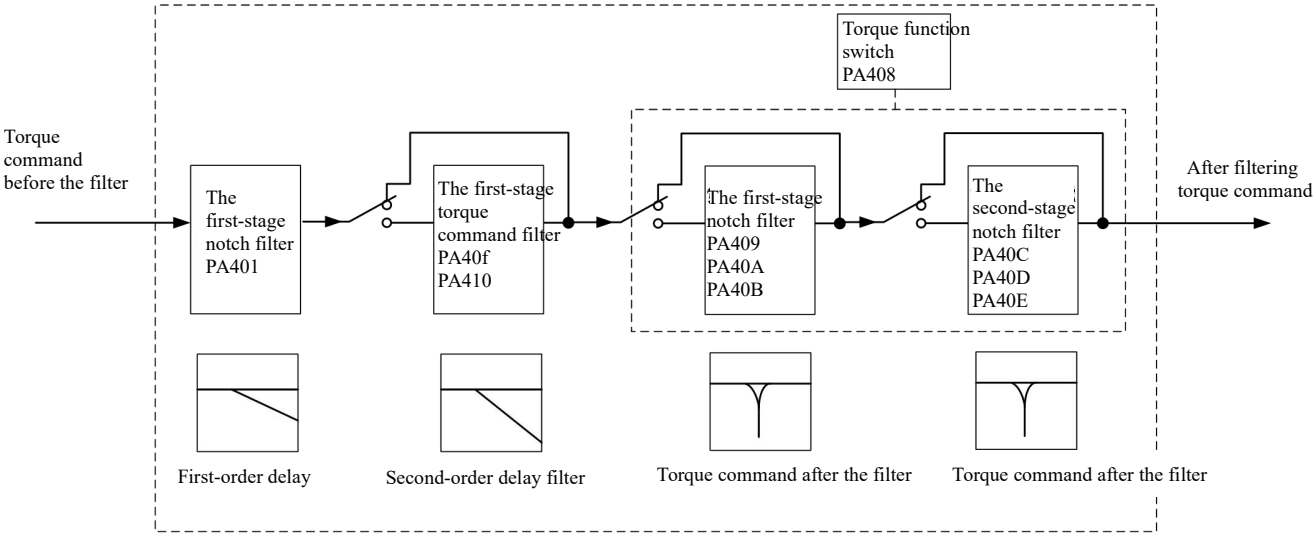
$$\text{PA103 setting value} = \frac{\text{Motor shaft converted load inertia (JL)}}{\text{Inertia of servo motor (JM)}} \times 100\%$$

PA103	Moment of inertia ratio				
	Range	Setting unit	Default	Effective	Category
	0～20000	%	100	Immediate	Gain adjustment

■ Torque command filter

The torque command filter is serially configured with a first-order delay filter and a notch filter, each functioning independently. The notch filter is switched active/ineffective via PA408.

The notch filter switches active/ineffective by PA408 = n.□X□X.



(1) Torque command filter

When mechanical vibration may be caused by servo drive, it is possible to eliminate vibration if the following torque command filter time parameters are adjusted. The smaller the value, the more responsive control is possible, but it is subject to mechanical conditions.

PA401	The first-stage torque command filter time parameter				Category
	Range	Setting unit	Factory setting	Effective	
	0 ～ 65535	0.01 ms	100	Immediate effect	Automatic

PA40F	The second-stage torque command filter frequency				Category
	Range	Setting unit	Factory setting	Effective	
	100 ～ 5000	1 Hz	5000	Immediate effect	Automatic

PA410	The second-stage torque command filter Q value				Category
	Range	Setting unit	Factory setting	Effective	
	50 ～ 1000	0.01	50	Immediate effect	Automatic

◆ Setting criteria of torque command filter

- Velocity loop gain and torque filter time parameters PA100 [Hz] PA401 [ms]

  Stable control range adjustment value PA401 [ms] ≤ 1000/ (2 π × PA100 [Hz] × 4)

  Critical adjustment value PA401 [ms] < 1000/ (2 π × PA100 [Hz] × 1)

(2) Notch filter

A notch filter is a filter used to remove a specific vibration frequency component caused by resonance of the ball screw axle, etc.

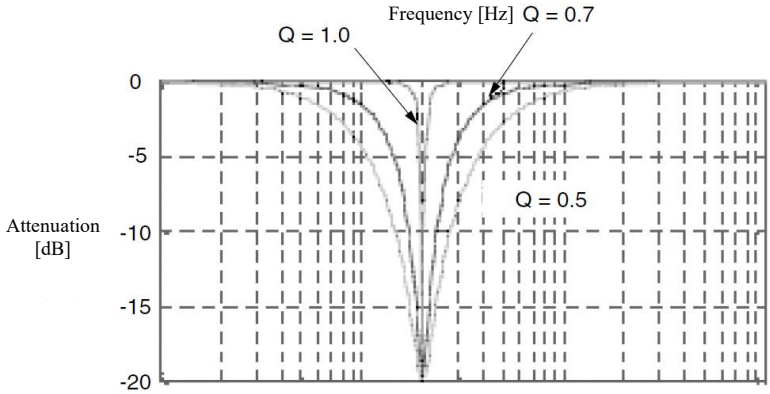
The gain curve is shown in the figure below, and the specific frequency (hereinafter called the notch frequency) has a notch shape. By this feature, the frequency components near the notch frequency can be eliminated or reduced.

The notch filter is set by three parameters: the notch filter frequency, the notch filter Q value, and the notch filter

depth. The notch filter Q value and the notch filter depth are explained below.

• Notch filter Q value

The notch filter Q value is the set value that determines the width of the filter frequency with respect to the notch filter frequency. The width of the notch varies depending on the notch filter Q value. The larger the notch filter Q value, the greater the depression and the narrower the width of the filter frequency.

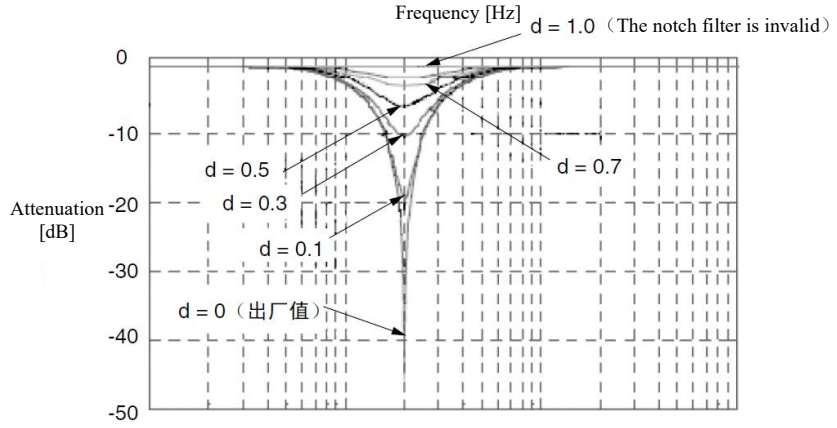


(Note) The said notch filter frequency characteristics are theoretical calculations, differing from the actual characteristics.

• Notch filter depth

The notch filter depth is the set value that determines the depth of the filter frequency with respect to the notch filter frequency. The depth of the notch varies depending on the depth of the notch filter.

The smaller the notch filter depth, the deeper the notch and the more effective the vibration reduction control. However, too small will increase the vibration.



(Note) The said notch filter frequency characteristics are theoretical calculations, differing from the actual characteristics.

The PA408 is used to select the effective/ineffective notch filter.

Paramete		Meaning	Effective	Category
PA408	n.□□□0	Invalidate the first-stage notch filter. (Factory	Immediate effect	Automatic adjustment
	n.□□□1	Validate the first-stage notch filter.		
	n.□0□□	Invalidate the second-stage notch filter.		
	n.□1□□	Validate the second-stage notch filter.		

Set the vibration frequency of the machine as the parameter of the notch filter to be used.

	The first-stage notch filter frequency	Categ

	Range	Setting unit	Factory setting	Effective	
	50 ～ 5000	1 Hz	5000	Immediate effect	Automatic
PA40A	The first-stage notch filter Q value				Category
	Range	Setting unit	Factory setting	Effective	
	50 ～ 1000	0.01	70	Immediate effect	Automatic
PA40B	The first-stage notch filter depth				Category
	Range	Setting unit	Factory setting	Effective	
	0 ～ 1000	0.001	0	Immediate effect	Automatic

PA40C	The second-stage notch filter frequency				Category
	Range	Setting unit	Factory setting	Effective	
	50 ～ 5000	1 Hz	5000	Immediate effect	Automatic
PA40D	The second-stage notch filter Q value				Category
	Range	Setting unit	Factory setting	Effective	
	50 ～ 1000	0.01	70	Immediate effect	Automatic
PA40E	The second-stage notch filter depth				Category
	Range	Setting unit	Factory setting	Effective	
	0 ～ 1000	0.001	0	Immediate effect	Automatic

Important

- Do not set the notch filter frequency (PA409 or PA40C) to be close to the response frequency of the velocity loop. This frequency should be set to at least 4 times the velocity loop gain (PA100) (but PA103 should be set correctly). If set incorrectly, vibration may occur, which may cause mechanical damage.
- Be sure to change the notch filter frequency (PA409 or PA40C) when the motor is stopped. If the change is made during motor operation, it may cause vibration.

General criteria for manual adjustment of servo gain

When adjusting the parameters manually, use the following condition formula as the general criteria based on a thorough understanding of the contents of the user's manual. The exact value of the parameter is affected by many conditions of the machine, so it cannot be specified as a unique value. Please start the machine and adjust the parameters while observing the operation status with DorVision/ServoLink software. Even if the motor is in a stable state when it is stopped, it may become unstable if a running command is input. Therefore, when adjusting the servo gain, you should input the run command and run the motor while making adjustments.

Stable adjustment value: A setting value with good balance between parameters.
When the load has a large moment of inertia and the mechanical system contains a vibration factor, machine vibration may occur if the set value is not increased to a certain level.

Critical adjustment value: A setting value interacting between parameters.
Depending on the machine conditions, overshoot and vibration may occur, resulting in unstable operation. If the critical adjustment value is exceeded, the operation will be more unstable and there is a risk of abnormal vibration

and large reciprocating motion of the motor shaft. So please do not exceed the critical adjustment value when setting.

If the torque command filter, secondary torque command filter, and notch filter are used simultaneously, the interference between each filter and the velocity loop gain will overlap. So a larger margin should be left for adjustment.

Important

- The PA103 (moment of inertia ratio) should be set correctly for the actual machine, based on the following approximate adjustment values

◆ **When PA10B = n.□□0□ (PI control)**

The Gain 1 is shown below.

The same applies to the Gain 2 (PA104, PA105, PA106, PA412).

- Velocity loop gain (PA100 [Hz]) and position loop gain (PA102 [/s])
  Stable adjustment value PA102 [/s] ≤ 2π × PA100/4 [Hz]
  Critical adjustment value PA102 [/s] < 2π × PA100 [Hz]
- Velocity loop gain (PA100 [Hz]) and velocity loop integration time constant (PA101 [ms])
  Stable adjustment value PA101 [ms] ≥ 4000/ (2π × PA100 [Hz])
  Critical adjustment value PA101 [ms] > 1000/ (2π × PA100 [Hz])
- Velocity loop gain and (PA100 [Hz]) the first-stage torque 1 command filter time parameter(PA401 [ms])
  Stable adjustment value PA401 [ms] ≤ 1000/ (2π × PA100 [Hz] × 4)
  Critical adjustment value PA401 [ms] < 1000/ (2π × PA100 [Hz] × 1)

◆ **When PA10B = n.□□1□ (IP control)**

The Gain 1 is shown below.

The same applies to the Gain 2 (PA104, PA105, PA106, PA412).

- Velocity loop gain (PA100 [Hz]) and velocity loop integration time constant (PA101 [ms])
  Stable adjustment value PA100 [Hz] ≥ 320/PA101 [ms]
- Position loop gain (PA102 [/s]) and velocity loop integration time constant (PA101 [ms])
  Stable adjustment value PA102 [/s] ≤ 320/PA101 [ms]

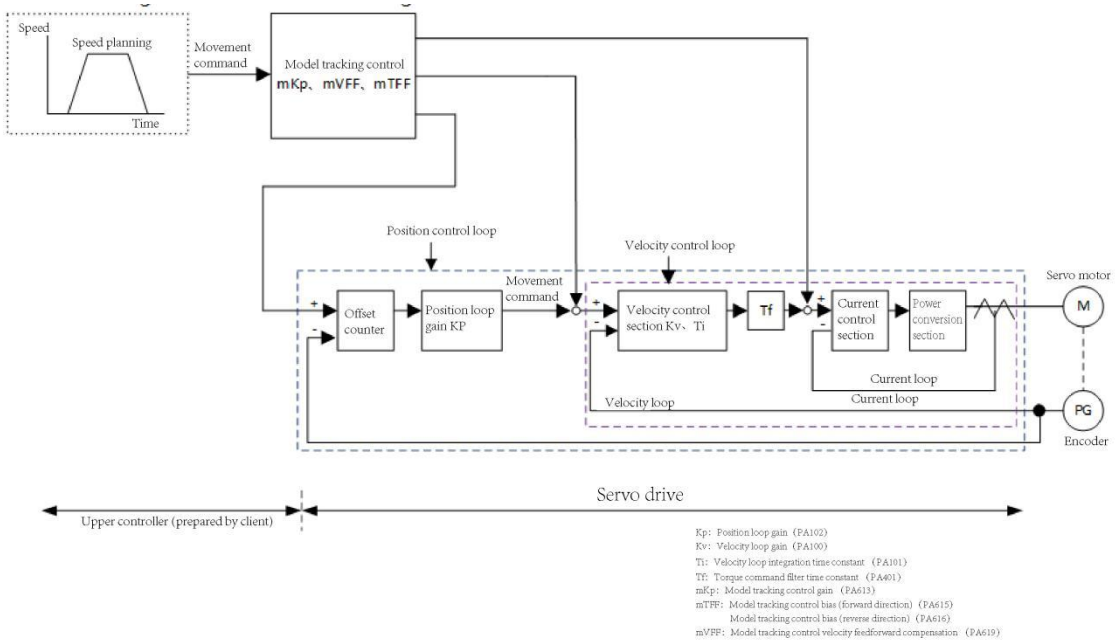
9.6.2 Model tracking control

Use model tracking control to improve responsiveness and shorten positioning time. Model tracking control is only available for position control.

Normally, the parameters used by this function are automatically set at the same time as the servo gain through automatic adjustment or custom adjustment. In the following cases, please adjust manually.

- When you are not satisfied with the adjustment result of automatic adjustment or manual adjustment
- When the responsiveness is more important than the adjustment result of automatic adjustment or custom adjustment
- When the customer decides the servo gain or model tracking control parameters by himself

The block diagram of the model tracking control is shown below.



◆Example of manual adjustment procedure

An example of the adjustment procedure when using the model tracking control is shown below.

Steps	What to check
1	Since the disturbance compensation function needs to be used at the same time, the parameters of the disturbance compensation function must be set.
2	1. Please try to set the correct moment of inertia ratio (PA103). 2. Please refer to the approximate standard for manual adjustment of servo gain, and set the position loop gain (PA102) within the range of stable adjustment value.
3	Increase tracking control gain in the range where overshoot and vibration do not occur (PA 613).
4	When overshoot occurs, or when the forward and reverse responses are different, the model tracking control bias (forward direction) (PA 615), model tracking control bias (reverse direction) (PA 616), model tracking Control velocity feed forward compensation (PA 619) for fine tuning.

■ Related parameters

The following parameters are used in model tracking control.

- PA 610 (model tracking control switch)
- PA 613 (model tracking control gain)
- PA 615 (model tracking control bias (forward direction))
- PA 616 (model tracking control bias (reverse direction))
- PA 619 (Model Tracking Control velocity Feedforward Compensation)

■ Model tracking control switch (PA610)

Use PA610 = n. □□□ X to select whether to use model tracking control.
When using the model tracking control and vibration reduction control functions at the same time, set PA610 = n. □□1□ or PA610 = n. □□2□. When using the vibration reduction control function at the same time, please adjust the vibration reduction control function through custom adjustment in advance.
When using the vibration reduction control function (PA610 = n. □□1□ or PA610 = n. □□2□), be sure to set it to PA610 = n. □□□1 (use model tracking control)

Parameter		Meaning	Effective	Category
PA610	n. 0□□□	Model tracking control and velocity/torque feedforward are used at the same time (factory setting)	Immediate	Automatic adjustment
	n. 1□□□	Model tracking control and velocity/torque feedforward are used at the same time.		

Model tracking control gain (PA613)

The model tracking control gain determines the responsiveness of the servo system. If the model tracking control gain is increased, the response becomes higher and the positioning time becomes shorter. The response of the servo system depends on this parameter, not PA102 (position loop gain).

PA613	Model tracking control gain				
	Range	Setting unit	Default	Effective	Category
	10～20000	0.1/S	500	Immediate	Gain adjustment

Additional notes:

For the machine whose model tracking control gain cannot be set too large, the position deviation during model tracking control depends on the model tracking control gain. For models with low stiffness, such as model tracking control gain that cannot be set too large, an excessive position deviation alarm may occur during high-speed operation. At this time, the PA 520 value can be set to a large value, but the detection of the alarm will become difficult.

As a guideline for setting values, refer to the following conditions.

$$\text{PA520} > \frac{\text{Maximum motor speed (rpm)} \times 10}{6 \times \text{PA102}} \times (1.2\sim2)$$

When using the position command filter, the transient deviation will increase according to the filter time parameter. The setting should consider the accumulation of filter signals

PA520	Excessive position deviation alarm				
	Range	Setting unit	Factory setting	Effective	Category
	1～ 500	0.1 turn	50	Immediate effect	Setting

▪ Model tracking control bias (forward direction), model tracking control bias (reverse direction)

When the response of forward rotation and reverse rotation are different, please fine -tune with the following parameters.

If the set value is decreased, although the response becomes slower, overshoot is less likely to occur.

PA615	Model tracking control bias (forward direction)				
	Range	Setting unit	Default	Effective	Category
	0～10000	0.1%	1000	Immediate	Gain adjustment
PA616	Model tracking control bias (reverse direction)				
	Range	Setting unit	Default	Effective	Category
	0～10000	0.1%	1000	Immediate	Gain adjustment

■ Model Tracking Control Velocity Feedforward Compensation

Even if you adjust the model tracking control gain, model tracking control bias (forward direction), and model tracking control bias (reverse direction), if overshoot still occurs, you can improve by adjusting the following parameters.

If the set value is decreased, although the response becomes slower, overshoot is less likely to occur.

PA619	Model Tracking Control Velocity Feedforward Compensation				
	Range	Setting unit	Default	Effective	Category
	0～10000	0.1%	1000	Immediate	Gain adjustment

9.7 Adjustment of the General Function

The DS2P series servo drives can be adjusted mechanically by the adjustment functions described in 9.1 to 9.7.

The following explains the functions that can be used as general functions in the adjustment functions of existing models such as servo drive.

9.7.1 Feedforward command

The feedforward command is a function that performs feedforward compensation to shorten the positioning time during position control.

PA109	Feedforward gain				Category
	Range	Setting unit	Factory setting	Effective	
	0 ～ 100	1%	0	Immediate effect	Automatic
PA10A	Feedforward filter time parameter				Category
	Range	Setting unit	Factory setting	Effective	
	0 ～ 6400	0.01 ms	0	Immediate effect	Automatic

(Note) However, if the feedforward gain is set too high, it may cause mechanical vibration. Please reduce the setting value to less than 80%.

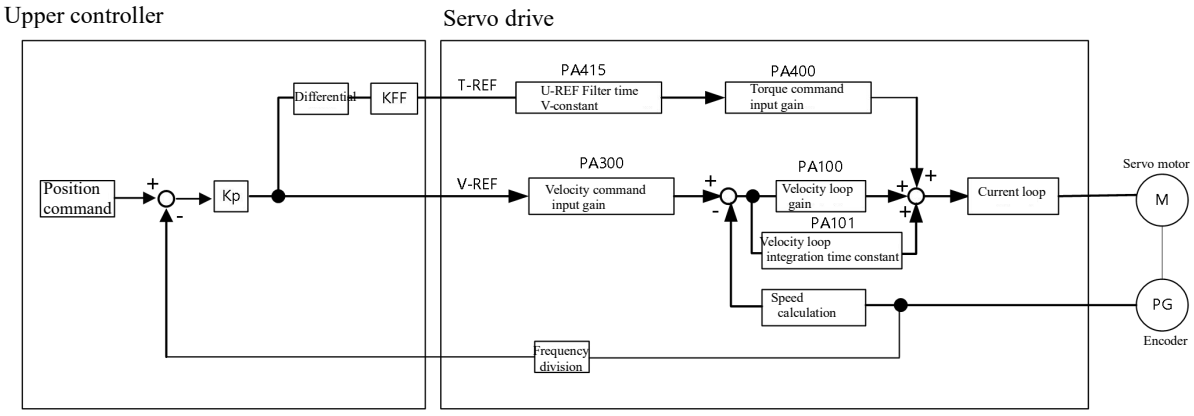
9.7.2 Torque feedforward

The torque feedforward is a function to shorten the positioning time. The torque feedforward command is valid during velocity control and position control.

The torque feedforward command is a command generated by differentiating the velocity command on the host device side. The torque feedforward command can be input to the servo drive at the same time as the velocity or position command.

(1) Example of connection for velocity control

The velocity command from the upper controller is connected to V-REF (CN1-5, 6), and the torque feedforward command is connected to T-REF (CN1-9, 10).



Kp: Position loop gain
KFF: Feedforward gain

(2) Related parameters

The torque feedforward is set by PA002, the torque command input gain (PA400), and the T-REF filter time parameter (PA415).

The factory PA400 setting is "PA400=3.0", so the torque feedforward value is "±100% torque (rated torque)" when set to "±3 V".

Para		Mean	Effective	Categ
PA002	n.□□□0	No T-REF allocated (factory setting)	After power is turned on again	Settin g
	n.□□□2	Use the T-REF terminal as the torque feedforward input terminal.		

PA400	**Torque command input gain**				Categ ory
	Range	Setting unit	Factory setting	Effective	
	10 ～ 100	0.1 V/ Rated torque	30	Immediate effect	Settin

(Note) 1. If the torque feedforward command is set too large, overshoot will occur. Make the appropriate setting while observing the response. 2. It cannot be used simultaneously with "torque limit based on analog voltage command".

PA415	**T-REF filtering**				Categ ory
	Range	Setting unit	Factory setting	Effective	
	0 ～ 65535	0.01 ms	0	Immediate effect	Settin g

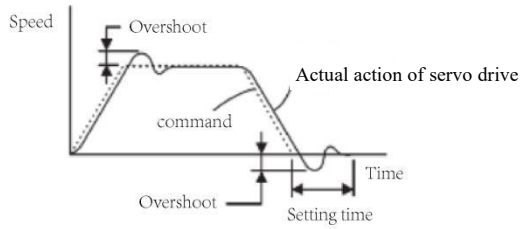
The following settings are required to use "velocity feedforward (V-REF)", "torque feedforward (T-REF)" and model tracking control at the same time.

Parameter		Function	Effective	Category
PA610	n. 0□□□	Model tracking control and velocity/torque feedforward are not used at the same time. (Factory setting)	Immediate effect	Automatic adjustment
	n. 1□□□	Model tracking control and velocity/torque feedforward are used at the same time.		

9.7.3 Setting of the mode switch (P control/PI control switching)

Mode switch (P control/PI control*) switching is a function used in the following cases.

For velocity control: to suppress overshoot during acceleration/deceleration.
For position control: to suppress overshoot during positioning and shorten the setting time.
P control: Proportional control
PI control: Proportional and integral control



-

With PA10B.0, the mode switch switches the velocity control section by PI control (proportional-integral control) and P control (proportional control).

<Supplement>

To make adjustments, observe the velocity response waveform and position deviation waveform.
When I-P control is selected for the velocity loop control method, the mode switch function is disabled.

(1) Related parameters

The following parameters are used to select the conditions for mode switch execution.

Parameter		Selection of mode switch	Parameters for the checkout point can be set	Effective	Category
PA10B	n.□□□0	Torque command is used as the checkout point (factory setting).	PA10C	Immediate effect	Setting
	n.□□□1	The velocity command is used as the checkout point.	PA10D		
	n.□□□2	The acceleration is used as the checkout point.	PA10E		
	n.□□□3	The position deviation pulse is used as the check point.	PA10F		
	n.□□□4	The mode switch is not used.	—		

■ **Parameters for the checkout point can be set**

PA10C	Mode switch (torque command)				Category
	Range	Setting unit	Factory setting	Effective	

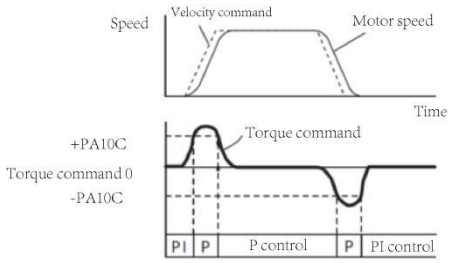
	0 ～ 800	1%	200	Immediate effect	Automatic adjustment
PA10D	Mode switch (velocity command)				Category
	Range	Setting unit	Factory setting	Effective	
	0 ～ 10000	1 min-1	0	Immediate effect	Automatic
PA10E	Mode switch (acceleration)				Category
	Range	Setting unit	Factory setting	Effective	
	0 ～ 30000	1 min-1/s	0	Immediate effect	Automatic
PA10F	Mode switch (position deviation)				Category
	Range	Setting unit	Factory setting	Effective	
	0 ～ 10000	1 command unit	0	Immediate effect	Automatic adjustmen

See the following page for the function of each mode switch checkout point.

■ When the checkout point of the mode switch is used as a torque command (factory setting)

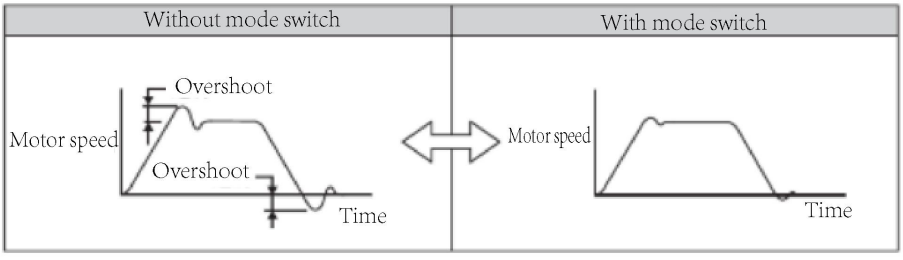
If the torque command exceeds the torque set in the PA10C, the velocity loop switches to P control.

The torque command value is set to 200% at the factory.



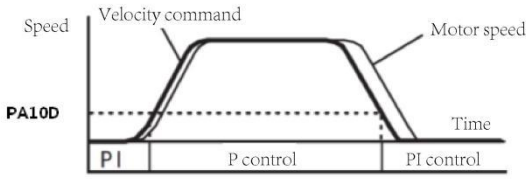
＜Example＞

When the velocity control mode is set to constant PI control without using the mode switch, the torque during acceleration/deceleration may saturate and the motor speed may overshoot. The saturation of torque can be suppressed by using the mode switch, and thus the overshoot of motor speed can be suppressed.



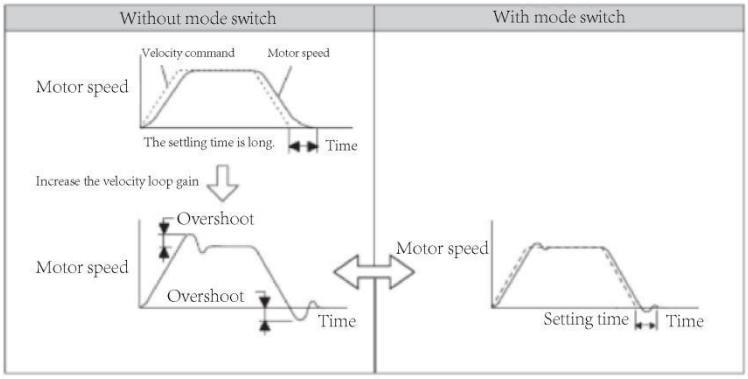
■ When the checkout point of the mode switch is used as the velocity command

If the velocity command exceeds the velocity set in PA10D, the velocity loop switches to P control.



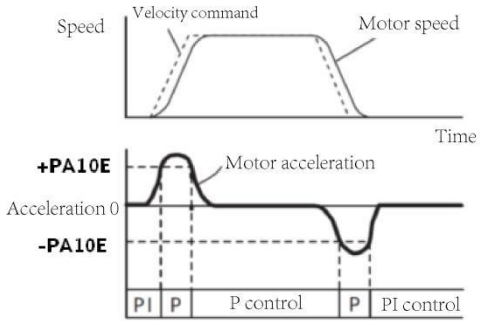
＜Example＞

It is used to shorten the setting time. Generally, it is necessary to increase the velocity loop gain in order to shorten the setting time, but the overshoot that occurs at this time can be suppressed.



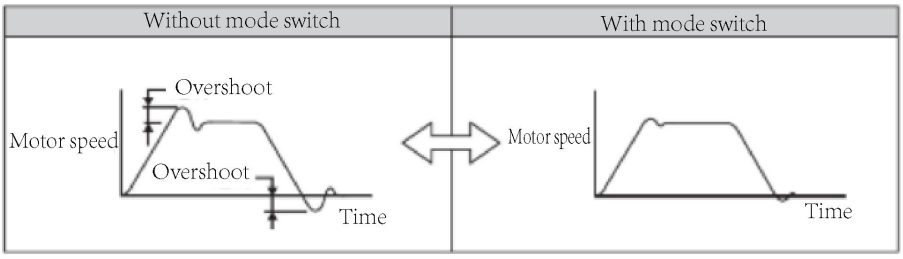
■ When the checkout point of the mode switch is used as the acceleration

If the velocity command exceeds the acceleration set in PA10E, the velocity loop switches to P control.



＜Example＞

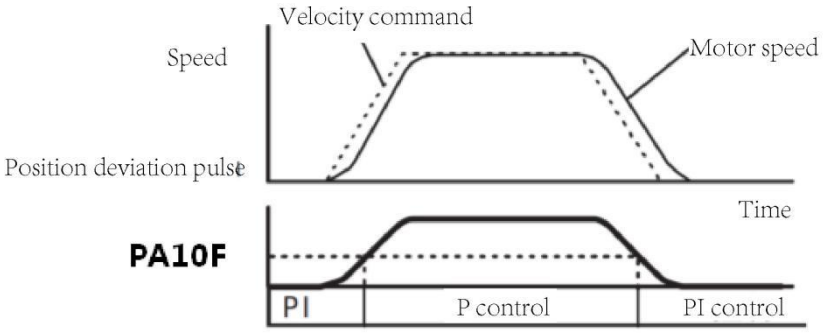
When it is set to constant PI control without using the mode switch, the torque during acceleration/deceleration may saturate and the motor speed may overshoot. The saturation of torque can be suppressed by using the mode switch, and thus the overshoot of motor speed can be suppressed.



■ **When the checkout point of the mode switch is used as the deviation pulse**

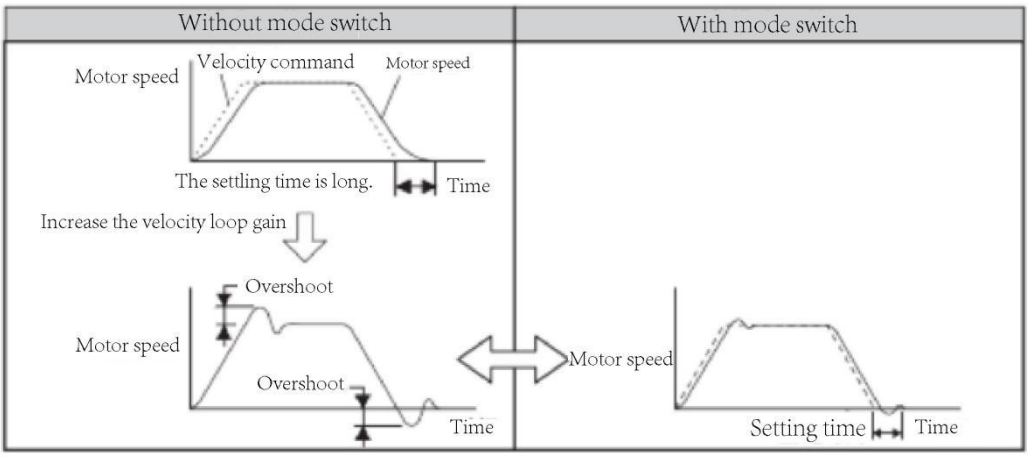
If the position deviation pulse exceeds the pulse set in PA10F, the velocity loop switches to P control.

This setting is valid only for position control.



＜Example＞

It is used to shorten the setting time. Generally, it is necessary to increase the velocity loop gain in order to shorten the setting time, but the overshoot that occurs at this time can be suppressed.



Chapter 10 Fault Diagnosis

10.1 Alarm Display

When an error occurs in the servo drive, the LED on the panel display shows the alarm code.

Flashing alarm code

10.2 Alarm List

The alarm list lists the alarm names, alarm contents, and whether the alarm can be reset or not in the sequence of alarm codes.

Whether alarm reset

Yes: The alarm can be cleared through alarm reset. However, if the alarm factor still exists, it cannot be removed.

No: Unable to remove the alarm.

> How to remove servo alarm?
> The servo alarm can be removed by pressing UP and DOWN at the same time.
> (Note): Before the servo alarm is removed, the cause of the alarm must be cleared.

Code	Alarm	Description	Reset
E.020	Abnormal parameter check 1	Abnormal servo drive internal parameter data.	No
E.021	Abnormal parameter check 2	Abnormal servo drive internal parameter data.	No
E.022	Parameter memory read and write error	Servo drive internal parameter memory read and write error.	No
E.030	Parameter value error	Servo drive parameter exceeds the range.	No
E.040	Parameter setting failure	Out of the setting range.	No
E.042	Parameter combination failure	Parameter combination failure	No
E.0A0	Combination error	Outside the combinable motor capacity (capacity	Yes

		mismatch)	
E.0A2	Motor and drive mismatch	Voltage type of motor and drive mismatch, etc.	Yes
E.0B4	Internal inter-chip communication error	Communication error between internal chips	No
E.0F0	Product does not support	Connected to non-support product	No
E.100	Over-current detected	Over-current detected in power transistor or heat sink overheating.	No
E.120	Motor overload (instantaneous overload)	The motor run for several seconds to dozens of seconds with a torque that greatly exceeds the rated value.	Yes
E.121	drive overload (instantaneous overload)	The drive runs for several seconds to dozens of seconds with a torque that greatly exceeds the rated value.	Yes
E.130	Motor overload (continuous overload)	The motor runs continuously with torque exceeding the rated value.	Yes
E.131	drive overload (continuous overload)	The drive runs continuously running with torque exceeding the rated value.	Yes
E.136	Motor collision error	When collision protection is turned on, motor load exceeds the rated value.	Yes
E.180	Over-voltage	The DC voltage of the main circuit is exceptionally high.	Yes
E.182	Block alarm	Motor is blocked.	Yes
E.190	Undervoltage	DC undervoltage in main circuit.	Yes
E.200	Bus voltage failure detected.	Bus voltage failure.	Yes
E.250	Current failure 1 detected	Circuit failure is detected in the current.	No
E.252	Current failure 2 detected	Circuit failure is detected in the current.	No
E.300	Regeneration error	Regeneration circuit failure.	Yes
E.320	Regeneration overload	Regeneration overload occurred.	Yes
E.340	Impulse current limiting resistor overload	The main circuit power is switched on too frequently.	No
E.360	IPM overheating	Temperature of the IPM module oft he drive is too high.	Yes
E.500	Encoder communication failure	Communication encoder motor parameter reading error / too many failed attempts (more than 5) to obtain multi-turn positions during drive initialization / no response frames for 100 consecutive times	No
E.502	Multiple encoder communication errors	Multiple consecutive errors in encoder communication (parity error, CRC error, frame length error)	No
E.504	Encoder communication check error	Failure to obtain multi-turn position during initialization/ CRC check failed for a total of 50 times	Yes
E.505	Encoder communication frame error 1	Communication frame error for communication encoders (drive side)	Yes
E.506	Encoder communication frame error 2	Status bit sent by the encoder is abnormal.	Yes
E.507	Encoder communication frame error 3	At least 50 consecutive return frame quantity error, but CRC check is satisfied	Yes

E.530	Encoder checksum alarm	Abnormal checksum result for communication encoder memory	Yes
E.532	Encoder parameter error	Encoder type obtained is not 17-bit or 23-bit	Yes
E.550	Encoder count error 1	Communication encoder count error 1	Yes
E.552	Multi-turn encoder error	Communication multi-turn encoder error.	Yes
E.554	Encoder overspeed	Communication multi-turn encoder overspeed error .	Yes
E.555	Encoder count error 2	Communication multi-turn encoder count error.	Yes
E.556	Encoder count overflow	Communication multi-turn encoder count overflow error .	Yes
E.558	Encoder multi-turn data error	Communication multi-turn encoder multi-turn data error .	Yes
E.55A	Encoder battery alarm	Communication multi-turn encoder low battery voltage alarm	Yes
E.590	Speed deviation protection	Mismatch between the actual speed and the given speed	Yes
E.594	Current deviation protection	Excessive deviation between the actual current and the given current	Yes
E.A00	Out of control	Servo motor out of control detected	Yes
E.A10	Overspeed	Motor speed exceeds maximum speed	Yes
E.A20	Vibration alarm	Detected abnormal vibration of motor speed.	Yes
E.A22	Auto-adjust alarm	Vibration detected during automatic adjustment.	Yes
E.A30	Excessive position deviation alarm	In the servo ON state, the position deviation exceeds the excessive position deviation alarm value (PA520).	Yes
E.A31	Excessive position deviation alarm when servo ON	Alarm displayed during servo OFF when the position deviation pulse exceeds the set value of PA526 and an attempt is made to turn the servo ON in this state.	Yes
E.A32	Excessive position deviation alarm due to speed limit	The speed limit is executed using the speed limit value (PA529) at servo ON state, the command pulse is input in this state, and the position deviation exceeds the set value of the excessive position deviation alarm value (PA520).	Yes
E.A90	Invalid servo ON command alarm	After executing the auxiliary function to energize the motor, a servo ON input (S-ON) signal is input from the host device.	Yes
E.AA2	Main circuit power alarm	There is ON→OFF→ON phenomenon in the main circuit power supply and PA00D.0!=0.	Yes
E.AB0	over-travel alarm	Alarm when servo detects over-travel and PA00D.3=2.	Yes
E.F00	System alarm 0	Servo drive internal program error 0 occurs.	No
E.F01	System alarm 1	Servo drive internal program error 1 occurs.	No
E.F02	System alarm 2	Servo drive internal program error 2 occurs.	No
E.F03	System alarm 3	Servo drive internal program error 3 occurs.	No
HARD	Hardware initialization failure	Hardware failure during initialization	No

10.3 Alarm Causes and Actions

Alarm code: Alarm name	Cause	Confirmation method	Action
E.020: System parameter checksum error 1 (Servo drive internal parameter data error)	Instantaneous drop in supply voltage	Measure the power supply voltage.	Set the power supply voltage within the specifications and initialize the parameter set values.
	Power supply failure when parameters are written	Confirm the time of power failure.	Re-enter the parameter after the parameter setting value is initialized.
	The number of parameter writes exceeds the maximum limit	Check whether the parameter is frequently changed from the host device.	May caused by servo drive failure. Replace the servo drive. Change the parameter writing method.
	False operation due to noise from AC power, grounding, and static electricity, etc.	Turn the power to the servo drive back on. If an alarm still occurs, there may be interference.	Take measures to prevent noise interference.
	Failure of internal components of the servo drive due to gas, water droplets or cutting oil, etc.	Confirm the setting environment.	May caused by servo drive failure. Replace the servo drive.
	Servo drive failure	Turn the power to the servo drive back on. If an alarm still occurs, there may be servo drive failure.	May caused by servo drive failure. Replace the servo drive.
	Others		Restore all parameters to factory setting (AF015).
E.021: System parameter checksum error 2 (Servo drive internal parameter data error)	Instantaneous drop in supply voltage	Measure the power supply voltage.	May caused by servo drive failure. Replace the servo drive.
	Power is turned off during operation of auxiliary functions	Confirm the time of power failure.	May caused by servo drive failure. Replace the servo drive.
	Servo drive failure	Turn the power to the servo drive back on. If an alarm still occurs, there may be drive failure.	May caused by servo drive failure. Replace the servo drive.
	Others		Restore all parameters to factory setting (AF015).
E.022:	Instantaneous drop in	Measure the power	May caused by servo drive

Parameter memory read/write error	supply voltage	supply voltage.	failure. Replace the servo drive.
	Servo drive failure	Turn the power to the servo drive back on. If an alarm still occurs, there may be drive failure.	May caused by servo drive failure. Replace the servo drive.
	Others		Restore all parameters to factory setting (AF015).
E.030: Parameter value error	Power supply failure when parameters are written	Confirm the time of power failure.	Re-enter the parameter after the parameter setting value is initialized.
	Power is turned off during operation of auxiliary functions	Confirm the time of power failure.	May caused by servo drive failure. Replace the servo drive.
	Servo drive failure	Turn the power to the servo drive back on. If an alarm still occurs, there may be drive failure.	May caused by servo drive failure. Replace the servo drive.
	Others		Restore all parameters to factory setting (AF015).
E.040: Parameter setting error (out of setting range)	Servo drive capacity does not match servo motor capacity	Check the capacity and combination of servo drive and servo motor	Match the capacity of servo drive and servo motor to each other.
	Servo drive failure	Turn the power to the servo drive back on. If an alarm still occurs, there may be drive failure.	May caused by servo drive failure. Replace the servo drive.
	Out of parameter setting range	Check the setting range of the changed parameter.	Set the changed parameter to a value within the setting range.
	The setting value of the electronic gear ratio is outside the setting range	Check if the electronic gear ratio is 0.001< （PA20E/PA210）< 64000。	Set the electronic gear ratio to 0.001< （PA20E/PA210）<64000.
	Others		Restore all parameters to factory setting (AF015).
E.042*1 ： Parameter combination error	The operation speed of the program JOG (AF00A) does not meet the setting range because the electronic gear ratio (PA20E/PA210) or servo motor has been changed.	Check whether the detection condition formula * 1 is satisfied .	Reduce the value of the electronic gear ratio (PA20E / PA210).
	The operation speed of program JOG(AF00A) does	Check whether the detection condition	Increase the value of the program JOG speed (PA5A3).

	not meet the setting range because the program JOG speed (PA5A3) has been changed.	formula is satisfied .	
	The movement speed of internal command auto-adjustment does not meet the setting range, because the electronic gear ratio (PA20E/PA210) or servo motor has been changed.	Check whether the detection condition formula* is satisfied .	Reduce the value of the electronic gear ratio (PA20E/PA210).
E.0A0 : Capacity combination error (out of the combinable motor capacity range)	The capacity of the servo drive does not match the capacity of the servo motor.	Confirm that (motor capacity) / (servo drive capacity) ≤ 1/4 or (motor capacity) / (servo drive capacity) ≤ 4 .	Match the capacity of servo drive and servo motor to each other.
	Encoder failure.	Replace with another motor and confirm that the alarm no longer occurs.	Replace servo motor (encoder).
	Servo drive failure	Turn the power to the servo drive back on. If an alarm still occurs, there may be drive failure.	May caused by servo drive failure. Replace the servo drive.
E.0A2 : Voltage combination error (out of the combinable motor capacity range)	The voltage of the servo drive does not match the voltage of the servo motor	Confirm that the motor input voltage is consistent with the servo drive voltage.	Match the voltage of servo drive and servo motor to each other.
	Encoder failure.	Replace with another motor and confirm that the alarm no longer occurs.	Replace servo motor (encoder).
	Servo drive failure	Turn the power to the servo drive back on. If an alarm still occurs, there may be drive failure.	May caused by servo drive failure. Replace the servo drive.
E.0B3 : drive internal data interaction error 1	Failure of internal components of the servo drive due to gas, water droplets or cutting oil, etc.	Confirm the setting environment.	May caused by servo drive failure. Replace the servo drive.
E.0B4 : drive internal data interaction	Servo drive failure	Turn the power to the servo drive back on. If an alarm still occurs, there	May caused by servo drive failure. Replace the servo drive.

error 1		may be drive failure.	
E.0F0 ：Product does not support	Motor parameter file is not written into the motor encoder.	Check whether the motor parameter file is written into the motor encoder or not.	Write the motor parameter file into the motor encoder.
	Servo drive is connected to non-support motor, encoder, etc.	Confirm the product combination specification.	Replace drive and motor with matched combination.
E.100 ：Overcurrent detected (overcurrent flowing through power transistor or heat sink overheating)	The main circuit cable or the cable for the motor main circuit is incorrectly connected or has poor contact	Confirm whether the wiring is correct. For details, refer to "Wiring of the Main Circuit".	Modify the wiring.
	Internal short circuit in the main circuit cable or in the cable used for the main motor circuit, or a grounded short circuit has occurred	Check if there is a short circuit between the UVW phases of the cable, or between UVW and ground. For details, please refer to "Wiring of the Main Circuit".	The cable may be short-circuited. Replace the cable.
	Short circuit or grounded short circuit inside the servo motor.	Check if there is a short circuit between the UVW phases of the motor terminals, or between UVW and ground. For details, please refer to "Wiring of the Main Circuit".	May caused by servo motor failure. Replace the servo motor.
	Short circuit or grounded short circuit inside the servo motor.	Check if there is a short circuit between the UVW phases of the servo drive motor connection terminals, or between UVW and ground. For details, please refer to "Wiring of the Main Circuit".	May caused by servo drive failure. Replace the servo drive.
	Regenerative resistor connection error or poor contact	Check if the connection is correct. For details please refer to the “Connection of Regenerative Resistor”.	Modify connection.
	Power device alarm	Reduce the overload	Decrease PA402, PA403 values.

	caused by large instantaneous overload current	multiple. Or increase the acceleration/deceleration time.	Increase PA216, PA217 values under position control; increase PA305, PA306 values under speed control.
E.120 : Motor overload (instantaneous overload) E.121 : drive overload (instantaneous overload) E.130 : Motor overload (continuous overload) E.131 : drive overload (continuous overload)	Poor motor wiring, encoder wiring or poor connection.	Check wiring.	Check if the motor wiring, encoder wring is correct.
	Motor operation exceeds overload protection characteristics	Confirm motor overload characteristics and operation command.	Re-examine the load conditions, operating conditions. Or re-examine the motor capacity.
	The motor cannot be driven due to mechanical factors, resulting in excessive load during operation	Confirm operation command and motor speed.	Improve mechanical factors.
	Servo drive failure	Turn the power to the servo drive back on. If an alarm still occurs, there may be drive failure.	May caused by servo drive failure. Replace the servo drive.
	Motor failure	Replace with the same model and run.	May caused by motor failure. Replace the servo motor.
	Frequent fast acceleration and deceleration	Increase the acceleration/deceleration time	Increase PA216, PA217 values under position control; increase PA305, PA306 values under speed control.
E.136 : Motor collision error	1. Check if PA43D is set too low; 2. Check if PA00D.2 time is set too short. 3. Check mechanical parts for abnormalities	Check the load condition.	According to the actual torque setting and protection time, if the setting is too low, there will be false operation, if the setting is too high, it will lose the protection function; troubleshoot mechanical problems.
E.180 : Overvoltage (Overvoltage detected in the main circuit power supply section inside the servo drive)	DC supply voltage above 420V is detected when AC220V is used with the servo drive. DC supply voltage above 820V is detected when AC380V is used with the servo drive.	Measure the power supply voltage.	Adjust the AC/DC supply voltage to within the product specification.
	The power supply is in an unstable state or has been affected by a lightning	Measure the power supply voltage.	Improve the power condition, set the surge suppressor and turn the power on again. If the

	strike		alarm still occurs, it may be caused by servo drive failure. Replace the servo drive.
	Acceleration and deceleration were performed	Confirm supply voltage, speed and torque in operation.	Adjust the AC supply voltage to within the product specification.
	External regeneration resistance value is greater than operating conditions	Confirm the operation condition and regeneration resistance.	Select the appropriate regeneration resistance value, considering the operation conditions and the load.
	Operation above the permissible load inertia	Confirm the load inertia ratio is within the permissible load inertia ratio.	Extend the deceleration time or reduce the load.
	Servo drive failure	Turn the power to the servo drive back on. If an alarm still occurs, there may be drive failure.	Turn on the control power again without turning on the main circuit power. If the alarm still occurs, it may be caused by servo drive failure. Replace the servo drive.
E.182	Motor is blocked.	Check for mechanical blocking.	Remove blocking.
E.190 : Undervoltage (Undervoltage detected in the main circuit power supply section of the servo drive)	AC supply voltage below 120V when AC220V is used with the servo drive. AC supply voltage below 240V when AC380V is used with the servo drive.	Measure the power supply voltage.	Adjust the power supply voltage to the normal range.
	Power supply voltage drop during operation	Measure the power supply voltage.	Increase the power supply capacity.
	Instantaneous power failure	Measure the power supply voltage.	If the instantaneous stop hold time (PA519) is changed, set it to a smaller value.
	Fuse blown in the servo drive		Replace or repair servo drive, connect the AC/DC reactor before using the servo drive.
	Servo drive failure	Turn the power to the servo drive back on. If an alarm still occurs, there may be drive failure.	May caused by servo drive failure. Replace the servo drive.
E.200: Bus voltage failure detected	Servo drive failure	Measure bus voltage	May caused by servo drive failure. Replace the servo drive.
E.250:	Circuit failure detected in		Turn the power to the servo

Current failure 1 detected	U-phase current		drive back on. If an alarm still occurs, there may be drive failure. Replace servo drive.
	Motor does not stop	Motor does not fully stop when powered on.	Re-power after the motor stops
E.252: Current failure 2 detected	Circuit failure detected in W current		Turn the power to the servo drive back on. If an alarm still occurs, there may be drive failure. Replace servo drive.
	Motor does not stop	Motor does not fully stop when powered on.	Re-power after the motor stops
E.300: Regeneration failure	When the drive is not connected with a regenerative resistor, PA 010.0 is not set to 1.	Check if the drive has internal or external braking resistor and if the wiring is correct.	≤400W drive without built-in braking resistor, ≥750W drive with braking resistor. When using the built-in braking resistor, P and D are shorted and P and C are disconnected. When using an external braking resistor, P and D are disconnected, and P and C are connected to the external braking resistor.
	drive regeneration resistor is not connected	Check the connection of the external regenerative resistor or regenerative resistor device.	After connecting to an external regenerative resistor, set an appropriate value for PA590 .
	Poorly wired, disconnected or broken external regenerative resistors	Check the wiring of the external regenerative resistor. Check the wiring of the power terminal jumper.	Correctly wire the external regenerative resistor. Correct wire the jumper.
	Servo drive failure	Turn the power to the servo drive back on. If an alarm still occurs, there may be drive failure.	May caused by servo drive failure. Replace the servo drive.
E.320: Regenerative overload	Power supply voltage out of specification range	Measure the power supply voltage.	Set the power supply voltage within specification range.
	Insufficient external regenerative resistor value or regenerative resistor capacity, or in continuous regeneration status	Reconfirm operation condition and capacity.	Change the regenerative resistance value, regenerative resistor capacity. Readjust operating conditions.

	Continuous negative load, in a continuous regenerative state	Confirm the load applied to the running servo motor.	Re-check the system including servo, mechanical and operating conditions.
	The capacity set in PA590 (regenerative resistor capacity) is less than the capacity of the external regenerative resistor	Confirm the connection of regenerative resistor and the value of PA5A0	Calibrate the setting value of PA590.
	External regenerative resistor value too large	Confirm if the regenerative value is correct.	Change it to the correct resistance value and capacity.
	Servo drive failure	Turn the power to the servo drive back on. If an alarm still occurs, there may be drive failure.	May caused by servo drive failure. Replace the servo drive.
E.340: Impulse current limiting resistor overload (The main circuit power is switched on too frequently.)	Exceeding the allowable number of impulse current limiting resistors of the main circuit power ON/OFF		Reduce the ON/OFF frequency of the main circuit power supply.
	Servo drive failure	Turn the power to the servo drive back on. If an alarm still occurs, there may be drive failure.	May caused by servo drive failure. Replace the servo drive.
E.360: Heat sink overheating (Abnormal power module temperature)	Ambient temperature too high	Measure the ambient temperature with a thermometer. Or confirm the operating conditions by setting up environmental monitoring with the Servo drive.	Improve the setting conditions of the servo drive and reduce the ambient temperature.
	Overloaded, or operating beyond regeneration capacity	Confirm operating load by cumulative load rate and confirm regenerative processing capacity by regenerative load rate.	Re-examine load conditions, operating conditions.
	Unreasonable installation orientation of servo drive, or unreasonable intervals between servo drives.	Confirm the placement of the servo drive.	Installation is carried out in accordance with the installation standards for servo drives.
	Servo drive failure	Turn the power to the servo drive back on. If an alarm still occurs, there	May caused by servo drive failure. Replace the servo drive.

		may be drive failure.	
E.500: Encoder communication failure	Encoder connector poor contact or incorrect wiring	Check the status of the encoder connector.	Reinsert the encoder connector and check the wiring of the encoder.
	The encoder cable is broken, shorted, or a cable exceeding the specified impedance is used	Check the status of the encoder cable. Check the wiring of the encoder cable shield.	。 Use encoder cables with specified specifications.
	Corrosion caused by temperature, humidity, and gas; short circuit caused by water droplets and cutting oil; poor connector contact caused by vibration	Confirm the environment of use.	Improve the environment of use and replace the cable. If it does not improve the condition, replace the servo drive.
	False operation caused by noise interference		Make correct wiring around the encoder (separate the encoder cable from the servo motor main circuit cable, grounding, etc.).
	Servo drive failure		When the servo motor is connected to another servo drive and the control power is turned on, if the alarm does not occur, it may be caused by servo drive failure. Replace the servo drive.
E.502: Multiple encoder communication errors	Multiple communication errors caused by interference	Check the wiring of the encoder.	1. Check if the ground connection is correct; 2. Check if the encoder cable shield is properly connected to the drive PE.
E.504: Encoder communication checksum error E.505: Encoder communication frame error 1	Incorrect encoder wiring, poor contact and interference	Check the wiring of the encoder.	Check if the encoder wiring is correct, try to change PA092=0010.
	Encoder cable has different specifications and is interfered	Check the wiring of the encoder cable shield.	Change the cable specifications to double- stranded shielded wires or double-stranded unified shielded wires with a core of 0.12mm2 or higher, tinned soft copper stranded wires.
E.506: Encoder communication	The encoder cable is too long and is interfered		For rotary servo motors: The wiring distance of the encoder cable is up to 20m .

frame error 2 E.507: Encoder communication frame error 3	Potential FG changes due to the influence of motor-side equipment (welder, etc.)	Check the status of the encoder cable and connector.	Ground the machine to prevent shunting to the FG on the encoder side.
	Encoder subjected to excessive vibration shocks	Confirm usage.	Reduce mechanical vibration. Correctly installed servo motor or linear encoder.
	Encoder failure		Turn the power to the servo drive back on. If an alarm still occurs, there may be drive failure or linear encoder failure. Replace servo motor or linear encoder.
	Servo drive failure	Turn the power to the servo drive back on. If an alarm still occurs, there may be drive failure.	Turn the power to the servo drive back on. If an alarm still occurs, there may be drive failure. Replace the servo drive.
E.530: Encoder checksum alarm (detected on the encoder side)	Encoder data storage area checksum error	Encoder data storage area data error	If this alarm still occurs after re-powering, it may be caused by the servo motor encoder failure. Replace the servo motor or encoder.
	Servo drive failure	Rotate the motor, the motor speed (dP000) and position (dP001) do not change.	May caused by servo drive failure. Replace the servo drive.
E.532: Encoder parameter error	Encoder data storage area data error	Encoder data storage area data error	Turn the power to the servo drive back on. If an alarm still occurs, there may be drive motor encoder failure. Replace servo motor or encoder.
	Encoder model error	Normally, the PA002.3 parameter is invalid and the drive will automatically match the encoder model.	Check if the PA002.3 encoder model matches the motor encoder model. PA002.3=0 corresponds to the 17-bit encoder (DM1□-□□□□□**I**□□) ; PA002.3=2 corresponds to the 23-bit encoder (DM1□-□□□□□**L**□□) ;
	Servo drive failure	Rotate the motor, the motor speed (dP000) and position (dP001) do not change.	May caused by servo drive failure. Replace the servo drive.

E. 550: Encoder count error	Incorrect encoder wiring, poor contact	Check the wiring of the encoder.	Check if the encoder wiring is correct.
	Encoder cable has different specifications and is interfered		Change the cable specifications to double- stranded shielded wires or double-stranded unified shielded wires with a core of 0.12mm2 or higher, tinned soft copper stranded wires.
	The encoder cable is too long and is interfered		For rotary servo motors: The wiring distance of the encoder cable is up to 20m .
	Potential FG changes due to the influence of motor-side equipment (welder, etc.)	Check the status of the encoder cable and connector.	Ground the machine to prevent shunting to the FG on the encoder side.
	Encoder subjected to excessive vibration shocks	Confirm usage.	Reduce mechanical vibration. Correctly installed servo motor or encoder.
	Encoder failure		Turn the power to the servo drive back on. If an alarm still occurs, there may be drive motor failure or encoder failure. Replace servo motor or encoder.
	Multi-turn encoder not connected to battery or low battery voltage	Multi-turn encoder battery not connected or alarm due to previous battery alarm	In the case of multi-turn encoder, please check the battery voltage and then execute the auxiliary function AF011: Reset encoder multi-turn data and alarm
E. 552: Multi-turn encoder error E. 555: Encoder count error 2	Serial communication is disturbed	Check the wiring of the encoder cable shield.	Check if the encoder wiring is correct.
	Multi-turn encoder not connected to battery or low battery voltage	Multi-turn encoder battery not connected or alarm due to previous battery alarm	After confirming the battery voltage, execute the auxiliary function AF 011 : Reset the encoder alarm
	Defective encoder or encoder decoding circuit		Turn the power to the servo drive back on. If an alarm still occurs, there may be drive motor failure or encoder failure. Replace servo motor or encoder.
E. 554: Encoder overspeed	After the power is turned OFF, the encoder rotates at a high speed;	Check whether the motor shaft moves at a high speed during power	After confirming the battery voltage, execute the auxiliary function AF011 : Reset the

		failure of the servo.	encoder multi-turn data and alarm
	Absolute encoder is not connected to battery or battery voltage is too low	Check whether the absolute encoder is connected to the battery and the battery voltage is correct ;	
E. 556: Encoder count overflow	The multi-turn encoder is not connected to the battery or the battery voltage is too low	Multi-turn encoder battery not connected or alarm due to previous battery alarm	After confirming the battery voltage, execute the auxiliary function AF011 : Reset the encoder multi-turn data and alarm
	The distance of the motor running in one direction exceeds 65535 turns, and multi-turn information overflows	16-bit information overflow	
E. 558: Encoder multi-turn data error	The multi-turn encoder is not connected to the battery or the battery voltage is too low	Multi-turn encoder battery not connected or alarm due to previous battery alarm	After confirming the battery voltage, execute the auxiliary function AF011 : Reset the encoder multi-turn data and alarm
E.55A: Encoder battery alarm (The voltage of the absolute encoder battery is below the specified value)	Battery poor contact or not connected.	Confirm the battery connection.	Connect the battery properly
	The battery voltage is lower than the specified value (2.7V)	Measure the voltage of the battery.	Replace battery
	Encoder failure	Encoder data error	Turn the power to the servo drive back on. If an alarm still occurs, there may be drive motor encoder failure. Replace servo motor or encoder.
E.590: Speed deviation protection	Actual speed does not match the given speed	UVW disorder, after the drive is powered up, the first enable motor starts to detect and issue an alarm for a period of time	Check if the three UVW inputs are wired in the correct order. For shielding, set the PA658 range to 100.
E.594: Current deviation protection	Excessive deviation of the actual current from the given current	UVW disorder, after the drive is powered up, the first enable motor starts to detect and issue an alarm for a period of time	Check if the three UVW inputs are wired in the correct order. For shielding, set the PA659 range to 120.

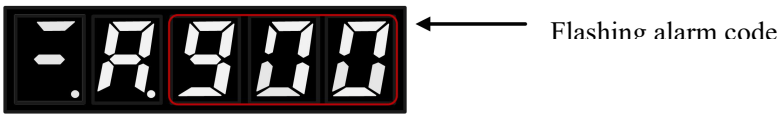
E.6F0: Gate drive error 1 (gate drive circuit error)	Servo drive failure		Turn the power to the servo drive back on. If an alarm still occurs, there may be servo drive failure. Replace the servo drive.
E.A00: Out of control detected (detected when the servo is ON)	Motor wiring UVW phase sequence error	Confirm motor wiring	Check if motor wiring is correct.
	Encoder failure		If the motor wiring is correct, alarm still exists after the power is turned back on, it may caused by servo motor failure or linear encode failure. Replace servo motor or linear encoder.
	Servo drive failure		Turn the power to the servo drive back on. If an alarm still occurs, there may be servo drive failure. Replace the servo drive.
E.A10: Super speed (the speed of the motor over the highest speed)	Motor wiring UVW phase sequence error	Confirm servo motor wiring	Check if motor wiring is correct.
	The command input value exceeds the overspeed value	Confirm input command	Decrease the command value. Or adjust the gain.
	Motor speed exceeds maximum speed	Check the waveform of the motor speed.	Reduce the speed command input gain and adjust the servo gain. Or adjust operating conditions
	Servo drive failure		May caused by servo drive failure. Replace the servo drive.
E.A20: Vibration alarm	Abnormal vibration of motor speed detected	Check the abnormal sound of the motor and the speed and torque waveform during operation.	Reduce motor speed. Or reduce the speed loop gain (PA100).
	The value of the moment inertia ratio (PA103) is larger than the actual value or has changed greatly	Confirm the moment inertia ratio or mass ratio	Set the moment inertia ratio (PA103) correctly
	Incorrect vibration value (PA312) detected	Check if the vibration value detected (PA312) is correct.	Correctly set the detected vibration value (PA312)
E.A22: Auto-adjust alarm (Custom adjustment, TFFT,	High motor vibration when using the auto adjustment function	Check the waveform of the motor speed.	Reduce the load so that it is below the permissible moment inertia ratio or increase the load value set by the automatic

vibration detected in the adaptive adjustment function.)			adjustment value and reduce the rigidity value.
	High motor vibration during custom adjustment, TFFT execution	Check the waveform of the motor speed.	Implement the processing methods described in the operating procedures for each function.
E.A30: Excessive position deviation alarm (Position deviation exceeds the excessive position deviation alarm value (PA520) in the servo ON state)	Incorrect wiring of the UVW of the servo motor.	Confirm the wiring of the servo motor main circuit cable.	Check if there is contact problem etc. for the motor cable or encoder cable. JOG test run to check if the motor and drive are operating correctly.
	The position command pulse frequency is high.	Try reducing the position command pulse frequency before running.	Reduce the position command pulse frequency or command acceleration, or adjust the electronic gear ratio.
	Position command acceleration is too high	Try reducing the command acceleration before running.	Smoothing function added for position command acceleration and deceleration time parameters (PA216), etc.
	Excessive position command acceleration compared to operating conditions, excessive deviation alarm value (PA520) is too low.	Check if the excessive position deviation alarm value (PA520) is appropriate.	Set the correct value for parameter PA520.
	Servo drive failure	--	Turn the power to the servo unit back on. If an alarm still occurs, there may be servo unit failure. Replace the servo unit.
E.A31: Excessive position deviation alarm when servo is ON	Alarm displayed during servo OFF when the position deviation pulse exceeds the set value of PA526 and an attempt is made to turn the servo ON in this state.	Check the amount of position deviation when the servo is OFF	Make the setting to clear the position deviation when the servo is OFF. Set the correct alarm value for excessive position deviation at servo ON (PA526).
E.A32: Excessive position deviation alarm due to speed limit	The speed limit is executed with the speed limit value (PA529) when the servo is ON, and the position deviation exceeds the set value of the excessive position deviation alarm (PA520)		Set the correct alarm value for excessive position deviation (PA520). Or set the speed limit value (PA529) when the servo is ON to the correct value.

	when the command pulse is entered in this state		
E.A90: Invalid servo ON command alarm	After performing the auxiliary function to power the motor, the servo ON (S-ON) signal is input from the host device.		Re-power and input the servo ON (S-ON) signal from the host device.
E.AA2: Main circuit power drop alarm	The ON→OFF→ON phenomenon exists in the main circuit power supply and PA00D.0!=0.	Measure the input power supply with a multimeter or oscilloscope and observe if there is any drop in the power supply.	Increase the power failure detection time PA519. or set PA00D.0 = 0.
E.AB0: over-travel alarm	Alarm when servo detects over-travel and PA00D.3 = 2	Check over-travel signal	Set PA00D.3=0 or 1;
E.F00: E.F01: E.F02: E.F03: System alarm	Failure of internal components of the servo drive due to gas, water droplets or cutting oil, etc.	Confirm the setting environment.	May caused by servo drive failure. Replace the servo drive.
	Servo drive failure	Turn the power to the servo drive back on. If an alarm still occurs, there may be drive failure.	
E.FF4: System alarm	The ON → OFF → ON phenomenon exists in the main circuit power supply or internal data error.	Measure the input power supply with a multimeter or oscilloscope and observe if there is any drop in the power supply.	May caused by servo drive failure. Replace the servo drive.
HARD: Hardware initialization failure	An error occurs during servo initialization.		Re-power, if this does not resolve the problem check if the power supply is stable.

10.4 Warning Display

When a servo drive warning occurs, the LED on the panel display shows the warning code



10.5 Warning List

Warning names and warning contents are listed in the order of warning codes here.

Warning code	Warning name	Warning content
A.900	Excessive position deviation	The accumulated position deviation exceeds the value set by PA520.
A.901	Excessive position deviation when servo ON	The accumulated position deviation when servo ON exceeds the value set by PA526.
A.910	Motor overload	Warning display before the motor overload (E.120 or E.130) alarm is about to be reached. If operation continues, an alarm may occur.
A.911	drive overload	Warning display before the drive overload (E.120 or E.130) alarm is about to be reached. If operation continues, an alarm may occur.
A.91A	Vibration	Abnormal vibration detected in motor operation. Same as the E.A20 detected value, set as alarm or warning by the vibration detection switch (PA310).
A.920	Regeneration overload	Warning display before the regeneration overload (E.320) alarm is about to be reached. If operation continues, an alarm may occur.
A.930	Absolute encoder battery failure	Warning display when absolute encoder battery voltage is too low.
A.941	Parameter changes requiring re-powering	Changed the parameters that requires re-powering.
A.970	Undervoltage	Warning display before the undervoltage (E.190) alarm is about to be reached. If operation continues, an alarm may occur.
A.9A0	over-travel	over-travel detected in servo ON.

10.6 Warning Causes and Actions

Warning code: Warning name	Cause	Confirmation method	Action
A.900: Excessive	The wiring of UVW of the servo motor is	Check the wiring of the servo motor main	Check whether there is poor contact and other problems for the motor cable or

position deviation	incorrect	circuit cable.	encoder cable.
	Servo drive gain is low	Check if the gain of the servo drive is too low.	Servo gain can be improved by automatic adjustment (no host command) function.
	Position command pulse frequency is high	Try lowering the command pulse before running.	Reduce the position command pulse frequency or command acceleration, or adjust the electronic gear ratio.
	Position command acceleration is too large	Try to reduce the command acceleration before running.	Add smoothing functions such as position command acceleration/ deceleration time parameter (PA216).
	Compared to the operation conditions, the position deviation alarm value (PA520) is low	Check if the position deviation alarm value (PA520) is proper.	Set the value of parameter PA520 correctly.
A.901: Excessive position deviation when servo ON	The position deviation accumulated when the servo is ON exceeds the value set by PA526.		Set to clear the position deviation when the servo is OFF. Set the excessive position deviation warning value (PA528) when servo ON.
A.910: Motor overload (warning before it becomes an overload alarm (E.120 or E.130))	Poor motor wiring, encoder wiring or poor connection.	Confirm the wiring.	Check if the motor wiring and encoder wiring is correct.
	Motor operation exceeds overload protection characteristics	Check the motor's overload characteristics and operating command	Re-examine the load conditions and operation conditions. Or re-examine motor capacity.
	The motor does not drive due to mechanical factors, causing excessive load during operation	Confirm the operation command and motor speed.	Improve mechanical factors.
A.911: Diver overload (warning before it becomes an overload alarm (E.121 or E.131))	drive operation exceeds the overload protection characteristics	Check the drive model and operation command.	Re-examine the load conditions and operation conditions. Or re-examine drive capacity.
	The motor does not drive due to mechanical factors, causing excessive load during operation	Confirm the operation command and motor speed.	Improve mechanical factors.
A.91A:	Abnormal vibration	Check the abnormal	Reduce motor speed. Or reduce the

Vibration	detected during motor operation.	sound of the motor and the speed and torque waveform during operation.	servo gain by custom adjustment, etc.
	The value of the moment inertia ratio (PA103) is larger than the actual value or has a large variation	Check the moment inertia ratio or mass ratio.	Set the moment inertia ratio correctly(PA103).
A.920: Regeneration overload (warning before it becomes a regeneration overload (E.320))	Power supply voltage exceeds specifications	Measure the power supply voltage.	Set the power supply voltage within the specifications.
	External regenerative resistor value, servo drive capacity or regenerative resistor capacity is insufficient, or is in continuous regeneration state	Reconfirm the operation condition and capacity	Change the regenerative resistance value, regenerative resistance capacity, or servo drive capacity. Adjust the operation condition again.
	Continuously under negative load, in continuous regeneration state	Check the load applied to the running servo motor.	Re-examine the system including servo, machinery, and operating conditions.
A.930: Battery failure of the absolute encoder	Battery is poorly connected, not connected	Confirm the battery connection.	Connect the battery properly.
	Battery voltage is lower than the set value (2.7V)	Measure the voltage of the battery.	Replace battery.
A.941: Parameter changes that requires re-powering	Changed the parameters that require re-powering	–	Turn the power of the servo drive back on.
A.970: Undervoltage	For AC220V servo drive, the AC supply voltage is below 140V	Measure the power supply voltage.	Adjust the power supply voltage to the normal range.
	Power supply voltage drops during operation	Measure the power supply voltage.	Increase the power capacity.
	Instantaneous power failure	Measure the power supply voltage.	If the instantaneous stop hold time (PA519) is changed, set to the smaller value.
	Servo drive fuse		Replace the servo drive and connect the

	blown		reactor before using the servo drive.
A.9A0: over-travel (over-travel state detected)	over-travel detected when servo ON.	Check the status of the over-travel signal by input signal monitoring.	If the over-travel signal cannot be confirmed by input signal monitoring, the over-travel may be detected instantly. Execute the following: • The command from the host device to the over-travel area are not executed. • Check the wiring of the over-travel signal. • Take anti-interference measures.

Chapter 11 Communication

11.1 Communication Interface

For communication interfaces, please refer to section 3.3 "Wiring of connectors CN4/CN5".

11.1.1 Communication Connection

1) If the host is connected to 1 servo drive only, connect CN4 port of the drive to the host and connect CN5 to a termination resistor of about 120 Ω.

2) If the host is connected to multiple servo drives, connect CN4 of first servo drive to host, and connect CN5 of first servo drive to CN4 of second servo drive. Connect all servo drives in this way and connect CN5 of last servo drive to a termination resistor of about 120Ω

11.2 Communication Parameter

The communication descriptions in this document are for MODBUS communication with RS485 only.

Parameter	Name	Range	Unit	Default	Effective
PA015	RS485 Communication address	1 ~ 31		1	Re-powering
PA016	RS48 Communication function selection switch	n.0000 ~ 0095		n.0035	Re-powering
	n.×××□:RS485 Communication rate 0：2400bps； 1：4800bps； 2：9600bps； 3：19200bps；				

	4: 38400bps; 5: 57600bps; **n.××□×: Communication protocol** 0: 8, N, 1; 1: 8, N, 2; 2: 8, E, 1; 3: 8, O, 1; **n.×□××: Reserved** **n.□×××: Reserved**

11.3 Communication Protocol

When using RS-485 serial communication interface, each servo drive must set its servo drive axis number in the parameters in advance. The host computer controls the corresponding servo drive according to the axis number. The communication method is MODBUS network communication, where MODBUS can be used in the following two modes: ASCII (American Standard Code for information interchange) mode or RTU (Remote Terminal Unit) mode.

The DS2P series servo drives support RTU (Remote Terminal Unit) mode.

The following is a description of MODBUS communication.

11.3.1 Encoding Definitions

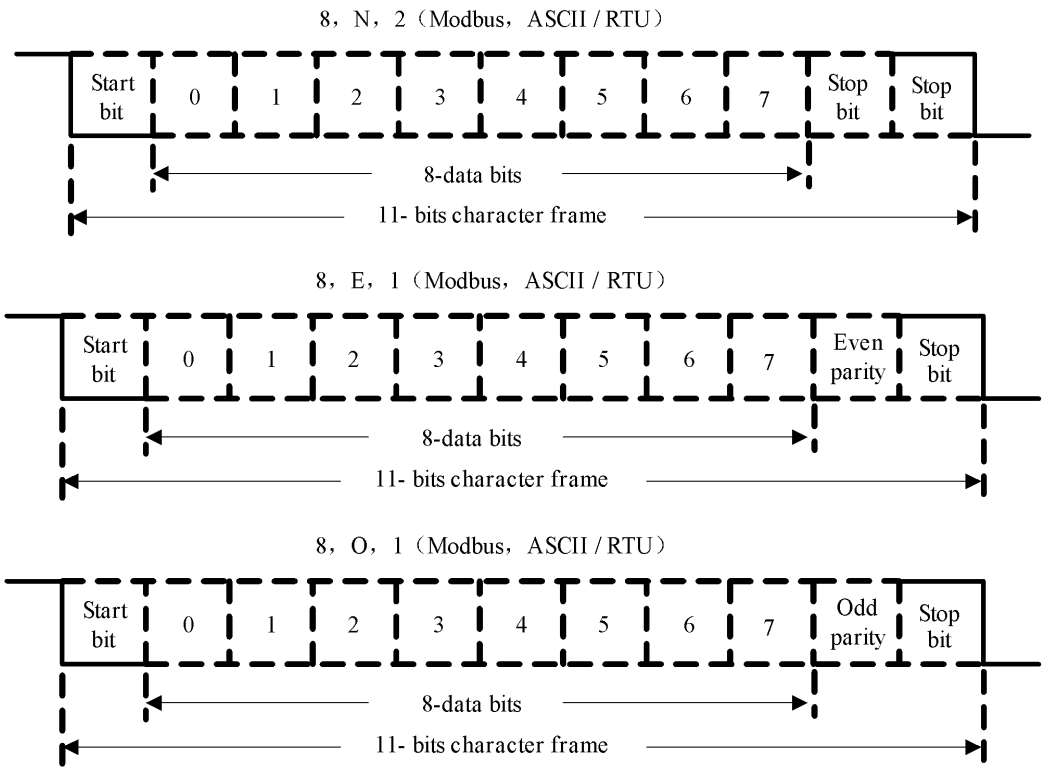
◆ RTU Mode

Each 8-bits data consists of two 4-bits hexadecimal bytes. For example, to exchange a value of 64H, the 1-byte data 64H is transferred directly.

11.3.2 Byte structure

◆ Byte box

Used for 8-bits byte.



11.3.3 Communication Data Structure

Data format of RTU communication mode is defined as follows:

STX	Static time exceeding 3.5 bytes
ADR	Communication address:1-byte
CMD	Command code: 1-byte
DATA (n-1)	Data content: n-word =2n-byte，n<=12
.....	
DATA (0)	
CRC	Command code: 1-byte
End 1	Static time exceeding 3.5 bytes

Detailed explanations of communication data format are as follows:

- **STX (Communication starting)**

RTU mode: Static time exceeding 3.5 bytes under current communication rate.

- **ADR (Communication address)**

Valid communication address is between 1 and 127. For example: to communicate with servo drive of Axis 16 (hexadecimal: 10H):

RTU mode: ADR =10H

- **CMD (command code) & DATA (data byte)**

Data byte format is determined by CMD. Common CMD is listed below:

Communication command

Command	Content	Description
03H	Read N words, N<=29	Standard command 03
06H	Write 1 word	Standard command 06
10H	Write N words, N<=29	Standard command 10

1) CMD: 03H, read N words, N≤29

For example: to continuously read 2 words from starting address 0200H of servo drive Axis 01H.

RTU mode:

Command:

ADR	**01H**
CMD	**03H**
Starting data position (high to low)	**02H**
	00H
Data byte (high to low)	**00H**
	02H
CRC Check Low	**C5H (low byte)**
CRC Check High	**B3H (high byte)**

Response:

ADR	**01H**
CMD	**03H**
Data quantity (bytes)	**04H**
Starting data address Content of 0200H	**00H (high byte)**
	B1H (low byte)
Second data address Content of 0201H	**1FH (high byte)**
	40H (low byte)
CRC Check Low	**A3H (low byte)**
CRC Check High	**D4H (high byte)**

2) CMD: 06H, write 1 word

For example: Write 100 (0064H) to starting address 0200H of the servo drive Axis 01H.

RTU mode:

Command:

ADR	**01H**
CMD	**06H**
Starting data address (high to low)	**02H**
	00H
Data content (high to low)	**00H**
	64H
CRC Check Low	**89H**
CRC Check High	**99H**

Response:

ADR	**01H**
CMD	**06H**
Starting data address (high to low)	**02H**
	00H
Data content (high to low)	**00H**
	64H
CRC Check Low	**89H**
CRC Check High	**99H**

3) Command：10H，write N words, N≤29

For example: write 100 (0064H), 102 (0066H) to starting address 0200H of servo drive Axis 01 H.

RTU mode:

Command:

ADR	01H
CMD	10H
Starting data address (high to low)	02H
	00H
Data word number (high to low)	00H
	02H
Data byte number	04H
Data 1 content (high to low)	00H
	64H
Data 2 content (high to low)	00H
	66H
CRC Check Low	2BH
CRC Check High	3AH

Response:

ADR	0
CMD	1
Starting data address (high to low)	02H
	00H
Data word number (high to low)	00H
	02H
CRC Check Low	40H
CRC Check High	70H

- **CRC (RTU mode) Calculation of detection error values**

RTU mode uses CRC (Cyclical Redundancy Check) to detect error value.

Step 1: CRC register is a 16-bits register whose content is FFFFH;

Step 2: Compute Exclusive OR with first byte of command and low byte of the 16-bits CRC register and store the result back to CRC register.

Step 3: Check lowest bit (LSB) of CRC register. If this bit is 0, then move it to the right by 1 bit; if this bit is 1, move the CRC register value to the right by 1 bit, then compute Exclusive OR with A001H.

Step 4: Go back to Step 3, until Step 3 has been executed for 8 times, then go to Step 5.

Step 5: Repeat Step 2 to Step 4 for the next byte of the CMD until all bytes have been processed.

At this point, CRC register content is the CRC detection error value.

Notes: After the CRC detection error value is calculated, in command, fill in CRC low bit first, then fill in CRC high bit.

4) End1、End0 (communication end)

RTU mode:

Static time exceeding 3.5 bytes in current communication rate.

11.3.4 Communication Troubleshooting

During communication, errors may occur and common error sources are as follows:

- Incorrect data address when reading and writing parameters.
- Writing parameters with data exceeding the maximum value of this parameter or less than the minimum value of this parameter.
- Communication is interfered, data transmission error or verification error. .

In the event of a communication error as described above, drive operation is not affected and the drive returns an error frame.

Error frame format as follows:

Host data frame:

Start	Slave address	Command	Data address, information, etc.	Verification

Servo drive feedback error frame:

Start	Slave address	Response code	Error code	Verification

Where,

Error frame response code = command + 80H;

Error code = 00H: normal communication;

=01H/31H: servo drive cannot recognize the request;

=02H/32H: data address of the request does not exist in the servo drive;

=03H/33H: data of the request is not allowed (exceeding upper/lower limit) in servo drive;

= 04H/34H: servo drive started to execute the request but failed;

For example: servo drive Axis number is 03H, write data 06H to parameter PA004. As both upper/lower limit of PA004 is 0, write-in data will not be accepted. Servo drive will send back an error frame; error code is 33H (exceeding upper/lower limit) . Structure is as below:

Host data frame:

Start	Slave address	Command	Data address, information, etc.		Verification
	03H	06H	0004H	0006H	

Servo drive feedback error frame:

Start	Slave address	Response code	Error code	Verification
	03H	86H	33H	

Note:

If the slave address in the data frame sent by the host is 00H, it means that the data in this frame is broadcast data and the drive will not return feedback frame.

11.4 Communication Address

Communication address HEX	Content	Related instructions	Data type	Operation (read and write)
0000~0F00H	Parameter area	Corresponds to parameter in the parameter table in 13.3.3 E.g. PA005 corresponds to address 0005H E.g. PA101 corresponds to address 0101H E.g. PA307 corresponds to address 0307H E.g. PA5A0 corresponds to address 05A0H	According to 13.3.3, there are following data types: ◆ Unsigned 16-bit (Uint16) ◆ Signed 16-bit (int16) ◆ Unsigned 32-bit (Uint32) ◆ Signed 32-bit (int32)	Read and write

		Functions for reading RAM or writing to RAM and EEPROM non-volatile memory.		
1000~1F00H	Temporary parameter area	Corresponds to parameter in the parameter table in 13.3.3 Use if the modified parameters need to be stored E.g. PA005 corresponds to address 1005H E.g. PA101 corresponds to address 1101H E.g. PA307 corresponds to address 1307H E.g. PA5A0 corresponds to address 15A0H Functions for reading RAM or writing to RAM and do not revise data in EEPROM.	According to 13.3.3, there are following data types: ◆ Unsigned 16-bit (Uint16) ◆ Signed 16-bit (int16) ◆ Unsigned 32-bit (Uint32) ◆ Signed 32-bit (int32)	Read and write
E000~E200H	Monitoring area	Corresponds to data in 13.1 monitoring table. E.g. dP000 corresponds to address E000H E.g. dP00A corresponds to address E00AH E.g. dP160 corresponds to address E160H	According to 13.1, there are following data types: ◆ Unsigned 16-bit (Uint16) ◆ Signed 16-bit (int16) ◆ Unsigned 32-bit (Uint32) ◆ Signed 32-bit (int32)	Readable

Notes:

1. If the addresses in the above table are continuous, continuous read/write operations can be performed. When the continuous operation data is not in the table, the read/write data will be invalid. For example, there are only two data at the beginning of 0x0630. When more than two consecutive data are read, the read data drive determines that it is invalid and returns an error code .
2. When operating 32 -bit data: when reading data, the lower 16 bits first, the higher 16 bits second; the write operation must use the 0x10 command to write two consecutive words, the lower 16 bits first, the higher 16 bits second.
3. In normal mode, the motor position feedback, encoder multi-turn data, and encoder single-turn data are all increased counterclockwise (viewed from the motor axis) and decreased clockwise.

4. E168H, E16AH instructions: Before use, you must manually clear the absolute value data (perform AF011 operation). After that, E168H, E16AH data will be automatically cleared; E168H, E16AH calculated data for electronic gears (in user units). For example, the electronic gear is 20:1; the motor runs for 50 turns (e.g., 1 motor turn is 131072 pulses); feedback data is 50 * 131072/20 = 327680. Thus address E168H data is 0x00050000 and address E16AH data is 0x00000000.

5. If the addresses in the above table are continuous, continuous read/write operations can be performed. When the continuous operation data is not in the table, the read/write data will be invalid. For example, there are only two data at the beginning of 0x0630. When more than two consecutive data are read, the read data drive determines that it is invalid and returns an error code .

6. When reading or writing parameters for temporary communication, use the temporary parameter area to avoid repeated operations on the EEPROM.

Chapter 12 Specifications

12.1 Servo Drive Specifications

12.1.1 Basic Specifications

Basic specifications for the servo drive are as follows.

Basic Specifications		
Input power	220V system	Single/Three Phase AC220V +10～-15%，50/60Hz
Control Mechanism		Single/Three phase full wave rectification IGBT PWM control, sine-wave current drive
Feedback		17-Bit serial encoder: 17-Bit (INC/ABS)； 23-Bit serial encoder: 23-Bit (INC/ABS)；
Use condition	Ambient temperature for use/storage temperature	Use temperature: 0～ 45°C Storage temperature: -20～ 55℃
	Ambient humidity/storage humidity	Below 90% RH (no freezing or frosting)
	Vibration/impact resistance	4.9 m/s²～19.6 m/s²
	Protection class/cleanness	Protection class: IP10; Cleanness: 2 But should be: ●With no corrosive or combustible gas ●With no water, oil or drug splashing ●Environment with little dust, ash, salt or metallic powder
	Altitude	Below 1000m
Applicable standard		CE
Construction		Base mount type
Performa	Speed control range	1：5000

nce	Speed fluctuation rate	Load fluctuation	0 ~ 100% load: below ±0.01% (at rated speed)	
		Voltage fluctuation	Rated voltage ±10%: 0.001% (at rated speed)	
		Temperature fluctuation	25 ±25℃: Below ±0.1% (at rated speed)	
	Torque control precision (reproducibility)		±3%	
	Soft start time setting		0 ~10S (acceleration or deceleration can be set respectively)	
Input/output signals	Encoder frequency division pulse output		phase A, phase B, phase Z: linear drive output Number of frequency division pulses: 16~16384;	
	Sequential input signals	Assignable input signal	Quantity	6 points
			Function	S-ON, C-MODE, POT, NOT, CLR, A-RST, GAIN, INHIBIT, etc. The assignment of the above signals and the change of positive/negative logic can be carried out.
	Sequential output signals	Assignable output signal	Quantity	4 points
			Function	ALM, COIN, CZ, BK, S-DRY, etc. The assignment of the above signals and the change of positive/negative logic can be carried out.
Communication functions	RS485communication	1 : N communication	With relay, maximum N=31	
		Axis address setting	By parameter setting	
		Device	PC, host	
	USB communication	Device	PC	
Display/keypad function			7 LED × 5-bit, 4 buttons	
Dynamic brake (DB) (optional)			Action at main circuit OFF, servo alarm, servo OFF, OT.	
Regenerative processing			Internal or external regenerative resistor	
Over-travel (OT) protections			While POT, NOT input, deceleration to stop, or coast to stop.	
Protection functions			Over-current, over-voltage, under-voltage, over-load, regenerative fault, etc.	

12.1.2 Position/speed/torque control specifications

Speed, position and torque control specifications of the servo drive are as follows:

Specification overview			
Control method			
Position control	Feedforward compensation		0～100% (unit: 1%)
	Position completion width		0～65535 encoder unit
	Input signals	Input pulse type	Select any of the following: PULS+SIGN, CW + CCW, 90° phase difference two-phase pulse (phase A + phase B)
		Input pulse pattern	Linear drive support, Collector open circuit
		Maximum input pulse frequency	Differential input: PULS+SIGN, CW+CCW: 500 kpps A+B: 125Kpps Collector open circuit: PULS+SIGN, CW+CCW: 200 kpps A+B: 125 kpps
		Clearance signal	Clear deviation pulses Collector open circuit
Speed control	Soft start time		0～10S (acceleration or deceleration can be set respectively)
	Internal speed control	Speed selection	Input selection using external IO signal
Torque control	Internal torque control	Torque selection	Input selection using external IO signal

12.2 Servo Motor Specifications

Work system: S1 continuous
Vibration: 5G
Insulation resistance: DC500V, above 10MΩ
Working temperature: 0~40℃ (no freezing)
Altitude: below 1000m

Heat resistance: B
Insulation withstand voltage: AC1500V, 1 min
Installation mode: flange
Operating humidity: 20%~80% (no condensation)
Protection method: Fully enclosed and self-cooling IP65 (except shaft-through part)

12.2.1 Series 40/60/80 Servo Motor Parameter Table

Flange size	□40		□60		□80	
Rated Power (kW)	0.05	0.1	0.2	0.4	0.75	1
Rated Voltage (v)	220	220	220	220	220	220
Rated Torque (N·m)	0.16	0.32	0.64	1.27	2.39	3.18
Maximum Torque (N·m)	0.56	1.12	2.24	4.50	8.40	11.13
Rated Current (A)	1.30	1.30	1.50	2.80	4.80	6.40
Instantaneous Maximum Current (A)	4.55	4.55	5.25	10.80	16.80	22.4
Rated Speed (rpm)	3000	3000	3000	3000	3000	3000
Instantaneous Maximum Speed (rpm)	6000	6000	6000	6000	6000	6000
Rotor Inertia (10-4kg.m2)	0.026	0.041	0.207	0.376	1.38	1.75
Brake Configuration	Retain	Retain	Retain	Retain	Retain	Retain
Brake Rated Power (w)	6.1	6.1	7.3	7.3	8.5	8.5
Brake Rated Voltage (v)	24	24	24	24	24	24
Brake Static Friction (N·m)	0.32	0.32	1.27	1.27	3.18	3.18
Brake Suction Time (ms)	100	100	100	100	100	100
Brake Release Time (ms)	60	60	80	80	80	80
Brake Inertia (10-4kg.m2)	0.002	0.002	0.013	0.013	0.05	0.05

12.2.2 Series 100 Servo Motor Parameter Table

Flange size	□100			
Rated Power (kW)	1	1.5	2	2.5
Rated Voltage (v)	220	220	220	220
Rated Torque (N·m)	3.18	4.77	6.37	7.96
Maximum Torque (N·m)	9.55	14.30	19.10	23.88
Rated Current (A)	6.60	8.20	11.30	14.69
Instantaneous Maximum Current (A)	28.00	35.00	48.00	63.17
Rated Speed (rpm)	3000	3000	3000	3000
Instantaneous Maximum Speed (rpm)	5000	5000	5000	5000
Rotor Inertia (10-4kg.m2)	2.15	3.1	4.06	5.02
Brake Configuration	Retain	Retain	Retain	Retain
Brake Rated Power (w)	14.4	14.4	14.4	14.4
Brake Rated Voltage (v)	24	24	24	24
Brake Static Friction (N·m)	8	8	8	8
Brake Suction Time (ms)	120	120	120	120
Brake Release Time (ms)	60	60	60	60
Brake Inertia (10-4kg.m2)	0.35	0.35	0.35	0.35

12.2.3 Series 130 Servo Motor Parameter Table

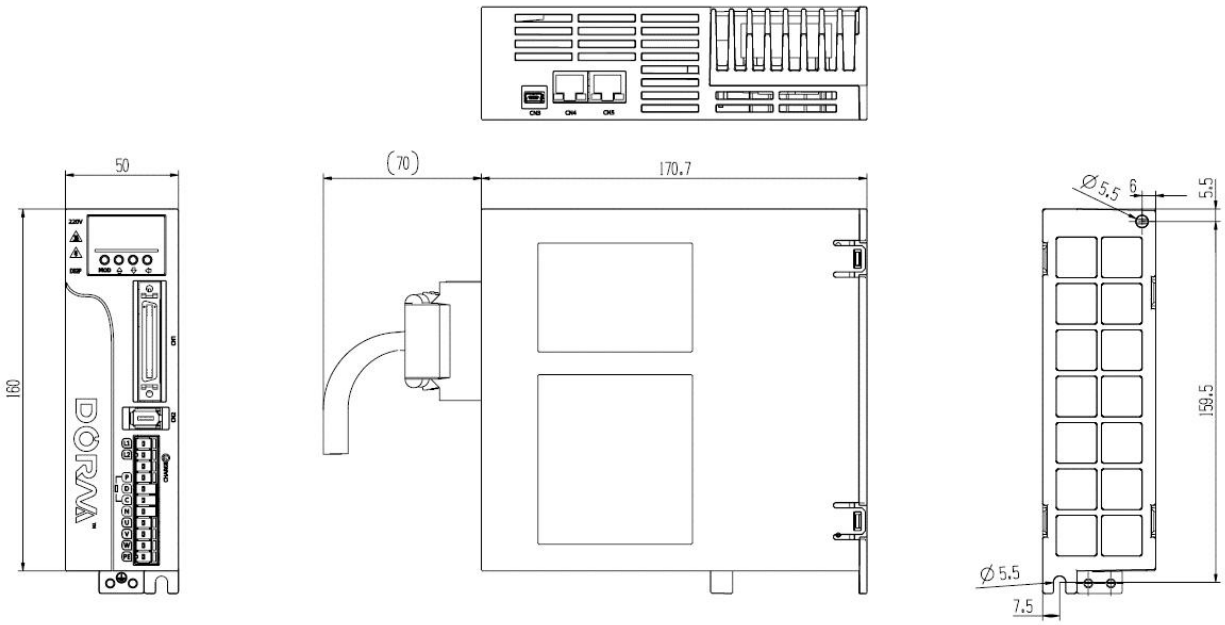
Flange size	□130						
Rated Power (kW)	1	1.5	2	3	0.85	1.3	1.8
Rated Voltage (v)	220	220	220	220	380	380	380
Rated Torque (N·m)	4.77	7.16	9.55	14.32	5.39	8.34	11.50
Maximum Torque (N·m)	14.30	21.50	28.60	42.96	16.17	25.02	34.50
Rated Current (A)	5.20	7.65	9.90	16.92	3.30	5.00	6.60
Instantaneous Maximum Current (A)	15.60	24.00	29.70	50.76	9.90	15.00	19.80
Rated Speed (rpm)	2000	2000	2000	1500	1500	1500	1500
Instantaneous Maximum Speed (rpm)	3000	3000	3000	3000	3000	3000	3000
Rotor Inertia (10-4kg.m2)	6.74	9.66	12	13.68	12.9	19.9	26
Brake Configuration	Retain	Retain	Retain	Retain	Retain	Retain	Retain
Brake Rated Power (w)	23	23	23	23	23	23	23
Brake Rated Voltage (v)	24	24	24	24	24	24	24
Brake Static Friction (N·m)	16	16	16	16	16	16	16
Brake Suction Time (ms)	100	100	100	100	100	100	100
Brake Release Time (ms)	80	80	80	80	80	80	80
Brake Inertia (10-4kg.m2)	1.22	1.22	1.22	1.22	1.22	1.22	1.22

Note:

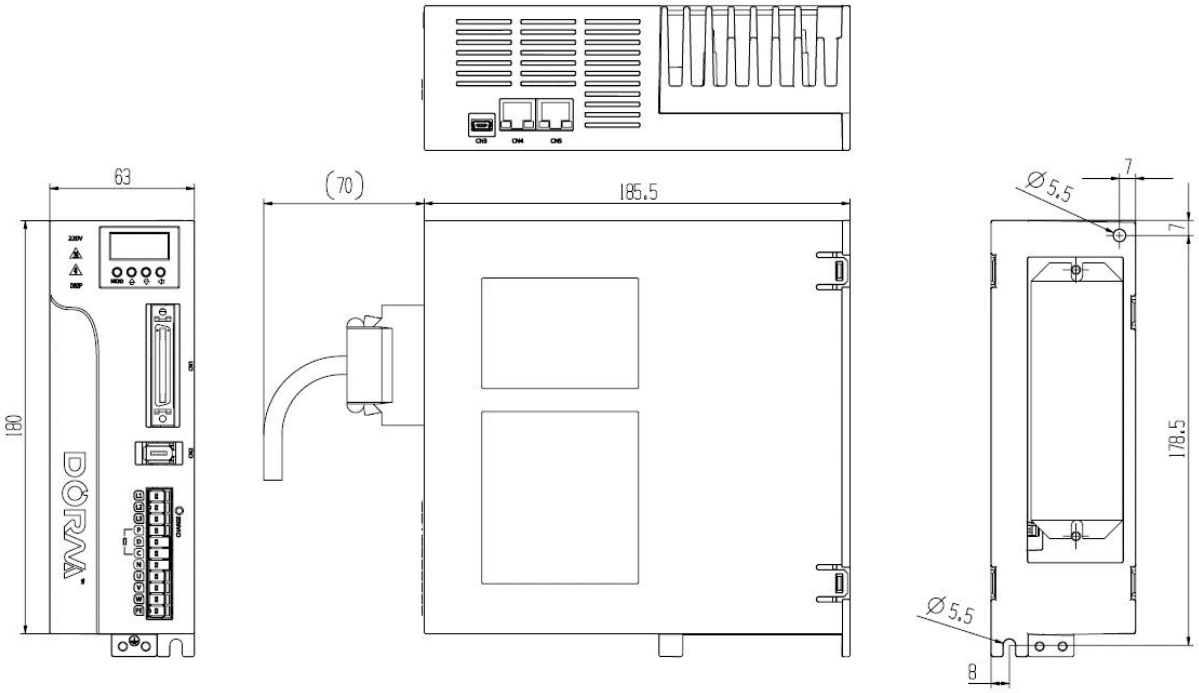
1) In the event of product changes due to design upgrades, no notice will be given.

12.3 Servo Drive Dimensions

12.3.1 A type Case（≤750W)



12.3.2 B type Case（1KW/1.5KW/2KW）



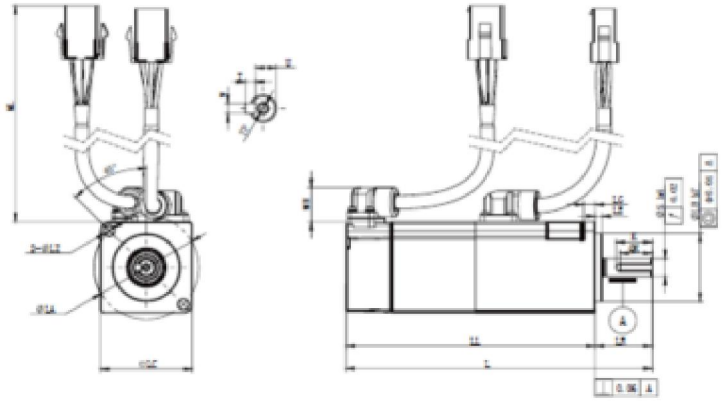
Note:

Dimensions are in mm.

In the event of dimension and weight changes due to product changes, no notice will be given.

12.4 Servo Motor Dimensions

12.4.1 Installation dimensions for series 40 motor: unit (mm)



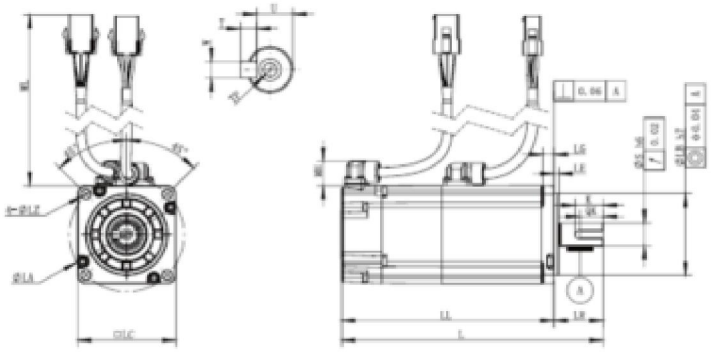
☐ 40 flange motor dimensions (unit: mm)

Power	L	LL	LR	LA	LB	LC	LE	LG
50W	88 (120)	63 (95)	25	46	30	40	3	3.5
100W	102 (134)	77 (109)	25	46	30	40	3	3.5

LZ	S	K	QK	W	T	U	TP
4.5	8	15.7	14	3	3	6.2	M3深7
4.5	8	15.7	14	3	3	6.2	M3深7

(Note)Dimensions with brake

12.4.2 Installation dimensions for series 60 motor: unit (mm)



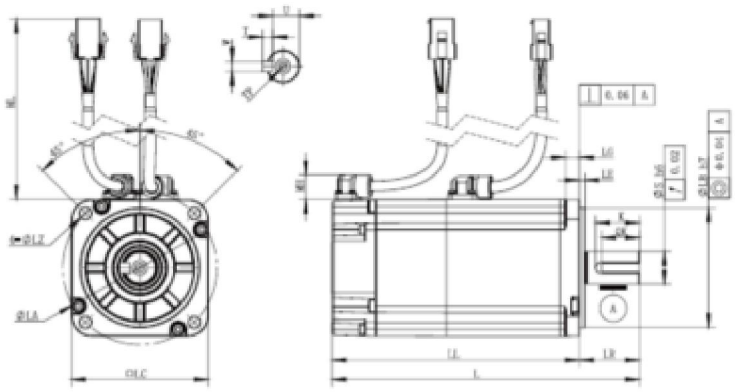
☐ 60 flange motor dimensions (unit: mm)

Power	L	LL	LR	LA	LB	LC	LE	LG
200W	108.5 (142)	78.5 (112)	30	70	50	60	3	6.5
400W	126.5 (60)	96.5 (130)	30	70	50	60	3	6.5

LZ	S	K	QK	W	T	U	TP
5.5	14	17	14	5	5	11	M5深12
5.5	14	17	14	5	5	11	M5深12

(Note)Dimensions with brake

12.4.3 Installation dimensions for series 80 motor: unit (mm)



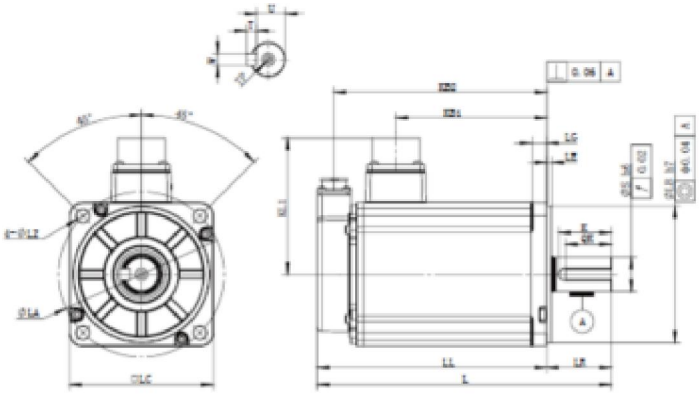
☐ 80 flange motor dimensions (unit: mm)

Power	L	LL	LR	LA	LB	LC	LE	LG	LZ
750W	143 (180)	108 (145)	35	90	70	80	3	8	6.6
1000W	155 (192)	120 (157)	35	90	70	80	3	8	6.6

S	K	QK	W	T	U	TP
19	22	25.5	6	6	15.5	M6深14
19	22	25.5	6	6	15.5	M6深14

(Note)Dimensions with brake

12.4.4 Installation dimensions for series 100 motor: unit (mm)



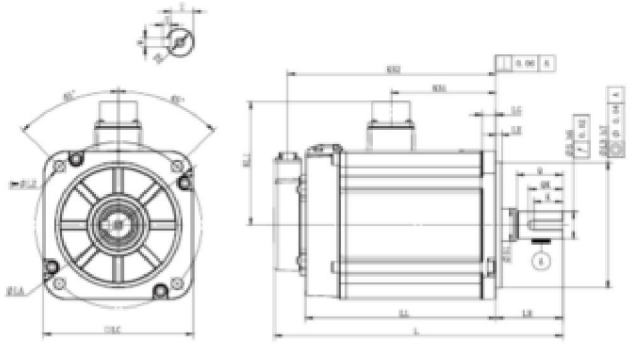
☐ 100 flange motor dimensions (unit: mm)

Power	L	LL	LR	KB1	KB2	KL1	LA	LB
1KW	165	120 (160)	45	65	108 (148)	95	115	95
1.5KW	185	140 (180)	45	85	128 (168)	95	115	95
2KW	205	160 (200)	45	105	148 (188)	95	115	95
2.5KW	225	180 (220)	45	125	168 (208)	95	115	95

LC	LE	LG	LZ	S	K	QK	W	T	U	TP
100	3.5	10	9	24	36.5	32	8	7	20	M6深16
100	3.5	10	9	24	36.5	32	8	7	20	M6深16
100	3.5	10	9	24	36.5	32	8	7	20	M6深16
100	3.5	10	9	24	36.5	32	8	7	20	M6深16

(Note)Dimensions with brake

12.4.5 Installation dimensions for series 130 motor: unit (mm)



□ 130 flange motor dimensions (unit: mm)

Power	L	LL	LR	KB1	KB2	KL1	LA	LB	LC
1KW	172 (201)	117 (146)	55	61	105 (134)	108	145	110	130
1.5KW	187 (216)	132 (161)	55	76	120 (149)	108	145	110	130
2KW	202 (231)	147 (176)	55	91	135 (164)	108	145	110	130
3KW	232 (271)	177 (206)	55	121	165 (194)	108	145	110	130

LE	LG	LZ	S	S1	Q	K	QK	W	T	U	TP
5	12	9	22	28	49	32	36.5	8	7	18	M6深16
5	12	9	22	28	49	32	36.5	8	7	18	M6深16
5	12	9	22	28	49	32	36.5	8	7	18	M6深16
5	12	9	22	28	49	32	36.5	8	7	18	M6深16

(Note)Dimensions with brake

Note:

Dimensions are in mm.

In the event of dimension and weight changes due to product changes, no notice will be given.

12.5 Annex

12.5.1 Braking resistor specification

Internal braking resistor

The servo drive has a built-in braking resistor to absorb the braking energy. This braking resistor is activated if the DC bus voltage in the servo drive exceeds the set value. The absorbed energy is converted into heat dissipation by the braking resistor. You can refer to the following table for the specifications of the DS2P series internal braking resistors.

Servo drive case	Internal braking resistor specification		Minimum permissible resistance value (Ω)
	Resistance value (Ω)	Continuous power (W)	
A type case(400W)	--	--	40
A type case(750W)	40	50	40
B type case(1/1.5/2KW)	40	55	33

External braking resistor

When servo motors must be braked frequently or used with high inertia, external braking resistors are required to dissipate excessive braking energy. When the E320 alarm appears during use, this means that the braking energy is greater than the maximum heat that can be dissipated by the braking resistor and the external braking resistor needs to be configured according to the specific operating conditions, while the internal braking resistor must be disabled. If required, multiple external braking resistors can also be connected in parallel, provided that the total resistance is greater than or equal to the minimum permissible resistance value.

You can select the standard braking resistors according to the following table:

Servo drive case	Recommended external braking resistor specification		Minimum permissible resistance value (Ω)
	Recommended resistor model	Continuous power (W)	
A type case(400W，750W)	ISOTEK ULH150 N 100 K FL500	150	40
	ISOTEK ULH300 N 100 K FL500	300	40
	FRIZLEN FZECU400x65-100	600	40
B type case(1KW，1.5KW，2KW)	ISOTEK ULH300 N 33 K FL500	300	33

	FRIZLEN FZECU400x65-33	600	33
	ISOTEK ULV1000 N 33 K FL500	1000	33
	FRIZLEN FZZCU600x65-33	2000	33

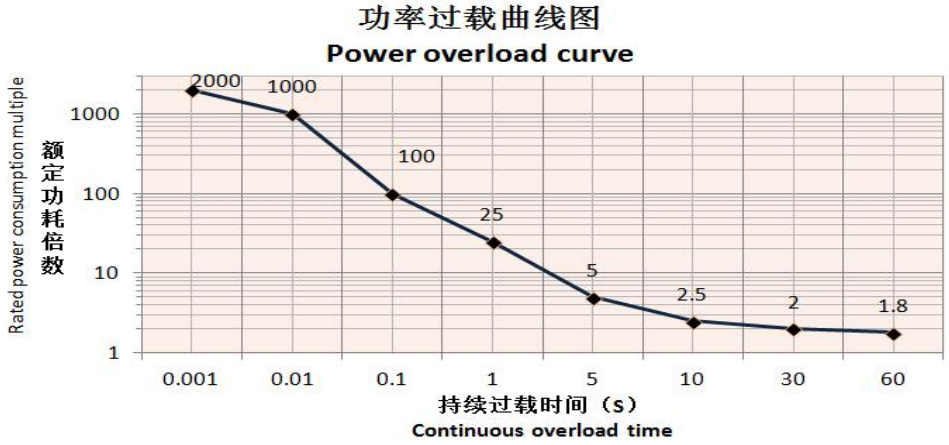
Description:

External braking resistors are recommended for applications with high moment inertia, high load equipment and machines with fast and frequent action cycles

Note:

The servo drive monitors the power dissipated in the braking resistor and the temperature of the resistor surface. The operating temperature of the braking resistor is between -20 and +50°C. The surface temperature of the resistor must not exceed 125°C during operation. To ensure safety, keep away from surrounding low temperatures and fusible parts, it is recommended to use a brake resistor with a thermal switch that automatically alerts you when the resistor temperature is too high.

For the power overload and protection curves for resistors, refer to the following overload curve:



12.5.2 Braking resistor wiring and parameter configuration

Internal/external braking resistor terminal (P/D/C)

When using an internal braking resistor, P and D are shorted and P and C are open; when using an external braking resistor, P and D are disconnected and P and C are connected to the external braking resistor.

Internal/external braking resistor parameter configuration (Regenerative resistor capacity PA590, regenerative resistor resistance PA591)

When using internal braking resistors, please keep the default parameters unchanged, PA590=0, PA591=40;

When using external braking resistors, please set the parameters according to the actual capacity and resistance

value, such as resistance value 40 ohms, capacity 50W, then set PA590=50, PA591=40, if the resistor performance is poor, the overload time does not meet the above overload protection curve, there is a burn resistor but not reported E320, it is recommended to adjust the PA590 parameters downward appropriately;

Note: The default PA010 bit 0 *□=0, each time the drive is powered on, it will detect whether the drain circuit is normal, if the E300 alarm is reported, it means drain circuit error, please detect whether the drain resistor has been damaged, this alarm can be shielded by PA010 bit 0 ***□=1, after shielding, the drain circuit will no longer be detected and the drain function will be turned off. 400W and below versions do not contain built-in drain resistor, thus the lowest bit of PA010 defaults is 1, i.e. the shielded state.**

Chapter 13 Appendix

13.1 Monitor Mode Overview

-	Content	Unit	Data length	Communication address
dP000	Motor speed	【r/min】	int16	0xE000
dP001	Number of motor feedback pulses (encoder unit)	【1 encoder pulse】	int32	0xE001
dP003	Number of pulses input by pulse command (before electronic gear)	【1 command pulse】	int32	0xE003
dP005	Number of position deviation pulses (encoder unit)	【1 encoder pulse】	int32	0xE005
dP007	Speed command (analog voltage command)	【V】	int16	0xE007
dP008	Internal speed command	【r/min】	int16	0xE008
dP009	Torque command (analog voltage command)	【V】	int16	0xE009
dP00A	Internal torque command (value relative to rated torque)	【%】	int16	0xE00A
dP00B	Accumulated load rate of the motor (using the rated value of the accumulated load as 100%)	【%】	Uint16	0xE00B
dP00C	Drive load rate (using the rated value of the regenerative load as 100%)	【%】	Uint16	0xE00C
dP00D	Regenerative load rate (using the rated value	【%】	Uint16	0xE00D

	of the regenerative load as 100%)			
dP011	Safety terminal input signal monitoring	——	Uint16	0xE011
dP012	Input signal monitoring	——	Uint16	0xE012
dP013	Output signal monitoring	——	Uint16	0xE013
dP014	Command pulse frequency	【0.1KHz】	int16	0xE014
dP015	Main circuit voltage	【V】	Uint16	0xE015
dP018	Feedback pulse counter	【1 command unit】	int32	0xE018
dP01A	Position deviation counter	【1command unit】	int32	0xE01A
dP020	Electrical angle 1 (32-bit decimal display)	【1 encoder pulse】	Uint32	0xE020
dP022	Electrical angle 2	【deg】	Uint16	0xE022
dP024	Total operation time	【100ms】	Uint32	0xE024
dP030	Effective gain monitoring (first gain = 1, second gain = 2)	——	Uint16	0xE030
dP032	Encoder resolution: 17-bit encoder with a resolution of 131072. 23-bit encoder with a resolution of 8388608.	pulse	Uint32	0xE032
dP050	Motor rated speed	【r/min】	Uint16	0xE050
dP051	Motor maximum speed	【r/min】	Uint16	0xE051
dP150	drive chassis:1->400W, 2->750W, 3->1KW	——	Uint16	0xE150
dP156	Maximum overload multiple	【%】	Uint16	0xE156
dP158	Motor rated current	【0.1A】	Uint16	0xE158
dP159	Motor maximum current	【0.1A】	Uint16	0xE159
dP160	Encoder single-turn value	【1 encoder pulse】	Uint32	0xE160
dP162	Encoder multi-turn value	【1 turn】	Uint16	0xE162
dP164	Motor absolute position lower 32 bits	【encoder unit】	int32	0xE164

	(encoder units)			
dP166	Motor absolute position lower 32 bits (encoder units)	【encoder unit】	int32	0xE166
dP168	Motor absolute position lower 32 bits user units)	【user unit】	int32	0xE168
dP16A	Motor absolute position lower 32 bits user units)	【user unit】	int32	0xE16A
dP211	Encoder error counter	——	Uint16	0xE211
dP30A	Current alarm code	——	Uint16	0xE30A
dPA0A	U-phase null drift calibration value	——	Uint16	0xEA0A
dPA0B	W-phase null drift calibration value	——	Uint16	0xEA0B
dPA11	Detect if cure parameters are enabled	——	Uint16	0xEA11
dPA12	Average internal torque command	【%】	Uint16	0xEA12

13.2 Miscellaneous Function Overview

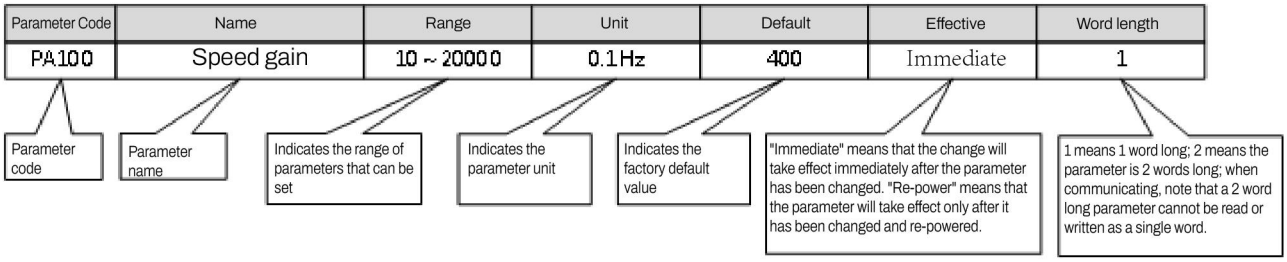
AF code	Function	Reference section
AF000	Display of error records	
AF001	Position demonstration (only valid in position mode)	
AF002	Jogging (JOG) mode of operation	
AF003	Parameter write disable setting	
AF004	Alarm record clearing	
AF005	Parameter initialization	
AF00A	Program JOG running	
AF010	Display the software version of the Servo Drive	

AF011	Absolute value encoder initialization	
AF015	Restore all parameters to factory values	
AF016	Drag	
AF021	Initialization of detection values for vibration detection	
AF030	Manual rigid adjustment	
AF050	Vibration monitoring	
AF060	FFT analysis	
AF105	Vibration control function	

13.3 User Parameter Overview

13.3.1 User Parameter Display

User parameters are displayed as follows:



13.3.2 Function Selection Parameter Display

Each bit of the function selection parameter has its own meaning.

The following representation of the function selection parameters is used in this manual.

Parameter	Meaning
PA000.0 or n.×××□	The value represented by the "0 digit" of the set value of the user parameter "PA000".
PA000.1 or n.××□×	The value represented by the "1 digit" of the set value of the user parameter "PA000".
PA000.2 or n.×□××	The value represented by the "2 digit" of the set value of the user parameter "PA000".
PA000.3 or n.□×××	The value represented by the "3 digit" of the set value of the user parameter "PA000".
PA500.01 or n.××□□	The value represented by the "0 digit" and "1 digit"of the set value of the user parameter "PA500".

13.3.3 List of Parameters

	Description	Range	Unit	Default	Effective	DL
PA000	**Basic function selection switch 0**	n.0000~00C1	--	n.0000	Re-power	1
	n.×××□: Direction 0: Positive rotation control; 1: Negative rotation control; **n.××□×: Control method rotation** 0: Position control; 2: Torque control; 3: Internal speed control; 5: Internal speed control (contact command)⟷ position control 6: Internal speed control (contact command)⟷torque control 8: Position control⟷Torque control A: Program JOG C: Internal position control **n.×□××: Reserved** **n.□×××: Reserved**					
PA001	**Basic function selection switch 1**	n.0000~1123	--	n.0000	Re-power	1
	n.×××□: Stop pattern upon alarm or SOFF 0: Stopped by dynamic brake (DB), the servo motor stops and remains in DB. (Factory value, note that standard servos do not come with DB). 1: Stopped by the dynamic brake (DB), the servo motor stops and enters inertial operation (non-powered). 2: Stopped by inertia, the servo motor stops and enters the inertia operation (non-powered) state. 3: Decelerate and stop motor using PA406 as maximum torque, when the speed is decrease to PA666 or time is larger than PA667, the motor enters cost state. **n.××□×: Stop pattern upon over-travel (OT)** 0: Coast to stop; 1: Decelerate and stop motor using PA406 as maximum torque, then enter servo lock state; 2: Decelerate and stop motor using PA406 as maximum torque, then enter coast state; **n.×□××: AC/DC input power selection** 0: AC power input: input AC power from L1, L2, L3 terminals 1: DC power input: input DC power from between P and N **n. □×××: Reserved**					
PA002	**Basic function selection switch 2**	n.0000~6113	--	n.0100	Re-power	1
	n.×××□: Reserved **n.××□×: Reserved** **n.×□××: Use of absolute encoder** 0: Configure absolute encoder as multi-turn encoder; 1: Configure absolute encoder as single-turn encoder; **n.□×××:Encoder type selection (No setting is required by default, the drive will automatically recognize the**					

	Description	Range	Unit	Default	Effective	DL
	encoder model and dP032 is the encoder resolution) 0：17-bit absolute encoder; 2：23-bit absolute encoder					
PA003	**Reserved**	--	--	--	--	--
PA004	**Reserved**	--	--	--	--	--
PA005	**Reserved**	--	--	--	--	--
PA006	**Basic function selection switch 6**	n.0000～4031	--	n.0001	Re-power	1
	n.×××□: Speed control integral retention 0 integral clearance 1 integral retention **n.××□×: Reserved** **n.×□××: Reserved** **n.□×××: Reserved**					
PA007	**Basic function selection switch 7**	n.0000～005F	--	n.0000	Immediate	1
	n.×××□: Reserved **n.××□×: Multi-turn encoder data overflow alarm** 0 alarm 1 no alarm **n.×□××: Reserved** **n.□×××: Reserved**					
PA008	**Basic function selection switch 8**	n.0000～7121	--	n.0000	Re-power	1
	n.×××□: Alarm/warning selection when battery voltage is low 0：Set battery voltage low to alarm(E.55A); 1：Set battery voltage low to warning(A.930); **n.××□×: Function selection when undervoltage** 0：Undervoltage not detected warning; 1：Undervoltage detected warning, execute the torque limit by the host device 2：Undervoltage detected warning, execute torque limit via PA424, PA425; **n.×□××: Warning detect selection** 0：Detect warning 1：Not detect warning **n.□×××: Reserved**					
PA009	**Basic function selection switch 9**	n.0000～0311	--	n.0010	Re-power	1
	n.×××□: Reserved **n.××□×: Reserved** **n.×□××: Speed detection method selection** 0：Select speed detection 1; 1：Select speed detection 2; **n.□×××: Reserved**					
PA00B	**Basic function selection switch B**	n.0000～1111	--	n.0001	Re-power	1
	n.×××□: Panel parameter display selection 0：Display setting parameters only 1：Display all parameters;					

	Description	Range	Unit	Default	Effective	DL
	n.××□×: Warning stop method selection 0: Zero speed stop 1: DB stop or coast to stop (same stop method as PA001.0) **n.×□××: Reserved** **n.□×××: Reserved**					
PA00C	**Reserved**	--	--	--	--	--
PA00D	**Basic function selection switch D**	n.0000 ~ n.2F17	--	0002	Immediate	1
	n.×××□: Main circuit power OFF alarm 0: No alarm when main power is OFF. However, if the main power is turned off multiple times within 1 minute, alarm E.340 will be reported. 1~7: Alarm when main power is OFF The number of detection is set according to this bit: if set to 1, when main power is turned off and then turned on, alarm E.AA2 will be reported; if set to 2, when main power is turned off and then turned on, and turned off and on again, Alarm E.AA2 will be reported. **n.××□×: Power-on current is automatically zero calibrated** 0: The current is automatically zero calibrated after power-on. 1: The current is not zero calibrated after power-on. **n.×□××: Motor anti-collision protection function** 0: When torque exceeds the LEVEL (percentage of rated torque) of PA43D, output torque arrival signal, and the anti-collision function is turned off. n: Anti-collision function is on. When the torque exceeds PA43D, output torque arrival signal, after n*100ms, drive alarms E.136. **n.□×××: Over-travel warning detection selection** 0: Over-travel not detected warning. 1: Over-travel detected warning A.9A0. 2: Over-travel detected alarm E.AB0.					
PA010	**Basic function selection switch 10**	n.0000 ~ n.9903	--	0300	Re-power	1
	n.×××□: Regenerative resistor detection (Default values for drives with different power may be different) 0: Detect regenerative resistor 1: Not detect regenerative resistor **n.××□×: Reserved** **n.×□××: Overload class** 0~9: The higher the value is, the higher the overload time is. **n.□×××: Reserved**					
PA012	**Motor model selection**	0 ~ 99	--	12	Re-power	1
	The drive and motor models need to match. The performance will be decreased if not matching. By default no setting is required, the servo drive can recognize the servo motor automatically. Motor related data please refer to dP050~dP159.					
PA015	**Axis address selection (UART/Communication)**	1 ~ 255	--	1	Immediate	1
PA016	**RS485 Communication function selection switch**	n.0000 ~ 0096	--	n.0035	Immediate	1
	n.×××□: RS485 Communication rate 0: 2400bps; 1: 4800bps;					

	Description	Range	Unit	Default	Effective	DL
	2：9600bps; 3：19200bps; 4：38400bps; 5：57600bps; 6：115200bps; **n.××□×: Communication protocol** 0：8，N，1; 1：8，N，2; 2：8，E，1; 3：8，O，1; **n.×□××: Reserved** **n.□×××: Reserved**					
PA018	**Reserved**	--	--	--	--	--
PA090	**Reserved**	--	--	--	--	--
PA091	**Reserved**	--	--	--	--	--
PA092	**Number of DI port filters**	0 ~ FFFF	bit	0010	Re-power	1
	n.×××□: DI port filter time*10ms **n.××□×: Encoder clearing filter switch** **0：OFF** **1：ON** **n.×□××: Reserved** **n.□×××: Reserved**					
PA093	**Reserved**	--	--	--	--	--
PA094	**drive motor parameter selection**	0000~3F03	bit	0001	Re-power	1
	n.×××□: drive motor parameter selection **1：Motor parameter** **3：drive built-in parameter** **n.××□×: Reserved** **n.×□××: Reserved** **n.□×××: Reserved**					
PA100	**First speed loop gain**	10 ~ 20000	0.1 Hz	400	Immediate	1
	Determines the speed loop responsiveness. In order to increase the position loop gain and improve the responsiveness of the servo system as a whole, it is necessary to increase the setting of the speed loop gain. However, if the setting is too large, vibration may occur, so pay attention when modifying.					
PA101	**First speed loop integral time constant**	15 ~ 51200	0.01 ms	2000	Immediate	1
	Set the speed loop integral time constant. The smaller the set value, the greater the integral action and the stronger the anti-disturbance capability, but an excessive setting may cause vibration.					
PA102	**First position loop gain**	10 ~ 20000	0.1/s	400	Immediate	1
	Determine the responsive characteristics of the position control system. Set the larger position loop gain value to shorten the positioning time. However, if the setting is too large, it may cause vibration. Please pay attention when modifying it.					

	Description	Range	Unit	Default	Effective	DL
PA103	**Moment of Inertia ratio**	0～20000	1%	100	Immediate	1
	PA103 value = (Load inertia for motor shaft conversion (*JL*) /Rotor inertia of servo motors (*JM*)) × 100 (%)					
PA104	**Second speed loop gain**	10～20000	0.1 Hz	400	Immediate	1
PA105	**Second speed loop integral time constant**	15～51200	0.01 ms	2000	Immediate	1
PA106	**Second position loop gain**	10～20000	0.1/s	400	Immediate	1
PA109	**Speed feed forward gain**	0～100	%	0	Immediate	1
	In the speed control command calculated according to the internal position command, the value multiplied by the ratio of this parameter is added to the speed command from the position control processing.					
PA10A	**Speed feed forward filter**	0~6400	0.01ms	0	Immediate	1
PA10B	**Gain application selection switch 0**	n.0000～5334	--	n.0000	Re-power	1
	n.×××□: Mode switch selection 0：conditioned by internal torque command; 1：conditioned by speed command; 2：conditioned by acceleration; 3：conditioned by position deviation pulse; 4：no mode switch function **n.××□×: Speed loop control method** 0：PI control; 1：I-P control; **n.×□××: Reserved** **n.□×××: Reserved**					
PA10C	**Mode switch (torque command)**	0～400	1%	200	Immediate	1
PA10D	**Mode switch (speed command)**	0～3000	1min-1	0	Immediate	1
PA10E	**Mode switch (acceleration)**	0～30000	1 min-1/s	0	Immediate	1
PA10F	**Mode switch (position deviation)**	0～10000	1 command unit	0	Immediate	1
PA11F	**Reserved**	--	--	--	--	--
PA121	**First disturbance compensation gain**	10～1000	1%	100	Immediate	1
PA122	**Second disturbance compensation gain**	10～1000	1%	100	Immediate	1
PA123	**Disturbance compensation coefficient**	0～100	1%	0	Immediate	1
PA124	**Disturbance compensation frequency compensation**	-10000～10000	0.1 Hz	0	Immediate	1
PA125	**Disturbance compensation frequency compensation**	1～1000	1%	100	Immediate	1
PA127	**Reserved**	--	--	--	--	--
PA128	**Reserved**	--	--	--	--	--
PA131	**Gain switching time 1**	0~32767	1ms	0	Immediate	1
PA132	**Gain switching time 2**	0~32767	1ms	0	Immediate	1
PA135	**Gain switching waiting time 1**	0~32767	1ms	0	Immediate	1
PA136	**Gain switching waiting time 2**	0~32767	1ms	0	Immediate	1
PA139	**Gain application selection switch 1**	n.0000～0052	--	n.0000	Immediate	1
	n.×××□: Gain switching selection switch					

	Description	Range	Unit	Default	Effective	DL
	0：Manual switch: by external input signal (G-SEL); 1：Reserved; 2：Automatic switch 1: When the switching condition A is met, switch from first gain to second gain; When the switching condition A is not met, switch from second gain to first gain **n.××□×: Switching condition A** 0：COIN signal ON; 1：COIN signal OFF; 2：NEAR signal ON 3：NEAR signal OFF 4：Position command filter output=0 AND command pulse output OFF; 6：Position command pulse ON; **n.×□××: Reserved** **n.□×××: Reserved**					
PA190	**Reserved**	--	--	--	--	--
PA200	**Position control function switch 0**	n.0000~2236	--	n.0000	Re-power	1
	n.×××□: Command pulse form 0：SIGN + PULS 1：CW+CCW; 2：phase A + phase B (frequency quadrupling) **n.××□×: Pulse signal negation** 0：PULS, SIGN not negate; 1：PULS not negate, SIGN negate; 2：PULS negate, SIGN not negate; 3：PULS negate, SIGN negate; **n.×□××: Pulse clearance action** 0：Clear position deviation pulse upon Servo OFF or alarm; 1：Not clear position deviation pulse (only clear by CLR signal) 2：Clear position deviation pulse upon alarm. **n.□×××: Pulse input channel selection** 0：PULS, SIGN input (low speed pulse channel);					
PA201	**1 Position control function switch 1**	n.0000~6177	--	n.0002	Re-power	1
	n.×××□: Low speed pulse input channel filter level 0~7： The higher the value, the longer the filtering time and the lower the pulse input cut-off frequency. 0 means no filtering function. **n.××□×: Low speed pulse input pre-filtering** 0~7： The higher the value, the longer the filtering time and the lower the pulse input cut-off frequency. 0 means no filtering function. **n.×□××: Frequency division pulse output logic negation** 0：Not negate 1：Negate **n.□×××: Frequency division pulse Z expansion** 0：Not expand 1：Expand by 8 times					

	Description	Range	Unit	Default	Effective	DL
	2：Expand by 64 times 3：Expand by 512 times					
PA202	**Position control function switch 2**	n.0000~3F32	--	n.0000	Re-power	1
	n.×××□: COIN signal output condition 0：Output when the absolute value of the position deviation is smaller than the positioning completion amplitude (PA522); 1：Output when the absolute value of the position deviation is less than the positioning completion amplitude (PA522) and the position command filtered command is 0; 2：Output when the absolute value of the position deviation is smaller than the positioning completion amplitude (PA522) and the position command input is 0. **n.××□×: CLR signal form** 0：Clear the position deviation pulse when the signal is H level; 1：The rising edge of the signal clears the position deviation pulse; 2：Clear the position deviation pulse when the signal is L level; 3：The falling edge of the signal clears the position deviation pulse; **n.×□××: Homing modes** 0：Search for the Z pulse in the negative direction, and the Z pulse as the zero point; 1：Search for the Z pulse in the positive direction, and the Z pulse as the zero point; 2：Running in the negative direction, after hitting the NOT signal, search for the Z pulse in positive direction, and the first Z pulse is used as the zero point; 3：Running in the positive direction, after hitting the NOT signal, search for the Z pulse in negative direction, and the first Z pulse is used as the zero point; 4：Run in positive direction when zero signal is invalid, run in negative direction after zero signal is valid, first Z pulse of the invalid zero signal used as zero point. Run in negative direction when zero signal is valid, first Z pulse of the invalid zero signal used as zero point. 5：Run in negative direction when zero signal is valid, run in positive direction after zero signal is invalid, first Z pulse of the valid zero signal used as zero point. Run in positive direction when zero signal is invalid, first Z pulse of the valid zero signal used as zero point. 6：Run in the negative direction, after hitting the NOT signal, it will run in positive direction, where NOT signal invalid is used as the zero point. 7：Run in the positive direction, after hitting the POT signal, it will run in negative direction, where POT signal invalid is used as the zero point. 8：Run in positive direction when zero signal is invalid, run in negative direction after zero signal is valid, where zero signal invalid is used as zero point. Run in negative direction when zero signal is valid, where zero signal invalid is used as zero point. 9：Run in negative direction when zero signal is valid, run in positive direction after zero signal is invalid, where zero signal valid is used as zero point. Run in positive direction when zero signal is invalid, where zero signal valid is used as zero point. 12：Run in positive direction when zero signal is invalid, run in positive direction after zero signal is valid, where zero signal invalid is used as zero point. Run in positive direction when zero signal is valid, where zero signal invalid is used as zero point. 13：Run in negative direction when zero signal is invalid, run in negative direction after zero signal is invalid, where zero signal valid is used as zero point. Run in negative direction when zero signal is invalid, where zero signal					

	Description	Range	Unit	Default	Effective	DL
	invalid is used as zero point. 14: Run in negative direction when zero signal is invalid, run in positive direction after zero signal is valid, where zero signal valid is used as zero point. Run in positive direction when zero signal is valid, where zero signal invalid is used as zero point. **n. □×××:Home start control** **0: OFF** **1: DI(HomeStart) start** **2: Activated on power-up, when first SON is active**					
PA205	**Multi-turn upper limit**	0 ~ 65535	1 rev	65535	Re-power	1
PA207	**Position control function switch**	0000 ~ 9210	--	0000	Re-power	1
	n.×××□: Reserved **n.××□×: Reserved** **n.×□××: Reserved** **n.□×××: Return home mode** **0: Not return home mode** **1: Equal division return home. When equal division is PA550, do not set value smaller than or equal to 0, or it will report alarm E.040. PA54D is the home speed.**					
PA20C	**Reserved**	--	--	--	--	--
PA20E	**Electronic gear ratio (numerator)**	1 ~ 1073741824	--	4	Immediate	2
	Refer to PA210.					
PA210	**Electronic gear ratio (denominator)**	0 ~ 1073741824	--	1	Immediate	2
	1、 When PA210 is not 0, electronic gear numerator = PA20E, electronic gear denominator = PA210 2、 When PA210 is 0, command pulse number of each turn = PA20E, i.e. the command pulse number is PA20E when motor rotates for 1 turn, In this way, drive will automatically calculate electronic gear according to encoder type.					
PA212	**Encoder pulse division pulse**	16 ~ 32768	1 P/Rev	2500	Re-power	2
	1. Set the resolution of the pulse output to the number of output pulses per turn of OA and OB. If set to 1000, the motor rotates 1 turn, the number of OA pulses output is 1000, and the number of OB pulses output is 1000. 2. When the value of PA212 is set to higher than 1/4 of the encoder resolution, the division value is 1/4 of the encoder resolution. If the encoder with a resolution of 131072 is used, and the PA210 is set to a value greater than 32768, the number of divided pulses is limited to 32768. 3. The Z pulse width of the communication encoder is equal to A pulse width, that is, the smaller the value of PA212, the wider the OA width at the same speed, and the wider the Z pulse width is.					
PA216	**Position command acceleration/deceleration time**	0 ~ 32767	0.1 ms	0	After motor stops	1
PA217	**Position command average filter**	0 ~ 10000	0.1 ms	0	After motor stops	1

PA210	Command division multiplier processing
≠0	Pulse input → PA20E / PA210 → Position command
=0	Pulse input → Encoder resolution / PA20E → Position command

	Description	Range	Unit	Default	Effective	DL
PA218	**Command pulse input rate**	1 ~100	1 time	1		1
PA230	**Reserved**	--	--	--	--	--
PA231	**Reserved**	--	--	--	--	--
PA233	**Reserved**	--	--	--	--	--
PA240	**Reserved**	--	--	--	--	--
PA2D0	**Reserved**	--	--	--	--	--
PA300	**Reserved**	--	--	--	--	--
PA301	**Internal speed 1**	-6000~ 6000	1 min-1	100	Immediate	1
	Under internal speed control, combination of external IO input signals INSPD1 and INSPD0 controls internal speed, unit is turn/min. Their relationship are as follows: **INSPD1** / **INSPD0** / **Speed control command** Invalid / Invalid / Zero speed Invalid / Valid / Internal speed 1 (PA301) Valid / Invalid / Internal speed 2 (PA302) Valid / Valid / Internal speed 3 (PA303)					
PA301	**Internal torque register 1**	-6000~ 6000	0.1%	100	Immediate	1
	Under torque control, the internal torque register mode is selected when the external input IO signal is selected as "Internal torque select 0 (INTor0)" or "Internal torque select 0 (INTor0)" and these two signals are not both invalid. The unit of this parameter is 0.1%, i.e. when PA301 = 100, the corresponding internal torque is 10% of the rated value.. **INTor1** / **INTor0** / **Torque control command** Invalid / Invalid / External analog command Invalid / Valid / Internal torque register 0 (PA301) Valid / Invalid / Internal torque register 1 (PA302) Valid / Valid / Internal torque register 2 (PA303)					
PA302	**Internal speed 2**	-6000~ 6000	1 min-1	200	Immediate	1
	Internal torque register 2	-6000~ 6000	0.1%	200	Immediate	1
PA303	**Internal speed 3**	-6000~ 6000	1 min-1	300	Immediate	1
	Internal torque register 3	-6000~ 6000	0.1%	300	Immediate	1
PA304	**JOG speed**	0 ~ 6000	1 min-1	200	Immediate	1
PA305	**Soft start acceleration time**	0 ~ 10000	1ms	0	Immediate	1
PA306	**Soft start deceleration time**	0 ~ 10000	1ms	0	Immediate	1
PA307	**Speed command filter time**	0 ~ 65535	0.01ms	40	Immediate	1
PA308	**peed feedback filter time**	0 ~ 65535	0.01ms	0	Immediate	1
PA30A	**Speed control function switch 0**	0000 ~ 0001	--	0000	Re-power	1
PA30B	**Reserved**	--	--	--	--	--
PA310	**Vibration detection switch**	0000 ~ 0F02	--	0000	Immediate	1
	n.×××□: Vibration detection selection 0: Not detect vibration;					

	Description	Range	Unit	Default	Effective	DL
	1：Report warning when vibration detected（A.91A）； 2：Report alarm when vibration detected（E.A20）； **n.××□×： Reserved** **n.□□××: N pulse suppression pulse number** N is encoder unit, N=0~F.					
PA311	**Vibration detection sensitivity**	50～500	1%	100	Immediate	1
PA312	**Vibration detection value**	0～5000	50min-1	50	Immediate	1
PA324	**Inertia estimation start value**	0～20000	1%	300	Immediate	1
PA400	**Torque command input gain**	10~100	0.1V	30	Immediate	
PA401	**1st torque command filter time constant**	0～32767	0.01ms	100	Immediate	1
PA402	**Positive torque limit**	0～400	1%	300	Immediate	1
PA403	**Negative torque limit**	0～400	1%	300	Immediate	1
PA404	**Positive external torque limit**	0～400	1%	100	Immediate	1
PA405	**Negative external torque limit**	0～400	1%	100	Immediate	1
PA406	**Emergency stop torque limit**	0～400	1%	300	Immediate	1
PA407	**Speed limit at torque control**	0～10000	1 min-1	1500	Immediate	1
PA408	**Torque function switch 0**	0000～1313	--	0000	Re-power	1
	n.×××□： Notch filter selection 1 0：The first stage notch filter is invalid. 1：Use the 1st stage notch filter. 2：The 1st stage notch filter is set to automatic. **n.××□×: Speed limit selection** 0：Use the smaller of the motor maximum speed or PA407 as the speed limit value. 1：Use the overspeed detection speed or the smaller of PA407 as the speed limit value. **n.×□××: Notch filter selection 2** 0：The 2nd stage notch filter is invalid. 1：Use the 2nd stage notch filter. **n.□×××: Disturbance compensation function selection** 0：Do not use the disturbance compensation function. 1：Use the disturbance compensation function.					
PA409	**1st stage notch filter frequency**	50～5000	1 Hz	5000	Immediate	1
PA40A	**1st stage notch filter attenuation value**	50～1000	0.01	70	Immediate	1
PA40B	**1st stage notch filter depth**	0～1000	0.001	0	Immediate	1
PA40C	**2nd stage notch filter frequency**	50～5000	1 Hz	5000	Immediate	1
PA40D	**2nd stage notch filter attenuation value**	50～1000	0.01	70	Immediate	1
PA40E	**2nd stage notch filter depth**	0～1000	0.001	0	Immediate	1
PA40F	**Reserved**	--	--	--	--	--
PA410	**Reserved**	--	--	--	--	--
PA412	**Reserved**	--	--	--	--	--
PA415	**Analog torque command filter time parameter**	0～32767	0.01ms	0	Immediate	1
PA416	**3rd stage notch filter frequency**	50～5000	1 Hz	5000	Immediate	1
PA417	**3d stage notch filter attenuation value**	50～1000	0.01	70	Immediate	1

	Description	Range	Unit	Default	Effective	DL
PA418	**3rd stage notch filter depth**	0 ~ 1000	0.001	0	Immediate	1
PA419	**4th stage notch filter frequency**	50 ~ 5000	1 Hz	5000	Immediate	1
PA41A	**4th stage notch filter attenuation value**	50 ~ 1000	0.01	70	Immediate	1
PA41B	**4th stage notch filter depth**	0 ~ 1000	0.001	0	Immediate	1
PA41C	**Reserved**	--	--	--	--	--
PA41D	**Reserved**	--	--	--	--	--
PA41E	**Reserved**	--	--	--	--	--
PA41F	**Torque function switch 1**	0000 ~ 0111	--	0000	Immediate	1
	n.×××□: Notch filter selection 3 0: The 3rd stage notch filter is invalid. 1: Use the 3rd stage notch filter. **n.××□×: Notch filter selection 4** 0: The 4th stage notch filter is invalid. 1: Use the 4th stage notch filter. **n.×□××: Reserved** **n.□×××: Reserved**					
PA423	**Reserved**	--	--	--	--	--
PA424	**Reserved**	--	--	--	--	--
PA425	**Reserved**	--	--	--	--	--
PA430	**Current loop gain coefficient**	25 ~ 400	1%	100	Immediate	1
PA431	**Current loop integral coefficient**	10 ~ 400	1%	100	Immediate	1
PA43A	**Reserved**	--	--	--	--	--
PA43D	**Torque reaches amplitude**	0 ~ 300	1%	0	Immediate	1
PA456	**Scan torque command amplitude**	1 ~ 400	1%	15	Immediate	1
PA460	**Notch filter adjustment switch 1**	0000 ~ 0101	--	0101	Immediate	1
	n.×××□: Notch filter adjustment selection 1 0: 1st stage notch filter not automatically adjusted by the auxiliary function. 1: 1st stage notch filter automatically adjusted by the auxiliary function. **n.××□×: Reserved** **n.×□××: Notch filter adjustment selection 2** 0: 2nd stage notch filter not automatically adjusted by the auxiliary function. 1: 2nd stage notch filter automatically adjusted by the auxiliary function. **n.□×××: Reserved**					
PA466	**Reserved**	--	--	--	--	--
PA470	**Reserved**	--	--	--	--	--
PA471	**Reserved**	--	--	--	--	--
PA472	**Reserved**	--	--	--	--	--
PA473	**Reserved**	--	--	--	--	--
PA474	**Reserved**	--	--	--	--	--
PA481	**Reserved**	--	--	--	--	--
PA482	**Reserved**	--	--	--	--	--
PA486	**Reserved**	--	--	--	--	--
PA487	**Reserved**	--	--	--	--	--

	Description	Range	Unit	Default	Effective	DL
PA488	**Reserved**	--	--	--	--	--
PA490	**Reserved**	--	--	--	--	--
PA493	**Reserved**	--	--	--	--	--
PA494	**Reserved**	--	--	--	--	--
PA495	**Reserved**	--	--	--	--	--
PA498	**Reserved**	--	--	--	--	--
PA4A0	**Reserved**	--	--	--	--	--
PA4A2	**Reserved**	--	--	--	--	--
PA500	**Port DI1 input signal selection（CN1-40）**	n.0000～n.212F	--	n.0000	Immediate	1
	n.××□□: Port DI1 input signal selection 【00】Servo enable（S-ON） 【01】Control mode switch（C-MOD） 【02】Positive rotation prohibited（POT） 【03】Negative rotation prohibited（NOT） 【04】Deviation counter clearance（CLR） 【05】Alarm reset（A-RST） 【06】Pulse input inhibited（INHIBIT） 【07】Reserved 【08】Positive torque limitation（PCL） 【09】Negative torque limitation（NCL） 【0A】Gain switch（GAIN） 【0B】Reserved 【0C】Command negation（CMDINV） 【0E】Reserved 【0F】Internal command speed selection 0（INSPD0） 【10】Internal command speed selection 1（INSPD1） 【13】Internal command torque selection 0（INTor0） 【14】Internal command torque selection 1（INTor1） 【15】Zero signal（HomeSwitch） 【16】Home start（HomeStart） 【17】Home stop signal（QStop） 【1C】Internal command position selection 3（INPos3） 【1D】Internal command position selection 2（INPos2） 【1E】Internal command position selection 1（INPos1） 【1F】Internal command position selection 0（INPos0） 【20】Internal position trigger signal（Ptrg） 【21】Internal position stop signal（PZero） 【23】 2nd gear ratio switch **n. ×□××: Port DI1 input signal negation** 【0】Not negate signal 【1】 Negate signal **n.□×××: Port DI1input signal status** 【0】Input signal status controlled by external IO 【1】Signal constant valid					

	Description	Range	Unit	Default	Effective	DL
	【2】Signal constant invalid					
PA501	**Port DI2 input signal selection (CN1-41) as PA500**	n.0000 ~ n.212F	--	n.0001	Immediate	1
PA502	**Port DI3 input signal selection (CN1-42) as PA500. Note default signal negation.**	n.0000 ~ n.212F	--	n.2002	Immediate	1
PA503	**Port DI4 input signal selection (CN1-43) as PA500. Note default signal negation.**	n.0000 ~ n.212F	--	n.2003	Immediate	1
PA504	**Port DI5 input signal selection (CN1-44) as PA500**	n.0000 ~ n.212F	--	n.0004	Immediate	1
PA505	**Port DI6 input signal selection (CN1-45) as PA500**	n.0000 ~ n.212F	--	n.0005	Immediate	1
PA506	**Port DI7 input signal selection (Virtual I corresponds to PA65E) As PA500**	n.0000 ~ n.212F	--	n.001C	Immediate	1
PA507	**Port DI8 input signal selection (Virtual IO corresponds to PA65F) As PA500**	n.0000 ~ n.212F	--	n.001D	Immediate	1
PA508	**Port DI9 input signal selection (Virtual IO corresponds to PA660) As PA500**	n.0000 ~ n.212F	--	n.001E	Immediate	1
PA509	**Port DI10 input signal selection (Virtual IO corresponds to PA661) As PA500**	n.0000 ~ n.212F	--	n.001F	Immediate	1
PA50A	**Port DO1 output signal configuration (CN1-31、CN1-32)**	n.0000 ~ n.011F	--	n.0000	Immediate	1
	n.××□□: Port DO1 output signal selection 【00】Alarm signal output（ALM） 【01】Positioning completed（COIN）: Output when position deviation is less than the value of PA522. 【02】Z pulse collector signal（CZ）; 【03】External brake release signal（BK） 【04】Servo output ready（S-RDY） 【05】Speed consistent output（VCMP） 【06】Motor rotation detected（TGON） 【07】Torque limited signal（TLC） 【08】Speed limited signal（VLC） 【09】Warning output（WARN） 【0A】Positioning near（NEAR）: Output when position deviation is less than the value of PA524. 【0D】Torque reached（TREACH): output when torque feedback reaches the value of PA43D 【0E】DB brake output signal（DB） 【0F】Home return signal（HOME） 【10】Position command completion signal（CMD-OK） 【11】Position command execution signal（MC-OK） **n.×□××: Port DO1 output signal negation** 【0】Not negate signal					

	Description	Range	Unit	Default	Effective	DL
	【1】Negate signal **n.□×××: Port DO1 Output signal status** 【0】Input signal status controlled by external IO					
PA50B	**Port DO2 output signal configuration (CN1-29、CN1-30)**	n.0000 ~ n.011F	--	n.0001	Immediate	1
	As above					
PA50C	**Port DO3 output signal configuration (CN1-27、CN1-28)**	n.0000 ~ n.011F	--	n.0002	Immediate	1
	As above					
PA50D	**Port DO4 output signal configuration (CN1-25、CN1-26)**	n.0000 ~ n.011F	--	n.0003	Immediate	1
	As above					
PA50E	**Reserved**	--	--	--	--	--
PA511	**Reserved**	--	--	--	--	--
PA512	**Rotation detection value**	1 ~ 6000	1 min-1	20	Immediate	1
PA513	**Same speed signal detection width**	0 ~ 100	1 min-1	10	Immediate	1
PA516	**Brake command - servo OFF delay**	0 ~ 1000	ms	0	Immediate	1
PA517	**Brake command output speed value**	0 ~ 5000	1 min-1	100	Immediate	1
PA518	**Servo OFF - brake command waiting time**	0 ~ 5000	1ms	500	Immediate	1
PA519	**Instantaneous stop holding time**	20 ~ 8000	1ms	20	Immediate	1
PA51E	**Warning value of excessive position deviation**	10 ~ 100	1%	80	Immediate	1
PA520	**Alarm value of excessive position deviation**	1 ~ 500	0.1 turn	50	Immediate	1
PA521	**Reserved**	--	--	--	--	--
PA522	**Positional completion width**	0 ~ 1073741824	1 command unit	7	Immediate	2
PA524	**NEAR signal width**	1 ~ 1073741824	1 command unit	65535	Immediate	2
PA526	**Servo ON excessive position deviation alarm value (ERR)**	1 ~ 500	0.1 turn	50	Immediate	1
PA527	**Reserved**	--	--	--	--	--
PA528	**Servo ON excessive position deviation warning value**	10 ~ 100	1%	80	Immediate	1
PA529	**Servo ON speed limit value**	0 ~ 10000	1 min-1	10000	Immediate	1
PA52B	**Overload warning value**	1~100	%	20	Immediate	1
PA52C	**Reserved**	--	--	--	--	--
PA52D	**Reserved**	--	--	--	--	--
PA52F	**Monitor display when power is on**	n.0000 ~ 0FFF	--	0FFF	Immediate	1
PA54A	**Reserved**	--	--	--	--	--
PA54B	**Reserved**	--	--	--	--	--

	Description	Range	Unit	Default	Effective	DL
PA54C	**Reserved**	--	--	--	--	--
PA54D	**Homing speed 1**	0 ~ 3000	1 min-1	500	Immediate	1
PA54E	**Homing speed 2**	0 ~ 3000	1 min-1	10	Immediate	1
PA550	**Homing position offset (only works if PA207.3 = 1, as an equal fraction of the homing point. For example, if set to 16, the home point is the nearest equal fraction of the motor's current absolute single-turn position)**	-32768 ~ 32767	Pulse	0	Re-power	1
PA551	**Reserved**	--	--	--	--	--
PA552	**Reserved**	--	--	--	--	--
PA553	**Reserved**	--	--	--	--	--
PA560	**Residual vibration detection amplitude**	1 ~ 3000	0.1%	400	Immediate	1
PA561	**Overshoot detection value**	0 ~ 100	1%	100	Immediate	1
PA587	**Reserved**	--	--	--	--	--
PA590	**Regenerative resistance capacity**	0 ~ 65535	1W	0	Immediate	1
PA591	**Regenerative resistance value**	0~200	Ω	40	Immediate	1
PA5A0	**Program JOG switches**	n.0000 ~ n.0F05	--	n.0000	Immediate	1
	n.□□□X: Program JOG parameters 【0】 (waiting time PA5A5 → positive movement PA5A1) × movement times PA5A6 【1】 (waiting time PA5A5 → negative movement PA5A1) × movement times PA5A6 【2】 (waiting time PA5A5 → positive movement PA5A1) × movement times PA5A6 (waiting time PA5A5 → negative movement PA5A1) × movement times PA5A6 【3】 (waiting time PA5A5 → negative movement PA5A1) × movement times PA5A6 (waiting time PA5A5 → positive movement PA5A1) × movement times PA5A6 【4】(waiting time PA5A5 → positive movement PA5A1 → waiting time PA5A5 → negative movement PA5A1) × movement times PA5A6 【5】(waiting time PA5A5 → negative movement PA5A1 → waiting time PA5A5 → positive movement PA5A1) × movement times PA5A6 **n.XX□X: Reserved** **n.X□XX: Reserved** **n.□XXX: Reserved**					
PA5A1	**Program JOG movement distance**	1 ~ 1073741824	1 command unit	32768	Immediate	2
PA5A3	**Program JOG movement speed**	1 ~ 10000	rpm	500	Immediate	1
PA5A4	**Program JOG acceleration/deceleration time**	2 ~ 10000	1ms	100	Immediate	1
PA5A5	**Program JOG waiting time**	0 ~ 10000	1ms	100	Immediate	1
PA5A6	**Program JOG movement times**	0 ~ 1000	1 time	1	Immediate	1
PA5C1	**Reserved**	--	--	--	--	--
PA5C2	**Reserved**	--	--	--	--	--
PA5C3	**Reserved**	--	--	--	--	--

	Description	Range	Unit	Default	Effective	DL
PA5C4	**Reserved**	--	--	--	--	--
PA5C5	**Reserved**	--	--	--	--	--
PA5C6	**Reserved**	--	--	--	--	--
PA5C7	**Reserved**	--	--	--	--	--
PA5C8	**Reserved**	--	--	--	--	--
PA5D0	**Reserved**	--	--	--	--	--
PA600	**Auto-tuning switches**	n.0000 ~ 2911	--	n.1400	Re-power	1
	n.×××□: Auto tuning selection 0: Disable auto-tuning function 1: Enable auto-tuning function **n.××□×: Reserved** **n.×□××: Auto-tuning rigid selection** 0~4: The higher the value is, the higher rigid lever when auto-tuning. **n.□×××: Auto-tuning rigid load selection** 0~2: The higher the load is, the higher this value should be set.					
PA60D	**Current gain value**	100~4000	0.1%	2000	Immediate	1
PA610	**Model tracking control switch**	n.0000 ~ 1121	--	n.0100	Immediate	1
	n.×××□: Model tracking control switch 0: Invalid 1: Valid **n.××□×: Vibration reduction control switch** 0: Invalid 1: Valid for special frequency 2: Valid for 2 different frequencies. **n.×□××: Vibration reduction control function adjustment** 0: No automatic adjustment by auxiliary function 1: Automatic adjustment by auxiliary function **n.□×××: Speed feedforward (VFF) / Torque feedforward selection** 0: Not use model tracking control and speed/torque feedforward simultaneously 1: Use model tracking control and speed/torque feedforward simultaneously					
PA611	**Reserved**	--	--	--	--	--
PA613	**Model tracking control gain**	10 ~ 20000	0.1/s	500	Immediate	1
PA614	**Model tracking control gain compensation**	500 ~ 2000	0.1%	1000	Immediate	1
PA615	**Model tracking control positive offset**	0 ~ 10000	0.1%	1000	Immediate	1
PA616	**Model tracking control negative offset**	0 ~ 10000	0.1%	1000	Immediate	1
PA617	**Vibration reduction control 1 frequency A**	10 ~ 2500	0.1Hz	500	Immediate	1
PA618	**Vibration reduction control 1 frequency B**	10 ~ 2500	0.1Hz	700	Immediate	1
PA619	**Model tracking control speed feedforward compensation**	0 ~ 10000	0.1%	1000	Immediate	1
PA61A	**Model tracking control gain 2**	10 ~ 20000	0.1/s	500	Immediate	1
PA61B	**Model tracking control gain compensation 2**	500 ~ 2000	0.1%	1000	Immediate	1

	Description	Range	Unit	Default	Effective	DL
PA61C	Vibration reduction control 2 frequency	10 ~ 2000	0.1Hz	800	Immediate	1
PA61D	Vibration reduction control 2 compensation	10 ~ 1000	1%	100	Immediate	1
PA630	Reserved	--	--	--	--	--
PA631	Vibration suppression frequency	10 ~ 20000	0.1Hz	1000	Immediate	1
PA632	Vibration suppression gain compensation	1 ~ 1000	1%	100	Immediate	1
PA633	Vibration suppression damping gain	0 ~ 300	1%	0	Immediate	1
PA654	Vibration suppression filter time 1 compensation	-1000 ~ 1000	0.01ms	0	Immediate	1
PA635	Vibration suppression filter time 2 compensation	-1000 ~ 1000	0.01ms	0	Immediate	1
PA636	Vibration suppression damping gain 2	0 ~ 300	1%	0	Immediate	1
PA637	Reserved	--	--	--	--	--
PA656	Encoder filter coefficient/current sampling chip configuration	0000~0076	--	0056	Re-power	1
	n.×××□: Current sampling chip configuration (factory default) n.××□×: Encoder filter coefficient (default 5) 0: Do not turn on filter 1-7: Filter narrow pulse interference below 10-70ns, respectively					
PA657	Brake command- Servo ON command waiting time	0 ~ 1000	1ms	250	Immediate	1
PA658	Give speed percentage	20~100	1%	100	Immediate	1
PA659	Rated current percentage	50~120	1%	120	Immediate	1
PA65A	Detection time length	2500~10000	2ms	3000	Immediate	1
PA65B	Allow real-time revision of electronic gear	n.0000~0001	--	0000	Immediate	1
PA65D	Reserved	--	--	--	--	--
PA65E	Remote IO1	n.0000~0001	--	0000	Immediate	1
PA65F	Remote IO2	n.0000~0001	--	0000	Immediate	1
PA660	Remote IO3	n.0000~0001	--	0000	Immediate	1
PA661	Remote IO4	n.0000~0001	--	0000	Immediate	1
PA662	Reserved	--	--	--	--	--
PA663	Reserved	--	--	--	--	--
PA664	Reserved	--	--	--	--	--
PA665	Reserved	--	--	--	--	--
PA666	Servo OFF stop speed limit	20~3000	rpm	50	Immediate	1
PA667	Servo OFF stop time limit	0~2500	1ms	1000	Immediate	1
PA668	Torque percentage average time	0000~65535	128ms	30	Immediate	1
PA669	Block alarm speed	0~50	rpm	10	Immediate	1
PA66A	Block alarm time	0~65535	ms	2000	Immediate	1
PA66B	Reserved	--	--	--	--	--

	Description	Range	Unit	Default	Effective	DL
PA66C	**Second electronic gear ratio (numerator)**	1～1073741824	--	4	Immediate	2
PA66E	**Second electronic gear ratio (denominator)**	0～1073741824	--	1	Immediate	2
PA670	**Reserved**	--	--	--	--	--
PA700	**Internal position mode switch 1**	n.0000~FF22	--	1001	Immediate	1
	n.×××□: Position for step method 0：External IO signal (INPOS) selects position segment, external IO signal (PTRG) triggers action; 1：External IO signal (PTRG) triggers action, position segment run loop. 2：Internal timed loop run position segments, with interval of PA5A5. **n.××□×: Position operation method** 0：Increment position 1：Absolute position 2： PA702 corresponds to the bit that selects the incremental position operation method or the absolute position operation method **n.×□××: Loop start position 0~F** **n.□×××: Loop end position 0~F**					
PA701	**Internal position mode switch 2**	n.0000~1111	--	0000	Immediate	1
	n.×××□: Trigger signal selection 0：Trigger operation using external signal PTRG 1：When position selection signal (INPOS0, INPOS1, INPOS2, INPOS3) changes, it triggers operation; **n.××□×: Trigger sequence selection** 0：Until after the current segment operation position is completed (CMD-OK signal valid), receive new trigger signal. 1：A new trigger signal for the next position can also be received if the current segment operation position is not completed **n.×□××: PZERO signal function** 0：Stop operation. With home or position node, this signal will stop operation immediately after it is valid. 1：Pause. With home or position node, operation will be paused when this signal is valid and continued when this signal is invalid. **n.□×××: Software limit enable:** 0：Software limit not enable. 1：Software limit enable. PA743, PA744 are positive limit distance, PA745 and PA746 are negative limit distance.					
PA702	**Internal position increment absolute selection**	0~FFFF	--	0000	Immediate	1
	16 segment positions, correspondence in binary: when the corresponding BIT is 0, the segment runs incrementally, when the corresponding BIT is 1, the segment runs in absolute position, note: to use this parameter, PA700.1 = 2 is required.					
PA703	**Internal position0 (unit)**	-9999~9999	Pulse	0	Immediate	1
PA704	**Internal position0(myriabit)**	-32767~32767	Pulse	2	Immediate	1
PA705	**Internal position 1 (unit)**	-9999~9999	Pulse	0	Immediate	1
PA706	**Internal position 1 (myriabit)**	-32767~32767	Pulse	4	Immediate	1
PA707	**Internal position 2 (unit)**	-9999~9999	Pulse	0	Immediate	1
PA708	**Internal position 2 (myriabit)**	-32767~32767	Pulse	6	Immediate	1

	Description	Range	Unit	Default	Effective	DL
PA709	Internal position 3 (unit)	-9999~9999	Pulse	0	Immediate	1
PA70A	Internal position 3 (myriabit)	-32767~32767	Pulse	8	Immediate	1
PA70B	Internal position 4 (unit)	-9999~9999	Pulse	0	Immediate	1
PA70C	Internal position 4 (myriabit)	-32767~32767	Pulse	10	Immediate	1
PA70D	Internal position 5 (unit)	-9999~9999	Pulse	0	Immediate	1
PA70E	Internal position 5 (myriabit)	-32767~32767	Pulse	12	Immediate	1
PA70F	Internal position 6 (unit)	-9999~9999	Pulse	0	Immediate	1
PA710	Internal position 6 (myriabit)	-32767~32767	Pulse	14	Immediate	1
PA711	Internal position 7 (unit)	-9999~9999	Pulse	0	Immediate	1
PA712	Internal position 7 (myriabit)	-32767~32767	Pulse	16	Immediate	1
PA713	Internal position 8 (unit)	-9999~9999	Pulse	0	Immediate	1
PA714	Internal position 8 (myriabit)	-32767~32767	Pulse	18	Immediate	1
PA715	Internal position 9 (unit)	-9999~9999	Pulse	0	Immediate	1
PA716	Internal position 9 (myriabit)	-32767~32767	Pulse	20	Immediate	1
PA717	Internal position 10 (unit)	-9999~9999	Pulse	0	Immediate	1
PA718	Internal position 10 (myriabit)	-32767~32767	Pulse	22	Immediate	1
PA719	Internal position 11 (unit)	-9999~9999	Pulse	0	Immediate	1
PA71A	Internal position 11 (myriabit)	-32767~32767	Pulse	24	Immediate	1
PA71B	Internal position 12 (unit)	-9999~9999	Pulse	0	Immediate	1
PA71C	Internal position 12 (myriabit)	-32767~32767	Pulse	26	Immediate	1
PA71D	Internal position 13 (unit)	-9999~9999	Pulse	0	Immediate	1
PA71E	Internal position 13 (myriabit)	-32767~32767	Pulse	28	Immediate	1
PA71F	Internal position 14 (unit)	-9999~9999	Pulse	0	Immediate	1
PA720	Internal position 14 (myriabit)	-32767~32767	Pulse	30	Immediate	1
PA721	Internal position 15 (unit)	-9999~9999	Pulse	0	Immediate	1
PA722	Internal position 15 (myriabit)	-32767~32767	Pulse	32	Immediate	1
PA723	Internal position 0 speed (for first gear ratio only)	0~10000	1min-1	100	Immediate	1
PA724	Internal position 1 speed (for first gear ratio only)	0~10000	1min-1	100	Immediate	1
PA725	Internal position 2 speed (for first gear ratio only)	0~10000	1min-1	100	Immediate	1
PA726	Internal position 3 speed (for first gear ratio only)	0~10000	1min-1	100	Immediate	1
PA727	Internal position 4 speed (for first gear ratio only)	0~10000	1min-1	100	Immediate	1
PA728	Internal position 5 speed (for first gear ratio only)	0~10000	1min-1	100	Immediate	1
PA729	Internal position 6 speed (for first gear ratio only)	0~10000	1min-1	100	Immediate	1
PA72A	Internal position 7 speed (for first gear ratio only)	0~10000	1min-1	100	Immediate	1

	Description	Range	Unit	Default	Effective	DL
PA72B	Internal position 8 speed (for first gear ratio only)	0~10000	1min-1	100	Immediate	1
PA72C	Internal position 9 speed (for first gear ratio only)	0~10000	1min-1	100	Immediate	1
PA72D	Internal position 10 speed (for first gear ratio only)	0~10000	1min-1	100	Immediate	1
PA72E	Internal position11 speed (for first gear ratio only)	0~10000	1min-1	100	Immediate	1
PA72F	Internal position 12 speed (for first gear ratio only)	0~10000	1min-1	100	Immediate	1
PA730	Internal position 13 speed (for first gear ratio only)	0~10000	1min-1	100	Immediate	1
PA731	Internal position 14 speed (for first gear ratio only)	0~10000	1min-1	100	Immediate	1
PA732	Internal position 15 speed (for first gear ratio only)	0~10000	1min-1	100	Immediate	1
PA733	Internal position 0 acceleration/deceleration time	0~10000	Ms	0	Immediate	1
PA734	Internal position 1 acceleration/deceleration time	0~10000	Ms	0	Immediate	1
PA735	Internal position 2 acceleration/deceleration time	0~10000	Ms	0	Immediate	1
PA736	Internal position 3 acceleration/deceleration time	0~10000	Ms	0	Immediate	1
PA737	Internal position 4 acceleration/deceleration time	0~10000	Ms	0	Immediate	1
PA738	Internal position 5 acceleration/deceleration time	0~10000	Ms	0	Immediate	1
PA739	Internal position 6 acceleration/deceleration time	0~10000	Ms	0	Immediate	1
PA73A	Internal position 7 acceleration/deceleration time	0~10000	Ms	0	Immediate	1
PA73B	Internal position 8 acceleration/deceleration time	0~10000	Ms	0	Immediate	1
PA73C	Internal position 9 acceleration/deceleration time	0~10000	Ms	0	Immediate	1
PA73D	Internal position 10 acceleration/deceleration time	0~10000	Ms	0	Immediate	1
PA73E	Internal position 11 acceleration/deceleration time	0~10000	Ms	0	Immediate	1
PA73F	Internal position 12 acceleration/deceleration time	0~10000	Ms	0	Immediate	1
PA740	Internal position 13	0~10000	Ms	0	Immediate	1

	Description	Range	Unit	Default	Effective	DL
	acceleration/deceleration time					
PA741	Internal position 14 acceleration/deceleration time	0~10000	Ms	0	Immediate	1
PA742	Internal position 15 acceleration/deceleration time	0~10000	Ms	0	Immediate	1
PA743	Positive limit unit data	-9999~9999	Pulse	5456	Immediate	1
PA744	Positive limit myriabit data	-32767~32767	Pulse	26843	Immediate	1
PA745	Positive limit unit data	-9999~9999	Pulse	-5356	Immediate	1
PA746	Positive limit myriabit data	-32767~32767	Pulse	-26843	Immediate	1
PA747	Origin offset unit data	-9999~9999	Pulse	0	Immediate	1
PA748	Origin offset myriabit data	-32767~32767	Pulse	0	Immediate	1
PA749	Communication speed JOG	n.0000~0001	--	0000	Immediate	1
PA74A	PZERO signal trigger method	n.0000~0001	--	0000	Re-power	1

13.4 New Function

13.4.1 Average Internal Torque Monitor

In some scenarios, the load rate of the servo changes rapidly and the dP00A does not visually reflect the average working condition of the servo. To get a better overview of the servo's operating status, the average internal torque of the servo can be monitored via dP211. The value of the monitoring code dP211 is more stable compared to the value of dP00A and reflects the average torque level.

The average number of internal torque commands can be set via PA668.

Parameter code	Name	Range	Unit	Default	Effective	Word length
PA668	**Average number of torque percentage**	0000~FFFF	*128ms*	30	Immediate	1

Monitor code	Name	Unit	Data length	Communication address
dP00A	**Internal torque command (relative to the value of rated torque)**	*[%]*	Int16	0xE00A
dPA12	**Average internal torque command (relative to the value of rated torque)**	*[%]*	Int16	0xEA12

13.4.2 Block Protection

When the servo motor is blocked, the motor can be protected by setting the block alarm speed and the block alarm time. When the motor running speed is less than the set block alarm speed and the torque is greater than or equal to PA402 or PA403 exceeds the block alarm time, the servo drive will raise the E-182 alarm and cut off the motor enable to protect the motor. It should be noted that when the servo system is in torque mode, the determination criteria will be the smaller of PA301 and PA402 and PA403, and when the setting value of PA301 is less than the rated torque, the E-182 alarm will not be raised even if it is blocked.

Parameter code	Name	Range	Unit	Default	Effective	Word length
PA669	**Block alarm speed**	10~50	rpm	10	Immediate	1
PA66A	**Block alarm time**	0~5000	ms	2000	Immediate	1

Note: When PA66A is set to 0, it is equivalent to shielding the block protection function

13.4.3 Second set of electronic gear ratio switch

Normally, gear ratio switching requires a power-off restart, but on some occasions the gear ratio needs to be switched in the enabled state or even the operating state, in which case a second set of electronic gear ratios can be used. The parameters to be set are as follows:

Parameter code	Name	Range	Unit	Default	Effective	Word length
PA66C	**Second electronic gear ratio numerator**	1 ~ 1073741824	--	4	Immediate	2
PA66E	**Second electronic gear ratio denominator**	0 ~ 1073741824	--	1	Immediate	2
PA65B	**Allow real-time change of the electronic gear**	n.0000~0001	--	0	Immediate	1

Set PA65B to XXX1 to allow the electronic gear to be changed, set the numerator and denominator of the corresponding second set of gear ratios and at the same time set any DI (PA500-PA505) to XX23 (switch electronic gear) to switch the electronic gear ratios in real time via this DI.

Special attention should be paid to the fact that this function allows the user to switch gear ratios during motor operation. It is important to note the actual position of the motor and the reasonableness of the gear ratio setting when using it to prevent equipment damage and personal injury caused by crashing or collision.

技术引领市场，品质铸造标杆

TECHNOLOGY LEADS THE MARKET, QUALITY CASTING BENCHMARKS

DORA™