Safety Precautions

Thank you for purchasing Shihlin Electric product. This user manual introduces how to install, wiring, inspect and operate Shihlin Servo Drive and Motor. Please read related items in this user manual prior to installation and operation for safety.

■ There are 2 safety notification levels in this user manual: Danger and Caution.

It indicates that it may cause severe or fatal injuries if the instructions are not followed.

It indicates that it may cause moderate injury or malfunction of the product if the instructions are not followed.

Besides, for those items remark as CAUTION, it may cause bad consequences in some cases, please follow the instructions to operate due to its importance.

■ Below symbols indicate the items should be followed.

It indicates the FORBIDDEN items.

It Indicates the MANDATORY Items.

In this user manual, NOTE indicates the cautions which may not cause malfunction of the product, but need pay attention.

Please read this manual carefully and keep it properly to make sure the user can reach it freely.

Safety Instruction

1. Electric Shock Prevention

DANGER

Do NOT operate the switch with wet hands, otherwise it may cause electric shock.

Any wring or inspection must perform AFTER turning off the power for over 20 minutes, charging indicator is off and voltage test is confirmed, otherwise it may cause electric shock.

Well ground the servo drive and motor.

Install the servo drive and motor before wiring, otherwise it may cause electric shock.

Do NOT damage the cable, apply excessive pressure, place heavy objects or extrude the cable, otherwise it may cause electric shock.

Do not disassemble the servo drive front cover when the power is on or under operation, otherwise it may cause electric shock.

Do NOT run the equipment when the servo drive front cover is disassembled, otherwise exposed the high voltage terminal and charging pins may cause electric shock.

Except for wiring and regular inspection, do NOT open the servo front cover, even if the power has been turned off, due to a charge may still remain in the components, which may cause electric shock.

Make sure that ground the servo drive protection grounding (PE) terminal (with ⏚ remark) on the protection grounding terminal (PE) of protection chamber.

Insulate the electrical terminal connection area to avoid electric shock.

2. Fire Disaster Prevention

CAUTION

Do NOT place the servo drive, motor or external regenerative resistor on or nearby inflammable objects, otherwise, fire disaster may be caused.

Turn off the servo drive power when problem occurs, otherwise, the high current flow may cause fire disaster.

Turn off the power by regenerative abnormal signal when regenerative resistor is used. If there is a regenerative brake transistor fault, which may make the regenerative resistor overheat and may cause fire disaster.

Never let below items go inside of the servo drive or motor. Including: flammable matter, such as oil, fat, etc. And conductive matter: such as screw, metal parts, etc.

Ensure the servo drive power supply is connected with a non-fuse breaker.

3. Injury Prevention

CAUTION

Do NOT apply voltages other than those specified in the specifications to each terminal, otherwise, a burst or damage may occur.

Do NOT make mistake when wiring to the terminal. Otherwise, a burst or damage may occur.

Do NOT make mistake on the(+ -)polarity. otherwise, a burst or damage may occur.

Do NOT touch the heat sink, regenerative resistor of the servo drive, servo motor and other components during operation or soon after the power just turned off, because it may get hot and cause injury.

4. Other cautions

Please pay attention to below notifications, improper operation may cause breakdown, injury , electric shock, etc.

(1) Delivery & Installation

CAUTION

Choose correct way to deliver the product base on its weight.

Never stack products which is beyond limitation.

Do NOT hand carry the cable, motor shaft, and encoder when deliver the servo motor.

Servo drive and motor must be installed on the location with enough bearing capacity.

Do NOT stand or put heavy staff on the product.

Ensure the product is installed correctly as specified in this manual.

Inside the protective chamber, a specified space must be reserved between the servo drive and other equipment.

Do NOT install, run the damaged or component missing servo drive and servo motor.

Do NOT congest the vent of servo drive. Otherwise, it may cause a malfunction.

Do NOT drop or strike the servo drive and servo motor as they are precision machinery.

Consult with Shihlin Electric system service representative if you need keep the product for a long period without using.

(2) Wiring

CAUTION

Do wiring carefully, otherwise, it may cause error on servo motor.

Do NOT install phase-in capacitors, surge absorber, and EMI noise filters between the servo drive and servo motor.

Connect the servo drive and motor correctly(terminal U,V,W), otherwise, it may cause malfunction of servo motor.

Connect the servo drive output(terminal U,V,W)and servo motor input(terminal U, V, W) directly, Do NOT connect them by electromagnetic contactor, otherwise, it may cause abnormality or fault.

Do NOT put the diode which control the output signal in wrong direction. Otherwise, it may cause malfunction: no signal output and protect circuit is disabled.

Fasten the cable which is connect to the terminal block with correct torque force. Otherwise, it may cause overheat on the cable and terminal block.

(3) Trial run and adjustment.

CAUTION

Check the program and parameters before operation. Otherwise, it may lead to malfunction of the machine.

Do NOT adjust the parameter settings drastically, otherwise, it may cause some abnormal on the product.

(4) Operation

CAUTION

Set an emergency stop circuit outside the drive, which can be activated immediately in urgent cases to turn off the power supply.

Do NOT disassemble, repair or modify the equipment.

Please confirm that the operation signal is off before clear the alarm. otherwise the motor might restart immediately and you may get injured.

Use noise filter to minimize the influence of electromagnetic interference, otherwise, the electric device nearby might be impacted.

Do NOT burn or disassemble the servo drive, or it may cause hazardous gas.

Ensure a specified combination of servo drive and motor is used.

The built-in electromagnetic brake is used to hold the motor shaft, do NOT use for ordinary braking.

(5) Maintenance and Inspection

Ensure the power LED indicator is off before maintenance or inspection.

Only qualified electricians can install, wire, repair and maintain the servo drive and servo motor.

Do NOT disassemble the servo motor, otherwise you may get electric shock or injured.

When the power is ON, do NOT connect or disconnect the servo drive with motor.

The built-in electromagnetic brake is designed to hold the motor shaft, do NOT use for ordinary braking.

Note: the content of this manual may be revised without prior notice. Please consult our distributors or download the latest version at ***http://www. seec. com. tw/en/***

1. Product overview and model description

1.1 Outline

Shihlin general type AC servo includes single mode and multi-mode. Single mode has the following four types of control mode: position mode(terminal input), position mode(internal register), speed mode and torque mode. And multi-mode has the following 8 types of control mode: position mode(terminal input)/speed mode, position mode(terminal input)/torque mode, position mode(internal register)/speed mode, position mode(internal register)/torque mode, speed mode/torque mode, position mode(terminal input)/position mode(internal register), position mode(terminal input)/position mode(internal register)/speed mode and position mode(terminal input)/position mode(internal register)/torque mode.

The servo can be used for high-precision positioning system, speed control smoothing system in general machinery industry, host machine and tension control system.

Shihlin servo provides RS-485 serial communication function, and it also provides the most convenient USB communication function, this enable you can rapidly perform parameter setting, test operation, status monitoring and gain adjustment control by a computer which is installed with Shihlin communication software.

Shihlin servo provides auto tuning function, servo gain can automatically perform adjustment with the mechanical. The Shihlin servo is equipped with 23&24-bit pulse/rev absolute encoder, it can perform high-precision control.

1.2 Product checklist

Please check below items before you start to use our product

- Any loose or fall off screw on motor or drive.
- Check if the product model name on nameplates of the motor and drive are align with your purchase order. You can refer to the product model list in next section.
- Check if any damage or scratch on the surface of the motor and drive.
- Check if any abnormality on the motor shaft, you can manually rotate the motor shaft to check if it can move smoothly. But if the motor is equipped with electromagnetic brake, you cannot manually rotate the motor shaft.

If any of the above problems occurs, please contact the distributor.

A complete servo system includes:

(1) A servo drive and a servo motor.

(2) A UVW motor power cable: its one end with the U, V, W cables connect to the corresponding terminal block, and the other end connects to the UVW connector on the motor. The green wire connects to the ground terminal of the servo drive (optional purchase).

(3) An encoder control signal cable: its one end connects to the CN2 of the servo drive and the other end to encoder.

(4) A USB communication cable, its one end connects to CN4 of the drive, the other end to USB port of the computer. (Optional purchase).

(5) A 50 Pin connector for CN1.

(6) A 12 pin (P,D,C,N,L1,L2,R,S,T,U,V,W) terminal block for servo below 1KW.

(7) A 6 pin(P,D,C,N,L1,L2) terminal block for1.5KW~3KW servo.

(8) A 6 pin (R,S,T,U,V,W) terminal block for 1.5KW~3KW servo.

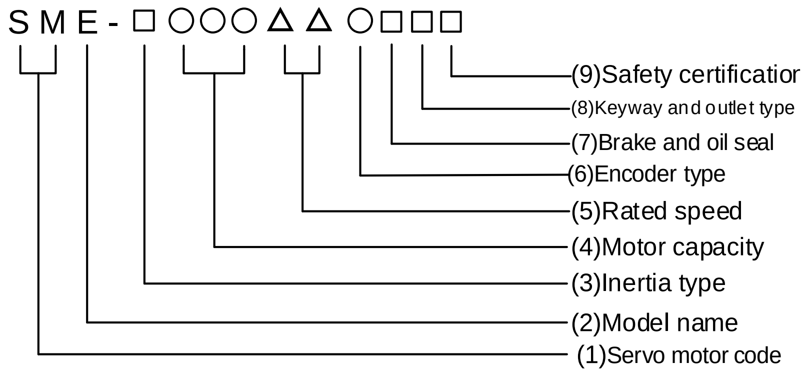
(9) An installation guide.

(10) Shihlin servo user manual, the electric copy can be download from the website.

1.3 Product model overview

1.3.1 Servo motor model naming rule

1. Naming rule



2.Description of each code item

(1) Servo motor code: SM indicates servo motor.

(2) Model code: E(200V), P(400V).

(3) Inertia classification: coding according to motor inertia:

Code	Classification
L	Low inertia
M	Middle inertia
H	High inertia

(4) Motor capacity: motor output power

Code	005	010	020	040	075	085	100
200V motor power(W)	50	100	200	400	750	850	1000
Code	130	150	180	200	300	500	700
200V motor power(W)	1300	1500	1800	2000	3000	5000	7000

Code	180	290	440	550	750
400V motor power(W)	1800	2900	4400	5500	7500

(5) Rated speed: the rated motor speed.

Code	15	20	30
Rated speed(rpm)	1500	2000	3000

(6) Encoder type: Shihlin servo motor encoder type.

Code	S	M
Single turn resolution type	200V: 24bit (50W~750W) 23bit (850W~7KW)	200V: 24bit (50W~750W) 23bit (850W~7KW) 400V: 23bit (1.8KW~7.5KW)
Multi-turn resolution type	—	16bit

(7) Brake and oil seal: the following codes is to indicate whether the motor is equipped with brake and oil seal.

Code / Item	A	B	C	D
Brake	—	●	—	●
Oil seal	—	—	●	●

(8) Keyway and outlet type: the following code indicates the configuration of motor keyway and outlet type.

Code / Item	A	B	C	D
Keyway	—	●	—	●
Back side cable	—	—	●	●

(9) Safety certification: the certified safety certification of the motor is indicated by the following code:

Code / Item	CE certification	Compliant with UL/CE certification
Code	-	U

Coding example:

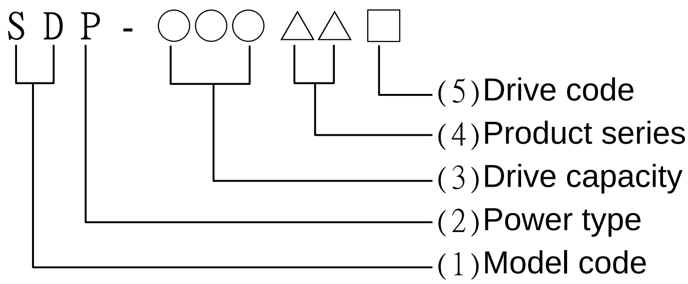
Example(1): for a 200W motor, low inertia, rated speed 3000rpm, without brake&oil seal& keyway, single turn encoder, CE certified model, its model name is as follows: SME-L02030SAA.

Example(2): for a 750W motor, low inertia, rated speed 3000rpm, with brake, without oil seal, with keyway, multi-turn encoder, back side cable, UL certified, its model name is SME-L07530MBDU.

Example(3): for a 3000W motor, low inertia, rated speed 2000rpm, without brake, with oil seal and keyway, multi-turn encoder, CE certified, the model name is SME-L30020MCB.

1.3.2 Servo drive model naming rule

1. Naming rule



2.Description of each coding item

(1) Drive code: SD means Servo Drive

(2) Product series: P

(3) Drive capacity: motor output power. Multiply the motor output power by 1/10 and then indicate it as a three-code number. For models above 1000W, the third code uses the English letter K to represent 1000W. The example is as follows:

020 means 200W

150 means 1500W

300 means 3000W…like that.

(4) Power type: input power specification

A2: single-phase or three-phase 200 ~ 240 VAC

A4: three-phase 380 ~ 480 VAC

(5) Mode code

A: without full-closed loop. (CN2L)

C: with full-closed loop. (CN2L)

Example:

Example (1): A 200W drive, single-phase or three-phase 200 ~ 240 VAC, with full-closed loop control function, the code is as follows: SDP-020A2C.

Example (2): A 3000W drive, three-phase 400 ~ 480 VAC, with full-closed loop control function, the code is as follows: SDP-300A4C.

1.3.3 SDP servo drive and motor

200VAC system

	Servo drive	Corresponding servo motor
100W	SDP-010A2C	SME-L00530○□□□ SME-L01030○□□□
200W	SDP-020A2C	SME-L02030○□□□ SME-H02030○□□□
400W	SDP-040A2C	SME-L04030○□□□ SME-H04030○□□□
750W	SDP-075A2C	SME-L07530○□□□ SME-H07530○□□□
1000W	SDP-100A2C	SME-H08515○□□□ SME-M10020○□□□ SME-L10020○□□□
1500W	SDP-150A2C	SME-M15020○□□□ SME-L15020○□□□
2000W	SDP-200A2C	SME-M20020○□□□ SME-L20020○□□□
3000W	SDP-300A2C	SME-H13015○□□□ SME-H18015○□□□ SME-M30020○□□□ SME-L30020○□□□

Note 1: refer to section 1.3.1 for the description of ○□□□ in servo motor model name.

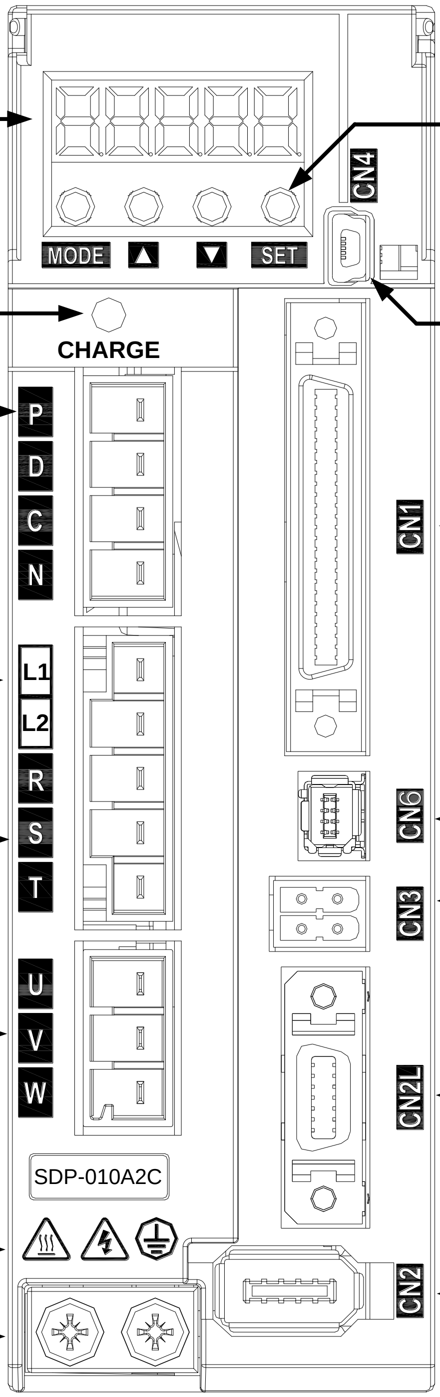
400VAC system

	Servo drive	corresponding servo motor
1800W	SDP-200A4C	SMP-H18015○□□□
2900W	SDP-300A4C	SMP-H29015○□□□
4400W	SDP-500A4C	SMP-H44015○□□□
5500W		SMP-H55015○□□□
7500W	SDP-700A4C	SMP-H75015○□□□

Note 1: refer to section 1.3.1 for the description of ○□□□ in servo motor model name.

1.4 Servo drive appearance and panel description

1.4.1 200V drive appearance and panel



Operation panel

To perform function and parameters setting.

MODE：Mode selection

▲：add one on the displayed value

▼：deduct one from the displayed value

SET：Press SET button to confirm the setting

Display

The 5-digit 7 segment LED displayer displays the alarm, servo status, parameter, etc.

Power indicator

If the indicator is on, it means the servo drive still has high voltage at that time.

USB connector

Connects the PC and controller.

Internal /external regenerative resistor/brake control module.

1. When external regenerative resistor is used, P and C connect to the resister; P and D are left open.
2. When internal regenerative resistor is used, P and C are left open; P and D are short-circuited (connected)
3. When external regenerative brake unit is used, P and N connect to the brake unit; P & C and P & D are left open.

Control interface.

1.controls the external I/O

2. connects to PLC

Control board power supply.

Use single-phase(200-240VAC, 50-60HZ power supply) to L1, L2 terminal.

STO terminal

Main circuit power supply

Connects R,S,T to commercial power (AC200-240V,50-60HZ power)

RS-485 connector

Connects the PC and controller.

Servo motor output

Connects to the motor power connector U, V, W, Do not connect to the main circuit power. Incorrect wiring will cause damage to the servo drive.

Position feedback connector

1. Linear scale feedback.
2. Hall sensor connector

Heat sink

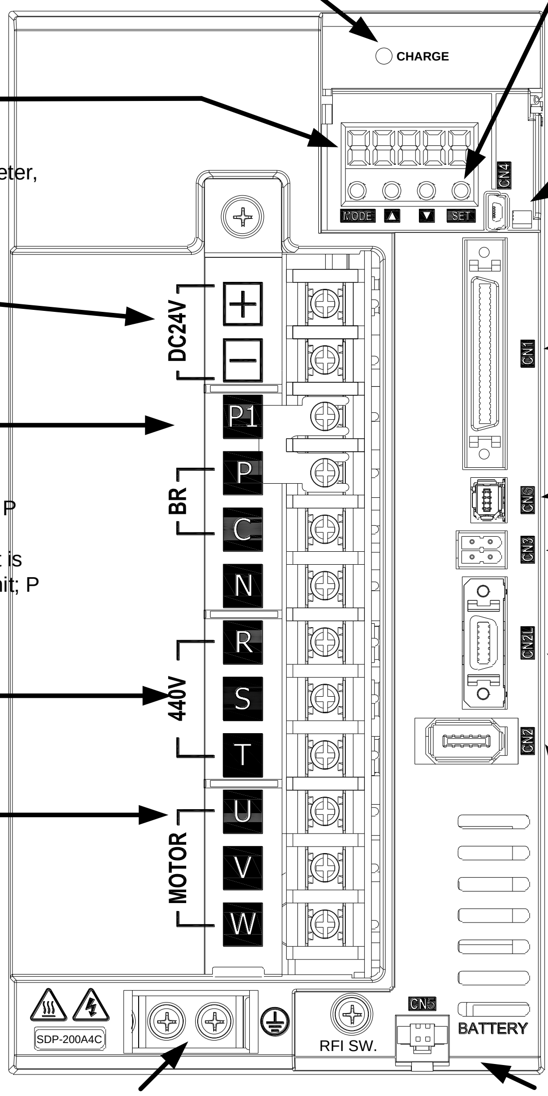
For fixing the servo and heat dissipation.

Grounding terminal

Encoder connector

Connects to the motor encoder

1.4.2 400V servo drive appearance and panel



Power indicator

If the indicator is on, it means the servo drive still has high voltage at that time.

Display

The 5-digit 7 segment LED displayer displays the alarm, servo status, parameter, etc.

Control board power supply.

Use DC24V power supply to +, - terminal.

Internal /external regenerative resistor/brake control module.

1.When external regenerative resistor is used, P and C connect to the resister; P and D are left open.
2.When external regenerative brake unit is used, P and N connect to the brake unit; P & C and P & D are left open.

Note: Do not remove the shorts of P1 and P!

Main circuit power supply

Connects R,S,T to commercial power (AC400-480V,50-60HZ power)

Servo motor output

Connects to the motor power connector U, V, W, Do not connect to the main circuit power. Incorrect wiring will cause damage to the servo drive.

Operation panel

To perform function and parameters setting.

MODE：Mode selection
▲：add one on the displayed value
▼：deduct one from the displayed value
SET：Press SET button to confirm the setting

USB connector

Connects the PC and controller.

Control interface.

1.controls the external I/O

2. connects to PLC

STO terminal

RS-485 connector

Connects the PC and controller.

Position feedback connector

1. Linear scale feedback.

2. Hall sensor connector

Encoder connector

Connects to the motor encoder

Grounding terminal

Absolute encoder battery connector

1.5 Servo drive control modes introduction

Shihlin drive provides a variety of control modes for you, as detailed in the below table:

<table>
<tr><th colspan="2">Mode name</th><th>Code</th><th>Description</th></tr>
<tr><td rowspan="4">Single mode</td><td>Position mode (terminal input)</td><td>Pt</td><td>Drive receives the external position pulse command which is input from terminal and runs the motor to the target position.</td></tr>
<tr><td>Position mode (internal register)</td><td>Pr</td><td>The drive receives the position command which is provided by the internal register (64 groups of registers). and runs the motor to the target position. The DI signal can be used to select the register number.</td></tr>
<tr><td>Speed mode</td><td>S</td><td>The drive receives the speed command and runs the motor to the target speed. The speed command can be selected by the DI signal to use analog voltage command or internal speed command(7 groups of register).</td></tr>
<tr><td>Torque mode</td><td>T</td><td>The drive receives torque command which is provided by analog voltage command or internal torque command, and runs the motor to the target torque.</td></tr>
<tr><td colspan="2" rowspan="8">Multi-mode</td><td>Pt-S</td><td>Pt/S is switched mutually via the signal of DI(LOP).</td></tr>
<tr><td>Pt-T</td><td>Pt/T is switched mutually via the signal of DI(LOP).</td></tr>
<tr><td>Pr-S</td><td>Pr/S is switched mutually via the signal of DI(LOP).</td></tr>
<tr><td>Pr-T</td><td>Pr/T is switched mutually via the signal of DI(LOP).</td></tr>
<tr><td>S-T</td><td>S/T is switched mutually via the signal of DI(LOP).</td></tr>
<tr><td>Pt-Pr</td><td>Pt/Pr is switched mutually via the signal of DI(Pt-Pr).</td></tr>
<tr><td>Pt-Pr-S</td><td>Pt/Pr/S is switched mutually via the signal of DI(LOP + Pt-Pr).</td></tr>
<tr><td>Pt-Pr-T</td><td>Pt/Pr/T is switched mutually via the signal of DI(LOP + Pt-Pr).</td></tr>
</table>

★ Set PA01 to select the mode. After setting the parameter, restart the power to activate the changed setting.

★ If use the default configuration directly, PA01 need set to 1XXX.

1.6 Recommended breaker and fuse specification table

Specification chart of Shihlin servo drive fuse and breaker(200V)

Drive model name	Fuse	Breaker
SDP－010A2C	5A	5A
SDP－020A2C	5A	5A
SDP－040A2C	10A	10A
SDP－075A2C	20A	15A
SDP－100A2C	20A	15A
SDP－150A2C	40A	20A
SDP－200A2C	50A	30A
SDP－300A2C	70A	30A

Specification chart of Shihlin servo drive fuse and breaker(400V)

Drive model name	Fuse	Breaker
SDP－200A4C	30A	20A
SDP－300A4C	50A	30A
SDP－500A4C	90A	60A
SDP－700A4C	120A	70A

2. Installation

2.1. Precautions and storage

- Do not install the product in the location with or nearby inflammable objects.
- Do not over tighten the cable between the drive and the motor.
- Do not place any heavy objects on the top of the drive.
- Be sure to fasten every screw tightly when fixing the drive.
- Install the drive at a location with proper weight capacity.
- The motor shaft must be aligned with the shaft of the equipment.
- Never let below items go inside of the servo drive. Including: conductive matter: such as screw, metal parts, etc, and flammable matter, such as oil, etc.
- Upgrade the diameter of cable which connect the U/V/W connector and the encoder if the distance between the drive and the motor is over 20meters.
- Do not congest vent of the drive, otherwise breakdown may be occurred.
- Do not drop or strike the drive.
- Do not try to operate the drive if something has been damaged.
- Refer to section 10.1 and 11.3 for drive and motor storage precautions.

2.2. Installation environment

The applicable ambient temperature for Shihlin drive is between 0℃ and 55℃. If it exceeds 45℃, please place the drive in a well-ventilated or air-conditioned room. It is recommended to keep the ambient temperature below 45℃ for long-term operation to ensure the reliable performance of the product. If this product is installed in a distribution box, check the size of the distribution box and its ventilation condition, make sure the internal electrical devices has no overheating risk, Besides, check if the vibration of the machine affects the electrical devices of the distribution box.

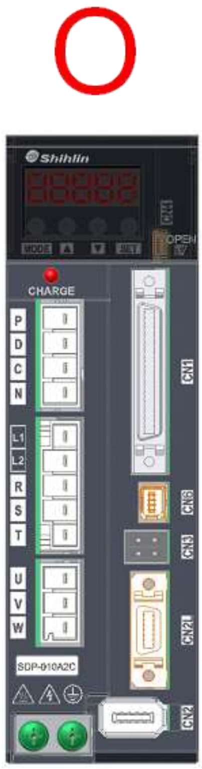
In addition, the conditions for using Shihlin servo include the following:

- ◆ Locations without high-heating devices.
- ◆ Locations without floating dust and metal particles.
- ◆ Locations without corrosive, inflammable gas and liquid.
- ◆ Locations without water drops, steam, dust or oil dust.
- ◆ Locations without electromagnetic noise interference.
- ◆ Select a solid, vibration-free location.

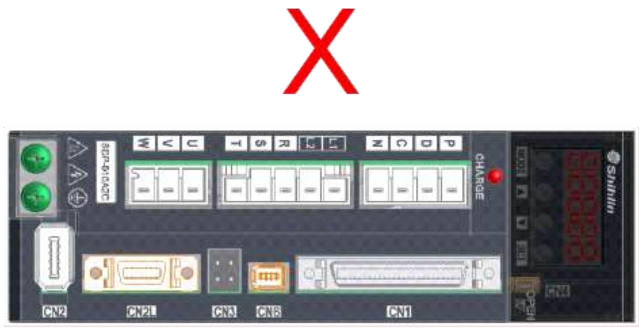
2.3. Installation Direction and Clearances

Precautions:

Mount the servo drive in the correct direction according to the requirement. Otherwise, it may cause malfunction. For better ventilation and cooling, when installing Shihlin AC servo drive, there must be sufficient clearance space between its adjacent objects and the wall, or overheating may result in machine malfunction. Do not congest the ventilation holes of the servo drive, and do not dump, otherwise it may cause malfunction of the servo drive.



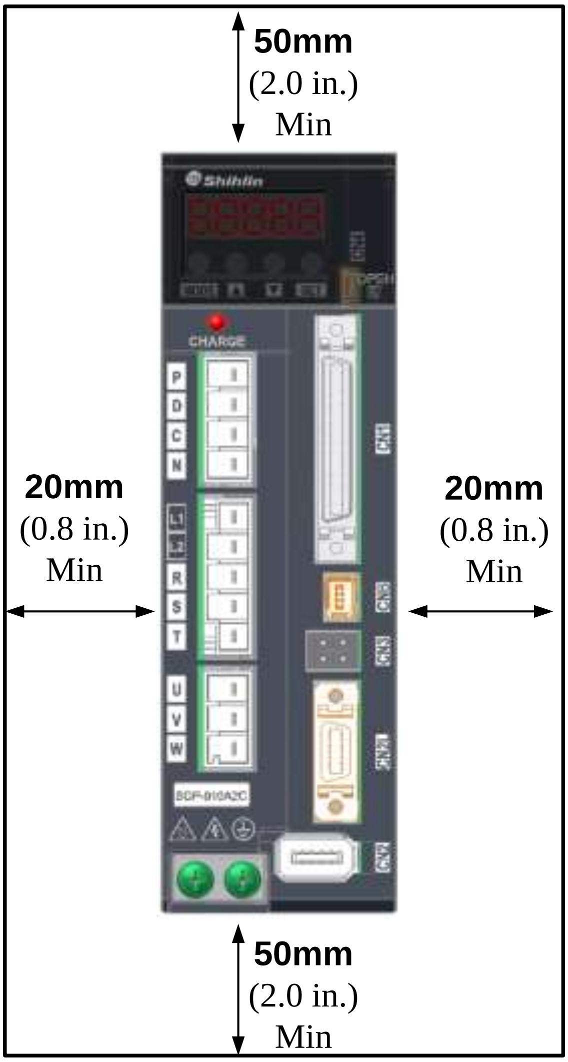
Correct

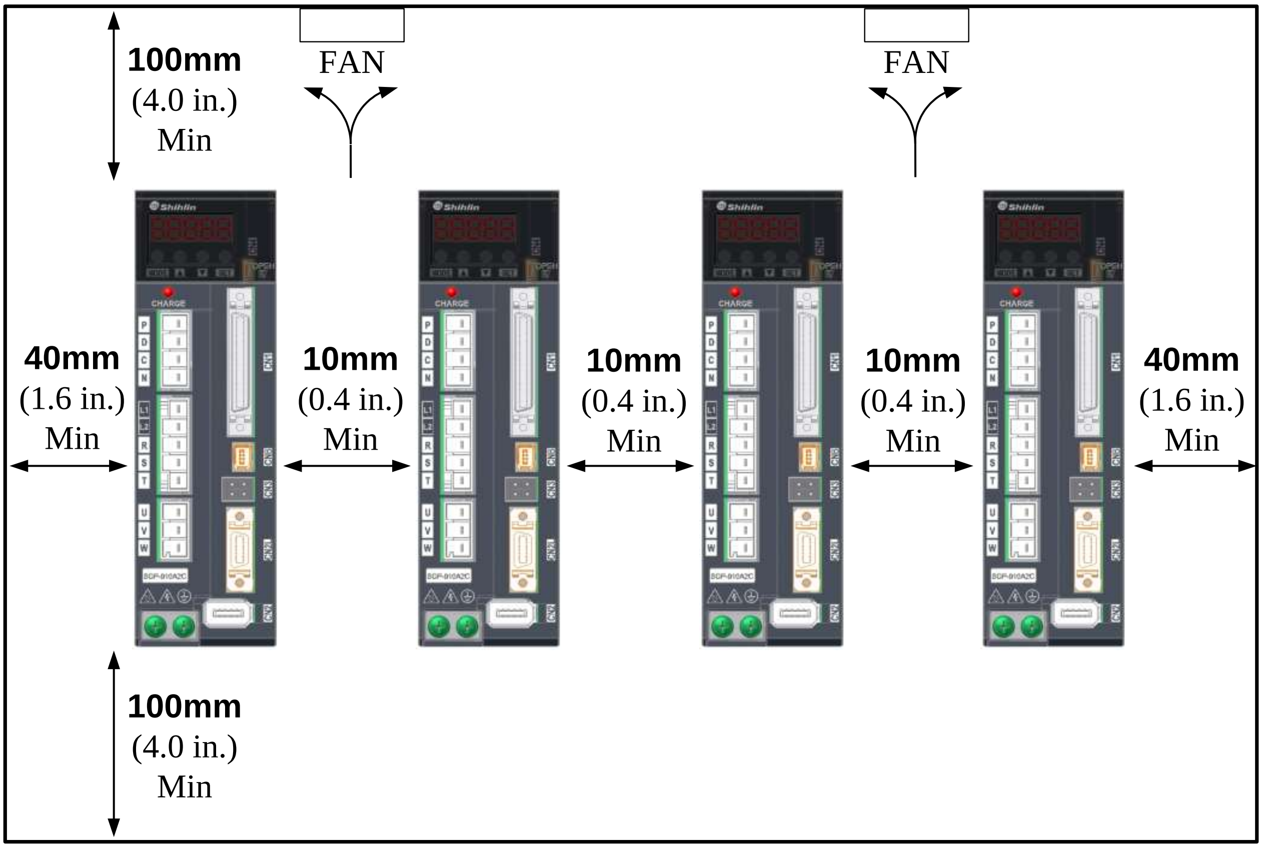


Wrong

Installation diagram

In order to have adequate air flow for ventilation, you must follow the suggested clearances when installing one or more servo drives (refer to the following diagrams).



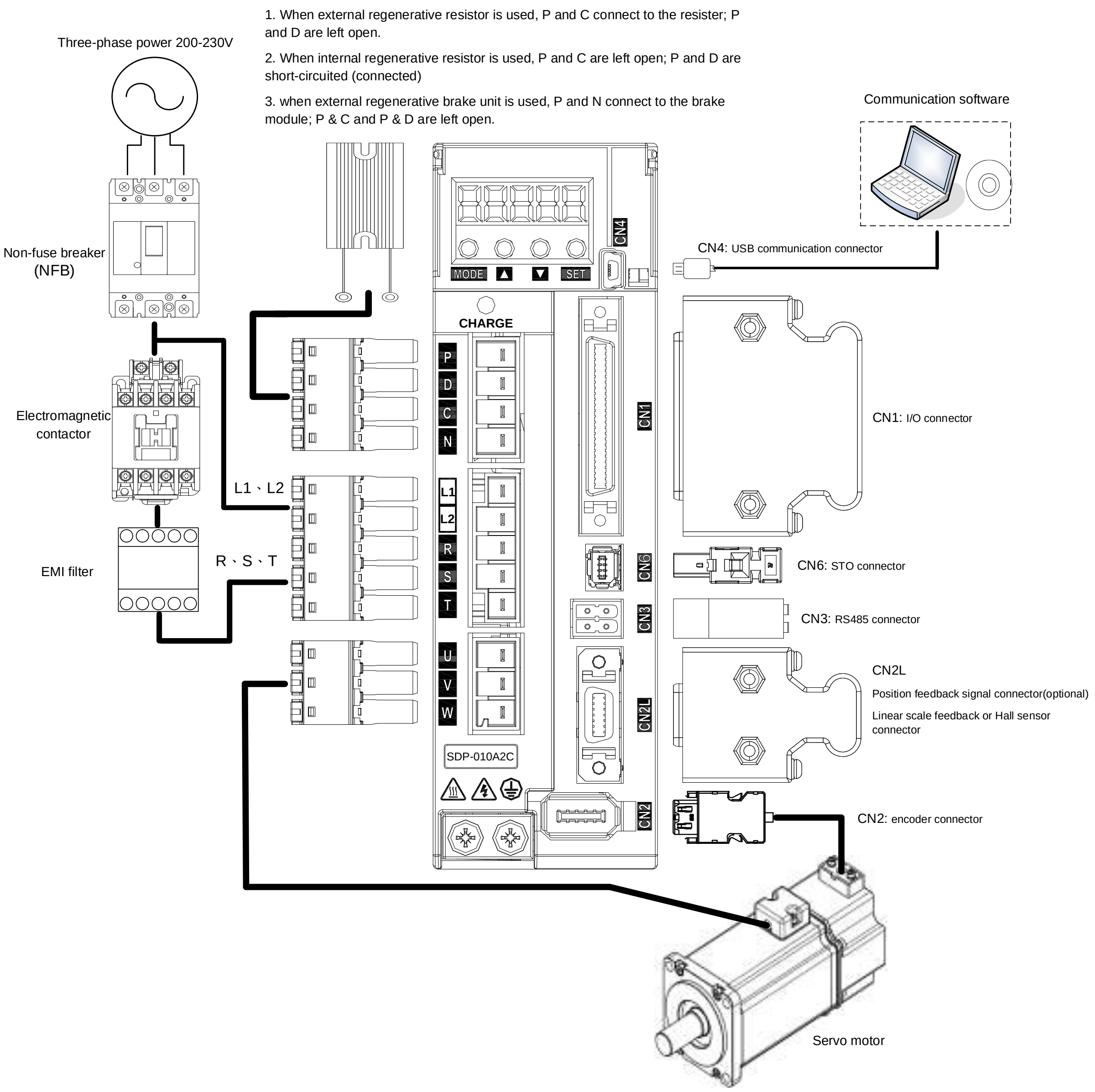

100mm
(4.0 in.)
Min
FAN
FAN
40mm
(1.6 in.)
Min
10mm
(0.4 in.)
Min
10mm
(0.4 in.)
Min
10mm
(0.4 in.)
Min
40mm
(1.6 in.)
Min
100mm
(4.0 in.)
Min

3. Wiring and signal

This chapter explains the wiring method of Shihlin servo drive and the definition of signals, as well as the standard wiring diagrams in all modes.

3.1. Connection of power supply and peripheral equipment

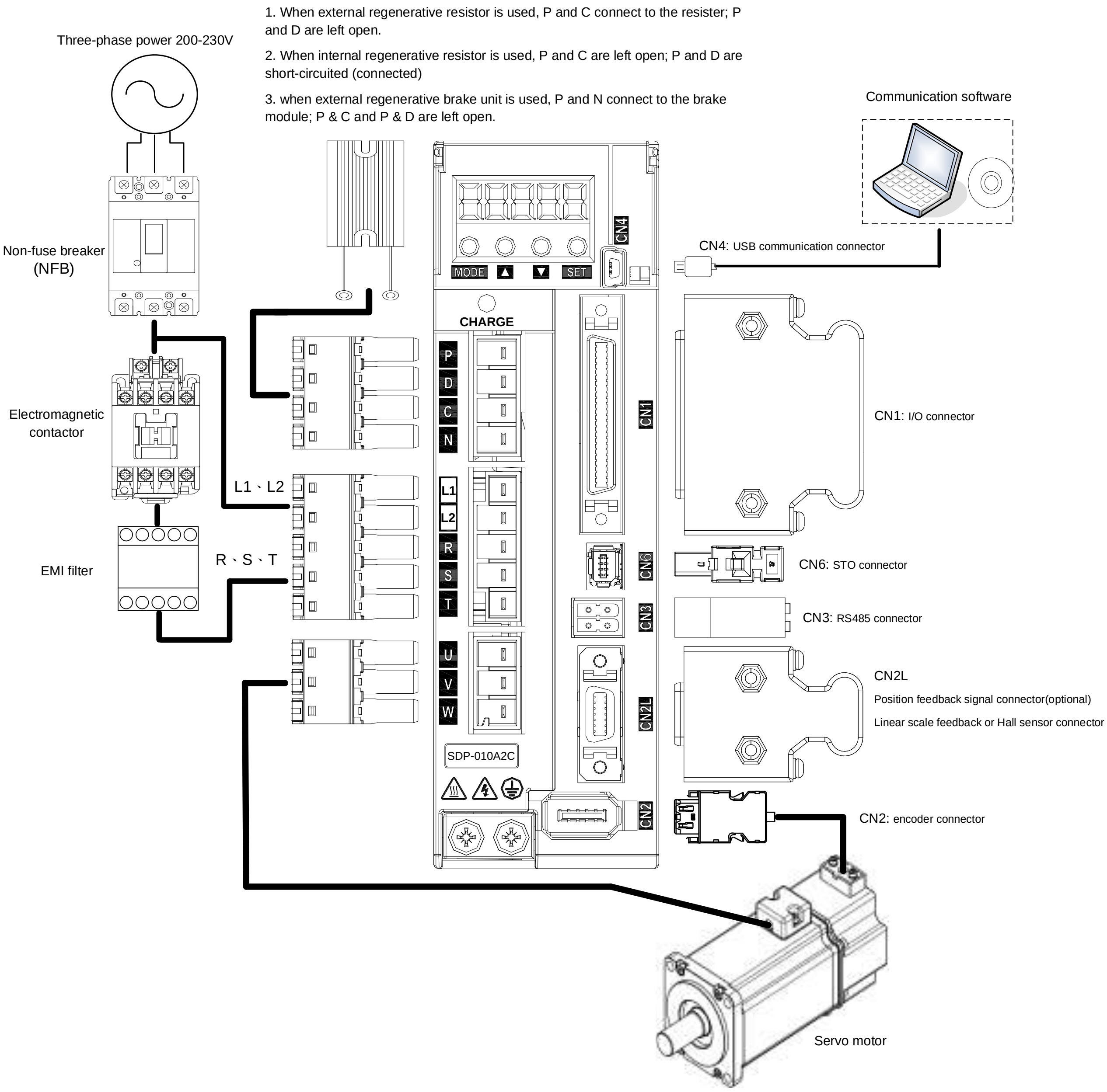
3.1.1. Peripheral equipment wiring diagram - 200V system



For detailed EMI filter content, please refer to section 12.6 EMI Filter

DANGER	To prevent electric shock, the ground protection (PE) terminal (marked terminal) of the servo drive must be connected to the ground protection terminal of the controller.

3.1.2. Peripheral equipment wiring diagram - 400V system



※ For detailed EMI filter content, please refer to section 12.6 EMI Filter

DANGER To prevent electric shock, the ground protection (PE) terminal (marked ⏚ terminal) of the servo drive must be connected to the ground protection terminal of the controller.

3.1.3 Description of drive connectors and terminals

<table>
<tr><th>Item</th><th>code</th><th>Description</th></tr>
<tr><td>Power input for the main circuit</td><td>R, S, T</td><td>Connect to three-phase AC power</td></tr>
<tr><td>Power input for the control circuit</td><td>L1, L2 / + -</td><td>Connect to single-phase AC power/DC24V.</td></tr>
<tr><td>Motor power connector</td><td>U, V, W, PE</td><td><table>
<tr><th>Terminal code</th><th>Wire color</th></tr>
<tr><td>U</td><td>Red</td></tr>
<tr><td>V</td><td>White</td></tr>
<tr><td>W</td><td>Black</td></tr>
<tr><td>PE</td><td>Green</td></tr>
</table></td></tr>
<tr><td>Regenerative resistor terminals</td><td>P, D, C, N</td><td><table>
<tr><td>Use an external resistor</td><td>Connect P and C to the resistor, and P and D are left open.</td></tr>
<tr><td>Use a built-in resistor</td><td>Short-circuit P and D contacts, and P and C are left open.</td></tr>
</table></td></tr>
<tr><td>Ground terminals</td><td>⏚</td><td>Connect to the ground wires for the power and servo motor, which is in the green screw on the outside of the controller.</td></tr>
<tr><td>P: main circuit [+] terminal

N: main circuit [-] terminal</td><td>P, N</td><td>If brake unit is used, you should connect its [+] terminal to the [P] terminal of servo drive, and connect its [-] to the [N] terminal of servo drive.

The brake unit is optional purchase item, usually it is not required. It is used to absorb the regenerative energy when the huge regenerative power generated by the servo motor.</td></tr>
<tr><td>I/O connector</td><td>CN1</td><td>Connect to the host controller.</td></tr>
<tr><td>Encoder connector</td><td>CN2</td><td>Connect to the encoder.</td></tr>
</table>

Position feedback connector	CN2L	Connect to position feedback unit.
RS-485 connector	CN3	Connect to RS-485 device.
USB connector	CN4	Connect to USB slot of PC
power connector for absolute encoder	CN5	Connect to battery pack of absolute encoder (optional purchase)

Pay special attention to the following when wiring:

1. Separate R, S, T and U, V, W from other signal wires. The separation should be at least 30 cm.

2. When the power is off, do not touch R, S, T and U, V, W power cables, since the capacitance inside the servo drive may still contain a dangerously large amount of electric charge. Wait until the charging light is off before touching.

3. If the connection cable for encoder is not long enough, use a shielded twisted-pair signal cable and the length should be within 20 meters (65.62 ft). If it is over 20 meters (65.62 ft), choose a signal cable with two times thicker gauge to avoid excessive signal attenuation.

4. If the power supply and the detector (encoder) of the SV motor are not fixed on the motor, it may sway and cause poor wire contact.

5. The control power for 400V model is DC24V.

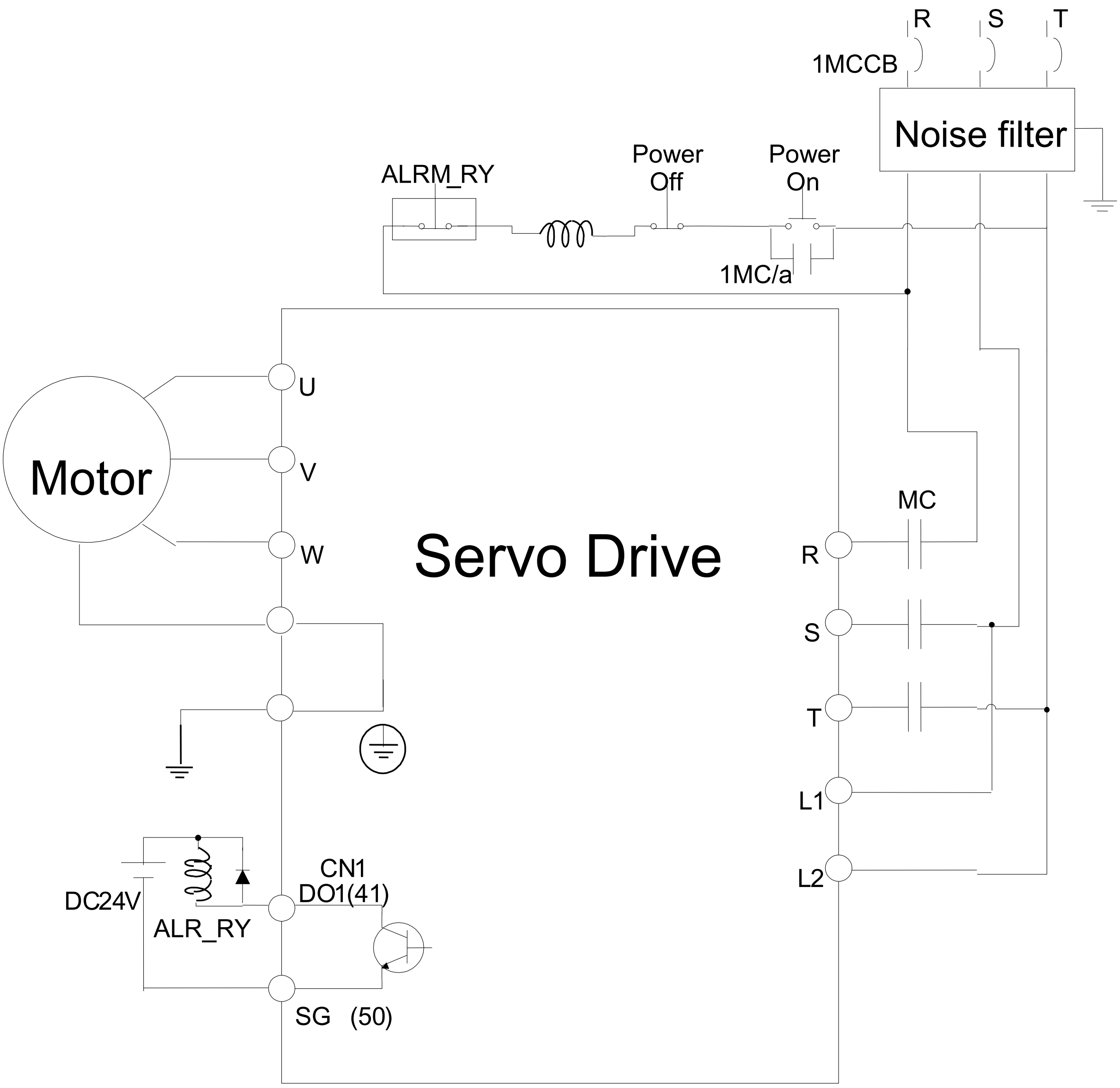
3.1.4 Wiring for power supply

DANGER	● Insulate the connection of the power terminal to avoid the possibility of electric shock.

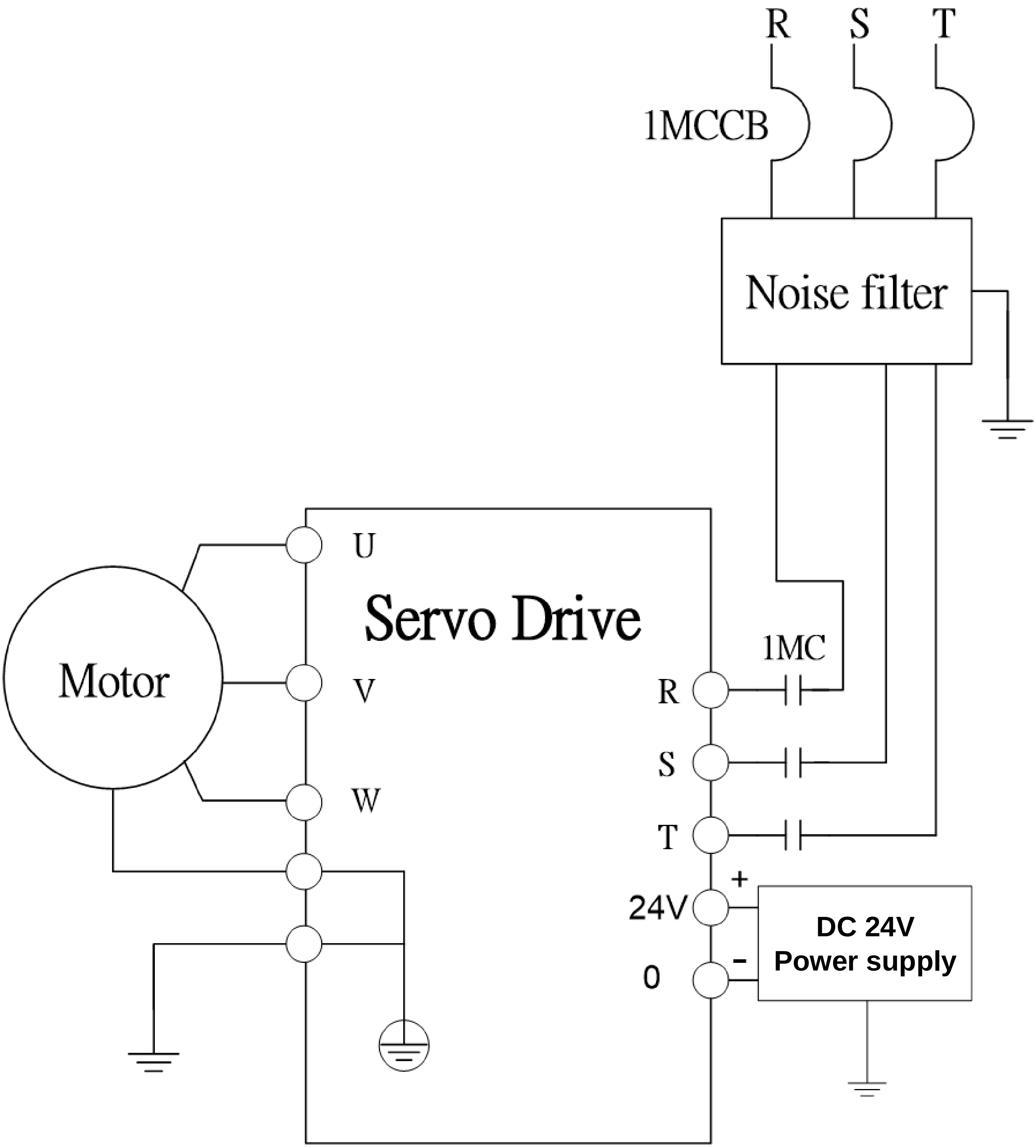
CAUTION	● The power supply cable(U,V,W) of servo drive and servo motor must be connected correctly to avoid abnormal operation on servo motor. ● Servo motor cannot be connected to commercial power supply, otherwise it may cause malfunction.

The Shihlin servo drive power wiring is three-phase power. In the following diagram, Power ON is a contact, and Power OFF and Alarm Processing are b contacts. 1MC/a is self-retaining power supply and 1MC is electromagnetic contactor.

200V Series:



400V series:

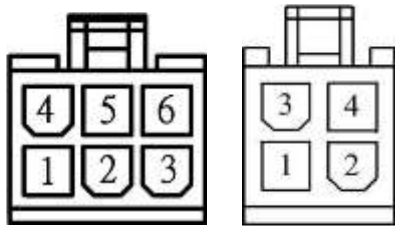


★ Note: terminal P,N cannot be grounded.

3.1.5 Specifications for the U,V,W connectors

U, V, W wiring connector (female) specifications of low/high inertia motor:

Dive capacity	Motor model
100W	SME－L00530○□□□ SME－L01030○□□□
200W	SME－□02030○□□□
400W	SME－□04030○□□□
750W	SME－□07530○□□□

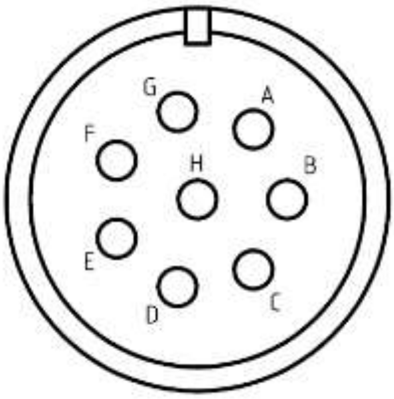


With brake   Without brake

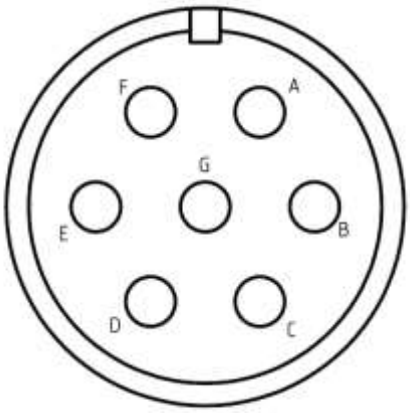
The following table shows the signal of the UVW connector on the low/high inertia motor:

PIN	Signal	Wire color
1	U	Red
2	V	White
3	W	Black
4	PE	Green/yellow(green is the bottom)
5	B1	Black(for motor with electromagnetic brake)
6	B2	Black(for motor with electromagnetic brake)

U, V, W connector (male) specifications of low/middle/high inertia motor:

Drive capacity	Motor model	
1KW	SME—H08515○□□□ SME—□10020○□□□	
1.5KW	SME—□15020○□□□	
2KW	SME—L20020○□□□	
3KW	SME—H13015○□□□ SME—H18015○□□□ SME—L30020○□□□	

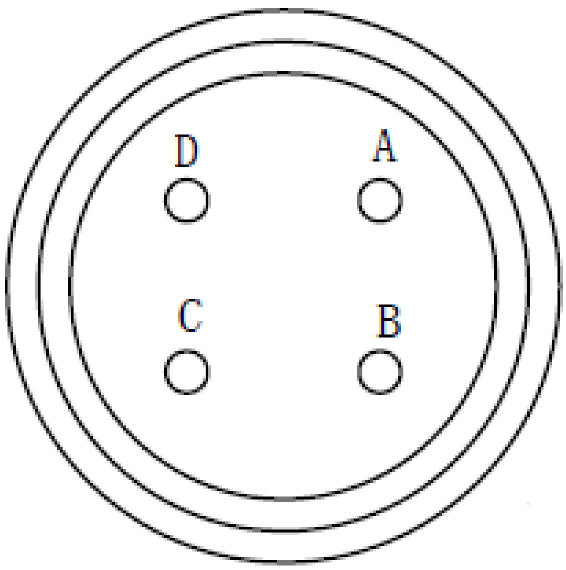
U, V, W connector (male) specifications of middle inertia motor:

Drive capacity	Motor model	
2KW	SME—M20020○□□□	
3KW	SME—M30020○□□□	

The following table shows the signal of the UVW connector on the low/middle/high inertia motor :

PIN	Signal
A	NC
B	U
C	V
D	W
E	PE
F	B1 (for motor with electromagnetic brake)
G	B2 (for motor with electromagnetic brake)
H	NC

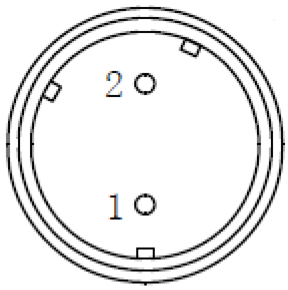
U, V, W connector (male) specifications of high inertia motor(400V):

<table>
<tr><th>Drive capacity</th><th>Motor model</th><td rowspan="5">
</td></tr>
<tr><td>2KW</td><td>SMP—H18015○□□□</td></tr>
<tr><td>3KW</td><td>SMP—H29015○□□□</td></tr>
<tr><td>5KW</td><td>SMP—H44015○□□□
SMP—H55015○□□□</td></tr>
<tr><td>7KW</td><td>SMP—H75015○□□□</td></tr>
</table>

The following table shows the signal of UVW connector on high inertia motor(400V).

PIN	Signal
A	U
B	V
C	W
D	PE

Brake connector (male) specifications of high inertia motor (400V):

<table>
<tr><th>Drive capacity</th><th>Motor model</th><td rowspan="5">
</td></tr>
<tr><td>2KW</td><td>SMP－H18015○□□□</td></tr>
<tr><td>3KW</td><td>SMP－H29015○□□□</td></tr>
<tr><td>5KW</td><td>SMP－H44015○□□□
SMP－H55015○□□□</td></tr>
<tr><td>7KW</td><td>SMP－H75015○□□□</td></tr>
</table>

The following table shows the signal of brake connector on high inertia motor(400V).

PIN	Signal
1	DC24V
2	PE

★ Note: the wiring above is the connector from the motor itself

★ Please refer to section 1.3.1 for description of ○□□□

3.1.6 Wire selection

rive model	Wire[mm²] Power supply wiring(AWG)				
	R, S, T	L1, L2	U, V, W	P, D, C, N	B1, B2
SDP－010A2C	2(AWG14)	2(AWG14)	2(AWG14)	2(AWG14)	2(AWG14)
SDP－020A2C					
SDP－040A2C					
SDP－075A2C					
SDP－100A2C					
SDP－150A2C					
SDP－200A2C	3.5(AWG12)		3.5(AWG12)		
SDP－300A2C					
SDP－200A4C	2(AWG14)		2(AWG14)		
SDP－300A4C	3.5(AWG12)		3.5(AWG12)		
SDP－500A4C	6(AWG10)		6(AWG10)		
SDP－700A4C					

Drive model	Encoder wiring(AWG)			
	Specification	Standard length	Number of wires	Size (mm² (AWG))
SDP－010A2C	UL1332	2 meters	7 wires	AWG24
SDP－020A2C				
SDP－040A2C				
SDP－075A2C				
SDP－100A2C				
SDP－150A2C				
SDP－200A2C				
SDP－200A4C				
SDP－300A2C				
SDP－300A4C				
SDP－500A4C				
SDP－700A4C				

★ Please use the recommended specification or higher to avoid danger.

★ The shield terminal should be grounded.

★ Using shielded twisted-pair cable for encoder wiring to reduce the noise interference.

★ American Wire Gauge (AWG) is US wire diameter standard.

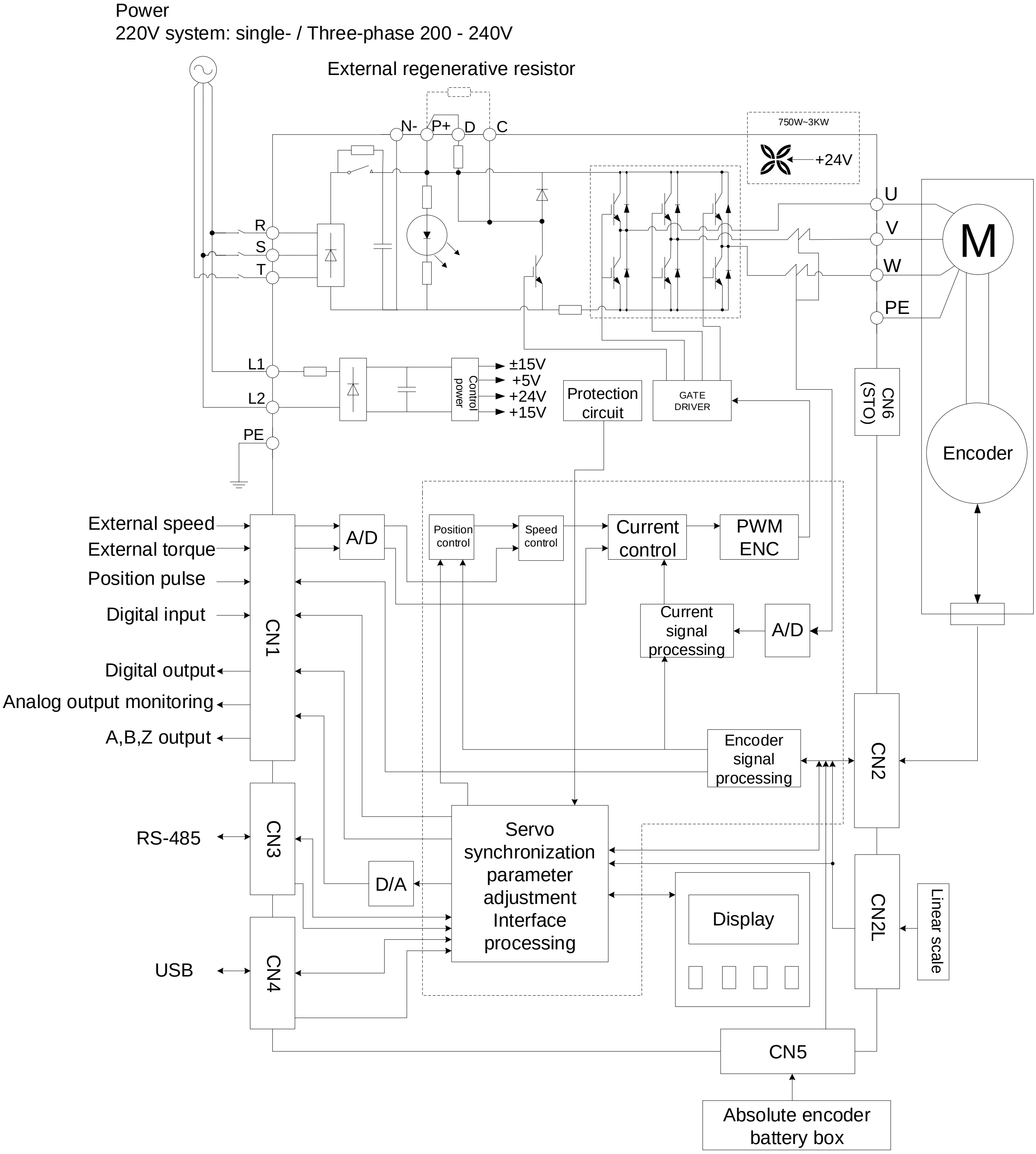
★ The standard is to use 600V vinyl wire, and the wiring length should be less than 30 meters.

★ If the wiring length exceeds 30meters, please consider the voltage drop when selecting wire gauge.

★ According to UL/C-UL (CSA) specifications, you should use UL-certified copper wires with 60°C or higher rated temperature.

3.2. The function diagram of servo system

- 200V system: models of 100W~3kW



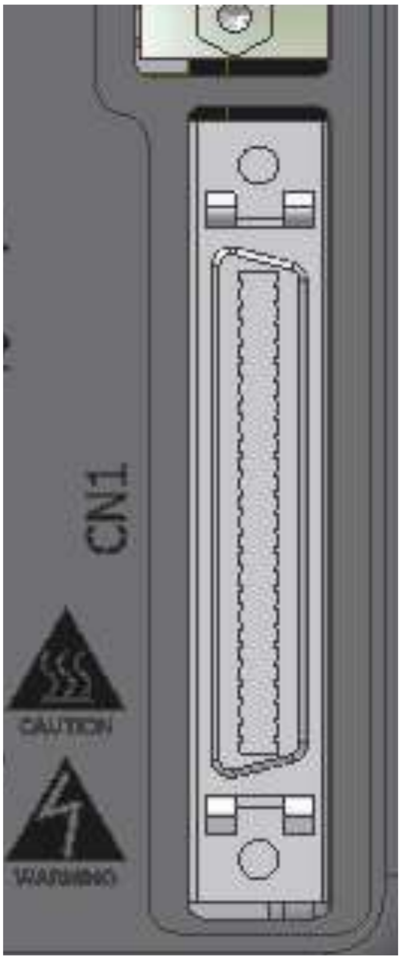
Note: models below 400W (included) have no fan; 400V model control power supply is DC24V.

3.3. Wiring for CN1(I/O signal)

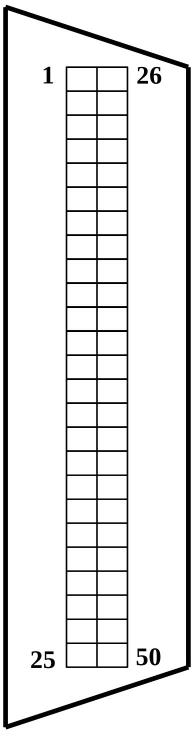
3.3.1. CN1 terminal diagram.

Shihlin servo drive provides 12 user-defined digital inputs (DI) and 6 digital outputs (DO), which enable a more flexible communication between the servo drive and the controller. The 12 user-defined DIs are PD02~PD09 and PD21~PD24, and the 6 DOs are PD10~PD14 and PD26. In addition, it provides differential output encoder A+, A-, B+, B-, Z+, Z- signals, analog torque command input, and analog speed command input, its pin diagram is as follows:

(1) CN1 connector(female)



Front view



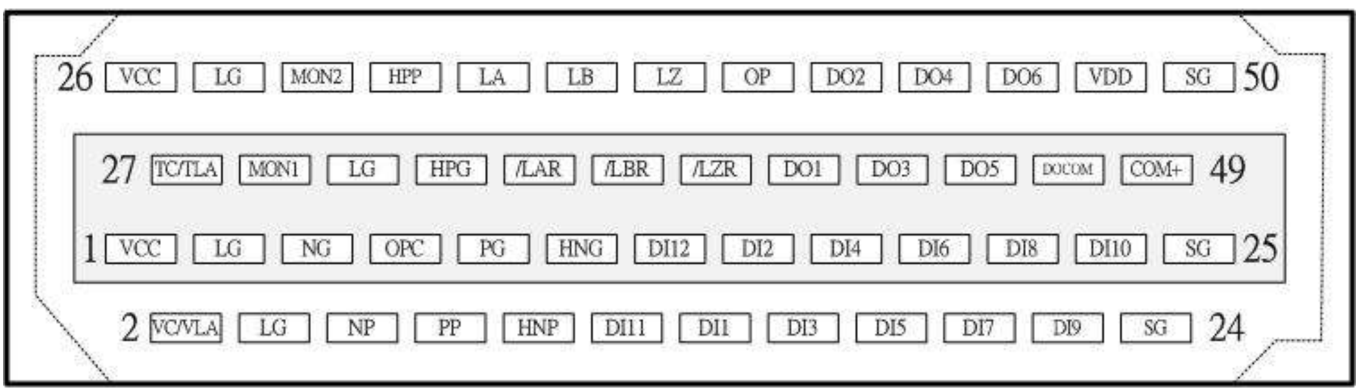
Pin assignment

(2) CN1 connector(male)

Front view

Side view

Rear view



CN1 wiring terminal on the back of CN1

Pin	Code	Function	Pin	Code	Function	Pin	Code	Function	Pin	Code	Function
1	Vcc (15V)	+ 15V power output (for analog command)	2	VC/ VLA	Analog speed command/limit (Note 2)	26	Vcc (15V)	+15V power output (for analog command)	27	TC/ TLA	Analog torque command/limit (Note 2)
3	LG	Ground for analog input signal	4	LG	Ground for analog input signal	28	LG	Ground for analog input signal	29	MON1	Analog monitoring 1
5	NG	Input pulse train	6	NP	Input pulse train	30	MON2	Analog monitoring 2	31	LG	Ground for analog input signal
7	OPC	Open collector power input	8	PP	Input pulse train	32	HPP	Input pulse train (high speed) (Note 1)	33	HPG	Input pulse train (high speed) (Note 1)
9	PG	Input pulse train	10	HNP	Input pulse train (high speed) (Note 1)	34	LA	Encode A phase pulse	35	LAR	Encode A phase pulse
11	HNG	Input pulse train (high speed) (Note 1)	12	DI11	Digital input 11	36	LB	Encode B phase pulse	37	LBR	Encode B phase pulse
13	DI12	Digital input 12	14	DI1	Digital input 1	38	LZ	Encode Z phase pulse	39	LZR	Encode Z phase pulse
15	DI2	Digital input 2	16	DI3	Digital input 3	40	OP	Encode Z phase pulse (open collector)	41	DO1	Digital output 1
17	DI4	Digital input 4	18	DI5	Digital input 5	42	DO2	Digital output 2	43	DO3	Digital output 3
19	DI6	Digital input 6	20	DI7	Digital input 7	44	DO4	Digital output 4	45	DO5	Digital output 5
21	DI8	Digital input 8	22	DI9	Digital input 9	46	DO6	Digital output 6	47	DOCOM	Digital output common terminal
23	DI10	Digital input 10	24	SG	Digital power ground	48	Vdd (24V)	+24V internal power output	49	COM+	Digital input power
25	SG	Digital power ground				50	SG	Digital power ground			

Note 1:If HPP, HPG, HNP, HNG are differential inputs, it can receive pulse commands of up to 4Mpps. If AB phase pulse input multiply by 4, it can receive pulse commands of up to 16Mpps.

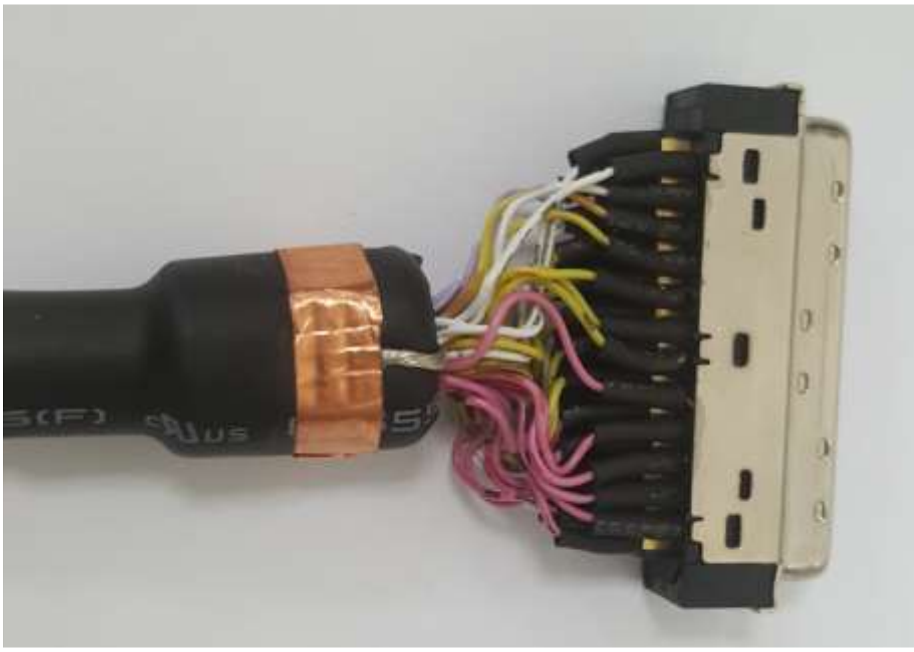
Note 2:A/D conversion needs to support 12bit/16bit resolution, and it’s not required to support them at the same time.

3.3.2 CN1 signal wire shielding and grounding

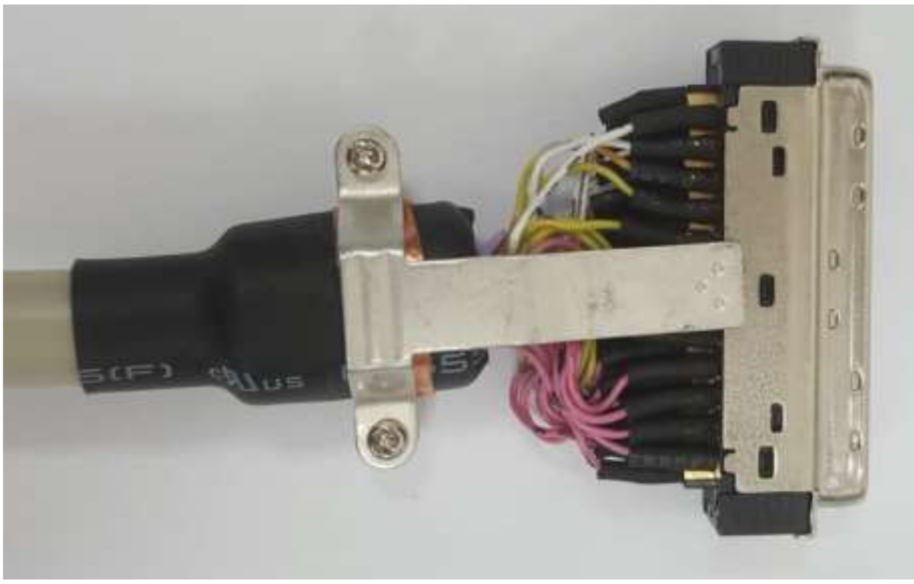
The both ends of the CN1 signal wire which are the CN1 connector and the upper controller connector, their shielding and grounding wire must be connected to the corresponding pins to effectively achieve the shielding and grounding functions.

The shielding of CN1 encoder connector wiring instruction is as follows:

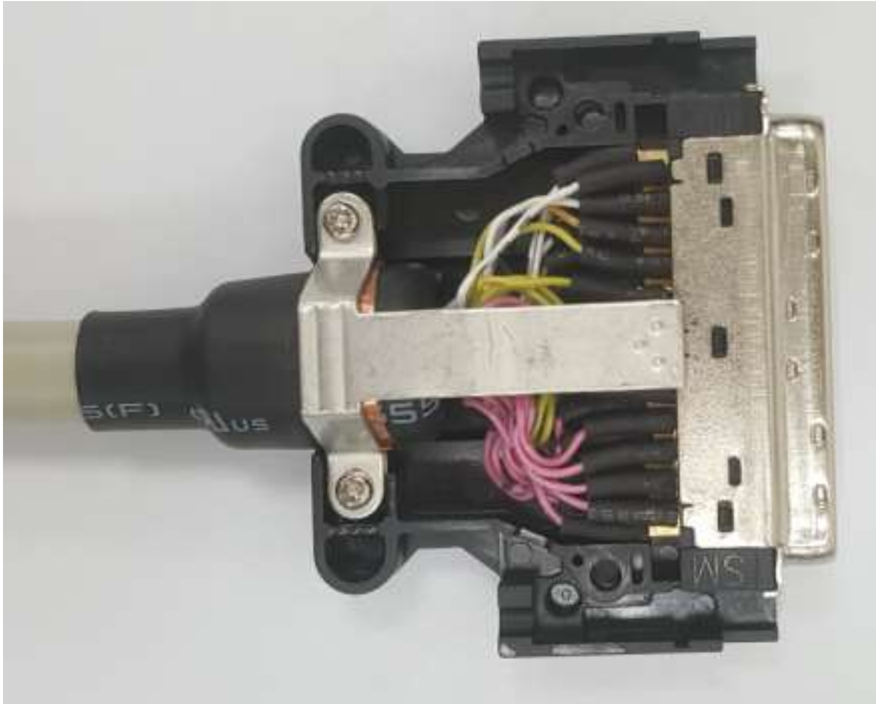
1. Pull out the metal shielding, surround and fix it with a copper sheet.



2.Screw the big metal case to fix the cooper sheet, make sure the copper sheet is completely covered the extended metal sheet, and it is contact with the metal part of the CN1 connector.



3. Put it into the connector housing as below picture shows:



4.The last step is to fasten the screw of housing:

3.3.3 CN1 Terminal signal description

This section introduces the signals which mentioned in section 3.3.1.

1. **CN1 terminal signal**

The detailed description of each signal in CN1 50Pins is as follows

The codes of the control modes in the following table are:

Pt : position control mode/ position mode(terminal input)
Pr : position control mode/position mode(internal register)
S: speed control mode
T: torque control mode

Signal name	Code	Pin NO	Function	Control mode
+15V power output(for analog command)	Vcc (15V)	CN1-1 CN1-26	Output DC15V from VCC-LG. It can be used as power supply for TC, TLA, VC, VLA.	ALL
Analog speed command/limit	VC/ VLA	CN1-2	It applies voltage of DC -10V~+10V between VC-LG. In S mode, the motor runs the PC12 setting speed at ±10V. It applies voltage of DC -10V~+10V between VLA-LG. In T mode, the motor runs the PC12 setting speed at ±10V.	S,T
Ground for analog input signal	LG	CN1-3/4 /28/31	It's common pin of TLA, TC, VC, VLA, OP, MO1, MO2, VCC. And each pin is connected internally.	ALL
Analog torque command/limit	TC/ TLA	CN1-27	To output or limit the torque of servo motor.The voltage of TC-LG is DC 0-10V. Maximum torque will be generated at ±10V(the torque generated at ±10V can be changed by PC13). When the analog torque limit (TLA) is valid, the servo motor torque will be limited in the entire range. The voltage of TLA-LG is DC 0-10V. Maximum torque will be generated at +10V if TLA is connected to the positive polarity of the power supply.	Pt, Pr, S

Signal name	Code	Pin NO	Function	Control mode
Forward pulse train Reverse pulse train	NG	CN1-5	Input command pulse train 1. In open-collector type(max input frequency is 200kpps) PP-SG is forward pulse train. NP-SG is reverse pulse train. 2.In differential line drive type (the max input frequency is 4Mpps) PG-PP is forward pulse train. NG-NP is reverse pulse train. The command pulse train type can be changed by PA13 setting.	Pt
	NP	CN1-6		
	PP	CN1-8		
	PG	CN1-9		
	HNP	CN1-10	High speed input command pulse train. 1. In differential line drive type(max input frequency is 4Mpps) HPG-HPP is forward pulse train. HNG-HNP is reverse pulse train. The command pulse train type can be changed by PA13 setting.	
	HNG	CN1-11		
	HPP	CN1-32		
	HPG	CN1-33		
open collector power input	OPC	CN1-7	When pulse signals input is open collector type, this pin supplies the positive polarity of DC24V.	ALL
Digital power ground	SG	CN1-24 CN1-25 CN1-50	1.It's common pins for input signal such as SON,EMG. 2.Each pin is connected internally and separated from LG.	ALL
Analog monitoring 1	MON1	CN1-29	To output voltage between MO1-LG according PC14 setting.	ALL
Analog monitoring 2	MON2	CN1-30	To output voltage between MO2-LG according PC14 setting.	ALL
Encode A phase pulse differential output(line driver)	LA	CN1-34	1.Output the differential pulses of PA14 setting value in one revolution. 2.A π/2 delay between A phase and B phase.(when the servo motor runs in CCW direction) 3.The phase sequence of rotation and	ALL
	LAR	CN1-35		
Encode B phase pulse differential output(line driver)	LB	CN1-36		ALL
	LBR	CN1-37		

			difference between A phase and B phase could be defined by the PA39 setting value.	
Encode Z phase pulse differential output(line driver)	LZ	CN1-38	Output the OP signal in differential line drive type.	ALL
	LZR	CN1-39		
Encode Z phase pulse train (open collector)	OP	CN1-40	Output the ZERO signal of encoder. Servo motor generates 1 pulse per revolution.	ALL
Digital input power	COM+	CN1-49	DC24V for input interface. It connects to either positive polarity of external DC24V power or VDD terminal. It's forbidden to connect them both at the same time.	ALL
Common pin of digital output	DOCOM	CN1-47	It's common pin of output signal for Sink type and Source type. When in Sink type, DOCOM connects to SG or negative polarity of external 24V power. When in Source type, DOCOM connects to VDD or positive polarity of external 24V power. Refer to section 3.3.4 for detailed wiring.	ALL
Internal +24V power output	VDD (24V)	CN1-48	It output +24V±10% power from VDD-SG. It need connect to COM+ when using as power of digital interface.	ALL

The signals of digital input and digital output will be explained in detail in the following sections.

2.Shihlin servo CN1 I/O

The table of Shihlin Servo CN1 I/O, digital input and digital output names & abbreviations are as follows:

Abbreviation	Signal name	Abbreviation	Signal name
SON	SERVO ON	CTRG	Position command trigger
LSP	Limit of forward rotation	TLC	Torque limiting control
LSN	Limit of reverse rotation	VLC	speed limiting control
CR	Clear	RD	Ready
SP1	Speed option 1	ZSP	Zero speed detection
SP2	Speed option 2	INP	In-position ready
PC	Proportion control	SA	Speed attained
ST1	Forward rotation activated	ALM	Alarm signal output
ST2	Reverse rotation activated	OP	Z phase pulse(open collector)
TL	Torque limit option	LZ	Encoder Z phase pulse (differential line drive)
RES	Reset	LZR	
EMG	External emergency stop	LA	Encoder A phase pulse (differential line drive)
LOP	Control mode switch	LAR	
VC	Analog speed command	LB	Encoder B phase pulse (differential line drive)
VLA	Analog speed limit	LBR	
TLA	Analog torque limit	VCC	Positive polarity of +15V power output
TC	Analog torque command	VDD	Positive polarity of +24V internal power output
RS1	Forward rotation option	COM +	Digital input power
RS2	Reverse rotation option	SG	24V power ground
PP	Input command pulse train	OPC	Open collector power input
NP		LG	15V power ground
PG		MON1	External analog output monitoring 1
NG		MON2	External analog output monitoring 2
HPP	High speed input command pulse train	SD	Shielding
HNP		POS1	Position command 1
HPG		POS2	Position command 2
HNG		POS3	Position command 3

3. Detailed explanation for DI/DO signal.

DI Wiring

The users can define the DI function by editing user parameters, see the following table for details:

Signal name	Code	Function	Control mode
Servo ON	SON	If SON is ON, the basic circuit is on and servo is ready to run(servo ON status). If SON is OFF, the basic circuit is off and the servo motor is in free run status(servo OFF status).	ALL
Reset	RES	If the RES is ON for over 50ms, reset is valid, but may not able to clear an abnormal alarm status (refer to section 11. 1). The circuit is still on when set PD20 to XXX1.	ALL
Proportion control	PC	The speed controller will switch from proportion integral control to proportion control when PC signal is ON. When servo motor stops, any external pulse will generate torque to adjust the position shift. Once the positioning is done(stopped) and machine shaft is locked, the PC signal will be on and the unnecessary torque adjustment will be suppressed. If you want to lock the servo for long time, you need to turn on both the PC signal and the TL signal at the same time, the analog torque limit will control it below the rated torque.	Pt, Pr, S
Torque limit option	TL	When TL is on, TLA will be valid. Please refer to description on TL1.	Pt, Pr, S

<table>
<tr>
<td>Inner torque limit option</td>
<td>TL1</td>
<td>When TL1 is on, inner torque limit 2 (parameter setting2) will be valid.
<table>
<tr><td colspan="2">Input signal</td><td rowspan="2">Valid torque limit value</td></tr>
<tr><td>TL1</td><td>TL</td></tr>
<tr><td>0</td><td>0</td><td>Parameter setting of PA05.</td></tr>
<tr><td>0</td><td>1</td><td>If TLA > PA05 setting => PA05 is valid.
If TLA < PA05 setting =>TLA is valid.</td></tr>
<tr><td>1</td><td>0</td><td>If PC25 setting > PA05 setting => PA05 is valid.
If PC25 setting < PA05 setting => PC25 is valid.</td></tr>
<tr><td>1</td><td>1</td><td>If TLA > PC25 setting => PC25 is valid.
If TLA < PC25 setting => TLA is valid</td></tr>
</table>
</td>
<td>ALL</td>
</tr>
<tr>
<td>Speed option 1</td>
<td>SP1</td>
<td rowspan="2">Speed control mode: which is to select the speed command. When SP3 is used, make it valid by setting internal parameters
<table>
<tr><td rowspan="2">Parameter setting</td><td colspan="3">Input signal</td><td rowspan="2">Speed command</td></tr>
<tr><td>SP3</td><td>SP2</td><td>SP1</td></tr>
<tr><td rowspan="4">When speed option (SP3) is not used. (initial status)</td><td></td><td>0</td><td>0</td><td>Speed analog command (VC)</td></tr>
<tr><td></td><td>0</td><td>1</td><td>Inner speed command 1</td></tr>
<tr><td></td><td>1</td><td>0</td><td>Inner speed command 2</td></tr>
<tr><td></td><td>1</td><td>1</td><td>Inner speed command 3</td></tr>
<tr><td>When speed</td><td>0</td><td>0</td><td>0</td><td>Speed analog command</td></tr>
</table>
</td>
<td rowspan="2">S, T</td>
</tr>
<tr>
<td>Speed option 2</td>
<td>SP2</td>
</tr>
</table>

<table>
<tr><td rowspan="2">Speed option 3</td><td rowspan="2">SP3</td><td>
<table>
<tr><td rowspan="8">option (SP3) is valid</td><td></td><td></td><td></td><td>(VC)</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>Inner speed command 1</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>Inner speed command 2</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>Inner speed command 3</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>Inner speed command 4</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>Inner speed command 5</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>Inner speed command 6</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>Inner speed command 7</td></tr>
</table>
Torque control mode: which is to select the speed limit.
<table>
<tr><td rowspan="2">Parameter setting</td><td colspan="3">Input signal</td><td rowspan="2">Speed limit</td></tr>
<tr><td>SP 3</td><td>SP 2</td><td>SP 1</td></tr>
<tr><td rowspan="4">When speed option (SP3) is not used. (initial status)</td><td></td><td>0</td><td>0</td><td>Analog speed limit (VLA)</td></tr>
<tr><td></td><td>0</td><td>1</td><td>Inner speed command 1</td></tr>
<tr><td></td><td>1</td><td>0</td><td>Inner speed command 2</td></tr>
<tr><td></td><td>1</td><td>1</td><td>Inner speed command 3</td></tr>
<tr><td rowspan="6">When speed option (SP3) is valid</td><td>0</td><td>0</td><td>0</td><td>Analog speed limit (VLA)</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>Inner speed command 1</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>Inner speed command 2</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>Inner speed command 3</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>Inner speed command 4</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>Inner speed</td></tr>
</table>
</td><td></td></tr>
</table>

<table>
<tr>
<td></td>
<td></td>
<td>
<table>
<tr><td rowspan="3"></td><td></td><td></td><td></td><td>command 5</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>Inner speed command 6</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>Inner speed command 7</td></tr>
</table>
</td>
<td></td>
</tr>
<tr>
<td>Forward rotation activated</td>
<td>ST1</td>
<td rowspan="2">When start the servo motor , it runs in the following directions:
<table>
<tr><td colspan="2">Input signal</td><td rowspan="2">Servo motor rotation direction</td></tr>
<tr><td>ST2</td><td>ST1</td></tr>
<tr><td>0</td><td>0</td><td>Stop(servo locked)</td></tr>
<tr><td>0</td><td>1</td><td>CCW</td></tr>
<tr><td>1</td><td>0</td><td>CW</td></tr>
<tr><td>1</td><td>1</td><td>Stop(servo locked)</td></tr>
</table>
1.If both ST1 and ST2 are ON or OFF during operation, the servo will be decelerated to stop and be locked. The decelerate time is PC18.
2.If analog speed command (VC) is 0V, it will not generate servo lock torque when start the servo.</td>
<td rowspan="2">S</td>
</tr>
<tr>
<td>Reverse rotation activated</td>
<td>ST2</td>
</tr>
<tr>
<td>Forward rotation option</td>
<td>RS1</td>
<td>To select the generation direction of servo motor torque, the options are as follows:</td>
<td>T</td>
</tr>
</table>

<table>
<tr><td>Reverse rotation option</td><td>RS2</td><td><table>
<tr><td colspan="2">Input signal</td><td rowspan="2">Torque generation direction</td></tr>
<tr><td>RS2</td><td>RS1</td></tr>
<tr><td>0</td><td>0</td><td>No torque generated</td></tr>
<tr><td>0</td><td>1</td><td>Forward rotation torque, reverse rotation regeneration.</td></tr>
<tr><td>1</td><td>0</td><td>Reverse rotation torque, forward rotation regeneration.</td></tr>
<tr><td>1</td><td>1</td><td>No torque generated</td></tr>
</table></td><td></td></tr>
<tr><td>Origin position</td><td>ORGP</td><td>This activated signal sets current position as homing origin in Pr mode.
Turn the SHOM ON to activate homing.</td><td>Pr</td></tr>
<tr><td>Return to origin</td><td>SHOM</td><td>In the internal position register mode, when searching the origin, the function of searching the origin is activated after SHOM is on.</td><td>Pr</td></tr>
<tr><td>Electronic gear option 1</td><td>CM1</td><td rowspan="2">When CM1, CM2 is used, the combination of CM1 and CM2 can be used as parameter setting, it sets 4 kinds of electronic gear ratios numerator.
CM1 and CM2 cannot be used in the absolute position detection system.<table>
<tr><td colspan="2">Input signal</td><td rowspan="2">Electronic gear numerator</td></tr>
<tr><td>CM2</td><td>CM1</td></tr>
<tr><td>0</td><td>0</td><td>PA06(CMX)</td></tr>
<tr><td>0</td><td>1</td><td>PC32(CMX2)</td></tr>
<tr><td>1</td><td>0</td><td>PC33(CMX3)</td></tr>
<tr><td>1</td><td>1</td><td>PC34(CMX4)</td></tr>
</table></td><td rowspan="2">Pt,
Pr</td></tr>
<tr><td>Electronic gear option 2</td><td>CM2</td></tr>
<tr><td>Clear</td><td>CR</td><td>Turn CR on to clear the position control counter error pulses on its rising edge. When the PD18 is set to xxx1, the pulse is always cleared if CR is on.</td><td>Pt,
Pr</td></tr>
<tr><td>Gain switching option</td><td>CDP</td><td>When using this signal, you should enable CDP and turn CDP on to switch each gain values to the setting value.</td><td>ALL</td></tr>
<tr><td>External emergency stop</td><td>EMG</td><td>If you turn EMG OFF, the motor will be in emergency state, servo will be off and the brake will be activated. Turning EMG ON will release the emergency stop status in urgent cases. When set PD01 to 1XXX, this signal will be automatically on(keeps ON) .</td><td>ALL</td></tr>
</table>

<table>
<tr><td>Limit of forward rotation</td><td>LSP</td><td>Use as limit of forward rotation. When LSP is on, the motor can be operated forwardly.</td><td rowspan="2">Pt,
Pr,
S</td></tr>
<tr><td>Limit of reverse rotation</td><td>LSN</td><td>Use as limit of reverse rotation. When LSN is on, the motor can be operated reversely.</td></tr>
<tr><td>Inhibit pulse input</td><td>INHP</td><td>To inhibit pulse input.
In position mode, external pulse input command will be invalid when INHP is on.</td><td>Pt</td></tr>
<tr><td>Control mode switch</td><td>LOP</td><td>In position/speed control switching mode, LOP is used to select control mode.
<table>
<tr><td>LOP</td><td>Control mode</td></tr>
<tr><td>0</td><td>Position</td></tr>
<tr><td>1</td><td>Speed</td></tr>
</table>
In speed/torque control switch mode, LOP is used to select control mode.
<table>
<tr><td>LOP</td><td>Control mode</td></tr>
<tr><td>0</td><td>Speed</td></tr>
<tr><td>1</td><td>Torque</td></tr>
</table>
In torque/position control switch mode, LOP is used to select control mode.
<table>
<tr><td>LOP</td><td>Control mode</td></tr>
<tr><td>0</td><td>Torque</td></tr>
<tr><td>1</td><td>Position</td></tr>
</table></td><td>Refer to the different control modes description</td></tr>
</table>

<table>
<tr><th>Signal name</th><th>Code</th><th>Function</th><th>Control mode</th></tr>
<tr><td>Position command 1</td><td>POS1</td><td rowspan="6"><table>
<tr><td>Position command</td><td>POS 6</td><td>POS 5</td><td>POS 4</td><td>POS 3</td><td>POS 2</td><td>POS 1</td><td>CTRG</td></tr>
<tr><td>P0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>↑</td></tr>
<tr><td>P1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>↑</td></tr>
<tr><td>~</td><td>~</td><td>~</td><td>~</td><td>~</td><td>~</td><td>~</td><td>↑</td></tr>
<tr><td>P50</td><td>1</td><td>1</td><td>0</td><td>0</td><td>1</td><td>0</td><td>↑</td></tr>
<tr><td>P51</td><td>1</td><td>1</td><td>0</td><td>0</td><td>1</td><td>1</td><td>↑</td></tr>
<tr><td>~</td><td>~</td><td>~</td><td>~</td><td>~</td><td>~</td><td>~</td><td>↑</td></tr>
<tr><td>P63</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>↑</td></tr>
</table></td><td rowspan="6">Pr</td></tr>
<tr><td>Position command 2</td><td>POS2</td></tr>
<tr><td>Position command 3</td><td>POS3</td></tr>
<tr><td>Position command 4</td><td>POS4</td></tr>
<tr><td>Position command 5</td><td>POS5</td></tr>
<tr><td>Position command 6</td><td>POS6</td></tr>
<tr><td>Position command trigger</td><td>CTRG</td><td>In Pr mode, when CTRG is on, the position command selected by POS1~6 is valid.</td><td>Pr</td></tr>
<tr><td>Motor stop command Pr</td><td>STOP</td><td>In Pr mode, if STOP is on, motor will stop.</td><td>Pr</td></tr>
<tr><td>E-Cam engaging control</td><td>CAM</td><td>To perform the E-Cam engagement control (refer to the setting method of u and z value in PC66).</td><td>Pr</td></tr>
<tr><td>E-Cam phase alignment</td><td>ALGN</td><td>When ALGN is enabled(PC82.bit0=1 & PC82.bit1=1), the servo will perform the alignment immediately if this DI is on.</td><td>Pr</td></tr>
<tr><td>Gantry control switch</td><td>GTRY</td><td>After this DI is on, it temporarily disables the monitoring function of the gantry (synchronous motion) when PA26.X=2 (gantry function enabled). The axis that receives this DI stops calculating and monitoring the deviation of the two axes.</td><td>Pt</td></tr>
</table>

Full-closed loop control switch	FHS	To temporary stop full-closed loop control function when X=1 in PA26. If this DI is on, full-closed control function will be invalid.	Pt, Pr
Full-closed error clearance	FEC	Used for clearing deviation pulse between full-closed linear scale and motor encoder.	Pt/Pr
Linear compensation switch	MAP	After the upper controller is reset to zero, the linear compensation function will be activated when MAP is on.	ALL
Event trigger Pr command 1	EV1	The event trigger Pr command 1-4: the status change of EV1~EV4 is used as a trigger event.	Pr
Event trigger Pr command 2	EV2		
Event trigger Pr command 3	EV3		
Event trigger Pr command 4	EV4		
Absolute system DI function 1	ABSE	When ABSE is on, servo will enter ABS mode and enable ABSQ, ABSC, ABSR, ABSD, ABSC. When ABSE is on, the functions of DI4,DO2,DO3 are no longer the ones assigned by the parameter. The DI4 function is changed to ASDQ, DO2 is ABSR, DO3 is ABSD. In addition, ABSC can be defined through parameters.	ALL
Absolute system DI function 2	ABSC	To clear the stored revolution data in absolute encoder when ABSC is ON. And this input is only valid when ABSE is ON.	ALL

<table>
<tr><td>ABS hand-shaking signal (Note 1)</td><td>DI4. ABSQ is fixed to DI4</td><td>To use as the handshaking pin for I/O transmission, it is transmitted by the controller. When ABSQ is OFF means that request command issues by the controller; When ABSQ is ON means that the controller has finished the ABSD data processing.
This input is valid only when DI ABSE is ON.</td><td>ALL</td></tr>
<tr><td>Torque command option 1</td><td>TC1</td><td rowspan="2">
<table>
<tr><td rowspan="2">Torque command NO#</td><td colspan="2">Input signal</td><td rowspan="2">Command source</td><td rowspan="2">Description</td></tr>
<tr><td>TC2</td><td>TC1</td></tr>
<tr><td>T1</td><td>0</td><td>0</td><td>Analog command</td><td>The voltage between TC and LG(the range is ±10V)</td></tr>
<tr><td>T2</td><td>0</td><td>1</td><td rowspan="3">Internal register parameter</td><td>PC75</td></tr>
<tr><td>T3</td><td>1</td><td>0</td><td>PC76</td></tr>
<tr><td>T4</td><td>1</td><td>1</td><td>PC77</td></tr>
</table>
</td><td rowspan="2">T</td></tr>
<tr><td>Torque command option 2</td><td>TC2</td></tr>
<tr><td>Pt-Pr switch</td><td>Pt-Pr</td><td>Switch between Pt and Pr mode
Pt-Pr=OFF: Pt mode
Pt-Pr= ON: Pr mode</td><td>Pt, Pr</td></tr>
</table>

Note 1: when DI ABSE is ON, the function of PD05 defined by parameter will be disabled and replaced by ABSQ, which is input by DI4.

DO wiring of CN1

DO function allows users to edit parameters by themselves, detail is in the following table.

Signal name	Code	Function	Control mode
Ready	RD	RD is on when servo is on and ready to operate.	ALL
Alarm signal output	ALM	ALM is off when power is off or activating protection circuit makes main circuit open. If no alarm occurs, ALM will be on 1 second after power is on.	ALL
In-position ready	INP	INP is on when the servo is in the setting in-position range. This range can be adjusted by parameter setting. When the in-position range setting is large, the INP may be kept conductive during low speed operation.	Pr, Pt
Speed attained	SA	SA is on when servo motor speed is nearly reached the setting. The SA keeps on when setting speed is 50r/min or below.	S
Home moving completion	HOME	Home is on after the completion of homing moving.	Pr
Torque limiting control	TLC	When the generated torque reaches the level set by internal torque limit(PA05) or analog torque limit(TLA), TLC is on. TLC turns off when SON is OFF.	Pr, Pt, S
Speed limiting control	VLC	In torque control mode, when the speed reaches internal speed command 1~7 or analog speed limit(VLA), VLC is on. VLC turns off when SON is off.	T
Electromagnetic brake interlock	MBR	If using the motor with electromagnetic brake, set its parameter to □1□□. MBR is off when servo is off or alarm occurs. MBR turns on when servo is ON.	ALL
Warning	WNG	WNG is on when a warning occurs. WNG is off if no warning occurs.	ALL

Zero speed detection	ZSP	When servo motor runs below zero speed(50r/min), ZSP is on. The zero speed range can be adjusted by parameter setting.	ALL
Pr command completion output	CMDOK	When internal position command is completed or stopped, CMDOK is on.	Pr
Overload output warning	OLW	When the motor reaches overload level setting, the OLW is ON.	ALL
Motion control completed	MC_OK	When both DO:CMD_OK and INP are ON, MC_OK signal is on. Otherwise, MC_OK is off.	Pr
position command overflow	OVF	The OVF signal is ON when the position command overflows.	Pr
Software positive limit	SWPL	When the motor feedback pulse exceeds the software positive limit(PF86) setting value, SWPL is ON. Otherwise, SWPL is OFF.	Pr
Software negative limit	SWNL	When the motor feedback pulse number is less than the software negative limit(PF87) setting value, SWNL is ON. Otherwise, SWNL is OFF.	Pr
Absolute system Warning	ABSW	The related alarms of absolute encoder will be output by ABSW.	ALL
Control mode switch status	LOPM	When the servo is in control switching mode, the current using control mode (related to LOP) is displayed. The display status is as follows: 1. When PA01= XXX1, LOPM off: position mode LOPM on: speed mode 2. When PA01= XXX3, LOPM OFF: speed mode LOPM ON: torque mode 3. When PA01= XXX5 LOPM OFF: torque mode LOPM ON: position mode	ALL
Pt-Pr switch status	PtrM	It indicates the current switching status of Pt-Pr terminal:	Pt, Pr

		PtrM is OFF means Pt-Pr is OFF; PtrM is ON means Pt-Pr is ON.	
When DI ABSE is ON, PD11 defined parameter function will be disabled and replaced by ABSR, which is output by DO2.	ABSR is fixed to DO2	When ABSR is OFF means the servo can accept the Request command of ABSQ; When ABSR is ON means the data has been prepared after receiving the Request command and the ABSD data is correct, and the controller can take away the ABSD data. The output is valid only when DI ABSE is ON.	ALL
When DI ABSE is ON, PD12 defined parameter function will be disabled and replaced by ABSD, which is output by DO3.	ABSD is fixed to DO3	It is output pin of ABS data, the data is guaranteed to be correct when ABSR is on. This output is valid only when DI ABSE is on.	ALL
Capture complete output	CAP_OK	The Capture function is executed successfully.	ALL
E-Cam designated area output 1	CAM_AREA1	To output the angle range specified by the E-Cam table.	Pr
E-Cam designated area output 2	CAM_AREA2	To output the angle range specified by the E-Cam table.	Pr
Software DO 1	S_DO0	To output bit00 of PD33.	ALL
Software DO 2	S_DO1	To output bit01 of PD33.	ALL
Software DO 3	S_DO2	To output bit02 of PD33.	ALL
Software DO4	S_DO3	To output bit03 of PD33	ALL
Software DO 5	S_DO4	To output bit04 of PD33	ALL
Software DO 6	S_DO5	To output bit05 of PD33	ALL
Software DO 7	S_DO6	To output bit06 of PD33	ALL
Software DO 8	S_DO7	To output bit07 of PD33	ALL
Software DO 9	S_DO8	To output bit08 of PD33	ALL
Software DO 10	S_DO9	To output bit09 of PD33	ALL
Software DO 11	S_DOA	To output bit10 of PD33	ALL

Software DO 12	S_DOB	To output bit11 of PD33	ALL
Software DO 13	S_DOC	To output bit12 of PD33	ALL
Software DO 14	S_DOD	To output bit13 of PD33	ALL
Software DO 15	S_DOE	To output bit14 of PD33	ALL
Software DO 16	S_DOF	To output bit15 of PD33	ALL

The terminal signal function of the CN1 changes according to the control mode. Please refer to the table below:

Recommended setting value for DI function.

DI code	Signal	Function	Pt	Pr	S	T	Pt-S	Pt-T	Pr-S	Pr-T	S-T
0x01	SON	Servo ON	DI1	DI1	DI1	DI1	DI1	DI1	DI1	DI1	DI1
0x02	RES	Reset	DI5	DI5	DI5	DI5	DI5	DI5	DI5	DI5	DI5
0x03	PC	Proportion control	DI3								
0x04	TL	Torque limit option	DI4		DI11		DI11	DI11			DI11
0x05	TL1	Inner torque limit option	DI11								
0x06	SP1	Speed option 1			DI6	DI6	DI2	DI2	DI11	DI11	DI6
0x07	SP2	Speed option 2			DI2	DI2					DI2
0x08	SP3	Speed option 3									
0x09	ST1	Forward rotation activated			DI3		DI3		DI3		
0x0A	ST2	Reverse rotation activated			DI4		DI4		DI6		
0x0A	RS1	Forward rotation option				DI4		DI4		DI6	DI4
0x09	RS2	Reverse rotation option				DI3		DI3		DI3	DI3
0x0B	ORGP	Origin position									
0x0C	SHOM	Start Home moving									
0x0D	CM1	Electronic gear option 1	DI2								

0x0E	CM2	Electronic gear option 2									
0x0F	CR	Clear	DI6	DI6			DI6	DI6			
0x10	CDP	Gain switch option	DI12		DI12	DI12	DI12	DI12			DI12
0x11	LOP	Control mode switch	DI8		DI8	DI8	DI8	DI8	DI8	DI8	DI8
0x12	EMG	External emergency stop	DI7	DI7	DI7	DI7	DI7	DI7	DI7	DI7	DI7
0x13	POS1	Position command 1		DI2					DI2	DI2	
0x14	POS2	Position command 2		DI3					DI12	DI12	
0x15	POS3	Position command 3		DI8							
0x16	CTRG	Position command trigger		DI4					DI4	DI4	
0x18	LSP	Limit of forward rotation	DI9	DI9	DI9	DI9	DI9	DI9	DI9	DI9	DI9
0x19	LSN	Limit of reverse rotation	DI10	DI10	DI10	DI10	DI10	DI10	DI10	DI10	DI10
0x1A	POS4	Position command 4		DI11							
0x1B	POS5	Position command 5		DI12							
0x1C	POS6	Position command 6									
0x1D	INHP	Inhibit pulse input									

DI code	Signal	Function	Pt	Pr	S	T	Pt-S	Pt-T	Pr-S	Pr-T	S-T
0x1E	EV1	Event trigger Pr command 1									
0x1F	EV2	Event trigger Pr command 2									
0x20	EV3	Event trigger Pr command 3									
0x21	EV4	Event trigger Pr command 4									
0x22	ABSE	Absolute system DI function 1									
0x23	ABSC	Absolute system DI function 2									
0x24	STOP	stop command in Pr mode									
0x25	CAM	E-Cam engagement									
0x26	ALGN	E-Cam alignment.									
0x27	GRTY	Gantry synchronous switch									
0x28	FHS	Full- closed loop control switch									
0x29	FEC	Full-closed loop error clearance									
0x2A	MAP	Linear compensation switch									
0x2D	TC1	Torque command option 1									
0x2E	TC2	Torque command option 2									
0x2F	Pt-Pr	Pt-Pr switch									

Recommended setting value for DO function

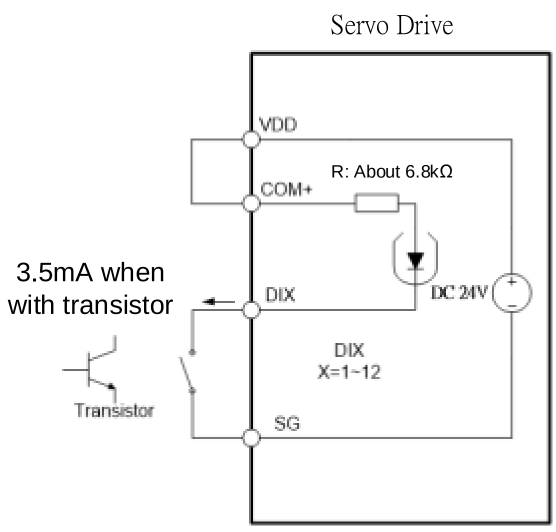
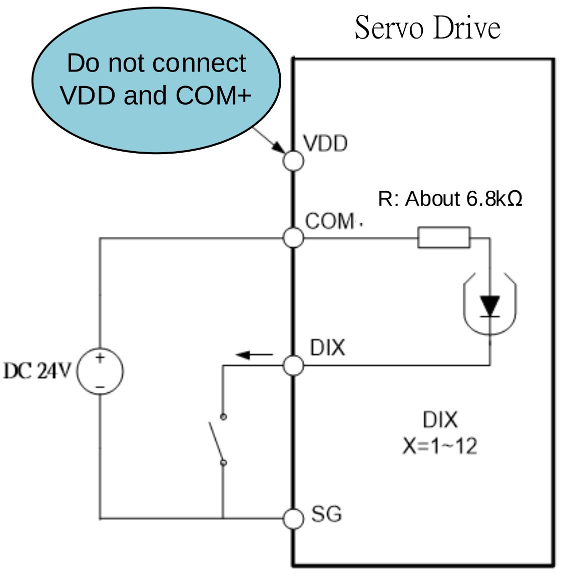
DO code	Signal	Function	Pt	Pr	S	T	Pt-S	Pt-T	Pr-S	Pr-T	S-T
0x01	RD	Ready	DO5	DO5	DO5	DO5	DO5	DO5	DO5	DO5	DO5
0x02	ALM	Alarm signal output	DO6	DO6	DO6	DO6	DO6	DO6	DO6	DO6	DO6
0x03	INP	In-position ready	DO1	DO1			DO1	DO1	DO1	DO1	
0x03	SA	Speed attained			DO1		DO1		DO1		DO1
0x04	HOME	Home moving completion									
0x05	TLC	Torque limiting control	DO4	DO4	DO4		DO4	DO4	DO4	DO4	DO4
0x05	VLC	Speed limiting control				DO4		DO4		DO4	DO4
0X06	MBR	Electromagnetic brake interlock			DO3	DO3					DO3
0x07	WNG	Warning	DO3			DO1	DO3	DO3			
0x08	ZSP	Zero speed detection	DO2	DO2	DO2	DO2	DO2	DO2	DO2	DO2	DO2
0x09	CMDOK	Position command completion output		DO3					DO3	DO3	
0x0A	OLW	Overload output warning									
0x0B	MC_OK	Motion control completed									
0x0C	OVF	Position command overflow									

0x0D	SWPL	Software positive limit									
0x0E	SWNL	Software negative limit									
0x0F	ABSW	Absolute system warning(Delta)									
0x10	ABSV	Absolute system data vanish (Mitsubishi)									
0x11	CAP_OK	Capture complete output									
0x12	CAM_AREA1	E-Cam designated area output 1									
0x13	CAM_AREA2	E-Cam designated area output 2									
0x17	LOPM	Mode switch status									
0x18	PrtM	Pt-Pr switch status									

DO code	Signal	Function	Pt	Pr	S	T	Pt-S	Pt-T	Pr-S	Pr-T	S-T
0x20	S_DO0	Software DO1									
0x21	S_DO1	Software DO2									
0x22	S_DO2	Software DO3									
0x23	S_DO3	Software DO4									
0x24	S_DO4	Software DO5									
0x25	S_DO5	Software DO6									
0x26	S_DO6	Software DO7									
0x27	S_DO7	Software DO8									
0x28	S_DO8	Software DO9									
0x29	S_DO9	Software DO10									
0x2A	S_DOA	Software DO11									
0x2B	S_DOB	Software DO12									
0x2C	S_DOC	Software DO13									
0x2D	S_DOD	Software DO14									
0x2E	S_DOE	Software DO15									
0x2F	S_DOF	Software DO15									

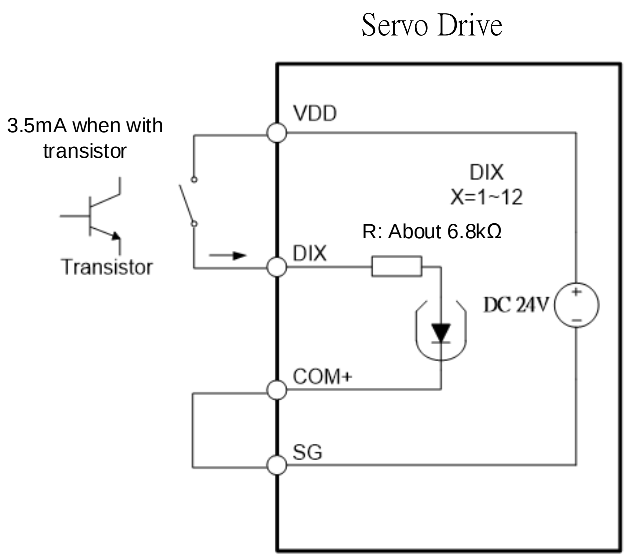
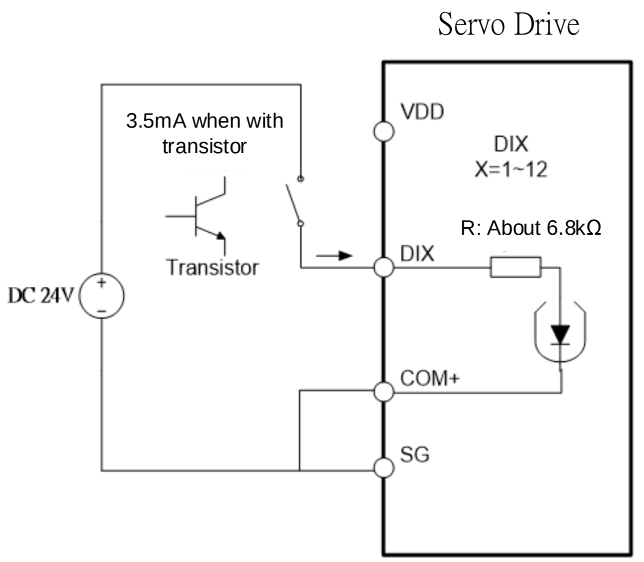
3.3.4 Interface wiring diagram

(1) DI in SINK type

With internal power supply	With external power supply
	

(2) DI in source type

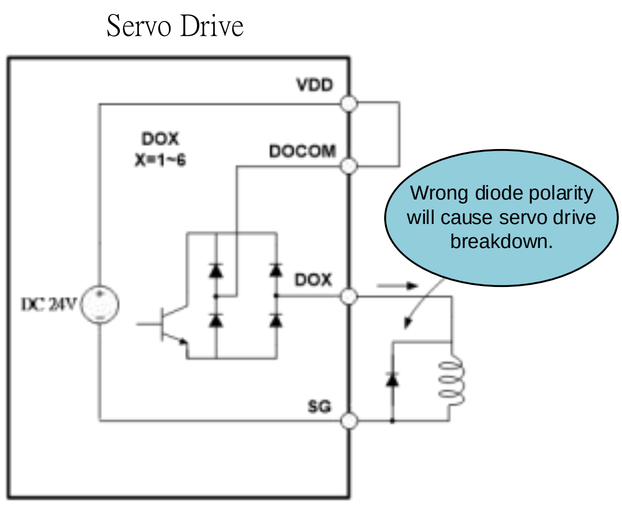
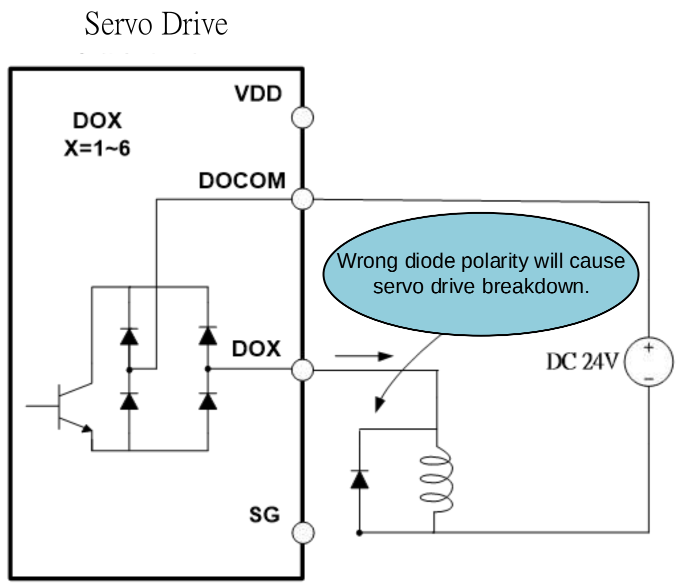
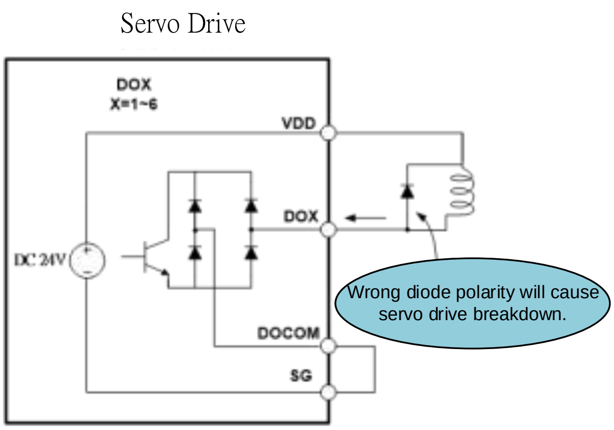
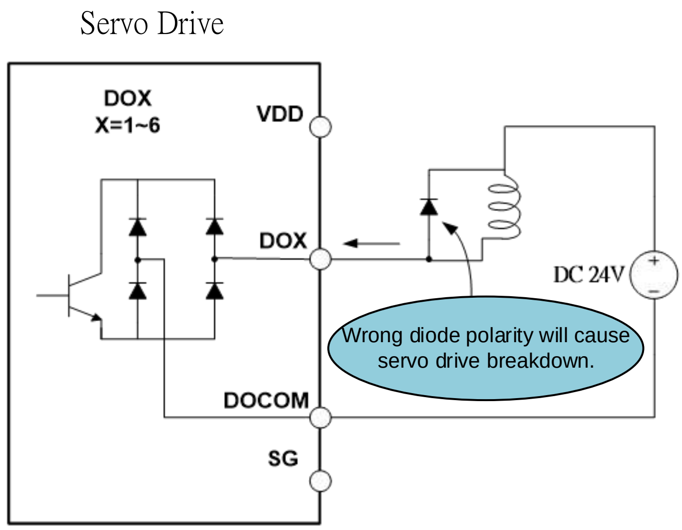
When using the source type of DI, all DI input signals are in source type. Output in source type is not available.

With internal power supply	With external power supply
	

(3) Digital output(DO)

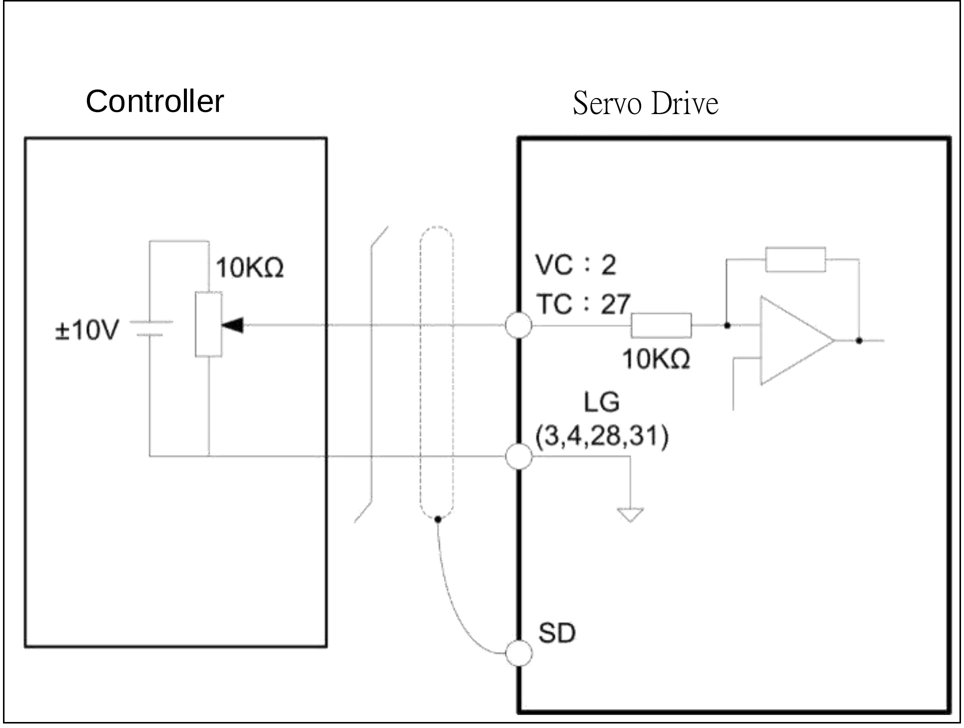
It can drive lamp, relay and photocoupler. When a relay is loaded, a diode is required, and when an external lamp is loaded, a resistor to suppress the surge current is required.

(Allowable current: 40mA or less, surge current: 100mA or less)

DO in Source type	
Relay Load With internal power supply	Relay Load With external power supply
	
DO in Sink type.	
Relay load With internal power supply	Relay load With external power supply
	

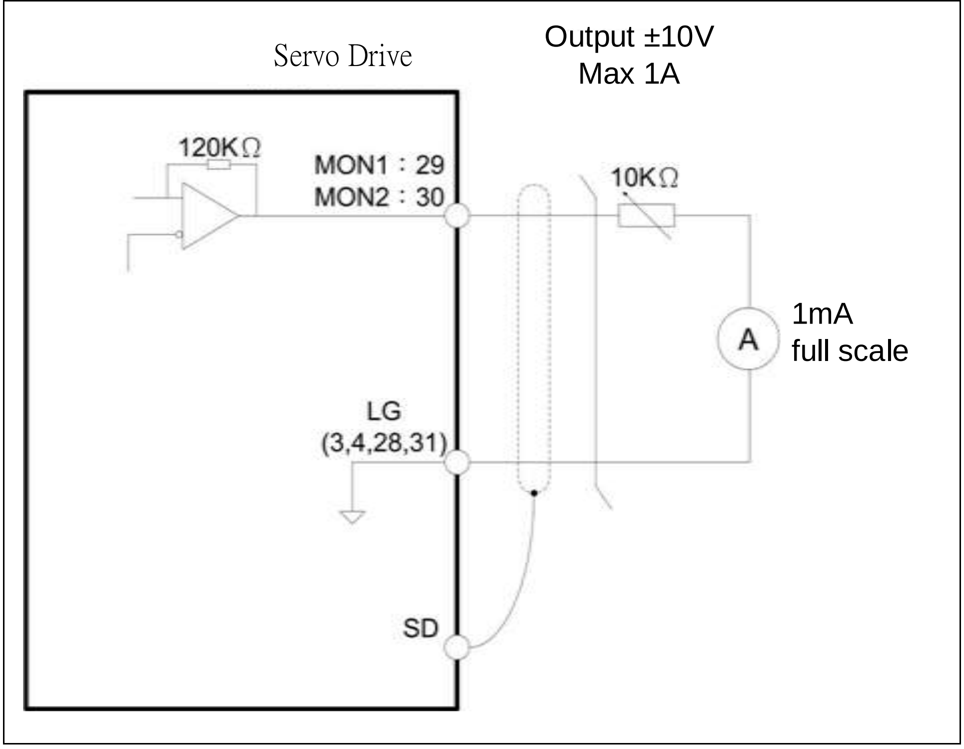
(4) Speed/torque analog input and MON1, MON2 analog output monitoring.

Speed/torque analog input command



Note: **the upper limit of the VC and TC voltage is 10V**. If the voltage is too high, the internal transistor will be burned.

MON1, MON2 analog output monitoring

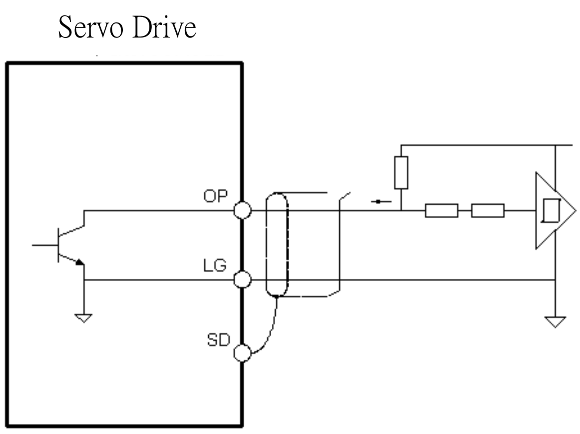
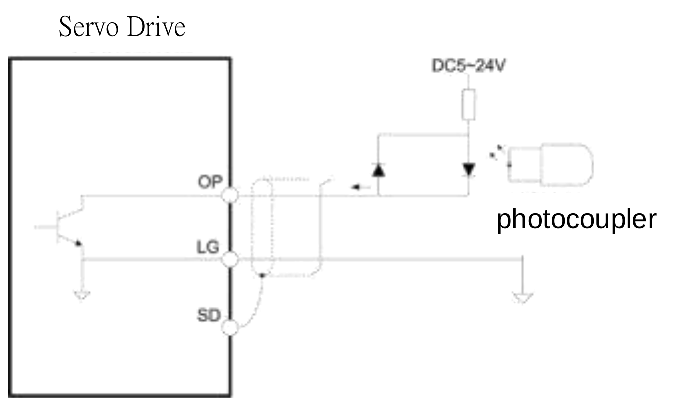


Note: the analog output voltage for MON1, MON2 is **±10V.**

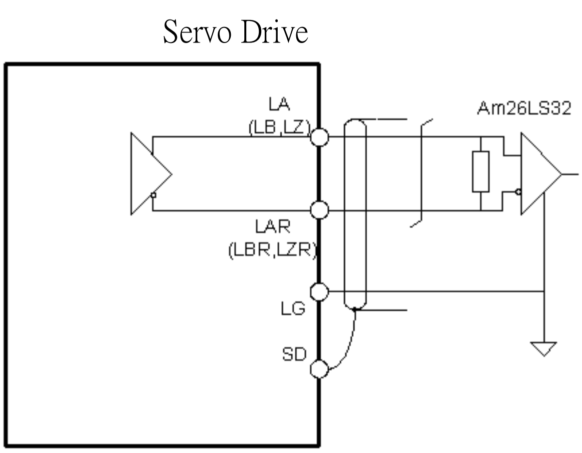
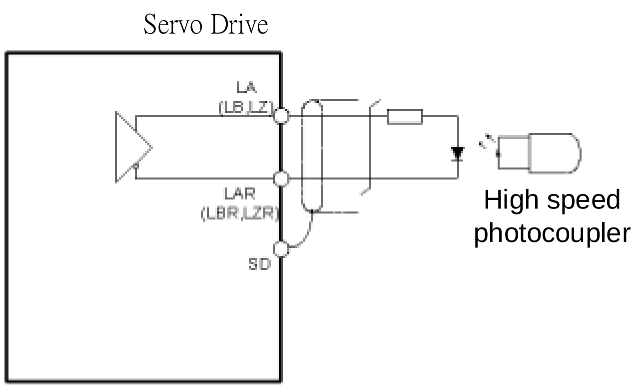
(5) Encoder position output.

Encoder output type includes open collector type and line drive type. And only CN1-40(OP) provides open collector type output.

※The maximum input current of the pulse detection circuit for open-collector type is 35mA

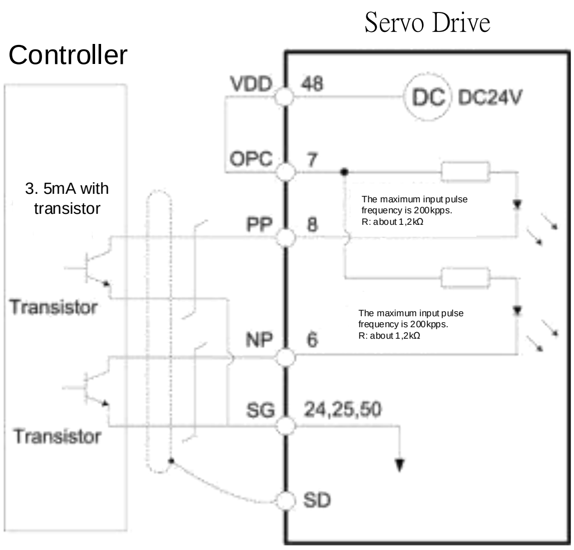
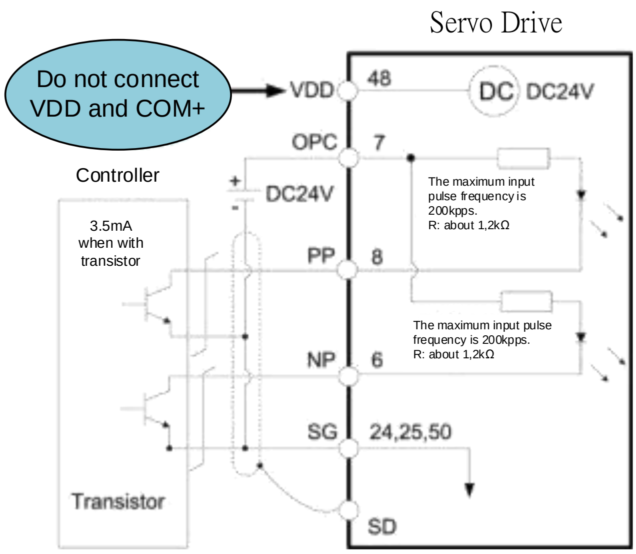
Open collector type Output by OP	Open collector type Output by photocoupler
	

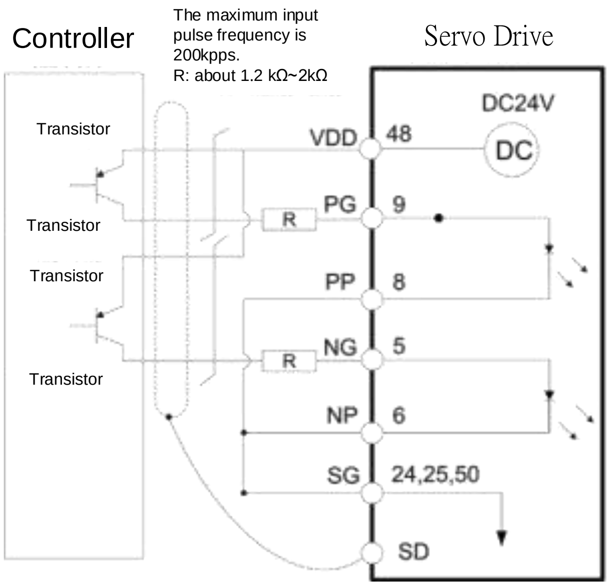
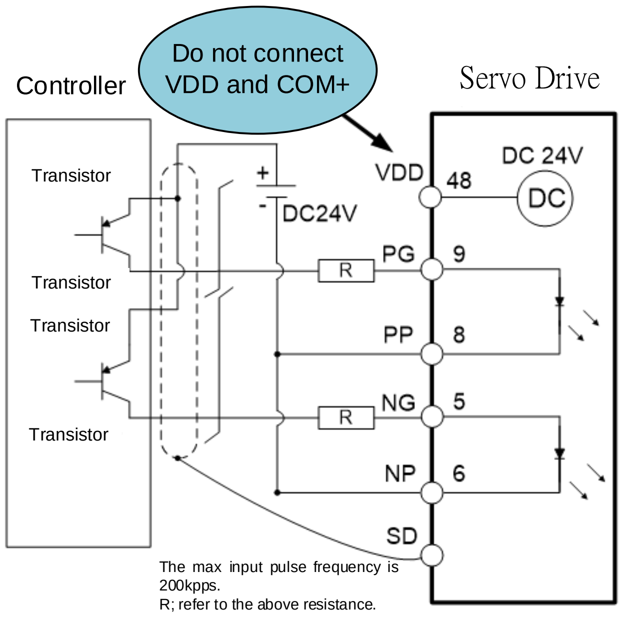
※The maximum output current of the pulse detection circuit for differential type is 20mA

Line driver type Output by OP	Line driver type Output by photocoupler
	

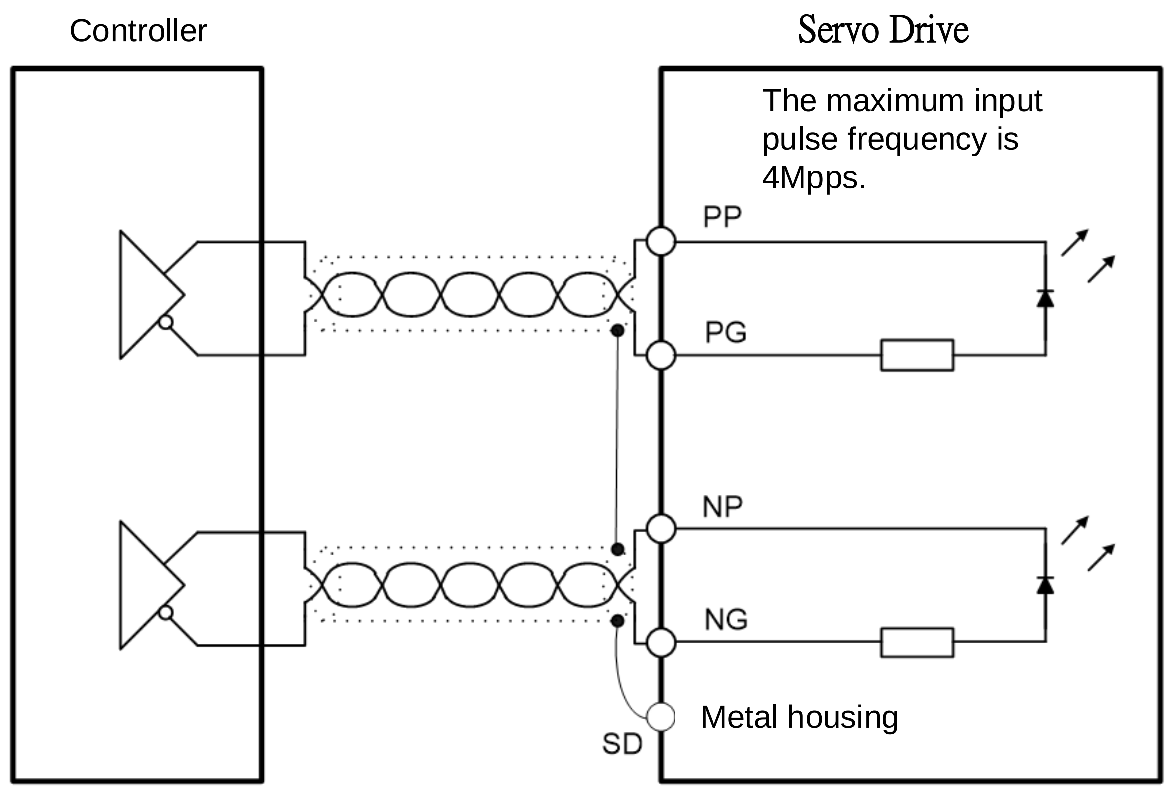
(6)Pulse command input

User can input the pulse command by open collector or line driver type. The maximum pulse input is 4 Mpps for the line driver type and the maximum pulse input is 200 kpps for the open collector type.

<table>
<tr><th>Open collector type(NPN)
With internal power supply</th><th>Open collector type(NPN)
With external power supply</th></tr>
<tr><td>
</td><td>
</td></tr>
</table>

Open collector type(PNP) With internal power supply	Open collector type(PNP) With external power supply
⋆Make sure an external resistor with R=1.2KΩ~2KΩ& 1/4W above is connected, which is to avoid burning the drive.	⋆Make sure an external resistor is connected in order to avoid burning the drive. DC24V: R=1. 2KΩ~2KΩ, 1/4W above DC12V: R=510Ω~820Ω,1/4W above DC5V: R=120Ω~200Ω, 1/4W above
	

Differential (Line Driver)type



Note 1: It is recommended to use a shielded twisted-pair cable for PP-PG and NP-NG connection.

3.3.5 The specified DI and DO signal

The preset DI and DO signals of Shihlin Servo are the signals of the position mode. If the preset DI/DO signals are not expected function, or the control mode is changed by modified PA01 setting, you can redo the DI/DO signal setting. The function of DI1 ~ DI12 and DO1 ~ DO6 signal are defined by PD02~PD09, PD21~PD24, PD10~PD14 and PD26 separately. You can input the DI code or DO code in the corresponding parameters to set its function. Below table lists DI/DO signal, its corresponding CN1 Pin and parameters.

DI

CN1 Pin	Signal name	Parameter
CN-14	DI1	PD 02
CN-15	DI2	PD 03
CN-16	DI3	PD 04
CN-17	DI4	PD 05
CN-18	DI5	PD 06
CN-19	DI6	PD 07
CN-20	DI7	PD 08
CN-21	DI8	PD 09
CN-22	DI9	PD 21
CN-23	DI10	PD 22
CN-12	DI11	PD 23
CN-13	DI12	PD 24

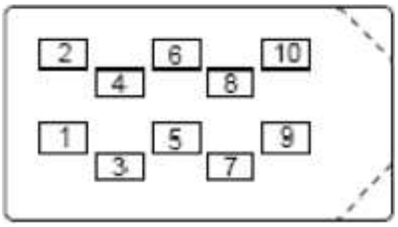
DO

CN1 Pin	Signal name	Parameter
CN-41	DO1	PD 10
CN-42	DO2	PD 11
CN-43	DO3	PD 12
CN-44	DO4	PD 13
CN-45	DO5	PD 14
CN-46	DO6	PD 26

3.4 CN2 encoder signal wiring and description.

The resolution of the Shihlin servo motor built-in encoder is 23&24-bit. its connector pin assignment and appearance are as below:

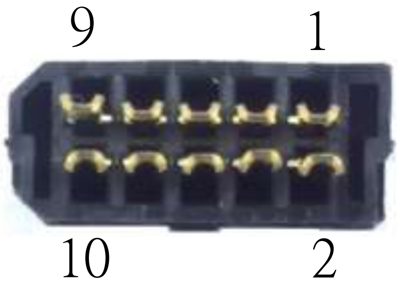
(1)CN2 connector(Female)



3M connector rear view

(2)CN2 connector(Male)

Connector side view



Molex connector rear view

CN2 signal list of incremental/absolute encoder

Pin	Pin marking	Signal
1, 3	Vcc(5V)	Encoder 5V power supply
2	GND	Encoder ground terminal
4	GNDB	Battery ground terminal
5	Vcc(3.6V)	Battery 3.6V power
6	ENCP	Encoder communication(+)
7	ENCN	Encoder communication(-)
8	CLKP	Linear motor EnDat 2.2 communication (note)
9	CLKN	Linear motor EnDat 2.2 communication (note)
10	NC	--
Casing	Shielding	Shielding

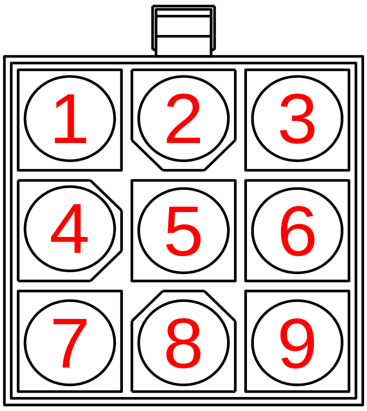
Note: please refer to section 14.1 for the accessories required for linear motor EnDat 2.2.

communication

3.4.1 Encoder connector specification

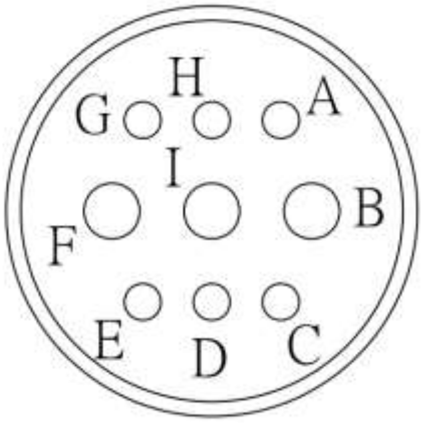
See the table below for the Shihlin servo capacity which is applicable to the quick connector:

Drive capacity	Motor model
100W	SME—L00530○□□□ SME—L01030○□□□
200W	SME—□02030○□□□
400W	SME—□04030○□□□
750W	SME—□07530○□□□



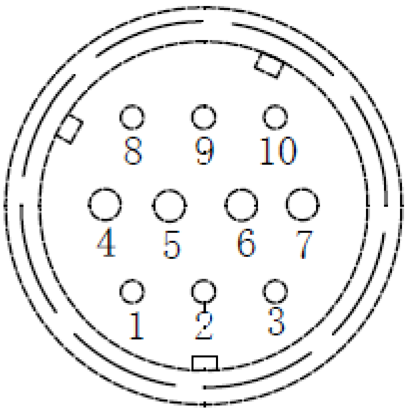
Pin	Pin marking	Motor model
1	--	--
2	--	--
3	Vcc(3.6V)	Battery power 3.6V
4	GNDB	Battery ground terminal
5	ENCN	Encoder communication(-)
6	ENCP	Encoder communication(+)
7	Vcc(5V)	Encoder 5V power supply
8	GND	Encoder ground terminal
9	Shielding	Shielding

See the table below for the Shihlin servo capacity which applicable to the military connector:

Drive capacity	**Motor model**	
1KW	SME－H08515○□□□ SME－□10020○□□□	
1.5KW	SME－□15020○□□□	
2KW	SME－□20020○□□□	
3KW	SME－H13015○□□□ SME－H18015○□□□ SME－□30020○□□□	

Pin No.	**Pin marking**	**Signal**
A	GND_B	Battery ground terminal
B	Vcc(5V)	Encoder 5V power supply
C	--	--
D	ENCP	Encoder communication(+)
E	ENCN	Encoder communication(-)
F	GND	Encoder ground terminal
G	--	--
H	Vcc(3.6V)	Battery power 3.6V
I	Shielding	Shielding

See the table below for the Shihlin servo capacity which applicable to the military connector(400V):

<table>
<tr><th>Drive capacity</th><th>Motor model</th><td rowspan="5">
</td></tr>
<tr><td>2KW</td><td>SMP－H18015○□□□</td></tr>
<tr><td>3KW</td><td>SMP－H29015○□□□</td></tr>
<tr><td>5KW</td><td>SMP－H44015○□□□
SMP－H55015○□□□</td></tr>
<tr><td>7KW</td><td>SMP－H75015○□□□</td></tr>
</table>

Pin No.	Pin marking	Signal
1	ENCP	Encoder communication(+)
2	ENCN	Encoder communication(-)
3	--	--
4	Vcc(5V)	Encoder 5V power supply
5	GNDB	Battery ground terminal
6	Vcc(3.6V)	Battery power 3.6V
7	--	--
8	--	--
9	GND	Encoder ground terminal
10	Shielding	Shielding

★ Note: the wiring above is the connector from the motor itself.

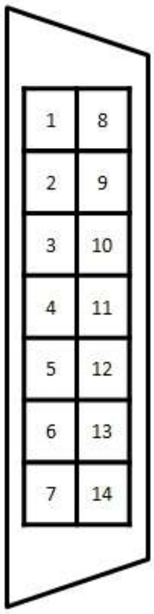
★ Please refer to section 1.3.1 for description of ○□□□

The wiring ends of the drive and the motor are summarized as follows:

Drive terminals			Motor wiring ends		
Pin No.	**Pin marking**	**Signal**	**Quick connector Pin No,**	**Military connector Pin No**	**Military connector(400V) pin No.**
1, 3	Vcc(5V)	Encoder 5V power supply	7	B	4
2	GND	Encoder ground terminal	8	F	9
4	GND_B	Battery ground terminal	4	A	5
5	Vcc(3.6V)	Battery power 3.6V	3	H	6
6	ENCP	Encoder communication(+)	6	D	1
7	ENCN	Encoder communication(-)	5	E	2
Casing	Shielding	Shielding	9	I	10

3.5 CN2L full-closed loop/linear scale signal and wiring description

If you need to use full-closed loop control or linear motor drive (using incremental optical scale, Hall sensor and temperature sensor), the pin number and appearance of the connector are as follows:



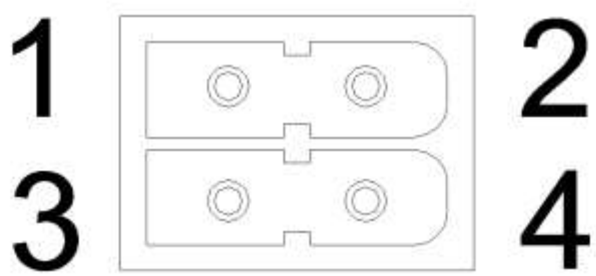
Pin definition of CN2L full-closed loop connector

CN2L Pin NO.	Pin marking	Function
1	Z	Z phase input
2	/Z	/Z phase input
3	B	B phase input
4	/B	/B phase input
5	A	A phase input
6	/A	/A phase input
7	GND	GND
8	Temp+	Linear motor temperature detection(+)
9	Temp-	Linear motor temperature detection(-)
10	HALL_U	Hall sensor U phase input
11	HALL_V	Hall sensor V phase input
12	HALL_W	Hall sensor W phase input
13	Vcc(5V)	+5V output

14	GND	GND

3.6 CN3 communication port signal and wiring description

CN3 is interface for RS-485 communication, you can connect the drive to PC and perform parameter setting, status monitoring, test operation and other actions by using Shihlin servo communication software. The CN3 provides RS-485 communication interface, which provides long-distance transmission and enables you to connect multiple servo drives simultaneously.



Definition of CN3 connection port

Pin NO	**Pin marking**	Function
1	RS-485-B	Data are transmitted in differential line driver. Line driver B
2	RS-485-A	Data are transmitted in differential line driver. Line driver A
3	GND	Signal GND terminal
4	GND	Signal GND terminal

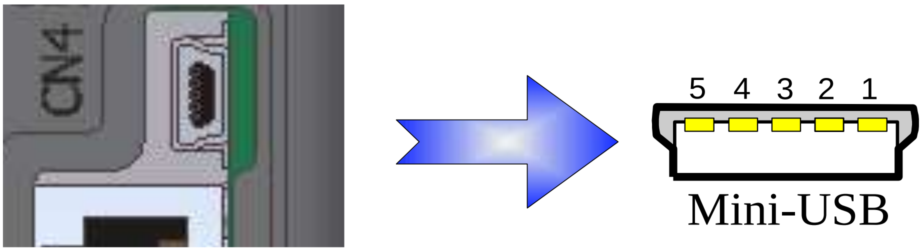
NOTE

1. For RS-485 communication method, please refer to section 9.1.
2. Please confirm clearly that the RS485 pin number assignment of SDP servo is different from other Shihlin products.

3.7 CN4 USB communication port

Shihlin servo drive is equipped with USB communication slot(CN4) which is able to plug in and operate conveniently. Same as RS-485, you can connect CN4 to PC with Mini-USB cable and perform parameter setting, status monitoring, test operation and other actions by using Shilin servo communication software.

Mini-USB is a common component in the market and very easy to buy, which greatly increases the convenience.

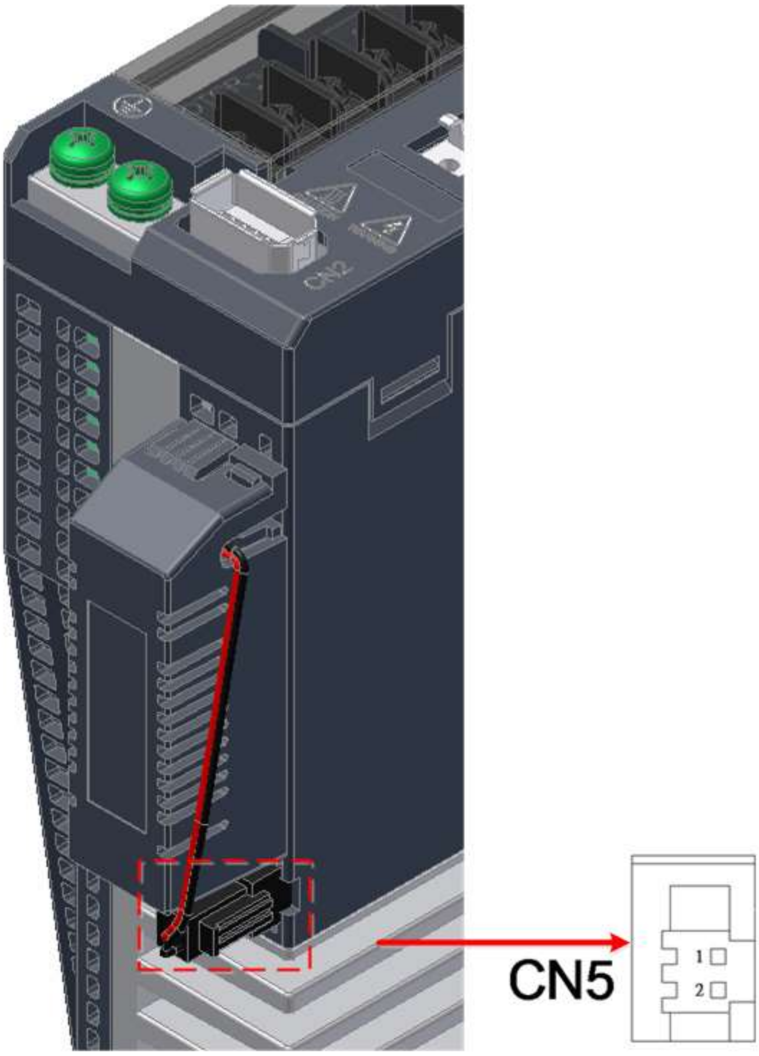


The following table lists Mini-USB standard pin assignment

Pin NO	Pin function
1	+5V
2	D-
3	D+
4	NC
5	GND

3.8 CN5 battery connector of absolute encoder

When using the absolute servo motor, an external battery box for absolute encoder is required. CN5 is battery connector, you can set related parameter after the battery is connected.



The picture above is wrong

The following table shows the standard pin assignment of CN5.

Pin NO	Pin function	Description
1	Vcc(3.6V)	Battery 3.6V power
2	GND	Battery GND terminal

3.9 Standard wiring instruction

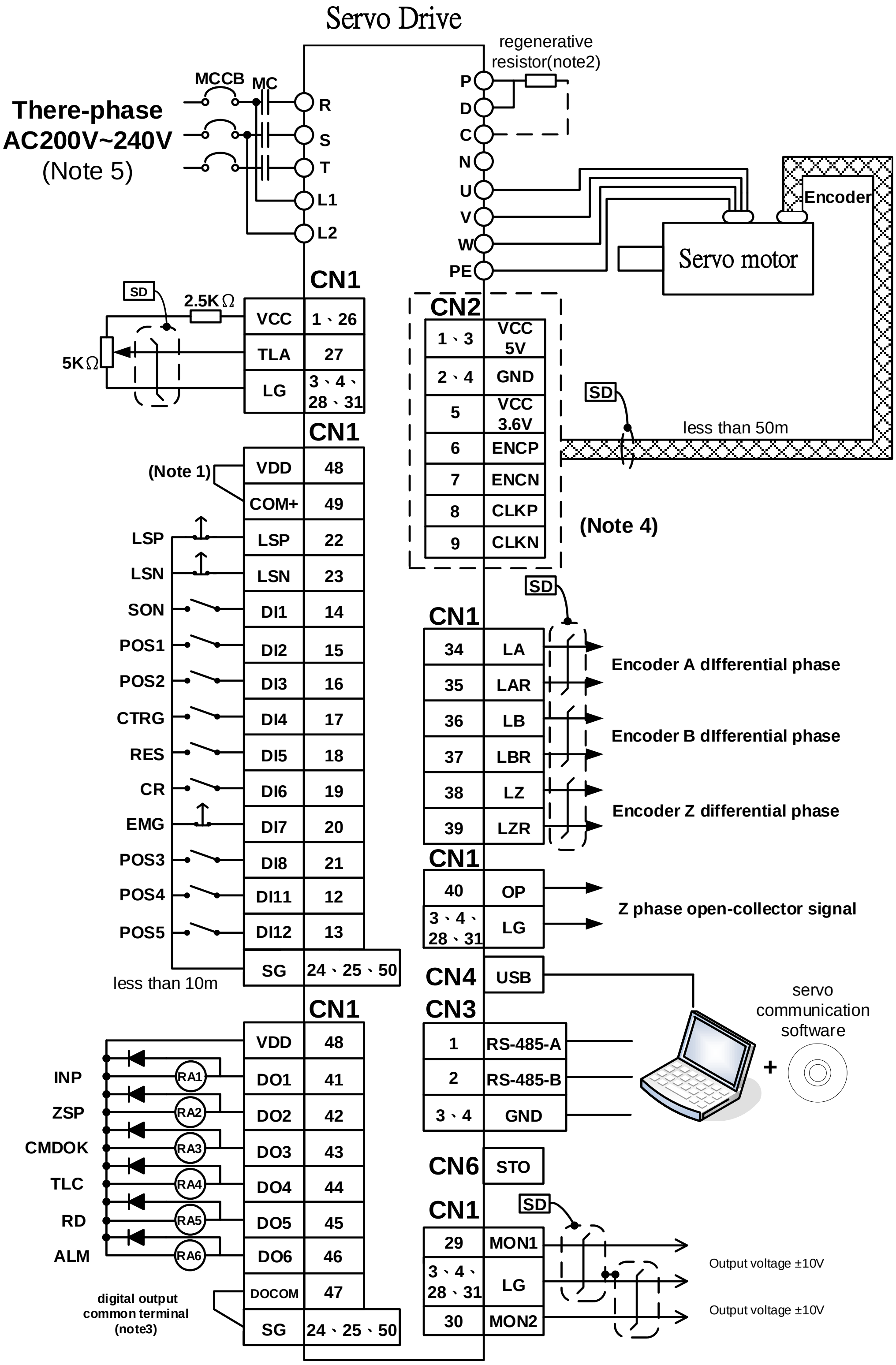
DANGER

- Only qualified engineer can do the wiring.
- Do not wire within 20 minutes after turning off the power, check if there is any residual voltage by electric meter before wiring, otherwise it may cause electric shock.
- The servo drive and servo motor must be well grounded.
- Install the servo drive and motor before wiring, otherwise it may cause electric shock.
- Don’t scratch or apply excessive stress on the cable, or hold it down by heavy objects.

CAUTION

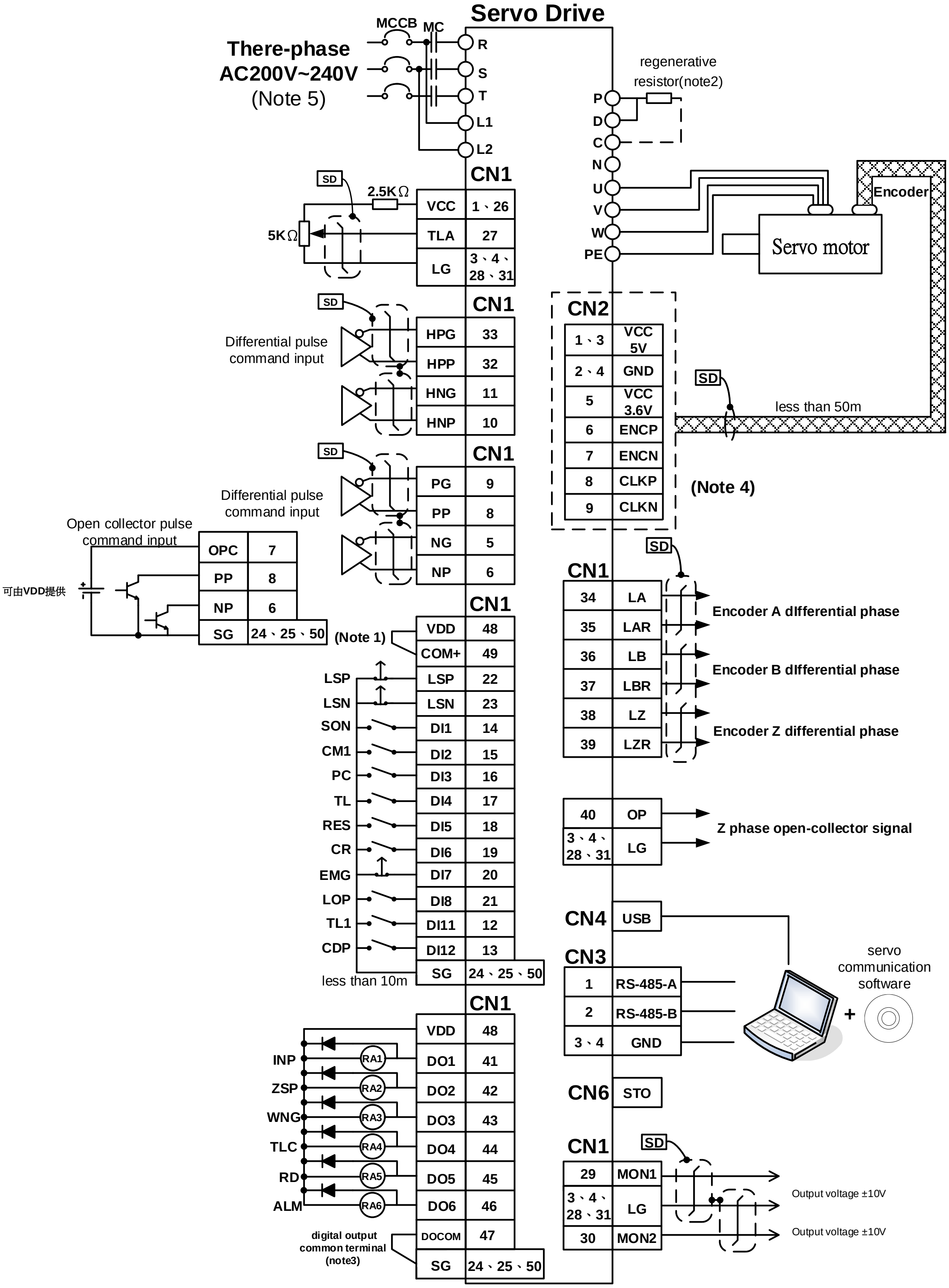
- The wiring should be correct, otherwise the servo motor is prone to sudden unintended acceleration.
- The terminals wiring should be correct, otherwise it may cause damage or abnormal operation.
- The polarity (+/-) must be correct, otherwise it may cause damage or abnormal operation.
- The polarity of the surge absorbing diode, which is installed on the output controlling DC relay, cannot be reversed, otherwise the alarm signal and emergency stop protection circuit will be disabled.
- The electric device nearby the servo drive may have electromagnetic interference, please use the EMI suppression filter to improve.
- Don’t install in-phase capacitor, surge absorber, or EMI noise suppression in the power circuit of the servo motor.
- When using a regenerative resistor, you should switch off power by regenerative abnormal signal. Otherwise, it may cause a fire by the overheated regenerative resistor.
- Do not modify the servo drive or servo motor by yourself.

3.9.1 Position control mode(Pr Mode) wiring diagram



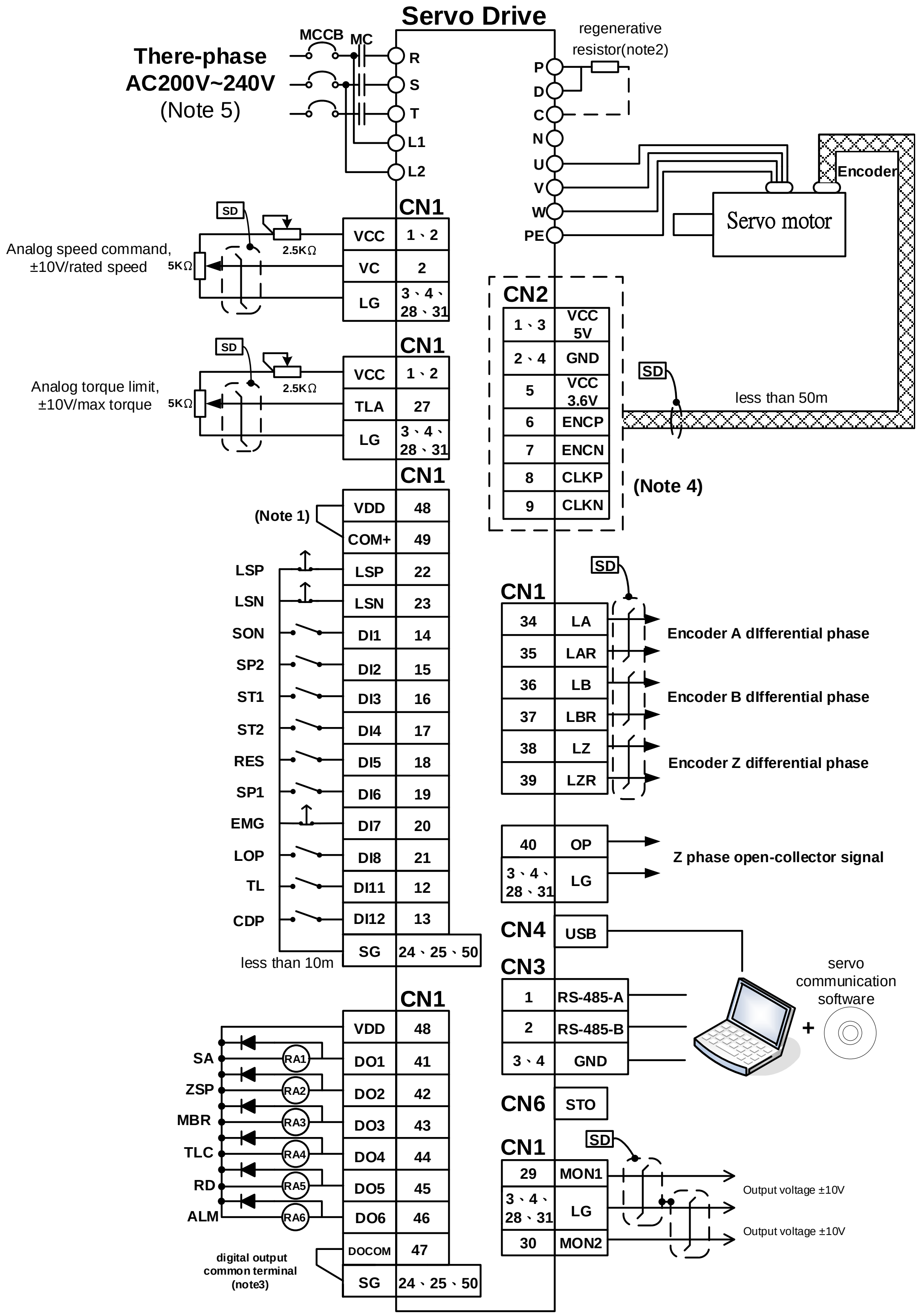
Note1: if external power supply is applied, do not connect VDD and COM+
Note2: please refer to user manual for description of regenerative resistor and brake control unit.
Note3: please refer to user manual for digital output DO sink type or source type wiring.
Note4: if HEIDENHAIN absolute communication protocol is applied, you should connect servo to all CN2 Pin6-9.
Note5: there is no L1,L2 for 440V system, please connect external DC24V power to the front panel +/- sign position.

3.9.2 Position control mode(Pt Mode) wiring diagram



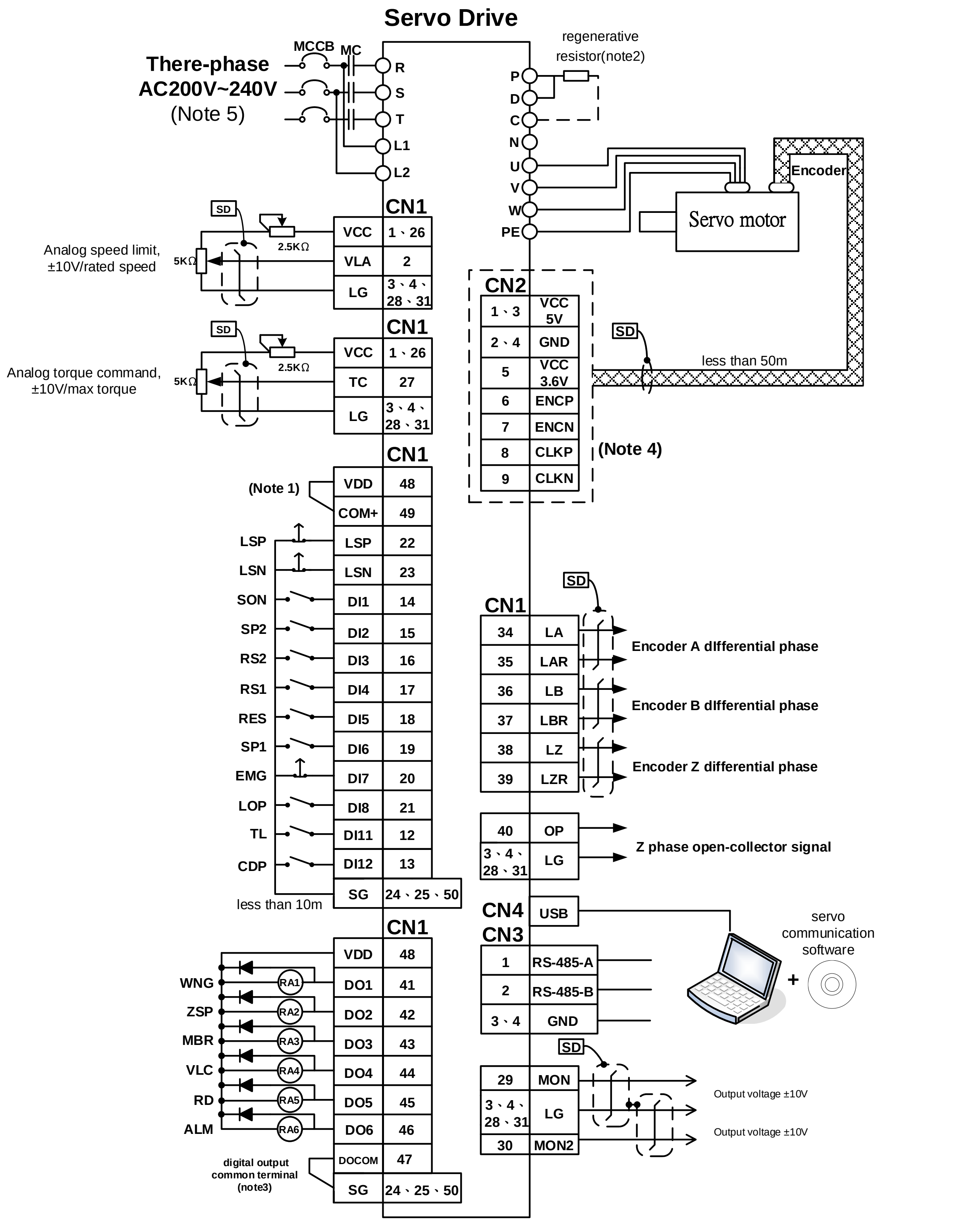
Note1: if external power supply is applied, do not connect VDD and COM+
Note2: please refer to user manual for description of regenerative resistor and brake control unit.
Note3: please refer to user manual for digital output DO sink type or source type wiring.
Note4: if HEIDENHAIN absolute communication protocol is applied, you should connect servo to all CN2 Pin6-9.
Note5: there is no L1,L2 for 440V system, please connect external DC24V power to the front panel +/- sign position.

3.9.3 Speed control mode (S Mode)wiring diagram



Note1: if external power supply is applied, do not connect VDD and COM+
Note2: please refer to user manual for description of regenerative resistor and brake control unit.
Note3: please refer to user manual for digital output DO sink type or source type wiring.
Note4: if HEIDENHAIN absolute communication protocol is applied, you should connect servo to all CN2 Pin6-9.
Note5: there is no L1,L2 for 440V system, please connect external DC24V power to the front panel +/- sign position.

3.9.4 Torque control mode (T Mode)wiring diagram



Note1: if external power supply is applied, do not connect VDD and COM+

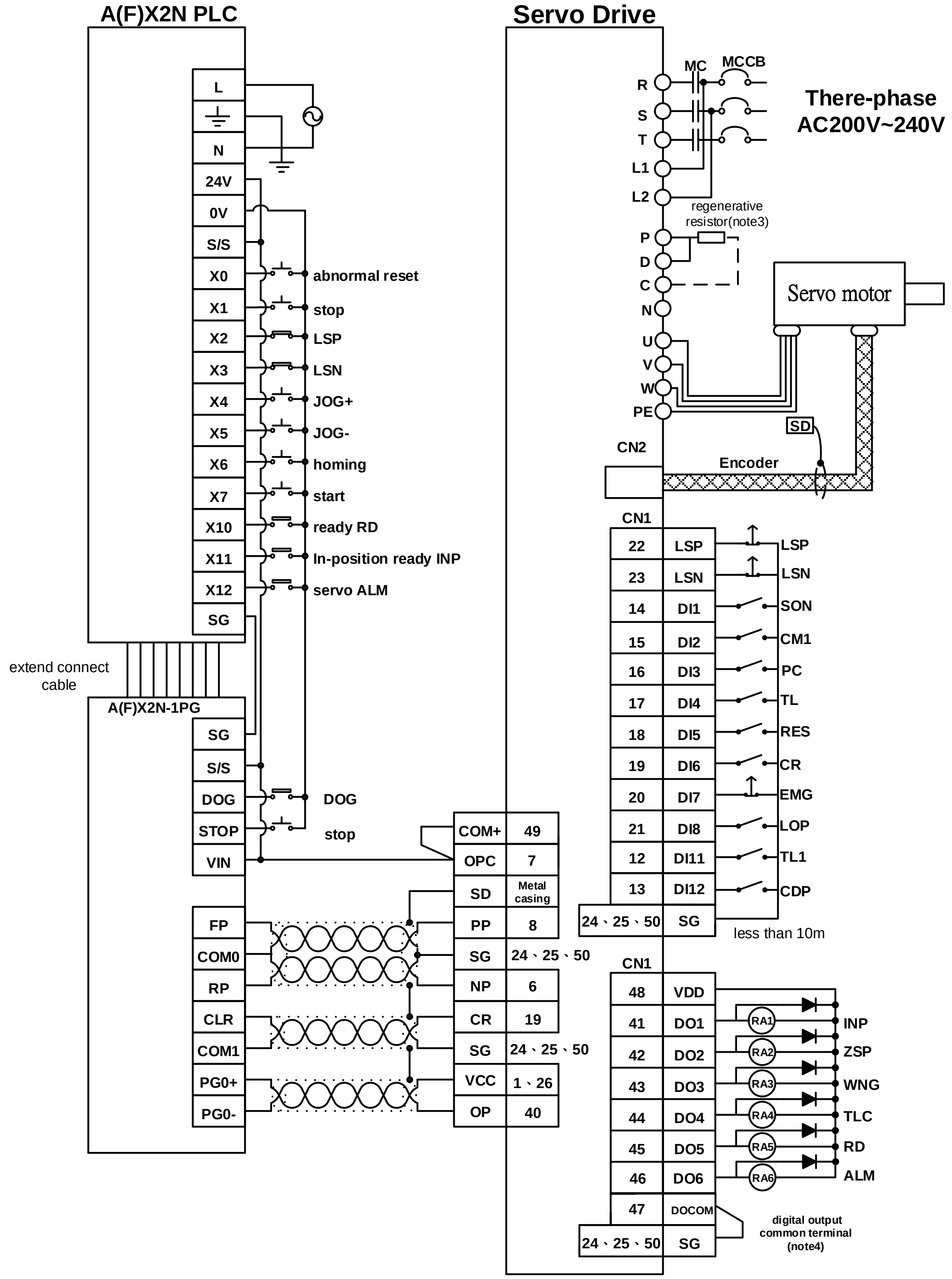
Note2: please refer to user manual for description of regenerative resistor and brake control unit.

Note3: please refer to user manual for digital output DO sink type or source type wiring.

Note4: if HEIDENHAIN absolute communication protocol is applied, you should connect servo to all CN2 Pin6-9.

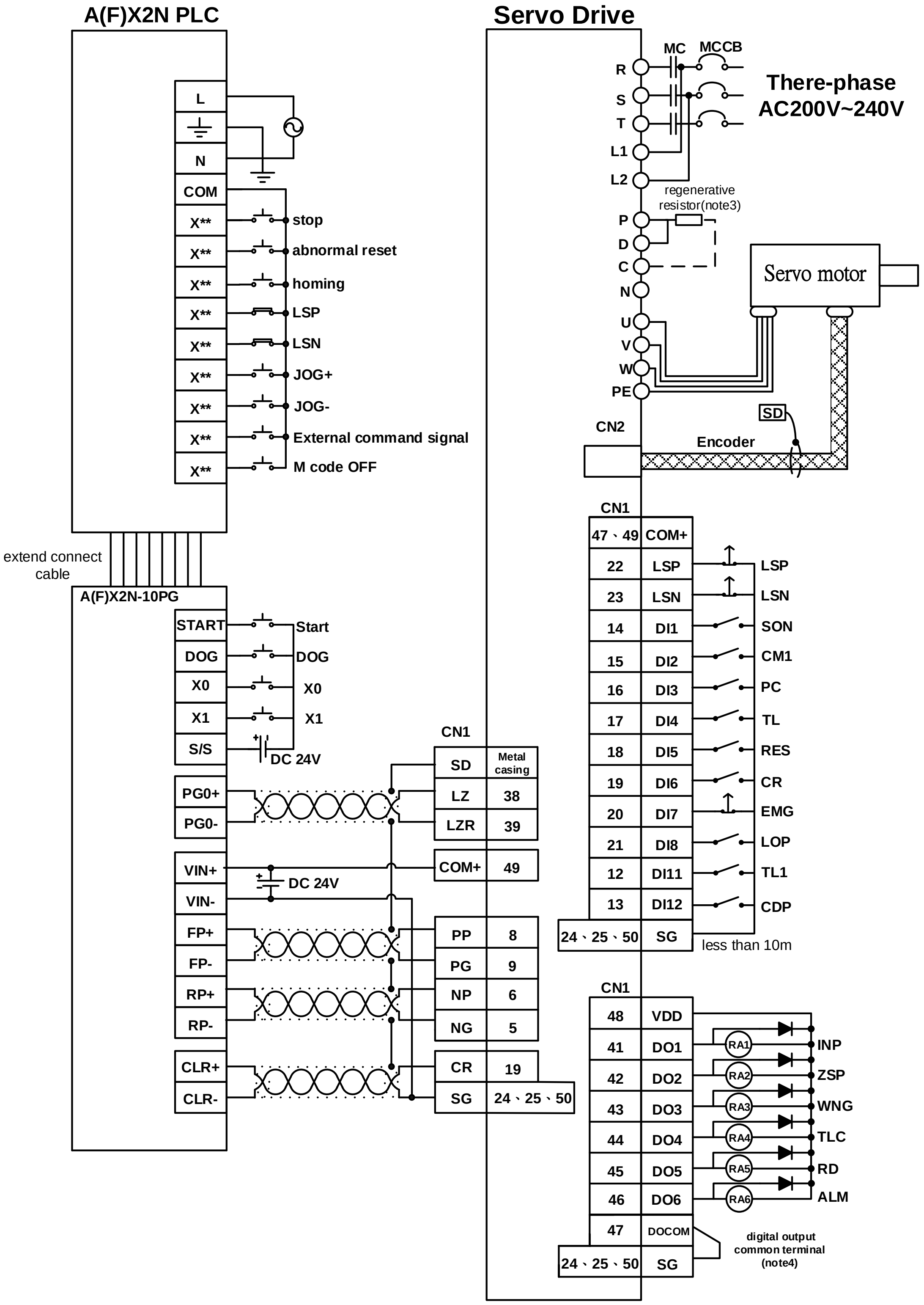
Note5: there is no L1,L2 for 440V system, please connect external DC24V power to the front panel +/- sign position.

3.9.5 1PG wiring diagram



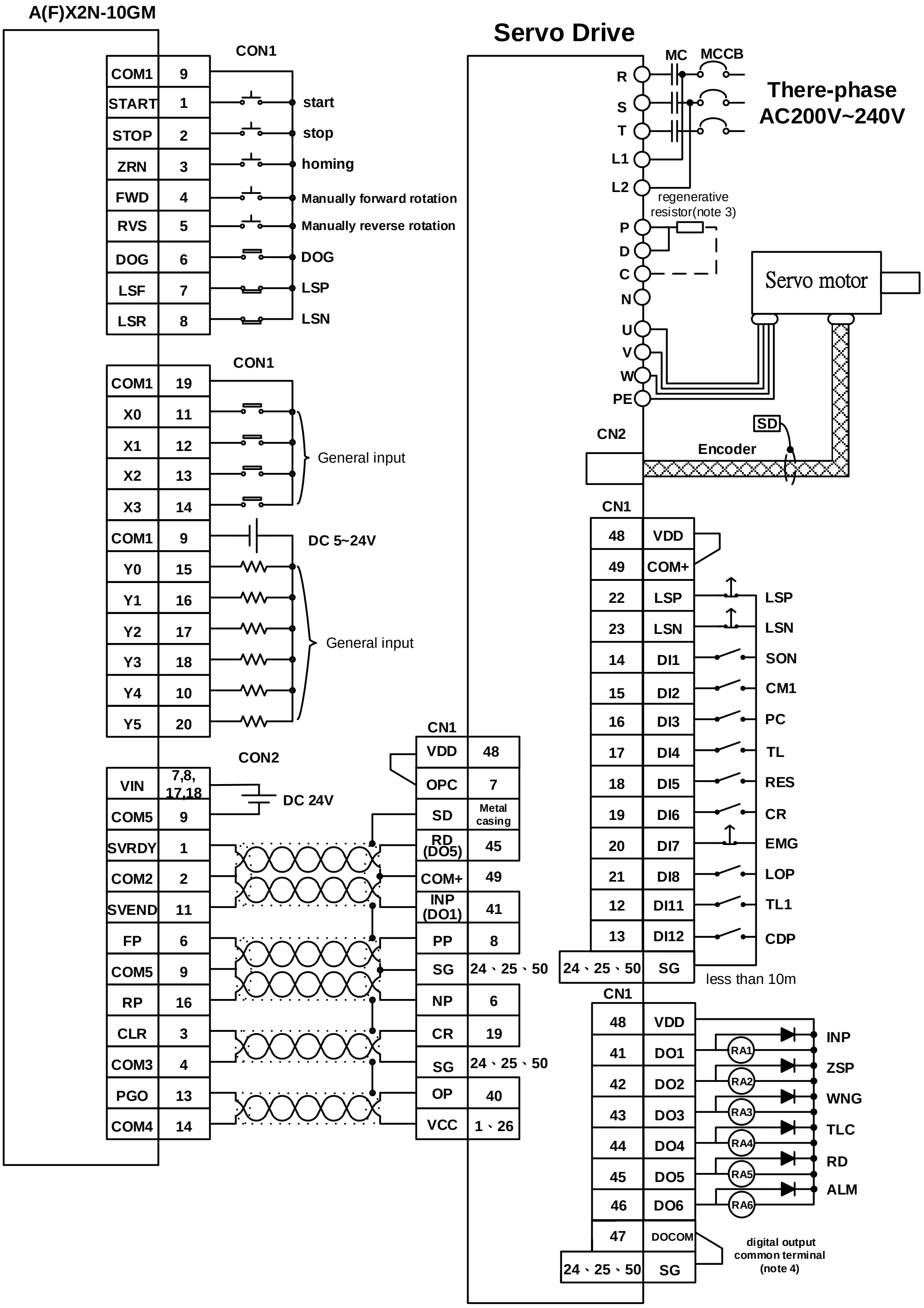
Note1: if the DC24V power provided by PLC is applied, the VDD and COM+ cannot be short-circuited.
Note2: due to A(F)X2N-1PG preset pulse type is negative logic/forward reverse pulse train, PA13 should set to 0010 if preset pulse type is applied.
Note3: please refer to user manual for regenerative resistor and brake control unit wiring.
Note4: please refer to user manual for digital output DO of sink type or source type wiring.

3.9.6 10PG wiring diagram



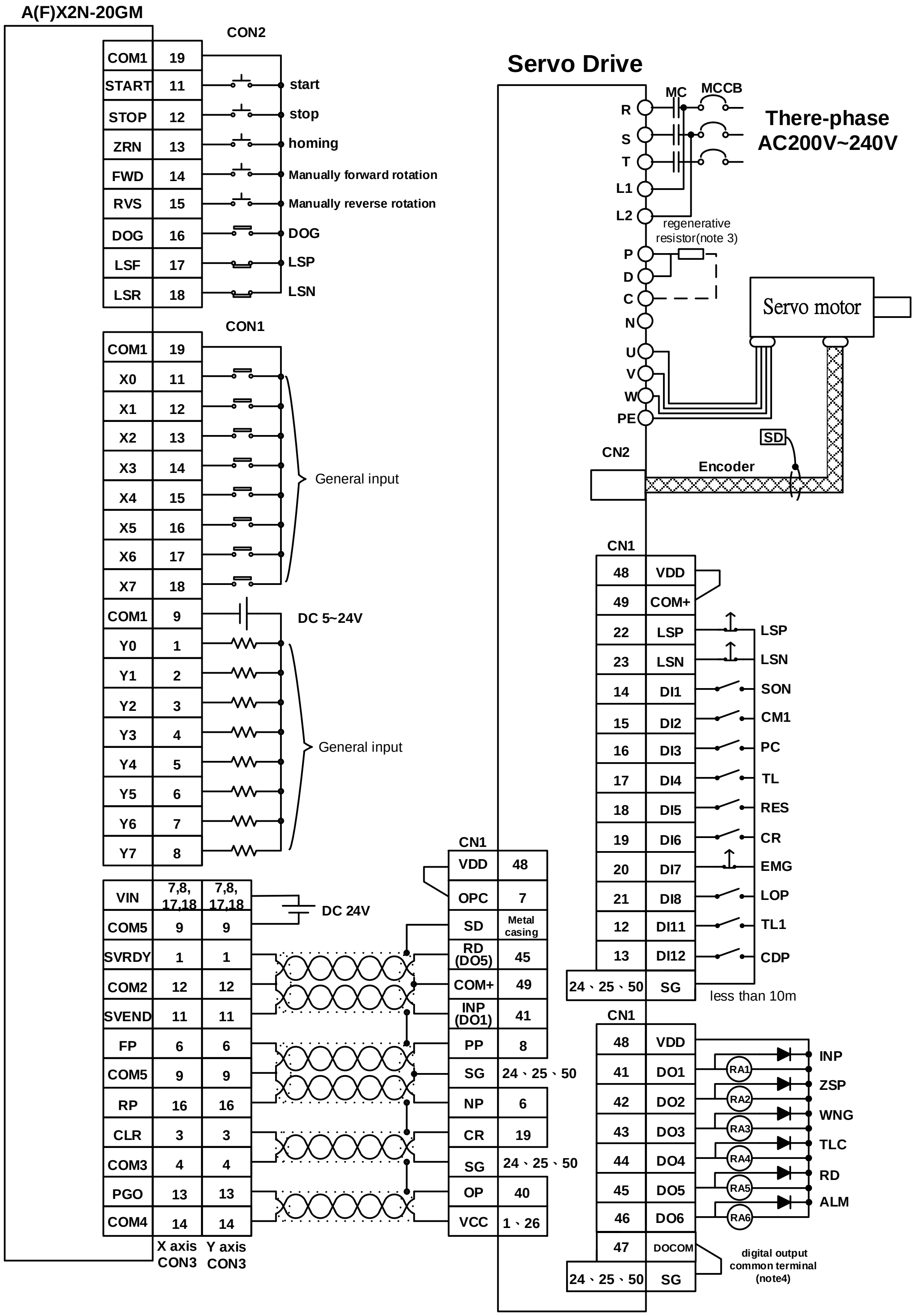
Note1: if the DC24V power provided by PLC is applied, the VDD and COM+ cannot be short-circuited.
Note2: due to A(F)X2N-10PG preset pulse type is negative logic/forward reverse pulse train, PA13 should set to 0010 if preset pulse type is applied.
Note3: please refer to user manual for regenerative resistor and brake control unit wiring.
Note4: please refer to user manual for digital output DO of sink type or source type wiring.

3.9.7 10GM wiring diagram



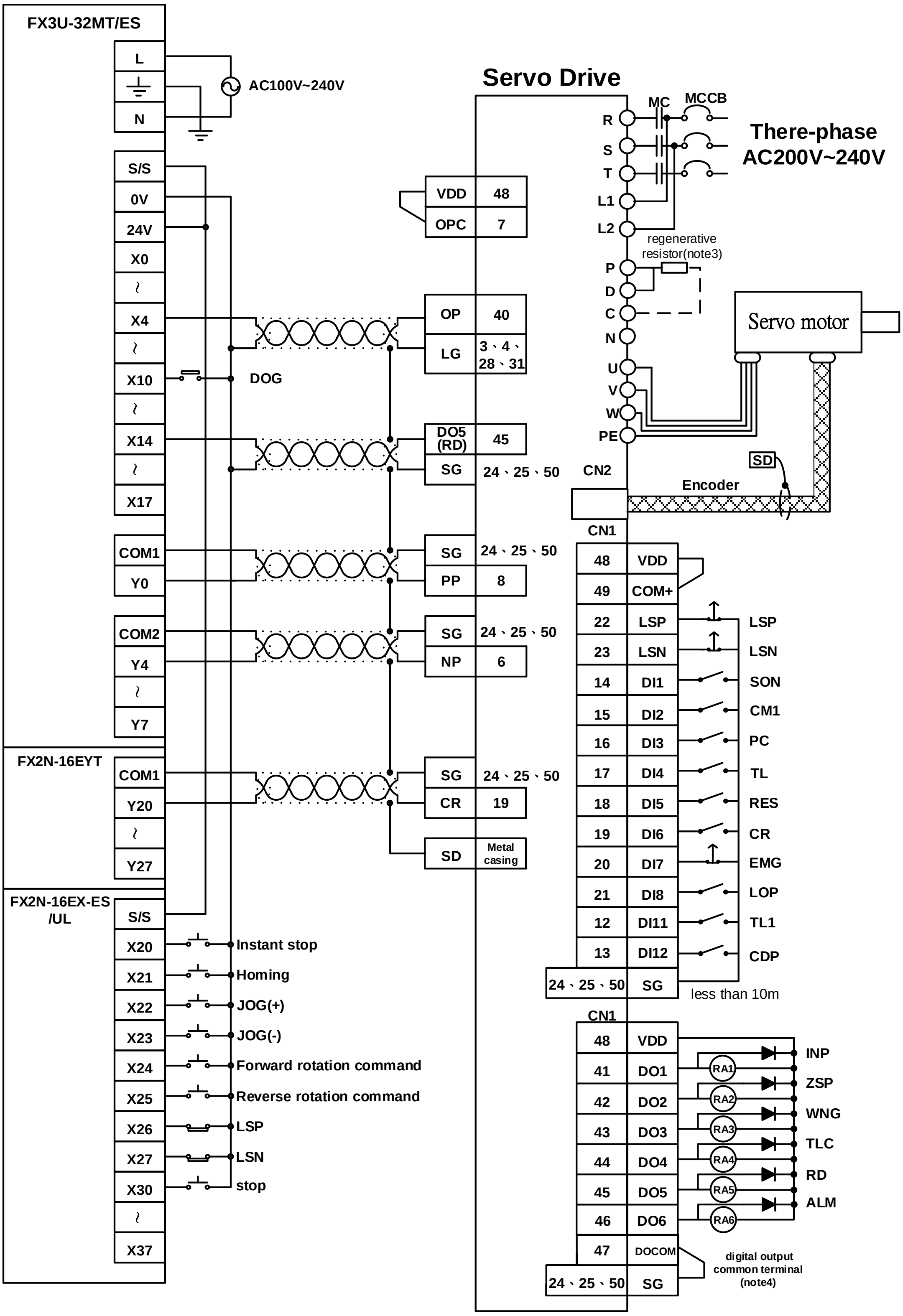
Note1: if the DC24V power provided by PLC is applied, the VDD and COM+ cannot be short-circuited.
Note2: due to A(F)X2N-10GM preset pulse type is negative logic/forward reverse pulse train, PA13 should set to 0010 if preset pulse type is applied.
Note3: please refer to user manual for regenerative resistor and brake control unit wiring.
Note4: please refer to user manual for digital output DO of sink type or source type wiring.

3.9.8 20GM wiring diagram



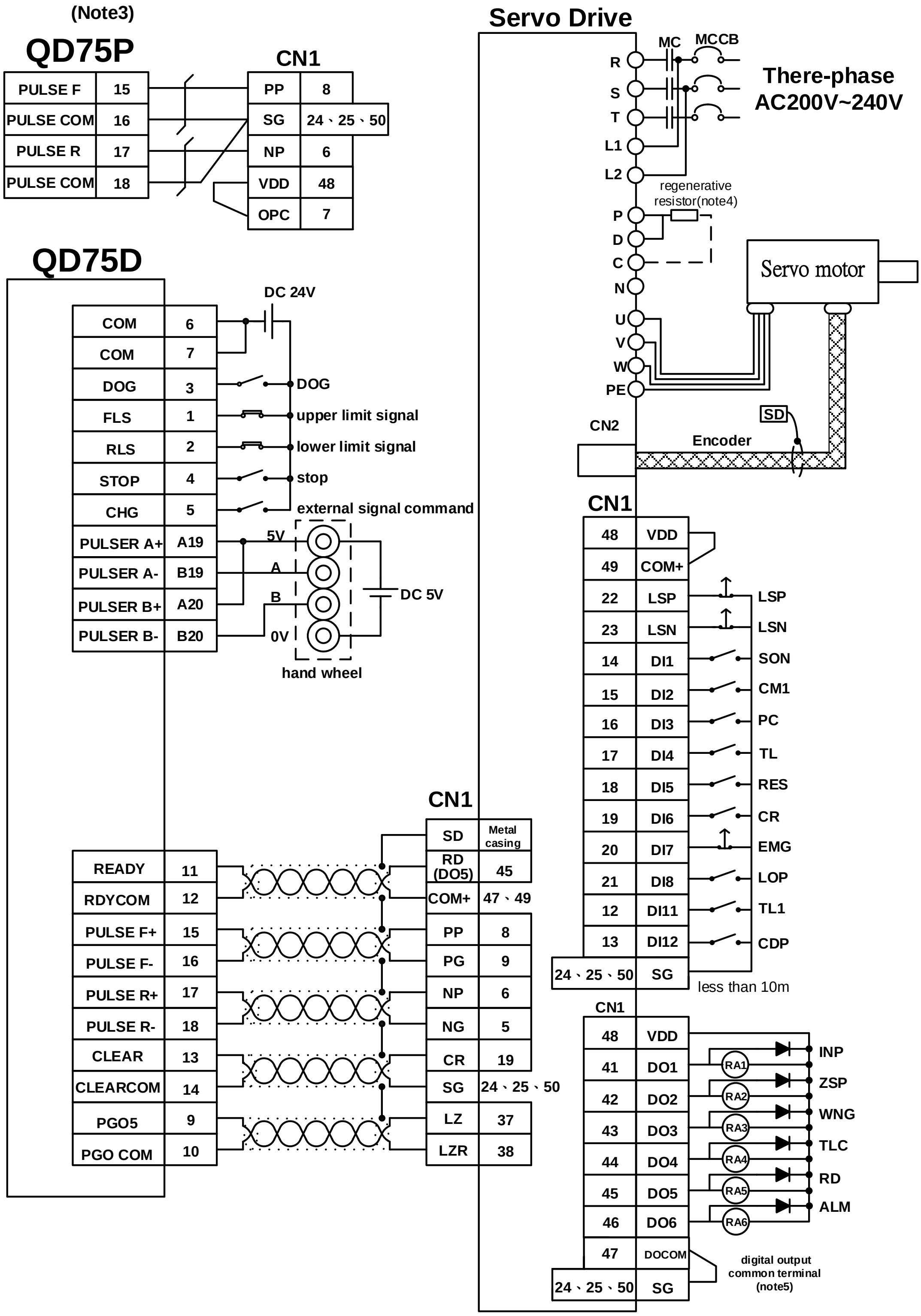
Note1: if the DC24V power provided by PLC is applied, the VDD and COM+ cannot be short-circuited.
Note2: due to A(F)X2N-20GM preset pulse type is negative logic/forward reverse pulse train, PA13 should set to 0010 if preset pulse type is applied.
Note3: please refer to user manual for regenerative resistor and brake control unit wiring.
Note4: please refer to user manual for digital output DO of sink type or source type wiring.

3.9.9 FX3U wiring diagram



Note1: if the DC24V power provided by PLC is applied, the VDD and COM+ cannot be short-circuited.
Note2: due to FX3U-MT host pulse type is negative logic forward /reverse pulse train, PA13 should set to 0010 if this pulse type is applied.
Note3: please refer to user manual for regenerative resistor and brake control unit wiring.
Note4: please refer to user manual for digital output DO of sink type or source type wiring.

3.9.10 QD75 wiring diagram

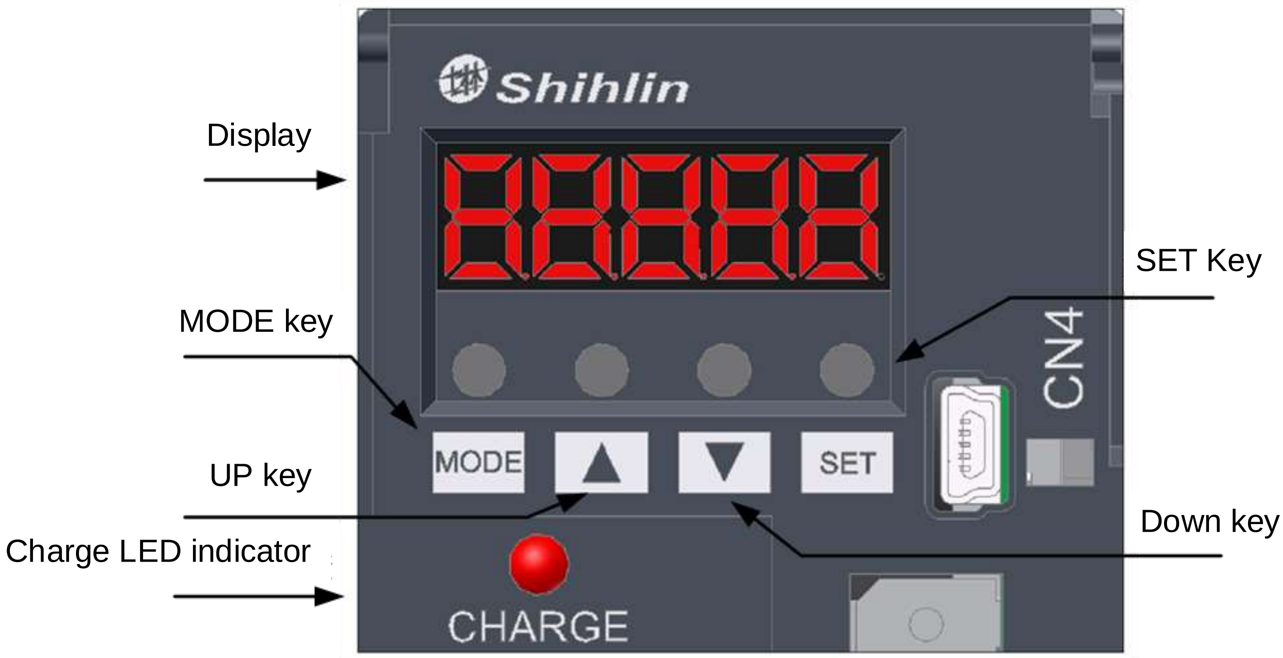


Note1: if the DC24V power provided by PLC is applied, the VDD and COM+ cannot be short-circuited.
Note2: if QD 75D/QD 75P use pre-set pulse type, set PA13 to 0000.
Note3: if QD75P is applied, OPC need to provide DC24V power.
Note4: please refer to user manual for regenerative resistor and brake control unit wiring.
Note5: please refer to user manual for digital output DO of sink type or source type wiring.

4. Panel display and operation

This chapter describes the panel display of Shihlin Servo Drive and its operation instructions.

4.1. Panel description

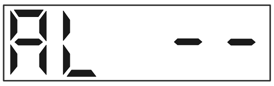
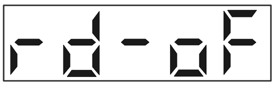
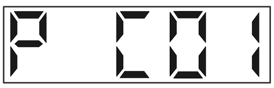


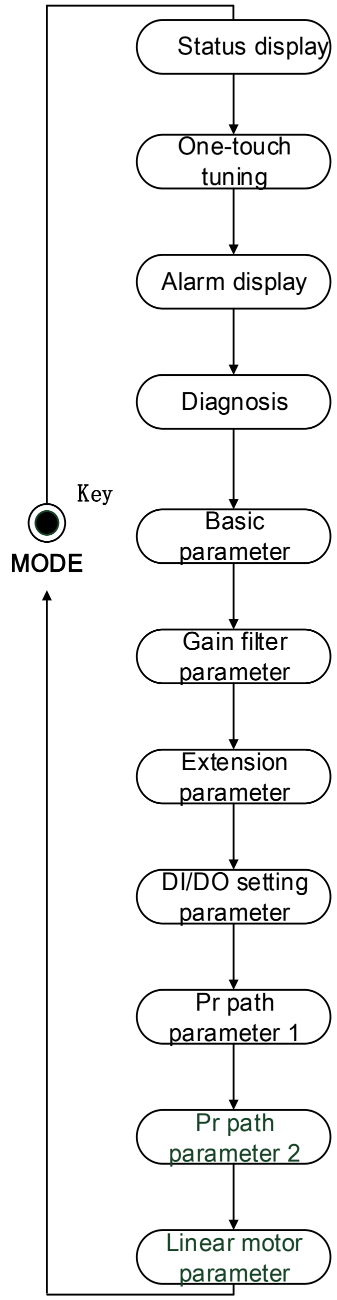
Name	Function
Display	5-digit, 7-segment LED displays the monitoring values, parameter numbers, setting values, etc.
MODE key	It switches the display among monitoring mode, parameter mode, and alarm mode. When writing parameter, this key is use as shift function.
UP key	scroll up the parameter code or setting value.
Down key	scroll down the parameter code or setting value.
SET Key	displays and stores the parameter setting value.
Charge LED indicator	The Charge LED indicator is on when the power is applied to the circuit.

4.2. Display procedure

The display on the front of the SERVO AMP displays servo status, performs parameter modification, etc. You can perform parameter setting, abnormal diagnosis, the external control and operation status check.
Press MODE,UP, DOWN key once to scroll down to the next display page.

The display process of servo panel is as follows

Panel display process	Initial screen	Function	Reference
		Status monitoring. This field is displayed after the power is turned on.	Section 4.3
		One-touch gain tuning function	Section 4.4
		Alarm display	Section 4.5
		In diagnosis mode, it displays external IO signal, DO force output, JOG operation, test positioning, VC automatic deviation correction, firmware version and so on.	Section 4.6
		Displays and sets the basic parameters.	Section 4.7
		Displays and sets the gain filter parameter.	
		Displays and sets extension parameters	
		Displays and sets DI/DO setting parameter	

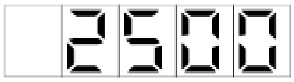
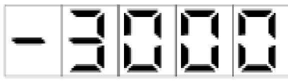
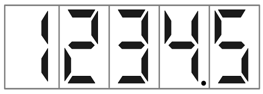
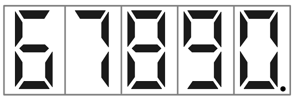
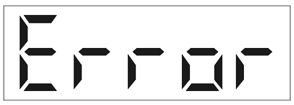
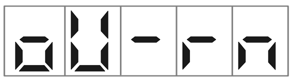
		Displays and sets Pr path parameter 1.	
		Displays and sets Pr path parameter 2.	
		Displays and sets Linear motor parameters.	

4.3. Status display

- ◆ The servo operation status displays on the 5-digit 7-segment LED display.
- ◆ Press the UP and DOWN keys to change the displayed value.
- ◆ When the power is applied, select the sign on panel and press the "SET" key to display its data.
- ◆ The display part of 7-segment LED can display the last 5 digits of the 16 items data, such as motor rotation speed.
- ◆ If the value is 5 digits, its negative value is displayed by the 5 lightening up decimal points. If the value is 4 digits or less, its negative symbol is displayed on the leftmost of LED.

  ▣ Examples

Examples are listed in the following table:

Item	**Status**	**Display method** **7-segment LED display**
Motor rotation speed	Forward rotation at 2500r/min	
	Reverse rotation at 3000r/min	
Load to motor inertia ratio	15.5times	
Motor feedback pulse number(High 5-digit)	The value is 1234567890 High 5-digit➔1234.5	
Motor feedback pulse number(low 5-digit)	The value is 1234567890 Low 5-digit➔67890.	
Parameter wring completed	Write successfully	
Parameter wring failed	Writing fail when servo is on(SON on)	 Rewrite after turning the SON off.
Parameter writing value is out of range	Parameter writing value is out of range	 Rewrite parameter setting value.

PS : for detailed numerical display, please refer to the parameter numerical display example in section 4.7.

Note: when setting the panel parameters, each parameter has the upper and lower limits.

(a) When the decimal data is modified, the modification should be within the upper and lower limits.

(b) When the hexadecimal data is modified, each Hex value has its upper and lower limits.

⊡ Status overview

The servo status are as follows:

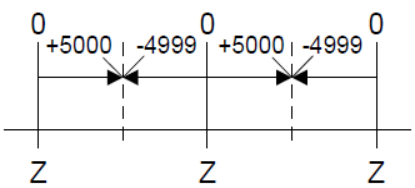
Status display	Symbol	Unit	Content	Displayable range
Motor feedback pulse number (High 5-digit) (before E-Gear ratio)	FPH.I	pulse	Motor feedback pulse number (High 5-digit)(before E-Gear ratio) Ex: if the value is 123456789 pulse, it displays 1234 (Note 1).	-21474 ~21474
Motor feedback pulse number (low 5-digit) (before E-Gear ratio)	FPL.I	pulse	Motor feedback pulse number (low 5-digit)(before E-Gear ratio) Ex: if the value is 123456789 pulse, it displays 56789 (Note 1).	-99999 ~99999
Input number of pulse commands (High 5-digit) (before E-Gear ratio)	CPH.I	pulse	Pulse number of commands input (High 5-digit) (before E-Gear ratio) If the value is 123456789 pulse, it displays 1234 (Note 1).	-21474 ~21474
Input number of pulse commands (low 5-digit) (before E-Gear ratio)	CPL.I	pulse	Input number of pulse commands (low 5-digit) (before E-Gear ratio) Ex: if the value is 123456789 pulse, it displays 56789 (Note 1).	-99999 ~99999
Deviation pulse number (before E-Gear ratio)	E. I	pulse	Deviation number between command input pulse and feedback pulse (before E-Gear ratio) It displays the last 5 digits of the actual value.	-99999 ~99999
Motor feedback pulse number (High 5-digit) (after E-Gear ratio)	FPH.O	pulse	Motor feedback pulse number (High 5-digit) (after E-Gear ratio) If the value is 123456789 pulse, it displays 1234 (Note 1).	-21474 ~21474

Motor feedback pulse number (low 5-digit) (after E-Gear ratio)	FPL.O	pulse	Motor feedback pulse number (low 5-digit)(after E-Gear ratio) Ex: if the value is 123456789 pulse, it displays 56789 (Note 1).	-99999 ~99999
Input number of pulse commands (high 5-digit) (after E-Gear ratio)	CPH.O	pulse	Input number of pulse commands (high 5-digit) (after E-Gear ratio) If the value is 123456789 pulse, it displays 1234 (Note 1).	-21474 ~21474
Input number of pulse commands (low 5-digit) (after E-Gear ratio)	CPL.O	pulse	Input number of pulse commands (low 5-digit) (after E-Gear ratio) If the value is 123456789 pulse, it displays 56789 (Note 1).	-99999 ~99999
Deviation pulse number (after E-Gear ratio)	E. O	pulse	Deviation number between command input pulse and feedback pulse (after E-Gear ratio) It displays the last 5 digits of the actual value.	-99999 ~99999
Command input pulse frequency	CPF	kHz	External command input pulse frequency.	-6000 ~6000
Current motor speed	r	rotary motor rpm linear motor mm/s	Displays current motor feedback speed.	-6000 ~6000
Analog speed command/limit voltage	F	V	(1) Speed mode: it displays the input voltage of analog speed command. (2) Torque mode: it displays the input voltage of analog speed limit.	-10.00 ~+10.00
Speed input command/limit	V	rotary motor rpm linear motor mm/s	(1) Speed mode: it displays analog input speed command. (2) Torque mode: it displays analog input speed limit.	-6000 ~6000
Analog torque command/limit voltage	U	V	(1) Position mode, speed mode: it displays voltage of analog torque limit (TLA)	0 ~ +10.00

			(2) Torque mode: it displays voltage of analog torque command.	-10.00 ~10.00
Torque command/limit	TC	%	(1) Position mode, speed mode. It displays rated analog torque command/limit.	0~300
			(2)Torque control mode It displays analog torque command.	-300~300
Effective load rate	J	%	It indicates the load ratio of continuous torque, and take rated torque as 100%.	0~300
Peak load rate	b	%	It displays the maximum generated torque value in the past 15 seconds, and take rated torque as 100%.	0~300
DC bus voltage	Pn	V	It displays the voltage between main circuit P-N. If the voltage between P-N is lower than the level that the servo can operate normally, the panel displays Lo-dC.	0~500
Load to motor inertia ratio	dC	rotary motor times linear motor Kg	Rotary motor: it displays load/motor inertia ratio. Linear motor: It displays load /linear motor mover + a total weight of load.	0.0~300.0
Instantaneous torque	T	%	It displays the Instantaneously generated torque. Taking the rated torque as 100%, the generated torque is displayed in real time.	0~100
Regenerative load ratio	L	%	It indicates the power ratio of allowable regenerative power in %.	0~100
Feedback pulse number of full-closed loop encoder (high 5-digit) (after E-Gear ratio)	FFH	pulse	It indicates feedback pulse number of full-closed loop encoder (high 5-digit) If the value is 123456789 pulse, it displays 1234 (Note 1).	-21474 ~21474
Feedback pulse number of full-closed loop encoder	FFL	pulse	It indicates feedback pulse number of full-closed loop encoder (low 5-digit) If the value is 123456789 pulse, it	-99999 ~99999

(low 5- digit) (after E-gear ratio)			displays 56789 (Note 1).	
Pulse number of full-closed loop command (high 5-digit) (after E-gear ratio)	FCH	pulse	It indicates pulse number of full-closed loop command(high 5- digit) If the value is 123456789 pulse, it displays 1234 (Note 1).	-21474 ~21474
Pulse number of full-closed loop command (low 5- digit) (after E-gear ratio)	FCL	pulse	Pulse number of full-closed loop command(low 5-digit) If the value is 123456789 pulse, it displays 56789 (Note 1).	-99999 ~99999
The absolute pulse number relative to encoder Z phase	ZP	pulse	The absolute pulse number relative to encoder Z phase, and Z phase is 0. It is +5000 or -4999 pulses when the motor rotates in the forward or reverse direction as below picture shows:	-4999 ~5000
Drive capacity buffer (residual current)	drC	A	It shows the remaining current value of the drive.	0 ~ the maximum output current of this drive

Note 1: when the panel is at value displaying screen, , if you press the SET key, Input number of pulse commands (before or after E-Gear ratio), feedback pulse number, and pulse deviation will be cleared, and this definition is same as the content of communication address 0x0951.

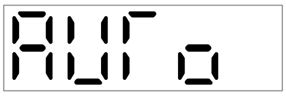


■ **Change of status on display**

By changing PA01, the 7-segment LED status display items can be changed when the power is on. The initial status display items are changed as follows according to the control mode.

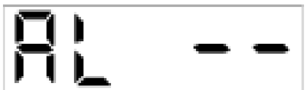
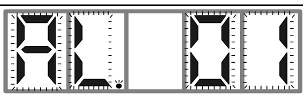
Control mode	Description
Position	Motor feedback pulse number (low 5-digit)
Position/Speed	Motor feedback pulse number (low 5-digit) / Current motor speed
Speed	Current motor speed
Position/torque	Current motor speed / Analog torque command limit voltage
Torque	Analog torque command limit voltage
Torque/position	Analog torque command limit voltage / motor feedback pulse number (low 5-digit)

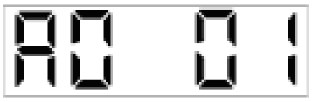
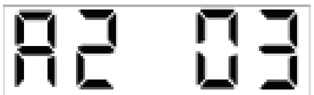
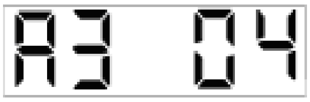
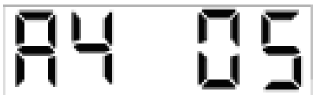
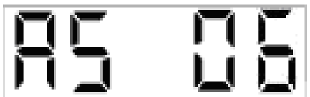
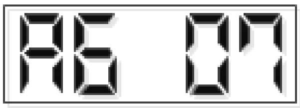
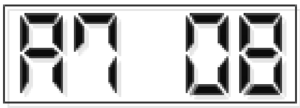
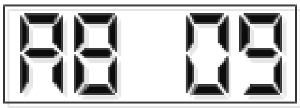
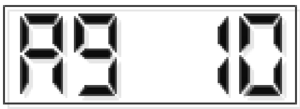
4.4. One-touch Tuning Function

Name	Panel display	Content
One-touch Tuning		One-touch tuning function can be operated when the servo is on this screen. You can refer to section 5.3.2 for detailed content.

4.5. Alarm mode

It shows current alarm and the alarm record. The last 2 digits indicate the Alarm NO.

Name	Panel display	Content
Current alarm		No alarm occurs.
		The screen will blink when an over-voltage alarm occurs(AL.01).

Alarm record		The last alarm in the past is over-voltage (AL.01).
		The 2nd alarm in the past is low-voltage (AL.02).
		The 3rd alarm in the past is over-current (AL.03).
		The 4th alarm in the past is regenerative abnormal (AL.04)
		The 5th alarm in the past is overload (AL.05).
		The 6th alarm in the past is over speed (AL.06).
		The 7th alarm in the past is abnormal pulse control (AL.07).
		The 8th alarm in the past is excessive position deviation (AL.08).
		The 9th alarm in the past is serial communication abnormal (AL.09).
		The 10th alarm in the past is overload 2 (AL.10).

Function of panel display when alarm occurs

A: the screen can show the current alarm in any mode.

B: other contents can still be displayed when an alarm occurs, Its fourth LED decimal point will blink(count from the right side) in this case.

C: the alarm can be cleared by one of the following methods after the cause is eliminated (a). Restart the power.

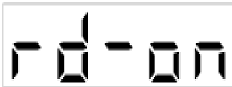
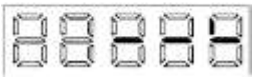
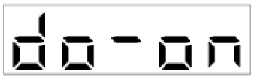
(b). Press SET key at the current alarm screen.

(c). Turn on the reset signal(RES).

D: use UP or DOWN key move to the next alarm record.

4.6. Diagnosis mode

The Diagnosis operation is introduced in the following table.

Item	Screen display	Content
Control status		Servo is not ready yet and RD terminal is off. This screen displays when the servo is initializing, alarm occurs, or SON terminal is off, and RD terminal is off.
		Servo is ready. When servo is on and ready to operate, or when RD terminal is on, this screen is displayed.
External I/O signal indication		It indicates the ON/OFF status of external I/O. The upper part of each segment shows the input signal, and the lower part shows the output signal. The I/O signal can be changed by PD02~PD09.
DO forced output		DO signal can be forced ON/OFF.
JOG test operation		When there is no command from an external device, JOG operation can be executed.
Positioning test operation		When there is no command from external devices, positioning operation can be executed. This operation cannot be performed with the display panel, it need connect to the communication software by RS-485/USB to test.
Inertia estimation test operation		This function can perform automatically estimate the load inertia ratio and the related gain value. This operation cannot be performed with the display panel, it need connect to the communication software by RS-485/USB to test.
Auto-offset of analog input		When you set the analog speed command or analog speed limit, the voltage is adjusted to 0V by the external analog circuit and motor is still rotating slowly, which will automatically set offset value.

		When using this function, PC 26 will be automatically set to the auto-adjusted value. Please follow the following steps to operate: 1). Enter the automatic offset screen of the diagnosis mode. 2). Press the SET key. 3). Press the UP / DOWN key and select 1 4), Press SET key.
Software version(Low)	SG100	It indicates the master version of the SERVO software
Software version(High)	XX	It indicates the subversion of SERVO software.

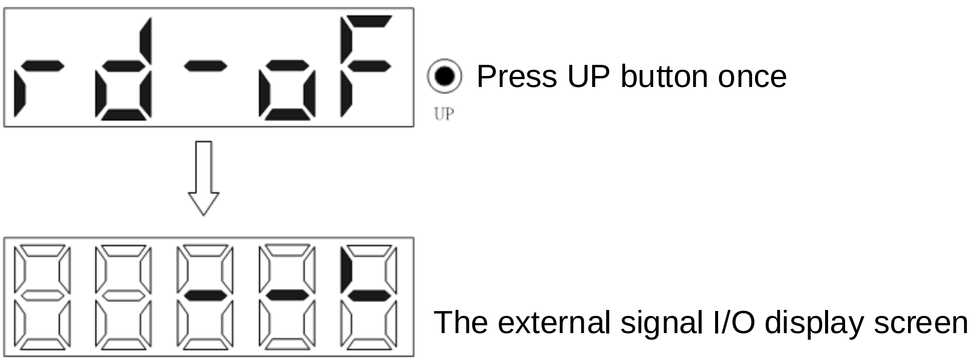
The use of the diagnosis mode will be introduced in detail as follows

4.6.1. External I/O signal indicator

This display is to check the ON/OFF status of SERVO AMP digital I/O signals.

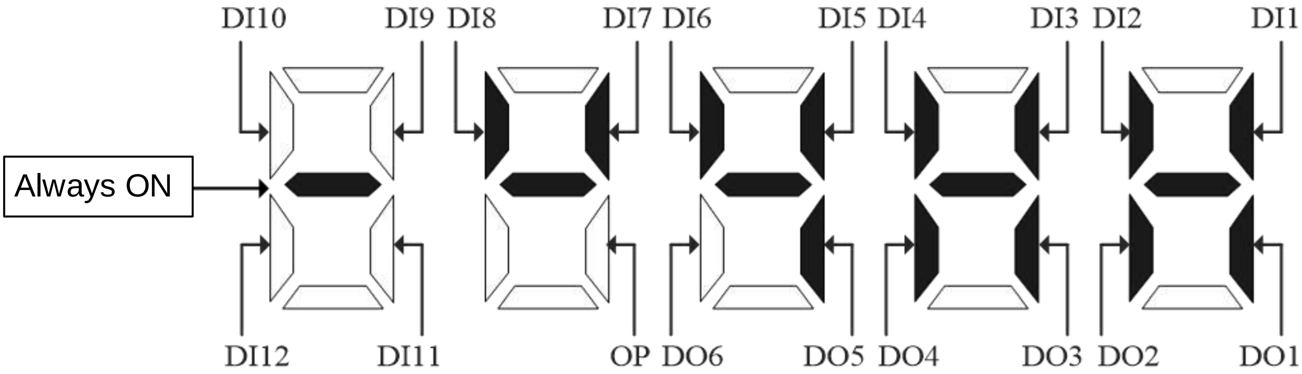
(1) Operation

It indicates the screen after power-on. You can switch to diagnostic screen by pressing MODE key.



(2) Display content

Corresponds to 7-segment LED position and PIN



It use 7-segement LED ON/OFF status to indicate. The upper part of each segment is the input signal (DI1~DI10), and the lower part is the output signal (DO1~DO6, OP) and the input signal DI11, DI12. Take the above picture as example, DI1~ DI8, DO1~DO5 are in ON status, DI9~DI12 ,DO6 and OP are in OFF status.

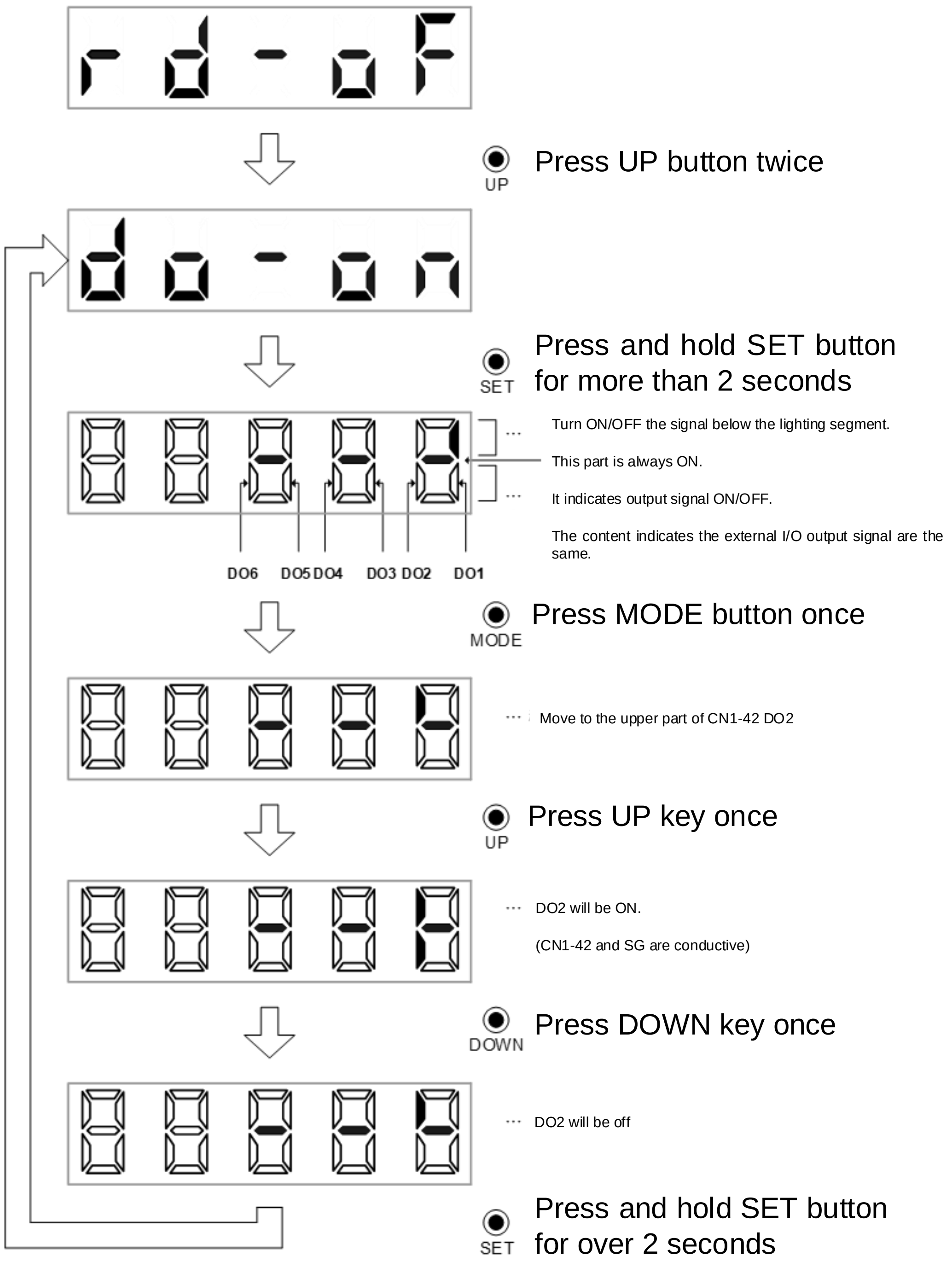
4.6.2 DO Forced output

The output signals which does not affect SERVO status can be forced ON/OFF. This function is applicable in output signal wiring inspection, etc.

- ★ Ensure that no alarm occurs and there is no external command.
- ★ Ensure that SON-SG is open-circuited when testing.

Operation

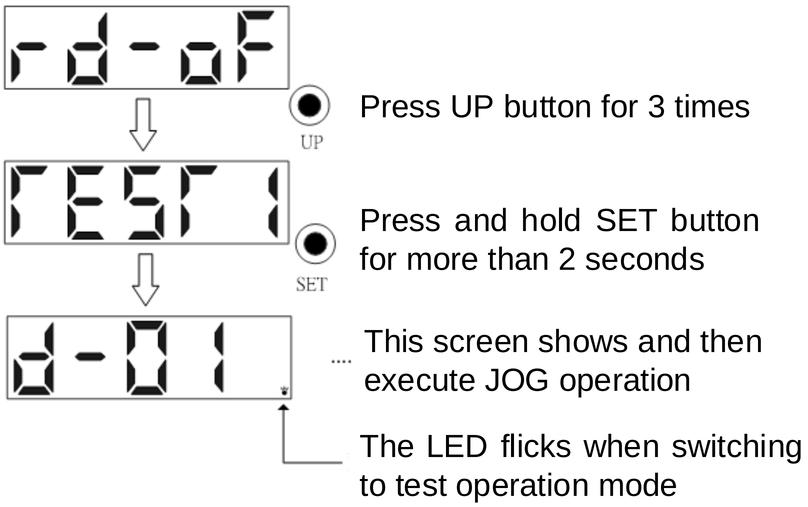
It indicates the display screen after power-on. You can switch to diagnostic mode by pressing MODE key.


Press UP button twice
UP
Press and hold SET button
for more than 2 seconds
SET
Turn ON/OFF the signal below the lighting segment.
This part is always ON.
It indicates output signal ON/OFF.
The content indicates the external I/O output signal are the same.
DO6
DO5
DO4
DO3
DO2
DO1
Press MODE button once
MODE
Move to the upper part of CN1-42 DO2
Press UP key once
UP
DO2 will be ON.
(CN1-42 and SG are conductive)
Press DOWN key once
DOWN
DO2 will be off
Press and hold SET button
for over 2 seconds
SET

4.6.3 JOG operation

- ★ JOG operation can be performed when no alarm or warning message occurs.
- ★ Ensure that SON-SG is open-circuited when testing.
- ★ Ensure that EMG, LSP, LSN are all on , and if CN1 has no external wiring, you can perform this function by using PD01.

Set JOG speed command by PC04, and set the acceleration time constant by PC01 and the deceleration time constant by PC02. Below picture shows the display screen after power-on. Please select JOG operation, test positioning operation, test estimation inertia analysis operation in following sequence and press the MODE button to show the diagnosis screen.



(1) Operation and Running.

To perform JOG operation, you should short the circuit between VDD and COM+ if internal power supply is used between EMG-SG.

Press and hold the UP/DOWN button to start the servo, and release it to stop. The setting is described in the following table:

Item	Setting value	Default value	Setting range
Rotation speed [r/min]	PC04	300	0~6000
Acceleration and deceleration time constant	PC01, PC02	200	0~20000

Note: the JOG speed setting value of the panel is set by PC04.

Button description is as follows:

Button	Content
“UP”	Press and hold UP button to run in CCW direction. Release it to stop.
“DOWN”	Press and hold DOWN button to run in CW direction. Release it to stop.

(2) Status display

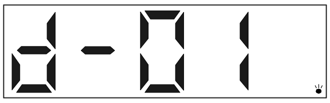
To verify the SERVO status during JOG operation.

When JOG operation is ready, if you press the MODE button, the status screen will be displayed. You can press UP/DOWN button to execute JOG. Pressing MODE button once will display the next screen and the screen will switch back to JOG operation screen after one cycle. Refer to section 4. 3 for status display details.

In JOG operation mode, the UP/Down button cannot change status display.

(3) JOG operation completion

During JOG operation, you can turn off the power once or press and hold the SET button in the test operation screen for more than 2 seconds to exit the JOG operation,



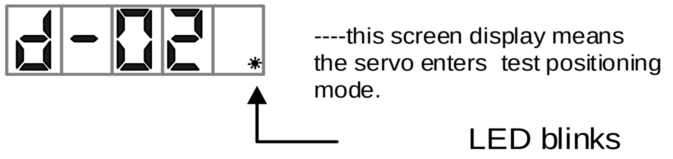
<u>Please refer to the description of step 3 in section 5.2.1 to understand how to use Shihlin servo PC software to operate the JOG function.</u>

4.6.4 Positioning test operation

- ★ Before using the positioning test operation, the servo should connect to the Shihlin communication software via RS-485 or USB.
- ★ Positioning test operation can be performed only when there is no external command and no alarm occurs.
- ★ Ensure SON is OFF during test.

★ The motor will stop suddenly if the communication cable falls off during operation.

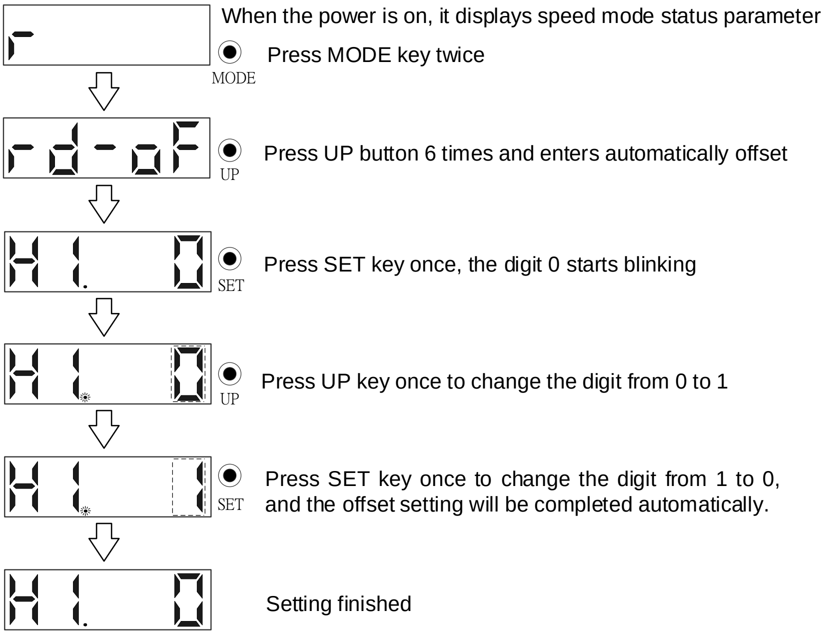
★ When the communication software enters the positioning test mode, the panel is showing the following figure:



Refer to section 5. 2. 2 for detailed positioning test operation instruction

4.6.5 Auto-offset of analog input

When the external analog speed command input is 0V, there may still have offset left which rotate the motor slowly. The user can enter the diagnostic mode and select the auto-offset of analog input function to automatically adjust the voltage offset. Please follow the following steps to operate:



📖 After the auto-offset setting is completed, the parameter automatically writes to PC26.

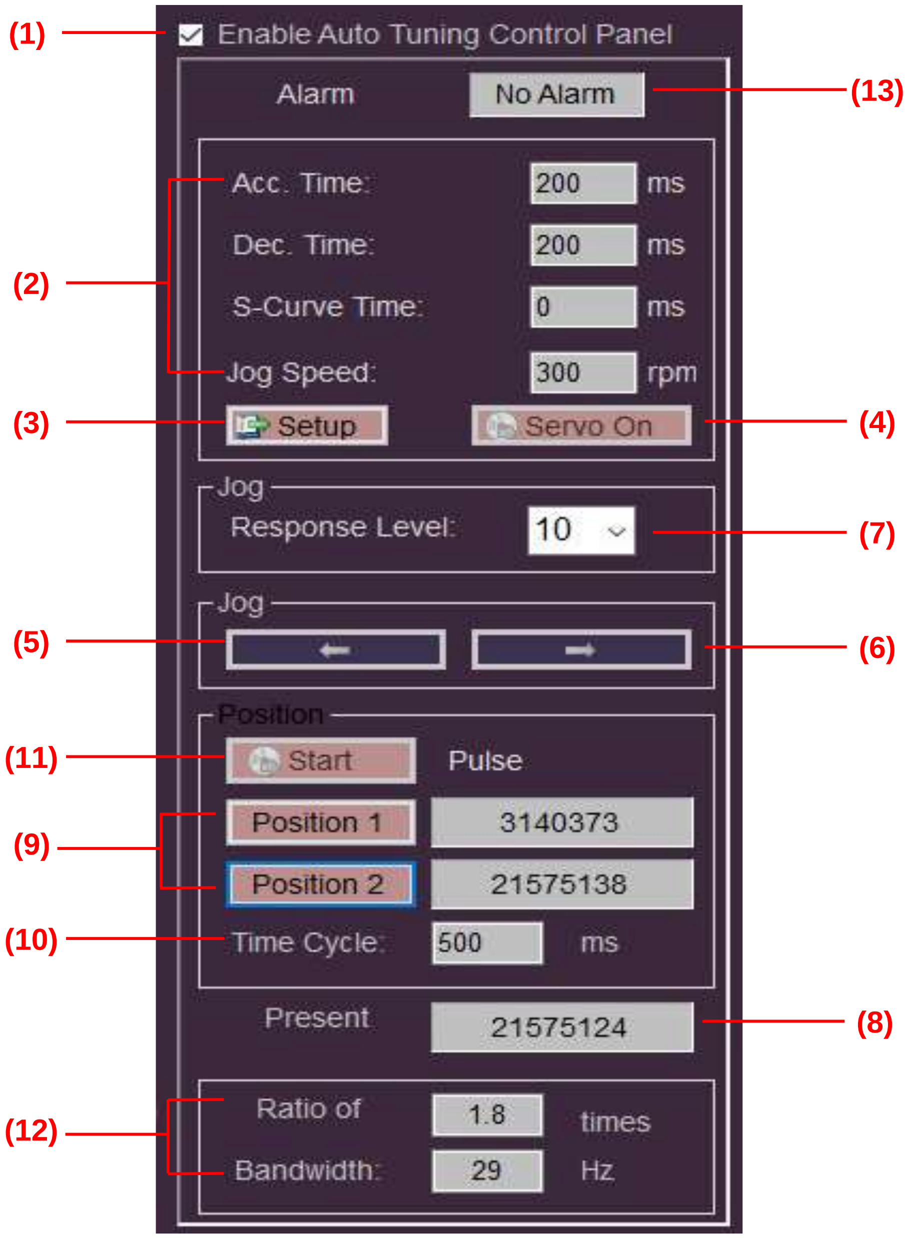
4.6.6 Inertia estimation and tuning by communication software

- ★ Before performing the positioning test operation, the servo must connect to the Shihlin communication software via RS-485 or USB.
- ★ Positioning test operation can be performed only when there is no external command and no alarm occurs.

Operation. Running

When using inertia estimation operation, ensure the motor is correctly wired and select Auto-gain adjustment function in Shihlin communication software.

The instruction for auto-gain adjustment function is as follows:



(1) Click [Enable Auto-gain Control Panel].

(2) Set speed acceleration time, deceleration time, S-curve acceleration and deceleration time and JOG speed.

(3) If no alarm occurs, Click [Setup] to write the setting value of step (2) to the drive.

(4) Click [Servo ON] and the servo motor will be ON.

(5) Press JOG ← button to rotate the motor reversely. Release it to stop the motor.

(6) Press JOG → button to rotate the motor forwardly. Release it to stop the motor.

(7) To perform the response setting. The larger the value, the stronger the gain, which has the same function as PA03.

(8) To show the current feedback position of the motor.

(9) To control the motor to run forwardly or reversely. After the motor reaches the first target position, press position 1 and then press JOG, Set position 2 when the motor is in the 2nd target position, and the software will record the 2 target position.

(10) The time interval is the static time after each positioning stops.

(11) After setting target position 1, target position 2, and time interval, Press [Start] (S) and motor runs between position 1&2 cyclically.

(12) After the motor runs a few operation cycles, the current “load inertia ratio” will be estimated and “bandwidth” value will be displayed.

(13) To display the current alarm status. If there is no alarm, it shows No Alarm, if there is an alarm, it shows the current alarm number.

- Caution

(a) During operation, you can directly set the response in the response setting menu if the response is not enough, but it is recommended not to set the response too large instantly, and it should increase gradually.

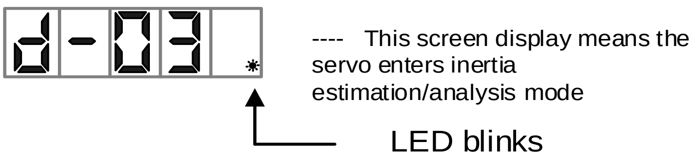
(b) To judge whether the load inertia ratio has reduced, or the machine features have satisfied the user’s requirement, you can press stop to complete the preliminary inertia estimation and gain adjustment.

(c) You can cancel the automatic gain control panel option or close the window form directly to exit. And the PC software will write the estimated load inertia ratio and response setting values to PB06 and PA03 respectively.

The servo will calculate the best gain value automatically after gain estimation. The following table is the estimation item.

Name	**Parameter abbreviation**	**Parameter code**	**Setting range**	**Unit**	**Default value**	**Control mode**
Resonance suppression low-pass filter	NLP	PB03	0~10000	0.1ms	10	Pt,Pr,S,T
Position feed-forward gain value	FFC	PB05	0~200	%	0	Pt,Pr
Servo motor load inertia ratio	GD1	PB06	0~1200	0.1time	70	Pt,Pr,S
Position loop gain	PG1	PB07	4~1024	rad/s	45	Pt,Pr
Speed loop gain	VG1	PB08	40~9000	rad/s	183	Pt,Pr,S
Speed integral gain value	VIC	PB09	1~1000	ms	34	Pt,Pr,S

★ When the communication software enters the inertia estimation and analysis mode, the panel will display the following figure:



4.7. Parameter mode

4.7.1 16 bit parameter setting instruction

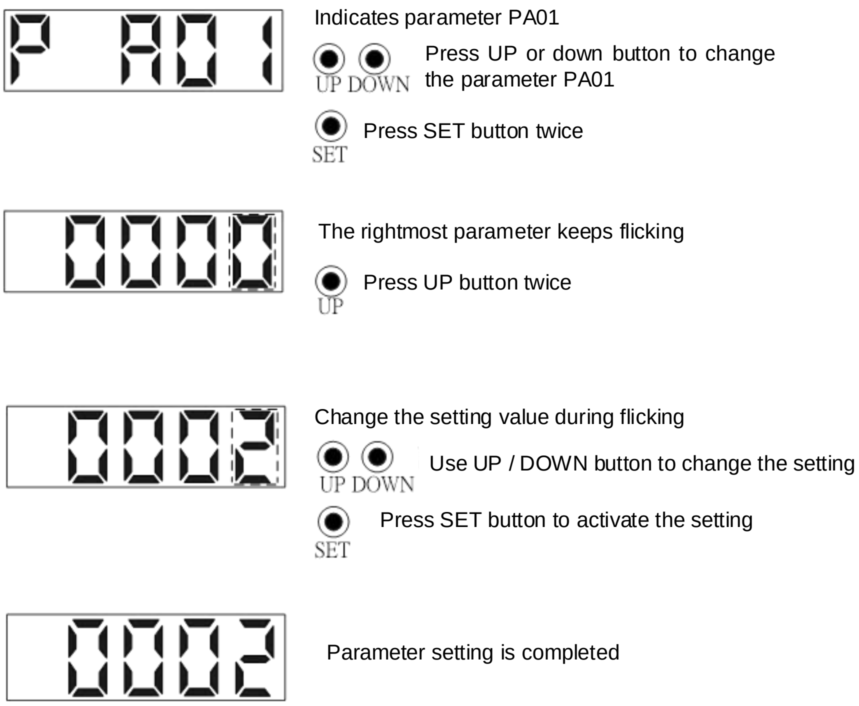
Some parameter changes become valid only after power cycling

(1) Operation instruction

The following is an example to illustrate the operation method after power cycling when the control mode (PA01) is changed to speed control mode.

Example 1: control mode(PA01)changes to speed control mode.

Press MODE button to switch to PA01 parameter.



Press UP/DOWN to move to next parameter.

When changing PA01, changed setting is activated only after power cycling.

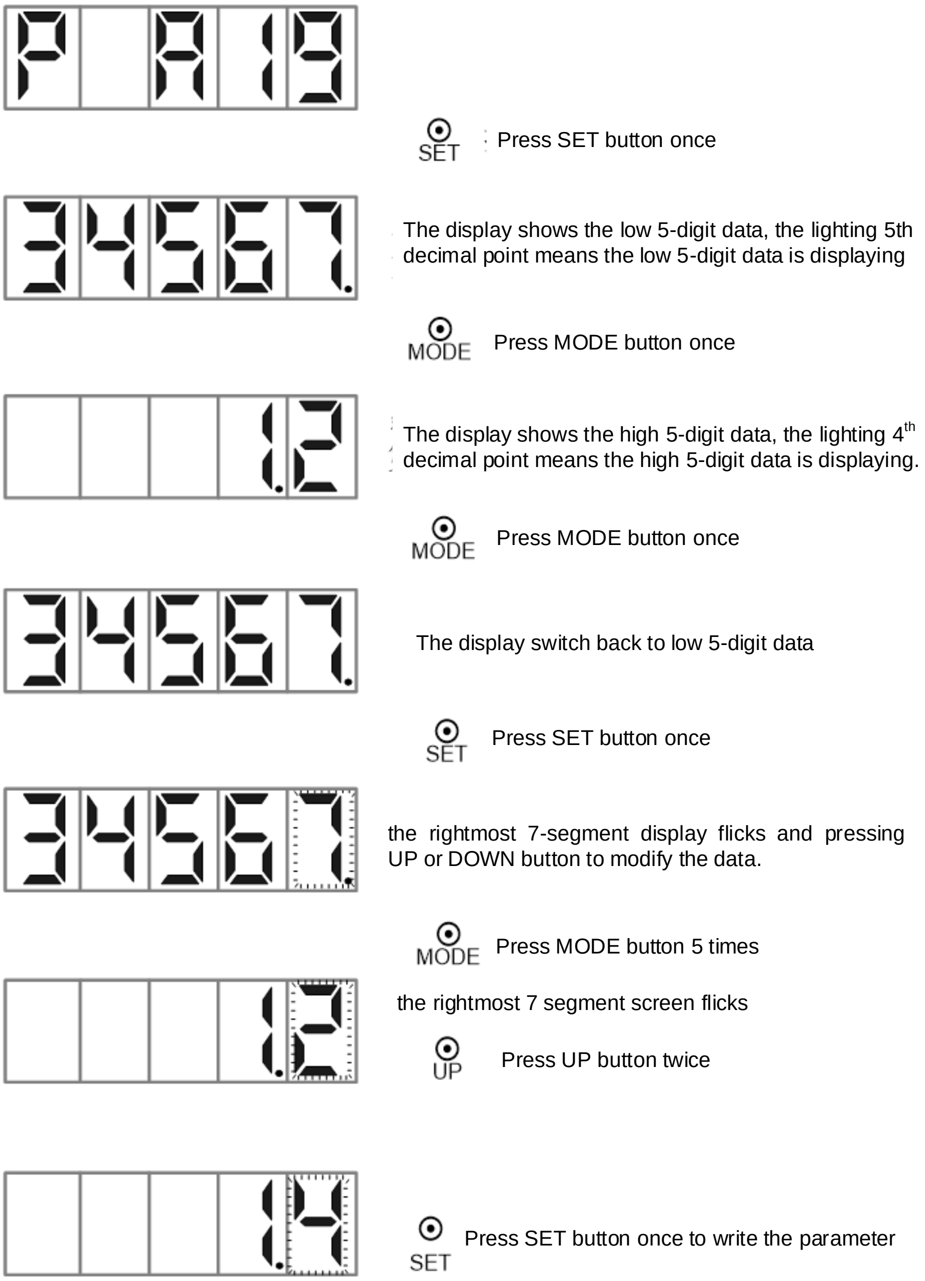
- The MODE key is use as shift function when setting the parameters.

Next section will introduce how to use the MODE, UP and DOWN buttons to operate.

4.7.2 32 bit parameter setting instruction

- <u>Decimal parameter reading and writing method (positive number)</u>

For example: PA19 = 1234567, you can follow below steps to change the parameter value to 1434567.



- <u>Decimal parameter reading and writing method (negative number)</u>

For example: PA19 = 1234567, you can follow below steps to change the parameter value to -1234567.

PA19 value is 1234567

SET Press SET button once

The display shows the low 5-digit data, and the lighting 5th decimal point means low 5-digit data is displaying

MODE Press MODE button once

The display shows the high-bit data, and the 4th decimal point LED means the high-bit data is displaying

SET Press SET button once

The rightmost 7-segment display flicks

MODE Press MODE button twice

SET Press SET button once

The high 5-digit data shows -12.

MODE Press MODE button once

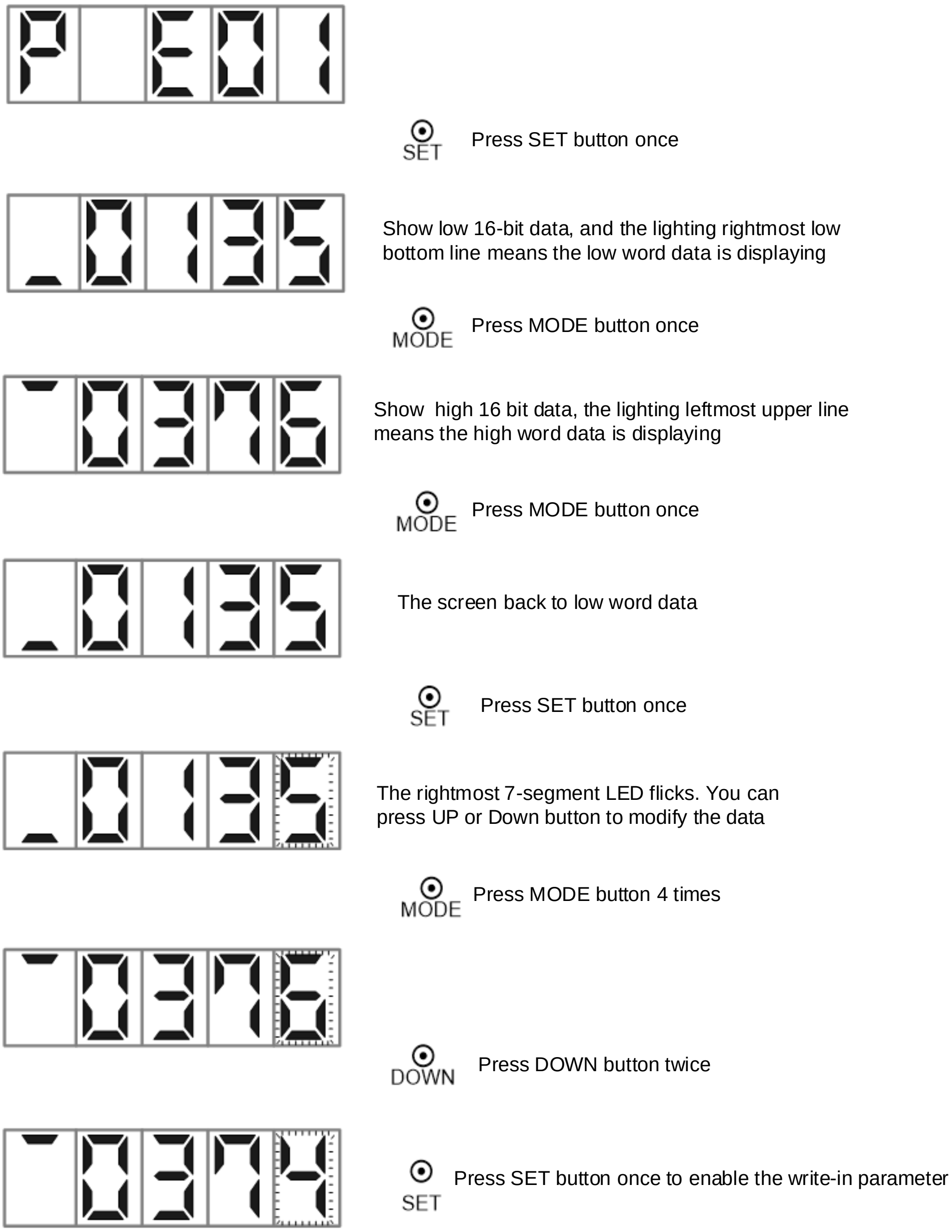
The low 5-digit data shows -34567, and the leftmost 2 decimal point indicates the negative sign.

UP Press UP button once

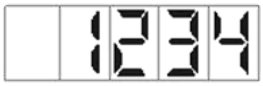
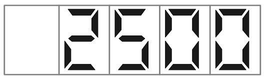
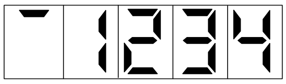
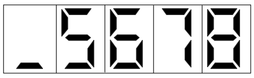
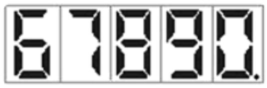
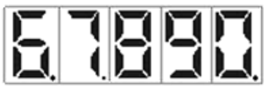
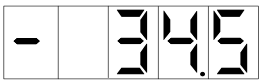
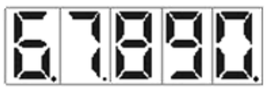
Back to PA group menu screen

- Hex parameter reading and writing method

For example, PE01 = 0x03760135, you can follow below steps to change the parameter value to 0x03740135



Example of parameter value display

Item	Description	Display in 7-segment LED display
16 bit data	**Hexadecimal display** if value is 0x1234, 1234 will be displayed.	 HEX
	Decimal positive number display if value is 2500, 2500 will be displayed.	 Positive DEC
	Decimal positive number display if value is -12566,1.2.5.6.6. will be displayed	 Negative DEC
32 bit data	**Hexadecimal display** if the value is 0x12345678, the high word shows 1234, and the low word shows 5678,	 HEX high word  HEX low word
	Decimal positive number display If the value is 1234567890, the high 5-digit shows 1234.5, and low 5-digit shows 67890.	 Positive DEC high 5-digit  Positive DEC low 5-digit
	Decimal negative number display method (1) if the data value is −1234567890, the high 5-digit shows 1.2.34.5 and the low 5-digit shows 6.7.890.	 Negative DEC high 5-digit  Negative DEC low 5-digit
	Decimal negative number display method (2) if the data value is −34567890, the high 5-digit shows -34.5, and the low 5-digit shows 6.7.890.	 Negative DEC high 5-digit  Negative DEC low 5-digit

Note1: Dec means decimal display, Hex means hexadecimal display.

Note 2: there is no sign in hexadecimal display.

4.7.3 Other precautions

(1). When the screen is in the PA~PL group, after holding the UP or DOWN button for 0.8 seconds, the panel display (PA XX) can quickly go up or down with 0.15s cycle time.

(2). When using the communication software to perform JOG, positioning test, and DO forced output functions, the panel screen should be displayed synchronously. If you have questions on this operation, you can use SDH to test.

5. Running operation

5.1. Check items Before Running

Check carefully on below listed items before the motor runs, this is to avoid unnecessary damage to the motor when applying power to servo motor.

- ◆ Check if the servo drive power terminals (R,S,T,L1,L2) wiring are correct.
- ◆ Servo motor power terminals (U,V,W) and servo drive U, V, W wiring phases must be consistent.
- ◆ Check if the ground terminal of the servo drive is correctly wired.
- ◆ Check if there is any conductive material or inflammable material inside or near the drive.
- ◆ Check if the voltage level of external power is correct.
- ◆ Check if the control switch is OFF.
- ◆ Do not put heavy staff on the drive or on its wiring.
- ◆ Use twisted cable for the regenerative resistor wiring.
- ◆ Check for any obvious visible damage.

DANGER	●Do not operate the switch with wet hands, otherwise it may cause electric shock.

CAUTION

●Check each parameter before running. Otherwise, there may be unexpected actions occurs.

●Do NOT touch the heat sink, regenerative resistor, servo motor and other components during running or soon after the power is turned off, because it may get hot and cause injury.

5.2. Test without load

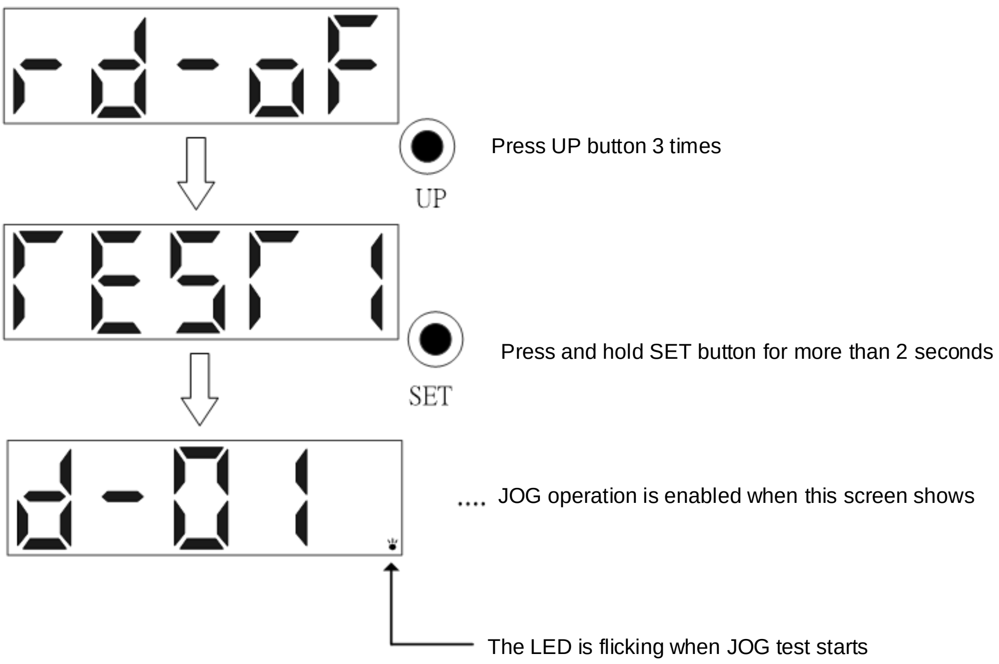
Before you perform test without load, first remove the load of the servo motor (including the unit, coupling on the shaft, accessories, etc.). After all the load is removed, first check if the motor can run normally by normal operation procedure. And then connect to all the load back.
The following introduces the motor test without load.

5.2.1. JOG test without load

- ★ JOG operation is available only when no alarm occurs.
- ★ Ensure that SON-SG is open-circuit (SON OFF) when testing.
- ★ Ensure that EMG, LSP, LSN are on , and if CN1 has no external wiring, you can perform this function by using PD01.

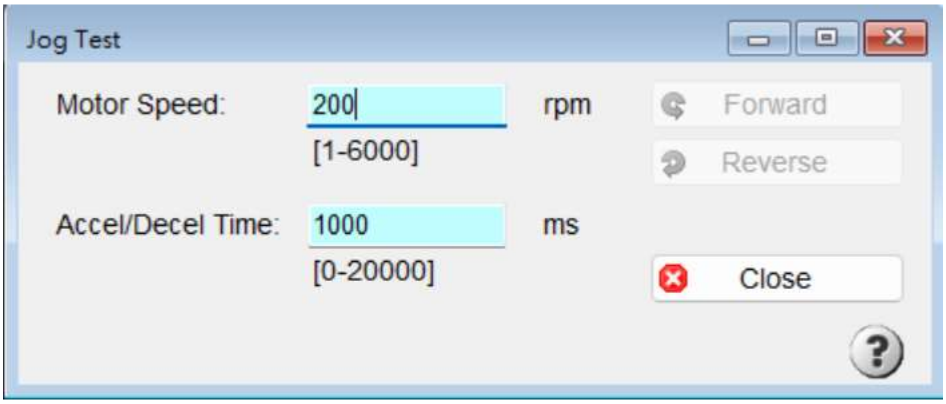
JOG without load can be performed by the panel or Shihlin communication software, it is to confirm whether the speed and direction of motor are as expected. You cannot modify the motor speed by the panel during JOG test, JOG test and its speed can only be modified by Shihlin communication software via RS-485 or USB transmission, and it is recommended to run JOG test at low speed. Below introduces JOG test of panel screen operation.

Step 1: connect servo drive and motor correctly, and then apply power to the servo drive.
Step 2: press the MODE button on the panel to enter the diagnosis screen, and then press the UP button 3 times to enter TEST1 (JOG mode). At this time, press and hold SET button for 2 seconds to switch to d-01. screen (JOG test operation).



Step 3: during JOG test, press the UP key to run the motor in CCW direction, and press DOWN key to run the motor in CW direction. Release the key to stop. and you can set PC04 to modify the JOG speed.

Note: when using Shihlin communication software to perform JOG test, the setting value and range are as follows:

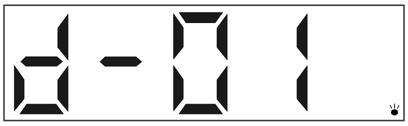


Precaution: when using the communication software for JOG test, if the communication cable is disconnected during operation, the servo motor will decelerate to stop.

The button operation description is as follows:

Button	Function
Forward	Press the button and runs the motor in CCW
Reverse	Press the button and runs the motor in CW
Close	To finish JOG test

Step 4: if the JOG operation is completed, turn off the power once or hold the SET button for more than 2 seconds in the test operation screen (d-01.) to exit the JOG operation mode.



5.2.2. Positioning Test without load

You should use Shihlin communication software which is connect by RS-485 or USB to do positioning test without load, which is to confirm whether the speed and direction of rotation are as expected, it is recommended to perform this operation at a low speed. You need set the number of revolutions and pulses for positioning test. For example, as the motor takes 22-bit pulse(that is 4194304 pulse) to rotate 1 circle, to set 10 and 1/2 circles, the pulse number setting should be 44040192 pulse. The following explains positioning operation:

Step 1: connect the servo drive and servo motor correctly, and then apply power to the servo drive.

Step 2: connect the computer and the CN4 of the servo drive with a standard Mini USB cable. Select the USB communication and its correct device number by Shihlin communication software.

Step 3: select Test/Positioning Test button on the top of the communication software and enter the positioning test screen.

Step 4: perform positioning test. You should set the number of revolutions and pulses firstly. Servo motor runs in the CCW direction to the target number of revolutions and pulses by pressing Forward button. and the servo motor runs in the CW direction to the target number by pressing Reverse button. The initial condition and setting range are as follows:

Description of buttons are as below:

Button	Content
"Forward"	Press it once, the motor will run in CCW direction until reaches target number of revolutions and pulses.
"Reverse"	Press it once, the motor will run in CW direction until reaches target number of revolutions and pulses. number.
Pause/clear	Press it once, the motor will stop temporarily if the motor does not reach the target number of revolutions and pulses. If you press the button again, the motor will run the remaining numbers of revolution and pulses. If you press the suspend button twice, the remaining number of revolution or pulse will be cleared.
Close	To finish positioning test

Step5: when positioning operation is finished, you can press the CLOSE button to exit.

5.3. Tuning procedure.

CAUTION	●Do not execute extremely adjustment and change on parameters, otherwise it may cause unstable action,

5.3.1. Tuning method and type

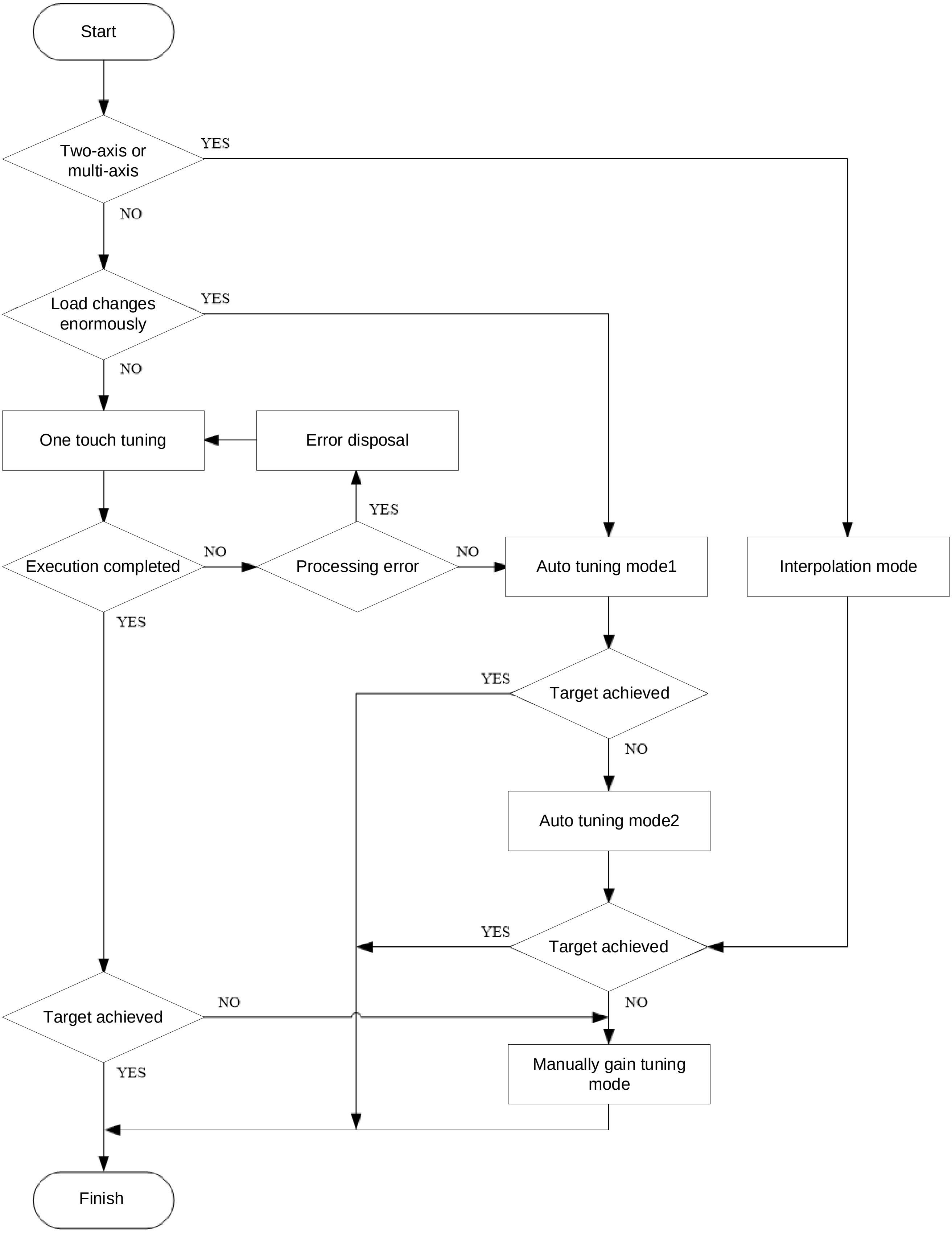
By the auto gain tuning function, the load inertia can be estimated quickly and accurately, and the appropriate servo gain under different loads can also be quickly searched. If the auto gain tuning mode cannot meet the target, manual tuning mode can be used.

The description of gain tuning mode are as follows:

Tuning mode	PA02 Parameter setting	Load inertia estimation method	Auto-estimate parameters	User-defined parameters
Manual gain tuning mode(PI control)	0000 0001	Fixed as value of PB06		GD1(PB06) PG1 (PB07) VG1 (PB08) VIC (PB09)
Auto- gain tuning mode 1	0002	Continuously estimation	GD1(PB 06) PG1 (PB07) VG1 (PB08) VIC (PB09)	ATUL(PA 03)
Auto-gain tuning mode 2	0003	Fixed as value of PB06	PG1 (PB07) VG1 (PB08) VIC (PB09)	ATUL(PA03) GD1(PB06)
Interpolation mode 1	0004	Continuously estimation	GD1(PB 06) VG1 (PB08) VIC (PB09)	ATUL(PA03) PG1 (PB07)
Interpolation mode 2	0005	Fixed as value of PB06	VG1 (PB08) VIC (PB09)	ATUL(PA03) GD1(PB06) PG1 (PB07)

★ PA02 cannot be written when SON-SG is short-circuited, you need make SON-SG open-circuited before setting.

Please refer to below recommended tuning procedure and mode.



If the servo is in first use after installation, a JOG test is required to confirm no abnormal issue before using the auto-tuning function.

When operating in auto-tuning mode, the servo needs to generate several acceleration/ deceleration commands. After the inertia ratio estimation is driven to a steady state, the inertia ratio estimation and the bandwidth searching can be performed.

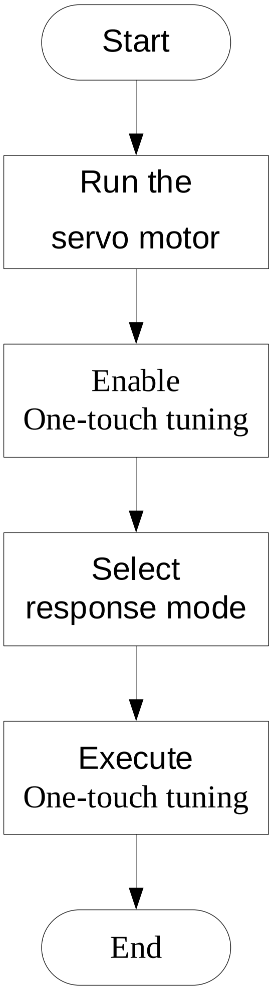
5.3.2. One-touch Tuning Function

You can use communication software or panel to perform one-touching tuning function. The relevant parameters which can automatically set by the one-touch tuning function are shown in the table below:

Parameter NO	Parameter abbreviation	parameter name
PA03	ATUL	Auto-tuning response level setting
PB01	NHF1	Frequency of machine resonance suppression filter 1
PB02	NHD1	Machine resonance suppression attenuation 1
PB03	NLP	Time constant of Resonance suppression low-pass filter
PB06	GD1	Servo motor Load inertia ratio
PB07	PG1	Position loop gain
PB08	VG1	Speed loop gain
PB09	VIC	Speed integral gain
PB21	NHF2	Frequency of Machine resonance suppression filter 2
PB22	NHD2	Machine resonance suppression attenuation 2
PB27	ANCF	Auto resonance suppression mode
PB28	ANCL	Resonance suppression detection level
PB29	AVSM	Auto low-frequency vibration suppression mode
PB30	VCL	Low-frequency vibration detection level
PB31	VSF1	Low-frequency vibration suppression frequency 1
PB32	VSG1	Low-frequency vibration suppression gain 1
PB33	VSF2	Low-frequency vibration suppression frequency 2
PB34	VSG2	Low-frequency vibration suppression gain 2
PB35	FRCL	Friction compensation level
PB36	FRCM	Friction compensation smoothing time constant
PB45	NHF4	Frequency of Machine resonance suppression filter 4
PB46	NHD4	Attenuation rate of Machine resonance suppression filter 4

5.3.2.1 One-touch tuning procedure

One-touch tuning have simple operation procedure, it provides two types of execution method. In addition, it can be performed only when the servo system runs normally.



Send control command by host or internally to run the servo motor. (if servo motor is off, the one touch tuning function is invalid)

There are 2 ways to operate:

1. Use the communication software one touch tuning function.
2. Panel operate(it will introduce in next section)

1. You can choose high response, middle response, and low response by communication software.
2. Select AUTO H, AUTO, AUTO L by up and down button in the display panel.

Communication software: press START to execute.

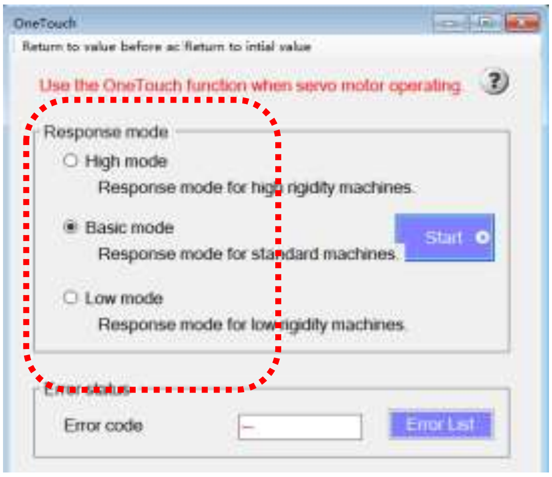
Panel: press SET button to execute.

And the motor must keep running during execution, when execution completed, the relevant parameters listed in previous section will be updated.

5.3.2.2 One-touch tuning display conversion and procedure

(a) Use communication software

(i) Three response modes can be selected in one-touch tuning window of the communication software.

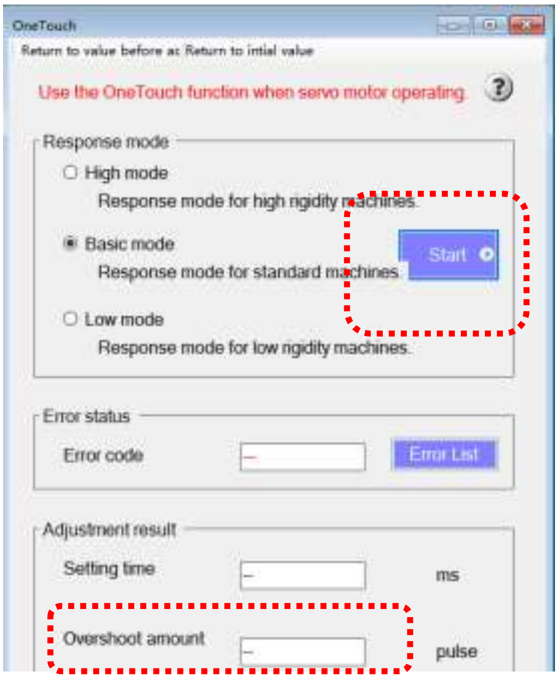


You can refer to below table for response mode selection.

Response mode	Description
High response	For high stiffness systems
Middle response	For general stiffness systems.
Low response	For low stiffness systems.

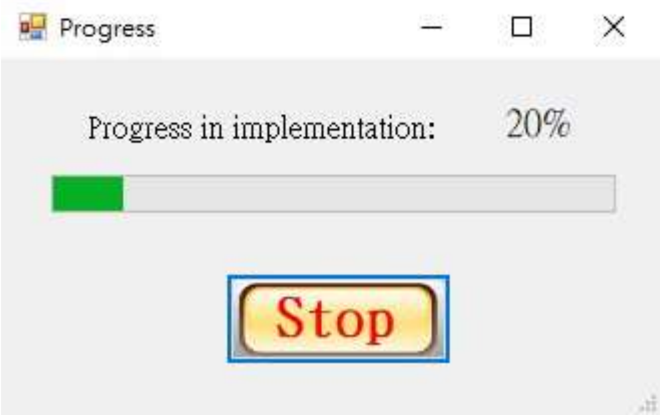
(ii)<u>One-touch tuning execution</u>

Select response mode and press START to execute.



If an error occurs, the error code will display on the error status window.

The execution progress will be displayed on the status window, and 100% means fully completed.

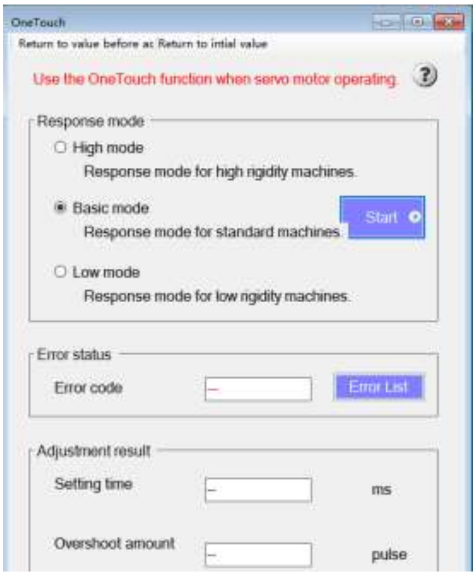


(iii)<u>Clear and reset</u>

There are two methods to clear and reset the tuning related parameters.

I: clear: the gain parameters reset to factory default setting.

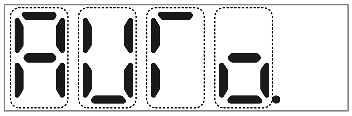
II: reset: the gain parameters reset to the setting value before one-touch tuning operation.



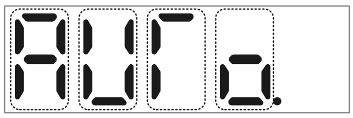
(b) Operate by servo panel

(i) There are 2 methods to enter one-touch tuning function by the panel.

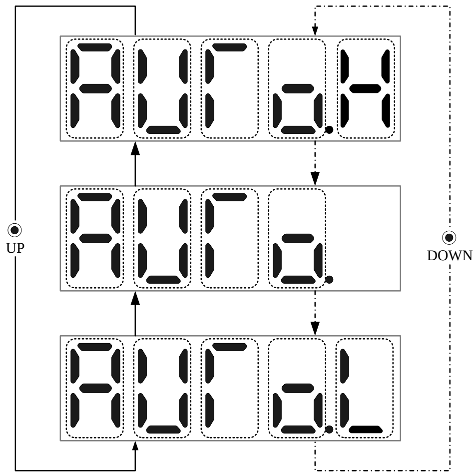
(i-1)Press MODE button to enter one-touch tuning screen(show AUTO), and after holding SET button for 2 seconds, the LED blinks as below:



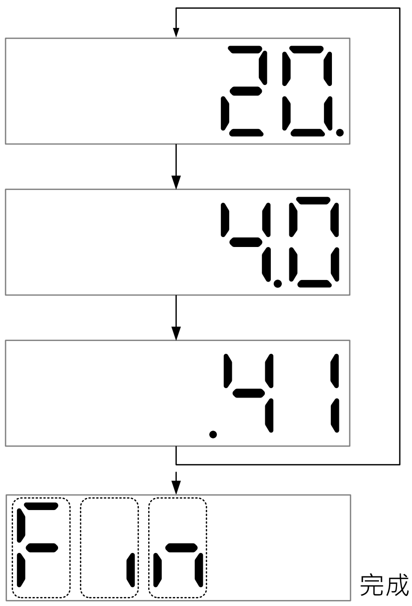
(i-2)In any screen, hold MODE and UP button at the same time for over 3 seconds to enter AUTO screen and LED blinks.



(ii)And then press UP or DOWN button to select one touch tuning response mode.

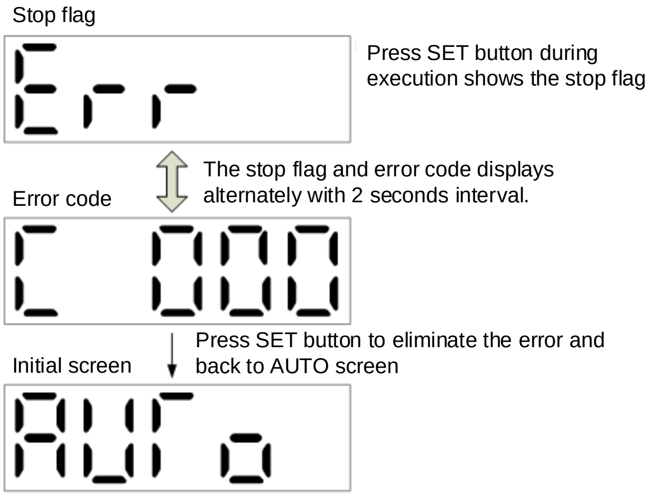


(iii) After selecting the response mode, press SET button to activate the one-touch tuning function and the execution progress shows on the screen.

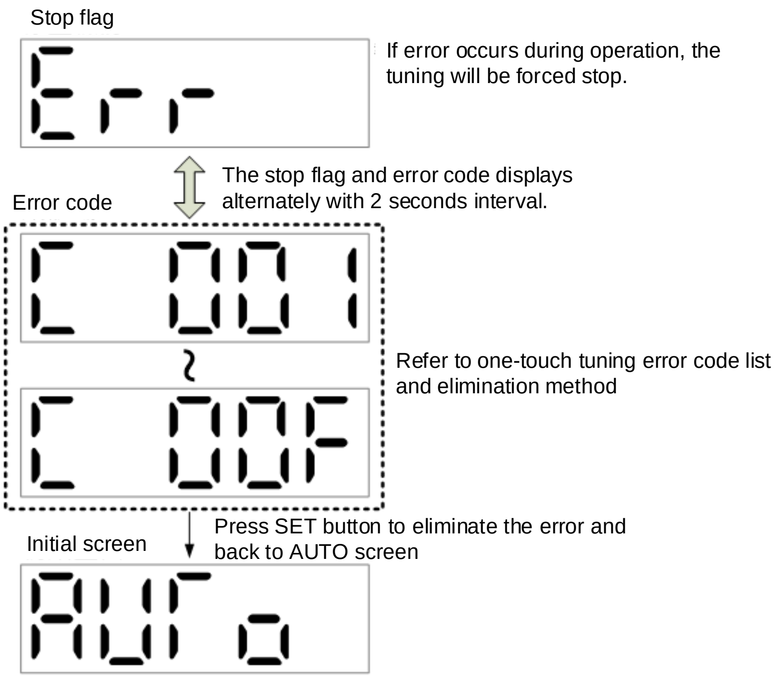


完成 Finish

(iv)You can press the SET button to stop the tuning, its panel screen and elimination procedure are as follows:



(v)If an error occurs during the tuning process, the panel screen and troubleshooting methods are as follows:

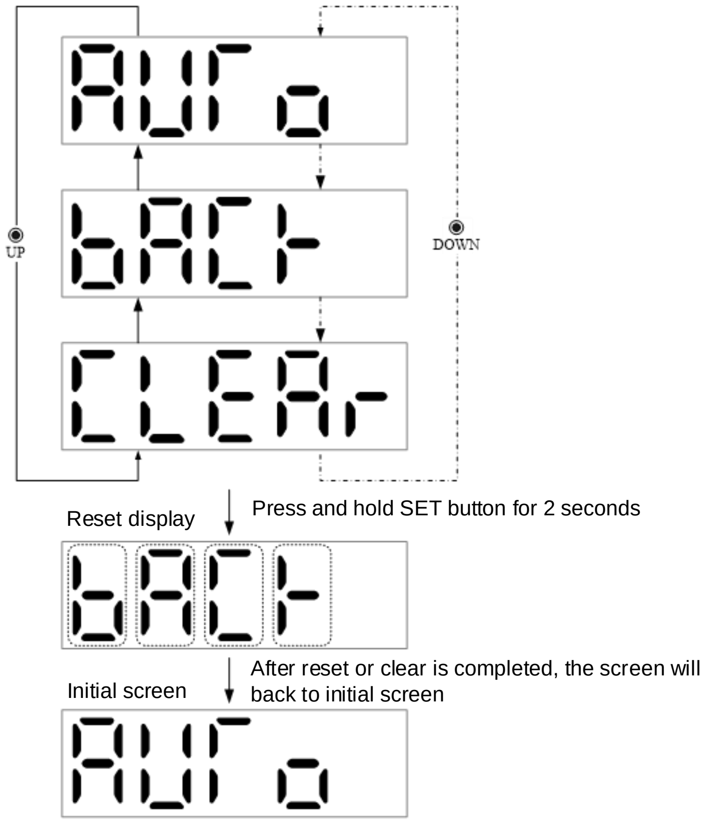


(vi)There are 2 modes to clear and reset one-touch tuning related parameters.

I: reset to default value (clear mode).

II: reset to the value before tuning (back mode).

Press MODE key to enter One-touch tuning screen (show AUTO) , and then you can press UP or DOWN button select clear mode or back mode, hold SET button for 2 seconds , the servo will execute the selected function and LED will blink for 3 seconds.


AUTo
bACK
CLEAr
UP
DOWN
Reset display
Press and hold SET button for 2 seconds
bACK
Initial screen
After reset or clear is completed, the screen will back to initial screen
AUTo

5.3.2.3 One-touch tuning error code list and solutions

Code	Error code	Description	Solution
C000	Cancellation during tuning	Press STOP or SET button.	
C001	Position overshot excess	Position overshot exceeds [PA12_INP] position attained range.	Increase [PA12_INP] setting value.
C002	SOV-OFF	Execute one-touch tuning when SON is off.	Execute one touch tuning when SON is on.
		Try to turn SON OFF during one-touch tuning.	Don't turn SON OFF during tuning.
C003	Control mode abnormal	Execute one-touch tuning in torque mode.	Switch to position or speed mode.
		Switch control modes during one-touch tuning.	Do not switch mode during tuning.
C004	Time out	Operation cycle period exceeds 30 seconds(count from current command starts to next command start)	Set the rotation cycle to more than 30 seconds.
		Motor speed is too low	The motor speed should be more than 100rpm.
		Operation interval is too short	Operation interval should be more than 500ms.
C005	Load inertia estimation abnormal	Load inertia estimation failure during one-touch tuning	The acceleration time from 0rpm to 2000rpm or the deceleration time from 2000rpm to 0rpm should be 2 seconds or less. If a 3000rpm case is applied, the acceleration and deceleration time should be 3 seconds or less. The speed command should be 250rpm or higher. The load inertia ratio should be 100 times or less. This tuning mode is not applicable to those occasions with enormous load and inertia ratio change. Acceleration or deceleration torque

			should be the 10% or more of rated torque.
		Load inertia estimation failure or inertia ratio change enormously due to resonance.	Adjust to semi-auto gain tuning mode, in which the motor will stop load inertia estimation, and then execute one-touch tuning again. Select [PA02_ATUM] Set[PB06_GD1] to manually set load inertia ratio.
C00F	One-touch tuning function invalid	In [PA38_AOP3] setting, the one-touch tuning function is disabled.	Set [PA38_AOP3]

5.3.3 Auto tuning function

The auto-tuning function can estimate the load inertia ratio for servo drive in real time, and automatically set the best gain (GAIN value) according to the estimated value and the operation conditions. By using the auto-tuning function, the gain tuning of the servo drive can be performed easily and quickly.

5.3.3.1Auto-tuning function

Auto-gain tuning mode 1

This mode is the factory default setting. If the servo is set to this function (PA02=0002), it will estimate the load inertia ratio continuously and set the servo gain value automatically. The only parameter that can be modified by the user is the response setting (PA03).

The related parameters and settings of this mode are as follows:

Parameter NO	**Parameter abbreviation**	**Parameter name**	**Modifiable or auto-estimated**
PA03	ATUL	Auto-tuning response level setting	Modifiable
PB06	GD1	Servo motor Load inertia ratio	Auto-estimate
PB07	PG1	Position loop gain	Auto-estimate
PB08	VG1	Speed loop gain	Auto-estimate
PB09	VIC	Speed integral gain	Auto-estimate

The following conditions is required if you set the servo to auto-gain tuning mode 1.

1.The acceleration time from 0rpm to 2000rpm or the deceleration time from 2000rpm to 0rpm should be 2 seconds or less. If a 3000rpm case is applied, the acceleration and deceleration time should be 3 seconds or less.

2.The speed command should be 250rpm or higher

3.The load inertia ratio should be 100 times or less.

4.This tuning mode is not applicable to those occasions with enormous load and inertia ratio change.

5.Acceleration or deceleration torque should be the 10% or more of rated torque.

Auto gain tuning mode 2

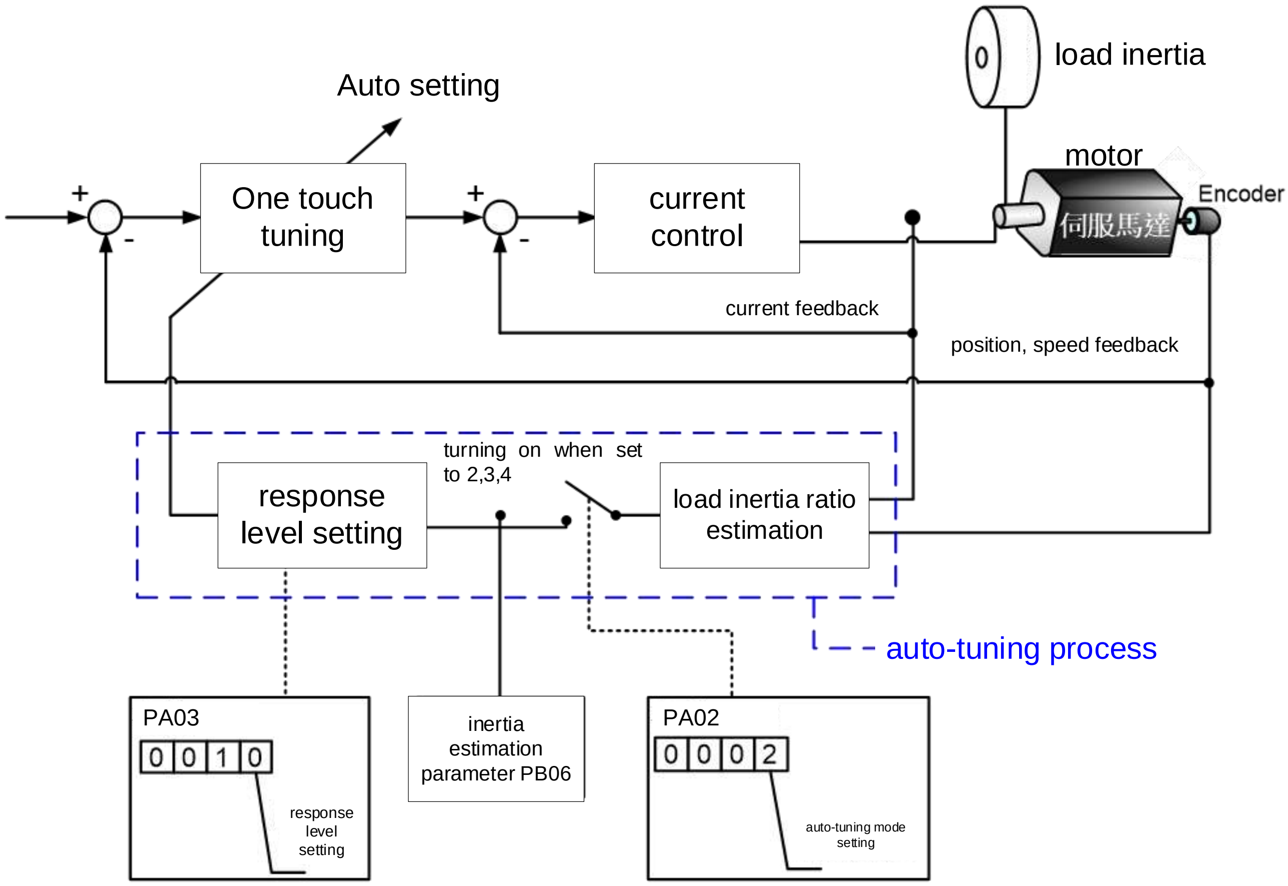
When automatic gain tuning mode 1 cannot estimate the inertia correctly, you can use auto-gain tuning mode 2. By setting PA02 to 0003 in this mode, the load inertia ratio will not be estimated automatically, you have to manually set PB06.

The related parameters setting are as follows:

Parameter NO	Parameter abbreviation	Parameter name	Modifiable or auto-estimated
PA03	ATUL	Auto-tuning response level setting	Modifiable
PB06	GD1	Servo motor Load inertia ratio	Modifiable
PB07	PG1	Position loop gain	Auto-estimate
PB08	VG1	Speed loop gain	Auto-estimate
PB09	VIC	Speed integral gain	Auto-estimate

5.3.3.2 Auto tuning procedure

When the user sets the servo to auto-tuning mode, the servo action is showing in the following block diagram.

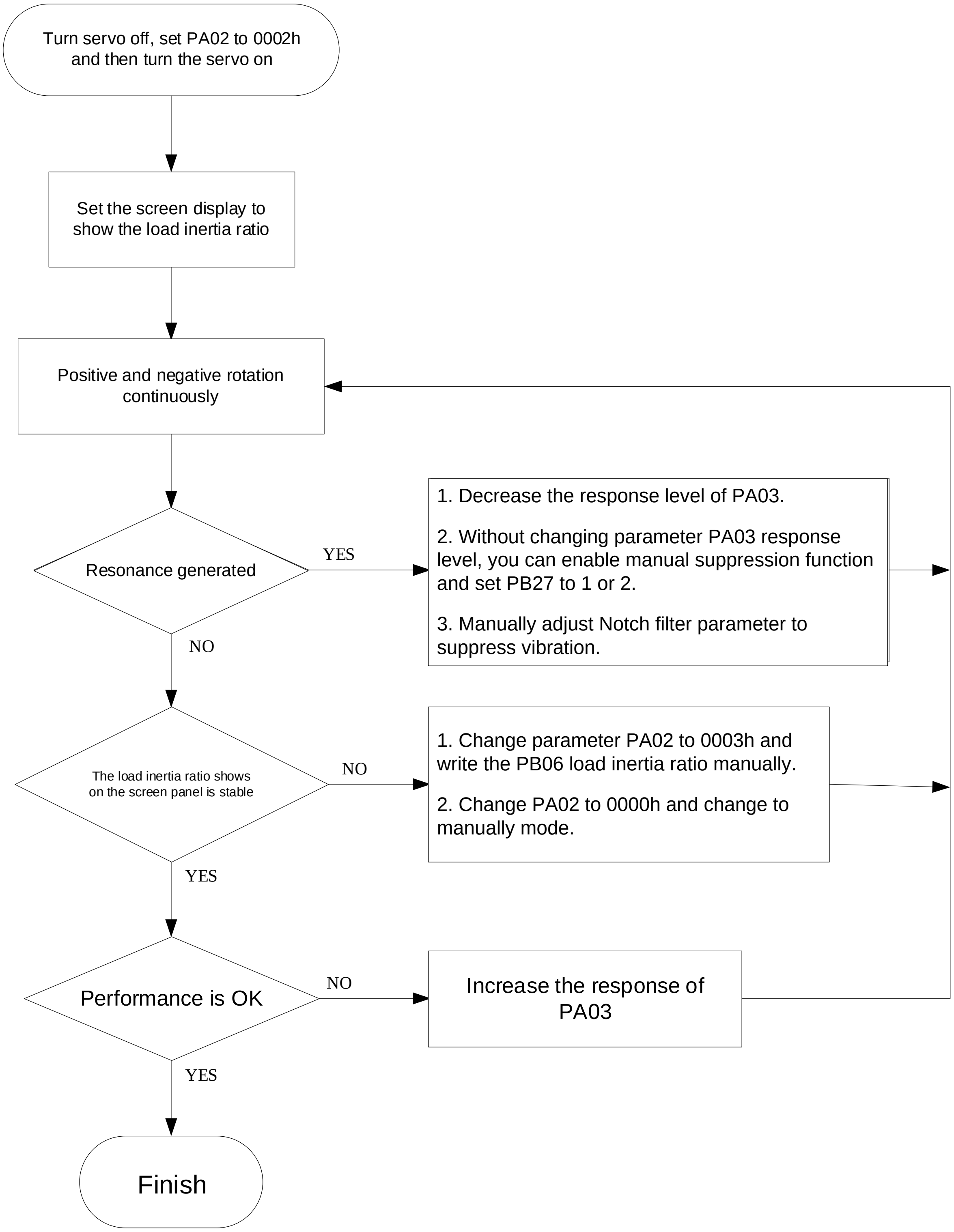


To complete the auto-gain tuning, the following are key points:

1. If the servo is sets to auto-gain tuning mode 1, you need accelerate and decelerate the motor first, and the inertia ratio will be estimated base on the current and speed of the motor, this value will update to PB06 and write into EEPROM(every 30 minutes).
2. If the user knows the load inertia ratio, or when the inertia ratio cannot be accurately estimated (when the inertia ratio changes drastically), you can set PA02 to auto gain tuning mode 2, and write the known inertia ratio into PB06 manually. During the time, the gain value will keep searching.

With the inertia ratio and response level setting, the servo drive will adjust to the best gain during acceleration and deceleration. The searched gain results will be written into the EEPROM every 30 minutes after power on. The current gain value saved in the EEPROM will be used as the initial value of the auto-gain tuning when power on.

Shihlin servo has set the auto gain tuning mode 1 as the factory default setting. Once the motor is accelerated and decelerated, the best controller gain will be automatically set. The user only needs to set the required response level to complete the entire process. The sequence is shown in below.

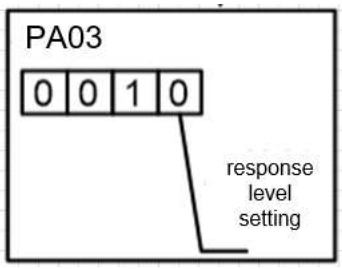


5.3.3.3 The response of auto tuning mode

PA03(response level setting) is for servo overall response level setting, and the response level will impact the entire system bandwidth. Increasing response setting will improve the command traceability and shorten the settling time. But if the response setting is too high, the system will vibrate. It’s recommended to set the response level within the non-vibrate range.

If the machine has resonated in the expected bandwidth, and yet the user wants to keep runs the servo in this bandwidth, The machine resonance suppression filter (PB01, PB02, PB21, PB22) and resonance suppression low-pass filter (PB03) can be used to suppress resonance, and sometimes response level can set to a higher level in this condition.

You can refer to section 6.3.6 for more information about machine resonance suppression filter and resonance suppression low-pass filter.



Response level	Machine rigidity	Speed response frequency (Hz)
1	Low response	10.0
2		11.3
3		12.7
4		14.3
5		16.1
6		18.1
7		20.4
8		23.0
9		25.9
10		29.2
11		32.9
12		37.0
13		41.7
14	Middle response	47.0
15		52.9
16		59.6

Response level	Machine rigidity	Speed response frequency (Hz)
17	Middle response	67.1
18		75.6
19		85.2
20		95.9
21		108.0
22		121.7
23		137.1
24		154.4
25		173.9
26		195.9
27		220.6
28		248.5
29		279.9
30		315.3
31	High response	355.1
32		400.0

For the response level setting, it is recommended to adjust response level from low to high gradually. If the default value is too high, it would very likely to cause resonance.

The applicable load inertia ratio is a reference data, and its applicable range varies with different systems.

5.3.4 Tuning in manual mode

If auto tuning function cannot meet the user's requirement, tuning in manual mode can be used to adjust gain parameters.

Manually tuning mode

In position and speed mode, the machine stiffness and the application will affect the selection of response bandwidth. Generally, for machines that require high precision, high response bandwidth is needed. However, increasing the response might cause mechanical resonance. Thus, machinery with higher stiffness is used to solve this problem.

When the allowable response bandwidth is unknown, you should set a smaller gain value first, and gradually increase the gain parameter values until the machine resonance occurs, and then decrease the gain value. The following are the user-defined gain parameter values of each control modes.

Name	Parameter abbreviation	Parameter code	Setting range	Unit	Default value	Control mode
Resonance suppression low-pass filter	NLP	PB03	0~10000	0.1ms	10	ALL
Position feed-forward gain	FFC	PB05	0~200	%	0	Pt, Pr
Servo motor load inertia ratio	GD1	PB06	0~1200	0.1 times	70	ALL
Position loop gain	PG1	PB07	4~1024	rad/s	45	Pt, Pr
Speed loop gain	VG1	PB08	40~9000	rad/s	183	ALL
Speed integral gain	VIC	PB09	1~1000	ms	34	ALL
Speed feed-forward gain	VFG	PB10	0~200	%	0	S, T

Position loop gain (PG1)

This parameter determines the response of the position loop. The bigger the PG1 value, the higher the response bandwidth of the position loop. It can decrease the following error and position error, and shorten the settling time. However, if you set the value too high, it may cause the machinery to vibrate or cause overshoot. The calculation of position loop gain is as follows:

$$PG1\ setting\ value \leq \frac{VG1\ setting\ value}{1 + ratio\ of\ load\ inertial\ to\ motor\ shaft} \times \frac{1}{4}$$

$$PG1\ setting\ value \approx speed\ loop\ bandwidth \times \frac{1}{4}$$

Speed loop gain(VG1)

This parameter determines the response of the speed control loop. The bigger the VG1 value, the higher the response bandwidth of the speed loop and the lower the following error. However, if you set the value too high, it may cause mechanical resonance. The response bandwidth of the speed loop must be 4 to 6 times higher than that of the position loop; otherwise, it may cause the machinery to vibrate or cause overshoot. The calculation of speed loop gain is as follows:

$$Speed\ loop\ response\ frequency(Hz) = \frac{VG1\ setting\ value}{(1 + ratio\ of\ load\ inertial\ to\ motor\ shaft) \times 2\pi}$$

Speed integral gain (VIC)

This parameter is to clear the fixed deviation of the corresponding command. The smaller the VIC, the better the elimination of the deviation. However, in the occasions of large load inertia and with machine vibrates, if you set the value too low, it may cause the machinery to resonate.

$$VIC\ setting\ value(ms) \geq \frac{3000\sim5000}{VG1\ setting\ value / (1 + GD1\ setting\ value \times 0.1)}$$

Low-pass filter for resonance suppression (NLP)

A high inertia ratio reduces the system response bandwidth. Therefore, you must increase the gain value to maintain the response bandwidth. However, Increasing the gain value might cause mechanical resonance. You can use this parameter to eliminate the noise from resonance. The higher the value, the better the capability for reducing high frequency noise. Increasing the setting will improve the high-frequency noise, but too large setting will cause instability of the entire system and increase the phase lag. The recommended setting value is to follow below calculation:

$$\text{NLP setting value(Hz)} = \frac{\text{VG1 setting value} * 10}{2\pi * (1 + \text{GD1 setting value} * 0.1)}$$

Position feed-forward gain (FFC)

This parameter can reduce the position error and shorten the settling time. However, if you set the value too high, it might cause overshoot in positioning when sudden acceleration or deceleration occurs. A large E-Gear ratio setting might cause noise as well.

Speed feed-forward gain (VFG)

This parameter can shorten the speed command following time. However, if you set the value too large, it might cause overshoot when sudden acceleration or deceleration occurs.

5.3.5 Interpolation mode

This mode is used to control two or more axis servo system, the controller gain parameter are still in the automatic tuning function, the main content is as follows:

Interpolation mode 1: only the position gain value (PB07) can be set manually. The remaining gain value (PB06, PB08, PB09) are automatically adjusted with PA03 settings.

Interpolation mode 2: the position gain (PB07) and load inertia ratio (PB06) can be adjusted manually, and the other gain value (PB08, PB09) are automatically adjusted with the setting of PA03.

5.4. Position mode parameter setting and operation

(1) Apply power to the servo drive

After applying power to the servo drive, please switch off the DI SON signal, the servo drive display shows “Servo Motor Rotation Speed “ 2 seconds later automatically.

(2) Test operation

Use JOG operation to check if the servo is running normally.

(3) Parameter setting

After wiring for position control mode, you need to set below parameters to perform basic positioning control function.

Parameter	Name	Setting value	Content
PA01(Note1)	Control mode option	□□□0	Position mode
PA02(Note2)	Auto tuning	0002	Auto gain mode 1
PA03	Auto-tuning response level setting	0012	Middle response
PA06	Electronic gear numerator	1	Set the numerator as 1
PA07	Electronic gear denominator	1	Set the denominator as 1
PA13	Command pulse option	Refer to section 8. 3 parameter description	
PD15(Note 1)	Digital input filter time	□□□2	Filter time constant is 4ms

Note 1: cycle the power to activate the parameter setting.

Note 2: the parameter cannot be set when SON-SG is short-circuited.

(4) Servo ON.

Below is the procedure to execute SERVO ON.

(a) Apply control power to servo motor.

(b) Turn on the servo on signal(SON) (SON-SG is short-circuited).

Servo is ready to run when SON is ON, and servo motor switches to SERVO LOCK immediately.

(c) When motor is stopped, AL.13 occurs if both LSP and LSN are OFF.

(5) Command pulse input

First run servo motor at low speed and input command pulse train after the rotation direction and speed is confirmed. PP and NP are pulse signal of forward/reverse rotation in open collector type. When differential type signals are applied, you should change the input signal circuit to PP-PG or NP-NG. Please set the auto-tuning function or manually input controller parameters and be careful about the mechanical resonance, you can adjust PA03 to achieve the best speed response.

(6) Homing

When performing homing, please confirm whether the direction and origin is correct, and execute the homing if necessary.

(7) Stop

You can follow below steps to stop the motor.

(a) When Servo ON signal (SON) is off

The PWM signal is disconnected and the servo will switch to a non-blocking free run state.

(b) When alarm occurs

When alarm occurs, the PWM signal is disconnected and the dynamic brake is activated to stop the servo motor immediately.

(c) When emergency stop(EMG) is OFF

The PWM signal is disconnected, and the dynamic brake is activated to stop the servo motor immediately. and the abnormal message are shown.

(d) When the LSP and LSN is off.

If LSP is ON, motor can rotate forwardly. If LSN is on, the motor can rotate reversely. If they are off, servo motor will stop immediately and servo is locked.

5.5. Speed mode parameter setting and operation

(1) Apply power to servo drive

After applying power to the servo drive, please switch off the DI SON signal, and then the servo drive display automatically shows “Servo Motor Rotation Speed” 2 seconds later.

(2) Test operation

Use JOG test to confirm if the servo is running normally.

(3) Parameter setting

After wiring for speed control mode, you need to set below parameters to perform basic speed control.

Parameter	Name	Setting value	Content
PA01(Note 1)	Control mode option	□□□2	Speed control mode
PC05	Internal speed command 1	1000	Set to 1000 rpm
PC06	Internal speed command 2	1500	Set to 1500 rpm
PC07	Internal speed command 3	2000	Set to 2000 rpm
PC01	Acceleration time constant	1000	Set to 1000ms
PC02	Deceleration time constant	500	Set to 500ms
PC03	S-curve acceleration/deceleration time constant	0	N/A
PD15(Note1)	Digital input filter time	□□□2	External terminal filter time constant is 4ms

Note 1: turn the power off and then turn on to activate the parameter setting.

(4) Servo ON

Below is the procedure to execute SERVO ON.

(a) Apply control power to servo motor.

(b) Turn on the SON signal (SON-SG is short-circuited).

Servo is ready to run when SON is ON, and servo motor switches to SERVO LOCK immediately.

(c)When motor is stopped, AL.13 occurs if either LSP or LSN is OFF.

(5) Start

Select the speed by SP1 or SP2 signal, and the options are as follows:

External input signal(Note)		Speed command
SP2	SP1	
0	0	Analog speed command(VC)
0	1	Inner speed command 1(PC05)
1	0	Inner speed command 2(PC06)
1	1	Inner speed command 3(PC07)

After selecting target speed, turning on operation command(ST1 or ST2)will rotate the motor. The instruction to run the motor forwardly and reversely are as follows:

(Note)External input rotation direction		**Rotation direction**
ST2	ST1	Internal speed command
0	0	Stop(servo locked)
0	1	CCW
1	0	CW
1	1	Stop(servo locked)

NOTE: 0: OFF(STx-SG is open-circuited)   1: ON(STx-SG is short-circuited)

First run the motor at low speed to check the rotation direction, check the input signal if needed. In status display panel, you can check the motor rotation speed, command pulse number, load rate and so on.

You can use auto-tuning function or manually set the controller parameter, and need to pay attention to avoid mechanical resonance, you can adjust PA03 to achieve the best response of speed control.

(6) Stop

You can follow below steps to stop the motor.

(a) When Servo ON signal (SON) is off
The PWM signal is disconnected and the servo will switch to a non-blocking free run state.

(b) When alarm occurs
When alarm occurs, the PWM signal is disconnected and the dynamic brake is activated to stop the servo motor immediately.

(c) When emergency stop(EMG) is OFF
The PWM signal is disconnected, and the dynamic brake is activated to stop the servo motor immediately. and the abnormal message are shown.

(d) When the LSP and LSN is off.
If LSP is ON, motor can rotate forwardly. If LSN is on, the motor can rotate reversely. If they are off, servo motor will stop immediately and servo is locked.

(e) When both ST1 and ST2 signal is on or off, the servo will decelerate to stop.

5.6. Torque mode parameter setting and operation

(1) Apply power to the servo drive

After applying power to the servo drive, please switch off the DI SON signal, the servo drive display shows “U(Torque command voltage)” 2 seconds later automatically.

(2) Test operation

Use JOG operation to confirm if the servo is running normally.

(3) Parameter setting

After wiring for torque control mode, you need to set below parameters to perform basic torque control and speed limit.

Parameter	Name	Setting value	Content
PA01(Note1)	Control mode option	□□□4	Torque control mode
PC05	Internal speed limit 1	1000	Set to 1000 rpm
PC06	Internal speed limit 2	1500	Set to 1500 rpm
PC07	Internal speed limit 3	2000	Set to 2000 rpm
PC01	Acceleration time constant	1000	Set to 1000ms
PC02	Deceleration time constant	500	Set to 500ms
PC03	S-curve acceleration/deceleration time constant	0	N/A
P15	Digital input filter time	□□□2	External terminal filter time constant is 4ms
PA05	Internal torque limit 1	50	Maximum torque 50% as a limit

(4) SERVO ON

Below is the procedure to perform SERVO ON.

(a)Apply control power to servo motor.

(b)Turn on the servo on signal(SON) (SON-SG is short-circuited).

Servo is ready to run when SON is ON, and servo motor will not be locked(SERVO LOCK).

(c) LSP and LSN function is invalid.

(5) Start

Use SP1 and SP2 to select speed limit value. When RS1 is ON, motor runs forwardly , when RS2 is on, the servo runs reversely, the torque is generated. You should run the motor at low speed in the beginning to check the rotation direction. Check the input signal if the direction is incorrect.

(6) STOP

You can follow below steps to stop the motor.

(a) When Servo ON signal (SON) is off

The PWM signal is disconnected and the servo will switch to a non-blocking free run state.

(b) When alarm occurs

When alarm occurs, the PWM signal is disconnected and the dynamic brake is activated to stop the servo motor immediately.

(c) When emergency stop(EMG) is OFF

The PWM signal is disconnected, and the dynamic brake is activated to stop the servo motor immediately, and the abnormal message are shown.

(d) When both RS1 and RS2 signal is on or off, the servo will be in free run status.

6. Control Function

6.1. Selecting the control mode

This servo drive provides four basic operation modes, Position(terminal input) mode, Position(internal register) mode, Speed mode, and Torque mode. You can choose either single mode or multi-mode. The following table lists all the modes and corresponding descriptions:

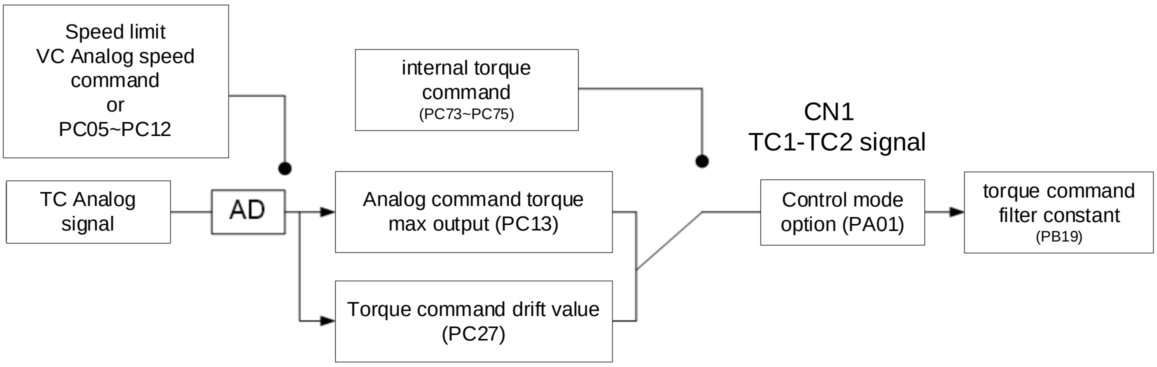
Mode		Code	PA01 setting	Description
Single mode	Position control (terminal input)	Pt	0000	Drive receives the external position pulse command which is input from terminal, and then runs the motor to reach the target position.
	Position control (inner register)	Pr	0010	The drive receives the position command which is provided by the internal register (63 groups of registers), and runs the motor to the target position. The DI signal can be used to select the register number.
	Speed control	S	0002	The drive receives the speed command and runs the motor to the target speed. The speed command can be selected by the DI signal(7 groups of register) to select analog voltage command or internal speed command.
	Torque control	T	0004	The drive receives torque command which is provided by analog voltage command and internal torque command, and runs the motor to the target torque.
Multi-mode	Position mode (terminal input) - Position mode (internal register)	Pt-Pr	0030	Pt/Pr is switched mutually via the signal of DI(LOP).

	Position mode (terminal input) - Position mode (internal register) - Speed mode	Pt-Pr-S	0031	Pt/Pr/S is switched mutually via the signal of DI(LOP).
	Position mode (terminal input) - Position mode (internal register) - Torque mode.	Pt-Pr-T	0035	Pt/Pr/T is switched mutually via the signal of DI(LOP).
	Position mode (terminal input) - Speed mode.	Pt-S	0001	Pt/S is switched mutually via the signal of DI(LOP).
	Position mode (terminal input) - Torque mode	Pt-T	0005	Pt/T is switched mutually via the signal of DI(LOP).
	Position mode (internal register) - Speed mode	Pr-S	0011	Pr/S is switched mutually via the signal of DI(LOP).
	Position mode (internal register) - Torque mode	Pr-T	0015	Pr/T is switched mutually via the signal of DI(LOP).
	Speed mode -Torque mode	S-T	0003	S/T is switched mutually via the signal of DI(LOP).

✦ After PA01 setting is changed, the setting is valid after power cycling.

6.2. Torque control mode

Torque control mode is usually used in the following torque control applications, such as winding machines, printing machines, injection molding machine, etc. Shihlin servo torque control has two kinds of command sources: analog input and internal register. The following figure shows the basic torque control structure:



First select torque control mode in mode option parameter, and then by signals of TC1 and TC2, you can choose command source between external analog voltage and internal register parameter.

6.2.1. Analog torque command

6.2.1.1 Torque command selection

Input torque command has 2 methods, one is the external input ±10V analog torque voltage command, another is to set 3 types of torque commands by internal parameters. It makes total 4 types of torque command.

Torque command code	(Note) Input signal		Torque command	Range	Related parameter
	TC2	TC1			
TCM	0	0	Analog torque command(TC)	±10V	PC 13
TC1	0	1	Inner torque command 1	-300~300	PC 75
TC2	1	0	Inner torque command 2	-300~300	PC 76
TC3	1	1	Inner torque command 3	-300~300	PC 77

Note 0: OFF(TCx-SG is open-circuited)   1: ON(TCx-SG is short-circuited)

6.2.1.2 Scaling of the analog torque command

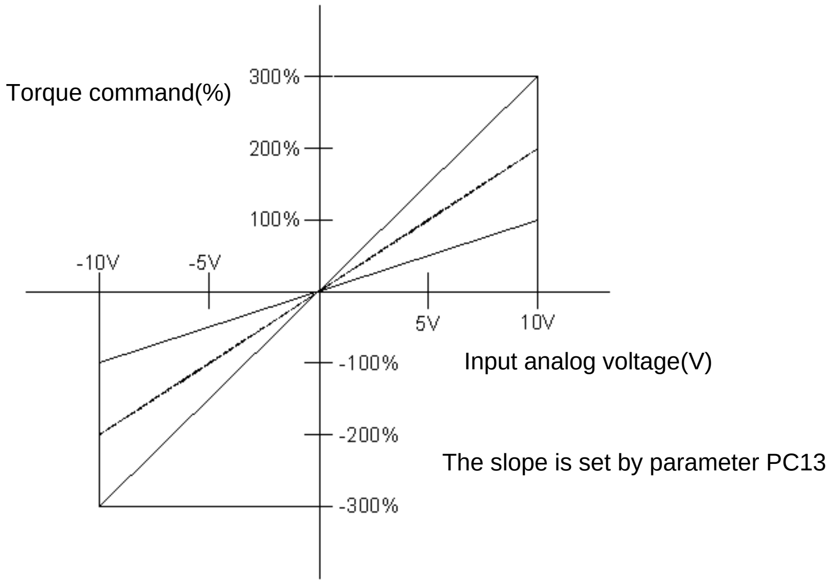
Scaling of the analog torque command is the maximum torque output of analog command, its content is as follows:

Name	Parameter code	Setting range	Unit	Default value	Control mode
Maximum torque output of analog command	PC13	0~2000	%	100	Pt, Pr, S, T

To set the analog torque command when the input voltage is in maximum(10V).

If you set PC13 to 100 and the external input voltage is 10V, the torque command is 100% of the maximum torque. If the input voltage is 5V, the torque command is 50% of the maximum torque, Its conversion relationship is as follows:

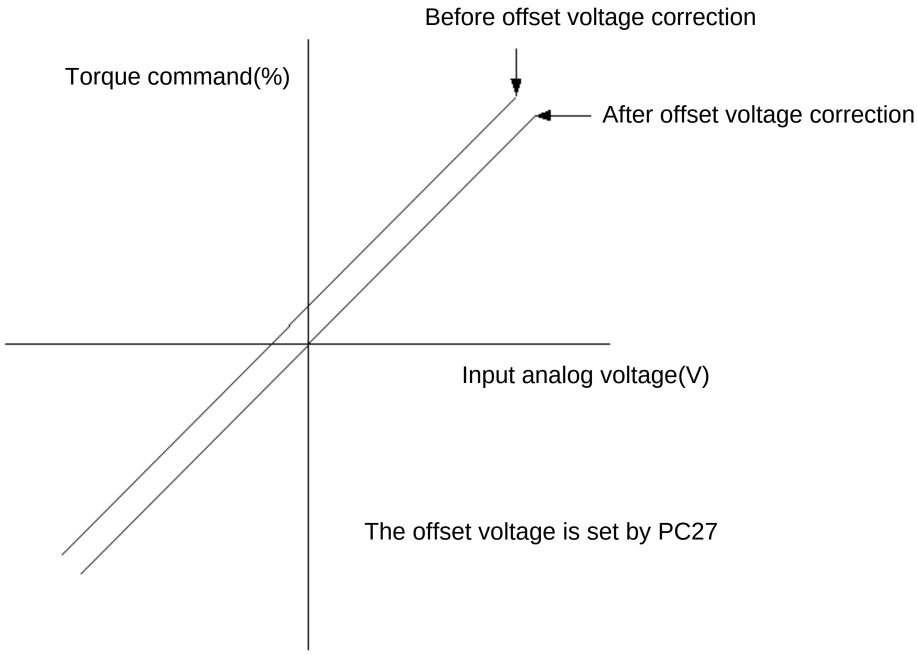
Torque command = input voltage value / 10 * parameter setting value



6.2.2. Offset adjustment of the analog torque command

When the analog torque command input is 0V, the motor may still rotate slowly, which is mainly because the external analog voltage may have some slightly voltage offset, it makes the input command voltage does not match the actual voltage. At this time, the offset voltage can be corrected by the PC27. The parameter content is shown in the below table:

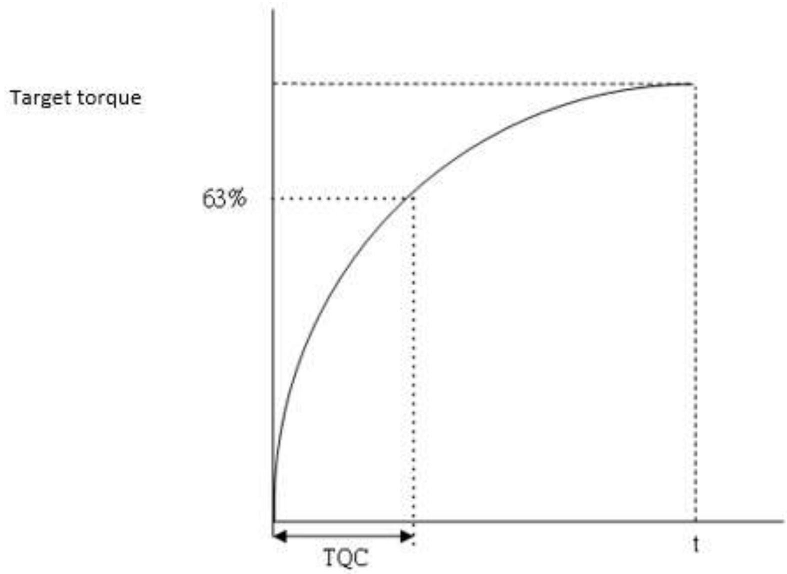
Name	Parameter code	Setting range	Unit	Default value	Control mode
Analog torque command/limited offset value	PC27	-8000~8000	mV	0	S, T



6.2.3. Torque command smoothing

This parameter is to set the filter time constant of torque command. With a proper filter time constant value, you can run the servo motor smoothly even if a sudden change occurs. The parameter description is as follows.

Name	Parameter code	Setting range	Unit	Default value	Control mode
Torque command filter time constant	PB19	0~5000	ms	0	T



6.2.4. Torque limit of torque control mode

When the torque control mode is performed, there are mainly 2 parameters to control the torque limit function. The description is as follows:

Name	Parameter abbreviation	Parameter code	Setting range	Unit	Default value	Control mode
Inner torque limit value 1	TL1	PA05	0~100	%	100	All
Inner torque limit value 2	TL2	PC25	0~100	%	100	All

For the TL1 signals of CN1. See the following table for more detail:

Name	Parameter abbreviation	Description	Control mode
Inner torque limit option	TL1	When this signal is used, you need set PD02~ PD09 or PD21~PD24 first. When TL1-SG is short-circuited, the inner torque limit 2 (PC25) will be activated.	All

Only when PD02~PD09 or PD21~PD24 is set to use internal torque limit option(TL1) signal, the internal torque limit 2 (PC25) can be selected, and there will be two options base on the status of DI TL1.

Digital input signal(Note)	Valid torque limit value
TL1	
0	PA05 setting
1	PC25 setting > PA05 setting => PA05 setting PC25 setting < PA05 setting => PC25 setting

Note 0: OFF(TL1-SG is open-circuited) 1: ON (TL1-SG is short-circuited)

6.2.5. The speed limit of torque mode

In torque control mode, the speed limit is selected by internal SP1,SP2,SP3 and external analog command. By counting all the internal and external analog limit, there are totally 8 types of speed limit options. The following table lists the speed limit options.

<table>
<tr><th rowspan="2">DI options</th><th rowspan="2">Speed limit code</th><th colspan="3">(Note) Input signal</th><th rowspan="2">Speed limit</th><th rowspan="2">Limit range</th><th rowspan="2">Related parameter</th></tr>
<tr><th colspan="2">SP2</th><th>SP1</th></tr>
<tr><td rowspan="4">Speed options when SP3 is invalid(default value)</td><td>VCM</td><td colspan="2">0</td><td>0</td><td>Analog speed limit(VC)</td><td>±10V</td><td>PC12</td></tr>
<tr><td>SC1</td><td colspan="2">0</td><td>1</td><td>Internal speed limit 1</td><td>-6000 ~ 6000</td><td>PC05</td></tr>
<tr><td>SC2</td><td colspan="2">1</td><td>0</td><td>Internal speed limit 2</td><td>-6000 ~ 6000</td><td>PC06</td></tr>
<tr><td>SC3</td><td colspan="2">1</td><td>1</td><td>Internal speed limit3</td><td>-6000 ~ 6000</td><td>PC07</td></tr>
<tr><td rowspan="9">SP3 is valid</td><th>Speed limit code</th><th>SP3</th><th>SP2</th><th>SP1</th><th>Speed limit</th><th>Range</th><th>Related parameter</th></tr>
<tr><td>VCM</td><td>0</td><td>0</td><td>0</td><td>Analog speed limit(VC)</td><td>±10V</td><td>PC12</td></tr>
<tr><td>SC1</td><td>0</td><td>0</td><td>1</td><td>Internal speed limit 1</td><td>-6000 ~ 6000</td><td>PC05</td></tr>
<tr><td>SC2</td><td>0</td><td>1</td><td>0</td><td>Internal speed limit 2</td><td>-6000 ~ 6000</td><td>PC06</td></tr>
<tr><td>SC3</td><td>0</td><td>1</td><td>1</td><td>Internal speed limit3</td><td>-6000 ~ 6000</td><td>PC07</td></tr>
<tr><td>SC4</td><td>1</td><td>0</td><td>0</td><td>Internal speed limit 4</td><td>-6000 ~ 6000</td><td>PC08</td></tr>
<tr><td>SC5</td><td>1</td><td>0</td><td>1</td><td>Internal speed limit 5</td><td>-6000 ~ 6000</td><td>PC09</td></tr>
<tr><td>SC6</td><td>1</td><td>1</td><td>0</td><td>Internal speed limit 6</td><td>-6000 ~ 6000</td><td>PC10</td></tr>
<tr><td>SC7</td><td>1</td><td>1</td><td>1</td><td>Internal speed limit 7</td><td>-6000 ~ 6000</td><td>PC11</td></tr>
</table>

Note 0: OFF(SPx-SG is open-circuited)   1: ON (SPx-SG is short-circuited)

- ◆ When the external input analog speed command is selected, please set the voltage to 0V, and set the value of PC12 which should not exceed the rated speed of the motor, otherwise it may cause damage to the motor and the mechanism.
- ◆ Before using SC4~SC7 function, make sure to enable the DI SP3 by PD02 ~PD09 setting or PD21~PD24.

The internal speed limit parameters description are as follows:

Name	Parameter code	Setting range	Unit	Default value	Control mode
Internal speed limit1	PC05	0~Instant permissible speed	rpm	100	T
Internal speed limit2	PC06	0~Instant permissible speed	rpm	500	T
Internal speed limit3	PC07	0~Instant permissible speed	rpm	1000	T
Internal speed limit4	PC08	0~Instant permissible speed	rpm	200	T
Internal speed limit5	PC09	0~Instant permissible speed	rpm	300	T
Internal speed limit6	PC10	0~Instant permissible speed	rpm	500	T
Internal speed limit7	PC11	0~Instant permissible speed	rpm	800	T

6.3. Speed control mode

Speed control mode is suitable for precise speed control applications, such as and CNC machines, drilling machine, etc. There are two types of command sources: (1) analog input, (2) internal register.

The analog command controls the motor speed by external voltage input.

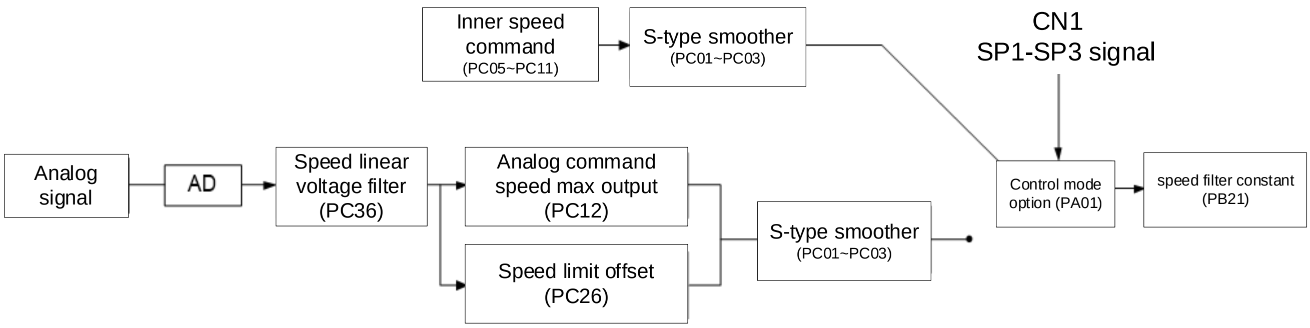
The register input controls the speed in two methods.

The first method is to manually set the 7 different required speeds in the 7 command registers (PC05~PC11) before starting the operation, and then switch DI of SP1, SP2, SP3 of CN1.

The second method is to changes the value in the register through communication software with RS485 or USB.

To deal with the problem of non-continuous speed when switching registers, you can use the S-curve function, thus the motor can keep running smoothly when switching to different speed. In a closed-loop system, the servo drive uses gain adjustment and the accumulative integrated PI controller. And it also provides two operation modes (manual and automatic).

In manual mode, you can set all the parameters, so all the auto or auxiliary functions are disabled. In auto gain adjustment modes, the servo drive performs load inertia estimation and provides parameter adjustment function. In this case, the parameter setting values are regarded as the initial values. This simple mode provides a robust system function for the user, which is different from the adaptability rule that requires a longer learning time in the automatic operation mode. Simple operation mode can suppress external load interference and mechanism resonance in real time, and tolerate load inertia change.



The upper part of the graph is the internal speed command, which controls the speed command by manually input parameter and switches by terminal DI. The lower part of the graph is the external analog input ±10V voltage. After processing by A/D, it calculates the set analog command max output(scaling) and voltage offset value and then outputs to the next part.

It is recommended that the user use S-curve smoother and low-pass filter when operating in the speed mode, which can effectively suppress the irregularity of the motor during operation.

6.3.1. Selecting the Speed command

There are two methods to input speed command, the first one is to set 7 speed commands by internal parameters. Another is the external input ±10V analog voltage command, It makes totally 8 types of speed command options.

DI options	Speed command code	(Note) Input signal SP2	(Note) Input signal SP1	Speed command	Limit range	Related parameter
Speed options when SP3 is invalid(Initial status)	VCM	0	0	Analog speed command(VC)	±10V	PC12
	SC1	0	1	Internal speed command 1	-6000 ~ 6000	PC05
	SC2	1	0	Internal speed command 2	-6000 ~ 6000	PC06
	SC3	1	1	Internal speed command 3	-6000 ~ 6000	PC07

DI options	Speed command code	SP3	SP2	SP1	Speed limit	Range	Related parameter
SP3 is valid	VCM	0	0	0	Analog speed command(VC)	±10V	PC12
	SC1	0	0	1	Internal speed command 1	-6000 ~ 6000	PC05
	SC2	0	1	0	Internal speed command 2	-6000 ~ 6000	PC06
	SC3	0	1	1	Internal speed command 3	-6000 ~ 6000	PC07
	SC4	1	0	0	Internal speed command 4	-6000 ~ 6000	PC08
	SC5	1	0	1	Internal speed command 5	-6000 ~ 6000	PC09
	SC6	1	1	0	Internal speed command 6	-6000 ~ 6000	PC10
	SC7	1	1	1	Internal speed command 7	-6000 ~ 6000	PC11

(Note) 0: OFF(SCx-SG is open-circuited)　1: ON (SCx-SG is short-circuited)

- When the external input analog speed command is selected, please set the voltage to 0V, and set the value of PC12 which should not exceed the rated speed of the motor, otherwise it may cause damage to the motor and the mechanism.
- Before using SC4~SC7 function, you should enable DI SP3 contact by PD02~PD09 or PD21~PD24 setting.

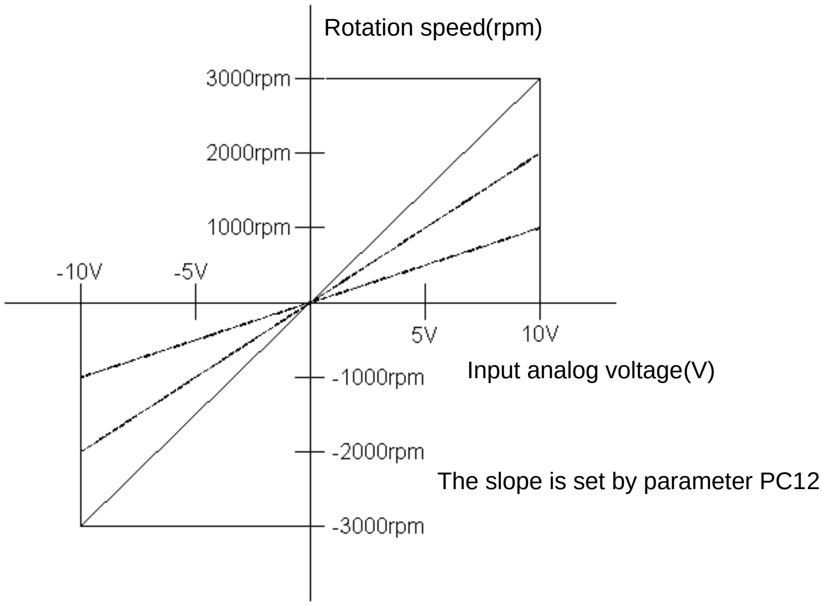
6.3.2. Scaling of the analog speed command

Scaling of the analog speed command is the maximum speed of analog command, its content is as follows:

Name	Parameter code	Setting range	Unit	Default value	Control mode
Maximum speed of analog command	PC12	0 ~30000	rpm	3000	S, T

To set the speed of the analog speed command when the input voltage is in maximum(10V).If you set PC12 to 3000 and the input voltage is 10V, the servo motor speed is 3000rpm. If the input voltage is 5V, the servo motor speed is 1500rpm, Its calculation is as follows:

Speed command = Parameter setting value* input voltage value / 10



6.3.3. Smooth Speed command

If the motor input command changes abruptly, it might cause motor vibrate and noise, or may even cause overshoot. Shihlin servo provides three smooth operation parameters to suppress the negative influence caused by sudden change of the input command. First of all, the speed acceleration time constant can adjust the slope of the change in acceleration, the speed deceleration time constant can adjust the slope of the change in deceleration, and the S-curve acceleration and deceleration time constant can improve the motor stability when starts and stops.

Name	Parameter abbreviation	Parameter code	Setting range	Unit	Default value	Control mode
Acceleration time constant	STA	PC01	0~20000	ms	200	S, T
Deceleration time constant	STB	PC02	0~20000	ms	200	S, T
S-curve acc. /dec. time constant	STC	PC03	0~10000	ms	0	Pr, S, T

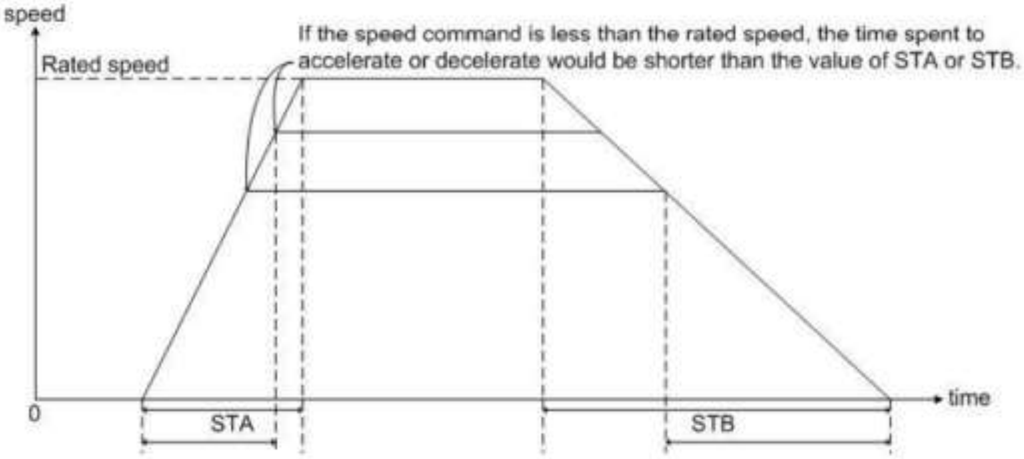
The description of the 3 parameters are as follows:

Speed acceleration time constant:

This parameter is the acceleration time when the motor speed changes from 0 rpm to the rated motor speed, which is set as the acceleration time constant. For example, the rated speed of the servo motor is 3000 rpm, and this parameter is set to 3000 (3s). so the time for the motor to accelerate from 0 rpm to 3000 rpm is 3 seconds. When the speed command is set to 1000 rpm, it takes 1 second for the motor to change from 0 rpm to 1000 rpm.

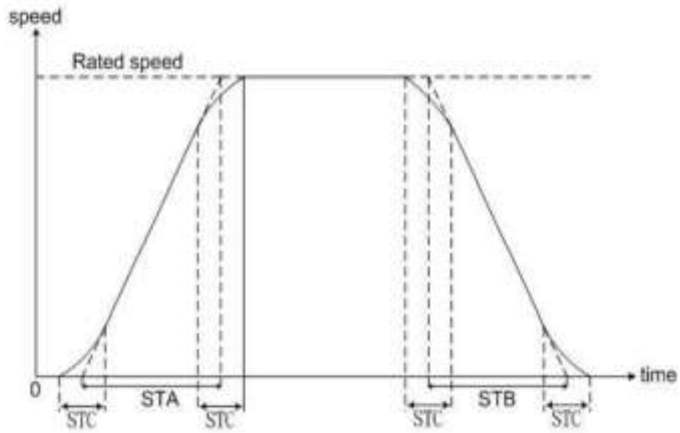
Speed deceleration time constant:

When the motor speed is decelerated from the rated speed to 0 rpm, the required deceleration time is the deceleration time constant. For example, the servo motor runs at 3000 rpm, this parameter is set to 3000(3s), then the time for the motor to decelerate from 3000 rpm to 0rpm is 3 seconds. When the motor is running at 1000 rpm, it takes 1 second to decelerate from 1000 rpm to 0 rpm.



S-curve acc. / dec. time constant:

The S-curve acceleration and deceleration constant is use three-stage acceleration and deceleration curve to smooth the motor when it starts and stops. Proper setting of STC helps to stabilize the motor operation when starting and stopping. The initial S-curve acceleration and deceleration constant is 0 second. It's recommended to enable this function before using speed mode.

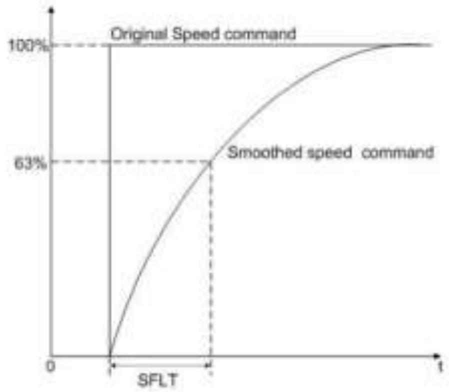


- ◆ The above parameters will have acceleration and deceleration protection functions in either internal speed state or the analog input state.
- ◆ Parameters STA, STB, STC can be set independently. Even if STC is 0, a trapezoidal acceleration and deceleration is still available.

Speed command low-pass smooth filter time constant :

Name	Parameter abbreviation	Parameter code	Setting range	Unit	Default value	Control mode
Speed command low-pass smooth filter time constant	SFLT	PB18	0~1000	ms	0	S, T

Increasing this parameter value will improve smoothness of command curve, and it will decrease the response. If it is set to 0, it means that this function is disabled.



6.3.4. Torque limit of speed control mode

When using the speed mode, the main parameters related to the torque limit are PA05 and PC25. The table below shows these two parameters:

Name	Parameter abbreviation	Parameter code	Setting range	Unit	Default value	Control mode
Internal torque limit value 1	TL1	PA05	0~100	%	100	Pt, Pr, S, T
Internal torque limit value 2	TL2	PC25	0~100	%	100	Pt, Pr, S, T

There are 3 input terminals in CN1, including one analog voltage signal input terminal and two digital input, which are explained in the following table:

Name	Parameter abbreviation	Description	Control mode
Analog torque limit	TLA	To use this signal in speed control mode, you should enable TL by PD02~PD09 or PD21~PD24 setting. When TLA is valid, the torque of the servo motor is limited in the entire system. Please apply a voltage of DC0~10V to TLA-LG circuit. TLA is connected to the positive polarity of power and the maximum torque will be generated at +10V.	Pt,Pr,S
Torque control option	TL	When this signal is used, you should activate PD02~PD09 or PD21~PD24 first. The internal torque limit 1 (PA05) is valid when TL-SG is open, and the analog torque limit (TLA) is valid when TL-SG is short-circuite.	Pt,Pr,S
Internal torque limit option	TL1	When this signal is used, you should activate PD02~PD09 or PD21~PD24 first. The internal torque limit 2 (PC25) is valid when TL1-SG is short.	Pt,Pr,S,T

Only when set the PD02~PD09 parameter to enable TL1, internal torque limit 2(PC25) is valid. There are 4 combinations which are decided by the DI of TL and TL1.

The usage of torque limit value (TL), inner torque limit option (TL1) and analog torque limit (TLA) are shown in the table below:

(Note) DI signal		Valid torque limit value
TL1	TL	
0	0	PA05 setting
0	1	TLA > PA05 setting => PA05 setting TLA < PA05 setting => TLA
1	0	PC25 setting > PA05 setting => PA05 setting PC25 setting < PA05 setting => PC25 setting
1	1	TLA > PC25 setting => PC25 setting TLA < PC25 setting => TLA

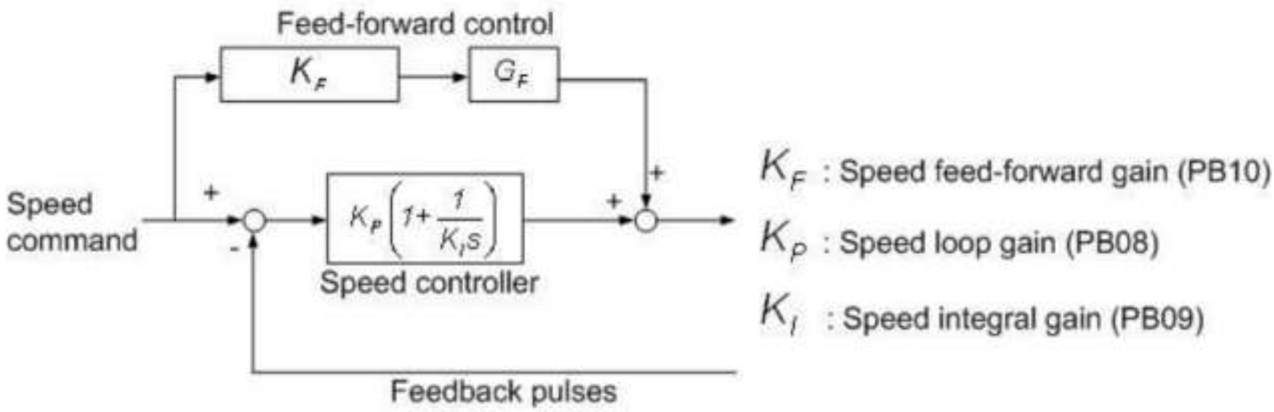
Note 0: OFF(TLx-SG is open-circuited) 1: ON (TLx-SG is short-circuited)

When the generated torque of the servo motor reaches the torque limit value setting by the PA05, PC 25 or the analog torque limit, TLC -SG will be conductive and TLC is digital output.

Name	Parameter abbreviation	Description	Control mode
Torque limiting control	TLC	When the generated torque reaches the torque value setting by the Inner torque limit 1(PA05) or the analog torque limit(TLA), TLC -SG will be conductive. TLC-SG will not be conductive when SON is off.	Pt,Pr,S

6.3.5. Gain adjustment of the speed loop

In the Speed control loop, you can adjust many different gain parameters. You can adjust the gain automatically or manually which is set by PA02. If set as auto adjustment, the load inertia ratio will be estimated continuously and the control gain value will be set automatically. If set as manual adjustment, you should manually set proper load inertia ratio and control gain value, and all auto or auxiliary functions will be disabled. The structure diagram of the speed loop is shown in the following figure:



In the speed control loop, the gain adjustment related parameters are summarized as follows:

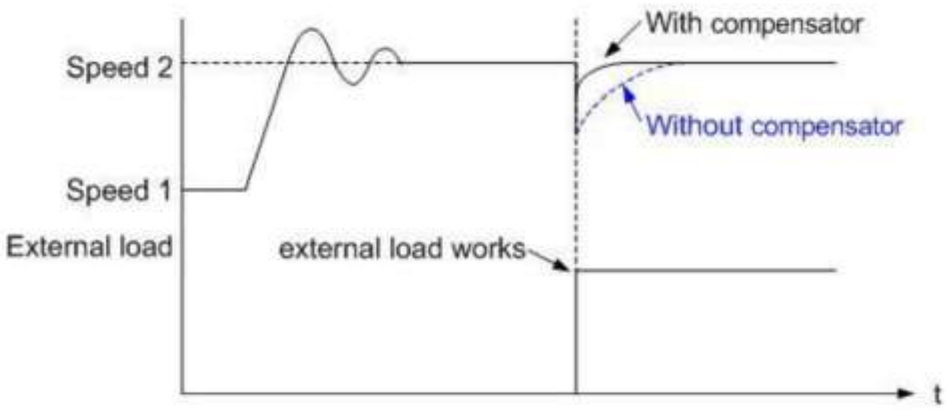
Name	Parameter abbreviation	Parameter code	Setting range	Unit	Default value	Control mode
Auto-tuning mode setting	ATUM	PA02	0000h~0004h	N/A	0002h	Pt, Pr, S, T
Auto-tuning response level setting	ATUL	PA03	1~32	N/A	10	Pt, Pr, S, T
Speed loop gain	VG1	PB08	40~9000	rad/s	183	Pt, Pr, S
Speed integral gain	VIC	PB09	1~1000	ms	34	Pt, Pr, S
Speed feed-forward gain	VFG	PB10	0~200	%	0	S

Auto mode:

The servo drive will adjust the optimal controller gain during acceleration and deceleration. And its detail description can refer to section 5.3.2.

Manual mode:

When you set PA02 to 0000 or 0001, its mainly effective gain value are speed loop gain (PB08), speed integral gain (PB09), and speed feed-forward gain (PB10). When PA02 is set to 0001, the interference compensator function will be automatically enabled, which can reduce torque ripple, overshoot and speed change rate. It is applicable in systems with frequently load changes, but it cannot be used in a system with an over 10 times load inertia ratio. The gain value also need to be adjusted according to the situation during operation. The diagram is as below:



Parameters used in manual mode:

Speed loop gain

Increasing the speed loop gain value will improve the bandwidth. but if the setting is too large, it will cause the system vibration. It is recommended to estimate a base value in the automatic mode, and then manually increase the value slowly until the system vibrates if necessary. Set back the value before system vibrates.

Speed integral gain

Decreasing the value of this parameter will increase the low-frequency stiffness of the speed loop and reduce the steady-state error. But setting too low may worsen the phase lag, and may cause system instability.

Speed feed-forward gain

The speed feed-forward gain can reduce the phase lag error and increase the ability of traceability. When the setting value is close to 100, the dynamic tracking error will be very small, and the pre-compensation will be the most completed. If the setting is too low, the improvement effect of the system is small. If the setting value is too large, the system will easily vibrate.

6.3.6. Resonance suppression unit

(1) Automatic high-frequency resonance suppression

Due to the limitation of the mechanism, Resonance may occur when the response bandwidth of control system is too large, and this may cause damage on the mechanism. Usually this phenomenon can be improved by increasing the rigidity of the mechanism or reducing the bandwidth of the system, but it will increase the cost and reduce the response. To suppress resonance without increasing the cost and reducing the bandwidth, this servo drive provides Automatic High-frequency Resonance Suppression. its related parameters, setting ranges and default values are shown in the below table. It mainly provides five groups of resonance suppression filters and one group of low-pass filters to suppress resonance, the user can manually or automatically operate as below instructions.

Name	Parameter abbreviation	Parameter code	Setting range	Unit	Default value	Control mode
Auto resonance suppression mode	ANCF	PB27	0~2	N/A	1	All
Auto-resonance suppression detection level	ANCL	PB28	1~300	%	50	All
Machine resonance suppression frequency 1	NHF1	PB01	10~4000	Hz	1000	All
Machine resonance suppression attenuation 1	NHD1	PB02	0~32	dB	0	All
Machine resonance suppression frequency 2	NHF2	PB21	10~4000	Hz	1000	All
Machine resonance suppression attenuation 2	NHD2	PB22	0~32	dB	0	All
Machine resonance suppression frequency 3	NHF3	PB25	10~4000	Hz	1000	All
Machine resonance suppression attenuation 3	NHD3	PB26	0~32	dB	0	All

Machine resonance suppression frequency 4	NHF4	PB45	10~4000	Hz	1000	All
Machine resonance suppression attenuation 4	NHD4	PB46	0~32	dB	0	All
Machine resonance suppression frequency 5	NHF5	PB47	10~4000	Hz	1000	All
Machine resonance suppression attenuation 5	NHD5	PB48	0~32	dB	0	All
Resonance suppression low-pass filter	NLP	PB03	0~10000	0.1ms	10	All

Manual mode

The drive provides five groups of filters and one group low-pass filters to manually suppress resonance, the first group is PB01, PB02; the second group is PB21, PB22; the third group is PB25, PB26; the fourth group is PB45, PB46; the fifth group is PB47, PB48; the low-pass filter is PB03, and PB01, PB21, PB25, PB45, PB47 are suppression frequencies, PB02, PB22, PB26, PB46, PB48 are resonance attenuation rates, and PB03 is time constant.

If the resonance frequency is known, the user can manually set the frequency of the filter and increase the attenuation rate gradually until there is no resonance phenomenon (Note 2), or slowly increase the low-pass filter time constant (reduce the low-pass filter bandwidth) until no resonance occurs, but this method will reduce the response bandwidth of the system.

Auto mode:

There are three groups of filters to perform automatic resonance suppression, the first is PB01 and PB02; the second is PB21 and PB22, and the fourth is PB45 and PB46. Among them, PB01, PB21 and PB45 are suppression frequencies, and PB02, PB22 and PB46 are resonance attenuation rates.

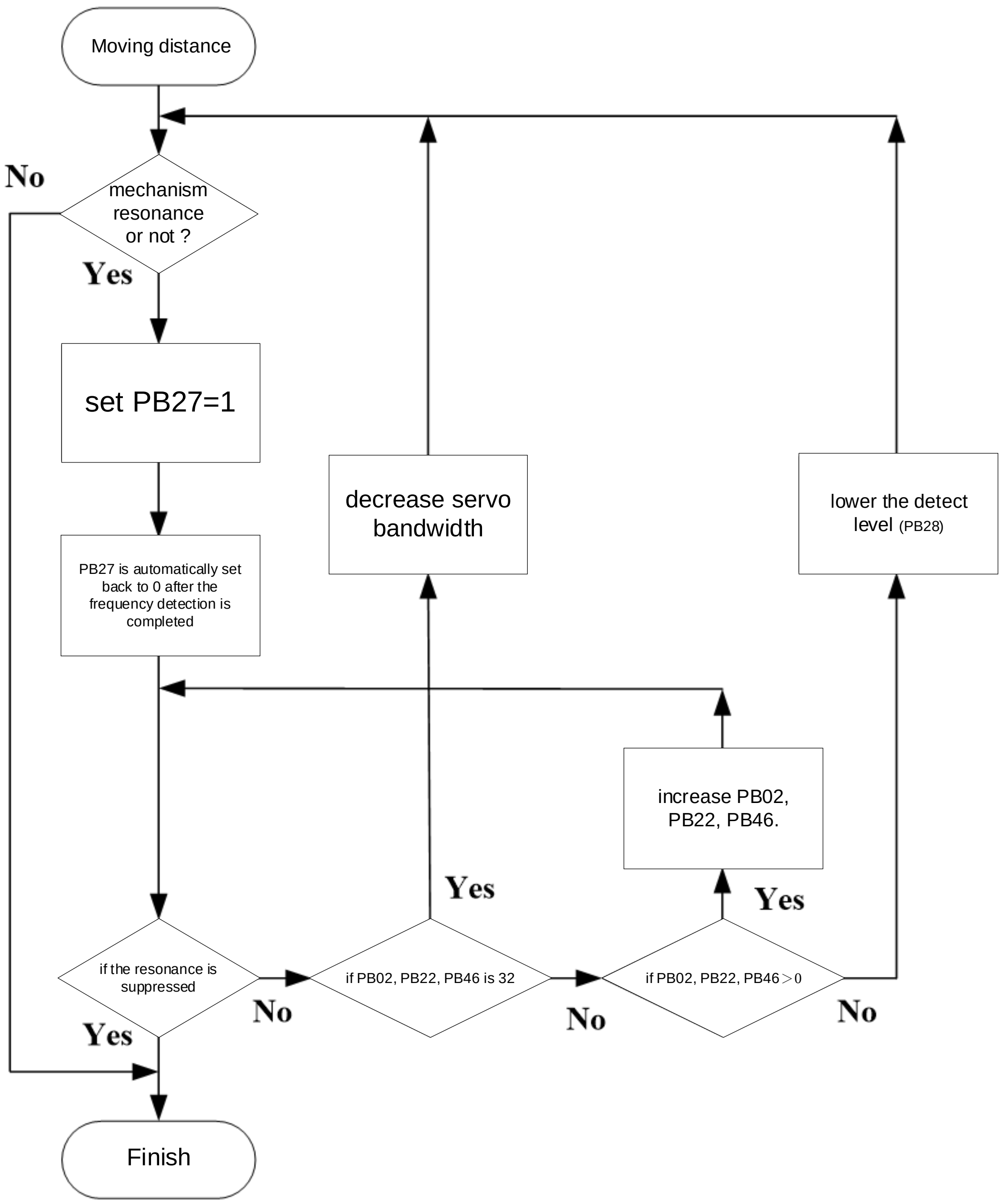
When resonance occurs, the user can set PB27 to 1 or 2 to activate the auto-suppression function if the resonance frequency is unknown, the drive will automatically detect the resonance frequency and attenuation rate and set the detected value to the first group, the second group and the fourth group of filters (Note 1) in sequence. If PB27 is set to 1, it will be change back to 0 automatically after automatic detection is completed; if PB27 is set to 2, it will perform resonance detection and suppression continuously. For other PB27 operation procedure, please refer to the table below.

When PB27 is set to 1 or 2, if the resonance still exists, please check whether one of the parameters of PB02, PB22 and PB46 is 32. If yes, the resonance phenomenon cannot be suppressed by the filter, and it is recommended to reduce the system bandwidth and perform re-estimation. If it is less than 32 and greater than 0, it means that the automatic detection mode has detected the resonance frequency, but the resonance still exists due to insufficient attenuation rate (Note 1), you can manually increase the attenuation rate to improve (Note 2). If PB02, PB22 and PB46 are 0, it means that the resonance frequency is not detected, which may due to the detection level (PB28) is too high, it is recommended to lower the level and then set PB27 to 1 or 2 before performing detection again. The complete automatic resonance suppression flow chart is as follows:

Note 1: the attenuation rate detected by the drive is the most suitable one, it may not be the best one, but it can ensure the stable operation of the system.

Note 2: be careful when manually adjust the attenuation rate, if the setting is too large, it may cause the system unstable.

PB27 parameter flow chart		
PB27 current value	PB27 modified value	Function
0	1	Clear PB01~02, 21~22, 46~47 values, enable auto-suppression function.
0	2	Clear PB01~02, 21~22, 46~47 values, enable continuously auto-suppression function.
1	0	Store PB01~02, 21~22, 46~47 value, disable auto-suppression function.
1	1	Clear PB01~02, 21~22, 46~47 values, enable auto-suppression function.
1	2	Not clear PB01~02, 21~22, 46~47 values, enable continuously auto-suppression function.
2	0	Store PB01~02, 21~22, 46~47 value, disable auto-suppression function.
2	1	Clear PB01~02, 21~22, 46~47 values, enable auto-suppression function.
2	2	Not clear PB01~02, 21~22, 46~47 values, enable continuously auto-suppression function.



(2) Automatic low-frequency vibration suppression

When the command changes instantaneously, the motor and the load will not be synchronized due to insufficient rigidity of the drive system, it will cause mechanical vibrate during motor positioning, and cause problems such as inaccurate motor positioning and bad product yield rate. Usually this problem can be improved by reducing the bandwidth of the system, but the response will be worse in this case. To suppress vibration without reducing the bandwidth, this servo drive provides an Automatic Low-frequency Vibration Suppression option, its related parameters, setting ranges, and default values are shown in the following table. It mainly provides two groups of low-frequency vibration filters for user to operate manually or automatically.

Name	Parameter abbreviation	Parameter code	Setting range	Unit	Default value	Control mode
Auto vibration suppression mode	AVSM	PB29	0~1	N/A	0	Pt, Pr
Low-frequency vibration detection level	VCL	PB30	1~8000	pulse	50	Pt, Pr
Low-frequency vibration suppression frequency 1	VSF1	PB31	1~3000	0.1Hz	100	Pt, Pr
Low-frequency vibration suppression gain 1	VSG1	PB32	0~15	N/A	0	Pt, Pr
Low-frequency vibration suppression frequency 2	VSF2	PB33	1~3000	0.1Hz	100	Pt, Pr
Low-frequency vibration suppression gain 2	VSG2	PB34	0~15	N/A	0	Pt, Pr

Manual mode:

This servo drive provides two groups of suppression filters for users to manually operate, the first group is PB31, PB32; the second group is PB33, PB34. In which, PB31 and PB33 are suppression frequencies, and PB32 and PB34 are suppression gains. If the vibration frequency is known, the user can manually set the vibration frequency to PB31, PB33, and set PB32, PB34 to 1. In these two parameters, set to 1 means to enable the suppression function, and set to 0 is to disable the suppression function. If you want to improve the position response, you can increase the gain value. The larger the value, the better the response. (Note 1).

Auto mode:

The drive provides two groups of filters for users to perform automatic low-frequency vibration suppression, the first group is PB31 and PB32; the second group is PB33 and PB34. Among them, PB21 and PB25 are suppression frequencies, and PB22 and PB26 are resonance attenuation rates. When low-frequency resonance occurs, the user can set PB29 to 1 to enable the auto-suppression function if the resonance frequency is unknown, the drive will automatically detect the resonance frequency, and then set the detected results to the PB31 and PB33 in sequence, and set PB32, PB34 to 1 to enable the auto-suppression function. After auto-detection is completed, PB29 will set back to 0 automatically. For other PB29 operate procedure, please refer to the table below.

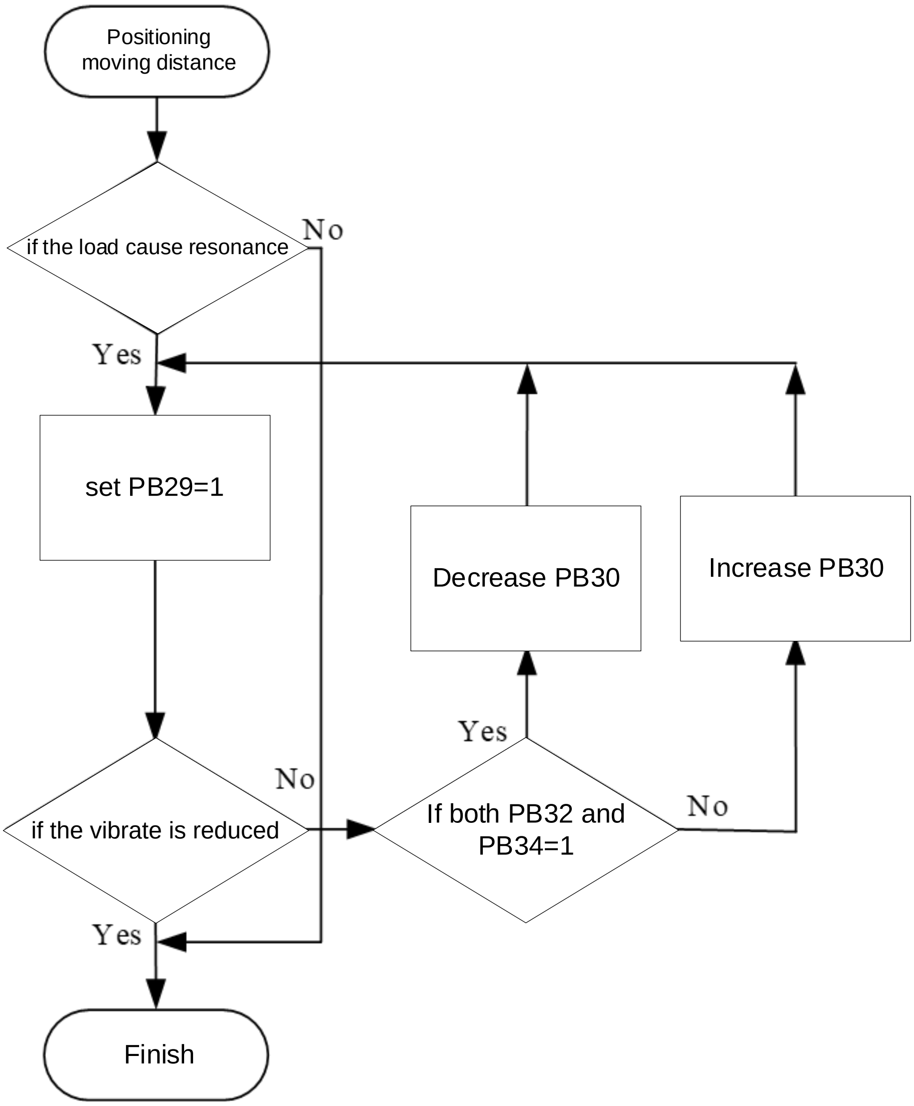
When PB29 is set to 1, if the resonance still exists, please check whether PB32 and PB34 are both 0. If yes, it means the vibrate frequency is not detected, which may impacted by high swing detection level(Note2). You can decrease the level and restart the detection to solve. If the values are not 0, which means the detection is wrong, which may cause by low swing detection level. You can increase the level before restart the detection. The complete auto-suppression flow chart is as follows:

Note 1. Too large gain value may make the motor to run un-smoothly.

Note 2. The swing detection level refers to the peak-to-peak value of the vibration, and the unit is pulse.

PB29 parameter flow chart		
PB29 current value	PB29 modified value	Function
0	1	Clear PB31~34 values, enable the auto-suppression mode
1	0	Store PB31~34 value, disable the auto-suppression function.
1	1	Clear PB31~34 values, enable the auto -suppression mode

Flow chart of auto-resonance suppression.



6.3.7. Gain switch function

Shihlin servo drive provides gain switching function. It can switch the gain on the operating or stopped servo motor. The switching can be performed by DI pins which are set to switch. If the users want to apply gain switching options, manual mode is required(PA02 is set to □□□0 or □□□1). If the auto-gain switching mode is applied, the gain switching function will be disabled.

It is applicable in below occasions:

(1).Servo gain setting is too large and makes big noise, you can use the gain switching function to reduce the system gain.

(2).When the load inertia ratio changes greatly during operation, to ensure the stability of the servo system, you can use the gain switching function to change the inertia ratio or gain value.

(3).To make the servo system have a higher response or a shorter settling time, you can use the gain switching function to increase the gain.

The related parameters and the detail descriptions for gain switching function are listed below:

Item	Parameter abbreviation	Parameter code	Setting range	Unit	Default value	Control mode
Servo motor load inertia ratio	GD1	PB06	0~1200	0.1 times	70	Pt, Pr, S
Position loop gain	PG1	PB07	4~1024	rad/s	45	Pt, Pr
Speed loop gain	VG1	PB08	40~9000	rad/s	183	Pt, Pr, S
Speed integral gain	VIC	PB09	1~1000	ms	34	Pt, Pr, S
Gain switching option	CDP	PB11	0000h~ 0008h	N/A	0000H	Pt, Pr, S
Gain switching condition value	CDS	PB12	0~4000000	Set according to parameter	10	Pt, Pr, S
Gain switching time constant	CDT	PB13	0~1000	ms	1	Pt, Pr, S
Servo motor load inertia ratio 2	GD2	PB14	0~1200	0.1 times	70	Pt, Pr, S
Position loop gain change ratio	PG2	PB15	10~500	%	100	Pt, Pr

Speed loop gain change ratio	VG2	PB16	10~500	%	100	Pt, Pr, S
Speed integral gain change ratio	VIC2	PB17	10~500	%	100	Pt, Pr, S

The following will explain the related parameters for gain switching.

(1). The four parameters, which are servo motor load inertia ratio GD1, position loop gain value PG1, speed loop gain value VG1, and speed integral gain value VIC, (PB06~PB09). They are adjusted in the same way as the manual mode parameters, but its value may be changed during gain switching.

(2). Gain switch option CDP(PB11)

This parameter is to set the condition of gain switching by changing the lowest digit of the parameter. It triggers the gain switching by external digital input(DI) signal. Its external digital input (DI) signal can be set as gain switching function by parameters PD02~PD09 or PD21~PD24

0	0	0	x

x=0: disable the gain switching.

x=1: activate the gain switching when CDP is ON.

x=2: activate the gain switching when position command frequency is equal to or higher than CDS setting.

x=3: activate the gain switching when position deviation pulse is equal to or higher than CDS setting.

x=4: activate the gain switching when motor speed is equal to or higher than CDS setting.

x=5: activate the gain switching when CDP is OFF.

x=6: activate the gain switching when position command frequency is less than or equal to CDS setting.

x=7: activate the gain switching when position deviation pulse is less than or equal to SDS setting.

x=8: activate the gain switching when servo motor speed is less than or equal to CDS setting.

(3). The value of gain switching condition CDS(PB12)

The setting value of gain switching condition (kpps, pulse, rpm) changes according to the setting of CDP (PB11). When set to☐☐☐2, the parameter is frequency (kpps), when set to☐☐☐3 , it is pulse number (pulse), when it is set to☐☐☐4, it is rotation speed (rpm). The unit of the setting value changes according to switching item.

PB11 setting	**Switch condition**	**Unit**
☐☐☐2	When position command frequency is equal to or higher than CDS setting.	kpps
☐☐☐3	When position deviation pulse is equal to or higher than CDS setting	pulse
☐☐☐4	When motor speed is equal to or higher than CDS setting	rpm
☐☐☐6	When position command frequency is less than or equal to CDS setting.	kpps
☐☐☐7	When position deviation pulse is less than or equal to CDS setting	pulse
☐☐☐8	When motor speed is less than or equal to CDS setting	rpm

(4). Time constant of gain switching CDT(PB13)

The gain switching time constant is to smooth the gain switching. It is used to set the time constant when switching the CDP and CDS conditions. If the gain setting is too large during gain switching, you can use this parameter to suppress the vibration.

(5). Servo motor Load inertia ratio 2 GD2 (PB14)

This parameter can be set to the load inertia ratio value to be switched. If the load inertia ratio does not change during operation, please set PB14 to the same value as GD1 (PB06).

(6).The change rate of position gain 2 PG2, speed gain 2 VG2, and speed integral Gain VIC2 during gain switching (PB15~PB17).

When performing the gain switching, the original servo gain value will be changed to the ratio value (%)of PG2, VG2, and VIC.

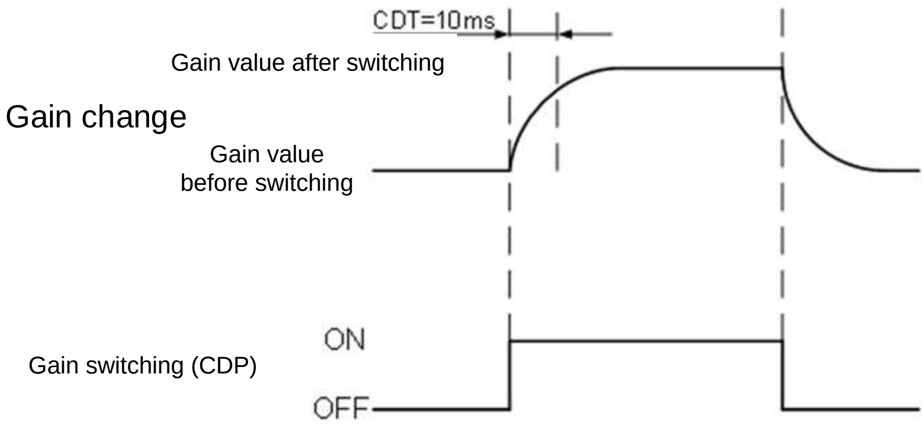
Below are examples to illustrate the gain switching operation.

Example 1: digital input signal use as switching source.

①. Relevant parameters setting:

Name	Parameter abbreviation	Parameter code	Default value	Unit
Servo motor load inertia ratio	GD1	PB06	10	0.1time
Position loop gain	PG1	PB07	100	rad/s
Speed loop gain	VG1	PB08	500	rad/s
Speed integral gain	VIC	PB09	100	ms
Gain switching option	CDP	PB11	0001	N/A
Gain switching time constant	CDT	PB13	10	ms
Servo motor load inertia ratio 2	GD2	PB14	20	0.1times
Position loop gain change ratio	PG2	PB15	80	%
Speed loop gain change ratio	VG2	PB16	120	%
Speed integral gain change ratio	VIC2	PB17	150	%

②. **The gain switching diagram**



③. **The states of parameters change**

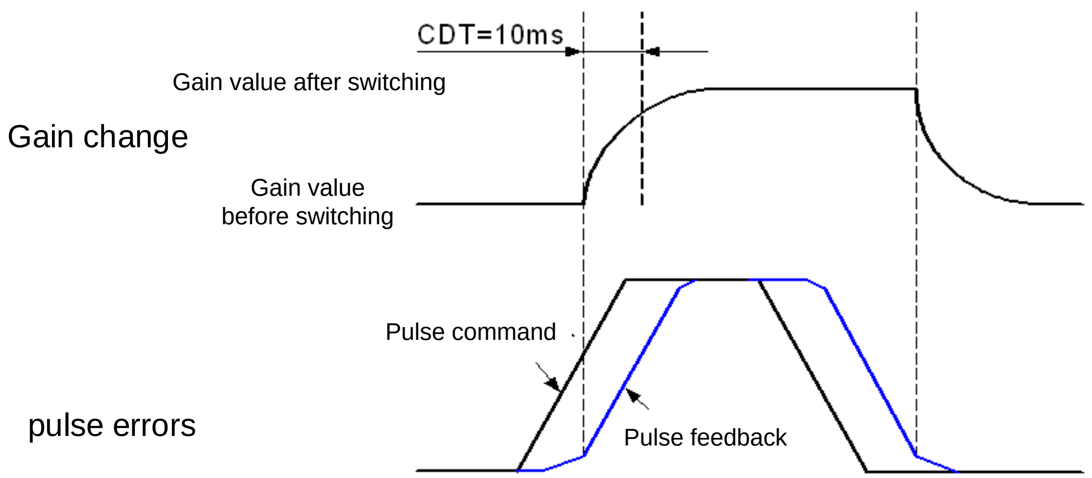
Name	CDP OFF		CDP ON		CDP OFF
Servo motor load inertia ratio	10	→	20	→	10
Position loop gain	100	→	80	→	100
Speed loop gain	500	→	600	→	500
Speed integral gain	100	→	150	→	100

Example 2: take deviation pulse as switching source

①. Relevant parameter setting

Name	Parameter abbreviation	Parameter code	Default value	Unit
Servo motor load inertia ratio	GD1	PB06	10	0.1 times
Position loop gain	PG1	PB07	100	rad/s
Speed loop gain	VG1	PB08	500	rad/s
Speed integral gain	VIC	PB09	100	ms
Gain switching option	CDP	PB11	0003	N/A
Gain switching condition value	CDS	PB12	100	pulse
Gain switching time constant	CDT	PB13	10	ms
Servo motor load inertia ratio 2	GD2	PB14	20	0.1times
Position loop gain change ratio	PG2	PB15	80	%
Speed loop gain change ratio	VG2	PB16	120	%
Speed integral gain change ratio	VIC2	PB17	150	%

②. The gain switching diagram.



③. The states of parameters change

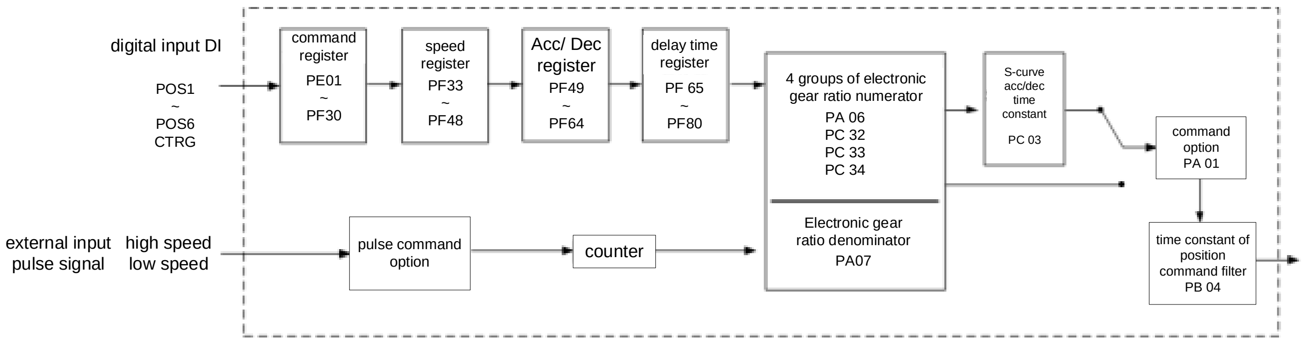
Name	CDP OFF		CDP ON		CDP OFF
Servo motor load inertia ratio	10	→	20	→	10
Position loop gain	100	→	80	→	100
Speed loop gain	500	→	600	→	500
Speed integral gain	100	→	150	→	100

6.4 Position control mode

The position control mode is used in where precise positioning is required, such as industrial machinery, processing machines, and so on. There are two types of position control mode: one is terminal input mode, and the other is internal register input mode. The terminal input mode is to receive the pulse command from the controller, and apply this command to control the positioning of the servo motor, and the internal register input mode is to manually input 63 groups of position command values (please refer to Chapter 7), and then define DI functions which are POS1~POS6 to switch the corresponding position command. Below table will introduce the setting of terminal input and internal register input.

Name	Parameter abbreviation	Parameter code	Setting range	Unit	Default value	Control mode	Description
Control mode setting value	STY	PA01 (*)	0000h ~ 1116h	N/A	0000h	ALL	Control mode setting value: | u | z | y | x | x: control mode setting x=0: position mode y: position control input command option y=0: terminal input y=1: internal register input

PA01 setting value is valid after power cycling.



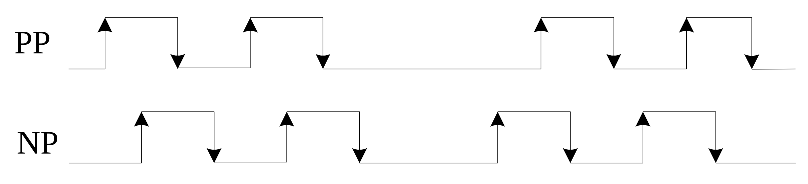
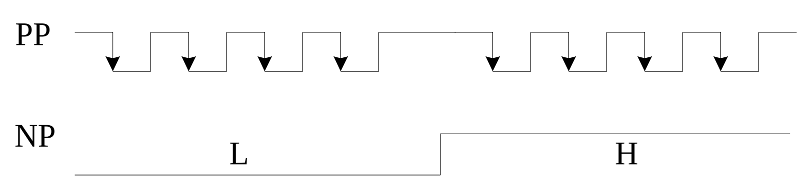
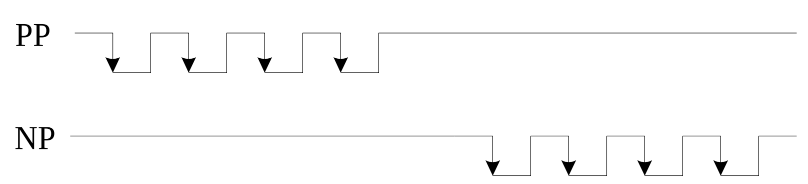
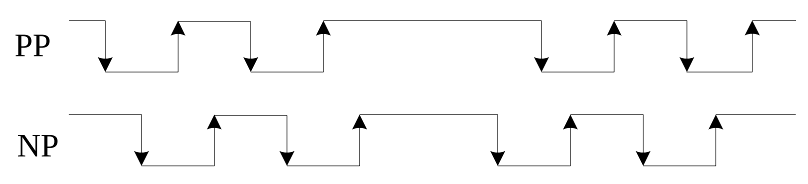
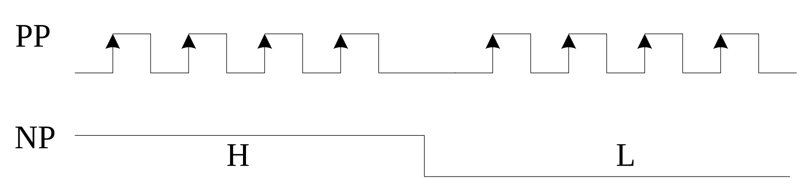
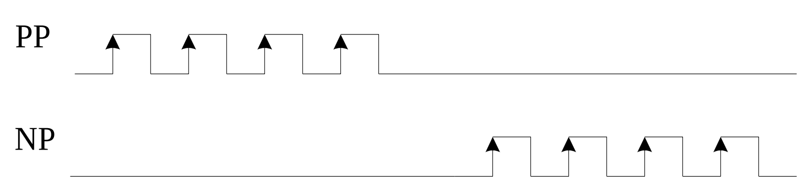
◆ When the external input pulse signal function is activated, the S-curve smoother is disabled.

6.4.1 External pulse command(Pt command)

The pulse command (Pt command) is provided by an external device. You should set PA01 to 0000 and then restart power to activate this parameter. There are three types of user-defined input waveform. each type can be defined positive and negative logic. Positive logic means the pulse is triggered by the rising edge, on the other hand, negative logic means the pulse is triggered by the falling edge. The related parameters and setting methods are as follows:

Name	Abbr.	Code	Range	Unit	Default	Mode	Description
Function mode option 3 (command pulse option)	PLSS	PA13	0000h ~ 0312h	N/A	0000h	Pt	Set external input pulse train type 0 | z | y | x **x: input pulse train format options** x=0:forward/reverse rotation pulse train x=1: pulse train+sign x=2: AB phase pulse train. **y: input pulse-train logic options** y=0: positive logic y=1: negative logic **z: The setting of input pulse filter.** z=0: the maximum input pulse frequency is 500kpps. (applicable frequency is between 200kpps-500kpps) z=1: the maximum input pulse frequency is 200kpps. (applicable frequency is below 200kpps) z=2: the maximum input pulse frequency is 2Mpps. (applicable frequency is between 500kpps ~2Mpps) z=3: the maximum input pulse frequency is 4Mpps. (applicable frequency is between 2MPPS~4MPPS)

This parameter setting is valid after power cycling.

Pulse logic and format		Forward rotation	Reverse rotation
Negative logic	AB phase pulse train		
	Pulse train + sign		
	Forward/reverse rotation pulse train		
Positive logic	AB phase pulse train		
	Pulse train+ sign		
	Forward/reverse rotation pulse train		

If input pulse is line drive type, the maximum frequency is 4Mpps. If input pulse is open collector type, the maximum frequency is 200Kpps.

6.4.2 Internal position command (Pr command)

◆ You can refer to detail in chapter 7.

The source of the PR position command is to use 64 groups built-in position command register of parameters(PE01~PE98), (PF01~PF30), together with external I/O(CN1, POS1 ~ POS6 and CTRG)to select one as position command, the detail shows in the following table.

Position command	POS6	POS5	POS4	POS3	POS2	POS1	CTRG	Related parameter
P0	0	0	0	0	0	0	↑	PE01
								PE02
P1	0	0	0	0	0	1	↑	PE03
								PE04
~								~
P50	1	1	0	0	1	0	↑	PF03
								PF04
P51	1	1	0	0	1	1	↑	PF05
								PF06
~								~
P63	1	1	1	1	1	1	↑	PF29
								PF30

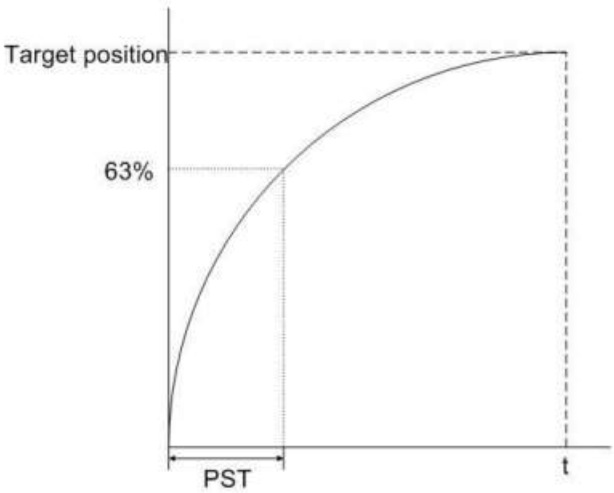
Status of POS1 - POS6: 0 means that DI is off (the circuit is open); 1 means that DI is on (the circuit is closed). CTRG : indicates the moment the DI is switched from off(0) to on(1).

Absolute and incremental position registers are widely used, which is equivalent to a simple program. You can easily complete a periodic motor operation according to the preceding table.

6.4.3 Position command smoothing

This parameter is to set the filter time constant of the position command. With an appropriate parameter setting, the motor can run smoothly even when it encounters abruptly position command changes.

Name	**Parameter code**	**Setting range**	**Unit**	**Default value**	**Control mode**
Position command filter time constant	PB04	0~20000	ms	3	Pt, Pr

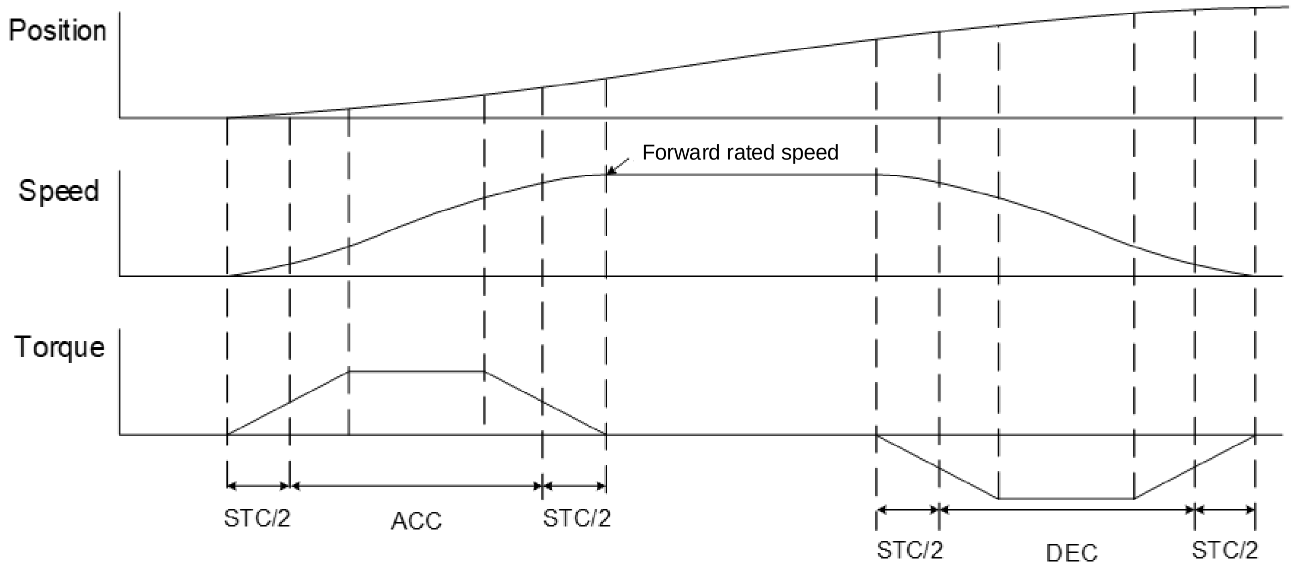


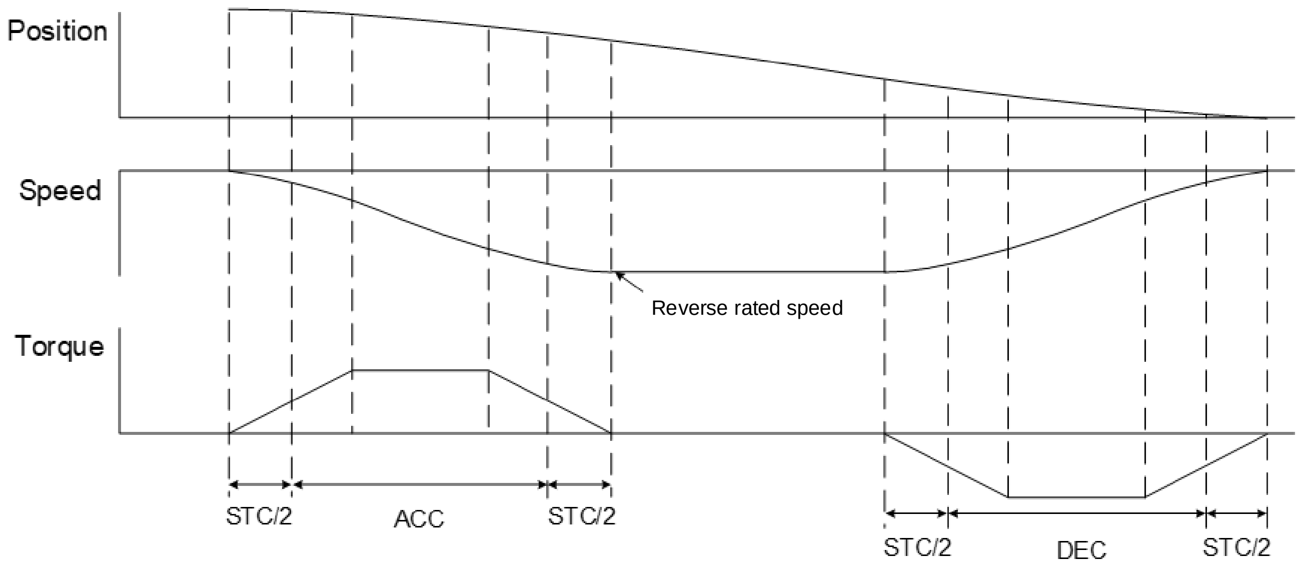
In addition, speed smoothing for acceleration/deceleration also can help the servo motor to run more smoothly. The speed smoothing for position acceleration/deceleration related parameter is as follows:

Name	Parameter abbreviation	Parameter code	Setting range	Unit	Default value	Control mode
S-curve acceleration /deceleration time constant.	STC	PC03	0~10000	ms	0	Pr, S, T
Note: you can refer to chapter 7 for the acceleration /deceleration time in PR mode.						

Speed smoothing for acceleration/deceleration can effectively improve the feature of motor acceleration and deceleration. When the motor load inertia increases, or when the inertia changes significantly, the motor is not able to run smoothly due to the inertia and friction. Increasing the setting of the STC (PC03) can effectively improve this.

When position command is determined by external pulse, the parameters STA (PC01), STB (PC02), and STC (PC03) will be invalid, due to the external input pulse command has been determined by the controller, which is to provide the continuity of speed and angular acceleration.





As can be seen in the above figure, for the forward rotation or reverse rotation command from position command, its acceleration and deceleration time is determined by PF49~PF64.

If the internal register is used as position command, to run the motor more smoothly, it is recommended to use the self-defined acceleration/ deceleration time(PF49~PF64) and the S-curve acceleration/deceleration time constants(PC03).

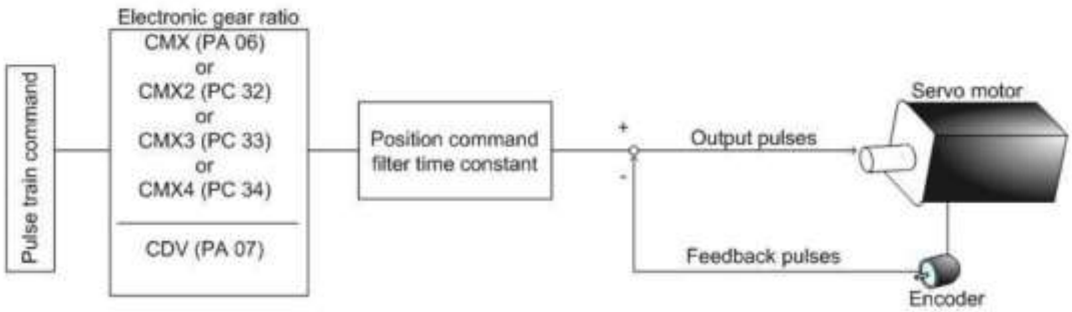
Note: please refer to Chapter 7 for above ACC and DEC settings.

6.4.4 Electronic gear ratio

Users could set different electronic gear ratios to enable the gearing to move different distances. The relevant parameters are as below:

Name	Parameter abbreviation	Parameter code	Setting range	Unit	Default value	Control mode
Electronic gear numerator	CMX	PA06	$1\sim2^{26}$	N/A	1	Pt, Pr
Electronic gear denominator	CDV	PA07	$1\sim2^{26}$	N/A	1	Pt, Pr
Electronic gear numerator 2	CMX2	PC32	$1\sim2^{26}$	N/A	1	Pt
Electronic gear numerator 3	CMX3	PC33	$1\sim2^{26}$	N/A	1	Pt
Electronic gear numerator 4	CMX4	PC34	$1\sim2^{26}$	N/A	1	Pt

Incorrect E-Gear ratio setting will cause servo motor suddenly unintended acceleration, so please ensure to set the parameter when servo is off. The E-Gear ratio setting value should be within the range of 1/50 <(CMX/CDV) <64000, otherwise the motor may cannot operate. The relationship between the E-Gear ratio numerator & denominator and the command is showing in the figure below.



There are four groups of E-Gear ratio numerators for users to switch, please set 2 DI input register as CM1 and CM2 before switching. Please refer to the following table for detail.

Name	CM1	CM2	Control mode
E-Gear numerator 1 (PA06)	0	0	Pt
E-Gear numerator 2 (PC32)	1	0	Pt
E-Gear numerator 3 (PC33)	0	1	Pt
E-Gear numerator 4 (PC34)	1	1	Pt

- 0: CMx-SG is open-circuited,1: CMx-SG is short-circuited.

Calculation of E-Gear ratio :

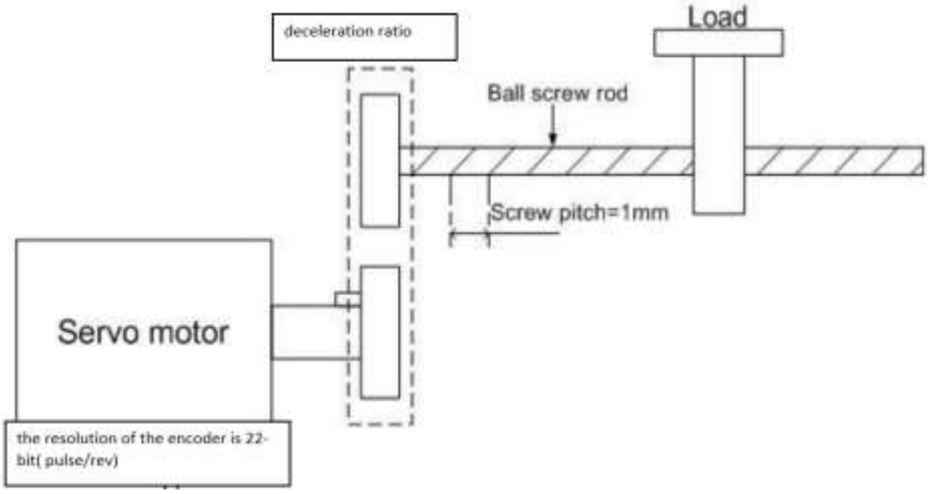
Before calculating the E-Gear ratio, the user must know the specifications of the system, such as the resolution of the motor encoder is 22bit Pulse/rev, the deceleration ratio of the mechanism, the E-Gear ratio and so on.

The E-Gear ratio calculation is as follows:

$$\text{E - gear ratio} = \frac{\text{Resolution of motor encoder}}{\text{(Load distance per revolution(angle) / Distance pulses to be shifted entered by user}}$$

If there is a deceleration ratio between the motor and the loads, you must multiply the deceleration ratio to it, which is revolution number of motor shaft / revolution number of load shaft.

The following is an example to illustrate how to set the E-Gear ratio.



From the figure above, it shows that the load (ball screw rod) has a moving distance of 1mm per revolution, and the motor resolution is 22-bit Pulse/rev. if you want the load axis to rotate 5μm distance, the calculation is as below.

Electronic gear ratio = 4194304 / 200

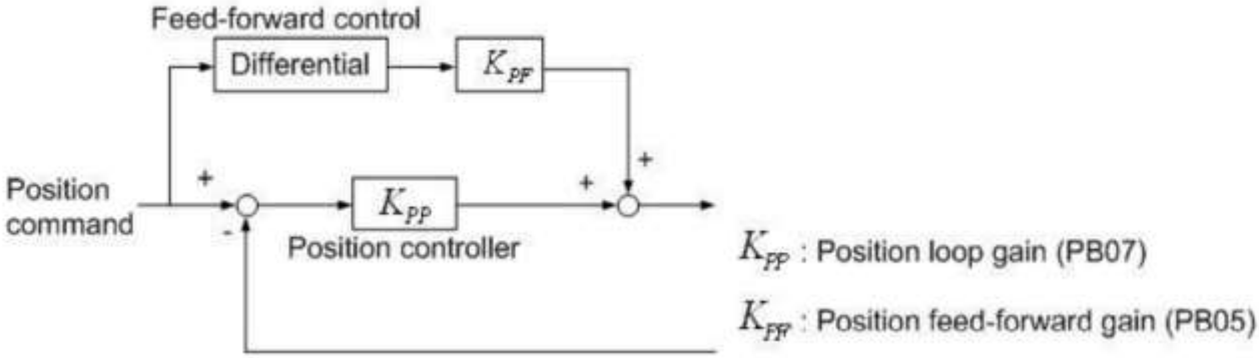
From which, it can be known that when the numerator of the E-Gear ratio is set to 4194304, the denominator is set to 200. and the ball screw rod will be shifted a 5-μm distance after a position pulse command.

6.4.5 Torque limit of position loop

Same as section 6.3.4.

6.4.6 Position loop gain.

As the position loop is outside control of speed loop, if the user uses the manual mode to adjust the position loop, it's necessary to set the speed gain related parameters first (refer to section 6.3.5), and then set the position proportional gain and the position feed-forward gain. The position loop gain can be set to a value of 1/4 ~ 1/6 of speed loop gain. The user can also use the auto-tuning mode to set the position and speed gains automatically. The position loop diagram is shown as below:



The relevant parameters of position gain adjustment are listed as below:

Name	Parameter abbreviation	Parameter code	Setting range	Unit	Default value	Control mode
Auto tuning mode option	ATUM	PA02	0000h~0004h	N/A	0002h	Pt,Pr,S,T
Auto-tuning response level setting	ATUL	PA03	1~32	N/A	10	Pt,Pr,S,T
Position feed-forward gain	FFC	PB05	0~200	%	0	Pt,Pr
Position loop gain	PG1	PB07	4~1024	rad/s	45	Pt,Pr

When the position loop gain PG1 (PB07) is set too large, although the bandwidth and response gets faster, the motor will run back and forth with vibration. This is not allowed in the application which requires precise position control, you must decrease the PG1 value until no vibration occurs.

If the bandwidth is limited by the machine, which makes the position feedback cannot track the position command and cannot meet the reasonable position error requirements, you can use the position feed-forward gain to reduce the dynamic error of the position tracking. In other words, using position feed-forward gain will increase the position settling time relatively.

The position feed-forward gain adjustment method is set from low to high. Theoretically, setting it to 1 should be the best. If the setting is too large, it may cause vibration. In this case, the position feed-forward value should be reduced until no vibration occurs.

6.5 Dual control mode

To easily switch control modes frequently, Shihlin servo also provides five dual-modes for user to set manually. PA01 can change the dual mode setting, see the table below:

Mode name		**Mode code**	**PA01 setting**	**Description**
Dual mode	Position with external command - speed	Pt-S	1001h	Pt/S is switched mutually via the signal of DI.
	Position with external command - torque	Pt-T	1005h	Pt/T is switched mutually via the signal of DI.
	Position with inner register command - speed	Pr-S	1011h	Pr/S is switched mutually via the signal of DI.
	Position with inner register command - torque	Pr-T	1015h	Pr/T is switched mutually via the signal of DI.
	Speed - torque	S-T	1003h	S/T is switched mutually via the signal of DI.

When using the dual mode, the assignment of DI and DO is very important. To avoid insufficient DI/DO pin, in S-T mode, you can input speed and torque by external analog input, and in position mode you can use external input pulse, which is to save DI.

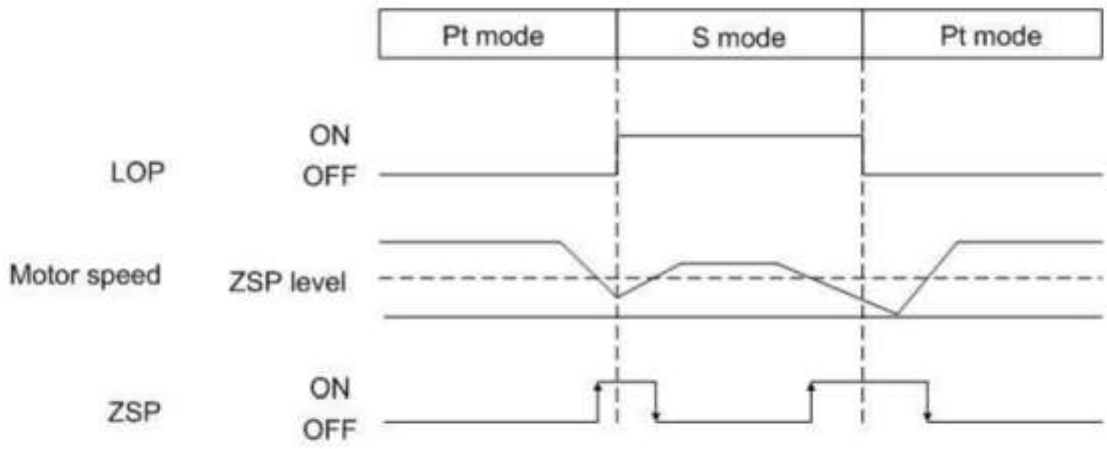
The DI pin of switching mode is LOP pin, please enable LOP function of DI. The description is as follows:

<table>
<tr><th>Name</th><th>Abbr.</th><th>I/O type</th><th>CN1 NO.</th><th>Description</th><th>Control mode</th></tr>
<tr><td>Control mode switching</td><td>LOP</td><td>DI</td><td>CN1-21 (Preset)</td><td>Options of position/speed control switch mode
<table>
<tr><td>(Note) LOP</td><td>Control mode</td></tr>
<tr><td>0</td><td>position</td></tr>
<tr><td>1</td><td>speed</td></tr>
</table>
Options of speed/torque control switch mode.
<table>
<tr><td>(note) LOP</td><td>Control mode</td></tr>
<tr><td>0</td><td>speed</td></tr>
<tr><td>1</td><td>torque</td></tr>
</table>
Options of torque/position control switch mode.
<table>
<tr><td>(note) LOP</td><td>Control mode</td></tr>
<tr><td>0</td><td>torque</td></tr>
<tr><td>1</td><td>position</td></tr>
</table>
Note
0: OFF(Open-circuit)
1: ON (Short-circuit)</td><td>Described according to different control mode</td></tr>
</table>

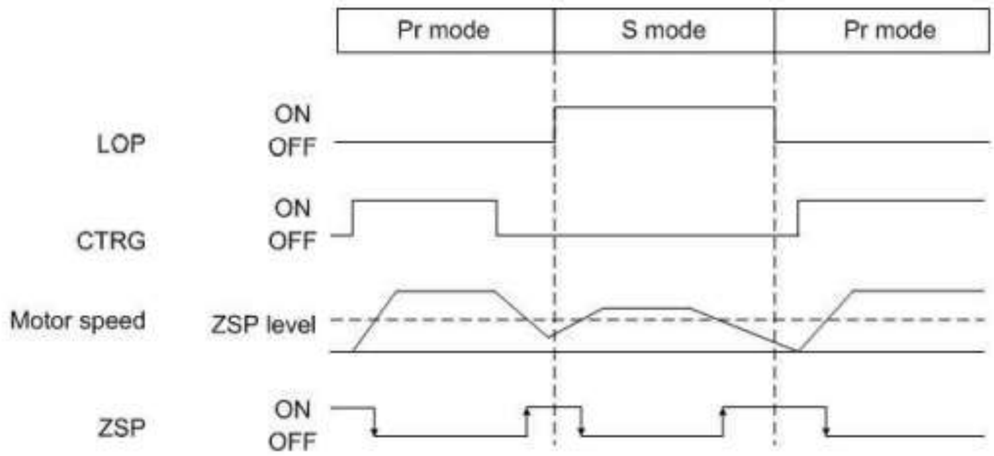
- ◆ The DI assigned ST1 and RS2 as the same pin. When S-T dual mode is applied, the ST1 function would have priority in speed control mode and the RS2 function would have priority in torque control mode.

6.5.1 Position/speed dual mode

There are two types Position/speed dual mode: Pt/S and Pr/S. The user can switch between them by the LOP terminal. When PA01 is set to the terminal input or the internal register input in the position mode, its switching timing diagram with the speed mode is shown as below:

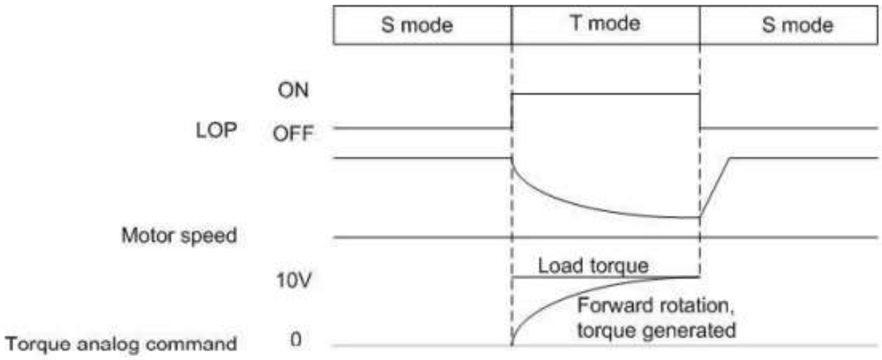


The mode cannot be switched if the motor is running at high speed. When DO ZSP is on, the control mode can be switched, and it is recommended that the user wait for the motor stops completely before mode switching.



6.5.2 Speed / Torque dual mode

Before using the speed/torque dual mode, please set PA01 to 1003H. The user can switch the speed/torque mode by the LOP terminal. Since the DI terminal ST1 (ST2) of speed mode is automatically changed to RS2 (RS1) when switching to the torque mode, the rotation direction of the motor will be reversed when switching between speed/torque modes. The timing diagram of the speed/torque mode is as follows:



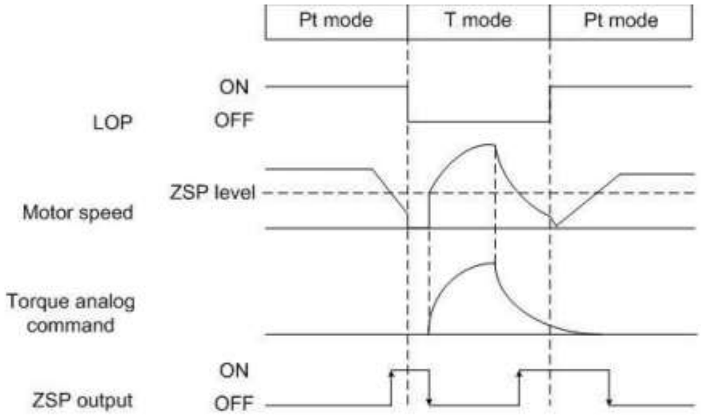
It is recommended to switch speed/torque mode after the motor is completely stopped.

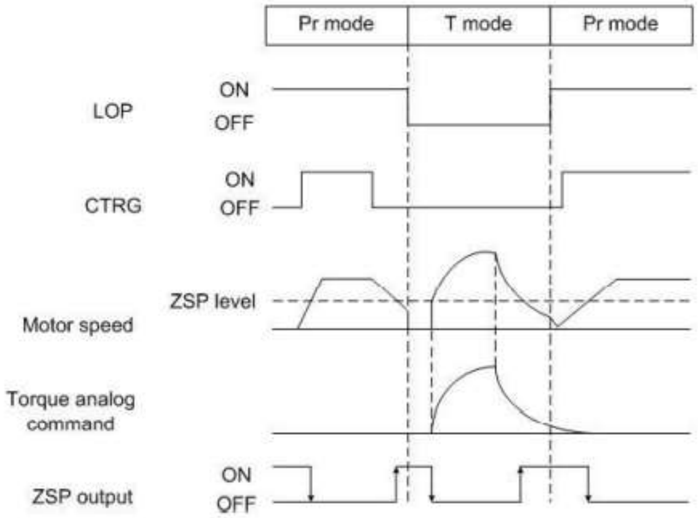
6.5.3 Torque/position dual mode

It has 2 types: T/Pt and T/Pr. The user can set PA01 to 1005 (T/Pt mode) or 1015 (T/Pr mode).

If the motor is running at high speed, the mode switching cannot be performed. When DO ZSP is on, the control mode can be switched.

The user can switch the torque/position dual mode through the LOP terminal of the DI pin. If you want to switch to position control with inner register mode, the CTRG signal need to be turned on, you can refer to the following timing diagram for details:





It is recommended that the user performs torque/position mode switching after motor is stopped completely.

6.6 Other functions

DANGER	●Before connecting to peripheral devices, turn off the power and wait for 20 minutes or more until the charge LED turns off, and check the residual voltage by meter. Otherwise, an electric shock may occur.

CAUTION	●Please use designated products for peripheral devices to avoid fire or malfunction.

6.6.1 Selection of regenerative resistor

CAUTION	●It's forbidden to use regenerative resistor and servo drive except for below specified combinations, otherwise, a fire disaster may occur.

If the torque direction of the motor is opposite to the rotation direction, the motor will switch to a power generator, The energy will be transferred from the load to the inside of drive, which will cause voltage excess of P-N terminal. To avoid module and capacitor damage, the regenerative protection function should control the voltage within 370V/740V. The regenerative protection function is mainly composed of IGBT and resistor. The regenerative energy is consumed by the resistor, and its resistance need to be checked when using it. The regenerative protection function is controlled by the regenerative transistor and you should check if the regenerative resistor is normal before operation. If the regenerative transistor is damaged, stop the motor urgently to avoid continuous energy regeneration which will damage the drive.

The drive has a built-in regenerative resistor for users .If the regenerative energy is too large, it is not recommended to use the built-in regenerative resistor, use an external regenerative resistor instead to avoid overheating or damage the drive due to failing to consume energy.

User can use the external terminals of P,D,C to connect either external regenerative resistor or built-in regenerative resistor. When built-in regenerative resistor is used, make sure P-D terminals is short-circuited. When external regenerative resistor is used, make P-D open and regenerative resistor is connected to P-C terminals.

The following tables shows the specification of built-in regenerative resistor for Shihlin servo drive.

The specification of regenerative resistor for 200V models:

Drive(W)	Specification of built-in regenerative resistor		The Minimum permissible resistance (Ω)	Consumption power of built-in resistor (W)
	Resistance(Ω)	Capacitor(W)		
100	100	20	100	10
200	100	20	100	10
400	100	20	100	10
750	40	40	40	20
1000	40	40	40	20
1500	13	100	13	50
2000	13	100	13	50
3000	13	100	13	50

The specification of regenerative resistor for 400V models:

Drive(W)	Specification of built-in regenerative resistor		The Minimum permissible resistance (Ω)
	Resistance(Ω)	Capacitor(W)	
2000	-	-	30
3000	-	-	30
5000	-	-	20
7000	-	-	15

- Please set the regenerative resistor resistance value (PA10) and capacity (PA11) correctly, otherwise it may affect this function
- The regenerative processing capacity of built-in regenerative resistors is the average value of the regenerative capacity, and its value is 50% of its rated capacity; Same rule as the external regenerative resistor

When the regenerative capacity exceeds the regenerative capacity of the built-in regenerative resistor, an external regenerative resistor should be used. When connecting external regenerative resistor, please select regenerative resistors with the same resistance. If you increase the capacity of the resistor in series or parallel connection, make sure that its resistance meets the requirement. To reduce the temperature, you can use regenerative resistor with thermal switch or use forced cooling system. Regarding the load feature of the resistor, you can consult the manufacturer for detail.

When selecting external regenerative resistor, please select the resistance value which is suggested in the above table. To easily estimate the required capacity of the regenerative resistor, below is the instruction of selecting the external regenerative resistor capacity:

(a) Without external load

If the motor is running forwardly and reversely, the regenerated energy from brake will first enter the capacitor of the DC bus. When the voltage of the capacitor exceeds a certain value, the regenerative resistor will consume the excess recharge energy. The selection method of regenerative resistor is as follows; The following table provides the calculation of regenerative energy. Users can refer to below table and calculate the required regenerative resistance.

Drive(W)		Motor	Motor inertia J ($x10^{-4}kg \cdot m^2$)	Es(joule) (Note 1)	Capacitor regenerative energy Ec(joule)	Maximum motor speed. (rpm)
low inertia	100	SME-L00530○□□□	0.030	0.15	8.1	3000
		SME-L01030○□□□	0.052	0.28	8.1	3000
	200	SME-L02030○□□□	0.161	0.79	8.1	3000
	400	SME-L04030○□□□	0.27	1.37	9.9	3000
	750	SME-L07530○□□□	1.07	5.28	16.8	3000
	1K	SME-L10020○□□□	6.1	13.38	16.8	2000
	1.5K	SME-L15020○□□□	8.8	19.30	40.8	2000
	2K	SME-L20020○□□□	11.5	25.22	40.8	2000
	3K	SME-L30020○□□□	16.7	36.63	40.8	2000
Middle inertia	1K	SME-M10020○□□□	10.3	22.59	16.8	2000
	1.5K	SME-M15020○□□□	15.0	32.90	40.8	2000
	2K	SME-M20020○□□□	32.1	70.4	40.8	2000
	3K	SME-M30020○□□□	61.2	134.23	40.8	2000
High inertia	200	SME-H02030○□□□	0.35	1.73	8.1	3000
	400	SME-H04030○□□□	0.62	3.06	9.9	3000
	750	SME-H07530○□□□	1.66	8.19	16.8	3000
	1K	SME-H08515○□□□	13.1	16.05	16.8	1500
	3K	SME-H13015○□□□	19.82	24.45	40.8	1500
	3K	SME-H18015○□□□	26.42	32.59	40.8	1500
High inertia(400V	2K	SMP-H18015○□□□	26.1	26.1	134.4	1500
	3K	SMP-H29015○□□□	46	46	163.2	1500
	5K	SMP-H44015○□□□	67.5	67.5	196.8	1500
	5K	SMP-H55015○□□□	89	89	196.8	1500
	7K	SMP-H75015○□□□	125	125	240	1500

Note 1: Es is the regenerated energy of a motor without loading that runs a rated speed then stops.

The capacity of regenerative resistor is calculated as follows by using the Es and Ec in the above table:

$$P_{BR} = 2 \times ((N+1) \times E_S - E_C)/T$$

In which N: the Load inertia ratio T: operation cycle(Defined by user)

Assuming that the load inertia is N times the motor inertia, when the motor decelerates from 3000rpm to 0, the regenerative energy is (N+1)×Es and the regenerative resistor needs to consume (N+1) × Es-Ec Joules. Assuming that the operation cycle is T sec, then the required regenerative resistor power =2×((N+1) × Es－Ec) / T . the calculation is as follows；

Note: J: motor inertia(unit: **kg·m²**), Wr: maximum speed of operation cycle(unit: rpm)

Step	Item	Calculation and instruction
1	Set the operation cycle T	Manual input(operation cycle)
2	Set rotation speed Wr	Manual input or read from panel status display(r)
3	Set load / motor inertia ratio N	Manual input or read from panel status display(Dc) (PA01=0002 is valid)
4	Calculate the maximum regenerative energy Es	Es = J * Wr^2 / 182 (if it's rated speed, you can check the value in the table directly)
5	Set the consumable regenerative energy Ec	Refer to the above table
6	Calculate the capacity of regenerative resistor	2 * ((N + 1) * Es - Ec) / T

Example 1

Taking the low inertia 400W model as an example, the operation cycle T = 1 sec, the maximum speed is 3000rpm, and the load inertia is 20 times of the motor inertia, then the required power of the regenerative resistor = 2 x ((20 + 1) x1.37 -9.9) / 1 = 37.7W. Therefore, an external regenerative resistor above 37.7w is required.

Note: since the maximum speed of 3000rpm is rated speed of 400W motor, it can be found from the above table that Es =1.37 J.

Example 2

Taking the middle inertia 2KW model as an example, the operation cycle T = 1 sec, the maximum speed is 1000rpm, and the load inertia is 20 times of the motor inertia, then Es = 32.1 x 0.0001 x 1000^2 / 182 = 17.6 J, and the required regenerative resistor power= 2 x ((20 + 1) x17.6-40.8) / 1 = 657W, which is far larger than capacity of built-in regenerative resistor. Therefore, it's recommended to use the designated 1KW regenerative resistor.

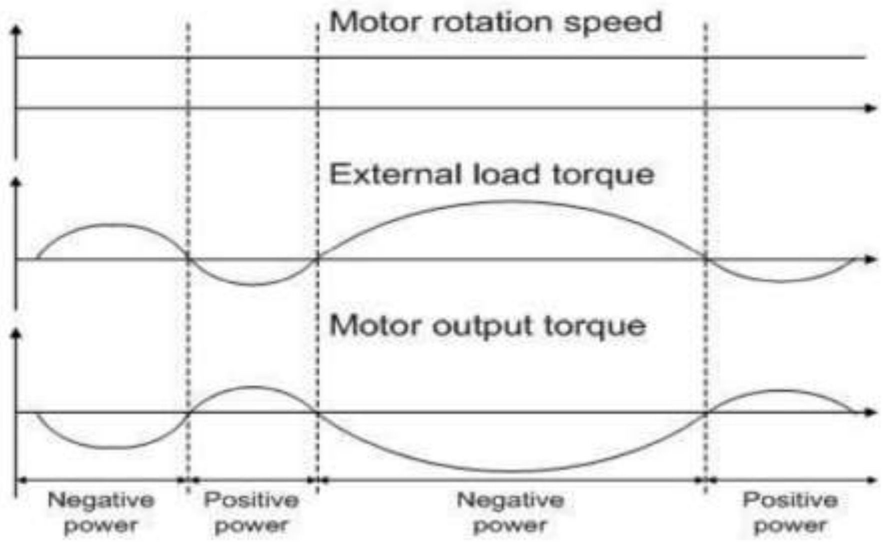
Generally, when the external load inertia is not large, the built-in regenerative resistor is sufficient. If you select a regenerative resistor with small resistance, its accumulated energy and temperature will increase. When the temperature exceeds a certain value, it may burn out the brake resistor.

You can refer to section 14.2 when using an external regenerative resistor.

(b) When there is external torque and makes the motor to do negative work

Usually, the motor does positive work and the motor's torque direction is identical to the rotation direction. However, in some case, if the external load exceeds motor torque, external energy will enter the servo drive and generate regenerative energy.

The following figure shows an example, when the motor is running at a stable speed, the external load torque is positive in most of the time and a large amount of energy is quickly transferred to the regenerative resistor.



Negative work by external load torque : TL×ω

In which TL: external load torque(Unit: Nt-m), ω: rotation speed(Unit: rad/s).

Users should try to calculate in the safest situation.

For example: when the external load torque is +50% of the rated torque and the motor speed reaches 3000 rpm, for a 400W model (rated torque: 1.27Nt-m), the users need to connect an external regenerative resistor which is 2 × (0.5× 1.27) × (3000 × 2 × π/60) = 399W, 100Ω.

Note: 1rpm = 2π／60 (rad/s).

6.6.2 Analog monitor function

This servo provides 2 analog output channels: MON1 and MON2, which is in CN1-30(MON1) and CN1-32(MON2) separately, for the users to check the required voltage signal easily. The two groups of analog output monitor item are introduced in the following table:

Name	Abbr.	Code	Range	Description	Default value	Control mode
Analog monitor output	MOD	PC14	0000h ~ 0909h	Set the analog monitor output signal, and there are 2 channels: ch1 and ch2. | 0 | ch2 | 0 | ch1 | The set values of Ch1 and Ch2 and its corresponding outputs are shown as below: 0: motor speed((±10V/2 times of rated speed) 1: motor torque (±10V/ max torque) 2: speed command (±10V/2 times of rated speed) 3: effective load rate (±10V/±300%) 4: pulse command frequency (±10V/4300k pules/s) 5: current command (±10V/max current command) 6: DC Bus voltage(±10V/450V) 7: error pulse number (±10V/1048576 pulse) 8: error pulse number (±10V/10000 pulse) 9: error pulse number (±10V/100 pulse)	0100h	ALL

Use below sample to illustrate:

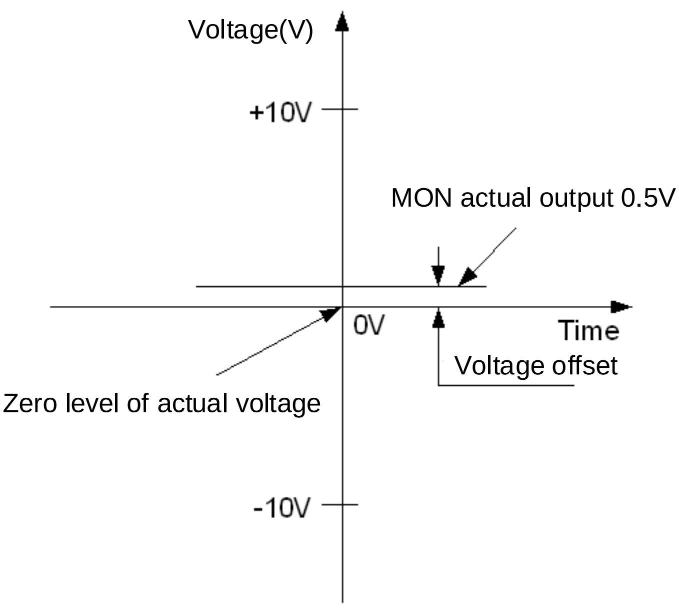
If the analog monitor output (PC14) is set to 0000, the rated speed of the motor is ±3000 rpm (± means forward and reverse rotation), and the current speed of the motor is 3000 rpm in forward direction. The user can measure the analog voltage output of +5V from the CN1-30 terminal. The above example is the analog voltage value observed when the user does not adjust the parameters of PC28~PC31.

Analog Monitor Voltage offset

The analog monitor voltage offset parameter are used to set the compensation to eliminate the analog voltage offset. Assuming that the zero value of MON1 and MON2 does not match the actual zero value, the analog monitor voltage offset parameter can be adjusted, the description is as follows:

Name	Abbr.	Code	Range	Description	Unit	Default value	Control mode
Analog monitor MO1 voltage offset	MO1	PC28	-999 ~ 999	Used to set the offset voltage of the analog monitor MON1 output.	mV	0	ALL
Analogue monitor MO2 voltage offset	MO2	PC29	-999 ~ 999	Used to set the offset voltage of the analog monitor MON2 output.	mV	0	ALL

Use below example to illustrate:



Assuming that the motor speed is 0 rpm, the voltage value which is observed by the analog output monitor (MOD) should be 0V. From the above figure, the difference between the analog voltage output by MOD and the actual voltage is 0.5V. At this time, as long as PC28 or PC29 is set to -500, the analog voltage of MOD can be corrected to the same value as the actual voltage. If the analog voltage of MOD is smaller than the actual voltage, please input a positive value in PC28 or PC29.

Analog monitor output ratio

The analog monitor output ratio is used to set the resolution of the analog monitor voltage output. The relevant parameters are as follows:

Name	Parameter abbreviation	Parameter code	Setting range	Description	Unit	Default value	Control mode
MON1 analog monitor output ratio	MOG1	PC30	1~100	Set the maximum ratio of analog monitor 1 output	%	100	ALL
MON2 analog monitor output ratio	MOG2	PC31	1~100	Set the maximum ratio of analog monitor 2 output	%	100	ALL

Assuming that the rated speed of the motor is ±3000 rpm, and the current speed of the motor is +3000 rpm, the voltage observed by the MON should be +5V. If MOG1 or MOG2 is set to 50%, the analog voltage observed by the MON will become +10V.

MOD output voltage= current monitoring value/ maximum monitoring value * 10V / MOG.

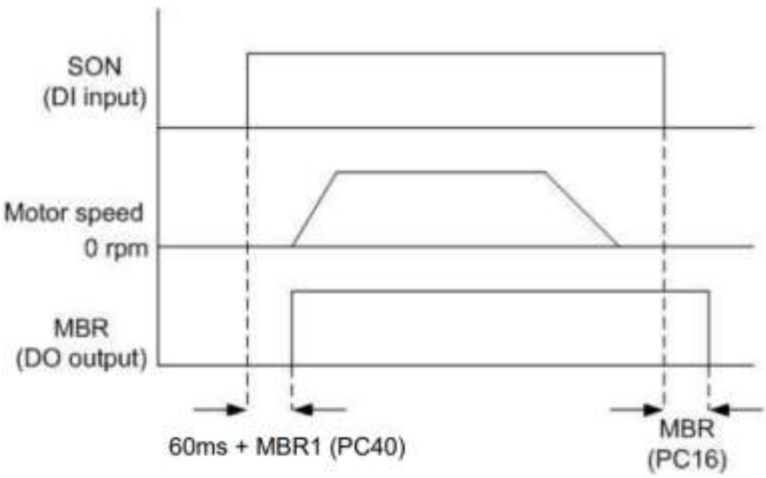
The unit of MOG1 and MOG2 are %.

6.6.3 Operation of electromagnetic brake

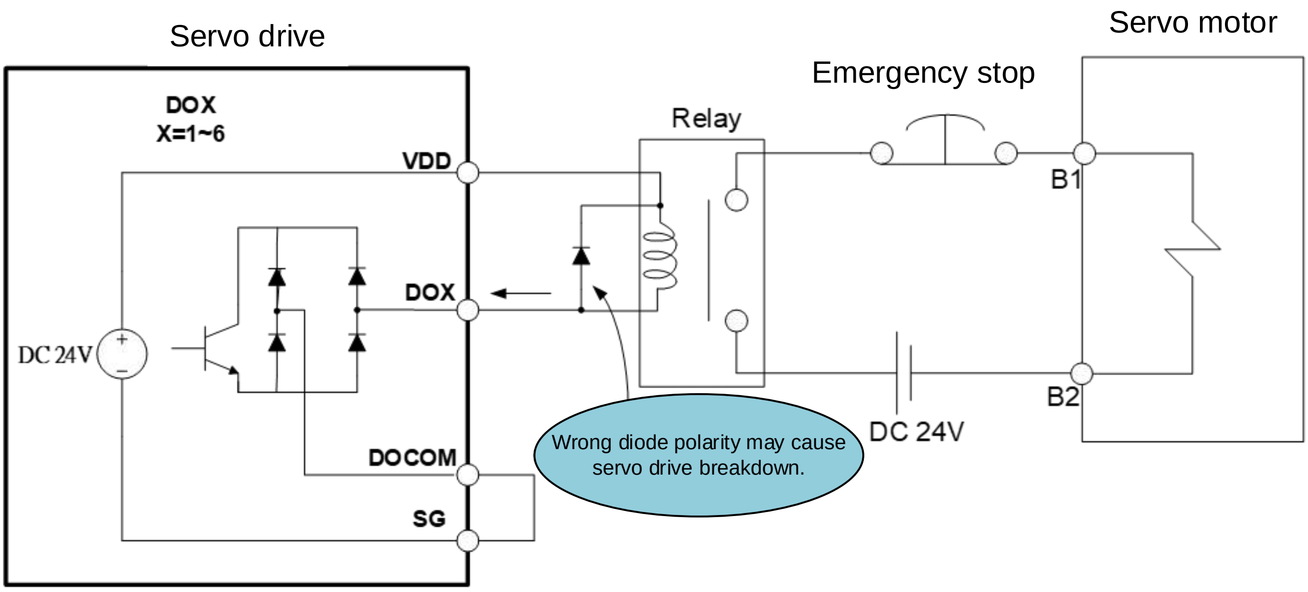
The electromagnetic brake operation is based on: (1)When the MBR is OFF, it means that the electromagnetic brake is disabled and the motor is locked; (2)When the MBR is ON, it means that the electromagnetic brake is activated and the motor can run freely. The electromagnetic brake operation can be set by PC40 and PC16. The PC40 controls the delay output time when the electromagnetic brake interlock signal (MBR) is turning on after the initial delay time of SON ON, and PC16 sets delay time from the SON signal OFF to the electromagnetic brake interlock signal (MBR) turn off. Usually electromagnetic brakes are used in the Z-axis (vertical axis) direction to reduce the large amount of heat generated by the continuous resistance of the servo motor, which is to shorten the lifetime of the motor. To avoid unnecessary malfunction, the electromagnetic brake must be operated after the servo is turned off. The brake signal controls solenoid valve, which makes a loop of 24V external power and provides power supply to turn on the electromagnetic brake.

- ◆ When the brake signal controls solenoid valve, makes a loop with external 24V power supply, provides power for electromagnetic brake and turn the electromagnetic brake on.
- ◆ Brake coil has no polarity.
- ◆ It is forbidden to use the internal +24V power supply (VDD) of the drive as the motor brake power supply
- ◆ If the MBR DO signal is not applied, you should follow the MBR brake control timing diagram.
- ◆ To enable DO MBR function, PA01 need to be set to 01 □□.

Electromagnetic brake control timing diagram:



Wiring diagram of electromagnetic brake:



Specification of electromagnetic brake:

Motor model name (○B□□/ ○D□□)	SME Series					
	L00530/ L01030	□02030/ □04030	L07530	H07530	H08515/ □10020/ H13015/ □15020/ H18015/ L20020/ L30020	M20020/ M30020
Electromagnetic brake type	Spring brake type					
Rated voltage (V)	DC 24V					
Power consumption (W)	6.3	7.9	8.6	8.0	23	34
Rated current (A)	0.24	0.32	0.35	0.33	0.95	1.41
Friction Torque (N·m)	0.3	1.3	2.4	2.5	16	45

Motor model name (○B□□/ ○D□□)	SMP series		
	H08515	H29015/ H44015	H55015/ H75015
Electromagnetic brake type	Spring brake type		
Rated voltage (V)	DC24V		

Power consumption (W)	19.5	18.3	25
Friction Torque (N·m)	≧19.6	≧44	≧74

★ **For the description of ○□□□, please refer to Section 1.3.1**

⚠ **Note:**

The electromagnetic brake is only for the safety maintenance when motor is stopped, and cannot be used for motor deceleration braking.

7. PR (procedure) program control introductions

7.1 PR introduction

PR (Procedure) program: in the PR mode, the PR program is the smallest unit of the command. It contains one or more programs and there are 64 groups of programs can be programmed. They are a group of homing programs (PATH#0) and 63 groups of PR programs (PATH#01~PATH#63). There are three different methods to trigger the program.

Standard trigger: use POS1~POS6 to assign the triggering program, and triggered by CTRG↑.

Event trigger: the program is triggered by the rising or falling edge of EV1~EV4, and you can refer to the parameters setting of PF83 and PF84.

Software trigger: the program can be triggered by writing the required trigger number into PF82 when servo is started.

7.2 The difference between the PR mode of SDP and SDA.

	The PR mode of SDA	The PR mode of SDP
Total number of commands	8 independent positions	1 set of homing (PATH#0) 63 sets of programs (PATH#01~PATH#63)
Command type	positioning command	positioning/speed/JUMP/WRITE/ Indexing positioning
Position command	Either absolute/ relative	Absolute/ incremental/relative(can use alternatively)
Acceleration/deceleration time	1 group	16 groups
Rotation speed	8 groups	16 groups
Delay time	N/A	16 groups

Command trigger method	DI: POSn + TRG↑	DI: POSn + CTRG↑ Event trigger: EV1~EV4 Software trigger: PF82
Position command format	Including revolution number and pulse number.	Set 32-bit data directly (different control types have different units)
Homing function	Automatic trigger when power on (First servo start) Trigger by DI:SHOM	Automatically trigger by power on (first servo start) Trigger by DI:SHOM Program 0 (PATH#0) is homing. After the homing is completed, the specified program can be automatically executed
Software limit protection	N/A	Yes

7.3 DI/DO and sequences in PR mode

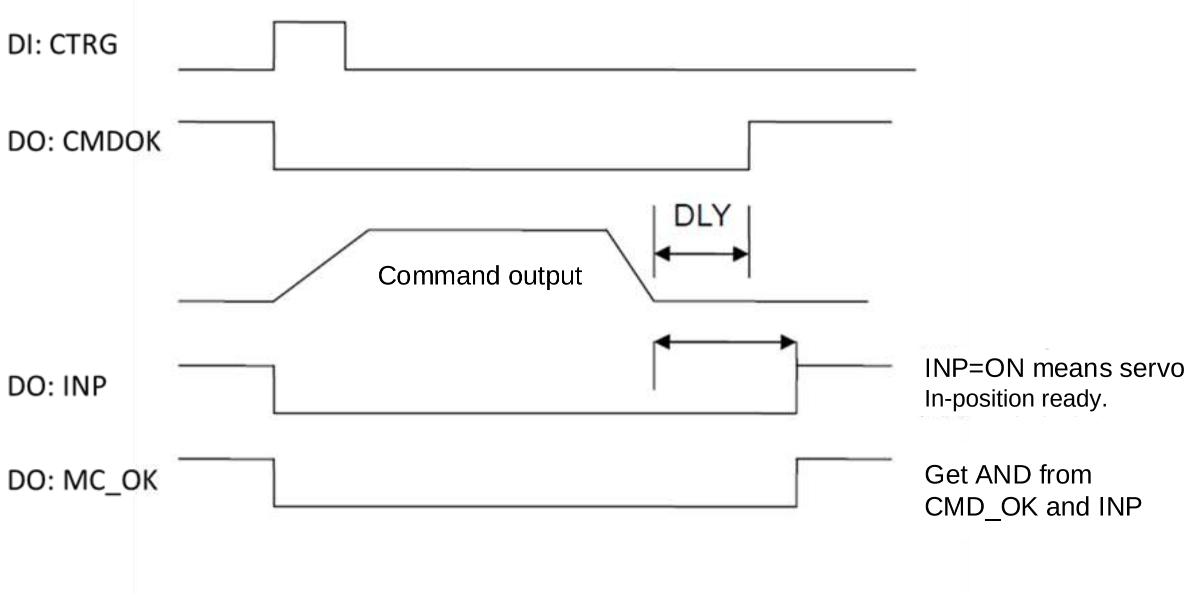
DI Signal:

CTRG, SHOM, STOP, POS1~POS6, ORGP, LSP, LSN, EV1~EV4.

DO Signal :

CMDOK, MC_OK, INP(Servo In-position ready), ALM, OVF(Position command overflow), SWPL(Software positive limit reached), SWNL(Software negative limit reached).

The timing diagram of INP, CMDOK and MC_OK are as below:



PR command trigger method description

	Command source	Description
STANDARD	DI: CTRG↑+POS1~6	Use DI: use POS1~6 to assign the triggered. program number, and triggered by rising edge of CTRG. Applicable occasions: PC or PLC issues commands via DI.
DEDICATED	DI: STOP, SHOM	DI: when STOP is activated, the command will be held. DI: when SHOM is activated, it will perform homing.
EVENT	DI: EV1~EV4	DI: the status change of EV1~EV4 is used as a trigger. Set the program number in PF83 triggered by event rising edge. Set the program number in PF84 triggered by event falling edge. Applicable occasions: sensor, trigger the preset program.
SOFTWARE	PF82	When servo starts, directly write the program number in PF82 to trigger the program. (Panel and PC communication software can be used.) Applicable occasions: PC controls the servo drive via communication.

7.4 Parameter setting of PR mode

Target speed: PF33~PF48, total 16 groups

	15~0 BIT
PF33~PF48	Target speed: 1 ~ 3000 (*rpm*)

Acceleration/deceleration time: PF49 ~ PF64, total 16 groups.

	15~0 BIT
PF49~PF64	Acceleration/deceleration time constant: 1 ~ 65500 (*ms*)

Delay time: PF65 ~ PF80, Total 16 groups

	15~0 BIT
PF49~PF64	Delay time: 1 ~ 32767 (*ms*)

Relevant parameters of PR mode

	Parameter description
PA04	Homing mode setting
PA08	Homing high speed option 1
PA09	Homing low speed option 2
PE01	Homing path definition
PE02	Origin offset value definition
PF81	Protection trigger deceleration time
PF82	PR command trigger register(software)
PF86	Software forward limit
PF87	Software reverse limit
PE03~PE98	PATH#01~ PATH#48 parameter settings
PF01~PF30	PATH#49~PATH#63 parameter settings

Definition of PR program path

There are a total of 126 parameters which is PE03~PE98 & PF01~PF30 to set 63 groups of PR programs (PATH#01~PATH#63). PATH#01 can be set by PE03 and PE04, PATH#02 can be set by PE05 and PE06. . . PATH#48 can be set by PE97 and PE98, PF#49 can be set by PF01 and PF02. . . PATH#63 can be set by PF29 and PF30. Therefore, each 63 groups of PR program has two parameters to set its functions. The following introduces the 63 groups of PR programs, take the parameters PE03 and PE04 of PATH#01 as example, and the setting of the rest of the PR programs follows the same rule.

The first parameter of each PR program is the function setting parameter, the second parameter is the data setting parameter, the definition of the function setting parameter is shown in the following table: (take PATH#01 as an example)

	31~28	27~24	23~20	19~16	15~12	11~8	7~4	3~0 BIT
PE03	−	−	−	−	−	−	−	TYPE
PE04	DATA(32bit)							

In which, the TYPE determines the path form and function, its definition is as follows:

TYPE=1 is speed control, TYPE=2 is positioning control, TYPE=3 is auto positioning control, TYPE=7 is program jump, TYPE=8 is parameter writing, TYPE=A is indexing positioning control, and TYPE=2 or 3 are both positioning control, the difference is that TYPE=3 can automatically execute the next program, so there are five different control types including speed control, positioning control, program jump, parameter writing and index positioning.

Speed control(TYPE=1): its parameter definition shows in below table:(take PATH#01 for example)

	31~28	27~24	23~20	19~16	15~12	11~8	7~4	3~0 BIT
PE03	x	x	DLY	x	DEC	ACC	OPT	1
PE04	DATA(32bit): target speed(UNIT is determined by the OPT setting.)							

※When this command is executed, the motor starts to accelerate (or decelerate) at current

speed (not necessarily as 0), once the target speed is reached, the command is completed. After completion, the command continues to output at this speed without stopping.

The definition of OPT option is as follows:

OPT option			
Bit 7 (0/8)	Bit 6 (0/4)	Bit 5 (0/2)	Bit 4 (0/1)
x	UNIT (Unit)	AUTO (Auto execution)	INS (Interrupt)

※Acceptable DI:STOP and software limit.

INS: if set as INS, it means the current PR will interrupt the previous PR during execution.

AUTO: when it reaches target speed, the next program will be automatically loaded.

UNIT: bit 6=0 unit is 0.1 rpm, Bit 6=1 unit is PPS (Pulse Per Second).

ACC/DEC: the value range is 0~F which can be set as the ACC/DEC time number, and its definition is as follows:

ACC/DEC value	F	E	D	C	B	…	4	3	2	1	0
Corresponding parameters	PF64	PF65	PF64	PF63	PF62	…	PF53	PF52	PF51	PF50	PF49

DLY: the value range is 0~F which can be set as delay time number, and its definition is as follows:

DLY value	F	E	D	C	B	…	4	3	2	1	0
Corresponding parameters	PF80	PF79	PF78	PF77	PF76	…	PF69	PF68	PF67	PF66	PF65

Positioning control: when TYPE=2, the motor will stop after completion. When TYPE=3, the motor will automatically execute the next path after completing current path.(take PATH#01 for example).

	31~28	27~24	23~20	19~16	15~12	11~8	7~4	3~0 BIT
PE03	x	x	DLY	SPD	DEC	ACC	OPT	2 or 3
PE04	DATA(32bit): target position, Unit: pulse							

The definition of OPT option is as follows:

OPT option			
Bit 7 (0/8)	Bit 6 (0/4)	Bit 5 (0/2)	Bit 4 (0/1)
CMD (Command type)		OVLP (overlap)	INS (Interrupt))

CMD option		
BIT 7	BIT 6	Description
0	0	Absolute positioning command (position command=DATA)
0	1	Relative positioning command (Position command=current feedback+DATA)
1	0	Incremental positioning command(position command=the end of previous command+ DATA)

※ Acceptable DI:STOP and software limit!

INS: if set as INS, it means the current PR will interrupt the previous PR.

OVLP: allow overlap to the next path. Set DLY to 0 when overlapping.

CMD: the calculation of the position command ending is shown in the above table.

ACC/DEC: the value range is 0~F which can be set as the acceleration/deceleration time number, and its definition is as follows:

ACC/DEC value	F	E	D	C	B	…	4	3	2	1	0
Corresponding parameters	PF64	PF65	PF64	PF63	PF62	…	PF53	PF52	PF51	PF50	PF49

SPD: the value range is 0~F which can set as the target speed number, and its definition is as follows:

SPD value	F	E	D	C	B	…	4	3	2	1	0
Correspondin g parameters	PF48	PF47	PF46	PF45	PF44	…	PF37	PF36	PF35	PF34	PF33

DLY: the value range is 0~F which can be set as delay time number, and its definition is as follows:

DLY value	F	E	D	C	B	…	4	3	2	1	0
Corresponding parameters	PF80	PF79	PF78	PF77	PF76	…	PF69	PF68	PF67	PF66	PF65

Program jump: when TYPE=7, it can jump to the specified PR program number. (Take PATH#01 as an example)

	31~28	27~24	23~20	19~16	15~12	11~8	7~4	3~0 BIT
PE03	x	x	DLY	x	x	x	OPT	7
PE04	PATH_NO: specified PR program number, range(1~63), if set to 0, it stops.							

PATH_NO: jump target program number.

The definition of OPT option is as follows:

OPT option			
Bit 7 (0/8)	Bit 6 (0/4)	Bit 5 (0/2)	Bit 4 (0/1)
x	x	x	INS (interrupts)

INS: if set as INS, it means the current PR will interrupt the previous PR.

DLY: the value range is 0~F which can be set as delay time number, and its definition is as follows:

DLY value	F	E	D	C	B	…	4	3	2	1	0
Corresponding parameters	PF80	PF79	PF78	PF77	PF76	…	PF69	PF68	PF67	PF66	PF65

Parameter writing: when TYPE=8, it enable to write specified parameter(take PATH#01 for example) .

	31~28	27~24	23~20	19~16	15~12	11~8	7~4	3~0 BIT
PE03	x	SOUR	DLY	Target writing parameter			OPT	8
PE04	Source (constant value or parameter number)							

The definition of OPT option is as follows:

OPT option			
Bit 7 (0/8)	Bit 6 (0/4)	Bit 5 (0/2)	Bit 4 (0/1)
x	ROM (Write in ROM)	AUTO (Automatic execution)	INS (Interrupt)

INS: if set to INS, it means the current PR will interrupt the previous PR.

AUTO: execute the next PR path automatically when the current PR is completed.

ROM: when BIT6=0, it means the parameter will not write to EEPROM, when Bit 6=1, it means the parameter will write to EEPROM in the meantime.

Target writing parameter: the group and number of the writing parameter can be set.

Target writing parameter		
Bit 16~19	Bit 12~15	Bit 11~8
Parameter group A→1 B→2 C→3 D→4 E→5 F→6	Parameter number(Decimal) P□05→05 P□45→45 P□98→98 P□77→77	

(For example: if the writing target parameter is PF34, you can set to 634)

DLY: the value range is 0~F, it can be set as delay time number, and its definition is as follows:

DLY value	F	E	D	C	B	…	4	3	2	1	0
Corresponding parameters	PF80	PF79	PF78	PF77	PF76	…	PF69	PF68	PF67	PF66	PF65

SOUR: it is used to set the data source. There are two options: constant or parameter value.

SOUR option				Description	
Bit 27	Bit 26 (SOUR)	Bit 25	Bit 24	Data source	Write destination
x	0	x	x	Constant	P□XX
x	1	x	x	P□XX	P□XX

□: parameter group(A~F) XX: parameter number

Source: it has different definition according to SOUR setting as shown in the following table

	Source							
	31~28	27~24	23~20	19~16	15~12	11~8	7~4	3~0 bit
SOUR =0	Constant							
SOUR =1	Rsvd (0x00000)					P_Grp	P_idx	

P_Grp, P_idx: the specified writing parameter group and number.

Constant: constant data to be written.

If the written value exceeds the parameter value range, AL.63 will be displayed. If P_Grp is out of range, AL.61 will be displayed. If P_Idx is out of range, AL.62 will be displayed. If some parameters cannot be written in when SON is ON, AL.64 will be displayed and the following PR command will stop automatically.

Index positioning(Indexing): when TYPE=A, it can be applied in turret application.
(Take PATH#01 for example)

	31~28	27~24	23~20	19~16	15~12	11~8	7~4	3~0 BIT
PE03	x	OPT2	DLY	SPD	DEC	ACC	OPT	A
PE04	DATA (0~4194304): index coordinate command, unit:pulse							

The definition of OPT is as follows:

OPT option			
Bit 7 (0/8)	Bit 6 (0/4)	Bit 5 (0/2)	Bit 4 (0/1)
00: always forward (CCW) 01: always reverse(CW) 10:shortest path. (Judging by current position and target position)		OVLP (overlap)	INS (interrupt)

INS: if set as INS, it means the current PR will interrupt the previous PR.

OVLP: it allows to overlap the next PR command. Set DLY as 0 when it is used.

ACC/DEC: the value range is 0~F and it can be set as acceleration / deceleration time number, its definition is as follows:

ACC/DEC value	F	E	D	C	B	…	4	3	2	1	0
Corresponding parameters	PF64	PF65	PF64	PF63	PF62	…	PF53	PF52	PF51	PF50	PF49

SPD: the value range is 0~F and it can be set as target speed number, its definition is as below:

SPD value	F	E	D	C	B	…	4	3	2	1	0
corresponding parameters	PF48	PF47	PF46	PF45	PF44	…	PF37	PF36	PF35	PF34	PF33

DLY: the value range is 0~F and it can be set as delay time number, its definition is as follows:

DLY value	F	E	D	C	B	…	4	3	2	1	0
Corresponding parameters	PF80	PF79	PF78	PF77	PF76	…	PF69	PF68	PF67	PF66	PF65

The definition of OPT2 option is as follows:

OPT2 option			
Bit 27 (0/8)	Bit 26 (0/4)	Bit 25 (0/2)	Bit 24 (0/1)
x	AUTO	S_LOW	

S_LOW: the speed unit options.
S_LOW =0 means the speed unit is 0.1 rpm.
S_LOW =1 means the speed unit is 0.01 rpm.
S_LOW =2 means the speed unit is1 rpm.
AUTO: execute the next PR path when the current PR completes

DATA: set each indexing positioning coordinate value.

DATA format
Pulse: 0~1048575

Homing definition: set by PE01 and PE02.

	31~28	27~24	23~20	19~16	15~12	11~8	7~4	3~0 BIT
PE01	BOOT	x	DLY	x	DEC1	ACC	PATH	
PE02	ORG_DEF (32 bit)							

PATH: set the action after homing, and its definition is shown in the table below:

PATH option		
Bit 4~7	Bit 0~3	Description
0	0	Stop after homing.
0	1	Execute PATH#01 after homing
0	2	Execute PATH#02 after homing
~	~	~
3	E	Execute PATH#62 after homing
3	F	Execute PATH#63 after homing

ACC: the value range is 0~F and it can be set as acceleration time number, its definition is as follows:

ACC value	F	E	D	C	B	…	4	3	2	1	0
Corresponding parameters	PF64	PF65	PF64	PF63	PF62	…	PF53	PF52	PF51	PF50	PF49

DEC1: the value range is 0~F, and it can be set as the first deceleration time number, its definition is shown as below:

ACC value	F	E	D	C	B	…	4	3	2	1	0
Corresponding parameters	PF64	PF65	PF64	PF63	PF62	…	PF53	PF52	PF51	PF50	PF49

The second deceleration time is same as the STP deceleration time in PF81.

DLY: the value range is 0~F and it can be set as delay time number, its definition is as follows:

DLY value	F	E	D	C	B	…	4	3	2	1	0
Corresponding parameters	PF80	PF79	PF78	PF77	PF76	…	PF69	PF68	PF67	PF66	PF65

BOOT: to set whether to execute the homing when the servo is started for the first time.

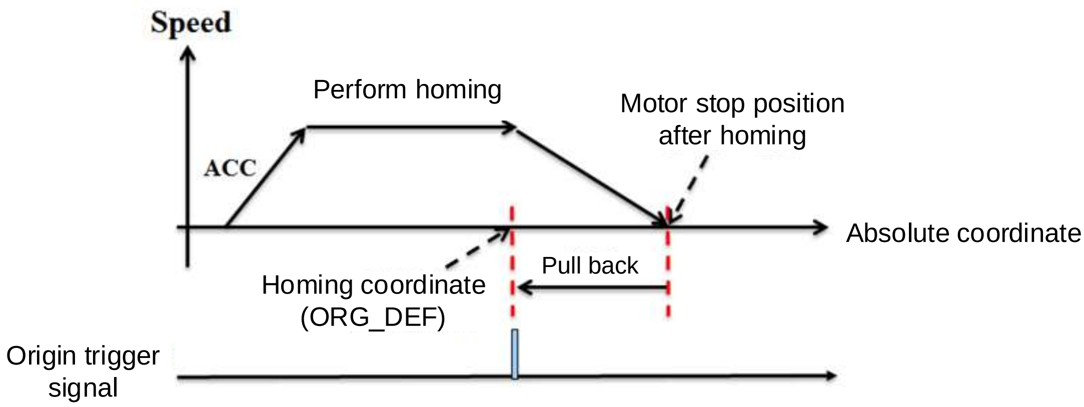
BOOT option

Bit 28~31	Description
0	NOT execute homing when servo starts for the first time
1	Execute homing when servo starts for the first time

ORG_DEF: the coordinate value of the origin and it may not be 0.

ORG_DEF format
Pulse: $(-2^{31}) \sim (2^{31}-1)$

The servo does not provide origin stop mode option, which is to set whether to pull back to the origin after completion! Since the motor must decelerate to stop after the origin is found (origin signal or Z pulse), and the stop position will be a little ahead over the origin as shown in the figure below:



If pull back is not needed, set PATH to 0.

If pull back is needed, set PATH=A , which means the servo will execute PATH#A automatically after homing when PATH#A is set to absolute command for positioning control and command value =ORG_DEF.

The homing does not define an offset value (Offset), and it uses PATH to specify a path as the offset value! It is recommended to use absolute positioning command for this path, and set the command value = offset value(value of absolute coordinates).

7.5 PR sequence status

In PR mode, all 63 groups of programs can be set as five control types: speed control, positioning, path jump, parameter writing and index positioning. As these 63 programs can perform various control combinations according to the settings, the PR mode of SDP servo provides three sequences which could be linked to the other PR: 1. automatically execute the next program (AUTO), 2.interrupt (INS), 3, overlap (OVLP). Among them, AUTO and interrupt can be applied in all five control types, but the overlap function can only be used when one positioning control program follows by another positioning control program. The following introduces the three different sequences:

1. **Sequential command:** if INS and OVLP are not set in PR, the program will follow the original setting sequence. If the previous program has set to AUTO sequences, the next program will execute automatically after the setting delay time when the previous program is completed.

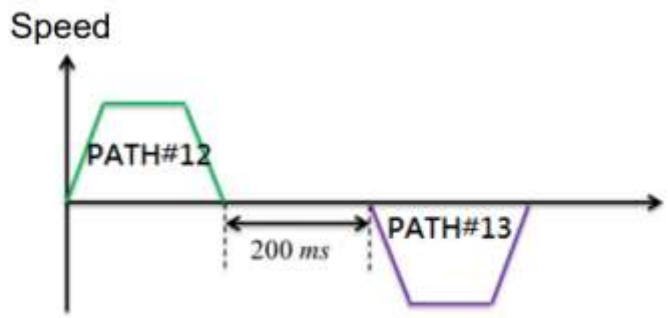
2. **Overlapping command:** if the previous and next program are both positioning control program, overlap function can be set in the previous program to enable overlapping to the next positioning control, which will make the two positioning control to transit smoothly, and reduce the vibration during transition.

3. **Interrupt command:** it indicates that the current PR will immediately replace or combined by another command before completion. The result of the final command will be varied according to different control types.

Sequential command(AUTO): use the AUTO function to generate a fixed sequence of program command combinations.

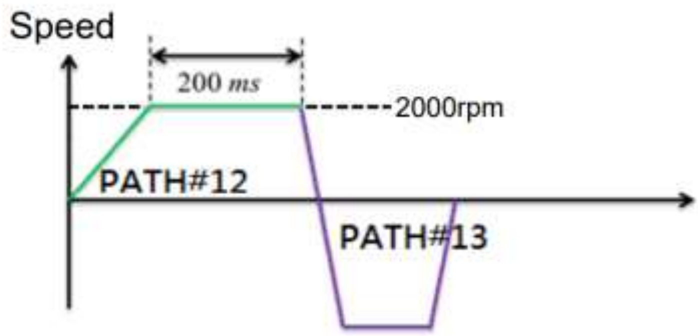
PATH#12 (AUTO positioning control, incremental positioning path: 104857600 pulse, delay time: 200ms) → PATH#13(Positioning control, absolute positioning: 0 pulse).

As shown in the figure below, which is a typical sequential command of positioning control followed by positioning control. In positioning control, the delay time starts counting after the positioning is completed.



PATH#12(AUTO speed control, target speed: 2000 rpm, delay time: 200ms) → PATH#13 (Positioning control, absolute positioning: 0 pulse)

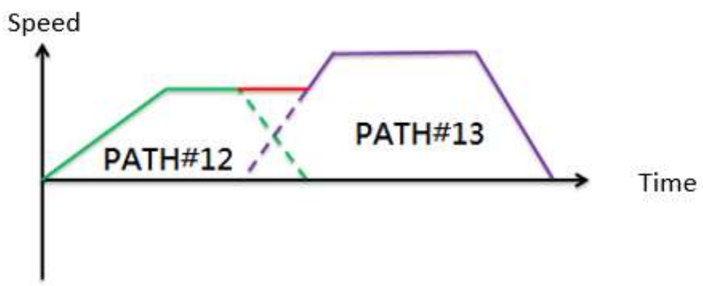
As shown in the figure below, it is a typical sequential command of speed control followed by positioning control. In speed control, the delay time will start counting after the positioning is completed.



Overlapping command(OVLP): in the sequential command, if one positioning control is followed by another positioning control, the former positioning will control the overlapping of the latter positioning control commands. Overlap is that the acceleration of latter command overlaps the deceleration of former command immediately, and helps this 2 positioning control to transit smoothly.

PATH#12(AUTO positioning control, overlap, incremental positioning path: 104857600 pulse, target speed: 500 rpm, ACC: 400 ms) → PATH#13(Positioning control, incremental positioning path: 104857600 pulse, target speed: 700 rpm, delay time: 0 ms, DEC: 200 ms).

From the figure below, it can be observed that the two positioning commands can be transited very smoothly by the overlapping function, and the speed vibration during program switching is reduced.

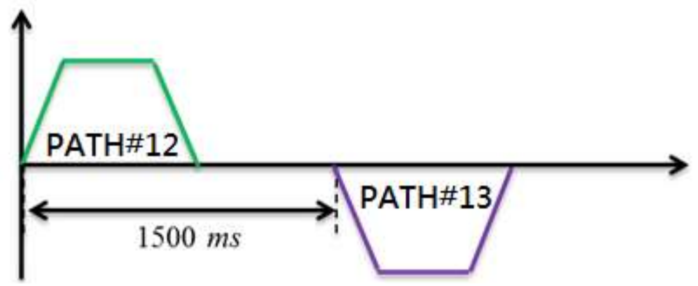


Interrupt command(INS): it can be applied in any control type, and it is always be set in the latter program. PR mode of SDP servo provides internal INS and external INS.

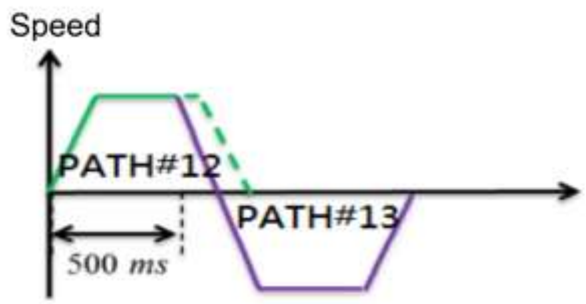
1.Internal INS: which is a sequential command with interrupt setting in the latter program. The biggest difference from the sequential command is the definition of the delay time. The delay time of sequential commands is calculated from when the target position or target speed is reached, but internal INS is calculated from the beginning of the former program, as shown in the following example.

PATH#12(AUTO positioning control, incremental positioning path: 10485760 pulse, target speed: 600 rpm, delay time: 1500 ms, ACC: 200 ms, DEC: 200 ms) → PATH#13(Positioning control, with INS command, incremental positioning path: -10485760 pulse, target speed: 600 rpm, delay time: 0 ms, ACC: 200 ms, DEC: 200 ms).

The execution result of this program is shown in the figure below, and the internal interruption helps the entire control program to manage time easily.



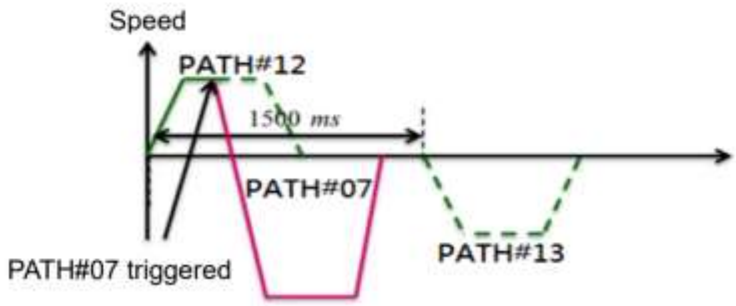
The delay time of internal INS should not be less than the completion time of the program, otherwise it will interrupt by the latter program before the former program is completed, as shown in the figure below:



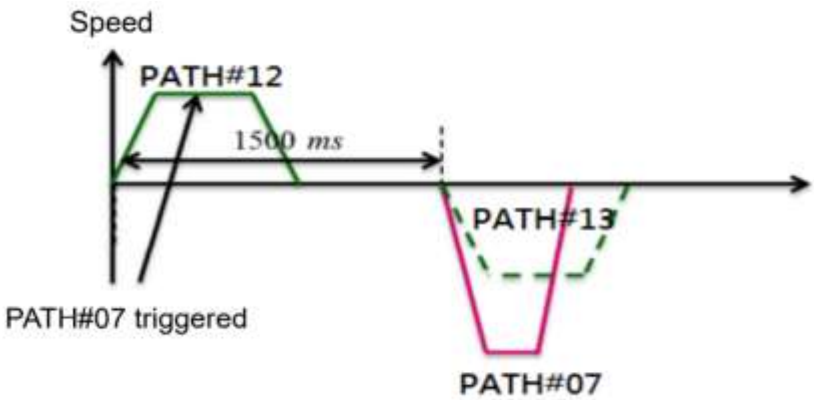
2.External INS: the biggest difference between internal INS and external INS is the trigger of the latter program with INS. The former is planned by sequential commands, and the latter is triggered by external triggers. In addition, the delay time setting in the previous program is invalid when the external interrupt occurs. As shown in below example:

PATH#12(AUTO positioning control, incremental positioning path: 10485760 pulse, target speed: 600 rpm, delay time: 1500 ms, ACC: 200 ms, DEC: 200 ms) → PATH#13(Positioning control, with INS, incremental positioning path: -10485760 pulse, target speed: 600 rpm, delay time: 0 ms, ACC: 200 ms, DEC: 200 ms) .

The above is a preset program control flow, if an external DI triggers PATH#07 at 400ms (positioning control, with INS, absolute positioning coordinate: 0 pulse, target speed: 3000 rpm, delay time: 0 ms, ACC: 200 ms, DEC: 200 ms), the execution result of the program is shown in below. Once the external INS occurs, the external INS program will replace the original sequential command and execute immediately, so the external interruption can be used for an emergency treatment.



In addition, if a new program is externally triggered during executing a program, which is not set interruption, you must wait for the complete of the executing program before starting the triggered program, as shown in the figure below:



8. Parameters

8.1. Parameter definitions

From the perspective of safety and frequency of use, Shihlin drive parameters have below types: basic parameters, gain and filter parameters, expansion parameters, and input/output setting parameters. When you want to adjust parameter reading and writing permissions, you can modify the setting of PA42 to change the setting of expansion parameters.

The following are the precautions of parameter setting.

1. Parameter type classification

In section 8.2, parameters are classified into a parameter list according to its function, which is for the users to use conveniently. For detailed parameter descriptions you can refer to section 8.3.

2. **Special symbols for parameter codes**

(■) the setting is vanished once power is off.

(*) the setting is valid after power cycling, such as PA01.

(▲) You are not able to set the parameter when Servo is ON, such as PA07. And there are 2 ways to switch off the servo.

(1) Turn off the SON DI signal.

(2) Set SON signal to 0 by changing PD16 , and ensure to restore PD16 after completion of the modification.

Below is the group classification according to different functions.

Parameter group	Main content
Basic parameter (No PA□□)	When the servo drive is used to perform position control, you need to set these basic parameters.
Gain, filter parameter (No PB□□)	When the servo drive is used to perform manual gain adjustment, you need to set these parameters.
Expansion setting parameter (No PC□□)	This is the main parameter group used when speed control and torque control mode is applied.
Input/output setting parameter (No PD□□)	Used to change the output/input signal of the servo drive.

Pr path parameter 1 (No PE□□)	Related parameter group 1 for Pr position path assignment.
Pr path parameter 2 (No PF□□)	Related parameter group 2 for Pr position path assignment.

The description of control mode is as follows:

Mode name		Mode code	Description
Single mode	Position mode (terminal input)	Pt	Drive receives the external position pulse command which is input from terminal, and runs the motor to the target position.
	Position mode (internal register input)	Pr	The drive receives the position command which is provided by the internal register and runs the motor to the target position. You can use the DI signal to select the register number.
	Speed mode.	S	The drive receives the speed command and runs the motor to the target speed. The speed command can be selected by the DI signal between analog voltage command or internal speed command(7 groups of register).
	Torque mode	T	The drive receives torque command and runs the motor to the target torque. The torque command is provided by analog voltage command and internal torque command.
Multi-mode		Pt-S	Pt/S is switched mutually via the signal of DI(LOP).
		Pt-T	Pt/T is switched mutually via the signal of DI(LOP)..
		Pr-S	Pr/S is switched mutually via the signal of DI(LOP)..
		Pr-T	Pr/T is switched mutually via the signal of DI(LOP)..
		S-T	S/T is switched mutually via the signal of DI(LOP)..
		Pt-Pr	Pt/Pr is switched mutually via the signal of DI(Pt-Pr)..
		Pt-Pr-S	Pt/Pr/S is switched mutually via the signal of DI(LOP+Pt-Pr).
		Pt-Pr-T	Pt/Pr/T is switched mutually via the signal of DI(LOP+Pt-Pr).

8.2. List of Parameters

The parameters of Shihlin servo are mainly classified into four categories, they are PA parameter group ~ PF parameter group. PA parameters are basic parameters, such as control mode selection, auto tuning function, etc. The PB parameters are gain and filter parameters. The PB parameters helps the servo motor to run in a more stable state. PC parameters are extension parameters, which includes parameters for speed mode, torque mode, analog relative parameter and communication setting parameter are also included. PD parameters are input and output setting parameters, which are mainly used to set the user-defined DI and DO parameters. PE and PF parameters are Pr path assignment related parameter. The following table will list all the parameters of Shihlin servo drive, which is easier for the user to enquiry.

(1) Basic parameters

NO	Abbreviation	Name	Default value	Unit	Control mode			
					Pt	Pr	S	T
PA01(*)	STY	Control mode setting	1000h	N/A	○	○	○	○
PA02(▲)	ATUM	AUTO tuning mode setting	0002h	N/A	○	○	○	
PA03	ATUL	Auto-tuning response level setting	10	N/A	○	○	○	
PA04	HMOV	Homing mode	0000h	N/A		○		
PA05	TL1	Internal torque limit 1	100	%	○	○	○	○
PA06	CMX	Electronic gear numerator	1	N/A	○	○		
PA07(▲)	CDV	Electronic gear denominator	1	N/A	○	○		
PA08	HSPD1	Homing high speed option 1	100	rpm, mm/s		○		
PA09	HSPD2	Homing high speed option 2	20	rpm, mm/s		○		
PA10	RES1	Regenerated resistor value	Depend on model	Ohm	○	○	○	○
PA11	RES2	Regenerated resistor capacity	Depend on model	Watt	○	○	○	○
PA12	INP	In-position range	41943	Pulse	○	○		
PA13(*)	PLSS	Command pulse option	0000h	N/A	○			
PA14(*)	ENR	Encoder output pulses	10000	Pulse/rev	○	○	○	○

		number		Pulse/mm				
NO	Abbreviation	Name	Default value	Unit	Control mode			
					Pt	Pr	S	T
PA15	CRSHA	Motor crash protect level(torque percentage)	0	%	○	○	○	○
PA16	CRSHT	Motor crash protect level (protection time)	1	ms	○	○	○	○
PA17	OVL	Output overload DO warning level	120	%	○	○	○	○
PA18	OVS	Over speed warning level	6300	rpm, mm/s	○	○	○	○
PA19	OVPE	Position deviation excess output level	$3* 2^{22}$	Pulse	○	○		
PA20(*)	OVPL1	Position pulse frequency excess level 1(the AB phase command pulse can reach 16M)	4500	kHz	○			
PA22(*)	DBF	Dynamic brake control	0	N/A	○	○	○	○
PA23(■)	MCS	Memory write-inhibit function	0	N/A	○	○	○	○
PA24(*)	PRES	Resolution of linear scale for full-closed loop control	5000	pulse/rev	○	○		
PA25	PERR	Protection range for feedback position error between motor encoder and linear scale	30000	Pulse	○	○		
PA26(▲)	FCON	Linear scale for full-closed loop switch	0000	N/A	○	○		
PA27	FELP	Low-pass filter time constant for full-closed and semi-closed loop	100	ms	○	○		
PA28(*)	ABS	Absolute encoder setting	0000h	N/A	○	○	○	○
PA29(■)	CAP	Absolute position reset	0000h	N/A	○	○	○	○
PA30(■)	UAP	Update encoder absolute position	0	N/A	○	○	○	○
PA31	APST	Absolute coordinate system status	0000h	N/A	○	○	○	○
PA32	APP	Encoder absolute	0	Pulse	○	○	○	○

NO	Abbreviation	Name	Default value	Unit	Control mode			
		position (pulse number)						
					Pt	Pr	S	T
PA33	APR	Encoder absolute position (revolution number)	0	rev	○	○	○	○
PA34(*)	ABSM	I/O communication of absolute system	0	N/A	○	○	○	○
PA35(*)	FNO1	Function option 1	0000h	N/A	○	○	○	○
PA36(*)	FNO2	Function option 2	0000h	N/A	○	○	○	○
PA37(*)	FNO3	Function option 3	0000h	N/A	○	○	○	○
PA38	AOP3	One-touch tuning function option	0000h	N/A	○	○	○	
PA39(*)	POL	Motor rotation direction option	0000h	N/A	○	○	○	○
PA40(▲)	SPW	Special parameter write option	0000h	N/A	○	○	○	○
PA41	POSPD	Max. speed setting of pulse output	6300	rpm, mm/s	○	○	○	○
PA42(*)	BLK	Parameter group write-inhibit setting	0000h	N/A	○	○	○	○
PA43(*)	ENB	Encoder type(read-only)	N/A	N/A	○	○	○	○
PA44(*)	EGM	Electronic gear ratio option	0	N/A	○	○		
PA45(▲)	FBP	Position command pulse number setting per revolution	10000	Pulse	○	○		
PA46(■)	ATST	One-touch gain tuning option (factory setting, forbidden to use)	0000h	N/A	○	○	○	
PA47	TLP	Positive torque limit value	5000	0.1%	○	○	○	○
PA48	TLN	Negative torque limit value	5000	0.1%	○	○	○	○
PA49	HMTQL	Homing-Torque detection level(range: 1~300)	50	%		○		
PA50	HMTQT	Homing-Torque attained time(range: 2~2000)	2000	ms		○		

(2) Gain, filter parameters

NO	Abbreviation	Name	Default value	Unit	Control mode			
					Pt	Pr	S	T
PB01	NHF1	Frequency of Machine resonance suppression filter 1	1000	Hz	○	○	○	○
PB02	NHD1	Attenuation rate of machine resonance suppression filter 1	0	dB	○	○	○	○
PB03	NLP	Resonance suppression low-pass filter	10	0.1ms	○	○	○	○
PB04	PST	Position command filter time constant	3	ms	○	○		
PB05	FFC	Position feed-forward gain	0	0.0001	○	○		
PB06	GD1	motor load inertia ratio	70	0.1 times	○	○	○	
PB07	PG1	Position loop gain	45	rad/s	○	○		
PB08	VG1	Speed loop gain	183	rad/s	○	○	○	
PB09	VIC	Speed integral gain	34	ms	○	○	○	
PB10	VFG	Speed feed-forward gain	0	%			○	
PB11(*)	CDP	Gain switch option	0000h	N/A	○	○	○	
PB12	CDS	Gain switch condition value	10	Kpps, rpm, pulse, mm/s	○	○	○	
PB13	CDT	Gain switch time constant	1	ms	○	○	○	
PB14	GD2	Servo motor load inertia ratio 2	70	0.1 times	○	○	○	
PB15	PG2	Position loop gain change ratio	100	%	○	○		
PB16	VG2	Speed loop gain change ratio	100	%	○	○	○	
PB17	VIC2	Speed integral gain change ratio	100	%	○	○	○	
PB18	SFLT	Speed command low-pass filter smooth time constant	0	ms			○	○

NO	Abbreviation	Name	Default value	Unit	Control mode			
					Pt	Pr	S	T
PB19	TQC	Torque command filter time constant	0	ms				○
PB20	SJIT	Speed feedback filter time constant	0	0.1ms	○	○	○	○
PB21	NHF2	Frequency of machine resonance suppression filter 2	1000	Hz	○	○	○	○
PB22	NHD2	Attenuation of machine resonance suppression filter 2	0	dB	○	○	○	○
PB23		Reserved						
PB24	VDC	Speed differential compensation	980	N/A	○	○	○	
PB25	NHF3	Frequency of machine resonance suppression filter 3	1000	Hz	○	○	○	○
PB26	NHD3	Attenuation of machine resonance suppression filter 3	0	dB	○	○	○	○
PB27	ANCF	Auto resonance suppression mode setting	1	N/A	○	○	○	○
PB28	ANCL	Auto resonance suppression detection level	50	%	○	○	○	○
PB29	AVSM	Auto low frequency vibration suppression mode	0	N/A	○	○		
PB30	VCL	Low-frequency vibration detection level setting	50	pulse	○	○		
PB31	VSF1	Low frequency vibration suppression frequency setting 1	1000	0.1Hz	○	○		
PB32	VSG1	Low frequency vibration suppression gain 1	0	N/A	○	○		
PB33	VSF2	Low frequency vibration suppression frequency setting 2	1000	0.1Hz	○	○		

NO	Abbreviation	Name	Default value	Unit	Control mode			
					Pt	Pr	S	T
PB34	VSG2	Low frequency vibration suppression gain 2	0	N/A	○	○		
PB35	FRCL	Friction compensation level	0	%	○	○	○	
PB36	FRCT	Friction compensation smoothing time constant	0	ms	○	○	○	
PB37	FRCM	Friction compensation mode option	0	N/A	○	○	○	
PB38	FFCT	Position feed-forward filter time constant	0	ms	○	○		
PB39 (▲)	SVP	Synchronous speed control gain	0	rad/s	○	○	○	○
PB40 (▲)	SVI	Synchronous speed integral compensation	0	rad/s	○	○	○	○
PB41 (▲)	SPI	Synchronous position integral compensation	0	Rad	○	○	○	○
PB42 (▲)	SBW	Synchronous control bandwidth	0	Hz	○	○	○	○
PB43	SVL	Synchronous speed error low-pass filter	0	0.1ms	○	○	○	○
PB44	PPD	Position loop compensation gain	0	N/A	○	○		
PB45	NHF4	Frequency of machine resonance suppression filter 4	1000	Hz	○	○	○	○
PB46	NHD4	Attenuation of machine resonance suppression filter 4	0	dB	○	○	○	○
PB47	NHF5	Frequency of machine resonance suppression filter 5	1000	Hz	○	○	○	○
PB48	NHD5	Attenuation of machine resonance suppression filter 5	0	dB	○	○	○	○
PB50	MVF	Position command average filter time constant	0	ms	○	○		

NO	Abbreviation	Name	Default value	Unit	Control mode			
					Pt	Pr	S	T
PB51	NHW1	Bandwidth of machine resonance suppression filter 1	5	N/A	○	○	○	○
PB52	NHW2	Bandwidth of machine resonance suppression filter 2	5	N/A	○	○	○	○
PB53	NHW3	Bandwidth of machine resonance suppression filter 3	5	N/A	○	○	○	○
PB54	NHW4	Bandwidth of machine resonance suppression filter 4	5	N/A	○	○	○	○
PB55	NHW5	Bandwidth of machine resonance suppression filter 5	5	N/A	○	○	○	○
PB56		Reserved						
PB57(*)	TOF	z-axis torque compensation	0	0.1%	○	○	○	○
PB58	VSD1	Attenuation of low-frequency suppression 1	80	dB	○	○		
PB59	VSD2	Attenuation of low-frequency suppression 2	80	dB	○	○		

(3) Extension parameters

NO	Abbreviation	Name	Default value	Unit	Control mode			
					Pt	Pr	S	T
PC01	STA	Acceleration time constant	200	ms			○	○
PC02	STB	Deceleration time constant	200	ms			○	○
PC03	STC	S-curve acceleration/deceleration time constant	0	ms		○	○	○
PC04	JOG	JOG speed command	300	rpm, mm/s	○	○	○	○
PC05	SC1	Internal speed command 1	100	rpm, mm/s			○	○
PC06	SC2	Internal speed command 2	500	rpm, mm/s			○	○
PC07	SC3	Internal speed command 3	1000	rpm, mm/s			○	○
PC08	SC4	Internal speed command 4	200	rpm, mm/s			○	○
PC09	SC5	Internal speed command 5	300	rpm, mm/s			○	○
PC10	SC6	Internal speed command 6	500	rpm, mm/s			○	○
PC11	SC7	Internal speed command 7	800	rpm, mm/s			○	○
PC12 (▲)	VCM	Maximum motor speed for analog speed command	3000	rpm, mm/s			○	○
PC13 (▲)	TLC	Maximum output of analog torque command	100	%	○	○	○	○
PC14	MOD	Analog monitor output	0100h	N/A	○	○	○	○
PC15(*)	SVZR	Analog input voltage zero voltage range	10	mV			○	○
PC16	MBR	Electromagnetic brake sequence output time	100	ms	○	○	○	○
PC17	ZSP	Zero speed range	50	rpm, mm/s	○	○	○	○
PC18(*)	COP1	Stop option and power interruption / restart option	0010h	N/A	○	○	○	○

NO	Abbreviation	Name	Default value	Unit	Control mode			
					Pt	Pr	S	T
PC19(*)	COP2	Alarm record clear option	0000h	N/A	○	○	○	○
PC20(*)	SNO	Servo drive communication device number	1	N/A	○	○	○	○
PC21(*)	CMS	Communication mode setting	0	N/A	○	○	○	○
PC22(*)	BPS	Communication protocol setting	0010h	N/A	○	○	○	○
PC23	SIC	Serial communication timeout option	0	s	○	○	○	○
PC24(*)	DMD	Drive status display option	0000h	N/A	○	○	○	○
PC25	TL2	Internal torque limit 2	100	%	○	○	○	○
PC26	VCO	Analog speed command offset	0	mV			○	○
PC27	TLO	Analog torque limit offset	0	mV			○	○
PC28	MO1	Analog monitor MON1 voltage offset	0	mV	○	○	○	○
PC29	MO2	Analog monitor MON2 voltage offset	0	mV	○	○	○	○
PC30	MOG1	Analog monitor MON1 output proportion	100	%	○	○	○	○
PC31	MOG2	Analog monitor MON2 output proportion	100	%	○	○	○	○
PC32	CMX2	Electronic gear numerator 2	1	N/A	○	○		
PC33	CMX3	Electronic gear numerator 3	1	N/A	○	○		
PC34	CMX4	Electronic gear numerator 4	1	N/A	○	○		
PC35(*)	VCL	Analog speed voltage limit	0	mV			○	○
PC36	VMFT	VC/VLA speed voltage linear filter time constant	0	0.1ms			○	○
PC37(*)	DTA9	AL.09 initialization delay time	0	ms	○	○	○	○
PC38(*)	FNO4	Function option 4	0000h	N/A	○	○	○	○
PC39	LPS	Low-pass setting option	0000h	N/A	○	○	○	○
PC40	MBR2	Electromagnetic brake MBR activate delay time	0	ms	○	○	○	○

NO	Abbreviation	Name	Default value	Unit	Control mode			
					Pt	Pr	S	T
PC41	CAST	Capture: start address of data array	0	N/A	○	○	○	○
PC42(■)	CAAX	Capture: axis position	0	Source pulse	○	○	○	○
PC43(■)	CAND	Capture: number of capturing times	1	N/A	○	○	○	○
PC44(■)	CACT	Capture: activate control option	0x2010	N/A	○	○	○	○
PC45	CPRS	Capture: reset position after first data captured	0	Source pulse	○	○	○	○
PC46	CPMK	Capture: masking range	0	Source pulse	○	○	○	○
PC47	CMST	Compare: start address of data array	0	N/A	○	○	○	○
PC48(■)	CMAX	Compare: axis position	0	Source pulse	○	○	○	○
PC49(■)	CMNO	Compare: number of comparing times	1	N/A	○	○	○	○
PC50(■)	CMCT	Compare: activate control	0x0064 0010	N/A	○	○	○	○
PC51	CMOF1	Compare: data shift	0	Source pulse	○	○	○	○
PC52(■)	CMOF2	Compare: data shift(can reset to zero)	0	Source pulse	○	○	○	○
PC53	CSAX	Position for synchronous capture axis	0	Source pulse		○		
PC54	CSDS	Interval between each synchronous capture action	100	Source pulse		○		
PC55	CPEX	Capture/Compare additional function setting	0x0000	N/A	○	○	○	○
PC56	CSDS	Pulse error for synchronous capture axis	0	Source pulse		○		
PC57	CSDS	Maximum correction rate for synchronous capture axis	10	%		○		

NO	Abbreviation	Name	Default value	Unit	Control mode			
					Pt	Pr	S	T
PC58	CSOF	Error offset compensation for synchronous Capture axis	0	Source pulse		○		
PC59	ECHD	E-Cam: start address of data array	100	N/A		○		
PC60	ECMN	E-Cam: segment number (N)	5	N/A		○		
PC61	ECMM	E-Cam: cycle number (M)	1	N/A		○		
PC62	ECMP	E-Cam: master axis pulse number (P)	3600	N/A		○		
PC63	ECME	E-Cam: engaged segment number	0	N/A		○		
PC64(■)	ECAX	E-Cam: master axis position	0	Source pulse		○		
PC65	PLED	E-Cam:initial lead pulse before engaged	0	Source pulse		○		
PC66(■)	ECON	E-Cam: activate E-Cam control	0x0000 0000	N/A		○		
PC67	ECRD	E-Cam: pulse number upon disengagement	0	Source pulse		○		
PC68	CPCT	Compensation time for the pulse of E-Cam master axis	0	ms		○		
PC69	CPCL	Minimum frequency of pulse compensation for the E-Cam master axis	0	Kpps		○		
PC70	CMAP1	DO:CAM_AREA1 rising-edge phase	0	Degree		○		
PC71	CMAN1	DO:CAM_AREA1 falling-edge phase	0	Degree		○		
PC72	CMAP2	DO:CAM_AREA2 rising-edge phase	0	Degree		○		
PC73	CMAN2	DO:CAM_AREA2 falling-edge phase	0	Degree		○		
PC74	PLED2	E-Cam pre-engaged pulse number	0	N/A		○		

NO	Abbreviation	Name	Default value	Unit	Control mode			
					Pt	Pr	S	T
PC75	TQ1	Inner torque command 1	100	%				○
PC76	TQ2	Inner torque command 2	100	%				○
PC77	TQ3	Inner torque command 3	100	%				○
PC78	CXFT	Filter setting for synchronous capture axis Correction	0000h	N/A		○		
PC79	ALOP	E-Cam phase alignment: operation setting	00000000h	N/A		○		
PC80	ALDY	DI delay time for E-Cam phase alignment	0	μs		○		
PC81	ALTG	E-Cam phase alignment: target position	0	Source pulse		○		
PC82	ALCT	E-Cam alignment: control switch	0000h	N/A		○		
PC83	CMSK	E-Cam master axis pulse masking setting	0000h	N/A		○		
PC84	CSDS	Motion control macro command: command parameter#4	0	N/A	○	○	○	○
PC85	CSDS	Motion control macro command: command parameter#3	0	N/A	○	○	○	○
PC86	CSDS	Motion control macro command: command parameter#2	0	N/A	○	○	○	○
PC87	CSDS	Motion control macro command: command parameter#1	0	N/A	○	○	○	○
PC88	CSDS	Motion control macro command: issue command / execution result	0	N/A	○	○	○	○
PC89	SPF1	PR special filter setting	0000h	N/A		○		
PC90	IDXS	Indexing coordinates total stroke	1000000000	Pulse	○	○	○	○
PC91(■)	PCTL	Special parameter write-in	0	N/A			○	
PC92	AYSZ	Total number of data array	800	N/A	○	○	○	○

NO	Abbreviation	Name	Default value	Unit	Control mode			
					Pt	Pr	S	T
PC93(■)	AYID	Data arrays read / write address	0	N/A	○	○	○	○
PC94(■)	AYD0	Data arrays read / write window 1	0	N/A	○	○	○	○
PC95(■)	AYD1	Data arrays read / write window 2	0	N/A	○	○	○	○
PC96	TBS	E-Cam: curve scaling	1000000	×10^(-6)		○		
PC97	ALER	E-Cam: overall pulse error	0	Source pulse		○		
PC98 ~ PC99		Reserved						

(4) Input/output setting parameters

NO	Abbreviation	Name	Default value	Unit	Control mode			
					Pt	Pr	S	T
PD01(*)	DIA1	Input signal automatic ON option 1	0000h	N/A	○	○	○	○
PD02(*)	DI1	Input signal option 1	0001h	N/A	○	○	○	○
PD03(*)	DI2	Input signal option 2	000Dh	N/A	○	○	○	○
PD04(*)	DI3	Input signal option 3	0003h	N/A	○	○	○	○
PD05(*)	DI4	Input signal option 4	0004h	N/A	○	○	○	○
PD06(*)	DI5	Input signal option 5	0002h	N/A	○	○	○	○
PD07(*)	DI6	Input signal option 6	000Fh	N/A	○	○	○	○
PD08(*)	DI7	Input signal option 7	0012h	N/A	○	○	○	○
PD09(*)	DI8	Input signal option 8	0011h	N/A	○	○	○	○
PD10(*)	DO1	Output signal option 1	0003h	N/A	○	○	○	○
PD11(*)	DO2	Output signal option 2	0008h	N/A	○	○	○	○
PD12(*)	DO3	Output signal option 3	0007h	N/A	○	○	○	○
PD13(*)	DO4	Output signal option 4	0005h	N/A	○	○	○	○
PD14(*)	DO5	Output signal option 5	0001h	N/A	○	○	○	○
PD15(*)	DIF	Digital input filter setting	0002h	N/A	○	○	○	○
PD16(■)	IOS	Digital input source control option	0000h	N/A	○	○	○	○
PD17(*)	DOP1	LSP, LSN stop mode option	0000h	N/A	○	○	○	
PD18(*)	DOP2	CR signal clear setting	0000h	N/A	○	○		
PD19(*)	DOP3	Alarm code output option	0000h	N/A	○	○	○	○
PD20(*)	DOP4	Operation option when the alarm reset signal is short-circuited	0000h	N/A	○	○	○	○
PD21(*)	DI9	Input signal option 9	0018h	N/A	○	○	○	○
PD22(*)	DI10	Input signal option 10	0019h	N/A	○	○	○	○
PD23(*)	DI11	Input signal option11	0005h	N/A	○	○	○	○
PD24(*)	DI12	Input signal option 12	0010h	N/A	○	○	○	○
PD25(■)	ITST	Communication control DI contact status	0000h	N/A	○	○	○	○
PD26(*)	DO6	Output signal option 6	0002h	N/A	○	○	○	○
PD27(*)	DOD	Definition of output signal contact	0020h	N/A	○	○	○	○

NO	Abbreviation	Name	Default value	Unit	Control mode			
					Pt	Pr	S	T
PD28	MCOK	Position attained(DO: MC_OK) option	0000h	N/A		○		
PD29(*)	DID	Software DI A/B contact setting	0000h	N/A	○	○	○	○
PD30(■)	SDO	DO contact source control switch(for turret mode)	0000h	N/A				
PD31(■)	OTST	DO communication control contact status (for turret mode)	0000h	N/A				
PD32(*)	SVDL	Servo ON delay time when SON is ON	0	ms	○	○	○	○
PD33	SFDO	Software DO register	0000h	N/A	○	○	○	○
PD34	DIS1	DI Uninterruptible Power switch function	0000h	N/A	○	○	○	○

(5) PR position path planning parameter group 1

NO	Abbreviation	Name	Default value	Unit	Control mode			
					Pt	Pr	S	T
PE01	ODEF	Homing definition	00000000h	N/A		○		
PE02	ODAT	Origin definition	0	N/A		○		
PE03	PDEF1	PATH#1 definition	00000000h	N/A		○		
PE04	PDAT1	PATH#1 data	0	N/A		○		
PE05	PDEF2	PATH#2 definition	00000000h	N/A		○		
PE06	PDAT2	PATH#2 data	0	N/A		○		
PE07	PDEF3	PATH#3 definition	00000000h	N/A		○		
PE08	PDAT3	PATH#3 data	0	N/A		○		
PE09	PDEF4	PATH#4 definition	00000000h	N/A		○		
PE10	PDAT4	PATH#4 data	0	N/A		○		
PE11	PDEF5	PATH#5 definition	00000000h	N/A		○		
PE12	PDAT5	PATH#5 data	0	N/A		○		
PE13	PDEF6	PATH#6 definition	00000000h	N/A		○		
PE14	PDAT6	PATH#6 data	0	N/A		○		
PE15	PDEF7	PATH#7 definition	00000000h	N/A		○		
PE16	PDAT7	PATH#7 data	0	N/A		○		
PE17	PDEF8	PATH#8 definition	00000000h	N/A		○		
PE18	PDAT8	PATH#8 data	0	N/A		○		
PE19	PDEF9	PATH#9 definition	00000000h	N/A		○		
PE20	PDAT9	PATH#9 data	0	N/A		○		
PE21	PDEF10	PATH#10 definition	00000000h	N/A		○		
PE22	PDAT10	PATH#10 data	0	N/A		○		
PE23	PDEF11	PATH#11 definition	00000000h	N/A		○		
PE24	PDAT11	PATH#11 data	0	N/A		○		
PE25	PDEF12	PATH#12 definition	00000000h	N/A		○		
PE26	PDAT12	PATH#12 data	0	N/A		○		
PE27	PDEF13	PATH#13 definition	00000000h	N/A		○		
PE28	PDAT13	PATH#13 data	0	N/A		○		
PE29	PDEF14	PATH#14 definition	00000000h	N/A		○		
PE30	PDAT14	PATH#14 data	0	N/A		○		
PE31	PDEF15	PATH#15 definition	00000000h	N/A		○		
PE32	PDAT15	PATH#15 data	0	N/A		○		
PE33	PDEF16	PATH#16 definition	00000000h	N/A		○		

NO	Abbreviation	Name	Default value	Unit	Control mode			
					Pt	Pr	S	T
PE34	PDAT16	PATH#16 data	0	N/A		○		
PE35	PDEF17	PATH#17 definition	00000000h	N/A		○		
PE36	PDAT17	PATH#17 data	0	N/A		○		
PE37	PDEF18	PATH#18 definition	00000000h	N/A		○		
PE38	PDAT18	PATH#18 data	0	N/A		○		
PE39	PDEF19	PATH#19 definition	00000000h	N/A		○		
PE40	PDAT19	PATH#19 data	0	N/A		○		
PE41	PDEF20	PATH#20 definition	00000000h	N/A		○		
PE42	PDAT20	PATH#20 data	0	N/A		○		
PE43	PDEF21	PATH#21 definition	00000000h	N/A		○		
PE44	PDAT21	PATH#21 data	0	N/A		○		
PE45	PDEF22	PATH#22 definition	00000000h	N/A		○		
PE46	PDAT22	PATH#22 data	0	N/A		○		
PE47	PDEF23	PATH#23 definition	00000000h	N/A		○		
PE48	PDAT23	PATH#23 data	0	N/A		○		
PE49	PDEF24	PATH#24 definition	00000000h	N/A		○		
PE50	PDAT24	PATH#24 data	0	N/A		○		
PE51	PDEF25	PATH#25 definition	00000000h	N/A		○		
PE52	PDAT25	PATH#25 data	0	N/A		○		
PE53	PDEF26	PATH#26 definition	00000000h	N/A		○		
PE54	PDAT26	PATH#26 data	0	N/A		○		
PE55	PDEF27	PATH#27 definition	00000000h	N/A		○		
PE56	PDAT27	PATH#27 data	0	N/A		○		
PE57	PDEF28	PATH#28 definition	00000000h	N/A		○		
PE58	PDAT28	PATH#28 data	0	N/A		○		
PE59	PDEF29	PATH#29 definition	00000000h	N/A		○		
PE60	PDAT29	PATH#29 data	0	N/A		○		
PE61	PDEF30	PATH#30 definition	00000000h	N/A		○		
PE62	PDAT30	PATH#30 data	0	N/A		○		
PE63	PDEF31	PATH#31 definition	00000000h	N/A		○		
PE64	PDAT31	PATH#31 data	0	N/A		○		
PE65	PDEF32	PATH#32 definition	00000000h	N/A		○		
PE66	PDAT32	PATH#32 data	0	N/A		○		
PE67	PDEF33	PATH#33 definition	00000000h	N/A		○		

NO	Abbreviation	Name	Default value	Unit	Control mode			
					Pt	Pr	S	T
PE68	PDAT33	PATH#33 data	0	N/A		○		
PE69	PDEF34	PATH#34 definition	00000000h	N/A		○		
PE70	PDAT34	PATH#34 data	0	N/A		○		
PE71	PDEF35	PATH#35 definition	00000000h	N/A		○		
PE72	PDAT35	PATH#35 data	0	N/A		○		
PE73	PDEF36	PATH#36 definition	00000000h	N/A		○		
PE74	PDAT36	PATH#36 data	0	N/A		○		
PE75	PDEF37	PATH#37 definition	00000000h	N/A		○		
PE76	PDAT37	PATH#37 data	0	N/A		○		
PE77	PDEF38	PATH#38 definition	00000000h	N/A		○		
PE78	PDAT38	PATH#38 data	0	N/A		○		
PE79	PDEF39	PATH#39 definition	00000000h	N/A		○		
PE80	PDAT39	PATH#39 data	0	N/A		○		
PE81	PDEF40	PATH#40 definition	00000000h	N/A		○		
PE82	PDAT40	PATH#40 data	0	N/A		○		
PE83	PDEF41	PATH#41 definition	00000000h	N/A		○		
PE84	PDAT41	PATH#41 data	0	N/A		○		
PE85	PDEF42	PATH#42 definition	00000000h	N/A		○		
PE86	PDAT42	PATH#42 data	0	N/A		○		
PE87	PDEF43	PATH#43 definition	00000000h	N/A		○		
PE88	PDAT43	PATH#43 data	0	N/A		○		
PE89	PDEF44	PATH#44 definition	00000000h	N/A		○		
PE90	PDAT44	PATH#44 data	0	N/A		○		
PE91	PDEF45	PATH#45 definition	00000000h	N/A		○		
PE92	PDAT45	PATH#45 data	0	N/A		○		

NO	Abbreviation	Name	Default value	Unit	Control mode			
					Pt	Pr	S	T
PE93	PDEF46	PATH#46 definition	00000000h	N/A		○		
PE94	PDAT46	PATH#46 data	0	N/A		○		
PE95	PDEF47	PATH#47 definition	00000000h	N/A		○		
PE96	PDAT47	PATH#47 data	0	N/A		○		
PE97	PDEF48	PATH#48 definition	00000000h	N/A		○		
PE98	PDAT48	PATH#48 data	0	N/A		○		
PE99		Reserved						

(6)Pr position path planning parameter group 2

NO	Abbreviation	Name	Default value	Unit	Control mode			
					Pt	Pr	S	T
PF01	PDEF49	PATH#49 definition	00000000h	N/A		○		
PF02	PDAT49	PATH#49 data	0	N/A		○		
PF03	PDEF50	PATH#50 definition	00000000h	N/A		○		
PF04	PDAT50	PATH#50 data	0	N/A		○		
PF05	PDEF51	PATH#51 definition	00000000h	N/A		○		
PF06	PDAT51	PATH#51 data	0	N/A		○		
PF07	PDEF52	PATH#52 definition	00000000h	N/A		○		
PF08	PDAT52	PATH#52 data	0	N/A		○		
PF09	PDEF53	PATH#53 definition	00000000h	N/A		○		
PF10	PDAT53	PATH#53 data	0	N/A		○		
PF11	PDEF54	PATH#54 definition	00000000h	N/A		○		
PF12	PDAT54	PATH#54 data	0	N/A		○		
PF13	PDEF55	PATH#55 definition	00000000h	N/A		○		
PF14	PDAT55	PATH#55 data	0	N/A		○		
PF15	PDEF56	PATH#56 definition	00000000h	N/A		○		
PF16	PDAT56	PATH#56 data	0	N/A		○		
PF17	PDEF57	PATH#57 definition	00000000h	N/A		○		
PF18	PDAT57	PATH#57 data	0	N/A		○		
PE19	PDEF58	PATH#58 definition	00000000h	N/A		○		
PF20	PDAT58	PATH#58 data	0	N/A		○		
PF21	PDEF59	PATH#59 definition	00000000h	N/A		○		
PF22	PDAT59	PATH#59 data	0	N/A		○		
PF23	PDEF60	PATH#60 definition	00000000h	N/A		○		
PF24	PDAT60	PATH#60 data	0	N/A		○		
PF25	PDEF61	PATH#61 definition	00000000h	N/A		○		
PF26	PDAT61	PATH#61 data	0	N/A		○		
PF27	PDEF62	PATH#62 definition	00000000h	N/A		○		
PF28	PDAT62	PATH#62 data	0	N/A		○		
PF29	PDEF63	PATH#63 definition	00000000h	N/A		○		
PF30	PDAT63	PATH#63 data	0	N/A		○		
PF31		Reserved						
PF32		Reserved						
PF33	POV1	Speed setting of internal position command 1	50	rpm, mm/s		○		

NO	Abbreviation	Name	Default value	Unit	Control mode			
					Pt	Pr	S	T
PF34	POV2	Speed setting of internal position command 2	10	rpm, mm/s		○		
PF35	POV3	Speed setting of internal position command 3	200	rpm, mm/s		○		
PF36	POV4	Speed setting of internal position command 4	300	rpm, mm/s		○		
PF37	POV5	Speed setting of internal position command 5	500	rpm, mm/s		○		
PF38	POV6	Speed setting of internal position command 6	800	rpm, mm/s		○		
PF39	POV7	Speed setting of internal position command 7	1000	rpm, mm/s		○		
PF40	POV8	Speed setting of internal position command 8	1200	rpm, mm/s		○		
PF41	POV9	Speed setting of internal position command 9	1500	rpm, mm/s		○		
PF42	POV10	Speed setting of internal position command 10	1800	rpm, mm/s		○		
PF43	POV11	Speed setting of internal position command 11	2000	rpm, mm/s		○		
PF44	POV12	Speed setting of internal position command 12	2200	rpm, mm/s		○		
PF45	POV13	Speed setting of internal position command 13	2400	rpm, mm/s		○		
PF46	POV14	Speed setting of internal position command 14	2700	rpm, mm/s		○		
PF47	POV15	Speed setting of internal position command 15	3000	rpm, mm/s		○		
PF48	POV16	Speed setting of internal position command 16	3000	rpm, mm/s		○		
PF49	POA1	Acceleration/deceleration time of internal position command 1	200	ms		○		
PF50	POA2	Acceleration/deceleration time of internal position command 2	300	ms		○		

NO	Abbreviation	Name	Default value	Unit	Control mode			
					Pt	Pr	S	T
PF51	POA3	Acceleration/deceleration time of internal position command 3	500	ms		○		
PF52	POA4	Acceleration/deceleration time of internal position command 4	600	ms		○		
PF53	POA5	Acceleration/deceleration time of internal position command 5	800	ms		○		
PF54	POA6	Acceleration/deceleration time of internal position command 6	900	ms		○		
PF55	POA7	Acceleration/deceleration time of internal position command 7	1000	ms		○		
PF56	POA8	Acceleration/deceleration time of internal position command 8	1200	ms		○		
PF57	POA9	Acceleration/deceleration time of internal position command 9	1400	ms		○		
PF58	POA10	Acceleration/deceleration time of internal position command 10	1600	ms		○		
PF59	POA11	Acceleration/deceleration time of internal position command 11	2000	ms		○		
PF60	POA12	Acceleration/deceleration time of internal position command 12	2500	ms		○		
PF61	POA13	Acceleration/deceleration time of internal position command 13	3000	ms		○		
PF62	POA14	Acceleration/deceleration time of internal position command 14	4000	ms		○		

NO	Abbreviation	Name	Default value	Unit	Control mode			
					Pt	Pr	S	T
PF63	POA15	Acceleration/deceleration time of internal position command 15	5000	ms		○		
PF64	POA16	Acceleration/deceleration time of internal position command 16	6000	ms		○		
PF65	DLY1	Delay time 1 after position reached	0	ms		○		
PF66	DLY2	Delay time 2 after position reached	100	ms		○		
PF67	DLY3	Delay time 3 after position reached	200	ms		○		
PF68	DLY4	Delay time 4 after position reached	300	ms		○		
PF69	DLY5	Delay time 5 after position reached	500	ms		○		
PF70	DLY6	Delay time 6 after position reached	600	ms		○		
PF71	DLY7	Delay time 7 after position reached	800	ms		○		
PF72	DLY8	Delay time 8 after position reached	1000	ms		○		
PF73	DLY9	Delay time 9 after position reached	1200	ms		○		
PF74	DLY10	Delay time 10 after position reached	1500	ms		○		
PF75	DLY11	Delay time 11 after position reached	2000	ms		○		
PF76	DLY12	Delay time 12 after position reached	2300	ms		○		
PF77	DLY13	Delay time 13 after position reached	2500	ms		○		
PF78	DLY14	Delay time 14 after position reached	3000	ms		○		
PF79	DLY15	Delay time 15 after position reached	4000	ms		○		

NO	Abbreviation	Name	Default value	Unit	Control mode			
					Pt	Pr	S	T
PF80	DLY16	Delay time 16 after position reached	5000	ms		○		
PF81	PDEC	Deceleration time for auto-protection	00000000h	ms	○	○	○	○
PF82(■)	PRCM	PR command trigger register	0	N/A		○		
PF83	EVON	PR number triggered by event rising edge	0000h	N/A		○		
PF84	EVOF	PR number triggered by event falling edge	0000h	N/A		○		
PF85(■)	PMEM	PATH#1 to PATH#2 data vanish after power off.	0000h	N/A	○	○	○	○
PF86	SWLP	Positive software limit	2^{31}-1	pulse		○		
PF87	SWLN	Negative software limit	-2^{31}+1	pulse		○		
PF88	BLSP	Backlash compensation value setting(before Electronic gear ratio)	0	pulse	○	○		
PF89	BLST	Backlash compensation time constant setting	0	0.1ms	○	○		
PF90	BLSF	Backlash compensation option	0	N/A	○	○		
PF91~PF99								

(7) Motor related parameters

NO	Abbreviation	Name	Default value	Unit	Motor type	
					SPM	LM
PL01		Motor type	0	N/A	○	○
PL02		Motor parameter automatic identification function and current response setting.	0	N/A	○	○
PL03		Linear motor parameter confirmation	0	N/A	○	○
PL04		Encoder type	0x0100	N/A	○	○
PL05		Encoder resolution	2500	Pulse/rev 10^{-3}um/pulse	○	○
PL06		Reserved				
PL07		Motor UVW and Hall sensor phase sequences	0x00	N/A	○	○
PL08		Hall sensor offset angle	0	0.1°(Electrical angle)	○	○
PL09		Hall sensor hysteresis width	0	0.1°(Electrical angle)	○	○
PL10		Electrical angle correction function	0x00	N/A	○	○
PL11		Z phase signal offset angle	0	0.1°(Electrical angle)	○	○
PL12		Current setting for initial magnetic field detection	100	%	○	○
PL13		Initial magnetic field detection condition	0x64	N/A	○	○
PL14		Reserved				
PL15		Reserved				
PL16		Current loop proportional gain (kp)	0	N/A	○	○
PL17		Current loop integral gain (ki)	0	N/A	○	○
PL18		Current loop gain magnification	0	%	○	○
PL19		Reserved				
PL20		Overload increase gain	100	%	○	○

NO	Abbreviation	Name	Default value	Unit	Motor type	
					SPM	LM
PL21		Overload decrease gain	100	%	○	○
PL22		Cogging compensation option	0x1A00	N/A	○	○
PL23		Motor temperature sensor	0	N/A	○	○
PL24		Motor over temperature mode option	0	N/A	○	○
PL25		Motor over temperature trigger level	150	Ohm	○	○
PL26		Motor over temperature release level	100	Ohm	○	○
PL27		Motor over temperature timeout setting	30	sec	○	○
PL28		Permanent-magnet rotary motor pole number	10	pole	○	
PL29		Permanent-magnet rotary motor rated current	30	0.01A	○	
PL30		Permanent-magnet rotary motor maximum current	100	0.01A	○	
PL31		Permanent-magnet rotary motor rated speed	3000	rpm	○	
PL32		Permanent-magnet rotary motor maximum speed	5000	rpm	○	
PL33		Permanent-magnet rotary motor torque constant	0	0.001Nm/A	○	
PL34		Permanent-magnet rotary motor rotor inertia	0	10^{-7} kg.m^2	○	
PL35		Permanent-magnet rotary motor phase resistance	0	0.001 ohm	○	
PL36		Permanent-magnet rotary motor phase inductance	0	0.01 mh	○	
PL37		Permanent-magnet rotary motor back electromotive force constant	0	10^{-4} Volt/rpm	○	
PL38		Pulse loss detection function	0	N/A	○	○
PL39		Pulse loss detection Threshold	400	pulse	○	○

NO	Abbreviation	Name	Default value	Unit	Motor type	
					SPM	LM
PL40		Pulse loss detection Z phase interval	2000	pulse	○	○
PL41		Reserved				
PL42		Linear motor pole pitch	0	0.1 mm / 360° Electrical angle		○
PL43		Linear motor rated current	30	0.01A		○
PL44		Linear motor maximum current	100	0.01A		○
PL45		Linear motor maximum speed	5000	mm/s		○
PL46		Linear motor force constant	0	0.01N/A		○
PL47		Linear motor phase resistance	0	0.001 ohm		○
PL48		Linear motor phase inductance	0	0.01 mh		○
PL49		Linear motor back electromotive force constant	0	0.1 Volt/(m/s)		○
PL50		Linear compensation option	0	N/A	○	○
PL51		Temperature sensor resistance (Read-only)	0	ohm	○	○

To facilitate the user to operate the Shihlin servo with relevant parameters and set appropriate parameters in different modes, below listed the parameters by its categories.

Torque control relevant parameters								
Parameter NO#	Abbreviation	Parameter function	Default value	Unit	Control mode			
					Pt	Pr	S	T
PA01(*)	STY	Control mode setting	1000h	N/A	○	○	○	○
PA05	TL1	Internal torque limit 1	100	%	○	○	○	○
PC05	SC1	Internal speed limit 1	100	rpm			○	○
PC06	SC2	Internal speed limit 2	500	rpm			○	○
PC07	SC3	Internal speed limit 3	1000	rpm			○	○
PC08	SC4	Internal speed limit 4	200	rpm			○	○
PC09	SC5	Internal speed limit 5	300	rpm			○	○
PC10	SC6	Internal speed limit 6	500	rpm			○	○
PC11	SC7	Internal speed limit 7	800	rpm			○	○
PC12 (▲)	VCM	Max. rotation speed of analog speed limit	3000	rpm			○	○
PC13 (▲)	TLC	Max. output of analog torque command	100	%	○	○	○	○
PC25	TL2	Internal torque limit 2	100	%	○	○	○	○
PC26	VCO	Analog speed command offset	0	mV			○	○
PC27	TLO	Analog torque limit offset	0	mV			○	○
PC35(*)	VCL	VC voltage limit	0	mV			○	○
PC75	TQ1	Internal torque command 1	100	%				○
PC76	TQ2	Internal torque command 2	100	%				○
PC77	TQ3	Internal torque command 3	100	%				○
PA47	TLP	Positive torque limit value	5000	0.1%	○	○	○	○
PA48	TLN	Negative torque limit value	5000	0.1%	○	○	○	○

Speed control relevant parameters								
Parameter NO#	Abbreviation	Parameter function	Default value	Unit	Control mode			
					Pt	Pr	S	T
PA01(*)	STY	Control mode setting	1000h	N/A	○	○	○	○
PA05	TL1	Internal torque limit 1	100	%	○	○	○	○
PA14(*)	ENR	Encoder output pulse number	10000	pulse/rev	○	○	○	○
PB18	SFLT	Speed command low-pass filter smooth time constant	0	ms			○	○
PC05	SC1	Internal speed command 1	100	rpm			○	○
PC06	SC2	Internal speed command 2	500	rpm			○	○
PC07	SC3	Internal speed command 3	1000	rpm			○	○
PC08	SC4	Internal speed command 4	200	rpm			○	○
PC09	SC5	Internal speed command 5	300	rpm			○	○
PC10	SC6	Internal speed command 6	500	rpm			○	○
PC11	SC7	Internal speed command 7	800	rpm			○	○
PC12 (▲)	VCM	Maximum motor speed for analog Speed command	3000	rpm			○	○
PC25	TL2	Internal torque limit 2	100	%	○	○	○	○
PC26	VCO	Analog speed command offset	0	mV			○	○
PC27	TLO	Analog torque limit offset	0	mV			○	○
PC35(*)	VCL	VC voltage limit	0	mV			○	○
PA47	TLP	Positive torque limit	5000	0.1%	○	○	○	○
PA48	TLN	Negative torque limit	5000	0.1%	○	○	○	○

Position control relevant parameters								
Parameter NO#	Abbreviation	Parameter function	Default value	Unit	Control mode			
					Pt	Pr	S	T
PA01(*)	STY	Control mode setting	1000h	N/A	○	○	○	○
PA04	HMOV	Homing mode	0000h	N/A		○		
PA05	TL1	Internal torque limit 1	100	%	○	○	○	○
PA06	CMX	Electronic gear numerator	1	N/A	○	○		
PA07 (▲)	CDV	Electronic gear denominator	1	N/A	○	○		
PA13 (*)	PLSS	Command pulse option	0000h	N/A	○			
PA14 (*)	ENR	Encoder output pulse number	10000	Pulse/rev	○	○	○	○
PA39(*)	POL	Motor rotation direction option	0000h	N/A	○	○	○	○
PC25	TL2	Internal torque limit 2	100	%	○	○	○	○
PC32	CMX2	Electronic gear numerator 2	1	N/A	○			
PC33	CMX3	Electronic gear numerator 3	1	N/A	○			
PC34	CMX4	Electronic gear numerator 4	1	N/A	○			
PE01	ODEF	Homing definition	00000000h	N/A		○		
PE02	ODAT	Origin definition	0	N/A		○		
PE03 ~ PE98		Refer to section 8.3 for PR related definition			○	○		
PF01 ~ PF87		Refer to section 8.3 for PR related definition			○	○		
PA47	TLP	Positive torque limit	5000	0.1%	○	○	○	○
PA48	TLN	Negative torque limit	5000	0.1%	○	○	○	○
PF89(*)	BLSF	Backlash compensation option	0	N/A	○	○		
PF90	BLSP	Backlash compensation value setting (before E-Gear ratio)	0	pulse	○	○		
PF91	BLST	Backlash compensation time constant setting	0	0.1ms	○	○		

Filter smoothing and resonance suppression relevant parameters								
Parameter NO#	Abbreviation	Parameter function	Default value	Unit	Control mode			
					Pt	Pr	S	T
PB01	NHF1	Frequency of machine resonance suppression filter 1	1000	Hz	○	○	○	○
PB02	NHD1	Attenuation rate of machine resonance suppression filter 1	0	dB	○	○	○	○
PB03	NLP	Resonance suppression low-pass filter	10	0.1ms	○	○	○	○
PB04	PST	Position command filter time constant	3	ms	○	○		
PB19	TQC	Torque command filter time constant	0	ms				○
PB20	SJIT	Speed feedback filter time constant	0	0.1ms	○	○	○	○
PB21	NHF2	Frequency of machine resonance suppression filter 2	1000	Hz	○	○	○	○
PB22	NHD2	Attenuation of machine resonance suppression filter 2	0	dB	○	○	○	○
PB23(▲)	IGE	Current gain enhancement function	0	N/A	○	○	○	○
PB25	NHF3	Frequency of machine resonance suppression filter 3	1000	Hz	○	○	○	○
PB26	NHD3	Attenuation of machine resonance suppression filter 3	0	dB	○	○	○	○
PB27	ANCF	Auto resonance suppression mode setting	1	N/A	○	○	○	○
PB28	ANCL	Auto resonance suppression detection level	50	%	○	○	○	○
PB29	AVSM	Auto low frequency vibration suppression mode setting	0	N/A	○	○		
PB30	VCL	Low-frequency vibration detection level setting	50	pulse	○	○		
PB31	VSF1	Low-frequency vibration suppression frequency setting 1	100	0.1Hz	○	○		
PB32	VSG1	Low-frequency vibration suppression gain 1	0	N/A	○	○		
PB33	VSF2	Low-frequency vibration suppression frequency setting 2	100	0.1Hz	○	○		

PB34	VSG2	Low-frequency vibration suppression gain 2	0	N/A	○	○		
PB35	FRCL	Friction compensation level	0	%	○	○	○	
PB36	FRCT	Friction compensation smoothing time constant	0	ms	○	○	○	
PB37	FRCM	Friction compensation mode option	0	N/A	○	○	○	
PB38	FFCT	Position feed forward filter time constant	0	ms	○	○		
PC01	STA	Acceleration time constant	200	ms		○	○	○
PC02	STB	Deceleration time constant	200	ms		○	○	○
PC03	STC	S-curve acceleration/deceleration time constant	0	ms		○	○	○
PD17(*)	DOP1	LSP, LSN stop mode option	0000h	N/A	○	○	○	
PB45	NHF4	Frequency of machine resonance suppression filter 4	1000	Hz	○	○	○	○
PB46	NHD4	Attenuation of machine resonance suppression filter 4	0	dB	○	○	○	○
PB47	NHF5	Frequency of machine resonance suppression filter 5	1000	Hz	○	○	○	○
PB48	NHD5	Attenuation of machine resonance suppression filter 5	0	dB	○	○	○	○
PB50	MVF	Position command average filter time constant	0	ms	○	○		
PC39	LPS	Low-pass filter setting option	0000h	N/A	○	○	○	○

Gain and switching relevant parameters								
Parameter NO#	Abbreviation	Parameter function	Default value	Unit	Control mode			
					Pt	Pr	S	T
PA02	ATUM	AUTO tuning mode setting	0002h	N/A	○	○	○	○
PA03	ATUL	Auto-tuning response level setting	0010	N/A	○	○	○	○
PB05	FFC	Position feed-forward gain	0	0.0001	○	○		
PB07	PG1	Position loop gain	45	rad/s	○	○		
PB08	VG1	Speed loop gain	183	rad/s	○	○	○	
PB09	VIC	Speed integral gain	34	ms	○	○	○	
PB10	VFG	Speed feed-forward gain	0	0.0001			○	
PB11(*)	CDP	Gain switch option	0000h	N/A	○	○	○	
PB12	CDS	Gain switch condition	10	Kpps / Pulse / rpm	○	○	○	
PB13	CDT	Gain switch time constant	1	ms	○	○	○	
PB14	GD2	Servo motor load inertia ratio 2	70	0.1times	○	○	○	
PB15	PG2	Position loop gain change ratio	100	%	○	○		
PB16	VG2	Speed loop gain change ratio	100	%	○	○	○	
PB17	VIC2	Speed integral gain change ratio	100	%	○	○	○	
PB24	VDC	Speed differential compensation	980	N/A	○	○	○	
PB44	PPD	Position loop compensation gain	0	rad/s	○	○		
PB49	DOB	External interference compensation gain	0	N/A	○	○	○	○
PB51	RND	Factory test only	0000h	N/A	○	○	○	○
PB52	TH0	Factory test only	0	N/A	○	○	○	○
PB53	TH1	Factory test only	0	N/A	○	○	○	○
PB55	Prd	Factory test only	1	sec	○	○	○	○
PB56	RnDF	Factory test only	5	ms	○	○	○	○

DI/DO relevant parameters								
Parameter NO#	Abbreviation	Parameter function	Default	Unit	Mode			
					Pt	Pr	S	T
PA12	INP	In-position range	41943	pulse	○	○		
PC17	ZSP	Zero speed range	50	rpm	○	○	○	○
PC16	MBR	Electromagnetic brake sequence output time	100	ms	○	○	○	○
PD01(*)	DIA1	Input signal automatic ON option 1	0000h	N/A	○	○	○	○
PD02(*)	DI1	Input signal option 1(pin CN1-14)	0001h	N/A	○	○	○	○
PD03(*)	DI2	Input signal option 2(pin CN1-15)	000Dh	N/A	○	○	○	○
PD04(*)	DI3	Input signal option 3(pin CN1-16)	0003h	N/A	○	○	○	○
PD05(*)	DI4	Input signal option 4(pin CN1-17)	0004h	N/A	○	○	○	○
PD06(*)	DI5	Input signal option 5(pin CN1-18)	0002h	N/A	○	○	○	○
PD07(*)	DI6	Input signal option 6(pin CN1-19)	000Fh	N/A	○	○	○	○
PD08(*)	DI7	Input signal option 7(pin CN1-20)	0012h	N/A	○	○	○	○
PD09(*)	DI8	Input signal option 8(pin CN1-21)	0011h	N/A	○	○	○	○
PD10(*)	DO1	Output signal option 1(pin CN1-41)	0003h	N/A	○	○	○	○
PD11(*)	DO2	Output signal option 2(pin CN1-42)	0008h	N/A	○	○	○	○
PD12(*)	DO3	Output signal option 3(pin CN1-43)	0007h	N/A	○	○	○	○
PD13(*)	DO4	Output signal option 4(pin CN1-44)	0005h	N/A	○	○	○	○
PD14(*)	DO5	Output signal option 5(pin CN1-45)	0001h	N/A	○	○	○	○
PD15(*)	DIF	Digital input filter setting	0002h	N/A	○	○	○	○
PD16(*)	IOS	Digital input source control option	0000h	N/A	○	○		
PD17(*)	DOP1	LSP, LSN stop mode option	0000h	N/A	○	○	○	
PD18(*)	DOP2	CR signal clear setting	0000h	N/A	○	○		
PD19(*)	DOP3	Alarm code output option	0000h	N/A	○	○	○	○
PD20(*)	DOP4	Operation option when the alarm reset signal is short-circuited	0000h	N/A	○	○	○	○
PD21(*)	DI9	Input signal option 9	0018h	N/A	○	○	○	○
PD22(*)	DI10	Input signal option 10	0019h	N/A	○	○	○	○
PD23(*)	DI11	Input signal option 11	0005h	N/A	○	○	○	○
PD24(*)	DI12	Input signal option 12	0010h	N/A	○	○	○	○
PD25(■)	ITST	Communication control DI status	0000h	N/A	○	○	○	○
PD26(*)	DO6	Output signal option 6	0002h	N/A	○	○	○	○
PD27(*)	DOD	Definition of output signal contact	0020h	N/A	○	○	○	○
PD29	DID	Software DI A/B contact setting	0000h	N/A	○	○	○	○
PD33	SFDO	Software DO register	0000h	N/A	○	○	○	○

Communication relevant parameters								
Parameter NO#	**Abbreviation**	**Parameter function**	**Default value**	**Unit**	**Control mode**			
					Pt	Pr	S	T
PC20(*)	SNO	Servo drive communication device number	1	N/A	○	○	○	○
PC21(*)	CMS	Communication mode option	0	N/A	○	○	○	○
PC22(*)	BPS	Communication protocol option	0010h	N/A	○	○	○	○
PC23	SIC	Serial communication timeout option	0	s	○	○	○	○
PA23(■)	MCS	Memory write-inhibit function	0	N/A	○	○	○	○
PC41 ~ PC60		Communication mapping relevant parameters						

Monitor and status display relevant parameters								
Parameter NO#	**Abbreviation**	**Parameter function**	**Default value**	**Unit**	**Control mode**			
					Pt	Pr	S	T
PC14	MOD	Analog output monitor	0100h	N/A	○	○	○	○
PC24(*)	DMD	Drive status display option	0000h	N/A	○	○	○	○
PC28	MO1	Analog monitor MON1 voltage offset	0	mV	○	○	○	○
PC29	MO2	Analog monitor MON2 voltage offset	0	mV	○	○	○	○
PC30	MOG1	Analog monitor MON1 output proportion	100	%	○	○	○	○
PC31	MOG2	Analog monitor MON2 output proportion	100	%	○	○	○	○

Other parameters								
Parameter NO#	Abbreviation	Parameter function	Default value	Unit	Control mode			
					Pt	Pr	S	T
PA40(▲)	SPW	Special parameter write-in function	0000h	N/A	○	○	○	○
PA42(*)	BLK	Parameter group write-inhibit setting	0000h	N/A	○	○	○	○
PB06	GD1	Servo motor load inertia ratio	70	0.1times	○	○	○	
PB14	GD2	Servo motor load inertia ratio 2	70	0.1times	○	○	○	
PC18(*)	COP1	Stop option and power interruption / restart option	0010h	N/A	○	○	○	○
PC19(*)	COP2	Alarm record clear option	0000h	N/A	○	○	○	○
PD20(*)	DOP4	Operation option when the alarm reset signal is short-circuited	0000h	N/A	○	○	○	○

8.3. Parameter group introduction

<table>
<tr><th>No</th><th>Abbr.</th><th>Parameter function and description</th><th>Mode</th><th>Default</th><th>Range</th><th>Unit</th></tr>
<tr><td>PA01</td><td>STY
(*)</td><td>Control mode setting value
<table><tr><td>u</td><td>z</td><td>y</td><td>x</td></tr></table>
<u>yx: to set control mode</u>
Pulse position mode: PT
Inner position mode: PR
Speed mode: S Torque mode: T
<table>
<tr><th>y</th><th>x</th><th>Control mode</th></tr>
<tr><td rowspan="6">0</td><td>0</td><td>PT</td></tr>
<tr><td>1</td><td>PT-S</td></tr>
<tr><td>2</td><td>S</td></tr>
<tr><td>3</td><td>S-T</td></tr>
<tr><td>4</td><td>T</td></tr>
<tr><td>5</td><td>P-T</td></tr>
<tr><td rowspan="6">1</td><td>0</td><td>PR</td></tr>
<tr><td>1</td><td>PR-S</td></tr>
<tr><td>2</td><td>S</td></tr>
<tr><td>3</td><td>S-T</td></tr>
<tr><td>4</td><td>T</td></tr>
<tr><td>5</td><td>PR-T</td></tr>
<tr><td rowspan="6">3</td><td>0</td><td>PT-PR</td></tr>
<tr><td>1</td><td>PT-PR-S</td></tr>
<tr><td>2</td><td>S</td></tr>
<tr><td>3</td><td>S-T</td></tr>
<tr><td>4</td><td>T</td></tr>
<tr><td>5</td><td>PT-PR-T</td></tr>
</table>
<u>z: electromagnetic brake function enabled option</u>
This function is digital output function, you can set it by setting PD10~PD14. It’s only valid when using a servo motor with electromagnetic brake.
z=0: disabled electromagnetic brake function
z=1: enable electromagnetic brake function</td><td>All</td><td>1000h</td><td>0000h
~
1135h</td><td>N/A</td></tr>
</table>

No	Abbr.	Parameter function and description	Mode	Default	Range	Unit
		u: DI,DO setting value control u=0: the value of DI, DO(PD02 ~ PD14, PD21~PD24, PD26) are fixed during mode switching, DI, DO can be planned by user at this time. u=1: the value of DI, DO(PD02 ~ PD14, PD21~PD24, PD26) are varied with different control modes during mode switching, DI, DO cannot be planned at this time.				
PA02	ATUM (▲)	Auto tuning mode setting: 0 | 0 | 0 | x x: auto gain tuning mode setting options x=0~1: manual gain tuning mode(PI control) x=2: auto-gain tuning mode 1(adjust load inertia ratio and bandwidth continuously) x=3: auto-gain tuning mode 2(fixed load inertia ratio, bandwidth is adjustable) x=4: interpolation mode (fixed position loop gain(PB07), and auto-adjust the remaining gain value) x=5: interpolation mode 2(fixed PB06 and PB07, and auto adjust the remaining gain value)	Pr, P, S	0002h	0000h ~ 0005h	N/A

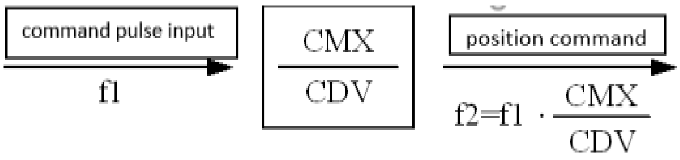
No	Abbr.	Parameter function and description	Mode	Default	Range	Unit
PA03	ATUL	Auto tuning response level setting	Pr, Pt, S	10	1~32	N/A

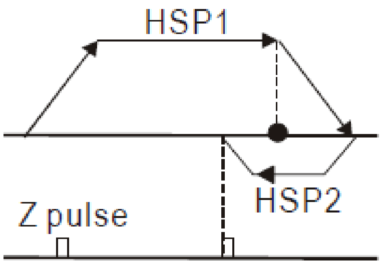
Auto tuning mode response setting

Response setting	Response	Speed loop response frequency (Hz)	Response setting	Response	Speed loop response frequency (Hz)
1	Low response	10.0	17	Middle response	67.1
2		11.3	18		75.6
3		12.7	19		85.2
4		14.3	20		95.9
5		16.1	21		108.0
6		18.1	22		121.7
7		20.4	23		137.1
8		23.0	24		154.4
9		25.9	25		173.9
10		29.2	26		195.9
11		32.9	27		220.6
12		37.0	28		248.5
13	Middle response	41.7	29	High response	279.9
14		47.0	30		315.3
15		52.9	31		355.1
16		59.6	32		400.0

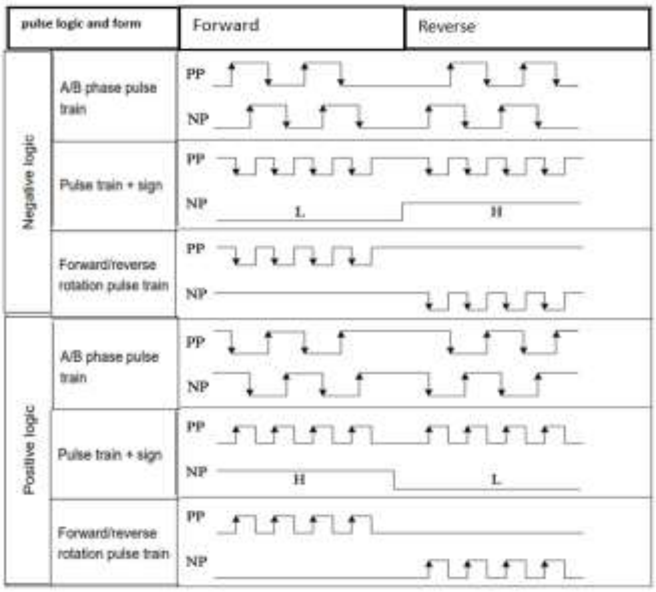
<table>
<tr><th>No</th><th>Abbr.</th><th colspan="3">Parameter function and description</th><th>Mode</th><th>Default</th><th>Range</th><th>Unit</th></tr>
<tr><td rowspan="16">PA04</td><td rowspan="16">HMOV</td><td colspan="3">Homing mode:
0 | z | y | x</td><td rowspan="16">Pr</td><td rowspan="16">0000h</td><td rowspan="16">0000h
~
0128h</td><td rowspan="16">N/A</td></tr>
<tr><td>x</td><td>y</td><td>z</td></tr>
<tr><td>Limit setting</td><td>signal setting</td><td>Homing methods</td></tr>
<tr><td>0~1</td><td>0~2</td><td>0~8</td></tr>
<tr><td></td><td rowspan="4">y = 0: return to Z pulse
y=1: do not return to Z pulse (go forward to next Z pulse)
y = 2: do not look for Z pulse</td><td>z=0: homing in forward direction and define LSP as homing origin</td></tr>
<tr><td></td><td>z=1: homing in reverse direction and define LSN as homing origin</td></tr>
<tr><td rowspan="9">When reaching the limits:
x=0: show error,
x=1: reverse direction</td><td>z= 2: homing in forward direction.
ORGP: OFF➔ON as homing origin</td></tr>
<tr><td>z= 3: homing in reverse direction
ORGP: OFF➔ON as homing origin</td></tr>
<tr><td rowspan="2"></td><td>z=4: look for Z pulse in forward direction and define it as homing origin</td></tr>
<tr><td>z=5: look for Z pulse in reverse direction and define it as homing origin</td></tr>
<tr><td rowspan="2">y = 0: return to Z
y = 1: do not return to Z pulse (go forward to next Z pulse)
y = 2: do not look for Z pulse</td><td>z=6: homing in forward direction
ORGP: ON➔OFF as homing origin</td></tr>
<tr><td>z=7: homing in reverse direction,
ORGP: ON➔OFF as homing origin</td></tr>
<tr><td></td><td>z=8: define current position as the origin</td></tr>
<tr><td rowspan="2">y = 0: return to last Z pulse
y = 2: do not look for Z pulse</td><td>z=9: defined as homing origin if forward direction meets motor torque.</td></tr>
<tr><td>z=A: defined as homing origin if reverse direction meets motor torque.</td></tr>
<tr><td colspan="3"></td></tr>
</table>

<table>
<tr><th>No</th><th>Abbr.</th><th>Parameter function and description</th><th>Mode</th><th>Default</th><th>Range</th><th>Unit</th></tr>
<tr><td>PA05</td><td>TL1</td><td>Internal torque limit value 1:
The parameter can limit the torque generated by the servo motor. The unit of parameter setting value is in percentage (%). The calculation is as follows:
Torque limit value=maximum current of motor/ motor rated current * the setting value
TL Input signals is used to select analog torque limit or internal parameter torque limit, and TL1 input signal is used to select internal parameter torque limit1 or internal parameter torque limit 2.
if external input signal TL-SG is open-circuited, the option of torque limit is as follows:
<table>
<tr><th>TL and SG</th><th>Torque limit</th></tr>
<tr><td>Open-circuited</td><td>Torque limit=PA05</td></tr>
<tr><td>Short-circuited</td><td>If TLA<PA05, torque limit=TLA
If TLA>PA05, torque limit=PA05.</td></tr>
</table>
if external input signal TL1-SG is short-circuited , the option of torque limit is as follows:
<table>
<tr><th>TL1 and SG</th><th>Torque limit</th></tr>
<tr><td>Open-circuited</td><td>If PC25<PA05, torque limit=PC25
If PC25>PA05, torque limit=PA05.</td></tr>
<tr><td>Short-circuited</td><td>If PC25<TLA, torque limit=PC25
If PC25>TLA, torque limit=TLA.</td></tr>
</table></td><td>All</td><td>100</td><td>0
~
100</td><td>%</td></tr>
<tr><td>PA06</td><td>CMX</td><td>Electronic gear numerator
Note: when servo is ON in PR mode, this parameter cannot be set.</td><td>Pr,Pt</td><td>1</td><td>1
~
2^{26}</td><td>N/A</td></tr>
</table>

<table>
<tr><th>No</th><th>Abbr.</th><th>Parameter function and description</th><th>Mode</th><th>Default</th><th>Range</th><th>Unit</th></tr>
<tr><td>PA07</td><td>CDV
(▲)</td><td>Electronic gear denominator
When setting E-Gear ratio, the incorrect setting may cause servo motor suddenly unintended acceleration. Ensure to do the setting when SERVO is OFF.


Note: limitation : 1/50 < (CMX/CDV) < 64000</td><td>Pr,Pt</td><td>1</td><td>1
~
2^{26}</td><td>N/A</td></tr>
<tr><td>PA08</td><td>HSPD1</td><td>Homing high speed option 1

</td><td>Pr</td><td>100</td><td>1
~
2000</td><td>Rpm
mm/s</td></tr>
<tr><td>PA09</td><td>HSPD2</td><td>Homing high speed option 2</td><td>Pr</td><td>20</td><td>1
~
500</td><td>Rpm
mm/s</td></tr>
<tr><td>PA10</td><td>RES1
(*)</td><td>Regenerative resistor value
<table><tr><th>Model</th><th>Default value</th></tr><tr><td>below 500W</td><td>100Ω</td></tr><tr><td>750W~1KW</td><td>40Ω</td></tr><tr><td>1.5KW~3KW</td><td>13Ω</td></tr></table></td><td>All</td><td>Refer to the left table.</td><td>10
~
750</td><td>Ohm</td></tr>
</table>

<table>
<tr>
<td>PA11</td>
<td>RES2
(*)</td>
<td>Regenerated resistor capacity
<table><tr><th>Model</th><th>Default</th></tr><tr><td>below 500W</td><td>20W</td></tr><tr><td>750W~1KW</td><td>40W</td></tr><tr><td>1.5KW~3KW</td><td>100W</td></tr></table>Refer to section 14.2 for external resistor capacity.</td>
<td>All</td>
<td>Refer to the left table.</td>
<td>0
~
3000</td>
<td>Watt</td>
</tr>
<tr>
<td>PA12</td>
<td>INP</td>
<td>In-position range:
In the position control mode, when the deviation between the position command and the actual motor position is less than the setting value of INP, the INP signal of DO will output.
<table><tr><th>Model</th><th>Default value</th></tr><tr><td>50W~750W</td><td>167772</td></tr><tr><td>1KW~3KW</td><td>83886</td></tr></table></td>
<td>Pt,Pr</td>
<td>Refer to the left table.</td>
<td>0
~
2^{24}</td>
<td>pulse</td>
</tr>
<tr>
<td>PA13</td>
<td>PLSS
(*)</td>
<td>Pulse command option
Select the type of external input pulse train.
<table><tr><td>u</td><td>z</td><td>y</td><td>x</td></tr></table>u: external pulse input source selection
u=0: low speed photocoupler (CN1 pin, PP, PG, NP, NG)
u=1: high speed differential (CN1pin, HPP, HPG, HNP, HNG)
x: input pulse train format selection
x=0:forward/reverse rotation pulse train
x=1: pulse train+sign
x=2: AB phase pulse train.
y: input pulse train logic selection
y=0: positive logic,
y=1: negative logic</td>
<td>Pt</td>
<td>0000h</td>
<td>0000h
~
1512h</td>
<td>N/A</td>
</tr>
</table>

		 **z: the setting of input pulse filter.** z=0: maximum input pulse frequency is 500kpps. z=1: maximum input pulse frequency is 200kpps. z=2: maximum input pulse frequency is 2Mpps. z=3: maximum input pulse frequency is 4Mpps. z=4: maximum input AB phase pulse frequency is 8MPPS. z=5: maximum input AB phase pulse frequency is 16MPPS.				
PA14	ENR (*)	Encoder output pulse number 1. Set the encoder output pulse number (A phase, B phase). The output pulses number is varied according to **PA39 encoder output pulse setting**. 2. Set the value 4 times greater than the A phase or B phase pulses. In fact, the number of A phase and B phase pulses actual output is 1/4 times. 3. The maximum output frequency is **20MHZ (after multiplication by 4)**, the operation output frequency should not exceed this limit value. Example 1: pulse setting output(PA39: z=0) If **PA39** is set to 0000h and **PA14** is set to 1024, the servo motor pulse number per revolution is 1024(pulse/rev). Example2: output division ratio setting (PA39:	All	10000	4 ~ 2^{24}	Pulse/ rev Pulse/ mm

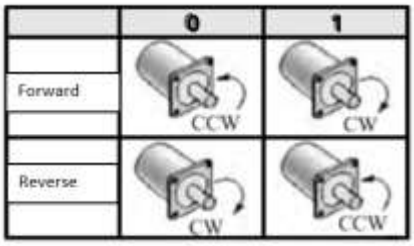
		z=1), $$Output\ pulses = \frac{\text{Number of pulses per revolution}}{PA14\ setting\ value}$$ If PA39 is set to 0100h and PA14 is set to 512, the output pulse number per revolution is 2^{22} / 512= 8192(pulse/rev)				
PA15	CRSHA	Motor crash protect level(torque percentage) To set protection level(for the rated torque percentage, 0=turn off , 1 or above =enable PA15.)	All	0	0 ~ 300	%
PA16	CRSHT	Motor crash protect level (protection time) To set protection time. When the setting level is reached and the setting protection time has taken, the AL.20 will occur. Note: PA15, PA16 function is only applicable for non-contact applications, such as electrical discharge machines.	All	1	0 ~ 1000	ms
PA17	OVL	Output overload DO warning level When the setting value is 0 - 100 and the servo motor continuously output exceeds this level, the warning signal is activated. PS: if the setting value is over 100, this function is disabled.	All	120	0 ~ 120	%
PA18	OVS	Over speed warning level If the feedback speed exceeds this value, AL.06 will occur.	All	6300	1 ~ 6500	rpm
PA19	OVPE	Position deviation excess output level	Pr,Pt	$3*2^{22}$	1	pulse

		when the position deviation exceeds this value, AL.08 will occur.			2^{31}-1	
PA20	OVPL1 (*)	Position pulse frequency excess level 1 When input position pulse frequency exceeds this value, AL.07 will occur.	Pt	4500	100 ~ 18000	KHz
PA21		Reserved				
PA22	DBF (*)	Dynamic brake control function (The operation setting of dynamic brake when alarm occurs.) 0: **enable** the dynamic brake and motor stops immediately. 1: **disable** the dynamic brake and motor coasts to stop gradually.	All	0	0~1	N/A
PA23	MCS (■)	Memory write-inhibit function 0: EEPROM is **writable**. 1: EEPROM is **prohibited to be written**. (Parameter will be vanished after power off. It's recommended to use this setting in communication control to avoid continually writing, which would shorten the lifetime of the EEPROM). Note: this parameter will set to 0 automatically after power cycling. **Cautions:** **1. Due to this parameter will set to 0 automatically after power cycling, to ensure that parameter value can be saved to the EEPROM, you need set this parameter to 1 after initialization, this will ensure that the communication write-in parameter not saved to the EEPROM.**	All	0	0~1	N/A

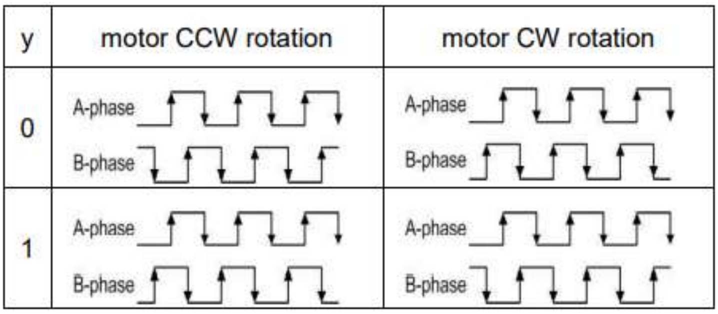
		2.EEPROM has a writing life limit (100,000 times), please set the MCS parameter to 1 if you need frequently write to drive parameters by communication command. **3.If the MCS parameter is not set, the memory may be damaged when the writing limit of EEPROM is reached and AL.0F alarm will occur.**				
PA24	PRES (*)	Resolution of linear scale for full-closed loop control The A/B phase number(after multiplication by 4) in full-closed loop per revolution.	Pt, Pr	5000	200 ~ 2^{24}	pulse
PA25	PERR	Protection range for feedback position error between motor encoder and linear scale When the deviation is too big between the A/B counter of full-closed loop feedback and encoder position feedback, it means the connector may loosen or other mechanical problem occurs.	Pt, Pr	30000	1 ~ $(2^{31}-1)$	pulse
PA26	FCON (▲)	Linear scale for full-closed loop control switch | 0 | z | y | x | **x: full-closed loop function switch** x=0: disable full-closed loop function x=1: enable full-closed loop function x=2: enable synchronous control function **y: pulse output source option(LA/ LB/ LZ)** y=0: motor encoder y=1: full-closed loop encoder. **z: full-closed loop encoder feedback forward / reverse phase option** z=0: A phase leads B phase in the positive direction. z=1: B phase leads A phase in the positive direction.	Pt, Pr	0000h	0000h ~ 0112h	N/A

PA27	FELP	Low-pass filter time constant for full-closed and semi-closed loop control When the stiffness of the mechanical system between full-closed and semi-closed loop is insufficient, set the proper time constant can enhance the stability of the system. In other words, temporarily create the semi-closed loop effect, and after stabilizing, the full-closed loop effect is created. When the stiffness is sufficient, set the value to 0 to disable the function.	Pt, Pr	100	0 ~ 1000	ms
PA28	ABS (*)	Absolute encoder setting. 0: incremental operation, and the absolute motor can be operated as an incremental motor. 1: absolute operation(only applicable to absolute motors, if applied to incremental motors, AL.24 will occur)	All	0000h	0000h ~ 0001h	N/A
PA29	CAP (■)	Absolute position reset Set PA29 to 1 to reset the current absolute position of the encoder. This function is the same as the DI:ABSC to clear the coordinate.	All	0000h	0000h ~ 0001h	N/A
PA30	UAP (■)	Update encoder absolute position When PA30=1, update the data to PA31~PA33, and the pulse deviation is not cleared. When PA30=2, update the data to PA31~PA33 and clear the pulse deviation, When this command is activated, the current position of motor is set as the end of position command.	All	0	0 ~ 2	N/A

PA31	APST	Absolute coordinate system status (Read-only) Bit0: 1 means the absolute position is lost, 0 means normal. Bit1: 1 means low battery voltage, 0 means normal. Bit2: 1 means the absolute revolution number overflows, 0 means normal Bit3: reserved (0) Bit4: 1 means the absolute coordinate has not been set. 0 means normal. Bit5 ~ Bit15: reserved (0)	All	0	0000h ~ 001Fh	N/A
PA32	APR	Encoder absolute position (pulse number) (read-only) The parameter displays the position feedback pulse number of the absolute position system, and it is valid in absolute system(PA28=1).	All	0	Pulse number per revolution	pulse
PA33	APP	Encoder absolute position (number of revolution) (read-only) The parameter displays the position feedback revolution number of absolute position system, and it is valid in absolute system(PA28=1)	All	0	32767 ~ -32768	rev
PA34	ABSM (*)	I/O communication mode of absolute system When PA34=0, it indicates Delta absolute IO communication function is applied. When PA34=1, it indicates Mitsubishi absolute IO communication function is applied.	All	0	0 ~ 1	N/A

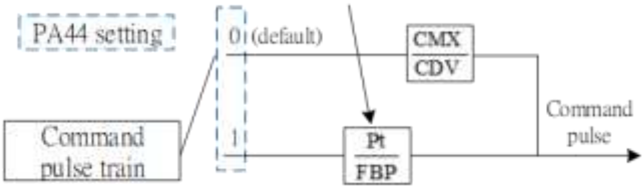
No	Abbr.	Parameter function and description	Mode	Default	Range	Unit
PA35	FNO1 (*)	Function option 1 u | z | y | x **x: set torque and motor output direction** In absolute system, when x of PA35 is changed, homing must be performed after power cycling.  **y: speed control direction definition** y=0: the motor runs forwardly when ST1 is ON. The motor runs reversely when ST2 is ON. y=1: the motor runs forwardly when ST1 is OFF. When ST1 is ON, the motor runs reversely, ST2 is invalid, and the SERVO LOCK function is disabled. y=2: the motor runs reversely when ST1 is OFF. When ST1 is ON, the motor runs forwardly, ST2 is invalid, and the SERVO LOCK function is disabled. **z: option of servo lock when speed control is stopped** z=0: servo lock is valid and the stop position is held. z=1: servo lock is invalid, the stop position is mobile. The drive will control the rotation speed to 0 rpm. **u: condition of mode switching** u=0: the ZSP signal will be referred when the mode is switched u=1: the ZSP signal will not be referred when the mode is switched.	All	0000h	0000h ~ 1121h	N/A

No	Abbr.	Parameter function and description	Mode	Default	Range	Unit
PA36	FNO2 (*)	Function option 2(reserved for factory test only)	All	0000h	0000h ~ FFFFh	N/A
PA37	FNO3 (*)	Function option 3(reserved for factory test only)				
PA38	AOP3	One-touch tuning function option. | 0 | z | y | x | **x: auto gain tuning function** x=0: disabled. x=1: enabled. **y: automatic high-frequency resonance suppression function** y=0: disabled y=1: enabled **z: auto low-frequency swing arm suppression function** z=0: disabled z=1: enabled Note 1: x=1 is necessary condition to enable one touch tuning function before you can set high-frequency or low-frequency suppression function Note 2: when y=1 and one-touch tuning is completed, you must set PB27 to 0. Note 3: when z=1 and one-touch tuning is completed, you must set PB29 to 0.	Pr, Pt, S	0000h	0000h ~ 0111h	N/A

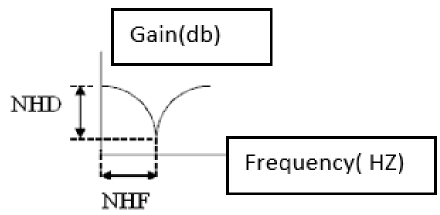
<table>
<tr><th>No</th><th>Abbr.</th><th>Parameter function and description</th><th>Mode</th><th>Default</th><th>Range</th><th>Unit</th></tr>
<tr><td>PA39</td><td>POL
(*)</td><td>Motor rotation direction option
The relation among motor rotation direction, input command pulse train rotation direction and encoder output pulse direction.
<table><tr><td>0</td><td>z</td><td>y</td><td>x</td></tr></table>
x: the input pulse command and motor rotation direction option
<table>
<tr><td rowspan="2">Setting value</td><td colspan="2">Rotation direction of servo motor</td></tr>
<tr><td>Forward pulse train input</td><td>Reverse pulse train input</td></tr>
<tr><td>0</td><td>CCW</td><td>CW</td></tr>
<tr><td>1</td><td>CW</td><td>CCW</td></tr>
</table>
y: to set the relationship between the motor rotation direction and encoder output pulse


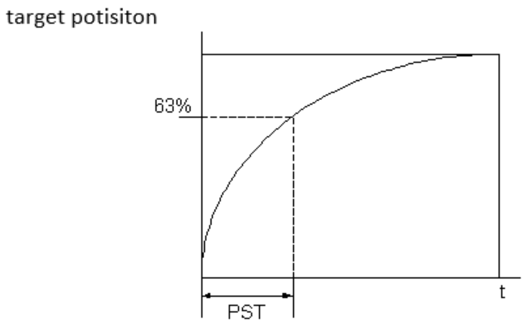
z: encoder output pulse setting option, which is related to PA14.
z=0: output pulse
z=1: output division ratio</td><td>Pt,
S,
T</td><td>0000h</td><td>0000h
~
0111h</td><td>N/A</td></tr>
<tr><td>PA40</td><td>SPW
(▲)</td><td>Special parameter write-in function
When the parameter is set to 0x0088, the factory default value will be restored after about 3 seconds, The servo can be operated only after power cycling.</td><td>All</td><td>0000h</td><td>0000h
~
00FFh</td><td>N/A</td></tr>
</table>

<table>
<tr><td>PA41</td><td>POSPD</td><td>Max. speed output setting of encoder
According to the application of the motor, the user sets the actual maximum speed that would be reached, if the speed exceeds the setting, AL.30 will occur.
Note: when PA41 set to 0, it indicates this function is disabled.</td><td>All</td><td>6300</td><td>0
~
6500</td><td>rpm
mm/s</td></tr>
<tr><td>PA42</td><td>BLK
(*)</td><td>Parameter group write-inhibit setting
<table>
<tr><td>Value</td><td>PA Group</td><td>PB Group</td><td>PC Group</td><td>PD Group</td><td>PE Group</td><td>PF Group</td><td>PL Group</td></tr>
<tr><td>0000
(Default value)</td><td colspan="7">readable and writable</td></tr>
<tr><td>0001</td><td colspan="6">readable and writable</td><td>unreadable and not writable</td></tr>
<tr><td>0002</td><td colspan="5">readable and writable</td><td colspan="2">unreadable and not writable</td></tr>
<tr><td>0003</td><td colspan="4">readable and writable</td><td colspan="3">unreadable and not writable</td></tr>
<tr><td>0004</td><td colspan="3">readable and writable</td><td colspan="4">unreadable and not writable</td></tr>
<tr><td>0005</td><td colspan="2">readable and writable</td><td colspan="5">unreadable and not writable</td></tr>
<tr><td>0006</td><td>readable and writable</td><td colspan="6">unreadable and not writable</td></tr>
<tr><td>0007</td><td colspan="7">Only PA42 is readable, the others is unreadable and not writable</td></tr>
</table>
Note 1: the parameter which is unreadable and not writable, it means the group is invisible on the panel.</td><td>All</td><td>0000h</td><td>0000h
~
00FFh</td><td>N/A</td></tr>
</table>

PA43	ENT (*)	Encoder resolution(This is an internal parameter which is for factory test only)	All			
PA44	EGM (*)	Electronic gear ratio option PA44 = 0: E-Gear ratio is default value(PA06/PA07). PA44 = 1: E-Gear ratio conversion is 1,(use position command pulse number setting per revolution (PA45)). **FBP is PA45 setting value, Pt is resolution pulse number per revolution** 	Pr,Pt	0	0 ~ 1	N/A

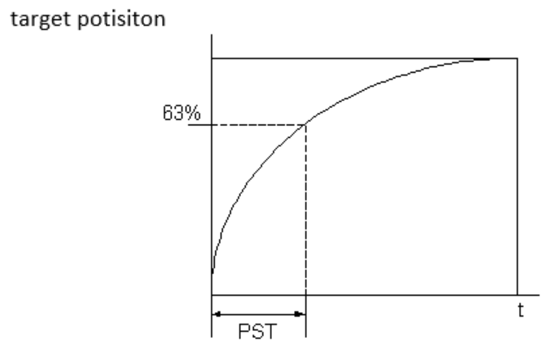
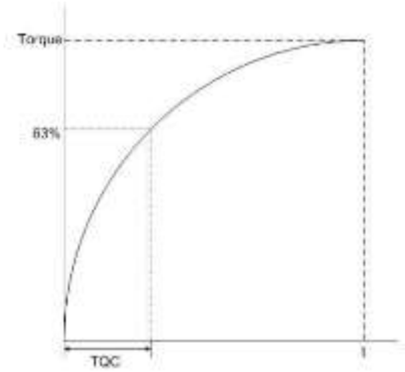
No	Abbr.	Parameter function and description	Mode	Default	Range	Unit
PA45	FBP (▲)	Position command pulse number setting per revolution. When PA44 = 1, this parameter can set the position command pulse number per revolution.	Pr,Pt	10000	10^3 ~ 10^6	pulse
PA46	ATST	One-touch tuning operation(Reserved for factory test only)	Pr, Pt, S	0000h	0000h ~ FF21h	N/A
PA47	TLP	Positive torque limit The parameter is to limit the torque generated during forward rotation. The unit of setting value is 0.1%. The calculation is as follows: $Positive\ torque\ limit\ = \frac{motor\ max\ current}{motor\ rated\ current} * \frac{PA47}{30}$	All	5000	0 ~ 32700	0.1%
PA48	TLN	Negative torque limit The parameter is to limit the torque generated during reverse rotation. The unit of setting value is 0.1%. The calculation is as follows $Negative\ torque\ limit\ = \frac{motor\ max\ current}{motor\ rated\ current} * \frac{PA48}{30}$	All	5000	0 ~ 32700	0.1%
PA49	HMTQL	Homing-Torque detection level The parameter can only be used in the torque homing mode. After triggering the homing, the motor will run in one direction and will make the mechanism hit the bumper pad. When the drive detects that the torque value keeps exceeding PA49[%] for PA50[ms], it will take current position as origin.	PR	50	1 ~ 300	%

No	Abbr.	Parameter function and description	Mode	Default	Range	Unit
PA50	HMTQT	Homing-Torque attained time setting	PR	2000	2 ~ 2000	ms
PB01	NHF1	Frequency of machine resonance suppression filter 1 This parameter is to set the frequency of machine resonance suppression filter 1. The schematic diagram is as follows:  	All	1000	10 ~ 4000	Hz
PB02	NHD1	Attenuation of machine resonance suppression filter 1 This parameter is to set attenuation rate of machine resonance suppression and it should use together with NHF1. Note: 0:turn off the Notch filter function.	All	0	0 ~ 32	dB
PB03	NLP	Resonance suppression low-pass filter This parameter is to set the time constant of resonance suppression low-pass filter.	All	10	0 ~	0.1ms

No	Abbr.	Parameter function and description	Mode	Default	Range	Unit
PB04	PST	Position command filter time constant This parameter is to set the filter time constant of position command. With an appropriate setting, the motor can run smoothly when the servo drive encounters a sudden change of position command.  The actual time to reach the target position is 5 times of PST.	Pt,Pr	3	0 ~ 20000	ms
PB05	FFC	Position feed-forward gain If the system runs smoothly in position mode, increasing the feed-forward gain value will reduce the position tracking errors. If the system has resonated in position mode, decreasing the gain value will reduce mechanical vibration.	Pt,Pr	0	0 ~ 200	%
PB06	GD1	Servo motor load inertia ratio This parameter is to set ratio of load inertia to servo motor inertia. When PA02= 1 which is set to auto gain tuning mode 1, it will set PB06 automatically. ★ When set to Linear motor drive(PL01=1), the range is 0 ~ 65535.	All	70	0 ~ 1200 or 65535	0.1 times 0.1kg

No	Abbr.	Parameter function and description	Mode	Default	Range	Unit
PB07	PG1	Position loop gain Increasing the position control gain can improve the traceability to position command and reduce the position errors. But too large setting value may cause noise and vibration. When auto gain tuning mode is used, PB07 will be set automatically.	Pt,Pr	45	4 ~ 1024	rad/s
PB08	VG1	Speed loop gain Increasing the speed control gain can improve the response speed, But too large setting value may cause vibration and noise. When auto gain tuning mode is used, PB08 will be set automatically.	Pt, Pr, S	183	40 ~ 9000	rad/s
PB09	VIC	Speed integral gain this parameter is integral time constant of speed loop.	Pt, Pr, S	34	1 ~ 1000	ms
PB10	VFG	Speed feed-forward gain value: If the system runs smoothly in speed control mode, increasing the feed-forward gain value will reduce the speed tracking errors. If the system has resonance in speed control mode, decreasing the gain value will reduce the mechanism vibration.	S	0	0 ~ 200	%
PB11	CDP (*)	Gain switching condition option: 0 | 0 | 0 | x x=0: disable gain switching function x=1: perform gain switching when CDP is ON. x=2: perform gain switching when position command frequency >= CDS setting x=3: perform gain switching when position error pulse >= CDS setting. x=4: perform gain switching when servo motor	Pt, Pr, S	0000h	0000h ~ 0008h	N/A

		rotation speed >= CDS setting. x=5: perform gain switching when CDP is OFF. x=6: perform gain switching when position command frequency <= CDS setting x=7: perform gain switching when position error pulse <= CDS setting x=8: perform gain switching when servo motor rotation speed <= CDS setting				
PB12	CDS	Gain switching condition value The set value of the CDS (kpps, pulse, rpm) is varied according to CDP setting, and its unit is depended on the switching item.	Pt, Pr, S	10	0 ~ 4000000	kpps pulse rpm mm/s
PB13	CDT	Gain switching time constant The CDT is used to smooth the gain switching, and it is used to set the time constant when switching the CDP and CDS conditions.	Pt, Pr, S	1	0 ~ 1000	ms
PB14	GD2	Servo motor load inertia ratio 2 This parameter is to set ratio of load inertia to motor inertia, which is only valid during gain switching.	Pt, Pr, S	70	0 ~ 1200	0.1 time 0.1kg
PB15	PG2	Position loop gain change ratio This parameter is to set position loop gain change ratio, and it's valid only after the auto tuning function is disabled.	Pt, Pr	100	10 ~ 500	%
PB16	VG2	Speed loop gain change ratio This parameter is to set speed loop gain change ratio, and it's valid only after the auto gain tuning function is disabled.	Pt , Pr, S	100	10 ~ 500	%
PB17	VIC2	Speed integral gain change ratio This parameter is to set speed integral gain change ratio, and it's only valid after the auto gain tuning function is disabled.	Pt, Pr, S	100	10 ~ 500	%

PB18	SFLT	Speed command low-pass filter smooth time constant Increasing time constant will smooth the speed command curve, but it will slow down the response. Note: 0 means this function is disabled.  The actual time to catch the speed command is around 5 times of SFLT.	S, T	0	0 ~ 1000	ms
PB19	TQC	Torque command filter time constant This parameter is to set filter time constant of torque command. With an appropriate setting, the motor can run smoothly when the servo drive encounters a sudden change of torque command.  The actual time to catch torque command is 5 times of TQC.	T	0	0 ~ 5000	ms

No	Abbr.	Parameter function and description	Mode	Default	Range	Unit
PB20	SJIT	Speed feedback filter time constant This parameter is to set speed feedback filter time constant.	All	0	0 ~ 1000	0.1ms
PB21	NHF2	Frequency of machine resonance suppression filter 2 This parameter is to set the frequency of machine resonance suppression filter, and the usage is same as PB01.	All	1000	10 ~ 4000	Hz
PB22	NHD2	Attenuation of machine resonance suppression filter 2 This parameter is to set the attenuation rate of machine resonance suppression filter and it should use together with NHF2. Note: 0: turn off Notch filter function	All	0	0 ~ 32	dB
PB23		Reserved	All	0	0~1	N/A
PB24	VDC	Speed differential compensation This parameter is to set speed differential compensation, it’s valid when DI terminal proportional control signal is ON.	Pr, Pt, S	980	0 ~ 1000	N/A
PB25	NHF3	Frequency of machine resonance suppression filter 3 This parameter is to set the frequency of machine resonance suppression filter, its usage is the same as PB01.	All	1000	10 ~ 4000	Hz

PB26	NHD3	Attenuation of machine resonance suppression filter 3 This parameter is to set attenuation rate of machine resonance suppression filter and it should use together with NHF3. Note: 0: turn off Notch filter function	All	0	0 ~ 32	dB
PB27	ANCF	Auto resonance suppression mode setting 0: fixed. 1: the resonance frequency is fixed after an auto-scan. 2: keep auto-scan to search the resonance frequency.	All	1	0 ~ 2	N/A
PB28	ANCL	Auto resonance suppression detection level Increasing setting of PB28 will reduce the resonance sensitivity. On the other hand, decreasing the setting of PB28 will increase the resonance sensitivity.	All	50	1 ~ 300	%
PB29	AVSM	Auto low-frequency vibration suppression mode 0: fixed. 1: after an auto-scan then the vibration frequency is fixed Auto mode setting description: When the value is 1, it will automatically perform vibration suppression. When the vibration cannot be scanned or the scanned frequency is stable, the system will reset the parameter to 0 and automatically save the low-frequency vibration suppression frequency to PB31(VSF1)	Pr, Pt	0	0 ~ 1	N/A

PB30	VCL	Low-frequency vibration detection level setting. When automatic low-frequency vibration suppression is enabled (PB29=1), the system will search automatically. Decreasing the PB30 setting value will increase the detection sensitivity, but it is easy to misjudge noise or other non-main low-frequency vibration as vibration suppression frequencies. Increasing this value will decrease detection sensitivity. However, if the vibration amplitude of the mechanism is small, it is not easy to search for low frequency vibration.	Pr, Pt	50	1 ~ 8000	pulse
PB31	VSF1	Low-frequency vibration suppression frequency setting 1 To set the frequency 1 of low-frequency vibration suppression. Note: when PB31 is 0, it means the 1st group of low-frequency vibration suppression filter is off.	Pr, Pt	100	1 ~ 3000	0.1Hz
PB32	VSG1	Low-frequency vibration suppression gain 1 To set the first group of low-frequency vibration suppression gain. Increasing the value can improve the position response, but if the setting value is too large, it will jeopardize the motor to run smoothly. So it is recommended to set to 1.	Pr, Pt	0	0 ~ 15	N/A

No	Abbr.	Parameter function and description	Mode	Default	Range	Unit
PB33	VSF2	Low-frequency vibration suppression frequency 2 To set the frequency 2 of low-frequency vibration suppression. Note: when PB33 is 0, it means the 2nd group of low-frequency vibration suppression filter is off.	Pr, Pt	100	1 ~ 3000	0.1Hz
PB34	VSG2	Low frequency vibration suppression gain 2 To set the second group of low-frequency vibration suppression gain. Increasing the value can improve the position response, but if the setting value is too large, it will jeopardize the motor to run smoothly. So it is recommended to set to 1.	Pr, Pt	0	0 ~ 15	N/A
PB35	FRCL	Friction compensation level Set friction compensation level(for the rated torque percentage, 0 = turn off. 1 or above = enable friction compensation)	Pr, Pt, S	0	0 ~ 100	%
PB36	FRCT	Friction compensation smoothing time constant To set friction compensation smoothing time constant.	Pr, Pt, S	0	0 ~ 1000	ms
PB37	FRCM	Friction compensation mode option 0: the compensation value remains unchanged when motor speed is slower than the value of PC17. 1: the compensation value reduces to 0 gradually when motor speed is slower than the value of PC17.	Pr, Pt, S	0	0 ~ 1	N/A
PB38	FFCT	Position feed-forward filter time constant Set the filter time constant when position feed-forward gain is used.	Pr, Pt	0	0 ~ 1000	0.1ms

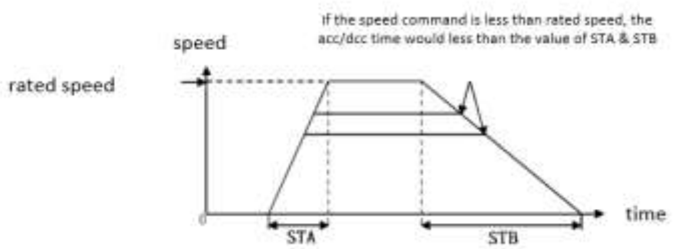
PB39	SVP (▲)	Synchronous speed control gain: Increase the synchronous speed control gain to enhance the speed following between two motors. If the value is too high, it may cause vibration and noise.	Pr, Pt, S, T	0	0 ~ 8191	rad/s
PB40	SVI (▲)	Synchronous speed integral compensation: Increase the synchronous speed integral compensation to enhance the speed following and reduce the speed errors between two motors. Note: if the value is too large, it may cause vibration and noise.	Pr, Pt, S, T	0	0 ~ 1023	rad/s
PB41	SPI (▲)	Synchronous position integral compensation Increasing the synchronous position integral compensation can enhance the position following and reduce the position errors between two motors. Note: if the value is too large, it may cause vibration and noise. It is recommended that you set this value to the same value as PB09.	Pr, Pt, S, T	0	0 ~ 1023	rad

No	Abbr.	Parameter function and description	Mode	Default	Range	Unit
PB42	SBW (▲)	Synchronous control bandwidth: If you are unsure about PB39~PB41 setting, set the value of synchronous control bandwidth instead so that the value corresponds to PB39~PB41. When the deviation between the synchronous control bandwidth and the servo bandwidth is greater, the synchronous following will be better. But when speed loop bandwidth + synchronous control bandwidth > system allowable bandwidth , it may cause resonance of system. Note: when increasing the speed loop bandwidth and synchronous control bandwidth, PB03 response should faster than them.	Pr, Pt, S, T	0	0 ~ 1023	Hz
PB43	SVL	Synchronous speed error low-pass filter: When the synchronous control is affected by low resolution, meaning that noise (less sharp and rough sound) is generated, you can use low-pass filter to suppress the noise. This filter must be faster than the synchronous control bandwidth.	Pr, Pt, S, T	0	0 ~ 1000	0.1ms
PB44	PPD	Position loop compensation Increasing this gain value will improve the tractability of position command.	Pr, Pt	0	0~500	N/A
PB45	NHF4	Frequency of machine resonance suppression filter 4 This parameter is to set the frequency of machine resonance suppression filter, its usage is same as PB01.	All	1000	10 ~ 4000	Hz

PB46	NHD4	Attenuation of machine resonance suppression filter 4 This parameter is to set attenuation rate of machine resonance suppression filter and it should use together with NHF4. Note: 0: turn off Notch filter function.	All	0	0 ~ 32	dB
PB47	NHF5	Frequency of machine resonance suppression filter 5 This parameter is to set the frequency of machine resonance suppression filter, its usage is same as PB01.	All	1000	10 ~ 4000	Hz
PB48	NHD5	Attenuation of machine resonance suppression filter 5 This parameter is to set attenuation rate of machine resonance suppression filter and it should use together with NHF5. Note: 0: turn off Notch filter function.	All	0	0 ~ 32	dB
PB49	DOB	External interference compensation gain In position mode, increasing this parameter setting value can reduce position overshoot. In speed mode, increasing this parameter setting value can reduce speed overshoot Note: if the parameter setting is too large, it might cause system vibration.	All	0	0 ~ 100	N/A
PB50	MVF	Position command average filter time constant 0: disable 1~50: enable the filter function	Pr, Pt	0	0 ~ 50	ms

No	Abbr.	Parameter function and description	Mode	Default	Range	Unit
PB51	NHW	Width of machine resonance suppression filter 1: This parameter is to set the first group of machine resonance suppression filter width. Note1: if PB02=0, this function is disabled. Note2: PB01, PB02 and PB51 are the first group of machine resonance suppression filter related parameters.	All	5	1 ~ 10	N/A
PB52	NHW2	Width of machine resonance suppression filter 2: This parameter is to set the second group of machine resonance suppression filter width. Note1: if PB22=0, this function is disabled. Note2: PB21, PB22 and PB52 are the second group of machine resonance suppression filter related parameters.	All	5	1 ~ 10	N/A
PB53	NHW3	Width of machine resonance suppression filter 3: This parameter is to set the third group of machine resonance suppression filter width. Note1: if PB26=0, this function is disabled. Note2: PB25, PB26 and PB53 are third group of machine resonance suppression filter related parameters.	All	5	1 ~ 10	N/A
PB54	NHW4	Width of machine resonance suppression filter 4: This parameter is to set the 4th group of machine resonance suppression filter width. Note1: if PB45=0, this function is disabled. Note2: PB44, PB45 and PB54 are 4th group of machine resonance suppression filter related parameters.	All	5	1 ~ 10	N/A

PB55	NHW5	Width of machine resonance suppression filter 5: This parameter is to set the 5th group of machine resonance suppression filter width. Note1: if PB47=0, this function is disabled. Note2: PB46, PB47 and PB55 are 5th group of machine resonance suppression filter related parameters.	All	5	1 ~ 10	N/A
PB56		Reserved				
PB57	TOF (*)	z-axis torque compensation When used in Z-axis applications, the torque command can be compensated. Note: improper settings may cause system instability	All	0	-3000 ~ 3000	0.1%
PB58	VSD1	Attenuation of Low-frequency suppression 1 This parameter is to set the first group of low-frequency suppression attenuation rate. Note 1: if PB32=0, this function is disabled. Note 2: PB31, PB32 and PB58 are first group of low frequency suppression filter related parameters.	Pr, Pt	80	0 ~ 1000	dB
PB59	VSD2	Attenuation of Low-frequency suppression 2 This parameter is to set 2nd group of low frequency suppression attenuation rate. Note 1: if PB34=0, this function is disabled. Note 2: PB33, PB34 and PB59 are 2nd group low frequency suppression filter related parameters.	Pr, Pt	80	0 ~ 1000	dB

No	Abbr.	Parameter function and description	Mode	Default	Range	Unit
PC01	STA	Acceleration time constant The acceleration time is required when the motor accelerates from 0 rpm to the rated motor speed, which is defined as the acceleration time constant. For example, if the servo motor rated speed is 3000 rpm, this parameter is set to 3000(3s). When the speed command is set to 1000 rpm, it takes 1 second for the motor to accelerate from 0 rpm to 1000 rpm. Please refer to section 6.4.3 for the instruction in Pr mode. The acceleration time in JOG mode is also set by this parameter. 	S, T	200	0 ~ 65550	ms
PC02	STB	Deceleration time constant The deceleration time is required when the motor decelerates from rated speed to 0 rpm, which is defined as the deceleration time constant. Please refer to section 6.4.3 for the instruction in Pr mode. The deceleration time in JOG mode is also set by this parameter.	S, T	200	0 ~ 65550	ms
PC03	STC	S-curve acceleration /deceleration time constant During acceleration/deceleration, a three-stage acceleration/deceleration curve is applied to provide smooth processing. An appropriate STC setting can improve the stability of the motor when starting and stopping. In order to make the command curve smoother,	Pr, S, T	0	0 ~ 10000	ms

		the S curve can be added, and there will be a slight deviation in the acceleration/deceleration time. The time of motor accelerate to rated speed = STA + STC. The time of motor decelerate from the rated speed to 0 = STB + STC.				
PC04	JOG	JOG speed command This parameter is JOG speed setting in JOG operation mode.	All	300	0 ~ 6000	rpm mm/s
PC05	SC1	Internal speed command 1(Limit 1) In speed control mode, this parameter is speed command 1. In torque control mode, this parameter is speed limit 1 and without direction. Note: the maximum internal speed command value is the maximum speed value of motor.	S, T	100	-6000 ~ 6000	rpm mm/s
PC06	SC2	Internal speed command 2(Limit 2) In speed control mode, this parameter is used as internal speed command 2. In torque control mode, this parameter is used as speed limit 2 and without direction. Note: the maximum internal speed command value is the maximum motor speed.	S, T	500	-6000 ~ 6000	rpm mm/s
PC07	SC3	Internal speed command 3(Limit 3) In speed control mode, this parameter is used as internal speed command 3. In torque control mode, this parameter is used as speed limit 3 and without direction. Note: the maximum internal speed command	S, T	1000	-6000 ~ 6000	rpm mm/s

		value is the maximum motor speed.				
PC08	SC4	Internal speed command 4(Limit 4) In speed control mode, this parameter is used as internal speed command 4. In torque control mode, this parameter is used as speed limit 4 and without direction. Note: the maximum internal speed command value is the maximum motor speed.	S, T	200	-6000 ~ 6000	rpm mm/s
PC09	SC5	Internal speed command 5(Limit 5) In speed control mode, this parameter is used as internal speed command 5. In torque control mode, this parameter is used as speed limit 5 and without direction. Note: the maximum internal speed command value is the maximum motor speed.	S, T	300	-6000 ~ 6000	rpm mm/s
PC10	SC6	Internal speed command 6(Limit 6) In speed control mode, this parameter is used as internal speed command 6. In torque control mode, this parameter is used as speed limit 6 and without direction. Note: the maximum internal speed command value is the maximum motor speed.	S, T	500	-6000 ~ 6000	rpm mm/s
PC11	SC7	Internal speed command 7(Limit 7) In speed control mode, this parameter is used as internal speed command 7. In torque control mode, this parameter is used as speed limit 7 and without direction. Note: the maximum internal speed command value is the maximum motor speed.	S, T	800	-6000 ~ 6000	rpm mm/s

No	Abbr.	Parameter function and description	Mode	Default	Range	Unit
PC12	VCM (▲)	Maximum motor speed for analog speed command Set the motor speed corresponding to 10V (maximum voltage) for the analog speed command. **Speed mode:** Speed control command = Setting value*input voltage/10. Example: If the setting value is 2000 and the external voltage input is 10V, then the speed control command is 2000 rpm. If external voltage input is 5V, then the speed control command is 1000rpm.	S	3000	0 ~ 30000	rpm mm/s
		Torque mode: Speed limit value = Setting value*input voltage / 10 This parameter setting indicates the speed limit value corresponding to maximum voltage.	T	3000	0 ~ 30000	rpm mm/s
PC13	TLC (▲)	Maximum output of analog torque command: Set the torque corresponding to 10V (maximum voltage) for the analog torque command. **Torque mode:** Torque command= input voltage / 10* setting value Example: If setting value is 100 and the external voltage input is 10V, then the torque control command is 100% of the maximum torque. If the external voltage input is 5V, then the torque control command is 50% of the maximum torque.	T	100	0 ~ 2000	%
		Position and speed mode: PC13 can set as torque limit in position and speed mode, you can refer to section 6.3.4 for detail.	Pr, Pt, S	100	0 ~ 2000	%

No	Abbr.	Parameter function and description	Mode	Default	Range	Unit
PC14	MOD	Analog monitor output: Set the analog monitor output signal, and there are 2 output channels: ch1 and ch2 | 0 | ch2 | 0 | ch1 | The setting value of Ch1 and Ch2, and its corresponding output are as follows: 0: motor speed(±10V/2 times rated speed) 1: motor torque((±10V/ maximum torque) 2: speed command((±10V/2 times rated speed) 3: effective load rate(±10V/±300%) 4:pulse command frequency(±10V/4300k pulse/s) 5:current command(±10V/max current command) 6: dc bus voltage(10V/450V) 7: error pulse number(±10V/4194304pulse) 8: error pulse number(±10V/10000 pulse) 9: error pulse number(±10V/100 pulse)	All	0100h	0000h ~ 0909h	N/A
PC15	SVZR (*)	Analog input voltage zero voltage range When the analog speed voltage is within the setting range, the motor speed will be regarded as 0 rpm.	S, T	10	0 ~ 1000	mv
PC16	MBR	Electromagnetic brake sequence output time If PC16≥0, this parameter indicates the delay time from SON OFF to electromagnetic brake MBR signal off. If PC16 < 0, this parameter PC16 indicates that to extend SERVO ON timing, MBR will turn off first, and then SERVO ON will be off after the delay time.	All	100	-1000 ~ 1000	ms

No	Abbr.	Parameter function and description	Mode	Default	Range	Unit
PC17	ZSP	Zero speed range: Set the zero speed signal output speed range. If the forward/reverse rotation motor speed is lower than this parameter setting value, the DO:ZSP will be on.	All	50	0 ~ 10000	rpm mm/s
PC18	COP1 (*)	Stop option and power interruption & restart option `0 0 y x` **x: power interruption and restart option** When power voltage is lower than allowable level, insufficient voltage alarm occurs and servo motor stops. When power voltage is normal and servo motor will restart without alarm reset. x=0: invalid x=1: valid **y: motor stop mode option.** Servo stop option in speed control mode. y=1: motor stops immediately y=0: motor decelerates to stop	All	0010h	0000h ~ 0011h	N/A
PC19	COP2 (*)	Alarm history clear option and overload early warning option. `0 z y x` **x: alarm record clear.** When set to clear, the clear action will only be activated after the power cycling, and it will be automatically set to 0 after the clear is completed. x=0: not clear alarm history x=1: clear alarm history **y: overload early warning** y=0: no action when warning occurs.	All	0000h	0000h ~ 0111h	N/A

		y=1: motor stops immediately when warning occurs **z: set the panel display status after alarm is cleared.** z=0: the display stays in alarm screen after alarm is cleared(AL--). z=1: the display go back to the former screen after alarm is cleared.				
PC20	SNO (*)	Servo drive communication device number During communication different device number must be set for different servo drives. If two drives are set to the same device number, it will cause communication failure.	All	1	1 ~ 32	Number
PC21	CMS (*)	Communication mode option | 0 | 0 | 0 | x | x: communication reply delay time(the parameter change is valid only after power cycling) x=0: reply within 0.5ms delay. x=1: reply after 1ms delay. x=2: reply after 2ms delay	All	0	0 ~ 2	N/A
PC22	BPS (*)	Communication protocol option | 0 | 0 | y | x | **x: communication protocol option** x=0: 7,N,2 (Modbus, ASCII) x=1: 7,E,1 (Modbus, ASCII) x=2: 7,O,1 (Modbus, ASCII) x=3: 8,N,2 (Modbus, ASCII) x=4: 8,E,1 (Modbus, ASCII)	All	0010h	0000h ~ 0058h	N/A

		x=5: 8,O,1 (Modbus, ASCII) x=6: 8,N,2 (Modbus, RTU) x=7: 8,E,1 (Modbus, RTU) x=8: 8,O,1 (Modbus, RTU) **y: RS-485 communication speed setting** y=0: 4800bps y=1: 9600bps y=2: 19200bps y=3: 38400bps y=4: 57600bps y=5: 115200bps				
PC23	SIC	Serial communication timeout option Time-out duration could be set from 1 to 60 seconds. Note: if it is set to 0, the timeout checking function is disabled.	All	0	0 ~ 60	s

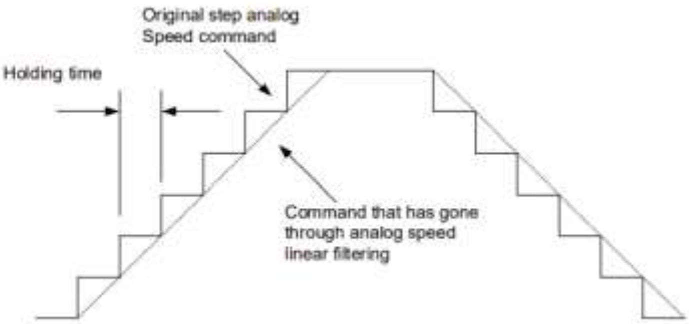
No	Abbr.	Parameter function and description	Mode	Default	Range	Unit
PC24	DMD (*)	Drive status display option | 0 | y | x | **x: display option after power on(hexadecimal)** x=0: motor feedback pulse number (high 5-digit) (before E-Gear ratio) x=1: motor feedback pulse number (low 5-digit) (before E-Gear ratio) x=2: input number of pulse commands (high 5-digit) (before E-Gear ratio) x=3: input number of pulse commands (low 5-digit) (before E-Gear ratio) x=4: input pulse command and feedback pulse deviation (before E-Gear ratio) x=5: pulse command input frequency x=6: current motor speed(Linear motor speed) x=7: analog speed command/limit voltage x=8: speed command/limit x=9: analog torque command/limit voltage x=A: torque command/limit x=B: effective load rate x=C: peak load rate x=D: DC Bus voltage x=E: load inertia ratio x=F: instantaneous torque x=10: regenerative load rate x=11: absolute pulse number of encoder Z phase x=12: feedback pulse number of full-closed loop encoder(low 5-digit) x=13: command pulse number of full-closed loop encoder(high 5-digit) x=14: command pulse number of full-closed loop encoder(low 5-digit) x=15: absolute pulse number of encoder Z phase x=16: drive capacity margin(by remaining current)	All	0000h	0000h ~ 0116h	N/A

No	Abbr.	Parameter function and description	Mode	Default	Range	Unit

		y: status display according to the control mode after power on y=1: status is displayed according setting value of PC24.x. y=0: the drive status is displayed according to the control mode, and the display status in different control modes is shown in the following table. <table><tr><th>Control mode</th><th>The drive status displayed after power on</th></tr><tr><td>Position</td><td>Motor feedback pulse number (Note 1)</td></tr><tr><td>Position and speed dual mode</td><td>Motor feedback pulse number(Note 1) /motor speed (Linear motor speed)</td></tr><tr><td>Speed</td><td>Motor speed (Linear motor speed)</td></tr><tr><td>Speed and torque dual mode</td><td>Motor speed (Linear motor speed) /analog torque command voltage</td></tr><tr><td>Torque</td><td>Analog torque command voltage</td></tr><tr><td>Torque and position dual mode</td><td>Torque command /motor feedback pulse number(note1)</td></tr></table>Note 1: display the motor feedback pulse number after E-Gear ratio (low 5-digit)				

No	Abbr.	Parameter function and description	Mode	Default	Range	Unit
PC25	TL2	Internal torque limit 2 The setting description is the same as PA05. In addition, when using the internal parameter torque limit together with external input signals TL and TL1, different torque limits can be selected. Please refer to PA05 description.	All	100	0 ~ 100	%
PC26	VCO	Analog speed command/limit offset: **Speed mode**: correct voltage offset of analog speed command(VC). **Torque mode**: correct voltage offset of analog speed limit(VLA).	S, T	0	-8000 ~ 8000	mV
PC27	TLO	Analog torque command/limit offset: **Torque mode**: correct voltage offset of analog torque command(TC). **Speed mode**: correct voltage offset of analog torque limit(TLA).	S, T	0	-8000 ~ 8000	mV
PC28	MO1	Analog monitor MON1 voltage offset: Set analog monitor MON1 output voltage offset.	All	0	-999 ~ 999	mV
PC29	MO2	Analog monitor MON2 voltage offset: Set analog monitor MON2 output voltage offset.	All	0	-999 ~ 999	mV
PC30	MOG1	Analog monitor MON1 output proportion: If set analog monitor MON1 output rated speed to 3000rpm, MOG1 set to 50, it means that analog monitor 1 output voltage is maximum when the speed reaches 3000rpm.	All	100	1~100	%

No	Abbr.	Parameter function and description	Mode	Default	Range	Unit
PC31	MOG2	Analog monitor MON2 output proportion: This parameter is to set the maximum proportion of analog monitor MON2 output, its function is same as PC30.	All	100	1~100	%
PC32	CMX2	Electronic gear numerator 2 To set the 2nd group of electronic gear numerator.	Pt	1	1 ~ 2^{26}	N/A
PC33	CMX3	Electronic gear numerator 3 To set the 3rd group of electronic gear numerator.	Pt	1	1 ~ 2^{26}	N/A
PC34	CMX4	Electronic gear numerator 4 To set the 4th^{h} group of electronic gear numerator.	Pt	1	1 ~ 2^{26}	N/A
PC35	VCL (*)	Analog speed voltage limit: This parameter is to limit the input voltage (VC) of the analog speed command. Setting it to 0 means no limitation. For example, if the analog voltage of the VC input is 10V, and PC35 is set to 5000, the drive will calculate the VC voltage as only 5V, and this can be used to control speed command/limit.	S, T	0	0 ~ 20000	mV

PC36	VMFT	VC/VLA speed voltage linear filter time constant: PC36 is the moving filter and PB18 is the low-pass filter and. The difference between them is the moving filter can smooth the beginning and end of the step command, while the low-pass filter can only smooth the end of command. Application: If the servo receives the command from the controller for the position control loop in speed mode, the low-pass filter is recommended. If the setting is only for the speed/torque control, the moving filter is recommended for better smoothing.  	S, T	0	0 ~ 40	0.1ms
PC37	DTA9 (*)	AL.09 initialization delay time: This parameter is to set AL.09 initialization delay checking time when start-up, If set the value to 0, means that this function is turned off.	All	0	0 ~ 20000	ms
PC38	FNO4 (*)	Function option 4 To force output the DO1~DO6 pin type option during initialization. The contact status of DO1 to DO6 is defined by the Bit0~Bit5 of this parameter, which defines the output contact as a contact or b contact. 0: initiate output as a contact 1: initiate output as b contact When this parameter used for DO6:ALM, set PC38 =0020h and the b contact will be output 0.5~1 second earlier when start-up.	All	0000h	0000h ~ 003Fh	N/A

No	Abbr.	Parameter function and description	Mode	Default	Range	Unit
PC39	LPS	Low-pass filter option | 0 | 0 | 0 | x | 0: PB03 will be automatically adjusted according to response level setting(invalid when PA02=0) 1: PB03 need to be set manually.	All	0000h	0000h ~ 0001h	N/A
PC40	MBR2	The delay time to release electromagnetic brake MBR when Servo ON. When the electromagnetic brake function is activated, this parameter is to set the delay output time of electromagnetic brake(MBR) signal when servo on.	All	0	0 ~ 1000	ms
PC41	CAST	Capture: start address of data array The first data capture obtained is saved at start address in the data array. Note: this parameter is only writable when CAP function is turned off (PC44x.Bit0 = 0).	All	0	0 ~ 799	N/A
PC42	CAAX (■)	Capture: axis position: Displays the axis position of Capture pulse source. Note 1: this parameter is only writable when CAP function is turned off (PC44x.Bit0 = 0) Note 2: this parameter is write-protected when the axis source of Capture is the feedback position of the motor (PC44y.Bit = 2).	All	0	$-2^{31}+1$ ~ $2^{31}-1$	Source pulse
PC43	CAND (■)	Capture: number of capturing times: When CAP stops(PC44 x.Bit0 = 0), this parameter indicates the current number of captured data (readable and writable). When CAP is in operation (PC44 x.Bit0 = 1), this parameter indicates the remaining number of data to be captured (read-only); each time it captures one data(DI7 ON), the value of PC43 decrements by 1 until the value is 0, indicating that capturing is complete. Note: the total number of data from CAP, CMP and E-Cam cannot exceed 800.	All	1	1 ~ (800 - PC41)	N/A

<table>
<tr><th>No</th><th>Abbr.</th><th>Parameter function and description</th><th>Mode</th><th>Default</th><th>Range</th><th>Unit</th></tr>
<tr><td>PC44</td><td>CACT
(■)</td><td>Capture: activate control:
<table><tr><td>u</td><td>z</td><td>y</td><td>x</td></tr></table>
x(HEX): activate Capture
<table><tr><td>x.bit3</td><td>x.bit2</td><td>x.bit1</td><td>x.bit0</td></tr></table>
x.Bit0 = 1
Start capturing; after capturing is complete, this bit is set to 0 automatically.
PC43>0, the capturing data quantity decrease to 0. Capture is complete, DO: CAP_OK(ON)
PC43=0: CAP function is disabled. DO:CAP_OK(OFF)
Note: if need change this setting, turn off CAP function to write in.
x.Bit1 = 1
After capturing the first data, automatically set the current position as the first position reset data(PC45).
x.Bit2 = 1
After capturing the first data, if PC50 d.Bit0 = 0, activate CMP function(PC50 x.Bit0 = 1) and reset PC49 to previously value, but this setting is invalid if CMP function is already activated.
If PC50 d.Bit0 = 1, the high speed CMP function is enabled(PC50 x.Bit0 = 1).
x.Bit3 = 1
Execute PR#50 after capturing is completed.
y: source option of Capture
y=0: capture is not working
y=1: auxiliary encoder
y=2: motor feedback position
y=3: CN1(pulse command)
z: capture DI: DI7 trigger edge
z=0: rising edge trigger
z=1: falling edge trigger
u(HEX): trigger minimum interval (unit: ms)</td><td>All</td><td>2010h</td><td>0
~
F13Fh</td><td>N/A</td></tr>
</table>

No	Abbr.	Parameter function and description	Mode	Default	Range	Unit
PC45	CPRS	Capture: reset position after first data captured Please refer to PC44x. Bit1 description. Note: pay attention to upper limit of the maximum and minimum values when setting this parameter.	All	0	-1073741823 ~ 1073741823	Source pulse
PC46	CPMK	Capture: masking range When capturing multiple points (PC43>1), once one data is captured, the system stops(masking) range definition is as follows. (the last capture data source position ± PC46 is set as masking area)	All	0	0 ~ 1000000	Source pulse
PC47	CMST	Compare: start address of data array: The first data to be compared is saved at start address in the data array. Note: this parameter is only writable when CMP turned off(PC50x.Bit = 0).	All	0	0 ~ 799	N/A
PC48	CMAX (■)	Compare: axis position: This parameter displays the axis position of the CMP pulse source. Note1: this parameter is only writable when CMP stops (PC50 x.Bit = 0). Note 2: this parameter is write-protected when the axis source of Compare is the Capture axis(PC50 y = 0). Note3: when the axis source of Compare is main encoder(PC50 Y=2), this parameter is also write-protected. When you set PC50 Y=2, this parameter is reset to the feedback position of the motor. When the motor feedback position is redefined due to homing or Capture, the value will be different from	All	0	$-2^{31}+1$ ~ $2^{31}-1$	Source pulse

<table>
<tr><td></td><td></td><td>the value of this parameter. In this case, set PC50.Y to 0 and then to 2 to reset this parameter to the motor feedback position.</td><td></td><td></td><td></td><td></td></tr>
<tr><td>PC49</td><td>CMNO
(■)</td><td>Compare: number of comparing times:

When CMP is stopped (PC44 x.Bit0 = 0), the parameter indicates the number of data expected to be compared (readable and writable).

When CMP is in operation(PC44 x.Bit0 = 1), this parameter indicates the remaining number of data to be compared (read-only). Each time it compares one data, the value of PC51 decrements by 1 until the value is 0, indicating that comparing is complete.

Note: the total number of data from CAP, CMP and E-Cam cannot exceed 800.</td><td>All</td><td>1</td><td>1
~
(800-
PC47)</td><td>N/A</td></tr>
<tr><td>PC50</td><td>CMCT
(■)</td><td>Compare: activate control
<table><tr><td>d</td><td>c</td><td>b</td><td>a</td><td>u</td><td>z</td><td>y</td><td>x</td></tr></table>x(HEX): activate Compare (d.Bit0=0)(DO4 is compare output pin)
<table><tr><td>x.bit3</td><td>x.bit2</td><td>x.bit1</td><td>x.bit0</td></tr></table>x.Bit0 = 1
Start comparing; automatically clear after finishing comparing
PC49> 0: CMP quantity decrease to 0.
PC49= 0: automatically turn off CMP.
Note: you need turn off the CMP function to enable writing before change the setting.

x.Bit1 = 1
Cycle mode, it will constantly reset the PC49.It need to turn off the CMP function to stop.
x.Bit2 = 1
After comparing is completed, activate Capture(PC44 x.Bit0 = 1) and reset PC43 to previously value, but this setting is invalid if capture is already activated.

x.Bit3 = 1</td><td>All</td><td>0064
0010h</td><td>0001
0000h
~
FFFF
312Fh</td><td>N/A</td></tr>
</table>

When the last data is compared, clear the PC48 position information to avoid the cumulative error of the first data and the last data.

y: source option of Compare

y=0: capture axis
y=1: auxiliary encoder
y=2: motor feedback position
y=3: CN1 (pulse command)

Note: when the source of Compare is the Capture axis, the source of Capture cannot be changed.

z: output polarity

DO4 trigger logic

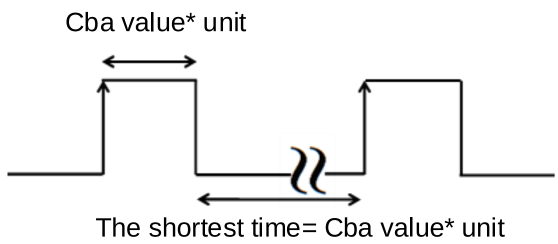
z=0: trigger by rising edge
z=1: trigger by falling edge.

u: trigger PR

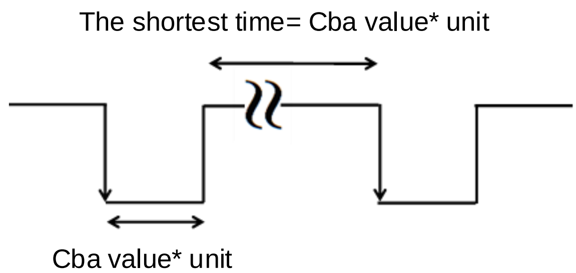
u=1: execute PR#45 after comparing is completed.

cba: duration of pulse output (unit: 1 ms)

When PC50 z=0, the definition is as follows:



When PC50 z=1, the definition is as follows:



No	Abbr.	Parameter function and description	Mode	Default	Range	Unit
PC51	CMOF1	Compare: data shift: CMP data array, plus PC51 value and PC52 value are actual compare data. The actual data array for comparison =the original comparison data array+PC51+PC52. Note: once PC52 is valid, if PC 55 z=1, PC52 will reset to 0 automatically.	All	0	-1000 0000 ~ 1000 0000	Source pulse
PC52	CMOF2 (■)	Compare: data shift(can reset to zero): CMP data array, plus PC51 value and PC52 value are the actual data for comparison. The actual data array for comparison = the original data array for comparison +PC51+PC52. Note: once this parameter is valid, if PC55 z=1, PC52 will reset to 0 automatically.	All	0	-1000 0000 ~ 1000 0000	Source pulse
PC53	CSAX	Position for synchronous capture axis: This parameter indicates the position for the synchronous capture axis, which can be used as the command source for the E-Cam master axis (PC66.y = 5). When capture operates every two times, the servo calculates the error between the moving distance of this axis and the set interval between each synchronous capture action(PC54).	Pr	0	-2147483648 ~ 2147483647	Pulse unit of master axis
PC54	CSDS	Interval between each synchronous capture action: Sets the moving pulse amount of the synchronous capture axis between two capturing actions. Note: The new value can only be written to the parameter when capture is not in operation (PC44 x.Bit0 = 0).	Pr	100	10 ~ 100000000	Pulse unit of master axis

No	Abbr.	Parameter function and description	Mode	Default	Range	Unit
PC55	CPEX	Capture/Compare additional function setting: | 0 | z | y | x | **x: CAP other functions** x=1: when the CAP is completed, it will not be turned off, however, it will be performed the next cycle operation automatically, and the data captured by the CAP will still be saved in PC41! **y: synchronous capture axis status(read only)** y=1: DI7 triggers too many times (10 times) when the synchronous capture axis is activated **z: CMP other function** z=1: PC52 automatically resets to 0 once PC52 is valid, otherwise PC52 keeps the value.	All	0000h	0h ~ 0111h	N/A
PC56	CSDS	Pulse error for synchronous Capture axis: When the synchronous Capture axis is operating, the pulse error should be 0. Each time when capturing data, the synchronous axis operates and this parameter updates once. It operates as follows: PC56 = incremental pulse amount between two capturing actions - interval pulse number between each synchronous Capture action (PC54) PC56 = PC53 accumulation – (PC54 * number of capturing times) You can also write the specified offset of the synchronous axis to this parameter. When the synchronous Capture axis is used for the rotary shear, modifying this parameter can shift the cutting position to the left or right. You can also use error offset compensation for synchronous Capture axis(PC58) to achieve this effect.	Pr	0	-2147483648 ~ 2147483647	Pulse unit of master axis

<table>
<tr>
<td>PC57</td>
<td>CSDS</td>
<td>Maximum correction rate for synchronous Capture axis:

This parameter limits the correction percentage (%) of the synchronous Capture axis.

Correction rate = Pulse number output by the synchronous axis / Pulse number input by the synchronous axis.

(100 – PC57)% ＜ Correction rate ＜ (100 + PC57)%
<table>
<tr><th>Correction rate</th><th>Synchronous error</th><th>Speed change</th></tr>
<tr><td>Bigger</td><td>faster falls to 0</td><td>drastic</td></tr>
<tr><td>Smaller</td><td>slower downs to 0</td><td>smoother</td></tr>
</table>
When PC57 used in rotary shear, after synchronous deviation of PC56 is adjusted, increasing PC57 setting will adjust the cutting spot to the target position quickly, but the speed synchronize will be worse.</td>
<td>Pr</td>
<td>10</td>
<td>0
~
90</td>
<td>%</td>
</tr>
<tr>
<td>PC58</td>
<td>CSOF</td>
<td>Error offset compensation for synchronous Capture axis:

When the synchronous Capture axis is enabled and you want to change the error pulse amount (PC56), you can use this parameter to write the offset value.

Write PC58: output PC56 = PC56 after filter + Write value

Read PC58: read value = PC56.</td>
<td>Pr</td>
<td>0</td>
<td>-32768
~
32767</td>
<td>Pulse unit of master axis</td>
</tr>
<tr>
<td>PC59</td>
<td>ECHD</td>
<td>E-Cam: start address of data array:

The first data of E-Cam data array is saved at start address in the data array.

This parameter is only effective at the moment of pre-engaged to engaged!</td>
<td>Pr</td>
<td>100</td>
<td>0
~
794</td>
<td>N/A</td>
</tr>
</table>

PC60	ECMN	E-Cam: segment number (N): Indicates that the E-Cam curve is divided into N segments, and the table includes N+1 data. $N \leq (PC92 - PC59)$ $PC60 \times PC62 \leq 2^{31}-1$ Note: this parameter is only writable when E-Cam stops (PC66x=0).	Pr	5	5 ~ 720	N/A
PC61	ECMM	E-Cam: cycle number (M): When source axis receives the pulse number P from the master axis, E-Cam rotates the M cycles defined by PC61. $PC60 \times PC61 \leq PC62$ $PC60 \times PC62 \leq 2^{31}-1$ Note: this parameter is only writable when E-Cam stops (PC66x.Bit0=0).	Pr	1	1 ~ 32767	N/A
PC62	ECMP	E-Cam: master axis pulse number (P): Please refer to PC61. Note: this parameter can be modified at any time. But drastic modification may cause sudden unintended acceleration.	Pr	3600	10 ~ $2^{30}-1$	N/A
PC63	ECME	E-Cam: engaged segment number Sets the segment number when E-Cam engages(segment number of outlined table).	Pr	0	0 ~ 719	N/A
PC64	ECAX (■)	E-Cam: master axis position: Position counter of the E-Cam master axis. Note: this parameter is only writable when E-Cam stops (PC66 x=0).	Pr	0	$-2^{31}+1$ ~ $2^{31}-1$	Pulse unit of master axis

PC65	**PLED1**	E-Cam: initial lead pulse before engaged: When the condition to engage E-Cam (PC66z) is met, the pulse number from the master axis has to exceed the value of this parameter for the E-Cam to fully engage. The pulse from the master axis will be neglected if the initial lead pulse is not reached. Parameter with + sign: need to receive forward pulse as lead pulse. Parameter with – sign: need to receive reverse pulse as lead pulse. This parameter can be written with the virtual master axis pulse function(refer to PC83)	Pr	0	$-2^{30}+1$ ~ $2^{30}-1$	**Pulse unit of master axis**
PC66	ECON (■)	E-Cam: activate E-Cam control: d | 0 | b | a | u | z | y | x **x: E-Cam function** x.bit2 | x.bit1 | x.bit0 **x.Bit0 = 1:** E-Cam is enabled. Note: this parameter is only writable when E-Cam stops. **x.Bit1** **0:** when the servo is off, the alarm occurs or Pr is performing homing, the E-Cam is disengages. 1: when the servo is off or alarm occurs, the E-Cam remains engaged. When the servo switches to on, or some big alarm is cleared, E-Cam can operate directly. **x.Bit2** 0: modified PC96 is effective in next engagement 1: modified PC96 is effective immediately **y: command source** y=0: Capture axis	Pr	0h	0h ~ 203F F267h	N/A

		y=1: auxiliary encoder y=2: PR command y=3: time axis (1 ms) y=4: CN1 (pulse command) y=5: synchronous Capture axis (PC53) y=6: analog voltage command (unit: 1M pulse/s per 10V) **z: engagement condition (Multiple choice is not allowed)** z=0: immediately z=1: DI.CAM trigger z=2: any one position data is captured, trigger by hardware, and which is applicable to engage the working master axis. **u: disengagement condition (+ indicates multiple conditions, but 2, 4, and 6 cannot be selected at the same time)** u=0: remains engaged. u=1: disengages when DI : CAM is off. u=2: disengages when master axis pulse number reaches the setting value of PC67 and stops(the sign shows the direction). u=6: same as 2. But the speed holds when disengaged. The engaged length will exceed PC67, and it will receive Pr positioning command and stop once available. u=4: the master axis exceeds the positioning offset PC67(the sign shows the direction), and back to pre-engaged status which is set by PC74. u=8: use together with u=1,2 or 6: change the status from stopped to disengaged, and the E-				

		Cam function is disabled. **ba: disengaged type** when the disengagement condition (PC66 u = 2, 4, 6) is met, a PR(hexadecimal) is executed automatically; its number is 00~3F(00 indicates not to continue with a PR command). **d: E-Cam engagement status (read-only)** d=0: stopped d=1: engaged d=2: pre-engaged				
PC67	ECRD	E-Cam: pulse number upon disengagement (Refer to PC66u=2 definition)	Pr	0	$-2^{30}+1$ ~ $2^{30}-1$	**Pulse unit of master axis**
PC68	CPCT	Compensation time for the pulse of E-Cam master Axis This parameter is to compensate the E-Cam phase to fix the phase-lag during operation. The calculation of compensation value: Compensation value(pulse)= PC68 * (E-Cam master axis pulse frequency(Kpps)-PC69) Compensation time(ms)=Compensation phase(pulse)* E-Cam master axis pulse cycle(ms) Note: this compensation amount is proportional to the frequency of the master axis. If master axis pulse frequency> 0: only when master axis pulse frequency > PC69 ? 0, the phase-lag will be compensated. If master axis pulse frequency < 0: only when master axis pulse frequency< PC69 ? 0, the phase-lag will be compensated.	Pr	0	-20000 ~ 20000	μs

PC69	CPCL	E-Cam phase compensation-master axis minimum frequency setting: Refer to parameter PC68 description for detail.	Pr	0	-32767 ~ 32767	Kpps
PC70	CMAP1	E-Cam segment 1 rising-edge phase setting : This parameter is to set E-Cam digital output(DO:CAM_AREA) rising-edge phase when E-Cam is engaged.	Pr	0	0~360	**Degree**
PC71	CMAN1	E-Cam segment 1 falling-edge phase setting: This parameter is to set E-Cam digital output (DO:CAM_AREA) falling-edge phase when E-Cam is engaged.	Pr	0	0 ~ 360	**Degree**
PC72	CMAP2	E-Cam segment 2 rising-edge phase setting: This parameter is to set E-Cam digital output(DO:CAM_AREA2) rising-edge phase when E-Cam is engaged.	Pr	0	0 ~ 360	**Degree**
PC73	CMAN2	E-Cam segment 2 falling-edge phase setting: This parameter is to set E-Cam digital output (DO:CAM_AREA2) falling-edge phase when E-Cam is engaged.	Pr	0	0 ~ 360	**Degree**
PC74	**PLED2**	E-Cam pre-engaged pulse number: When PC66 u=4(engagement exceeds the specified pulse number, it will be dis-engaged): When E-Cam is disengaged, it will not stop but enter pre-engaged status, the pre-engaged value is determined by this parameter. Pulse number send by mater axis must exceed this parameter to ensure the E-Cam can be engaged. If the setting pre-engaged pulse number is not reached, the master axis pulse will be neglected. For parameter sign is +: use forward pulse as lead pulse. For parameter sign is -: use reverse pulse as lead	Pr	0	-100000000 ~ 100000000	N/A

<table>
<tr><td></td><td></td><td>pulse.</td><td></td><td></td><td></td><td></td></tr>
<tr><td>PC75</td><td>TQ1</td><td>Internal torque command 1
The first internal torque command(100% indicates rated torque)</td><td>T</td><td>100</td><td>-300~
300</td><td>%</td></tr>
<tr><td>PC76</td><td>TQ2</td><td>Internal torque command 2
The 2nd internal torque command(100% indicates rated torque)</td><td>T</td><td>100</td><td>-300~
300</td><td>%</td></tr>
<tr><td>PC77</td><td>TQ3</td><td>Internal torque command 3
The 3rd internal torque command(100% indicates rated torque)</td><td>T</td><td>100</td><td>-300~
300</td><td>%</td></tr>
<tr><td>PC78</td><td>CXFT</td><td>Filter setting for synchronous capture axis Correction
<table><tr><td>u</td><td>z</td><td>y</td><td>x</td></tr></table>
yx: range of filter (%)
The new correction rate is calculated after the synchronous Capture axis captures the signal. If both the new and previous correction rates are less than the range (%) set in this parameter, they are filtered out. Otherwise, the error is corrected with the new correction rate.
<table><tr><td>yx</td><td>00</td><td>01~5F</td></tr><tr><td>Function</td><td>Filter disabled</td><td>If | Error | ≤ (1 - yx)%, then the filter is enabled</td></tr></table>
Z: filter intensity (Increasing the value will slow down the changes and improve the filter function.)
<table><tr><td>z</td><td>0</td><td>1~F</td></tr><tr><td>Function</td><td>Filter disabled</td><td>Use the average times of (2 to the z power)</td></tr></table>
u: value definition (read-only)
u=0: filter is disabled, and it indicates the correction rate and previous error is out of the yx set range.
u=1: filter is enabled, and it indicates the correction</td><td>Pr</td><td>0000h</td><td>0h
~
1F5Fh</td><td>N/A</td></tr>
</table>

<table>
<tr><td></td><td></td><td>rate and previous error is within the yx set range.
(Note: if either z or yx =0, the filter is invalid)</td><td></td><td></td><td></td><td></td></tr>
<tr><th>No</th><th>Abbr.</th><th>Parameter function and description</th><th>Mode</th><th>Default</th><th>Range</th><th>Unit</th></tr>
<tr><td>PC79</td><td>ALOP</td><td>E-Cam alignment: operate condition setting:
<table><tr><td>d</td><td>c</td><td>b</td><td>a</td><td>u</td><td>z</td><td>y</td><td>x</td></tr></table>
yx: range of filter(0~95%)
When DI: ALGN is triggered, the E-Cam phase alignment function is enabled, and the system will detect the current E-Cam position. When the difference (%) between the current E-Cam position and its previous alignment position is less than the value set by the parameter, the filter function is enabled. Otherwise, the system uses the new position to do the alignment directly.
<table><tr><td>yx</td><td>00</td><td>01~5F</td></tr><tr><td>Function</td><td>Filter disabled</td><td>If | Error | ≤ (1 - yx)%, then the filter is enabled</td></tr></table>
uz: maximum allowable correction rate (%)
When phase alignment is enabled, the limitation of the maximum allowable correction rate (C) is defined as ｜C｜ <= (PC62/PC61) x PC79.uz%.
When the alignment error is large, correcting this error once may cause motor vibration or overloading. Using this parameter can divide the phase alignment into several stages to smooth the process, but it may need longer time to complete the phase alignment.
ba: PR number
After each alignment, any shortage of pulse numbers from the E-Cam(slave axis) is stored in a specified PR. This PR can compensate for the slave position at the appropriate timing point.
Note: if ba is set to 0, any shortage of pulse</td><td>Pr</td><td>0000
0000h</td><td>0h
~
5F3F
6F5Fh</td><td>N/A</td></tr>
</table>

No	Abbr.	Parameter function and description	Mode	Default	Range	Unit
		numbers is not stored in PR. **dc: masking range (%)** When DI:ALGN is triggered, the next alignment action is allowed only after the increasing pulses of the master axis are greater than the masking distance (M). M ≥ (PC62/PC61) x PC79.dc%. Note: this masking function only allows forward pulse input and does not work for reverse pulse input.				
PC80	ALDY	E-Cam alignment: DI delay time setting: This parameter offsets the alignment target to resolve DI and sensor delays. The setting works as follows: PC80 = PD15 (DI response filter time) + delay time of sensor.	Pr	0	-25000 ~ 25000	us
PC81	ALTG	E-Cam alignment: alignment target position: When the input value is out of range, the writing is prohibited and error occurs. When the input value is within the setting range, but if changes in the value of PC62 or PC61 causes the value to exceed the range, this parameter is automatically reset to 0: PC81 new value = 0 if PC81 ≧ (PC62 /PC61)	Pr	0	0 ~ (PC62 /PC61) -1	Pulse unit of master axis

<table>
<tr><td>PC82</td><td>ALCT</td><td>E-Cam alignment: control switch:
<table><tr><td>z</td><td>y</td><td>x</td></tr></table>
x: E-Cam alignment control
<table>
<tr><td>Digits</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>Function</td><td>Reserved</td><td>Reverse alignment</td><td>Trigger PR immediately</td><td>Enable alignment</td></tr>
<tr><td>Description</td><td>-</td><td>1: enable. Set this bit to 1 if the mark is on a compensated motion axis, as the position of the mark is affected during E-Cam phase alignment. This function is applicable for feeding control of reverse rotary shears.</td><td>1: enable. The E-Cam displacement value is stored in the PR data location which is assigned by PC79ba.Bit. Set this bit to 1 to trigger this PR command immediately. Otherwise, this PR should be triggered and completed before DI: ALGN triggered</td><td>1: enable. When alignment is enabled, it will perform E-Cam alignment correction if DI:ALGN is triggered.</td></tr>
</table>
y: filter intensity (0 - F)
Indicates average of 2^(y). By increasing the value of y, the correction will be slower, which can avoid</td><td>Pr</td><td>0000h</td><td>0h
~
6FF7h</td><td>N/A</td></tr>
</table>

		large amounts of correction during E-Cam alignment. This can also make the operation more stable by avoiding disturbances caused by sensor noise. Note1. y=0 filter is disabled. Note 2: if the setting is too large, the alignment correction cannot be performed. The recommended value is 3. **uz: alignment forward direction allowable rate (0 - 100%)** 0 : backward alignment only 30: forward 30%, backward 70% 50: alignment with the shortest distance 80: forward 80%, backward 20% ≧100: forward alignment only.				

No	Abbr.	Parameter function and description	Mode	Default	Range	Unit
PC83	CMSK	E-Cam master axis pulse masking setting u | z | y | x **x:** pulse masking function of master axis / pulse input method of master axis	Pr	0000h	0h ~ FF7Dh	N/A

x	Function	Actual master axis pulse	Virtual master axis pulse	Description
0	Function disabled	Acceptable	Disabled	Slave axis is driven by the actual master axis pulse.
1	Master axis pulse masked	masked		Slave axis stops operating, but the masked master pulse continues to be stored in the internal variable.
2	Continuous forward running		Enable	Command source is the virtual pulse frequency (unit: Kpps) set by PC83.uz. This function will operate continuously. To stop the virtual pulse, set x to 1.
3	Continuously reverse running			
4	Forward JOG			Command source is the virtual pulse number (unit: pulse) set by PC83.uz. This function only executes the pulse number set by PC83.uz.
5	Reverse JOG			
6 ~ 8	-	-	-	-

No	Abbr.	Parameter function and description	Mode	Default	Range	Unit
		(see table below)				

x	Function	Actual master axis pulse	Virtual master axis pulse	Description
9	Master axis pulse masked	Receive actual master axis pulse	Disabled	Slave axis is driven by the actual master axis pulse and the master axis pulse continues to be stored in the internal variable.
A	Continuous forward running		Enable	Command source is the frequency transmitted by the actual master axis (PC66.y) plus the virtual pulse frequency (unit: Kpps) set by PC83.uz. This function will continue to operate. To stop the virtual pulse, set x to 9.
B	Continuous reverse running			
C	Forward JOG			Command source is the pulse transmitted by the actual master axis (PC66.y) plus the virtual pulse number (unit: pulse) set by PC83.uz. This function is often used for dynamic adjustment.
D	Reverse JOG			

No	Abbr.	Parameter function and description	Mode	Default	Range	Unit

y: masking pulse / virtual pulse correction initial lead setting

<table>
<tr><th>y</th><th>Function</th><th>Description</th></tr>
<tr><td>0</td><td>Function disabled</td><td>Virtual pulse number is not written to initial lead pulse(PC65).</td></tr>
<tr><td>0→1</td><td>Write the lead</td><td>Write the virtual pulse number to Initial lead pulse(PC65).</td></tr>
<tr><td>0→2</td><td rowspan="2">Write to ROM</td><td rowspan="2">Write the virtual pulse number to initial lead pulse(PC65) and also write to EEPROM.</td></tr>
<tr><td>0→3</td></tr>
<tr><td>0→4</td><td rowspan="2">Plus one cycle</td><td rowspan="2">Write the virtual pulse number plus the pulse of one cycle (PC62/PC61) to initial lead pulse(PC65).</td></tr>
<tr><td>0→5</td></tr>
<tr><td>0→6</td><td rowspan="2">Plus one cycle and write to ROM</td><td rowspan="2">Write the virtual pulse number plus the pulse of one cycle (PC62/PC61) to initial lead pulse(PC65), and write to EEPROM.</td></tr>
<tr><td>0→7</td></tr>
<tr><td>8~15</td><td>Reserved</td><td>-</td></tr>
</table>

Example: initial lead pulse PC65 = 2000; pulse number of one cycle is 5000.

1. Virtual pulse number is 255. Set PC83.y to 1, and then PC65= 2000 + 255 = 2255.

2. Virtual pulse number is 255. Set PC83.y to 4, and then PC65= 2000 + 255 + 5000 = 7255.

3. Virtual pulse number is -2550. Set PC83.y to 1, and then PC65= 2000 - 2550 + 5000 = 4450.

uz: pulse data when master axis performs continuous forward / reverse running or JOG operation.

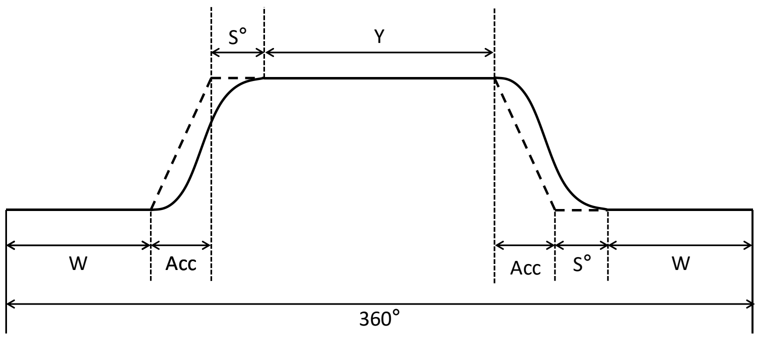
Example:

Initiate masking of the actual pulse of master axis	uzyx = 0x0001
Continuous forward running of master axis at 20 Kpps	uzyx = 0x1402
Continuous reverse running of master axis at 32 Kpps	uzyx = 0x2003
Forward JOG of master axis for 255 pulses	uzyx = 0xFF04
Reverse JOG of master axis for 18 pulses	uzyx = 0x1205
Complete and adjust for lead	uzyx = 0x0020 (write to EEPROM)
Stop this function	uzyx = 0x0000

No	Abbr.	Parameter function and description	Mode	Default	Range	Unit
PC84	CSDS	Motion control macro command: command parameter#4: Before executing the macro command, you should set the relevant parameters #4 in advance. The function of the parameter is determined by the macro command. Not every macro command requires this parameter.	All	0	0h ~ FFFFFFFFh	N/A
PC85	CSDS	Motion control macro command: command parameter#3 Before executing the macro command, you should set the relevant parameters #3 in advance. The function of the parameter is determined by the macro command. Not every macro command requires this parameter.	All	0	-2^31 ~ 2^31-1	N/A
PC86	CSDS	Motion control macro command: command parameter#2 Before executing the macro command, you should set the relevant parameters #2 in advance. The function of the parameter is determined by the macro command. Not every macro command requires this parameter.	All	0	-2^31 ~ 2^31-1	N/A
PC87	CSDS	Motion control macro command: command parameter#1 Before executing the macro command, you should set the relevant parameters #1 in advance. The function of the parameter is determined by the macro command. Not every macro command requires this parameter.	All	0	-2^31 ~ 2^31-1	N/A

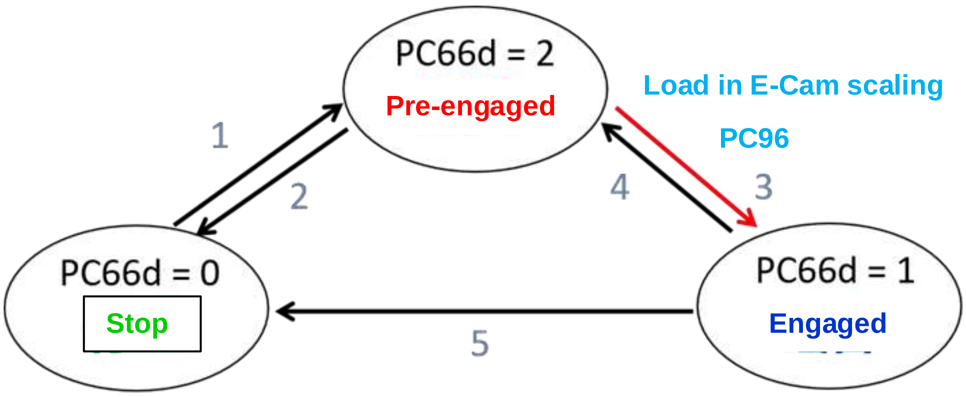
<table>
<tr><th>No</th><th>Abbr.</th><th>Parameter function and description</th><th>Mode</th><th>Default</th><th>Range</th><th>Unit</th></tr>
<tr><td rowspan="2">PC88</td><td rowspan="2">CSDS</td><td>Motion control macro command: issue command / read execution result:
Write: to issue a macro command (0CBAh).
Read: to examine the execution result of a macro command(1CBAh is returned if successful).
If you issue command 0001:
1:1001h is returned if successful
2: F01xh is returned if unsuccessful (depending on the command description).
3: If not supported, the failure code F001h is returned.</td><td>All</td><td>0</td><td>0h
~
099Fh</td><td>N/A</td></tr>
<tr><td colspan="5"><table>
<tr><td>Command code
0005h</td><td>E-Cam disengages after engaged for one cycle</td></tr>
<tr><td>Macro parameter</td><td>PC86=pulse number of master axis</td></tr>
<tr><td colspan="2">This function can set the pulse number of master axis (PC62) and pulse number of disengaging time (PC67) as the same value synchronously, with the disengagement condition (PC66u = 2, 4, 6) and the cycle number of master axis as 1 (PC61 =1), it will make the E-Cam disengaged after being engaged for one cycle.</td></tr>
<tr><td>Failure code
F005h</td><td>Pulse number of master axis (PC62) exceeds the range
$\mathrm{PC60} \times \mathrm{PC61} \leq \mathrm{PC62} \leq \frac{2^{31}}{\mathrm{PC60}}$</td></tr>
<tr><td>Success code
1005h</td><td>-</td></tr>
</table></td></tr>
</table>

<table>
<tr><td>PC88</td><td>CSDS</td><td>
<table>
<tr><td>Command code 0006h</td><td>Create E-Cam table: rotary shear (with synchronous zone)</td></tr>
<tr><td>General parameters</td><td>PC59=Start address (data array).
PC60=7(this macro is fixed to 7 segments, 8 points.)
PA06, PA07 E-Gear ratio need to be set firstly.</td></tr>
<tr><td>Macro parameters</td><td>PC85= A(number of teeth on the motor) x C(cutting count)
PC86= B (number of teeth on the cutter)
PC87= 1000000 * R * V
In which:
R(cutting length ratio, range 0.07 ~ 2.5) =
L(target cutting length)/ ℓ(perimeter of cutter)
V(speed scaling, range -20% ~ 20%)=cutting speed / feeding speed
V=1.0: during cutting, the speed of cutter is the same as the feeding speed.
V=1.1: during cutting, the speed of cutter increases 10%.
V=0.9: during cutting, the speed of cutter decreases 10%.</td></tr>
<tr><td colspan="2">1. This macro automatically calculates the data for the E-Cam table according to the macro parameters, and stores them in the data array specified by PC59.
2. The above listed parameters are all related to E-Cam table calculation, it must be correctly set before executing this macro.
3. After this macro is executed, if the macro parameters have been modified, the E-Cam table must be recreated and you must execute this macro again.
4. Data in the E-Cam table is changed after this macro is executed; Ensure do not execute the macro when E-Cam is engaged.
5. In E-Cam applications, parameters (such as PC62, PC61) that are irrelevant to this macro are not listed here, you should set the parameters according to the actual application.
Note: after this macro is executed, the E-Cam table is not saved to EEPROM automatically.</td></tr>
<tr><td>Failure code F061h</td><td>The E-Cam is engaged, so the E-Cam table cannot be created</td></tr>
<tr><td>Failure code F062h</td><td>Data of PC85 exceeds the range (1 - 65535)</td></tr>
<tr><td>Failure code F063h</td><td>Data of PC86 exceeds the range (1 - 65535)</td></tr>
<tr><td>Failure code F064h</td><td>Data of PC87 exceeds the range (300000~2500000)</td></tr>
<tr><td>Failure code F065h</td><td>PC59 data array exceeds the data array size.</td></tr>
<tr><td>Failure code F066h</td><td>PC60 E-Cam segment number must be set to 7</td></tr>
<tr><td>Failure code F067h</td><td>Data calculation error. Decrease the value of E-Gear ratio, but keep the same proportions. For example: adjust 167772160/36000 to 16777216/3600.</td></tr>
<tr><td>Success code 1006h</td><td>-</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>No</th><th>Abbr.</th><th>Parameter function and description</th></tr>
<tr><td>PC88</td><td>CSDS</td><td>
<table>
<tr><td>Command code
0007h</td><td>Create E-Cam table: rotary shear (adjustable synchronous speed zone)</td></tr>
<tr><td>General parameters</td><td>PC59 = Start address (data array)
PC60 = N(30~72)(E-Cam segment number)
PA06,PA07 E-Gear ratio need to be set firstly.</td></tr>
<tr><td>Macro parameters</td><td>PC84.H16(high word)(Hex) = S(S-curve smoothing level, range 1 - 4)
PC84.L16(low word)(Hex) = W(degree of waiting zone, range -1 to 170 degrees)
PC85=Y(degree of synchronous speed zone, range 0 - 330 degrees)
PC86.H16(high word)(Hex) = A(number of teeth on the motor) * C (cutting count)
PC86.L16(low word)(Hex) = B (number of teeth on the cutter)
PC87 = 1000000 * R * V(range1.88 > R x V)
In which:
R (cutting length ratio) = L (target cutting length) / ℓ (perimeter of cutter)
V (speed scaling) = cutting speed / feeding speed
Example:
V = 1.0: during cutting, the speed of cutter is the same as the feeding speed
V = 1.1: during cutting, the speed of cutter increases 10%
V = 0.9: during cutting, the speed of cutter decreases 10%

</td></tr>
<tr><td colspan="2">Supplementary formula:
W'= 180 +(360 / N)-(360 / R)+(Y / 2)
When
① PC84.L16 < W´,E-Cam table is in error(failure code F07Ah).
② PC84.L16 = W´, initial speed is 0 in E-Cam table.
③ PC84.L16 > W´, initial speed > 0 in E-Cam table, W must be set to -1.</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>No</th><th>Abbr.</th><th>Parameter function and description</th></tr>
<tr><td>PC88</td><td>CSDS</td><td>
<table>
<tr><td>Command code 0007h</td><td>Create E-Cam table: rotary shear (adjustable synchronous speed zone)</td></tr>
<tr><td colspan="2">1. This macro automatically calculates the data for the E-Cam table according to the macro parameters, and stores them in the data array specified by PC59.
2. The above listed parameters are all related to E-Cam table calculation, it must be correctly set before executing this macro.
3. After this macro is executed, if the macro parameters have been modified, the E-Cam table must be recreated and you must execute this macro again.
4. Data in the E-Cam table is modified after this macro is executed; ensure do not execute this macro when E-Cam is engaged.
5. In E-Cam applications, parameters (such as PC62, PC61) that are irrelevant to this macro are not listed here. You should set the parameters according to the actual application.
Note: after this macro is executed, the E-Cam table is not saved to EEPROM automatically.</td></tr>
<tr><td>Failure code F071h</td><td>The E-Cam is engaged, so the E-Cam table cannot be created</td></tr>
<tr><td>Failure code F072h</td><td>Synchronous speed zone of PC85 exceeds the range (0 - 330)</td></tr>
<tr><td>Failure code F073h</td><td>S-curve smoothing level of PC84.H16 exceeds the range (1 - 4)</td></tr>
<tr><td>Failure code F074h</td><td>Degree of waiting zone of PC84.L16 exceeds the range (-1 to 170)</td></tr>
<tr><td>Failure code F075h</td><td>Data of PC87 exceeds the range (50000 - 5000000)</td></tr>
<tr><td>Failure code F076h</td><td>E-Cam segment number of PC60 exceeds the range (30 - 72).</td></tr>
<tr><td>Failure code F077h</td><td>PC59 data array start position exceeds the array length.</td></tr>
<tr><td>Failure code F078h</td><td>Data calculation error. Decrease the value of E-Gear ratio, but maintain the same proportions. For example: adjust 167772160/36000 to 16777216/3600.</td></tr>
<tr><td>Failure code F079h</td><td>Degree of acceleration zone is too small.
You can decrease the value for the waiting zone, synchronous speed zone, or S-curve level</td></tr>
<tr><td>Failure code F07Ah</td><td>waiting zone < minimum waiting zone.
Increase the value for the waiting zone(W)or decrease the value for the synchronous speed zone(Y).</td></tr>
<tr><td>Success code 1007h</td><td>-</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>No</th><th>Abbr.</th><th>Parameter function and description</th></tr>
<tr><td>PC88</td><td>CSDS</td><td>
<table>
<tr><td>Command code 0008h</td><td>E-Cam curve scaling (PC96) is effective once immediately</td></tr>
<tr><td>Macro parameter</td><td>N/A</td></tr>
<tr><td colspan="2">1. If this macro is triggered, the E-Cam scaling (PC96) becomes effective once immediately when the E-Cam is engaged.
2. The E-Cam scaling is loaded into the system by PC96 at the point when E-Cam is engaged (see the following transition 3). The scaling cannot be changed when E-Cam is engaged, it can only be changed after one cycle is finished which is to ensure the E-Cam can return to the original position without cumulative error.



<table>
<tr><td>前置</td><td>Pre-engaged</td></tr>
<tr><td>停止</td><td>Stop</td></tr>
<tr><td>载入凸轮倍率</td><td>Load in E-Cam scaling</td></tr>
<tr><td>啮合</td><td>Engaged</td></tr>
</table>

If it is necessary to change the E-Cam scaling immediately in the application, there are two methods in below:
1. Set PC66x.Bit2=1: set this bit when E-Cam is engaged, so that every change to the PC96 takes effect immediately.
2. Execute macro#8: each time macro#8 is triggered, it will activate PC96 immediately.</td></tr>
<tr><td>Failure code</td><td>N/A</td></tr>
<tr><td>Success code 1008h</td><td>-</td></tr>
</table>
</td></tr>
</table>

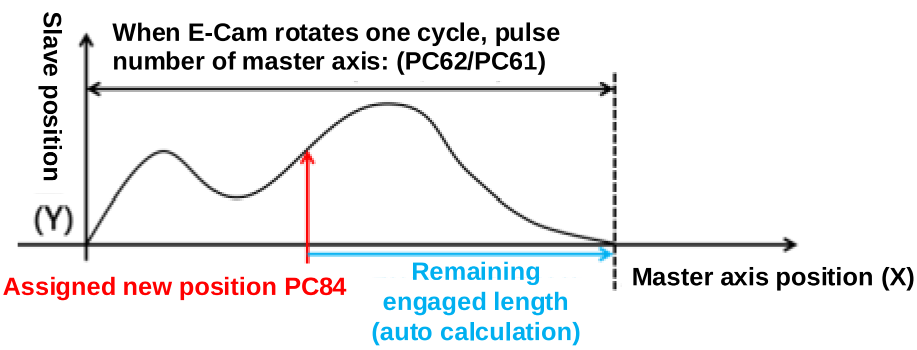
No	Abbr.	Parameter function and description
PC88	CSDS	

Command code 000Ch	Change engaged X position: rotates in forward direction until disengagement condition is met
General parameter	N/A
Macro parameter	PC84=new master axis engaged X position(unit: pulse number of master axis)

1. This macro command can change the engaged position immediately even when the E-Cam is engaged, and it will also automatically calculate the remaining engaged length and disengage the E-Cam after rotating one cycle (360°) in the forward direction. At that time, only E-Cam is disengaged , and you should set the disengagement condition PC66.u=2,4,6 to complete this operation.

2. E-Cam disengages when an alarm occurs or power supply is cut off. If you want E-Cam to re-engage at the last disengaged position and continue its remaining cycle, it is recommended that you record the master axis position(X) of the last disengagement and then execute this macro command.

3.Note that when E-Cam is disengaged, the servo position might shift slightly, causing position error when E-Cam re-engages.



Note: when using this macro command, it is recommended that you execute the macro command before operating the master axis.

Failure code F0C1h	when this macro command is executed, E-Cam is not in engaged status
Failure code F0C2h	PC84 data is wrong, the value cannot be less than 0.
Failure code F0C3h	PC84 data is wrong, it has to be less than the value of (PC62/PC61)
Success code 100Ch	-

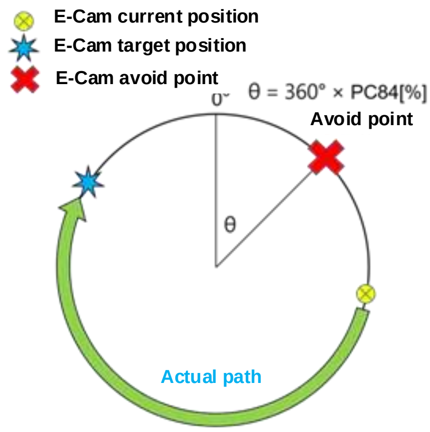
No	Abbr.	Parameter function and description
PC88	CSDS	(see nested table below)

Command code 000Dh	Calculate the error between the current position of the E-Cam and indexing coordinates for PR positioning
General parameters	N/A
Macro parameters	PC84 = dcba : uzyx(HEX) yx (PR number): 0~0x3F, invalid when value is 0! uz: must set to 0 ba (PC86 format): ba = 0: avoid point ba = 1: allowable forward rate Dc (inhibit reverse rotation) dc = 0: invalid dc = 1: inhibit reverse rotation PC86(avoid point or allowable forward rate) avoid point cycle 0 - 100(%) or allowable forward rate 0~100(%)

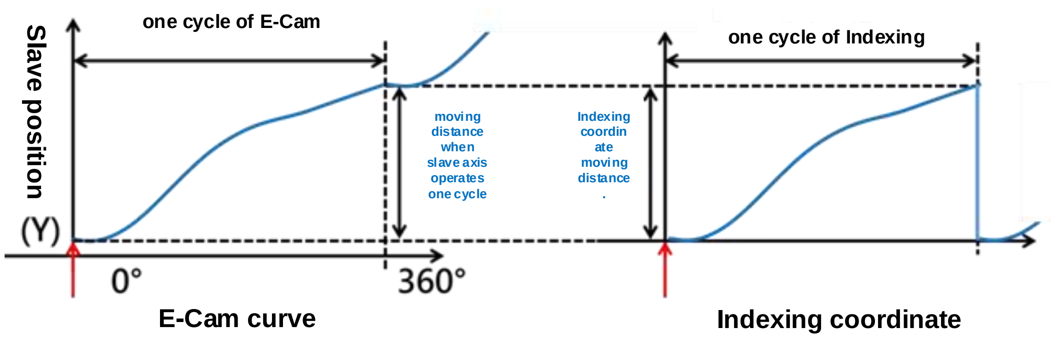
When the E-Cam is engaged, if the motor is stopped due to Servo Off or an alarm, position error will occur between the actual position and the E-Cam position. After the servo switches to on again, in order to return the E-Cam back to target position, you can use this macro command to automatically calculate the correction value and write the value to the specified PR for incremental positioning.
When using this macro command:
1. Set PC66 x.bit1 to 1 to keep the E-Cam engaged and to keep calculating the position of E-Cam when Servo is Off.
2. The indexing coordinates and the E-Cam coordinates should be at the same height: total index coordinate moving distance (PC90) = E-Cam moving distance when slave axis operates one cycle (table(the last data-the first data).
3. Set the E-Cam curve scaling PC96 to 1.0 times.
4. Have the 0 degree positions in the E-Cam table point to the origin of the indexing coordinate when E-Cam is engaged for the first time. You can achieve this alignment by executing homing.
5. You can only use this macro command for a periodic operation which always starts from the same position.
Note1: when using PR command, usually the value of incremental commands are different, you can use avoid point position to define forward and reverse rotation timing. To run the motor from current position to target position, both forward and reverse rotation can achieve the target due to E-Cam is running periodically. The difference between forward and reverse rotation is offset value. And you can use avoid point to define forward and reverse rotation timing.
Note2: avoid point: means impassable point when this macro PR is positioning.

No	Abbr.	Parameter function and description

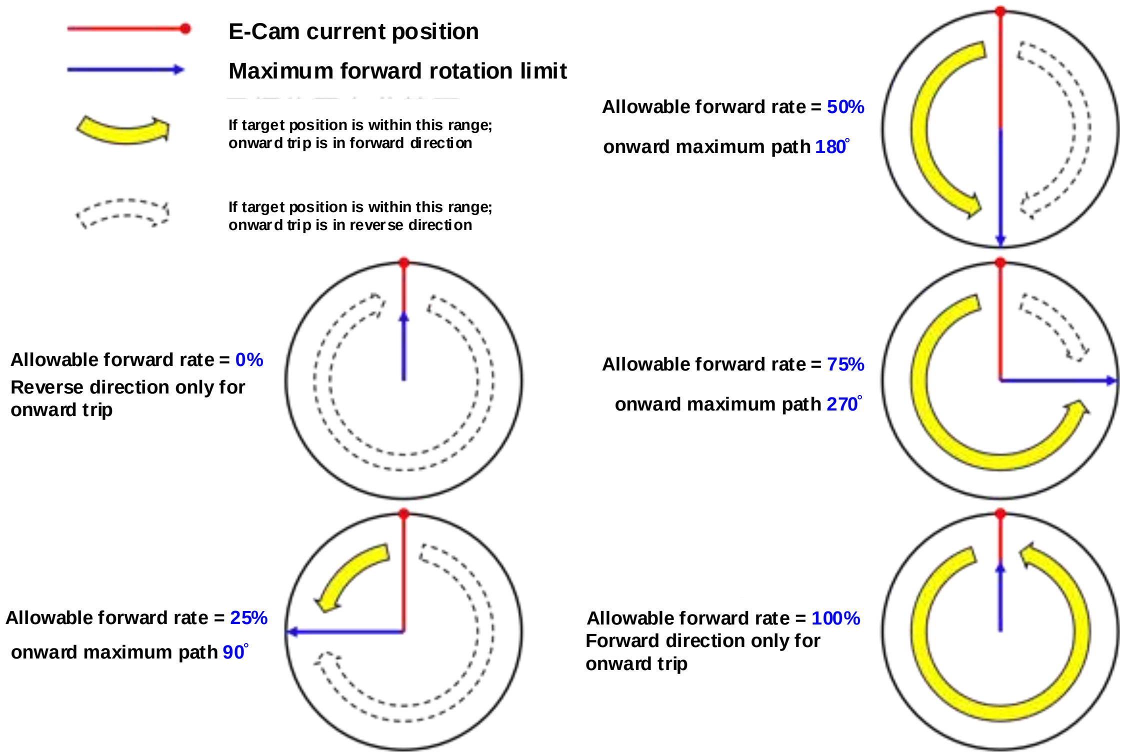
PC88	CSDS	



E-Cam current position
E-Cam target position
E-Cam avoid point
0°
θ = 360° × PC84[%]
Avoid point
θ
Actual path



Slave position
(Y)
one cycle of E-Cam
moving distance when slave axis operates one cycle
Indexing coordinate moving distance.
one cycle of Indexing
0°
360°
E-Cam curve
Indexing coordinate



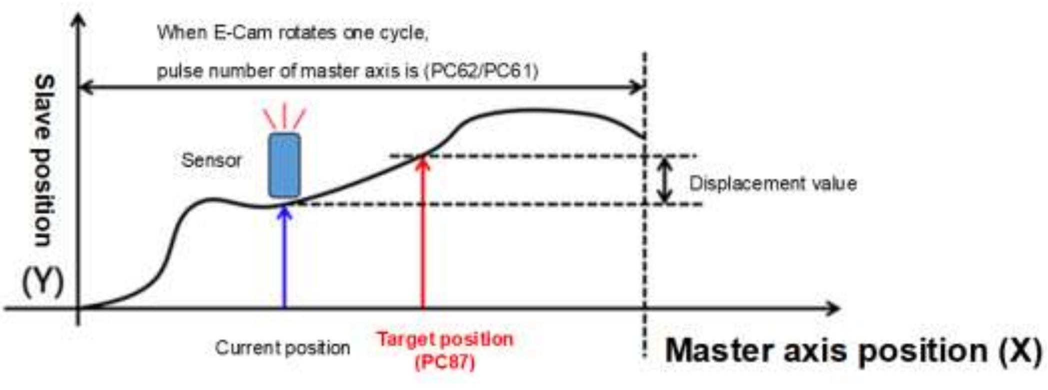
E-Cam current position
Maximum forward rotation limit
If target position is within this range; onward trip is in forward direction
If target position is within this range; onward trip is in reverse direction
Allowable forward rate = 50%
onward maximum path 180°
Allowable forward rate = 0%
Reverse direction only for onward trip
Allowable forward rate = 75%
onward maximum path 270°
Allowable forward rate = 25%
onward maximum path 90°
Allowable forward rate = 100%
Forward direction only for onward trip

Failure code F0D1h	when this macro command is executed, E-Cam is not in engaged status.
Failure code F0D2h	PC84yx, PR number exceeds the range (1~0x3F).
Failure code F0D3h	PC86 avoid point or allowable forward rate exceeds the range (0 - 100%).
Failure code F0D5h	Position correction value does not exist. This macro command might be triggered twice.
Failure code F0D6h	When servo switches to on again, E-Cam is not engaged.
Failure code F0D7h	E-Cam table Y axis height does not equal to the total index moving distance(PC90)
Failure code F0D8h	E-Cam table scaling does not equal 1.
Failure code F0D9h	PC84.ba, PC86 data exceeds the range: 0~1.
Failure code F0DAh	PC84.dc reverse inhibit setting exceeds the range: 0~1.
Failure code F0DBh	The reverse inhibit function has failed. Do not use macro commands #D and #10 consecutively.

No	Abbr.	Parameter function and description
PC88	CSDS	(see below)

Command code 000Eh	E-Cam displacement value for PR positioning
Macro parameters	PC84 = dcba:uzyx(HEX) yx (PR number): 0 ~ 0x3F, invalid when value is 0! uz (maximum allowable alignment correction rate): 0 ~ 0x64 (%) a (triggering specified PR): a = 0: manual trigger. a = 1: immediate trigger automatically. b(position of the mark): b = 0: on non-compensated motion axis b = 1: on compensated motion axis c(DI channel): c = 0: generally DI with event write to macro command #E. c = 1: high-speed DI7 with Capture(need enable to execute PR#50 at the end point) d: must set to 0 PC85(DI time delay compensation) : - 25000 ~ 25000, unit: µsec PC86 (Allowable forward rotate rate): 0~100(%), Refer to macro command #D for the setting PC87(Alignment target position X): 0 ~ (PC62/PC61)-1, unit: pulse number of master axis

During E-Cam operation, if you want to quickly align the E-Cam position with the mechanical referral point, you can use the sensor to trigger the DI:EVx or use high-speed DI7 with Capture to execute this macro command. This will calculate the displacement value for the slave axis alignment, and then write the displacement value to the specified PR for incremental positioning.
Trigger this PR when needed to move the slave axis to the corresponding target position. For those applications which is not need this PR, you can set PC84.a to 0, at this time, the PR still need to be manually triggered, this macro command is just for data collection.

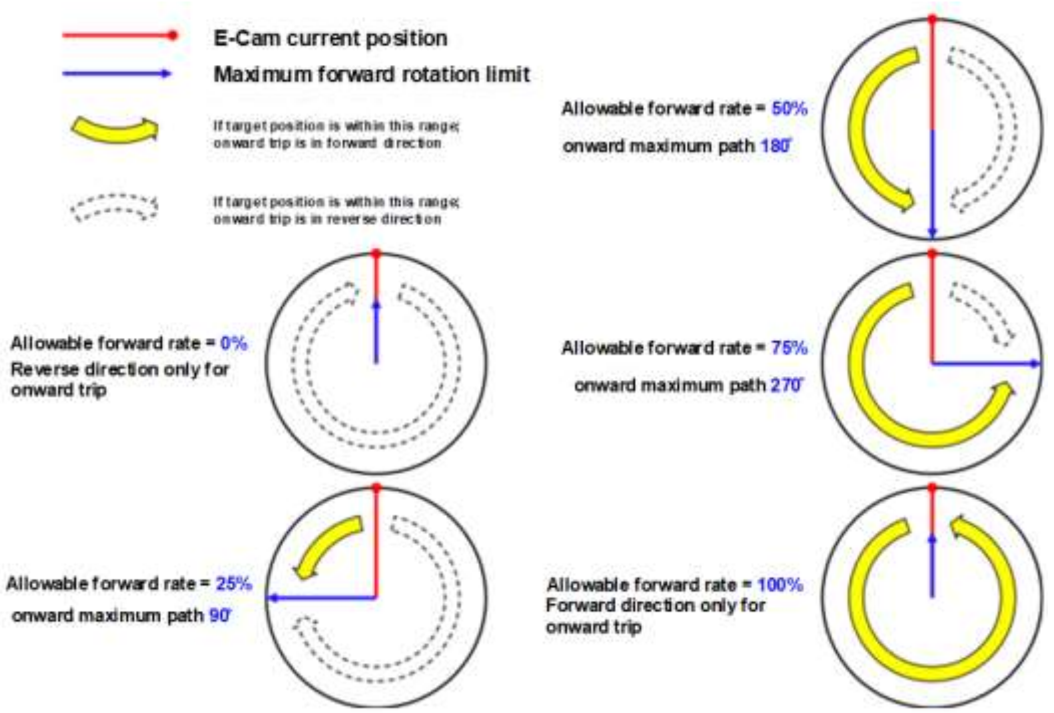


PC84.uz , which is to limit the maximum allowable correction rate. After replacement, the alignment target is different from PC87.

｜target position – current position｜ / (PC62/PC61) <= PC84.uz [%]

PC85: this parameter can use for DI time delay compensation, to overcome the deviation at different speed.

PC86: set the maximum allowable alignment correction rate when onward trip is in forward direction.



Failure code F0E1h	when this macro command is executed, E-Cam is not in engaged status
Failure code F0E2h	PC84.yx PR number specified exceeds the range: 0~0x3F
Failure code F0E3h	PC84.uz maximum correction rate exceeds the range: 0~0x64%
Failure code F0E4h	PC85 DI time compensation exceeds the range: -25000 ~ 25000.
Failure code F0E5h	PC86 allowable forward rate exceeds the range: 0~100%
Failure code F0E6h	PC87 alignment target position exceeds the range: 0~(PC62/PC61)-1
Failure code F0E7h	PC84.dcba setting value exceeds the range: 0x0000~0x0111
Failure code F0E8h	when using DI7 with Capture (PC84.c = 1), set the master axis pulse source to the Capture axis (PC66.y = 0).
Failure code F0E9h	when using DI7 with Capture (PC84.c = 1), execute PR #50 (PC44.xBit3 = 1) after the end point is captured.
Success code 100Eh	-

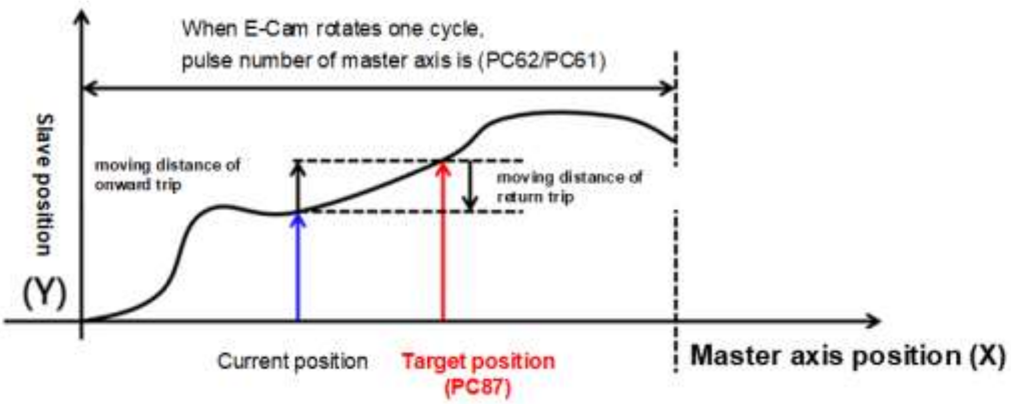
<table>
<tr><th>No</th><th>Abbr.</th><th>Parameter function and description</th></tr>
<tr><td>PC88</td><td>CSDS</td><td>

Command code 000Fh	Calculate the moving distance between the current and target position of the E-Cam for PR positioning
General parameter	N/A
Macro parameter	PC84 = dcba:uzyx(HEX) yx(PR number of onward trip): 0~0x3F, invalid when value is 0! uz(PR number of return trip): 0~0x3F, invalid when value is 0! dcba: must set to 0. PC86(allowable forward rate): 0~100(%), refer to macro command #D for the setting. PC87(target position X): 0~(PC62/PC61)-1, unit: pulse number of master axis.

When the E-Cam is engaged, this macro command calculates the moving distance between the current and target position of X, and writes the value to the specified PR command. Note that PR command must be executed in incremental type in both onward trip or returning trip.

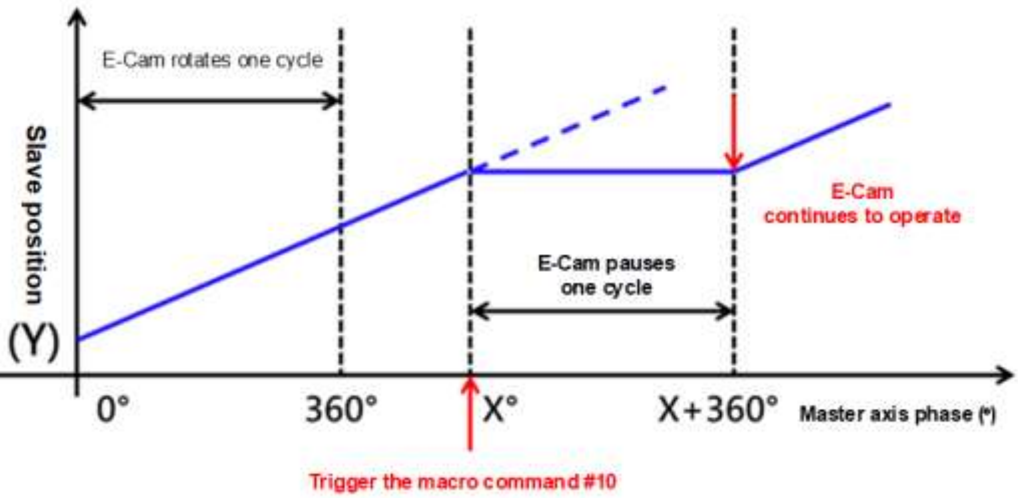
The macro application: when E-Cam is operating, the master axis is stopped and still engaged, if you want to move the slave axis to the specified position, this macro command can be used to calculate the moving distance of the onward trip and save the value for PR incremental command.

When the master axis is about to resume operation, another PR can be used for the return displacement to return to the original position. (moving distance of onward trip + moving distance of return trip = 0).

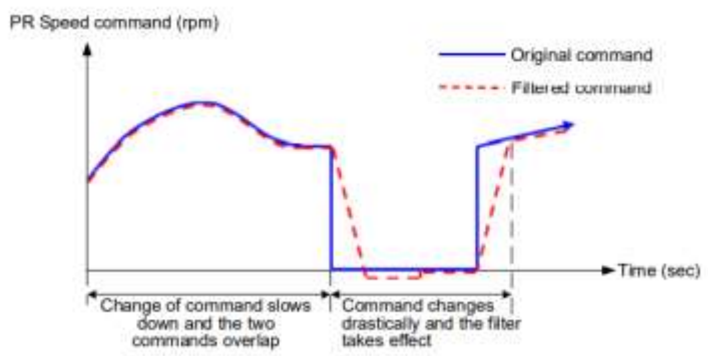


</td></tr>
</table>

			Failure code F0F1h	When this macro command is executed, E-Cam is not in engaged status	
			Failure code F0F2h	PC84.yx , PR onward number exceeds the range: 0~0x3F	
			Failure code F0F3h	PC84.uz, PR returning number exceeds the range: 0~0x3F	
			Failure code F0F5h	PC86 allowable forward rate exceeds the range: 0~100%	
			Failure code F0F6h	PC87 alignment target position exceeds the range: 0~(PC62/PC61)-1	
			Success code 100Fh	-	

<table>
<tr><th>No</th><th>Abbr.</th><th colspan="2">Parameter function and description</th></tr>
<tr><td rowspan="10">PC88</td><td rowspan="10">CSDS</td><td colspan="2"></td></tr>
<tr><td>Command code 0010h</td><td>E-Cam immediately pauses for one cycle, and resume operation in next cycle.</td></tr>
<tr><td>General parameter</td><td>N/A</td></tr>
<tr><td>Macro parameter</td><td>PC84 must set to 0.</td></tr>
<tr><td colspan="2">After the E-Cam is engaged, this macro command can immediately pause the slave axis for one cycle regardless of the current E-Cam angle(one cycle means a 360° operation of E-Cam).
To use this macro command, the following conditions must be met:
1.The E-Cam must be engaged.
2.The E-Cam curve must be in forward operation curve (including straight line). Use this macro command with PC89.yx acceleration time limit and PC89.u reverse rotation inhibit and to prevent mechanical vibration.


E-Cam pause distance= table(the end point-the start point) * PC96(the activated E-Cam ratio).
This function is accumulative. If the command is triggered for N times consecutively, it pauses the E-Cam for N cycles.
Note that the accumulated pause distance cannot overflow the range(> 2^31), otherwise the macro command will have failure code.
When the pause cycle is complete, the slave axis continues to operate and the accumulated pause distance is cleared to 0.</td></tr>
<tr><td>Failure code F101h</td><td>When this macro command is executed, the E-Cam is not in the engaged status</td></tr>
<tr><td>Failure code F102h</td><td>PC84 data exceeds the range. PC84 must set to 0.</td></tr>
<tr><td>Failure code F103h</td><td>The E-Cam must operate in forward direction. Check if the E-Cam table and PC96 > 0.</td></tr>
<tr><td>Failure code F104h</td><td>Accumulated pause distance overflow (> 2^31). Do not execute this macro command consecutively.</td></tr>
<tr><td>code 1010h</td><td>-</td></tr>
</table>

No	Abbr.	Parameter function and description	Mode	Default	Range	Unit
PC89	SPF1	PR special filter setting: <table><tr><td>u</td><td>z</td><td>y</td><td>x</td></tr></table>**yx: the acceleration time limit** PC89.yx = 00: invalid PC89.yx = 1~7F: acceleration time limit: yx * 10[ms] With acceleration time limit(0~1270 ms), if the PR(E-Cam) command changes too drastically, it will cause mechanical vibration and jeopardize the production. This function can control the acceleration/deceleration within the limit in any time, smooth the operation, reduce the noise and extend the lifetime. This function is different from the general filter: the traditional filter works regardless the change of command, which may cause command lag and reduce system efficiency. This function only filter when command change exceeds the limitation. When the variation value is small, the filter is invalid and no lag occurs. The definition of this acceleration time is the motor acceleration time from 0 to 3000rpm. Increasing time will improve the effectiveness of filter, and also improve the stability of the acceleration /deceleration operation. 	Pr	0000h	0000h ~ 107Fh	N/A

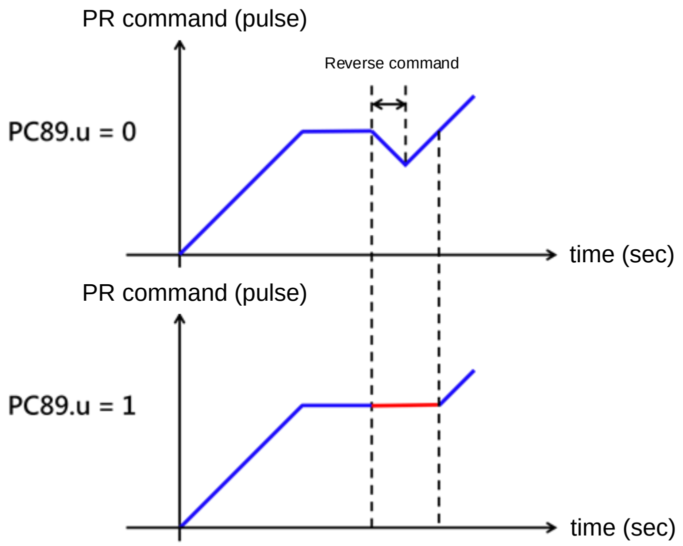
<table>
<tr><th>No</th><th>Abbr.</th><th>Parameter function and description</th><th>Mode</th><th>Default</th><th>Range</th><th>Unit</th></tr>
<tr><td>PC89</td><td>SPF1</td><td>z: reserved

u: reverse inhibit

PC89.u = 0: disabled.

PC89.u = 1: enabled.

When this function is enabled, the reverse command is inhibited and saved inside. When the value of forward rotation exceeds this reverse value, the forward command output is generated.


</td><td>Pr</td><td>0000h</td><td>0000h
~
107Fh</td><td>N/A</td></tr>
</table>

No.	Abbr.	Parameter function and description	Mode	Default	Range	Unit
PC90	IDXS	Indexing coordinates total stroke: Sets the scale of the indexing coordinates, indexing command position, and indexing feedback position. If the value is too small, it may cause errors in the indexing coordinates. The ranges of values for PC90 are: PC90> (1.05 * Maximum motor speed (rpm) * (1280000/ 60000) * (PA07/PA06))> (22.4 * Maximum motor speed (rpm) * (PA07/PA06))	All	1000000000	0 ~ 1000000000	Pulse
PC91	PCTL (■)	Special parameter write-in function PC91 = 30: current data array value is saved in EEPROM. PC91 = 999: initialize the value of data array. Note: when SON is ON, EEPROM write inhibit and shows error code.	Pr	0	0 ~ 65535	N/A
PC92	AYSZ	Total number of data arrays(read-only): The total number of data arrays which is to place CAP, CMP and E-Cam is 800.	Pr	800	-32767~ 32767	N/A
PC93	AYID (■)	Data arrays read / write address When you read / write specified data in data array, you can use panel screen or use communication software to read/write PC94/PC95.	Pr	0	0 ~ 799	N/A
PC94	AYD0 (■)	Data arrays read / write window 1 Data window 1(data array [PC93++]) When read by panel , PC93 will not add 1. If read/write PC93 in other ways, it will add 1.	Pr	0	$-2^{31}+1$ ~ $2^{31}-1$	N/A
PC95	AYD1 (■)	Data arrays read / write window 2 Data window 2(data array [PC93++]) PC93 will add 1 when you read/write by panel or communication software. Note: only the panel is not writable.	Pr	0	$-2^{31}+1$ ~ $2^{31}-1$	N/A

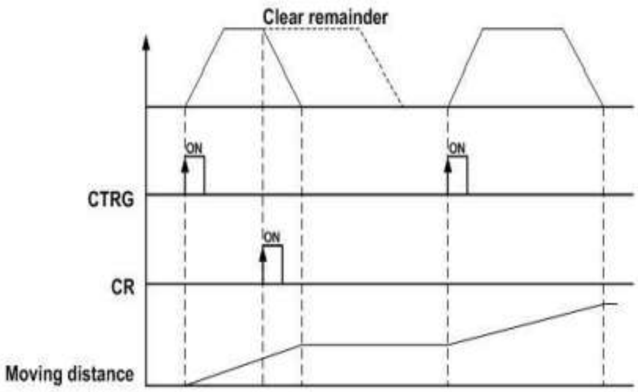
No.	Abbr.	Parameter function and description	Mode	Default	Range	Unit
PC96	TBS	E-Cam: curve scaling: Modifying this parameter to magnify or reduce the E-Cam table without changing the values. Example: when the data in the table is 0, 10, 20, 30, 40, 20, and the scaling is set to 2.000000, which is equal to the data: 0, 20, 40, 60, 80, 40, with the scaling as 1.000000. When using same master axis pulse frequency to operate E-Cam, increase this magnification will increase the E-Cam moving distance, and also enlarge the rotation speed. If negative value is used in PC96, the servo will run reversely. Note: this parameter can be set at any time, but the time when it becomes effective is determined by PC66.xBit.2.	Pr	100 0000	-2147000000 ~ +2147000000	10^{-6}
PC97	ALER	E-Cam: overall pulse error: During E-Cam alignment operation, it will control the pulse deviation to 0. Each time DI:ALGN is triggered, PC97 will be updated once.	Pr	0	2^{31} ~ $-2^{31}-1$	Pulse unit of master axis
PC98 ~ PC99		Reserved.				

<table>
<tr><th>No.</th><th>Abbr.</th><th colspan="4">Parameter function and description</th><th>Mode</th><th>Default</th><th>Range</th><th>Unit</th></tr>
<tr><td rowspan="2">PD01</td><td rowspan="2">DIA1
(*)</td><td colspan="4">Input signal automatic ON option</td><td rowspan="2">All</td><td rowspan="2">0000h</td><td rowspan="2">0000h
~
1111h</td><td rowspan="2">N/A</td></tr>
<tr><td>u (EMG)</td><td>z (LSN)</td><td>y (LSP)</td><td>x (SON)</td></tr>
<tr><td></td><td></td><td colspan="4">x=0: the open/short status of SON-SG is controlled by the external circuit of the drive.
x=1: SON-SG is auto short-circuited internally without external wiring.
y=0: the open/short status of LSP-SG is controlled by the external circuit of the drive.
y=1: LSP-SG is auto short-circuited internally without external wiring.
z=0: the open/short status of LSN-SG is controlled by the external circuit of the drive.
z=1: LSN-SG is auto short-circuited internally without external wiring.
u=0: the open/short status of EMG-SG is controlled by the external circuit of the drive.
u=1: EMG-SG is short-circuited internally without external wiring.</td><td></td><td></td><td></td><td></td></tr>
<tr><td>PD02</td><td>DI1
(*)</td><td colspan="4">Input signal option 1:
To define the function of CN1-14 pin input signal.
In different control modes, the input signals are not exactly the same. The user can define CN1-14 input signal in different control mode by setting PD02.</td><td>All</td><td>0001h</td><td>0000h
~
002Fh</td><td>N/A</td></tr>
<tr><td>PD03</td><td>DI2
(*)</td><td colspan="4">Input signal option 2
To define the function of CN1-15 pin input signal.
CN1-15 can be assigned for any input signal, its parameter setting is same as PD02, you can refer to PD02 setting description.</td><td>All</td><td>000Dh</td><td>0000h
~
002Fh</td><td>N/A</td></tr>
</table>

No.	Abbr.	Parameter function and description	Mode	Default	Range	Unit
PD04	DI3 (*)	Input signal option 3 To define the function of CN1-16 pin input signal. CN1-16 can be assigned for any input signal, its parameter setting method is same as PD02, you can refer to PD02 setting description.	All	0003h	0000h ~ 002Fh	N/A
PD05	DI4 (*)	Input signal option 4 To define the function of CN1-17 pin input signal. CN1-17 can be assigned for any input signal, its parameter setting method is same as PD02, you can refer to PD02 setting description.	All	0004h	0000h ~ 002Fh	N/A
PD06	DI5 (*)	Input signal option 5 To define the function of CN1-18 pin input signal. CN1-18 can be assigned for any input signal, its parameter setting method is same as PD02, you can refer to PD02 setting description.	All	0002h	0000h ~ 002Fh	N/A
PD07	DI6 (*)	Input signal option 6 To define the function of CN1-19 pin input signal. CN1-19 can be assigned for any input signal, its parameter setting method is same as PD02, you can refer to PD02 setting description.	All	000Fh	0000h ~ 002Fh	N/A
PD08	DI7 (*)	Input signal option 7 To define the function of CN1-20 pin input signal. CN1-20 can be assigned for any input signal, its parameter setting method is same as PD02, you can refer to PD02 setting description.	All	0012h	0000h ~ 002Fh	N/A

PD09	DI8 (*)	Input signal option 8 To define the function of CN1-21 pin input signal. CN1-21 can be assigned for any input signal, its parameter setting method is same as PD02, you can refer to PD02 setting description.	All	0011h	0000h ~ 002Fh	N/A
PD10	DO1 (*)	Output signal option 1 To define the function of CN1-41 pin output signal. In different control modes, the output signals are not exactly the same. The user can define CN1-41 output signal in different control mode by setting PD10.	All	0003h	0000h ~ 002Fh	N/A
PD11	DO2 (*)	Output signal option 2 To define the function of CN1-42 pin output signal. CN1-42 pin can be assigned to any output signal, its parameter setting is the same as PD10, you can refer to PD10 setting description.	All	0008h	0000h ~ 002Fh	N/A
PD12	DO3 (*)	Output signal option 3 To define the function of CN1-43 pin output signal. CN1-43 pin can be assigned to any output signal, its parameter setting is the same as PD10, you can refer to PD10 setting description.	All	0007h	0000h ~ 002Fh	N/A
PD13	DO4 (*)	Output signal option 4 To define the function of CN1-44 pin output signal. CN1-44 pin can be assigned to any output signal, its parameter setting is the same as PD10, you can refer to PD10 setting description.	All	0005h	0000h ~ 002Fh	N/A

No.	Abbr.	Parameter function and description	Mode	Default	Range	Unit
PD14	DO5 (*)	Output signal option 5 To define the function of CN1-45 pin output signal. CN1-45 pin can be assigned to any output signal, its parameter setting is the same as PD10, you can refer to PD10 setting description.	All	0001h	0000h ~ 002Fh	N/A
PD15	DIF (*)	Digital input filter time option 0 0 0 x x=0: N/A x=1: 2ms x=2: 4 ms x=3: 6 ms x=4: 8ms x=5: 10 ms	All	0002h	0000h ~ 0005h	N/A
PD16	SDI (■)	Digital input source control option This parameter can be used as DI source control switch. Each bit of this parameter determines the signal input source of 1 DI. Bit0 ~ Bit11 is correspond to DI1 ~ DI12. Bit setting shows as below: 0: input contact status is controlled by external hardware terminal. 1: input contact status is controlled by communication parameter (PD25) For DI function assignment, please refer to: DI1 ~ DI8: PD02 ~ PD09 DI9 ~ DI12: PD21 ~ PD24	All	0000h	0000h ~ 0FFFh	N/A
PD17	DOP1 (*)	The servo emergency stop mode setting when LSN or LSP signal is off. 0 0 0 x **x: options of emergency stop** x=0: stops immediately. x=1: servo decelerates to stop according to the decelerate time constant setting. Note: the decelerate time is set according to PF81(Deceleration time for auto-protection).	Pt, Pr, S	0000h	0000h ~ 0001h	N/A

No.	Abbr.	Parameter function and description	Mode	Default	Range	Unit
PD18	DOP2 (*)	CR signal clear setting 0 0 0 x x=0: to clear the position pulse error. When CR is triggered at the rising edge, the position pulse error of drive will be cleared to 0 (Pt mode). x=1: to clear the position pulse error. When CR-SG is short-circuited, the position pulse error of drive will be kept cleaning to 0 (Pt mode) x=2: to stop the positioning function. When the CR - SG rising edge is triggered, the motor will decelerate to stop according to the deceleration time and the remaining unfinished pulses will be ignored. When CTRG-SG is short-circuited again, the current position command will be executed (Pr mode). 	Pt, Pr	0000h	0000h ~ 0002h	N/A

<table>
<tr><th>No.</th><th>Abbr.</th><th>Parameter function and description</th><th>Mode</th><th>Default</th><th>Range</th><th>Unit</th></tr>
<tr><td>PD19</td><td>DOP3
(*)</td><td>Alarm code output option:
<table><tr><td>0</td><td>0</td><td>0</td><td>x</td></tr></table>
<table>
<tr><td rowspan="2">x setting</td><td colspan="3">Pin number</td></tr>
<tr><td>CN1-41</td><td>CN1-42</td><td>CN1-45</td></tr>
<tr><td>0</td><td>DO function</td><td>DO function</td><td>DO function</td></tr>
<tr><td>1</td><td colspan="3">Output an alarm code when an alarm occurs</td></tr>
</table>
Note: DO function is determined by PD10 ~ PD14 setting.
<table>
<tr><td colspan="3">(Note) Alarm code</td><td rowspan="2">Alarm display</td><td rowspan="2">Name</td></tr>
<tr><td>CN1-41</td><td>CN1-42</td><td>CN1-45</td></tr>
<tr><td rowspan="5">0</td><td rowspan="5">0</td><td rowspan="5">0</td><td>AL.09</td><td>Serial communication error</td></tr>
<tr><td>AL.0A</td><td>Serial communication timeout</td></tr>
<tr><td>AL.0E</td><td>IGBT overheat</td></tr>
<tr><td>AL.0F</td><td>Memory error</td></tr>
<tr><td>AL.10</td><td>Overload 2</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>AL.02</td><td>Low voltage</td></tr>
<tr><td rowspan="2">0</td><td rowspan="2">1</td><td rowspan="2">0</td><td>AL.01</td><td>Over voltage</td></tr>
<tr><td>AL.04</td><td>Regenerative alarm</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>AL.03</td><td>Over current</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>AL.05</td><td>Overload</td></tr>
<tr><td rowspan="3">1</td><td rowspan="3">0</td><td rowspan="3">1</td><td>AL.06</td><td>Over speed</td></tr>
<tr><td>AL.07</td><td>Pulse command abnormal</td></tr>
<tr><td>AL.08</td><td>Position error excess</td></tr>
<tr><td rowspan="2">1</td><td rowspan="2">1</td><td rowspan="2">0</td><td>AL.0B</td><td>Position detector error 1</td></tr>
<tr><td>AL.0C</td><td>Position detector error 2</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>AL.11</td><td>Motor mismatch</td></tr>
</table>
Note 1: please refer to section 11.1 alarm list for detail description.
Note 2: 0: OFF, 1: ON</td><td>All</td><td>0000h</td><td>0000h
~
0001h</td><td>N/A</td></tr>
</table>

PD20	DOP4 (*)	Operation option when the alarm reset signal is short-circuited. 0 | 0 | 0 | x x=0: PWM signal is off(SERVO ON is disabled) x=1: PWM power is on(SERVO ON is enabled)	All	0000h	0000h ~ 0001h	N/A
PD21	DI9 (*)	Input signal option 9 To define the function of CN1-22 pin input signal. CN1-22 can be assigned for any input signal, its parameter setting method is same as PD02, you can refer to PD02 setting description.	All	0018h	0000h ~ 002Fh	N/A
PD22	DI10 (*)	Input signal option 10 To define the function of CN1-23 pin input signal. CN1-23 can be assigned for any input signal, its parameter setting method is same as PD02, you can refer to PD02 setting description.	All	0019h	0000h ~ 002Fh	N/A
PD23	DI11 (*)	Input signal option 11 To define the function of CN1-12 pin input signal. CN1-12 can be assigned for any input signal, its parameter setting method is same as PD02, you can refer to PD02 setting description.	All	0005h	0000h ~ 002Fh	N/A
PD24	DI12 (*)	Input signal option 12 To define the function of CN1-13 pin input signal. CN1-13 can be assigned for any input signal, its parameter setting method is same as PD02, you can refer to PD02 setting description.	All	0010h	0000h ~ 002Fh	N/A

No	Abbr.	Parameter function and description	Mode	Default	Range	Unit
PD25	ITST (■)	Communication control DI status(HEX): To determine the DI contact status(12 points in total) by bit setting method. Bit 0~11 of PD25 is correspond to DI1~DI12. In binary bits: 0: DI is OFF 1: DI is ON. PD16 controls the input source, either from external hardware terminals (DI1 ~ DI12) or communication commands(correspond to Bit 0 ~ 11 of PD25). If the bit of PD16 is 1, which means the source is communication DI (PD25), If not, the source is hardware terminal DI. If the value read from PD25 is 0x0011, it indicates that DI1 and DI5 are ON eventually. If the value written into PD25 is 0x0011, which means that the communication contacts DI1 and DI5 are ON; but it does not mean that the terminal signals of the DI1 and DI5 are ON, which is determined by PD16 setting value. For the function definition of DI(DI1~DI8), you can refer to PD02~PD09. For the function definition of DI(DI9~DI12), you can refer to PD21~PD24. Example 1 If set PD16 to 0FFFh and PD25 to 0000h. then all DI1~DI12 will be controlled by the communication contacts, and all digital input contact will be turned OFF. If the external hardware terminals connect DI1~DI12 to SG is conductive, the DI signal will not be affected, but it still will be controlled by the communication contact and the DI contact DI1~DI12 still will be OFF.	All	0000h	0000h ~ 0FFFh	N/A

		Example 2: The external hardware terminals DI12~DI1 are represented by bit11~bit0 in binary values. Bit11~bit0 indicates DI12~DI1 (from left to right). DI contact source control switch (PD16): 111111000000. The external hardware terminal status: 111100001111 (1 means ON, 0 means OFF) Communication control digital input contact status(PD25): 111000111000.				

No	Abbr.	Parameter function and description	Mode	Default	Range	Unit
PD26	DO6 (*)	Output signal option 6 To define the function of CN1-46 pin output signal. CN1-46 pin can be assigned to any output signal, its parameter setting is the same as PD10, you can refer to PD10 setting description.	All	0002h	0000h ~ 002Fh	N/A
PD27	DOD (*)	Definition of output signal contact 0 : output contact is normally open(a contact). 1 : output contact is normally close (b contact). To define the output contact of DO1~DO6 signal. bit0~bit5 of this parameter defines the contact of DO1~DO6 separately, and defines output contact a contact or b contact.	All	0020h	0000h ~ 003F	N/A

<table>
<tr><th>No</th><th>Abbr.</th><th>Parameter function and description</th><th>Mode</th><th>Default</th><th>Range</th><th>Unit</th></tr>
<tr><td>PD28</td><td>MCOK</td><td>
Operation option of DO: MC_OK

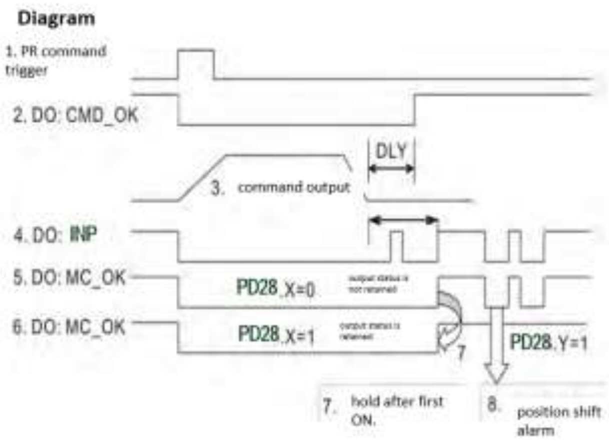
0	0	y	x

x=0: output status is not retained.

x=1: output status is retained.

y=0: disable position deviation alarm AL.1B.

y=1: enable position deviation alarm AL.1B.



1. Command trigger: new Pr command is activated. Command 3 starts and clears signals 2, 4, 5, and 6.

2. CMD_OK: indicate if command 3 output is completed and the delay time (DLY) can be set.

3. Command output: output the profile of position command based on the acceleration / deceleration setting.

4. INP: indicates if positioning error of the servo drive is within PA12 setting range.

5. MC_OK: command output and servo positioning are both completed, which indicate that DO.CMD_OK and DO.TPOS are both on..

6. MC_OK (retains digital output status): same as 5. Once this DO is on(7), its status is retained regardless of the signal 4 status.
</td><td>Pr</td><td>0000h</td><td>0000h
~
0011h</td><td>N/A</td></tr>
</table>

		7. Either signal 5 or signal 6 can be output, and the choice is specified in PD28. X. 8. Position deviation: when event 7 occurs, if signal 4 (or 5) is off, it means the position has deviated and AL.1B can be triggered. Note: set whether to enable this alarm with PD28.Y.				
PD29	DID	Software DI A/B contact setting **The corresponding DI bit is 0:** If DI setting is LSP/LSN/EMG signal, it is B contact. If DI setting is not LSP/LSN/EMG signal,it is A contact. **The corresponding DI bit is 1:** If DI function is LSP/LSN/EMG, it is A contact. If DI function is not LSP/LSN/EMG, it is B contact. Note: if any DI is assigned to be controlled by Communication(refer to PD16), this setting is invalid.	All	0000h	0000h ~ 0FFFh	N/A
PD30	SDO (■)	DO contact source control switch: **DO Source control switch.** Each bit of this parameter determines one DO signal output source. Bit0~Bit5 is correspond toDO1~DO6 separately. The bit setting is as follows: 0: output contact status is controlled by program automatically. 1: output contact status is controlled by PD31. For DO functional assignment: 1.DO1 ~ DO5: PD10 ~ PD14 2.DO6: PD26	Turret mode	0000h	0000h ~ 003Fh	N/A

PD31	OTST (■)	DO communication control contact status(HEX): If DO is controlled by parameter, PD31 can determine DO contact status(6 contacts). Bit0~Bit5 corresponds to DO1~DO6. 0=DO contact is off. 1=DO contact is on. Note, you can refer to PD25 setting.	Turret mode	0000h	0000h ~ 003Fh	N/A
PD32	SDLY (*)	Servo ON delay time when SON is ON. This parameter is to set the delay time of SERVO ON when the SON is ON.	All	0	0 ~ 3000	msec
PD33	SFDO	Software DO register The bit0 ~ bit7 of this parameter setting controls DO signal S_DO0 ~ S_DO7 separately.	All	0000h	0000h ~ 00FFh	N/A

No	Abbr.	Parameter function and description	Mode	Default	Range	Unit
PD34	DIS1	DI uninterruptible power switch function: | d | c | b | a | u | z | y | x | uzyx: The 1st group of uninterruptible power switch DI uz: Set the 1st group of switchable DI code yx: Set the 1st group of switchable DI code. dcba: The 2nd group of uninterruptible power switch DI. dc: Set the 2nd group of switchable DI code. ba: Set the 2nd group of switchable DI code. Example: PD34 = 161E0C1F The 1st group of switchable DI is SHOM and EV2. The 2nd group of switchable DI is CTRG and EV1.	All	0h	0h ~ 2F2F 2F2Fh	N/A
PD35 ~ PD99	-	Reserved	-	-	-	-

<table>
<tr><th>No</th><th>Abbr.</th><th>Parameter function and description</th><th>Mode</th><th>Default</th><th>Range</th><th>Unit</th></tr>
<tr><td rowspan="2">PE01</td><td rowspan="2">PDEF1</td><td>Definition of homing
The detailed parameter definition is as follows:</td><td>Pr</td><td>00000000h</td><td>00000000h~10FFFF3Fh</td><td>N/A</td></tr>
<tr><td colspan="5">
<table>
<tr><td>31~28</td><td>27~24</td><td>23~20</td><td>19~16</td><td>15~12</td><td>11~8</td><td>7~0 bit</td></tr>
<tr><td>BOOT</td><td>−</td><td>DLY</td><td>−</td><td>DEC1</td><td>ACC</td><td>PATH</td></tr>
</table>
1.PATH: path type(bit0~bit7)
0: Stop: homing complete and stop
1~63:Auto: homing complete and execute the specified path.
2.ACC: select acceleration time 0 - F , which is correspond to PF49~PF64.
3.DEC1: deceleration time selection for first homing, DEC setting is 0~F, which is correspond to PF49~PF64.
3. DLY: delay time selection, DLY setting is 0~F, which is correspond to
4. PF65~PF80.
5.BOOT: when the drive is powered on, whether to search for the origin
0: do not execute homing.
1: execute homing automatically (servo on for the first time after power on).
6. Apart from the above definitions, the related settings for homing also include:
a.PA04 homing mode.
b. PA08~PA09 speed setting of searching for the origin.
c. PE02: ORG_DEF is the coordinate of the origin and may not be 0. This function is used as a traversal of the coordinate.
Note1: after the origin (sensor or Z) is found, the servo has to decelerate to stop. The stop position exceeds the origin by a short distance:
1. If returning to the origin is not needed, set PATH to 0.
2. If returning to the origin is needed, set PATH to a non-zero value and set PABS = ORG_DEF.
Note 2: if the origin is found (sensor or Z), and you want the servo to move an offset S and define the coordinate as P after moving, then PATH = non-zero and set ORG_DEF = P - S, and this absolute position command = P.
</td></tr>
</table>

No	Abbr.	Parameter function and description	Mode	Default	Range	Unit
PE02	**PDEF1**	Origin definition	Pr	0	$(-2^{31}+1)$ ~ $(2^{31}-1)$	N/A
PE03	**PDEF1**	PATH#1 definition The detailed parameters are defined as follows:	Pr	00000000h	00000000h~FFFFFFFFh	N/A

PE02 Origin definition:

31~16	15~0 bit
ORG_DEF(32bit)	

PE03 PATH#1 definition:

(bit)	31~28	27~24	23~20	19~16	15~12	11~8	7~4	3~0
PE03	−	−	DLY	−	−	−	OPT	TYPE
PE04	DATA(32bit)							

1. TYPE, OPT

OPT option				Path TYPE
7	6	5	4 bit	3 ~ 0 bit
-	UNIT	AUTO	INS	1: SPEED speed control.
CMD		OVLP	INS	2: SINGLE positioning control. It stops when finished.
				3: AUTO positioning control. It automatically loads the next path when finished.
-	-	-	INS	7: JUMP, jump to the specified path.
-	-	AUTO	INS	8: write specified parameter to specified path.

2. **TYPE:** When 1, 2, or 3 is executed, it can be stopped by DO: STP and software limits.
3. **INS:** If INS is set, it interrupts the previous program
4. **OVLP:** Allow overlapping of the next path. Overlapping is not allowed in Speed mode. When overlapping in position mode, DLY is invalid.
5. **AUTO:** Executing the next PR path when the current PR completes
6. **CMD:** Refer to Chapter 7 PR command instruction.
7. **DLY:** 0 ~ F can use as the delay time number (4 BIT). It is the delay time after the execution of this path. The external INS is invalid! (DLY related parameters: PF65~PF80).

No	Abbr.	Parameter function and description	Mode	Default	Range	Unit
PE04	**PDAT1**	PATH#1 data PE03 defines the property of the target point; PE04 defines the target position of PE03 or the target jumping PATH_NO. Note: PATH: Program Note2: using non-indexing positioning function. Note3: using indexing positioning function.	Pr	0	(-2^{31}) ~ $(2^{31}-1)$ (Note2) 0~4194304 (Note3)	N/A
PE05	**PDEF2**	PATH#2 definition Refer to description of PE03.	Pr	00000000h	**00000000h ~FFFFFFFFh**	N/A
PE06	**PDAT2**	PATH#2 data Refer to description of PE04.	Pr	0	Refer to PE04	N/A
PE07	**PDEF3**	PATH#3 definition Refer to description of PE03.	Pr	00000000h	**00000000h ~FFFFFFFFh**	N/A
PE08	**PDAT3**	PATH#3 data Refer to description of PE04.	Pr	0	Refer to PE04	N/A
PE09	**PDEF4**	PATH#4 definition Refer to description of PE03.	Pr	00000000h	**00000000h ~FFFFFFFFh**	N/A
PE10	**PDAT4**	PATH#4 data Refer to description of PE04.	Pr	0	Refer to PE04	N/A
PE11	**PDEF5**	PATH#5 definition Refer to description of PE03.	Pr	00000000h	**00000000h ~FFFFFFFFh**	N/A
PE12	**PDAT5**	PATH#5 data Refer to description of PE04.	Pr	0	Refer to PE04	N/A
PE13	**PDEF6**	PATH#6 definition Refer to description of PE03.	Pr	00000000h	**00000000h ~FFFFFFFFh**	N/A

PE14	**PDAT6**	PATH#6 data Refer to description of PE04.	Pr	0	Refer to PE04	
PE15	**PDEF7**	PATH#7 definition Refer to description of PE03.	Pr	00000000h	**00000000h ~FFFFFFFFh**	N/A
PE16	**PDAT7**	PATH#7 data Refer to description of PE04.	Pr	0	Refer to PE04	N/A
PE17	**PDEF8**	PATH#8 definition Refer to description of PE03.	Pr	00000000h	**00000000h ~FFFFFFFFh**	N/A
PE18	**PDAT8**	PATH#8 data Refer to description of PE04.	Pr	0	Refer to PE04	N/A
PE19	**PDEF9**	PATH#9 definition Refer to description of PE03.	Pr	00000000h	**00000000h ~FFFFFFFFh**	N/A

No	Abbr.	Parameter function and description	Mode	Default	Range	Unit
PE20	PDAT9	PATH#9 data Refer to description of PE04.	Pr	0	Refer to PE04	N/A
PE21	PDEF10	PATH#10 definition Refer to description of PE03.	Pr	00000000h	00000000h~ FFFFFFFFh	N/A
PE22	PDAT10	PATH#10 data Refer to description of PE04.	Pr	0	Refer to PE04	N/A
PE23	PDEF11	PATH#11 definition Refer to description of PE03.	Pr	00000000h	00000000h~ FFFFFFFFh	N/A
PE24	PDAT11	PATH#11 data Refer to description of PE04.	Pr	0	Refer to PE04	N/A
PE25	PDEF12	PATH#12 definition Refer to description of PE03.	Pr	00000000h	00000000h~ FFFFFFFFh	N/A
PE26	PDAT12	PATH#12 data Refer to description of PE04.	Pr	0	Refer to PE04	N/A
PE27	PDEF13	PATH#13 definition Refer to description of PE03.	Pr	00000000h	00000000h~ FFFFFFFFh	N/A
PE28	PDAT13	PATH#13 data Refer to description of PE04.	Pr	0	Refer to PE04	N/A
PE29	PDEF14	PATH#14 definition Refer to description of PE03.	Pr	00000000h	00000000h~ FFFFFFFFh	N/A
PE30	PDAT14	PATH#14 data Refer to description of PE04.	Pr	0	Refer to PE04	N/A
PE31	PDEF15	PATH#15 definition Refer to description of PE03.	Pr	00000000h	00000000h~ FFFFFFFFh	N/A
PE32	PDAT15	PATH#15 data Refer to description of PE04.	Pr	0	Refer to PE04	N/A
PE33	PDEF16	PATH#16 definition Refer to description of PE03.	Pr	00000000h	00000000h~ FFFFFFFFh	N/A
PE34	PDAT16	PATH#16 data Refer to description of PE04.	Pr	0	Refer to PE04	N/A
PE35	PDEF17	PATH#17 definition Refer to description of PE03.	Pr	00000000h	00000000h~ FFFFFFFFh	N/A
PE36	PDAT17	PATH#17 data Refer to description of PE04.	Pr	0	Refer to PE04	N/A
PE37	PDEF18	PATH#18 definition Refer to description of PE03.	Pr	00000000h	00000000h~ FFFFFFFFh	N/A

PE38	PDAT18	PATH#18 data Refer to description of PE04.	Pr	0	Refer to PE04	N/A
PE39	PDEF19	PATH#19 definition Refer to description of PE03.	Pr	00000000h	00000000h~ FFFFFFFFh	N/A
PE40	PDAT19	PATH#19 data Refer to description of PE04.	Pr	0	Refer to PE04	N/A
PE41	PDEF20	PATH#20 definition Refer to description of PE03.	Pr	00000000h	00000000h~ FFFFFFFFh	N/A
PE42	PDAT20	PATH#20 data Refer to description of PE04.	Pr	0	Refer to PE04	N/A
PE43	PDEF21	PATH#21 definition Refer to description of PE03.	Pr	00000000h	00000000h~ FFFFFFFFh	N/A
PE44	PDAT21	PATH#21 data Refer to description of PE04.	Pr	0	Refer to PE04	N/A
PE45	PDEF22	PATH#22 definition Refer to description of PE03.	Pr	00000000h	00000000h~ FFFFFFFFh	N/A
PE46	PDAT22	PATH#22 data Refer to description of PE04.	Pr	0	Refer to PE04	N/A
PE47	PDEF23	PATH#23 definition Refer to description of PE03.	Pr	00000000h	00000000h~ FFFFFFFFh	N/A
PE48	PDAT23	PATH#23 data Refer to description of PE04.	Pr	0	Refer to PE04	N/A
PE49	PDEF24	PATH#24 definition Refer to description of PE03.	Pr	00000000h	00000000h~ FFFFFFFFh	N/A
PE50	PDAT24	PATH#24 data Refer to description of PE04.	Pr	0	Refer to PE04	N/A
PE51	PDEF25	PATH#25 definition Refer to description of PE03.	Pr	00000000h	00000000h~ FFFFFFFFh	N/A
PE52	PDAT25	PATH#25 data Refer to description of PE04.	Pr	0	Refer to PE04	N/A
PE53	PDEF26	PATH#26 definition Refer to description of PE03.	Pr	00000000h	00000000h~ FFFFFFFFh	N/A
PE54	PDAT26	PATH#26 data Refer to description of PE04.	Pr	0	Refer to PE04	N/A
PE55	PDEF27	PATH#27 definition Refer to description of PE03.	Pr	00000000h	00000000h~ FFFFFFFFh	N/A
No	**Abbr.**	**Parameter function and description**	**Mode**	**Default**	**Range**	**Unit**

PE56	PDAT27	PATH#27 data Refer to description of PE04.	Pr	0	Refer to PE04	N/A
PE57	PDEF28	PATH#28 definition Refer to description of PE03.	Pr	00000000h	00000000h~ FFFFFFFFh	N/A
PE58	PDAT28	PATH#28 data Refer to description of PE04.	Pr	0	Refer to PE04	N/A
PE59	PDEF29	PATH#29 definition Refer to description of PE03.	Pr	00000000h	00000000h~ FFFFFFFFh	N/A
PE60	PDAT29	PATH#29 data Refer to description of PE04.	Pr	0	Refer to PE04	N/A
PE61	PDEF30	PATH#30 definition Refer to description of PE03.	Pr	00000000h	00000000h~ FFFFFFFFh	N/A
PE62	PDAT30	PATH#30 data Refer to description of PE04.	Pr	0	Refer to PE04	N/A
PE63	PDEF31	PATH#31 definition Refer to description of PE03.	Pr	00000000h	00000000h~ FFFFFFFFh	N/A
PE64	PDAT31	PATH#31 data Refer to description of PE04.	Pr	0	Refer to PE04	N/A
PE65	PDEF32	PATH#32 definition Refer to description of PE03.	Pr	00000000h	00000000h~ FFFFFFFFh	N/A
PE66	PDAT32	PATH#32 data Refer to description of PE04.	Pr	0	Refer to PE04	N/A
PE67	PDEF33	PATH#33 definition Refer to description of PE03.	Pr	00000000h	00000000h~ FFFFFFFFh	N/A
PE68	PDAT33	PATH#33 data Refer to description of PE04.	Pr	0	Refer to PE04	N/A
PE69	PDEF34	PATH#34 definition Refer to description of PE03.	Pr	00000000h	00000000h~ FFFFFFFFh	N/A
PE70	PDAT34	PATH#34 data Refer to description of PE04.	Pr	0	Refer to PE04	N/A
PE71	PDEF35	PATH#35 definition Refer to description of PE03.	Pr	00000000h	00000000h~ FFFFFFFFh	N/A
PE72	PDAT35	PATH#35 data Refer to description of PE04.	Pr	0	Refer to PE04	N/A
PE73	PDEF36	PATH#36 definition Refer to description of PE03.	Pr	00000000h	00000000h~ FFFFFFFFh	N/A
No	**Abbr.**	**Parameter function and description**	**Mode**	**Default**	**Range**	**Unit**

PE74	PDAT36	PATH#36 data Refer to description of PE04.	Pr	0	Refer to PE04	N/A
PE75	PDEF37	PATH#37 definition Refer to description of PE03.	Pr	00000000h	00000000h~ FFFFFFFFh	N/A
PE76	PDAT37	PATH#37 data Refer to description of PE04.	Pr	0	Refer to PE04	N/A
PE77	PDEF38	PATH#38 definition Refer to description of PE03.	Pr	00000000h	00000000h~ FFFFFFFFh	N/A
PE78	PDAT38	PATH#38 data Refer to description of PE04.	Pr	0	Refer to PE04	N/A
PE79	PDEF39	PATH#39 definition Refer to description of PE03.	Pr	00000000h	00000000h~ FFFFFFFFh	N/A
PE80	PDAT39	PATH#39 data Refer to description of PE04.	Pr	0	Refer to PE04	N/A
PE81	PDEF40	PATH#40 definition Refer to description of PE03.	Pr	00000000h	00000000h~ FFFFFFFFh	N/A
PE82	PDAT40	PATH#40 data Refer to description of PE04.	Pr	0	Refer to PE04	N/A
PE83	PDEF41	PATH#41 definition Refer to description of PE03.	Pr	00000000h	00000000h~ FFFFFFFFh	N/A
PE84	PDAT41	PATH#41 data Refer to description of PE04.	Pr	0	Refer to PE04	N/A
PE85	PDEF42	PATH#42 definition Refer to description of PE03.	Pr	00000000h	00000000h~ FFFFFFFFh	N/A
PE86	PDAT42	PATH#42 data Refer to description of PE04.	Pr	0	Refer to PE04	N/A
PE87	PDEF43	PATH#43 definition Refer to description of PE03.	Pr	00000000h	00000000h~ FFFFFFFFh	N/A
PE88	PDAT43	PATH#43 data Refer to description of PE04.	Pr	0	Refer to PE04	N/A
PE89	PDEF44	PATH#44 definition Refer to description of PE03.	Pr	00000000h	00000000h~ FFFFFFFFh	N/A
PE90	PDAT44	PATH#44 data Refer to description of PE04.	Pr	0	Refer to PE04	N/A
PE91	PDEF45	PATH#45 definition Refer to description of PE03.	Pr	00000000h	00000000h~ FFFFFFFFh	N/A

No	Abbr.	Parameter function and description	Mode	Default	Range	Unit
PE92	PDAT45	PATH#45 data Refer to description of PE04.	Pr	0	Refer to PE04	N/A
PE93	PDEF46	PATH#46 definition Refer to description of PE03.	Pr	00000000h	00000000h~ FFFFFFFFh	N/A
PE94	PDAT46	PATH#46 data Refer to description of PE04.	Pr	0	Refer to PE04	N/A
PE95	PDEF47	PATH#47 definition Refer to description of PE03.	Pr	00000000h	00000000h~ FFFFFFFFh	N/A
PE96	PDAT47	PATH#47 data Refer to description of PE04.	Pr	0	Refer to PE04	N/A
PE97	PDEF48	PATH#48 definition Refer to description of PE03.	Pr	00000000h	00000000h~ FFFFFFFFh	N/A
PE98	PDAT48	PATH#48 data Refer to description of PE04.	Pr	0	Refer to PE04	N/A
PE99	-	Reserved	-	-	-	-

No	Abbr.	Parameter function and description	Mode	Default	Range	Unit
PF01	PDEF49	PATH#49 definition Refer to description of PE03.	Pr	00000000h	00000000h~ FFFFFFFFh	N/A
PF02	PDAT49	PATH#49 data Refer to description of PE04.	Pr	0	Refer to PE04	N/A
PF03	PDEF50	PATH#50 definition Refer to description of PE03.	Pr	00000000h	00000000h~ FFFFFFFFh	N/A
PF04	PDAT50	PATH#50 data Refer to description of PE04.	Pr	0	Refer to PE04	N/A
PF05	PDEF51	PATH#51 definition Refer to description of PE03.	Pr	00000000h	00000000h~ FFFFFFFFh	N/A
PF06	PDAT51	PATH#51 data Refer to description of PE04.	Pr	0	Refer to PE04	N/A
PF07	PDEF52	PATH#52 definition Refer to description of PE03.	Pr	00000000h	00000000h~ FFFFFFFFh	N/A
PF08	PDAT52	PATH#52 data Refer to description of PE04.	Pr	0	Refer to PE04	N/A
PF09	PDEF53	PATH#53 definition Refer to description of PE03.	Pr	00000000h	00000000h~ FFFFFFFFh	N/A
PF10	PDAT53	PATH#53 data Refer to description of PE04.	Pr	0	Refer to PE04	N/A
PF11	PDEF54	PATH#54 definition Refer to description of PE03.	Pr	00000000h	00000000h~ FFFFFFFFh	N/A
PF12	PDAT54	PATH#54 data Refer to description of PE04.	Pr	0	Refer to PE04	N/A
PF13	PDEF55	PATH#55 definition Refer to description of PE03.	Pr	00000000h	00000000h~ FFFFFFFFh	N/A
PF14	PDAT55	PATH#55 data Refer to description of PE04.	Pr	0	Refer to PE04	N/A
PF15	PDEF56	PATH#56 definition Refer to description of PE03.	Pr	00000000h	00000000h~ FFFFFFFFh	N/A
PF16	PDAT56	PATH#56 data Refer to description of PE04.	Pr	0	Refer to PE04	N/A
PF17	PDEF57	PATH#57 definition Refer to description of PE03.	Pr	00000000h	00000000h~ FFFFFFFFh	N/A

No	Abbr.	Parameter function and description	Mode	Default	Range	Unit
PF18	PDAT57	PATH#57 data Refer to description of PE04.	Pr	0	Refer to PE04	N/A
PF19	PDEF58	PATH#58 definition Refer to description of PE03.	Pr	00000000h	00000000h~ FFFFFFFFh	N/A
PF20	PDAT58	PATH#58 data Refer to description of PE04.	Pr	0	Refer to PE04	N/A
PF21	PDEF59	PATH#59 definition Refer to description of PE03.	Pr	00000000h	00000000h~ FFFFFFFFh	N/A
PF22	PDAT59	PATH#59 data Refer to description of PE04.	Pr	0	Refer to PE04	N/A
PF23	PDEF60	PATH#60 definition Refer to description of PE03.	Pr	00000000h	00000000h~ FFFFFFFFh	N/A
PF24	PDAT60	PATH#60 data Refer to description of PE04.	Pr	0	Refer to PE04	N/A
PF25	PDEF61	PATH#61 definition Refer to description of PE03.	Pr	00000000h	00000000h~ FFFFFFFFh	N/A
PF26	PDAT61	PATH#61 data Refer to description of PE04.	Pr	0	Refer to PE04	N/A
PF27	PDEF62	PATH#62 definition Refer to description of PE03.	Pr	00000000h	00000000h~ FFFFFFFFh	N/A
PF28	PDAT62	PATH#62 data Refer to description of PE04.	Pr	0	Refer to PE04	N/A
PF29	PDEF63	PATH#63 definition Refer to description of PE03.	Pr	00000000h	00000000h~ FFFFFFFFh	N/A
PF30	PDAT63	PATH#63 data Refer to description of PE04.	Pr	0	Refer to PE04	N/A
PF31	-	Reserved	-	-	-	-
PF32	-	Reserved	-	-	-	-

No.	Abbr.	Parameter function and description	Mode	Default	Range	Unit
PF33	POV1	Speed setting of internal position command 1	Pr	50	1~6000	rpm, mm/s
PF34	POV2	Speed setting of internal position command 2	Pr	10	1~6000	rpm, mm/s
PF35	POV3	Speed setting of internal position command 3	Pr	200	1~6000	rpm, mm/s
PF36	POV4	Speed setting of internal position command 4	Pr	300	1~6000	rpm, mm/s
PF37	POV5	Speed setting of internal position command 5	Pr	500	1~6000	rpm, mm/s
PF38	POV6	Speed setting of internal position command 6	Pr	800	1~6000	rpm, mm/s
PF39	POV7	Speed setting of internal position command 7	Pr	1000	1~6000	rpm, mm/s
PF40	POV8	Speed setting of internal position command 8	Pr	1200	1~6000	rpm, mm/s
PF41	POV9	Speed setting of internal position command 9	Pr	1500	1~6000	rpm, mm/s
PF42	POV10	Speed setting of internal position command 10	Pr	1800	1~6000	rpm, mm/s
PF43	POV11	Speed setting of internal position command 11	Pr	2000	1~6000	rpm, mm/s
PF44	POV12	Speed setting of internal position command 12	Pr	2200	1~6000	rpm, mm/s
PF45	POV13	Speed setting of internal position command 13	Pr	2400	1~6000	rpm, mm/s
PF46	POV14	Speed setting of internal position command 14	Pr	2700	1~6000	rpm, mm/s
PF47	POV15	Speed setting of internal position command 15	Pr	3000	1~6000	rpm, mm/s
PF48	POV16	Speed setting of internal position command 16	Pr	3000	1~6000	rpm, mm/s
PF49	POA1	Acceleration/deceleration time of internal position command 1. To set the acceleration/deceleration time in Pr mode, which is time needed from 0 to motor rated speed.	Pr	200	1~65550	ms

No	Abbr.	Parameter function and description	Mode	Default	Range	Unit
PF50	POA2	Acceleration/deceleration time of internal position command 2 Refer to description of PF49.	Pr	200	1~65550	ms
PF51	POA3	Acceleration/deceleration time of internal position command 3 Refer to description of PF49.	Pr	300	1~65550	ms
PF52	POA4	Acceleration/deceleration time of internal position command 4 Refer to description of PF49.	Pr	500	1~65550	ms
PF53	POV5	Acceleration/deceleration time of internal position command 5 Refer to description of PF49.	Pr	600	1~65550	ms
PF54	POV6	Acceleration/deceleration time of internal position command 6 Refer to description of PF49.	Pr	800	1~65550	ms
PF55	POV7	Acceleration/deceleration time of internal position command 7 Refer to description of PF49.	Pr	900	1~65550	ms
PF56	POV8	Acceleration/deceleration time of internal position command 8 Refer to description of PF49.	Pr	1000	1~65550	ms
PF57	POV9	Acceleration/deceleration time of internal position command 9 Refer to description of PF49.	Pr	1200	1~65550	ms
PF58	POV10	Acceleration/deceleration time of internal position command 10 Refer to description of PF49.	Pr	1400	1~65550	ms
PF59	POV11	Acceleration/deceleration time of internal position command 11 Refer to description of PF49.	Pr	1600	1~65550	ms
PF60	POV12	Acceleration/deceleration time of internal position command 12 Refer to description of PF49.	Pr	2000	1~65550	ms
PF61	POV13	Acceleration/deceleration time of internal position command 13 Refer to description of PF49.	Pr	2500	1~65550	ms

PF62	POV14	Acceleration/deceleration time of internal position command 14 Refer to description of PF49.	Pr	3000	1~65550	ms
PF63	POV15	Acceleration/deceleration time of internal position command 15 Refer to description of PF49.	Pr	4000	1~65550	ms
PF64	POV16	Acceleration/deceleration time of internal position command 16 Refer to description of PF49.	Pr	5000	1~65550	ms
PF65	DLY1	Delay time 1 after position reached To set the delay time 1 in Pr mode.	Pr	0	0~32767	ms
PF66	DLY2	Delay time 2 after position reached Refer to description of PF65.	Pr	100	0~32767	ms
PF67	DLY3	Delay time 3 after position reached Refer to description of PF65.	Pr	200	0~32767	ms
PF68	DLY4	Delay time 4 after position reached Refer to description of PF65.	Pr	300	0~32767	ms
PF69	DLY5	Delay time 5 after position reached Refer to description of PF65.	Pr	500	0~32767	ms
PF70	DLY6	Delay time 6 after position reached Refer to description of PF65.	Pr	600	0~32767	ms
PF71	DLY7	Delay time 7 after position reached Refer to description of PF65.	Pr	800	0~32767	ms
PF72	DLY8	Delay time 8 after position reached Refer to description of PF65.	Pr	1000	0~32767	ms
PF73	DLY9	Delay time 9 after position reached Refer to description of PF65.	Pr	1200	0~32767	ms

PF74	DLY10	Delay time 10 after position reached Refer to description of PF65.	Pr	1500	0~32767	ms
PF75	DLY11	Delay time 11 after position reached Refer to description of PF65.	Pr	2000	0~32767	ms
PF76	DLY12	Delay time 12 after position reached Refer to description of PF65.	Pr	2300	0~32767	ms
PF77	DLY13	Delay time 13 after position reached Refer to description of PF65.	Pr	2500	0~32767	ms
PF78	DLY14	Delay time 14 after position reached Refer to description of PF65.	Pr	3000	0~32767	ms
PF79	DLY15	Delay time 15 after position reached Refer to description of PF65.	Pr	4000	0~32767	ms
PF80	DLY16	Delay time 16 after position reached Refer to description of PF65.	Pr	5000	0~32767	ms

No	Abbr.	Parameter function and description	Mode	Default	Range	Unit
PF81	PDEC	Deceleration time for auto-protection	Pr,Pt, S,T	00000000h	0 ~ FFF0FFFFh	N/A

The parameter setting is divided into 8 parts(hex), which are D, C, B, A, W, Z, Y, and X:

Including:

1. Deceleration time when the auto-protection function is enabled

Digit	D	C	B	A	W	Z	Y	X
function	STP	OVT	CTO	Reserved	SNL	SPL	NL	PL
Range	0~F	0~F	0~F	-	0~F	0~F	0~F	0~F

2. The definition of the function code is as follows

STP : the second deceleration time of homing, DI STOP deceleration time

CTO : the deceleration time when communication timeout or ABS communication alarm occurs.

SNL : the deceleration time when the software negative limit reaches and alarm occurs.

SPL :the deceleration time when the software positive limit reaches and alarm occurs.

NL : the deceleration time when the LSN reverse limit reaches and alarm occurs.

PL : the deceleration time when the LSP positive limit reaches and alarm occurs.

OVT: the deceleration time when motor overheats.

0~F is used to index the deceleration time of PF49~PF64.

For example, if X is set to A, the deceleration time of PL is determined by the value of PF58.

No	Abbr.	Parameter function and description	Mode	Default	Range	Unit
PF82	PRCM (■)	Pr command trigger register	Pr	0	0~~1000	N/A

Set value	Function
0	start homing
1 ~ 63	To execute the specified PR procedure, which is the same as using DI:CTRG+POSn
64 ~ 9999	You cannot set to 64 ~ 9999 as the value exceeds the valid range.
1000	to execute stop command which is the same as DI:STOP.

When reading PF82,

1.if the command is incomplete, the drive reads the current command(1 - 99).

2.If the command is complete, the drive reads the current command +10000.

3.If the command is complete, and DO:TPOS is on, and motor position is reached, the drive reads the current command +20000.

4.Commands triggered by DI are also applicable.

Example: if set to 3, which means PR#3 is triggered.

1. If the read value is 3, it means PR#3 is incomplete.

2.If the read value is 10003, it means PR#3 is completed, but the motor has not reached the target position yet.

3.If the read value is 20003, it means PR#3 is completed and the motor reached the target position.

No	Abbr.	Parameter function and description	Mode	Default	Range	Unit
PF83	EVON	PR number triggered by event rising edge	Pr	0000h	0000h~DDDDh	N/A
		Parameter setting: by UZYX. This parameter is to define the executing PR number when EVx is on. X=0: no action when EV1 is on X=1~D: execute PR# 51 ~ 63 when EV1 is on Y=0: no action when EV2 is on Y=1~D: execute PR# 51~ 63 when EV2 is on Z=0: no action when EV3 is on Z=1~D: execute PR# 51 ~63 when EV3 is on U=0: no action when EV4 is on U=1~D: execute PR# 51~ 63 when EV4 is on				
PF84	EVOF	PR number triggered by falling edge	Pr	0000h	0000h~DDDDh	N/A
		Parameter setting: UZYX This parameter is to define the executing PR number when EVx is off. X=0: no action when EV1 is off X=1~D: execute PR# 51 ~ 63 when EV1 is off Y=0: no action when EV2 is off Y=1~D: execute PR# 51 ~ 63 when EV2 is off Z=0: no action when EV3 is off Z=1~D: execute PR# 51~ 63 when EV3 is off U=0: no action when EV4 is off U=1~D: execute PR# 51 ~ 63 when EV4 is off				
PF85	PMEM (■)	PATH#1 to PATH#2 volatile setting: 0 0 y x x=0: PATH#1 data is non-volatile x=1: PATH#1 data is volatile y=0: PATH#2 data is non-volatile y=1: PATH#2 data is volatile The others are reserved. This parameter is used to write new target point continuously though communication.	All	0000h	0000h ~ 0011h	N/A

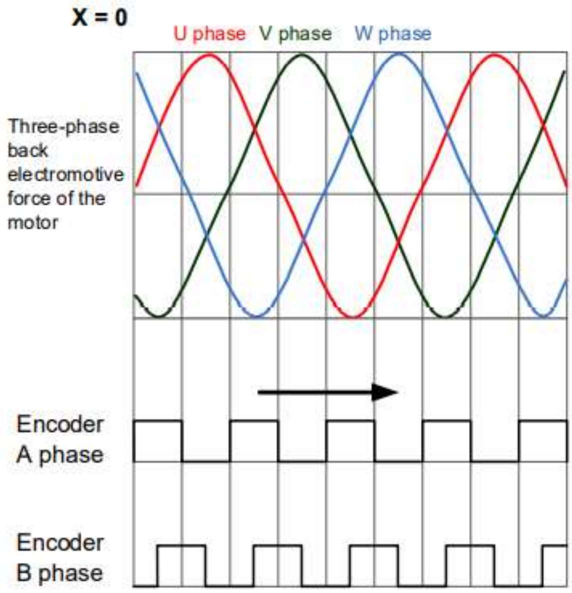
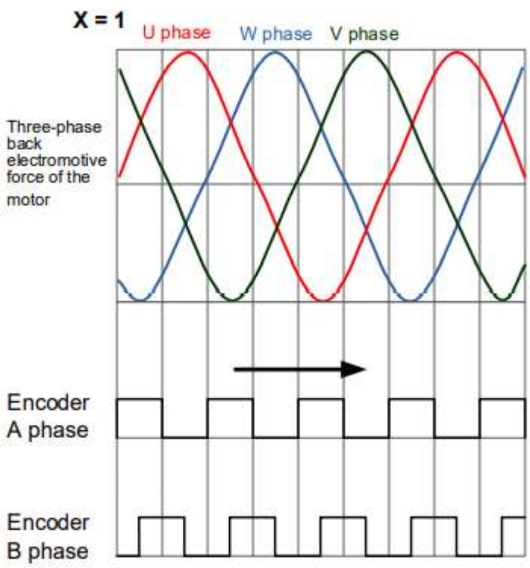
No	Abbr.	Parameter function and description	Mode	Default	Range	Unit
PF86	SWLP	Positive software limit: In PR mode, if the motor moves in the positive direction and its position command pulse number exceeds the value of PF86, AL14 will occur. (Note: position command is before E-Gear ratio). In PT mode of absolute system, if the motor moves in positive direction and its feedback position pulse number exceeds the value of PF86, AL14 will occur. (Note: feedback position pulse number is position feedback value before E-Gear ratio).	Pr, Pt	2^{31}-1	$-2^{31}+1$ ~ 2^{31}-1	pulse
PF87	SWLN	Negative software limit: In PR mode, if the motor moves in the negative direction and its position command pulse number exceeds the value of PF87, AL15 will occur. (Note: position command is before E-Gear ratio). In PT mode of absolute system, if the motor moves in the negative direction and its feedback position pulse number exceeds the value of PF87, AL15 will occur. (Note: feedback position pulse number is the feedback position value before E-Gear ratio).	Pr, Pt	$-2^{31}+1$	$-2^{31}+1$ ~ 2^{31}-1	pulse
PF88	BLSP (*)	Backlash compensation value setting(before E-Gear)	Pr, Pt	0	-32767 ~32767	pulse
PF89	BLST	Backlash compensation time constant setting	Pr, Pt	0	0 ~ 10000	0.1ms

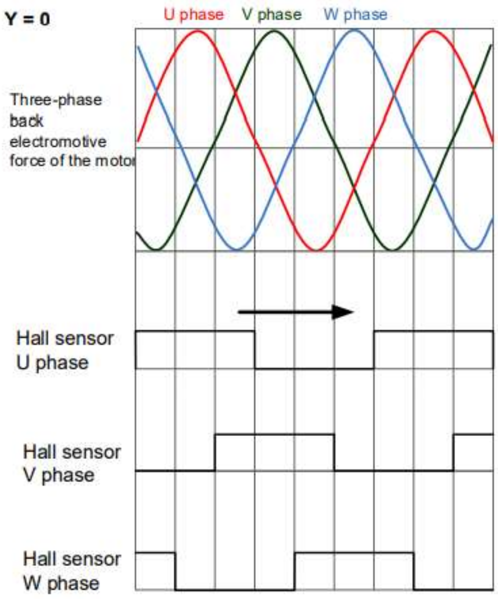
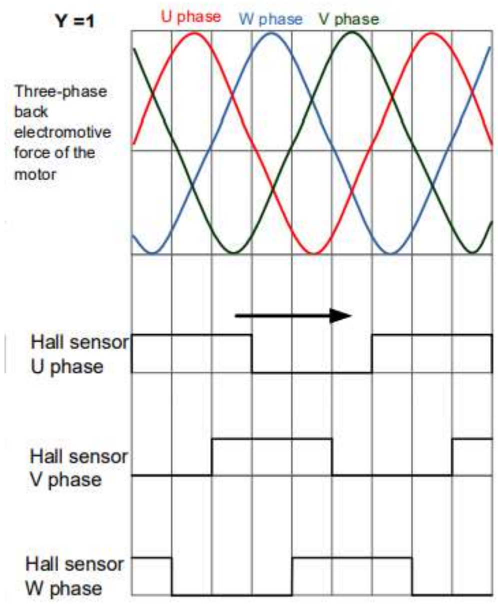
PF90	BLSF	Backlash compensation option Setting value: 0: disable. 1: forward direction compensation . 2: reverse direction compensation	Pr, Pt	0	0 ~ 2	N/A
PF91 ~ PF99	-	Reserved	-	-	-	-

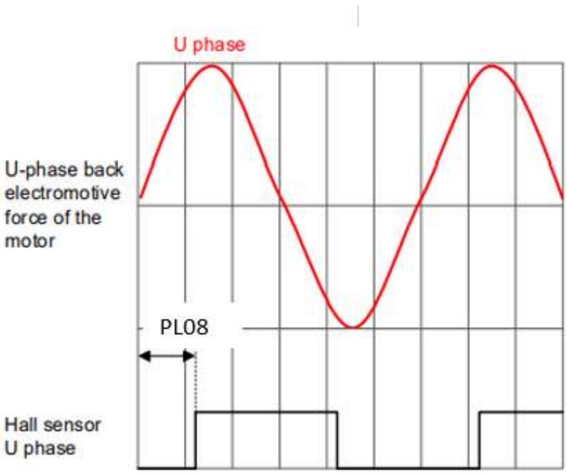
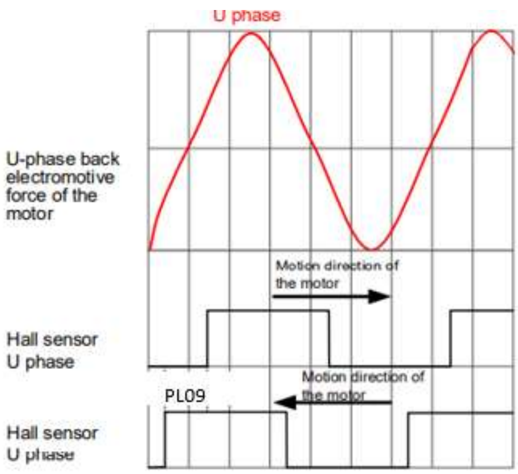
No.	Abbr.	Parameter function and description	Mode	Default	Range	Unit
PL01		Motor type 0: Shihlin servo motor(PL group parameter is invalid) 1: permanent-magnet synchronous linear motor (LM) 2: SPM rotary motor (for internal test only)	All	0	0 ~ 2	N/A
PL02		Motor parameter automatic identification function and current response setting. 0: disable motor parameter automatic identification function. 1: enable motor parameter automatic identification function(high response) 2: enable motor parameter automatic identification function(middle response) 3: enable motor parameter automatic identification function(low response) 4: enable motor parameter manually setting function(high response) 5: enable motor parameter manually setting function(middle response) 6: enable motor parameter manually setting function(low response)	All	0	0 ~ 6	N/A
PL03		Motor parameter confirmation: 0: motor parameter is invalid. 1: motor parameter is valid. 1: if Servo is On and PL03=0, AL53 occurs. 2: PL03 must set to 1 before SERVO is turning ON, regardless parameter identification in automatically or manually type.	All	0	0 ~ 1	N/A
PL04		Encoder type setting: u | z | y | x	All	100h	0h ~	N/A

		x: encoder signal type option x=0: square wave signal(CN2L) (u bit can set 0 or 1) x=1: Endat 2.2 communication signal(CN2) (When use linear motor and Endat 2.2 Linear scale , u bit can only set to 1) u bit=0: output CN2L A/B/Z signal u bit=1: output virtual ABZ signal according to Endat 2.2. **y: Hall sensor setting** y=0: no Hall sensor y=1: with Hall sensor Note1: if you select “no Hall sensor”, the motor moves slowly to detect the magnetic pole when the servo is on for the first time. Note2: It cannot operate the Z-axis without spring or balance treatment. **z: AB phase pulse filter setting** z=0: turn off the filter. z=1: applicable for 16MPPS pulse feedback. z=2: applicable for 8MPPS pulse feedback. z=3: applicable for 3MPPS pulse feedback. **u: AB phase(LA/LB) pulse output type setting.** u=0: directly output LA/LB/LZ of Linear scale u=1: output pulse according to PA14 and PA39 setting.(output LZ when electrical angle is 0°) Example: Suppose PA39 is set to 0000h and PA14 is set to 1024, the number of pulses output by the linear motor per PL42 length is 1024 (pulse/PL42[mm]), The number of pulses output per revolution of the rotary motor is 1024 (pulse/rev).			1311h	

		Example: Suppose PA39 is set to 0100h and PA14 is set to 512, The number of pulses output by the linear motor per PL42 length is (PL42 * 100000 / PL05) / 512 (pulse/PL42[mm]), The number of pulses output per revolution of the rotary motor is the number of pulses per revolution / 512 (pulse/rev).				
PL05		Encoder resolution: If PL01=1, PL05 unit is 10^{-3} um/pulse. If PL01=2, PL05 unit is pulse/rev.	All	1000	1 ~ 2^{29}-1	Refer to PL05
PL06		Reserved	-	-	-	-

No.	Abbr.	Parameter function and description	Mode	Default	Range	Unit
PL07		Motor UVW and Hall sensor phase sequences: | 0 | 0 | y | x | **x: the relation of UVW phase sequence and encoder feedback signal** x=0: phase sequence is consistent.  x=1 phase sequence is reversed.  	All	0h	0h ~ 11h	N/A

No.	Abbr.	Parameter function and description	Mode	Default	Range	Unit
PL07		**y: the relation of motor UVW phase sequence and Hall sensor** y=0: phase sequence is consistent.  y=1: **phase sequence is reversed.**  	All	0h	0h ~ 11h	N/A

No.	Abbr.	Parameter function and description	Mode	Default	Range	Unit
PL08		Hall sensor offset angle: When the Hall sensor makes hysteresis due to different motion directions of the motor, the U phase zero point of the Hall sensor will be based on the central angle of the hysteresis. (For the description of hysteresis, refer to the diagram of PL09). 	All	0	0 ~ 3600	0.1° (Electrical angle)
PL09		Hall sensor hysteresis width: Hysteresis width is as follows: 	All	0	0 ~ 3600	0.1° (Electrical angle)

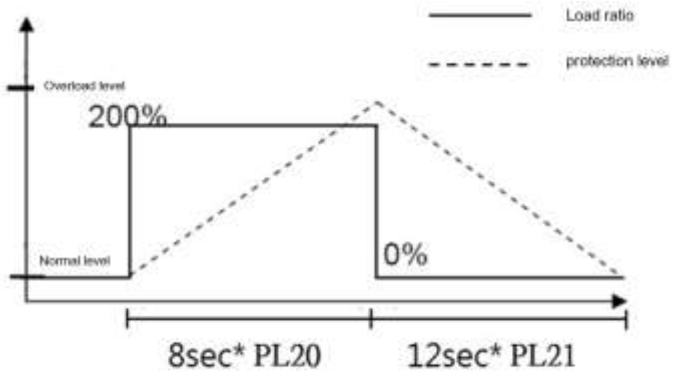
PL10		Electrical angle correction function: **x: Z phase correction function** x=1: add electrical angle which is trigged by z phase signal with PL11 offset angle. **y: check Hall sensor move distance** y=1: if the deviation between commutation angel detected by Hall sensor and actual electrical angle exceeds 90 degree, AL.55 occurs.	All	0x00	0h ~ 11h	N/A
PL11		Z phase signal offset angle: When PL10.xBit=1, the electrical angle will change to PL11 setting when z phase signal is triggered for the first time.	All	0	0 ~ 3600	0.1° (Electrical angle)
PL12		Current setting for initial magnetic field detection: If PL04.y=0, the servo drive will automatically detect the motor magnetic field when the servo is On for the first time, the detection current is PL12 setting value and the setting is as follows: 1. When the friction between the motor and the mechanical parts is too large, magnetic field detection error may occur which triggers AL.52. Increasing the setting value of PL12 can reduce the occurrence of AL.52. 2. When the initial magnetic field detection vibration of the motor is too large, you can reduce the setting value of PL12 to reduce the detection motion. ※The initial magnetic field current detection cannot used for the Z-axis without spring or balance treatment.	All	100	0 ~ 300	%

PL13		Initial magnetic field detection condition: | 0 | 0 | y | x | **x: minimum move angle of magnetic field** During initial magnetic field detection, the move angle of motor magnetic field should exceed x * 0.25 degree. **y: motor magnetic field recheck move angle** During initial magnetic field detection, motor magnetic field move angle is y * 5degree. 1.When y <= 2, the onward and backward move angle is 10°. 2.Only when x and y conditions are both met at the same time, the motor magnetic filed detection is completed successfully. 3.If either x or y cannot meet, it will detect again in different angle. When the number of detection failures reaches 4 times, AL.52 will occur.	All	0x0064	0h ~ FFh	N/A
PL14 ~ PL15		Reserved	-	-	-	-

No.	Abbr.	Parameter function and description	Mode	Default	Range	Unit
PL16		Current loop proportional gain (kp): When reading PL16, it displays the proportional gain value of auto-adjustment. This parameter can be manually adjusted base on user's requirement. Increasing the value of PL16 can enhance the current loop bandwidth, and it may cause servo unstable and vibration. Note: when PL01=0, this parameter is invalid.	All	0	0~999 9999	N/A
PL17		Current loop integral gain (ki): When reading PL17, it displays the integral gain value of auto-adjustment. It can be manually adjusted base on the user's requirement. Decreasing the value of PL17 can reduce the settling time of current loop, and it may cause servo unstable and vibration. Note: when PL01=0, this parameter is invalid.	All	0	0~99 99999	N/A
PL18		Current loop gain magnification: When PL18=0, the actual current loop gain is PL16,PL17. When PL18 is not 0, the actual current loop gain is as follows: Current loop gain Kp = PL16 * PL18[%] Current integral gain Ki = PL17 * PL18[%]	All	0	0~ 999	%
PL19		Reserved.	-	-	-	-

No.	Abbr.	Parameter function and description	Mode	Default	Range	Unit

<table>
<tr>
<td>PL20</td>
<td></td>
<td>Overload increase gain:
<table>
<tr><th>Load ratio</th><th>Operating time</th></tr>
<tr><td>0%</td><td>-12.00sec * PL-21</td></tr>
<tr><td>20%</td><td>-12.30sec * PL-21</td></tr>
<tr><td>40%</td><td>-13.60sec * PL-21</td></tr>
<tr><td>60%</td><td>-16.30sec * PL-21</td></tr>
<tr><td>80%</td><td>-22.60sec * PL-21</td></tr>
<tr><td>100%</td><td>N/A</td></tr>
<tr><td>120%</td><td>263.8sec * PL-20</td></tr>
<tr><td>140%</td><td>35.20sec * PL-20</td></tr>
<tr><td>160%</td><td>17.60sec * PL-20</td></tr>
<tr><td>180%</td><td>11.20sec * PL-20</td></tr>
<tr><td>200%</td><td>8.00sec * PL-20</td></tr>
<tr><td>220%</td><td>6.10sec * PL-20</td></tr>
<tr><td>240%</td><td>4.80sec * PL-20</td></tr>
<tr><td>260%</td><td>3.90sec * PL-20</td></tr>
<tr><td>280%</td><td>3.30sec * PL-20</td></tr>
<tr><td>300%</td><td>2.80sec * PL-20</td></tr>
<tr><td>320%</td><td>2.50sec * PL-20</td></tr>
<tr><td>340%</td><td>2.20sec * PL-20</td></tr>
<tr><td>360%</td><td>2.00sec * PL-20</td></tr>
<tr><td>380%</td><td>1.80sec * PL-20</td></tr>
<tr><td>400%</td><td>1.60sec * PL-20</td></tr>
<tr><td>420%</td><td>1.40sec * PL-20</td></tr>
<tr><td>440%</td><td>1.30sec * PL-20</td></tr>
<tr><td>460%</td><td>1.20sec * PL-20</td></tr>
<tr><td>480%</td><td>1.10sec * PL-20</td></tr>
<tr><td>500%</td><td>1.00sec * PL-20</td></tr>
</table>
</td>
<td>All</td>
<td>100</td>
<td>15
~
600</td>
<td>%</td>
</tr>
</table>

No.	Abbr.	Parameter function and description	Mode	Default	Range	Unit
		The operation time is continuous operation time in different load ratio. When the time exceeds the level, AL.05 will occur. Below picture take load rate 200% as example.  If operate the motor base on the above operating cycle, AL.05 will not occur.				
PL21		Overload decrease gain: Refer to PL20 for detail.	All	100	15 ~ 600	%
PL22		Cogging compensation: u | z | y | x **x: Cogging Torque compensation function** 1: enable 0: disable **y: estimate Cogging Torque** 1: enable 0: disable **z: low-pass filter for estimation** 1~A: 30~300 Hz **u: high-pass filter for estimation** 1~A: 0.5~5K Hz If PL22.yx = 11, Cogging data will be saved in EEPROM, and then PL22.yx will switched to 01.	All	0x1A00	1100h ~ AA11h	N/A

No.	Abbr.	Parameter function and description	Mode	Default	Range	Unit
PL23		Motor temperature sensor: 0 | 0 | 0 | x x=0: no motor temperature sensor x=1: use NTC temperature sensor x=2: use PTC temperature sensor x=3: use normally closed temperature switch. Note: Connect the 2 pin of motor temperature sensor to the temperature detection pin of CN2L..	All	0	0 ~ 3	N/A
PL24		Motor over temperature mode option: 0 | 0 | 0 | x x=0: stop immediately if reaches the temperature level x=1: decelerate to stop according to PF81 setting when it reaches the temperature level. x=2: stops immediately when the over temperature lasts PL27 setting time. x=3: decelerate to stop according to PF81 setting when the over temperature lasts PL27 setting time. x=4: displays AL.67 but it keeps running(which may burn out the motor coil)	All	0	0 ~ 4	N/A
PL25		Motor over temperature trigger level	All	150	0 ~ 100000 0	Ohm

PL26		Motor over temperature release level	All	100	0~ 1000000	Ohm
PL27		Motor over temperature timeout setting	All	30	0~300	sec
PL28		Permanent-magnet rotary motor pole number	All	10	2~20	pole
PL29		Permanent-magnet rotary motor rated current	All	30	0~ 4000	0.01A
PL30		Permanent-magnet rotary motor maximum current	All	90	0~ 12000	0.01A
PL31		Permanent-magnet rotary motor rated speed	All	3000	0~ 6000	rpm
PL32		Permanent-magnet rotary motor maximum speed	All	6000	0~ 8000	rpm
PL33		Permanent-magnet rotary motor torque constant	All	0	0~ 13850	0.001 Nm/A
PL34		Permanent-magnet rotary motor rotor inertia	All	0	0~ 2147483647	10^{-7} $Kg*m^2$
PL35		Permanent-magnet rotary motor phase resistance	All	0	0~ 15999	0.001 ohm
PL36		Permanent-magnet rotary motor phase inductance	All	0	0~ 3200	0.01 mh
PL37		Permanent-magnet rotary motor back electromotive force constant	All	0	0~ 3000	10^{-4} V/rpm

No.	Abbr.	Parameter function and description	Mode	Default	Range	Unit
PL38		Pulse loss detection function: 0: disable 1: when encoder type is square wave(PL04.x = 0), it is enabled.	All	0	0 ~ 1	N/A
PL39		Pulse loss detection threshold: When PL38 = 1 and the Z phase signal is output for the first time, every two Z pulse interval must meet the following two conditions, otherwise AL.57 will be triggered. 1. ±PL39 2. PL40±PL39 	All	400	0 ~ 32767	pulse
PL40		Pulse loss detection Z phase interval: Refer to PL39 for detail.	All	2000	0~ 2147483647	pulse
PL41		Reserved	-	-	-	-
PL42		Linear motor pole pitch	All	0	0~ 32767	0.1mm / 360° (Electrical angle)
PL43		Linear motor rated current	All	30	0~ 4000	0.01A

No.	Abbr.	Parameter function and description	Mode	Default	Range	Unit
PL44		Linear motor maximum current	All	90	0~ 12000	0.01A
PL45		Linear motor maximum speed	All	5000	0~ 15999	mm/s
PL46		Linear motor force constant	All	0	0~ 177362	0.01N /A
PL47		Linear motor phase resistance	All	0	0~ 100000	0.001 ohm
PL48		Linear motor phase inductance	All	0	0~ 65189	0.01 mH
PL49		Linear motor back electromotive force constant	All	0	0~ 11824	0.1Volt /(m/s)
PL50		Linear Compensation function option 0: disabled 1: enabled automatically after homing is completed.	All	0	0 ~ 1	N/A
PL51		Linear motor temperature sensor resistance (Read-only)	All	0	0~ 4294967295	ohm

Table 8.1 Digital input (DI) descriptions

DI name	Setting value	Description
SON	0x01	When this signal is turned on, the servo is on.
RES	0x02	When alarm occurs, some of alarm can be released by turning on this signal.
PC	0x03	When this signal is on, it switches the speed controller from proportion integral type to proportion type.
TL	0x 04	When this signal is on, the analog torque limit is valid.' When this signal is off, the inner torque limit 1 is valid.
TL1	0x 05	When this signal is on, the inner torque limit 2 is invalid.
SP1	0x 06	Speed control option 1
SP2	0x 07	Speed control option 2
SP3	0x 08	Speed control option 3
ST1/RS2	0x 09	In speed mode, when this signal is on, it will activate forward speed command. In torque mode, when this signal is on, it will activate reverse torque command.
ST2/RS1	0x0A	In speed mode, when this signal is on, it will activate reverse speed command. In torque mode, when this signal is on, it will activate forward torque command.
ORGP	0x0B	In internal register position mode, when searching for the origin, the servo uses this position as the homing origin by turning on this signal.
SHOM	0x0C	In internal position register mode, when searching for the origin, origin searching function is activated by turning on this signal.
CM1	0x0D	In position mode, it is E-Gear ratio numerator option 1.
CM2	0x0E	In position mode, it is E-Gear ratio numerator option 2.
CR	0x0F	When this signal is on, it clears the position control counter deviation pulses on its leading edge. The pulse width should be over 10ms.
CDP	0x10	When this signal is on, it switches all the gain values to the multiplier of PB14~PB17 setting.
LOP	0x11	It used to switch control modes in multi-mode.
EMG	0x12	When this signal is off, servo is in emergency status. You can turn on this signal to release the emergency status.
POS1	0x13	Position command option 1 in internal register position mode.
POS2	0x14	Position command option 2 in internal register position mode.

POS3	0x15	Position command option 3 in internal register position mode.
CTRG	0x16	When this signal is on, it triggers operation command of internal register position mode.
LSP	0x18	Limit of forward rotation.
LSN	0x19	Limit of reverse rotation.
POS4	0x1A	Position command option 4 in internal register position mode.
POS5	0x1B	Position command option 5 in internal register position mode.
POS6	0x1C	Position command option 6 in internal register position mode.
INHP	0x1D	Inhibit pulse input
EV1	0x1E	Event trigger Pr command 1.
EV2	0x1F	Event trigger Pr command 2.
EV3	0x20	Event trigger Pr command 3.
EV4	0x21	Event trigger Pr command 4.
ABSE	0x22	Delta ABS transmission mode.
ABSC	0x23	Delta/Mitsubishi ABS origin setting.
ABSM	0x22	Mitsubishi ABS transmission mode.
STOP	0x24	In internal register position mode, when this signal is on, the motor stops.
MD1	0x28	Mode switching input 1 of turret mode
MD2	0x29	Mode switching input 2 of turret mode
MPD1	0x2A	Manually continuous operation in turret mode.
MPD2	0x2B	Manually single operation in turret mode.
SPS	0x2C	The second speed option in turret mode.
TC1	0x2D	Torque command option 1
TC2	0x2E	Torque command option 2
Pt-Pr	0x2F	Pt-Pr mode switching.

Table 8.2 Digital output (DO) descriptions

DO name	Setting value	Description
RD	0x01	When servo is on and ready to operate, RD-SG is short-circuited.
ALM	0x02	ALM-SG is open-circuited when power is off or activating protection circuit makes main circuit open. If no alarm occurs, ALM-SG is short-circuited 1 second after power is on.
INP/SA	0x03	In position mode, INP-SG is short-circuited when deviation pulse number is in the positioning range. In speed mode, SA-SG is short-circuited when servo motor speed is nearly reached the setting speed.
HOME	0x04	When homing is complete, this DO is on.
TLC/ VLC	0x05	In position/speed mode, When the generated torque reaches the torque value set by the internal torque limit 1 or the analog torque limit(TLA), TLC -SG is on. TLC-SG is off when SON is off. In torque control mode, when motor speed reaches internal speed command 1~7 or analog speed limit(VLA), VLC-SG is on, and VLC-SG is off when SON is off.
MBR	0x06	When using this DO, PA01 must set to □1□□. When servo is off or alarm occurs, MBR-SG is off. MBR-SG is off when alarm occurs, and it's not related to main circuit status.
WNG	0x07	You should set PD19 for pin assignment before using this signal, otherwise, this signal is invalid. When alarm occurs, WNG-SG is on. If no alarm occurs, WNG-SG is off after power on 1 second.
ZSP	0x08	When servo motor speed is below the value of zero speed, ZSP-SG is on.
CMDOK	0x09	When internal position command is completed or internal position command stops, this DO is on.
OLW	0x0A	When overload setting level(PA17) is reached, this DO is on.
MC_OK	0x0B	When both CMDOK and INP are ON, then this DO is on, otherwise it is off.
OVF	0x0C	When motor position command pulse number is bigger than 2^{31}-1 or smaller than-2^{31}, this DO is on, otherwise it is off.
SWPL	0x0D	When position command is bigger than software forward limit(PF86),

		this DO is on, otherwise, it is off.
SWNL	0x0E	When position command is smaller than software reverse limit(PF87), this DO is on, otherwise, it is off.
ABSW	0x0F	The related alarms of Delta absolute encoders will be indicated by this DO output
ABSV	0x10	When the position of the Mitsubishi absolute system is lost, ABSV is on.
POS1	0x11	Position output point1 of Turret mode.
POS2	0x12	Position output point 2 of Turret mode.
POS3	0x13	Position output point 3 of Turret mode.
POS4	0x14	Position output point 4 of Turret mode.
POS5	0x15	Position output point 5 of Turret mode.
POS6	0x16	Position output point 6 of Turret mode.
LOPM	0x17	If in control switching mode, the current using control mode (related to LOP) is output.

Note: you can set PD27 to determine the logic level of DO, which is normally open(a contact) or normally close(b contact).

9. Communication function

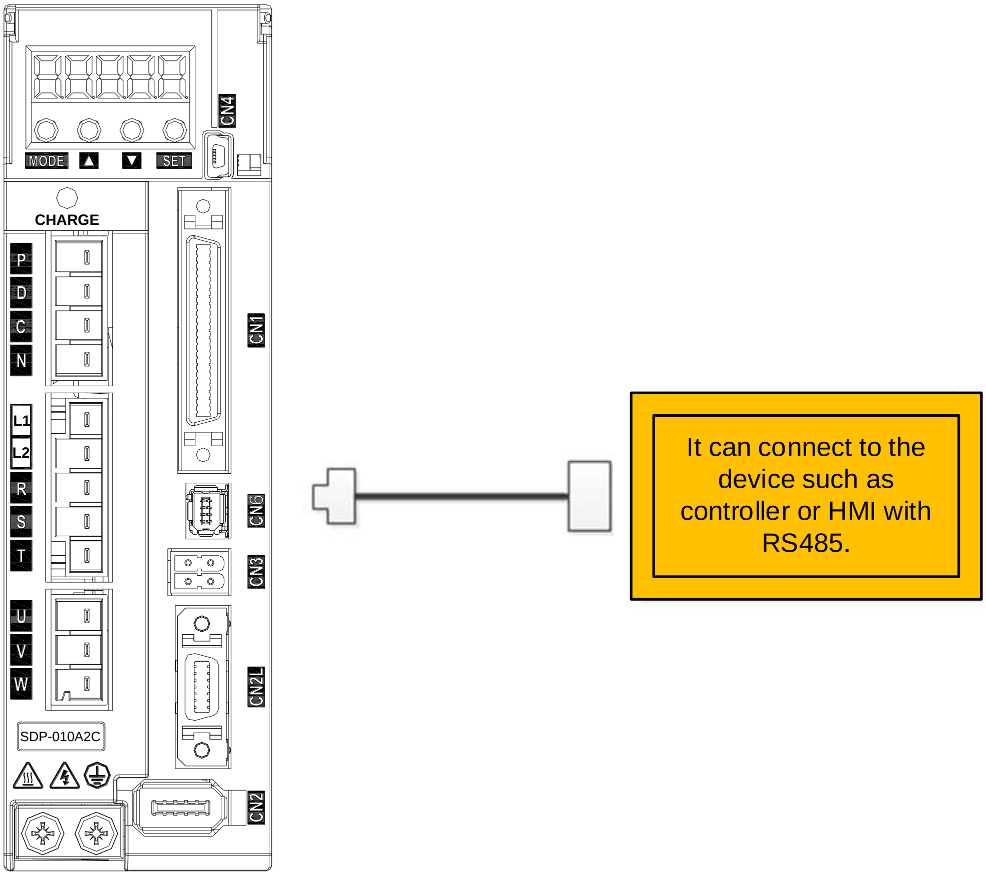
9.1 Communication hardware interface and wiring

This servo drive has the serial communication function of RS-485 and plug-and-play universal USB. By using this function, it can drive the servo system, change parameters and monitor the status of the servo system. However, RS-485 and USB communication functions cannot be used at the same time, and the wiring instructions of RS485 and USB are as follows:

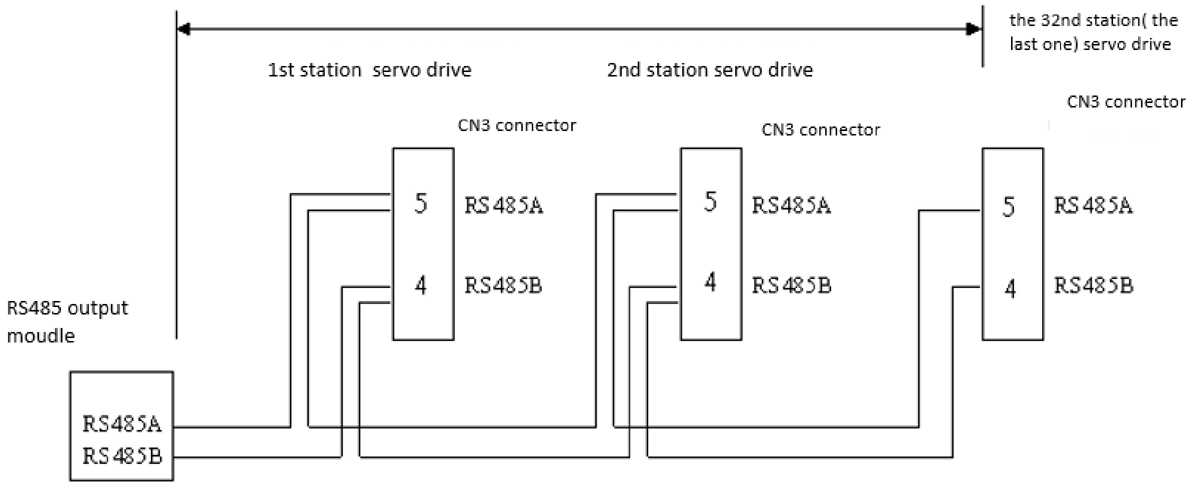
RS-485

(1) External schematic diagram

You can operate maximum 32 axis of servo drives from device number 1 to 32 on the same Bus.



(2) Wiring diagram



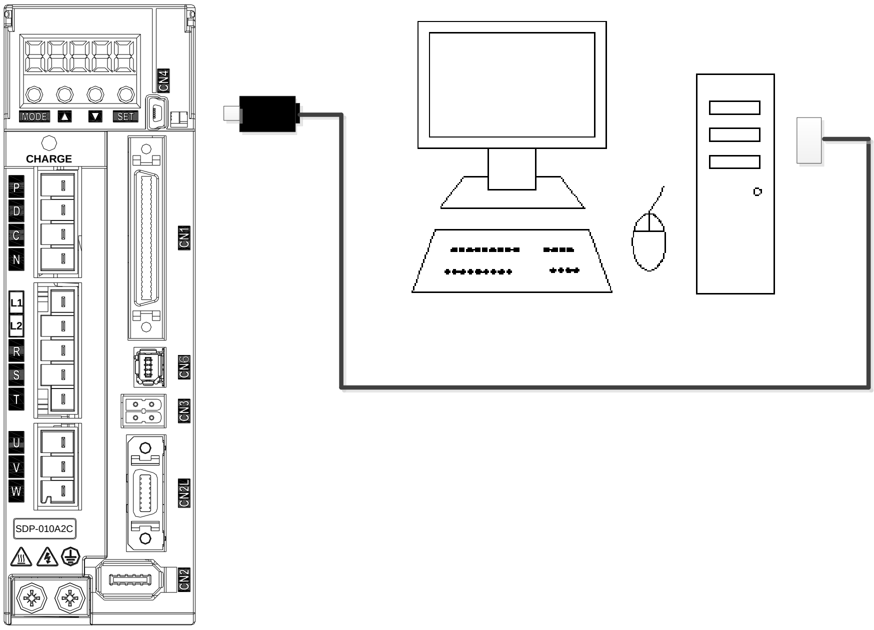
Note 1: the cable length can be up to 100 meters when the servo drive is installed in a quiet environment. If the transmission speed is over 38,400 bps, a 15-meter cable is recommended to ensure data transmission accuracy.

Recommendation: if the communication is likely to be interrupted, you can short circuit the GND of the communication device (or the terminal with the same communication protocol such as HMI) and the GND (PIN8) of the servo controller CN3 to reduce communication failure.

USB

(1) External schematic diagram

Please use standard Mini-USB cable. It is recommended to use the USB cable with a magnetic ring, which has stronger anti-interference function.



9.2 Communication specifications.

When using RS-485 communication function to operate servo drive, the communication specifications of SERVO AMP are as follows:

(1) Device number setting (PC20)

Refer to PC20 and its setting range is 1~32.

(2) Communication response delay time(PC21)

0	0	0	x

x=0: delay time is within 1ms, x=1: delay time is over 1ms

(3) Communication protocol option (PC22)

x=0:	7 data bit, No parity	2 Stop bit	(Modbus, ASCII Mode)
x=1:	7 data bit, Even parity	1 Stop bit	(Modbus, ASCII Mode)
x=2:	7 data bit, Odd parity	1 Stop bit	(Modbus, ASCII Mode)
x=3:	8 data bit, No parity	2 Stop bit	(Modbus, ASCII Mode)
x=4:	8 data bit, Even parity	1 Stop bit	(Modbus, ASCII Mode)
x=5:	8 data bit, Odd parity	1 Stop bit	(Modbus, ASCII Mode)
x=6:	8 data bit, No parity	2 Stop bit	(Modbus, RTU Mode)
x=7:	8 data bit, Even parity	1 Stop bit	(Modbus, RTU Mode)
x=8:	8 data bit, Odd parity	1 Stop bit	(Modbus, RTU Mode)

(4) Transmission speed (PC22)

0	0	y	x

y=0: 4800bps, y=1: 9600bps, y=2: 19200bps

y=3: 38400bps, y=4: 57600bps, y=5: 115200bps

9.3 Modbus communication protocol

To communicate with the computer, each servo drive must set its device number(PC20) firstly, and then the computer controls the individual servo drives according to the device number. The communication method is MODBUS Networks, and there are two mode of MODBUS network communication: ASCII (American Standard Code for Information Interchange) and RTU (Remote Terminal Unit). You can set the communication mode(ASCII or RTU) by PC21 according to your requirements.

Note: USB and MODBUS cannot be used at the same time.

The Shihlin servo drive provides these function codes: 0x03, 0x04, 0x06, 0x10, which can do relevant communication control with the host controller.

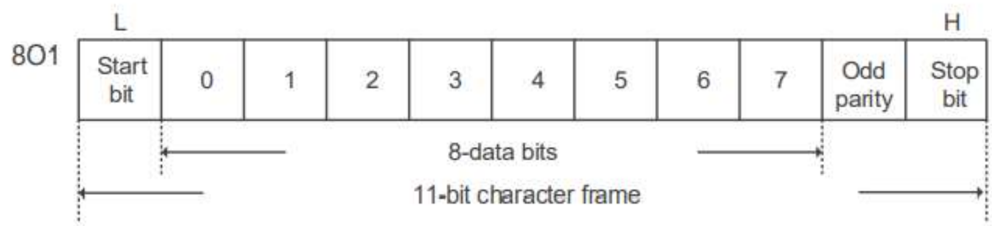
9.3.1 ASCII mode

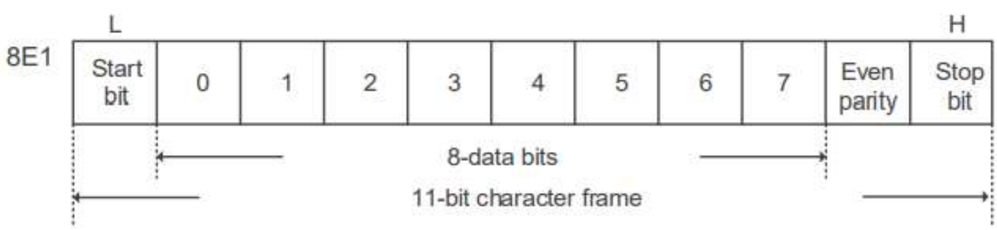
(a)Code description

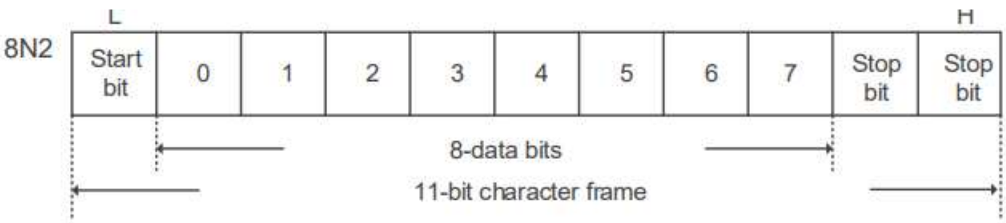
Every 8-bit data frame consists of two ASCII characters. For example, if 1 byte of data 75H (hexadecimal notation) is represented by ASCII "75", which contains the ASCII code of '7' (37H) and the ASCII code of '5' (35H).

(b)Frame structure

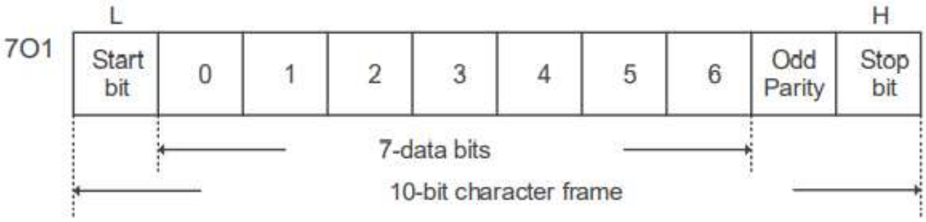
11 bit frame structure(for 8-bit data length)

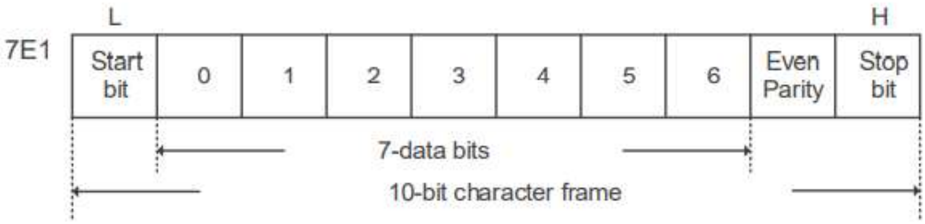


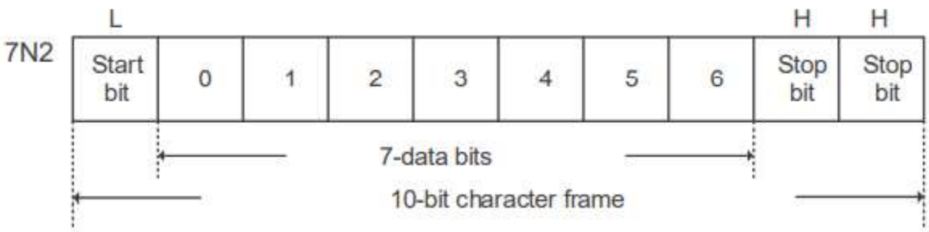




10 bit frame structure (for 7-bit data length)







(c)Communication data structure

Bit code	Name	Description
STX	Start character	“:” (3AH) of ASCII.
ADR	Device number	1 byte consists of 2 ASCII codes
CMD	Function code	1 byte consists of 2 ASCII codes
DATA(n-1)	Data content	n-word = 2n-byte consists of 4n ASCII codes, n <= 29
………		
DATA(0)		
LRC	Error check	1 byte consists of 2 ASCII codes

End1	End code 1	(0DH) of ASCII (CR)
End0	End code 0	0AH of ASCII (LF)

The detailed descriptions in the communication data format box are as follows:

STX(Communication start)

’:’ Character

ADR(Communication device number)

Communication device number is 1~32. For example: if communicate with the servo drive in device number 18 (hexadecimal 12H):

ADR=’1’,’2’ = > ’1’=31H,’2’=32H

CMD(function code) and DATA(data word)

The format of data characters depends on the function code, the common used function codes are as follows:

Example 1, function code 03H, reading N words:

The maximum N is 29, for example: read 2 words consecutively from the start address of the servo drive is 0100H in the device number 01H,

Command message(Host)	
STX	:
ADR	0
	1
CMD	0
	3
Start data address	0
	1
	0
	0
Word length	0
	0
	0
	2
LRC check	F

Response message(Slave)	
STX	:
ADR	0
	1
CMD	0
	3
Byte length (byte)	0
	4
Content of start data address 0100H	0
	1
	0
	2
Content of the	1

			2nd data address 0101H	2
	9			2
				1
End1	0DH(CR)		LRC check	C
				2
End0	0AH(LF)		End1	0DH(CR)
			End0	0AH(LF)

Example 2: function code 06H, writing 1 single word

For example: write 325 (0145H) to the starting address 0100H of the servo drive with device number 01H.

Command message(Host)	
STX	:
ADR	0
	1
CMD	0
	6
Start data address	0
	1
	0
	0
Data content	0
	1
	4
	5
LRC check	B
	2
End1	0DH(CR)
End0	0AH(LF)

Response message(Slave)	
STX	:
ADR	0
	1
CMD	0
	6
Start data address	0
	1
	0
	0
Data content	0
	1
	4
	5
LRC check	B
	2
End1	0DH(CR)
End0	0AH(LF)

Example 3 : function code 10H, writing multiple words

Example: write the data of 2 byte groups 0BB8H and 0000H to the starting address 0112H of the servo drive with device number 01H.That is, 0BB8H is written to 0112H and 0000H is written to 0113H. The maximum allowable data in one single access is 10.

Command message(Host)	
STX	:
ADR	0
	1
CMD	1
	0
Start Data Address	0
	1
	1
	2
Data quantity (word)	0
	0
	0
	2
Data quantity (byte)	0
	4
Content of the 1 st Data	0
	B
	B
	8
Content of the 2nd Data	0
	0
	0
	0
LRC check	1
	3
End1	0DH(CR)
End0	0AH(LF)

Response message(Slave)	
STX	:
ADR	0
	1
CMD	1
	0
Start Data Address	0
	1
	1
	2
Data quantity	0
	0
	0
	2
LRC check	D
	A
End1	0DH(CR)
End0	0AH(LF)

LRC error check(ASCII mode)

The error check in ASCII mode is LRC (Longitudinal Redundancy Check). To calculate the LRC value: add all the data from ADR to the last one, take the result by using 256 as the unit, and the excess part is removed(for example, the result obtained after adding is 128H in hexadecimal, then only 28H is taken), and then calculate complement of 2. The complement is LRC error value.

For example: read 2 words (word) from the start address 0104h of the servo drive device number 01h. 01H+03H+01H+04H+00H+02H = 0BH. The complement of 2 is F5H, thus LRC is ’F’,’5’.

STX	:
ADR	0
	1
CMD	0
	3
Start Data Address	0
	1
	0
	4
Data quantity	0
	0
	0
	2
LRC error check	F
	5
End1	0DH(CR)
End0	0AH(LF)

End1, End0(communication is completed)

Use “0Dh” which character is ’\r’〖carriage return〗 and “0Ah” which character is ’\n’〖new line〗 to denote the end of communication.

9.3.1 RTU mode

(a) Code description.

Each 8-bit data consists of two 4-bit hexadecimal characters. For example: 1-byte data is expressed as 62H.

(b) Communication data structure

Data frame is as below:

Bit code	Name	Content
STX	Start word	To keep an idle more than 6mS
ADR	Device number	1 byte
CMD	Function code	1 byte
DATA(n-1)	Data content	n-word = 2n-byte, n<=29
………		
DATA(0)		
CRC	Error check	2 byte
End	End code	To keep an idle more than 6mS

STX(start communication)

To keep an idle for more than 6mS.

ADR(Communication device number)

The device number is from 1 to 32. For example, the device number of the servo drive is 18 (hexadecimal 12H) ADR=12H.

CMD(Function code)and DATA(Data word)

The format of data characters are varied according to different function codes.

Example 1: function code: 03h, reading N words.

The maximum allowable data(N) in one single access is 29, for example: read 2 words consecutively from the start address 0200H of the servo drive device number 01H.

Command message(Host)	
ADR	01H
CMD	03H
Start data address	02H(high byte)
	00H(low byte)
Data quantity(word)	00H
	02H
CRC Check (low byte)	C5H(low byte)
CRC Check (high byte)	B3H(high byte)

Response message(Slave)	
ADR	01H
CMD	03H
Data quantity(byte)	04H
Content of start data address 0100H	00H(high byte)
	B1H(low byte)
content of 2nd data address 0101H	1FH(high byte)
	40H(low byte)
CRC Check (low byte)	A3H(low byte)
CRC Check (high byte)	D4H(high byte)

Example 2: function code: 06H, writing single word.

For example: write 100 (0064H) to the starting address 0200H of the servo drive with device number 01H.

Command message(Host)	
ADR	01H
CMD	06H
Start data address	02H(high byte)
	00H(low byte)
Data content	00H(high byte)
	64H(low byte)
CRC Check (low byte)	89H(low byte)
CRC Check (high byte)	99H(high byte)

Response message(Slave)	
ADR	01H
CMD	06H
Start data address	02H(high byte)
	00H(low byte)
Data content	00H(high byte)
	64H(low byte)
CRC Check (low byte)	89H(low byte)
CRC Check (high byte)	99H(high byte)

Example 3 : function code 10H, writing multiple words.

Write the data of 2 byte groups 0BB8H and 0000H to the starting address 0112H of the servo drive with device number 01H, that is, 0BB8H is written to 0112H and 0000H is written to 0113H. The maximum allowable data in one single access is 10.

Command message(Host)	
ADR	01H
CMD	10H
Start data address	01H(high byte)
	12H(low byte)
Data quantity (word)	00H(high byte)
	02H(low byte)
Data quantity(byte)	04H
Content of the 1 st Data	0BH(high byte)
	B8H(low byte)
Content of the 2nd Data	00H(high byte)
	00H(low byte)
CRC Check (low byte)	FCH(low byte)
CRC Check (high byte)	EBH(high byte)

Response message(Slave)	
ADR	01H
CMD	10H
Start data address	01H(high byte)
	12H(low byte)
Data quantity	00H(high byte)
	02H(low byte)
CRC Check (low byte)	E0H(low byte)
CRC Check (high byte)	31H(high byte)

CRC error check value calculation(RTU mode) :

The error check in RTU mode is CRC(Cyclical Redundancy Check).
The CRC error detection value calculation is explained in the following steps:

Step 1: load a 16-bit register with the content of FFFFH, which is called the “CRC” register.

Step 2: perform Exclusive OR calculation between the first byte of the command message and the 16-bit CRC register, and then save the result in the CRC register.

Step 3: check the least significant bit (LSB) of the CRC register. If the bit is 0, shift the register one bit to the right. If the bit is 1, shift the register one bit to the right and execute Exclusive OR calculation between the CRC register and A001H.

Step 4: repeat step 3 for 8 times and then go to step 5.

Step 5: repeat steps 2 and 4 until all bytes have been processed. The content of the CRC register is the CRC value.

Note: after calculating the CRC error check value, fill in the low byte of the CRC value in the command message first, and then fill in CRC high byte. Please refer to below example:

Example: read 2 words from the start address 0101H of the servo drive with device number 01H. The last content of the CRC register calculated from ADR to the last byte of the data is 3794H, then the command message is as follows. It should be noted that 94H is sent before 37H.

ADR	01H
CMD	03H
Start data address	01H(high byte)
	01H(low byte)
Data quantity	00H(high byte)
	02H(low byte)
CRC Check (low byte)	94H(low byte)
CRC Check (high byte)	37H(high byte)

End1, **End0(communication is completed)**

Keeping an idle for more than 6mS means communication is completed.

CRC program example:

This function calculates the CRC value in the C language. It needs two parameters:

unsigned char* data;

unsigned char length;

This function will return the CRC value of unsigned integer type.

```
unsigned int crc_chk(unsigned char* data, unsigned char length)
{
    int j;
    unsigned int reg_crc=0xFFFF;
    while( length-- )
    {
        reg_crc^= *data++;
        for (j=0; j<8; j++ )
```

```
        {
            if( reg_crc & 0x01 )            /*LSB(bit 0 ) = 1 */
            reg_crc = (reg_crc >> 1)^0xA001;
            else
                reg_crc = (reg_crc>>1);
        }
    }
    return reg_crc;
}
```

(c) Function code and error code.

The function code and error code of the servo drive is introduced as follows:

Function code	Description
03H	Read parameter
04H	Read-only parameter(Read-only)
06H	Write one single parameter
10H	Write multiple parameter

Function code 03H indicates reading parameter, the maximum allowable parameter in one single access is 29.

Function code 04H indicates accessing the read-only parameter, the maximum allowable parameter in one single access is 29.

Function code 06H indicates writing a single parameter.

Function code 10H indicates writing multiple parameters, and the maximum allowance parameter in one single access is 10.

Error code	Description
01	Function code error
02	Parameter address error
03	Parameter range error

Error code 01H indicates the received function code is wrong.

Error code 02H indicates the received parameter address is wrong. The parameter address range should be within 0x0000~0x20FF.

Error code 03H indicates the received parameter value is out of range, The parameter value range is mainly judged as follows:

1. Check whether the number of read data exceeds the range and current data (word) ranges is from 1 to 29 words.

2. Check whether the written parameter value exceeds range. In current communication address (0x0000~0x20FF), most addresses have a defined range. If some addresses are reserved and not used, the range is -32728~32767.

When there is an error in receiving data, the function code will be added 0x80, which means an error has occurred. The following package will be returned.

(a)ASCII mode

STX	‘:’
Slave device number	‘0’
	‘1’
Function	‘8’
	‘3’
Error code	‘0’
	‘2’
LRC CHK	‘7’
	‘A’
END1	CR
END0	LF

(b)RTU mode

Slave device number	01H
Function	83H
Error code	02H
CRC CHK Low	C0H
CRC CHK High	F1H

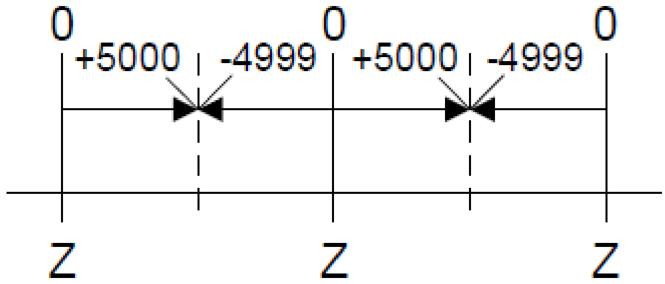
9.4 Write and read communication parameters.

(1) Status monitor(Read-only)

Communication address	Content	Data length
0x0000	Motor feedback pulses (after E-Gear ratio) [pulse]	2word
0x0002	Input number of pulse commands (before E-Gear ratio)[pulse]	2word
0x0004	Number of pulses error(after E-Gear ratio) [pulse]	2word
0x0006	Pulse command input frequency [Hz]	2word
0x0008	The value of communication address 0x0235 determines its content. Setting value !=2 ➔Motor current speed[rpm] Setting value =2 ➔ Motor current speed[mm/s]	2word
0x000A	Analog speed command/limit voltage [V] (Display 2 decimal point)	2word
0x000C	The value of communication address 0x0235 determines its content. Setting value !=2 ➔speed command /limit [rpm] Setting value =2 ➔speed command /limit [mm/s]	2word
0x001E	Analog torque command/limit voltage [V] (Display 2 decimal point)	2word
0x0010	Torque input command/limit [%]	2word
0x0012	Effective load ratio [%]	2word
0x0014	Peak load ratio [%]	2word

0x0016	DC bus voltage [V]	2word
0x0018	Load to motor inertia ratio [times] (Display 1 decimal point)	2word
0x001A	Instantaneous torque [%]	2word
0x001C	Regeneration load ratio [%]	2word
0x001E	The motor feedback pulse number of full-closed encoder [pulse]	2word
0x0020	Z phase offset [pulse] (Note 1)	2word
0x0022	Input number of pulse commands(after E-Gear ratio) [pulse]	2word
0x0024	Motor feedback pulse number(before E-Gear ratio) [pulse]	2word
0x0026	Pulses error number(before E-Gear ratio) [pulse]	2word

Note 1: Z phase offset, that is, Z phase origin is 0, sets +5000 or -5000 pulses when the motor rotates in the forward or reverse direction. It is as below picture shows:



Every two Z phase pulse commands interval is 10000 pulses

(2) Digital IO monitor(Read-only)

(a) IO pin status

Communication address	Content	Data length
0x0204	To show the ON/OFF status of DI pin, the pin assignment is as follows	1word

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	Bit number
DI8	DI7	DI6	DI5	DI4	DI3	DI2	DI1	Pin number
Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8	Bit number
				DI12	DI11	DI10	DI9	Pin number

Note: the status of this digital IO pin is the integrated with both input contact (DI) source control switch (PD16) and the communication control digital input contact status (PD25), below example will further illustrate this:

The external hardware terminals DI12~DI1 status are represented by bit11~bit0, The following use binary value to illustrate:

DI contact source control switch (PD16): 111111000000.

The state of the external hardware terminal: 111100001111 (from left to right are DI12~DI1, 1 means ON, 0 means OFF).

Communication control DI contact status (PD25): 111000111000.

In summary, the status of DI12~DI7 (communication address 0x0204) is determined by the communication, and DI6~DI1 is determined by the status of the external hardware terminal.

Therefore, the status of DI terminal (communication address 0x0204) is represented as 111000 001111.

Communication address	Content	Data length
0x0205	To show the ON/OFF status of DO pin, the pin assignment is as follows	1word

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	Bit number
		DO6	DO5	DO4	DO3	DO2	DO1	Pin number

(b) IO pin function

Communication address	Content	Data length
0x0206~0x020D	Display the current DI/DO pin function definition, the pin assignment is as follows.	1word

Note: if DI/DO functions are not applicable to the current control mode, it will return 0.

Example: if in speed control mode currently, PD07=0x000B, then the bit0~bit7 of Address 0x0208 will return 0.

Address: 0x0206

Bit8~Bit15	Bit0～bit7	Bit number
DI1	DI2	Pin number
0x00~0x2F	0x00~0x2F	Function code

Address: 0x0207

Bit8~Bit15	Bit0～bit7	Bit number
DI3	DI4	Pin number
0x00~0x2F	0x00~0x2F	Function code

Address: 0x0208

Bit8~Bit15	Bit0～bit7	Bit number
DI5	DI6	Pin number
0x00~0x2F	0x00~0x2F	Function code

Address: 0x0209

Bit8~Bit15	Bit0～bit7	Bit number
DI7	D8	Pin number
0x00~0x2F	0x00~0x2F	Function code

Address: 0x020A

Bit8~Bit15	Bit0～bit7	Bit number
DI9	D10	Pin number
0x00~0x2F	0x00~0x2F	Function code

Address: 0x020B

Bit8~Bit15	Bit0～bit7	Bit number
DI11	DI12	Pin number
0x00~0x2F	0x00~0x2F	Function code

Address: 0x020C

Bit8～bit15	Bit0～bit7	Bit number
DO2	DO1	Pin number
0x00~0x3F	0x00~0x3F	Function code

Address: 0x020D

Bit8～bit15	Bit0～bit7	Bit number
DO4	DO3	Pin number
0x00~0x3F	0x00~0x3F	Function code

Address: 0x020E

Bit8～bit15	Bit0～bit7	Bit number
DO6	DO5	Pin number
0x00~0x3F	0x00~0x3F	Function code

(c)Current control mode and servo status(Read-only)

Communication address	Content	Data length
0x0200	Bit0: servo ready status (0: Servo OFF, 1: Servo ON)	1word
0x0201	Bit0~Bit3: display current control mode of drive. 0: Pt position mode. 1: absolute Pr position mode. 2: incremental Pr position mode. 3: speed control mode. 4: torque control mode. 5: full-closed loop control mode.	1word

Note 1: the DI function selection definition table is as follows:

0x07	0x06	0x05	0x04	0x03	0x02	0x01	0x00	Function code
SP2	**SP1**	**TL1**	**TL**	**PC**	**RES**	**SON**	**N/A**	Signal
0x0F	0x0E	0x0D	0x0C	0x0B	0x0A	0x09	0x08	Function code
CR	**CM2**	**CM1**	**SHOM**	**ORGP**	**ST2/RS1**	**ST1/RS2**	**SP3**	Signal
0x17	0x16	0x15	0x14	0x13	0x12	0x11	0x10	Function code
	CTRG	**POS3**	**POS2**	**POS1**	**EMG**	**LOP**	**CDP**	Signal
0x1F	0x1E	0x1D	0x1C	0x1B	0x1A	0x19	0x18	Function code
EV2	**EV1**	**INHP**	**POS6**	**POS5**	**POS4**	**LSN**	**LSP**	Signal
		0x25	0x24	0x23	0x22	0x21	0x20	Function code
		CAM	**STOP**	**ABSC**	**ABSE**	**EV4**	**EV3**	Signal
					0x2F	0x2E	0x2D	Function code
					Pt-Pr	**TC2**	**TC1**	Signal

Note2 : the DO function selection definition table is as follows:

0x05	0x04	0x03	0x02	0x01	0x00	Function code
TLC/VLC	**HOME**	**INP/SA**	**ALM**	**RD**	**N/A**	Signal
0x0B	0x0A	0x09	0x08	0x07	0x06	Function code
MC_OK	**OLW**	**CMDOK**	**ZSP**	**WNG**	**MBR**	Signal
0x11	0x10	0x0F	0x0E	0x0D	0x0C	Function code
CAP_OK	**ABSV**	**ABSW**	**SWNL**	**SWPL**	**OVF**	Signal
0x17	0x16	0x15	0x14	0x13	0x12	Function code
LOPM				**CAM_AREA2**	**CAM_AREA1**	Signal
			0x18	0x20~0x2F		Function code
			PtrM	**SDO_0 ~ SDO_F**		Signal

(3) Alarm information (Read-only)

Communication address	Content	Data length
0x0100	Current alarm	1word
0x0101	The last alarm	1word
0x0102	The 2nd alarm in the past	1word
0x0103	The 3rd alarm in the past	1word
0x0104	The 4th alarm in the past	1word
0x0105	The 5th alarm in the past	1word

0x0106	The 6th alarm in the past	1word
0x0107	The 7th alarm in the past	1word
0x0108	The 8th alarm in the past	1word
0x0109	The 9th alarm in the past	1word
0x010A	The 10th alarm in the past	1word
0x010B	Alarm occurrence time(low word)(PG05)	1word
0x010C	Alarm occurrence time(high word)(PG06)	1word
0x010D	1st alarm record occurrence time(low word)(PG07)	1word
0x010E	1st alarm record occurrence time(high word) (PG08)	1word
0x010F	2nd alarm record occurrence time(low word) (PG09)	1word
0x0110	2nd alarm record occurrence time(high word)(PG10)	1word
0x0111	3rd alarm record occurrence time(low word)(PG11)	1word
0x0112	3rd alarm record occurrence time(high word)(PG12)	1word
0x0113	4th alarm record occurrence time(low word)(PG13)	1word
0x0114	4th alarm record occurrence time(high word)(PG14)	1word
0x0115	5th alarm record occurrence time(low word)(PG15)	1word
0x0116	5th alarm record occurrence time(high word)(PG16)	1word
0x0117	6th alarm record occurrence time(low word)	1word
0x0118	6th alarm record occurrence time(high word)	1word
0x0119	7th alarm record occurrence time(low word)	1word
0x011A	7th alarm record occurrence time(high word)	1word
0x011B	8th alarm record occurrence time(low word)	1word
0x011C	8th alarm record occurrence time(high word)	1word
0x011D	9th alarm record occurrence time(low word)	1word
0x011E	9th alarm record occurrence time(high word)	1word

Note: returning 0x00ff means no alarm, returning 0x0001 means AL.01 occurs, returning 0x0012 means AL.12 occurs, and so on.

(4) Alarm data clearance (readable and writable)

Communication address	Content	Data length
0x0130	If “0x1EA5” is written to this address, it will clear current alarm. When reading this address, it will return current alarm. The setting range is 0~0xFFFF.	1word

0x0131	If "0x1EA5" is written to this address, it will clear all the alarm record and occurrence time. When reading this address, it will return the last alarm record. The setting range is 0~0xFFFF.	1word

(5)<u>Parameter reading and writing</u> (readable and writable)

Communication address	Content	Data length
0x0300~0x03C5	PA group parameters, and the data length of each parameter is 32 bits and occupying 2 addresses: such as PA01: 0x0300~0x0301.	2word
0x0400~0x04C5	PB group parameters, and the data length of each parameter is 32 bits and occupying 2 addresses: such as PB01: 0x0400~0x0401.	2word
0x0500~0x05C5	PC group parameters, and the data length of each parameter is 32 bits and occupying 2 addresses: such as PC01: 0x0500~0x0501.	2word
0x0600~0x06C5	PD group parameters, and the data length of each parameter is 32 bits and occupying 2 addresses: such as PD01: 0x0600~0x0601.	2word
0x0700~0x07C5	PE group parameters, and the data length of each parameter is 32 bits and occupying 2 addresses: such as PE01: 0x0700~0x0701.	2word
0x0800~0x08C5	PF group parameters, and the data length of each parameter is 32 bits and occupying 2 addresses: such as PF01: 0x0800~0x0801.	2word
0x0A00~0x0A62	There are 99 parameters in PG group, and the data length of each parameter is 16 bits.	1word
0x0B00~0x0B62	There are 99 parameters in PH group, and the data length of each parameter is 16 bits.	1word
0x0E00~0x0EC5	PL group parameters, and the data length of each parameter is 32 bits and occupying 2 addresses: such as PL01: 0x0E00~0x0E01.	2word

Note 1: the maximum allowance data in one access is 29 (29 words).

Note 2: when writing PA~PH group parameters by communication by using MODBUS 0x06 or 0x10 function code, the drive firmware must confirm that the write value cannot exceed the range. If it exceeds the range and communication error will occur, you can refer to section 9.3 for details.

(6) **Reset to the factory default value(readable and writable)**

Communication address	Content	Data length
0x0140	After writing data 0x1EA5 to this address, all parameters of PA~PF and PL group will be reset to the default value, and the writing will be completed after 3 seconds. The setting range is 0~0xFFFF When reading this parameter, if 1 is returned, it means the drive is still writing EEPROM. If 0 is returned, it means the writing to EEPROM is completed.	1word

(7) **Software input contact control(readable and writable)**

Step 1: select the input mode of DI contact.

Communication address	Content	Data length
0x061E	Digital input source control option(PD16) 1. each bit of this parameter determines the signal input control source of 1 DI. Bit0 ~ Bit8 is correspond to DI1 ~ DI9 2.Bit setting shows as below: 0: input contact status is controlled by external hardware terminal. 1: input contact status is controlled by communication contact(PD25).	2word

Step 2: writing DI contact on/off status(ON/OFF)

Communication address	Content	Setting range	Data length
0x0630	To write the status of DI (ON/OFF) as shown in below: Writing data is valid only when the corresponding bit of PD16 is 1, otherwise the actual DI contact status will be still controlled by external hardware contact. Refer to PD25 for details.	Refer to PD16	2word

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	Bit number

SDI8	SDI7	SDI6	SDI5	SDI4	SDI3	SDI2	SDI1	Pin name

Bit12~Bit31	Bit11	Bit10	Bit9	Bit8
All these bit values should be set to 0.	SDI12	SDI11	SDI10	SDI9

Note: cautions for test mode (terminal forced output control, JOG test, positioning test)

When using the communication commands in the test mode, the user must pay attention to the following matters, otherwise the drive will not work normally in the test mode.

1.The drive can enter the test mode only when there is no alarm and the servo is off.

2.In the test mode, if the communication is interrupted for more than 1 second, the drive will switch to Servo Off status and exit the test mode. Therefore, the Host device should perform uninterrupted communication in the test mode (each communication command interval should be within 1 second). There are no special restrictions on the communication command address. For example, you can repeat the read command to the communication address 0x0900 to maintain the continuous communication state.

3.After entering the test mode (terminal forced output control, JOG test, positioning test), the normal external hardware signal and software contact signal are invalid, except the EMG signal.

(8) DO forced output (readable and writable)

Step 1: read the alarm and Servo ON information from the following communication address to make sure that there is no alarm and the servo is in servo Off status currently, otherwise it will not enter test mode.

Communication address	Content	Data length
0x0900 (Read-only)	0x0UVW, in which UV=Alarm information, W=1 means SON signal is ON, W=0 means SON signal is OFF	1word

Step 2: enter Forced DO mode and write data 0x0002, the definition of its communication address is as follows:

Communication address	Content	Setting range	Data length
0x0901	To switch operation mode 0000: exit test mode 0001: reserved 0002: DO forced output(Output signal forced output) 0003: JOG operation 0004: positioning operation	0000 ~ 0004	1word

Note: when writing data 0x0002~0x0004 to the address 0x0901, the test mode cannot be entered if SERVO is ON.

Step 3 : writing DO contact on/off status

Communication address	Content	Setting range	Data length
0x0203	To write DO contact on/off status, as shown below	0~0x003F	1word

Bit6~Bit15	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	Bit number
	DO6	DO5	DO4	DO3	DO2	DO1	Pin name

Step 4: exit Forced DO mode: write data 0x0000 to the communication address 0x0901

(9)JOG test(readable and writable)

Step 1: read the alarm and Servo ON information from the following communication address. Make sure that there is no alarm and the servo is in servo Off status currently, otherwise it will not enter test mode.

Communication address	Content	Data length
0x0900 (Read-only)	0x0UVW, in which UV=Alarm information, W=1 means SON signal is ON, W=0 means SON signal is OFF	1word

Step2: enter JOG mode: write data 0x0003 to the communication address 0x0901.

Step 3: set the acceleration/deceleration time constant of JOG mode.

Communication address	Content	Data length
0x0902	To set acceleration/ deceleration time constant in JOG mode and positioning mode. (range: 0~20000)(unit: ms)	1word

Step4: set JOG speed command and activate it.

Communication address	Content	Data length
0x0903	To input the speed command in JOG and positioning mode. (Range 0~6000) (unit: rpm(rotary motor), mm/s(linear motor))	1word

Step 5: set JOG test operation command

Communication address	Content	Data length
0x0904	0: JOG operation is stopped. 1: JOG is operating forwardly. 2: JOG is operating reversely. The setting range is 0~2.	1word

Step 6: exit JOG mode, write data 0x0000 to communication address 0x0901.

(10) Positioning test (readable and writable)

Step 1: read the alarm and Servo ON information from the following communication address, make sure that currently there is no alarm and the servo is in servo Off status, otherwise it will not enter test mode.

Communication address	Content	Data length
0x0900 (Read -only)	0x0UVW, in which UV=Alarm information, W=1 means SON signal is ON, W=0 means SON signal is OFF.	1word

Step 2: enter positioning mode: write 0x0004 to the communication address 0x0901.

Step3: set the acceleration /deceleration time constant.

Communication address	Content	Data length
0x0902	To set acceleration and deceleration time constant in JOG mode and positioning mode.	1word

Step 4: set positioning speed command

Communication address	Content	Data length
0x0903	To input the speed command in JOG and positioning mode (range: 0~3000)(unit: rpm(rotary motor), mm/s(linear motor))	1word

Step 5: set the command pulse number in positioning mode.

Communication address	Content	Data length
0x0905 ~ 0x0906	To set the pulse number in positioning mode (0x0905 returns low 16 bits, 0x0906 returns high 16 bits). The range is 0～ (2^{31}-1) (unit: pulse)	1word

Step 6: positioning test operation

Communication address	Content	Data length
0x0907	When the written data is 0, it means that the positioning operation is paused/stopped (send the command during the operation will pause operation, and send the 2nd command will stop the operation) When the written data is 1, it means the positioning operation is running forwardly When the written data is 2, it means that the positioning operation is running reversely (after the drive receives the data, the position command will change to a negative value inside) (The setting range is 0~2)	1word

Step 7: exit positioning mode: write data 0x0000 to the communication address 0x0901.

10.Troubleshooting

CAUTION	● When an alarm occurs, eliminate its root cause first to ensure safety. Wait until the alarm is cleared and then restart operation, otherwise, it may cause injury. ● When an alarm such as AL03, AL05, AL10, AL.34 occurs, please check the root cause and eliminate it, turn off the power for more than 30 seconds to cool down the temperature of power module, and then restart the power to avoid servo drive damage which is caused by the repeated occurrence of alarms.

10.1 Alarm list and corrective actions

An alarm or warning will be displayed when an error occurs during operation. If Alarm or warning occurs, please follow the section 11.2 to take appropriate actions. Setting PD19 to xxx1 to output the alarm code.

The alarm code is output based on the ON/OFF status between each PIN and SG, and the warning (AL12-AL1B) has no alarm code.

When an alarm occurs, the related DO will output alarm code in below list. In normal operation, the related DO output the setting signal before alarm occurs.

(CN1-41: DO1, CN1-42: DO2, CN1-45: DO5)

	Display	Alarm code			Alarm name	Alarm elimination method		
		CN1 41	CN1 42	CN1 45		Power OFF→ON	Press SET button in current alarm screen	RES signal
Alarm	AL.01	0	1	0	Over voltage	○		
	AL.02	0	0	1	Under voltage	○	○	○
	AL.03	0	1	1	Over current	○		
	AL.04	0	1	0	Regenerative error	○	○	○
	AL.05	1	0	0	Overload 1	○	○	○
	AL.06	1	0	1	Over speed	○	○	○
	AL.07	1	0	1	Abnormal pulse command	○	○	○
	AL.08	1	0	1	Position deviation excessive	○	○	○
	AL.09	0	0	0	Serial communication error	○	○	○
	AL.0A	0	0	0	Serial communication timeout	○	○	○

	AL.0B	1	1	0	Encoder error 1	○		
	AL.0D	1	1	0	Fan error	○		
	AL.0E	0	0	0	IGBT overheat	○		
	AL.0F	0	0	0	Memory error	○		
	AL.10	0	0	0	Overload 2	○		
	AL.11	1	1	1	Motor combination error	○		
	AL.20	1	1	1	Motor collision error	○	○	○
	AL.21	1	1	1	Motor UVW cable disconnection	○		
	AL.22	1	1	0	Encoder communication error	○		
	AL.23	0	1	0	Excessive position error of full-closed loop control	○	○	○
	AL.24	0	0	0	Motor encoder type error	○		
	AL.25	1	1	0	Linear scale is disconnected	○		
	AL.26	1	1	0	Encoder error 3	○		
	AL.27	1	1	0	Encoder error 4	○		
	AL.28	1	1	0	Encoder overheat	○		
	AL.29	1	1	0	Encoder error 5(overflow)	○		
	AL.2A	1	1	0	Absolute encoder error 1	○		
	AL.2B	1	1	0	Absolute encoder error 2	○		
	AL.2E	0	1	1	Control circuit error	○		
	AL.2F	0	1	1	Regenerative energy error	○	○	○
	AL.30	0	1	1	Pulse output frequency excess	○	○	○
	AL.31	0	1	1	Over current 2	○		
	AL.32	0	1	1	Control circuit error 2	○		
	AL.33	0	1	1	Memory error 2	○		
	AL.34	0	0	0	Overload 4	○	○	○
	AL.35	1	0	1	STO module abnormal	○	○	○
	AL.51	1	0	1	Motor parameter automatic identification error	○	○	○
	AL.52	1	0	1	Initial magnetic field detection error	○	○	○
	AL.53	1	0	1	Motor parameters are not confirmed	○		
	AL.54	1	0	1	Motor parameter is out of range	○		
	AL.55	1	0	1	Motor magnetic field error	○		
	AL.57	1	0	1	Feedback pulse is lost	○		
	AL.58	1	0	1	Position error excessive after initial magnetic field detection	○	○	○

	Display	Alarm name	Warning elimination method		
			Power OFF→ON	Press SET button in current warning screen	Reset (RES) signal
Warning	AL.12	Emergency stop	After eliminating the cause, it can be automatically released.		
	AL.13	Forward and reverse limit error			
	AL.14	Software positive limit			
	AL.15	Software negative limit			
	AL.16	Early overload warning			
	AL.17	ABS timeout warning	○	○	○
	AL.19	Pr command error	After eliminating the cause, it can be automatically released.		
	AL.1A	Undefined index coordinate	After eliminating the cause, it can be automatically released.		
	AL.1B	Position shift warning	○	○	○
	AL.1C	Early overload warning 4	After eliminating the cause, it can be automatically released.		
	AL.2C	Absolute encoder error 3	After eliminating the cause, it can be automatically released.		
	AL.2D	Encoder battery low voltage	Eliminate the cause, and then cycling the power of servo.		
	AL.61	Parameter group source of PR is out of range	○	○	○
	AL.62	The parameter number of PR is out of range.	○	○	○
	AL.63	The writing parameter value using PR is out of range.	○	○	○
	AL.64	The writing parameter using PR is wrong.	○	○	○
	AL.67	Motor temperature warning	After eliminating the cause, it can be automatically released.		

Related caution items:

1: If AL.61 occurs, cycling the power of servo can also eliminate the warning.

2: if an alarm occurs, DO ALM will activate.

3: if a warning occurs, DO WNG will activate.

Causes and corrective actions

AL.01 Over voltage

Alarm cause	Checking method	Corrective action
Main circuit voltage exceeds the rated allowable value.	Use a voltmeter to check whether the main circuit input voltage is within the rated allowable voltage value.	Use the correct voltage source or connect to the voltage regulator in series.
Incorrect power input (incorrect power system).	Use a voltmeter to check if the voltage system complies with the specifications.	Use the correct voltage source or connect to the voltage regulator in series.
Drive hardware failure.	Use a voltmeter to check whether the input voltage of the main circuit is within the rated allowable voltage value, and yet the error still occurs.	Send your servo drive back to the distributor or manufacturer.
Built-in regenerative resistor or regenerative device is disconnected.	Check whether the PD short-circuited piece is connected correctly, or whether the regenerative resistor or device wiring is disconnected.	Wire the short-circuited piece correctly or change the wiring cable.
Burned or damaged of the internal regenerative resistor or regenerative related device	Check whether the regenerative resistor or regenerative related device is burnt or damaged.	When using the internal regenerative resistor, please replace the drive; When using the regenerative related device, please replace it.
The capacity of internal regenerative resistor or regenerative option is insufficient.	Refer to section 6.6.1, check the capacity of regenerative resistor.	Increase the capacity or add additional regenerative device.

AL.02 Under voltage

Alarm cause	Checking method	Corrective action
The input voltage of the main circuit is lower than the allowable rated value.	Check if the input voltage wiring for the main circuit is normal.	Recheck the voltage wiring.
No voltage input to the main circuit.	Use a voltmeter to check if the voltage of the main circuit is normal	Recheck the voltage switch.
Incorrect power input (incorrect power system).	Use a voltmeter to check if the power system complies with the specifications.	Use the correct voltage source or connect to the voltage regulator in series.

AL.03 Over-current

Alarm cause	Checking method	Corrective action
Motor wiring error.	Check the wire connection sequence between the motor and the servo drive.	Followed the wiring sequence as described in this manual.
The servo drive output is short-circuited.	Check the connection between the motor and servo drive and make sure that the wire is not short-circuited.	Check and make sure that the wire is not short-circuited. Do not expose the metal part of the wiring.
IGBT abnormal.	Check if the temperature of the heat sink is abnormal.	Send your servo drive back to the distributor or manufacturer.
Parameter setting is in error.	Check if the setting value of the parameter is much greater than the default.	Reset the parameter to the factory default setting and then modify the setting gradually.

AL.04 Regenerative error

Alarm cause	Checking method	Corrective action
Invalid regenerative brake transistor.	Check if the regenerative brake transistor is short-circuited.	Send your servo drive back to the distributor or manufacturer.
The regenerative resistor is disconnected	Check the connection of the regenerative resistor.	Reconnect the regenerative resistor.

AL.05 Overload 1

Alarm cause	Checking method	Corrective action
The load is over the rated value continuously.	Check if the load is too large.	Increase the motor capacity or reduce the load.
Improper parameter setting.	Check if there is any mechanical vibration.	Execute auto acceleration/deceleration tuning.
Unstable system.	Acceleration/deceleration time constant is too short.	Increase acceleration/ deceleration time.
Incorrect wiring of motor and encoder.	Check if the wiring of the UVW and the position encoder cables are correct.	Wiring correctly.

AL.06 Over speed

Alarm cause	Checking method	Corrective action
The input frequency of the pulse command is too high.	Check whether the input frequency of the pulse command is too high.	Correctly set the pulse frequency.
Improper setting for acceleration/deceleration time parameter.	Check whether the acceleration /deceleration time constant is too short.	Increase the acceleration /deceleration time constant.
Unstable servo system which cause large overshoot.	Check whether the system has been vibrating.	1. Set proper gain value. 2. if it’s not working, (a)decrease the load inertia ratio. (b)change the accelerate /decelerate time constant.

AL.07 Abnormal pulse command

Alarm cause	Checking method	Corrective action
The frequency of the pulse command is over the rated value.	Use the pulse frequency tester to check the input frequency	Correctly set the pulse frequency
Input pulse command device error	Replace the input pulse command device.	

AL.08 Excessive deviation of position control

Alarm cause	Checking method	Corrective action
Improper setting of acceleration/deceleration time parameter.	Check if the acceleration/deceleration time constant is too short.	Increase the acceleration /deceleration time constant.
Improper torque limit setting.	Check if the torque limit parameter(PA05) setting is too small.	Increase the torque limit parameter setting value.
Gain setting is too low.	Check if the position gain (PB07) is too small.	Increase the position loop gain value.
Excessive external load.	Check the external load.	Reduce the external load or re-evaluate the motor capacity.

AL.09 Serial communication error

Alarm content: AL.09 occurs when RS485 communication is abnormal.

Alarm cause	Checking method	Corrective action
Incorrect communication protocol setting.	Check if the communication protocol setting is correct.	Correctly set the communication parameter value.
Incorrect communication address.	Check communication address.	Correctly set communication address.
Incorrect communication value.	Check the access value.	Correctly set the communication value.

AL.0A Serial communication timeout

Alarm cause	Checking method	Corrective action
Servo drive has not received the communication message for a long time	Check if the communication cable is broken or loose.	Replace the cable or reconnect the wiring.
Improper parameter setting for PC23.	Check the setting value of PC23.	Correctly set the value of PC23.

AL.0B Encoder error 1

Alarm cause	Checking method	Corrective action
Encoder wiring is incorrect.	Check if the wiring follows the instructions in the user manual.	Wiring correctly.
Encoder connector is loose.	Check the connection.	Re-install.
Encoder is damaged.	Check if the motor is abnormal.	Replace the motor.
Encoder wiring is poor.	Check if there is any poor wiring.	Reconnect the wiring.

AL.0D Fan error

Alarm cause	Checking method	Corrective action
Fan stops working.	Turn off the power, replace the fan by yourself, or send your servo drive back to the distributor or manufacturer.	

AL.0E IGBT overheat

Alarm cause	Checking method	Corrective action
The load is continuously over the rated value or the drive output is short-circuited.	Check if servo drive is overloaded or motor is over-current. Check the drive output wiring.	Reducing the load, or replace the drive with a larger capacity.

AL.0F Memory error

Alarm cause	Checking method	Corrective action
Memory data access abnormal.	Reset parameter or reset power.	If the issue persists after reset, send the servo back to the distributor or manufacturer.

AL.10 Overload 2

Alarm cause	Checking method	Corrective action
Mechanical collision.	Check if there is a problem with the rotation cycle.	Adjust the operation curve or install limit switches.
Motor wiring is wrong.	Check the motor wiring.	Wiring correctly.
The System is operating with vibration.	Check if the mechanical has high frequency noise.	Reduce the stiffness setting or change to manual adjustment.
Encoder error	Check if encoder is normal.	Replace servo motor.

AL.11 Motor combination error

Alarm cause	Checking method	Corrective action
Motor and drive capacity is inconsistent.	Check if they match for each other in capacity.	Use the correct motor which matches the drive.

AL.12 Emergency stop

Alarm content: AL.12 occurs when pressing emergency stop button.

Alarm cause	Checking method	Corrective action
The emergency stop button is pressed.	Check the button position.	Turn on the emergency stop button.

AL.13 Forward and reverse limit error

Alarm cause	Checking method	Corrective action
Positive limit switch is triggered.	Check the position of the switch.	Turn on the positive limit switch.
Negative limit switch is triggered.	Check the position of the switch.	Turn on the negative limit switch.

AL.14 Software positive limit error

Alarm cause	Checking method	Corrective action
In Pr Mode, when the position command pulse number exceeds the software positive limit PF86.	1.The software positive limit is calculated based on the position command rather than the actual feedback position, because the command always arrives earlier than the feedback. When this limit protection is activated, the actual position may not exceed the limit, you can set an appropriate deceleration time to achieve the desired effect. 2.Refer to the description on PF86.	Adjust the pulse number of current position command to be smaller than the software positive limit.

AL.15 Software negative limit error

Alarm cause	Checking method	Corrective action
In Pr Mode, when the position command pulse number less than the software negative limit PF87.	1.The software negative limit is calculated based on the position command rather than the actual feedback position, because the command always arrives earlier than the feedback. When this limit protection is activated, the actual position may not exceed the limit, you can set an appropriate deceleration time to achieve the expected effect. 2.Refer to the description on PF87.	Adjust the pulse number of the current position command to be greater than the software negative limit.

AL.16 Early overload warning

Alarm cause	Checking method	Corrective action
The load exceeds the setting time of the protection curve *PA17. (Please refer to section 13. 3 of SDP series manual for protection curve) .	1. Check whether the load is overloaded. 2. Check whether the PA17 setting is too low.	1. Refer to AL.05 corrective action. 2. Increase the setting value of PA17 or set the value to more than 100 to disable this function.

AL.17 ABS timeout warning

Alarm cause	Checking method	Corrective action
The signal waiting time of absolute position communication is too long.	Delta DIO communication: in absolute position communication, no signal is issued (ABSQ) within 5 seconds after the servo drive DATA is ready(ABSR). Mitsubishi DIO communication: please refer to section 14.1.5 item 3. (Transmission Error).	Turn off the ABSE or ABSM signal terminal to release the alarm, and check whether the communication format of the controller is wrong.

AL.19 Pr command error

Alarm cause	Checking method	Corrective action
The position command counter overflows.	**Incremental system:** If in PR mode, the motor keeps running in a single direction, it will cause the feedback position register overflow and the coordinate system fail to reflect the correct position. This error occurs if the PR absolute positioning command is issued at this time. **Absolute system:** This error occurs when the absolute positioning command is issued in the following conditions: 1. The feedback position register overflows. 2. The homing program has not been executed after changing the E-Gear ratio (PA06, PA07). 3. Execute absolute position command when DO HOME signal is OFF.	Execute homing.

AL.20 Motor collision error

Alarm cause	Checking method	Corrective action
When the motor current reaches the value of PA15 and the protection time of PA16 has run out.	1. Check if PA15 is valid. 2. Check if PA15 setting is too low, and if PA16 is too small.	1. Set PA15 to 0 if you open it by mistake. 2. When setting with actual torque, if the setting is too low, it will cause malfunction, and if the setting is too high, the protection function will be invalid.

AL.21 Motor UVW cable disconnection

Alarm cause	Checking method	Corrective action
When Motor U,V,W cable disconnection is detected.	Check if the Motor U,V,W cable is loose.	Reconnect the U,V,W cables.

AL.22 Encoder communication error.

Alarm cause	Checking method	Corrective action
The encoder has three consecutive CRC code errors or internal memory errors.	1. Check if the grounding of motor is normal. 2. Check whether the encoder signal line is separated from the power line or high current line to avoid interference. 3. Check whether the wire of encoder has an shielding net.	1. Connect the U,V,W ground terminal (green wire) to the heat sink base of the drive 2. Please separate the encoder cable from the motor power cables and high current cables. 3. Use the wire with shielding net 4. If the issue persists, send it back to the distributor or manufacturer.

AL.23 Excessive position error of full-closed loop control

Alarm cause	Checking method	Corrective action
Position control deviation pulses exceed PA25 setting value.	1. check if PA25 setting value too small. 2. Check if the connector is loose or there is other connection problem on the other mechanical parts.	1. Increasing PA25 setting value. 2.Make sure the connector is firmly connected or there is no problem when the connector connects to the mechanical parts.

AL.24 Motor encoder type error

Alarm cause	Checking method	Corrective action
The incremental motor is not able to perform absolute type function.	1.Check the motor is incremental type or absolute type encode. 2.Check parameter PA28.	To use absolute type of function, you have to use absolute motor. If absolute type function is not needed, please set PA28 to 0.

AL.25 Linear scale is disconnected

Alarm cause	Checking method	Corrective action
When PA26 =□□□1 or □□□2, and SERVO is ON, if linear scale is disconnected, AL.25 occurs.	Check the communication circuit of Linear scale.	cycling the power.

AL.26 Encoder error 3

Alarm cause	Checking method	Corrective action
Encoder LED light decay or encoder rotation count value is abnormal.	Restart the motor and check whether the alarm recurs.	If the issue persists, send it back to the distributor or manufacturer.

AL.27 Encoder error 4

Alarm cause	Checking method	Corrective action
The internal memory of the encoder error.	1. Check if the grounding of motor is normal. 2. Check if the encoder signal line is separated from the power line or high current line to avoid interference. 3. Check whether the wire of encoder has a shielding net.	1. Connect the U,V,W ground terminal (green wire) to the heat sink base of the drive. 2. Please separate the encoder cable from the motor power cables and high current cables. 3. Use the wire with shielding net. 4. If the issue persists, send it back to the distributor or manufacturer.

AL.28 Encoder overheat

Alarm cause	Checking method	Corrective action
Encoder operating temperature is higher than 95℃.	Put encoder away from heat source and do not operate in high temperature environment.	1. Do not operate in high temperature environment and wait for the encoder board cool down to room temperature. 2. If the issue persists, send it back to the distributor or manufacturer.

AL.29 Encoder error 5

Alarm cause	Checking method	Corrective action
The move distance of the absolute position revolution number is out of range.	Check if the absolute motor operating revolution number is within the range between -32768 and +32767.	Re-execute homing and initialize absolute coordinate according to chapter 14 description.

AL.2A Absolute encoder error 1

Alarm cause	Checking method	Corrective action
Encoder backup battery voltage is too low.	Check whether the battery voltage is lower than 2. 45V (TYP).	Replace the battery, and then re-execute homing and initialize absolute coordinate according to the description of chapter 14 or PA29.
Poor contact or disconnection of battery power supply circuit.	1. Check the encoder wiring. 2. Check the connection between the battery external box and drive.	Connect or fix the connection to make sure the encoder power supply is normal, and re-execute homing, and then initialize absolute coordinate according to the description of chapter 14

AL.2B Absolute encoder error 2

Alarm cause	Checking method	Corrective action
The revolution count value of absolute encoder is in error.	Restart the motor and check whether the alarm recurs.	If the issue persists, send it back to the distributor or manufacturer.

AL.2C Absolute encoder error 3

Alarm cause	Checking method	Corrective action
Replace the battery when the drive control power is OFF.	Do not replace or remove the battery when the drive control power is OFF.	Re-execute homing and initialize absolute coordinate according to chapter 14 or PA29 description.
After activating the absolute function, the absolute position coordinate initialization has not been completed.	1. Install the battery 2. Check the connection between the battery external box and drive. 3. Check the encoder wiring	Execute homing and initialize absolute coordinate according to chapter 14 or PA29 description.

AL.2D Encoder battery low voltage

Alarm cause	Checking method	Corrective action
Encoder backup battery voltage is too low.	1. Check whether the battery voltage is lower than 3.0V (TYP). 2. Check if the battery voltage is lower than 3.0V(TYP)	Replace the battery with a new one when the drive control power is ON and re-power on servo drive to eliminate the AL.2D.

AL.2E Control circuit error

Alarm cause	Checking method	Corrective action
When the motor is running with large external load, the servo ON (SON) state is instantly turned OFF→ON.	Check whether the servo ON (SON) is operate by mistake.	Correctly operate the servo ON (SON) command.
The drive current feedback is abnormal.	Restart the drive. If the issue persists, send your drive back to the distributor or manufacturer.	

AL.2F Regenerative energy error

Alarm cause	Checking method	Corrective action
When the regenerative load rate exceeds 100%.	1. Check if the acceleration/deceleration time is too short. 2. Check if the frequency of forward and reverse rotation is too fast.	1. Adjust the acceleration /deceleration time, or reduce the frequency of forward and reverse rotation. 2. Press SET button in current alarm screen display. 3. Restart the power.

AL.30 Pulse output frequency excess

Alarm cause	Checking method	Corrective action
Detector output error which is caused by encoder error.	Check the error history to see whether it is accompanied with an encoder error (AL0B, AL0C, AL22, AL26, AL27).	Follow the corrective action of AL.0B, AL.22, AL.26, AL.27.
The output pulse exceeds the hardware allowable range.	Check whether the following conditions exist: (a) Motor feedback speed> PA41. (b) (Motor speed/60) * detector output pulse number per revolution > 20x10^6	Correctly set PA41 and PA14: PA41> motor speed and (motor speed/60)* the detector output pulse number per revolution <20x10^6

AL.31 Over current 2

Alarm cause	Checking method	Corrective action
The drive current feedback is abnormal.	Restart the drive. If the issue persists, send your servo drive back to the distributor or manufacturer.	

AL.32 Control circuit error 2

Alarm cause	Checking method	Corrective action
FPGA is abnormal.	Restart the drive. If the issue persists, send your servo drive back to the distributor or manufacturer.	

AL.33 Memory error 2

Alarm cause	Checking method	Corrective action
Cache memory is abnormal.	Restart the drive. If the issue persists, send your servo drive back to the distributor or manufacturer.	

AL.34 Over load 4

Alarm cause	Checking method	Corrective action
continuous use curve which exceeds the drive rated load.	Check if the frequency of the repeatable operation cycle is too fast.	Increase motor capacity or reduce operation cycle frequency.
Unstable system.	Check whether the acceleration/deceleration time setting is too short.	Increase the setting value of acceleration/deceleration time.

AL.35 STO module abnormal

Alarm cause	Checking method	Corrective action
STO safety signal is triggered.	Check if the STO safety signal is triggered by CN6. If CN6 is not used, check whether the connector of shipping configuration is well connected.	Restart the drive after checking. If the issue persists, send your servo drive back to the distributor or manufacturer.

AL.51 Motor parameter automatic identification error

Alarm cause	Checking method	Corrective action
when the motor is executing the PL02 Motor Parameter auto identification function, this alarm is triggered if the friction is too large made the motor unable to run, or input values of the resolution and pole pitch error.	1. Check if input values of the resolution and pole pitch are correct. 2. Check if the motor is stuck during detection. 3. Check if the friction between the motor and mechanical part is too large. 4. Check if linear scale feedback is normal, disconnected, stick unevenly, or there is noise interference.	1.Input the actual value and then executing auto detection. 2.Due to the linear motor will move 1 pole pitch forward or reversely during detection. You need to leave the motor moving distance before detection. 3.Correct the linear scale problem.

AL.52 Initial magnetic field detection error

Alarm cause	Checking method	Corrective action
When the motor is not using the Hall sensor, it will automatically detect the magnetic field after power-on. If the magnetic field is not found, this alarm occurs.	1.Check if the feedback is normal. 2.Check if the motor friction is too large.	1.Eliminate feedback error. 2.Increase PL12(the magnetic detection current).

AL.53 Motor parameters are not confirmed

Alarm cause	Checking method	Corrective action
When PL03=0, if the motor is SERVO ON, the alarm occurs.	Check PL03.	Check if motor parameters is correct, if yes, set PL03=1 and cycling the power.

AL.54 Motor parameter is out of range

Alarm cause	Checking method	Corrective action
When the motor executes the PL02 motor parameter automatic identification function, the motor resistance (PL47) and inductance (PL48) are out of range or are zero, and then this alarm occurs.	Check if the motor resistance (PL47), inductance (PL48) values are out of range or are zero.	Check the value of motor resistance (PL47) and inductance(PL48).

AL.55 Motor magnetic field error

Alarm cause	Checking method	Corrective action
1. The difference between magnetic field feedback by the Hall sensor and the control magnetic field inside the servo is big. 2. Hall sensor three-phase (UVW) are all high or all low and the output time is over1ms.	1. Check whether the Hall sensor is abnormal or interfered. 2. Check whether there is interference in the feedback signal, which caused pulses leakage.	Eliminate the Hall sensor or feedback signal problem, and cycling the power.

AL.57 Feedback pulse is lost

Alarm cause	Checking method	Corrective action
Activate pulse lost detection, and after initial Z phase signal output, the pulse interval number between every 2 Z phase output signal is out of the range.	1.Check if the feedback is normal. 2. Check if the pulse interval number which triggered by 2 Z phase pulse is fixed value or not.	1.Eliminate feedback abnormal. 2. Set correct pulse number to PL39, PL40.

AL.58 Excessive position deviation after initial magnetic field detection

Alarm cause	Checking method	Corrective action
During initial magnetic field detection, it will check if the position deviation is within the range. If not, AL.58 occurs.	1. check if the command is issued right after the power is applied 2. check if the move distance is too far during initial magnetic detection	1.Do not input the command right after apply power to the servo. 2.Decrease PL12(the magnetic detection current).

AL.1A Undefined index coordinate

Alarm cause	Checking method	Corrective action
When using the indexing function, you need to execute homing to define the starting point of the indexing coordinates. otherwise, an alarm will occur.	Check whether homing has been executed.	1. Before operating the indexing function, make sure execute homing first to avoid this alarm. 2. Use DI:Alm reset function to clear the alarm when alarm occurs. 3. This alarm can also be cleared when Servo is ON.

AL.1B Position shift warning

Alarm cause	Checking method	Corrective action
When DO: MC_OK is already on, and then MC_OK signal turns off. Please refer to PD28 description.	When DO:MC_OK is already on, it may turn off when DO:INP turns off, The external force after motor completed positioning may cause the position shift.	1. Turn on RES signal. 2. Press Set button at alarm display screen. 3. Restart the power. 4. Restart SON signal

AL.1C Early overload warning 4

Alarm cause	Checking method	Corrective action
The load duration exceeds the warning time of protection curve.	Check whether the load exceeds the motor capacity.	1. Refer to AL.34 overload 4 alarm instruction.

AL.61 Parameter group source of PR is out of range

Alarm cause	Checking method	Corrective action
Parameter group source of PR is out of range.	The parameter group setting is out of range when writing the parameter by PR procedure.	Clear the alarm by any of the following solutions: 1. Restart the power. 2. Press "SET" button at alarm display screen. 3. Turn on RES signal.

AL.62 The parameter number of PR command source exceeds the range.

Alarm cause	Checking method	Corrective action
Parameter number source of PR is out of range.	The parameter number setting is out of range when writing the parameter by PR procedure.	Clear the alarm by any of the following solutions: 1. Restart the power. 2. Press the "SET" button at alarm display screen. 3. Turn on the RES signal.

AL.63 The writing parameter value using PR is out of range.

Alarm cause	Checking method	Corrective action
The writing parameter value of PR command(TYPE=8) is out of range.	Check whether the writing parameter value is out of range when writing the parameter by PR procedure.	Clear the alarm by any of the following solutions: 1. Restart the power. 2. Press the "SET" button at alarm display screen. 3. Turn on the RES signal.

AL.64 The writing parameter using PR is wrong.

Alarm cause	Checking method	Corrective action
The PR program(TYPE=8) writes the parameter during Servo ON.	The servo is on or setting value is unreasonable when writing the parameter by PR procedure	Adjust PR commands and parameters

AL.67 Motor temperature warning

Alarm cause	Checking method	Corrective action
The motor temperature is too high.	Check the temperature of motor.	The alarm will be released automatically after the motor temperature return to normal.

11. Specifications

11.1 Servo drive standard specifications.

200V series specifications

Drive Model Type SDP-□□□A2C			010	020	040	075	100	150	200	300	
Servo Motor type SME-□□□□			L005 L010	L020	L040	L075	L100	L150	L200	L300	
			--	--	--	--	M100	M150	M200	M300	
			--	H020	H040	H075	H085	--	--	H130	H180
Motor capacity			50W	200W	400W	750W	1.0KW	1.5KW	2KW	3.0KW	
			100W				850W			1.3KW	1.8KW
Main circuit power	Input	Voltage 50/60Hz	Single-phase or Three-phase 200～240VAC							Three-phase 200~240VAC	
		Permissible voltage variation 50/60Hz	Single-phase or Three-phase 170～264VAC							Three-phase 170~264VAC	
		Permissible frequency variation	±5%								
	output	Voltage	110V				140V				
		Current	1.0 A	1.8 A	3.2 A	5.8 A	6.4 A	9.4 A	12.1 A	17.6 A	
		Frequency	0~250 Hz				0~167 Hz				
Control circuit power	Input voltage		Single-phase 200～240VAC(50/60Hz)								
	Permissible voltage variation		Single-phase 170～264VAC(50/60Hz)								
	Permissible frequency variation		±5%								
	Power consumption (W)		30								
Control method			3φ sine wave rectification, IGBT-PWM control (SVPWM drive)								
Dynamic brake			Built-in(software)								

<table>
<tr><th colspan="2">Drive Model Type
SDP-□□□A2C</th><th>010</th><th>020</th><th>040</th><th>075</th><th>100</th><th>150</th><th>200</th><th colspan="2">300</th></tr>
<tr><th colspan="2" rowspan="3">Servo Motor type
SME-□□□□</th><td>L005
L010</td><td>L020</td><td>L040</td><td>L075</td><td>L100</td><td>L150</td><td>L200</td><td colspan="2">L300</td></tr>
<tr><td>--</td><td>--</td><td>--</td><td>--</td><td>M100</td><td>M150</td><td>M200</td><td colspan="2">M300</td></tr>
<tr><td>--</td><td>H020</td><td>H040</td><td>H075</td><td>H085</td><td>--</td><td>--</td><td>H130</td><td>H180</td></tr>
<tr><th colspan="2" rowspan="2">Motor capacity</th><td>50W</td><td rowspan="2">200W</td><td rowspan="2">400W</td><td rowspan="2">750W</td><td>1.0KW</td><td rowspan="2">1.5KW</td><td rowspan="2">2KW</td><td colspan="2">3.0KW</td></tr>
<tr><td>100W</td><td>850W</td><td>1.3KW</td><td>1.8KW</td></tr>
<tr><th colspan="2">Protection function</th><td colspan="9">Over current, under voltage, over voltage, overheat, overload(electron accumulated heat) , fan error protection, pulse command error protection, encoder error protection, regenerative error protection, over speed protection, excessive deviation protection, serial communication error, serial communication timeout, motor combination error, motor collision error, motor UVW cable disconnection, control circuit error.</td></tr>
<tr><th colspan="2">Feedback encoder</th><td colspan="9">(50W~750W motor) single turn 24bit / Multi-turn 24bit &16bit
(850W~3KW motor) single turn 23bit / Multi-turn 23bit &16bit
HEIDENHAIN Endat 2.2 (Incremental/absolute encoder)</td></tr>
<tr><th colspan="2">Communication interface</th><td colspan="9">RS-485(MODBUS), USB</td></tr>
<tr><th colspan="2">Safety function</th><td colspan="9">STO</td></tr>
<tr><th rowspan="8">Position control mode</th><th>Input pulse frequency</th><td colspan="9">Differential transmission method:
500Kpps(low speed) / 8Mpps(high speed)
Open-collect type transmission type : 500kpps</td></tr>
<tr><th>Command pulse type</th><td colspan="9">CCW pulse train+CW pulse train; pulse train+sign; AB phase pulse train.</td></tr>
<tr><th>Command source</th><td colspan="9">External pulse / internal register</td></tr>
<tr><th>Command smoothing method</th><td colspan="9">Low-pass filter / Linear / PS-curve</td></tr>
<tr><th>Command pulse ratio</th><td colspan="9">Electronic gear ratio A/B times A: 1~4194304, B: 1~4194304
(Limited to: 1/50 < A/B < 25600)</td></tr>
<tr><th>Deviation excess</th><td colspan="9">±3 revolutions</td></tr>
<tr><th>Torque limit</th><td colspan="9">Internal parameter or external analog input ((0～+10VDC/max torque)</td></tr>
<tr><th>Feed-forward compensation</th><td colspan="9">Internal parameter 0～200%</td></tr>
</table>

Drive Model Type SDP-□□□A2C		010	020	040	075	100	150	200	300	
Servo Motor type SME-□□□□		L005 L010	L020	L040	L075	L100	L150	L200	L300	
		--	--	--	--	M100	M150	M200	M300	
		--	H020	H040	H075	H085	--	--	H130	H180
Motor capacity		50W	200W	400W	750W	1.0KW	1.5KW	2KW	3.0KW	
		100W				850W			1.3KW	1.8KW
Speed control mode	**Speed control range**	Analog speed command 1:2000, Internal speed command 1:5000								
	Command source	External analog voltage input/Internal register setting								
	Command smoothing method	Low-pass filter / Linear acceleration and deceleration curve / S-curve smoothing								
	Analog speed command input	0～±10VDC/rated speed (input impedance 10~12kΩ)								
	Speed change rate*	Load fluctuation 0~100% maximum ±0. 01% Power fluctuation ±10% maximum 0.01% Ambient temperature fluctuation 0℃~55℃: maximum ±0. 5%(analog speed command)								
	Torque limit	Internal parameter or external analog input (0～+10VDC /max torque)								
	Bandwidth	Maximum 3KHz								
Torque control mode	**Command source**	External analog voltage input/Internal register setting								
	Command smoothing method	Low-pass filter smoothing								
	Analog torque command input	0～±10VDC / maximum torque (input impedance 10～12kΩ)								
	Speed limit	Internal parameter setting or external analog input setting (0～+10VDC /max torque)								

<table>
<tr><th colspan="2">Drive Model Type
SDP-□□□A2C</th><th>010</th><th>020</th><th>040</th><th>075</th><th>100</th><th>150</th><th>200</th><th colspan="2">300</th></tr>
<tr><td colspan="2" rowspan="3">Servo Motor type
SME-□□□□</td><td>L005
L010</td><td>L020</td><td>L040</td><td>L075</td><td>L100</td><td>L150</td><td>L200</td><td colspan="2">L300</td></tr>
<tr><td>--</td><td>--</td><td>--</td><td>--</td><td>M100</td><td>M150</td><td>M200</td><td colspan="2">M300</td></tr>
<tr><td>--</td><td>H020</td><td>H040</td><td>H075</td><td>H085</td><td>--</td><td>--</td><td>H130</td><td>H180</td></tr>
<tr><td colspan="2" rowspan="2">Motor capacity</td><td>50W</td><td rowspan="2">200W</td><td rowspan="2">400W</td><td rowspan="2">750W</td><td>1.0KW</td><td rowspan="2">1.5KW</td><td rowspan="2">2KW</td><td colspan="2">3.0KW</td></tr>
<tr><td>100W</td><td>850W</td><td>1.3KW</td><td>1.8KW</td></tr>
<tr><td rowspan="5">Digital input/output</td><td>Digital Input</td><td colspan="9">Servo on, forward and reverse rotation limit , pulse deviation elimination, torque direction option, speed command selection, position command selection, forward and reverse rotation command, proportional control switching, torque limit switching, alarm reset, emergency stop, control mode switching, E-Gear ratio selection, gain switching, position command selection, position command trigger, motor stop, pulse input inhibit, event trigger command, origin point, homing. E-Cam engaged.</td></tr>
<tr><td rowspan="2">Digital Output</td><td colspan="9">ABZ Line driver output, Z open collector type output.</td></tr>
<tr><td colspan="9">Torque limit reached, speed limit reached, servo ready, zero speed reached, target position reached, target speed reached, servo alarm, servo warning, homing is completed, overload level reached, internal position is attained, position command overflows, software positive limit reached, software reverse limit reached.</td></tr>
<tr><td>Analog input</td><td colspan="9">Analog speed command/limit, Analog torque command/limit.</td></tr>
<tr><td>Analog output</td><td colspan="9">Command pulse frequency, pulse deviation, current command, DC bus voltage, servo motor speed, motor torque value.</td></tr>
<tr><td rowspan="5">Environment</td><td>Temperature</td><td colspan="9">0℃ ~ 55℃ (If the operating temperature is above 45˚C,
forced cooling is required)
Storage: -20~65℃ (Non-freezing)</td></tr>
<tr><td>Humidity</td><td colspan="9">Maximum 90% RH (Non-condensing)
Storage: below 90%RH (Non-condensing)</td></tr>
<tr><td>Installation site</td><td colspan="9">Indoors (avoid direct sunlight), no corrosive vapor,
avoid flammable gases, fumes and dust.</td></tr>
<tr><td>Altitude</td><td colspan="9">Altitude below 1000m</td></tr>
<tr><td>Vibration</td><td colspan="9">Maximum 5.9m/s^2</td></tr>
<tr><td colspan="2">Cooling method</td><td colspan="3">Air convection cooling, IP20.</td><td colspan="6">Fan cooling, IP20.</td></tr>
</table>

Weight(kg)	1.4	1.7	2.6

Note: *1 when command is at the rated speed, the speed change rate calculation is: (rotational speed with no load - rotational speed with full load) / rated speed.

400V series specifications

Drive Model Type SDP-□□□A4C			200	300	500		700
Servo Motor type SMP-□□□□			H180	H290	H440	H55	H750
Motor capacity			1.8K	2.9K	4.4KW	5.5KW	7.5KW
Main circuit power	**Input**	**Voltage** 50/60Hz	Three-phase 380～480VAC				
		Permissible voltage variation 50/60Hz	Three-phase 323～528VAC				
		Permissible frequency variation	±5%				
	output	**Voltage**	0~240VAC				
		Current	8.4 A	11.9 A	16.5 A	20.8 A	27.2 A
		Frequency	0~125 Hz				
Control circuit power	**Input voltage**		24VDC				
	Permissible voltage variation		21.6~26.4VDC				
	Power consumption (W)		30				
Control method			3φ sine wave rectification, IGBT-PWM control (SVPWM)				
Dynamic brake			Built-in(software)				
Protection function			Over current, under voltage, over voltage, overheat, overload(electronic accumulated heat) , fan error protection, pulse command error protection, encoder error protection, regenerative error protection, over speed protection, excessive deviation protection, serial communication error, serial communication timeout, motor combination error, motor collision error, motor UVW cable disconnection, control circuit error.				
Feedback encoder			(2KW~7.5KW motor) single turn23bit /Multi-turns23bit &16bit HEIDENHAIN Endat 2.2 (Incremental type/absolute type encoder)				
Communication interface			RS-485(MODBUS), USB				

Drive Model Type SDP-□□□A4C		200	300	500		700
Servo Motor type SMP-□□□□		H180	H290	H440	H550	H750
Motor capacity		1.8K	2.9K	4.4KW	5.5KW	7.5KW
Safety function		STO				
Position control mode	Input pulse frequency	Line driver: 500Kpps(low speed)/8Mpps(high speed); Open collector: 500Kpps				
	Command pulse mode	CCW pulse train +CW pulse train; pulse train + sign; AB phase pulse train.				
	Command source	External pulse control / Internal register setting				
	Smoothing method	Low-pass filter / Linear / PS-curve smoothing				
	Command pulse ratio	Electronic gear ratio A/B times A: 1~4194304, B: 1~4194304 (Limited to: 1/50 < A/B < 25600)				
	Deviation excess	±3revolutions				
	Torque limit	Internal parameter setting or external analog input setting (0~+10VDC/maximum torque)				
	Feed forward compensation	Internal parameter setting0~200%				
Speed control mode	Speed control range	Analog speed command 1:2000, Internal speed command 1:5000				
	Command source	External analog voltage input/Internal register setting				
	Smoothing method	Low-pass filter / Linear acceleration/deceleration curve / S-curve smoothing				
	Analog speed command input	0～±10VDC/rated speed(input impedance 10~12kΩ)				
	Speed change rate*	Load fluctuation 0~100% maximum ±0.01% Power fluctuation ±10% maximum 0.01% Ambient temperature fluctuation 0℃~55℃: maximum ±0. 5%(analog speed command)				
	Torque limit	Internal parameter setting or external analog input setting(0~+10VDC /maximum torque)				
	Bandwidth	Maximum 3KHz				

<table>
<tr><th colspan="2">Drive Model Type
SDP-□□□A4C</th><th>200</th><th>300</th><th colspan="2">500</th><th>700</th></tr>
<tr><th colspan="2">Servo Motor type
SMP-□□□□</th><td>H180</td><td>H290</td><td>H440</td><td>H550</td><td>H750</td></tr>
<tr><th colspan="2">Motor capacity</th><td>1.8K</td><td>2.9K</td><td>4.4KW</td><td>5.5KW</td><td>7.5KW</td></tr>
<tr><th rowspan="4">Torque control mode</th><th>Command source</th><td colspan="5">External analog voltage input/Internal register setting</td></tr>
<tr><th>Smoothing method</th><td colspan="5">Low-pass filter smoothing</td></tr>
<tr><th>Analog torque command input</th><td colspan="5">0～±10VDC / Maximum torque(input impedance 10~12kΩ)</td></tr>
<tr><th>Speed limit</th><td colspan="5">Internal parameter setting or external analog input setting
(0~±10VDC/maximum speed)</td></tr>
<tr><th rowspan="3">Digital input/output</th><th>Digital Input</th><td colspan="5">Servo on, forward and reverse rotation limit , pulse deviation elimination, torque direction option, speed command selection, position command selection, forward and reverse rotation command, proportional control switching, torque limit switching, alarm reset, emergency stop, control mode switching, E-Gear ratio selection, gain switching, position command selection, position command trigger, motor stop, pulse input inhibit, event trigger command, origin point, homing. E-Cam engaged.</td></tr>
<tr><th rowspan="2">Digital Output</th><td colspan="5">ABZ Line driver output, Z open collector output</td></tr>
<tr><td colspan="5">Torque limit reached, speed limit reached, Servo ready, Zero speed reached, Target position reached, Target speed reached, Servo alarm, Servo warning, Homing completed, Overload level reached, Internal position attained, Position command overflows, Software positive limit reached, Software reverse limit reached.</td></tr>
<tr><th rowspan="2">AI/AO</th><th>Analog input</th><td colspan="5">Analog speed command/limit, Analog torque command/limit,</td></tr>
<tr><th>Analog output</th><td colspan="5">Command pulse frequency, pulse error, current command, DC bus voltage, servo motor speed, motor torque value</td></tr>
<tr><th rowspan="5">Environment</th><th>Temperature</th><td colspan="5">0℃ ~ 55℃
(If the operating temperature is above 45˚C, forced cooling is required)
Storage: -20～65℃ (Non-freezing)</td></tr>
<tr><th>Humidity</th><td colspan="5">Maximum 90% RH (Non-condensing)
Storage: below 90%RH (Non-condensing)</td></tr>
<tr><th>Installation site</th><td colspan="5">Indoors (avoid direct sunlight), no corrosive vapor,
avoid flammable gases, fumes and dust.</td></tr>
<tr><th>Altitude</th><td colspan="5">Below 1,000 m</td></tr>
<tr><th>Vibration</th><td colspan="5">Maximum 5.9m/s^2</td></tr>
<tr><th colspan="2">Cooling method</th><td colspan="5">Fan cooling, IP20.</td></tr>
<tr><th colspan="2">Weight(kg)</th><td colspan="5">5.3</td></tr>
</table>

11.2 Interface and out dimensions of the servo drive

200V series

Item	Shihlin SDP		
	A frame	B frame	C frame
	100~400W	0.75~1kW	1.5~3kW
H (mm)	162	162	162
L (mm)	50	70	85
D (mm)	150	170	190
Screw hole	2-M5	3-M5	3-M5

400V series

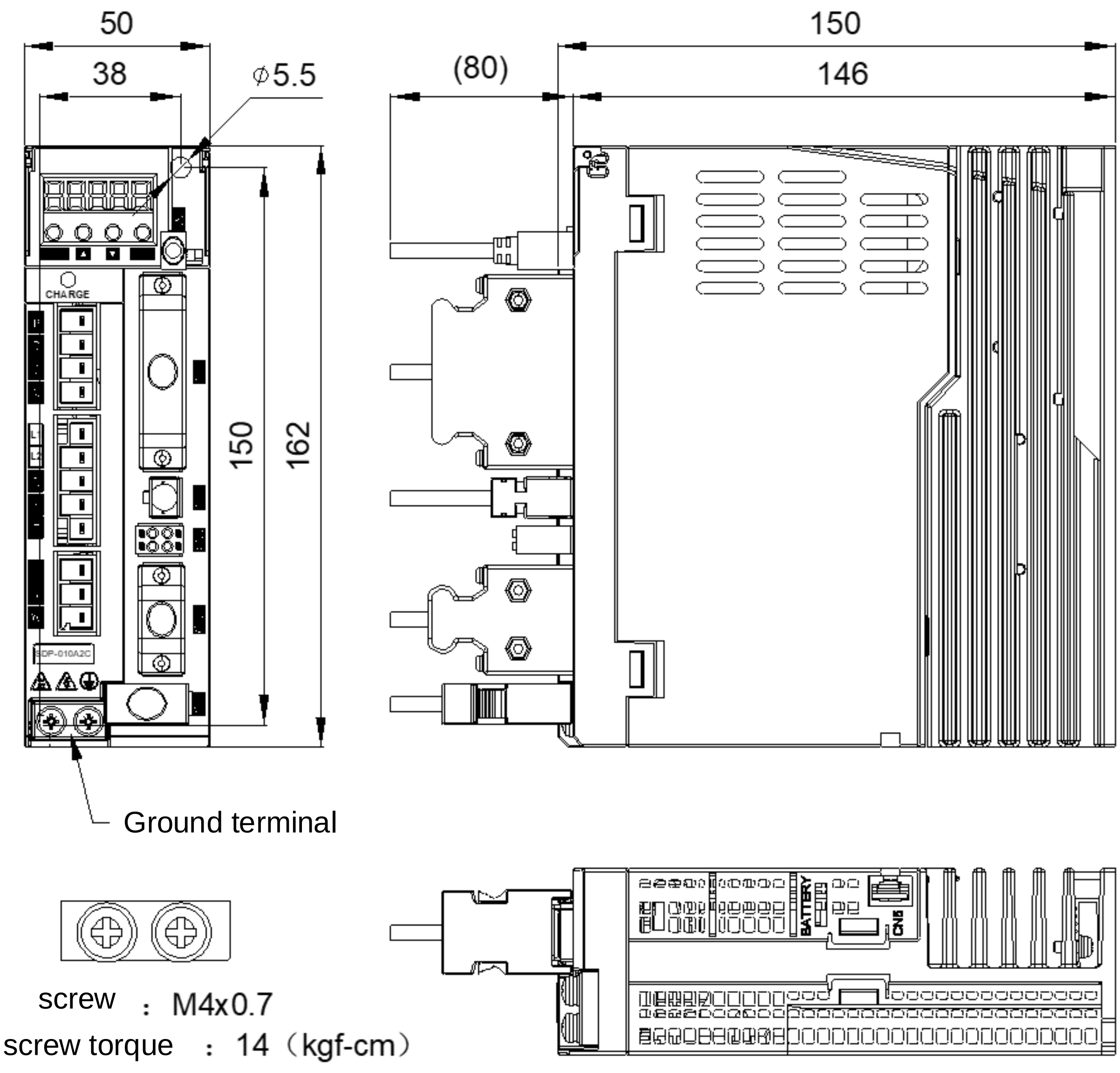
Item	Shihlin SDP
	D frame
	2~7KW
H (mm)	245
L (mm)	123.5
D (mm)	205
Screw hole	4-M5

11.3 Dimensions of servo drive

200V AC system

SDP-010A2C, SDP-020A2C, SDP-040A2 C(100W~400W)

Unit[mm]

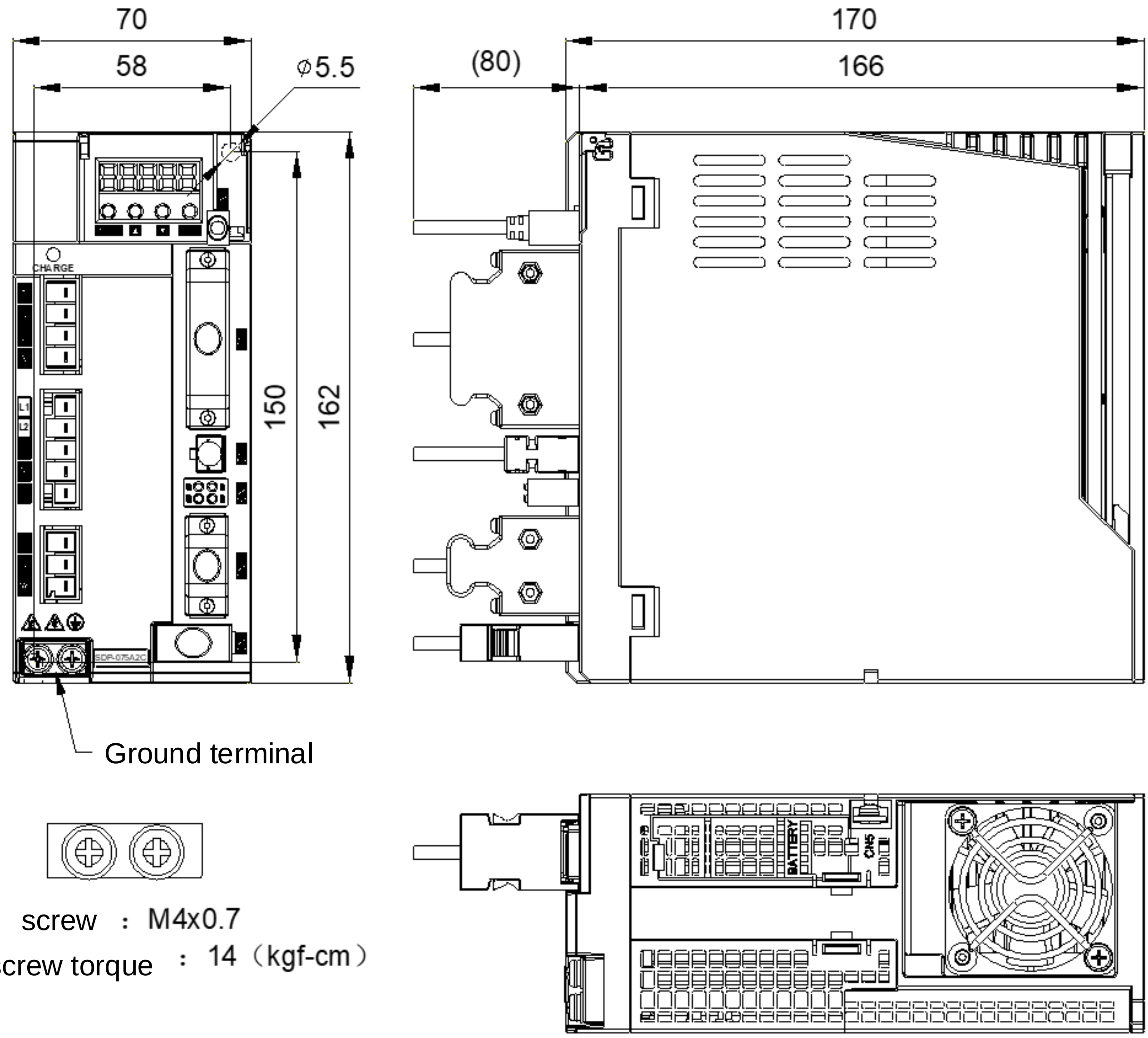


★ Dimensions of the servo drive may be updated without prior notice.

200VAC system

SDP-075A2C, SDP-100A2C(750W, 1KW)

Unit[mm]

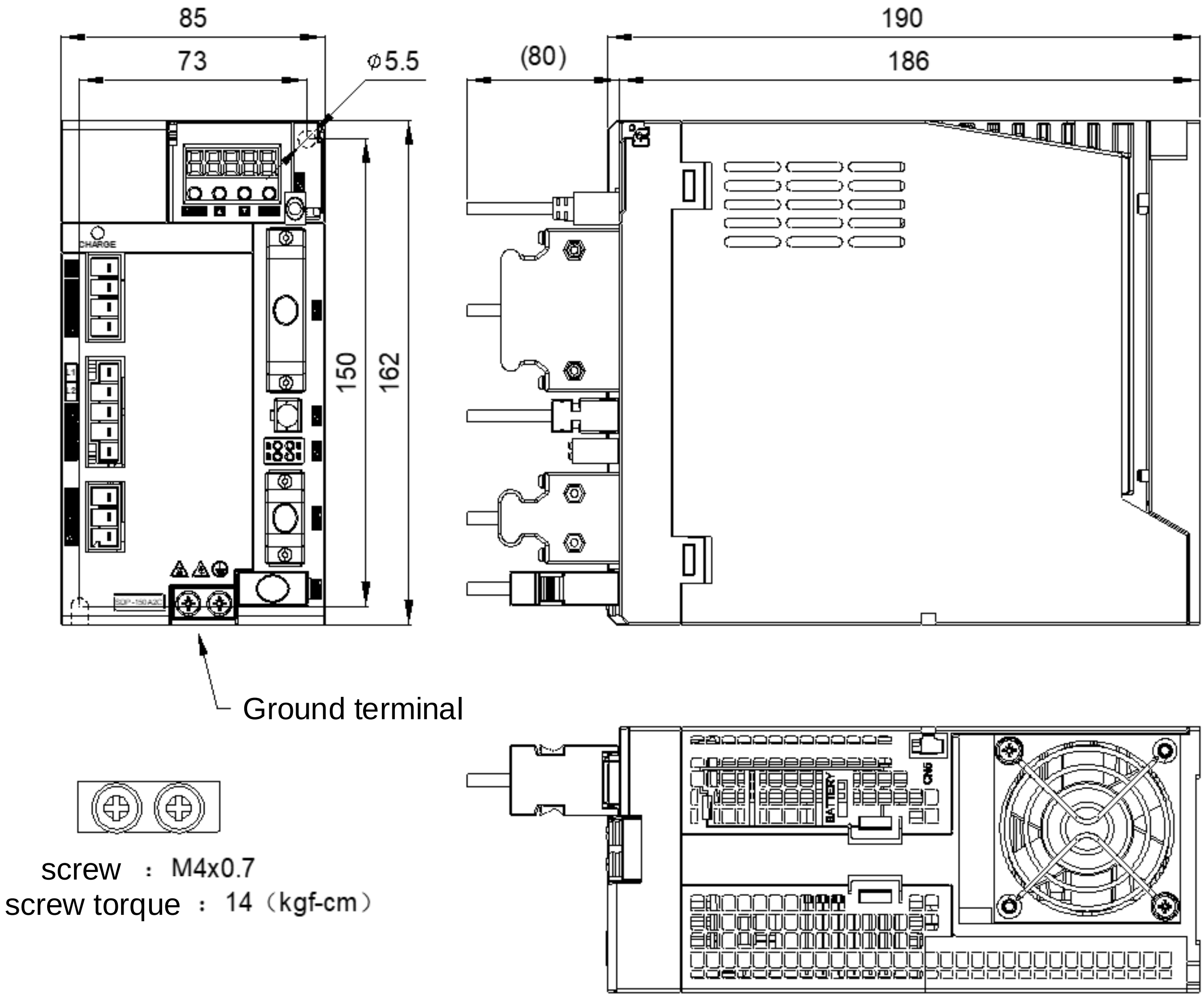


★ Dimensions of the servo drive may be updated without prior notice.

200VAC system

SDP-150A2C, SDP-200A2C, SDP-300A2 C(1.5KW~3KW)

Unit[mm]

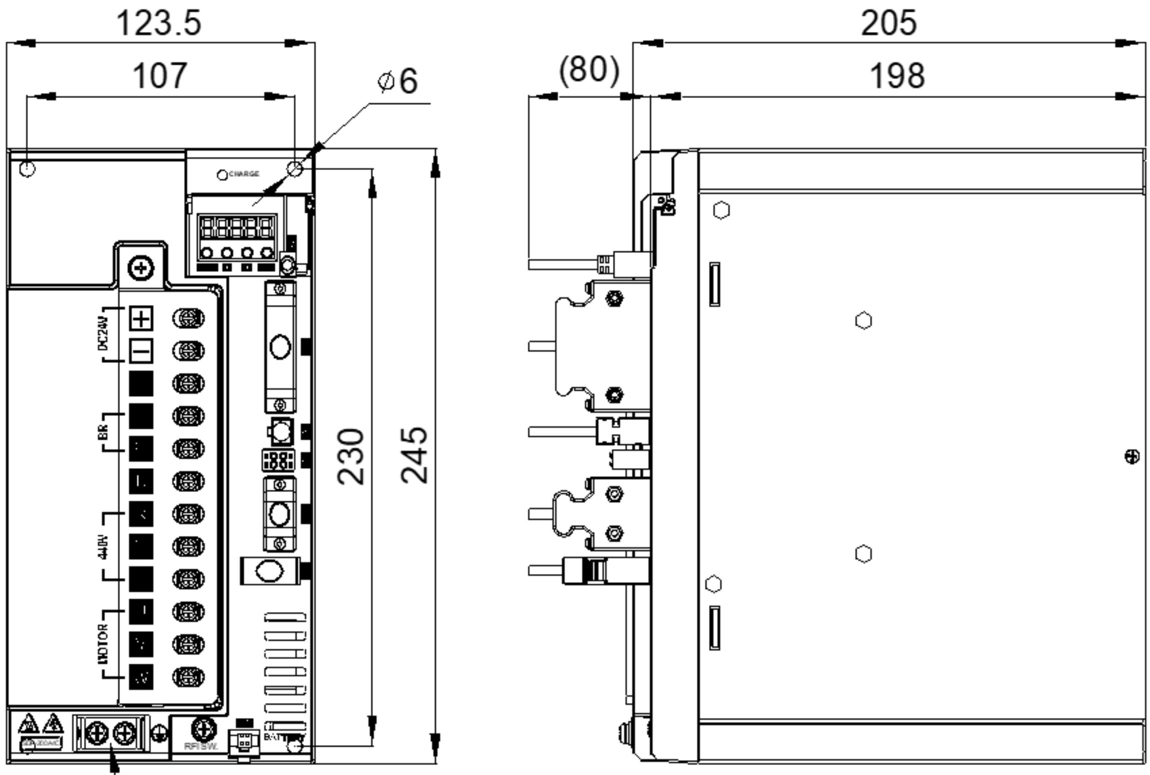


★ Dimensions of the servo drive may be updated without prior notice.

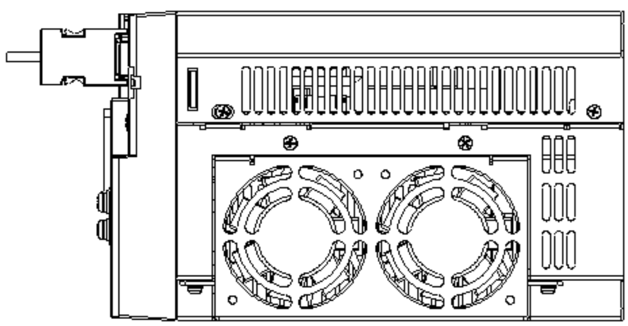
400VAC system

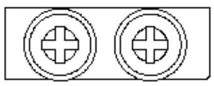
SDP-200A4C, SDP-300A4C, SDP-500A4C, SDP-700A4C(2KW~7KW)

Unit[mm]



Ground terminal





screw ： M4x0.7

screw torque ： 14（kgf-cm）

★ Dimensions of the servo drive may be updated without prior notice.

11.4 SME series servo motor general specification

11.4.1 Standard specification of low capacity servo motor

Motor type□□□□		--	L005	L010	L020	L040	L075
Flange number		mm	□40		□60		□80
Rated output capacity		W	50	100	200	400	750
Rated torque**(Note 1)**		Nm	0.16	0.32	0.64	1.27	2.4
Maximum torque		Nm	0.48	0.96	1.92	3.81	7.2
Rated speed		rpm	3000				
Maximum speed		rpm	6000				
Rated current		A	0.85	0.85	1.7	2.8	5.8
Maximum current		A	2.7	2.7	5.2	9.0	18.5
Rotor inertia *J* ($x10^{-4}$) **(Note 2)**		kg-m^2	0.0295 (0.0299)	0.0518 (0.0523)	0.161 (0.178)	0.277 (0.294)	1.07 (1.11)
Power at continuous rated torque		kw/s	8.6	19.6	25.2	58.5	53.3
Mounting aluminum plate size		mm	250 x 250 x 6				
Insulation class		--	CE(B) & UL(A)				
Insulation impedance		--	100MΩ @ DC500V				
Insulation strength		--	60sec @ AC1500V				
Encoder resolution		--	Single turn resolution24bit (16,777,216 Pulse); Multi-tun16bit (65,536 Turn)				
Motor structure**(Note 3)**		--	Full-closed and Air convection cooling(IP rating IP65)				
Vibration grade		--	V-15				
Operation environment	Temperature	--	0℃～40℃(Non- freezing) / Storage: -15℃～70℃(Non- freezing)				
	Humidity	--	Below 80%RH (Non-condensing) / Storage: below 90%RH (Non-condensing)				
	Altitude	--	Altitude below 1000m				
	Environment restrictions	--	Indoors (avoid direct sunlight), no corrosive vapor , avoid flammable gases, fumes and dust.				
	Vibration resistant	--	5G				
Axial allowable load**(Note 5)**	Fd	mm	20		25		35
	Radial loading Fr	N	68.6		245		392
	Axial loading Fa	N	39.2		98		147

Motor type□□□□		--	L005	L010	L020	L040	L075
Brake specification **(Note4)**	Input voltage	V	DC: 26.4V~ 21.6V				
	Brake holding torque	Nm	0.3		1.3		2.4
	Power consumption	W	6.3		7.9		8.6
	Current consumption	A	0.24		0.32		0.35
	impedance @20℃	Ω	92.4		75.4		67
	Brake release time	ms	20		30		50
	Brake close time	ms	20		20		20
Motor weight(Note 2)		Kg	0.33 (0.55)	0.45 (0.67)	0.85 (1.23)	1.23 (1.59)	2.24 (2.87)

Note 1: in the vertical lift or reciprocating mechanism application, please make sure the average load rate is below 75%. (refer to section 12.1 for S-T curve)

Note 2: () is the rotor inertia and weight with electromagnetic brake.

Note 3: the motor IP65 protection test is for the motor body, excluding the output shaft and the connector itself.

Note 4: the electromagnetic brake is used for holding when the mechanism stops, and it cannot be used for braking during operation.

Note 5: refer to note 5 in Section 11.4.3.

11.4.2 Standard specification of medium capacity servo motor

<table>
<tr><th colspan="2">Motor type□□□□</th><th>--</th><th>L100</th><th>L150</th><th>L200</th><th>L300</th><th>M100</th><th>M150</th><th>M200</th><th>M300</th></tr>
<tr><td colspan="2">Flange number</td><td>mm</td><td colspan="6">□130</td><td colspan="2">□176</td></tr>
<tr><td colspan="2">Rated output capacity</td><td>W</td><td>1000</td><td>1500</td><td>2000</td><td>3000</td><td>1000</td><td>1500</td><td>2000</td><td>3000</td></tr>
<tr><td colspan="2">Rated torque(Note 1)</td><td>Nm</td><td>4.78</td><td>7.16</td><td>9.55</td><td>14.3</td><td>4.78</td><td>7.16</td><td>9.55</td><td>14.3</td></tr>
<tr><td colspan="2">Maximum torque</td><td>Nm</td><td>14.4</td><td>21.6</td><td>28.5</td><td>43.0</td><td>14.4</td><td>21.6</td><td>28.5</td><td>43.0</td></tr>
<tr><td colspan="2">Rated speed</td><td>rpm</td><td colspan="8">2000</td></tr>
<tr><td colspan="2">Maximum speed</td><td>rpm</td><td colspan="8">3500</td></tr>
<tr><td colspan="2">Rated current</td><td>A</td><td>5.8</td><td>8.5</td><td>11</td><td>16</td><td>5.8</td><td>8.5</td><td>11</td><td>16</td></tr>
<tr><td colspan="2">Maximum current</td><td>A</td><td>17.4</td><td>25.5</td><td>33</td><td>48</td><td>17.4</td><td>25.5</td><td>34.7</td><td>48</td></tr>
<tr><td colspan="2">Rotor inertia J ($\times 10^{-4}$) (Note 2)</td><td>kg-m^2</td><td>6.1
(8.0)</td><td>8.8
(10.7)</td><td>11.5
(13.5)</td><td>16.7
(18.7)</td><td>10.3
(12.2)</td><td>15.0
(17.0)</td><td>32.1
(42.4)</td><td>61.2
(71.6)</td></tr>
<tr><td colspan="2">Power at continuous rated torque</td><td>kw/s</td><td>37.6</td><td>58.3</td><td>79.3</td><td>122.9</td><td>22.1</td><td>34.2</td><td>28.4</td><td>33.5</td></tr>
<tr><td colspan="2">Mounting aluminum plate size</td><td>mm</td><td colspan="6">300 x 300 x 12</td><td colspan="2">400 x 400 x 20</td></tr>
<tr><td colspan="2">Insulation class</td><td>--</td><td colspan="8">CE(F) / CE(B) & UL(A) (the product only CE certified can be used, please refer to section 1.3.1 for detail.)</td></tr>
<tr><td colspan="2">Insulation impedance</td><td>--</td><td colspan="8">100MΩ @ DC500V</td></tr>
<tr><td colspan="2">Insulation strength</td><td>--</td><td colspan="8">60sec @ AC1500V</td></tr>
<tr><td colspan="2">Encoder resolution</td><td>--</td><td colspan="8">Single turn resolution 23bit (8,388,608 Pulse)；Multi-turn resolution16bit (65,536 Turn)</td></tr>
<tr><td colspan="2">Motor structure(Note 3)</td><td>--</td><td colspan="8">Full-closed and Air convection cooling(IP rating IP65)</td></tr>
<tr><td colspan="2">Vibration grade</td><td>--</td><td colspan="8">V-15</td></tr>
<tr><td rowspan="5">Operation environment</td><td>Temperature</td><td>--</td><td colspan="8">0℃～40℃(Non- freezing) / Storage: -15℃～70℃(Non- freezing)</td></tr>
<tr><td>Humidity</td><td>--</td><td colspan="8">Below 80%RH(Non-condensing)
/Storage: Below 90%RH(Non-condensing)</td></tr>
<tr><td>Altitude</td><td>--</td><td colspan="8">Below 1,000m above sea level</td></tr>
<tr><td>Environment restrictions</td><td>--</td><td colspan="8">Indoors (avoid direct sunlight), no corrosive vapor,
avoid flammable gases, fumes and dust.</td></tr>
<tr><td>Vibration resistant</td><td>--</td><td colspan="8">2.5G</td></tr>
</table>

Motor type□□□□		--	L100	L150	L200	L300	M100	M150	M200	M300
Axial allowable load **(Note 5)**	Fd	mm	50						70	
	Radial loading Fr	N	490						980	
	Axial loading Fa	N	196						392	
Brake specification **(Note4)**	Input voltage	V	DC 24V ± 10%							
	Brake holding torque	Nm	16						45	
	Power consumption	W	23						34	
	Current consumption	A	0.95						1.41	
	Impedance @20℃	Ω	25						17	
	Brake release time	ms	95						110	
	Brake close time	ms	85						30	
Motor weight(Note 2)		Kg	5.2/5.6 (7.0/7.4)	6.5/6.9 (8.3/8.7)	7.7/8.1 (9.5/9.9)	10.2/10.6 (12.0/12.4)	5.6/5.8 (7.4/7.6)	6.9/7.2 (8.7/9.0)	10.5/11.0 (15.8/16.3)	15.3/15.8 (20.6/21.1)

Note 1: in the vertical lift or reciprocating mechanism application, please make sure the average load rate is below 75%. (refer to section 12.1 for S-T curve)

Note 2: () is the rotor inertia and weight with electromagnetic brake.

Note 3: the motor IP65 protection test is for the motor body, excluding the output shaft and the connector itself.

Note 4: the electromagnetic brake is used for holding when the mechanism stops, and it cannot be used for braking during operation.

Note 5: refer to note 5 in Section 11.4.3.

11.4.3 High inertia motor specification

Motor type□□□□		--	H020	H040	H075	H085	H130	H180
Flange number		mm	□60		□80	□130		
Rated output capacity		W	200	400	750	850	1300	1800
Rated torque**(Note 1)**		Nm	0.64	1.27	2.4	5.4	8.3	11.5
Maximum torque		Nm	2.24	4.45	8.4	13.8	23.2	28.7
Rated speed		rpm	3000			1500		
Maximum speed		rpm	6000			3500		
Rated current		A	1.7	3.0	5.8	7.2	13.2	17.6
Maximum current		A	5.95	10.5	20.3	20.1	40.3	48.3
Rotor inertia *J* ($x10^{-4}$) **(Note 2)**		kg-m^2	0.354 (0.371)	0.619 (0.636)	1.655 (1.713)	13.01 (14.91)	19.82 (21.72)	26.42 (28.32)
Power at continuous rated torque		kw/s	11.58	26.15	34.33	22.51	34.56	49.7
Mounting aluminum plate size		mm	250 x 250 x 6			300 x 300 x 12		
Insulation class		--	CE(B)			CE(F)		
Insulation impedance		--	100MΩ @ DC500V					
Insulation strength		--	60sec @ AC1500V					
Encoder resolution		--	Single turn resolution 24bit (16,777,216 Pulse); Multi-turn 16bit (65,536 Turn)			Single turn resolution 23bit (8,388,608 Pulse); Multi-turn 16bit (65,536 Turn)		
Motor structure**(Note 3)**		--	Full-closed and Air convection cooling(IP rating IP65)					
Vibration grade		--	V-15					
Operation environment	Temperature	--	0 °C to 40 °C/ storage: -15 °C to 70 °C, non-freezing					
	Humidity	--	80 %RH maximum / storage: 90 %RH maximum, non-condensing					
	Altitude	--	Altitude below 1000m					
	Environment restrictions	--	Indoors (avoid direct sunlight), no corrosive vapor , avoid flammable gases, fumes and dust.					
	Vibration resistant	--	5G			2.5G		

Motor type□□□□		--	H020	H040	H075	H085	H130	H180
Axial allowable load(**Note 5**)	Fd	mm	25		35	50		
	Radial loading Fr	N	245		392	490		
	Axial loading Fa	N	98		147	196		
Brake specification (**Note4**)	Input voltage	V	DC 24V ± 10%					
	Brake holding torque	Nm	1.3		2.5	16		
	Power consumption	W	7.9		8.0	23		
	Current consumption	A	0.32		0.33	0.95		
	impedance @20℃	Ω	75.4		72.0	25		
	Brake release time	ms	30		60	95		
	Brake close time	ms	20		20	85		
Motor weight(Note 2)		Kg	0.86 (1.23)	1.25 (1.63)	2.27 (3.10)	5.1 (6.9)	6.6 (8.4)	7.8 (9.6)

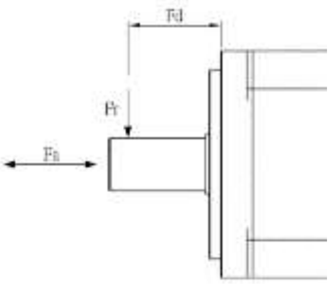
Note 1: in the vertical lift or reciprocating mechanism application, please make sure the average load rate is below 75%. (refer to section 12.1 for S-T curve)

Note 2: () is the rotor inertia and weight with electromagnetic brake.

Note 3: the motor IP65 protection test is for the motor body, excluding the output shaft and the connector itself.

Note 4: the electromagnetic brake is used for holding when the mechanism stops, and it cannot be used for braking during operation.

Note 5: the diagram for the shaft permissible load is as follows.



11.4.4 (400V)High inertia motor specification

Motor series			SMP				
Motor type□□□□		--	H180	H290	H440	H550	H750
Flange number		mm	□130	□180			
Rated output capacity		W	1800	2900	4400	5500	7500
Rated torque**(Note 1)**		Nm	11.5	18.6	28.4	35	48
Maximum torque		Nm	28.7	45.1	71.1	87.6	119
Rated speed		rpm	1500				
Maximum speed		rpm	3000				
Rated current		A	8.4	11.9	16.5	20.8	27.2
Maximum current		A	20	28	40.5	52	69
Rotor inertia *J* ($x10^{-4}$) **(Note 2)**		kg-m^2	26.1 (28.1)	46 (54.5)	67.5 (75.4)	89 (97.5)	125 (134)
Insulation class		--	CE(F)				
Insulation impedance		--	100MΩ @ DC500V				
Insulation strength		--	60sec @ AC1500V				
Encoder resolution		--	Single turn resolution23bit (8,388,608 Pulse)； Multi-turn resolution16bit (65,536 Turn)				
Motor structure**(Note 3)**		--	Full-closed and Air convection cooling(IP rating IP65)				
Axial allowable load**(Note 5)**	Fd	mm	55	79		113	
	Radial loading Fr	N	880	1270		1556	
	Axial loading Fa	N	320	395		472	
Brake specification **(Note4)**	Input voltage	V	DC 24V				
	Brake holding torque	Nm	≧19.6	≧44		≧74	
	Power consumption	W	19.5	18.3		25	
	Operating voltage	@20℃	≦DC16.8V	≦DC19.2V		≦DC19.2V	
	Release voltage	@20℃	≧DC1.5V	≧DC0.5V		≧DC1V	
Motor weight**(Note 2)**		Kg	8.8 (10.76)	13 (19.5)	17.5 (24)	22 (27.8)	29.5 (35)

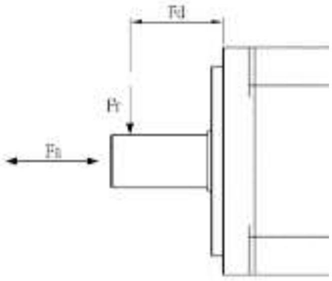
Note 1: in the vertical lift or reciprocating mechanism application, please make sure the average load rate is below 75%. (refer to section 12.1 for S-T curve)

Note 2: () is the rotor inertia and weight with electromagnetic brake.

Note 3: the motor IP65 protection test is for the motor body, excluding the output shaft and the connector itself.

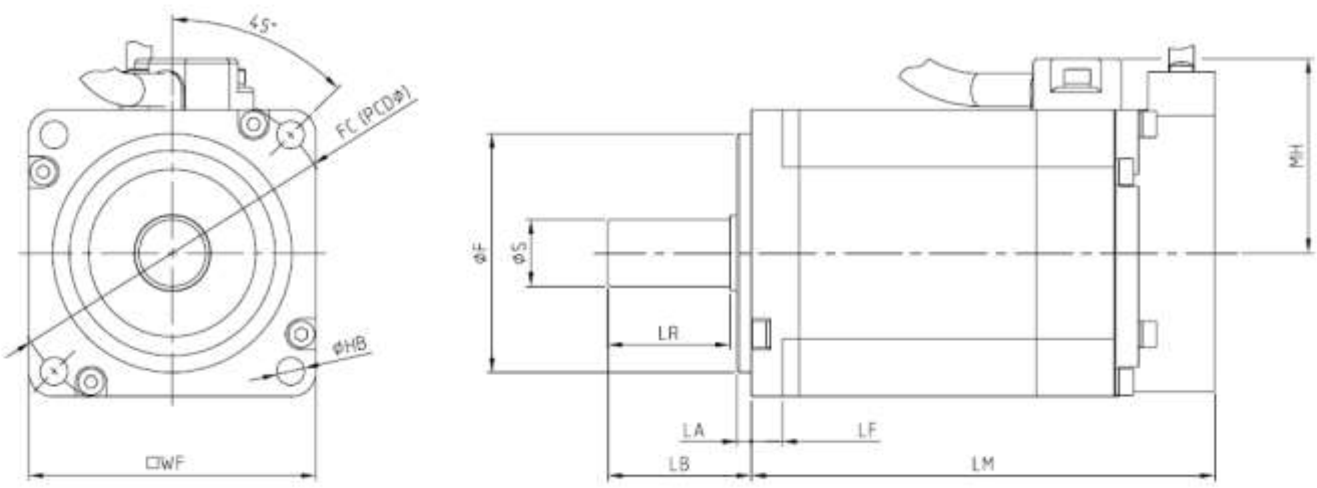
Note 4: the electromagnetic brake is used for holding when the mechanism stops, and it cannot be used for braking during operation.

Note 5: the diagram for the shaft permissible load is as follows.



11.5 Motor dimensions

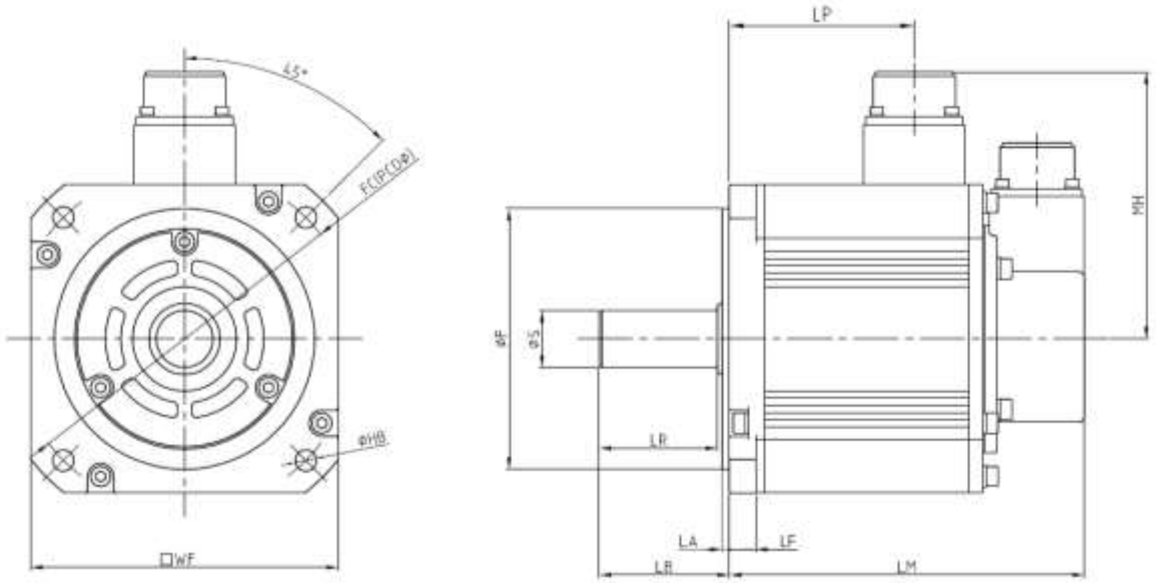
11.5.1 Dimensions of 300rpm motor.



<table>
<tr><th rowspan="2">Model</th><th colspan="11">Dimension(mm)</th></tr>
<tr><th>WF</th><th>ψS</th><th>ψF</th><th>LA</th><th>LB</th><th>LF</th><th>LR</th><th>MH</th><th>LM</th><th>FC</th><th>HB</th></tr>
<tr><td>SME-L005(B)</td><td rowspan="2">40</td><td rowspan="2">$\varphi 8\ ^{0}_{-0.009}$</td><td rowspan="2">$\varphi 30\ ^{0}_{-0.03}$</td><td rowspan="2">2.5</td><td rowspan="2">25</td><td rowspan="2">5.5</td><td rowspan="2">21</td><td rowspan="2">32</td><td>64.5
(99.2)</td><td rowspan="2">46</td><td rowspan="2">2-ψ4.5</td></tr>
<tr><td>SME-L010(B)</td><td>80
(114.7)</td></tr>
<tr><td>SME-L020(B)
SME-H020(B)</td><td rowspan="2">60</td><td rowspan="2">$\varphi 14\ ^{0}_{-0.011}$</td><td rowspan="2">$\varphi 50\ ^{0}_{0.03}$</td><td rowspan="2">3</td><td rowspan="2">30</td><td rowspan="2">6.5</td><td rowspan="2">25</td><td rowspan="2">42</td><td>77
(112)</td><td rowspan="2">70</td><td rowspan="2">4-ψ5.8</td></tr>
<tr><td>SME-L040(B)
SME-H040(B)</td><td>97
(132)</td></tr>
<tr><td>SME-L075(B)</td><td rowspan="2">80</td><td rowspan="2">$\varphi 19\ ^{0}_{-0.013}$</td><td rowspan="2">$\varphi 70\ ^{0}_{-0.03}$</td><td rowspan="2">3</td><td rowspan="2">40</td><td rowspan="2">7.5</td><td rowspan="2">34.5</td><td rowspan="2">52</td><td>101.2
(140.2)</td><td rowspan="2">90</td><td rowspan="2">4-ψ6.6</td></tr>
<tr><td>SME-H075(B)</td><td>101.2
(145.5)</td></tr>
</table>

LM ( ): length of model with brake

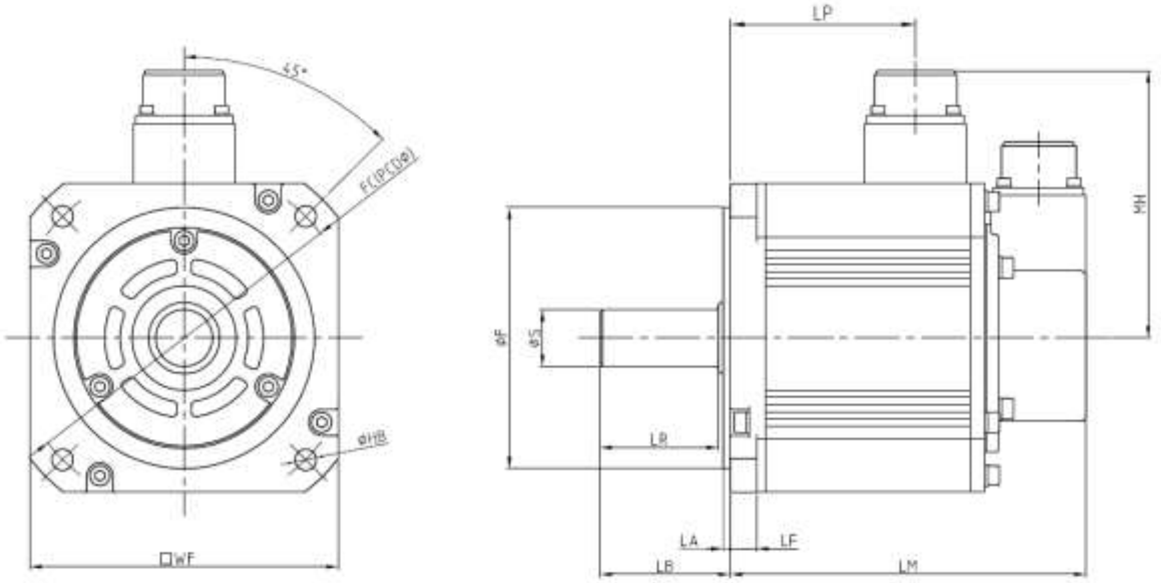
11.5.2 Dimensions of 2000rpm motor



<table>
<tr><th rowspan="2">Model</th><th colspan="12">Dimension(mm)</th></tr>
<tr><th>WF</th><th>ψS</th><th>ψF</th><th>LA</th><th>LB</th><th>LF</th><th>LR</th><th>LP</th><th>MH</th><th>LM</th><th>FC</th><th>HB</th></tr>
<tr><td>SME-L100</td><td rowspan="6">130</td><td rowspan="6">$\varphi 24^{\ 0}_{-0.013}$</td><td rowspan="6">$\varphi 110^{\ 0}_{-0.035}$</td><td rowspan="6">3</td><td rowspan="6">55</td><td rowspan="6">11</td><td rowspan="6">50</td><td>55.5</td><td rowspan="6">113</td><td>127
(161)</td><td rowspan="6">145</td><td rowspan="6">4-ψ9.0</td></tr>
<tr><td>SME-L150</td><td>70</td><td>141.5
(175.5)</td></tr>
<tr><td>SME-L200</td><td>84.5</td><td>156
(190)</td></tr>
<tr><td>SME-L300</td><td>113.5</td><td>185
(219)</td></tr>
<tr><td>SME-M100</td><td>55.5</td><td>127
(161)</td></tr>
<tr><td>SME-M150</td><td>70</td><td>141.5
(175.5)</td></tr>
<tr><td>SME-M200</td><td rowspan="2">176</td><td rowspan="2">$\varphi 35^{\ 0}_{-0.016}$</td><td rowspan="2">$\varphi 114.3^{\ 0}_{\ 0.025}$</td><td rowspan="2">3</td><td rowspan="2">78</td><td rowspan="2">18.5</td><td rowspan="2">74</td><td>61.5</td><td rowspan="2">139</td><td>139
(189)</td><td rowspan="2">200</td><td rowspan="2">4-ψ13.5</td></tr>
<tr><td>SME-M300</td><td>91.5</td><td>169
(219)</td></tr>
</table>

LM ( ): length of model with brake

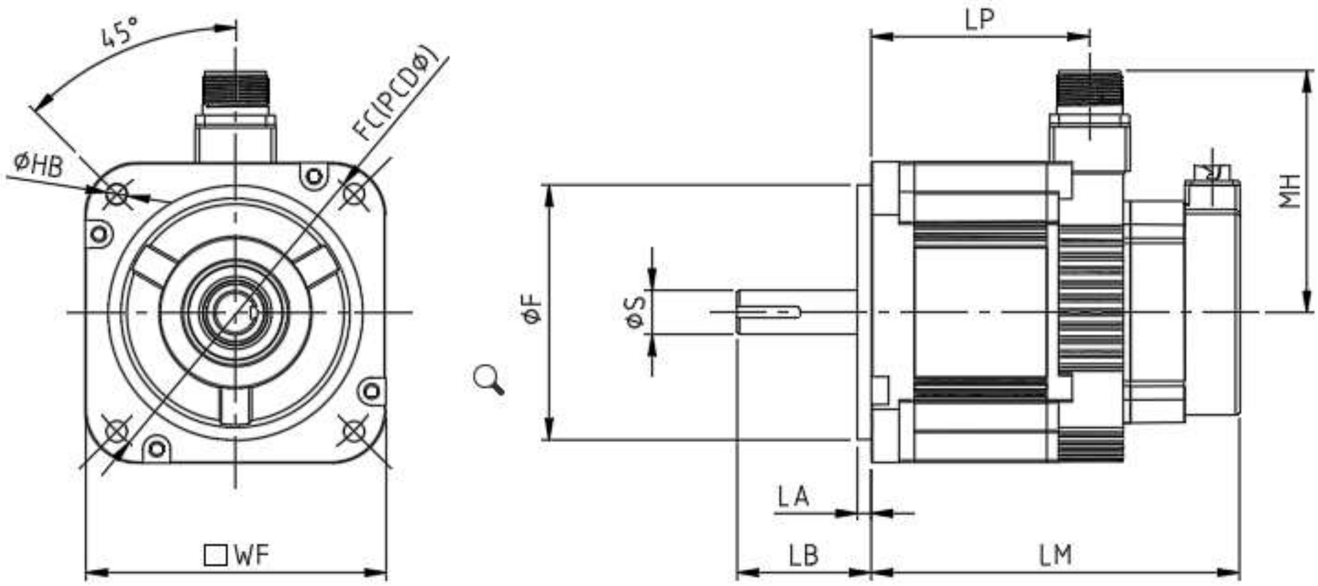
11.5.3 Dimensions of 1500rpm motor



Model	Dimension(mm)											
	WF	ψS	ψF	LA	LB	LF	LR	LP	MH	LM	FC	HB
SME-H085(B)	130	$\varphi 24\ ^{0}_{-0.013}$	$\varphi 110\ ^{0}_{-0.035}$	3	58	11	40	55.5	113	127 (161)	145	4-ψ9.0
SME-H130(B)								70		141.5 (175.5)		
SME-H180(B)								84.5		156 (190)		

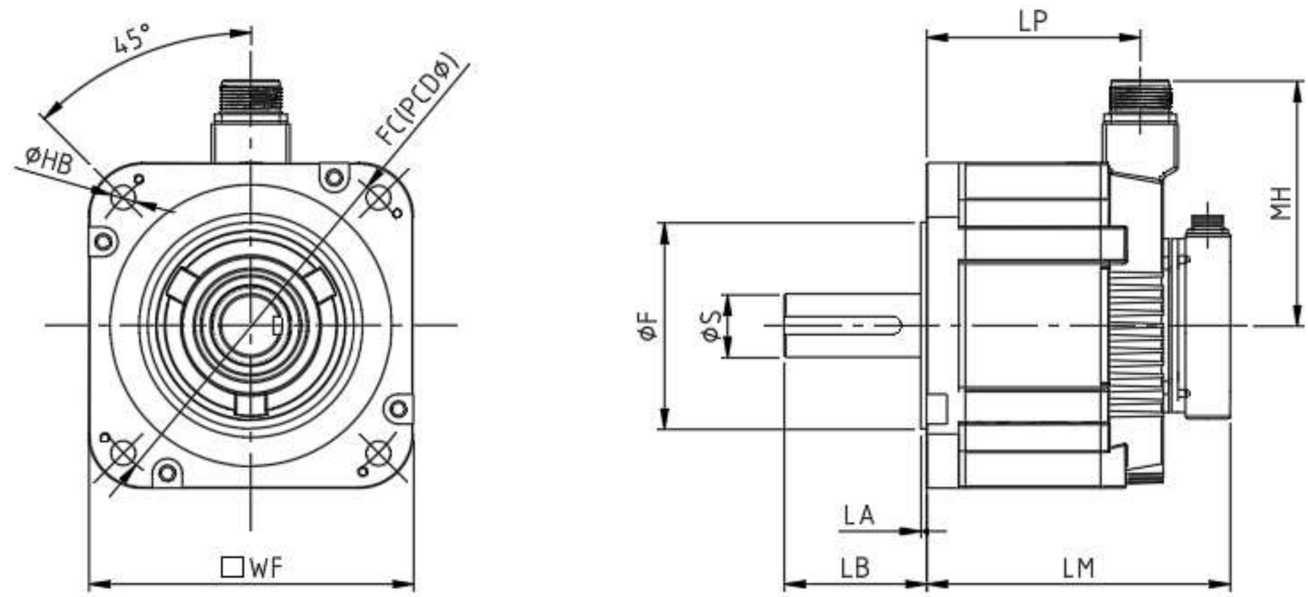
LM ( ): length of model with brake

11.5.4 (400V) dimensions of 1500rpm motor



Model	Dimension(mm)									
	WF	ψS	ψF	LA	LB	LM	FC	ψHB	LP	MH
SMP-H180(B)	130	$\Psi 24^{0}_{-0.013}$	$\Psi 110^{0}_{-0.022}$	6	55	184.9 (217.4)	145	4-ψ9.0	128.5	104.5

LM ( ): length of model with brake.

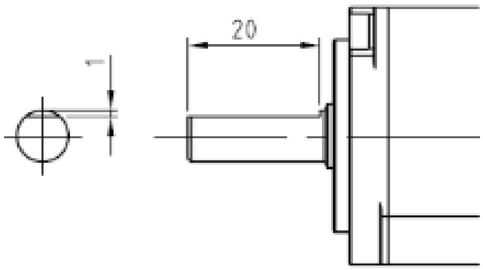


<table>
<tr><th rowspan="2">Model</th><th colspan="10">Dimension(mm)</th></tr>
<tr><th>WF</th><th>ψS</th><th>ψF</th><th>LA</th><th>LB</th><th>LM</th><th>FC</th><th>ψHB</th><th>LP</th><th>MH</th></tr>
<tr><td>SMP-H290(B)</td><td rowspan="4">180</td><td rowspan="2">ψ $35_{0}^{+0.01}$</td><td rowspan="4">ψ $114.3_{-0.025}^{0}$</td><td rowspan="4">3.2</td><td rowspan="2">79</td><td>173.3
(231)</td><td rowspan="4">200</td><td rowspan="4">4-ψ13.5</td><td>118.5</td><td rowspan="4">135.5</td></tr>
<tr><td>SMP-H440(B)</td><td>197.3
(255)</td><td>142.5</td></tr>
<tr><td>SMP-H550(B)</td><td rowspan="2">ψ $42_{-0.016}^{0}$</td><td rowspan="2">113</td><td>236.3
(278)</td><td>173.5
(172.5)</td></tr>
<tr><td>SMP-H750(B)</td><td>282.3
(324)</td><td>219.5
(218.5)</td></tr>
</table>

LM ( ): length of model with brake

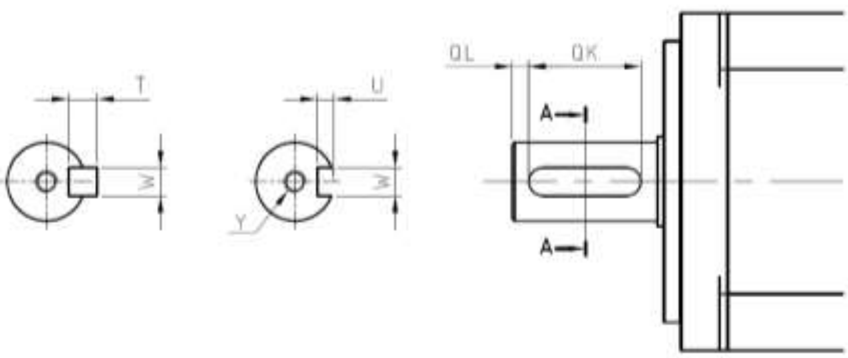
11.5.5 Dimension of servo motor keyway

D type keyway applicable model: L005(B) / L010(B)



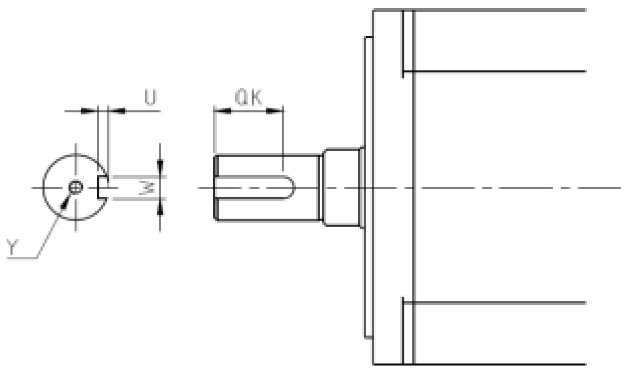
General keyway

Model	Dimension					
	QL	QK	W	T	U	Y
L020(B) \ L040(B) H020(B) \ H040(B)	3	20	$5^{0}_{-0.03}$	5	3	M4x depth 15
L075(B) H075(B)	5	25	$6^{0}_{-0.03}$	6	3.5	M5x depth 20
L100(B) \ L150(B) \ L200(B) \ L300(B) M100(B) \ M150(B)	5	35	$8^{0}_{-0.036}$	7	4	M8x depth 20
M200(B) \ M300(B)	5	55	$10^{0}_{-0.036}$	8	5	M8x depth 20



<table>
<tr><td rowspan="2">Model</td><td></td><td colspan="4">Dimension</td></tr>
<tr><td>QK</td><td>W</td><td>T</td><td>U</td><td>Y</td></tr>
<tr><td>H085(B) \ H130(B) \ H180(B)</td><td>25</td><td>$8^{\ 0}_{-0.036}$</td><td>7</td><td>4</td><td>M5x depth 12</td></tr>
</table>

<table>
<tr><td rowspan="2">Model</td><td colspan="5">Dimension</td></tr>
<tr><td>QK</td><td>W</td><td>T</td><td>U</td><td>Y</td></tr>
<tr><td>SMP-H180(B)</td><td>29</td><td>8</td><td>7</td><td>4</td><td>M6x depth 20</td></tr>
<tr><td>SMP-H290(B) \ H440(B)</td><td>65</td><td>10</td><td rowspan="2">8</td><td rowspan="2">5</td><td>M12x depth 25</td></tr>
<tr><td>SMP-H550(B) \ H750(B)</td><td>96</td><td>12</td><td>M16x depth 32</td></tr>
</table>



11.6 Electromagnetic Interference Filter (EMI Filter)

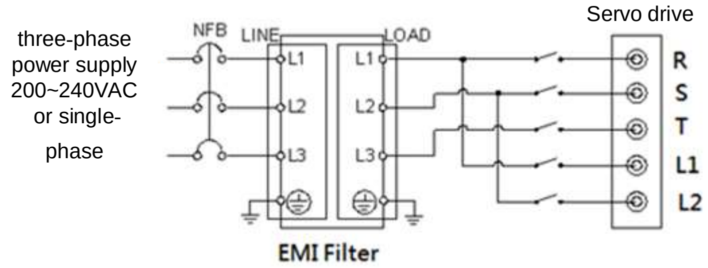
To comply with EMI command of EN specification, it is recommended to use the following filters:

Servo drive	Recommended filter
SDP－010A2C	NF312C5/05
SDP－020A2C	
SDP－040A2C	NF312C10/05
SDP－075A2C	NF312C20/05
SDP－100A2C	
SDP－150A2C	NF312C30/05
SDP－200A2C	
SDP－300A2C	
SDP－200A4C	NF312C20/05
SDP－300A4C	
SDP－500A4C	NF312C30/05
SDP－700A4C	

★ Filter is optional purchase item.

★ The use of the filter needs to consider the site conditions, check whether there is electromagnetic compatibility interference before installation.

The following schematic diagram describes the wiring of the servo drive with EMI filter to three-phase power:



★ If the power is single-phase, there will be no T terminal.

★ Ground the EMI Filter.

11.7 EMI interference countermeasure

The following figure shows the recommended wiring diagram of the servo drive on the distribution board:

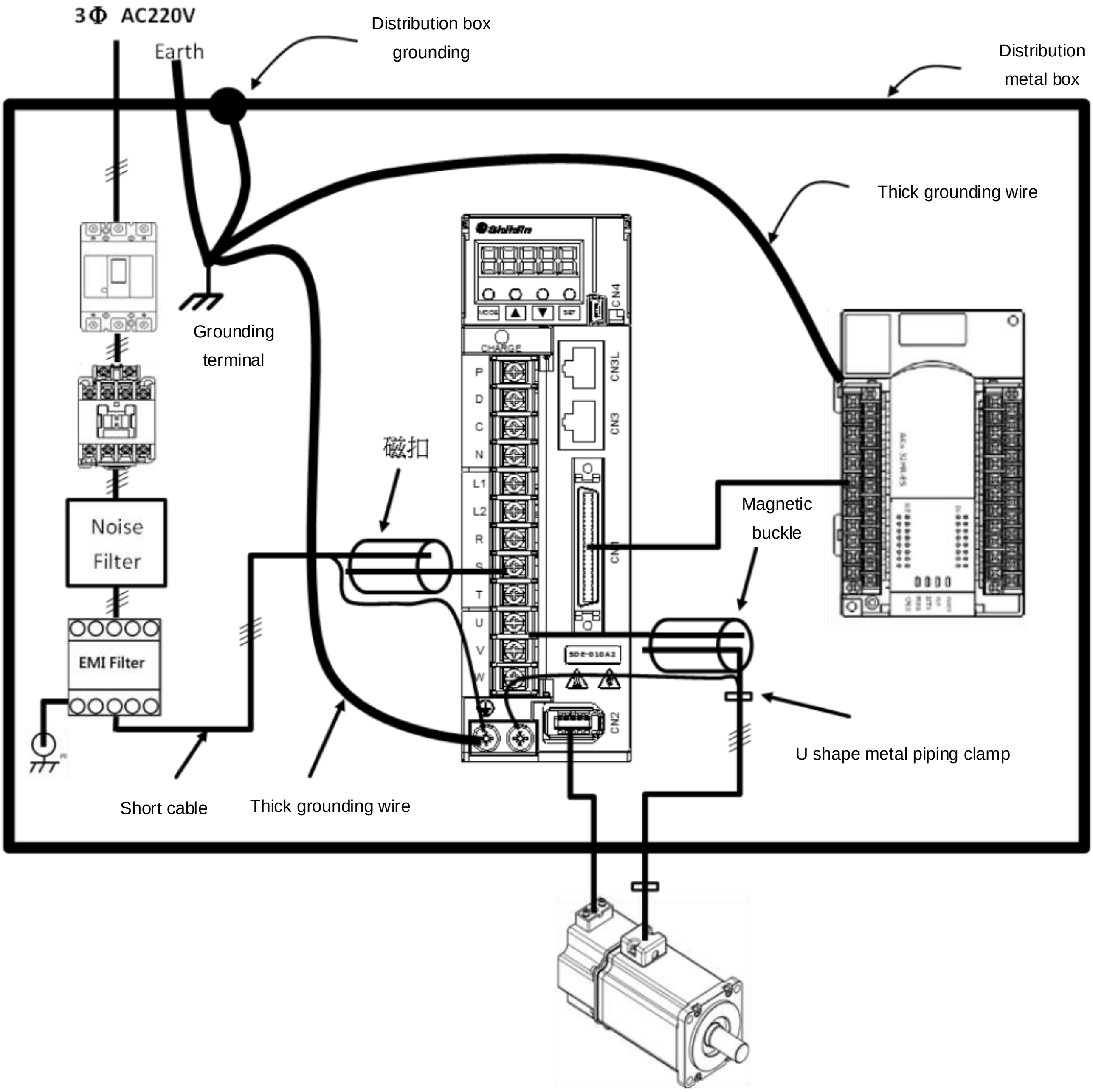


Figure 1: recommended wiring diagram

The selection of motor power cable and the installation of related accessories are the key to affect electromagnetic interference. To reduce the noise interference, the following items should be paid attention to when wiring on the distribution board.

1. The EMI filter and the servo drive should be installed on the same wiring metal panel, and the wiring should be as short as possible.
2. The servo drive and EMI filter installed on the wiring metal panel must be fixed tightly, and the two fixed metal panel contact surface should be in good contact (the isolation paint needs to be removed).
3. Use motor power cables with isolation nets, the one with double-layer isolation nets is preferred.
4. The isolation nets at both ends of the motor power cable should be grounded with the largest contact area (U-shaped metal pipe clamp).
5. The U-shaped metal piping clamp and the metal plate should be fastened with screws (the isolation paint needs to be removed) to ensure good contact, See the following figure 2.
6. The power distribution box and the door should have good conductivity, a thick ground wire or metal isolation net should be installed between the doors to avoid interference.
7. The magnetic buckle must be wound on the power cable (except the ground wire) with more than one circle and should wire as close as possible to the servo drive side to prevent common mode noise interference.
8. The power cable and I/O cable should be kept as far away as possible, and should not wiring in parallel direction.
9. When installing the metal part of the motor, use a thick ground cable or metal isolation net to connect the ground terminal.

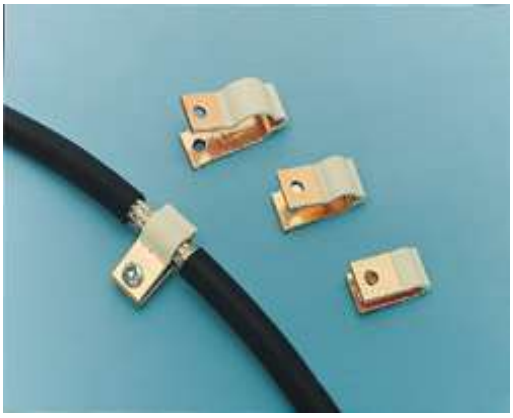


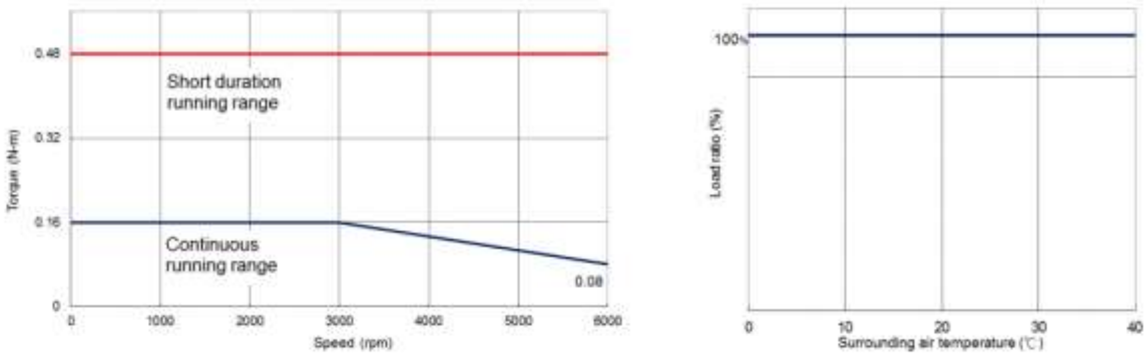
Figure 2: U-shaped metal pipe clamp

12. Features

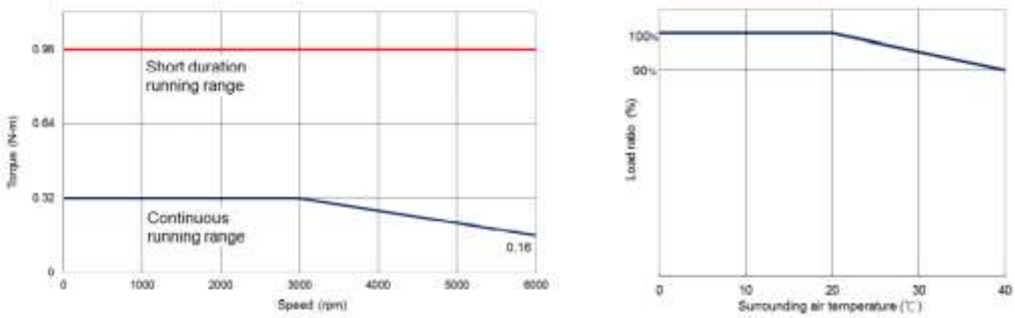
12.1 Motor T-N curve/S-T curve

- Motor performance with three-phase 200V power: torque feature will be weaker when voltage is insufficient.

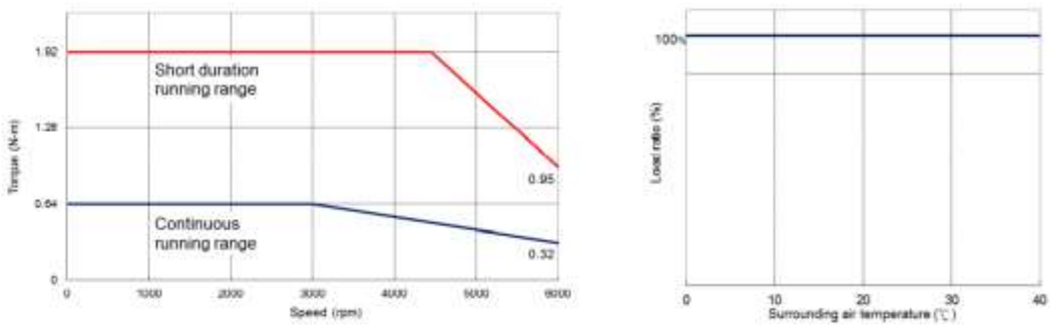
【SME-L005】



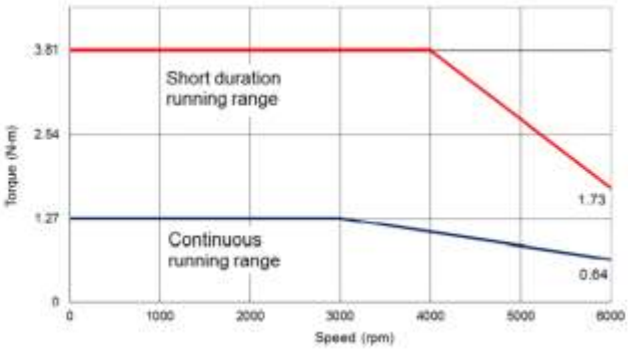
【SME-L010】

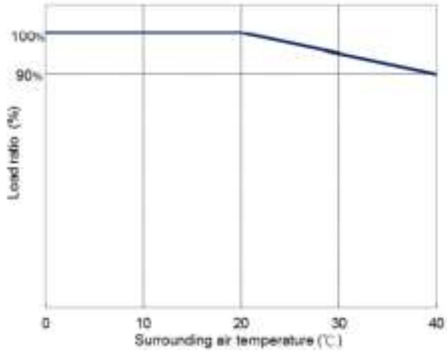


【SME-L020】

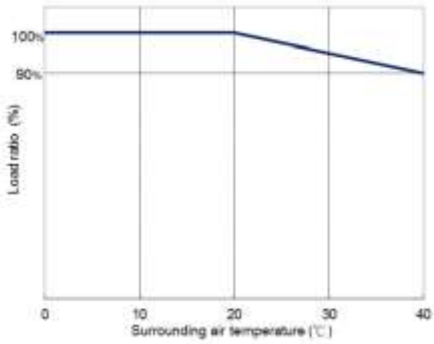


【SME-L040】

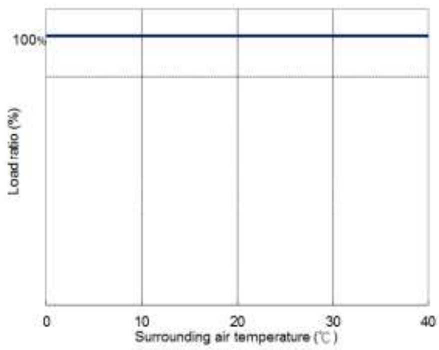




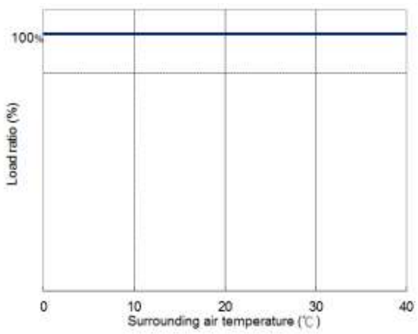
【SME-L075】



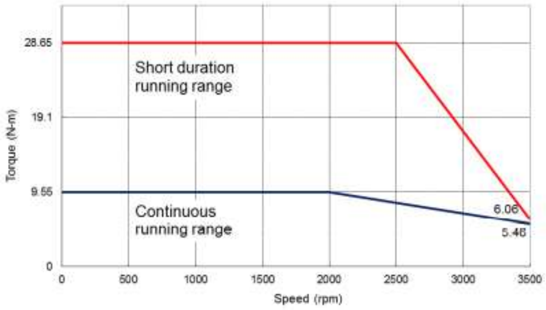
【SME-L100】

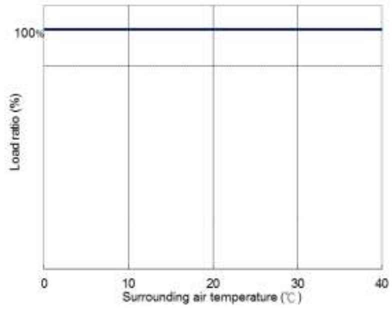


【SME-L150】

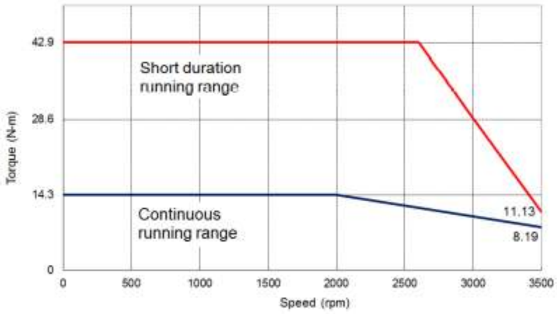


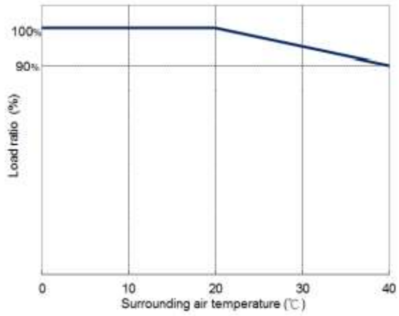
【SME-L200】



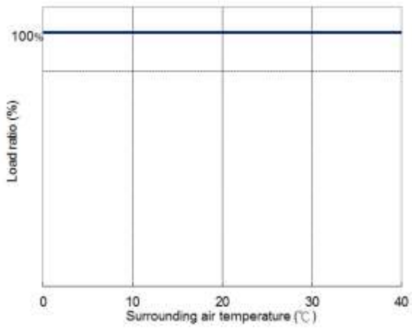


【SME-L300】

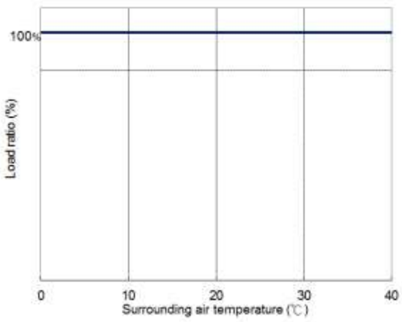




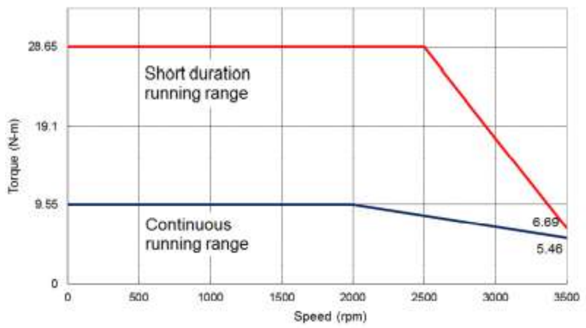
【SME-M100】

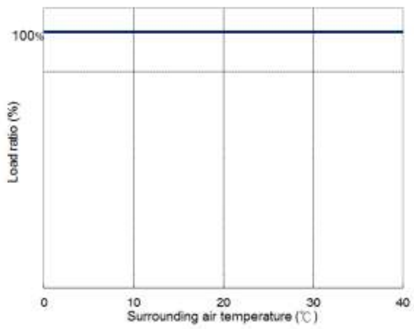


【SME-M150】

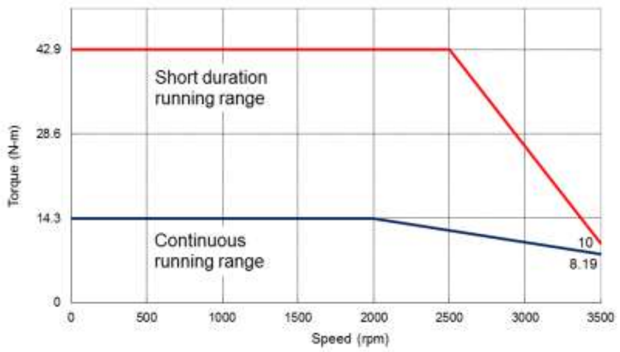


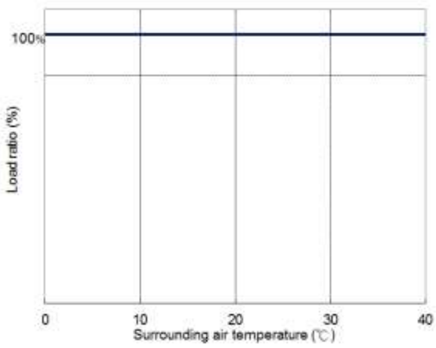
【SME-M200】



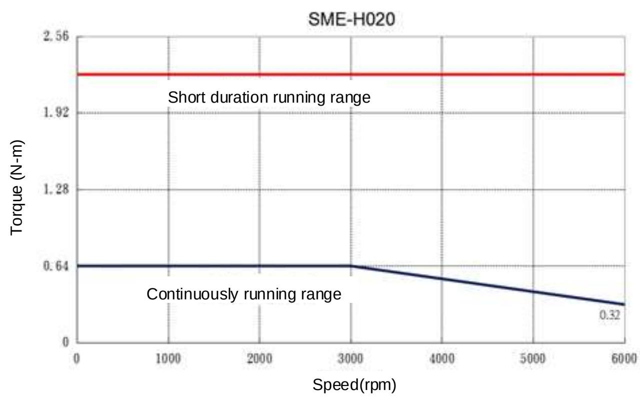


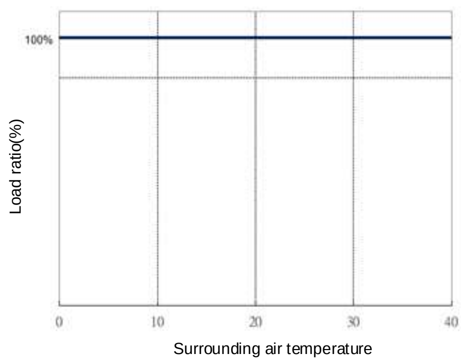
【SME-M300】



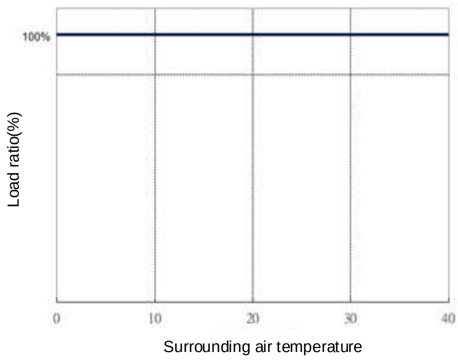


【SME-H020】

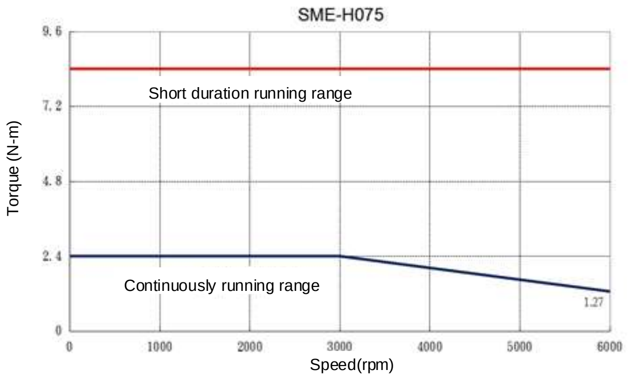


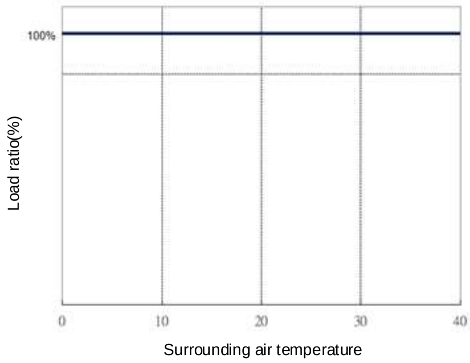


【SME-H040】

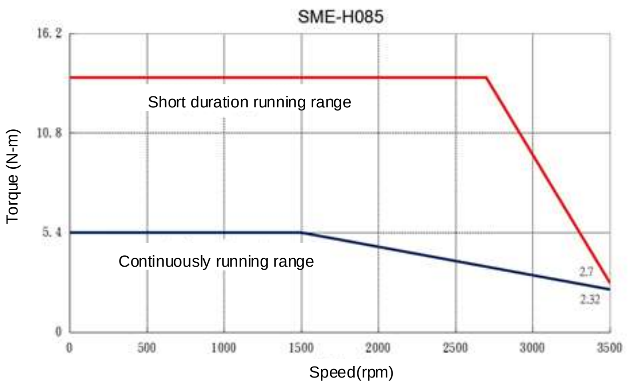


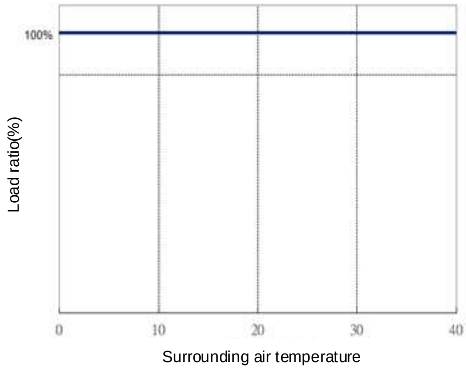
【SME-H075】



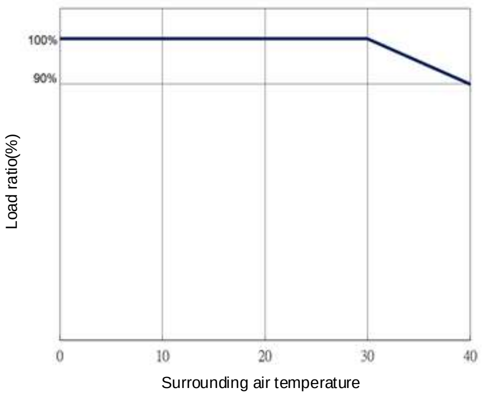


【SMP-H085】

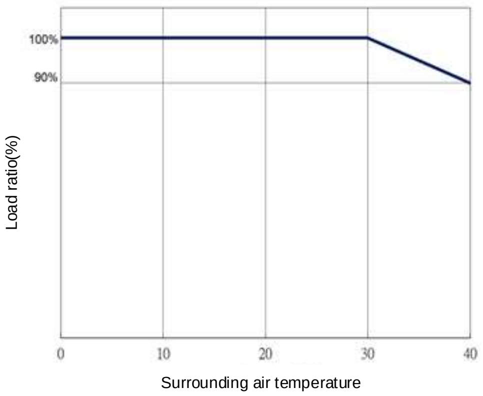




【SME-H130】



【SME-H180】



★ This feature is applicable to three-phase 200-240V power.

【SMP-H180】

【SMP-H290】

【SMP-H440】

【SMP-H550】

【SMP-H750】

★ This feature is applicable to three-phase 380~480V power.

12.2 Overload protection feature

Overload protection is to prevent the servo motor from operating under overload conditions.

The Causes of overload are as follows:

(1) The inertia ratio is too large.

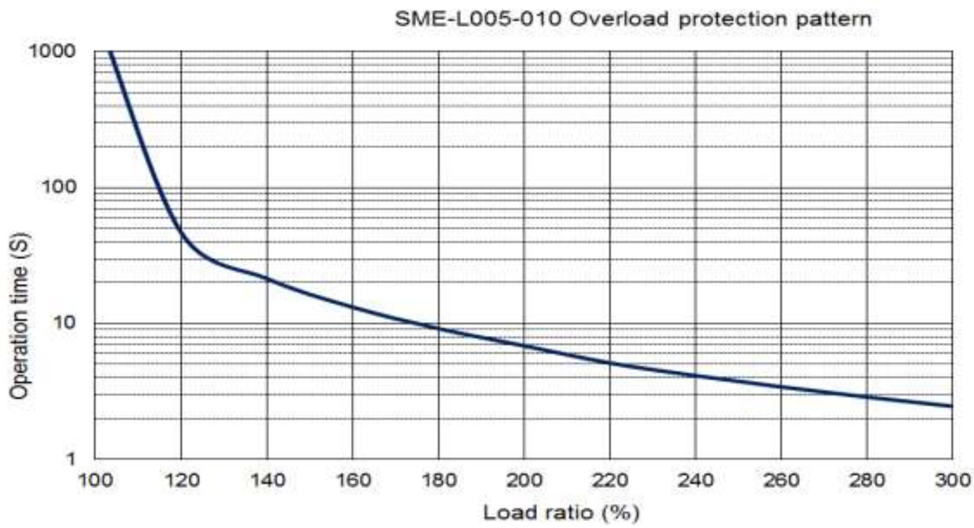
(2) Acceleration /deceleration time which cannot be reached theoretically is set when loaded.

(3) The motor operating torque exceeds the rated range and the operating time is too long.

(4) Large servo gain setting causes resonance in the motor and yet the motor keeps running.

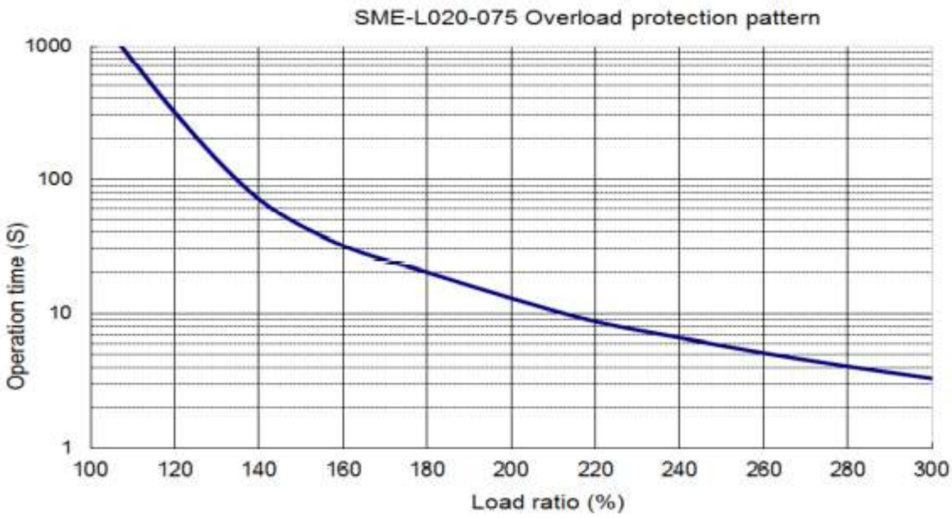
(5) Incorrect wiring of the power and encoder cables.

If the operating servo motor may exceed the rated torque during operation, you can refer to the chart of Load and Operating Time as follows:



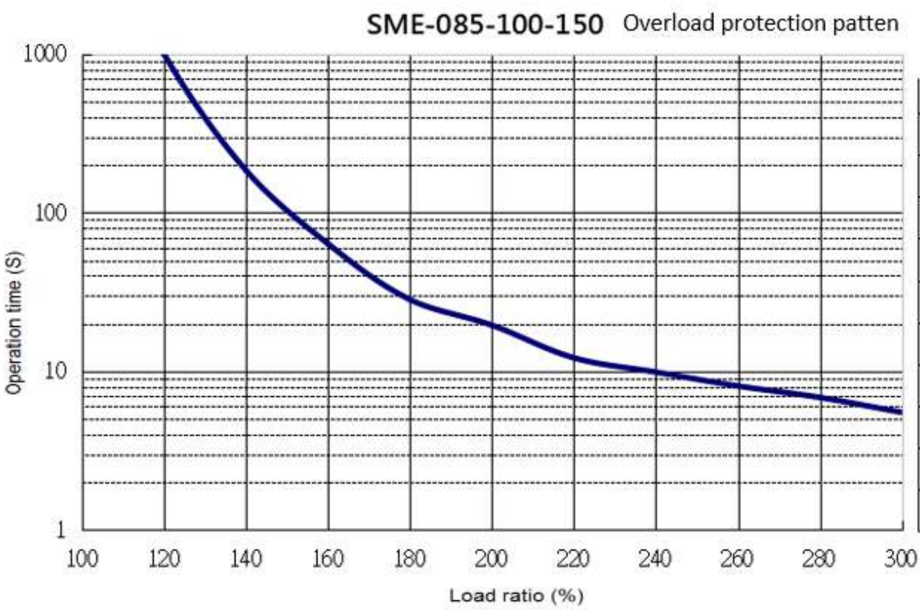
Load ratio (%)	Operation time (S)
100	2000.0
120	46.71
140	21.41
160	13.17
180	9.17
200	6.85
220	5.12
240	4.13
260	3.41
280	2.87
300	2.46

When the load reaches 300%, the operation time is 2.46 seconds.



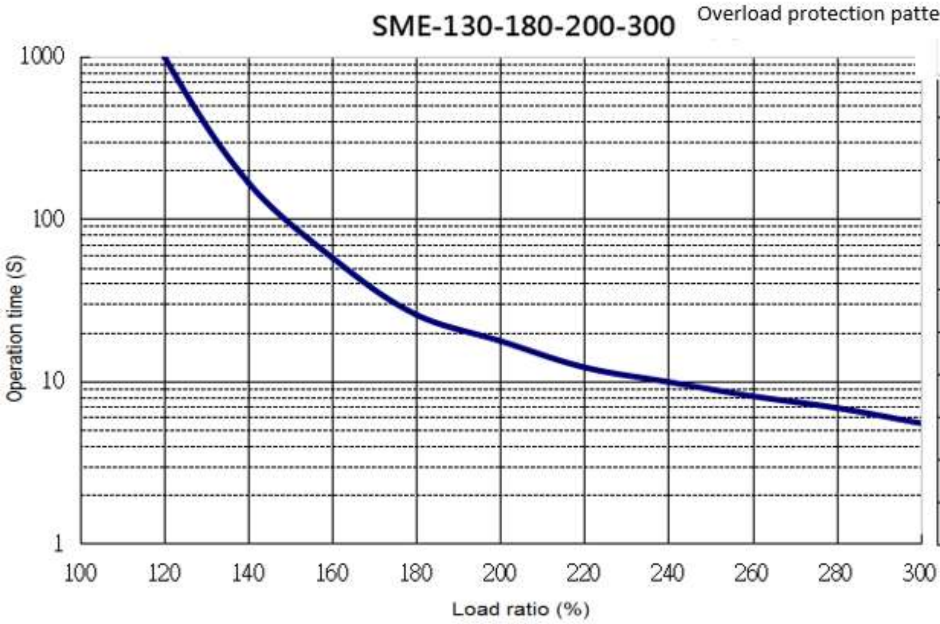
Load ratio (%)	Operation time (S)
100	2000.00
120	313.60
140	71.14
160	31.76
180	20.30
200	13.02
220	8.74
240	6.65
260	5.13
280	4.09
300	3.33

When the load reaches 300%, the operation time is 3.33 seconds.



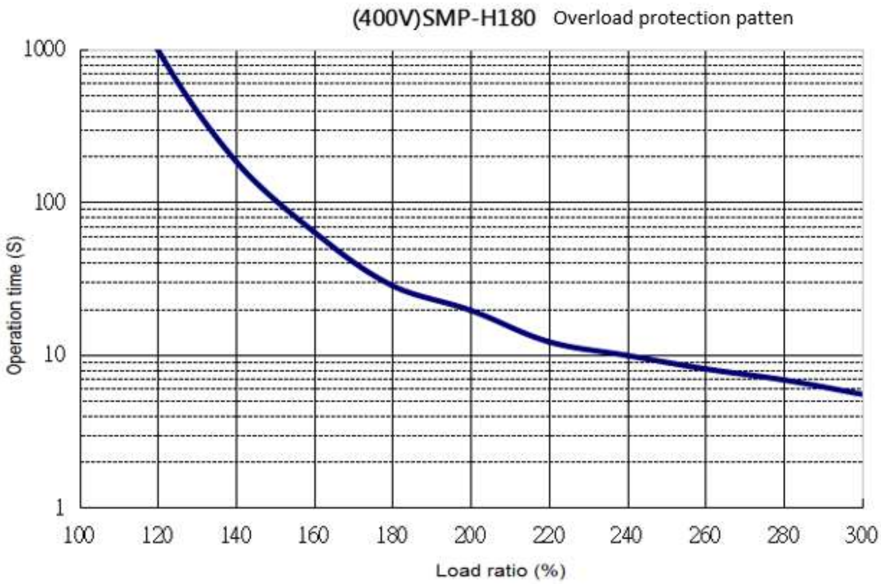
Load ratio (%)	Operation time (S)
100	10000.00
120	1000.00
140	185.15
160	63.70
180	28.35
200	19.53
220	12.16
240	9.88
260	8.08
280	6.84
300	5.51

When the load reaches 300%, the operation time is 5.51 seconds.



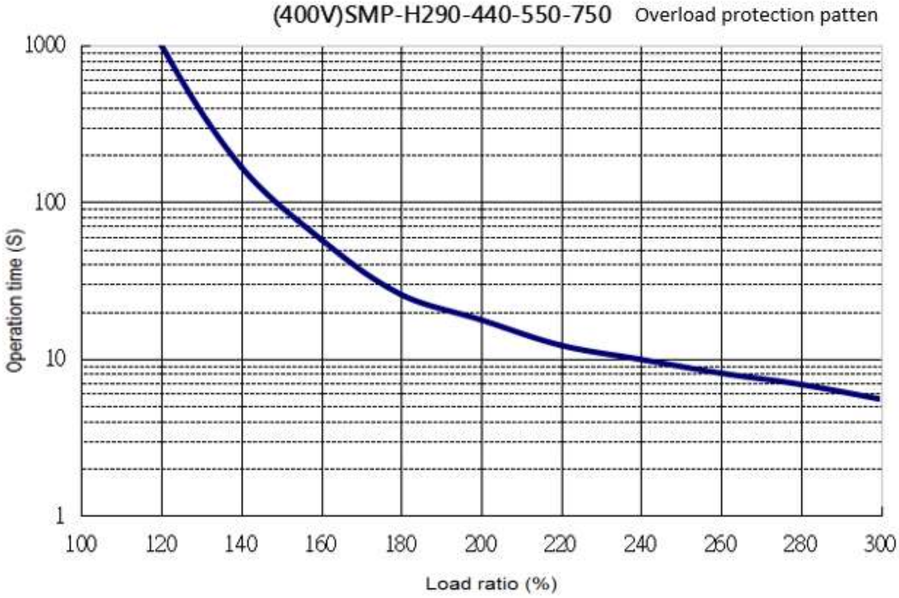
Load ratio (%)	Operation time (S)
100	10000.00
120	1000.00
140	167.52
160	57.63
180	25.65
200	17.67
220	12.16
240	9.88
260	8.08
280	6.84
300	5.51

When the load reaches 300%, the operation time is 5.51 seconds.



Load ratio (%)	Operation time (S)
100	10000.00
120	1000.00
140	185.15
160	63.70
180	28.35
200	19.53
220	12.16
240	9.88
260	8.08
280	6.84
300	5.51

When the load reaches 300%, the operation time is 5.51 seconds.



Load ratio (%)	Operation time (S)
100	10000.00
120	1000.00
140	167.52
160	57.63
180	25.65
200	17.67
220	12.16
240	9.88
260	8.08
280	6.84
300	5.51

When the load reaches 300%, the operation time is 5.51 seconds.

13.Absolute servo system

Absolute servo system includes servo drive, absolute servo motor and absolute encoder cable (including battery box). The absolute position detection system does not store the data in the PLC controller, it detects the absolute position of the machine and store the data by battery power. Therefore, as long as the origin is set during installation, operation can be easily resumed even if power outage or breakdown.

If the drive has enabled the relevant parameters of the absolute system, an absolute servo motor must be used. If using the incremental servo motor, an alarm AL.24 will occur.

The absolute motor model description is as follows:

SME-□○○○ΔΔM□□□

M: Absolute servo motor

Note	When [Absolute position lost] or [Absolute position overflows] occurs, the origin setting needs to be performed again.
	Please put the battery in the battery box before using it to prevent unexpected factors such as battery is short-circuited.
	When using an absolute servo motor, please make sure that the motor speed is lower than 50 rpm at the moment of the power is applied.
	After the drive is powered off and in battery mode, the speed should not exceed 50 rpm in battery mode.

Focus	The absolute position will vanish when the battery is removed, in this case, you must set the origin before running

Restricted items:

Some operation conditions described below are not suitable to perform the absolute system.

(1) Speed control mode and torque control mode.

(2) Switching control mode.

(3) Rotating axis, infinite operation cycle positioning.

(4) Change the E-Gear ratio after setting the origin.

(5) Alarm code output occupies the DO hardware.

How to replace the battery

(1) When the drive displays alarm AL.2D, which means the voltage is too low, please replace the battery immediately to avoid data loss.

(2) When the battery voltage is less than 2. 45V, AL.2A alarm will occur and the motor position data has lost, the homing must be performed after the battery is replaced.

☆☆☆ **Attention!!!**

It is recommended to replace the battery when power is applied on the drive and the motor is stopped, which is to avoid absolute position data loss.

System initialization

(1) Install absolute motor and battery.

(2) Set PA28 to 1 which is to activate the absolute system, and then restart the drive.

(3) [AL.2A Absolute encoder abnormal 1] alarm will occur after power-on, you can clear the alarm by cycling the power.

(4) Absolute position loss [AL.2C Absolute Encoder error 3] alarm will occur after power-on, and it is necessary to reset the absolute system origin to clear this alarm. The method is as follows

(a) Set PA29 to 1 to complete the coordinate initialization.

(b) The absolute coordinate system will be reset after the homing is completed in PR mode.

Cautions:

In the absolute system, the position movement has certain restrictions. When the motor revolution number exceeds the range of -32768 ~ +32767, an alarm AL.29 will occur.

Pulse number calculation

The motor maximum countable revolution number range is -32768 ~ +32767. If it exceeds this range during operation, an overflow (AL.29) alarm will occur. According to the motor encoder type, the motor single turn pulse number is 4194304 (22bit).

The revolution number and pulse number of the absolute servo system can be read through communication or DI/DO, the overall pulse number calculation is as follows.

Total pulse number = r (number of revolutions) x 4194304 + pulse number (0~4194303).

If the motor has rotated 10 cycles with 50000 pulse, the total pulse number is as follows according to the above calculation:

The total pulse value = 10 x 4194304+ 50000

= 41993040 (pulse)

Method of reading motor absolute position

(1)Read the absolute position with communication.

Generally, you can use parameters which is in the status monitoring communication parameter table in section 9.4 to read the data, and it is recommended to use the "Motor Feedback Pulse Number (before E-Gear ratio)". The following is a brief table.

Communication address	Item	Data length
0x0000	Motor feedback pulse number(after E-Gear ratio) [pulse]	2word
0x0024	Motor feedback pulse number(before E-Gear ratio) [pulse]	2word

(2)Read absolute position by PLC DIO communication

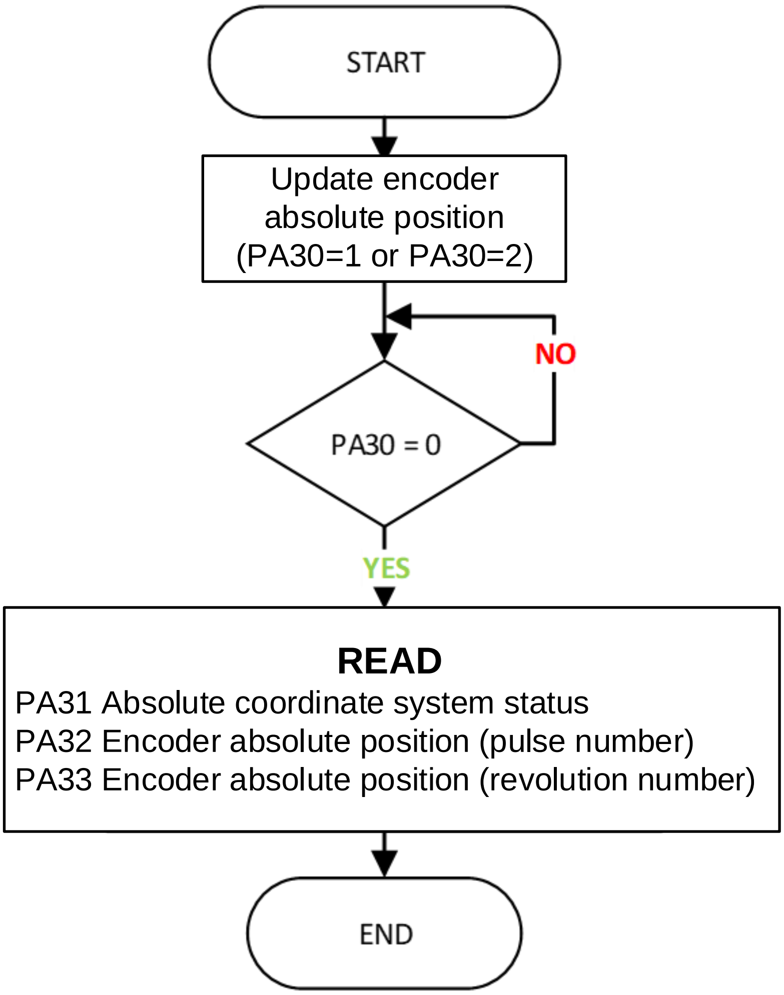
Return the position through the DI/DO handshake communication between the PLC and the drive, you can refer to the descriptions in sections 13.1 and 13.2.

(3) Returning position by parameter setting

By setting parameter PA30 with communication, the encoder status and motor absolute position are updated. If PA30 is set to 1, the drive does not clear the error when reading the position value. If PA30 is set to 2, the drive clears the error at the same time when reading the position value.

The servo motor moves slightly forward and backward to correct its position even it is stopped. To avoid the difference between the reading motor position and actual positions, you can set PA30 to have the motor’s actual position updated to the servo drive, and clears the position error at the same time. After encoder status and motor absolute position are updated, PA30 is automatically reset to 0. It means the controller can access the parameter values.

When the encoder status shows “absolute position lost” or “number of revolutions overflow”, it means the reading absolute position is invalid. In this case, the coordinate initialization or homing must be performed again.


START
Update encoder absolute position (PA30=1 or PA30=2)
NO
PA30 = 0
YES
READ
PA31 Absolute coordinate system status
PA32 Encoder absolute position (pulse number)
PA33 Encoder absolute position (revolution number)
END

13.1 Mitsubishi Absolute Position Detection System

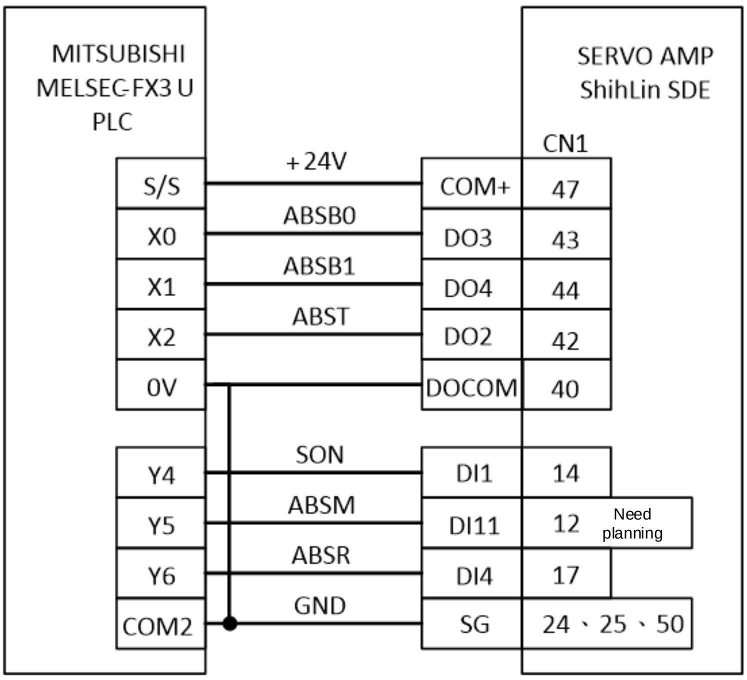
This section mainly introduces the use of Mitsubishi PLC with SDP servo to read absolute position by DIO communication.

13.1.1 Signal description

When transmitting absolute position data, the signal of CN1 terminal will be changed.

Signal	Code	CN1 Pin	Function	I/O
ABS Transmission mode	ABSM	User-defined	To activate ABSM and start ABS transmission mode. Enable ABSR, ABST, ABSB0, ABSB1.	DI-x
ABS request	ABSR	17	To turn ABSR ON during accessing ABS data in ABS transmission mode.	DI-4 (fixed)
ABS data 0	ABSB0	43	Low bit of 2 bit ABS data.	DO-3 (fixed)
ABS data 1	ABSB1	44	High bit of 2 bit ABS data.	DO-4 (fixed)
ABS ready	ABST	42	Turn ABST on when ABS data is ready in ABS transmission mode.	DO-2 (fixed)
ABS origin setting	ABSC	User-defined	Origin data is cleared when ABSC is ON.	DI-x
ABS position lost	ABSV	User-defined	ABSV is ON when absolute position is lost.	DO-x

Please refer to the following wiring example for details:



13.1.2 Start procedure

(1) Install absolute motor and battery

(2) Parameter setting

Set PA28 to 1, and set absolute system.

Set PA34 to □□□1, and restart the drive to set the Mitsubishi absolute position detection system.

And then cycling power to activate the parameter setting.

(3) [AL.2A Absolute encoder error 1] Alarm release

When the battery is replaced and the power is turned on for the first time, an "AL.2A Absolute Encoder error 1" alarm will occur. You can cycle the power to release the alarm.

(4) Absolute position loss [AL.2C Absolute encoder error 3] Alarm release

When the absolute system is powered on for the first time, an alarm of "AL.2C Absolute Encoder error 3" will occur. Please set PA29 to 1 or perform coordinate initialization to clear the alarm.

(5) Absolute position data transmission confirmation

Turn on SON, and the absolute position data starts to transmit to the PLC. After normal transmission of ABS data.

(a) RD (ready) is ON.

(b) ABST (ready) of PLC is ON.

(c) If [ABS timeout alarm] occurs, refer to section 10.1 for how to release this alarm.

(6) Homing

Origin setting should be done in the following conditions

(a) When setting absolute system.

(b) When changing servo drive.

(c) When changing servo motor.

(d) When absolute position loss [AL.2C Absolute encoder error 3] alarm occurs.

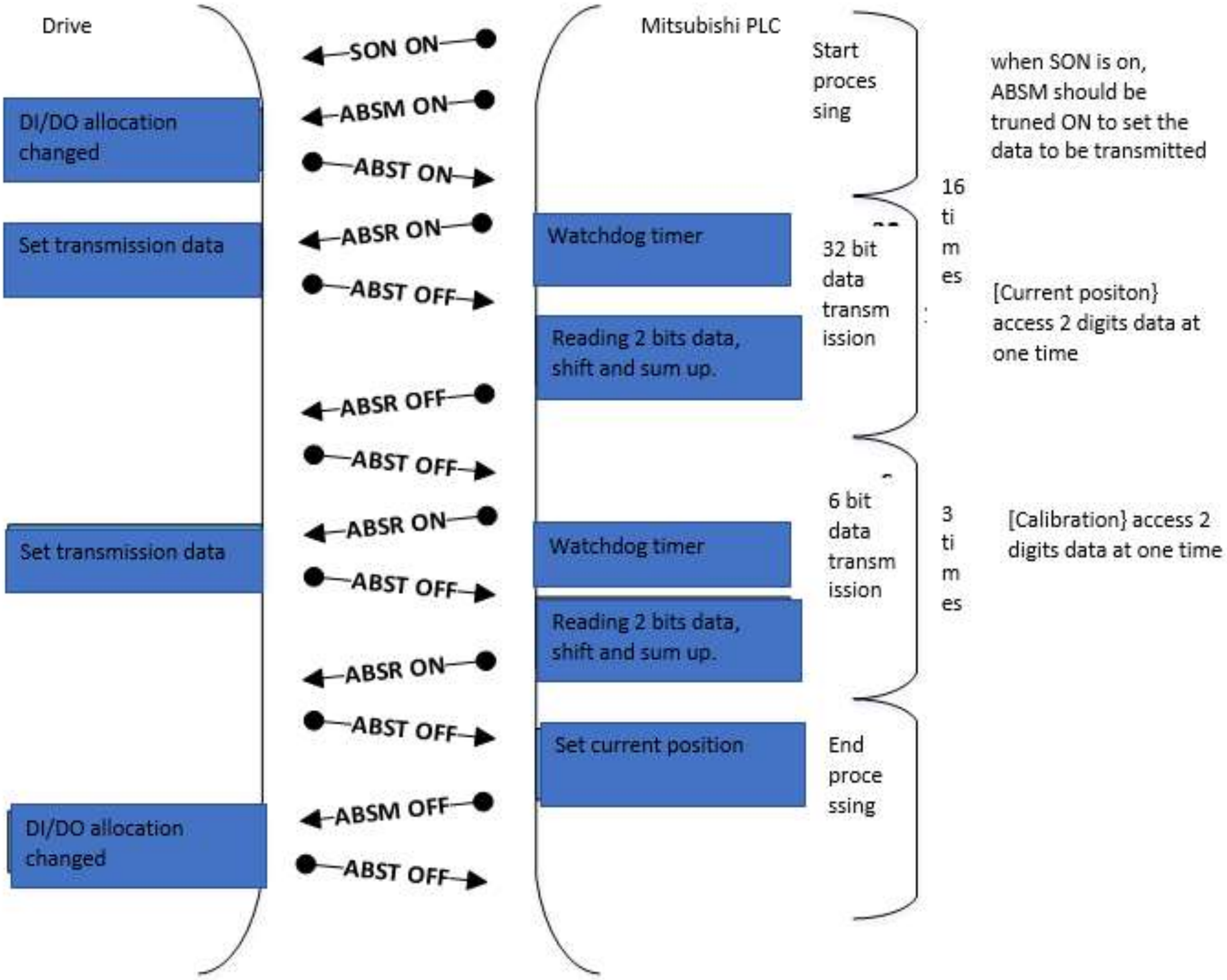
When setting an absolute position system, you can establish an absolute coordinate position through the origin setting. If you run the motor without setting the origin, unexpected actions may occur.

13.1.3 Absolute position data transmission protocol

(1) Data transmission procedure

After the power is applied, the PLC reads the current position of the drive when each time SON is turned on.

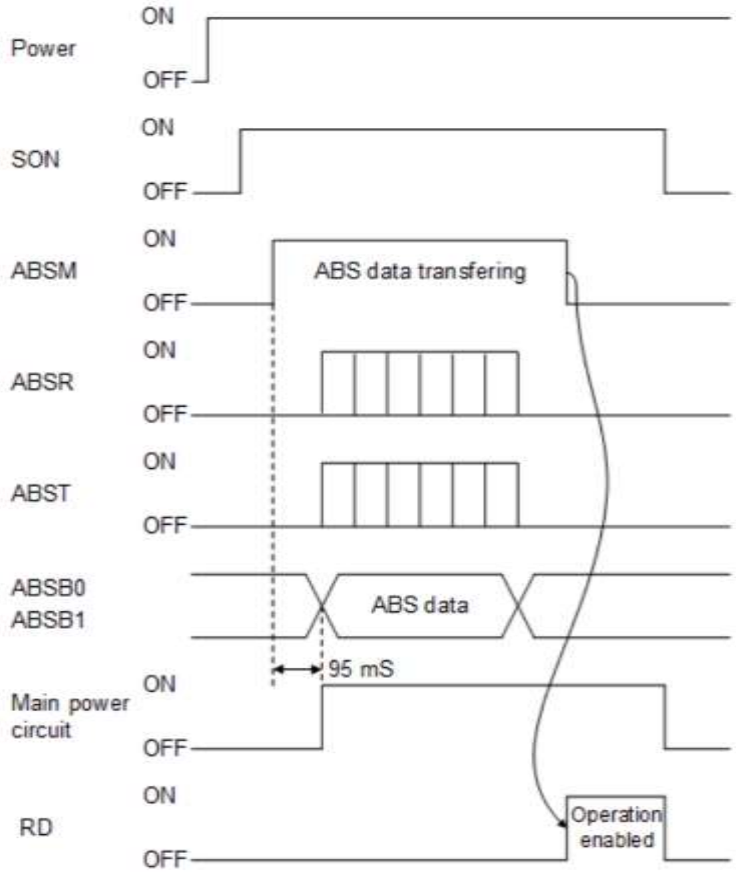
Focus	When ABSM is off, If you turn SON on, the main power circuit will be invalid.



(2) Transmission method

In the absolute position detection system, when SON is turned on, ABSM must be turned on to transmit the current position of the drive to the host controller. If ABSM is turn off, the main power circuit will be off.

(a)Timing diagram



(1) After the ABS data transmission is completed, RD turns on and ABSM is OFF. When RD is on, ABSM can not be turned on.

(2) Even if SON is turned on, the main circuit will not be switched on until the ABSM is turned on. When an alarm occurs, ABSM can not be enabled; when a warning occurs, ABSM can be enabled.

(3) During ABS transmission, if ABSM is OFF, the ABS transmission mode is interrupted and [AL.17 ABS timeout warning] occurs.

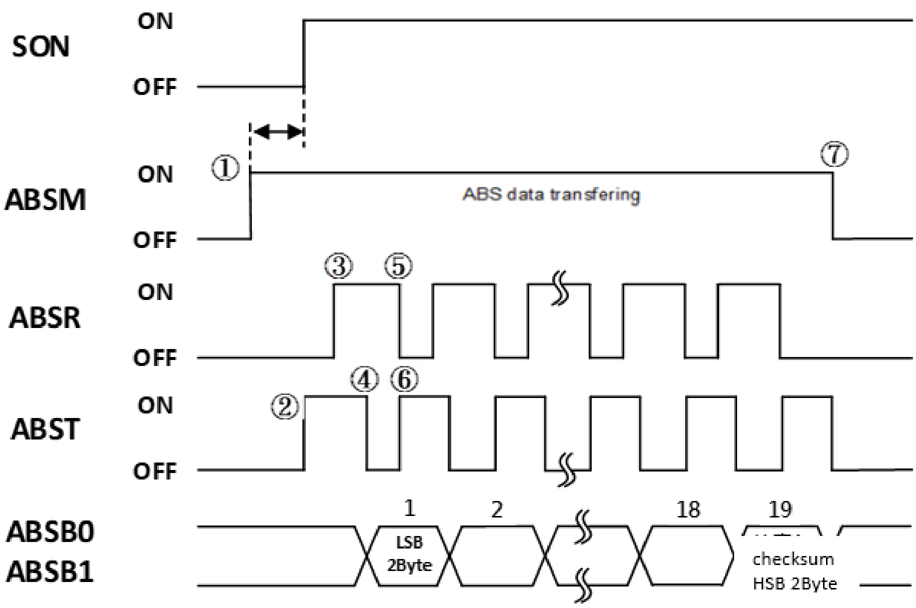
During ABS transmission, [AL.17 ABS timeout warning] will also occur when SON OFF, RES ON or EMG OFF.

(4) The output signal functions of ABST, ABSB0 and ABSB1 will change according to the status of ABSM.

CN1 pin number	Output signal	
	ABSM OFF	ABSM ON
43	WNG Warning/ CMDOK internal position command is completed	ABS Data bit 0
44	TLC torque limit control	ABS data bit 1
42	ZSP zero speed is detected.	ABS data ready

(5) When the main circuit is on, ABSM is not allowed to turn on. If you want to send data again, you must turn off the SON and wait for the main circuit to turn off for more than 20mSec.

(b)Detailed description of absolute position data transmission timing



After the ABSM is turned on, the ABS servo turn-on timeout will occur if the SON is not turned on within 1 second, but the transmission will not be impacted. If you want to clear the ABS servo on warning, you can just turn the SON on. The detailed timing diagram is as follows:

(1) The PLC turns on ABSM and SON.

(2) When entering the ABS transmission mode, ABST (data ready) is ON after the drive calculates the absolute position,

(3) After PLC confirms that ABST is turned on, ABSR (data request) will be ON.

(4) After confirming that ABSR is turned on, the servo will output the ABS data (2bit) and turn off ABST.

(5) If PLC confirms that ABST is closed, it will read ABS data (2bit) and close ABSR.

(6) The drive turns ABST on to prepare for the next data transfer. Repeat the operation of ③~⑥ until the transmission of 32-bit data and 6-bit checksum data is completed.

(7) After the PLC finish receiving the data, it will confirm that the 19th ABST state has been turned on, and then ABSM is turned off. At the end of data transmission, turning off ABSM will interrupt the ABS transmission mode, and [AL.17 ABS timeout warning] will occur.

(c) Checksum

The checksum is used to detect whether the ABS data has errors. The PLC uses the program to calculate the checksum value of the ABS data and compare it with the checksum value transmitted by the drive.

Calculation: the checksum is calculated by adding up the 2-bit ABS data received each time to obtain a 6-bit checksum value.

(Example) ABS data: -30000 (FFFF8AD0), the calculated checksum value is 22H

```
   00b
   00b
   01b
   11b
   10b
   10b
   00b
   10b
   11b
   11b
   11b
   11b
   11b
   11b
   11b
+  11b
-------
100010b
```

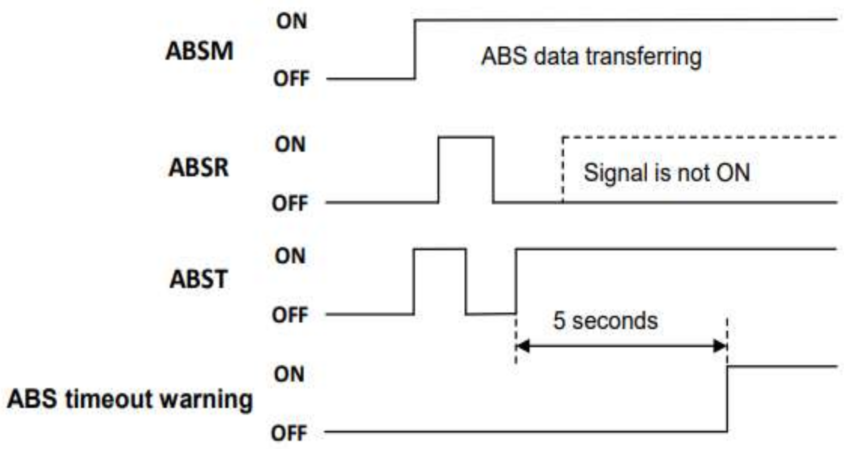
(3) Transmission error

[AL.17 ABS timeout warning]

In the ABS transmission mode, a time-out warning will occur in the following conditions. Warning will be released automatically when ABSM is turned on.

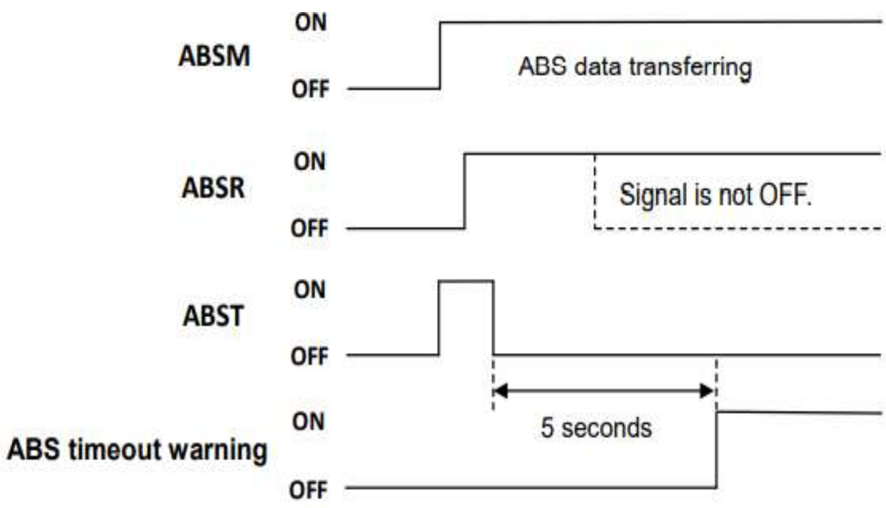
(1) Timeout check when ABSR data requested signal is off.

After the ABST ready signal is on, if the ABSR data requested signal is not turned on within 5 seconds, [AL.17 ABS timeout warning] will occur.



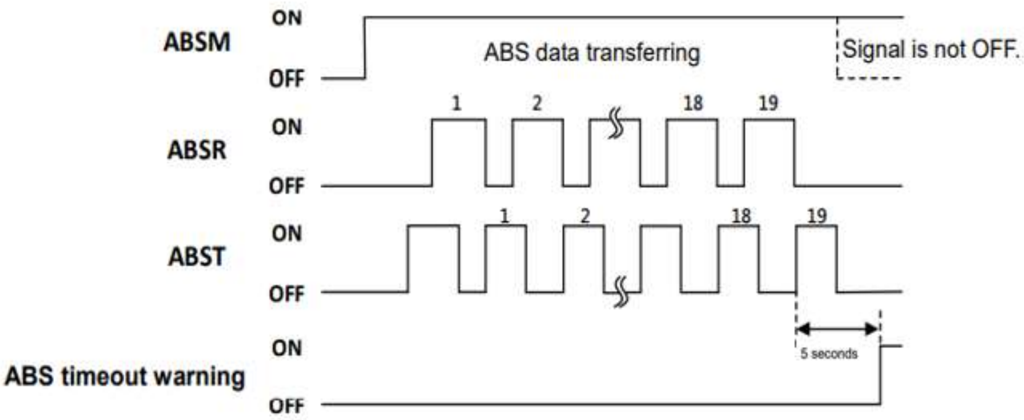
(2) Timeout check when ABSR data requested signal is on.

After the ABST ready signal is off, if the ABSR data requested signal is not turned off within 5 seconds, [AL.17 ABS timeout warning] will occur.



(3) Timeout check after the ABSM transmission mode is completed.

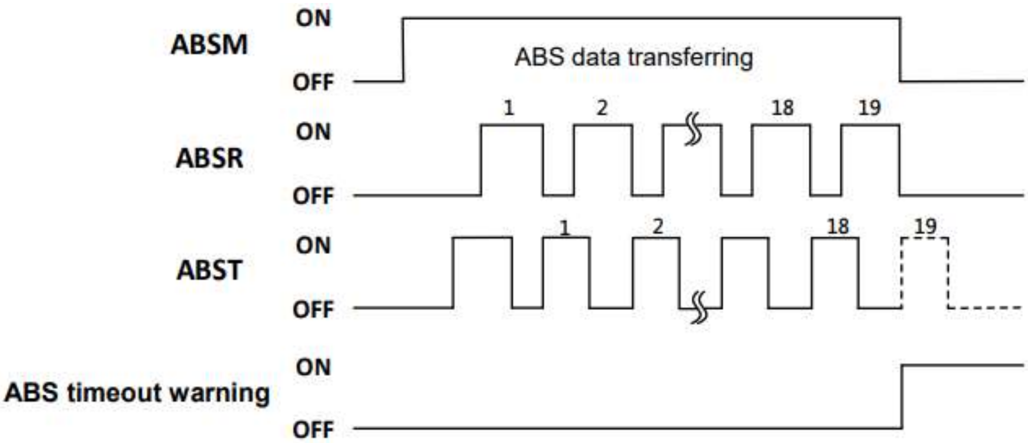
After the ABS data transfer is completed and ABST ready signal is turned on, if the ABSM is not turned off within 5 seconds, [AL.17 ABS timeout warning] will occur.



(4) ABSM signal check in ABS transmission mode

If the ABSM signal is turned off during ABS transmission, [AL.17 ABS timeout warning] will occur.

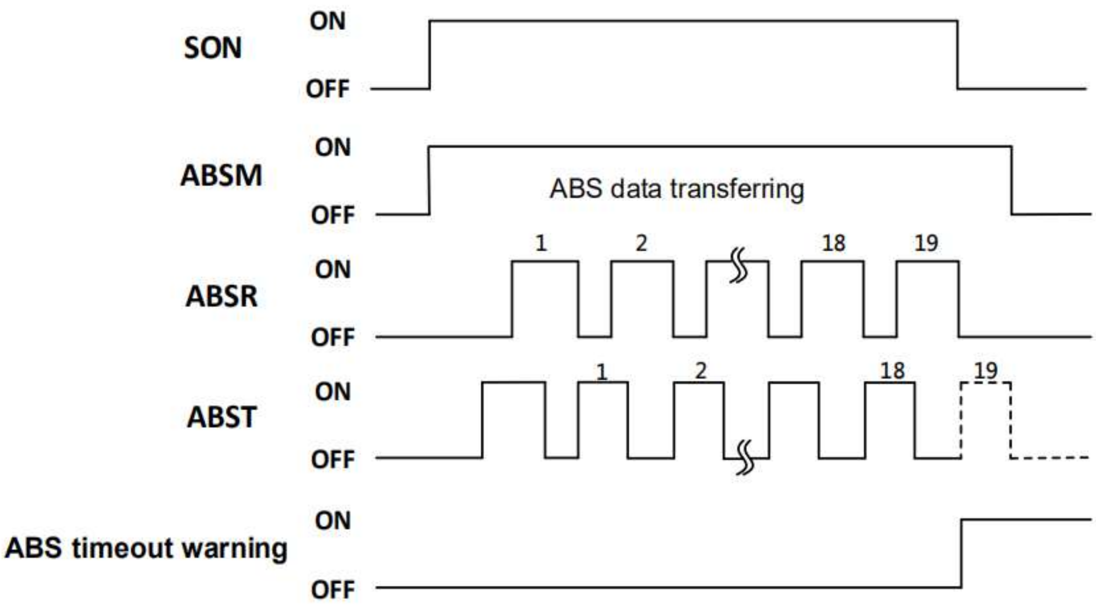
This example is to turn ABSM OFF before the 19th ABST data ready.



(5) SON signal check in ABS transmission mode

If the SON signal is turned off during the ABS transmission, [AL.17 ABS timeout warning] will occur.

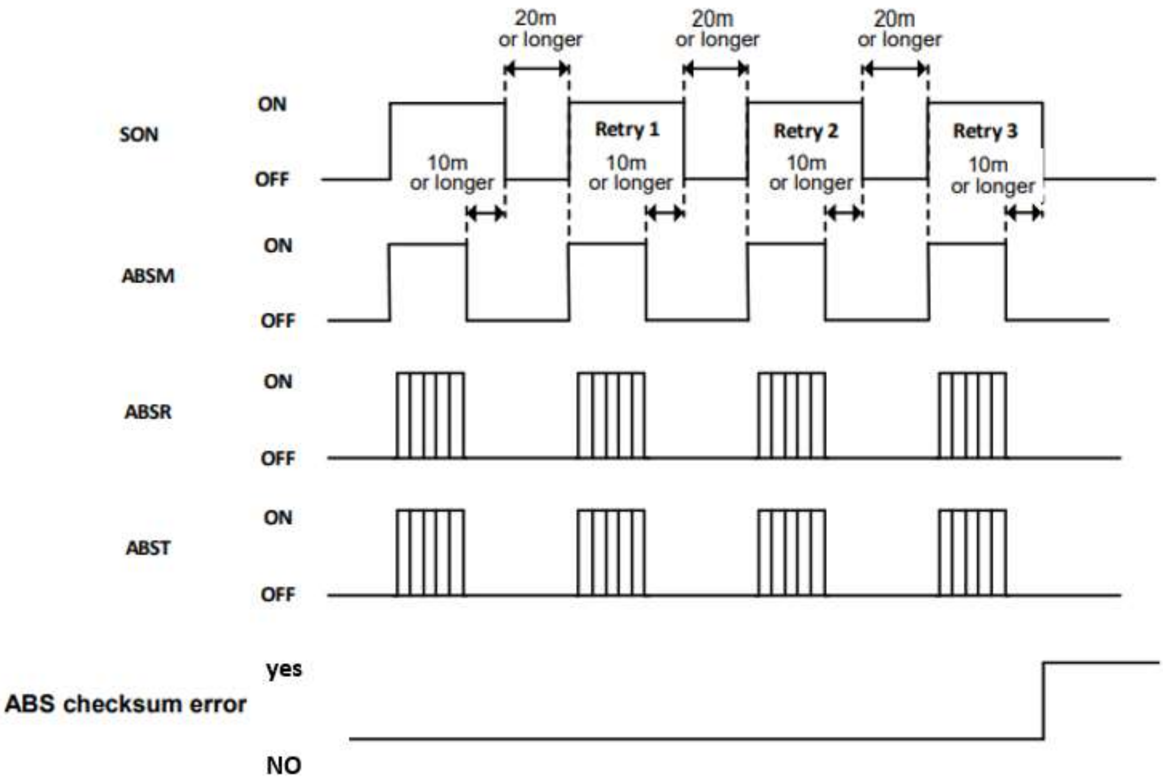
This example is to turn SON off before the 19th ABST data ready.



Checksum error

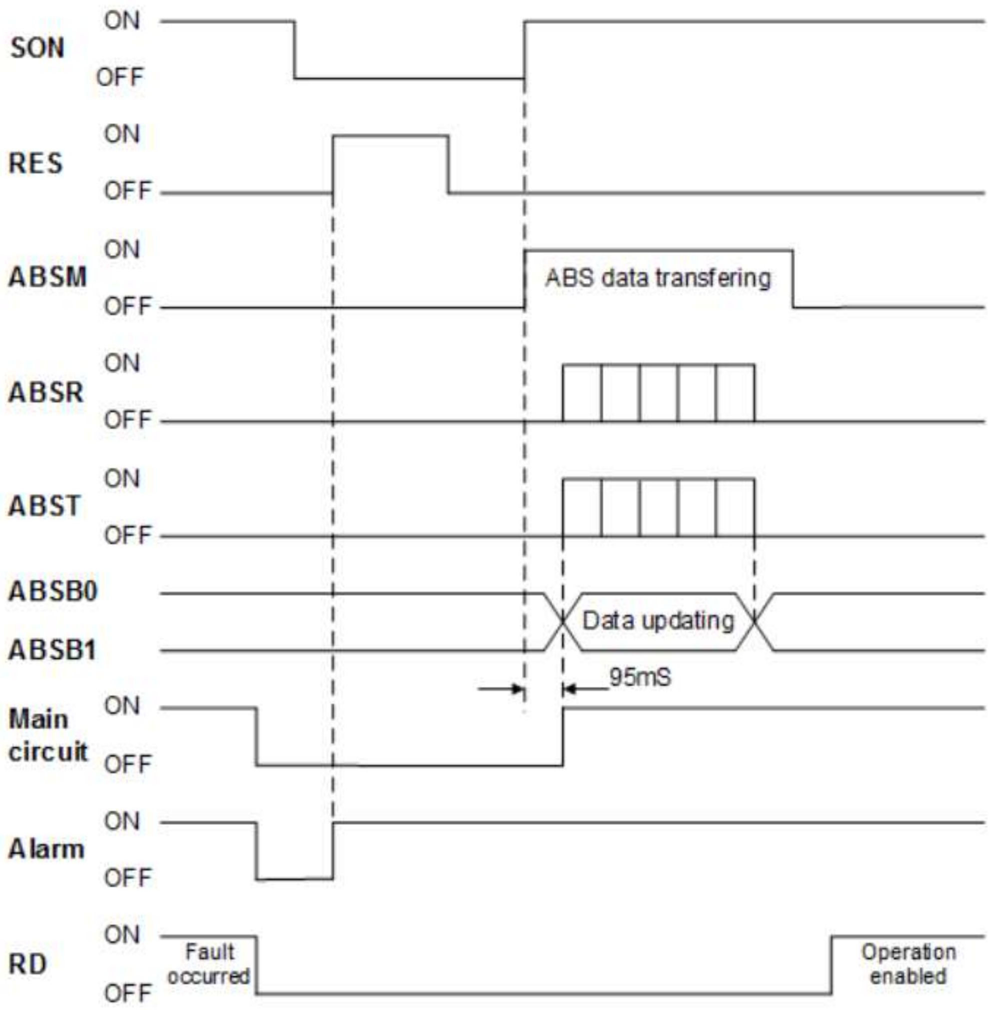
When the checksum error is detected, the ABS data transmission will be restarted. After the ABSM is closed for 10mSec, the SON will close, and then turn them on after 20mSec at least.

If the absolute position data transmission fails even after 3 retry, the ABS checksum error will occur.



Clear alarm

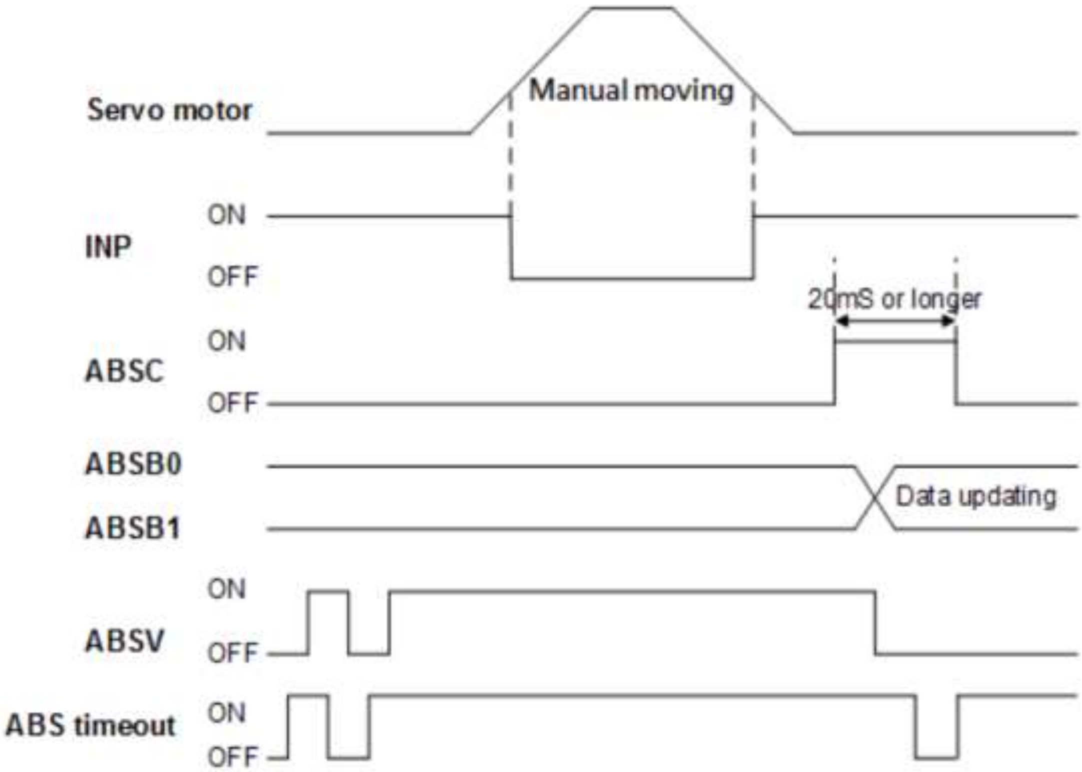
When an alarm is detected by the servo, SON will be OFF, and ABSM can not be received when there is an alarm. It can only be received when the alarm is cleared. After the alarm is cleared, ABSM can be turned on.



(4) **Homing**

Focus	Please perform the homing when the motor stops, otherwise the origin position may shift.

Move to the target origin position by manual operation (JOG, test positioning). If turning on CR for over 20mSec, the current position is regarded as the ABS origin and the data is stored in the non-volatile memory (the maximum number of writing is 1 million).



13.2 Delta absolute position detection system

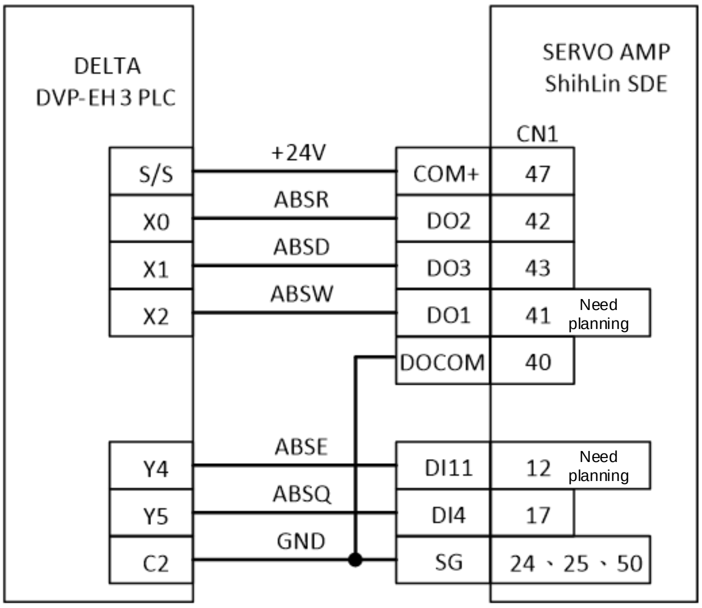
This section mainly introduces the use of Delta PLC with SDP servo to read absolute position by DIO communication.

13.2.1 Signal description

When transmitting absolute position data, the signal of CN1 terminal will be changed.

Signal	Code	CN1 Pin	Function	I/O
ABS communication enabled	ABSE	User-defined	When ABSE is on, the ABS mode is activated, it will enable ABSQ, ABSC, ABSR, ABSD.	DI-x
ABS signal request	ABSQ	17	Handshake communication check pin during I/O transmission, ABSQ OFF means the controller has issued the requested command; ABSQ ON means the controller has processed the ABSD data.	DI-4 (Fixed)
ABS signal ready	ABSR	43	ABSR OFF means that ABSQ command can be received; ABSR ON means that the data is ready and the ABSD data has been updated.	DO-3 (Fixed)
ABS data content	ABSD	44	The output pin of ABS data, the data is guaranteed to be correct when ABSR is on.	DO-4 (Fixed)
ABS communication error	ABSW	User-defined	The related alarm of the absolute encoder is indicated by this DO output.	DO-x
Origin setting	ABSC	User-defined	When ABSC is turned on, the pulse number in the absolute encoder will be cleared to zero. This input is valid only when ABSE is turned on.	DI-x

Please refer to the following wiring example for details.



13.2.2 Start procedure

(1) Install absolute motor and battery.

(2) Parameter setting.

PA28 is set to 1 which is absolute system setting.

Set PA34 to □□□0, and restart the drive to set the Delta absolute position detection system.

And then restart again to activate the parameter setting.

(3) [AL.2A Absolute encoder error 1] Alarm release.

When the battery is replaced and the power is turned on for the first time, an "AL.2A Absolute Encoder error 1" alarm will occur. You can restart the power to release the alarm.

(4) Absolute position loss [AL.2C Absolute encoder error 3] Alarm release

When the absolute system is powered on for the first time, an alarm of "AL.2C Absolute Encoder error 3" will occur. You can set PA29 to 1 or perform coordinate initialization to clear the alarm.

(5) Homing.

Origin setting should be done in the following conditions

(a) When setting absolute system.

(b) When changing servo drive.

(c) When changing servo motor.

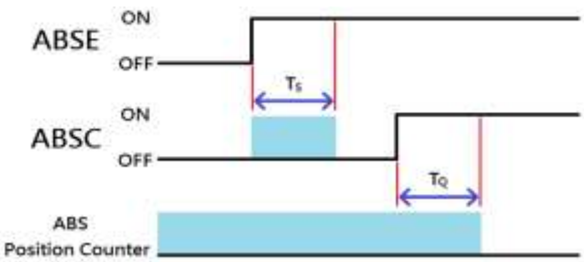
(d) When absolute position loss [AL.2C Absolute encoder error 3] alarm occurs.

When setting an absolute position system, you can establish an absolute coordinate position by the origin setting. If you run the motor without establishing the origin, unexpected actions may occur.

13.2.3 Use DI/DO to initialize absolute coordinates

Absolute coordinate initialization can be performed with PA29 or DI/DO. If in Pr mode, please do the coordinate initialization by homing.

When DI ABSE is ON and DI ABSC is switched from OFF to ON, the coordinate initialization function will be executed. The pulse number of the absolute encoder will be cleared to zero when initiation is completed. Please refer to the figure below for the operation sequence.



	Ts(ms)	Tq(ms)
Min	PD15 + 2	
Max	PD15 + 10	

Description of operation sequence.

1. When the host controller switches the ABSE signal from OFF to ON, it will need to wait for Ts time before the system can proceed to the next step.

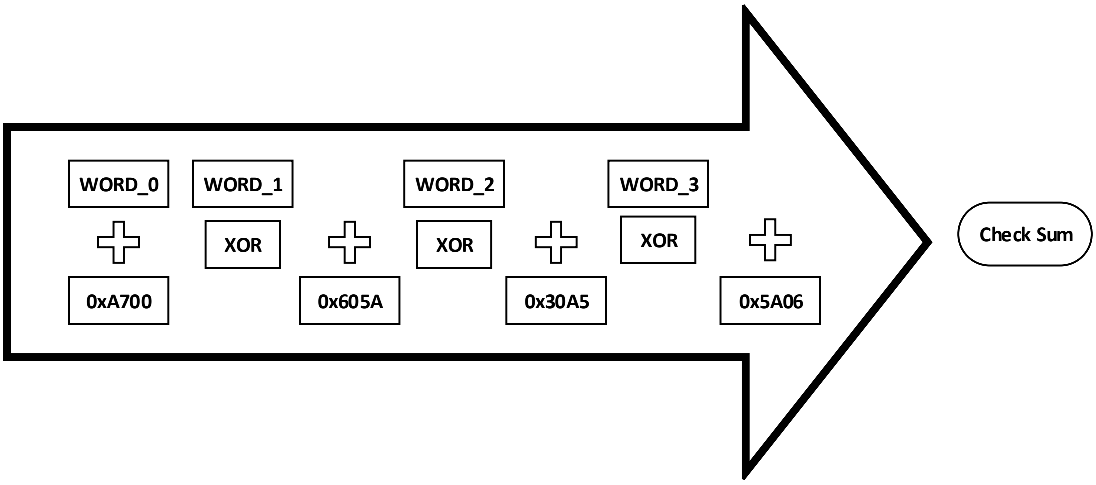
2. After taking the Ts time, the controller can perform the coordinate reset function, when the ABSC is switched from OFF to ON and after the Tq time , the pulse number of the absolute coordinate will be cleared to zero.

13.2.4 Use parameter settings to initialize absolute coordinates

You can write PA29 to perform absolute coordinate initialization by panel operation or communication command. When PA29 is set to 1, the absolute coordinates will be reset immediately. Please use the homing to initialize the coordinates in Pr mode.

Bit79~Bit64	Bit63 ~ Bit32	Bit31 ~ Bit16	Bit15 ~ Bit0
Check Sum	Encoder pulse number per revolution 0 ~ 4194304 (22bit Encoder)	Encode revolution number -32768 ~ +32767	PA31 encoder status

Checksum method description:



Check Sum = ((((((WORD_0+0xA700) xor WORD_1)+0x605A) xor WORD_2)+0x30A5) xor WORD_3)+0x5A06

Remind:

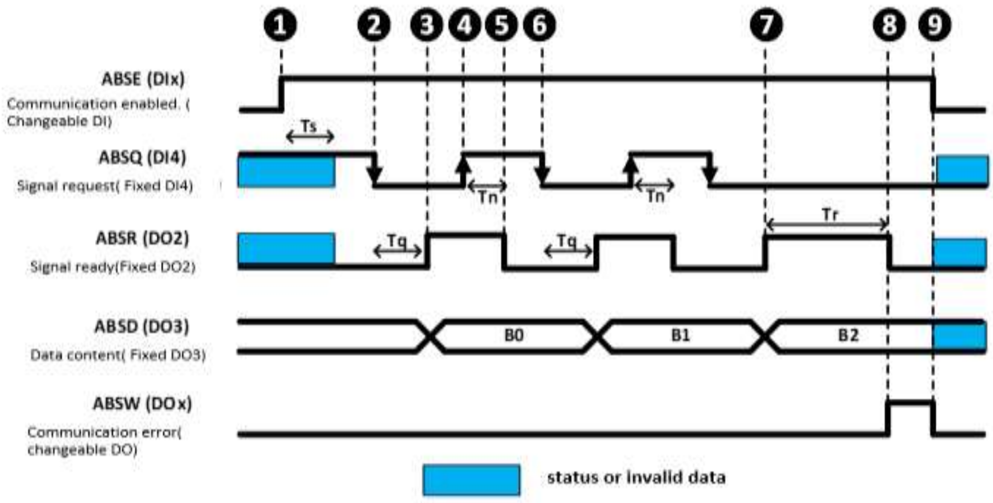
1. The algorithm has no sign.
2. 0xA700, 0x605A, 0x30A5, 0x5A06 are hexadecimal constants.
3. WORD_0: encoder status(Bit15 ~ Bit0)

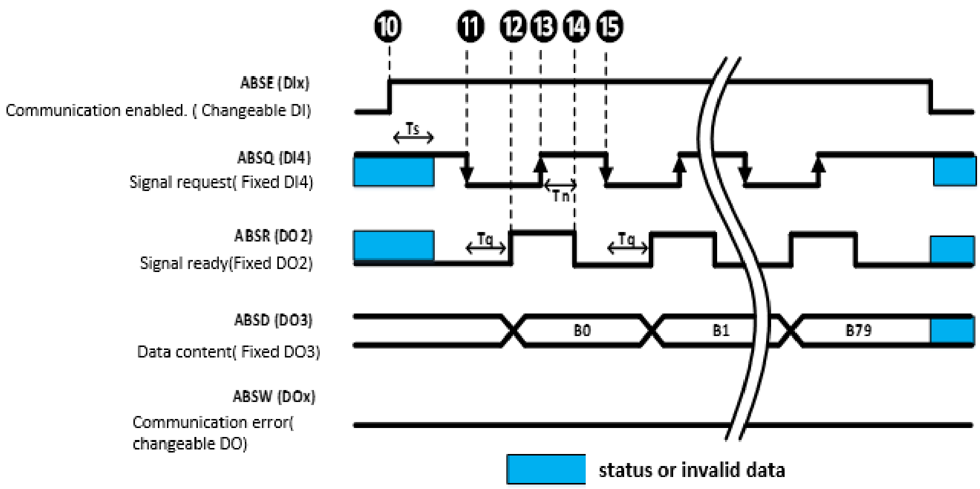
   WORD_1: encoder revolution number(Bit31~Bit16)

   WORD_2: encoder pulse number(Bit47 ~ Bit32)

   WORD_3: encoder pulse number(Bit63 ~ Bit48)

13.2.5 Absolute position data transmission protocol





The description of communication procedure.

1. When starting communication, the controller will enable ABSE signal and start DI/DO communication of absolute system. After Ts digital input filter time, DI4, DO2 and DO3 will switch to ABSQ, ABSR, ABSD.
2. The controller sets the ABSQ signal to low level, which means that the host controller makes a read request to the drive.
3. After the Tq confirmation time, the drive has the data ready and enabled the ABSR signal to notify the host controller for data reading.

4. When the host controller detects that the ABSR is at the high level, it will immediately read the data on the ABSD. And then set the ABSQ to the high level to notify the drive for data reading competition.
5. After the Tn confirmation time, the drive sets ABSR to the low level, and informs the host controller to prepare communication for the next bit.
6. When the controller detects that the ABSR is at a low level, it will request the next bit from the drive.
7. If the drive has the data ready, the ABSR signal will be enabled.
8. After Tr communication waiting time, if the controller does not read data and pulls up the ABSQ signal, ABSW alarm will occur and the communication will stop.
9. After the controller detects the ABSW communication error, it will set ABSE to the low level to make it ready for re-communication.
10. Re-enable ABSE signal and restart the communication.
11. The controller sets the ABSQ signal to a low level and sends a reading request.
12. After the Tq confirmation time, the drive will notify the controller that data can be read.
13. When the controller detects that the ABSR is at the high level, it will immediately read the data on the ABSD and set the ABSQ to the high level to notify the drive that the data has been read.
14. After the Tn confirmation time, the drive sets ABSR to the low level and informs the host controller that it can prepare for the communication of next bit.
15. When the host controller detects that the ABSR is at a low level, it will request the next bit from the drive. Repeat step 11 ~ step 14 to complete data communication of a total of 80 bits from 0 to 79.

13.3 Absolute battery specifications

Cautions for use

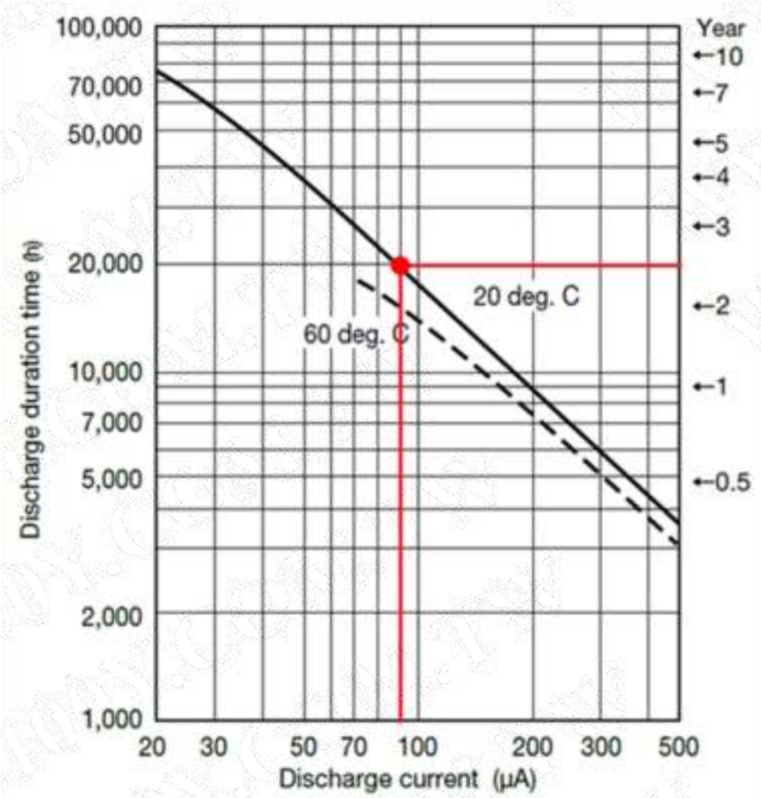
Carefully read the following safety cautions. Only use the specified batteries to avoid damage or dangerous conditions.

CAUTION
1. Make sure the installation location is free of vapor, corrosive and inflammable gas. 2. Correctly place the battery into the battery box to avoid short-circuit. 3. Do not short circuit the positive and negative polarity of the battery, and do not install the battery in reverse direction.
DANGER
1. Do not place the battery in a high-temperature environment over 100°C (212°F) or fires, as this may cause a fire or an explosion. 2. The batteries are non-rechargeable. Do not charge the batteries as this may result in an explosion. 3. Do not directly weld on the surface of the battery.

Battery specifications

Material	Lithium-thionyl chloride/inorganic electrolyte battery
Type	ER6C
Shihlin model name:	SDH-BAT
Standard voltage	3.6 V
Standard capacity	1800 mAh
Continuous discharge current	100 μA
Dimension(D x H)	14.5 x 51 mm
Weight	15 g
Operating temperature	-55˚C~85˚C (-67˚F~185˚F)

Battery life



The figure above is the life curve provided by the battery manufacturer. If the absolute encoder current consumption is 90μA, the battery life is about 20000hr, which is equivalent to 2.3 years.

14. Appendix

14.1 Accessories

Item	Name	Model name	L(mm)
Encoder connector (CN2)	Low/High inertia (50W~750W) encoder connector	SDH-ENCNL	--
	Low/Middle/High inertia (850W~3KW) encoder connector	SDH-ENCNM	--
	(400V)High inertia (1.8KW~7.5KW) encoder connector	SDP-ENCNM	--
Encoder cable	Low/High inertia(50W~750W) encoder cable 2M	SDH-ENL-2M-L/H	2000±100
	Low/High inertia(50W~750W) encoder cable 5M	SDH-ENL-5M-L/H	5000±100
	Low/High inertia(50W~750W) encoder cable 10M	SDH-ENL-10M-L/H	10000±100
	Low/Middle/High inertia(850W~3KW) encoder cable 2M	SDH-ENM-2M-L/H	2000±100
	Low/Middle/High inertia(850W~3KW) encoder cable 5M	SDH-ENM-5M-L/H	5000±100
	Low/Middle/High inertia(850W~3KW) encoder cable 10M	SDH-ENM-10M-L/H	10000±100
	(400V)High inertia (1.8KW~7.5KW) encoder cable 2M	SDP-ENM-2M-L/H	2000±100
	(400V)High inertia (1.8KW~7.5KW) encoder cable 5M	SDP-ENM-5M-L/H	5000±100
	(400V)High inertia (1.8KW~7.5KW) encoder cable 10M	SDP-ENM-10M-L/H	10000±100
Power connector	Low/High inertia(50W~750W) (without brake)	SDA-PWCNL1	--
	Low/High inertia(50W~750W)(with brake)	SDA-PWCNL2	--
	Low(1KW~3KW) Middle(1KW/1.5KW) /High inertia(850W~1.8KW) power connector	SDA-PWCNM1	--
	Middle inertia(2KW/3KW) power connector	SDA-PWCNM2	--

	(400V)High inertia (1.8KW) power connector	SDP-PWCNH1	--
	(400V)High inertia (2.9KW/4.4KW) power connector	SDP-PWCNH2	--
	(400V)High inertia (5.5KW/7.5KW) power connector	SDP-PWCNH3	--
	(400V)High inertia (1.8KW~7.5KW) brake connector	SDP-BKCNS1	--
Power cable	Low/High inertia (50W~750W) power cable 1(without brake)	SDA-PWCNL1-2M-L/H	2000±100
	Low/High inertia (50W~750W) power cable 2(without brake)	SDA-PWCNL1-5M-L/H	5000±100
	Low/High inertia (50W~750W) power cable 3(without brake)	SDA-PWCNL1-10M-L/H	10000±100
	Low/High inertia (50W~750W) power cable 1(with brake)	SDA-PWCNL2-2M-L/H	2000±100
	Low/High inertia (50W~750W) power cable 2(with brake)	SDA-PWCNL2-5M-L/H	5000±100
	Low/High inertia (50W~750W) power cable 3(with brake)	SDA-PWCNL2-10M-L/H	10000±100
	Low(1KW~3KW) Middle(1KW/1.5KW)/ High inertia (850W~1.8KW) power cable 1(without brake)	SDA-PWCNM1-2M-L/H	2000±100
	Low(1KW~3KW) Middle(1KW/1.5KW)/ High inertia (850W~1.8KW) power cable 2(without brake)	SDA-PWCNM1-5M-L/H	5000±100
	Low(1KW~3KW) Middle(1KW/1.5KW)/ High inertia (850W~1.8KW) power cable 3(without brake)	SDA-PWCNM1-10M-L/H	10000±100
	Low(1KW~3KW) Middle(1KW/1.5KW)/ High inertia (850W~1.8KW) power cable 1(with brake)	SDA-PWCNM1B-2M-L/H	2000±100
	Low(1KW~3KW) Middle(1KW/1.5KW)/ High inertia (850W~1.8KW) power cable 2(with brake)	SDA-PWCNM1B-5M-L/H	5000±100
	Low(1KW~3KW) Middle(1KW/1.5KW)/ High inertia (850W~1.8KW) power cable 3(with brake)	SDA-PWCNM1B-10M-L/H	10000±100

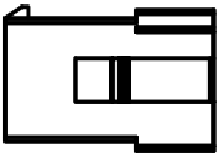
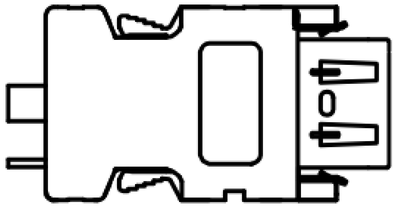
	Middle inertia(2KW/3KW) power cable 1(without brake)	SDA-PWCNM2-2M-L/H	2000±100
	Middle inertia(2KW/3KW) power cable 2(without brake)	SDA-PWCNM2-5M-L/H	5000±100
	Middle inertia(2KW/3KW) power cable 3(without brake)	SDA-PWCNM2-10M-L/H	10000±100
	Middle inertia(2KW/3KW) power cable 1(with brake)	SDA-PWCNM2B-2M-L/H	2000±100
	Middle inertia(2KW/3KW) power cable 2(with brake)	SDA-PWCNM2B-5M-L/H	5000±100
	Middle inertia(2KW/3KW) power cable 3(with brake)	SDA-PWCNM2B-10M-L/H	10000±100
	(400V)High inertia(1.8KW) power cable 1(without brake)	SDP-PWCNH1-2M-L/H	2000±100
	(400V)High inertia(1.8KW) power cable 2(without brake)	SDP-PWCNH1-5M-L/H	5000±100
	(400V)High inertia(1.8KW) power cable 3(without brake)	SDP-PWCNH1-10M-L/H	10000±100
	(400V)High inertia(2.9KW/4.4KW) power cable 1(without brake)	SDP-PWCNH2-2M-L/H	2000±100
	(400V)High inertia(2.9KW/4.4KW) power cable 2(without brake)	SDP-PWCNH2-5M-L/H	5000±100
	(400V)High inertia(2.9KW/4.4KW) power cable 3(without brake)	SDP-PWCNH2-10M-L/H	10000±100
	(400V)High inertia(5.5KW/7.5KW) power cable 1(without brake)	SDP-PWCNH3-2M-L/H	2000±100
	(400V)High inertia(5.5KW/7.5KW) power cable 2(without brake)	SDP-PWCNH3-5M-L/H	5000±100
	(400V)High inertia(5.5KW/7.5KW) power cable 3(without brake)	SDP-PWCNH3-10M-L/H	10000±100
	(400V)High inertia (1.8KW~7.5KW) brake power cable 1	SDP-BKCNS1-2M-L/H	2000±100
	(400V)High inertia (1.8KW~7.5KW) brake power cable 2	SDP-BKCNS1-5M-L/H	5000±100
	(400V)High inertia (1.8KW~7.5KW) brake power cable 3	SDP-BKCNS1-10M-L/H	10000±100
Communication cable (CN4)	Drive and PC USB communication cable	SDA-USB3M	3000

Communication cable (CN3)	USB to RS-485 ADAPTER	USB01	
	Data transmission cable 1.5meters	SNKCBL1R5GTN2	1500
	Data transmission cable 3meters	SNKCBL3GTN2	3000
	Data transmission cable 5meters	SNKCBL5GTN2	5000
	Data transmission cable 10meters	SNKCBL10GTN2	10000
I/O connector (CN1)	I/O connector	SDA-CN1	--
	I/O cable	SDA-TBL05M	500±10
	I/O cable	SDA-TB1M	1000±10
	I/O cable	SDA-TBL2M	2000±10
	I/O terminal block	SDA-TBL50	--
Battery set (CN5)	Absolute encoder battery set	SDH-BAT-SET	--
	Absolute encoder battery	SDH-BAT	--

❖ Encoder connector

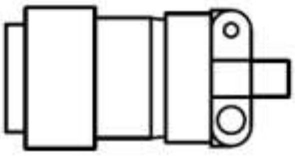
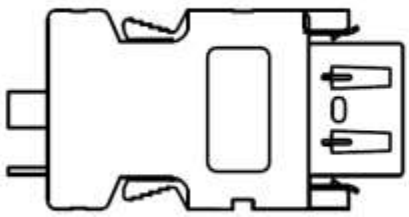
- Part number: SDH-ENL

Low inertia: 50W, 100W, 200W, 400W, 750W
High inertia: 200W, 400W, 750W

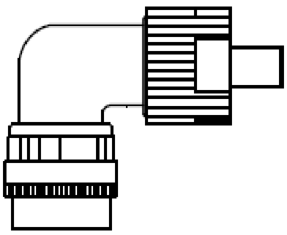
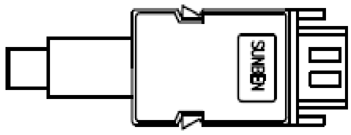
- Part number: SDH-ENM

Low inertia: 1KW, 1.5KW, 2.0KW, 3.0KW
Middle inertia: 1KW, 1.5KW, 2.0KW, 3.0KW
High inertia: 850W, 1.3KW, 1.8KW

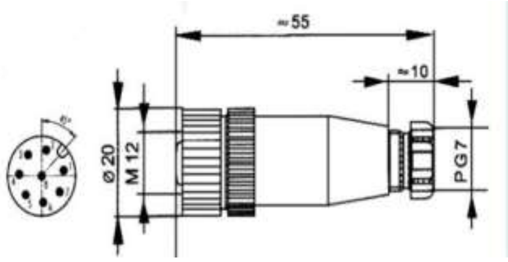



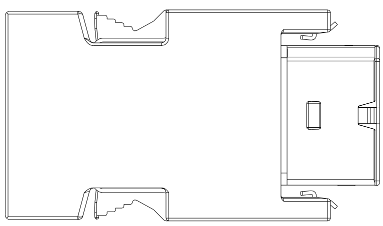
- Part number: SDP-ENM

(400V)High inertia: 1.8KW, 2.9KW, .4.4KW, 5.5KW, 7.5KW

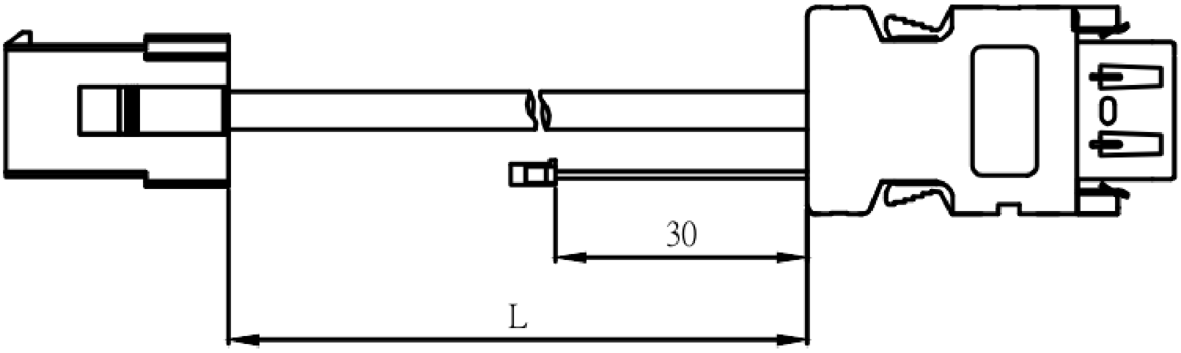
- Part number: SDP-Endat(Encoder cable of Linear motor (Endat2.2 communication type))

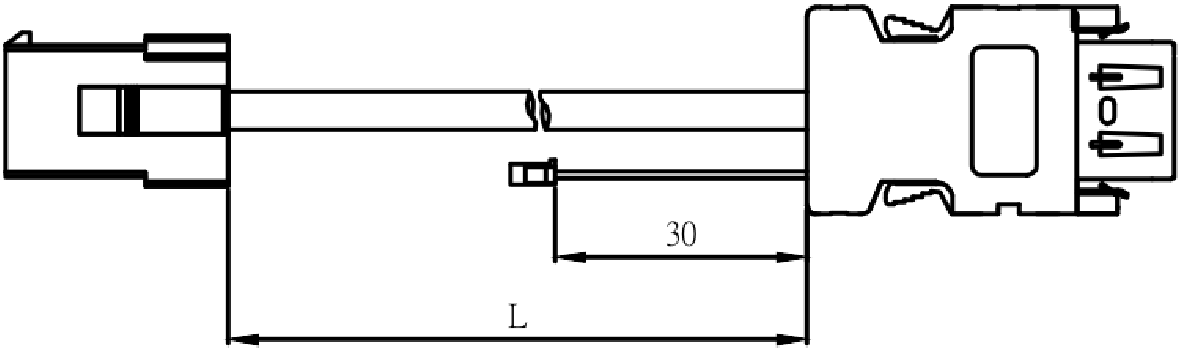




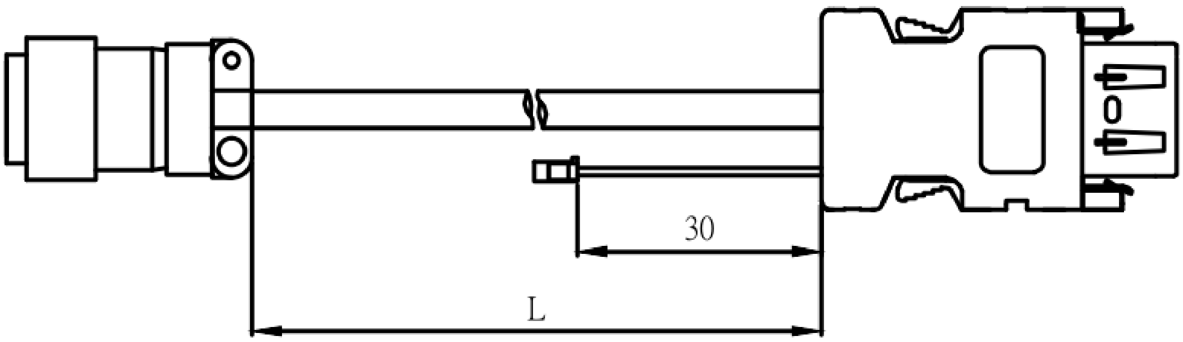
Encoder cable

- Low inertia encoder cable: 50W, 100W, 200W, 400W, 750W
- High inertia encoder cable: 200W, 400W, 750W

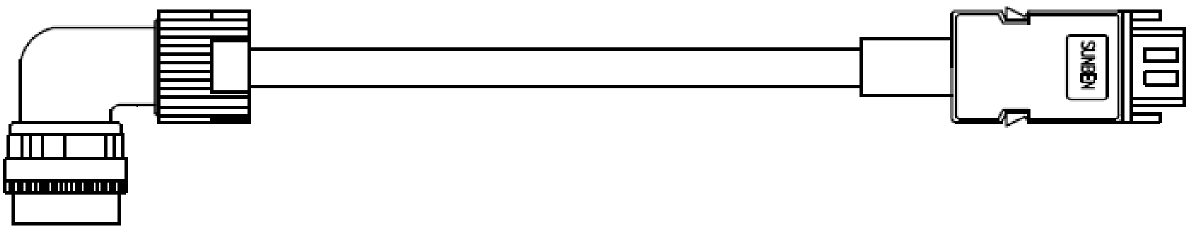




- Low inertia encoder cable: 1KW, 1.5KW, 2.0KW, 3.0KW
- Middle inertia encoder cable: 1KW, 1.5KW, 2.0KW, 3.0KW
- High inertia encoder cable: 850W, 1.3KW, 1.8KW

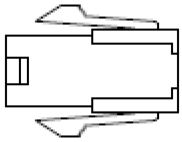


- (400V)High inertia encoder cable: 1.8KW, 2.9KW, 4.4KW, 5.5KW, 7.5KW

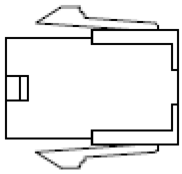


❖ **Power connector**

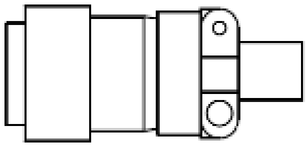
- Part number: SDA-PWCNL1 (50W, 100W, 200W, 400W, 750W without brake)



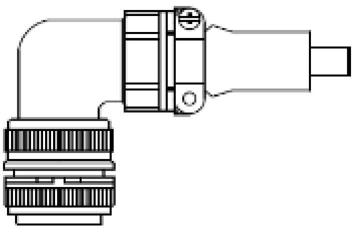
SDA-PWCNL2 (50W, 100W, 200W, 400W, 750W with brake)



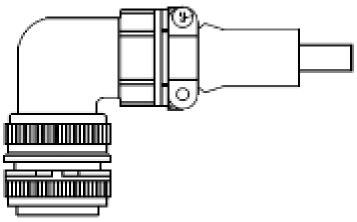
- Part number: SDA-PWCNM2 (Middle inertia 2KW, 3KW)



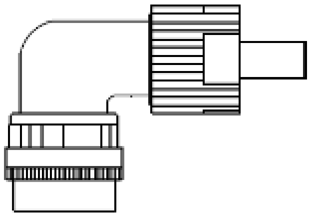
- Part number: SDP-PWCNH1(400V High inertia 1.8KW)



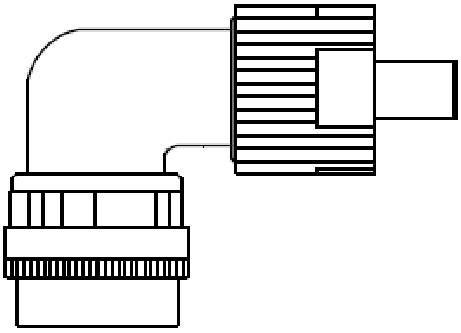
- Part number: SDP-PWCNH2(400V High inertia 2.9KW, 4.4KW)



- Part number: SDP-PWCNH3(400V High inertia5.5KW, 7.5KW)

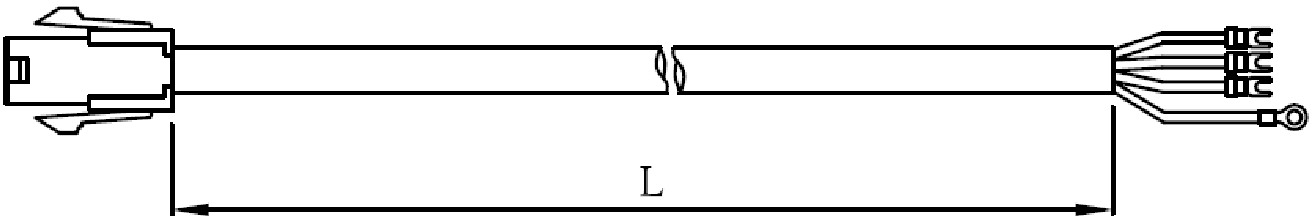


- Part number: SDP-BKCNS1(400V High inertia 1.8KW, 2.9KW, .4.4KW, 5.5KW, 7.5KW)

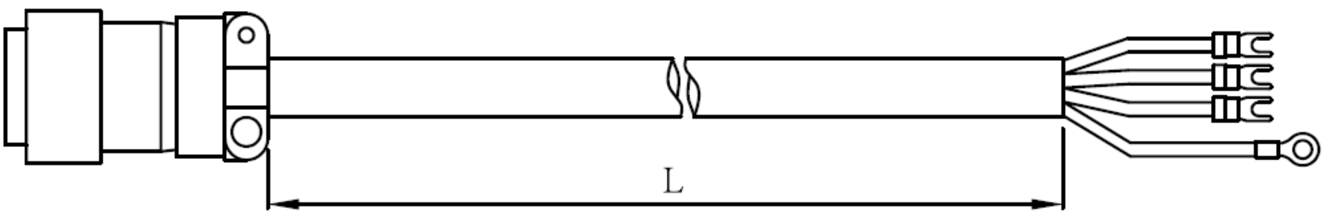


❖ Power cable

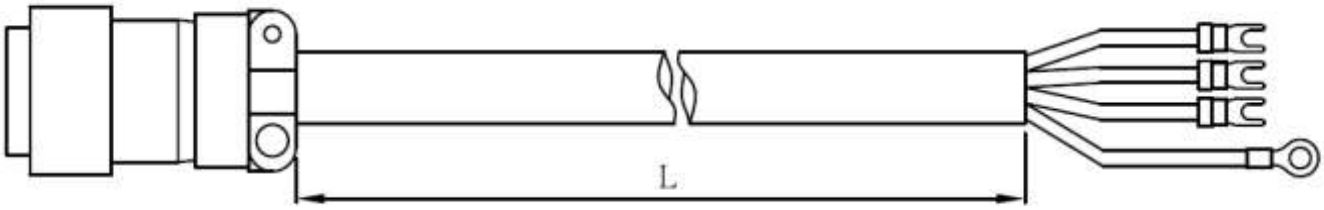
- Low inertia power cable: 50W, 100W, 200W, 400W, 750W
- High inertia power cable: 200W, 400W, 750W



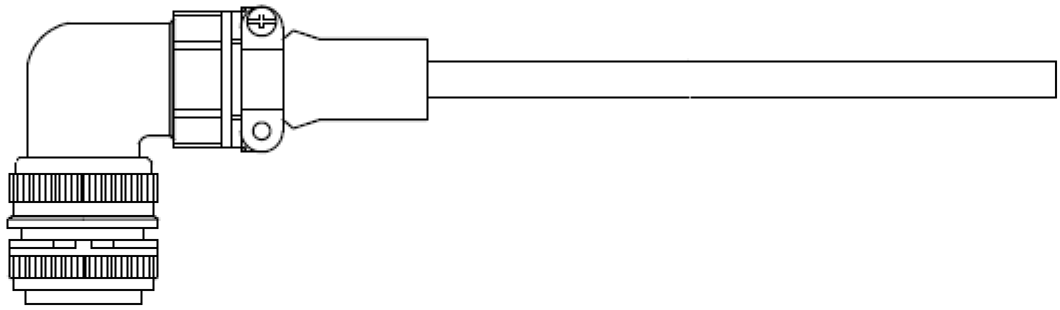
- Low inertia power cable: 1KW, 1.5KW, 2.0KW, 3.0KW
- Middle inertia power cable: 1KW, 1.5KW
- High inertia power cable: 850W, 1.3KW, 1.8KW



- Middle inertia power cable: Middle inertia 2KW, 3KW

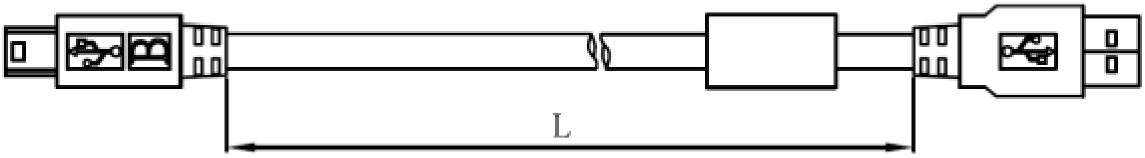


- (400V)High inertia power cable: 1.8KW, 2.9KW, .4.4KW, 5.5KW, 7.5KW



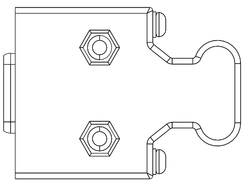
❖ **USB communication cable for drive and computer**

Part number: SDA-USB3M



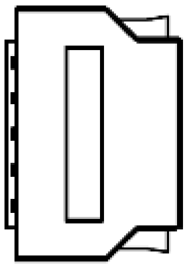
❖ Full-closed loop(differential A,B,Z type)

Part number: SDP-CN2



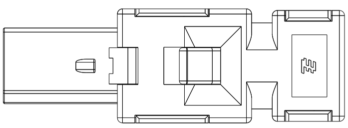
❖ I/O cable

Part number: SDA-CN1



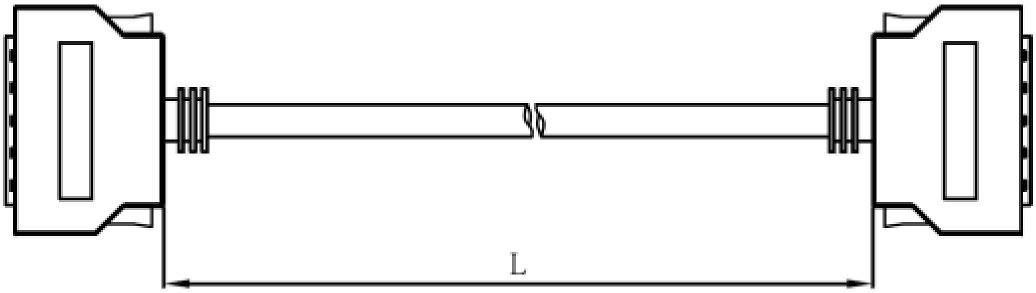
❖ STO communication cable

Part number: SDP-CN6



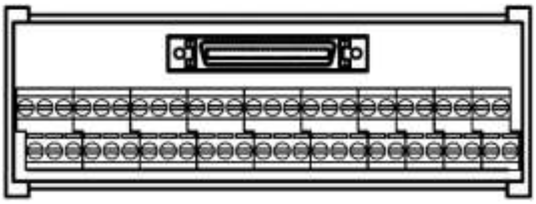
❖ I/O cable

Part number: SDA-TBL05M, SDA-TBL1M, SDA-TBL2M

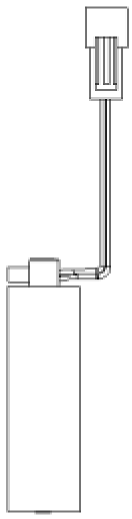


❖ I/O terminal block

Part number: SDA-TBL50



Absolute encoder accessory:

Absolute encoder battery set	Absolute encoder battery
Part number: SDH-BAT-SET	Part number: SDH-BAT
	

14.2 Regenerative resistor

Drive model name	Built-in regenerative resistor specification			
	Resistance value (Ω)	Capacity (W)	PA10 Regenerative resistance value	PA11 Regenerative resistance capacity.
SDP-010A2C	100	20	100	20
SDP-020A2C	100	20	100	20
SDP-040A2C	100	20	100	20
SDP-075A2C	40	40	40	40
SDP-100A2C	40	40	40	40
SDP-150A2C	13	100	13	100
SDP-200A2C	13	100	13	100
SDP-300A2C	13	100	13	100

★When using external regenerative resistor, the terminal P,D should be open-circuited.

Drive model name	Specification of external resistor(proposed)				Resistor Part Number
	Min allowance resistance value (Ω)	Recommended capacity (W)	PA10 Regenerative resistance value	PA11 Regenerative resistance capacity	
SDP-010A2C	100	300	100	300	ABR-300W100
SDP-020A2C	100	300	100	300	ABR-300W100
SDP-040A2C	100	300	100	300	ABR300W100
SDP-075A2C	40	500	40	500	ABR-500W40
SDP-100A2C	40	500	40	500	ABR-500W40
SDP-150A2C	13	1000	13	1000	ABR-1000W13
SDP-200A2C	13	1000	13	1000	ABR-1000W13
SDP-300A2C	13	1000	13	1000	ABR-1000W13
SDP-200A4C	30	1000	30	1000	ABR-1000W30
SDP-300A4C	30	1000	30	1000	ABR-1000W30
SDP-500A4C	20	2000	20	2000	ABR-2000W20
SDP-700A4C	15	2000	15	2000	ABR-2000W15

★When using external regenerative resistor on 400V drive, connect to P,C terminal.

14.3 Table of communication address

NO	address	NO	address	NO	address	NO	address
PA01	0x0300	PA16	0x031E	PA31	0x033C	PA46	0x035A
PA02	0x0302	PA17	0x0320	PA32	0x033E	PA47	0x035C
PA03	0x0304	PA18	0x0322	PA33	0x0340	PA48	0x035E
PA04	0x0306	PA19	0x0324	PA34	0x0342	PA49	0x0360
PA05	0x0308	PA20	0x0326	PA35	0x0344	PA50	0x0362
PA06	0x030A	PA21	0x0328	PA36	0x0346		
PA07	0x030C	PA22	0x032A	PA37	0x0348		
PA08	0x030E	PA23	0x032C	PA38	0x034A		
PA09	0x0310	PA24	0x032E	PA39	0x034C		
PA10	0x0312	PA25	0x0330	PA40	0x034E		
PA11	0x0314	PA26	0x0332	PA41	0x0350		
PA12	0x0316	PA27	0x0334	PA42	0x0352		
PA13	0x0318	PA28	0x0336	PA43	0x0354		
PA14	0x031A	PA29	0x0338	PA44	0x0356		
PA15	0x031C	PA30	0x033A	PA45	0x0358		
NO	**address**	**NO**	**address**	**NO**	**address**	**NO**	**address**
PB01	0x0400	PB16	0x041E	PB31	0x043C	PB46	0x045A
PB02	0x0402	PB17	0x0420	PB32	0x043E	PB47	0x045C
PB03	0x0404	PB18	0x0422	PB33	0x0440	PB48	0x045E
PB04	0x0406	PB19	0x0424	PB34	0x0442	PB49	0x0460
PB05	0x0408	PB20	0x0426	PB35	0x0444	PB50	0x0462
PB06	0x040A	PB21	0x0428	PB36	0x0446	PB51	0x0464
PB07	0x040C	PB22	0x042A	PB37	0x0448	PB52	0x0466
PB08	0x040E	PB23	0x042C	PB38	0x044A	PB53	0x0468
PB09	0x0410	PB24	0x042E	PB39	0x044C	PB54	0x046A
PB10	0x0412	PB25	0x0430	PB40	0x044E	PB55	0x046C
PB11	0x0414	PB26	0x0432	PB41	0x0450	PB56	0x046E
PB12	0x0416	PB27	0x0434	PB42	0x0452	PB57	0x0470
PB13	0x0418	PB28	0x0436	PB43	0x0454	PB58	0x0472
PB14	0x041A	PB29	0x0438	PB44	0x0456	PB59	0x0474
PB15	0x041C	PB30	0x043A	PB45	0x0458		

NO	address	NO	address	NO	address	NO	address
PC01	0x0500	PC26	0x0532	PC51	0x0564	PC76	0x0596
PC02	0x0502	PC27	0x0534	PC52	0x0566	PC77	0x0598
PC03	0x0504	PC28	0x0536	PC53	0x0568	PC78	0x059A
PC04	0x0506	PC29	0x0538	PC54	0x056A	PC79	0x059C
PC05	0x0508	PC30	0x053A	PC55	0x056C	PC80	0x059E
PC06	0x050A	PC31	0x053C	PC56	0x056E	PC81	0x05A0
PC07	0x050C	PC32	0x053E	PC57	0x0570	PC82	0x05A2
PC08	0x050E	PC33	0x0540	PC58	0x0572	PC83	0x05A4
PC09	0x0510	PC34	0x0542	PC59	0x0574	PC84	0x05A6
PC10	0x0512	PC35	0x0544	PC60	0x0576	PC85	0x05A8
PC11	0x0514	PC36	0x0546	PC61	0x0578	PC86	0x05AA
PC12	0x0516	PC37	0x0548	PC62	0x057A	PC87	0x05AC
PC13	0x0518	PC38	0x054A	PC63	0x057C	PC88	0x05AE
PC14	0x051A	PC39	0x054C	PC64	0x057E	PC89	0x05B0
PC15	0x051C	PC40	0x054E	PC65	0x0580	PC90	0x05B2
PC16	0x051E	PC41	0x0550	PC66	0x0582	PC91	0x05B4
PC17	0x0520	PC42	0x0552	PC67	0x0584	PC92	0x05B6
PC18	0x0522	PC43	0x0554	PC68	0x0586	PC93	0x05B8
PC19	0x0524	PC44	0x0556	PC69	0x0588	PC94	0x05BA
PC20	0x0526	PC45	0x0558	PC70	0x058A	PC95	0x05BC
PC21	0x0528	PC46	0x055A	PC71	0x058C	PC96	0x05BE
PC22	0x052A	PC47	0x055C	PC72	0x058E	PC97	0x05C0
PC23	0x052C	PC48	0x055E	PC73	0x0590	PC98	0x05C2
PC24	0x052E	PC49	0x0560	PC74	0x0592	PC99	0x05C4
PC25	0x0530	PC50	0x0562	PC75	0x0594		
NO	**address**	**NO**	**address**	**NO**	**address**	**NO**	**address**
PD01	0x0600	PD11	0x0614	PD21	0x0628	PD31	0x063C
PD02	0x0602	PD12	0x0616	PD22	0x062A	PD32	0x063E
PD03	0x0604	PD13	0x0618	PD23	0x062C	PD33	0x0640
PD04	0x0606	PD14	0x061A	PD24	0x062E	PD34	0x0642
PD05	0x0608	PD15	0x061C	PD25	0x0630	PD35	0x0644
PD06	0x060A	PD16	0x061E	PD26	0x0632	PD36	0x0646
PD07	0x060C	PD17	0x0620	PD27	0x0634	PD37	0x0648
PD08	0x060E	PD18	0x0622	PD28	0x0636	PD38	0x064A
PD09	0x0610	PD19	0x0624	PD29	0x0638	PD39	0x064C
PD10	0x0612	PD20	0x0626	PD30	0x063A	PD40	0x064E

NO	address	NO	address	NO	address
PE01	0x0700	PE34	0x0742	PE67	0x0784
PE02	0x0702	PE35	0x0744	PE68	0x0786
PE03	0x0704	PE36	0x0746	PE69	0x0788
PE04	0x0706	PE37	0x0748	PE70	0x078A
PE05	0x0708	PE38	0x074A	PE71	0x078C
PE06	0x070A	PE39	0x074C	PE72	0x078E
PE07	0x070C	PE40	0x074E	PE73	0x0790
PE08	0x070E	PE41	0x0750	PE74	0x0792
PE09	0x0710	PE42	0x0752	PE75	0x0794
PE10	0x0712	PE43	0x0754	PE76	0x0796
PE11	0x0714	PE44	0x0756	PE77	0x0798
PE12	0x0716	PE45	0x0758	PE78	0x079A
PE13	0x0718	PE46	0x075A	PE79	0x079C
PE14	0x071A	PE47	0x075C	PE80	0x079E
PE15	0x071C	PE48	0x075E	PE81	0x07A0
PE16	0x071E	PE49	0x0760	PE82	0x07A2
PE17	0x0720	PE50	0x0762	PE83	0x07A4
PE18	0x0722	PE51	0x0764	PE84	0x07A6
PE19	0x0724	PE52	0x0766	PE85	0x07A8
PE20	0x0726	PE53	0x0768	PE86	0x07AA
PE21	0x0728	PE54	0x076A	PE87	0x07AC
PE22	0x072A	PE55	0x076C	PE88	0x07AE
PE23	0x072C	PE56	0x076E	PE89	0x07B0
PE24	0x072E	PE57	0x0770	PE90	0x07B2
PE25	0x0730	PE58	0x0772	PE91	0x07B4
PE26	0x0732	PE59	0x0774	PE92	0x07B6
PE27	0x0734	PE60	0x0776	PE93	0x07B8
PE28	0x0736	PE61	0x0778	PE94	0x07BA
PE29	0x0738	PE62	0x077A	PE95	0x07BC
PE30	0x073A	PE63	0x077C	PE96	0x07BE
PE31	0x073C	PE64	0x077E	PE97	0x07C0
PE32	0x073E	PE65	0x0780	PE98	0x07C2
PE33	0x0740	PE66	0x0782	PE99	0x07C4

NO	address	NO	address	NO	address
PF01	0x0800	PF34	0x0842	PF67	0x0884
PF02	0x0802	PF35	0x0844	PF68	0x0886
PF03	0x0804	PF36	0x0846	PF69	0x0888
PF04	0x0806	PF37	0x0848	PF70	0x088A
PF05	0x0808	PF38	0x084A	PF71	0x088C
PF06	0x080A	PF39	0x084C	PF72	0x088E
PF07	0x080C	PF40	0x084E	PF73	0x0890
PF08	0x080E	PF41	0x0850	PF74	0x0892
PF09	0x0810	PF42	0x0852	PF75	0x0894
PF10	0x0812	PF43	0x0854	PF76	0x0896
PF11	0x0814	PF44	0x0856	PF77	0x0898
PF12	0x0816	PF45	0x0858	PF78	0x089A
PF13	0x0818	PF46	0x085A	PF79	0x089C
PF14	0x081A	PF47	0x085C	PF80	0x089E
PF15	0x081C	PF48	0x085E	PF81	0x08A0
PF16	0x081E	PF49	0x0860	PF82	0x08A2
PF17	0x0820	PF50	0x0862	PF83	0x08A4
PF18	0x0822	PF51	0x0864	PF84	0x08A6
PF19	0x0824	PF52	0x0866	PF85	0x08A8
PF20	0x0826	PF53	0x0868	PF86	0x08AA
PF21	0x0828	PF54	0x086A	PF87	0x08AC
PF22	0x082A	PF55	0x086C	PF88	0x08AE
PF23	0x082C	PF56	0x086E	PF89	0x08B0
PF24	0x082E	PF57	0x0870	PF90	0x08B2
PF25	0x0830	PF58	0x0872	PF91	0x08B4
PF26	0x0832	PF59	0x0874	PF92	0x08B6
PF27	0x0834	PF60	0x0876	PF93	0x08B8
PF28	0x0836	PF61	0x0878	PF94	0x08BA
PF29	0x0838	PF62	0x087A	PF95	0x08BC
PF30	0x083A	PF63	0x087C	PF96	0x08BE
PF31	0x083C	PF64	0x087E	PF97	0x08C0
PF32	0x083E	PF65	0x0880	PF98	0x08C2
PF33	0x0840	PF66	0x0882	PF99	0x08C4

NO	address	NO	address	NO	address
PL01	0x0E00	PL21	0x0E28	PL41	0x0E50
PL02	0x0E02	PL22	0x0E2A	PL42	0x0E52
PL03	0x0E04	PL23	0x0E2C	PL43	0x0E54
PL04	0x0E06	PL24	0x0E2E	PL44	0x0E56
PL05	0x0E08	PL25	0x0E30	PL45	0x0E58
PL06	0x0E0A	PL26	0x0E32	PL46	0x0E5A
PL07	0x0E0C	PL27	0x0E34	PL47	0x0E5C
PL0E	0x0E0E	PL28	0x0E36	PL48	0x0E5E
PL09	0x0E10	PL29	0x0E38	PL49	0x0E60
PL10	0x0E12	PL30	0x0E3A	PL50	0x0E62
PL11	0x0E14	PL31	0x0E3C	PL51	0x0E64
PL12	0x0E16	PL32	0x0E3E		
PL13	0x0E18	PL33	0x0E40		
PL14	0x0E1A	PL34	0x0E42		
PL15	0x0E1C	PL35	0x0E44		
PL16	0x0E1E	PL36	0x0E46		
PL17	0x0E20	PL37	0x0E48		
PL18	0x0E22	PL38	0x0E4A		
PL19	0x0E24	PL39	0x0E4C		
PL20	0x0E26	PL40	0x0E4E		

14.4 Compliance with global standards

14.4.1. Safety instructions

Before installing this equipment, please read this manual carefully to ensure use it correctly. This section explains the safety regulations for users and equipment operation.


To avoid the possibility of electric shock, please turn off the power for more than 20 minutes until the charging indicator is off and the voltage test is confirmed, and then It can be wired or inspected, otherwise it may cause electric shock.

14.4.2. Professional technicians.

Only the professional technician who has received professional training can install the SDP servo drive.

14.4.3. Compliance with standards

(1) Safety regulations

SDP general type servo drive complies with IEC/EN61800-5-1 standards.

(2) Compliance with EU standards

SDP general type servo complies with EMC directive(2014/30/EU) and low voltage directive(2014/35/EU).

(3) Compliance with USA/Canada regulations

This servo drive design complies with UL 508C and CSA C22.2 No.274-13

(a) Installation

The minimum size of the distribution box should be 200% the size of the SDP servo drive. For ventilation of the fan and to keep the ambient temperature below 55°C, only copper wires can be used for wiring. The servo drive should be installed in a metal distribution box.

(b) Overload protection feature

The SDP servo drive has overload protection function. (It is specified based on 120% of the rated current of the servo drive (full load current).)

(c) Motor overheat protection

There is no temperature sensor inside the motor, and the SDP series do not have overheat protection.

(d) Capacitor discharge

After the power is turned off, do not touch the servo and its terminals immediately. The capacitor discharge takes 20 minutes.

(e) About wiring protection

When installing equipment in the United States, branch circuit protection is based on national electrical regulations and local regulations. When installing equipment in Canada, branch circuit protection is based on the Canadian Electrical regulations and provincial regulations.

14.4.4. Correct use

The use of equipment must comply with the specifications (voltage, temperature, etc. , please refer to section 12.1 for details).

(1) Power cable

Refer to section 3.1.6 for detailed power cable selection instruction.

Note 1: when connecting to the terminal block, use the screws included with the terminal block.

Note 2: the letters in the table indicate crimping tools, please refer to the recommended crimping terminal table for crimping terminals and suitable tools.

Note 3: the cable AWG selection depends on the specifications of the servo motor.

(2) Fixed terminal block: crimp terminals must comply with UL specifications, and insulating sleeves must be used to prevent direct contact.

Drive	**Recommended torque(Nt-m)**			
	R, S, T	**U, V, W**	**+, -, P, P1, D, C, N**	**PE**
SDP－200A4C	1.53	1.53	1.53	1.4
SDP－300A4C				
SDP－500A4C				
SDP－700A4C				

(3) Example of non-fuse circuit breaker selection

Drive	UL certified current-limiting circuit breaker	Example
SDP-010A2C	240 V, 5 A	NF50-SVFU 5A
SDP-020A2C		
SDP-040A2C	240 V, 10 A	NF50-SVFU 3P 10A
SDP-075A2C	240 V, 15 A	NF50-SVFU 3P 15A
SDP-100A2C		
SDP-150A2C	240 V, 30 A	NF50-SVFU 3P 30A
SDP-200A2C		
SDP-300A2C		
SDP-200A4C	480 V, 20 A	NF125-SVU 3P 20A
SDP-300A4C	480 V, 30 A	NF125-SVU 3P 30A
SDP-500A4C	480 V, 60 A	NF125-SVU 3P 60A
SDP-700A4C	480 V, 70 A	NF125-SVU 3P 70A

14.4.5. Basic inspection and maintenance

14.4.5.1.Basic inspection

It is recommended that the user do the following inspection regularly. Please carefully check whether the servo drive is powered off and the charging indicator is off before performing the following inspection:

- Check whether the screws of the terminal block, drive installation part, servo motor and mechanism connection are loose, if yes, please tighten it.
- The servo should not be placed where harmful gas exists.
- Avoid placing conductive objects next to the drive and the drive wiring.
- Servo motor wiring should avoid excessively long bare area and avoid use damaged or broken wire.
- Insulation should be done at the wiring terminal.
- Check whether the external voltage is correctly with AC220V.
- Check whether the operation switch is OFF.
- Check whether power wiring and encoder wiring is correct.

14.4.5.2.Maintenance

Do not disassemble the servo drive by yourself. Please follow below instruction for regular maintenance:

- Wipe the servo drive and servo motor regularly to avoid the dust.
- Do not operate for a long time in harsh environment.
- The vents of the servo drive should be kept clean to avoid dust accumulation.

14.4.5.3 Parts service life

The lifetime of the parts may be changed due to the user's operating environment. When an abnormality occurs, it needs to be replaced immediately. Please contact the distributor for replacing parts. The service life of the parts is as follows:

Component name	Approximate lifetime	Description
Relay	100,000 times	The power capacity will impact its life, the accumulative number of switching is about 100,000 times.
Cooling fan	10,000~30,000 hours (2-3 years)	Continuous operation or placing the servo drive in a place with harmful gas will shorten the service life of the fan. Normally the lifetime is about 2 to 3 years. However, if the fan runs with abnormal noise, it needs to be replaced.
Rectified capacitor	10 years	If the rectified capacitor is affected by the ripple current, its features will be decreased. The service life of the capacitor is affected by the surrounding temperature and use conditions. If the servo is operated in a general environment with air conditioning, the service life is about 10 years.

14.5 Manual version and revision history

Manual version: V1.00

Release month: July, 2022