DORNA

AC SERVO SYSTEM

DS1 SERIES
USER MANUAL

（V1.00）

http://en.dorna.com.cn

Contents

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 decelerations.**
  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.

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 transconnector 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 driver 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 driver.

Please contact your vendor if anything above occurs.

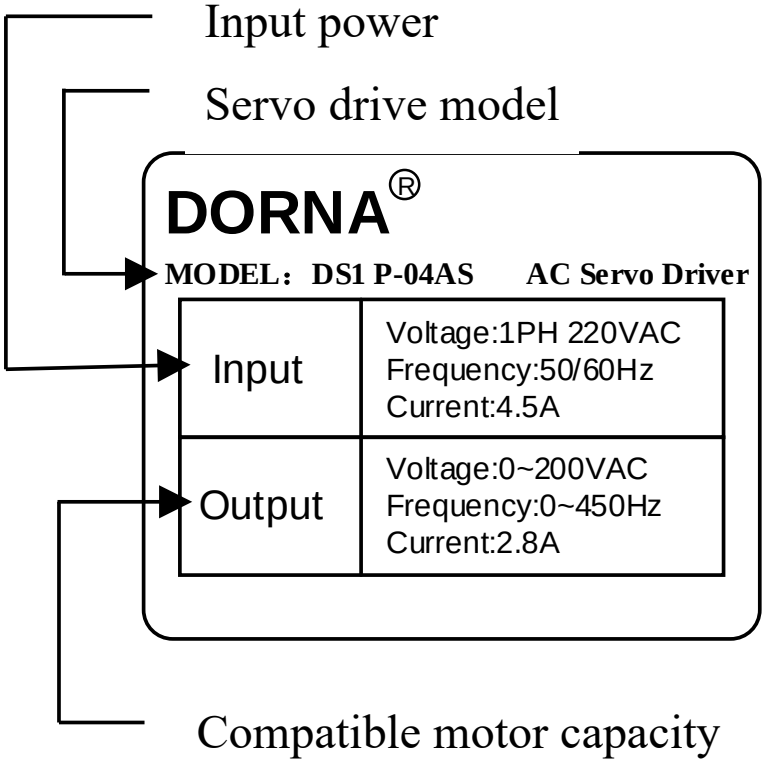
A complete set of servo components shall include the following:

No.	Reference
1	Servo drive and its matching servo motor.
2	Motor power cable: connectors (standard) or complete cable (optional)
3	Motor encoder cable: connectors (standard) or complete cable (optional)
4	RJ45 connector for EtherCAT or RS485 communication (optional)
5	50-PIN plug for CN2 (optional)
6	20-PIN plug for CN3 (optional)
7	P/D terminal shorting cable for internal/external regenerative resistor
8	Shorting cable
9	One copy of user manual

1.2 Product model identifications

1.2.1 Description of nameplate

■ Description of the nameplates of DS1 series servo drives



1.2.2 Model identifications

Note: drive and motor models can be updated from time to time. Please contact our after-sales service for updated information.

■ **Description of the models of DORNA DS1 servo drive**

DS1 P– 08 A S – □ – □□□□

DS1 【1】 【2】 【3】【4】 【5】 【6】

【1】Series

Mark	Specifications
P	Pulse type
E	EhterCAT type

【2】Capacity

Mark	Specifications
01	100W
02	200W
04	400W
08	750W
10	1.0KW
15	1.5KW

【3】Input voltage

Mark	Specifications
A	**220V**
B	**380V**

【4】Encoder

Mark	Specifications
S	Communication type encoder

【5】Non-standard

0	Standard

【6】Factory code

Mark	Specifications
0000	Standard

■ **Description of the models of DORNA DM1M servo motors**

DM	1	M	04	A	60	I	8	S	**
DORNA	Servo motor	Inertia	Rated power	Voltage class	Flange size	Encoder	Shaft keyway	Options	Sepcial models
	1: servo motor	M: medium	01: 100W	A: 220V	40: 40mm	I: 17-bit	7: no keyway	N: nil	
			02: 200W		60: 60mm	L: 23-bit	8: with keyway	B: brake	
			04: 400W		80: 80mm			S: oil seal	
			08: 750W		130: 130mm			E: brake & oil seal	
			10: 1KW						
			15: 1.5KW						
			20: 2KW						
			30: 3KW						

1.4 Servo drive part names

1.5 Maintenance and inspections

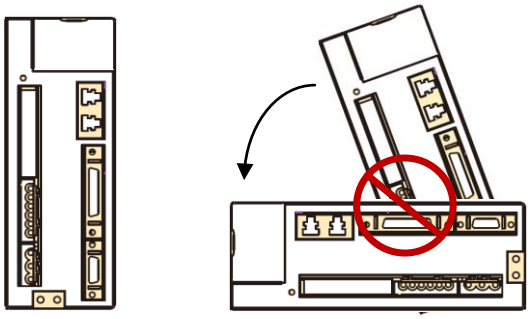
Please make regular maintenance and inspection of the drive and motor for safe and easy use. Routine and periodical inspections shall be carried out according to the following items

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 driver 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

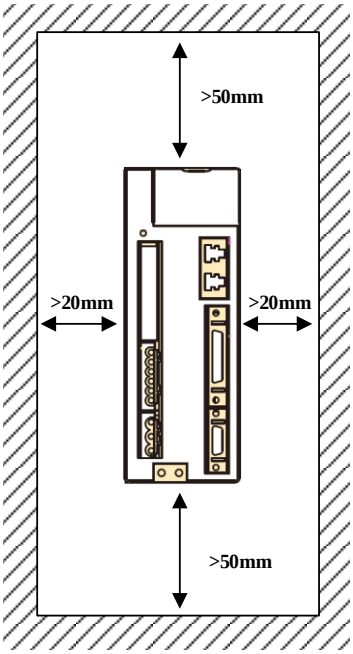
2.1 Installation direction and space

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.



Correct

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	10A	20A
B	20A	40A
C	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.

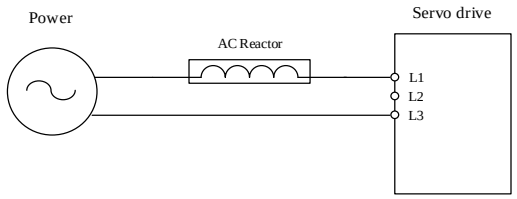
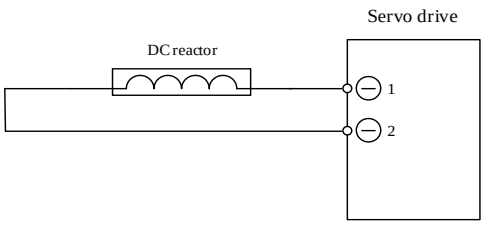
2.3.1 Installation of EMI filter

In order to ensure the EMI filter can fully suppress the interference, please note:

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	The motor power cable shall have shielded (double shielding layer is preferred) .
6	Ground shielding copper with the shortest distance and maximum contact.

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:

AC Reactor	DC Reactor
	

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 DS1 series servo drives.

Servo drive case type	Internal regenerative resistor specs		Minimum allowable resistance value (Ohm)
	Resistance (Ohm)	Capacity (Watt)	
A	-	-	30
B	40	60	20
C	40	80	13

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 power terminals	Connect to 1/3 PH AC power supply. (Please choose correctly)
L1C, L2C	Control circuit input power terminals	Connect 1PH AC power supply. (Please choose correctly)
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	Servo motor power supply terminals	Connect with the servo motor
⏚	Earth terminal	Connect with input power supply & motor power supply earth terminals for grounding.
CN1/CN2	Communication connector 1	• DS1P: Modbus communication connector (optional) • DS1E: EtherCAT communication connector (optional)
CN3	I/O connector	Connect with upper controller
CN4	Encoder connector	Connect with the motor encoder
CN5	USB connector	For PC communication.
CN6	Safety connector	Connect with safety device.
CN7	Communication connector 2	DS1E: Modbus communication connector

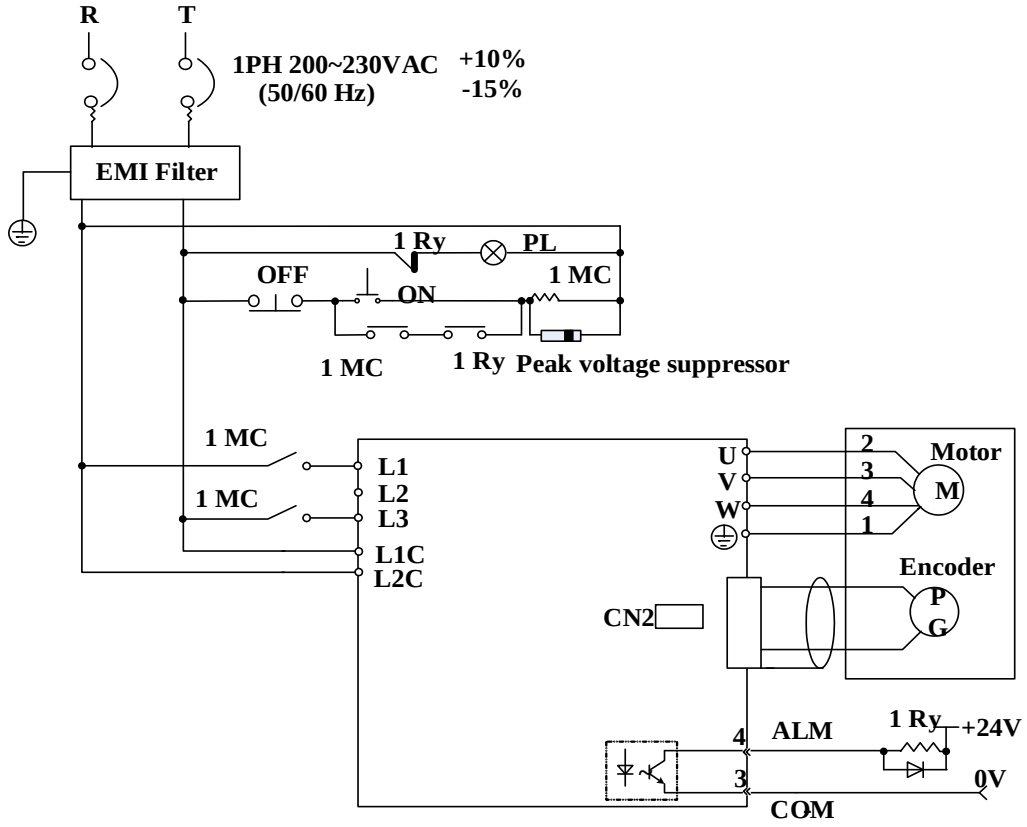
3.1.3 Main circuit wirings

1) **Cable diameter requirement**

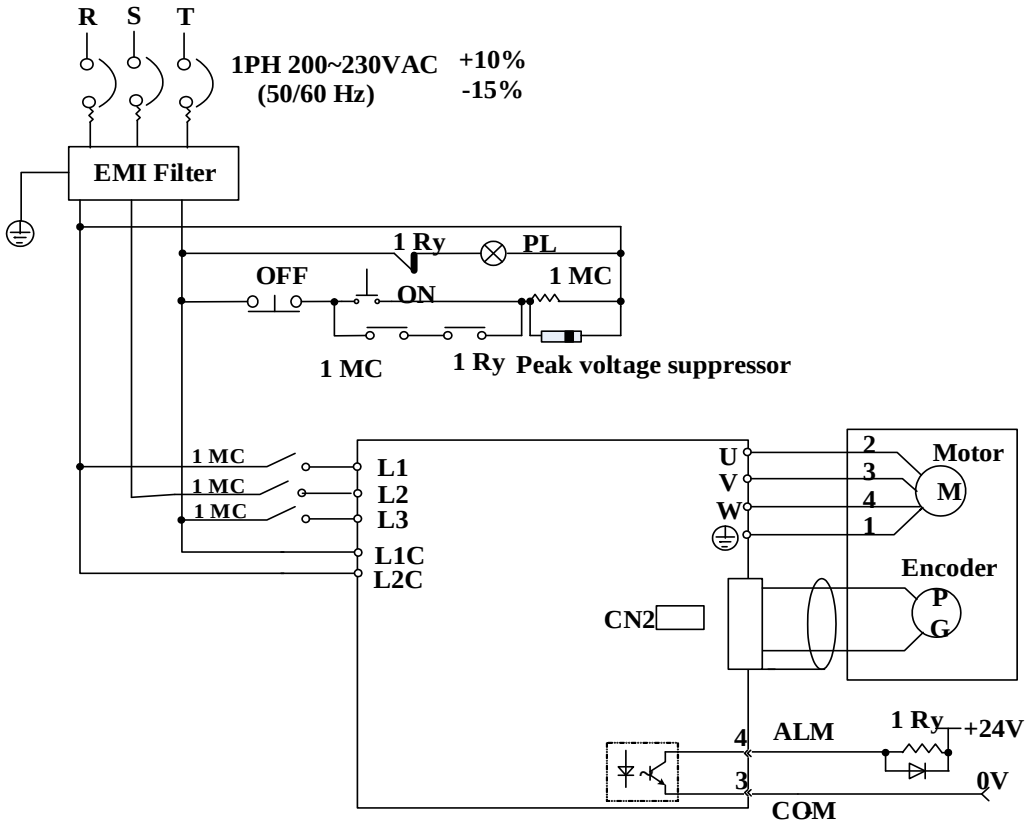
Marking	Name	Cable diameter: mm² (AWG)				
		DS1*-				
		02A	04A	08A	10A	15A
L1, L2, L3	Main circuit input power terminals	1.25 (AWG-16)		2.0 (AWG-14)		
L1C, L2C	Control circuit input power terminals	1.25 (AWG-16)				
U, V, W	Servo motor power supply terminals	1.25 (AWG-16)		2.0 (AWG-14)		
P, D, C	Regenerative resistor terminals	1.25 (AWG-16)				
⏚	Earth wire	Above 2.0 (AWG-14)				

2) Typical main circuit wiring example

- When the signal of ALM is active, power supply of the main circuit shall be OFF.
- Main circuit & control circuit shall be powered on at the same time, or the control circuit first.
- The main circuit shall be powered off before the control circuit.
- **1PH 220VAC:**

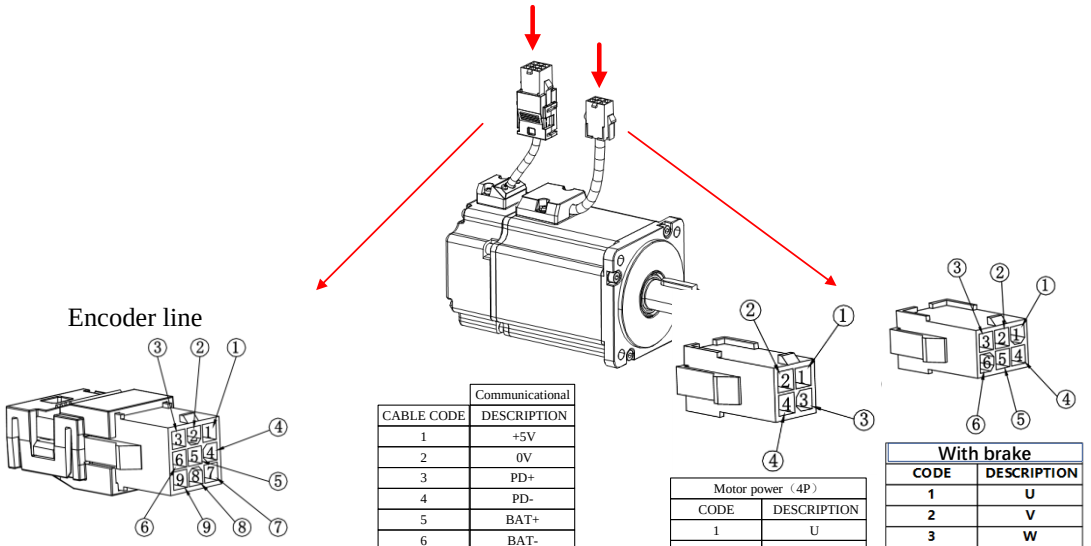


- **3PH 220VAC/380VAC:**



3.2 Wirings between servo drive & servo motor

3.2.1 Configurations & definitions of quick plug terminals

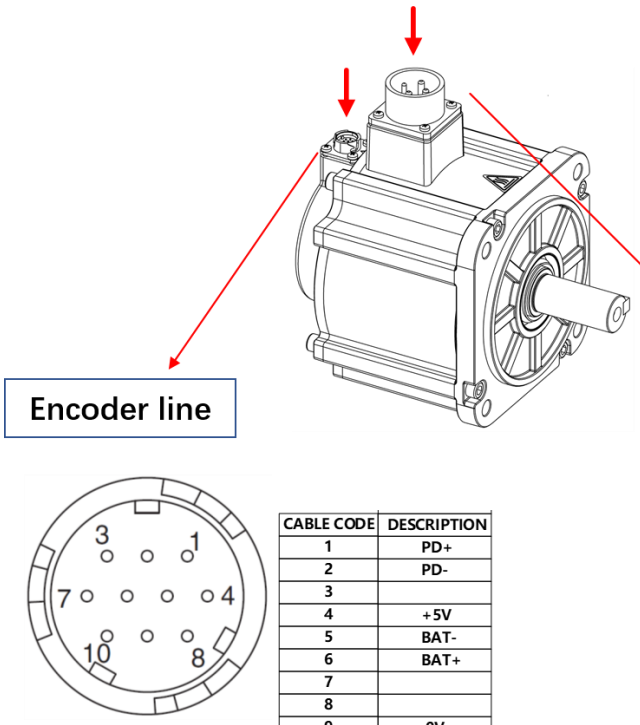


	Communicational
CABLE CODE	DESCRIPTION
1	+5V
2	0V
3	PD+
4	PD-
5	BAT+
6	BAT-
7	
8	
9	FG

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

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

3.2.2 Configurations and definitions of aviation plug terminals



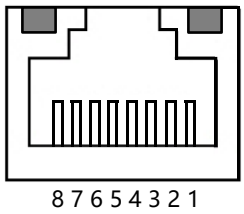
CABLE CODE	DESCRIPTION
1	PD+
2	PD-
3	
4	+5V
5	BAT-
6	BAT+
7	
8	
9	0V
10	FG

4P	
CODE	DESCRIPTION
1	PE
2	V
3	U
4	W

7P with brake	
CODE	DESCRIPTION
1	PE
2	V
3	U
4	W
5	+24V
6	24VGND
7	

3.3 Wirings of CN1/CN2 (Communication connector)

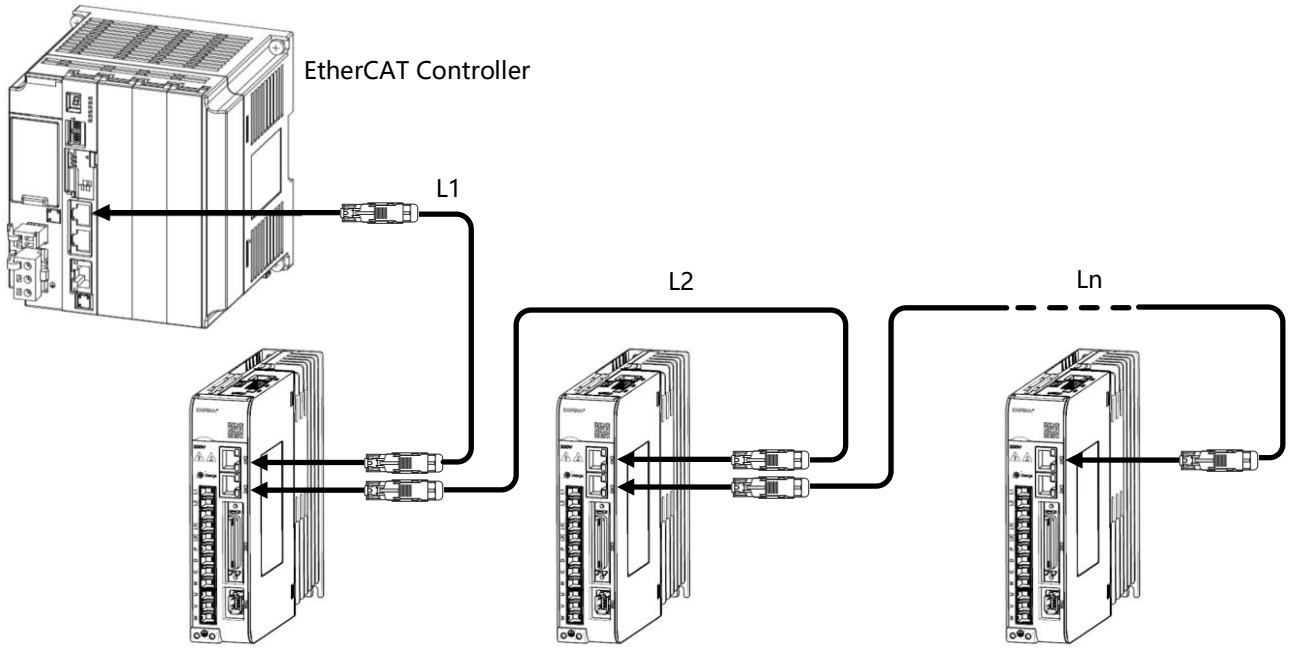
1) Terminal appearance



2) Signal definitions

DS1P: pulse type				DS1E: EtherCAT type		
Pin	**Name**	**Function**		**Pin**	**Name**	**Function**
1	RS485+	RS485 postivie		1	TX+	Data transmission +
2	RS485-	RS485 negative		2	TX-	Data transmission -
3	GND	Digital ground		3	RX+	Data reception +
4		Leave open		4		Leave open
5		Leave open		5		Leave open
6	GND	Digital ground		6	RX-	Data reception -
7		Leave open		7		Leave open
8		Leave open		8		Leave open
Housing	FG	Shielded cable		Housing	FG	Shielded cable

3) EtherCAT connections

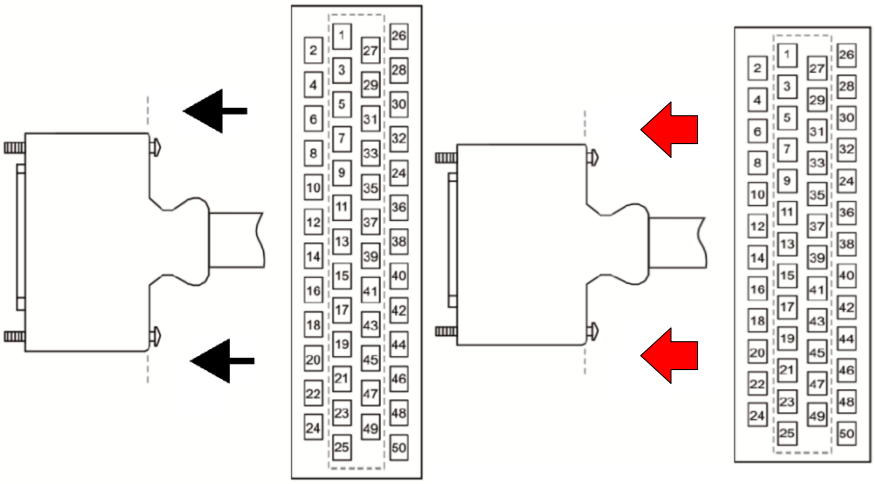


Remarks:

- Connect using a Category 5e Ethernet communication cable.
- The cable length between the stations (L1, L2, ... Ln) must be less than or equal to 50 m.

3.4 Wirings of CN3 (I/O signal connector)

3.4.1 Pin arrangement of CN3 connector



2	SG	GND	1	SG	GND	27	DO3+	Digital output 3 (+)	26	DO4 −	Digital output 4 (-)
4			3	PL	Open collector power input	29	DO2+	Digital output 2 (+)	28	DO3 −	Digital output 3 (-)
6	V-REF-	Speed instruction input (-)	5	V-REF+	Speed instruction input (+)	31	DO1+	ALM (+)	30	DO2 −	Digital output 2 (-)
8	/PULS	Pulse input (-)	7	PULS	Pulse input (+)	33	PAO	Encoder A Phase output (+)	32	DO1 −	ALM (-)
10	T-REF-	Torque instruction input (-)	9	T-REF+	Torque instruction input (+)	35	PBO	Encoder B Phase output (+)	34	/PAO	Encoder A Phase output (-)
12	/SIGN	Sign input (-)	11	SIGN	Sign input (+)	37			36	/PBO	Encoder B Phase output (-)
14	DO5 −	Digital output 5 (-)	13			39			38		
16	HPULS	High-speed pulse input (+)	15	DO5 +	Digital output 5 (+)	41	DI2	Digital input 2	40	DI1	Digital input 1
18			17	/HPULS	High-speed pulse input (-)	43	DI4	Digital input 4	42	DI3	Digital input 3
20	/PZO	Encoder Z phase output (-)	19	PZO	Encoder Z phase output (+)	45	DI6	Digital input 6	44	DI5	Digital input 5

22			21			47	COM+	External 24V power input	46	DI7	Digital input 7
24	/HSIGN	High-speed sign input (-)	23	HSIGN	High-speed sign input (+)	49	+24V	Internal 24V power supply	48	DI8	Digital input 8
			25	DO4+	Digital output 4 (+)				50	24VGND	Internal 24V GND

Notes:

1) do not use vacant terminals.
2) Connect the shielding of control line (I/O cable) to the connector housing to achieve FG (frame grounding)
3) except for the alarm signal (ALM), all input and output signals can change allocations by parameters.
4) Maximum output current of internal 24V is 300mA. If internal 24V is used, internal 5V will lose power very quickly.

3.4.2 CN3 signal descriptions

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

Mode	Signal	Pin No.	Function	
Universal	S-ON	40	Servo ON: The motor is powered on.	
	C-MOD	41	Control mode switch: Switch between two control modes.	
	POT	42	Forward rotation prohibited	Overtravel prohibited: Stop operation of servo motor when it is on.
	NOT	43	Reverse rotation prohibited	
	CLR	44	Clear position deviation pulses counter during position control.	
	A-RESTART	45	Reset alarms	
	INHIBIT	46	Pulse input inhibited	
	ZEROSPD	48	Zero-speed clamp signal input	
	COM+	47	External 24VDC for I/O signals	
Position control	HPULS+	16	High-speed channel pulse input * Sign+pulse train * CCW+CW Pulse train * A + B Pulse train	
	HPULS-	17		
	HSIGN+	23		
	HSIGN-	24		
	PULS+	7	Low-speed channel pulse input level: * Sign+pulse train * CCW+CW Pulse train * A + B Pulse train	
	PULS-	8		
	SIGN+	11		
	SIGN-	12		
	PL	3	Open collector pulse signal terminal	
Speed control	V-REF+	5	Speed instruction voltage input	
	V-REF-	6		
Torque control	T-REF+	9	Torque instruction voltage input	
	T-REF-	10		

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

Mode	Signal	Pin No.	Function	
Universal	PAO+	33	A phase signal	Two-phase pulse (A phase and B phase) encoder frequency dividing signal output
	PAO-	34		
	PBO+	35	B phase signal	
	PBO-	36		
	PZO+	19	Z phase signal	Original point (Z phase) signal output
	PZO-	20		
	+24V	49	Internal 24V power supply, can provide for DI and DO signals, can withstand 300mA current	
	24VGND	50	Internal 24V power supply ground	
	ALM+	31	Servo alarm: OFF when abnormal state is detected.	
	ALM-	32		
	COIN+	29	Positioning completed: Under position control mode, when deviation pulse is smaller than PA525, the signal is active.	
	COIN-	30		
	CZ+	27	Optocoupler Z phase pulse output	
	CZ-	28		
	BK+	25	External brake signal output	
	BK -	26		

3.4.3 Allocation of I/O signals

1) Allocation of input signals

▪ Default input signal allocations

PA	Description	Range	Unit	Default	Effective
PA500	**n.XX□□: DI 1 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] Zero-speed clamp (ZEROSPD) [08] Forward torque limitation (PCL) [09] Reverse torque limitation (NCL) [0A] Gain switch (GAIN) [0B] Reserved [0C] Reserved [0D] Instruction division/ multiplication switch 0 (DIV0)	n.0000~ n.211F	~	n.0000	Immediate

	[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] HOMESWTICH [16] HOMESTART **n.X□XX: DI 1 signal negation** [0] Not negate [1] Negate **n.□XXX: DI 1 signal status** [0] Controlled by external I/O [1] Normally active [2] Normally inactive				
PA501	DI 2 input signal selection	n.0000~ n.211F		n.0001	Immediate
PA502	DI 3 input signal selection	n.0000~ n.211F		n.0002	Immediate
PA503	DI 4 input signal selection	n.0000~ n.211F		n.0003	Immediate
PA504	DI 5 input signal selection	n.0000~ n.211F		n.0004	Immediate
PA505	DI 6 input signal selection	n.0000~ n.211F		n.0005	Immediate
PA506	DI 7 input signal selection	n.0000~ n.211F		n.0006	Immediate
PA507	DI 8 input signal selection	n.0000~ n.211F		n.0007	Immediate

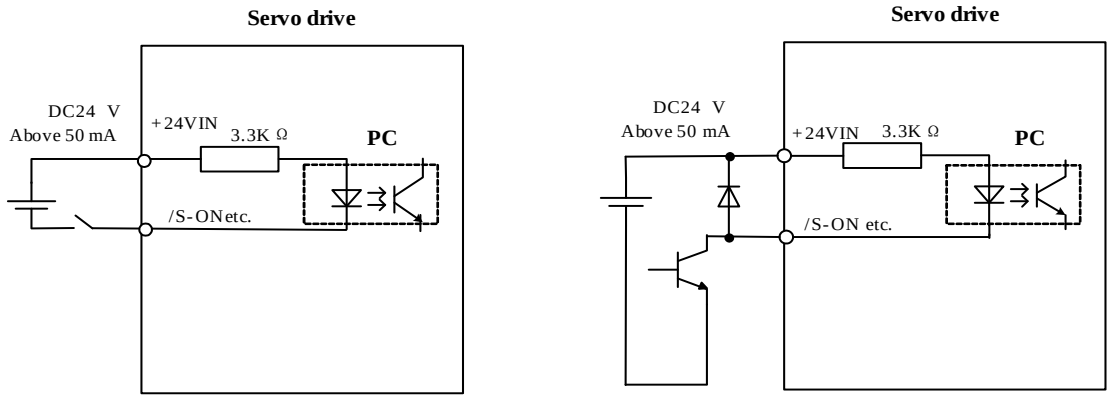
- Default signals and corresponding pins of DI 1~ DI 8:

Parameter No.	Terminal name	CN2 pin	Default signal
PA500	DI 1	40	S-ON
PA501	DI 2	41	C-MOD
PA502	DI 3	42	POT
PA503	DI 4	43	NOT
PA504	DI 5	44	CLR
PA505	DI 6	45	A-RESTART
PA506	DI 7	46	INHIBIT
PA507	DI 8	48	ZEROSPD

- 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.

- Confirmation of input signal level selections

The level selection of the input signal can be confirmed by the input signal monitoring (dP012) .

- Multiple pins with same signal allocation

If same signal has been allocated to multiple I/O pins, the higher grade pin prevails. For example, DI1 and DI2 are both set to 0 (S-ON), then S-ON is only determined by DI2 (higher grade pin).

2) Allocation of output signals

- Default allocations of output signals

PA	Description	Range	Unit	Default	Effective
PA50A	**Output signal selection** **n.XX□□: DO 1 output signal selection** [00] Alarm signal output (ALM) [01] Positioning completed (COIN) [02] Z pulse open-collector signal (CZ) [03] Brake release signal (BK) [04] Servo ready signal (S-RDY) [05] Speed instruction reached (VCMP) [06] Motor rotation detection (TGON) [07] Torque limited signal (TLC) [08] Zero-speed detection signal (ZSP) [09] Warning output (WARN) [0D] Torque reached (TREACH) **n.X□XX: DO1 signal negation** [0] Not negate [1] Negate **n.□XXX: DO1 signal status** [0] Controlled by external I/O	n.0000 ~ n.211F		**n.0000**	Immediate

	[1] Normally active [2] Normally inactive				
PA50B	**DO 2 output signal selection**	n.0000 ~ n.211F		n.0000	Immediate
PA50C	**DO 3 output signal selection**	n.0000 ~ n.211F		n.0000	Immediate
PA50D	**DO 4 output signal selection**	n.0000 ~ n.211F		n.0000	Immediate

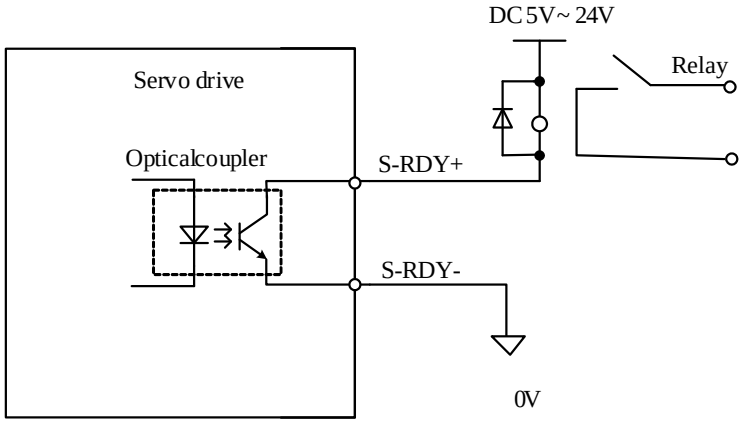
- Default signals and corresponding pins of DO 1 to DO 4

Parameter No.	Terminal name	CN2 pin	Default signal
PA50A	DO1	31, 32	ALM
PA50B	DO2	29, 30	COIN
PA50C	DO3	27, 28	CZ
PA50D	DO4	25, 26	BK

- 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 speed control mode.

Typical output signal circuit is shown in the following diagram:



Maximum allowable voltage: DC 30V
Maximum allowable current: DC 50mA

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.

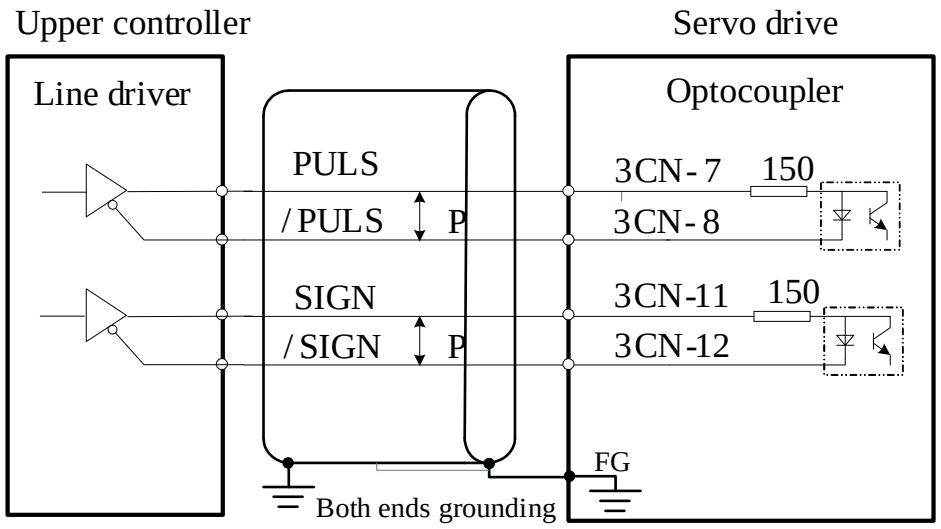
- Notes:
  - ALM, WARN: active means alarm; inactive means no alarm.
  - CZ level status cannot be modified by PA50X.2;

➢ If same signal has been allocated to multiple I/O pins, the higher-grade pin prevails. For example, DO2 and DO3 are both set to 02 (CZ), then CZ is only determined by DO3 (higher grade pin).

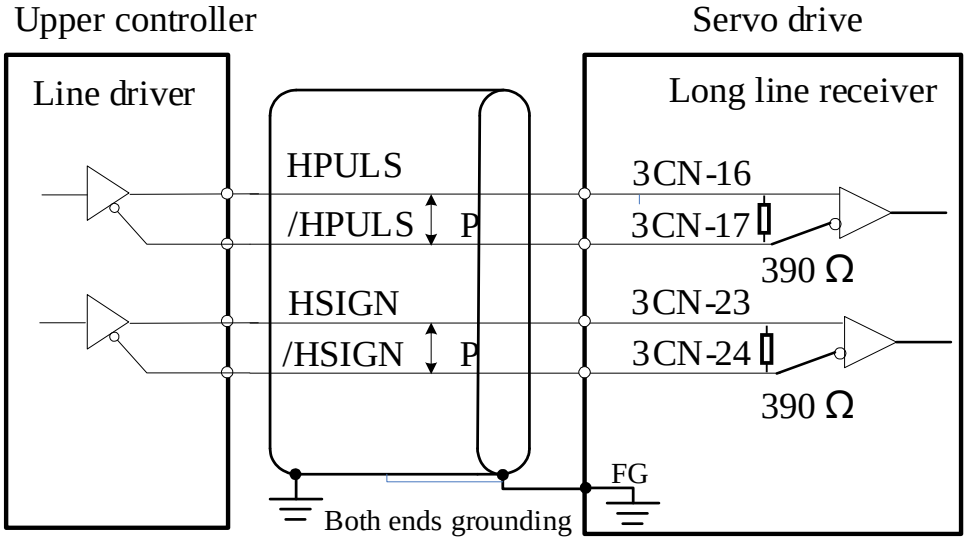
3.4.4 Examples of connection with upper controllers

1) Input signal connections

- Line driver, low speed pulse

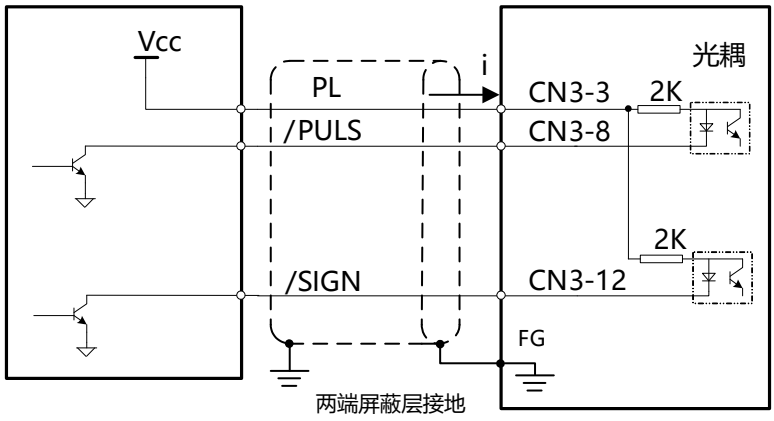


- Line driver, high speed pulse (maximum voltage: 5VDC)

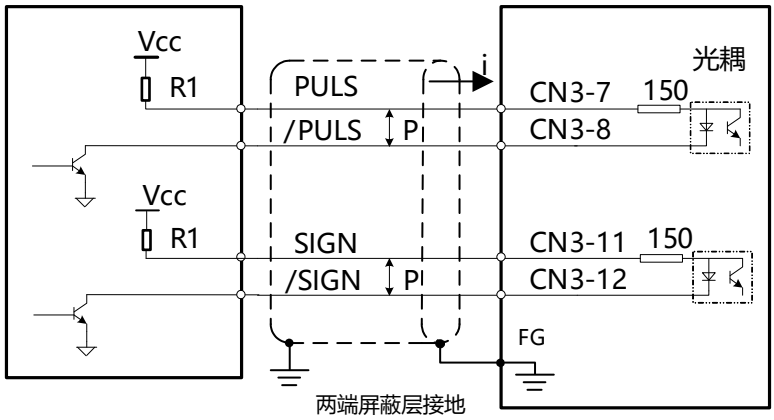


Compatible line driver: AM26LS31 (TI) or equivalent.
Connect the grounding of both controller & servo drive together in order to improve the anti-interference ability of the high-speed pulse input interface.

- Open collector, option 1 (external 24VDC)



- Open collector, option 2 (external 5VDC, 12VDC or 24VDC)

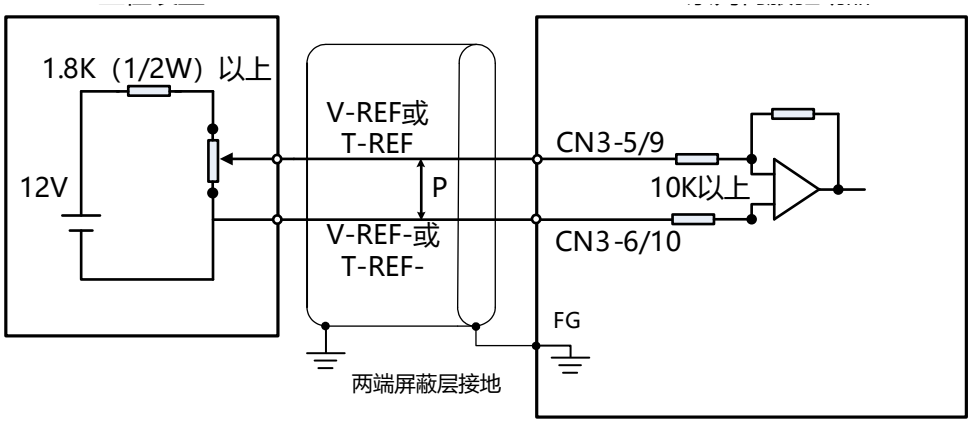


Input current I = 10 ~ 15mA, thus R1 resistance:
If 24VDC, R1=2K Ω;
If 12VDC, R1=510 Ω;
If 5VDC, R1=180 Ω;

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

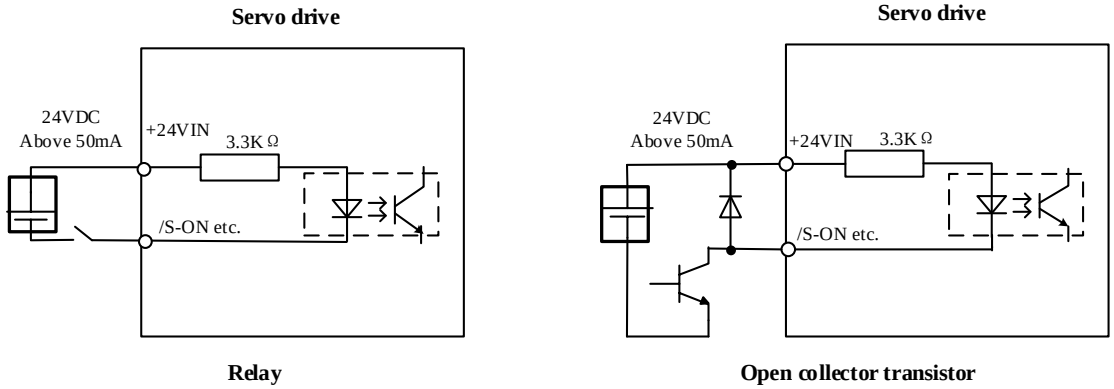
- Grounding: control line shielding shall connect to ground of upper controller power supply; on the drive side, the shielding shall hang in air;
- Modify PA201.0: the higher PA201.0, the higher filtering effect, the lower input chop frequency.

- Analog input



- Sequential control input

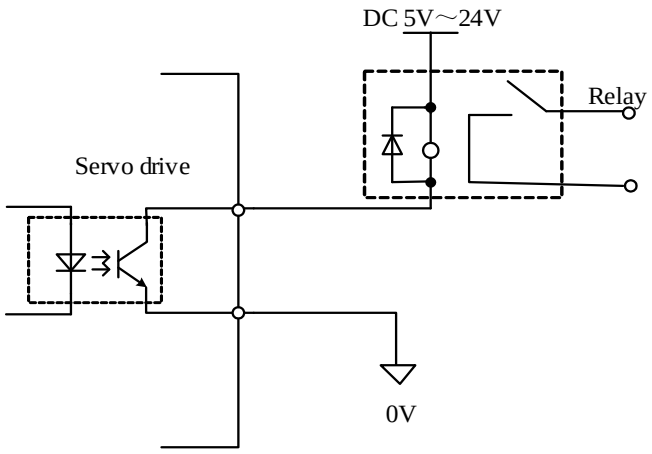
Connected by a relay or an open collector transistor circuit. When using relay connections, select the micro current relay. If you do not use small current relay, it will cause bad contact.



2) Output signal connections

- Sequential control output

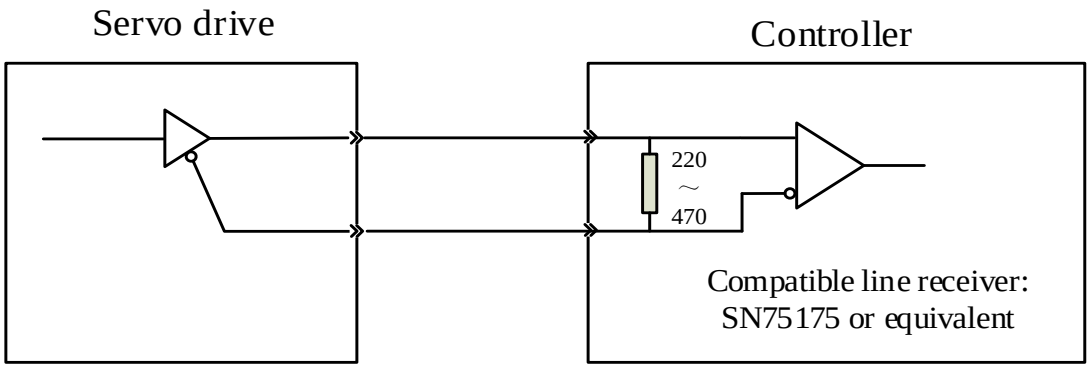
ALM, S-RDY and other sequence of output signals are consisted of optocoupler. Please connect with relays.



Maximum DC voltage: 30VDC
Maximum DC current: 50mA

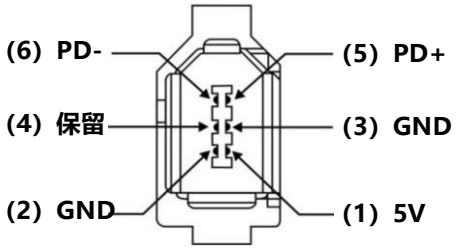
- Line driver output

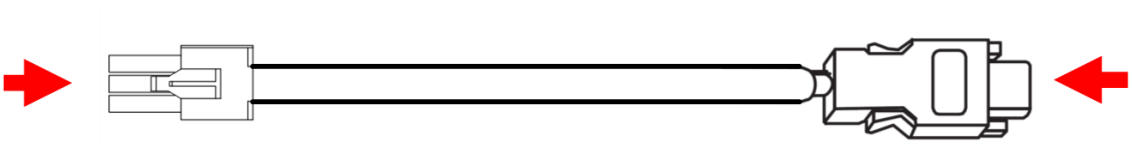
Encoder serial data are inverted into differential signals. Please use line receiver to process the output signals: PAO, /PAO; PBO, /PBO; PZO, /PZO.

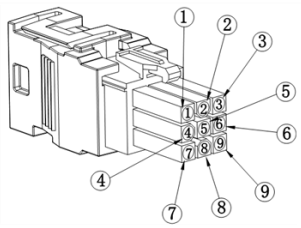


3.5 Wirings of CN4 (Encoder feedback connector)

3.5.1 CN4 connector appearance

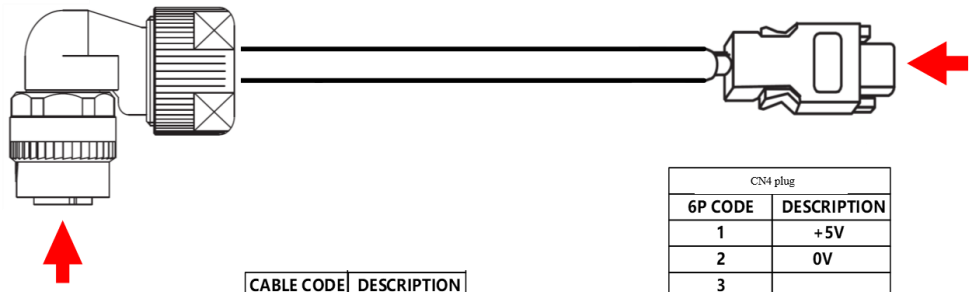






CN4 plug	
6P CODE	DESCRIPTION
1	+5V
2	0V
3	
4	
5	PD+
6	PD-

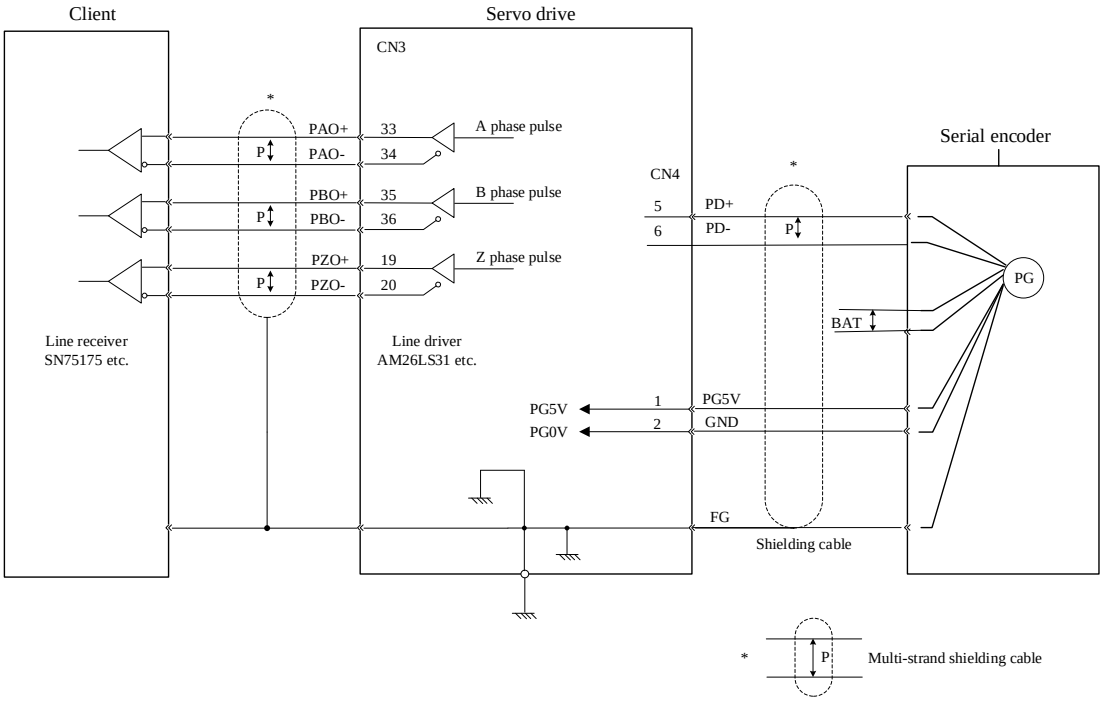
CABLE CODE	DESCRIPTION
1	+5V
2	0V
3	PD+
4	PD-
5	BAT+
6	BAT-
7	
8	
9	FG



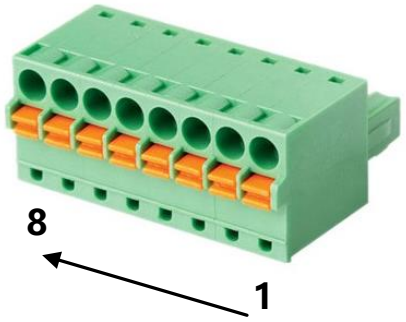
CABLE CODE	DESCRIPTION
1	PD+
2	PD-
3	
4	+5V
5	BAT-
6	BAT+
7	
8	
9	0V
10	FG

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

3.5.2 Examples of CN4 connections



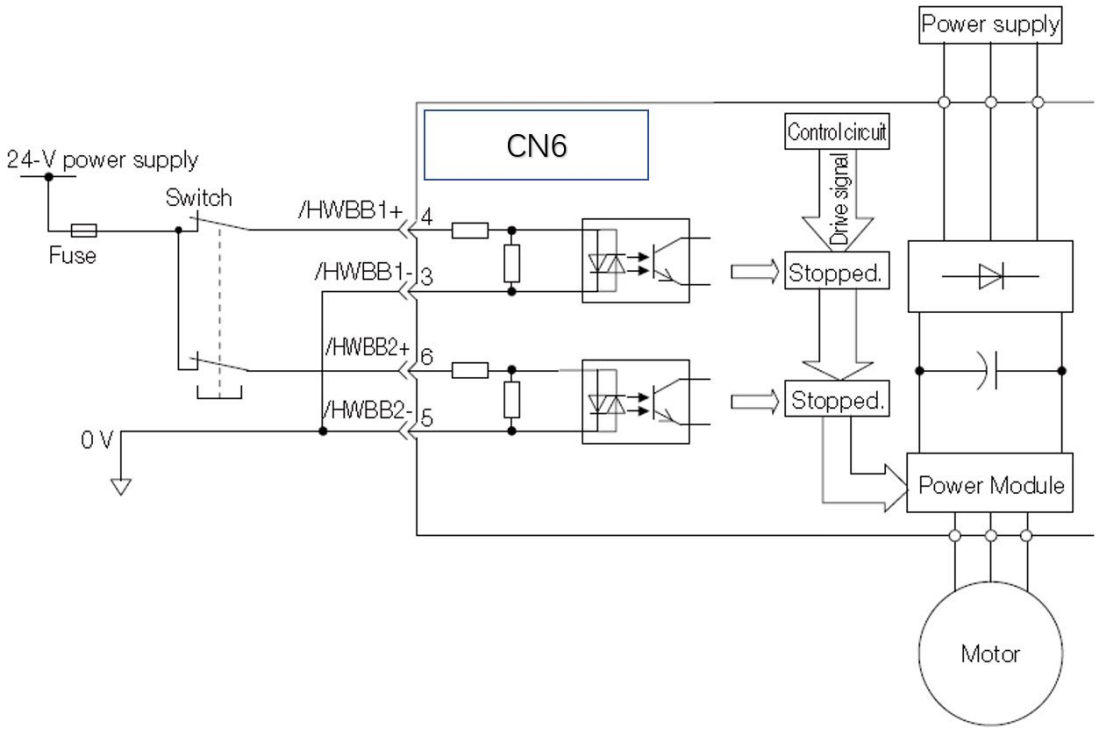
3.6 Wirings of CN6 (Safety connector)



Pin	Signal	Name	Function
1	——	– Connected to internal circuit. Do not connect!	
2	——		
3	/HWBB1-	Hard wire base block input 1	The base is blocked (motor current cut-off) by the Hard wire base block input signal OFF.
4	/HWBB1+		
5	/HWBB2-	Hard wire base block input 2	
6	/HWBB2+		
7	EDM1-	External device monitor output	/HWBB1, /HWBB2 are both inputed and HWBB status is ON.
8	EDM1+		

■ Safety input circuit

Safety input signal (HWBB) connection example



■ Safety input signal (HWBB) specifications

Type	Signal	Pin	Input status	Function
Input	/HWBB1	CN5-4	ON	HWBB invalid

		CN5-3	OFF	HWBB valid
	/HWBB2	CN5-6	ON	HWBB invalid
		CN5-5	OFF	HWBB valid

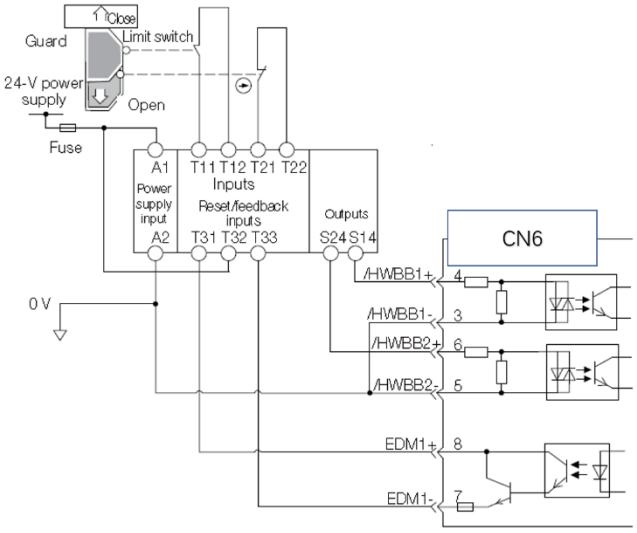
■ HWBB signal electrical characteristics

Item	Characteristics	Remarks
Internal impedience	3.3 kΩ	
Working voltage range	+11 V ～ +25 V	
Maximum delay time	20 ms	Time from /HWBB1 & /HWBB2 OFF until HWBB starts

■ Diagnostic detection circuit

Connection example of output signal (EDM1 signal)

The output signal (EDM1 signal) is the common emitter output, and the connection example is shown below.



■ EDM1 signal specifications

Type	Signal	Pin	Output status	Function
Output	EDM1+	CN5-8	ON OFF	ON: The base blockade performed by the /HWBB1 signal and the base block by the /HWBB2 signal operate normally.
	EDM1-	CN5-7		

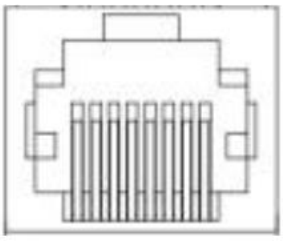
■ EDM1 signal electrical characteristics

Item	Characteristics	Remarks
Maximum voltage	DC30 V	
Maximum current	DC50 mA	
Maximum voltage drop upon ON	1.0 V	Voltage between EDM1+ and EDM1- when current is 50 mA.
Maximum delay time	20 ms	Time from /HWBB1 & /HWBB2 until EDM1

3.7 Wirings of CN7 (Communication connector)

CN7 is a communication connector. For DS1E, CN7 is for RS485 communication.

1. Appearance



2. Pin arrangement

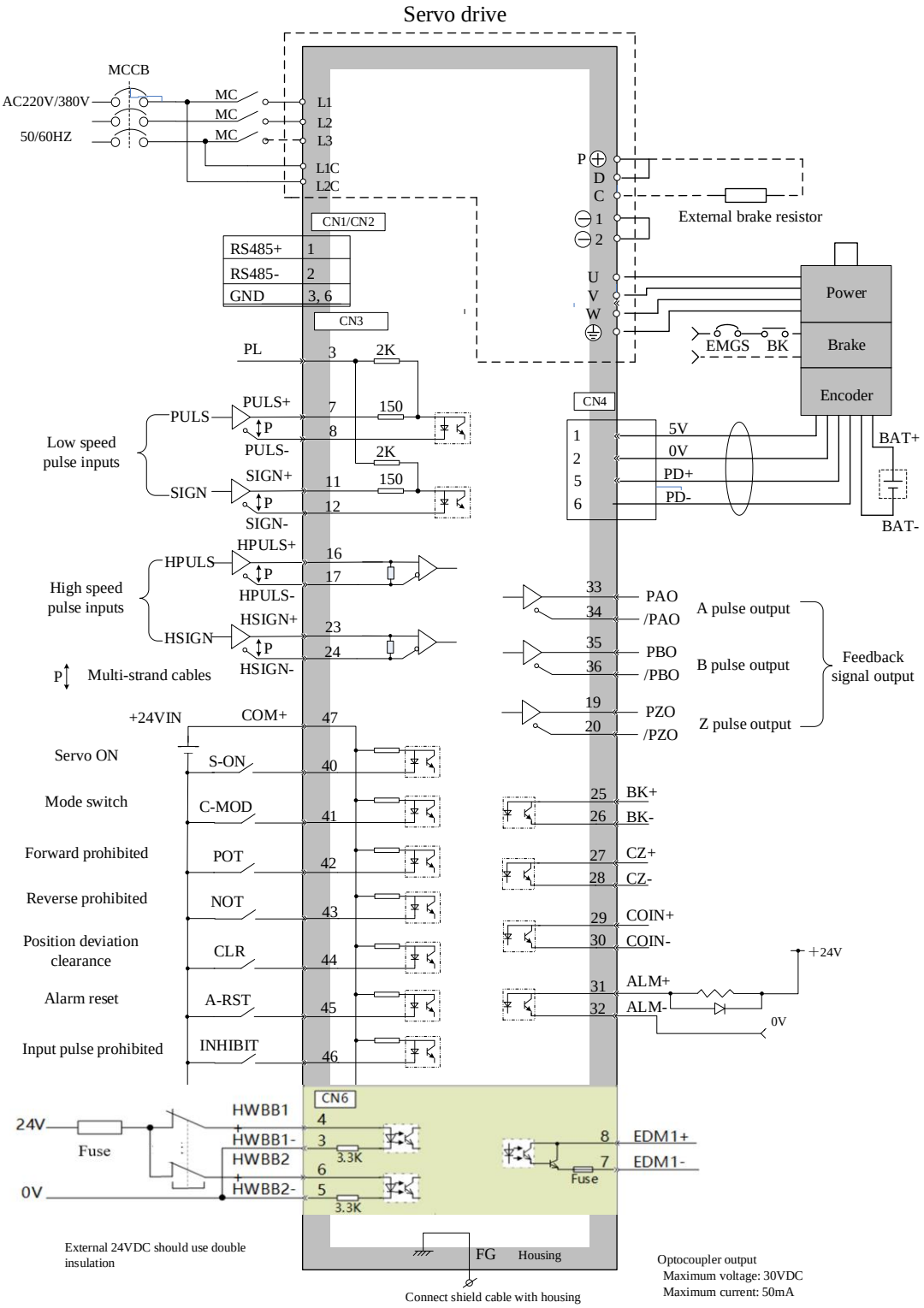
DS1E servo drive		
Pin	**Name**	**Function**
1	RS485+	RS485 positive
2	RS485-	RS485 negative
3	GND	Digital ground
4	NC	Leave open
5	NC	Leave open
6	NC	Leave open
7	NC	Leave open
8	NC	Leave open
Housing	FG	Shielding

3.8 CN5 connector

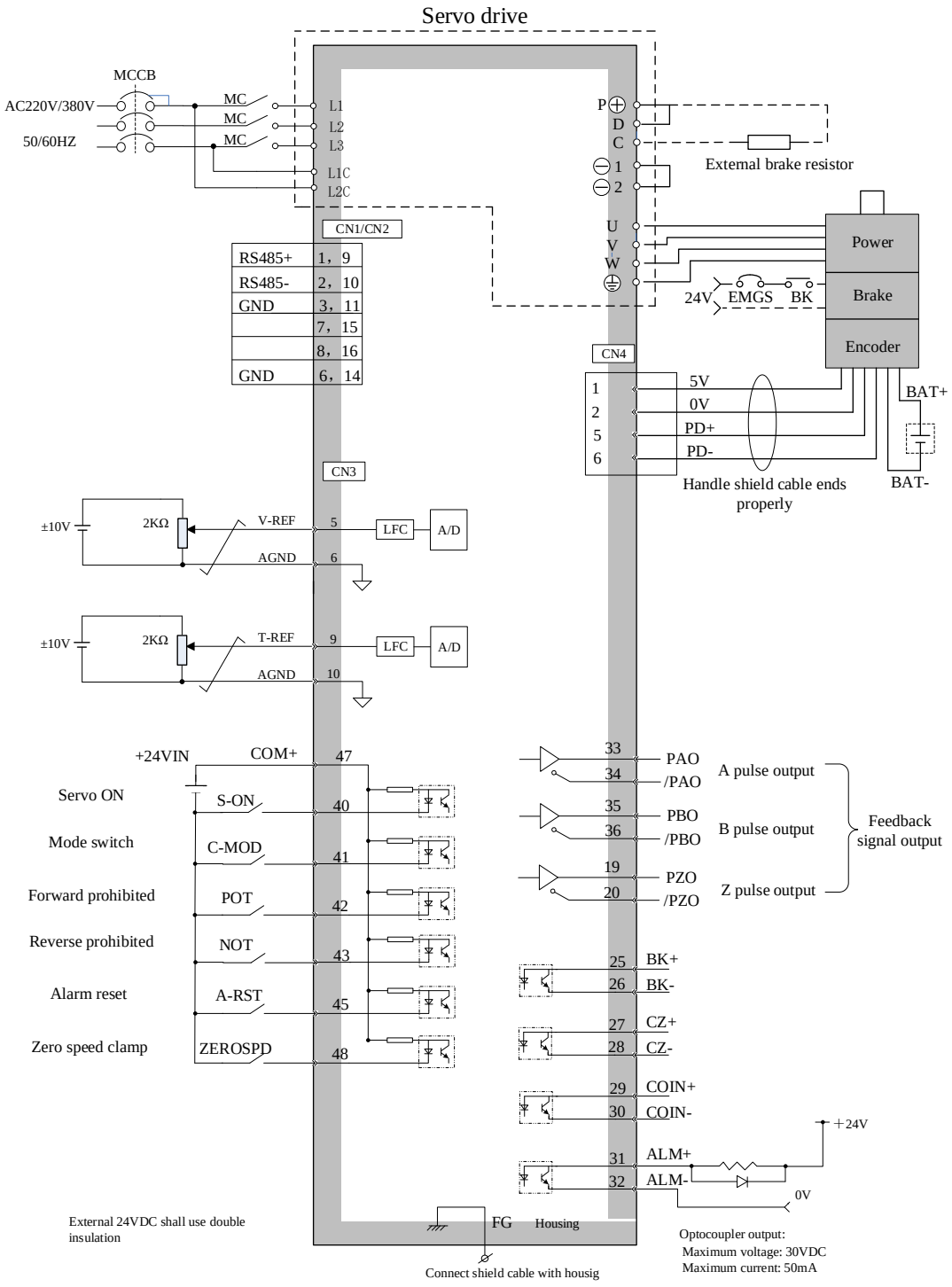
CN5 is mini-USB communication connector for connecting to software.

3.9 Standard wiring diagram

3.9.1 Position control



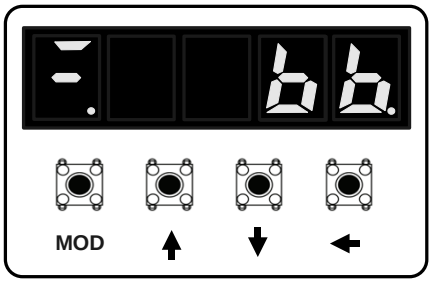
3.9.2 Speed/torque control



Chapter 4 Panel operations

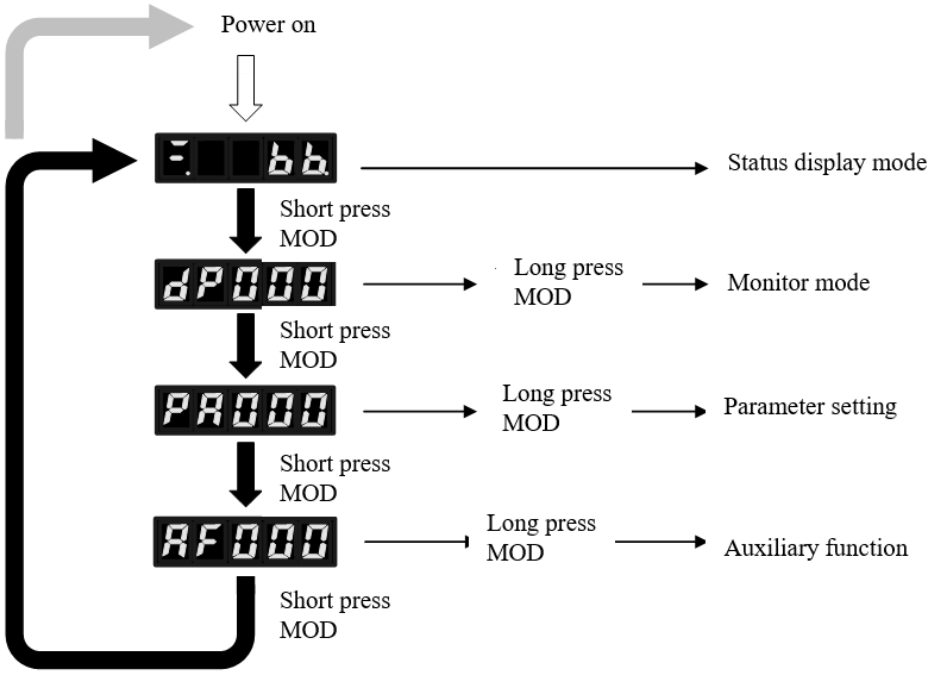
4.1 Panel operator

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.
Hold & press ↑ & ↓ keys together can clear servo drive alarms. BUT please find out the cause of alarms first.



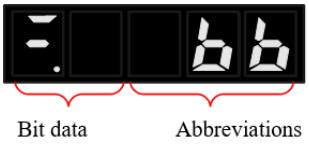
Key	Function description
MOD	Switch between different modes or cancel
↑	Increase value
↓	Decrease value
←	Long press: ENTER Short press: move decimal point

4.2 Switch between different functions

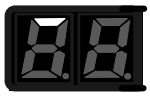


4.3 Status code display

Status of servo drive is displayed by digits.



Display	Meaning	Display	Meaning
bb	Base blockade Indicates the state of the servo OFF (the servo motor is not energized).	not	Reverse driving prohibited Indicates that the input signal (N-OT) is in an open state.
run	Running Indicates the status of the servo ON (servo motor energization status).	Hbb	Security function Indicates that the safety function is activated, and the servo drive is in the Hard wire base block state.
Pot	Forward driving prohibited Indicates that the input signal (P-OT) is in an open state.	E.020 A910	Alarm status Flashing display alarm number or warning number

Display	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 OFF.
	Base block display Lights up in the base block (servo OFF state). Off when the servo is turned ON.
	Speed and torque control: for speed consistent (V-CMP) display When the difference between the servo motor speed and the command speed 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 speed 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 xtinguished.
	For speed and torque control: display for speed command input Lights when the speed 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 speed 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.

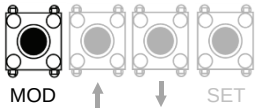
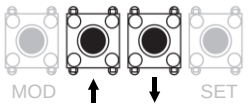
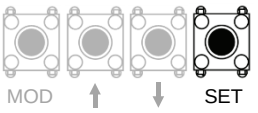
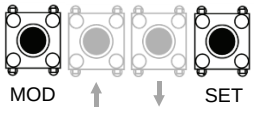
4.4 Monitoring display mode (dP □□)

At monitoring display mode, user can monitor the set values, I/O signal status and internal status of the servo drive.

4.4.1 Contents of monitoring display mode

Please refer to Chapter 5.1.

4.4.2 Example of operations at monitoring display mode (dP 00)

Steps	Panel display	Keys	Operations
1			Press MOD key to choose monitoring display function.
2			If the panel display is not dP000, press UP & DOWN 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 (PA □□□)

4.5.1 Remarks at parameter mode

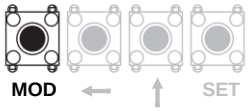
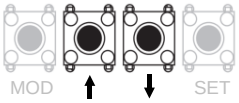
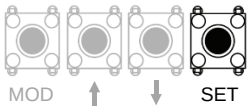
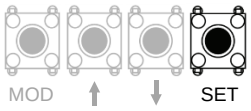
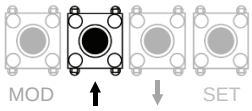
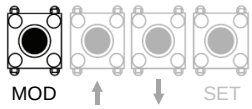
■ Storage setting status

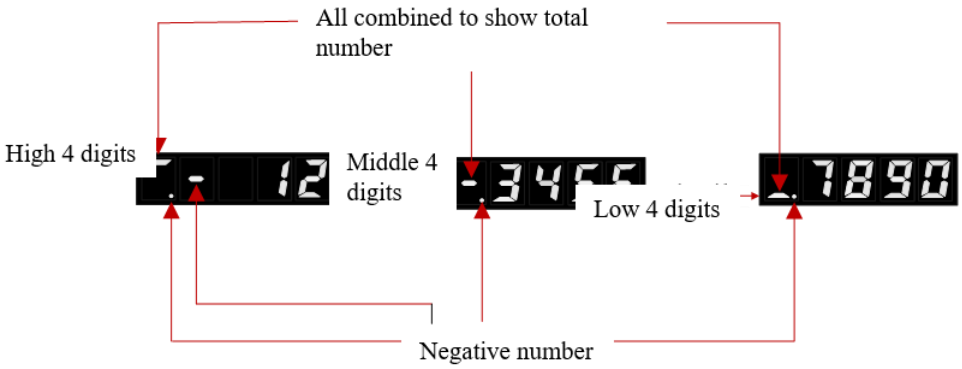
After parameter editing, press SET to store the setting, and the panel display will blink accordingly.

■ Data type

Panel display	Remarks
	Unassigned decimal.
	Hexadecimal.

4.5.2 Example of operations at parameter mode (PA100)

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 make the point next to 4 blink.
5			Press "↑" for 4 times and the value becomes 80.0.
6			Press SET for 1s to set the value of PA100 to 80. Or press MOD to cancel previous changes.
7	End of operations		



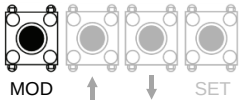
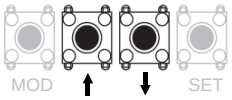
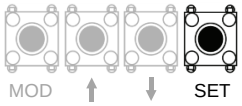
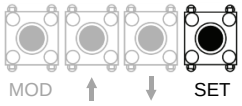
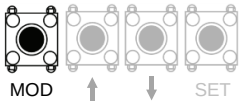
4.6 Auxiliary function mode (AF □□)

Auxiliary functions are used to perform some additional setting & tuning of the servo drive.

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)

Steps	Panel display	Keys	Operations
1			Press MOD key to choose the auxiliary function.
2			Press "↑" or "↓" to show "AF005".
3			If the servo is in S-OFF status, press SET for 1s and the panel will display the left figure.
			If the servo is running or the panel lock (AF 03) is set, the panel will display the left figure.
4			Press and hold "↑" to show the left figure.
5			Continue pressing it and the left figure means operation is completed.
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		

Chapter 5 Monitoring display parameters

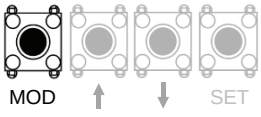
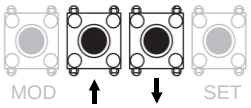
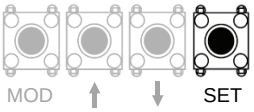
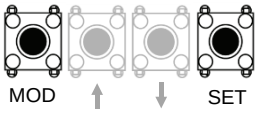
5.1 List of monitoring display parameters

No.	Function	Unit
dP000	**Motor speed** Display the motor operating speed	[rpm]
dP001	**Motor feedback pulse counter** The sum of motor encoder feedback pulse.	[1 encoder pulse]
dP003	**Input pulse counter before electronic gear** The sum of input pulse number in position control mode.	[1 input pulse]
dP005	**Deviation pulse counter** The sum of deviation pulse number in position control mode.	[1 encoder pulse]
dP007	**Speed instruction (analog voltage instruction)**	[0.1V]
dP008	**Internal speed instruction** Internal speed instruction under speed control and position control.	[r/min]
dP00A	**Torque instruction (analog voltage instruction)**	[0.1V]
dP00B	**Cumulative load factor (take rated cumulative load as 100%)**	[%]
dP00C	**Regeneration load factor (take rated regeneration load as 100%)**	[%]
dP00D	**DB load factor (take rated DB load as 100%)**	[%]
dP011	**Safety terminal signal status**	-
dP012	**Input signal status**	-
dP013	**Output signal status**	-
dP014	**Instruction pulse frequency**	[0.1Khz]
dP015	**DC bus voltage**	[V]
dP016	**Fully closed-loop control feedback pulse counter**	[1 encoder pulse]
dP018	**Feedback pulse counter**	[1 input pulse]
dP01A	**Deviation pulse counter**	[1 input pulse]

dP020	**Electrical angle 1 (32-bit hexadecimal)**	[1 encoder pulse]
dP022	**Electrical angle 2 (U-phase 0 degree)**	[deg]
dP023	**Hall sensor information**	
dP024	**Cumulative running time**	[100ms]
dP030	**Effective group of gains (1= 1st group; 2=2nd group)**	-

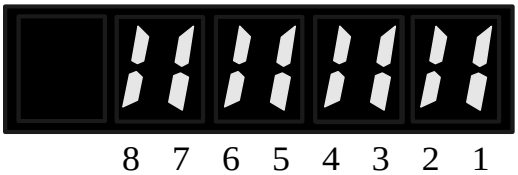
5.2 Input signal monitoring (dP012)

5.2.1 Operations of entering dP012

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 dP 12.
3			Long press SET to enter dP012.
4			Long press SET or press MOD to exit to Step 1.
5	End of operations		

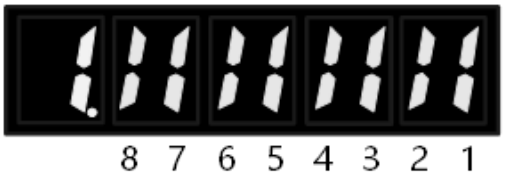
5.2.2 Explanations of dP012 LED displays

Input signal status are shown by the LED displays.



Upper: corresponding signal status
Lower: level of corresponding signal

DI number



Upper: signal is valid
Lower: signal is invalid
Digits

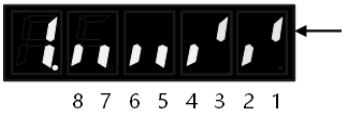
- Upper display
  - LED off: signal is inactive
  - LED on: signal is active
- Lower display
  - LED off: high level (non-conductive)
  - LED on: low level (conductive)

DI number	Pin (CN3)	Default signal
1	40	S-ON
2	41	C-MOD
3	42	POT
4	43	NOT
5	44	CLR
6	45	A-RESTART
7	46	INHIBIT
8	48	ZEROSPD

- Even without external signal inputs, by modifying PA500.2~PA507.2, user can still make corresponding signal active. Please note dP012 is only for displaying status of external I/O signals.

5.2.3 Example of dP012 LED displays

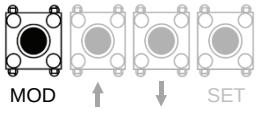
- S-ON is active

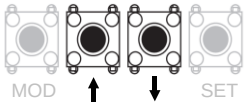
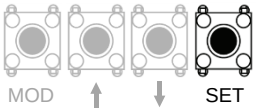
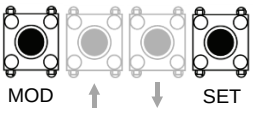


- S-ON is inactive

5.3 Output signal monitoring (dP013)

5.3.1 Operations of entering dP013

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

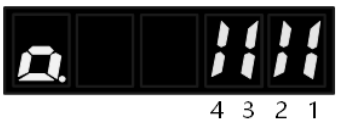
2			If the panel display is not dP013, press ↑ & ↓ until it is dP013.
3			Long press SET to enter dP013.
4			Long press SET or press MOD to exit to Step 1.
5	End of operations		

5.3.2 Explanations of dP013 LED displays

Output signal status are shown by the LED displays.

Upper: corresponding signal status
Lower: level of corresponding signal

DO number



Upper: signal is valid
Lower: signal is invalid

Digits

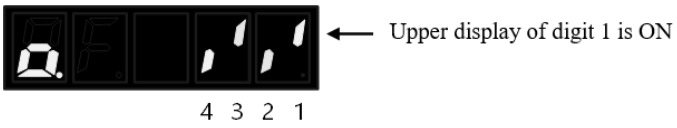
- Upper display
  - LED off: signal is inactive
  - LED on: signal is active
- Lower display
  - LED off: high level (non-conductive)
  - LED on: low level (conductive)

DO number	Pin (CN3)	Default signal
1	31, 32	ALM
2	29, 30	COIN
3	27, 28	CZ
4	25, 26	BK

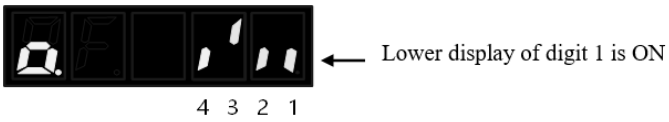
- Even output signal is inactive, by modifying PA50A.2, user can still make corresponding signal active.
- CN3-31, CN3-32 can only be used for ALM signal
- dP13 is always off if the output signal is CZ.

5.3.3 Examples of dP013 LED displays

- ALM is inactive



- ALM is active



5.4 Initial monitoring display at power on

- If PA52F is not 0FFF, then user can set which monitoring display parameter to display at power on.
- If PA52F is 0FFF (default) , then status codes will be displayed at power on (such as bb, run)

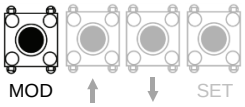
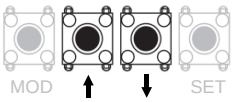
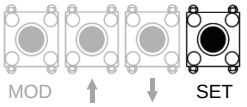
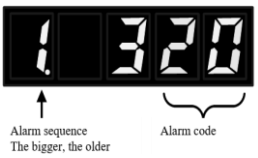
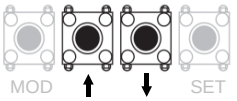
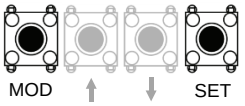
Chapter 6 Auxiliary functions

6.1 List of auxiliary function parameters

No.	Function	Reference
AF000	Display of alarm logging	6.2
AF001	Position assignment (only active in position control mode)	6.3
AF002	JOG run	6.4
AF003	Panel lock	6.5
AF004	Clearance of alarm logging	6.6
AF005	Parameter initialization	6.7
AF006	Analog instruction (speed & torque) automatic offset adjustment	6.8
AF007	Speed instruction manual offset adjustment	6.9
AF008	Torque instruction manual offset adjustment	6.10
AF00A	Programmed JOG run	6.11
AF010	Display of main software version of servo drive	6.12
AF011	Setting up absolute encoders	6.13
AF013	Multi-turn upper limit setting upon error A.CC0	6.13
AF015	Parameter initialization of all parameters	
AF016	Dragging	
AF021	Vibration detection value initialization	
AF030	Manual stiffness adjustment	
AF050	Vibration monitoring	
AF060	FFT analysis	
AF100	Automatic stiffness adjustment	
AF101	Internal instruction type automatic adjustment	
AF102	External instruction type automatic adjustment	
AF103	Simple parameter type automatic adjustment	
AF104	Vibration suppression control function	
AF105	Vibration reduction control function	

6.2 Display of error logging (AF000)

Up to 10 most recent alarms can be displayed.

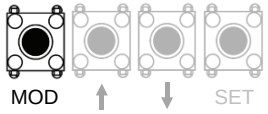
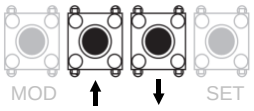
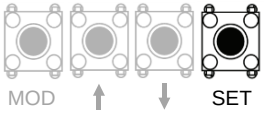
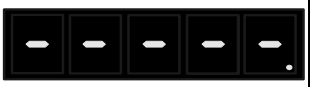
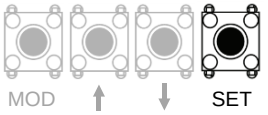
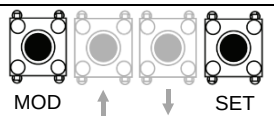
Steps	Panel display	Keys	Operations
1			Press MOD key to choose auxiliary function mode.
2			If the panel display is not AF000, press ↑ & ↓ until it is AF000.
3			Long press SET to enter AF 00.
4			Press ↑ once and it will display one previous alarm. Press ↓ once and it will display a new alarm. The bigger the number on the left side, the older the alarm displayed.
5			Press SET to exit to Step 2.
6	End of operations.		

Notes:

- 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 loggings.

6.3 Position assignment (AF001)

With this function, motor feedback position & instruction pulse position is assigned by value of 0.

Steps	Panel display	Keys	Operations
1			Press MOD key to choose auxiliary function mode.
2			If the panel display is not AF001, press ↑ & ↓ until it is AF001.
3			Long press SET to enter AF001.
4			Press and hold SET.
5			
6			Release the key.
7			Press MOD or SET to exit to Step 2.
8	End of operations.		

6.4 JOG run (AF002)

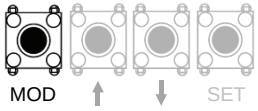
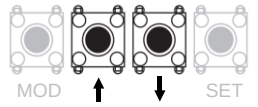
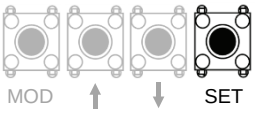
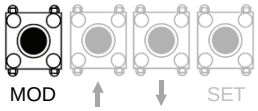
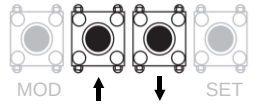
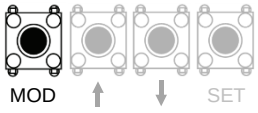
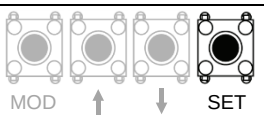
JOG run is the function to confirm the servo motor action through speed control without connecting to the upper controller. During JOG run, the overtravel prevention function (POT, NOT) is inactive. User shall pay close attention to mechanical movement of the machinery caused by JOG run.

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.

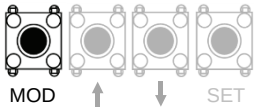
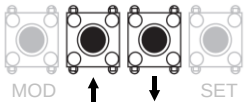
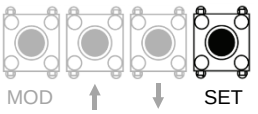
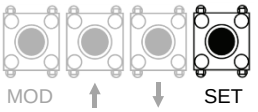
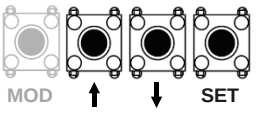
2) JOG run procedures

Steps	Panel display	Keys	Operations
1			Press MOD key to choose auxiliary function mode.
2			If the panel display is not AF002, press ↑ & ↓ until it is AF002.
3			Press SET for 1s to enter AF002.
4			*This will show if the servo is running or panel is locked (AF003).*
5			Press MOD to enable the servo.
6			Press ↑ to JOG forward or ↓ to JOG reversely.
7			Press MOD (or SET) to stop enabling the servo.
8			Long press SET to exit to Step 2.
9	End of operations.		

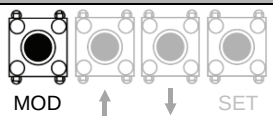
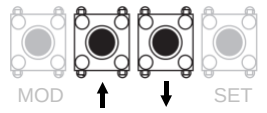
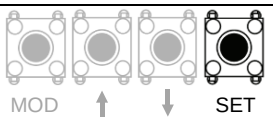
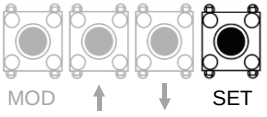
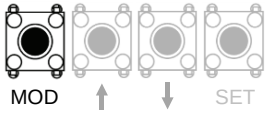
6.5 Panel lock (AF003)

Password settings:

- When it is set to be 58, no parameters or functions can be operated.
- When it is set to be not 58, the parameters can be operated.

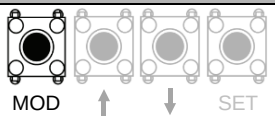
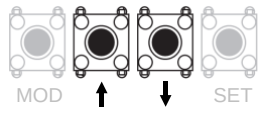
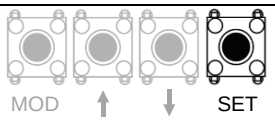
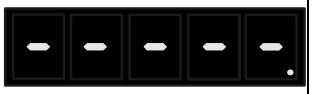
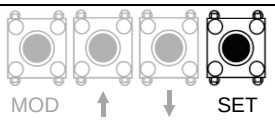
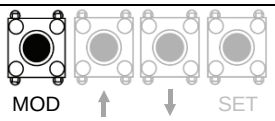
Steps	Panel display	Keys	Operations
1			Press MOD key to choose auxiliary function mode.
2			If the panel display is not AF003, press ↑ & ↓ until it is AF003.
3			Long press SET.
4			Enter AF003
5			Press ↑ or ↓ to set the password.
6			Long press SET to finish password setting and exit to Step 2.
7	End of operations.		

6.6 Clearance of alarm logging (AF004)

Steps	Panel display	Keys	Operations
1			Press MOD key to choose auxiliary function mode.
2			If the panel display is not AF004, press ↑ & ↓ until it is AF004.
3			Long press SET.
4			Press and hold SET.
5			This shows the operation is done.
6			Release the key.
7			Press MOD to exit to Step 2.
8	End of operations.		

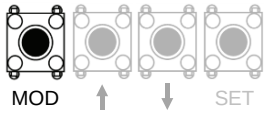
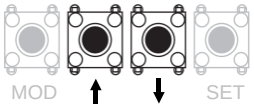
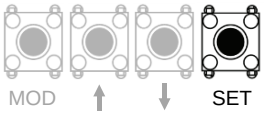
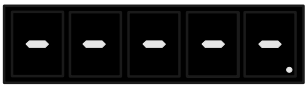
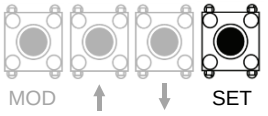
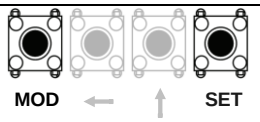
6.7 Parameter initialization (AF005)

To achieve parameter initialization, servo must not be ON. Also, restart afterwards to make initialization effective.

Steps	Panel display	Keys	Operations
1			Press MOD key to choose auxiliary function mode.
2			If the panel display is not AF005, press ↑ & ↓ until it is AF005.
3			Long press SET if the servo is not ON.
4			*This will show if the servo is running or panel is locked (AF 03)* .
5			Press and hold SET.
6			This shows the operation is done.
7			Release the key.
8			Press MOD to exit to Step 2.
9	Power off, then power on again.		
10	End of operations.		

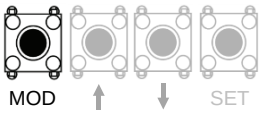
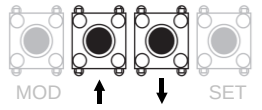
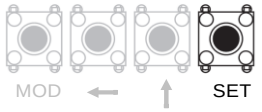
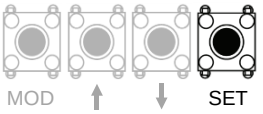
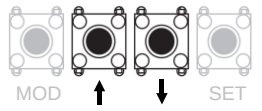
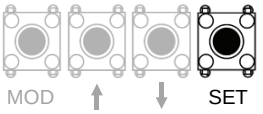
6.8 Analog instruction automatic offset adjustment (AF006)

This is a method for self-regulation of the instruction voltage (speed instruction and torque instruction) after measuring the offset. The measured offset will be saved in the servo drive.

Steps	Panel display	Keys	Operations
1			Press MOD key to choose auxiliary function mode.
2			If the panel display is not AF006, press ↑ & ↓ until it is AF006.
3			Long press SET.
4			Press and hold SET.
5			This shows the operation is done.
6			Release the key.
7			Press MOD to exit to Step 2.
8	End of operations.		

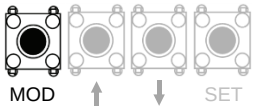
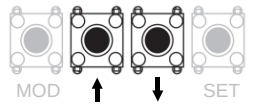
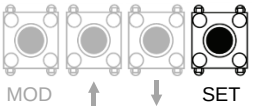
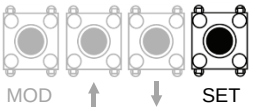
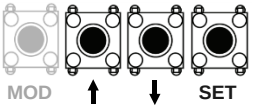
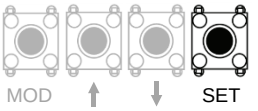
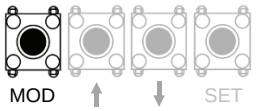
6.9 Speed instruction manual offset adjustment (AF007)

This is the method to input the speed instruction offset directly for regulation.

Steps	Panel display	Keys	Operations
1			Press MOD key to choose auxiliary function mode.
2			If the panel display is not AF007, press ↑ & ↓ until it is AF007.
3			Press SET.
4			This will show if the servo is S-ON.
5			Press SET for 1s to display current offset value.
6			Press ↑ or ↓ for adjustment.
7			Long press SET, ‘donE’ will show and blink, then will exit to Step 2.
8	End of operations.		

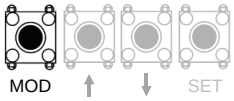
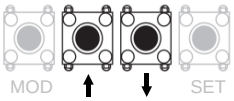
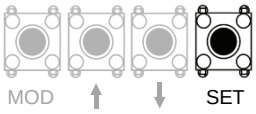
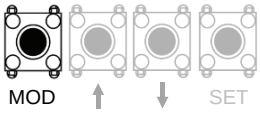
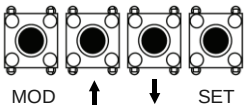
6.10 Torque instruction manual offset adjustment (AF008)

This is the method to input the torque instruction offset directly for regulation.

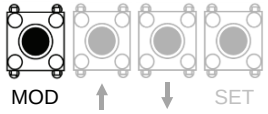
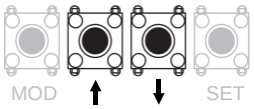
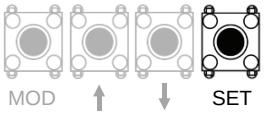
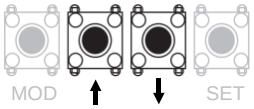
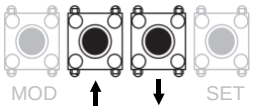
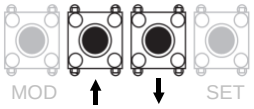
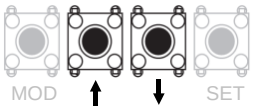
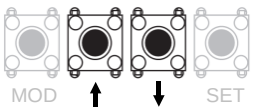
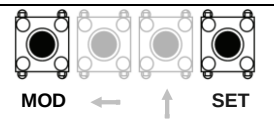
Steps	Panel display	Keys	Operations
1			Press MOD key to choose auxiliary function mode.
2			If the panel display is not AF008, press ↑ & ↓ until it is AF008.
3			Press SET.
4			This will show if the servo is S-ON.
5			Press SET to display current offset value.
6			Press ↑ or ↓ for adjustment.
7			Long press SET, ‘donE’ will show and blink, then will exit to Step 2.
8			Press MOD to exit to Step 2 without saving.
9	End of operations.		

6.11 Programmed JOG run (AF00A)

This function is like AF002 however the motor will run at preset speed, acceleration, waiting time etc. Relevant parameters are PA5A0 to PA5A6.

Steps	Panel display	Keys	Operations
1			Press MOD key to choose auxiliary function mode.
2			If the panel display is not AF00A, press ↑ & ↓ until it is AF00A.
3			Press SET.
4			Press MOD to make S-ON. If press MOD during operation, servo will go OFF and return to Step 3. If press SET for 1s during operation, servo will go to Step 2.
5			Press ↑ or ↓ based on initial direction setting and the servo will start run after preset waiting time. If press MOD during operation, servo will go OFF and return to Step 3. If press SET for 1s during operation, servo will go to Step 2.
6			If programmed JOG run is finished, display will blink and show END, then return to Step 4.
7	End of operations.		

6.12 Display of main software version of servo drive (AF010)

Steps	Panel display	Keys	Operations
1			Press MOD key to choose auxiliary function mode.
2			If the panel display is not AF010, press ↑ & ↓ until it is AF010.
3			Long press SET. Left shows chip A software version is 1.10.
4			Press ↑ again. Left shows chip B software version is 1.00.
5			Press ↑ again. Left shows chip C software version is 1.00.
6			Press ↑ again. Left shows chip A testing version is 0.0.
7			Press ↑ again. Left shows chip B testing version is 0.1.
8			
9			Press MOD or long press SET to exit to Step 2.
10	End of operations.		

6.13 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:

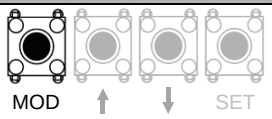
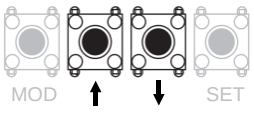
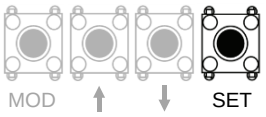
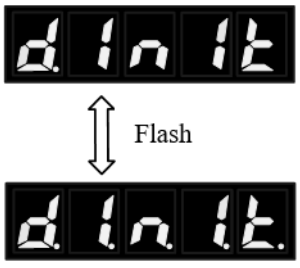
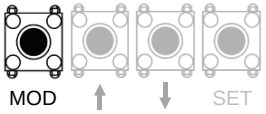
Parameter		Meaning	Effective	Category
PA310	n.□□□0	No detection (default)	Immediate	Setting
	n.□□□1	Warning after detection(A.91A)。		
	n.□□□2	Alarm after detection(E.A20)。		

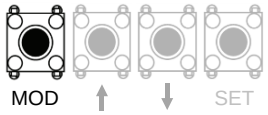
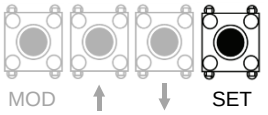
When the detected value is obtained by the following formula,

$$Detected\ value = \frac{(PA312[rpm]) * (PA311[\%])}{100}$$

Notes:

- This function can only be used when the "Vibration Alarm (E.520)" or "Vibration Warning (A.911)" 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).

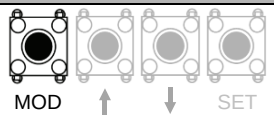
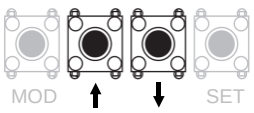
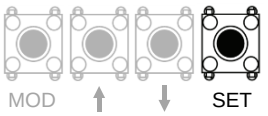
Steps	Panel display	Keys	Operations
1			Press MOD key to choose auxiliary function mode.
2			If the panel display is not AF021, press ↑ & ↓ until it is AF021.
3			Long press SET. When set to disable writing, "no_oP" will flash for about 1 second. Please set the AF003 to the writable state before operating.
4			Press the MOD button, display will flash, and the vibration value will be detected and updated. This will continue until the MOD button is pressed again. Notes: • Please control the operation with the actual instructions

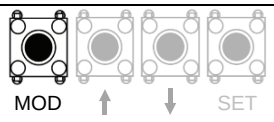
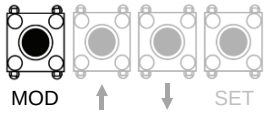
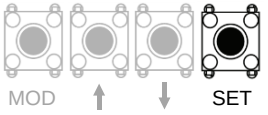
			used. • When the servo motor is running at a maximum speed of 10% or less, “Error” will be displayed.
5			Press the MOD button again at the appropriate time to end the checkout and update for the settings to take effect. “donE” is displayed after the setting is completed normally. “Error” is displayed when the setting cannot be completed normally
6			Long press SET to exit to Step 2.
7	End of operations.		

6.14 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. User can use AF060 first and use AF050 for fine-tuning.

Steps	Panel display	Keys	Operations
1			Press MOD key to choose auxiliary function mode.
2			If the panel display is not AF050, press ↑ & ↓ until it is AF050.
3			Long press SET. When set to disable writing, “no_oP” will flash for about 1 second. Set the AF003 to the writable state before operating.

4			Press SET button, dots will display and start detecting.
5			If the detection is normal, the result is displayed. The displayed vibration frequency is the frequency at the maximum peak. If you only confirm the vibration frequency and do not set the detection result, you must press the MOD button. When setting the detection result, you must proceed to step 6. (Note) • If the frequency detection fails, “F----” is displayed. • If the detection process does not end normally, "no_oP" is displayed.
6			Press the SET button to automatically set the notch filter frequency or torque command filter time parameter that is most suitable for this frequency. “donE” flashes when the setting is normal.
7			Long press SET to exit to Step 2.
8	End of operations.		

6.15 FFT analysis (AF060)

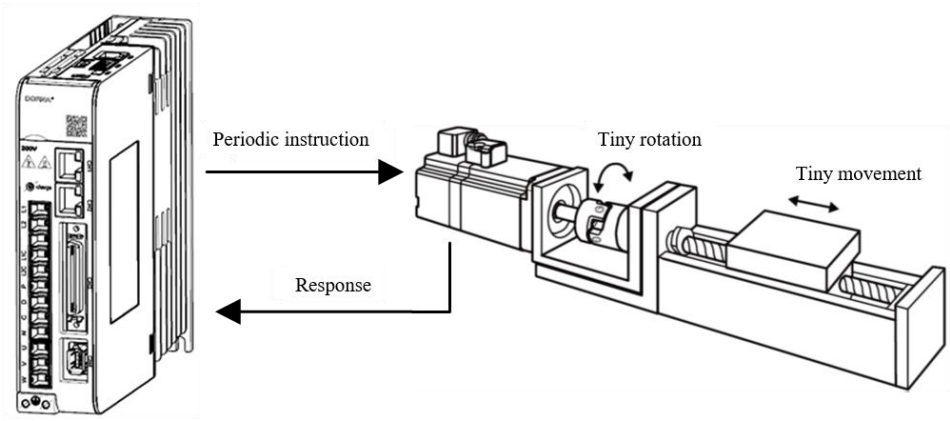
The AnFFT transmits the periodic waveform command from the servo driver to the servo motor, and the servo motor is slightly rotated a few times for a certain period of time to cause the machine to vibrate. The servo driver detects the resonance frequency based on the vibration generated by the machine,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

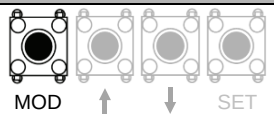
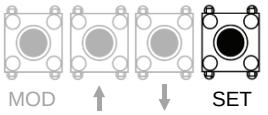
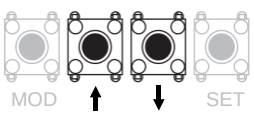
Danger

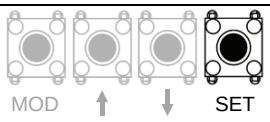
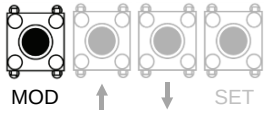
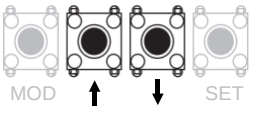
The servo motor rotates slightly during the AnFFT. Do not touch the servo motor and machine during execution. Failure to do so may result in injury.

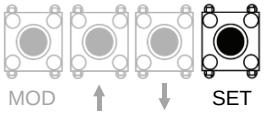
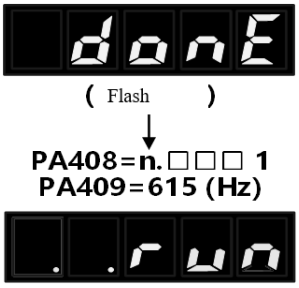
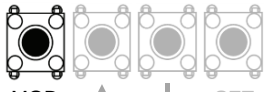
Important

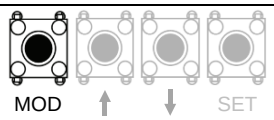
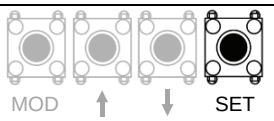
- The AnFFT function must be used in a state where the gain is low in the initial stage of servo adjustment. Execute if a higher gain is set
- AnFFT function, which may be subject to vibration due to mechanical characteristics and gain balance.
- When the mechanical vibration occurs, if the notch filter is set according to the vibration frequency, there is a certain effect on eliminating the vibration.
- This function should be operated in the servo OFF state.
- When this function is used, a dedicated command is output from the servo driver. Do not enter commands from the outside.



Steps	Panel display	Keys	Operations
1			Press MOD key to choose auxiliary function mode.
2			If the panel display is not AF060, press ↑ & ↓ until it is AF060.
3			Long press SET. When set to disable writing, “no_oP” will flash for about 1 second. Set the AF003 to the writable state before operating.
4			Press the “ ↑ ” or “ ↓ ” button 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 the command amplitude, 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 button to start operation. To cancel, press MOD button gain.
7			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 proceed 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 the command amplitude, increase the amplitude value gradually and change it while observing the situation.
9			Long press SET to let servo enter OFF state.
10			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			Press MOD to return to ready state.
12			Long press SET to exit to Step 2.
13	End of operations.		

Chapter 7 JOG run

7.1 Preparations before JOG run

Please check the following items before JOG run:

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 (by separate 24VDC) in advance?
Servo drive	Whether the wirings and connections are correct?
	Whether the input voltage to the servo drive is stable?

7.2 JOG run by panel operations

Please refer to Chapter 6.4

7.3 Stand-alone JOG run with upper controllers

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

Item	What to check
1	Whether I/O signals are correctly set?
2	Whether the connections between upper controller and servo drive is correct and whether the polarities are set correctly?
3	Whether the instructions are correctly set?

7.3.1 Wiring & status check of input signal circuit

Steps	Operations	Reference
1	Please make sure following signals are connected to CN3: ▪ S-ON ▪ POT & NOT	3.4
2	Connect servo drive to upper controller.	-
3	Power on. Check status of dP012.	4.3
4	Input S-ON to enable the servo.	4.3
5	End of preparations for JOG run.	-

7.3.2 JOG run in position control mode

Steps	Operations	Reference
1	Reconfirm the power supply and input signal circuit and then switch on the control power supply of servo drive.	3.1
2	Use PA200.0 to set the input pulse form.	8.4.1
3	Use PA20E and PA210 to set the electronic gear ratio; Use PA212 to set encoder divided frequency pulse number.	8.4.2 8.5.7
4	Power on again.	-
5	Input S-ON to enable the servo.	-
6	Output low speed pulse instruction from the upper controller with easily confirmed motor rotation (such as: 1 turn) .	-
7	Monitor the input pulse number (dP003).	5.1
8	Monitor feedback pulse number (dP001).	5.1
9	Confirm whether the servo motor rotates in the direction given by the instruction.	-
10	Check whether the number of feedback pulse corresponds with the expected number. Feedback pulse number = dP001*PA212*4/ encoder resolution	5.1
11	Stop the pulse instruction and make the servo OFF.	-

7.3.3 JOG run in speed control mode

Steps	Operations	Reference
1	Reconfirm the power supply and input signal circuit and then switch on the control power supply of servo drive.	3.1
2	Adjust speed instruction input gain by PA300.	8.5
3	Power on.	-
4	Confirm the speed instruction input (voltage between V- REF and AGND) is 0 V, and then switch on the servo ON (S-ON) input signal.	-
5	Increase speed instruction input voltage (voltage between V-REF and AGND) from 0V slowly.	-
6	Confirm the speed instruction value (voltage) through the speed instruction monitoring (dP007).	5.1
7	Confirm the motor speed (rotating speed) through motor speed monitoring (dP000).	5.1
8	Confirm the values in procedures 6 and 7 (dP007 and dP000) are consistent according to the conversion relation.	5.1
9	Confirm whether the servo motor rotates in the direction given by the instruction.	-
10	Return speed instruction input to 0V, and make the servo OFF. Then the speed test run is finished.	-

7.4 JOG run with mechanical connections

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

Steps	Items	Operations	Reference chapter
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	Installation	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	Operation	Conduct JOG run same way as Chapter 7.3. Confirm the JOG run result is up to expectations with mechanical connections.	-
6	Adjustment	Adjust the servo gains (if necessary) to improve the response characteristic of servo motor. 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	Finish	Then, the JOG run is finished.	-

7.5 JOG run with a holding brake

Item	Remarks
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

Parameter		Control mode	Reference
PA000	**n.□□0□**	**Position control (pulse train instruction)** The position of servo motor is controlled through the pulse train position instruction. The position is controlled through the pulse number inputted, and speed is controlled through the frequency of input pulse. It is used when the action needs to be positioned.	8.4
	n.□□1□	**Speed control (analog voltage instruction)** Use this under the following occasions: ▪ To control the rotating speed; ▪ Use the encoder pulse output of servo drive and establish the position loop through the upper controller for position control.	8.5
	n.□□2□	**Torque control (analog voltage instruction)** Use the analog voltage torque instruction to control the output torque of servo motor.	8.6
	n.□□3□	**Internal speed control** Use 2 input signals, INSPD0, INSPD1, for speed control through the 3 preset speeds in the servo drive. When this control mode is used, the analog instruction is not needed.	8.7

8.2 Basic function settings

8.2.1 S-ON settings

- S-ON is the instruction for servo motor on/off

Type	Signal	Status	Level	Remarks
Input	S-ON	ON	CN3-40: Low	Servo is ON & ready for operations.
		OFF	CN3-40: High	Servo is OFF.

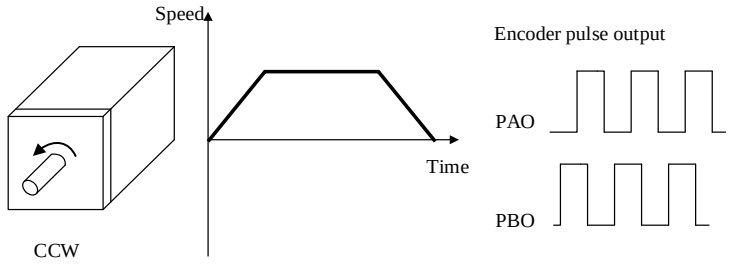
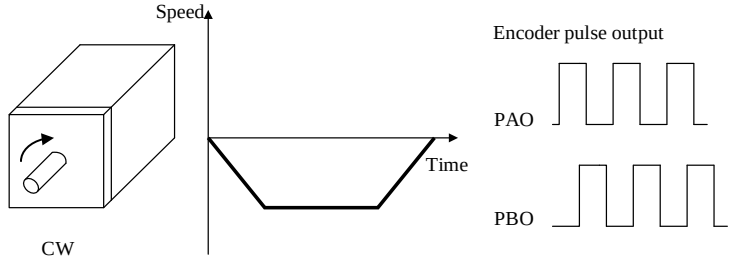
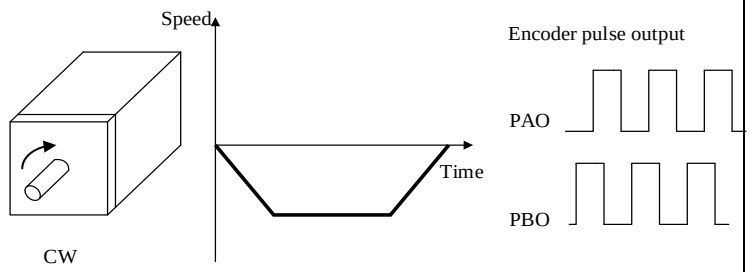
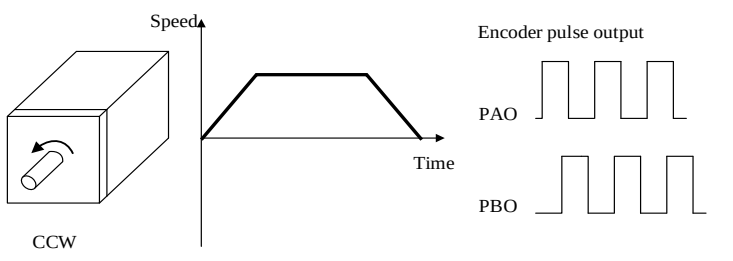
- Selection of S-ON level

Parameter		Remarks
PA500	n.□0□□	L level active (optocoupler conductive) (default)
	n.□1□□	H level active (optocoupler not conductive)

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 positive direction is counter clockwise rotation (CCW) . Negative mode only changes the rotational direction of the motor and positive direction becomes clockwise rotation (CW) , and encoder pulse output polarity remains unchanged.

<table>
<tr><th colspan="2">Parameter</th><th>Instructions & rotational directions</th><th>Overtravel (OT)</th></tr>
<tr><td rowspan="4">PA000</td><td rowspan="2">n.□□□0</td><td>■ Rotational direction at positive instruction
 
</td><td>POT</td></tr>
<tr><td>■ Rotational direction at negative instruction
 
</td><td>NOT</td></tr>
<tr><td rowspan="2">n.□□□1</td><td>■ Rotational direction at positive instruction
 
</td><td>NOT</td></tr>
<tr><td>■ Rotational direction at negative instruction
 
</td><td>POT</td></tr>
</table>

8.2.3 Overtravel (OT) settings

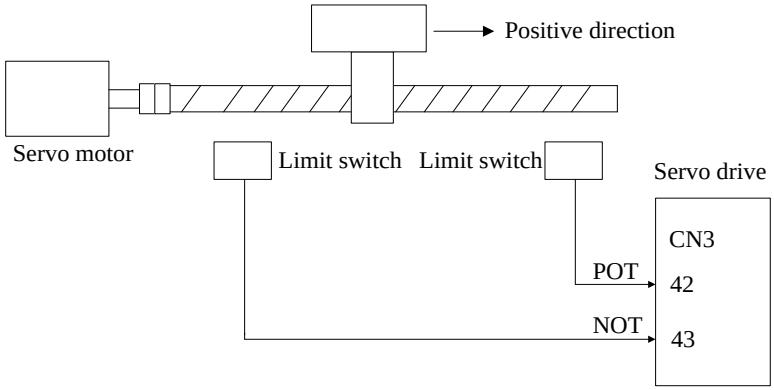
Overtravel refers to the safety function which can make the limit switch function (ON) and force the servo motor to stop when the moving parts of a machine go beyond the movable area.

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

Type	Signal	Pin	Setting	Meaning
Input	POT	CN3-42 (default)	ON=L level	Can forward run
			OFF=H level	Forward run prohibited (positive overtravel)
Input	NOT	CN3-43 (default)	ON=L level	Can reverse run
			OFF=H level	Reverse run prohibited (negative overtravel)

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



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.

(2) Selection of servo stop patterns at overtravel

Parameter		During stop	After stop	Meaning
PA001	n.□□00 n.□□01	DB to stop	Free state	DB to stop and enter free state (power off) after stop.

	n.□□02	Coast to stop		Coast to stop and enter free state (power off) after stop.
	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□		Free state	Use emergency stop torque (PA406) to decelerate and enter free state (power off) after stop.

- Please restart the servo drive after modifying this parameter.
- If the servo receives S-ON signal during coast to stop, the servo motor can only be controlled after the speed has decelerated to 0.
- Definitions:
  - DB: dynamic brake (internal short-circuit of servo drive) . This feature is optional.
  - Coast to stop: stop using natural frictions.
  - Zero-speed clamp: the state when position instruction is 0 and position deviation is cleared.

(3) Stop torque setting during overtravel

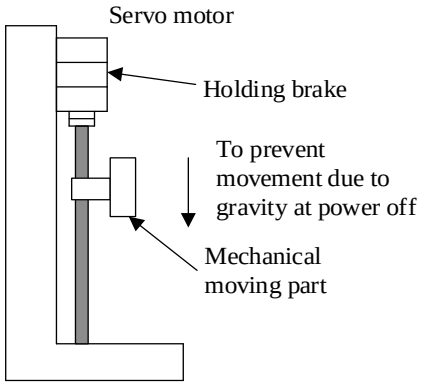
PA406	Emergency Stop Torque			
	Range	Unit	Default	Effective
	0 ~ 400	1%	400	Immediately

- 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%)

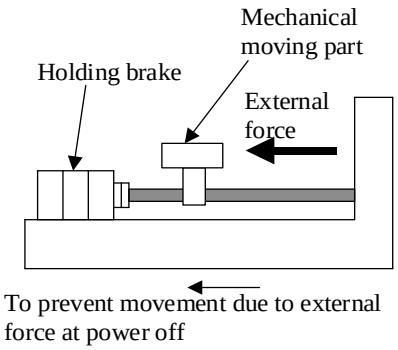
8.2.4 Holding brake settings

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



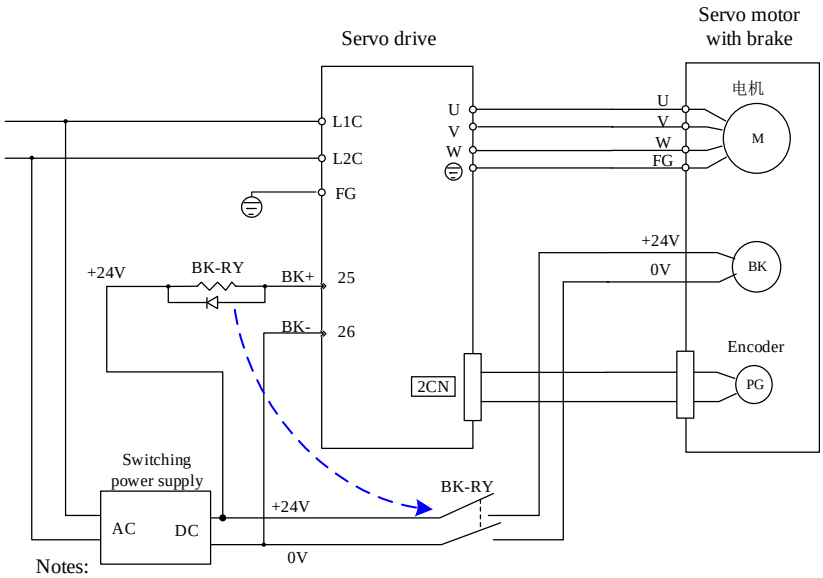
■ Horizontal axis



- 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.
- If only the speed loop is used to activate the servo motor, when the brake functions, set the servo OFF and input instruction to be "0V".
- 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

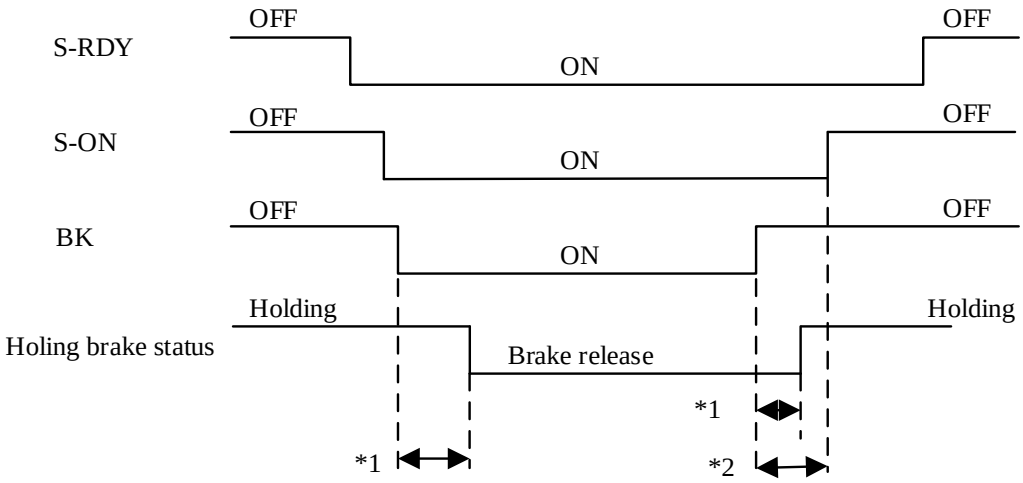
The sequential output signal of servo drive (BK) and brake power supply forms the ON/OFF of the brake. Standard connection of a circuit is illustrated as follows.



Notes:

1. BK-RY: the relay for brake control
2. The current provided by switching power supply shall 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

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 BK signal active to brake release is different for different types of brakes.
*2. Set by PA516, PA517, PA518

(2) BK signal output

Type	Signal name	Pin	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 (CN3-25, CN3-26) by default, but can also be allocated freely.

Parameter	Pin		Meaning
	+	-	
PA50A.01=03	CN2-29	CN2-30	BK signal output from CN3-29, CN3-30
PA50B.01=03	CN2-27	CN2-28	BK signal output from CN3-27, CN3-28
PA50C.01=03	CN2-25	CN2-26	BK signal output from CN3-25, CN3-26

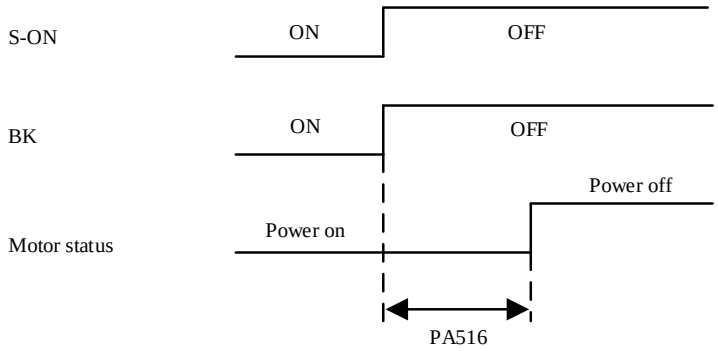
Please refer to Chapter 3.4.3 ‘Allocation of I/O signals’

(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	Unit	Default	Effective
	0~500	ms	0	Immed

When used on a vertical axis, 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.



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

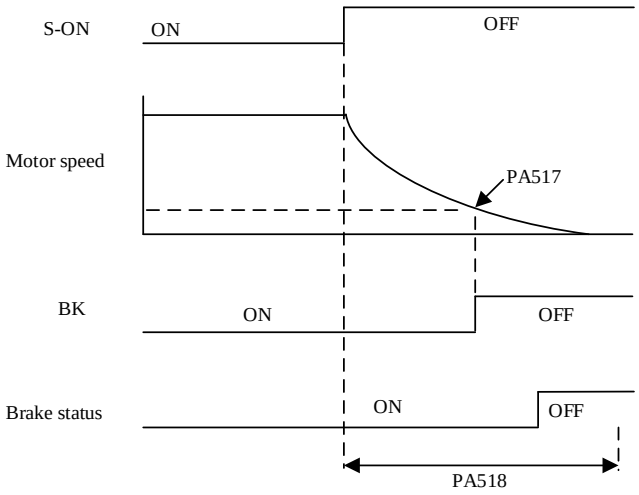
(5) Setting of BK signal timing during the rotation of servo motor

When a halt instruction 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 speed limit			
	Range	Unit	Default	Effective
	0~1000	rpm	100	Immed
PA518	BK signal waiting time at Servo-OFF			
	Range	Unit	Default	Effective
	100~5000	1ms	500	Immed

BK signal will be OFF (H level, nonconductive) in following situations:

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



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

8.2.5 Selection of servo stop patterns at servo OFF

Parameter		During stop	After stop	Meaning
PA001	n.□□□0	DB to stop	DB state	DB to stop and maintain DB state after stop.
	n.□□□1		Free state	DB to stop and enter free state (power off) after stop.
	n.□□□2	Coast to stop	Free state	Coast to stop and enter free state (power off) after stop.

- 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 speed, no brake force will be generated.

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 speed input instruction and position control instruction.

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

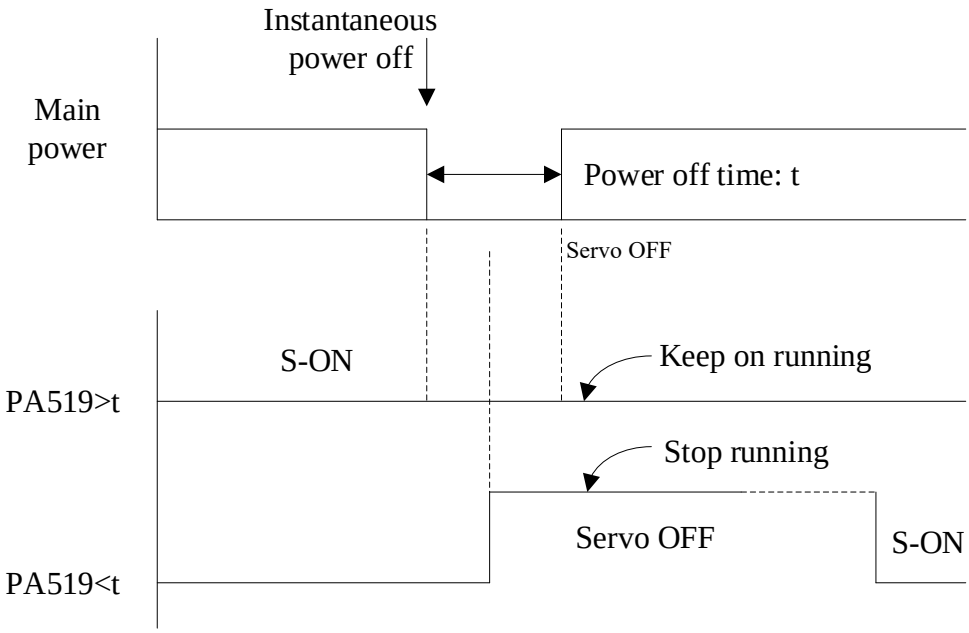
PA519	Instantaneous power off holding time			
	Range	Unit	Default	Effective
	20~1000	1ms	20	Immed

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.



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.

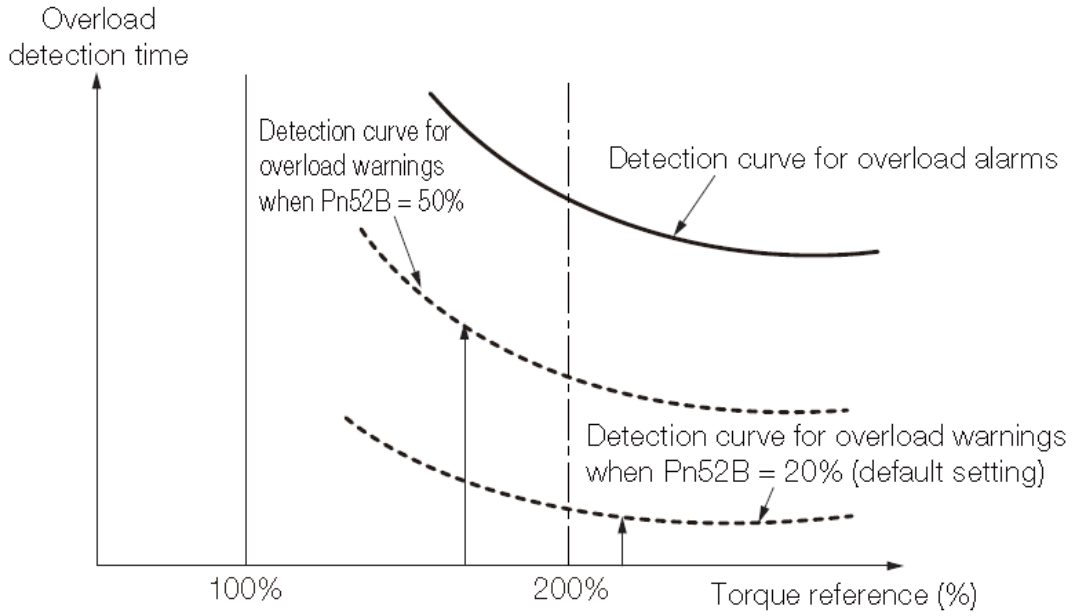
8.2.7 Motor overload detection value setting

This servo driver 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) (A.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	Unit	Default	Effective
	1 ~ 100	1%	20	Immed

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

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

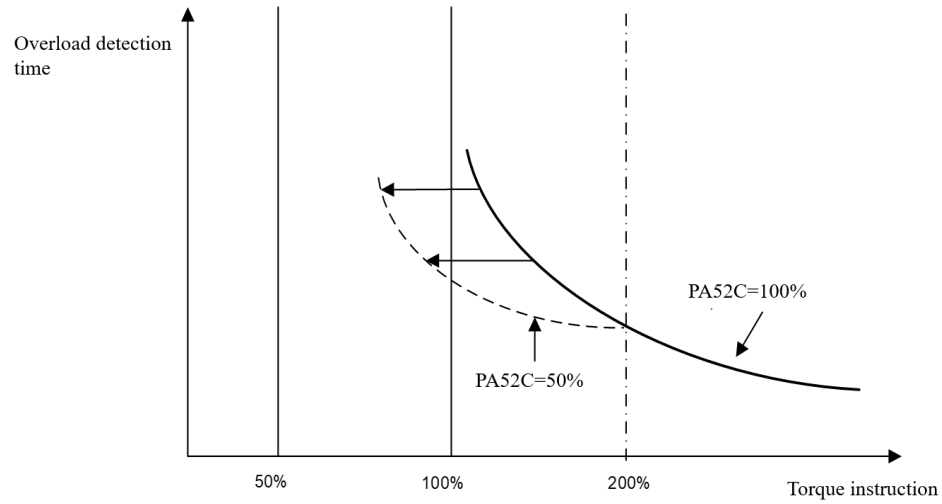
By using the "base current after reduction of rated value" in the following formula to detect an overload alarm, the time for detecting the overload alarm can be shortened. The detected value of the overload (instantaneous maximum load) alarm (E.120) cannot be changed.

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	Unit	Default	Effective
	10 ~ 100	1%	20	Restart

8.3 Using absolute encoders

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

Encoder type	Resolution	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.58 will output. PA007.1 can disable this alarm

Parameter		Meaning
PA007	n.□□0□	Multi-turn data overflows will output E.58 (default) .
	n.□□1□	Multi-turn data overflows will not output E.58

8.3.1 Absolute encoder selection

Parameter		Meaning
PA002	n.□0□□	Use absolute encoders as incremental encoders. (default)
	n.□1□□	Use absolute encoders as absolute encoders.

- When use absolute encoders as incremental 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 instruction 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 "17-bit 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 "17-bit serial encoder battery warning (A.930) ".
3. Restart the power of servo drive; if there is no abnormal action, the battery is successfully replaced.

Important

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) .

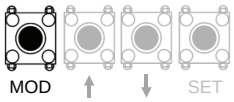
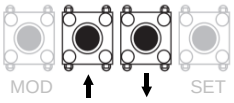
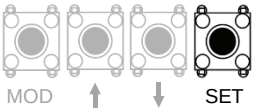
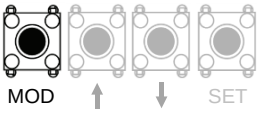
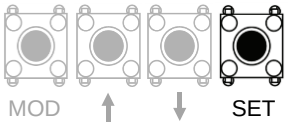
8.3.4 Setting up absolute encoders (AF011)

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 auxiliary function mode.
2			If the panel display is not AF011, press ↑ & ↓ until it is AF011.
3			Long press SET.
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 for 1s during operation, servo will go to Step 2.
6	End of operations.		

8.4 Position control operations

8.4.1 Parameter settings

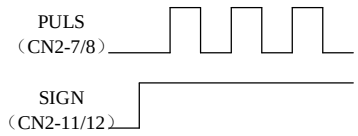
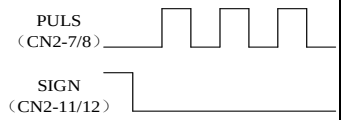
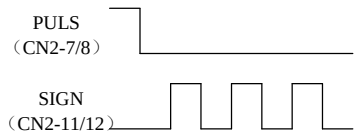
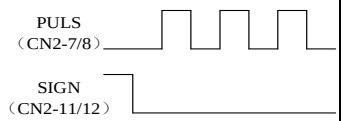
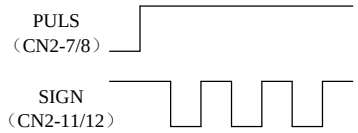
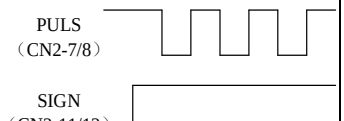
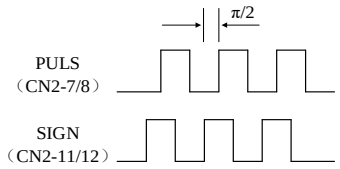
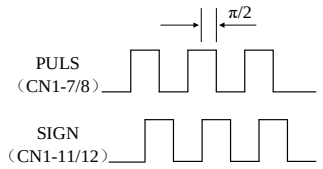
When using pulses for position control, please pay attention to following parameters.

1) Control mode selection

Parameter		Meaning
PA000	n.□□0□	Position control (pulse train)

2) Pulse form selection

Type		Signal	Pin
Input	Low speed channel (<500 Kbps)	PULS+	CN3-7
		PULS-	CN3-8
		SIGN+	CN3-11
		SIGN-	CN3-12
	High speed channel (<4 Mbps)	HPULS+	CN3-16
		HPULS-	CN3-17
		HSIGN+	CN3-23
		HSING-	CN3-24

Parameter		Pulse form	Forward rotation	Reverse rotation
PA200	n.□□00	PULS+ SIGN		
	n.□□01	CW+ CCW		
				
	n.□□02	A phase + B phase		

3) Position deviation clearance

Besides CLR signal, a timed position deviation clearance can be selected by parameter PA200.2.

Parameter		Meaning
PA200	n.□0□□	Clear position deviation when S-ON is off, power is off or by CLR signal.
	n.□1□□	Clear position deviation only by CLR signal.
	n.□2□□	Clear position deviation only when servo has alarm or by CLR signal.

4) Input pulse channel selection

User can select input pulse channel by PA200.3.

Parameter	Meaning

PA200	n. 0□□□	**PULS+SIGN input: low speed pulse channel** Pulse input in this channel is received by optocoupler. It is suitable for upper controller of collector output and long-line transmitter output, frequency ≤ 500K bps.
	n. 1□□□	**HPULS+HSIGN input: high speed pulse channel** Pulse input in this channel is received by long-line receiver. It is suitable for upper controller of long-line transmitter output, frequency ≤ 4M bps.

8.4.2 Electronic gear ratio settings

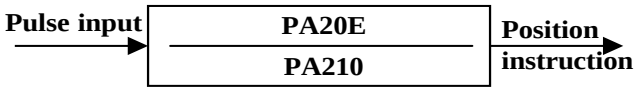
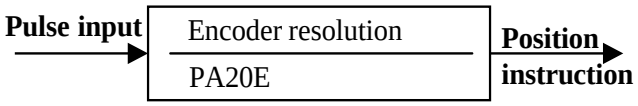
1) Encoder resolutions

Parameter		Encoder type	Pulses per revolution	Resolution
PA002	n. 0□□□	17-bit absolute encoder	32768	131072 (17-bit)
	n. 2□□□	23-bit absolute encoder	2097152	8388608 (23-bit)

Remarks: encoder resolution is 4 times (quadruple frequency) of encoder pulses per revolution.

2) Electronic gear ratio

The function of electronic gear is for setting the work-piece moving distance by 1 pulse instruction (1 command unit) .

PA210	Instruction processing
≠0	
=0	

8.4.3 Position instructions

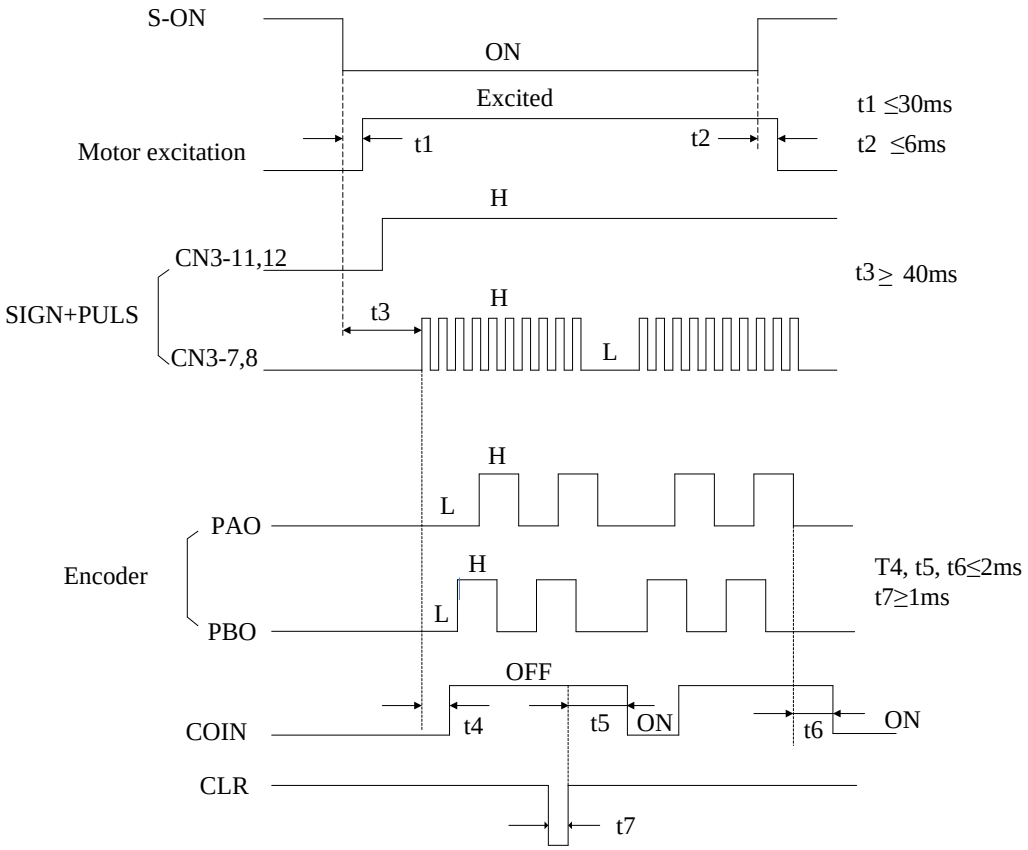
Upper controller's output forms include the following:

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

Open-collector output signals can only connect to servo drive's CN3-7, 8, 11, 12, and the parameter should be set to low speed pulse channel, i.e. PA200.3=0 (factory default).

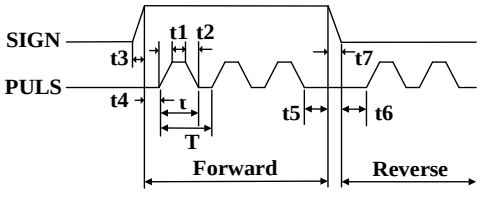
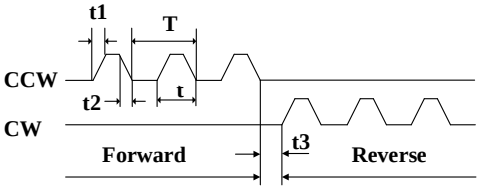
In case of open-collector pulse input, the interference tolerance for input signal will decrease. In case of deviation due to interference, changes should be made in the following user parameters.

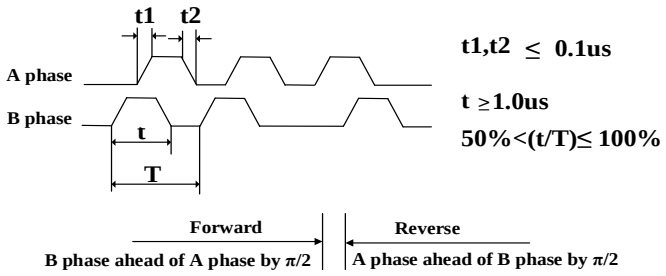
1) Example of I/O signal time sequence



- The interval between S-ON signal and input pulse instructions should be above 40ms. If this interval is less than 40ms, servo drive may fail to receive the pulse instructions.
- Please set CLR signal to be above 20 μs.

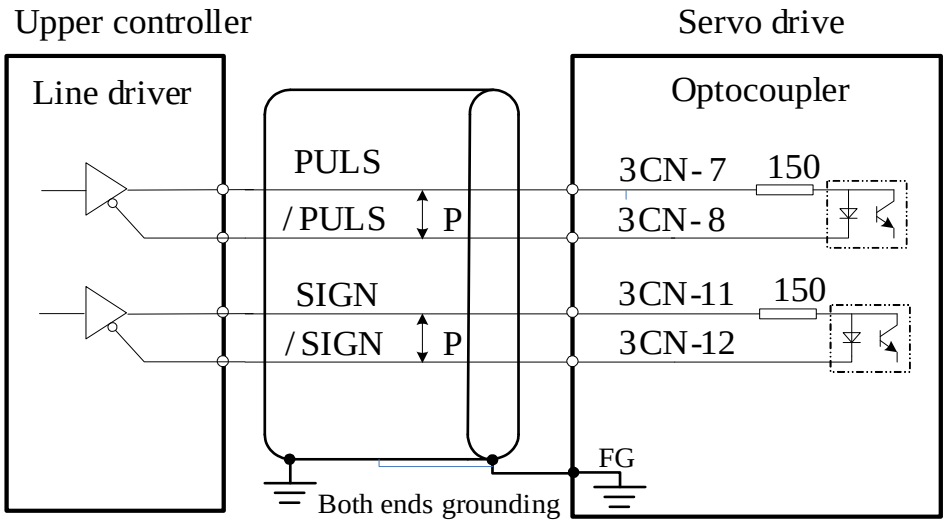
.

Pulse forms	Maximum frequency	Specifications
SIGN+ PULS	500Kbps. Open-collector: 200Kbps	
CW+ CCW	500Kbps. Open-collector: 200Kbps	

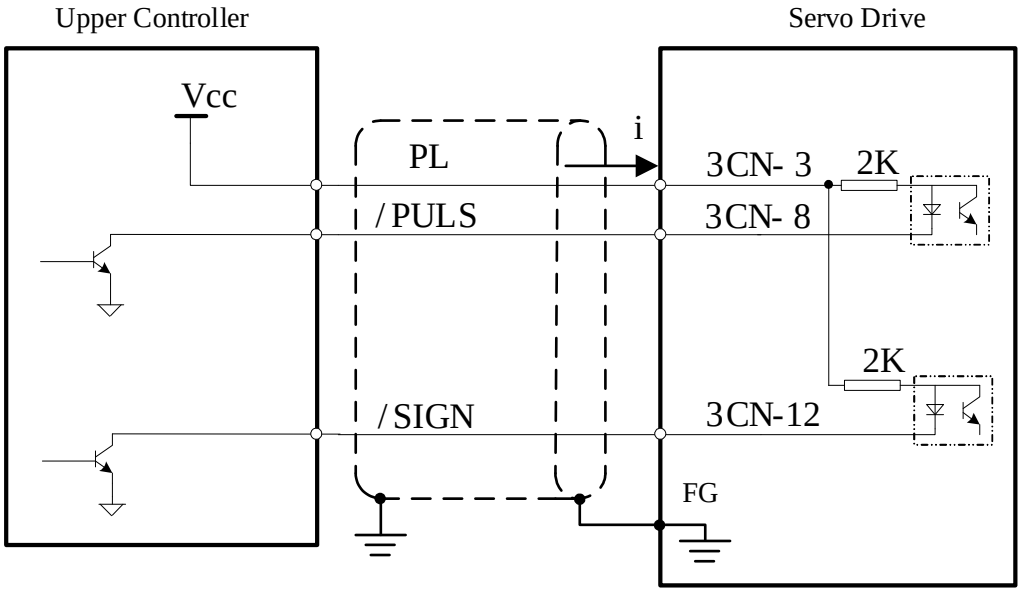
A phase+ B phase	200Kbps. Open-collector: 150Kbps	

2) Connection examples

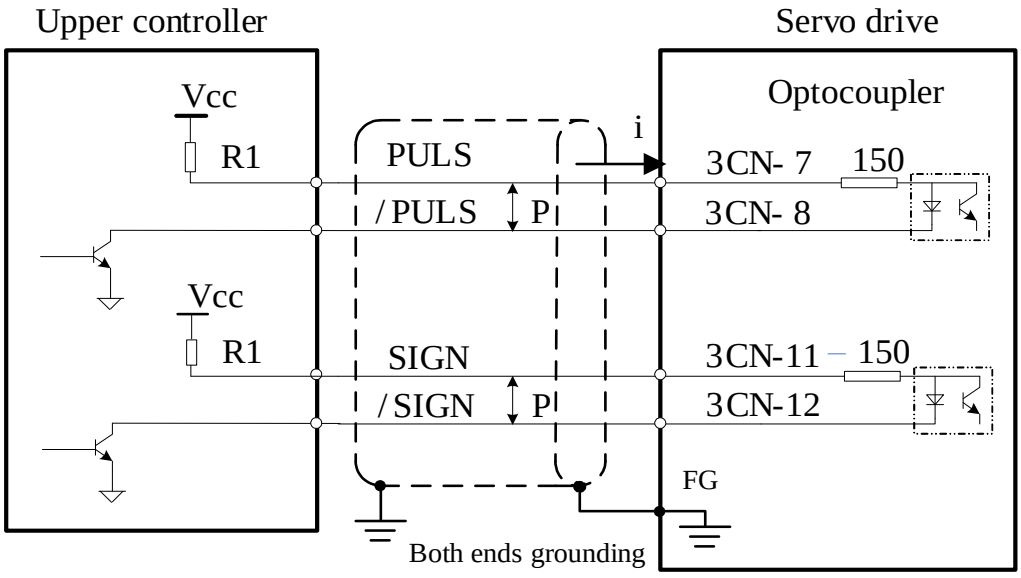
- Line driver, low speed pulse



- Open collector, option 1 (external 24VDC)



- Open collector, option 2 (external 5VDC, 12VDC or 24VDC)



Input current should be 7 ~ 15mA, thus R1 resistance should be:
If 24VDC, R1=2KΩ;
If 12VDC, R1=510Ω;
If 5VDC, 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; on the drive side, the shielding shall hang in air;
- Modify PA201.0: the higher PA201.0, the higher filtering effect, the lower input chop frequency.

8.4.4 Smoothness

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

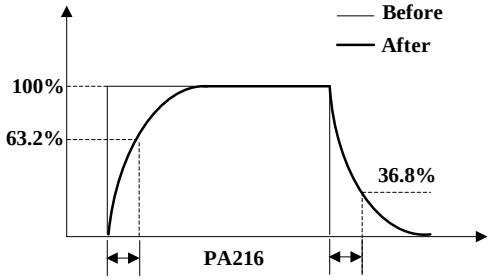
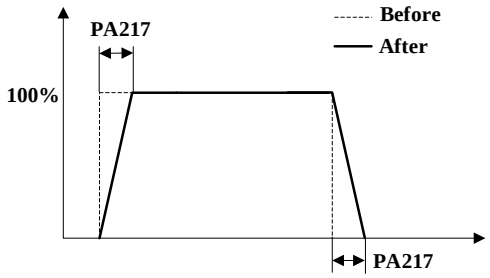
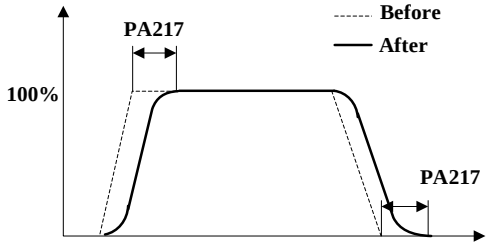
PA216	Position instruction acceleration/deceleration time constant 1			
	Range	Unit	Default	Effective
	0~32767	0.1ms	0	Immed
PA217	**Position instruction average-moving filter**			
	Range	Unit	Default	Effective
	0~1000	rpm	0	Immed

If position instruction acceleration/deceleration time constants (PA216, PA217) are changed, the changed value takes effect only if there's no simultaneous pulse input. In order to truly reflect the set value, please input CLR signal to prohibit pulse instructions.

Even in the following cases, motor can operate smoothly. Also, this setting has no effect on movement amount (instruction pulse count) .

- The upper controller that sends the instructions can't accelerate or decelerate.
- The frequency of instruction pulse is low
- The electronic gear ratio is relatively high (more than 100 times)

Effects of PA214, PA215, PA216 are shown as below:

Position instruction acceleration/deceleration time constants (PA216)	Position instruction average-moving filter (PA217)
	
	

8.4.5 Positioning completed signal (COIN)

This signal means that servo motor positioning is completed at position control.

Type	Signal	Pin	Level	Name
Output	COIN	CN3-29, 30 (default)	ON= L level	Positioning completed
			OFF=H level	Positioning not completed

PA525	COIN signal width			
	Range	Unit	Default	Effective
	0~1073741824	1pulse	7	Immed

- If the difference between the upper controller's instruction 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; this also depends on the electronic gear setting.
- If the set value of PA525 is too high and servo is running in low speed, 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.

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 instruction 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	Pin	Level	Name
Output	NEAR	To be allocated	ON=L level	Near positioning completion
			OFF=H level	Not near positioning completion

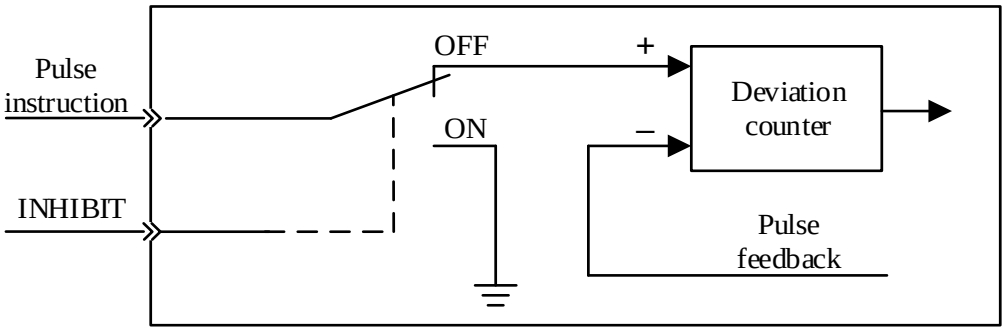
PA524	NEAR signal width			
	Range	Unit	Default	Effective
	0~1073741824	1pulse	100	Immed

- If the difference between the upper controller's instruction 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. this also depends on the electronic gear setting.
- Value of PA524 should be greater than value of PA525.

8.4.7 Pulse input inhibited (INHIBIT)

This is a function that stops (inhibits) instruction pulse input counting in case of position control.

It is in servo locking (clamping) state when this function is used.



Type	Signal	Pin	Level	Name
Input	INHIBIT	CN3-46 (default)	ON=L level	INHIBIT is ON
			OFF=H level	INHIBIT is OFF
INHIBIT is only valid in position control mode.				

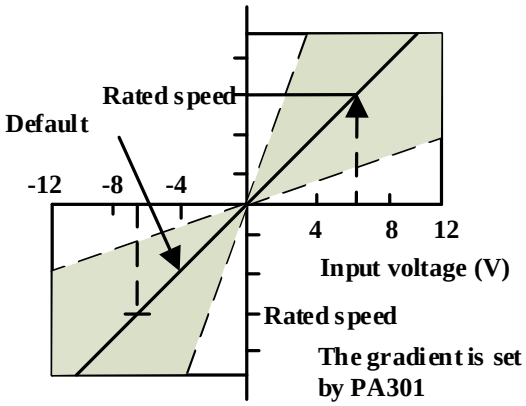
8.5 Speed control operations

8.5.1 Parameter settings

Parameter		Meaning
PA000	n.□□1□	Control mode selection: speed control

PA300	**Speed instruction gain**			
	Range	Unit	Default	Effective
	150~3000	0.01V/ rated speed	600	-

This parameter is for setting the instruction voltage (V-REF) at motor rated speed.



Input voltage range: DC±2V ~ ±10V / rated speed

Examples:

- PA300=600 means that with 6V input, the motor will at the rated speed (default) ;
- PA300=1000 means that with 10V input, the motor will at the rated speed.

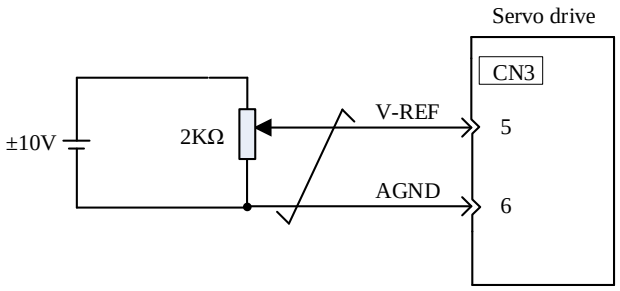
8.5.2 Input signals

1) Speed instruction input

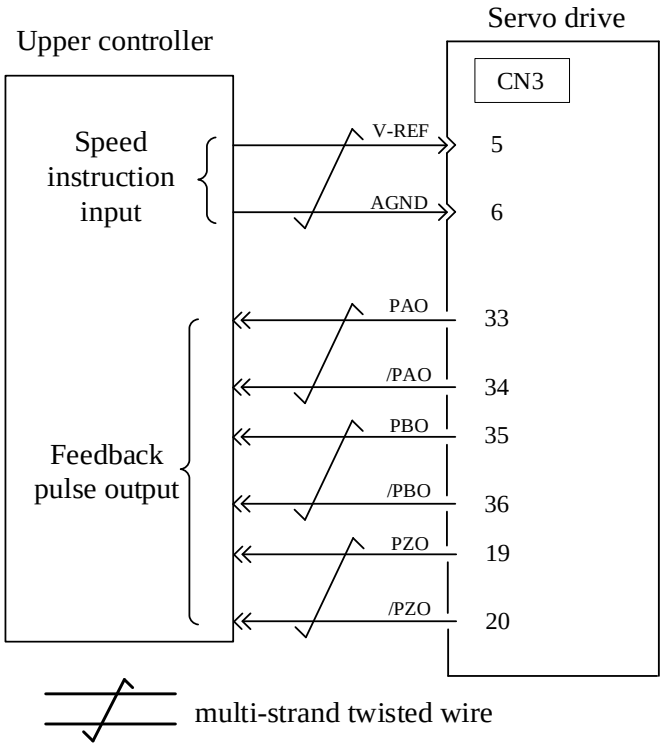
If speed instruction is sent to the servo drive, servo motor will run at a speed proportional to input voltage.

Type	Signal	Pin	Name
Input	V-REF	CN3-5	Speed instruction input
	AGND	CN3-6	GND for speed instruction input

Please use multi-strand twisted wire to prevent interferences.



Programmable controller and so on are used for connection with the instruction controller's speed instruction output terminal in case of position control by



2) Proportional action instruction signal (P-CON)

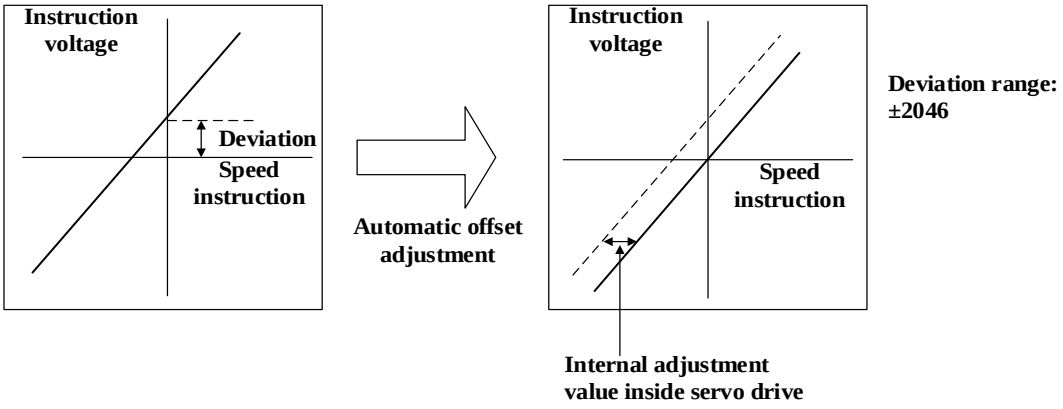
Type	Signal	Pin	Level	Name
Input	P-CON	To be allocated	ON=L level	Operate the servo drive in proportional (P) mode;
			OFF=H level	Operate the servo drive in proportional & integral (PI) mode

- P-CON signal is a signal in respect of which speed control mode is selected from PI (Proportional and integral) or P (Proportional) control.
- If it's set to P, then control can relieve motor rotation and slight vibration caused by speed instruction input drifting.
- Input instruction: It can progressively reduce servo motor rotation caused by drifting at 0V, but servo rigidity (supconnector strength) decreases at stop.

8.5.3 Instruction offset adjustment

When in speed control mode, even with 0V instruction, the motor may still rotate at a slight speed. This happens when instruction voltage of upper controller or external circuit has slight (mV unit) deviation (offset). In this case, instruction offset can be adjusted automatically or manually by using the panel operator. Please use automatic or manual offset adjust by referring to Chapter 6.8 & 6.9.

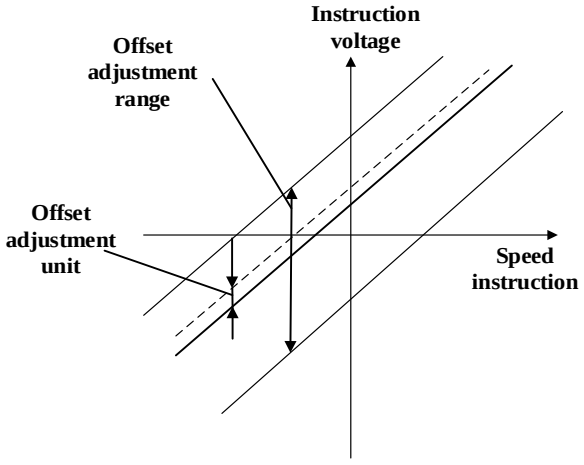
Automatic offset adjustment is the function of offset measuring and automatic voltage adjustment. When the voltage instruction of upper controller and external circuit is deviated, the servo drive will adjust the offset automatically as follows:



1) Analog instruction automatic offset adjustment (AF006)
Please refer to Chapter 6.8.

2) Speed instruction manual offset adjustment (AF007)
Use AF 07 in following situations (Please refer to Chapter 6.9) :

- When servo is locked and deviation pulse is set to 0, AF006 can't be used.
- When user wants to set offset to a certain value;
- When the offset value is confirmed by AF006.



Offset adjustment range: ±2046
Speed instruction: ±750mV

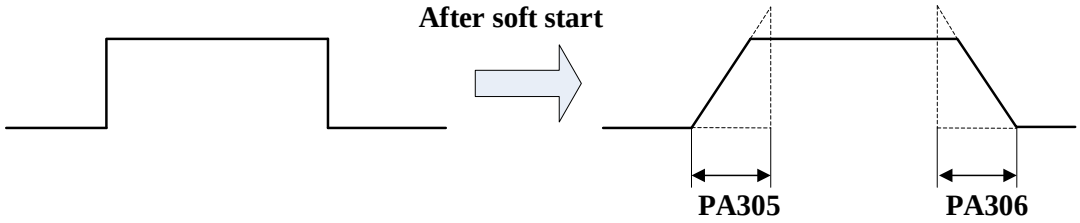
Offset adjustment unit
Speed instruction: 1= 0.05mV

8.5.4 Soft start

Soft start is the function that phase step speed instruction input is transformed to instruction with certain acceleration and deceleration curves inside servo drive, thus to achieve smooth operations.

PA305	**Soft start acceleration time**			
	Range	Unit	Default	Effective
	0~10000	1ms	0	Immed
PA306	**Soft start deceleration time**			
	Range	Unit	Default	Effective
	0~10000	1ms	0	Immed

- PA305: Acceleration time from 0rpm to 1000rpm;
- PA306: Deceleration time from 1000rpm to 0rpm.



8.5.5 Speed instruction filter time constant

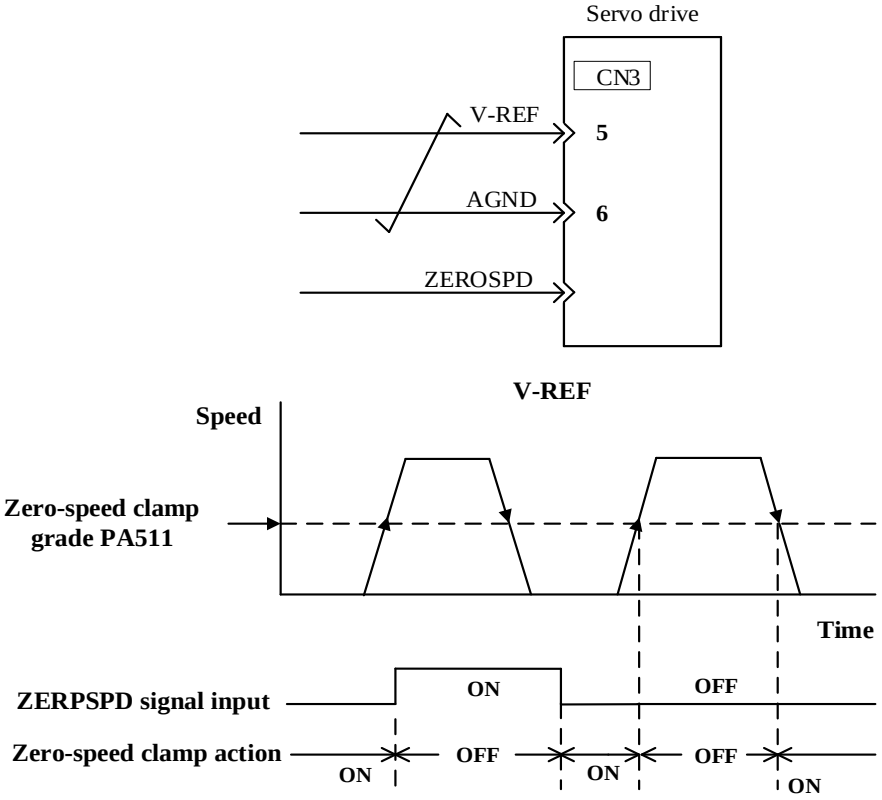
PA307	**Speed instruction filter time constant**			
	Range	Unit	Default	Effective
	0~65535	0.01ms	40	Immed

Analog speed instruction (V-REF) is input through 1-time relay filter to smooth speed instruction. The responsiveness will be reduced if the set value is too large.

8.5.6 Zero-speed clamp function

This is a function used when upper controller is not configured with position loop in case of speed control.

If zero-speed clamp (ZEROSPD) signal is set to be ON, and input voltage of speed instruction (V-REF) (PA300.3=1) is below PA511 (zero-speed clamp grade) , servo drive is configured with position loop inside, and speed instruction is ignored and servo motor is stopped in the servo locking state. The servo motor is clamped to within ±1 pulse at the position where zero-speed clamp is effective, and it will return to the zero-speed clamp position even if turned by external force.



PA511	Zero-speed clamp grade			
	Range	Unit	Default	Effective
	1~2000	1rpm	30	Immed

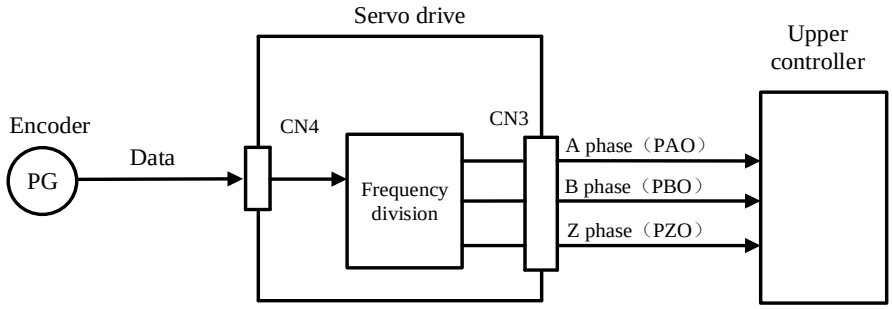
This is to set the motor into automatic zero-speed clamp state when speed is lower than PA511 setting. PA511 should be lower than maximum motor speed.

Type	Signal	Pin	Level	Name
Input	ZERPSPD	To be allocated	ON=L level	Zero-speed clamp function ON
			OFF=H level	Zero-speed clamp function OFF

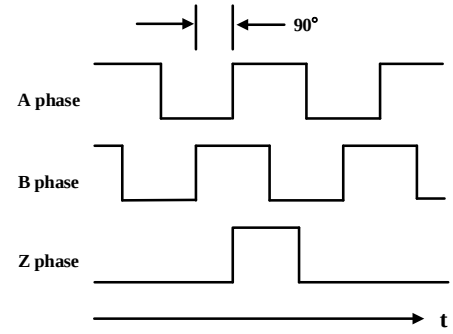
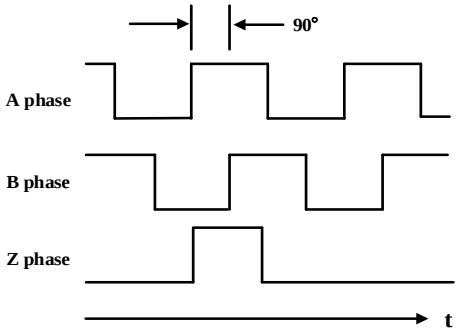
8.5.7 Encoder signal output

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

Type	Signal	Pin	Name
Output	PAO	CN3-33	Encoder Output A Phase
	/PAO	CN3-34	Encoder Output /A Phase
Output	PBO	CN3-35	Encoder Output B Phase
	/PBO	CN3-36	Encoder Output /B Phase
Output	PZO	CN3-19	Encoder Output Z Phase (reference point)
	/PZO	CN3-20	Encoder Output /Z Phase (reference point)



- **Output phase status**

Positive rotation (B phase is π/2 ahead of A phase)	Negative rotation (A phase is π/2 ahead of B phase)
	

Please make servo drive rotate by two turns before using servo drive's Z phase 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 speed below 600rpm (calculated according to servo motor's rotating speed) .

- **Frequency division**

This is a transformation process of the encoder pulse feedbacks by changing the density of pulses. The parameter is PA212.

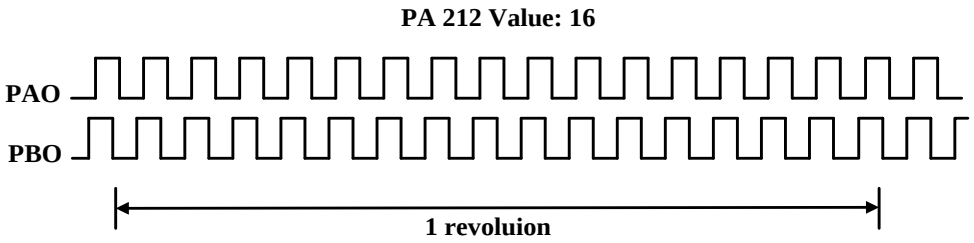
- **Encoder resolution (frequency-division) setting**

PA212	Encoder resolution (frequency-division) setting			
	Range	Unit	Default	Effective
	16~16384	1Pulse/ rev	2500	Immed

The setting range is dependent on the encoder resolution.

Encoder specification	Resolution	Pulse per revolution	Range
17-bit	131072	32768ppr	16~16384

- **Example: PA212=16**



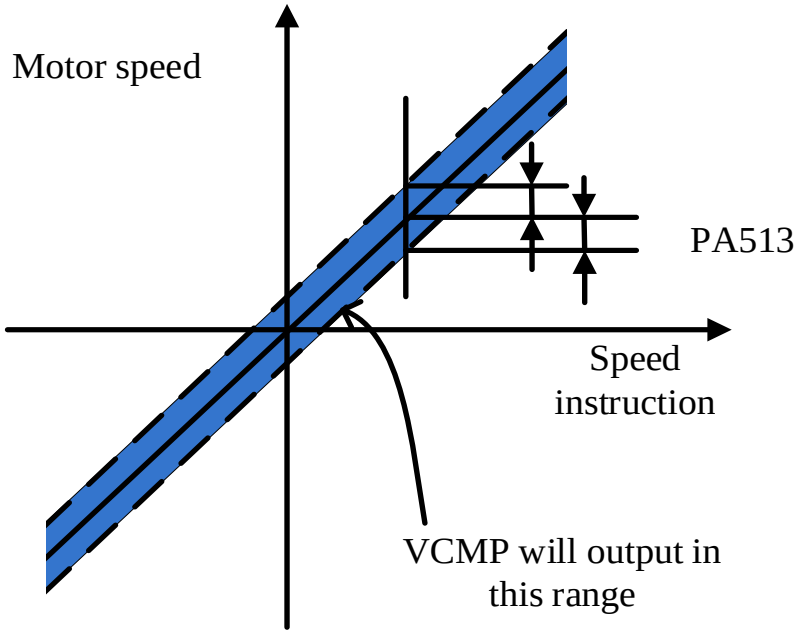
8.5.8 Speed instruction reached (VCMP)

When motor rotation speed is same as speed instruction, VCMP will output

Type	Signal	Pin	Level	Name
Output	VCMP	To be allocated	ON=L level	Same speed
			OFF=H level	Not same speed

PA513	VCMP signal detection width			
	Range	Unit	Default	Effective
	0~100	rpm	10	Immed

If the difference between motor speed and instruction speed is less than PA517 value, VCMP will output.



For example, PA513=100, speed instruction is 2000rpm, if motor speed is within 1900rpm to 2100rpm, VCMP will be ON.

8.6 Torque control operations

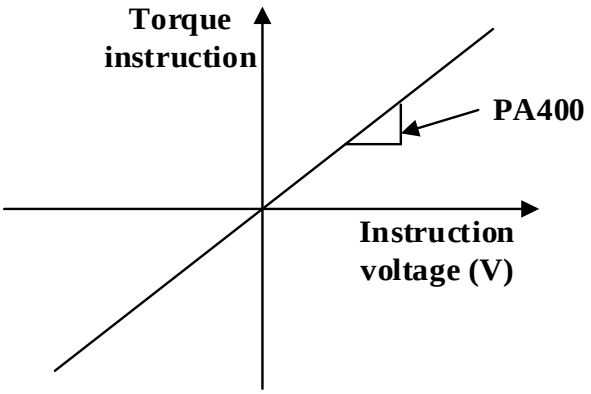
8.6.1 Parameter settings

When using analog instructions for torque control, following parameters need to be set:

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

PA400	Torque instruction gain			
	Range	Unit	Default	Effective
	10~100	0.1V/ rated torque	30	Immed

This parameter is for setting the instruction voltage (T-REF) at motor rated torque.



- **Examples**

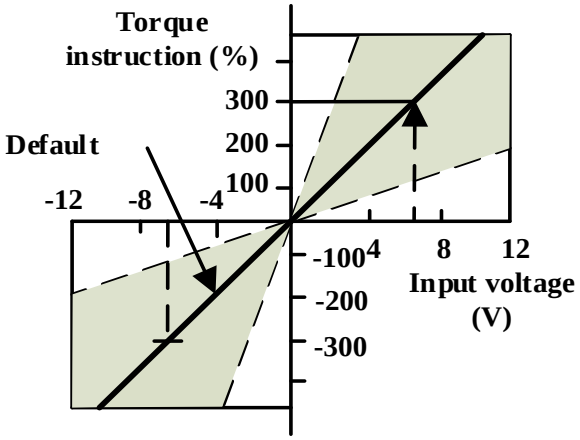
PA400=30: Input 3VDC will output rated torque (Default)
PA400=100: Input 10VDC will output rated torque
PA400=20: Input 2VDC will output rated torque

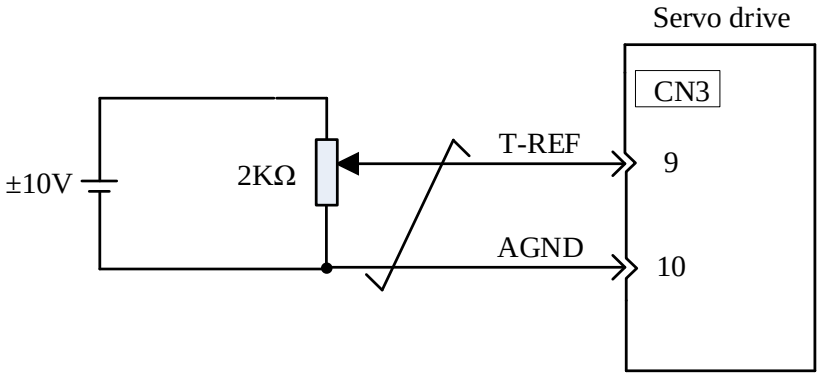
8.6.2 Input signals

If speed instruction is sent to the servo drive, servo motor will run at a speed proportional to input voltage.

Type	Signal	Pin	Name
Input	T-REF	CN3-9	Torque instruction input
	AGND	CN3-10	GND for torque instruction input

Input voltage range: DC±2V ~ ±10V / rated torque



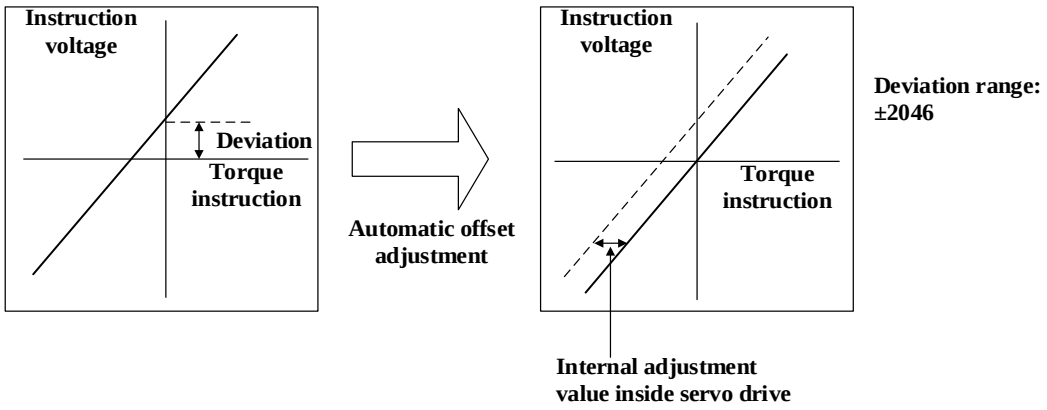


dP00A is for Internal torque instruction (value in relation to the rated torque) display in internal torque instruction in torque/speed/position control modes.

8.6.3 Instruction offset adjustment

When in torque control mode, even with 0V instruction, the motor may still output at a slight torque. This happens when instruction voltage of upper controller or external circuit has slight (mV unit) deviation (offset) . In this case, instruction offset can be adjusted automatically or manually by using the panel operator. Please use automatic or manual offset adjust by referring to Chapter 6.8 & 6.10.

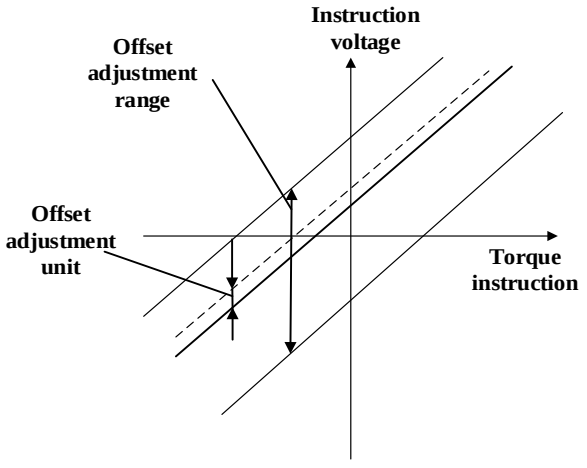
Automatic offset adjustment is the function of offset measuring and automatic voltage adjustment. When the voltage instruction of upper controller and external circuit is deviated, the servo drive will adjust the offset automatically as follows:



1) Analog instruction automatic offset adjustment (AF006)
Please refer to Chapter 6.8.

2) Torque instruction manual offset adjustment (AF008)
Use AF008 in following situations (Please refer to Chapter 6.10) :

- When servo is locked and deviation pulse is set to 0, AF006 can't be used.
- When user wants to set offset to a certain value;
- When the offset value is confirmed by AF006.

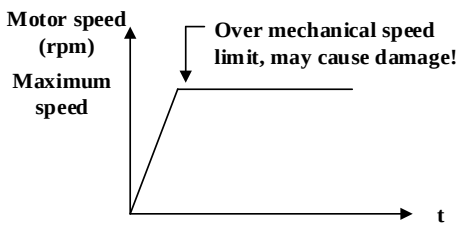
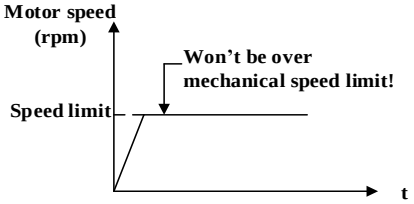


Offset adjustment range: ±2046
Torque instruction: ±750mV

Offset adjustment unit
Torque instruction: 1= 0.05mV

8.6.4 Speed limit in torque control mode

When servo motor needs to be output torque following torque instructions, motor's rotating speed is not controlled. If instruction torque is too large due to the load torque at mechanical side, motor's rotating speed may increase too much. As a protection measure at mechanical side, servo motor's rotating speed needs to have limits in torque control mode.

With no speed limit	With speed limit
	

- **Speed limit in torque control mode selection**

Parameter		Meaning
PA002	n.□□0□	Use PA407 as speed limit (internal speed limit)
	n.□□1□	Use V-REF & PA300 setting as speed limit (external speed limit)

- **Speed limit in torque control mode**

PA407	Speed limit in torque control mode			
	Range	Unit	Default	Effective
	0~6000	rpm	1500	Immed

When PA002.1=0, settings of this parameter is effective.
Value of PA407 shall not exceed maximum motor speed.

- **External speed limit**

Type	Signal	Pin	Name
Input	V-REF	CN3-5	External speed limit
	AGND	CN3-6	GND for external speed limit

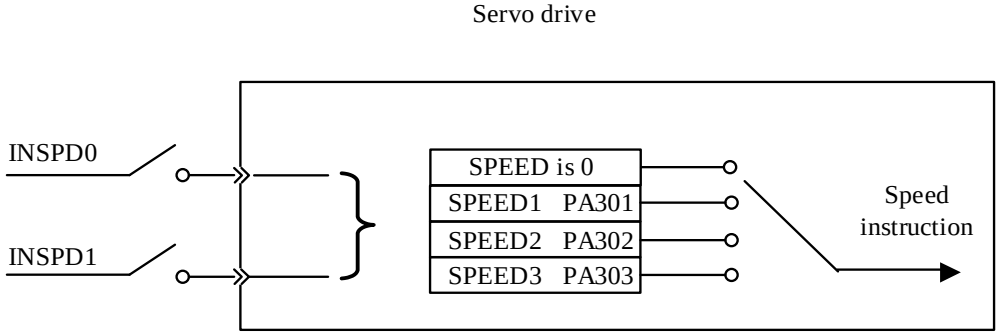
PA300 setting has no polarity.

PA300	Speed instruction gain			
	Range	Unit	Default	Effective
	150~3000	0.01 V/rated speed	600	Immed

8.7 Internal speed control

Internal speed control is to set 3 speeds beforehand through parameters inside servo drive and to select among them by using external input signals INSPD1 and INSPD0.

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



INSPD1	INSPD0	Internal speed selection
0 (Invalid)	0 (Invalid)	Speed is 0
0 (Invalid)	1 (Valid)	Internal speed 1 (PA301)
1 (Valid)	0 (Invalid)	Internal speed 2 (PA302)
1 (Valid)	1 (Valid)	Internal speed 3 (PA303)

8.7.1 Parameter settings

Parameter		Meaning		
PA000	n. □□3□	Control mode selection: internal speed control		
PA301	**Internal speed 1**			
	Range	Unit	Default	Effective
	－6000~6000	rpm	100	Immed
PA302	**Internal speed 2**			
	Range	Unit	Default	Effective
	－6000~6000	rpm	200	Immed
PA303	**Internal speed 3**			
	Range	Unit	Default	Effective
	－6000~6000	rpm	300	Immed

8.7.2 Input signals

Type	Signal	Pin	名称
Input	INSPD0	To be allocated	Internal speed register 0
	INSPD1	To be allocated	Internal speed register 1

8.8 Combination of different control modes

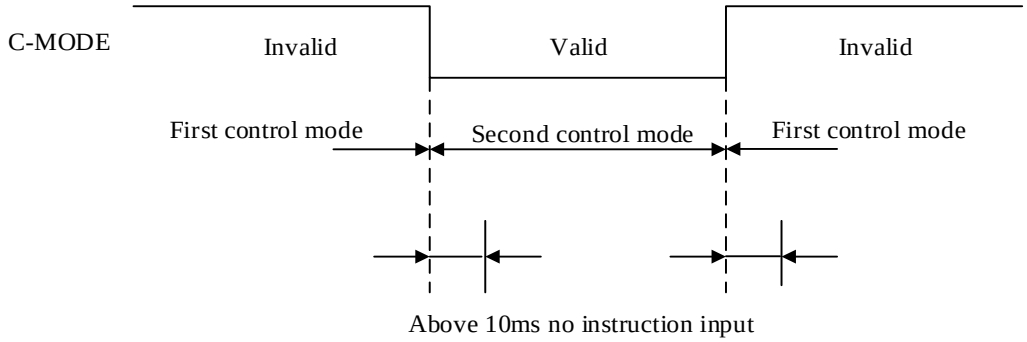
The servo can select two control modes and switch between them. Settings are as below:

8.8.1 Parameter settings

Parameter		Control mode combinations
PA000	n.□□4□	Internal speed control ←→ Position control
	n.□□5□	Internal speed control ←→ Speed control
	n.□□6□	Internal speed control ←→ Torque control
	n.□□7□	Position control ←→ Speed control
	n.□□8□	Position control ←→ Torque control
	n.□□9□	Torque control ←→ Speed control

8.8.2 Input signal

- When C-MODE is invalid, first control mode is selected;
- When C-MODE is valid, second control mode is selected

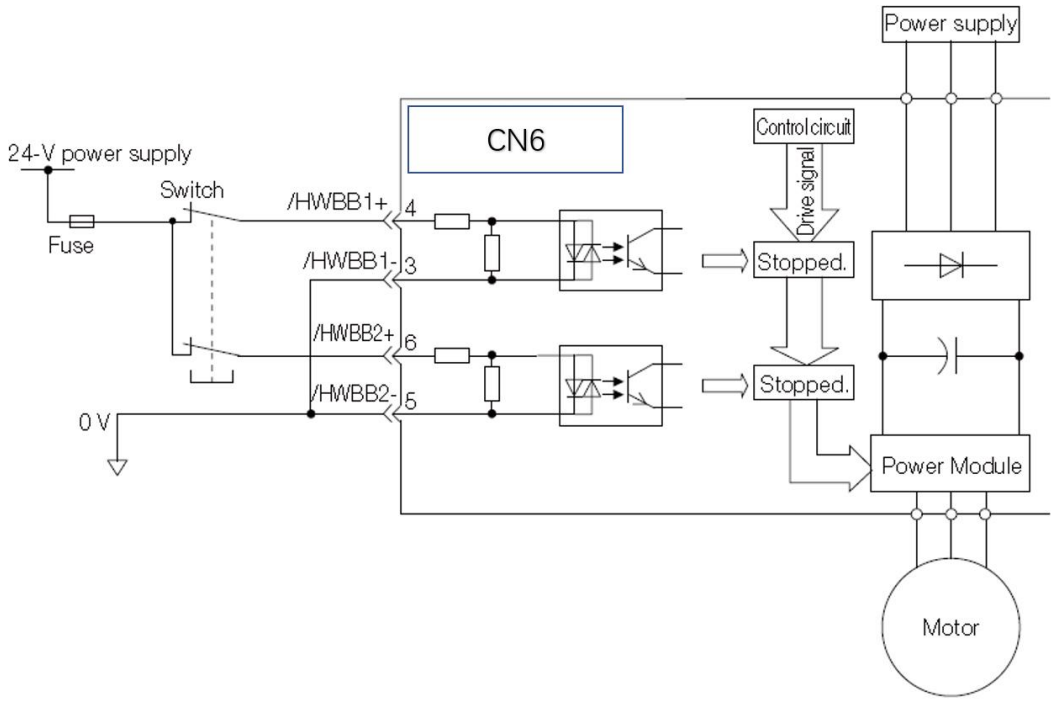


8.9 Safety functions

In order to protect the operator from the dangerous action of the moving parts of the machine, reduce the risk when using the machine, and improve its safety, this servo driver has built-in safety functions. This function can prevent the dangerous action caused by the moving parts of the machine, especially when the protective cover must be opened for work maintenance

8.9.1 Hard wire base block (HWBB)

The Hard wire base blocking function (hereinafter referred to as HWBB function) refers to the safety function of base blocking (cutting off the motor current) by hardware.
By blocking the drive signal of the power module that controls the motor current through independent circuits connected to the input signals of the two channels, the power module can be turned off and the motor current can be cut off (refer to the circuit diagram below).



1) Risk assessment
When using the HWBB function, be sure to perform a risk assessment of the equipment and confirm that the equipment meets the safety requirements specified in the following safety standards.
EN954 Category3
IEC61508 SIL2
Even if the HWBB function is effective, the following risks still exist. Be sure to consider the safety of the following factors in the risk assessment.

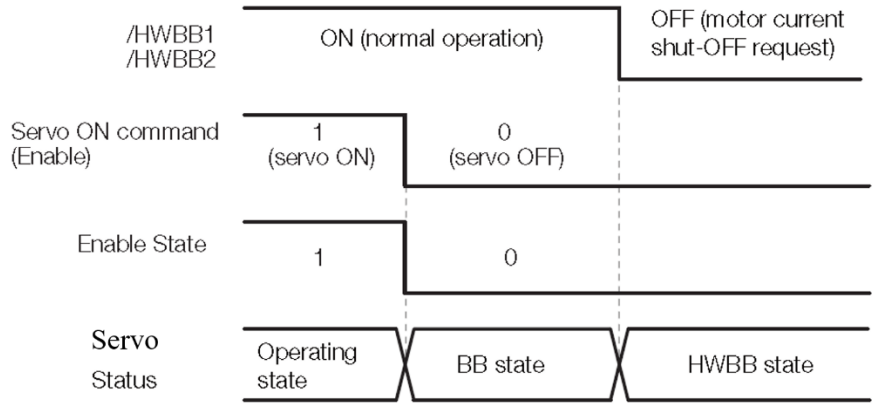
- The motor will operate when external force (gravity, etc. in the vertical axis) is applied. Prepare separate devices such as mechanical brakes.
- Due to the failure of the power module, the motor may operate within the electrical angle of 180

degrees. Check if this operation is dangerous.

● The HWBB function cannot cut off the power of the servo driver and does not perform electrical insulation. When maintaining the servo driver, prepare a separate device such as cutting off the power of the servo driver.

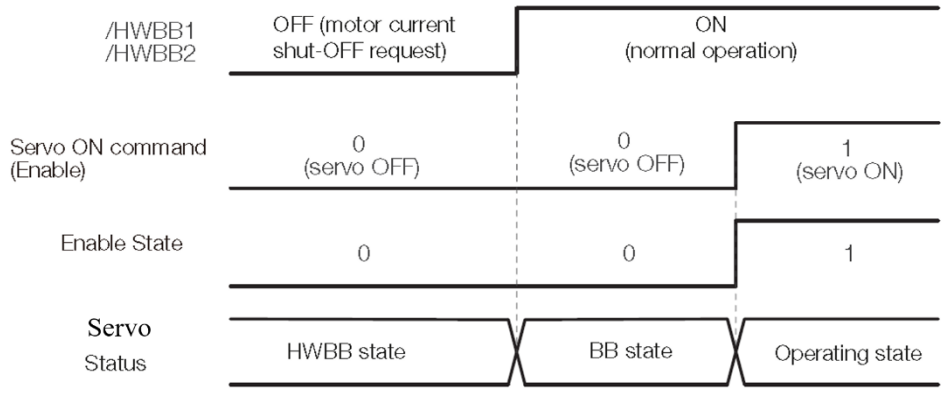
2) HWBB state

The status of the servo driver when the Hard wire base blocking function is operating is as follows. When the / HWBB1 or / HWBB2 signal is OFF, the HWBB function of the servo driver operates and enters the Hard wire base blocking state (hereinafter referred to as HWBB state).



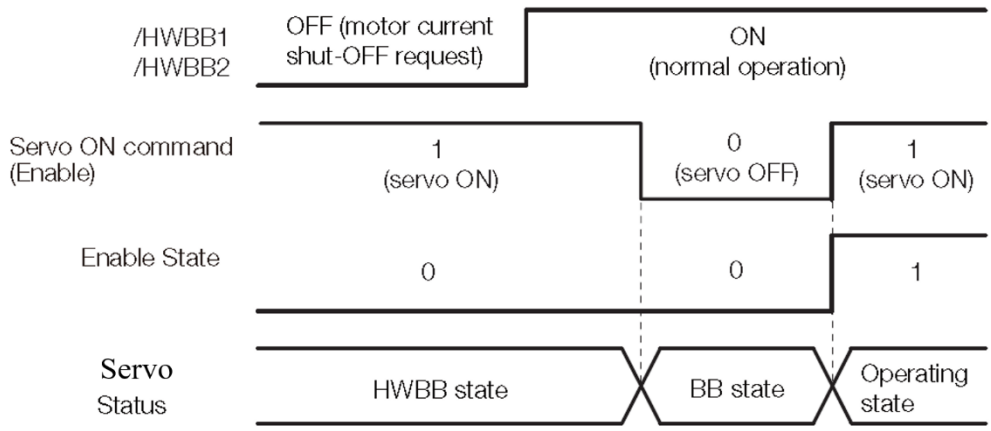
3) Restore from HWBB state

Normally, after entering the base blocking state with the servo OFF command (the servo motor is not energized), the servo driver can enter the HWBB state by turning off the / HWBB1 and / HWBB2 signals. After the / HWBB1 and / HWBB2 signals are turned ON in this state, the base will be blocked (hereinafter referred to as the BB state), and the servo ON command can be received.



If the servo ON command is input while the / HWBB1, / HWBB2 signals are OFF, the HWBB status will remain unchanged even after the / HWBB1, / HWBB2 signals are turned ON.

At this time, please input the servo OFF command to enter the BB state, and then input the servo ON command again.



(Note)

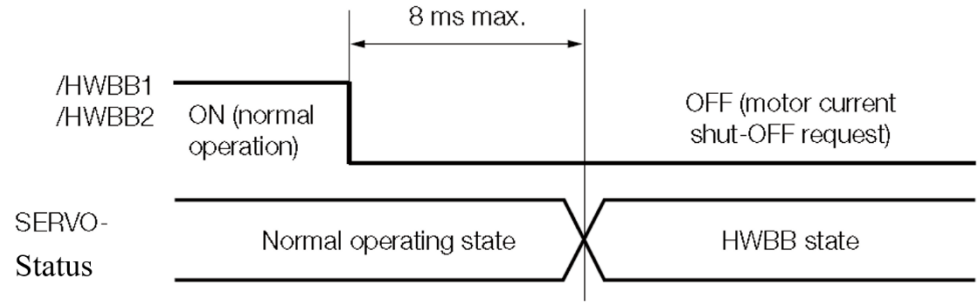
1. Even if the base is blocked by cutting off the main circuit power, etc., the HWBB state will remain until the servo OFF command is input.
2. If the / S-ON signal is always set to "active" by the / S-ON signal distribution (PA50A.1), it cannot be restored. Do not make this setting when using the HWBB function.

4) HWBB alarm output

When either of the / HWBB1 or / HWBB2 signals is input and the other signal is not input within 10 seconds, the "input signal failure (E.600) alarm for safety function" will occur. This function can detect faults such as HWBB signal disconnection.

5) HWBB connection example

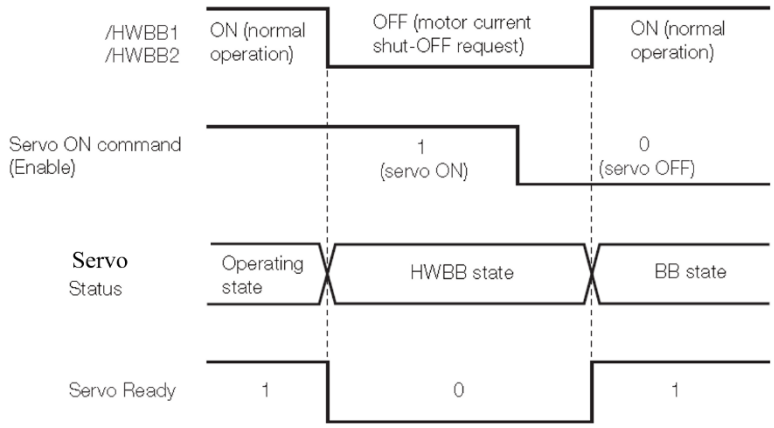
Type	Signal	Pin	State	Remarks
Input	/HWBB1	CN5-4	ON	HWBB function invalid
		CN5-3	OFF	HWBB function valid
	/HWBB2	CN5-6	ON	HWBB function invalid
		CN5-5	OFF	HWBB function valid



6) About S-RDY

Since the servo ON command cannot be received in the HWBB state, the servo ready output is OFF. When the / HWBB1 and / HWBB2 signals are both ON and the / S-ON signal is OFF (BB status), the servo ready output turns ON.

The following is an example when the main circuit power is ON, the S-ON signal is ON (when using an absolute encoder), and no servo alarm has occurred.



7) About BK

When the / HWBB1 or / HWBB2 signal is OFF and the HWBB function is operating, the brake signal (/ BK) is OFF. At this time, due to the " BK signal hysteresis time after Servo-OFF (PA516)" is invalid, so after the brake signal (BK) is turned off and before the brake is actually applied, the motor may operate due to external force.

(Note) Since the brake signal output has nothing to do with the safety function, make sure that the system is designed in the HWBB state so that no danger will occur even if the brake signal fails. Please note that the brakes of servo motors are for holding postions only and cannot be used for braking purposes.

8) About DB

When the dynamic brake is set to "enabled" by PA001.0, the / HWBB1 or / HWBB2 signal is turned off and the HWBB function is operated, the dynamic brake will stop the servo motor.

Since the dynamic brake has nothing to do with the safety function, make sure that the system is designed in the HWBB state so that no danger will occur even when it enters free running. It is generally recommended to take a sequence loop that stops after entering the HWBB state by a command.

9) About position deviation clearance

The position deviation clear in HWBB state is implemented according to the setting of the clear signal format (PA200.2).

If the position deviation is not cleared during position control (PA200.2 = 1), in the HWBB state, if the position command from the host device is not stopped, the position deviation will continue to accumulate, resulting in the following situations.

- An excessive position deviation alarm (A.d00) occurred.
- When the servo is turned on from the HWBB state to the BB state, the motor will only run the accumulated position deviation.

Therefore, in the HWBB state, stop the position command from the host device. In addition, if it is set to not clear the position deviation (PA200.2 = 1), in HWBB state or BB state, please input the clear signal (CLR) to clear the position deviation.

8.9.2 External device monitor (EDM1)

External device monitor (EDM1) is a function that monitors the failure of the HWBB function. Connect with feedback such as safety devices. The relationship between EDM1 and / HWBB1, / HWBB2 signals is shown below.

Signal	Logic			
/HWBB1	ON	ON	OFF	OFF
/HWBB2	ON	OFF	ON	OFF
EDM1	OFF	OFF	OFF	ON

Type	Signal	Pin	State	Remarks
Output	EDM1+	CN5-8	ON OFF	ON: The base blocking performed by the / HWBB1 signal and the base blocking performed by the / HWBB2 signal both operate normally.
	EDM1-	CN5-7		

8.9.3 Safety precautions when using HWBB function

● To confirm whether the HWBB function meets the security requirements of the application system, be sure to perform a system risk assessment.
Otherwise, personal injury may occur due to improper use.
● Even during HWBB function operation, the motor may be operated by external force (gravity of the vertical axis, etc.). Please install a mechanical brake that meets the system safety requirements.
Otherwise, personal injury may occur due to improper use.
● Even during HWBB function operation, the motor may operate within 180 ° of the electrical angle due to a servo drive failure. Use it only for applications that ensure that the operation does not cause danger.
Otherwise, personal injury may occur due to improper use.
● Dynamic brakes and brake signals are not related to safety functions. When designing the system, make sure that these failures do not cause danger when the HWBB function operates.
Otherwise, personal injury may occur due to improper use.
● Please connect a device that complies with safety standards to the signal for safety function.
Otherwise, personal injury may occur due to improper use.
● When using the HWBB function as an emergency stop function, use separate electrical and mechanical parts to cut off the power to the motor.
Otherwise, personal injury may occur due to improper use.
● HWBB function is not used to cut off the power of the servo drive or perform electrical insulation. When performing maintenance on the servo driver, be sure to use other methods to cut off the power of the servo driver.Otherwise it may cause electric shock.

Chaper 9 Gain adjustment

9.1 Gain 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 driver.
The servo gain is set by a combination of multiple parameters (speed 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-rigidity machine can improve responsiveness by increasing the servo gain. However, for a machine with low rigidity, 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 driver.

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.

Using this function, the above-mentioned multiple parameters will be adjusted automatically, so usually there is no need to adjust the parameters separately.

Adjustment-related Auxiliary function	Summary	Control mode
Automatic stiffness adjustment (AF100)	The factory setting is effective for this function. Regardless of machine type and load fluctuation, stable response can be obtained.	Position control , speed control
Internal instruction type automatic adjustment (AF101)	While running automatically according to the internal instructions of the servo driver, the following items are adjusted automatically. ● Inertia ratio ● Gain (position loop gain, speed loop gain, etc.) ● Filter (torque command filter, notch filter) ● Disturbance compensation ● Vibration reduction control ● Vibration suppression control	Position control , speed control
External instruction type automatic adjustment (AF102)	Input the position command from the host device, and automatically adjust the following items while running. ● Gain (position loop gain, speed loop gain, etc.)	Position control

	● Filter (torque command filter, notch filter) ● Disturbance compensation ● Vibration reduction control ● Vibration suppression control	
Simple parameter type automatic adjustment (AF103)	Input the position command or speed command from the host device, the following items are automatically adjusted while running. ● Gain (position loop gain, speed loop gain, etc.) ● Filter (torque command filter, notch filter) ● Disturbance compensation ● Vibration suppression control	Position control , speed control
Vibration suppression control function (AF104)	This function suppresses continuous vibration.	Position control , speed control
Vibration reduction control function (AF105)	This function suppresses aftershocks generated during positioning .	Position control

Notes

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 driver protection function shown in (1) to (6) below under appropriate conditions .

(1) Overtravel setting

Make the overtravel setting. Refer to Chapter 8.2.3.

(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.

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

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

$$\text{PA520} > \frac{\text{Motor speed (rpm)}}{60} * \frac{\text{Encoder resolution}}{\text{PA102}} * (1.2\sim2)$$

'*(1.2~2)' is a surplus coefficient to avoid frequent occurrence of excessive position deviation alarm (A.d00). 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.

The calculation example using the motor with maximum motor speed: 3000 rpm, PA102 = 40, and encoder resolution: 8388608 (23-bit) is shown below.

$$\text{PA520} = \frac{3000}{60} \times \frac{8388608}{40} \times 2 = 10485760 \times 2 = 20971520$$

When the acceleration and deceleration speed 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 and deceleration speed of the position command to a value that the motor can track, or increase the alarm value of excessive position deviation.

Related parameters : PA520

Related alarm : A.d00

(4) Setting of vibration detection function

Initialize the vibration detection value initialization (AF021), and set an appropriate value for the vibration detection function.

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

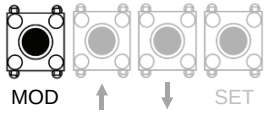
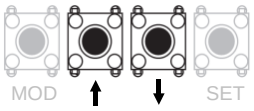
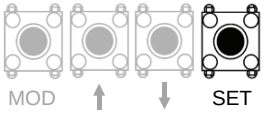
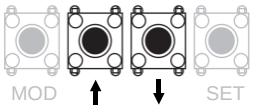
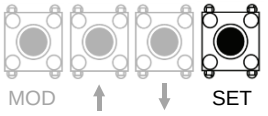
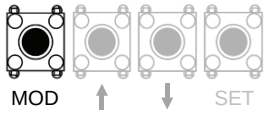
When the clear operation (PA200.2) is set to a value other than "0", if the servo is turned on while the position deviation is accumulated, the position will be returned to the original position so that the position deviation becomes 0. This is very dangerous. To avoid this situation, you can set an 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, PA528, PA529

Related alarms : A.d01, A.d02

9.2 Manual stiffness adjustment (AF030)

Manual stiffness adjustment means to set PA100, PA101, PA102 and PA401 according to user experience.

Steps	Panel display	Keys	Operations
1			Press MOD key to choose auxiliary function mode.
2			If the panel display is not AF030, press ↑ & ↓ until it is AF030.
3			Long press SET. It will show system present stiffness level.
4			Press ↑ & ↓ to adjust system stiffness level.
5			Long press SET to store adjusted value into system.
6			Press the MOD button to exit.
7	End of operations.		

9.3 Automatic stiffness adjustment (AF100)

For general machinery, you can try to run directly without changing the factory settings. If the resonant sound or vibration occurs in the position control, please use AF100 to automatically adjust stiffness level value (corresponding PA600.2) and load level value (corresponding to PA600.3).

Notes
● When auto-tuning is valid, after the servo motor is installed on the machine, an instant sound may occur when the servo is turned on. This is the sound when the automatic notch filter is set, and it is not a malfunction. No sound will occur the next time the servo is turned on. ● When the 17-bit encoder is used and the load inertia ratio is more than 10 times, please set Mode =2 of AF100. ● When the motor is used in excess of its allowable inertia, the motor may vibrate. At this time, please set Mode = 2 through AF100, or reduce the automatic adjustment value.

The automatic adjustment function is enabled or disabled by PA600 . The automatic adjustment function is a function that can obtain a stable response through automatic adjustment regardless of the type of machine and load fluctuation.

The automatic adjustment function is effective during position control and speed control. It is invalid during torque control. In addition, when the automatic adjustment function is enabled, the control functions in the table below are partially limited.

Auxiliary function	Executability	Executable conditions and notes
Vibration detection value initialization (AF021)	○	
Internal instruction type automatic adjustment (AF101)	●	It can only be selected when estimating the inertia ratio. The automatic adjustment function is invalid during AF101 operation, and it becomes valid after the execution.
External instruction type automatic adjustment (AF102)	X	
Simple parameter type automatic adjustment (AF103)	X	
Vibration suppression control function (AF104)	X	
Vibration reduction control function (AF105)	X	
FFT analysis (AF060)	○	The automatic adjustment function is invalid during AF106 operation, and it becomes valid after the execution.
Disturbance compensation	X	
Switching gain	X	
Off-line moment of inertia estimation	X	
Mechanical analysis	○	The automatic adjustment function is invalid during the mechanical analysis, and it becomes valid after the execution.

○: executable ●: executable under conditions ×: not performed

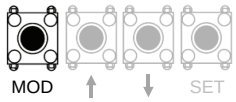
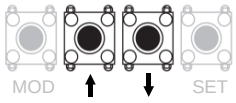
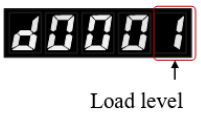
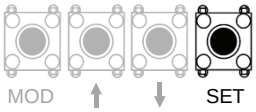
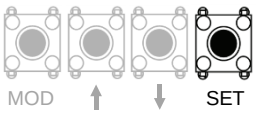
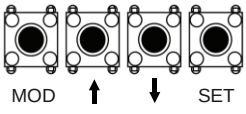
The setting of the automatic notch filter (PA460) should normally be set to automatic (default). The vibration will be automatically detected and the notch filter will be set when the auto adjustment function is enabled. Please set it to "not set automatically "only if you do not want to change the notch filter setting before executing this function .

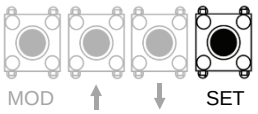
The automatic adjustment value is divided into two types: "automatic stillness level" and "automatic load level value". You can select the respective value by setting the auxiliary function (AF100) and parameter (PA600) .

By changing the auto-tuning value, the servo gain can be adjusted from rigidity value 4 (high gain) to rigidity value 0 (low gain).

Procedure for setting the automatic adjustment value (AF100) is shown below.

Notes
● In the operation of automatic adjustment, in order to ensure safety, please perform the automatic adjustment function in an emergency stop state at any time. ● Before setting the automatic adjustment value, check the following settings. When the setting is not satisfied, "NO-OP" is displayed during operation. ■ The automatic adjustment function must be enabled (PA600.0 = 1) ■ Must not be set to panel lock (AF003) ● If A.521 is shown during operation, please reduce AF100 mode or value setting; or reduce PA600.2 and PAPA600.3 setting value. ● If there are vibrations during operation, please increase AF100 mode setting or PA600.3 setting; or reduce AF100 value setting or PA600.2 setting.

Steps	Panel display	Keys	Operations
1			Press MOD key to choose auxiliary function mode.
2			If the panel display is not AF100, press ↑ & ↓ until it is AF100.
3			Long press SET to enter mode selection. If 'NO-OP' is shown, make sure AF003 is not locked. If waveform shows overshoot, or if load is higher than allowable value, set this to 2.
4			Long press SET to enter value setting.
5			Press ↑ or ↓ to change value. If there is high pitch noise, press MOD and SET simultaneously to store present frequency into notch filter setting.

6			Press SET for 1s and display will show ‘donE’.
7	End of operations.		

When the factory setting is valid for the automatic adjustment function, the parameters PA100, PA101, PA102, PA103, PA104, PA105, PA106, PA630, PA139, PA408 in the table below become invalid. However, when the functions shown in the table below are executed, the above parameters related to gain will become effective.

For example, when the automatic adjustment function is valid, if AnFFT is performed, the setting values of PA100, PA104, PA101, PA105, PA102, PA106, PA103 and manual gain switching are valid, while those of PA408.3, PA630.0 and PA139.0 are invalid .

	Functions performed and valid parameters		
Parameter number	**Torque control**	**AnFFT**	**Mechanical analysis (Vertical axis mode)**
PA100 PA104	○	○	○
PA101 PA105	X	○	○
PA102 PA106	X	○	○
PA103	○	○	○
PA408.3	X	X	X
PA630.0	X	X	X
PA139.0	X	X	X

○: parameter setting value is valid

9.4 Internal instruction type automatic adjustment (AF101)

This section explains how to adjust by internal instruction type automatic adjustment.

Important

The internal instruction type automatic adjustment starts the adjustment based on the currently set speed loop gain (PA100). Therefore, if vibration occurs at the start of adjustment, correct adjustment will not be possible. In this case, perform adjustment after setting a sufficiently stable gain with simple parameter type automatic adjustment (AF103).

- When performing the internal instruction type automatic adjustment while the automatic adjustment function is active (PA600.0 =1), use the " Estimated Inertia (Jcalc = ON)" setting. At this time, the automatic adjustment function will be set to invalid automatically, and the gain will be set by the internal instruction type automatic adjustment . When the internal instruction type automatic adjustment is performed with the setting " No

estimated inertia (Jcalc = OFF)", "Error" is displayed and the internal instruction type automatic adjustment cannot be performed .

● After executing the internal instruction type automatic adjustment , if you change the load state and transmission mechanism of the machine and perform the internal instruction type automatic adjustment again , change the following parameters and set all the settings after the last adjustment to invalid. If the internal instruction type automatic adjustment is performed without changing the parameters , it may cause mechanical vibration and mechanical damage.

PA00B.0 = 1 (display all parameters)

PA610.0 = 0 (do not use model tracking control)

PA630.0 = 0 (do not use vibration suppression control)

PA408=n.00□0 (not used disturbance compensation and the first, second notch filter)

Internal instruction type automatic adjustment refers tothe function that the servo driver automatically adjusts according to the mechanical characteristics when performing automatic operation (forward and reverse reciprocating motion) within the set range. Internal instruction type automatic adjustment can be performed without a host device . At this time, the operation specifications for automatic operation are as follows.

● Maximum speed : rated motor speed × 2/3

● Acceleration torque : The rated torque of the motor is about 100% . The acceleration torque may change due to the influence of the moment of inertia ratio (PA103) setting, mechanical friction, and external interference.

● Movement distance : can be set arbitrarily. The factory setting is equivalent to 3 rotations of the motor .

The internal instruction type automatic adjustment adjusts the following items.

● Moment of inertia ratio

● Gain adjustment (position loop gain, speed loop gain, etc.)

● Filter adjustment (torque command filter, notch filter)

● Disturbance compensation

● Vibration suppression control

● Vibration reduction control (only when Mode = 2 or 3)

Note

The internal instruction type automatic adjustment is performed in the automatic operation mode, so vibration or overshoot may occur during operation. In order to ensure safety, please execute it in an emergency stop state at any time.

Before executing internal instructions automatic adjustment, please confirm the following items. If the setting is not correct, “NO-OP” will be displayed during operation.

◇ Main circuit power must be ON

◇ Servo must be OFF

◇ Overtravel signals must be invalid

◇ Not for torque control

◇ The automatic gain switching must be invalid

◇ Can not choose 2nd gain

◇ No alarms or warnings

◇ Hardware baseblock (HWBB) function must be invalid

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

When executing internal instruction type automatic adjustment under speed control , it will automatically switch to position control and perform adjustment, and return to speed control after adjustment. When executing under speed control, please select "Mode=1".

Situations when internal instruction type automatic timing cannot be performed:

◇ When the mechanical system can only run in one direction

◇ When the range of motion is smaller than 0.5 turns. Use AF102 or AF103 for adjustment.

◇ Unable to obtain proper range of activities

◇ When using the position integration function

◇ During P (proportional action) control

◇ When the moment of inertia changes within the set operating range

◇ When the dynamic friction of the machine is large

◇ When the rigidity of the machine is low and vibration occurs during positioning operation

◇ When using the mode switch

◇ When speed feedforward and torque feedforward are input

◇ Positioning completion margin (PA522) is too small

Important

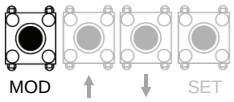
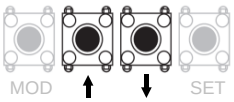
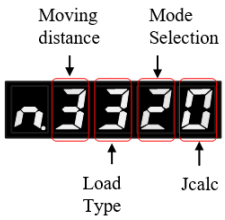
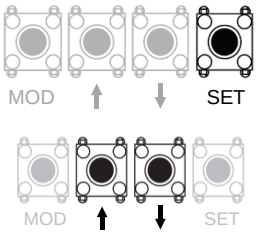
- The internal instruction type automatic adjustment refers to Positioning completion COIN amplitude (PA522)" for adjustment.
  When operating with "Position control (PA000.1 = 1)", please set the "Electronic gear ratio (PA20E / PA210)" and "Positioning Completion (PA522)" to the values during actual operation. When operating with "Speed Control (PA000.1 = 0)", use the factory settings.
- After positioning is completed, if the positioning completion signal (COIN) is not ON within about 3 seconds, "WAITING" will flash. If the positioning completion signal (COIN) does not turn on within about 10 seconds, the automatic adjustment will be aborted after 2 seconds of “Error” flashing .

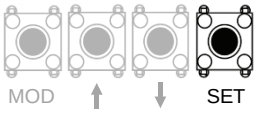
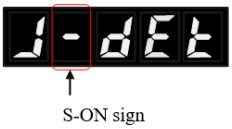
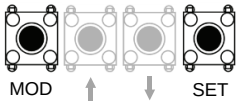
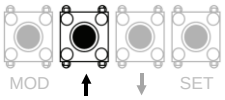
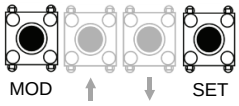
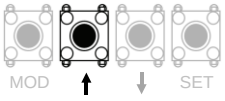
Use the overshoot detection value (PA561) only when you do not want to change the positioning completion COIN amplitude (PA522) and want to fine-tune the overshoot amount. Since the factory setting of PA561 is 100%, it is allowed to adjust up to the same overshoot amount as the positioning completion range. If it is changed to 0%, it can be adjusted without overshooting within the positioning completion range. But changing to this value may result in longer positioning time

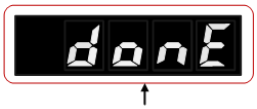
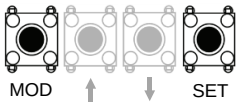
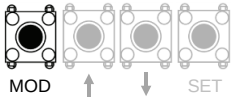
The operation steps of the internal instruction type automatic adjustment are shown below.

Note

- When using " Jcalc = 1 (not estimating load moment of inertia)", set the "Moment of Inertia Ratio (PA103)" correctly . If the moment of inertia ratio is set incorrectly, it will not be controlled properly and vibration will occur.

Steps	Panel display	Keys	Operations
1			Press MOD key to choose auxiliary function mode.
2			If the panel display is not AF101, press ↑ & ↓ until it is AF101.
3			Press SET for 1 second to display the initial setting screen for internal instruction type automatic adjustment .
3-1	◆ Jcalc of inertia Select the estimated / non-estimated moment of inertia. Normally select "0" (estimated moment of inertia). Jcalc = 0: Estimated moment of inertia. (Factory setting) Jcalc = 1: Do not estimate the moment of inertia. If the moment of inertia is known from the mechanical parameters , set the correct value in PA103 and select "1".		
3-2	◆ Mode selection Mode=1: Response characteristics and stability are taken into account during adjustment. (Standard adjustment value) Mode=2: Positioning-only adjustment. (Factory setting) Mode=3: Suppresses overshoot on the basis of positioning-specific adjustments.		
3-3	◆ Load Type Select the type based on the mechanical factors driven. If an abnormal sound occurs and the gain cannot be increased, changing the rigidity type may improve the effect. Select the type based on the following guidelines. Type=1: belt drive, etc. Type=2: Ball screw drive, etc. (factory setting) Type=3: Directly connected rigid body without reducer and transmission		
3-4	◆ Movement distance Setting range of moving distance: The movement setting range is 1 to 8 turns. The minimum setting scale of the movement distance is 1 turn. The direction is reverse driving and the + direction is forward driving, which indicates the moving distance from the current position. Initial setting: approx. 3 turns * ● Set the number of rotations of the motor to at least one rotation.		

	● In order to ensure the estimation of inertia and the accuracy of automatic adjustment , it is recommended to set the number of rotations of the motor to about three.		
4			Press and hold SET for about 1 second to display the internal instruction type automatic adjustment execution screen.
5			Press MOD and SET at the same time to enter the servo ON state.
6			◆ Estimate the inertia . After pressing the "↑" key, the moment of inertia will be estimated. During the estimation of the moment of inertia, the set value of PA103 will flash. After the estimation is completed, the blinking stops and the value of the moment of inertia ratio is displayed. After the servo is ON, the automatic operation will be suspended. When it is set to not estimate the moment of inertia (Jcalc = OFF), the estimation is not started and the value currently set in PA103 is displayed .
7			◆ Save the inertia value During the pause, press and hold SET for about 1 second to save the estimated moment of inertia in the servo driver . If you do not adjust the gain and only end the operation by estimating the moment of inertia, you can press the MOD key to end the operation.
8			◆ Adjustment of gain After long-pressing the SET key, the estimated value of the moment of inertia ratio will be

			written into the servo driver . After pressing the "↑" key again, the automatic movement will start again according to the set moving distance. Automatically set various gains and filters. “ADJ - T ” will flash. **(Note)** ● " A.Err□" will be displayed if the adjustment cannot be made due to factors such as mechanical resonance . In this case, perform the adjustment using AF103. ● Note that this operation takes a long time. Press the "MOD" key to exit the operation.
9	 Flash		After the adjustment is completed normally, the servo is OFF and “END” flashes. .
10	 Flash		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 change to "END" display. Press MOD to cancel saving
11			Press the MOD key to return to the display of " AF101 ".
12	End of operations		

Causes and countermeasures if cannot operate normally

The following are the causes and countermeasures when normal operation is not possible.

■ Possible causes and countermeasures when "NO-OP" flashes

the reason	Countermeasure
Main circuit power is OFF	Switch on the main circuit power .
An alarm or warning has occurred	Eliminate the cause of the alarm or warning.
Overtravel	Eliminate the cause of the overtravel.

2nd gain selected by gain switching	Disable automatic gain switching.

■ Possible causes and countermeasures when "ERR" flashes

Error content	Causes	Countermeasure
Gain adjustment does not end normally	When the motor is stopped or the occurrence of mechanical vibrations, COIN signal unstable.	Increase the setting value of PA522 . ● Change the MODE from 2 to 3. ● When mechanical vibration occurs, please use vibration suppression adjustment function and vibration reduction control function to suppress vibration.
When the automatic adjustment function is valid, Jcalc is not performed	Jcalc is set to 1.	● Disable the automatic adjustment function. ● Set Jcalc to 0.
Incorrect travel distance setting	Moving distance is set lower than the minimum adjustable movement amount or less (about 0.5 turns)	Increase the moving distance.
CON signal is not ON within 10 seconds after positioning adjustment is completed	Positioning complete set amplitude is set too small or P control operation is set.	Increase the setting value of PA522 . .

■ Possible causes and countermeasures for errors in the estimation of moment of inertia

Error display	Causes	Countermeasure
AErr1	The estimation of the moment of inertia is started, but the estimation process is not performed.	● Increase the setting value of speed gain (PA100). ● Increase the moving distance .
AErr2	The deviation of the estimated value of the moment of inertia is too large, and the deviation has not been reduced after 10 retries .	Based on the mechanical parameters in PA103, then execute when Jcalc = OFF.
AErr3	Low-frequency vibration detected	Set the start value PA324 to 2-times of the original value.

AErr4	Torque limit reached	● When using torque limit, increase the limit value. ● Set the start value PA324 to 2-times of the original value.
AErr5	During proportional control (P-CON) is input , the speed control becomes proportional control during the estimation of the moment of inertia.	During the estimation process, it is PI control.

■ Notch filter adjustment switch (PA460)

Normally please use default value of PA460 (0101). Vibration will be automatically detected and the notch filter will be adjusted when this function is executed.

■ Vibration reduction control function (PA610)

Vibration reduction control function is mainly used to reduce vibration due to low frequency (1~100Hz) transient oscillation during the machine positioning.

Normally please use default value of PA610. Because this function uses model tracking control, it can be executed only when the mode is 2 or 3.

■ Vibration suppression control function (PA630)

Vibration suppression control is effective when low-frequency vibration that notch filters do not apply occurs.

Normally please use default value of PA630.

■ Disturbance compensation function (PA408)

The disturbance compensation function is a compensation function for the following state changes:

◇ Viscosity resistance change of lubricant in mechanical sliding part
◇ Friction resistance change caused by mechanical assembly deviation
◇ Friction resistance change caused by aging

When mode=1, this is determined by the setting of PA408.3.

■ Feed-forward function (PA610)

Important
The model tracking control will set the optimal feedforward inside the servo. Therefore, it is usually not possible to use the "speed feedforward (V-REF) input" and the "torque feedforward (T-REF) input" simultaneously. If improper "V-REF" input and "T-REF" input are input, it may cause overshoot.

In the factory setting and mode is 2 or 3, PA109, T-REF and V-REF become invalid.

9.5 External instruction type automatic adjustment (AF102)

This section explains how to adjust by external instruction type automatic adjustment.

Important
The external instruction type automatic adjustment starts the adjustment based on the currently set speed loop gain (PA100). Therefore, if vibration occurs at the start of adjustment, correct adjustment will not be possible. In this case, perform adjustment after setting a sufficiently stable gain with simple parameter type automatic adjustment (AF103).

The external instruction type automatic adjustment is a method for automatically adjusting the operation command (pulse sequence command) from a host device. It can also be used for additional adjustment after internal instruction type automatic adjustment.
In addition, if the correct moment of inertia ratio is set in PA103, the internal instruction type automatic adjustment can be omitted and only the external instruction type automatic adjustment is performed.The external instruction type automatic adjustment adjusts the following items:

- Gain adjustment (position loop gain, speed loop gain, etc.)
- Filter adjustment (torque command filter, notch filter)
- Disturbance compensation
- Vibration suppression control
- Vibration reduction control

Note
The external instruction type automatic adjustment is performed in the automatic operation mode, so vibration or overshoot may occur during operation. In order to ensure safety, please execute it in an emergency stop state at any time.

Before executing internal instructions automatic adjustment, please confirm the following items. If the setting is not correct, "NO-OP" will be displayed during operation.

◇ Main circuit power must be ON
◇ Servo must be OFF
◇ Overtravel signals must be invalid
◇ Not for torque control
◇ Must be position control
◇ The automatic gain switching must be invalid
◇ The automatic stiffness adjustment must be invalid
◇ Can not choose 2nd gain
◇ No alarms or warnings
◇ Hardware baseblock (HWBB) function must be invalid
◇ Writing prohibited (AF003) is not set to "Writing prohibited"

Situations when external instruction type automatic timing cannot be performed:

◇ When the movement amount indicated by the host device command is higher than the setting value of PA522

◇ When the moving speed indicated by the host device command is higher than the set value of PA512

◇ Stop time (time when the positioning completion signal (COIN) is OFF) is more than 10ms

◇ When the rigidity of the machine is low and vibration occurs during positioning

◇ When using the position integration function

◇ During P (proportional action) control

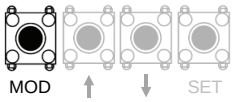
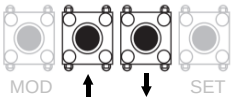
◇ When using the mode switch

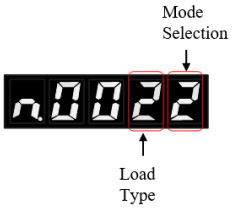
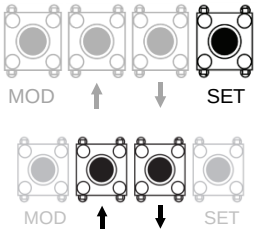
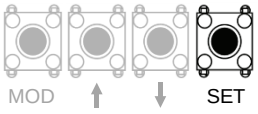
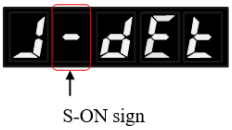
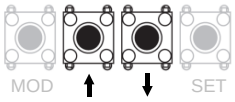
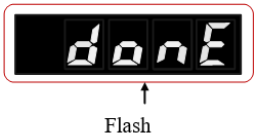
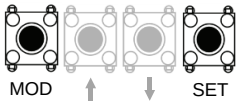
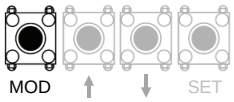
In the above cases, perform the adjustment with the simple parameter type automatic adjustment (AF103).

Important
● The external instruction type automatic adjustment refers to PA522 Positioning completion COIN amplitude for adjustment. Please set the "Electronic gear ratio (PA20E / PA210)" and " Positioning completion COIN amplitude (PA522)" to the values during actual operation. ● After positioning is completed, if the positioning completion signal (COIN) is not ON within about 3 seconds, "WAITING" will flash. If the positioning completion signal (COIN) does not turn on within about 10 seconds, the automatic adjustment will be aborted after 2 seconds of “Error” flashing .

Use the overshoot detection value (PA561) only when you do not want to change the positioning completion COIN amplitude (PA522) and want to fine-tune the overshoot amount. Since the factory setting of PA561 is 100%, it is allowed to adjust up to the same overshoot amount as the positioning completion range. If it is changed to 0%, it can be adjusted without overshooting within the positioning completion range. But changing to this value may result in longer positioning time

The operation steps of the external instruction type automatic adjustment are shown below.

Steps	Panel display	Keys	Operations
1			Press MOD key to choose auxiliary function mode.
2			If the panel display is not AF102, press ↑ & ↓ until it is AF102.

3			Press SET for 1 second to display the initial setting screen for external instruction type automatic adjustment .
3-1	◆ Mode selection Mode=1: Response characteristics and stability are taken into account during adjustment. (Standard adjustment value) Mode=2: Positioning-only adjustment. (Factory setting) Mode=3: Suppresses overshoot on the basis of positioning-specific adjustments.		
3-2	◆ Load Type Select the type based on the mechanical factors driven. If an abnormal sound occurs and the gain cannot be increased, changing the rigidity type may improve the effect. Select the type based on the following guidelines. Type=1: belt drive, etc. Type=2: Ball screw drive, etc. (factory setting) Type=3: Directly connected rigid body without reducer and transmission		
4			Press and hold SET for about 1 second to display the external instruction type automatic adjustment execution screen.
5			Input S-ON signal externally to enter the servo ON state.
6			Press ↑ & ↓ and “ADJ - T ” will flash.
7			After the adjustment is completed normally, the servo is OFF and “END” flashes. .
8			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 change to "END" display. Press MOD to cancel saving
9			Press the MOD key to return to the display of " AF102 ".

10	End of operations

Causes and countermeasures if cannot operate normally

The following are the causes and countermeasures when normal operation is not possible.

■ Possible causes and countermeasures when "NO-OP" flashes

the reason	Countermeasure
In automatic adjustment mode	Set PA600.0 to 0 to disable automatic adjustment mode
The control mode is not position control.	Set PA000. 0 to 0 to enable position control mode.
Main circuit power is OFF	Switch on the main circuit power .
An alarm or warning has occurred	Eliminate the cause of the alarm or warning.
Overtravel	Eliminate the cause of the overtravel.
2nd gain selected by gain switching	Disable automatic gain switching.

■ Possible causes and countermeasures when "ERR" flashes

Error content	Causes	Countermeasure
Gain adjustment does not end normally	When the motor is stopped or the occurrence of mechanical vibrations, COIN signal unstable.	Increase the setting value of PA522 . ● Change the MODE from 2 to 3. ● When mechanical vibration occurs, please use vibration suppression adjustment function and vibration reduction control function to suppress vibration.
When the automatic adjustment function is valid, Jcalc is not performed	Jcalc is set to 1.	● Disable the automatic adjustment function. ● Set Jcalc to 0.

■ Notch filter adjustment switch (PA460)

Normally please use default value of PA460 (0101). Vibration will be automatically detected and the notch filter will be adjusted when this function is executed.

■ Vibration reduction control function (PA610)

Vibration reduction control function is mainly used to reduce vibration due to low frequency (1~100Hz) transient oscillation during the machine positioning.

Normally please use default value of PA610. Because this function uses model tracking control, it can be executed only when the mode is 2 or 3.

■ Vibration suppression control function (PA630)

Vibration suppression control is effective when low-frequency vibration that notch filters do not apply occurs.

Normally please use default value of PA630.

■ Disturbance compensation function (PA408)

The disturbance compensation function is a compensation function for the following state changes:

◇ Viscosity resistance change of lubricant in mechanical sliding part
◇ Friction resistance change caused by mechanical assembly deviation
◇ Friction resistance change caused by aging

When mode=1, this is determined by the setting of PA408.3.

■ Feed-forward function (PA610)

Important
The model tracking control will set the optimal feedforward inside the servo. Therefore, it is usually not possible to use the "speed feedforward (V-REF) input" and the "torque feedforward (T-REF) input" simultaneously. If improper "V-REF" input and "T-REF" input are input, it may cause overshoot.

In the factory setting and mode is 2 or 3, PA109, T-REF and V-REF become invalid.

9.6 Simple parameter type automatic adjustment (AF103)

This section explains how to adjust by simple parameter type automatic adjustment.

Simple parameter type automatic adjustment is a method of inputting a position command or speed command from a host device and performing manual adjustment while running. Through simple parameter type automatic adjustment to adjust one or two values, the related servo gain setting value can be adjusted automatically. The simple parameter type automatic adjustment adjusts the following items.

● Gain adjustment (position loop gain, speed loop gain, etc.)
● Filter adjustment (torque command filter, notch filter)
● Disturbance compensation
● Vibration suppression control

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 suppression 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.

Before executing simple parameter automatic adjustment, please confirm the following items. If the setting is not correct, "NO-OP" will be displayed during operation.

◇ The automatic stiffness adjustment must be invalid

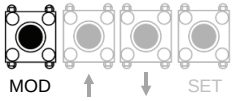
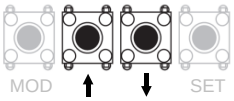
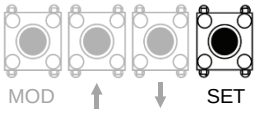
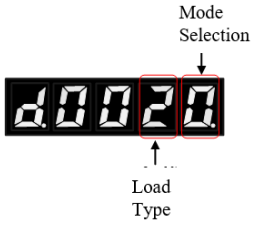
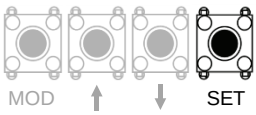
◇ Writing prohibited (AF003) is not set to "Writing prohibited"

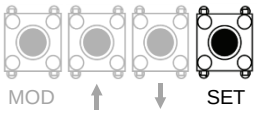
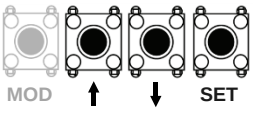
◇ In speed control automatic adjustment mode must be 0 or 1.

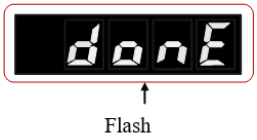
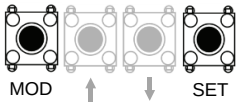
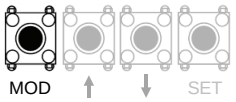
The operation steps of the simple parameter type automatic adjustment are shown below. There are 4 modes:

- Tuning mode 0: stability-oriented adjustment
- Tuning mode 1: response-oriented adjustment
- Tuning mode 2: positioning-oriented adjustment
- Tuning mode 3: positioning-oriented adjustment with overshoot suppression

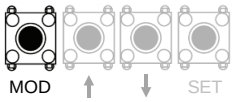
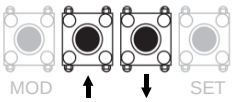
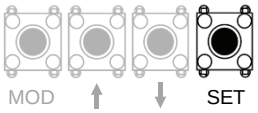
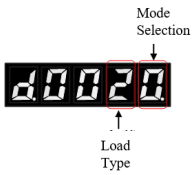
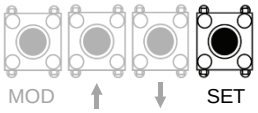
Tuning mode 0 or 1:

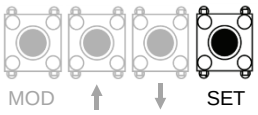
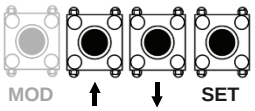
Steps	Panel display	Keys	Operations
1			Press MOD key to choose auxiliary function mode.
2			If the panel display is not AF103, press ↑ & ↓ until it is AF103.
3			Press SET for about 1 second to display the inertia ratio set in PA103. When changing, press SET to move the digits, and press ↑ or ↓ to change the value.
4			Press SET for 1 second to display the initial setting screen for simple parameter type automatic adjustment .

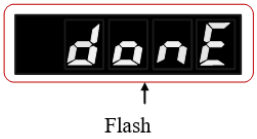
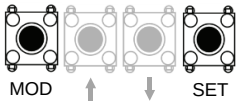
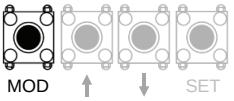
4-1	◆ Mode selection ● Tuning mode 0: stability-oriented adjustment ● Tuning mode 1: response-oriented adjustment		
4-2	◆ Load Type Select the type based on the mechanical factors driven. If an abnormal sound occurs and the gain cannot be increased, changing the rigidity type may improve the effect. Select the type based on the following guidelines. Type=1: belt drive, etc. Type=2: Ball screw drive, etc. (factory setting) Type=3: Directly connected rigid body without reducer and transmission		
5			Input S-ON signal externally to enter the servo ON state.
6			Press SET for about 1 second to enter simple parameter adjustment interface.
7			Change the setting value of "LEVEL" to adjust the response. Use the "SET" key to move the digits, and use the "↑" or "↓" key to change the set value. After changing, press the SET button for about 1 second to save. < When vibration occurs > Increasing the setting value of "LEVEL" will improve the response, but vibration will occur if it is too large. When vibration occurs, if you press the "MOD" and "SET" keys at the same time, the vibration frequency will be automatically detected and a notch filter or vibration suppression control will be set. ＜ Supplements ＞ When the vibration is large, even if you don't press the "MOD" and "SET" keys at the same time, the vibration frequency will be automatically detected, and a notch filter or vibration suppression control will be set.

8			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 change to "END" display. Press MOD to cancel saving
9			Press the MOD key to return to the display of " AF103 ".
10	End of operations		

Tuning mode 2 or 3:

Steps	Panel display	Keys	Operations
1			Press MOD key to choose auxiliary function mode.
2			If the panel display is not AF103, press ↑ & ↓ until it is AF103.
3			Press SET for about 1 second to display the inertia ratio set in PA103. When changing, press SET to move the digits, and press “ ↑ ” or “ ↓ ” to change the value.
4			Press SET for 1 second to display the initial setting screen for simple parameter type automatic adjustment .
4-1	◆ Mode selection ● Tuning mode 2: positioning-oriented adjustment ● Tuning mode 3: positioning-oriented adjustment with overshoot suppression		

4-2	◆ Load Type Select the type based on the mechanical factors driven. If an abnormal sound occurs and the gain cannot be increased, changing the rigidity type may improve the effect. Select the type based on the following guidelines. Type=1: belt drive, etc. Type=2: Ball screw drive, etc. (factory setting) Type=3: Directly connected rigid body without reducer and transmission		
5			Input S-ON signal externally to enter the servo ON state.
6			Press SET for about 1 second to enter simple parameter adjustment interface.
7	 Move to FF or FB and press ↑  	Change the setting values of "FF LEVEL" and "FB LEVEL" to adjust the response. Use the "SET" key to move the digits, and use the " ↑ " or " ↓ " keys to increase or decrease the value to change the set value. After changing, press the "SET" key for about 1 second to save. ＜ When vibration occurs ＞ Increasing the setting value of "LEVEL" will improve the response, but vibration will occur if it is too large. When vibration occurs, if you press the "MOD" and "SET" keys at the same time, the vibration frequency will be automatically detected and a notch filter or vibration suppression control will be set. ＜ Supplements ＞ When the vibration is large, even if you don't press the "MOD" and "SET" keys at the same time, the vibration frequency will be automatically detected, and a notch filter or vibration suppression control will be set. (Note) ● When FF LEVEL is increased, the positioning time will be shortened. However, if the set value is too large, overshoot will occur. ● The setting change value of FF LEVEL becomes effective when the motor stops and no command is input, and the response of the motor changes accordingly. Please wait until each run command is stopped to adjust the FF LEVEL, and then change the set value after confirming the response. If the FF LEVEL is greatly changed during operation, when the set value becomes effective, the response will change sharply, which may cause vibration.	

		● "FF LEVEL" will flash before the FF value becomes effective. If the motor does not stop for about 10 seconds after the setting is changed, a timeout will occur and the setting will be automatically restored to the setting before the change. ● When slight vibration occurs, the vibration frequency search may not be performed. At this time, press the "MOD" and "SET" keys at the same time to force the vibration frequency search.	
8			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 change to "END" display. Press MOD to cancel saving
9			Press the MOD key to return to the display of " AF103 ".
10	End of operations		

■ Notch filter adjustment switch (PA460)

Normally please use default value of PA460 (0101). Vibration will be automatically detected and the notch filter will be adjusted when this function is executed.

■ Vibration suppression control function (PA630)

Vibration suppression control is effective when low-frequency vibration that notch filters do not apply occurs. Normally please use default value of PA630.

■ Disturbance compensation function (PA408)

The disturbance compensation function is a compensation function for the following state changes:

◇ Viscosity resistance change of lubricant in mechanical sliding part

◇ Friction resistance change caused by mechanical assembly deviation

◇ Friction resistance change caused by aging

When tuning mode= 0 or 1, this is determined by the setting of PA408.3.

■ Feed-forward function (PA610)

In the factory setting and tuning mode is 2 or 3, PA109, T-REF and V-REF become invalid.

9.7 Vibration suppression control function (AF104)

This function is effective for suppression of continuous vibration frequencies from 100 to 1,000 Hz that occur when the control gain is increased. Vibration can be eliminated by setting vibration frequencies through automatic detection or by manually setting them to adjust the damping gain.

To improve response characteristics after executing this function, perform simple parameter type automatic adjustment (AF103). If the control gain is increased by simple parameter type automatic adjustment., vibration may occur again. In this case, execute this function again for fine adjustment.

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 suppression 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 100 Hz to 1000 Hz. Vibrations outside the detection range cannot be detected, but "F ----" is displayed. In this case, please set the notch filter automatically using "Tuning Mode = 2" with simple parameter type automatic adjustment or use the vibration reduction control function (AF105). ● Increasing the damping gain (PA633) can improve the anti-vibration effect, but if the damping gain is too large, it will increase the vibration. While confirming the anti-vibration effect, gradually increase the setting value of the damping gain in the range of 0% to 200% in 10% increments. If the anti-vibration effect cannot be obtained even after the damping gain reaches 200%, stop the setting and reduce the control gain by simple parameter type automatic adjustment.

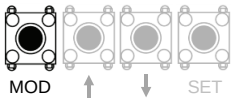
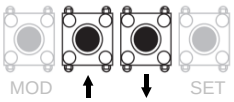
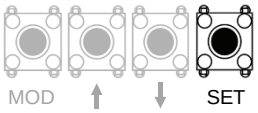
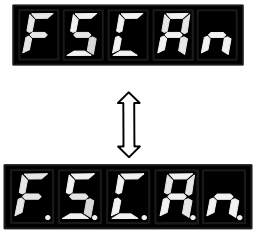
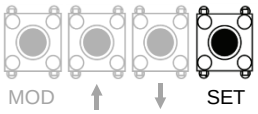
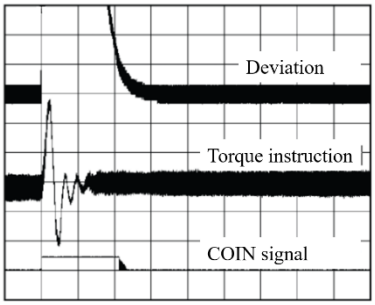
Before executing this function, please confirm the following items. If the setting is not correct, "NO-OP" will be displayed during operation.

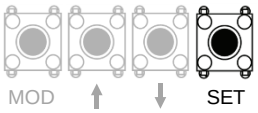
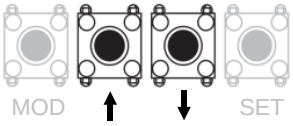
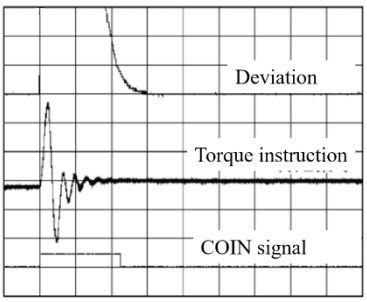
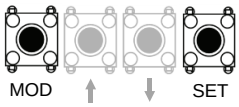
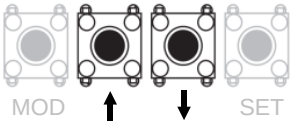
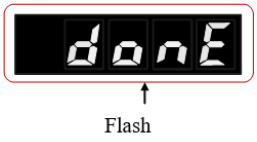
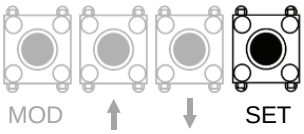
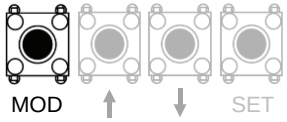
◇ The automatic stiffness adjustment must be invalid

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

◇ Cannot be in torque control mode

Typical procedures:

Steps	Panel display	Keys	Operations
1			Press MOD key to choose auxiliary function mode.
2			If the panel display is not AF104, press ↑ & ↓ until it is AF104.
3			Press SET for about 1 second to auto-tuning interface. Press ↑ & ↓ to select Tuning mode = 0.
4			After pressing the "SET" key for about 1 second while the Tuning Mode = 0 is displayed, the display on the left appears and the vibration frequency is detected. During detection, "fscan" flashes. If no vibration is detected, return to step 3. (Note) If vibration is not detected, decrease the vibration detection sensitivity (PA311) setting. If the setting value of the vibration detection sensitivity is decreased, the detection sensitivity will increase. However, if the sensitivity value is too small, vibration may not be detected correctly. Please be careful.
5			Vibration frequency will be shown: 

6			Press SET for about 1 second to enter damping gain setting interface.
7			Press ↑ & ↓ to set damping gain. 
8			When fine adjustment is needed, press the "MOD" and "SET" keys at the same time to move the interface from "G.XXXX" to "F.XXXX" and proceed to step 9. When fine adjustment is not required, go directly to step 10.
9			Press ↑ & ↓ for fine adjustment.
10			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 change to "END" display. Press MOD to cancel saving
11			Press the MOD key to return to the display of AF104.
12	End of operations		

9.8 Vibration reduction control function (AF105)

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 instruction type automatic adjustment or external instruction 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, perform simple parameter type automatic adjustment (AF103), etc.

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 suppression 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 displacementr 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.

Before executing this function, please confirm the following items. If the setting is not correct, “NO-OP” will be displayed during operation.

◇ The automatic stiffness adjustment must be invalid

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

◇ Must be in position control mode

When vibrations continue to occur when stopped, sufficient vibration reduction control effects cannot be obtained with the vibration reduction control function. In this case, adjust it with the vibration suppression control function (AF104) or simple parameter type automatic adjustment (AF103).

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

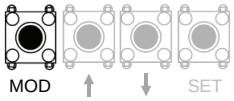
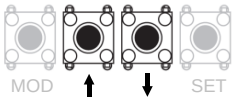
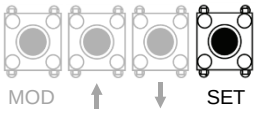
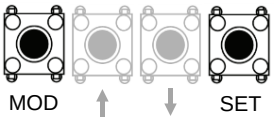
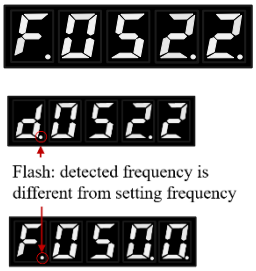
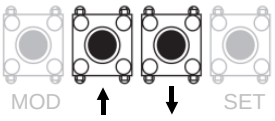
to the positioning completion amplitude (PA522), that is, the setting of the residual vibration detection amplitude (PA560), so please adjust the residual vibration detection amplitude (PA560) and perform the vibration frequency detection again.

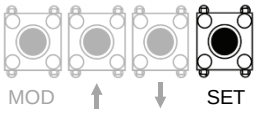
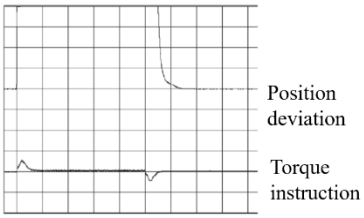
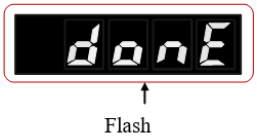
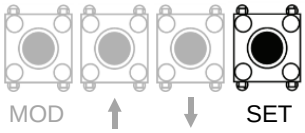
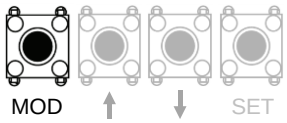
Please change the setting value to approximately 10%. The smaller the setting value is, the higher the detection sensitivity is. However, if the setting value is too small, vibration may not be detected correctly.

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.

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.

Typical procedures:

Steps	Panel display	Keys	Operations
1			Press MOD key to choose auxiliary function mode.
2			If the panel display is not AF105, press ↑ & ↓ until it is AF105.
3			Press SET for about 1 second to display 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]. 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.
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 pressing SET for about 1 second, the adjusted settings will be stored in the servo drive , "DONE" will flash for 2 seconds, and then change to "END" display. Press MOD to cancel saving
8			Press the MOD key to return to the display of AF104.
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 suppression 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".

9.9 Disturbance compensation

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

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.

To use the disturbance compensation function, the following parameters need to be set:
PA408, PA121, PA123, PA124, PA125.

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.

Typical procedures:

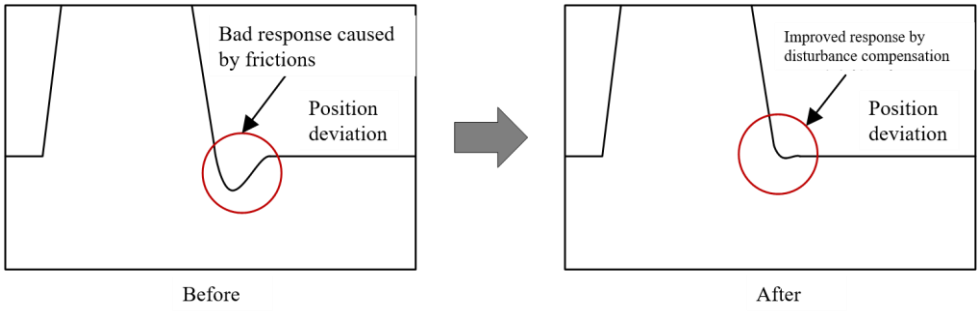
Steps	Operations
1	Restore the following disturbance compensation related parameters to the factory settings. Disturbance compensation gain (PA121) → Factory setting: 100 Disturbance compensation coefficient (PA123) → Factory setting: 0 Disturbance compensation frequency correction (PA124) → Factory setting: 0 Disturbance compensation gain correction (PA125) → Factory setting: 100 (Note) 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. The upper limit value of the disturbance compensation coefficient (PA123) is 95%.

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.

Setting the PA121 too large may cause vibration. When increasing PA121, adjust it gradually at intervals of about 10%.

The results of the adjustment are shown below as examples of the waveform graphs before and after adjustment.

3



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.

9.10 Feedforward function

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

Torque feedforward is a function to shorten the positioning time. The torque feedforward command is valid during speed control and position control.
The torque feedforward command is a command generated by differentiating the speed command on the host device side. The torque feedforward command can be input to the servo drive at the same time as the speed or position command.

Speed feedforward is a function to shorten the positioning time. Speed feed forward is effective during position control.
Speed feedforward is a command generated by differentiating a position command on the host device side. The speed feed forward command can be input into the servo unit at the same time as the position command.

Chapter 10 Fault diagnosis

10.1 Alarm display

When an error occurs in the servo driver, the LED on the panel display shows the alarm number.

10.2 Alarm List

The alarm list lists the alarm names, alarm contents, and whether or not the alarm can be reset in the order of alarm numbers.

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 dismiss the alarm

Alarm number	Alarm name	Alarm content	alarm reset	other
E.020	Parameter and check check exception 1	The parameter data of the servo driver is abnormal.	no	
E.021	Parameter and check check exception 2	The parameter data of the servo driver is abnormal.	no	
E.022	Parameter memory read and write abnormal	The parameter memory in the servo drive is not read or written properly .	no	
E.030	Parameter value is abnormal	The servo drive parameters are out of rangE.	no	
E.040	Parameter setting failure	Beyond the setting range	no	
E.042	Parameter combination failure	Parameter combination failure	no	
E.0A0	Combination error	Outside combinable motor capacity (capacity mismatch)	can	
E.0A2	Motor and drive mismatch	Mismatch of voltage type of motor and driver, etc.	can	
E.0B3	Internal chip communication error 1	Communication error between internal chips	no	
E.0B4	Internal chip communication error 2	Communication error between internal chips	no	
E.100	Overcurrent detection	Power transistor overcurrent or heat sink overheating.	no	

E.120	Motor overload (transient overload)	The motor is operated for several seconds to several tens of seconds with a torque that greatly exceeds the rated value.	can	
E.121	Drive overload (transient overload)	The drive is operated for several seconds to several tens of seconds with a torque that greatly exceeds the rated value.	can	
E.130	Motor overload (continuous overload)	The motor is continuously running with torque exceeding the rated value.	can	
E.131	Drive overload (continuous excessive overload)	Driver has been transported to above the rated continuous torque line.	can	
E.180	Overvoltage	The DC voltage of the main circuit is abnormally high.	can	
E.190	Undervoltage	The DC voltage of the main circuit is insufficient.	can	
E.250	Current detection failure 1	The current detection circuit is faulty.	no	
E.252	Current detection failure 2	The current detection circuit is faulty.	no	
E.300	Abnormal regeneration	The regeneration circuit is faulty.	no	
E.320	Regeneration overload	A regeneration overload has occurred.	can	
E.340	Inrush current limiting resistor overload	The main circuit power-on frequency is too high.	no	
E.360	Heat sink overheating	The heat sink of the drive is too hot.	can	
E.500	Encoder communication failure	Communication encoder communication failure	no	
E.502	Encoder communication error multiple times	Encoder communication encountered multiple errors	no	
E.504	Encoder communication check error	Communication type communication data check error	can	
E.505	Encoder communication frame error 1	Communication type encoder communication frame error (driver side)	can	

E.506	Encoder communication frame error 2	Communication frame communication frame error (encoder side)	can	
E.507	Encoder communication frame error 3	Communication encoder communication data error	can	
E.510	Incremental encoder disconnected	Incremental encoder cable disconnected	no	
E.512	Incremental encoder phase error	Incremental encoder phase error	no	
E.530	Encoder and calibration alarm	Sum check result of communication type encoder memory is abnormal	can	
E.532	Encoder parameter is abnormal	Parameter of communication encoder is abnormal	can	
E.550	Encoder count error 1	Communication type encoder count error 1 .	can	
E.552	Multiturn encoder error	Communication type multi-turn encoder error .	can	
E.554	Encoder overspeed	Communication type multi-turn encoder over speed error .	can	
E.555	Encoder count error 2	Communication multi-turn encoder count is incorrect .	can	
E.556	Encoder count overflow	Communication type multi-turn encoder count overflow error .	can	
E.558	Encoder multi-turn data error	Communication multi-turn encoder multi-turn data error .	can	
E.55A	Encoder battery alarm	Communication multi-turn encoder low battery voltage alarm	can	
E.600	Signal input time failure for safety function	The signal input time of the safety function is abnormal.	no	
E.A00	out of control	Detected servo motor out of control	can	
E.A10	Speeding	Motor speed exceeds maximum speed	can	
E.A20	Vibration alarm	Detected abnormal vibration of motor speed.	can	
E.A22	Auto-adjust alarm	Vibration was detected during automatic adjustment.	can	
E.A30	Excessive position deviation alarm	In the servo ON state, the position deviation exceeds the excessive position deviation alarm value (P A 520).	can	

E.A31	Excessive position deviation alarm when servo ON	Position deviation pulses accumulated too much .	can	
E.A32	Servo ON since the bit rate limitations caused by positional deviation is too large alarm	Servo position deviation accumulated in the ON state, the servo ON when the speed limit value (P A 52 is . 9 limit) execution speed system. When the command pulse is input in this state, the set value of the excessive position deviation alarm value (P A 520) is exceeded without releasing the limit .	can	
E.A90	Servo ON command invalid alarm	After executing the auxiliary function of energizing the motor, a servo ON input (S-ON) signal was input from the host device.	can	
E.F00	System alarm 0	Internal servo program error 0 occurred.	no	
E.F01	System alarm 1	An internal program error 1 of the servo driver occurred .	no	
E.F02	System alarm 2	An internal program error 2 of the servo driver has occurred .	no	
E.F03	System alarm 3	An internal program failure 3 of the servo driver has occurred .	no	

10.3 Alarm causes and actions

Alarm number: **Alarm name**	**Cause**	**Confirmation method**	**Action**
E.020: Parameter and check check exception 1 (The data of the servo drive's internal parameters is abnormal)	Instantaneous power supply voltage drop	Measure the power supply voltage.	Set the power supply voltage within the specifications and initialize the parameter set values.
	Power off when parameter is written	Confirm the time of power failure.	Re-enter the parameter after the parameter setting value is initialized.

Alarm number: Alarm name	Cause	Confirmation method	Action
	Parameter write times exceeded maximum	Check whether the parameter is frequently changed from the host device.	It is possible that the servo driver is malfunctioning. Replace the servo driver. Change the parameter writing method.
	Malfunction due to noise from AC power, ground, static electricity, etc.	Turn on the power of the servo driver again. If the alarm still occurs, there may be interference.	Take measures to prevent noise interference.
	The components inside the servo drive have failed due to gas, water droplets, or cutting oil, etc.	Confirm the setting environment.	It is possible that the servo driver is malfunctioning. Replace the servo driver.
	Servo drive failure	Turn on the power of the servo driver again. If the alarm still occurs, the driver may be faulty.	It is possible that the servo driver is malfunctioning. Replace the servo driver.
E.021: System parameters and check exceptions 2 (The data of the servo drive's internal parameters is abnormal)	Instantaneous power supply voltage drop	Measure the power supply voltage.	It is possible that the servo driver is malfunctioning. Replace the servo driver.
	The power was turned off during operation of the accessibility function	Confirm the time of power failure.	It is possible that the servo driver is malfunctioning. Replace the servo driver.
	Servo drive failure	Turn on the power of the servo driver again. If the alarm still occurs, the driver may be faulty.	It is possible that the servo driver is malfunctioning. Replace the servo driver.
E.022: Parameter memory read and write abnormal	Instantaneous power supply voltage drop	Measure the power supply voltage.	It is possible that the servo driver is malfunctioning. Replace the servo driver.
	Servo drive failure	Turn on the power of the servo driver again. If the alarm still occurs, the driver may be faulty.	It is possible that the servo driver is malfunctioning. Replace the servo driver.
E.030: Parameter value is abnormal	Power off when parameter is written	Confirm the time of power failure.	Re-enter the parameter after the parameter setting value is initialized.

Alarm number: Alarm name	Cause	Confirmation method	Action
	The power was turned off during operation of the accessibility function	Confirm the time of power failure.	It is possible that the servo driver is malfunctioning. Replace the servo driver.
	Servo drive failure	Turn on the power of the servo driver again. If the alarm still occurs, the driver may be faulty.	It is possible that the servo driver is malfunctioning. Replace the servo driver.
E.040: Parameter setting is abnormal (beyond the setting range)	Servo drive capacity does not match servo motor capacity	Check the capacity and combination of servo driver and servo motor.	Match the capacity of servo driver and servo motor to each other.
	Servo drive failure	Turn on the power of the servo driver again. If the alarm still occurs, the driver may be faulty.	It is possible that the servo driver is malfunctioning. Replace the servo driver.
	Outside the 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.
A.042 * 1 : Parameter combination exception	Because the electronic gear ratio (PA20E / PA210) or the servo motor is changed , the speed of the program JOG operation (AF00A) does not satisfy the setting range.	Check whether the detection condition formula * 1 is satisfied .	Reduce the value of the electronic gear ratio (PA20E / PA210).
	The program JOG speed (PA5A3) was changed , so that the speed of the program JOG operation (AF00A) did not meet the setting range.	Confirm whether the detection condition formula is satisfied	Increase the program JOG speed (PA5A3).
	Because the electronic gear ratio (PA20E / PA210) or the servo motor is changed , the movement speed of the internal instruction type automatic	Check whether the detection condition formula is satisfied *	Reduce the value of the electronic gear ratio (PA20E / PA210).

Alarm number: Alarm name	Cause	Confirmation method	Action
	adjustment does not satisfy the setting range.		
A.0A0 : Capacity combination error (out of range of motor capacity that can be combined)	The capacity of the servo driver 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 driver and servo motor to each other.
	Encoder failure	Replace with another motor and confirm that the alarm no longer occurs.	Replace the servo motor (encoder).
	Servo drive failure	Turn on the power of the servo driver again. If the alarm still occurs, the driver may be faulty.	It is possible that the servo driver is malfunctioning. Replace the servo driver.
A.0A2 : Voltage combination error (out of range of motor capacity that can be combined)	The voltage of the servo driver 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 the servo driver and the servo motor to each other.
	Encoder failure	Replace with another motor and confirm that the alarm no longer occurs.	Replace the servo motor (encoder).
	Servo drive failure	Turn on the power of the servo driver again. If the alarm still occurs, the driver may be faulty.	It is possible that the servo driver is malfunctioning. Replace the servo driver.
A.0B3 : Drive internal data interaction error 1 A.0B4 : Drive internal data interaction error 1	The components inside the servo drive have failed due to gas, water droplets, or cutting oil, etc.	Confirm the setting environment.	It is possible that the servo driver is malfunctioning. Replace the servo driver.
	Servo drive failure	Turn on the power of the servo driver again. If the alarm still occurs, the driver may be faulty.	It is possible that the servo driver is malfunctioning. Replace the servo driver.
A.100 : Overcurrent detection (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 that the wiring is correct. For details, refer to "Wiring the Main Circuit".	Modify the wiring.
	The main circuit cable or the motor main circuit cable has an internal short circuit, or a short circuit to ground	Check if there is a short circuit between the UVW phase of the cable , UVW and ground. For details, refer to "Wiring the Main Circuit".	The cable may be shorted. Replace the cable.

Alarm number: Alarm name	Cause	Confirmation method	Action
	A short circuit or a ground fault occurred in the servo motor.	Check if there is a short circuit between the UVW phase of the motor terminals , UVW and ground. For details, refer to "Wiring the Main Circuit".	It is possible that the servo motor is malfunctioning. Replace the servo motor.
	Short circuit or short to ground in the servo drive	Check if there is a short circuit between the UVW phase, UVW and ground of the servo drive motor connection terminals . For details, refer to "Wiring the Main Circuit".	It is possible that the servo driver is malfunctioning. Replace the servo driver.
	The regenerative resistor is incorrectly connected or has poor contact	Confirm that the wiring is correct. For details, refer to "Connection of Regenerative Resistors".	Modify the wiring.
	Power device alarm due to large instantaneous overload current	Reduce the overload multiple. Or increase the acceleration / deceleration time.	Decrease PA 402 and PA 403 values. Increase the values of PA216 and PA 217 under position control; increase the values of PA 305 and PA 306 under speed control .
E.120 : Motor overload (transient overload) E.121 : Drive overload (transient overload) E.130 : Motor overload (continuous overload) E.131 : Drive overload (continuous overload)	Motor wiring, encoder wiring or connection is bad	Confirm the wiring.	Check if there are any problems with the motor wiring and encoder wiring.
	Motor operation exceeds overload protection characteristics	Check the motor's overload characteristics and operating instructions.	Re-examine the load and operating conditions. Or re-examine the motor capacity.
	The motor cannot be driven due to mechanical factors, resulting in excessive load during operation	Confirm the running command and motor speed.	Improve mechanical factors.
	Servo drive failure	Turn on the power of the servo driver again. If the alarm still occurs, the driver may be faulty.	It is possible that the servo driver is malfunctioning. Replace the servo driver.
	Motor failure	Replace with the same model and run .	It is possible that the motor is

Alarm number: Alarm name	Cause	Confirmation method	Action
			malfunctioning. Replace the servo motor.
	Frequent fast acceleration and deceleration	Increase acceleration / deceleration time	Increase the values of PA 216 and PA 217 under position control; increase the values of PA 305 and PA 306 under speed control .
E.180 : Overvoltage (main loop of the servo drive power sources overvoltage detection portion)	When the AC 200 V servo driver was used, a DC power supply voltage of 410 V or more was detected . When the AC 400 V servo driver detected a DC power supply voltage of 820 V or more	Measure the power supply voltage.	The AC/DC power supply voltage is adjusted to within the product specifications.
	Power supply is unstable or affected by lightning	Measure the power supply voltage.	Improve the power supply. Turn on the power again after setting the surge suppressor. If the alarm still occurs, the servo driver may be faulty. Replace the servo driver.
	Acceleration and deceleration	Check the power supply voltage and speed during operation Degrees, torque.	The AC supply voltage is adjusted to within the product specifications.
	External regenerative resistor value is greater than operating conditions	Check the operating conditions and the regenerative resistance value.	Consider the operating conditions and load, and choose a suitable regenerative resistor value.
	With the allowable load moment of inertia Running	Check that the load moment of inertia ratio is within the allowable load moment of inertia ratio.	Increase the deceleration time or reduce the load.
	Servo drive failure	Turn on the power of the servo driver again. If the alarm still occurs, the driver may be faulty.	Without turning on the main circuit power, turn on the control power again. If the alarm still occurs, the servo driver

Alarm number: Alarm name	Cause	Confirmation method	Action
			may be faulty. Replace the servo driver.
A.190 : Undervoltage (Undervoltage detected in the main circuit power supply section of the servo driver)	AC200V with a servo drive, the AC supply voltage 120 V or less; the AC 400V a servo drive, the AC supply voltage 240 V or less	Measuring power supply voltage	Adjust the power supply voltage to the normal range.
	Power supply voltage drops during operation	Measuring power supply voltage	Increase the power capacity.
	A momentary power outage occurred	Measuring power supply voltage	If the instantaneous stop holding time (PA519) is changed , set it to a smaller value.
	The fuse of the servo driver is blown		Replace or repair the servo driver, and connect the AC / DC reactor before using the servo driver.
	Servo drive failure	Turn on the power of the servo driver again. If the alarm still occurs, the driver may be faulty.	It is possible that the servo driver is malfunctioning. Replace the servo driver.
E.250 : Current detection failure 1	U-phase current detection circuit failure		Turn on the power of the servo driver again. If the alarm still occurs, the servo driver may be faulty. Replace the servo driver.
	Motor does not stop	Motor does not stop completely when power is applied	After the motor stops, power on again
E.252 : Current detection failure 2	W current detection circuit failure		Turn on the power of the servo driver again. If the alarm still occurs, the servo driver may be faulty. Replace the servo driver .
	Motor does not stop	Motor does not stop completely when power is applied	After the motor stops, power on again
E.300 : Regeneration failure	When the drive is not connected with a	Check if the driver has internal or external braking resistor and the wiring is correct.	≤4 00 W is no built-in braking resistor drive,

Alarm number: Alarm name	Cause	Confirmation method	Action
	regenerative resistor, PA 010.0 is not set to 1.		≥7 50 W is built with a drive brake 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.
	Driver regeneration resistor is not connected	Check the connection of the external regenerative resistor or regenerative resistor device.	After connecting an external regenerative resistor, set an appropriate value for PA590 .
	Defective, disconnected or disconnected external regenerative resistor	Check the wiring of the external regenerative resistor. Check the wiring of the power terminal jumper.	Connect the external regenerative resistor correctly. Wire the jumper properly.
	Servo drive failure	Turn on the power of the servo driver again. If the alarm still occurs, the driver may be faulty.	It is possible that the servo driver is malfunctioning. Replace the servo driver.
E.320 : Regeneration overload	Power supply voltage exceeds specifications	Measure the power supply voltage.	Set the power supply voltage within the specifications.
	External regenerative resistor value or capacity is insufficient or continuous Regeneration state	Reconfirm operating conditions and capacity	Change the regenerative resistance value and regenerative resistance capacity. Adjust the operating conditions again
	Continuously under negative load, in continuous regeneration state	Check the load applied to the running servo motor.	Check the system including servo, machinery, and operating conditions again.
	The capacity set in PA590 (Regenerative resistor capacity) is less	Check the connection of the regenerative resistor and the value of PA5A0 .	Correct the setting value of PA590

Alarm number: Alarm name	Cause	Confirmation method	Action
	than the capacity of external		
	The external regeneration resistance is too large	Check if the regenerative resistance is correct.	Change it to the correct resistance value and capacity.
	Servo drive failure	Turn on the power of the servo driver again. If the alarm still occurs, the driver may be faulty.	It is possible that the servo driver is malfunctioning. Replace the servo driver.
E.340 : Inrush current limiting resistor overload (main circuit power-on frequency is too high)	Exceeds the allowable number of times of the inrush current limiting resistance when the main circuit power supply is turned on / off		Reduce the ON / OFF frequency of the main circuit power .
	Servo drive failure	Turn on the power of the servo driver again. If the alarm still occurs, the driver may be faulty.	It is possible that the servo driver is malfunctioning. Replace the servo driver.
E.360 : Heat sink (power of module temperature abnormality)	Ambient temperature is too high	Measure the ambient temperature with a thermometer. Or, set the environmental monitoring through the servo driver to confirm the operating status.	Improve the setting conditions of the servo driver and reduce the ambient temperature.
	Excessive load or exceeding regeneration processing capacity during operation	The running load is confirmed by the cumulative load factor, and the regeneration processing capacity is confirmed by the regenerative load factor.	Re-examine the load and operating conditions.
	The installation direction of the servo driver and the distance from other servo drivers are unreasonable	Check the installation status of the servo driver.	Install according to the installation standard of the servo driver.
	Servo drive failure	Turn on the power of the servo driver again. If the alarm still occurs, the driver may be faulty.	It is possible that the servo driver is malfunctioning. Replace the servo driver.
E.500 : Encoder communication failure	Encoder connector has poor contact or incorrect wiring	Check the status of the encoder connector.	Insert the encoder connector again and check the wiring of the encoder.

Alarm number: Alarm name	Cause	Confirmation method	Action
	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 the specified encoder cable.
	Corrosion caused by temperature, humidity, and gas; short circuit caused by water droplets and cutting oil; poor connector contact caused by vibration	Confirm the use environment.	Improve the use environment and replace the cable. If this does not improve, replace the servo driver.
	Malfunction due to 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 driver and the control power is turned on, if the alarm does not occur, the servo driver may be faulty. Replace the servo driver.
E.5 0 2: Encoder communication error multiple times	Due to the influence of interference, communication abnormalities occur many times	Check the wiring of the encoder.	1. Check if the ground connection is correct; 2. Check whether the encoder cable shield is properly connected to the driver PE.
E.504 : Encoder communication checksum error	Encoder incorrect wiring and poor contact	Check the wiring of the encoder.	Check if there is any problem with the encoder wiring.
E.505 : Encoder communication frame error 1 E.506 : Encoder communication frame error 2 E.507 :	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 wire of 0.12mm2 or more and

Alarm number: Alarm name	Cause	Confirmation method	Action
Encoder communication frame error 3			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 30m .
	FG potential 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 withstands excessive vibration shock	Confirm usage.	Reduce mechanical vibration. Correctly installed servo servo motor or a linear encoder.
	Encoder failure		Turn on the power of the servo driver again. If the alarm still occurs, the servo motor or linear encoder may be faulty. Replace the servo motor or linear encoder.
	Servo drive failure	Turn on the power of the servo driver again. If the alarm still occurs, the driver may be faulty.	Turn on the power of the servo driver again. If the alarm still occurs, the servo driver may be faulty. Replace the servo driver.
E.510 : Incremental encoder disconnected	Wire-saving encoder signal line is broken	Make sure the cables are connected properly	Check the encoder wiring;
	Low encoder signal level	The signal level does not meet the requirements because the cable is too long	Reduce the cable length or increase the signal level by thickening the cable diameter.
	PA 002.2 Parameter setting error	Check whether the setting of parameter PA002.3 matches the type of motor encoder;	Set correct PA002.3 according to the encoder model;
	Motor encoder failure	Check if the motor encoder is abnormal	Replace the same motor and check whether the same fault occurs.
	Servo drive failure		It is possible that the servo driver is

Alarm number: Alarm name	Cause	Confirmation method	Action
			malfunctioning. Replace the servo driver.
E.512 : Incremental encoder phase error	Low encoder signal level	The signal level does not meet the requirements because the cable is too long	Reduce the cable length or increase the signal level by thickening the cable diameter.
	PA 002.2 Parameter setting error	Check whether the setting of parameter PA002.3 matches the type of motor encoder;	Set correct PA002.3 according to the encoder model;
	Motor encoder failure	Check if the motor encoder is abnormal	Replace the same motor and check whether the same fault occurs.
	Servo drive failure		It is possible that the servo driver is malfunctioning. Replace the servo driver.
E.530 : Encoder and calibration alarm (Detected on the encoder side)	Encoder data storage area check error	Encoder data storage area data error.	This alarm still appears after the power is turned on again. The servo motor encoder may be faulty. Replace the servo motor or encoder.
	Servo drive failure	Rotating the motor, the speed (dp 000) and position (dp 001) of the motor show no change.	It is possible that the servo driver is malfunctioning. Replace the servo driver.
E.532 : Encoder parameter is abnormal	Encoder data storage area data error	Encoder data storage area data error	Turn on the power of the servo driver again. If the alarm still occurs, the servo motor encoder may be faulty. Replace the servo motor or encoder.
	Incorrect encoder model	Confirmation PA002.3	Check whether the PA002.3 encoder model matches the motor encoder model. PA002.3 = 0 corresponds to a 17-bit encoder (D M1 □ - □ □ □ □ □ **I** □ □); PA002.3 = 2 corresponds to 23 -bit

Alarm number: Alarm name	Cause	Confirmation method	Action
			encoder (D M1 □ - □ □ □ □ □ **L** □ □);
	Servo drive failure	Rotating the motor, the speed (dp 000) and position (dp 001) of the motor show no change.	It is possible that the servo driver is malfunctioning. replace server Driver.
E. 550 : Encoder count error	Encoder incorrect wiring and poor contact	Check the wiring of the encoder.	Check if there is any problem with the encoder wiring.
	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 wire of 0.12mm2 or more and 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 30m .
	FG potential 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 withstands excessive vibration shock	Confirm usage.	Reduce mechanical vibration. Install the servo motor or encoder correctly.
	Encoder failure		Turn on the power of the servo driver again. If the alarm still occurs, the servo motor or encoder may be faulty. Replace the servo motor or encoder.
	The multi-turn encoder is not connected to the battery or the battery voltage is too low	Multi-turn encoder battery is not connected or alarm due to previous battery alarm	If it is a multi-turn encoder, please confirm the battery voltage and execute the auxiliary function AF 01 1 : Reset

Alarm number: Alarm name	Cause	Confirmation method	Action
			the encoder multi-turn data and alarm
E. 552 : Multiturn encoder error E. 555 : Encoder count error 2	Serial communication is disturbed	Check the wiring of the encoder cable shield.	Check if there is any problem with the encoder wiring.
	The multi-turn encoder is not connected to the battery or the battery voltage is too low	Multi-turn encoder battery is not connected or alarm due to previous battery alarm	After confirming the battery voltage, execute the auxiliary function AF 012 : Reset the encoder alarm
	Defective encoder or encoder decoding circuit		Turn on the power of the servo driver again. If the alarm still occurs, the servo motor or encoder may be faulty. Replace the 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 the power failure of the servo.	After confirming the battery voltage, execute the auxiliary function AF011 : Reset the 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 is not connected or alarm due to previous battery alarm	After confirming the battery voltage, execute auxiliary function AF011 : reset encoder multi-turn data and alarm
	The distance of the motor running in one direction exceeds 65535 turns, and multi-turn information overflows	1 6 -bit multi-turn 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 is not connected or alarm due to previous battery alarm	After confirming the battery voltage, execute auxiliary function AF011 : reset encoder multi-turn data and alarm
E.55A : Encoder battery alarm (The voltage of the absolute encoder battery	Battery is badly connected, 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.	Replacement battery

Alarm number: Alarm name	Cause	Confirmation method	Action
is below the specified value)	Encoder failure	Encoder data error	Turn on the power of the servo driver again. If the alarm still occurs, the servo motor encoder may be faulty. Replace the servo motor or encoder.
E.600 : Signal input time failure for safety function	Hard wire base blocking function input signal / HWBB1 , / HWBB2 start time difference is more than 10 seconds	Measurement 2 input signals a time difference.	The output signal circuit of / HWBB1 , / HWBB2 , machine failure, input signal circuit failure of the servo driver, or the input signal cable may be broken. Check for malfunction or disconnection.
E.6F0 : Gate drive error 1 (abnormality of gate drive circuit)	Servo drive failure		Turn on the power of the servo driver again. If the alarm still occurs, the servo driver may be faulty. Replace the servo driver.
E.A00 : Out of control detection (detected when the servo is ON)	Motor wiring the U- , V , W is wrong phase sequence	Confirm motor wiring	Check if there is any problem with the motor wiring
	Encoder failure		If there is no problem with the motor wiring, if the alarm still occurs after turning on the power again, the servo motor or linear encoder may be faulty. Replace the servo motor or linear encoder.
	Servo drive failure		Turn on the power of the servo driver again. If the alarm still occurs, the servo driver may be faulty. Replace the servo driver.

Alarm number: Alarm name	Cause	Confirmation method	Action
E.A10 : Super speed (the speed of the motor at the highest speed on)	Motor wiring the U- , V , W is wrong phase sequence	Check the wiring of the servo motor.	Check if there is any problem with the motor wiring
	The command input value exceeds the overspeed value	Confirm input instructions	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		It is possible that the servo driver is malfunctioning. Replace the servo driver.
E.A20 : Vibration alarm	Detect abnormal vibration of motor speed	Check the abnormal sound of the motor and the speed and torque waveforms during operation.	Reduce motor speed. Or reduce the speed loop gain (PA100).
	The value of the moment of inertia ratio (PA103) is larger than the actual value or has changed greatly	Confirm the moment of inertia ratio or mass ratio	Set the moment of inertia ratio correctly (PA103)
	Vibration detection value (PA312) is not appropriate	Check if the vibration detection value (PA312) is appropriate	Set the vibration detection value (PA312) appropriately.
E.A22 : Auto-adjust alarm (Vibration detected in custom adjustment, TFFT , adaptive adjustment function	Motor when using auto tuning Great vibration	Check the waveform of the motor speed.	Reduce the load so that it is below the allowable moment of inertia ratio, or increase the load value set by the automatic adjustment value to reduce the rigidity value.
	Motor vibration during custom tuning and TFFT execution	Check the waveform of the motor speed.	Implement the processing method described in the operation steps of each function.
E.A30 : Excessive position deviation alarm when servo ON	Position deviation exceeded during servo OFF Over PA526 (S-ON	Check the amount of position deviation when the servo is OFF	Set to clear the position deviation when the servo is OFF . Correctly set the alarm value of excessive

Alarm number: Alarm name	Cause	Confirmation method	Action
	Position deviation alarm value) Keep the servo ON at the set valuE.		position deviation (PA526) when the servo is ON .
E.A32 : Excessive position deviation alarm caused by speed limit when servo ON	Servo position deviation accumulation state at ON , the servo ON when the speed limit value (PA529 execution speed limit). When the command pulse is input in this state, the setting value of excessive position deviation alarm value (PA520) is exceeded.		Set to clear the position deviation when the servo is OFF . Set the correct position deviation alarm value (PA520) or S-ON speed limit value (PA529) set to the correct value.
E.F00 : E.F01 : E.F02 : E.F03 : System alarm	The components inside the servo drive have failed due to gas, water droplets, or cutting oil, etc.	Confirm the setting environment.	It is possible that the servo driver is malfunctioning. Replace the servo driver.
	Servo drive failure	Turn on the power of the servo driver again. If the alarm still occurs, the driver may be faulty.	

10.4 Warning display

When a servo drive warning occurs, the LED on the panel display shows the warning number.

10. 5 Warning List

Here, warning names and warning contents are listed in the order of warning numbers .

Warning number	Warning name	Warning content
A.900	Excessive position deviation	The accumulated position deviation exceeds the ratio set by (PA520 × PA51E) / 100.

A.901	Excessive position deviation when servo ON	Servo O N accumulated when the positional deviation exceeds (PA526 PA528 ×) / ratio of 100 is set.
A.910	Motor overload	Is about to reach the motor overload (E.120 or E.130) warning before the alarm display. If the operation continues, an alarm may occur.
A.911	Drive overload	It is approaching the drive overload (E.120 or E.130) prior warning alarm display. If the operation continues, an alarm may occur.
A.91A	vibration	Abnormal vibration detected during motor operation. Same as the detection value of A.520, it is set to alarm or warning by vibration detection switch (PA310).
A.920	Regeneration overload	This is the warning display immediately before the regeneration overload (A.320) alarm is reached. If the operation continues, an alarm may occur.
A.930	Battery failure of the absolute encoder	It is a warning display that the absolute encoder battery voltage is too low.
A.941	Parameter changes that need to be turned on again	Changed the parameters that need to be turned on again.
A.970	Undervoltage	Is about to reach under-voltage (E.190) warning alarm before the show. If the operation continues, an alarm may occur.
A.9A0	Overtravel	Overtravel detected during servo ON.

10.6 Warning causes and actions

Warning number: Warning name	**Cause**	**Confirmation method**	**Action**
A.900: Excessive position deviation	The wiring of U, V, W of the servo motor is incorrect	Check the wiring of the servo motor main circuit cable.	Check whether the motor cable or encoder cable has poor contact.
	Servo driver gain is low	Check if the gain of the servo driver is too low.	Servo gain can be improved by automatic adjustment (no host command) function.
	High frequency of position command pulse	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.	Added smoothing functions such as position command acceleration / deceleration time parameter (PA216).

	Relative to running conditions, the position deviation alarm value (PA520) is low	Check the position deviation alarm value (PA520) Is it appropriate.	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 ratio set by (PA526 × PA528) / 100.		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 (overload alarm becomes (E warning prior to .120 or E.130))	Motor wiring, encoder wiring or connection is bad	Confirm the wiring.	Check if there are any problems with the motor wiring and encoder wiring.
	Motor operation exceeds overload protection characteristics	Check the motor's overload characteristics and operating instructions.	Re-examine the load and operating conditions. Or re-examine the motor capacity.
	The motor does not drive due to mechanical factors, causing excessive load during operation	Confirm the running command and motor speed.	Improve mechanical factors.
A.911: Drive overload (overload alarm becomes (E warning prior to .121 or E.131))	Drive operation exceeds overload protection characteristics	Check the drive model and operation instructions.	Re-examine the load and operating conditions. Or re-examine the drive capacity.
	The motor does not drive due to mechanical factors, causing excessive load during operation	Confirm the running command and motor speed.	Improve mechanical factors.
A.91A: vibration	Detect abnormal vibration during motor operation	Check the abnormal sound of the motor and the speed and torque waveforms during operation.	Reduce motor speed. Or reduce the servo gain by custom adjustment, etc.
	The value of the moment of inertia ratio (PA103) is larger than the actual value or has a large change	Check the moment of inertia ratio or mass ratio.	Set the moment of inertia ratio correctly (PA103).
A.920: Regenerative overload (Warning before becoming Regenerative 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	Reconfirm operating conditions and capacity	Change the regenerative resistance value, regenerative resistance capacity, or servo drive capacity. Be shipped again to adjust the line conditions .

	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 badly 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.	Replacement battery
A.941: Parameter changes that need to be turned on again	Changed the parameters that need to be turned on again	–	Turn on the power of the servo driver again.
A.970 : Undervoltage	AC 200V power servo drives, AC power voltage. 1 . 4 0V or less	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.
	A momentary power outage occurred	Measure the power supply voltage.	If the instantaneous stop holding time (P A 5 1 9) is changed , set it to a smaller value.
	Servo driver fuse Cut off		Replace the servo driver and connect the reactor before using the servo driver.
A.9A0: Overtravel	Overtravel detected during servo ON	Check the status of the overtravel signal by input signal monitoring.	If the overtravel signal cannot be confirmed by input signal monitoring, the overtravel may be detected instantly. Do the following. • The instructions from the host device to the overtravel area are not executed. • Check the wiring of the overtravel signal. • Take anti-interference measures.

Chapter 11 Communications

11.1 Communication terminals

Please refer to chapter 3.3 for wirings of CN1/CN2.

1) If upper controller only connects to one servo drive, connect CN1 to upper controller and CN2 to a 120Ω resistor.
2) If upper controller connects to multiple servo drives, connect CN1 of first servo drive to upper controller and CN2 of first servo drive to CN1 of second servo drive. Connect all servo drives in this way and connect CN2 of last servo drive to a 120Ω resistor.

11.2 Communication parameters

Parameter	Name	Range	Unit	Default	Effective
PA015	RS485 communication address	1~31		1	Immed
PA016	RS485 communication function selection	n.0000~0095		n.0035	Immed

n. □ □ □ □ (3 2 1 0)

RS485 baud rate

0	2400bps
1	4800bps
2	9600bps
3	19200bps
4	38400bps
5	57600bps

Communicational protocal

0	8，N，1 (Modbus protocol, RTU mode)
1	8，N，2 (Modbus protocol, RTU mode)
2	8，E，1 (Modbus protocol, RTU mode)
3	8，O，1 (Modbus protocol, RTU mode)

Reserved

Reserved

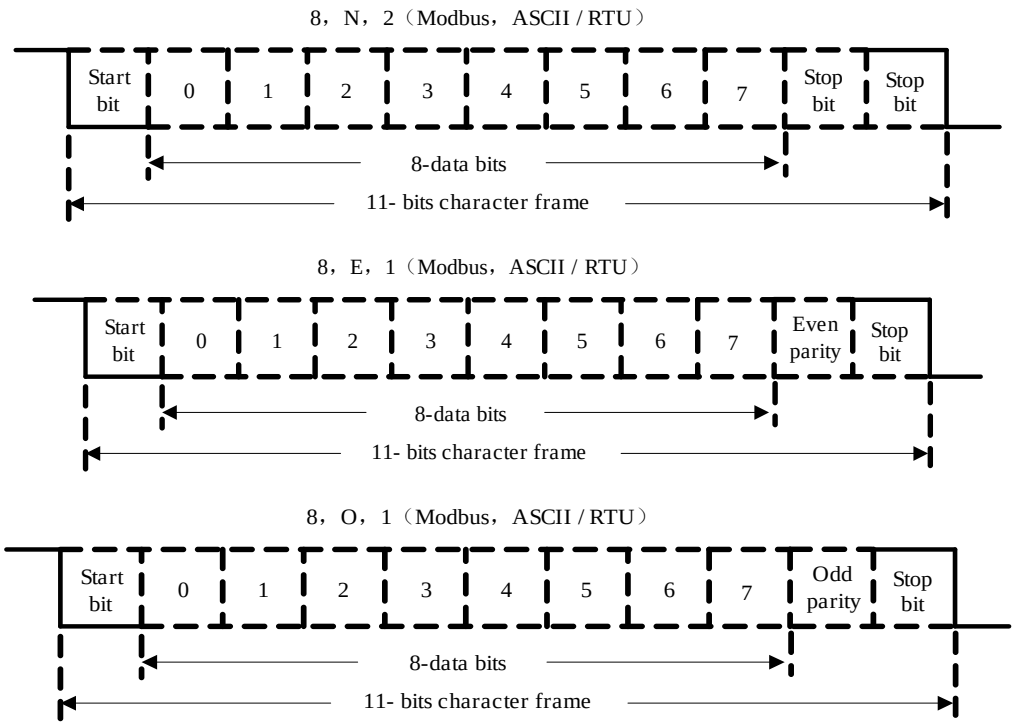
11.3 Communication protocol

When using RS-485 for serial communications, each servo drive must set its own axis number (PA015). There are two MODBUS modes: ASCII (American Standard Code for Information Interchange) or RTU (Remote Terminal Unit). DS1 series servo drive only supports RTU mode.

10.3.1 Encoding definitions

Every 8-bits data consists of two 4-bits hexadecimal bytes.

10.3.2 Byte structure



10.3.3 Communication data structure

STX	Static time exceeding 3.5 bytes
ADR	Communication address: 1-byte
CMD	Command code: 1-byte
DATA (n-1)	Data content (n≤12) : Word number=n; Byte number=2n;
…….	
DATA (0)	

CRC	Command code: 1-byte
End 1	Static time exceeding 3.5 bytes

Detailed explanations are as below:

- **STX (Communication starting)**

Static time exceeding 3.5 bytes under current communication speed.

- **ADR (communication address)**

Valid communication address is between 1 and 127. For example: to communicate with servo drive of Axis 16 (hexadecimal: 10H): ADR =10H

- **CMD (command code) & DATA (data content)**

DATA format is determined by CMD. Common CMD listed below:

Command	Meaning	Remarks
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:

Command

ADR	**01H**
CMD	**03H**
Starting address (high to low)	**02H**
	00H
Data byte number (high to low)	**00H**
	02H
CRC check low	**C5H**
CRC check high	**B3H**

Response

ADR	**01H**
CMD	**03H**
Data quantity (bytes)	**04H**
Starting address 0200H (high to low)	**00H**
	B1H
Second address 0200H (high to low)	**1FH**
	40H
CRC check low	**A3H**
CRC check high	**D4H**

2) **CMD: 06H (write one word)**

For example, write 100 (0064H) to starting address 0200H of servo drive Axis 01H:

Command

ADR	**01H**
CMD	**06H**
Starting 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 address (high to low)	**02H**
	00H
Data content (high to low)	**00H**
	64H
CRC check low	**89H**
CRC check high	**99H**

3) CMD: 10H (write N words, N≤29)

For example, write 100 (0064H) , 102 (0066H) to starting address 0200H of servo drive Axis 01H:

Command

ADR	**01H**
CMD	**10H**
Starting address (high to low)	**02H**
	00H
Data word number (high to low)	**00H**
	02H
Data byte number	**04H**
Data 1 content	**00H**
	64H
Data 2 content	**00H**
	66H
CRC check low	**50H**
CRC check high	**11H**

Response

ADR	**01H**
CMD	**10H**
Starting 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) detected error value calculation**

RTU mode uses CRC (Cyclical Redundancy Check) detected error value.
Step 1: CRC register is a 16-bits register whose content is FFFFH;
Step 2: **Exclusive OR** compute first byte of command & low place byte of 16-bits CRC register and store the result back to CRC register.
Step 3: Check lowest place (LSB) of CRC register. If this place is 0, then move to the right by 1 place;If this place is 1, then CRC register value move to the right by 1 place and **Exclusive OR** compute with A001H.
Step 4: Go back to Step 3 until Step 3 has been executed 8 times; then to Step 5.
Step 5: Repeat Step 2 to Step 4 for next byte of the CMD until all bytes have been processed.

At this point, CRC register content is CRC detected error value.

Notes:
After calculated CRC detected error value, in command, shall first fill in CRC low place, then CRC high place.

3) End1, End0 (communication end)

RTU mode:

Static time exceeding 3.5 bytes in current communication speed.

10.3.4 Communication troubleshooting

Common error causes are:

- When reading-writing parameters, data address is wrong;
- When writing parameters, data exceeds upper/lower limit of this parameter;
- Communication is interfered, data transmission error or verification error.

When above communication error occurs, the servo drive will continue running, meanwhile will send back an error frame.

Error frame format:

Upper controller data frame:

Start	Slave address	Command	Data address	Verification

Servo drive feedback error frame:

Start	Slave address	Response code	Error code	Verification

Error frame response code = command + 80H

Error code＝00H: communication normal;
＝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);
＝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, data cannot be written. Servo drive will send back an error frame; error code is 33H (exceeding upper/lower limit) . Structure is as below.

Upper controller data frame:

Start	Slave address	Command	Data address	Verification
	03H	06H	0004H, 0006H	

Servo drive feedback error frame:

Start	Slave address	Response code	Error code	Verification
	03H	86H	33H	

If slave address is 00H, this is broadcast data and the servo drive will send no feedback.

11.4 Communication address

Communication address HEX	content	Related instructions	Data type	Operation (read and write)
0000 ~ 0F00H	Parameter area	Corresponds to parameters in Chapter 13. For example, the corresponding address of PA005 is 0005H; For example, the corresponding address of PA101 is 0101H; For example, the corresponding address of PA307 is 0307H; For example, the corresponding address of PA5A0 is 05A0H; Function to read RAM or write RAM and EEPROM.	◆ Unsigned 16 (Uint 16) ◆Signed 16 (int 16) ◆ Unsigned 32-bit (Uint 32) ◆Signed 32-bit (int 32)	Read and write
1000 ~ 1F00H	Temporary parameter area	Corresponds to parameters in Chapter 13. For example, the corresponding address of PA005 is 0005H; For example, the corresponding address of PA101 is 0101H; For example, the corresponding address of PA307 is 0307H; For example, the corresponding address of PA5A0 is 05A0H; Function to read RAM or write RAM but not edit EEPROM.	◆ Unsigned 16 (Uint 16) ◆Signed 16 (int 16) ◆ Unsigned 32-bit (Uint 32) ◆Signed 32-bit (int 32)	Read and write
E000 ~ E200H	Monitoring area	Corresponds to parameters in Chapter 5. For example, the corresponding address of dp000 is E000H; For example, the corresponding address of dp00A is E00AH; For example, the corresponding address of dp 160 is E160H.	◆ Unsigned 16 (Uint 16) ◆Signed 16 (int 16) ◆ Unsigned 32-bit (Uint 32) ◆Signed 32-bit (int 32)	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 driver determines that it is invalid and returns an error code .

2. When operating 32 -bit data: when reading data, the lower 16 bits are first, the upper 16 bits are last; the write operation must use the 0x10 command to write two consecutive words, the lower 16 bits are first, and then the upper 16 bits.

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 execution, 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 50 turns (e.g., 1 turn is 131072 pulses); feedback data is50 * 131072/20 = 327 680. Thus E168H data is 0x00050000 and E16AH data is 0x00000000.

Chapter 12 Product specifications

12.1 Servo drive specifications

12.1.1 Basic specifications

<table>
<tr><td rowspan="2">Input voltage</td><td colspan="2">220VAC</td><td colspan="2">Singe/Three Phase 220VAC -15%~+10%, 50/60Hz</td></tr>
<tr><td colspan="2">380VAC</td><td colspan="2">Three Phase 380VAC -15%~+15%, 50/60Hz</td></tr>
<tr><td colspan="3">Control mechanism</td><td colspan="2">▪ Single/Three phase full wave rectification
▪ IGBT PWM control, sine-wave current control</td></tr>
<tr><td colspan="3">Feedback devices</td><td colspan="2">▪ 17-BIT SERIAL (INC/ABS)
▪ 23-BIT SERIAL (INC/ABS)</td></tr>
<tr><td rowspan="4">Use conditions</td><td colspan="2">Ambient temperature</td><td colspan="2">▪ Use temperature: 0~+45℃
▪ Storage temperature: -20~55℃</td></tr>
<tr><td colspan="2">Humidity</td><td colspan="2">Below 90%RH (no freezing or condensing)</td></tr>
<tr><td colspan="2">Vibration</td><td colspan="2">4.9 m/s^2~19.6 m/s^2</td></tr>
<tr><td colspan="2">Protection class/cleanness</td><td colspan="2">Protection class: IP10; Cleanness: 2. But should be:
● With no corrosive or combustible gas
● With no water, oil or drug splashing
● With little dust, ash, salt or metallic powder</td></tr>
<tr><td></td><td colspan="2">Altitude</td><td colspan="2">Below 1000m</td></tr>
<tr><td rowspan="5">Performance</td><td colspan="2">Speed control precision</td><td colspan="2">1: 5000</td></tr>
<tr><td rowspan="3">Speed fluctuation rate</td><td>Load fluctuation</td><td colspan="2">0 ~100% load: below ±0.01% (at rated speed)</td></tr>
<tr><td>Voltage fluctuation</td><td colspan="2">Rated voltage ±10%: 0.001% (at rated speed)</td></tr>
<tr><td>Temperature fluctuation</td><td colspan="2">25 ±25℃: below ±0.1% (at rated speed)</td></tr>
<tr><td colspan="2">Torque control precision</td><td colspan="2">±3% (repeatable)</td></tr>
<tr><td colspan="2">Soft start time</td><td colspan="2">0~10s (acceleration or deceleration)</td></tr>
<tr><td rowspan="5">Input/output signals</td><td colspan="2">Encoder pulse output (A phase, B phase, Z phase)</td><td colspan="2">16~16384</td></tr>
<tr><td colspan="2" rowspan="2">Sequential input signals</td><td>Quantity</td><td>8</td></tr>
<tr><td>Functions</td><td>S-ON, C-MODE, POT, NOT, etc.</td></tr>
<tr><td colspan="2" rowspan="2">Sequential output signals</td><td>Quantity</td><td>4</td></tr>
<tr><td>Functions</td><td>ALM, COIN, CZ, S-RDY, etc.</td></tr>
<tr><td>Communicati</td><td>RS485</td><td>1: N</td><td colspan="2">With relay, maximum N=31</td></tr>
</table>

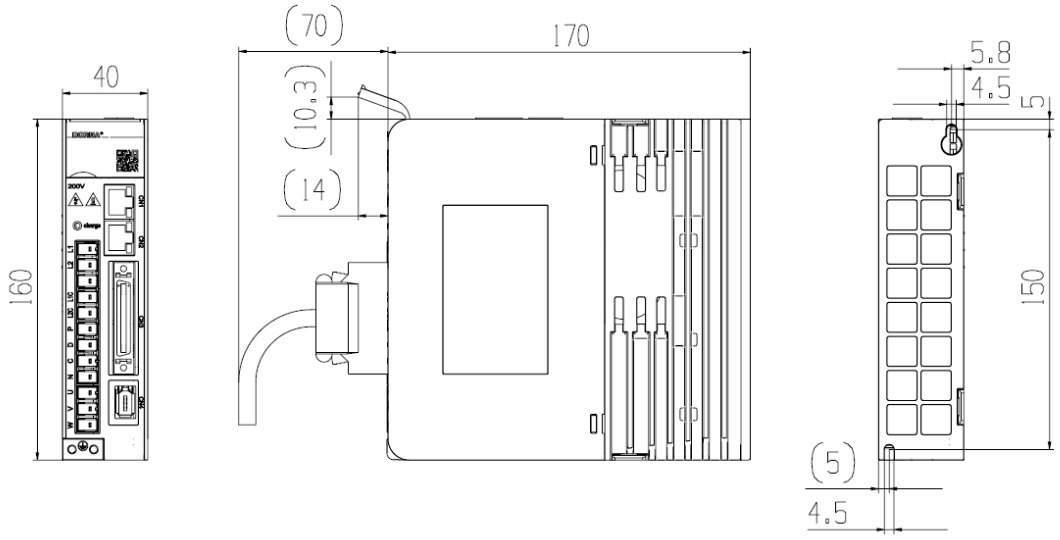
on functions		Address	By parameter setting
		Devices	PC, upper controller
Display/keypad			7 LED X 5 bit, 4 buttons
Dynamic brake (DB) (optional)			At Servo OFF, forward/backward rotation inhibition, power OFF, or stop due to failure.
Regenerative functions			Internal or external
Over-travel (OT) protections			POT, NOT. DB, deceleration to stop, coast to stop.
Protection functions			Over-current, over-voltage, under-voltage, over-load, regenerative fault, etc.

12.1.2 Position/speed/torque control specifications

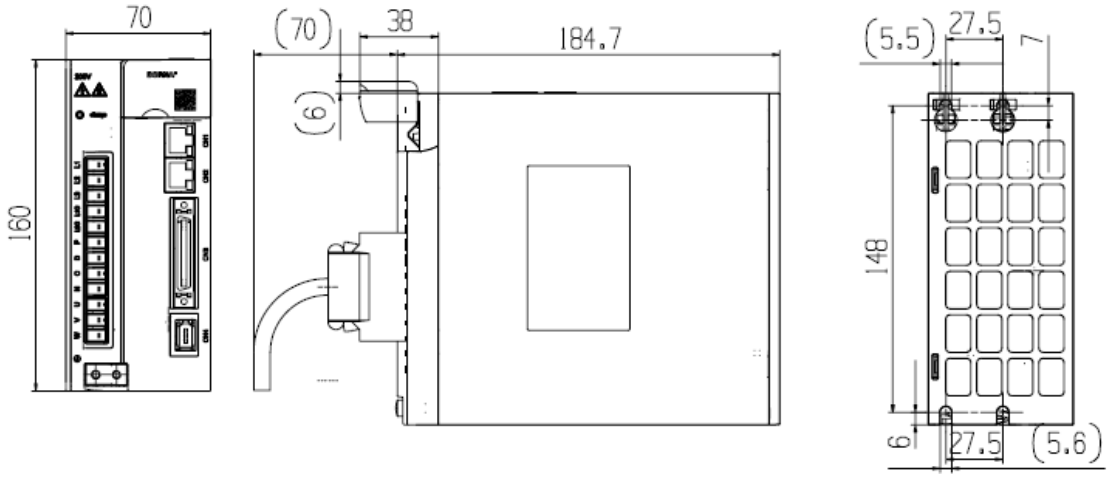
Position control	Feedforward compensation		0~100% (Unit: 1%)			
	Position completion width		0~65535 Encoder unit			
	Input signals	Pulse form	PULS+SIGN, CW+CCW, A+B			
		Pulse status	Supconnector line-driver, open collector			
		Maximum input pulse frequency		PULS+SIGN	CW+CCW	A+B
			Long line-driver	4Mbps	4 Mbps	1 Mbps
			Line-driver	500Kbps	500Kbps	125Kbps
			Open-collector	200Kbps	200Kbps	200Kbps
		Clearance	Clear deviation pulses			
	Internal position	Position selection	External input signals			
Speed control	Soft start time		0~5s			
	Input signals	Instruction voltage	±10 V			
		Input resistance	Approximately 9kΩ			
	Internal speed	Speed selection	External input signals			
Torque control	Input signals	Instruction voltage	±10 V			
		Input resistance	Approximately 9kΩ			

12.1.3 Servo drive dimensions

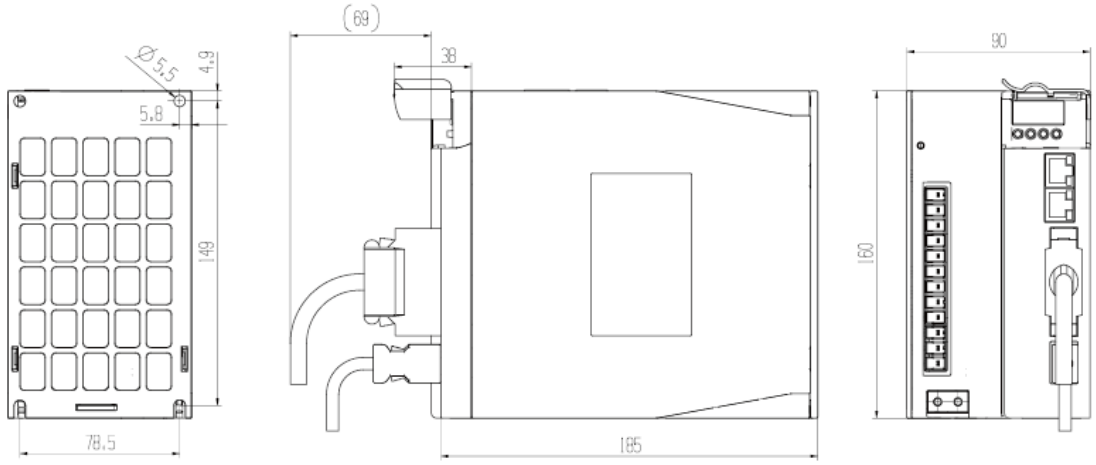
A type case (≦400W):



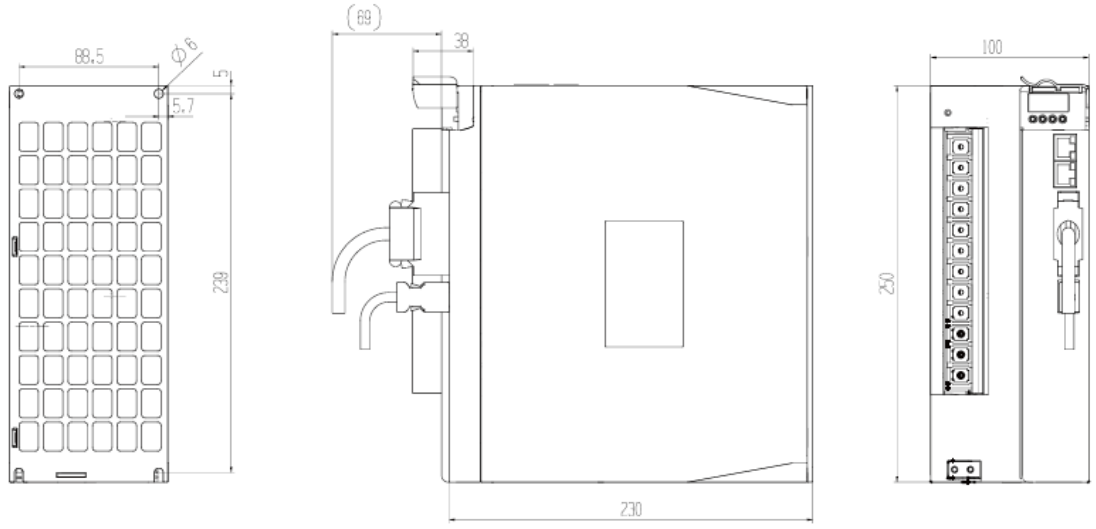
B type case (>400W, ≦1KW):



C type case (>1KW, ≦3KW):



D type case (>3KW, ≦7.5KW):



Notes:

- Unit is mm.
- Dimensions are subject to changes without prior notice.

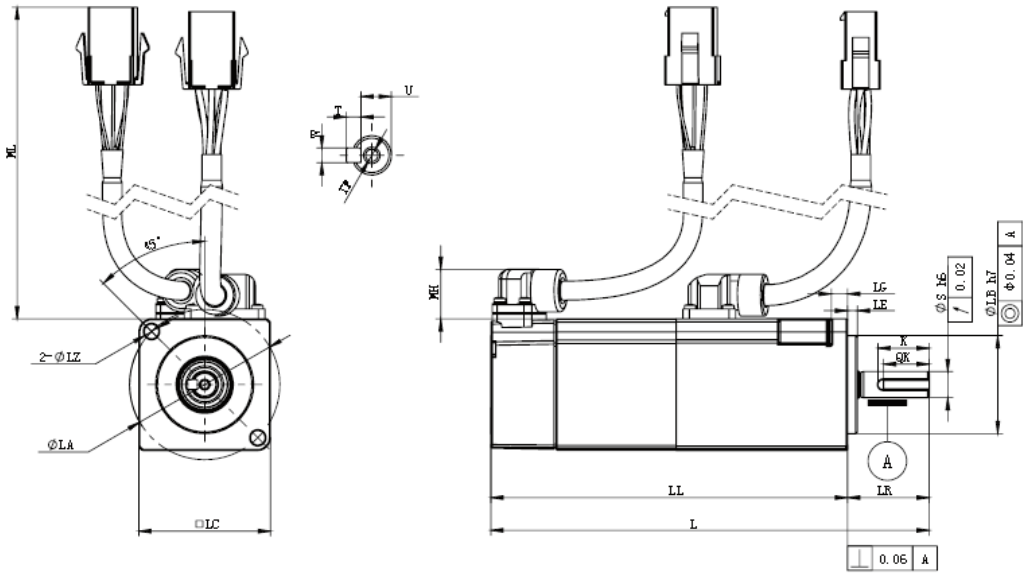
12.2 Servo motor specifications & dimensions

General specifications

Working system: S1 continuous	Heat resistance class: B
Vibration: 5G	Insulation voltage class: AC1500V, 1 minute
Insulation resistance: DC500V, above 10MΩ	Installation mode: Flange
Working temperature: 0~40℃ (no freezing)	Operating humidity: 20%~80% (no dewing)
Altitude: Below 1000m	Protections: Full-enclosed IP65 (except the shaft-through part)

Flange size	□40		□60		□80	
Rated capacity (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
Max 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
Max current (A)	4.55	4.55	5.25	10.80	16.80	22.4
Rated speed (rpm)	3000	3000	3000	3000	3000	3000
Max speed (rpm)	6000	6000	6000	6000	6000	6000
Rotary inertia (10 4kg.m²)	0.026	0.041	0.207	0.376	1.38	1.75
Brake type	Holding	Holding	Holding	Holding	Holding	Holding
Brake capacity (w)	6.1	6.1	7.3	7.3	8.5	8.5
Brake voltage (v)	24	24	24	24	24	24
Brake friction torque (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 tme (ms)	60	60	80	80	80	80
Brake inertia (10 4kg.m²)	0.002	0.002	0.013	0.013	0.05	0.05

40 flange motors (unit: mm)



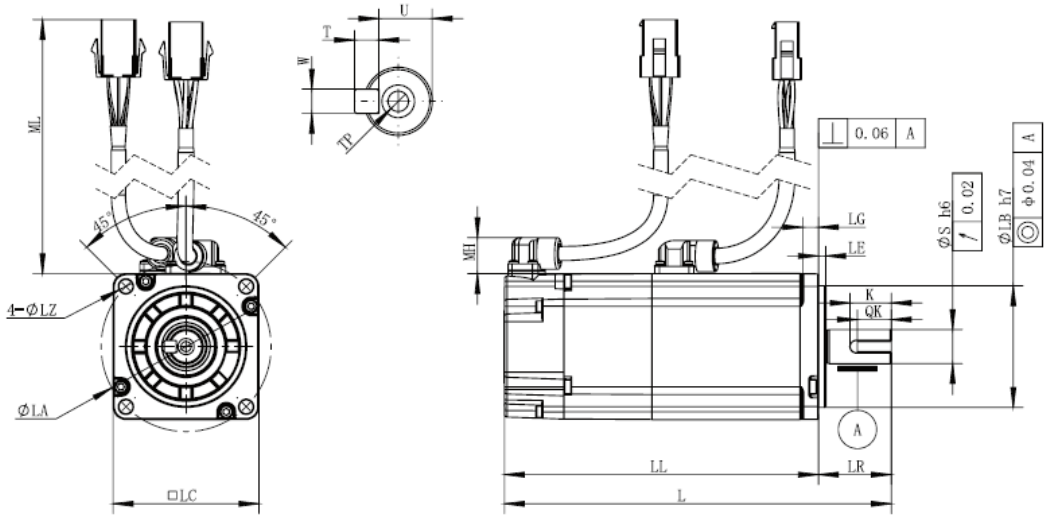
□40 flange motor dimensions (unit: mm)

Capacity	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 deep 7
4.5	8	15.7	14	3	3	6.2	M3 deep 7

(with brackets): dimensions with brake

60 flange motors (unit: mm)



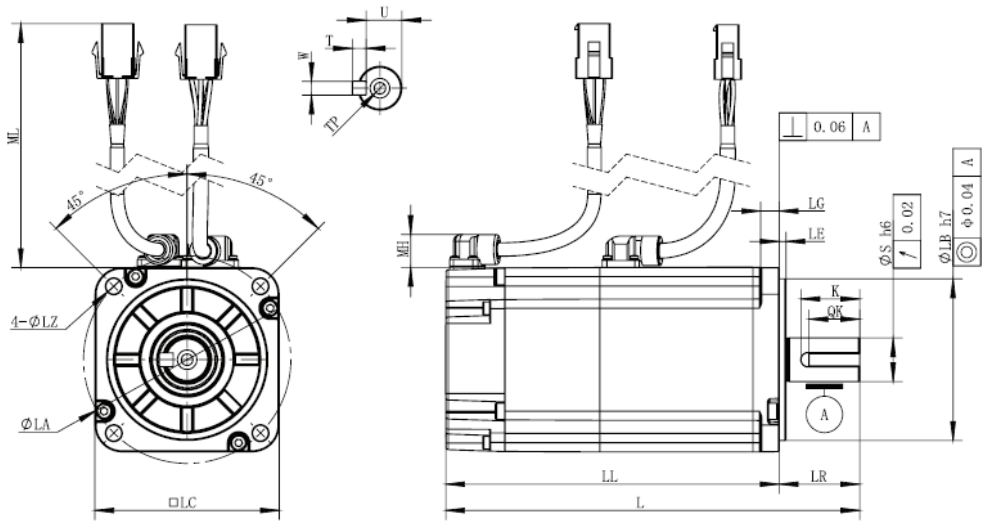
□60 flange motor dimensions (unit: mm)

Capacity	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 deep 12
5.5	14	17	14	5	5	11	M5 deep 12

(with brackets): dimensions with brake

80 flange motors (unit: mm)



□80 flange motor dimensions (unit: mm)

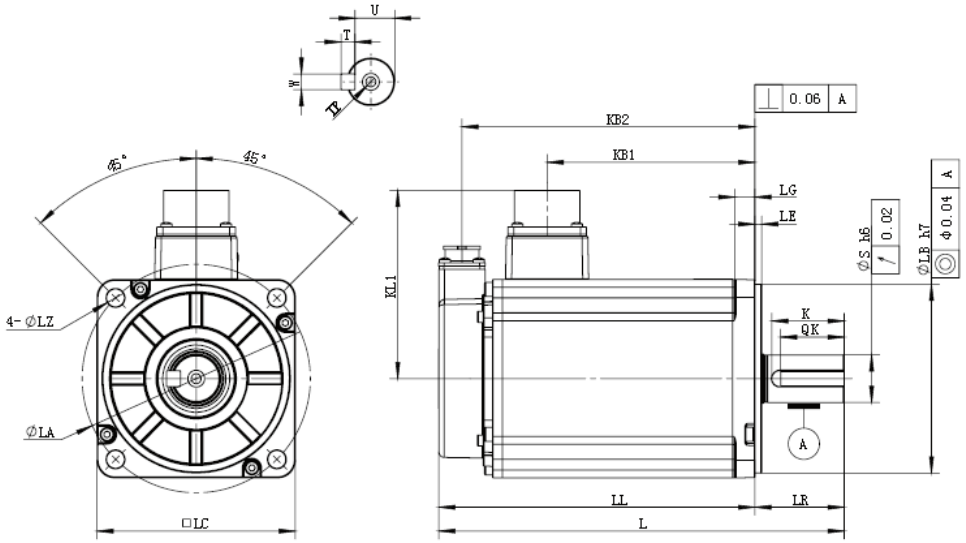
Capacity	L	LL	LR	LA	LB	LC	LE	LG	LZ
750W	143 (180)	108 (145)	35	90	70	80	3	8	6.6
1000W	155 (192)	120 (157)	35	90	70	80	3	8	6.6

S	K	QK	W	T	U	TP
19	22	25.5	6	6	15.5	M6 deep 14
19	22	25.5	6	6	15.5	M6 deep 14

(with brackets): dimensions with brake

Flange size	□100				
Rated capacity (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	
Max torque (N·m)	9.55	14.30	19.10	23.88	
Rated current (A)	6.60	8.20	11.30	14.69	
Max current (A)	28.00	35.00	48.00	63.17	
Rated speed (rpm)	3000	3000	3000	3000	
Max speed (rpm)	5000	5000	5000	5000	
Rotary inertia (10 4kg.m^2)	2.15	3.1	4.06	5.02	
Brake type	Holding	Holding	Holding	Holding	
Brake capacity (w)	14.4	14.4	14.4	14.4	
Brake voltage (v)	24	24	24	24	
Brake friction torque (N·m)	8	8	8	8	
Brake suction time (ms)	120	120	120	120	
Brake release tme (ms)	60	60	60	60	
Brake inertia (10 4kg.m^2)	0.35	0.35	0.35	0.35	

100 flange motors (unit: mm)



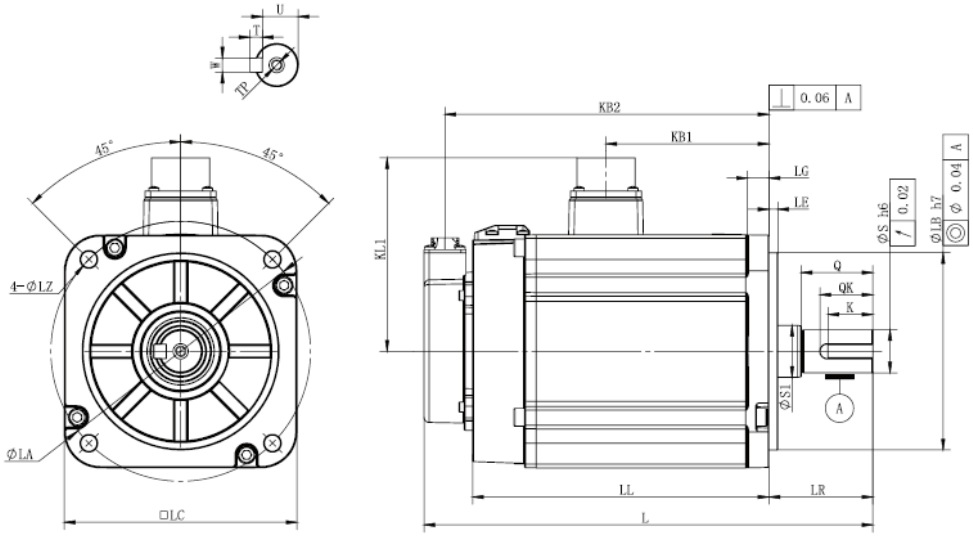
□100 flange motor dimensions (unit: mm)

Capacity	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 deep 16
100	3.5	10	9	24	36.5	32	8	7	20	M6 deep 16
100	3.5	10	9	24	36.5	32	8	7	20	M6 deep 16
100	3.5	10	9	24	36.5	32	8	7	20	M6 deep 16

Flange size	□130						
Rated capacity (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
Max 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
Max 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
Max speed (rpm)	3000	3000	3000	3000	3000	3000	3000
Rotary inertia (10 4kg.m²)	6.74	9.66	12	13.68	12.9	19.9	26
Brake type	Holding	Holding	Holding	Holding	Holding	Holding	Holding
Brake capacity (w)	23	23	23	23	23	23	23
Brake voltage (v)	24	24	24	24	24	24	24
Brake friction torque (N·m)	16	16	16	16	16	16	16
Brake suction time (ms)	100	100	100	100	100	100	100
Brake release tme (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

130 (Minor inertia) flange motors (unit: mm)

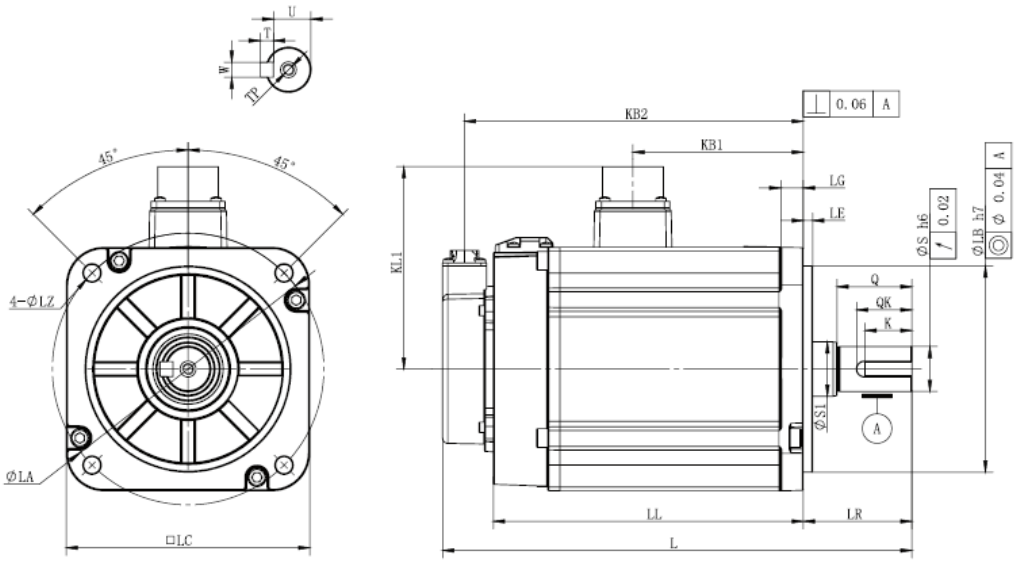


□130 flange motor dimensions (unit: mm)

Capacity	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 deep 16
5	12	9	22	28	49	32	36.5	8	7	18	M6 deep 16
5	12	9	22	28	49	32	36.5	8	7	18	M6 deep 16
5	12	9	22	28	49	32	36.5	8	7	18	M6 deep 16

130（Middle inertia） flange motors (unit: mm)

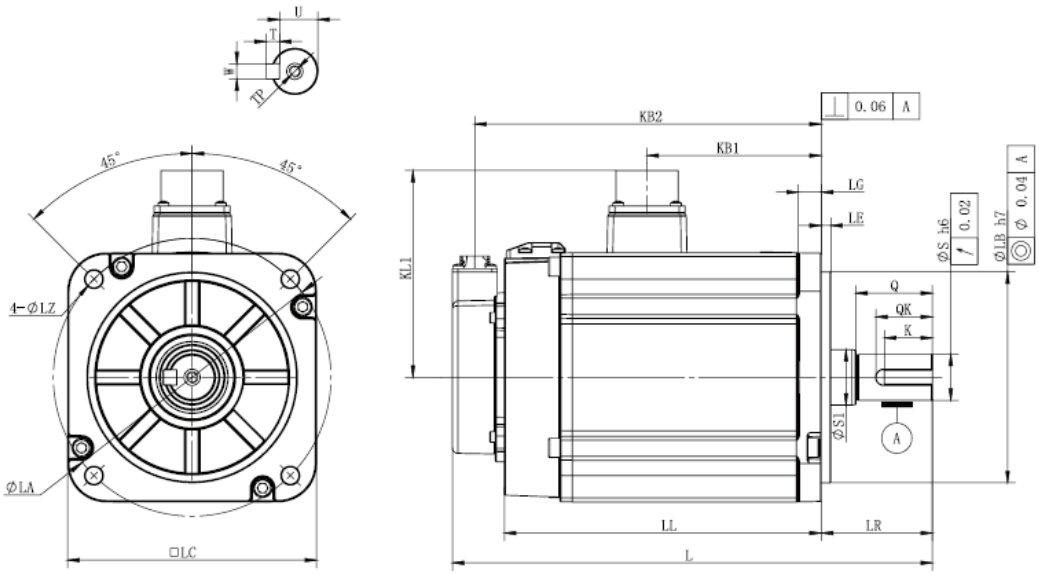


□130 flange motor dimensions (unit: mm)

Capacity	L	LL	LR	KB1	KB2	KL1	LA	LB
0.85KW	195 (219)	137 (166)	58	61	125 (152)	108	145	110
1.3KW	211 (238)	153 (185)	58	76	141 (168)	108	145	110
1.8KW	229 (256)	171 (203)	58	91	159 (185)	108	145	110

LC	LE	LG	LZ	S	S1	Q	K	QK	W
130	5	12	9	19	28	40	27.5	25	5
130	5	12	9	22	28	40	28.5	25	6
130	5	12	9	24	28	40	29.5	25	8

130（Minor inertia） flange motors (unit: mm)



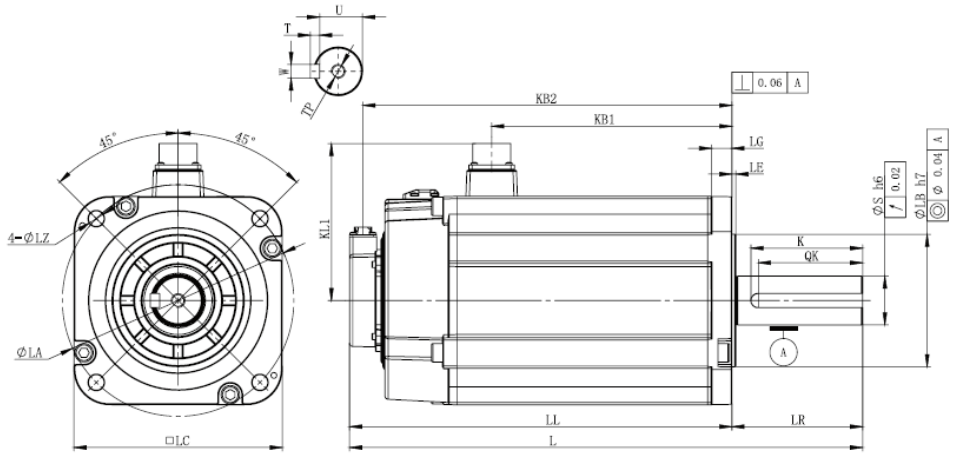
□130 flange motor dimensions (unit: mm)

Capacity	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 deep 16
5	12	9	22	28	49	32	36.5	8	7	18	M6 deep 16
5	12	9	22	28	49	32	36.5	8	7	18	M6 deep 16
5	12	9	22	28	49	32	36.5	8	7	18	M6 deep 16

Flange size	□180				
Rated capacity (kW)	2.9	4.4	5.5	7.5	
Rated voltage (v)	380	380	380	380	
Rated torque (N·m)	18.60	28.40	35.00	48.00	
Max torque (N·m)	46.50	71.00	87.50	120.00	
Rated current (A)	11.90	16.50	20.85	25.70	
Max current (A)	29.75	41.25	52.13	64.25	
Rated speed (rpm)	1500	1500	1500	1500	
Max speed (rpm)	3000	3000	3000	3000	
Rotary inertia (10 4kg.m²)	51.8	85.7	103.8	137.8	
Brake type	Holding	Holding	Holding	Holding	
Brake capacity (w)	32.2	32.2	32.2	32.2	
Brake voltage (v)	24	24	24	24	
Brake friction torque (N·m)	48	48	48	48	
Brake suction time (ms)	100	100	100	100	
Brake release tme (ms)	80	80	80	80	
Brake inertia (10 4kg.m²)	2.43	2.43	2.43	2.43	

180 flange motors (unit: mm)



□180 flange motor dimensions (unit: mm)

Capacity	L	LL	LR	KB1	KB2	KL1	LA	LB	LC
2.9KW	244 (297)	165 (218)	79	95	153 (206)	136	200	114.3	180
4.4KW	272 (325)	193 (246)	79	123	181 (234)	136	200	114.3	180
5.5KW	235 (388)	222 (275)	113	152	210 (263)	136	200	114.3	180
7.5KW	391 (444)	278 (331)	113	208	266 (319)	136	200	114.3	180

LE	LG	LZ	S	K	QK	W	T	U	TP
3.5	17.5	13.5	35	65.5	60	10	8	30	M12 deep 25
3.5	17.5	13.5	35	65.5	60	10	8	30	M12 deep 25
3.5	17.5	13.5	42	96.5	90	12	8	37	M16 deep 32
3.5	17.5	13.5	42	96.5	90	12	8	37	M16 deep 32

Chapter 13 List of parameters

Legends:

- P: Parameter number.
- Descriptions: Parameter detailed descriptions.
- Range: Parameter setting range.
- Unit: Parameter unit.
- Default: Parameter factory default setting value.
- Effective: Parameter effective time.
  - Immediate: Parameter to be effective immediately.
  - Restart: Parameter to be effective after restart the servo drive.
- DL: Data length

P	Description	Range	Unit	Default	Effective	DL
PA000	Function selection basic switch 0	n.0000~11D1		n.0000	Restart	1
	n.×××□: Reserved n.××□×: Control mode selection 0: Position control; 1: Speed control; 2: Torque control; 3: Internal speed control; 4: Internal speed control ⇔ Speed control 5: Internal speed control ⇔ Position control 6: Internal speed control ⇔ Torque control 7: Position control ⇔ Speed control 8: Position control ⇔ Torque control 9: Torque control ⇔ Speed control n.×□××: Reserved n.□×××: Reserved					
PA001	Function selection basic switch 1	n.0000~1264		n.0000	Restart	1
	n.×××□: Stop pattern upon alarm or SOFF 0: Coast to stop; n.××□×: Stop pattern upon overtravel (OT) 0: Coast to stop; 1: Decelerate using PA406 as maximum torque, then enter lock state; 2: Decelerate using PA406 as maximum torque, then coast to stop; n.×□××: AC/DC input power selection 0: AC power input: from L1, L2, L3; 1: DC power input : from P, N. n. □×××: Reserved					
PA002	Function selection basic switch 2	n.0000 ~ 8112		n.0100	Restart	1
	n.×××□: Speed/Position control selection(T-REF assignment)					

P	Description	Range	Unit	Default	Effective	DL
	0: No T-REF assignment; 1: Use T-REF as external torque limit; 2: Use T-REF as torque feedforward; 3: Use T-REF as external torque limit when P-CL & N-CL are valid. n.××□×: Torque control selection(V-REF assignment) 0: No V-REF assignment; 1: Use V-REF as external speed limit. n.×□××: Use of absolute enocoders 0: Use absolute encoders as absolute encoders; 1: Use absolute encoders as incremental encoders. n.□×××: Encoder type selection 0: 17-bit; 2: 23-bit.					
PA003	Reserved					
PA004	Reserved					
PA005	Reserved					
PA006	Function selection basic switch 6	n.0000 ~ 4000		n.0000	Restart	1
	n.×××□: Speed control integral retention 0 integral clearance 1 integral retention n.××□×: Reserved n.×□××: Reserved n.□×××: Use of external encoders 0 Not use. 1 Use in forward direction. 2 Reserved 3 Use in reverse direction. 4 Reserved					
PA008	Function selection basic switch 8	n.0000 ~ 1211		b.0000	Restart	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: Do not detect undervoltage warning; 1: Check out the undervoltage warning and execute the torque limit by the host device; 2: Check out undervoltage warning and execute torque limit via PA424, PA425; n.×□××: Warning detection selection 0: Detect; 1: Not detect; n.□×××: Reserved					
PA009	Function selection basic switch 9	b.0000 ~ 1311		b.0000	Restart	1
	n.×××□: Reserved n.××□×: Reserved					

P	Description	Range	Unit	Default	Effective	DL
	n.×□××: Speed detection method selection 0: Speed detection method 1; 1: Speed detection method 2; n.□×××: Reserved					
PA00B	Function selection basic switch B	n.0000 ~ 9953		n.0021	Restart	1
	n.×××□: Panel parameter display selection 0: Only display setting parameters; 1: Display all parameters; n.××□×: Warning stop method selection 0: Zero speed stop; 1: Coast to stop (same as PA001.0); n.×□××: Reserved n.□×××: Reserved					
PA00D	Function selection basic switch D	n.0000 ~ n.0200		0000	Immediate	1
	n.×××□: Reserved n.××□×: Reserved n.×□××: Reserved n.□×××: Overtravel warning selection 0: Not detect overtravel; 1: Overtravel warning; 2: Overtravel alarm.					
PA010	Function selection basic switch 10	n.0000 ~ n.0601		0300	Restart	1
	n.×××□: Regenerative resistor detection 0: Detect; 1: Not detect; n.××□×: Reserved n.×□××: Overload class 0~9: the higher this value is, the higher overload time is; n.□×××: Reserved					
PA012	Motor model selection Please refer to section 1.3. The drive and motor models need to match. AF005 must be performed after modifying this parameter. Note: An alarm will be generated when the incorrect motor model is modified.	0 ~ 59		12	Restart	1
PA015	Axis address (UART/EtherCAT communication)	1 ~ 255		1	Restart	1
PA016	RS485 Communication function selection switch	n.0000 ~ 1096		n.0035	Immediate	1
	n.×××□: RS485 baud rate 0: 2400bps; 1: 4800bps; 2: 9600bps; 3: 19200bps;					

P	Description	Range	Unit	Default	Effective	DL
	4: 38400bps; 5: 57600bps; n.××□×: Protocol 0: 8，N，1; 1: 8，N，2; 2: 8，E，1; 3: 8，O，1; n.×□××: Reserved n.□×××: Reserved					
PA100	First speed loop gain	10 ~ 20000	0.1 Hz	400	Immediate	1
	Determine the speed loop responsiveness. In order to increase the position loop gain and improve the overall responsiveness of the servo system, the speed loop gain value must be increased. However, if the setting is too large, it may cause vibration. Please pay attention when modifying it.					
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.					
PA103	Inertia ratio	0 ~ 20000	1%	100	Immediate	1
	PA103 value = load inertia (*JL*) / rotorary inertia(*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 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 feedforward filter	0~6400	0.01ms	0	Immediate	1
PA10B	Gain application selection switch 0	n.0000 ~ 0014		n.0000	Immediate	1
	n.×××□: Mode selection 0: conditioned by internal torque command; 1: conditioned by the speed command; 2: conditioned by acceleration; 3: conditioned by the position deviation pulse; 4: no mode switch function; n.××□×: Speed loop control method 0: PI control; 1: I-P control; n.×□××: Reserved n.□×××: Reserved					

P	Description	Range	Unit	Default	Effective	DL
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 pulse)	0 ~ 10000	1 pulse	0	Immediate	1
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 gain compensation	1 ~ 1000	1%	100	Immediate	1
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 ~ 0014		n.0000	Immediate	1
	n.×××□: Gain switching selection switch 0: Manual: by external G-SEL signal. 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 instruction filter output=0 AND instruction pulse output OFF 6: Position instruction pulse ON n.×□××: Reserved n.□×××: Reserved					
PA200	Position control function switch 0	n.0000~1232		n.0000	Restart	1
	n.×××□: Instruction pulse form 0: SIGN+PULS; 1: CW+CCW; 2: A phase + B phase; n.××□×: Pulse signal negation 0: PULS, SIGN not negate; 1: PULS not negate, SIGN negate; 2: PULS negate, SIGN negate; 3: PULS negate, SIGN negate; n.×□××: Pulse clearance action 0: Clear deviation pulse upon Servo OFF or alarm; 1: Clear deviation pulse only by CLR signal;					

P	Description	Range	Unit	Default	Effective	DL
	2: Clear deviation pulse upon alarm. n.□×××: Pulse input channel selection 0: PULS, SIGN input (low speed channel); 1: PULSH, SIGNH input (high speed channel).					
PA201	Position control function switch 1	n.0000~3177		n.0000	Restart	1
	n.×××□: Reserved n.××□×: Reserved n.×□××: Frequency division pulse output negation 0: Not negate 1: Negate n.□×××: Frequency division pulse Z expansion 0: Not expand 1: Expand					
PA202	Position control function switch 2	n.0000~0022		n.0000	Restart	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, the Z pulse is searched in the forward direction, and the first Z pulse is used as the zero point; 3: Running in the positive direction, after hitting the POT signal, the Z pulse is searched negatively, and the first Z pulse is used as the zero point; 4: The zero signal is invalid, running in the positive direction. After the zero signal is valid, the negative Z is running. The first Z pulse with zero signal is invalid. The zero signal is valid, the negative direction is running, and the zero signal is invalid. Z pulses as zero points; 5: The zero signal is valid, running in the negative direction, after the zero signal is invalid, the forward operation, the first Z pulse after the zero signal is valid is zero; the zero signal is invalid, the positive direction is running, and the zero signal is valid. a Z pulse as a zero point; 6: Running in the negative direction, after hitting the NOT signal, it will run in the forward direction, and the NOT signal will be invalid as the zero position; 7: Running in the positive direction, after hitting the POT signal, it runs in the negative direction, and the invalid position of the POT signal is used as the zero position; 8: The zero signal is invalid, running in the positive direction. After the zero signal is valid, the negative direction is running,					

<table>
<tr><th>P</th><th>Description</th><th>Range</th><th>Unit</th><th>Default</th><th>Effective</th><th>DL</th></tr>
<tr><td></td><td colspan="6">and the zero signal is invalid as the zero point; the zero signal is valid, the negative direction is running, and the zero signal is invalid as the zero point;
9: The zero signal is valid, running in the negative direction. After the zero signal is invalid, the forward operation is performed, and the zero signal is valid as the zero point; the zero signal is invalid, the positive direction is running, and the zero signal is valid as the zero point;
n. □×××: Reserved</td></tr>
<tr><td>PA205</td><td>Multi-turn upper limit</td><td>0 ~ 65535</td><td>1 rev</td><td>65535</td><td>Restart</td><td>1</td></tr>
<tr><td rowspan="2">PA207</td><td>Position control function switch</td><td>0000 ~ 2210</td><td>--</td><td>0000</td><td>Restart</td><td>1</td></tr>
<tr><td colspan="6">n.×××□: Reserved
n.××□×: Position control selection
0: No V-REF assignment;
1: Assign V-REF as speed feedforward input.
n.×□××: Reserved
n.□×××: Reserved</td></tr>
<tr><td rowspan="2">PA20E</td><td>Electronic gear ratio numerator</td><td>1 ~ 1073741824</td><td>1</td><td>4</td><td>Restart</td><td>2</td></tr>
<tr><td colspan="6">Refer to PA210.</td></tr>
<tr><td rowspan="2">PA210</td><td>Electronic gear ratio denominator</td><td>0 ~ 1073741824</td><td>1</td><td>1</td><td>Restart</td><td>2</td></tr>
<tr><td colspan="6"><table><tr><th>PA210</th><th>Electronic gear ratio calculation</th></tr><tr><td>≠0</td><td>PA20E/PA210</td></tr><tr><td>=0</td><td>Encoder resolution/PA20E</td></tr></table></td></tr>
<tr><td rowspan="2">PA212</td><td>Encoder pulse division output</td><td>16 ~ 16384</td><td>1 P/Rev</td><td>2500</td><td>Restart</td><td>2</td></tr>
<tr><td colspan="6">1. Set the resolution of the pulse output to the number of output pulses per rotation of OA and OB. If set to 1000, the motor rotates once, 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 exceed 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 type 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.</td></tr>
<tr><td>PA216</td><td>Position command acceleration/deceleration time</td><td>0 ~ 32767</td><td>0.1 ms</td><td>0</td><td>After motor stops</td><td>1</td></tr>
<tr><td>PA217</td><td>Position command FIR filter</td><td>0 ~ 1000</td><td>0.1 ms</td><td>0</td><td>After motor stops</td><td>1</td></tr>
<tr><td>PA218</td><td>Command pulse input rate</td><td>1 ~ 100</td><td>1 time</td><td>1</td><td></td><td>1</td></tr>
<tr><td>PA300</td><td>Speed command input gain</td><td>150 ~ 3000</td><td>0.01 V/ rated speed</td><td>600</td><td>Immediate</td><td>1</td></tr>
<tr><td rowspan="2">PA301</td><td>Internal speed 1</td><td>-6000~ 6000</td><td>1 min-1</td><td>100</td><td>Immediate</td><td>1</td></tr>
<tr><td colspan="6">In internal speed control mode, combination of external IO signals INSPD1 and INSPD0 controls internal speed.<table><tr><th>INSPD1</th><th>INSPD0</th><th>Internal speed</th></tr><tr><td>Invalid</td><td>Invalid</td><td>Zero speed</td></tr><tr><td>Invalid</td><td>Valid</td><td>Internal speed 1 (PA301)</td></tr><tr><td>Valid</td><td>Invalid</td><td>Internal speed 2 (PA302)</td></tr><tr><td>Valid</td><td>Valid</td><td>Internal speed 3 (PA303)</td></tr></table></td></tr>
</table>

P	Description	Range	Unit	Default	Effective	DL
	Internal torque register 0	-6000~ 6000	0.1%	100	Immediate	1
	In internal torque control mode, combination of external IO signals INTor1 and INTor0 controls internal torque. INTor1 / INTor0 / Torque setting value Invalid / Invalid / Analog input Invalid / Valid / Internal torque 1 (PA301) Valid / Invalid / Internal torque 2 (PA302) Valid / Valid / Internal torque 3 (PA303)					
PA302	Internal speed 2	-6000~ 6000	1 min-1	200	Immediate	1
	Internal torque register 1	-6000~ 6000	0.1%	200	Immediate	1
PA303	Internal speed 3	-6000~ 6000	1 min-1	300	Immediate	1
	Internal torque register 2	-6000~ 6000	0.1%	300	Immediate	1
PA304	JOG speed	0 ~ 6000	1 min-1	500	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	Speed feedback filter time	0 ~ 65535	0.01ms	0	Immediate	1
PA30A	Speed control function switch 0					1
PA30B	Speed control function switch 1					1
PA310	Vibration detection switch	0000 ~ 0F02	-	0000	Immediate	1
	n.×××□: Vibration detection selection 0: No detection; 1: After detection, outputs warning (A.911); 2: After detection, outputs alarm (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/ rated torque	30	Immediate	1
PA401	1st torque command filter time constant	0 ~ 32767	0.01ms	100	Immediate	1
PA402	Positive torque limit	0 ~ 400	1%	400	Immediate	1
PA403	Negative torque limit	0 ~ 400	1%	400	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%	400	Immediate	1
PA407	Speed limit at torque control	0 ~ 5000	1 min-1	1500	Immediate	1
PA408	Torque function switch 0	0000 ~ 1111	-	0000		1
	n.×××□: Notch filter selection 1 0: The first stage notch filter is invalid.					

P	Description	Range	Unit	Default	Effective	DL
	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	50 ~ 5000	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	50 ~ 5000	0.001	0	Immediate	1
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	3rd stage notch filter attenuation value	50 ~ 1000	0.01	70	Immediate	1
PA418	3rd stage notch filter depth	50 ~ 5000	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	50 ~ 5000	0.001	0	Immediate	1
PA41F	Torque function switch 1	0000 ~ 1111	--	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					
PA43D	Torque reaches amplitude	0 ~ 300	1%	0	Immediate	1
PA456	Torque scan 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 automatic adjustment 1: 1st stage notch filter automatic adjustment n.××□×: Reserved n.×□××: Notch filter adjustment selection 2 0: 2nd stage notch filter not automatic adjustment					

P	Description	Range	Unit	Default	Effective	DL
	1: 2nd stage notch filter automatic adjustment n.□×××: Reserved					
PA500	DI 1 function selection	n.0000 ~ n.211F	--	n.0000	Immediate	1
	n.XX□□: DI 1 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] Zero-speed clamp (ZEROSPD) [08] Forward torque limitation (PCL) [09] Reverse torque limitation (NCL) [0A] Gain switch (GAIN) [0B] Reserved [0C] Reserved [0D] Instruction division/ multiplication switch 0 (DIV0) [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] HOMESWTICH [16] HOMESTART n.X□XX: DI 1 signal negation [0] Not negate [1] Negate n.□XXX: DI 1 signal status [0] Controlled by external I/O [1] Normally active [2] Normally inactive					
PA501	DI 2 input signal selection	n.0000 ~ n.211F	--	n.0001	Immediate	1
PA502	DI 3 input signal selection	n.0000 ~ n.211F	--	n.2002	Immediate	1
PA503	DI 4 input signal selection	n.0000 ~ n.211F	--	n.2003	Immediate	1
PA504	DI 5 input signal selection	n.0000 ~ n.211F	--	n.0004	Immediate	1
PA505	DI 6 input signal selection	n.0000 ~ n.211F	--	n.0005	Immediate	1
PA506	DI 7 input signal selection	n.0000 ~ n.211F	--	n.0006	Immediate	1
PA507	DI 8 input signal selection	n.0000 ~ n.211F	--	n.0007	Immediate	1
PA50A	DO 1 function selection (CN3-31, CN3-32)	n.0000 ~ n.0100	--	n.0000	Immediate	1
	n.××□□: DO1 function selection 【00】Alarm output(ALM)					

P	Description	Range	Unit	Default	Effective	DL
	n.×□××: DO 1 signal negation [0] Not negate [1] Negate n.□×××: DO 1 signal status [0] Controlled by external I/O					
PA50B	DO 2 signal selection (CN3-29, CN3-30)	n.0000 ~ n.011F		n.0001	Immediate	1
	n.XX□□: DO 2 output signal selection [00] Alarm signal output (ALM) [01] Positioning completed (COIN) [02] Z pulse open-collector signal (CZ) [03] Brake release signal (BK) [04] Servo ready signal (S-RDY) [05] Speed instruction reached (VCMP) [06] Motor rotation detection (TGON) [07] Torque limited signal (TLC) [08] Zero-speed detection signal (ZSP) [09] Warning output (WARN) [0D] Torque reached (TREACH) n.X□XX: DO 2 signal negation [0] Not negate [1] Negate n.□XXX: DO2 signal status [0] Controlled by external I/O [1] Normally active [2] Normally inactive					
PA50C	DO 3 signal selection (CN3-27, CN3-28)	n.0000 ~ n.011F		n.0002	Immediate	1
PA50D	DO 4 signal selection (CN3-25, CN3-26)	n.0000 ~ n.011F		n.0003	Immediate	1
PA511	Zero-speed clamp grade	0 ~ 5000	1 min-1	10	Immediate	1
PA512	Rotation detection (TGON) value	1 ~ 6000	1 min-1	20	Immediate	1
PA513	VCMP signal detection width	0 ~ 100	1 min-1	10	Immediate	1
PA516	BK signal hysteresis time after Servo-OFF	0 ~ 1000	ms	0	Immediate	1
PA517	BK signal speed limit	0 ~ 5000	1 min-1	100	Immediate	1
PA518	BK signal waiting time at Servo-OFF	100 ~ 5000	1ms	500	Immediate	1
PA519	Instantaneous power off holding time	20 ~ 1000	1ms	20	Immediate	1
PA51B	Motor-load position deviation too large value	1 ~ 1073741824	1 command unit	1000	Immediate	2
PA51E	Position deviation too large warning value	10 ~ 100	1%	100	Immediate	1
PA520	Position deviation too large alarm value	1 ~ 1073741824	1 command unit	5242880	Immediate	2
PA522	Positioning completion COIN amplitude	1 ~ 1073741824	1 command unit	7	Immediate	2
PA524	NEAR signal width	1 ~ 1073741824	1 command	65535	Immediate	2

P	Description	Range	Unit	Default	Effective	DL
			unit			
PA526	S-ON position deviation alarm value (ERR)	1 ~ 1073741824	1 command unit	5242880	Immediate	2
PA528	S-ON position deviation warning value	10 ~ 100	1%	100	Immediate	1
PA529	S-ON speed limit value	0 ~ 10000	1 min-1	10000	Immediate	1
PA52B	Overload warning value	5~100	%	20	Immediate	1
PA52F	Display setting at power on	0000 ~ 0FFF	--	0FFF	Immediate	1
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 deviation value	0 ~ 67108864	Pulse	0	Immediate	1
PA560	Residual vibration detection amplitude	1 ~ 3000	0.1%	400	Immediate	1
PA561	Overshoot detection value	0 ~ 100	1%	100	Immediate	1
PA590	Regenerative resistance capacity	0 ~ 32767	1W	0	Immediate	1
PA591	Regenerative resistance	1~200	Ω	40	Immediate	1
PA5A0	Programmed JOG switches	n.0000 ~ n.0005	--	n.0000	Immediate	1
	n.□□□X: Programmed 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	Programmed JOG moving distance	1 ~ 1073741824	1 command unit	32768	Immediate	2
PA5A3	Programmed JOG movement speed	1 ~ 10000	rpm	500	Immediate	1

P	Description	Range	Unit	Default	Effective	DL
PA5A4	Programmed JOG acceleration/deceleration time	2 ~ 10000	1ms	100	Immediate	1
PA5A5	Programmed JOG waiting time	0 ~ 10000	1ms	100	Immediate	1
PA5A6	Programmed JOG movement times	0 ~ 1000	1 time	1	Immediate	1
PA600	Auto-tuning switches	0000 ~ 2401	--	1400	Immediate	1
	n.×××□: Auto-tuning adjustment function switch 0: Invalid 1: Valid n.××□×: Reserved n.×□××: Automatic stiffness level adjustment 0~4: The higher this value is, the higher stiffness level should be n.□×××: Automatic load level adjustment 0~2: The higher the load is, the higher this value should be					
PA60D	Current gain value	100~2000	0.1%	1000	Immediate	1
PA610	Model tracking control switch	0000 ~ 1121	--	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 / Torque feedforward selection 0: Not to use model tracking and feedforward simultaneously 1: Use model tracking and feedforward simultanesously					
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	2nd model tracking control gain	10 ~ 20000	0.1/s	500	Immediate	1
PA61B	2nd model tracking control gain compensation	500 ~ 2000	0.1%	1000	Immediate	1
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	Vibration suppression control swtiches	0000 ~ 0011	-	0010	Restart	1
	n.×××□: Vibration suppression control switch 0: Invalid 1: Valid					

P	Description	Range	Unit	Default	Effective	DL
	n.××□×: Vibration suppression control adjustment switch 0: No automatic adjustment by auxiliary function 1: Automatic adjustment by auxiliary function n.×□××: Reserved n.□×××: Reserved					
PA631	Vibration suppression frequency	10 ~ 20000	0.1Hz	1000	Immediate	1
PA632	Vibration suppression gain compensation	1 ~ 1000	1%	100	Immediate	1
PA633	Damping gain	0 ~ 300	1%	0	Immediate	1
PA634	Vibration suppression filter time parameter 1 compensation	-1000 ~ 1000	0.01ms	0	Immediate	1
PA635	Vibration suppression filter time parameter 2 compensation	-1000 ~ 1000	0.01ms	0	Immediate	1
PA636	Vibration suppression gain 2	0 ~ 1000	1%	0	Immediate	1