Introduction

Thank you for choosing EA180 Series Servo Drives!

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Version: 100

EA180 series servo drives are high-performance medium and small power AC servo units developed by SINEE. This series of products adopt advanced DSP chips for motor control, large-scale field programmable gate array (CPLD/FPGA) and PIM power module, and features high integration, small size, perfect protection and high reliability. The optimized PID control algorithm enables accurate full-digital control of torque, position and speed to achieve high precision and fast response. It provides advanced functions such as rigid selection, real-time automatic gain setting, automatic resonance suppression, etc. In addition, the products have rich digital and analog interfaces and support MODBUS communication protocol to facilitate networking. The two sub-series respectively support motors using 2500 PPR incremental pulse encoders or 17-bit incremental magnetic encoders, Tamagawa's 17-bit incremental photoelectric encoders and 23-bit absolute photoelectric encoders to meet different requirements on cost and performance. The products can be widely used in automation fields such as numerical control machine tools, printing and packaging machinery, textile machinery, robots, automatic production lines, etc.

The EA180 series servo drives are also available in three models supporting EtherCAT bus (EA180E), CANopen bus (EA180C) and PROFINET bus (EA180P).

We have been committed to the continuous improvement of products and product information. Therefore, the information provided by us is subject to change without prior notice. For the latest changes and more information, please visit www.sineedrive.com.

Safety Precautions

Safety definitions: In this Manual, safety precautions include the following two types:

	Danger: Danger caused by failure to operate as required, which may lead to serious injuries and even death;
	Attention: Danger caused by failure to operate as required, which may lead to moderate or minor injuries and equipment damage;

Please read this chapter carefully when installing, debugging and repairing this system, and be sure to operate according to the safety precautions required herein. We bear no liability for any injury and loss caused by illegal operation.

Safety Precautions

Before installation:

 **Danger**
1. If it is found that the package is flooded, any parts are missing or damaged after unpacking, please do not install the device! 2. If the mark on the outer package does not match the name of the physical product, please do not install the device!

 **Attention**
1. Please handle the device gently, otherwise it may be damaged! 2. Do not use damaged servo drives or servo drives with missing parts, otherwise there is a risk of injury! 3. Do not touch any component of the control system with your hands, otherwise electrostatic damage may be caused!

During installation:

 **Danger**
1. Please install the device on metal or other flame retardant objects and keep it away from combustible materials, otherwise a fire may be caused!

 **Attention**
1. Please prevent any lead end or screw from falling into the servo drive, otherwise the device will be damaged! 2. Please install the servo drive in a place with less vibration and no direct sunlight. 3. When the servo drive is placed in a relatively closed cabinet or space, please reserve the installation gap to ensure the cooling effect.

When wiring:

 **Danger**
1. The instructions in this Manual must be followed and used by professional electrical engineers, otherwise unexpected risks will occur! 2. There must be a circuit breaker between the servo drive and the power supply, otherwise a fire may occur! 3. Please make sure the power supply is in zero energy state before wiring, otherwise electric shock may be caused! The servo drive must be grounded correctly according to the standard, otherwise electric shock may be caused! 4. The grounding terminal must be grounded reliably, otherwise electric shock or a fire may be caused.

⚠ Attention
1. Never connect the input power supply to the output terminals (U, V, W) of the servo drive. Pay attention to the marking on the wiring terminals to ensure correct wiring! Otherwise, the servo drive will be damaged! 2. Please ensure that the power lines comply with EMC requirements and local safety standards. Please refer to the recommendations for the preferred wire diameter, otherwise accidents may occur! 3. Never connect the braking resistor directly between the DC bus P + and - terminals! Otherwise, it will cause a fire! 4. Please fasten the terminals with a screwdriver with the specified torque, otherwise a fire may be caused. 5. Never connect a phase-shift capacitor and LC/RC noise filter to the output circuit. 6. Never connect an electromagnetic switch or magnetic contactor to the output circuit. Otherwise, the overcurrent protection circuit of the servo drive will operate, which will cause internal damage to the servo drive in serious cases. 7. Do not remove the connection cables inside the servo drive, otherwise it may cause internal damage to the servo drive.

Before power-on:

⚠ Attention
1. Please confirm whether the voltage level of the input power supply is consistent with the rated voltage level of the servo drive and whether the wiring positions on the power input terminals (L1, L2, L3) and output terminals (U, V, W) are correct; and pay attention to check whether there is any short circuit in the peripheral circuit connected with the servo drive and ensure the wire connections are reliable, otherwise the servo drive may be damaged! 2. Withstand voltage test has been performed for the product before delivery from the factory, and it's not necessary to do it again for any part. Otherwise, an accident may be caused!

⚠ Attention
1、The servo drive must be covered with the cover plate before being powered on, otherwise it may cause electric shock! 2、The wiring of all peripheral fittings must be performed correctly according to the instructions and circuit connection method in this Manual. Otherwise, an accident may be caused!

After power-on:

⚠ Danger
1. Do not touch the servo drive and peripheral circuits with wet hands, otherwise an electric shock may be caused! 2. After power-on, if the indicator light is not on or the keypad displays nothing, please disconnect the power switch immediately. Do not touch the servo drives L1, L2, L3 or any connection terminals by hand or screwdriver, otherwise an electric shock may be caused. After disconnecting the power switch, contact our customer service personnel immediately. 3. At the beginning of power-on, the servo drive will automatically carry out safety detection on the external strong current circuit. At this time, never touch the U, V, W connection terminals of the servo drive or the motor connection terminals, otherwise an electric shock may be caused!

Attention
1. If parameter identification is required, please pay attention to the danger of injury caused by motor rotation, otherwise accidents may occur! 2. Do not change the default parameters of the servo drive, otherwise it may cause damage to the device!

During operation:

Danger
1. Do not test the temperature by touching the cooling fan, radiator, servo motor or discharge resistor, otherwise it may cause burns! 2. Non-professional technicians are not allowed to detect signals during operation, otherwise personal injury or equipment damage may be caused!

Attention
1. Please prevent anything from falling into the servo drive during its operation, otherwise the device may be damaged! 2. Do not control the start and stop of servo drive by switching on or off the contactor, otherwise the device may be damaged! 3. Do not touch the rotating shaft of a running motor, otherwise it may cause injury!

During maintenance:

Danger
1. Please do not repair or maintain the device when powered on, otherwise an electric shock may occur! 2. Cut off the power supply of the main circuit and confirm that the CHARGE indicator light is off before maintenance or repair of the servo drive, otherwise personal injury may be caused by the residual charge on the capacitor! 3. Personnel without professional training is not allowed to repair and maintain the servo drive, otherwise personal injury or equipment damage may be caused! 4. After replacing a variable servo drive, the parameters must be set, and power must be cut before plugging or unplugging of any pluggable component!

Precautions

- **If there is any voltage-sensitive component or capacitor to improve the power factor on the output side:**

  The servo drive outputs PWM waves. If there is any capacitor or voltage-sensitive component to improve the power factor or capacitor for lightning protection on the output side, instantaneous overcurrent of or even damage to the servo drive may be easily caused. Please do not use it.

- **Lightning shock protection**

  This series of servo drives are equipped with lightning overcurrent protection unit, which have certain self-protection capability for induced lightning. For areas with frequent lightning, lightning protection device should also be installed before the servo drive.

- **Altitude and derating**

  In areas with an altitude of more than 1,000m, the servo drive will have a poor cooling effect due to thin air, so it is necessary to derate the device. Please consult us for technical advice in such a case.

- **Attention for servo drive scrapping**

  The electrolytic capacitor in the main circuit and the one on the PCB may explode during incineration, and toxic gases will be generated during incineration of plastic parts. Please treat them as industrial waste.

Maintenance and Inspection

Please carry out regular maintenance and inspection on the drive and motor for safe use.

Notes for maintenance and inspection

1) The operator should first cut off the power supply. Do not approach the motor and the machine it drives when wrong actions occur during power-on.
2) For a short period of time after the power supply is cut off, the internal circuit still maintains a high voltage charging state. Before inspection, the power supply must be cut off; wait for 10 minutes, and make sure that the charging light is completely off.
3) If it is necessary to test the insulation resistance of the drive, all connections to the drive must be cut off. Insulation resistance test on the drive connected with wires or a motor will damage the device.
4) Do not use gasoline, diluents, acidic or alkaline detergents to clean the device, otherwise discoloration or damage to the case may occur.

Inspection items and frequencies

Normal use conditions

The environmental conditions are as follows: the annual average temperature is 30 ℃, the average load rate is below 80%, and the daily operation time is below 20 hours.

Daily inspections and regular inspections shall be carried out according to the following list below.

Inspection	Frequency	Items
Daily inspection	Daily	● Confirm the use environment (temperature and humidity, dust, foreign matters) ● Check for any abnormal vibration or sounds ● Check whether the power supply voltage is in the normal range ● Check for peculiar odors ● Check for fiber adhesion at the vents ● Check whether connections are clean and tight ● Check for wire damage ● Check whether any connection with the device is loose or eccentricity occurs ● Check whether any foreign matter has entered the mechanical transmission part
Regular inspection	Yearly	● Check whether any fastening part is loose ● Check for signs of overheating ● Check whether there is any oil leakage in the transmission mechanism and whether the shaft extension of the motor has been polluted. ● Check whether the terminals are intact ● Check whether any connection between wires and the drive is loose

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Chapter 1 Product Information

1.1 Confirmation upon unpacking

In order to check if there is negligence in the purchase and delivery of this product, please check the items listed in the following table in detail:

Items	Content
Is it consistent with the model you ordered?	Check the product model on the motor and drive nameplates respectively. If cables are ordered, check the type and length listed on the label of the cables.
Is there any damage during transportation?	Visually inspect the appearance for any damage or scratches
Does the motor shaft run smoothly?	Rotate the motor shaft by hand. If it can run smoothly, it means that the motor shaft is normal. However, the motor with a brake cannot be rotated by hand!

If there is any abnormal situation, please contact the agent for a proper solution.

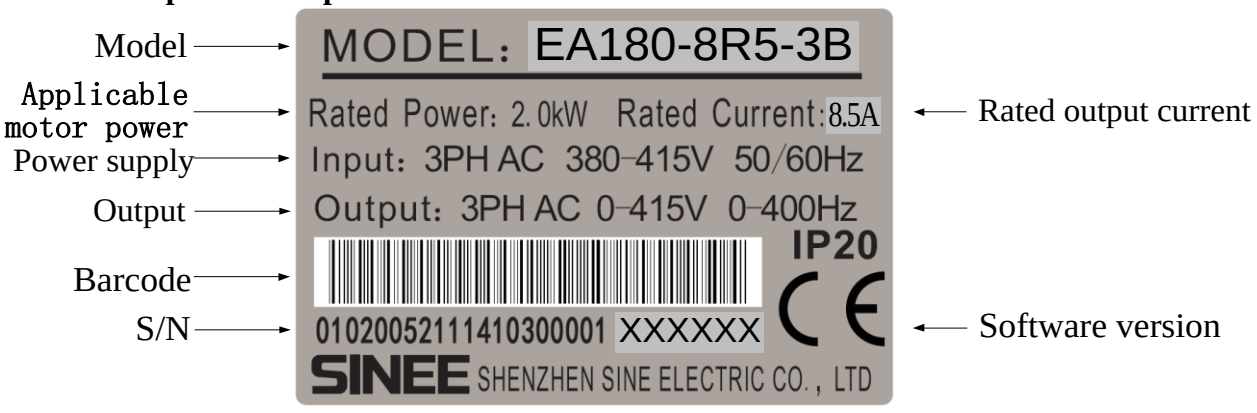
1.1.1 A fully operable servo assembly shall include:

1) A servo drive and a matching servo motor.
2) An encoder signal line connecting the mother seat of the motor-side encoder and the CN5 terminal of the drive.
3) A motor power line with four core wires of U (red), V (white or blue), W (black or brown) and PE (yellow and green) (a motor with a brake should also have two power lines for the brake). U, V and W wires must be connected to the corresponding terminals on the drive in sequence, and PE wire must be connected to the ground terminal of the drive.
4) The DB44 connector for CN4 can be used to make control lines according to actual needs.

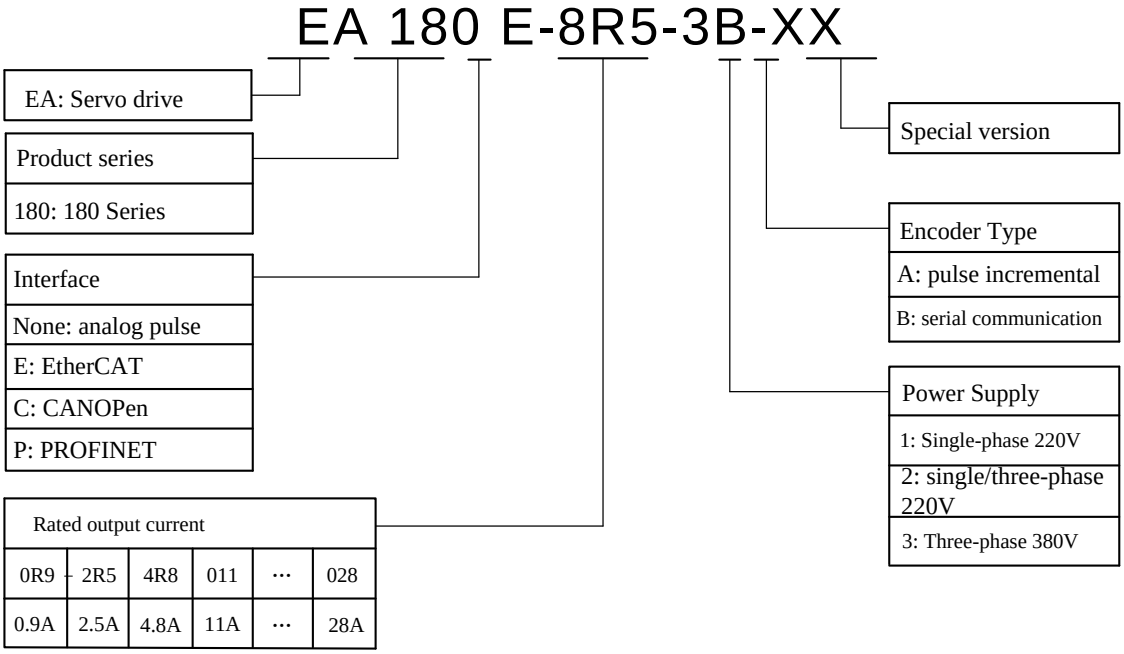
Note: 1) It is strongly recommended to purchase encoder signal lines from SINEE.
2) The colors of internal core wires of your motor power line purchased may be different from the above description. Therefore, please be sure to follow the letter marks on the core wires rather than colors.

1.2 EA180 servo drive

1.2.1 Nameplate description



1.2.2 **Product model description**



Note: 1): Products of AC220V, 4.8A - 6.2A apply to single-phase and three-phase AC220V power supply, so there is no special single-phase AC220V product.

2): For products of AC 220V, 11A and above, only the ones applicable to three-phase AC 220V power supply are provided.

3): For products of AC 220V, 2.5A and below, only the ones applicable to single-phase AC 220V power supply are provided.

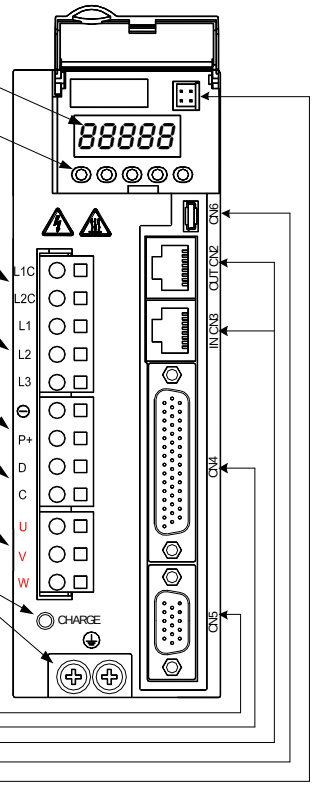
1.2.3 **Servo drive part names**

LED display	5-bit 7-segment LED displays running state
Buttons	Parameters setting

L1C, L2C control circuit power supply	Refer to the nameplate
L1, L2, L3 main circuit power supply	Refer to the nameplate (Size A model, i.e. 0R9, 1R6, 2R5 models have no L3 terminal)
P+, ⊖	DC bus voltage terminal, for DC bus sharing
P+, D, C external braking resistor	A short connector is installed between P+ and D by default; when using external braking resistor, remove the short bar to create open circuit between P+ and D, and connect an external braking resistor between P+ and C. (Size A model, i.e. 0R9, 1R6, 2R5 models have no D terminal)
U, V, W Servo motor	Connected to servo motor U, V, W

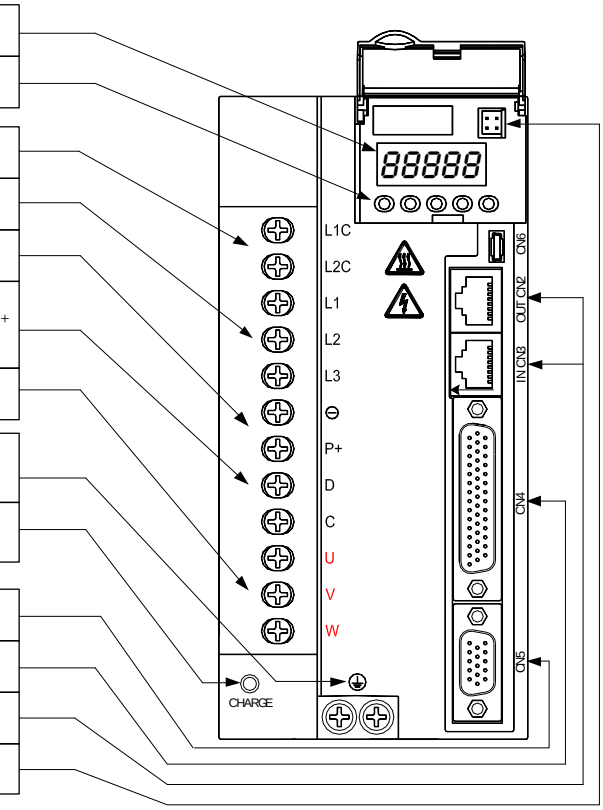
PE grounding terminal	Connected to power supply and servo motor ground
CHARGE Bus voltage indicator lamp	Used to indicate whether the bus capacitance is in a charged state. When the lamp is on, the capacitor inside the drive is charged even if the main circuit power supply is OFF.

CN5 encoder connection terminal	Connected to the encoder of servo motor
CN4 control terminal	Connected to the upper controller
CN2, CN3 comm terminal	Two in parallel, including RS232, RS485, CAN comm. port
CN6 USB comm. port	USB comm. port reserved
CN1 analog Monitoring port	Two analog outputs



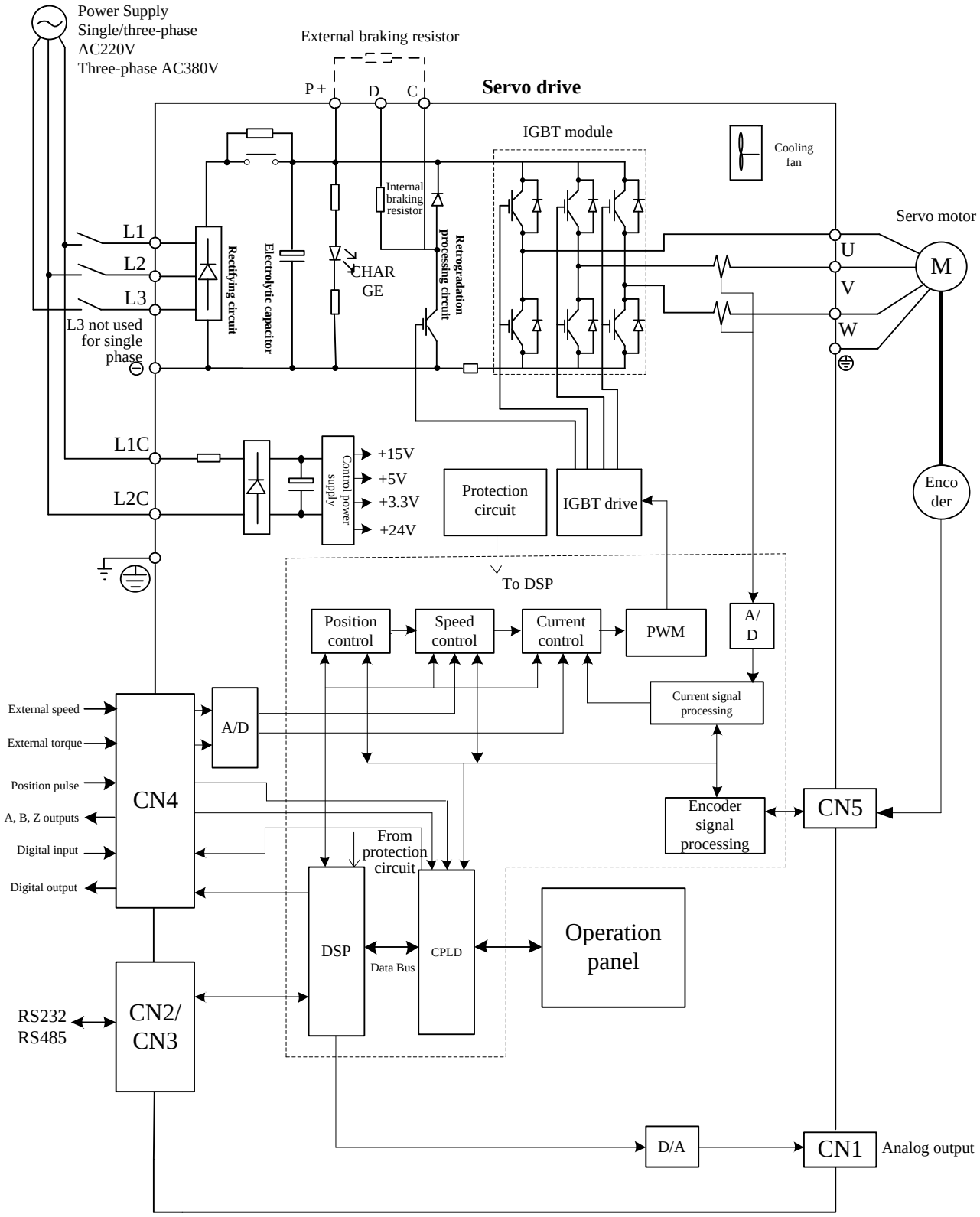
SIZE A/B model part names

LED display	5-bit 7-segment LED displays running state
Buttons	Parameters setting
L1C, L2C control circuit power supply	Refer to the nameplate
L1, L2, L3 Main circuit power supply	Refer to the nameplate
P+, ⊖	P+, ⊖ DC bus voltage terminal, for DC bus sharing
P+, D, Cexternal braking resistor	A short connector is installed between P+ and D by default; when using external braking resistor, remove the short bar to create open circuit between P+ and D, and connect an external braking resistor between P+ and C. (Size D models, i.e. 017, 022, 028 models have no D terminal)
U, V, W Servo motor	Connected to servo motor U, V, W
PE grounding terminal	Connected to power supply and servo motor ground (PE terminals of SIZE D model are in the same row as other ones)
CHARGE Bus voltage indicator lamp	Used to indicate whether the bus capacitance is in a charged state. When the lamp is on, the capacitor inside the drive is charged even if the main circuit power supply is OFF.
CN5 encoder connection terminal	Connected to the encoder of servo motor
CN4 control terminal	Connected to the upper controller
CN2, CN3 comm terminal	Two in parallel, including RS232, RS485, CAN comm. port
CN1 analog Monitoring port	Two analog outputs



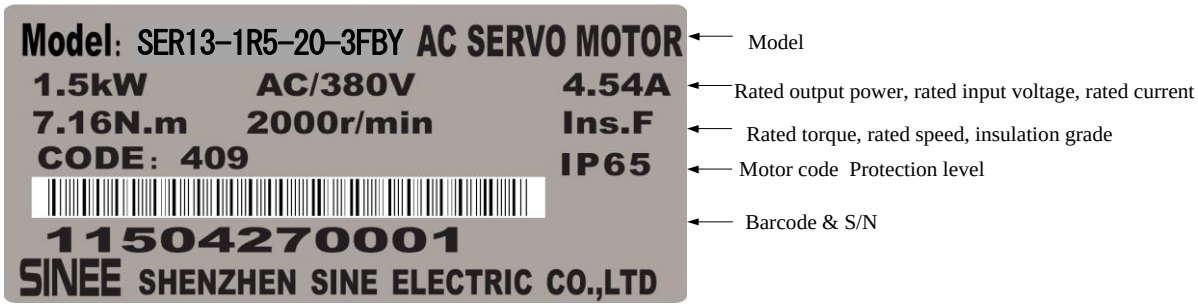
SIZE C/D model part names

1.2.4 **Block diagram of EA180 servo drive**



1.3 Servo motor

1.3.1 Nameplate description



Note: The text on the actual product nameplate may be slightly different from that shown in the figure.

1.3.2 Model description

SER ① 08 ② - 0R7 ③ - 30 ④ - 2 ⑤ F ⑥ A ⑦ Y ⑧ 1 ⑨ -XX ⑩

① Product series	② Motor flange size	③ Rated output power
SER: Standard servo motor SES: High performance servo motor SEM: High-power servo motor	04: 40mm 06: 60mm 08: 80mm 09: 86mm 11: 110mm 13:130mm 18: 180mm 20: 200mm 26: 266mm	005: 50W 0R1: 100W 0R2: 200W 0R4: 400W 0R7: 750W 1R0: 1000W 1R5: 1500W 2R0: 2000W 3R0: 3000W 4R4: 4400W 5R5: 5500W 7R5: 7500W 011: 11000W
④ Rated motor speed		
10: 1000rpm 15: 1500rpm 20: 2000rpm 25: 2500rpm 30: 3000rpm	⑦ Inertia type	
⑤ Voltage level	A: Low inertia B: Medium inertia C: High inertia	
2: 220V 3: 380V		⑨ Optional
⑥ Encoder type	⑧ Shaft end	None: No option
A: 2500ppr incremental B: 17-bit incremental H: 17-bit magnetic incremental F: 23-bit absolute G*1: 2500ppr wire-saving encoder	X: Shaft without keyway*1 Y: Shaft with U-shaped keyway and screw hole*2 Z: Shaft with double round keyways and screw hole	1: With brake (DC24V) 2: With oil seal 3: With a brake and oil seal
		⑩ Special specifications

*1: Non-standard product, not recommended.
*2: Some varieties may have double round keyways, but except the 130 flange motors, the width and height of the key are the same as those of the U keyway. See Chapter 10.

The above 10 elements are not optional, please refer to the selection guide or consult SINEE.

1.4 Confirm servo drive and motor models

1.4.1 Servo drive and motor matching table

Servo drive			Servo motor			
Drive model	Voltage	Size	Model	Power	Rated speed	Rated torque
EA180□-0R9-1□	Single-phase AC 220V	SIZE A	SES04-005-30-2□AY□	50W	3000rpm	0.16Nm
EA180□-1R6-1□			SES04-0R1-30-2□AY□	100W	3000rpm	0.32Nm
			SER06-0R2-30-2□AY□	200W	3000rpm	0.64Nm
EA180□-2R5-1□			SER06-0R4-30-2□AY□	400W	3000rpm	1.28Nm
EA180□-4R8-2□	Single/three-phase AC 220V	SIZE B	SER08-0R7-30-2□AY□	750W	3000rpm	2.38Nm
			SER08-0R7-30-2□AY□	750W	3000rpm	2.38Nm
			SER08-0R7-20-2□AY□	750W	2000rpm	3.58Nm
			SER08-1R0-30-2□AY□	1000W	3000rpm	3.18Nm
EA180□-6R2-2□			SER13-1R0-10-2□BY□	1000W	1000rpm	9.55Nm
			SER13-1R0-20-2□BY□	1000W	2000rpm	4.77Nm
			SER13-1R0-30-2□BY□	1000W	3000rpm	3.18Nm
EA180□-011-2□	Three-phase AC 220V	SIZE C	SER13-1R5-10-2□BY□	1500W	1000rpm	14.32Nm
			SER13-1R5-20-2□BY□	1500W	2000rpm	7.16Nm
			SER13-1R5-30-2□BY□	1500W	3000rpm	4.77Nm
EA180□-8R5-3□	Three-phase AC 380V		SER13-1R5-10-3□BY□	1500W	1000rpm	14.32Nm
EA180□-5R6-3□			SER13-1R5-20-3□BY□	1500W	2000rpm	7.16Nm
			SER13-1R5-30-3□BY□	1500W	3000rpm	4.77Nm
EA180□-8R5-3□			SER13-2R0-20-3□BY□	2000W	2000rpm	9.55Nm
			SER13-2R0-30-3□BY□	2000W	3000rpm	6.37Nm
EA180□-013-3□			SER13-3R0-20-3□BY□	3000W	2000rpm	14.32Nm
			SER13-3R0-30-3□BY□	3000W	3000rpm	9.55Nm
			SES18-2R9-15-3FBY□	2900W	1500rpm	19Nm
EA180□-017-3□		SIZE D	SES18-4R4-15-3FBY□	4400W	1500rpm	28Nm
EA180□-022-3□			SES18-5R5-15-3FBY□	5500W	1500rpm	35Nm
EA180□-028-3□			SES18-7R5-15-3FBY□	7500W	1500rpm	48Nm

Note that the type of encoder used for servo motors must be consistent with the one supported by the servo drive.
For more specifications of servo motors, please consult SINEE.

1.4.2 Cables for encoders

Motor flange size	Encoder type	Cable model
40~80	2500ppr standard-wire incremental encoder	A10-LP-A000-m*1
	17-bit incremental encoder	A10-LS-A000-m
	23-bit absolute encoder	A10-LA-A000-m*2
110~180	2500ppr standard-wire incremental encoder	A10-LP-H100-m
	17-bit incremental encoder	A10-LS-H100-m
	23-bit absolute encoder	A10-LA-H100-m*2

Note *1: m indicates cable length, in meters.
Note *2: Battery for absolute encoder is mounted on the cable. When an absolute encoder is used as incremental, the 17-bit incremental encoder cable can be used.

1.4.3 Servo motor power cables / brake cables

Motor flange size	Motor power cables		Brake cables (brake)
	Motor power cables	Motor power with brake cables	
40~60	A10-LM-A010-m*1	-	A10-LZ-A005-m
80	A10-LM-A010-m*1	-	A10-LZ-A005-m
110~130	A10-LM-H120-m	A10-LB-H120-m	-
180(2.9~4.4KW)	A18-LM-M525-m*2	-	A18-LZ-H405-m
180(5.5~7.5KW)	A10-LM-M240-m	-	A18-LZ-H405-m

Note *1: m indicates cable length, in meters.

Note *2: For 180 flange, 2.9 and 4.4 KW motors with a brake, the motor power cable needs to be A10-LM-M240-m.

For the above cables, we only provide length of an odd number.
If you want to make the cables by yourself, please carefully read Chapter 3 in this Manual.

Chapter 2 Installation

2.1 Notes for installation

Please pay attention to the following points:

- The cable between the servo drive and servo motor should be kept loose.
- If the cable between the servo drive and servo motor exceeds 20 meters, please thicken the UVW cables and the encoder cable.
- When fixing the servo drive, the installation direction must follow the instructions, and each fixing screw must be firmly fastened.
- Make sure the servo motor shaft is concentric with the equipment shaft to prevent radial stress during operation.
- The four fixing screws of the servo motor must be fastened according to the specified torque.
- In order to have a good cooling effect, when installing the AC servo drive, please keep enough space between the device and adjacent articles and baffles (walls) around it, otherwise faults may be caused.
- The servo drive shall not be toppled and placed during installation, and its suction and exhaust holes shall not be blocked, otherwise faults may be caused.

2.2 Environmental conditions for storage

Please put this product in its packing box before installation. If the servo set is not used for the time being, in order to make the product conform to the warranty scope and requirements for future maintenance of SINEE, the following matters must be paid attention to during storage:

Item	Description
Ambient temperature	-20 ℃ ~ + 65 ℃
Ambient humidity	Relative humidity 20%～90% (no condensation)
Vibration	Below 49m/s ²
Shock	Below 49m/s ²

2.3 Environment conditions for installation

2.3.1 Operating conditions of EA180 servo drive

Item	Description
Dust and gas	The device must be installed in a dust-free environment without corrosive gases or liquids.
Ambient humidity	Relative humidity 20%～90% (no condensation)
Ambient temperature	0 ℃ ~ + 45 ℃
Vibration	Below 49m/s ²
Shock	Below 49m/s ²
Altitude	Below 1000m; if above 1000m, please derate the device

2.3.2 Operating conditions of servo motor

Item	Description
Ambient humidity	Relative humidity 20%～90% (no condensation)
Ambient temperature	0℃～+40℃
Vibration	Below 49m/s ²
Shock	Below 49m/s ²
Altitude	Below 1000m; if above 1000m, please derate the device

- Do not use the motor in a closed environment. Closed environment will lead to high temperature of motor and shorten its service life.

2.3.3 Other notes

In addition to the above environmental conditions, no matter the servo drive or motor, please follow the following instructions when selecting the installation location, otherwise the product may not meet our warranty scope and future maintenance requirements:

- Places without high-temperature devices
- Places free of water droplets, vapor, dust or oily dust
- Places free of corrosive or flammable gases or liquids
- Places free of floating dust or metal particles
- Firm places without vibration or electromagnetic noise interference.

2.4 Installation direction and space of servo drive

Refer to Chapter 11 for outer dimensions and weight of servo drives and servo motors.

2.4.1 **Method**

Please ensure that the installation direction is perpendicular to the wall. Use natural convection or a cooling fan to cool the servo drive. Fix the servo drive firmly on the mounting surface through the mounting holes.

When installing, ensure that the front side of the servo drive (the actual installation surface of the operator) faces the operator and make it perpendicular to the wall.

2.4.2 **Cooling**

In order to ensure air convection, please refer to Fig. 2-1 and leave enough space around the servo drive.

In order to prevent local high temperature in the operating environment of the servo drive, it is necessary to keep uniform temperature in the electric cabinet. Please be sure to install a cooling fan above the servo drive in the electric cabinet.

2.4.3 **Grounding**

Please be sure to ground the grounding terminal, otherwise an electric shock or misoperation due to interference may be caused.

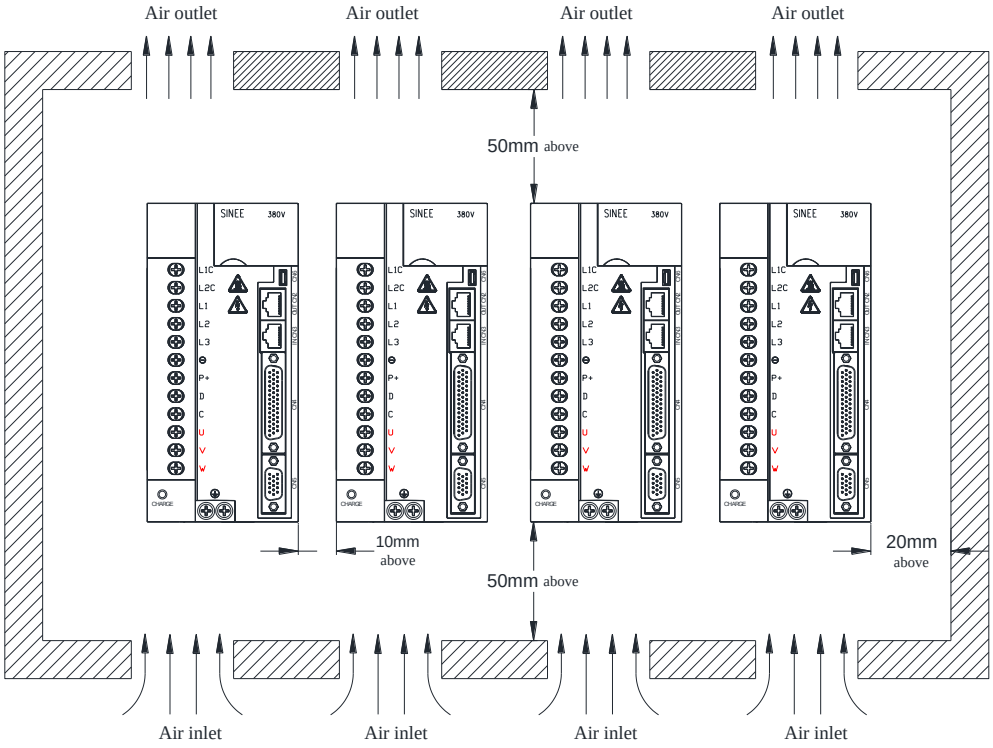


Figure 2-1 Installation space of servo drive

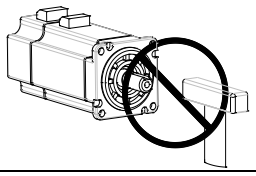
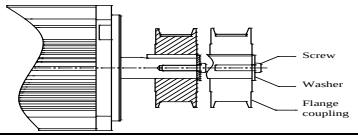
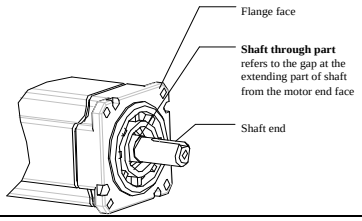
2.5 Installation direction and space of servo motor

2.5.1 **Motor installation**

Servo motors must be properly installed on a dry and strong platform. Please maintain good ventilation and cooling circulation during installation, and keep proper grounding.

Please refer to "Chapter 11 Specifications" for the outer dimensions and weight of the motors.

2.5.2 **Schematic diagram of installation**

Item	Description
Antirust treatment	Before installation, please wipe off the "rust inhibitor" on the extension of the servo motor shaft before relevant antirust treatment.
Notes for encoders	● The shaft extension shall not be impact during installation, otherwise the encoder inside will be cracked. 
Pulley installation	● When installing pulleys on a servo motor shaft with a keyway, use screw holes at the shaft end. In order to install the pulley, first insert the double-headed nail into the screw hole of the shaft, use a washer on the surface of the coupling end, and gradually fasten the pulley with a nut. ● For servo motor shaft with a keyway, install it with the screw hole at shaft end. For a shaft without keyway, wear coupling or similar methods can be adopted. ● When the pulley is removed, a pulley remover should be used to prevent impact on the bearing. ● In order to ensure safety, a protective cover or similar device shall be installed in the rotating area. 
Centering	● Please use a coupling to connect the device with the machine and keep the axis of the servo motor in a straight line with that of the machinery. The radial runout of the coupling should not be greater than 0.03 mm. If centering is not sufficient, vibration will occur, which may damage bearings, encoders, etc.
Installation direction	● Servo motor can be installed in a horizontal or vertical direction. Please do not install the device obliquely, otherwise it may cause wearing of motor bearing.
Countermeasures for oil and water	For use in places with water dripping, please confirm the protection rating of the servo motor before use (except the shaft penetration part). For use in places where oil drips to the shaft penetration part, please be sure to use servo motors with oil seals. Service conditions for servo motors with oil seals: ● Please make sure that the oil level is lower than the lip of the oil seal during use. ● Please use the oil seal in a state where the oil spatter can be kept in a good degree. ● When the servo motor is installed vertically upward, please be careful to prevent oil accumulation on the oil seal lip. 
Cable stress condition	Do not bend the cables excessively or apply tension to them, especially for the 0.14 mm^2 or 0.2 mm^2 core wires of the encoder signal cables, which is very thin. So please do not stretch them too tightly during wiring and use. When installing in the tow chain, high-flexibility tow chain cables must be selected.
Connector handling	**For the connector part, please pay attention to the following:** ● When connecting a connector, please make sure that there is no foreign matter such as garbage or metal debris in the connector. ● When connecting the connector to the servo motor, be sure to connect from the side of the main circuit cable of the servo motor first, and the main cable must be reliably grounded. Otherwise, the encoder may fail due to the potential difference with PE. ● When wiring, please make sure the pins are arranged correctly. ● The connector is made of resin. Do not apply impact to the connector, otherwise it may be damaged. ● Always hold the main body of the servo motor during handling while the cables remain connected. Otherwise, the connector may be damaged or the cables may be broken. ● If a cable needs to be bent, due care should be taken during wiring so as not to cause pressure or tension on the connector, otherwise damage or poor contact of the connector may be caused.

2.6 Suggestions for circuit breakers and fuses

If the servo drive is equipped with a residual current circuit breaker for leakage fault protection, please select a model with sensitivity current above 200mA and operation time above 0.1 second in order to prevent misoperation of the circuit breaker.
Please use a quick-action fuse, and its rated current should be about 1.5 times the drive capacity.

UL/CSA recognized fuses and circuit breakers are strongly recommended.

2.7 Selection of braking resistor

When the output torque and rotation speed of the motor are in opposite directions, energy will be transmitted back from the load to the drive. This energy will be injected into the capacitor of the bus to increase the voltage of the bus inside the drive. The amount of recharged energy depends on the inertia of the motor rotor and load. If the system inertia is small, the recharged energy may be absorbed by the capacitor inside the drive. If the system inertia is large and exceeds the amount of energy that the capacitor can absorb, the voltage may rise high, causing the drive to stop or even damage. Therefore, when the voltage rises to a certain level, the recharged energy must be consumed by a braking resistor.
Table 2-1 below lists the rotor inertia of commonly used SER series servo motors, the energy absorption capacity of capacitor inside EA180 servo drive, and the calculation formula of regenerative energy.

Table 2-1 Rotor inertia and regenerative energy absorption capacity of capacitor of common SER/SES series servo motors

Drive model	Motor	Rotor inertia $J(\times 10^{-4} kg \cdot m^2)$	Regenerative energy from rated speed to 0 with no-load Eo (Joule)	Maximum regenerative energy capacity of capacitor Ec (Joule)
EA180□-0R9-1□	SES04-005-30-2□AY	0.02	0.1	9.5
EA180□-1R6-1□	SES04-0R1-30-2□AY	0.04	0.2	9.5
	SER06-0R2-30-2□AY	0.18	0.89	9.5
EA180□-2R5-1□	SER06-0R4-30-2□AY	0.3	1.48	19
EA180□-4R8-2□	SER08-0R7-30-2□AY	1.01	4.99	20.2
EA180□-6R2-2□	SER13-1R0-10-2□BY	8.71	19.1	20.2
EA180□-011-2□	SER13-1R5-20-2□BY	12.08	26.5	45.7
EA180□-5R6-3□	SER13-1R5-20-3□BY	12.08	26.5	31.4
EA180□-8R5-3□	SER13-2R0-20-3□BY	17.14	37.67	51.7
EA180□-013-3□	SER13-3R0-20-3□BY	25.58	56.22	51.7
EA180□-017-3□	SES18-4R4-15-3FBY	67.5	83.45	110.7
EA180□-022-3□	SES18-5R5-15-3FBY	89	110.0	110.7
EA180□-028-3□	SES18-7R5-15-3FBY	125	154.53	138.4

- **Calculation formula of regenerative energy:** $Eo = j.v^2/182(\text{Joule})$ v: rpm, generally the rated speed of the motor

The rotor inertia of a servo motor with brake and that of a servo motor without brake is slightly different, which can be regarded as the same.

2.7.1 Built-in braking resistor

EA180 series servo drives contain braking resistors inside, which are suitable for general load inertia. Table 2-2 shows the specifications of built-in brake resistors of EA180 series servo drives.

Table 2-2 Minimum resistance of built-in braking resistor and allowable minimum external resistance of EA180 servo drive

Drive model	Built-in braking resistor specifications		Energy handling capacity of built-in braking resistor	Allowable minimum external resistance
	Resistance (P8-10)	Capacity (P8-11)		
EA180-0R9-1□	N/A	N/A	N/A	50Ω
EA180-1R6-1□	N/A	N/A	N/A	50Ω
EA180-2R5-1□	N/A	N/A	N/A	50Ω
EA180-4R8-2□	50Ω	100W	50W	50Ω
EA180-6R2-2□	50Ω	100W	50W	50Ω
EA180-011-2□	50Ω	100W	50W	40Ω
EA180-5R6-3□	50Ω	100W	50W	50Ω
EA180-8R5-3□	50Ω	100W	50W	50Ω

Drive model	Built-in braking resistor specifications		Energy handling capacity of built-in braking resistor	Allowable minimum external resistance
	Resistance (P8-10)	Capacity (P8-11)		
EA180-011-2□	50Ω	100W	50W	45Ω
EA180-017-3□	N/A	N/A	N/A	30Ω
EA180-022-3□	N/A	N/A	N/A	30Ω
EA180-028-3□	N/A	N/A	N/A	25Ω

2.7.2 Calculation of external braking resistor capacity

- When the regenerative energy exceeds the handling capacity of the built-in braking resistor (e.g. alarm Al017 occurs), an external braking resistor should be used.
- According to the calculation formula of the regenerative energy, assuming total load inertia is N times the inertia of the motor rotor, when brake motor is braked from the rated speed to 0, regenerative energy is N *Eo, the action cycle is T(s), then,

$$Power\ of\ braking\ resistor = \frac{2(N \times E_0 - E_c)}{T}$$

2.7.3 Notes for using external braking resistor

- When using an external braking resistor, the resistor should be connected to the P + and C terminals of the drive. At the same time, the short connector installed on the P + and D terminals must be removed to create an open circuit between the P and D terminals.
- The resistance of the external braking resistor cannot be less than that listed in Table 2-2, otherwise the servo drive may be damaged.
- Please correctly set the resistance and capacity of the external braking resistor used into the function parameters of the drive, otherwise the function will be affected.
  - P8-10 (braking resistance value), P8-11 (braking resistor power), P8-13 (braking resistor derating percentage).
- In the natural environment, when the braking resistor is used at the rated capacity, the temperature of the resistor will rise to above 120 ℃ (under the condition of continuous braking). For safety reasons, please use forced cooling to lower the temperature of braking resistor, or a braking resistor with a thermal switch is recommended. Please consult the manufacturer about the load characteristics of the brake resistor.

Attention☞

1. **The resistance of the external braking resistor cannot be less than that listed in Table 2-2, otherwise the servo drive may be damaged.**
2. **When using an external brake resistor, the servo drive will be damaged if the short connector between P and D is not removed.**

2.8 EMI filters

All electronic equipment (including servo drives) will generate high-frequency or low-frequency noise during normal operation, which will interfere with peripheral equipment by conduction or radiation. The interference can be minimized if an appropriate EMI filter is used and correctly installed.
If the servo drive and EMI filter can be installed and wired according to the instructions in this Manual, we can make sure that they meet the following specifications:

1. EN61000-6-4 (2001)
2. EN61800-3 (2004) PDS of category C2
3. EN55011+A2 (2007) Class A Group 1

2.8.1 Notes for installation of EMI filter:

In order to ensure that the EMI Filter can exert the greatest effect of suppressing the interference of the servo drive, in addition to the installation and wiring of the servo drive according to the instructions in this Manual, attention should also be paid to the following points:

1) The servo drive and EMI filter must be installed on the same well-grounded metal plane.
2) All wires should be as short as possible.
3) The metal casing of the servo drive and EMI filter must be reliably connected to the metal plane, and the contact area should be as large as possible.

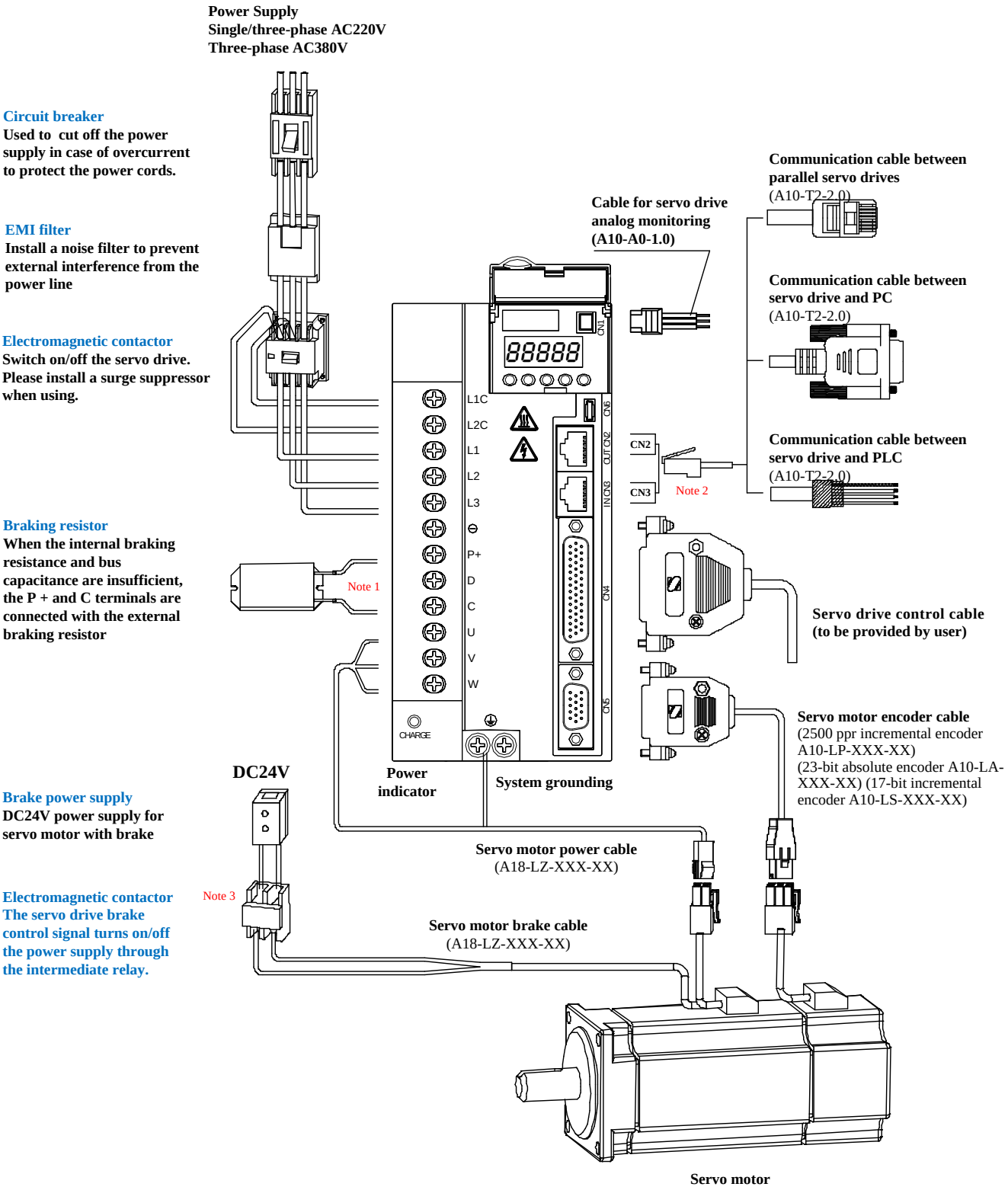
2.8.2 Notes for motor cable selection and installation

The selection and installation of motor cables partly determine whether EMI Filter can exert the maximum interference suppression effect. Please note the following points:

1) Use cables with isolation copper mesh (preferably with double isolation layers).
2) The isolation copper mesh at both ends of the motor cable must be grounded at the shortest distance and with the maximum contact area.
3) The isolation copper mesh of the motor cable must be correctly connected with the metal plane, and the isolation copper mesh at both ends shall be fixed with the metal plane using a U-shaped metal piping bracket.

Chapter 3 Wiring

3.1 Peripherals connection



Note:

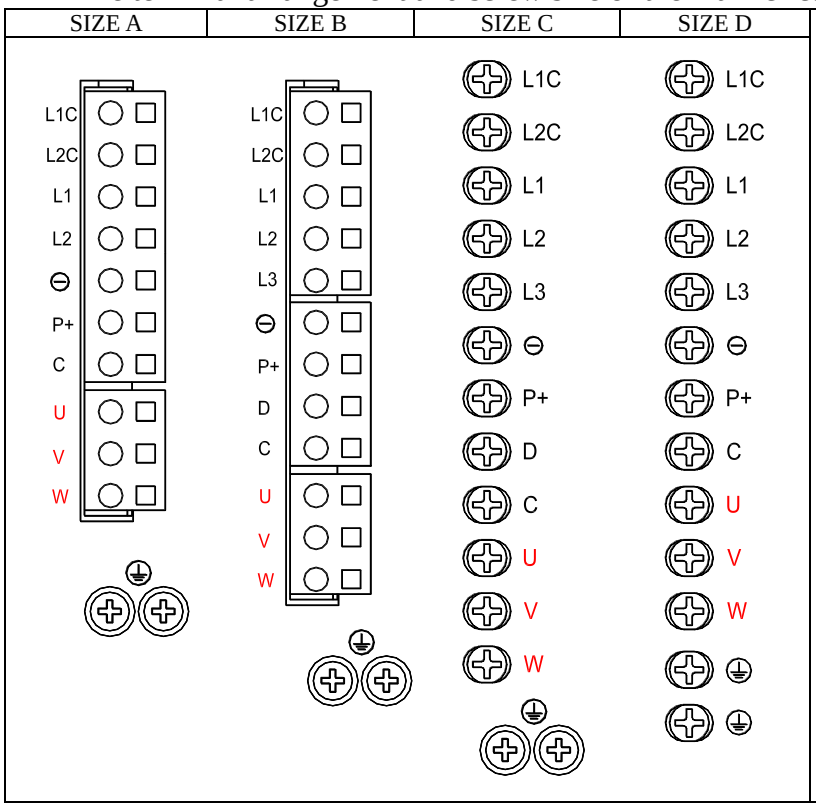
1) The servo drive is directly connected to the industrial power supply and is not isolated by a transformer or other isolation devices. In order to prevent the servo system from causing cross electric shock accidents, please use a fuse or circuit breaker for wiring on the input power supply.
2) It is strictly prohibited to install an electromagnetic contactor between the servo drive and the motor, otherwise it will cause damage to the drive.
3) Please pay attention to the capacity of the power supply when connecting external control power supply

and 24V power supply, especially when power is supplied to several servo drives or brakes at the same time. Insufficient power supply capacity will lead to insufficient supply current, which may cause damage to the servo drives or brakes.

4) Please note that the brake power supply is 24V DC, and its capacity shall meet the power requirements of the brake. For braking power, please refer to the servo motor description.
5) Confirm correct phase sequence and wiring of the U, V and W output terminals of the servo motor. Wrong wiring may cause the motor to fail to run or run disorderly, thus causing alarm and even motor damage.
6) When an external braking resistor is used, the P+ and D terminals shall be open-circuited, and the resistor shall be connected to the P+ and C terminals. If an internal braking resistor is used, the P+ and D terminals shall be short-circuited and the P+ and C terminals shall be open-circuited (refer to Section 2.7).
7) In single-phase 220V wiring, the main power supply terminals are L1 and L2. If there is an L3 terminal, please do not wire on it.
8) CN2 and CN3 are two communication interfaces with exactly the same definition of pins, and you can use either of them.

3.2 Main circuit terminal connection

The terminal arrangement and screw size of the main circuit (high voltage part) are as follows.



Drive size	Main circuit terminals	
	Screw size	Torque
SIZE A	N/A	-
SIZE B	N/A	-
SIZE C	M4	2.5 N.m
SIZE D	M4	2.5 N.m

Drive size	PE ground terminals	
	Screw size	Torque
SIZE A	M4	2.5 N.m
SIZE B	M4	2.5 N.m
SIZE C	M4	2.5 N.m
SIZE D	M4	2.5 N.m

3.2.1 Main circuit (high voltage part) terminals description

Table 3-1 Description of main circuit terminals of servo drive

Terminal mark	Terminal name	Terminal function	
L1C, L2C	Control power input terminal	Input single-phase voltage consistent with that of the main circuit power supply	
L1, L2, L3	Main circuit AC power input terminal	EA180□-0R9-1□ EA180□-1R6-1□ EA180□-2R5-1□	L1, L2 single-phase 220V input
		EA180□-4R8-2□ EA180□-6R2-2□	L1, L2 single-phase 220V input or L1, L2, L3 3-phase 220V input
		EA180□-010-2□	L1, L2, L3 3-phase 220V input
		EA180□-5R6-3□ EA180□-8R5-3□EA180□-013-3□ EA180□-017-3□ EA180□-022-3□ EA180□-028-3□	Three-phase 380V Supply Input

Terminal mark	Terminal name	Terminal function
P +, D, C	External brake resistor connection terminal	Short circuit connection is between P + and D by default. When the braking capacity is insufficient, please open the circuit between P+ and D, and connect an external braking resistor between P+ and C. (SIZE A and SIZE D have no D terminal or short circuit connection)
P+, ⊖	Common DC bus terminal	The DC bus terminals of the servo drive can be connected in parallel when multiple drives are in operation.
U, V, W	Servo motor connection terminal	The connection terminals of the servo motor are connected with U, V and W wires of the motor.
PE	Grounding	Two grounding terminals are connected to the power supply and the motor grounding terminals.

3.2.2 **Power connection**

The power connection methods of servo drives are divided into single-phase and three-phase methods. Single-phase method is only allowed for models with output current of 6.2A or below.

- Single-phase power supply connection method (applicable to a rated output current of 6.2 A and below)

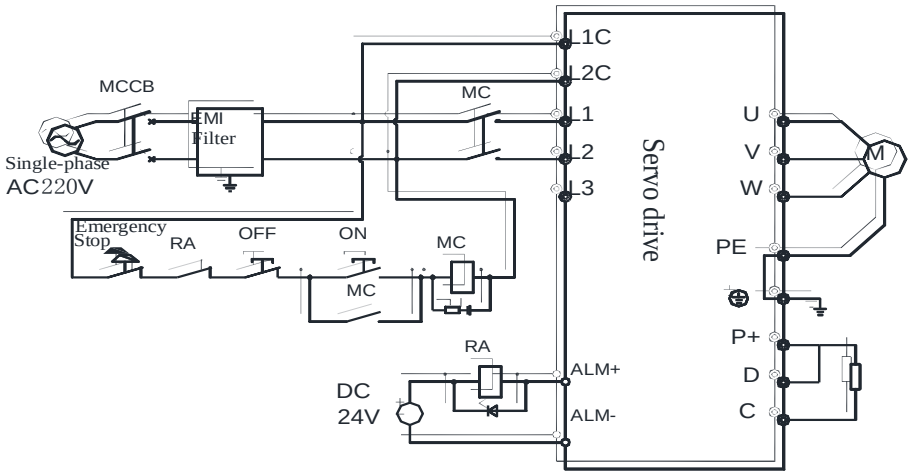


Figure 3-1 Single-phase power supply connection

- Three-phase power supply connection method (4.8 A and above are applicable)

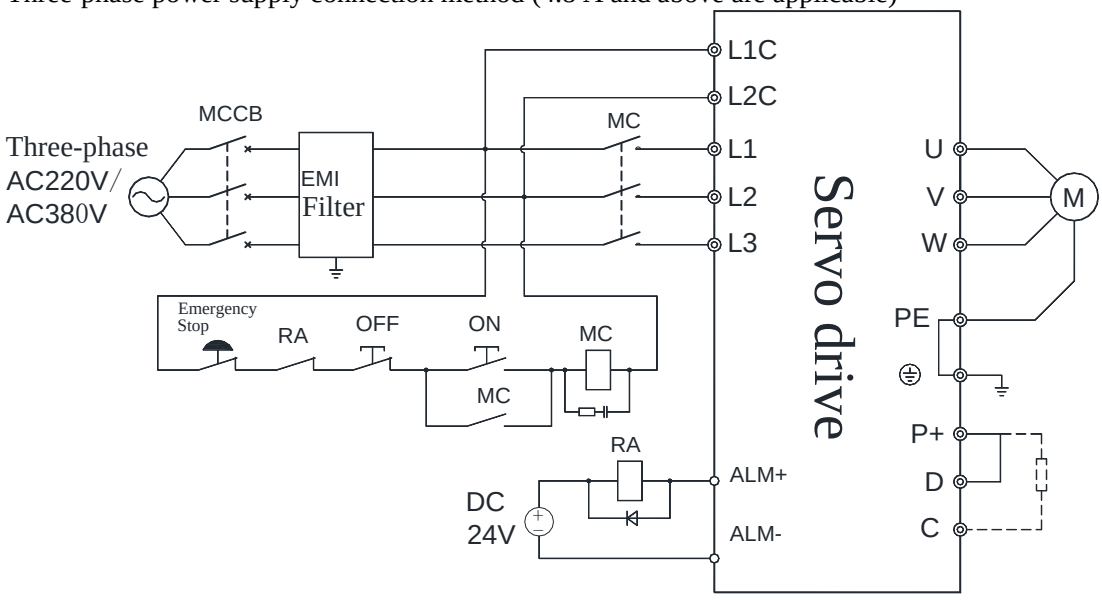


Figure 3-2 Three-phase power supply connection

Attention☞	**1. If you do not want to cut off the main circuit power supply in the event of a fault, there is no need to use the RA relay.** 2. **L1C and L2C can also be connected to P + and - terminals (with no need to distinguish polarity) respectively without using external power supply.**

3.2.3 **Power-on timing sequence diagram**

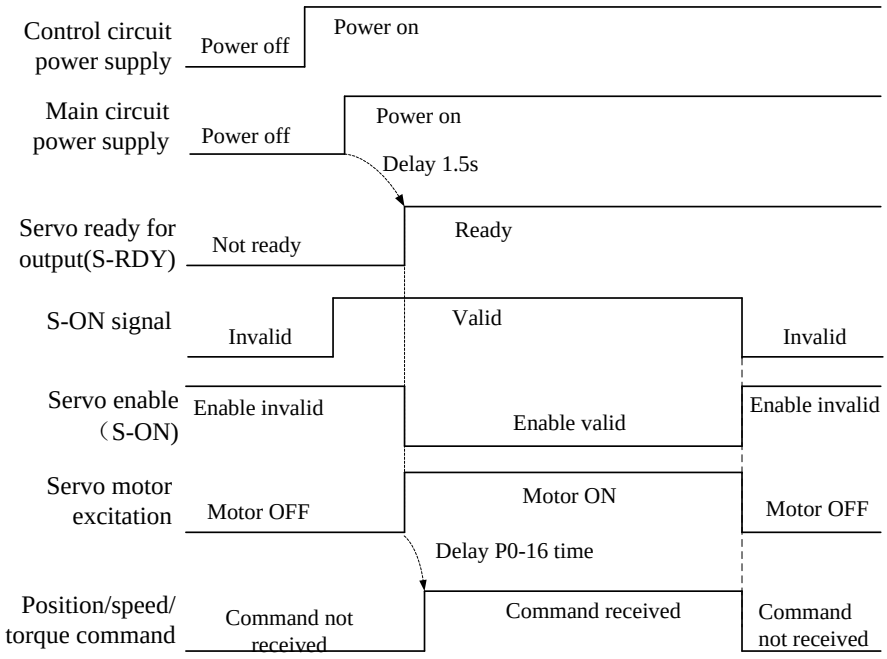


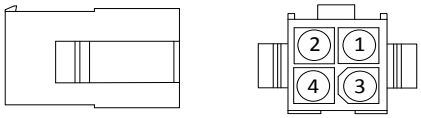
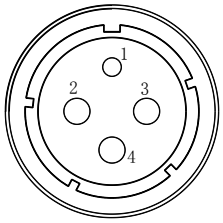
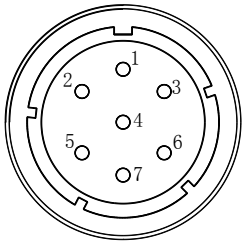
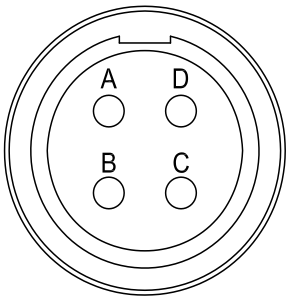
Figure 3-3 Power-on timing sequence diagram

Please refer to Figure 3-1 and Figure 3-2 for power supply connection, and turn on the power supply in the following sequence:

1) The power supply L1C and L2C of the control circuit must be turned on before or at the same time as the main circuit power supply is turned on. If only the power supply of the control circuit is switched on, the servo ready signal (S-RDY) will not be valid.
2) Connect the power supply to the power input terminals (L1, L2 and L3 for three-phase, and L1 and L2 for single-phase) of the main circuit through the electromagnetic contactor.
3) After the power supply of the main circuit is turned on, the servo ready signal (SRDY) will be valid after a delay of about 1.5s, and now the servo enable (S-ON) signal can be accepted. After detecting that the servo enable signal is valid, the motor is excited and runs. If servo enable signal is void or an alarm is detected, the servo drive output is switched off and the motor is in a free state.
4) When the servo is enabled at the same time as the power supply is turned on, the motor will be excited in about 1.5 seconds.
5) Frequent switching on and off the main circuit power supply may damage the soft-start circuit and the energy consumption braking circuit. The frequency of switching on and off is preferably limited to 5 times per hour and less than 30 times per day. If the drive unit or motor is overheated, after the cause of the fault is eliminated, it will take 30 minutes to cool down before the power supply can be switched on again.
6) Do not connect the input power line to the output terminals U, V, and W, otherwise it will damage the servo drive.
7) It is absolutely forbidden to connect braking resistor between the P + and ⊖ terminals of the DC bus, otherwise a fire may be caused.
8) After the power supply is turned off, there may be residual voltage on the internal capacitor of the servo drive. Please make sure that the CHARGE indicator on the servo drive panel is off before checking.

3.2.4 **Specifications of motor power cable connectors**

Table 3-2 Servo motor power cable and connecting terminals

<table>
<tr><th>Connector shape and type</th><th>Terminal pin distribution</th><th>Motor flange</th></tr>
<tr><td> 
Shell type: 172159-1 TE MATE-N-LOCK
Insert spring type: 170362-1 TE MATE-N-LOCK</td><td>4PIN Amp plug (excluding brake)
<table><tr><th>Pin #</th><th>Function</th></tr><tr><td>1</td><td>U</td></tr><tr><td>2</td><td>V</td></tr><tr><td>3</td><td>W</td></tr><tr><td>4</td><td>PE</td></tr></table></td><td>40
60
80
86</td></tr>
<tr><td> 
Type: YD28K4TS</td><td>Air plug (excluding brake)
<table><tr><th>Pin #</th><th>Function</th></tr><tr><td>1</td><td>PE</td></tr><tr><td>2</td><td>U</td></tr><tr><td>3</td><td>V</td></tr><tr><td>4</td><td>W</td></tr></table></td><td>110
130 (SER Series)</td></tr>
<tr><td> 
Type: YD28K4TS</td><td>Air plug (including brake)
<table><tr><th>Pin #</th><th>Function</th></tr><tr><td>1</td><td>PE</td></tr><tr><td>2</td><td>U</td></tr><tr><td>3</td><td>V</td></tr><tr><td>4</td><td>W</td></tr><tr><td>5</td><td>24V (brake)</td></tr><tr><td>6</td><td>0V (brake)</td></tr><tr><td>7</td><td>N/A</td></tr></table></td><td>110
130 (SER Series)</td></tr>
<tr><td> 
Type: MS3108A32-17S
MS3108A18-10S
MS3108A22-22S</td><td>Air plug
<table><tr><th>Pin #</th><th>Function</th></tr><tr><td>A</td><td>U</td></tr><tr><td>B</td><td>V</td></tr><tr><td>C</td><td>W</td></tr><tr><td>D</td><td>PE</td></tr></table></td><td>130 (SES Series)
180 (SES Series)</td></tr>
</table>

Attention☞

1. For 40, 60, 80, 86 flanged motors with a brake, the brake power supply has a separate 2P Amp plug, with no need to distinguish polarities.
2. For SES series motors with a brake, the brake power supply has a CM10-SP2S-MD plug, with no need to distinguish polarities.
3. The graph in the table is the cable end.

3.2.5 **Recommended specifications for main circuit connection cables**

Table 3-3 Recommended specifications for main circuit connection cables

Drive model	L1C，L2C	L1，L2，L3	P+，C	U，V，W	PE
EA180□-0R9-1□	0.5mm^2	0.5mm^2	0.5mm^2	0.5mm^2	1.0mm^2
EA180□-1R6-1□		0.5mm^2	0.5mm^2	0.5mm^2	1.0mm^2
EA180□-2R5-1□		1.0mm^2	1.0mm^2	1.0mm^2	2.5mm^2 and above
EA180□-4R8-2□					
EA180□-6R2-2□					
EA180□-011-2□		2.0mm^2	2.0mm^2	2.0mm^2	
EA180□-5R6-3□		1.5mm^2	1.5mm^2	1.5mm^2	
EA180□-8R5-3□		2.0mm^2	2.0mm^2	2.0mm^2	

Drive model	L1C，L2C	L1，L2，L3	P+，C	U，V，W	PE
EA180□-013-3□					
EA180□-017-3□		4.0mm^2	4.0mm^2	4.0mm^2	
EA180□-022-3□					
EA180□-028-3□		6.0mm^2	6.0mm^2	6.0mm^2	

3.3 CN5 encoder signal terminal

CN5 is the encoder signal terminal and is a DB15 socket. Its position is shown in Figure 3-4:

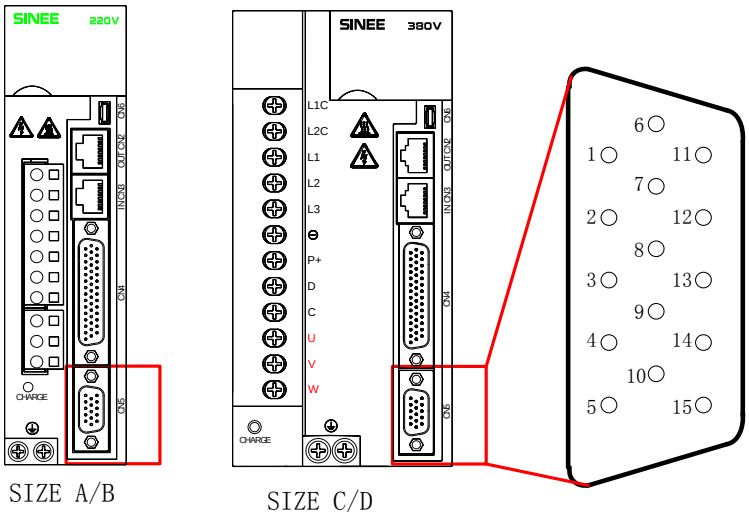


Figure 3-4 CN5 Terminal position

3.3.1 Servo drive side encoder terminal definition

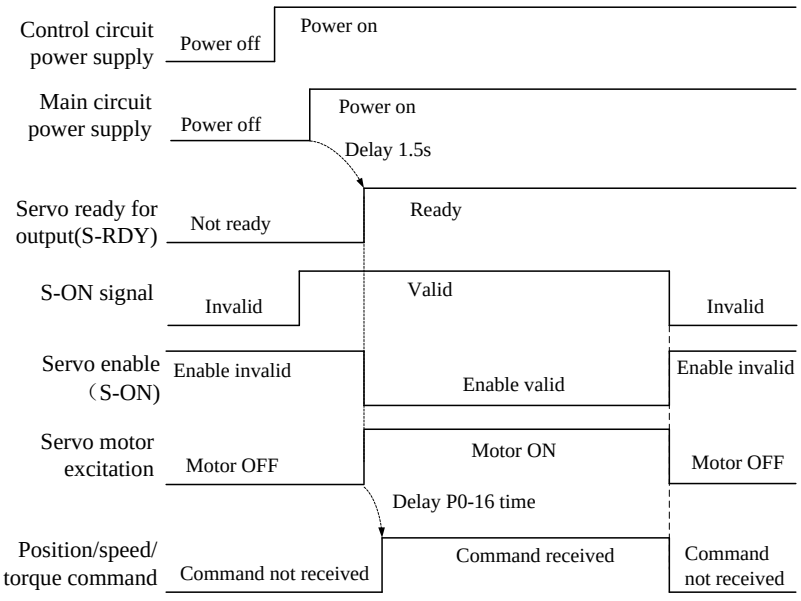


Figure 3-5 CN5 terminal pins distribution

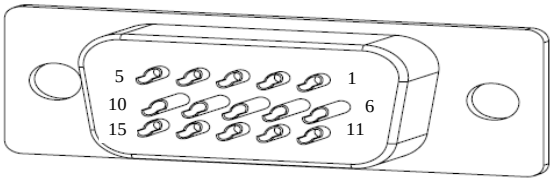
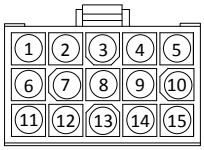
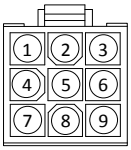
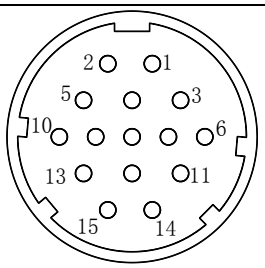
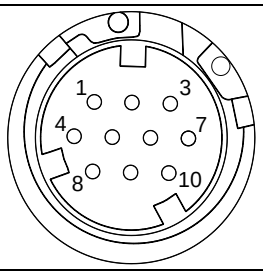


Figure 3-6 CN5 pins distribution

3.3.2 **Servo motor side encoder terminal definition**

There are 4 types of encoder terminals on the servo motor side.

	TE 172163-1				TE 172161-1		YD28K15TS				CM10-SP10S-MD	
Connector Type												
2500ppr incremental encoder	Signal	Pin #	Signal	Pin #			Signal	Pin #	Signal	Pin #		
	A+	9	V+	10			A+	4	V+	11		
	A-	13	V-	12			A-	7	V-	14		
	B+	4	W+	11			B+	5	W+	12		
	B-	14	W-	15			B-	8	W-	15		
	Z+	7	+5V	2			Z+	6	+5V	2		
	Z-	5	GND	3			Z-	9	GND	3		
	U+	6	PE	1			U+	10	PE	1		
	U-	8					U-	13				
17/23-bit encoder					Signal	Pin #	Signal		Pin #		Signal	Pin #
					+5V	1	+5V		2		+5V	4
					GND	2	GND		3		GND	9
					SD+	5	SD+		4		SD+	1
					SD-	6	SD-		7		SD-	2
					VD+	3	VD+		14		VD+	6
					VD-	4	VD-		15		VD-	5
					PE	9	PE		1		PE	10
Note: The figure in the table is the motor side view.												

Notes for encoder wiring:

1) **Make sure that the drive side and motor side shield layers are reliably grounded, otherwise drive alarms will be caused.**
2) Ensure that the differential signal corresponds to the cores in the twisted pair of the connecting cable. For example, A + and A- are a set of differential signals, and a twisted pair should be used.
3) When a 17-bit incremental encoder is used, there are no VD + or VD- signals.
4) **When a 17/23-bit encoder is used, please use a cable with a cross-sectional area of 0.2 mm^2 if the wire length is less than 5 meters. If the wire is more than 5 meters, the cross-sectional area of the wire core shall be increased by 0.05 mm^2 for every additional meter.**

3.4 CN4 control signal terminal

CN4 signal terminals provide the signals required for connection with the upper controller and use a DB44 socket. Pin distribution and signals definition are as follows:

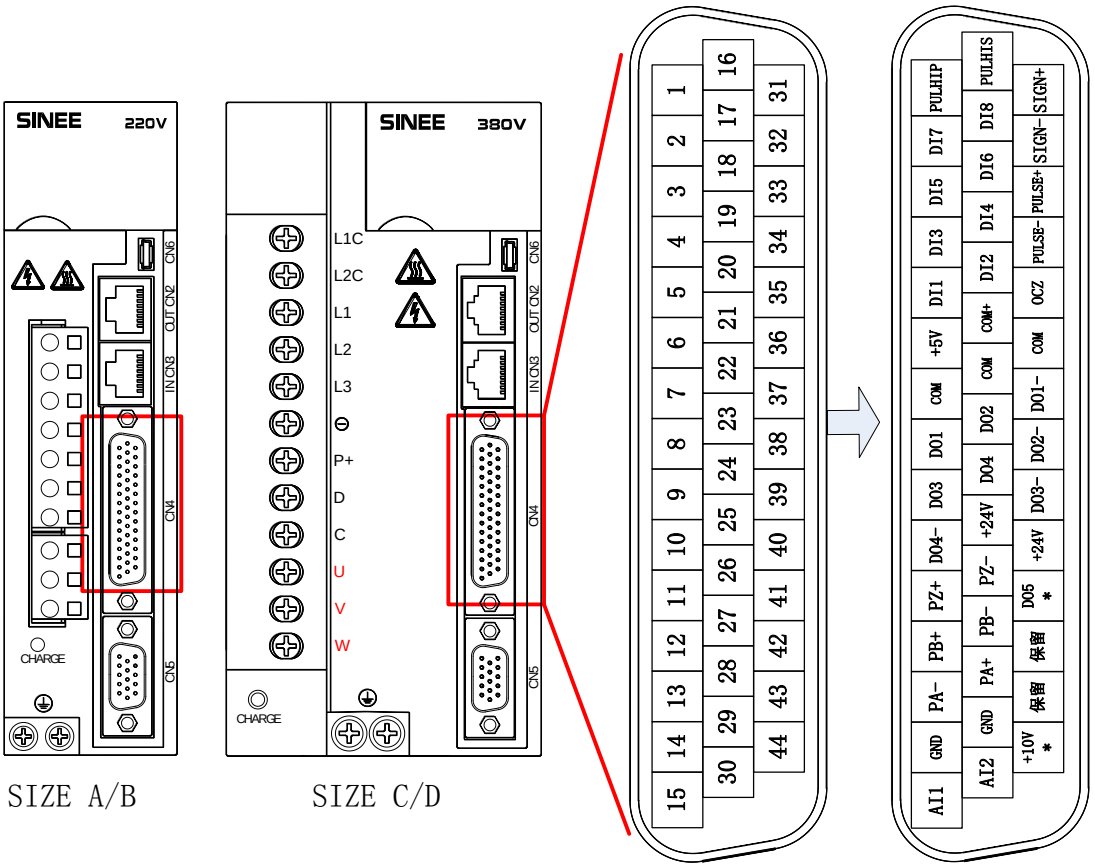


Fig. 3-7 Terminal position and pin distribution of servo drive control circuit

3.4.1 Control signal terminal plug pin distribution

Signal		Pin #	Function description	
Digital input	DI1	5	Digital input, the default function number is 1	Refer to Sections 3.4.2 and 3.4.4
	DI2	20	Digital input, the default function number is 2	
	DI3	4	Digital input, the default function number is 13	
	DI4	19	Digital input, the default function number is 14	
	DI5	3	Digital input, the default function number is 3	
	DI6	18	Digital input, the default function number is 12	
	DI7	2	Digital input, the default function number is 20	
	DI8	17	Digital input, the default function number is 21	
	COM+	21	Digital input common terminal (+)	
Power supply	+24V	25/40	Internal 24V power supply, voltage range + 20V ~ 26V, maximum output current 200mA	
	COM	7/22/36	Internal 24V power ground; digital input common ground	
	+5V	6	+ 5V power supply with maximum output current of 50mA	
	+10V	44	+ 10V power supply with maximum output current of 50mA	
	GND	29	+ 5V, + 10V power ground	
Digital output	DO1	8	Digital output, the default function number is 1	Refer to Sections 3.4.3 and 3.4.5
	DO1-	37		
	DO2	23	Digital output, the default function number is 2	
	DO2-	38		
	DO3	9	Digital output, the default function number is 8	
	DO3-	39		
	DO4	24	Digital output, the fixed function number is 12	

Signal		Pin #	Function description	
	DO4-	10		
	DO5	41	Digital output, ground is COM. The default function number is 0	
Position pulse input	PULHIP	1	The positive end when command pulse is used with 24V power supply	Refer to Section 3.4.7
	PULSE+	33	Position pulse command +	
	PULSE-	34	Position pulse command -	
	PULHIS	16	The positive end when command pulse is used with 24V power supply	
	SIGN+	31	Position direction command +	
	SIGN-	32	Position direction command -	
Frequency division output	PA+	28	A pulse differential frequency division output, maximum allowable current 20mA	Refer to Section 3.4.8
	PA-	13		
	PB+	12	B pulse differential frequency division output, maximum allowable current 20mA	
	PB-	27		
	PZ+	11	B pulse differential frequency division output, maximum allowable current 20mA	
	PZ-	26		
	OCZ	35	Z pulse open collector output, maximum allowable current 40mA	
	GND	14		
Analog input	AI1	15	Analog input 1	Refer to Section 3.4.6
	AI2	30	Analog input 2	
	GND	29	Analog input signal ground	

Attention☞ All GND terminals are connected inside the drive and all COM terminals are connected inside the drive

3.4.2 **Digital input (DI) function definition table**

Value	Name	Function	Description		Trigger mode	Operating mode
0	Disabled	Terminal invalid				
1	S-ON	Servo enable	ON: Enabled	OFF: Disabled	Level	P S T
2	ALM-RST	Alarm and fault reset	OFFON: Resettable fault reset		Edge	P S T
3	P-CLR	Position error clear	The trigger mode is defined in P1-16		Edge/Level	P
4	DIR-SEL	Speed command direction selection	ON: Reverse speed command direction	OFF: Set speed command direction	Level	S
5	CMD0	Internal command bit0	In the multi preset position control mode, the signal is multi-position switching function; In the multi preset speed control mode, the signal is multi-speed switching function;		Level	P S
6	CMD1	Internal command bit1			Level	P S
7	CMD2	Internal command bit2			Level	P S
8	CMD3	Internal command bit3			Level	P S
9	CTRG	Internal command trigger	Multi position trigger		Edge	P
10	MSEL	Control mode switching	Control mode switching; see P0-00 for the meaning of ON/OFF		Level	P S T
11	ZCLAMP	Zero speed clamp enable	ON: Enabled	OFF: Disabled	Level	S
12	INHIBIT	Pulse inhibit	ON: Inhibited	OFF: Pulse input allowed	Level	P
13	P-OT	Inhibit forward drive	ON: Inhibited	OFF: Allowed	Level	P S T
14	N-OT	Inhibit reverse drive	ON: Inhibited	OFF: Allowed	Level	P S T
15	GAIN_SEL	Gain switching	ON: Use second gain	OFF: Use first gain	Level	P S T
16	J_SEL	Inertia switching	ON: Use second inertia ratio P4-11 ON: Use first inertia ratioP4-10		Level	P S T
17	JOG_P	Forward jog	ON: Forward jog	OFF: No function	Level	S
18	JOG_N	Reverse jog	ON: Reverse jog	OFF: No function	Level	S
19	TDIR-SEL	Torque command direction selection	ON: Reverse torque command direction	OFF: Set torque direction	Level	T

<table>
<tr><th>Value</th><th>Name</th><th>Function</th><th>Description</th><th></th><th>Trigger mode</th><th>Operating mode</th></tr>
<tr><td>20</td><td>GNUM0</td><td>Electronic gear ratio numerator selection 0</td><td rowspan="5"><table><tr><th>GNUM1</th><th>GNUM0</th><th>Code</th></tr><tr><td></td><td>0</td><td>P1-04</td></tr><tr><td>0</td><td>1</td><td>P1-08</td></tr><tr><td>1</td><td>0</td><td>P1-10</td></tr><tr><td>1</td><td>1</td><td>P1-12</td></tr></table></td><td></td><td rowspan="2">Level</td><td rowspan="2">P</td></tr>
<tr><td>21</td><td>GNUM1</td><td>Electronic gear ratio numerator selection 1</td></tr>
<tr><td>22</td><td>ORGP</td><td>External detector input</td><td colspan="2">Rising edge: External detector valid
Falling edge: External detector invalid</td><td>Edge</td><td>P S T</td></tr>
<tr><td>23</td><td>SHOM</td><td>Homing</td><td colspan="2">OFF→ON: Homing starts</td><td>Edge</td><td>P S T</td></tr>
<tr><td>24</td><td>TL2</td><td>External torque limiting</td><td colspan="2">ON: Enabled
OFF: Disabled</td><td>Level</td><td>P S T</td></tr>
<tr><td>25</td><td>EMGS</td><td>Emergency stop</td><td>ON: Emergency stop</td><td>OFF: No function</td><td>Level</td><td>P S T</td></tr>
<tr><td>33</td><td>PDIR_SEL</td><td>Position command direction selection</td><td>ON: Negative position command direction</td><td>OFF: Set position command direction</td><td>Level trigge</td><td>P</td></tr>
<tr><td>34</td><td>GBK</td><td>Position probe</td><td>ON: Execute position probe</td><td>OFF: No action</td><td>Edge trigger</td><td>P S T</td></tr>
<tr><td>35</td><td>PUL_UP</td><td>Forward direction pulse offset</td><td>Rising edge: Forward direction offset</td><td>Falling edge: No action</td><td>Edge trigger</td><td>P</td></tr>
<tr><td>36</td><td>PUL_DN</td><td>Reverse direction pulse offset</td><td>Rising edge: Reverse direction offset</td><td>Falling edge: No action</td><td>Edge trigger</td><td>p</td></tr>
</table>

3.4.3 **Digital output (DO) function definition table**

Value	Name	Function	Description	Operating mode
0	Disable	Terminal invalid		
1	S-RDY	Servo ready	Valid - servo ready to receive S-ON command Invalid - the servo is not ready and does not receive the S-ON command	P S T
2	BK	Brake control	Valid - brake disengaged (brake powered on) Invalid - brake engaged (brake powered off)	P S T
3	TGON	Motor rotation	Valid - the motor is rotating (speed is above the P0-04 set value) Invalid - the motor stops rotating (speed is below the P0-04 set value)	P S T
4	ZER0	Motor zero speed	Valid - the motor speed is 0 (speed is above the P0-03 set value) Valid - the motor speed is not 0 (speed is above the P0-04 set value)	P S T
5	V-CLS	Speed close	Valid: The actual speed of the motor reaches or exceeds the set value of P2-08 (regardless of direction).	P S T
6	V-CMP	Speed comparison	Valid: During speed control, the absolute value of the difference between the actual speed of the motor and the speed command value is less than the P2-09 set value.	S
7	PNEAR	Position proximity	Valid: In the position control mode, the position deviation pulse is less than the set value of the positioning approach width P1-23.	P
8	COIN	Positioning completed	Valid: In the position control mode, the position deviation pulse is less than the positioning completion width, the P1-24 set value, and the condition of the P1-22 definition is satisfied.	P
9	C-LT	Torque limiting	Valid - motor torque limited Invalid - motor torque not limited	P S T
10	V-LT	Speed limiting	Valid - motor speed limited Invalid - motor speed not limited	T
11	WARN	Warning output	Valid: Warning occurs	P S T

Value	Name	Function	Description	Operating mode
12	ALM	Alarm output	Valid: Alarm occurs	P S T
13	Tcmp	Torque compliance	Valid: Motor output torque reaches set value Invalid: Motor output torque does not reach set value	T
14	Home	Homing	Valid: Homing completed Invalid: Homing is in progress	P
15	S-RUN	Servo enable	Valid - servo enabled Invalid - servo disabled	P S T
27	T_CLS	Torque close	Valid: The current percentage of the motor reaches or exceeds the set value of P2-08 (regardless of direction).	P S T
29	SPD_P	Speed programming comparison output	P8-36 selection judgment logic. When the conditions are met, the output is valid; When the conditions are not met, the output is invalid; 10rpm is used to judge the hysteresis, and the output does not change during the hysteresis.	P S T
30	TRQ_P	Torque programming compares output	P8-39 selection judgment logic. When the conditions are met, the output is valid; When the conditions are not met, the output is invalid; 3.0% is used to judge the hysteresis, and the output does not change during the hysteresis.	P S T
31	SPD_TRQ	Speed programming compares output	Valid: Both SPD_P and TRQ_P are valid Valid: SPD_P or TRQ_P is invalid	P S T

Attention☞ **1. The speed judgment generally has 10rpm hysteresis, and the output remains unchanged during the hysteresis.**
2. The torque judgment generally has 3.0% hysteresis, and the output remains unchanged during the hysteresis.

3.4.4 Digital input terminal connection

The digital input (DI) terminal of EA180 series servo drives adopts a full bridge rectifier circuit. The current flowing through the terminal can be either positive (NPN mode) or negative (PNP mode).

Taking DI1 as an example, DI1 ~ DI8 interface circuits are identical.

1) When the upper device is relay output:

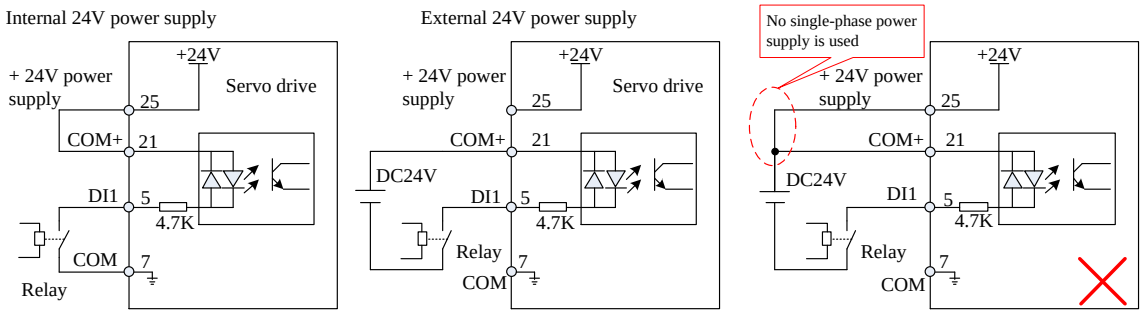


Fig. 3-8 Wiring of digital input terminals when the upper device is relay output

Attention☞ **Default settings:**

- The COM terminal uses pin# 7, and pin# 22/36 is also applicable.
- The GND terminal uses pin# 14, and pin# 29 is also applicable.
- Servo internal + 24V supply uses pin# 25, and pin# 40 is also applicable.

2) When the upper device is NPN open collector circuit output:

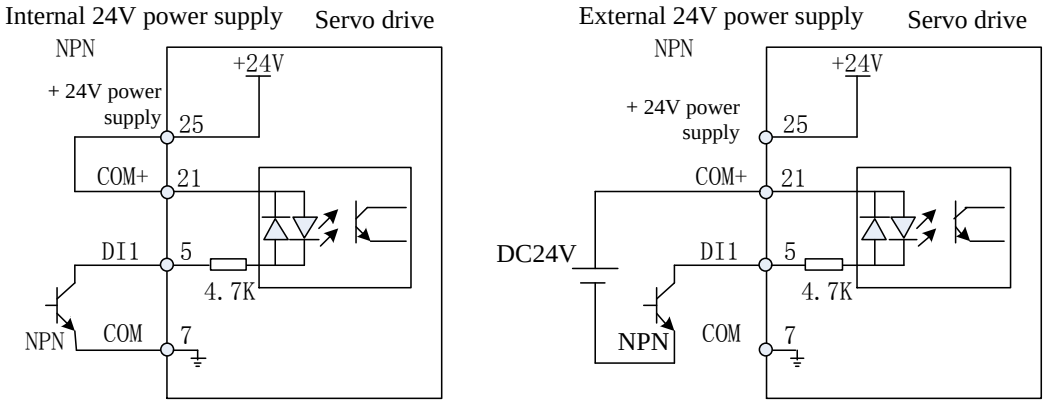


Fig. 3-9 (a) Wiring of digital input terminals when the upper device is NPN open collector circuit output

3) When the upper device is PNP open collector circuit output:

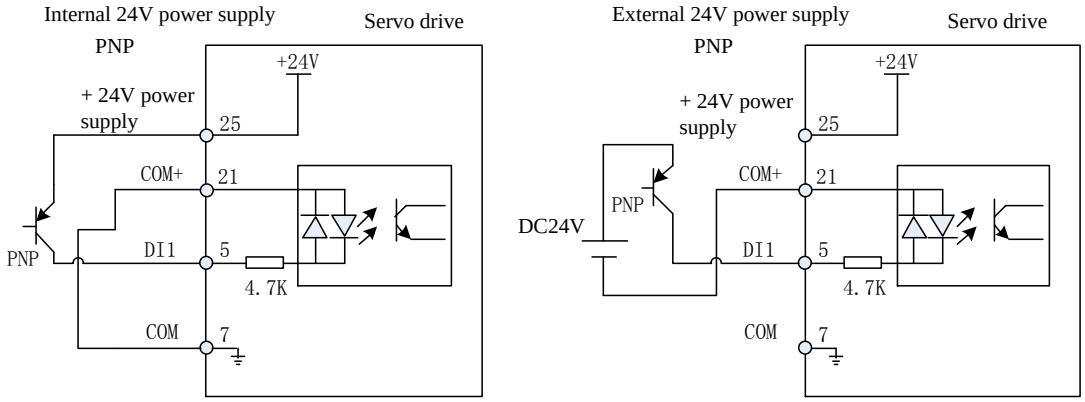


Fig. 3-9 (b) Wiring of digital input terminals when the upper device is PNP open collector circuit output

Attention☞	**1. When using an external power supply, be sure to keep an open circuit between the 24V and COM+ terminal** **2. PNP and NPN mixed input is not supported**

3.4.5 Digital output terminal connection

Taking DO1 as an example, DO1～DO4 interface circuits are identical. DO5 has no DO-terminal (internal COM shorting) and only supports internal power connection.

1) When the upper device is relay input:

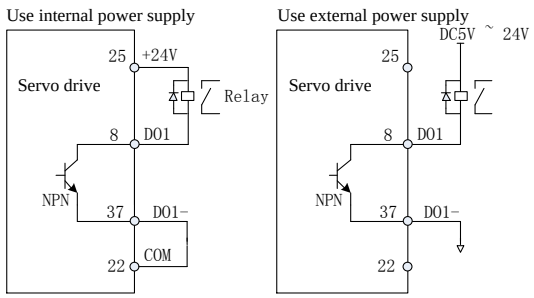


Fig. 3-10 (a) Correct wiring of DO terminal when the upper device is relay input

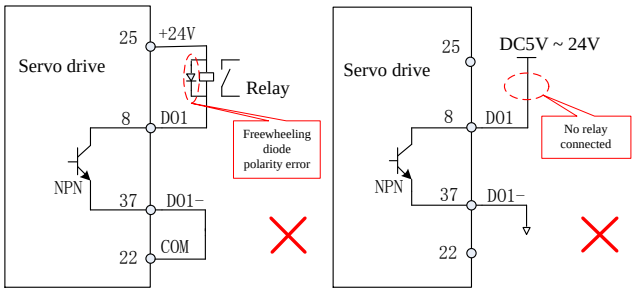


Fig. 3-10 (b) Wrong wiring of DO terminal when the upper device is relay input

Attention☞ **When the upper device is relay input, be sure to connect the flywheel diode, otherwise the DO port may be damaged.**

2) When the upper device is optocoupler input

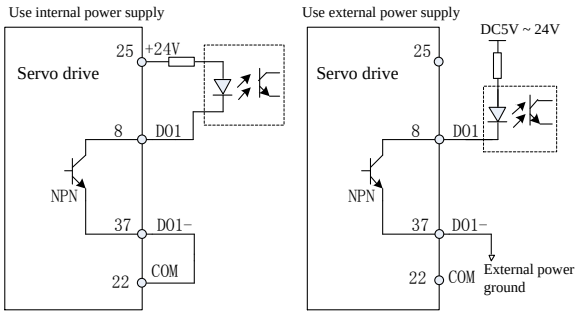


Fig. 3-11 (a) Correct wiring of digital output terminal when the upper device is optocoupler input

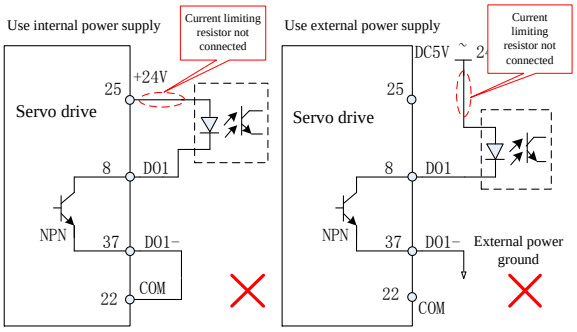


Fig. 3-11 (b) Wrong wiring of digital output terminal when the upper device is optocoupler input

Attention☞ The maximum allowable voltage and current of the optocoupler output circuit inside the servo drive are as follows:

- Voltage: DC30V (max)
- Current: DC50mA (max)
- As for inductive loads (such as relays and contactors) are driven, a surge voltage absorption circuit should be installed, such as RC absorption circuit (note that its leakage current should be less than that of the control contactor or relay), varistor, or flywheel diode, etc. (for DC electromagnetic circuit, pay attention to polarity during installation). The components of the absorption circuit shall be installed near the coil of the relay or contactor.

3.4.6 CN4 analog input terminal wiring

Signal		Pin #	Function	
Analog	AI1	15	Voltage analog input	Voltage input range:-10V ~ +10V, resolution 12 bits Maximum allowable voltage: ±12 V Input impedance: 10K
	AI2	30		
	GND	29	Analog input ground	

AI1 and AI2 are generally used for speed or torque analog signal input.

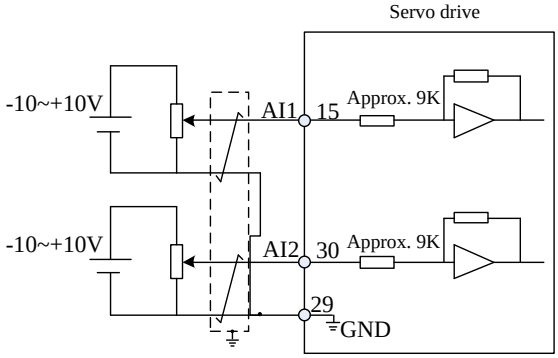


Figure 3-12 AI1 and AI2 terminals wiring

3.4.7 CN4 position command input signal

The position command pulse input signal and command symbol input signal terminals in the CN4 terminal will be described below.

Table 3-6 Description of position pulse input signal

Signal		Pin #	Function	
Position command	PULSE+	33	Pulse command input mode: Differential input open collector input	Input pulse mode: Direction + Pulse Phase A and B orthogonal pulse CW/CCW pulse
	PULSE-	34		
	SIGN+	31		
	SIGN-	32		
	PULHIP	1	External power input interface for command pulse	
	PULHIS	16		
	+24V	25/40	24V power +	
	COM	36	24V power ground	

The pulse command can be input using open collector mode or differential mode. The maximum input pulse frequency of differential input mode is 500Kpps, and that of open collector mode is 200Kpps.

A certain filter time needs to be set for the pulse input terminal to prevent interference signals from entering the servo drive to cause motor misoperation. For filter time, see the description of P1-15 function parameters.

Different command input pulse modes have different timing and time parameters, as shown in Tables 3-7 and 3-8:

Table 3-7 Timing of different command pulses

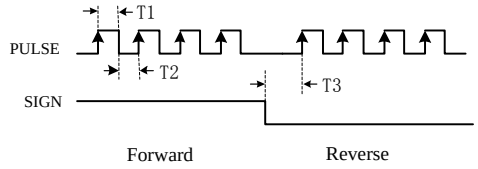
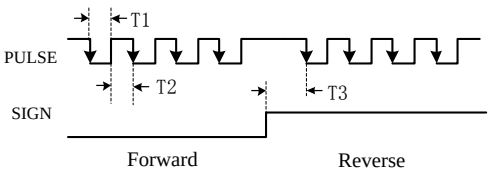
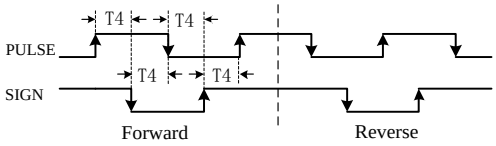
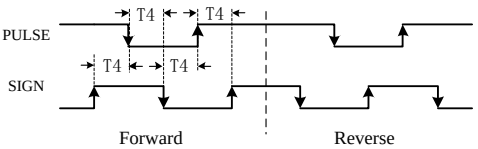
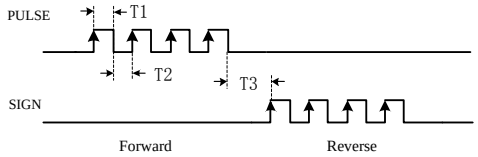
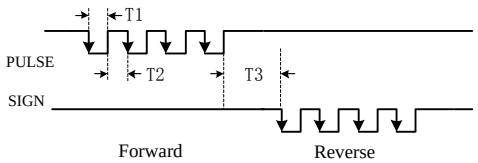
Pulse command mode	Logical state	Pulse waveform
Pulse + Direction	P1-01=0 positive logic	
	P1-01=1 negative logic	
Two-phase orthogonal pulse (frequency quadrupling)	P1-01=2 positive logic	
	P1-01=3 negative logic	
CW/CCW pulse	P1-01=4 positive logic	
	P1-01=5 negative logic	

Table 3-8 Pulse input time parameter

Pulse mode	Maximum input frequency	Minimum allowable width:				Voltage
		T1	T2	T3	T4	
Differential	500Kpps	1s	1s	2s	0.5s	5V
Open collector	200Kpps	2.5s	2.5s	5s	1.25s	24V (MAX)

3.4.7.1 Differential input mode of position command pulse

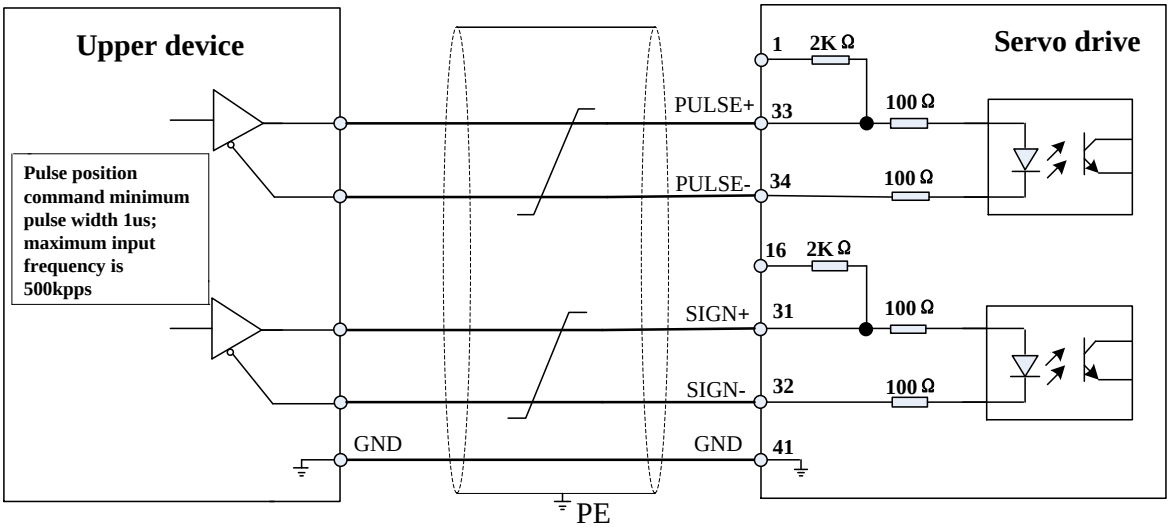


Fig. 3-13 Wiring diagram of differential mode input pulse command

Attention☞ **Please ensure that "2.8 V ≤ (H level-L level) ≤ 3.7 V", otherwise the input pulse of the servo drive will be unstable. This can result in the following:**

- Pulse loss occurs when the command pulse is input.
- Command reversal occurs when the command direction is input.

3.4.7.2 Open collector input mode of position command pulse

- When using internal 24V power supply:

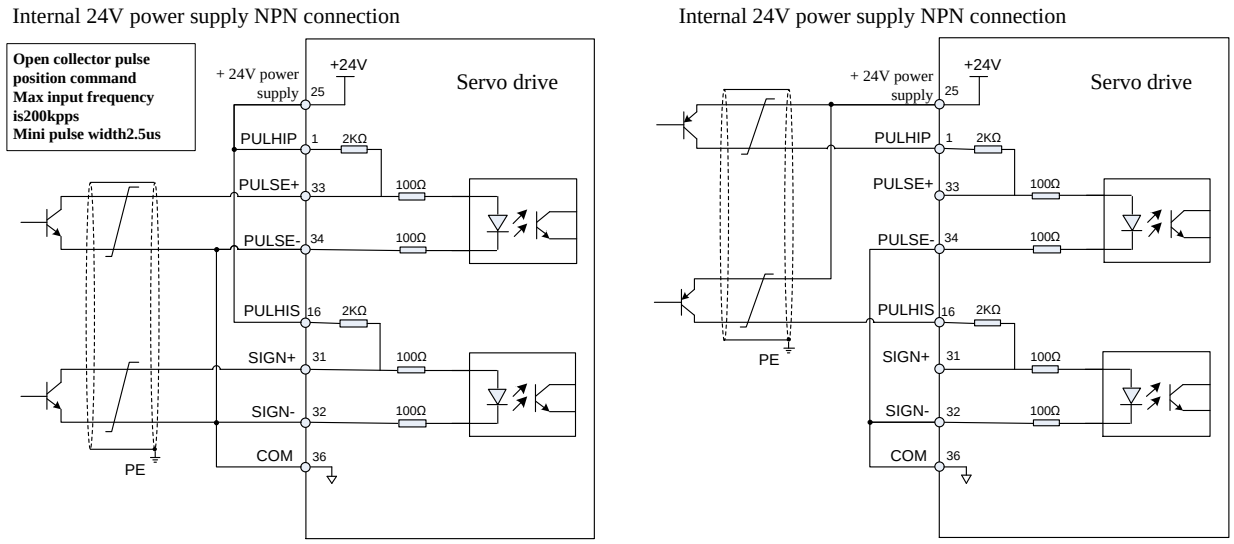


Fig. 3-14 Wiring diagram of open collector mode input pulse command (using internal 24V power supply)

- When using the external 24V power supply and internal current limiting resistance

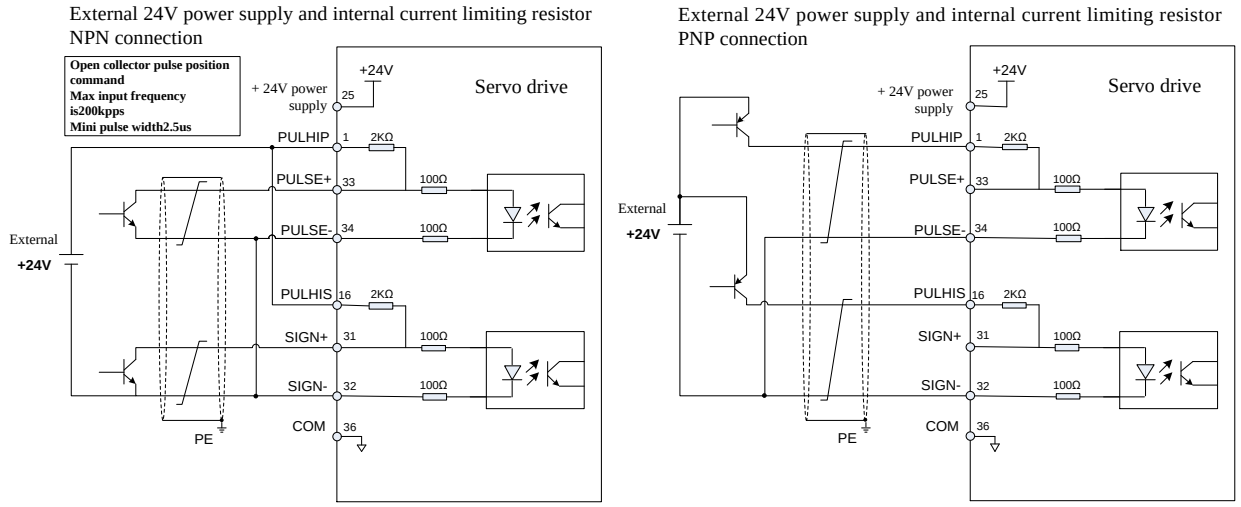


Fig. 3-15 (a) Wiring diagram of open collector mode input pulse command (using external power supply and internal current limiting resistor)

- When using the external 24V power supply and internal current limiting resistor:

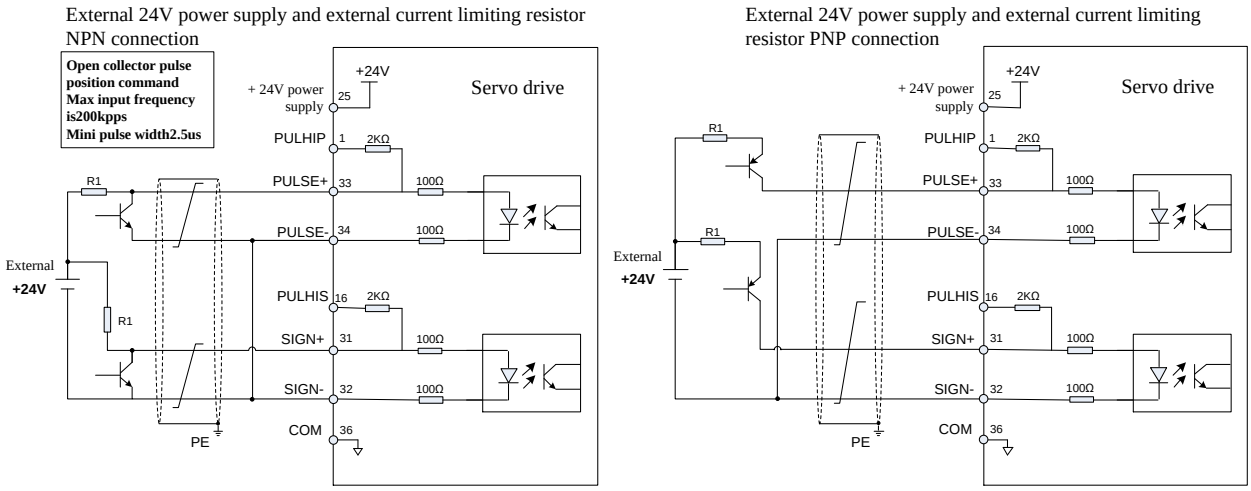


Fig. 3-15 (b) Wiring diagram of open collector mode input pulse command (using external power supply and external current limiting resistor)

The current limiting resistor R1 is selected as follows:

The selection of resistor R1 should meet the formula: $\frac{V_{CC}-1.5}{R1+200}=10mA$

The recommended resistance of R1:

VCC voltage	R1 resistance	R1 power
24V	2.0K	0.5W
12V	0.8K	0.5W

Attention☞

1. **Always use a twisted pair for a pair of differential signals.**
2. **The pulse input signal cable must be separated from the power cable at a distance of at least 30cm.**
3. **Since the pulse input interface is not a shielded input interface, in order to reduce noise interference, it is recommended to connect the output signal ground of the upper device with the signal ground of the servo drive.**

- Typical examples of incorrect connection

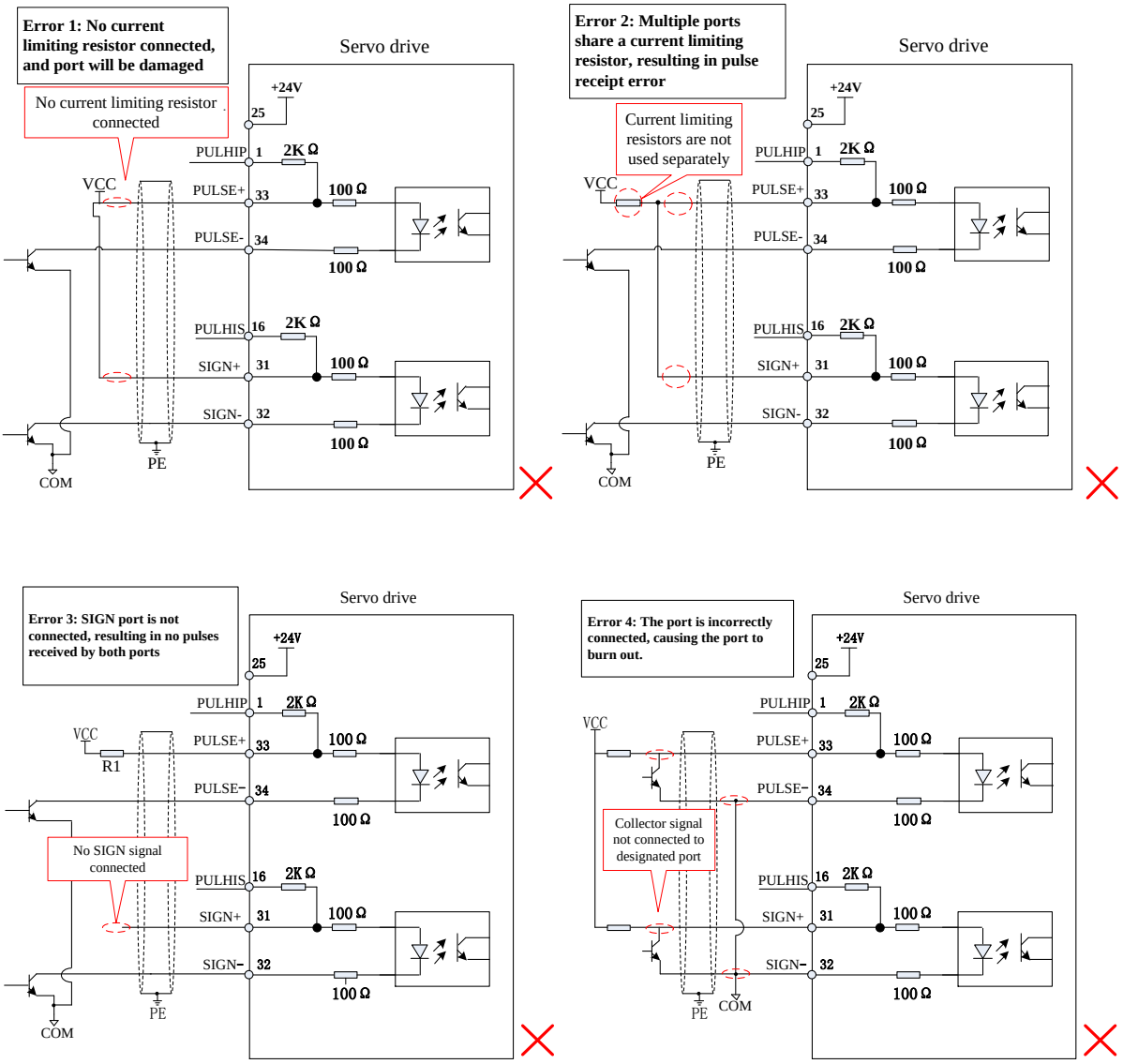


Figure 3-16 Four typical incorrect connections

3.4.8 **Frequency division output circuit of CN4 encode**

Table 3-9 Encoder frequency division output signal description

Signal	Pin #	Function	
PA+	28	Phase A differential frequency division output signal	Phase A, B orthogonal frequency division pulse output signal
PA-	13		
PB+	12	Phase B differential frequency division output signal	
PB-	27		
PZ+	11	Phase Z differential frequency division output signal	Origin pulse output signal
PZ-	26		
OCZ	35	Phase Z OC gate frequency division output signal	Origin pulse open collector output signal
GND	14	Origin pulse open collector output signal ground	

The encoder frequency division output circuit outputs differential signals through a differential drive. In general, it will provide feedback signals when the drive and the host device constitute the position control system. In the upper device, please use differential or optocoupler receiving circuit to receive signals, with a maximum output current of 20mA.

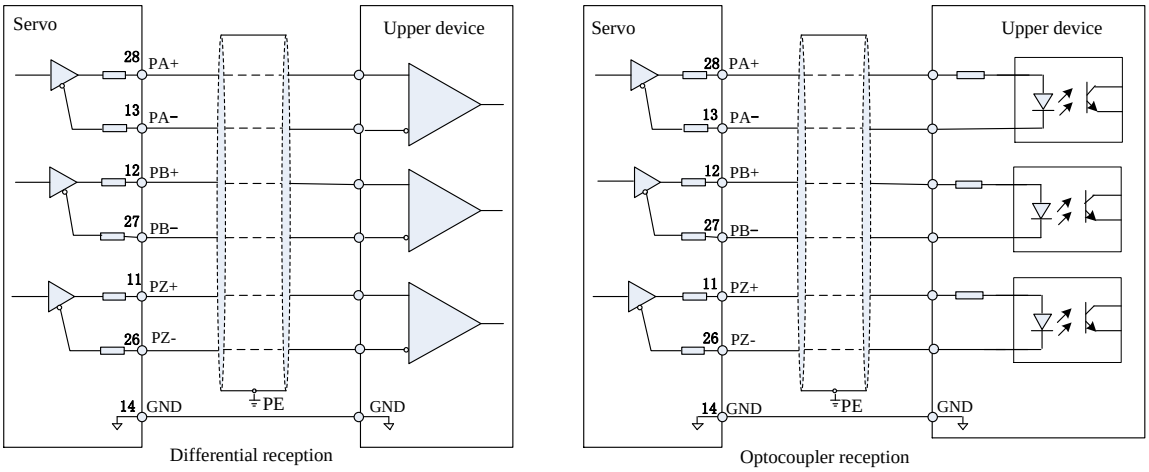


Figure 3-17 Frequency division output wiring diagram

The encoder Z-phase frequency division output circuit can provide feedback signals through the collector open circuit signal, usually when the position control system is formed by the upper device and servo drive. In the upper device, it can receive signals through optocoupler and relay receiving circuit, with a maximum output current of 40mA.

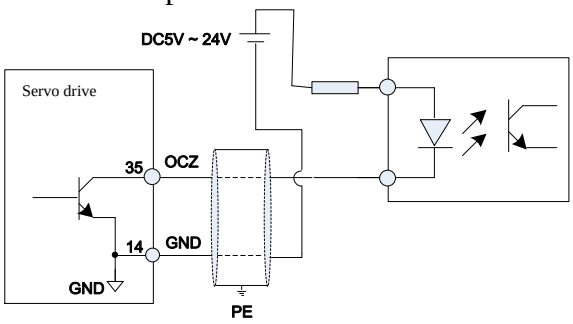


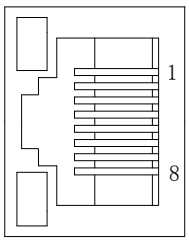
Figure 3-18 OCZ terminal wiring diagram

Attention☞ **Please be sure to connect the signal power supply ground of the upper device to the servo drive GND and use twisted pair shielded cables to reduce noise interference.**
The triode inside the drive has a maximum withstand voltage of DC30V and a maximum allowable input current of 40mA.

3.5 CN2 and CN3 communication terminal wiring

The servo drive is connected to the upper device through two identical communication signal connectors CN2 and CN3 connected in parallel. Users can use MODBUS communication to operate the drive, with a communication distance of about 15m.

Table 3-10 Description of communication connector pins

Signal	Pin #	Function	Terminal pin distribution
RS485+	1	RS485 communication interface	
RS485-	2		
GND	3	RS485/RS232 communication reference ground	
RS232-RXD	4	The sender of RS232 is connected with the receiver of upper device	
RS232-TXD	5	The receiver of RS232 is connected with the sender of upper device	
GND ISO	6	CAN communication reference ground	
CANH	7	CAN communication port (This port is available only for CANopen bus type products)	
CANL	8		

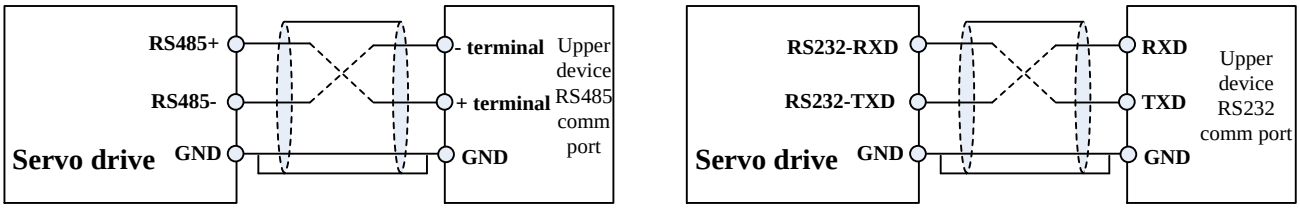
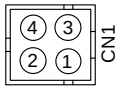
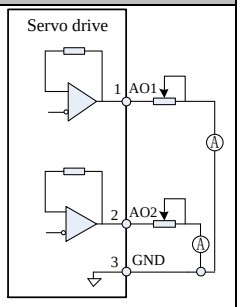


Figure 3-18 Communication terminal wiring diagram

3.6 CN1 analog output terminal

Table 3-11 Analog output signal description

Signal	Pin #	Function		Pin distribution	Circuit diagram
AO1	1	Analog output 1, output voltage -10V ~ 10V, maximum output current 1mA	The corresponding output information can be set by the P6 group codes	 (front view when servo drive is vertical)	
AO2	2	Analog output 2, output voltage -10V ~ 10V, maximum output current 1mA			
GND	3	Analog output signal common ground			
Reserved	4	Cannot connect to any signal cable			

Note:

1) After the control power supply is OFF, the analog monitoring output terminal may output a voltage of about 5V within a maximum period of 10ms. Please consider it during use.
2) The maximum output current of the analog terminal is 1 mA, and the drive may be damaged if this is exceeded. Please consider it fully when selecting the load.

3.7 Brake

When the motor is used to drive the vertical axis or under similar conditions (e.g. external force), a motor with a brake is required in order to prevent the movement of moving parts due to gravity or external force in case of power failure.

Attention☞	**1. The brake is only used for keeping the motor in a stopped state and must not be used to stop the operation of the motor.** **2. The brake may give off clicking sound when the motor runs, but it does not affect its function.**

External 24V power supply is needed for brake. The wiring methods of brake signal and power supply are as follows:

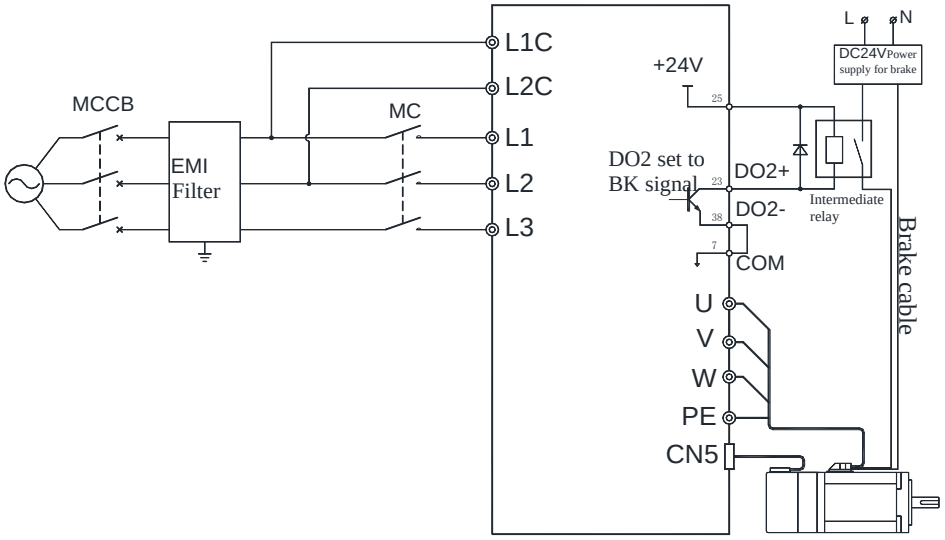


Figure 3-20 Brake signal and power supply wiring

3.7.1 **Notes for brake wiring:**

1) **The intermediate relay must be controlled through the signal terminal (DO2 +, DO2- in the above figure) defined as function 2 (BK), and the brake power supply is switched on and off by the NO contacts of the intermediate relay.**
2) There is no need to distinguish the polarity of the brake coil, and the brake is in release state when powered on (at this time, the brake pads are separated and there is no braking force).
3) **Be sure to use external power supply for the brake.** Internal DC 24V power supply can be used for the intermediate relay coil, and it is not recommended that the relay coil and brake share the same power supply when an external power supply is used.
4) When using an external power supply for the intermediate relay coil, please note that the DO2+ terminal should be connected to the positive terminal and the DO2- terminal should be connected to the negative terminal of the power supply.
5) The operation of brake requires an input voltage of at least 21.5 V, so the voltage drop caused by the power cable resistance needs to be fully considered, and cables above 0.5 mm^2 are recommended. Refer to Chapter 10 for specific parameters of brake power.
6) It is better not to share a power supply with other electrical appliances to prevent voltage or current drop due to the work of other electrical appliances, which will eventually lead to misoperation of the brake.

3.7.2 **Brake action timing sequence**

3.7.2.1 The brake has an action delay time. Please refer to the following figure for the release and engagement delay time of the brake.

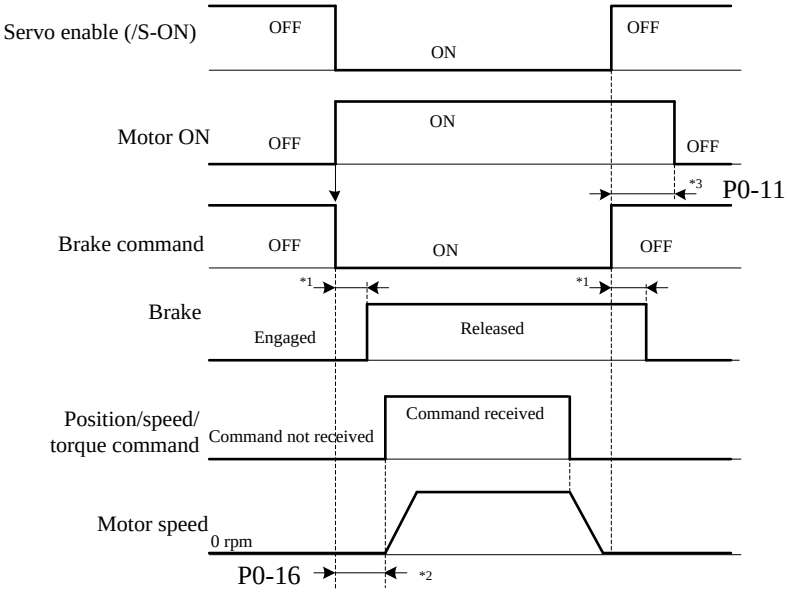


Figure 3-21 Brake release and engagement delay time

*1: The delay time of brake varies with the motor model. Please refer to Chapter 11 and the actual situation shall prevail.

*2: P0-16 specifies the time interval from the time when the servo drive receives the enable (/S-ON) command to the time when it can receive the position, speed and torque commands, which must be greater than the time required for brake release. After the/S-ON signal is ON, the upper device should wait for this time before outputting commands to the servo drive.

*3: Please use P0-09, P0-10, P0-11 to set the time for brake action and servo drive OFF.

3.7.2.2 Brake signal (/BK) output time when servo motor stops

In the case of vertical axis, the dead weight of the moving parts of the machine or external force may cause slight movement of the machine. By setting P0-11, the motor can be in a non-energized state only after the brake is engaged to eliminate slight mechanical movement.

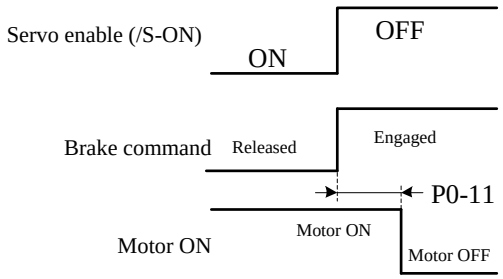


Figure 3-22 Brake action timing sequence when servo enable OFF

Attention☞	**When an alarm occurs under any circumstances, P0-11 is invalid and the servo motor will immediately enter the OFF state. At this time, the moving part may move freely before the brake acts.**

3.7.2.3 Brake signal (/BK) output time when servo motor rotates

When an alarm occurs or the enable signal is forcibly cancelled during the rotation of the servo motor, the servo motor will immediately enter the OFF state. At this time, the brake signal (/BK) output time can be adjusted by setting the brake command output speed value P0-10 and the servo OFF-brake command waiting time P0-09.

Brake operation conditions when servo motor rotates

When any of the following conditions is true, the brake signal will act:

- The motor speed is lower than the set value of P0-10 after the motor enters the OFF state.
- The set time of P0-09 has passed after the motor enters the OFF state.

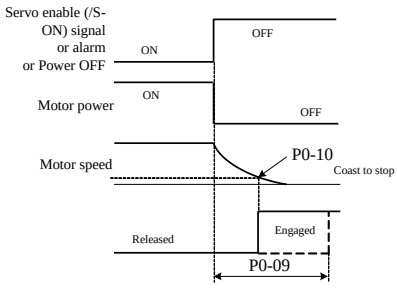


Fig. 3-23 Brake actions when servo motor rotates

Attention☞	**1.** The servo motor speed will not exceed its maximum speed even if the set value in P0-10 is higher than the maximum speed. **2. Do not assign the motor rotation signal (TGON) and the brake signal (BK) to the same terminal. Otherwise, the TGON signal will be ON due to the falling speed of the vertical axis, and the brake may not operate.**

3.8 Standard wiring diagram of control circuit

3.8.1 Position control mode

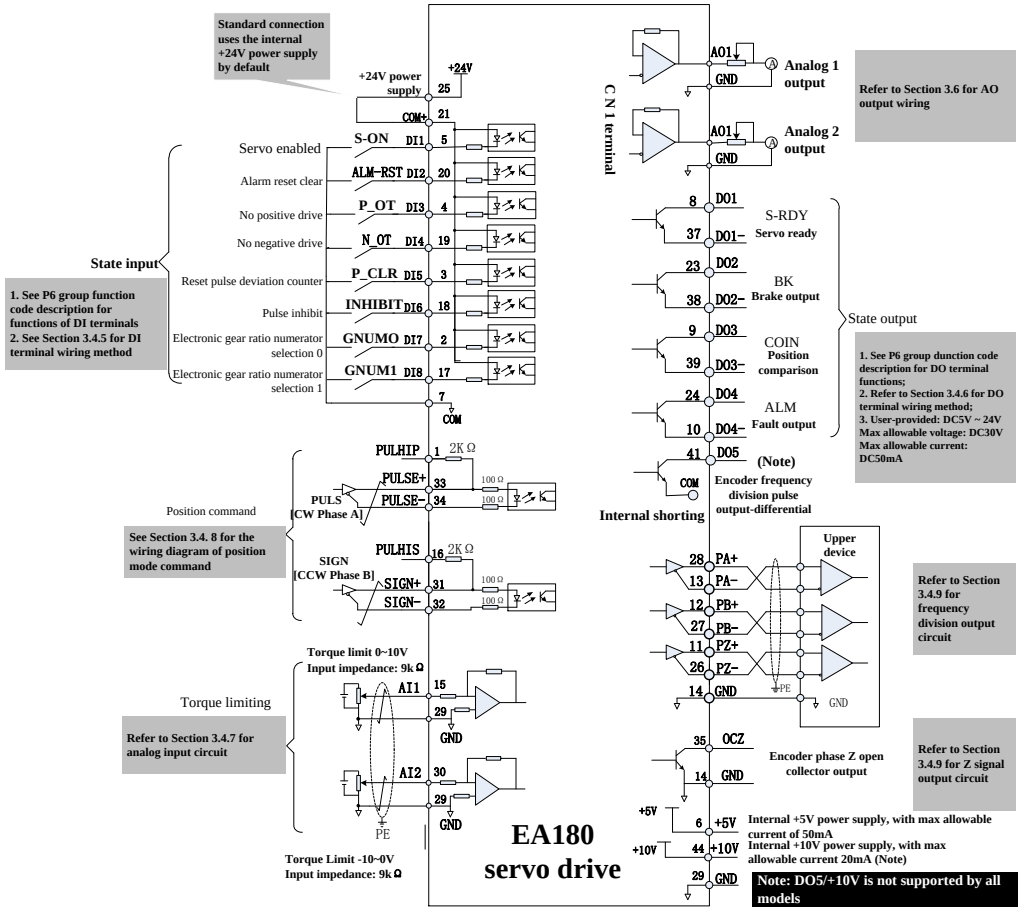


Figure 3-24 Position control mode standard wiring diagram

3.8.2 Speed control mode

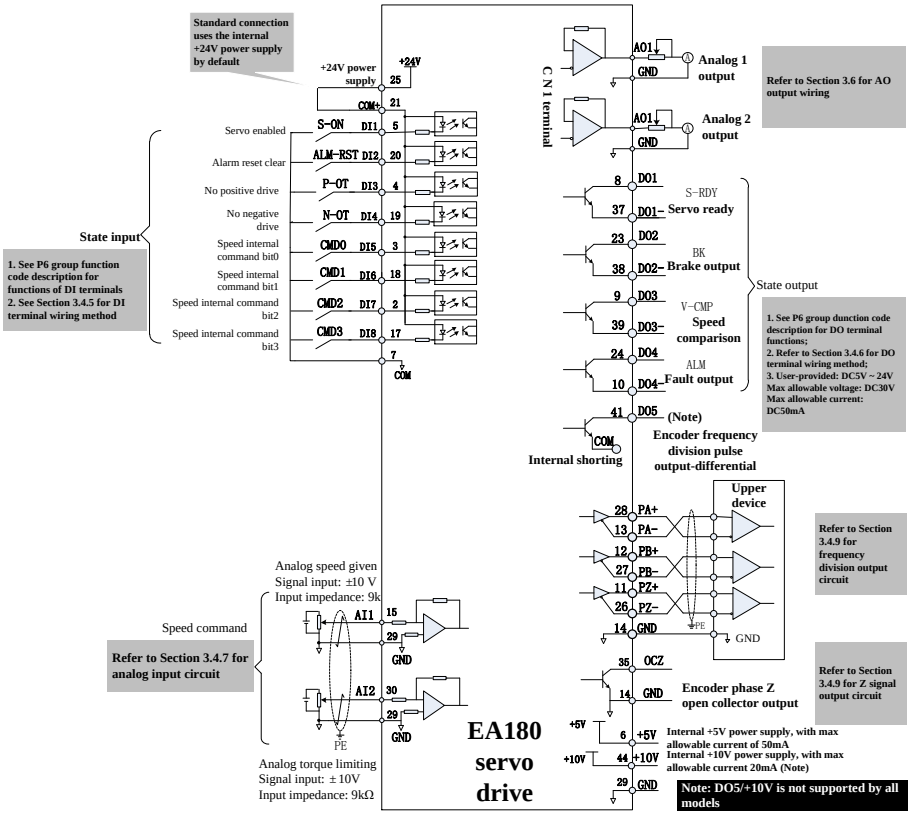


Figure 3-25 Speed control mode standard wiring diagram

3.8.3 **Torque control mode**

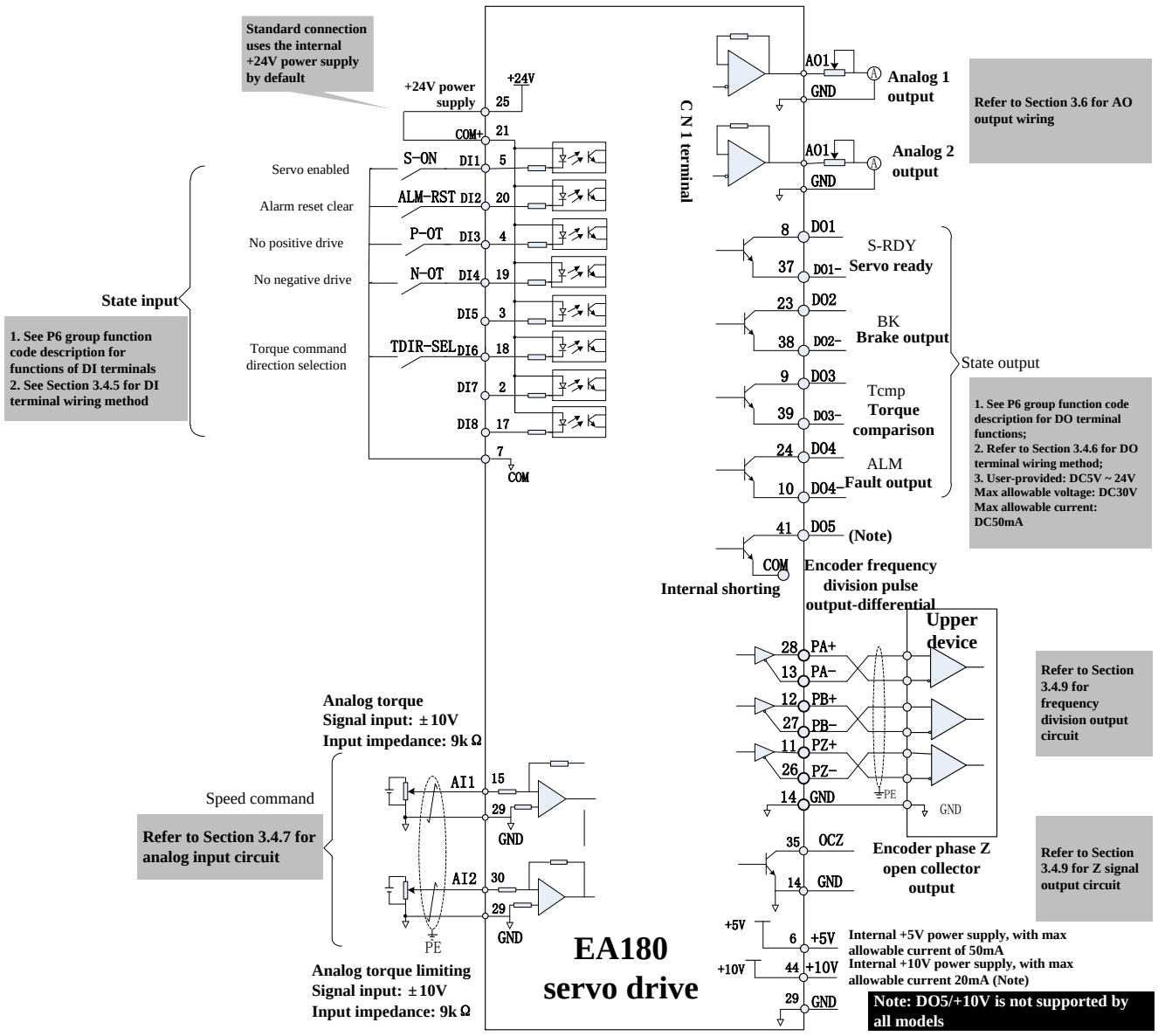


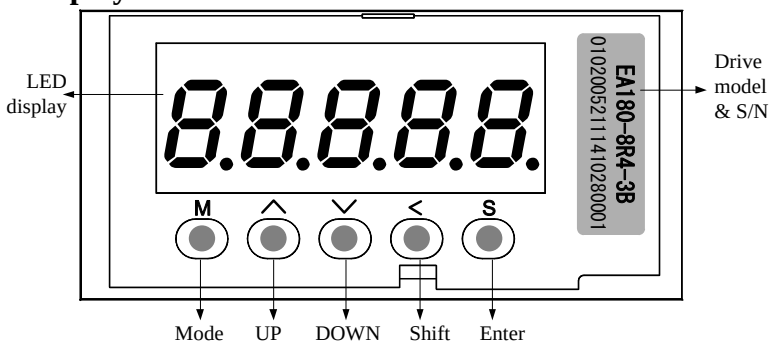
Figure 3-26 Torque control mode standard wiring diagram

3.9 Notes for control circuit wiring

- The control circuit cable and the power cable must be separated at a minimum distance of 30cm.
- If the control circuit cable is short and needs to be extended, please ensure that the shield is reliably connected to ensure reliable shielding and grounding.
- The + 24V of servo drive is referenced by COM, and + 5V/+ 10V is referenced by GND. The load should not exceed the maximum allowable current, otherwise the drive will not work properly.
- Try to use the shortest command input and encoder cables.
- Please use cables above 1.5 mm^2 for grounding.
- Single ground point is required.

Chapter 4 Display and Operation

4.1 Appearance of display and buttons



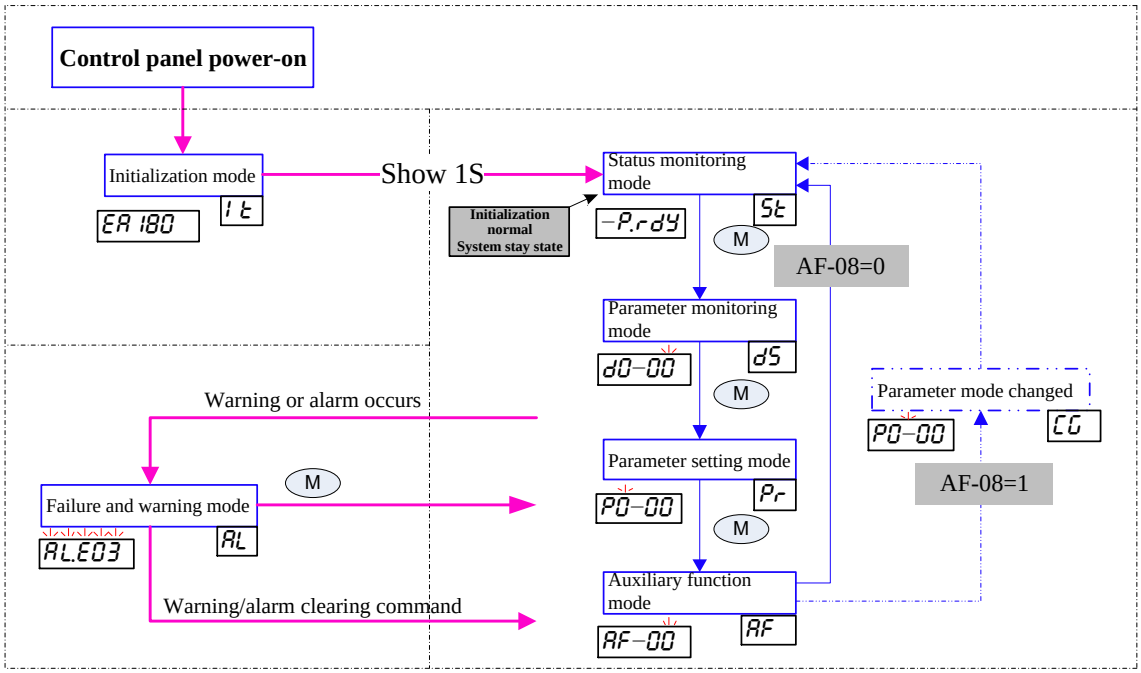
Part names	Sign	Function description
Mode	M	◆ Switch between different operating modes ◆ Exit current parameter/function operation ◆ Exit from AL mode to normal operating mode
UP	∧	◆ Increase current cursor value ◆ Forward jog when AF-02 auxiliary function is in at level 2 ◆ Directly display the first level of next parameter when dS and CC modes are at level 2 ◆ Switch downward to view the fault information when there is a fault in AL mode ◆ Switch between AF-07 parameter selection and drive state in St mode
DOWN	∨	◆ Decrease the current cursor value ◆ Reverse jog when AF-02 auxiliary function is in at level 2 ◆ Switch upward to view the fault information when there is a fault in AL mode ◆ Directly display the first level of previous parameter when dS and CC modes are at level 2
Shift	<	◆ Move the cursor rightward when dS, Pr and AF modes are at level 1 (>); ◆ Move the cursor leftward when dS and AF modes are at level 2 (<); ◆ Switch to display when dS and CC modes are at level 2 and one screen cannot display all parameters;
Enter	S	Confirm the current operation
LED LED0 LED1 LED2 LED3 LED4	JI dt	◆ The information in the box is the LED display content;
	1.20.	◆ ◦ on the box indicates that the corresponding LED flashes. ◆ ◦ beneath the box indicates that the lower right point of the corresponding LED flashes.
	-. 11	◆ If the lower right dot "." of LED4 is on, it indicates that the current data is the second screen of the current information, and you can switch between the two screens with SHIFT button.
	-. 11 1.3011	◆ The LED4 symbol "-" indicates that the current data is negative (the number of bits on current screen ≤ 4); ◆ The lower right dots ".." of LED4 and LED3 are on, it indicates that the current data is negative (the number of digits on current screen = 5);
	1.3011	◆ If the lower right dot "." of LED4 flashes and that of LED3 is on, it indicates that the current data is the second screen of the current information, and you can switch between the two screens with SHIFT button, and the current data is negative.
	1.20.	◆ When digits are displayed, the lower right dots "." of LED3, LED2, and LED1 indicate the decimal point position of the current parameter.
		◆ If the lower right dot "." of LED0 flashes, it indicates that a fault or warning occurs.

4.2 Overview of drive operating modes

EA180 servo drives have seven operating modes:

Operating Mode		Function	Menu Display Levels		
Name	Sign		Level 1	Level 2	Level 3
Initialization mode	It	Display drive model	-	EA 180	-
Status monitoring mode	St	Show current drive status	-	-PrdY	-
Parameter monitoring mode	dO	Select monitoring parameters and monitor their values	dO-00	- 100	-
Parameter setting mode	Pr	Select a parameter and change its value	P0-00	1	-End-
Auxiliary function mode	AF	Select an auxiliary function and perform corresponding operations	AF-05	JI dt	JI dt
Changed parameter mode (hidden by default)	CG	Check all parameters that differ from the default values (Check with auxiliary function AF-08=1, which the information will be hidden again after power-on again)	P I-00	0	-
Warning and alarm Mode (displayed in case of exception)	AL	Display warnings and alarm information	-	AL.E03	-

The modes are switched as follows:

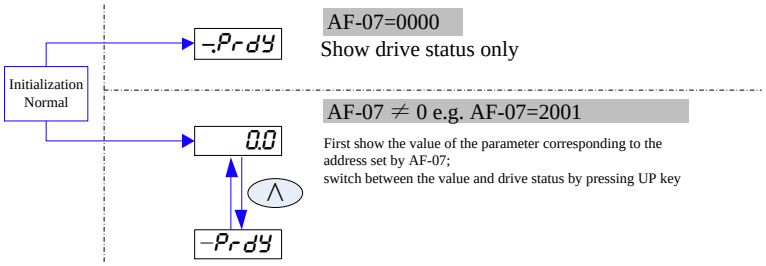


4.3 Initialization mode It

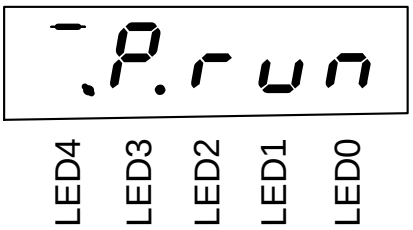
After the drive control boards (L1C and L2C) are powered on for the first time or reset by AF-00 software, they first enter the initialization mode, display EA 180, and automatically enter the status monitoring mode in 1 second.

4.4 Status monitoring mode St

After the system initialization, it will automatically enter the status monitoring mode in 1 second:



The following figure shows the display schematic of the drive's LED display in the status monitoring mode.



LED2 to LED0 display the current operating state of the drive, including five types:

ndY	The current drive is not ready (please check the bus voltage of the control circuit/drive circuit, and check for faults, etc.)
rdY	The current drive is ready to enable
run	The current drive is enabled
Poo	The current drive is in the process of homing
PAL	The current drive has a warning or an alarm

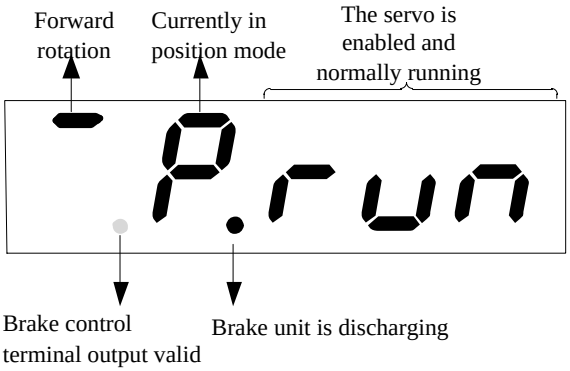
LED3 shows the control mode of the current servo drive, and the decimal point shows whether the brake unit is in the discharging state.

P	The servo drive is in position control mode and the brake unit is not operating	P	The servo drive is in position control mode and the brake unit is discharging
S	The servo drive is in speed control mode and the brake unit is not operating	S	The servo drive is in speed control mode and the brake unit is discharging
t	The servo drive is in torque control mode and the brake unit is not operating	t	The servo drive is in torque control mode and the brake unit is discharging

LED4 shows the direction of the current motor speed and the decimal point shows the state of the brake terminal (BK)

-.	Motor runs reversely, and BK terminal output is valid	-.	Motor runs reversely, and BK terminal output is invalid
-	Motor speed is 0, and BK terminal output is valid	-.	Motor speed is 0, and BK terminal output is invalid
8	Motor runs forwards, and BK terminal output is valid	8.	Motor runs forwards, and BK terminal output is invalid

Example: Description for the following LED display:

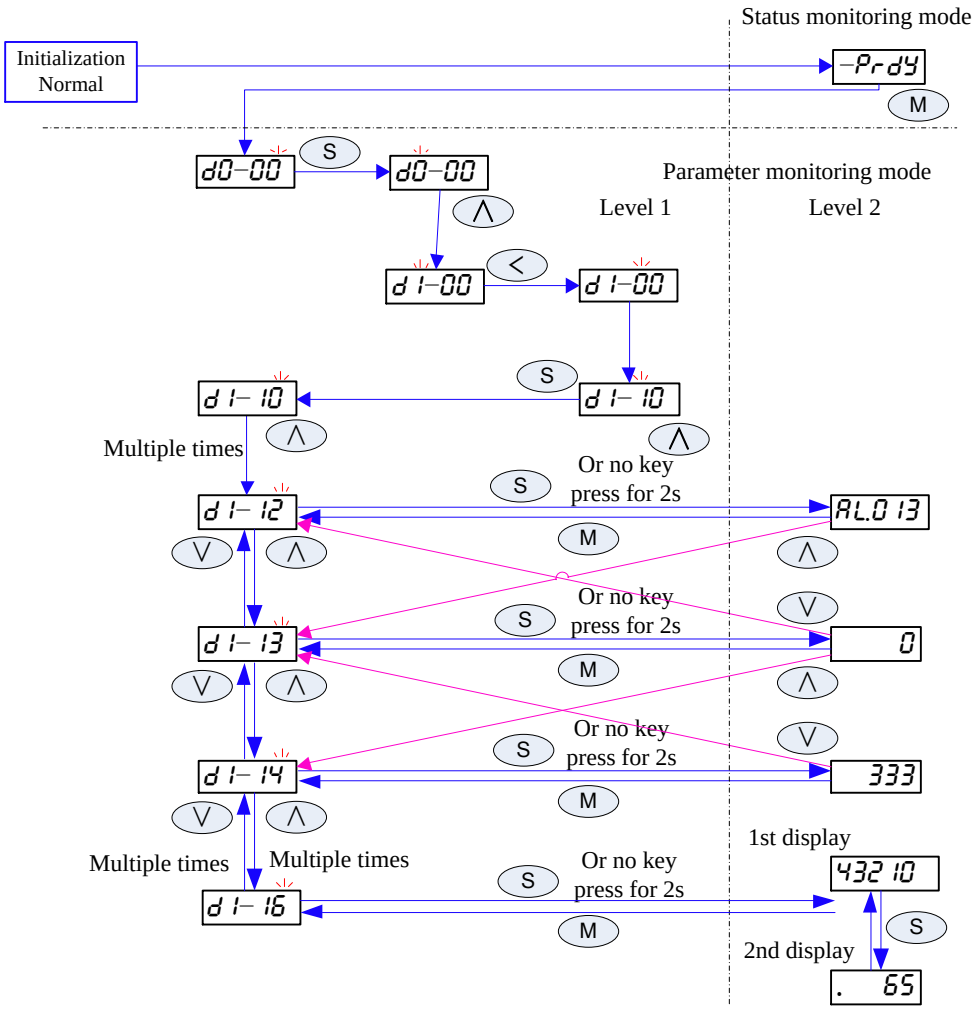


Attention☞	**1: AF-07 parameter is hexadecimal. For example, the communication address of D0-01 is 2001H, you can enter 2001 with the buttons, but if it is written through communication, you should write 2001H.** **2: AF-07 cannot be set to an address that does not exist, otherwise the content displayed may be unknown.** **3: If it is currently not enabled, LED3 will display position control mode, and once enabled, it will be display the actual operating control mode.**

4.5 Parameter monitoring mode d5

After the system initialization, it will automatically enter the status monitoring mode; press the M button once to switch to the parameter monitoring mode.

Take checking the previous fault information (d0-12 ~ d0-14 and d0-16) as an example, the following figure illustrates the button operation in parameter monitoring mode.

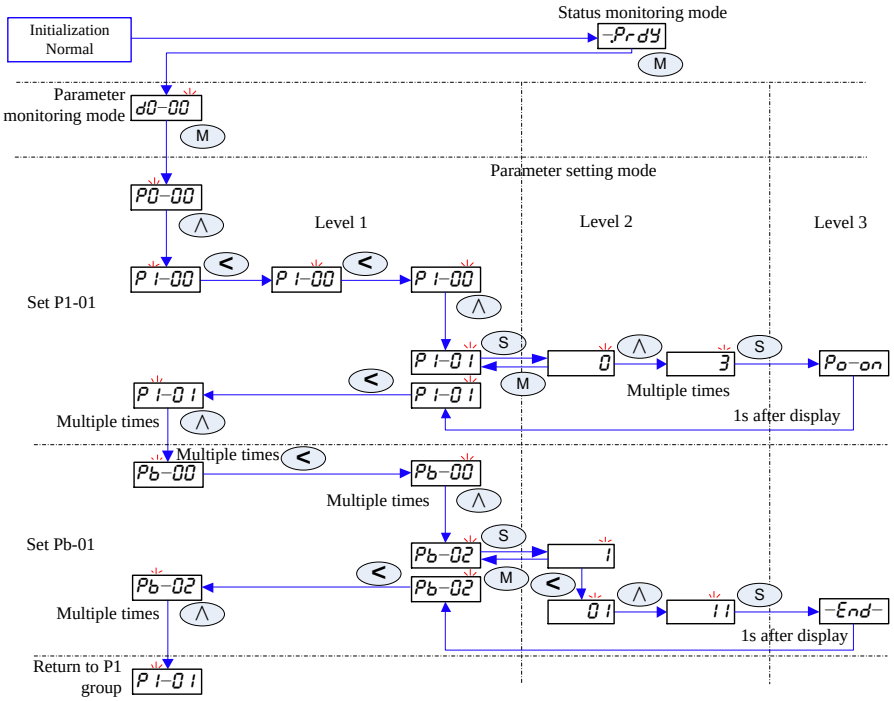


- When selecting the monitoring parameter dx-yz, please select the group number (x) first, and then select the intra-group number (yz, z can be carried to y).
- The Shift button (S) controls the cursor to move rightward circularly in the first-level interface of this mode, and the position change route is LED0 (initial position)→ LED3→LED1→LED0 …; in this mode, the second-level interface controls the data of the first and second screens to be displayed back and forth.
- The monitoring parameter value can be checked more easily. If the current interface is the second level in this mode, press (∧) button to directly switch to the first-level interface display of the next parameter (equivalent to (M) + (∧)); you can press the (∨) button to directly switch to the first-level interface display of the previous parameter (equivalent to (M) + (∨));
- In this mode, when the first-level interface is displayed, you can press (S) button to directly enter the second-level interface. If there is no key operation for more than 2s, it will automatically enter the second-level interface for display.

4.6 Parameter setting mode

After the system initialization, it will automatically enter the status monitoring mode; press (M) button twice to switch to the parameter setting mode.

The following is an example of setting P1-01=2, Pb-01=1 and returning to P1 group parameters.



- When selecting the setting parameter Px-yz, please select the group number (x) first, and then select the intra-group number (yz, z can be carried to y);

  When selecting a group, the last operated intra-group number will be automatically displayed (if returning to Group P1 again, P1-01 will be directly displayed).
- The Shift button (<) controls the cursor to move rightward circularly in the first-level interface of this mode, and the position change route is LED3 (initial position)→LED1→LED0→LED3 …; in the second-level interface of this mode, it controls the cursor to move leftward circularly, and the position change route is LED0 (initial position)→LED1→LED2→LED3→LED4→ (second screen LED0→second screen LED1→second screen LED2→second screen LED3→second screen LED4)→LED0→LED1.... The leftmost position of the cursor is determined by the number of bits displayed by the current parameter;
- When entering the parameter setting mode from other modes, the cursor stops at LED3 by default;

  When pressing (M) or (S) button to enter the first level from the second level of this mode, the cursor stops at LED0 by default;
- When entering the second level of a parameter, its current value will be automatically cached and displayed. At this time, after the value is changed through other channels (such as communication), the display will not be automatically refreshed.

  After changing the parameters with the buttons, press the (M) button to return to the first level, and

the parameter remains the value before the change;

After changing the parameters with the buttons, press the (S) button to confirm the setting; show the third level for 1s and automatically return to the first level, and the parameter will be set to the new value.

- After setting the parameter and pressing (S) button, whether the current parameter is valid immediately and what is displayed at the third level is related to the parameter attribute.

Parameter attribute	Display after pressing (S)	Description
○	-End-	Set at any time, valid immediately
●	Po-on	The values before and after change are different: Set at any time, and valid the power-on again
	-End-	The values before and after change are the same: The initial value is always valid.
☆	HALt	The values before and after change are different: Set at any time, and valid after the motor is static for 1s.
	-End-	The values before and after change are the same: The initial value is always valid.
▲	-	Read-only

4.7 Changed parameter mode CG

After each power-on of the control panel, the changed parameter mode defaults to be hidden. You need to set AF-08=1 and switch to this mode with the (M) button.

Below is the description in two cases:

- No function code and different from the factory set value: When entering the changed parameter mode, the LED displays nuLL.

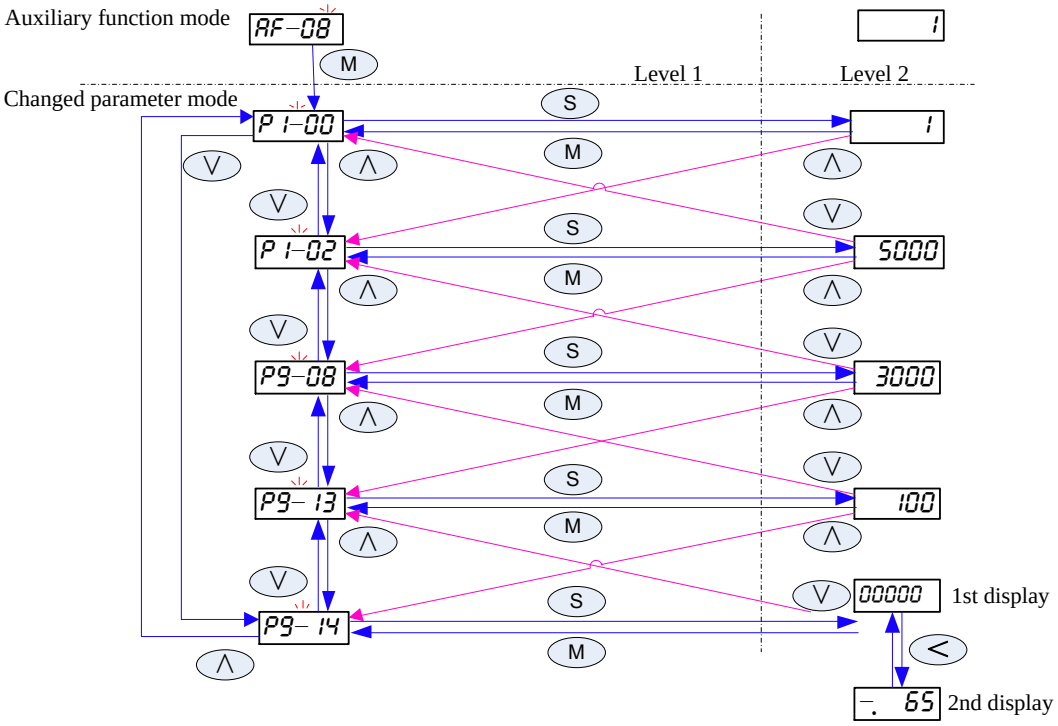
- The following function codes (P1-00/P1-02/P9-08/P9-13/P9-14) are different from the factory set values:

A. In order to distinguish from the normal function display, "-" flashes at LED2;

B. Find the changed function code with (∧) or (∨) button;

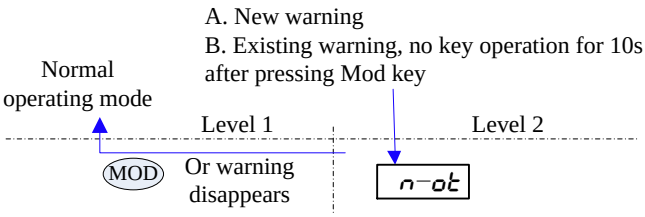
C. The monitoring parameter value can be changed more easily. If the current interface is the second level in this mode, press (∧) button to directly switch to the first-level interface display of the next parameter (equivalent to (M) + (∧)); you can press the (∨) button to directly switch to the first-level interface display of the previous parameter (equivalent to (M) + (∨));

D. Only the current changed value can be viewed when entering the second level. Parameter changes in this interface are not supported.

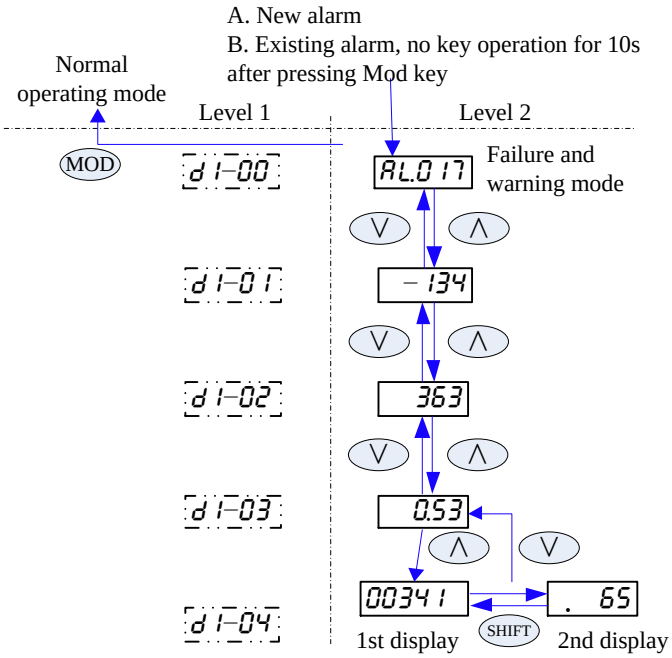


4.8 Warning and alarm mode AL

In any mode, once a warning or alarm occurs, the system will directly enter the warning or alarm mode. At this time, you can temporarily switch to the normal operation mode by pressing the M button (the lower right dot of LED0 flashes to show the difference), but the system will return to the warning or alarm mode if there is no key operation within 10s.



The above figure shows the button operation when there is a warning. In the warning mode, only the warning sign (N-ot) is displayed, and the system will automatically return to normal operation mode after the warning disappears.



The above figure shows the button operation when there is an alarm. In the warning and alarm mode, the alarm information can be viewed by switching with the ∧ and ∨ buttons (alarm code AL.017, motor speed -134rpm, bus voltage 363V, motor current 0.53 A, and cumulative operation time 6500341min).

When an alarm occurs, first clear the alarm source, then perform alarm reset or power on the control power supply again before system can exit the warning and alarm mode.

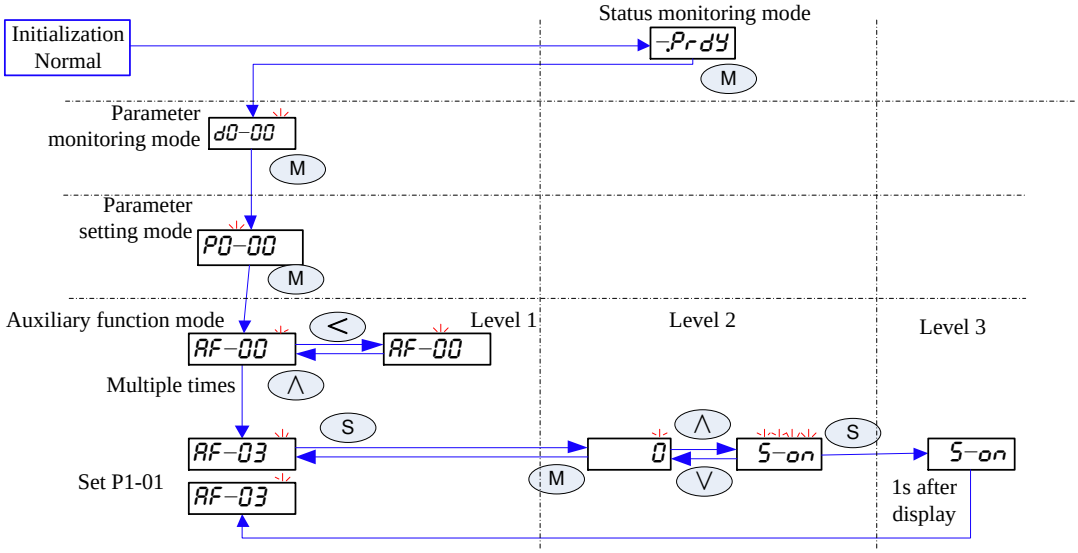
Display	Description
Al0nn	When the drive gives an alarm, the panel displays the alarm sign "Al0" and the alarm number "nn".
AlEnn	When the drive gives a warning, the panel displays the warning sign "AlE" and the warning number "nn". *: In the case of positive or negative overtravel, it directly displays the characters "-POT-" or "-NOT-".

Note: Please refer to the Warning and Alarm Handling section for specific warning and alarm information.

4.9 Auxiliary function mode AF

After the system initialization, it will automatically enter the status monitoring mode; press the M button thrice to switch to the auxiliary function mode.

Take AF-03 (Internal S-ON) auxiliary function as an example for operation description. Other functions have the same operation method, and only different levels have different displays and meanings.



- When selecting the auxiliary function AF-yz, because there are not many parameters in this group, you can directly press the ∧ and ∨ buttons to select when the cursor flashes in the Z position, and it will be automatically carried to or borrowed from position y. You can also set them separately by moving the cursor with < button.
- In this mode, < is used to control the cursor to move between position z and position y in the first level.
- When entering the second level of a parameter, its current value will be automatically cached and displayed. At this time, after the value is changed through other channels (such as communication), the display will not be automatically refreshed.

  After changing the parameters with the buttons, press the M button to return to the first level, and the parameter will be the value before the change;
- After changing the parameters with the buttons, press the S button to confirm the operation; show the third level for 1s and automatically return to the first level.

IMPORTANT: Auxiliary functions are parameters set to perform specific function operations, and the keypad display content is not the value of the internal register.
During operation with the keypad, the displayed symbol shall prevail. During operation with communication mode, the register value is written to the corresponding address. A register value of '-' indicates that the operation cannot be performed by communication.

4.10 Auxiliary function operation

AF-00	Software reset	Data size	16bit	Commu. addr.	3F00H
		Register value storage	Auto reset upon completion		

Register value	Display	Operation
0	0	Press S, it displays -End-, no operation
1	rESEt	Press S to reset software (equivalent to power-on again of control power supply)

AF-01	Alarm reset	Data size	16bit	Commu. addr.	3F01H
		Register value storage	Auto reset upon completion		

Register value	Display	Operation
0	0	Press S, it displays -End-, no operation
1	AL.CLr	Press S to perform the alarm reset operation * It must be a resettable alarm and the cause of current alert has been eliminated.

AF-02	JOG	Data size	16bit	Commu. addr.	3F02H
		Register value storage	-		

Register value	Display	Operation
-	-JoG	Press ∧, the motor rotates forward and it displays JoG. Press ∨, the motor runs reversely and it displays _JoG. Do not press the key, motor is static, display -JoG * The speed of jog operation is determined by P8-00, and the acc/dec time is determined by P8-01. * Please operate in the -.Prdy (not enabled, and ready) state, and the jog process will automatically exit if a warning occurs.

AF-03	Internal S_ON command	Data size	16bit	Commu. addr.	3F03H
		Register value storage	Stored		

Register value	Display	Operation
0	0	Press S to display -End-. If there is no other enable input, the drive will enter the enable OFF state.
1	S-on	If the enable condition is met, press S to display S-on, and the drive will enter the enable-ON state.

* This parameter will be stored and the drive will be enabled ON immediately upon the next power-on. If this is not desired, please modify this parameter value to 0 before power-off.

AF-04	FFT test	Data size	16bit	Commu. addr.	3F04H
		Register value storage	Auto reset upon completion		

Register value	Display	Operation
0	0	Press S, it displays -End-, no operation
1	EydFt	Press S, and it displays EydFt and carries out speed bandwidth test with the upper device software identification system; after the test, automatically exit and upload the data to the upper device for analysis and display. * The motor has slight vibration and sound.

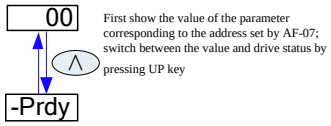
AF-05	Offline inertia identification	Data size	16bit	Commu. addr.	3F05H
		Register value storage	Auto reset upon completion		

Register value	Display	Operation
0	0	Press S, it displays -End-, no operation
1	JI dt	Press S, it displays JI dt and starts to identify the current system inertia. After successful identification, the inertia (multiple of the motor inertia) is automatically stored in P4-10. * Refer to Section 6.6 for detailed description of inertia identification.

AF-06	**AI channel self-correction**			Data size	16bit	Commu. addr. 3F06H
				Register value storage	Auto reset upon completion	
	Register value	Display	Operation			
	0	0	Press S, it displays -End-, no operation			
	1	AI 1	The given AI1 external voltage source is 0V (the actual voltage may not be 0V); press S, it displays AI 1 and carries out zero drift learning, and the results will be automatically stored in P6-33 after completion.			
	2	AI 2	The given AI2 external voltage source is 0V (the actual voltage may not be 0V); press S, it displays AI 2 and carries out zero drift learning, and the results will be automatically stored in P6-34 after completion.			

Attention☞

1: When performing zero drift automatic correction, it is necessary to ensure that the given command of the upper device itself is 0V (the actual voltage may not be 0)
2: Zero drift automatic correction is only applicable to external power supply of -10 ~ 10V.
3: If that actual voltage at the AI terminal exceeds ± 2 V while the correction is performed, an AI034 alarm will occur.

AF-07	**Status displayed by default upon power-on**			Data size	16bit	Commu. addr. 3F07H
				Register value storage	Stored	
	Register value	Display	Operation			
	0000H	0000	Press S, it displays -End-; only display the drive status in status monitoring mode.			
	2001H (example)	2001	Press S, it displays -End-; if AF-07 is a non-0 value, the status monitoring mode displays function code at the corresponding communication address (such as D0-01) by default. You can switch between the monitoring value and the drive status with ∧ button. 			

Attention☞

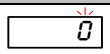
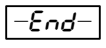
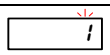
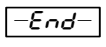
1: AF-07 is displayed in hexadecimal format, which means the correspondence address. If the set address has no corresponding function code, the display value is unknown.
2: If it is not enabled, LED3 will display position control mode (P), and once enabled, it will display the actual operating control mode.

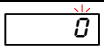
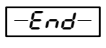
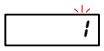
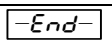
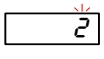
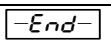
AF-08	**Non-factory value display**			Data size	16bit	Commu. addr. 3F08H
				Register value storage	Auto reset upon power-on	
	Register value	Display	Operation			
	0	0	Press S, it displays -End-, display normally			
	1	1	Press S, it displays -End-; press M again to enter the changed parameter mode, where "-" in the middle flashes to be different from the normal function code display. You can press ∧ or ∨ to view the changed parameters in turn, and press S to view the new values.			

AF-09	**System parameter initialization**			Data size	16bit	Commu. addr. 3F09H
				Register value storage	Auto reset upon power-on	
	Register value	Display	Operation			
	1	1	If AF-09 ≠ 65535, press S, it displays Po-on; no operation			
	65535	65535	If AF-09=65535, press S, it displays Po-on and restore the function code to the default state.			

Attention☞

1: After using this function, the control power supply must be powered on again.
2: This operation does not restore motor parameters.

AF-10	**Display motor parameters**		Data size	16bit	Commu. addr.	3F0AH
			Register value storage	Auto reset upon power-on		
	Register value	Display	Operation			
	0		Press (S), it displays  and hides Pd group parameters			
	1		Press (S), it displays  and displays Pd group parameters			

AF-16	**Multi-turn data and fault handling of absolute encoder**		Data size	16bit	Commu. addr.	3F10H
			Register value storage	Auto reset upon completion		
	Register value	Display	Operation			
	0		Press (S), it displays  , no operation			
	1		Clear multi-turn encoder fault: Press (S), it displays  and executes the corresponding operation.			
	2		Clear multi-turn data and fault of multi-turn encoder: Press (S), it displays  and executes the corresponding operation.			
IMPORTANT: This function is operable only in a non-enabled state.						

Chapter 5 Trial Run

According to the instructions in this Manual, the load of the servo motor can be connected only after the motor operates normally. Usually the servo drive cannot be put into use after it has passed the following tests.

1) Wiring, inspection.
2) Power on servo drive and adjust the parameters.
3) No-load operation.
4) Control function debugging.

Strongly recommendation: Please make sure the servo motor works normally without load before connecting the load to avoid unnecessary danger.

5.1 Drive power-on

5.1.1 Pre-power-on inspection

1) Check whether the drive matches the motor specifications.
2) L1, L2, L3 and U, V, W must be connected correctly and looseness is not allowed.
3) The U, V and W of the motor must one-to-one correspond to the U, V and W of the drive.
4) Check whether the input voltage is consistent with the voltage level shown on the drive nameplate or panel.
5) Check whether the encoder terminals are connected properly.
6) Check whether the servo motor and drive are well grounded.

5.1.2 Power-on timing sequence

1) Refer to Section 3.3.2 for proper power-on timing sequence.

5.2 Trial run

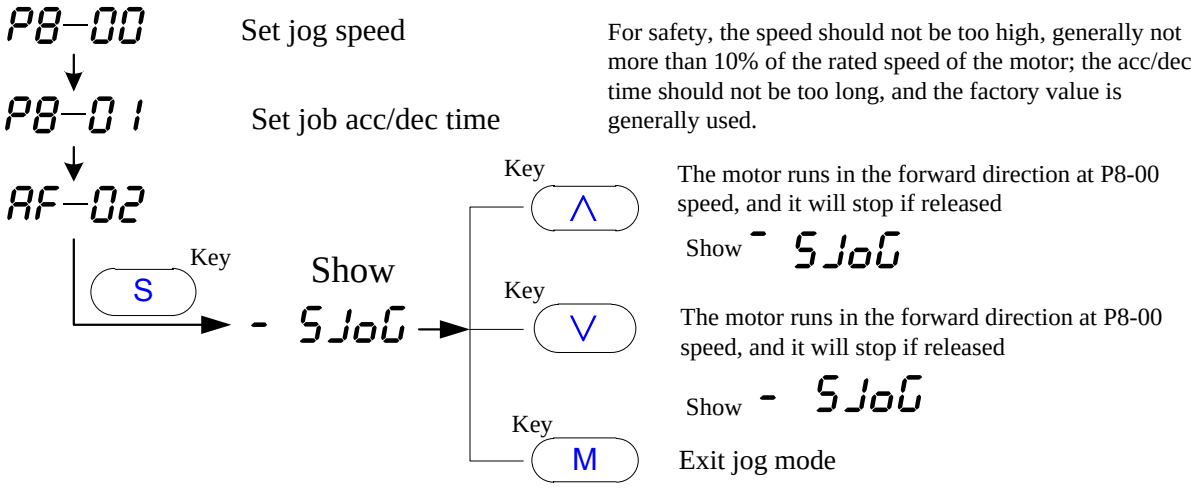
5.2.1 Jog parameter setting

Set the following parameters when servo drive is disabled:

Parameter	Name
P8-00	JOG speed setting (usually factory value can be used)
P8-01	JOG acc/dec time (usually factory value can be used)

5.2.2 JOG operation

Operate as shown below:



If the motor runs normally in JOG mode, it indicates that the wiring and the basic functions of the drive and the motor are normal.

If the motor does not run or does not run properly, please first check whether the system wiring is correct, including whether the motor control line UVW sequence is correct and in good contact, whether the encoder wiring is correct and in good contact, and then confirm whether the motor CODE (d2-01) is consistent with the motor in use. Repeat the above steps. If it still does not work normally, please contact the manufacturer for a solution.

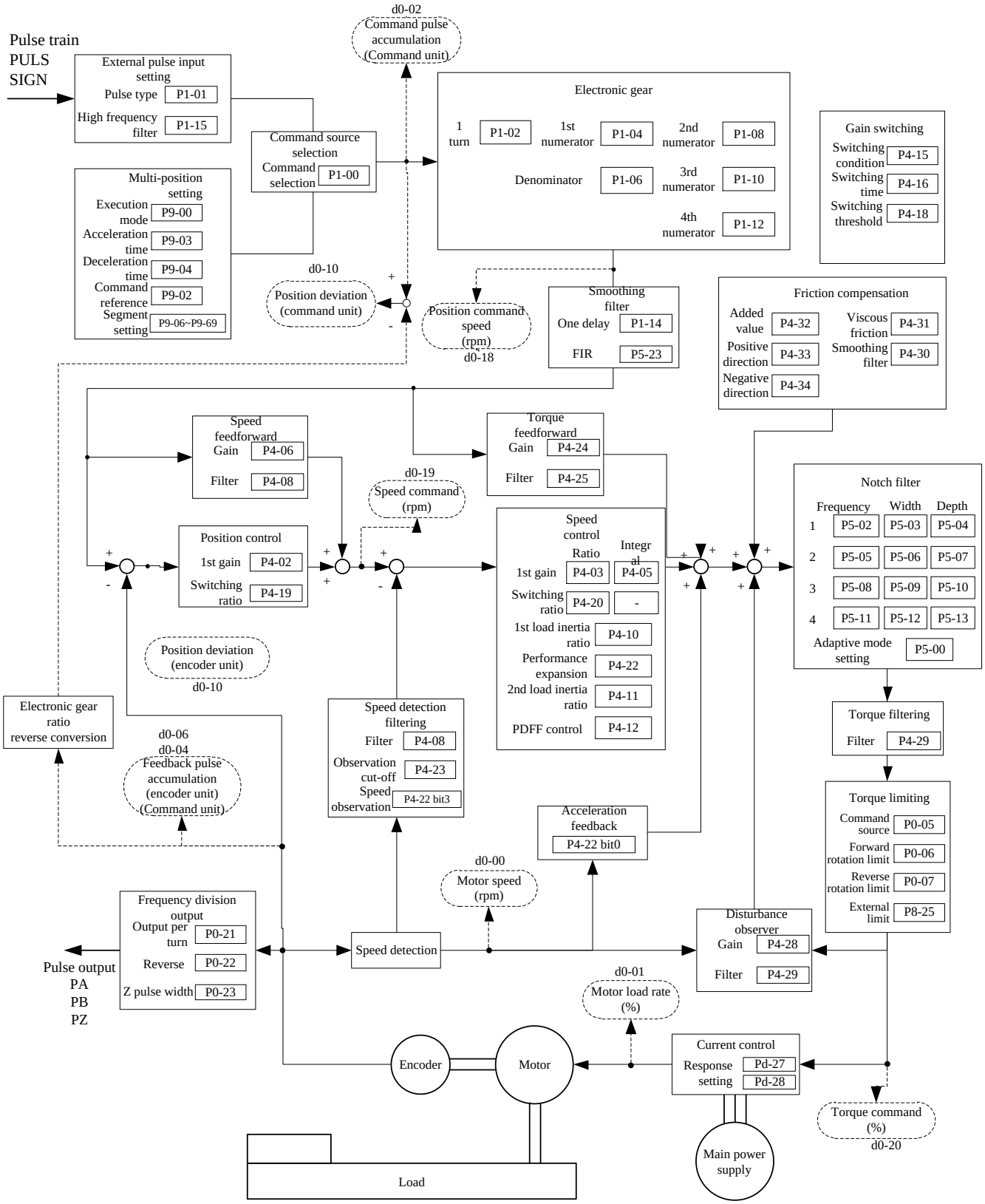
5.3 Servo enable method

There are three ways to enable the drive:

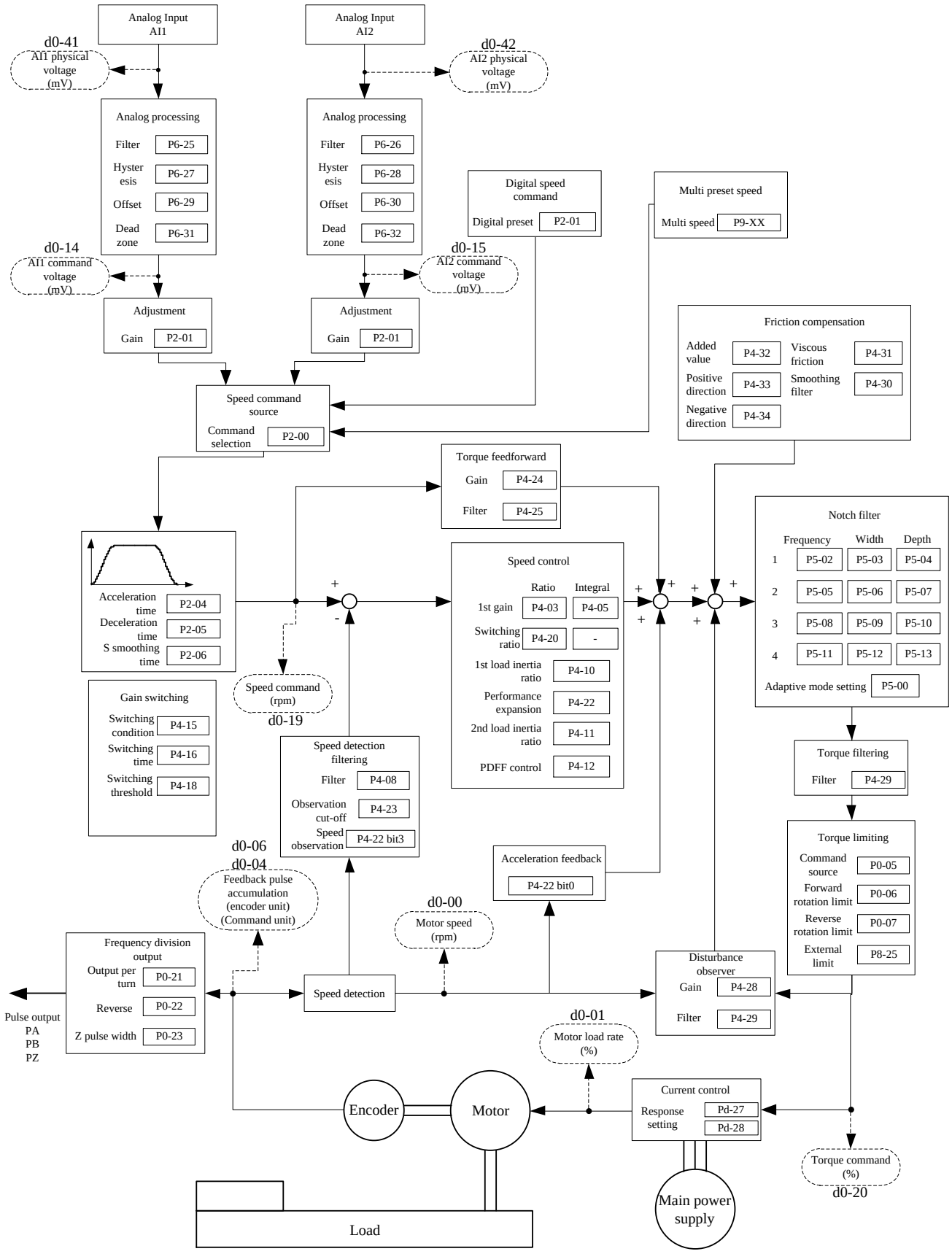
1) After the drive is powered on, set the parameter AF-03 to 1 (the keypad displays S-on), and the drive is enabled ON (if the AF-03 value is not modified, the drive will be enabled immediately when powered on again).
2) By default, the input terminal DI1 is for enabling the servo drive. Reverse the logic of the DI1 terminal by setting P6-01=00000001, and the drive can be enabled ON (if the P6-01 value is not modified, the drive will be enabled immediately when powered on again).
3) According to the standard wiring method, the S_ON command is given through the DI terminal defined for the S_ON function.

Chapter 6 Adjustment

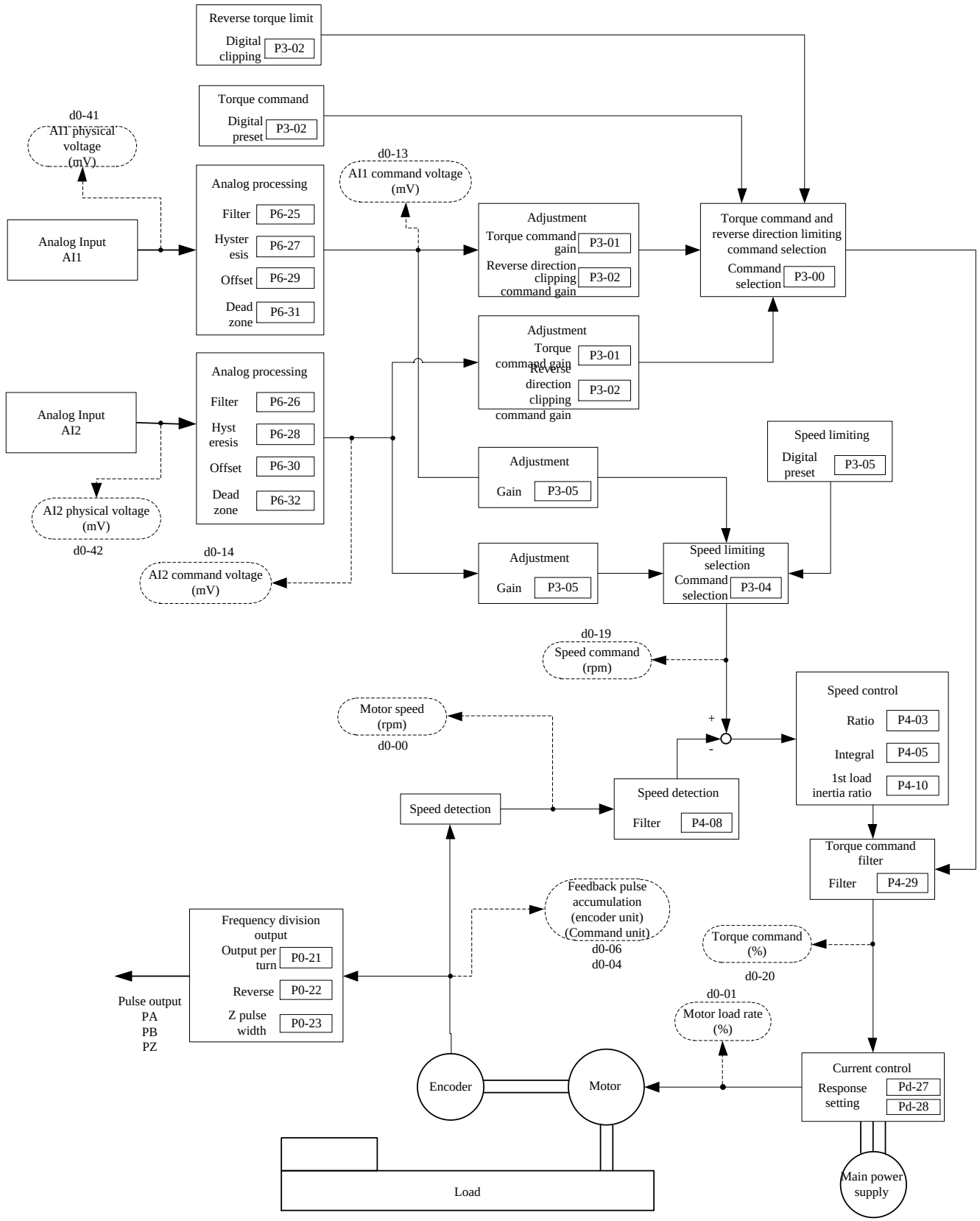
6.1 Position control mode block diagram



6.2 Speed control mode block diagram



6.3 Torque control mode block diagram



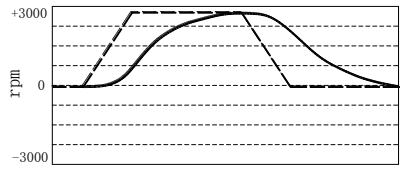
6.4 Gain adjustment summary

6.4.1 Purpose

For the commands issued from the upper device, the drive needs to make the motor work faithfully and without delay according to the command as far as possible. In order to make the motor act more closely to the command and maximize the mechanical performance, gain adjustment is required.

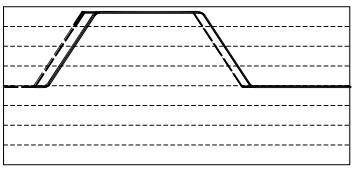
(Example: Screw)

Gain setting: Low



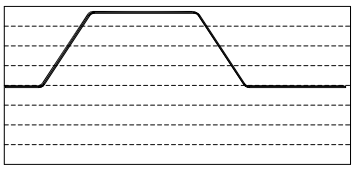
Position loop gain	20.0 1/s
Speed loop gain	8.0 Hz
Integral time constant of speed loop	30.0 ms
Speed feedforward gain	0.0 %
Inertia ratio	20.0

Gain setting: High



Position loop gain	60.0 1/s
Speed loop gain	30.0 Hz
Integral time constant of speed loop	30.0 ms
Speed feedforward gain	0.0 %
Inertia ratio	20.0

Gain setting: High + feedforward setting



Position loop gain	60.0 1/s
Speed loop gain	30.0 Hz
Integral time constant of speed loop	30.0 ms
Speed feedforward gain	100.0 %
Inertia ratio	20.0

6.4.1 Gain adjustment modes

Adjustment mode	P4-00	Load inertia ratio	Auto-set parameters	Manually set parameters	General applications
Manual mode	P4-00=0	Fixed as the value of P4-10	-	All gain parameters	Universal
Semi-auto mode	P4-00=1		P4-02 P4-03 P4-05 P4-29	P4-01 P4-10	The load inertia is basically unchanged.
Auto mode 1	P4-00=2	Auto measurement	P4-10 P4-02 P4-03 P4-05 P4-29	P4-01	Load inertia changes slowly
Auto mode 2	P4-00=3				Load inertia changes a bit fast
Auto mode 3	P4-00=4				Load inertia changes fast

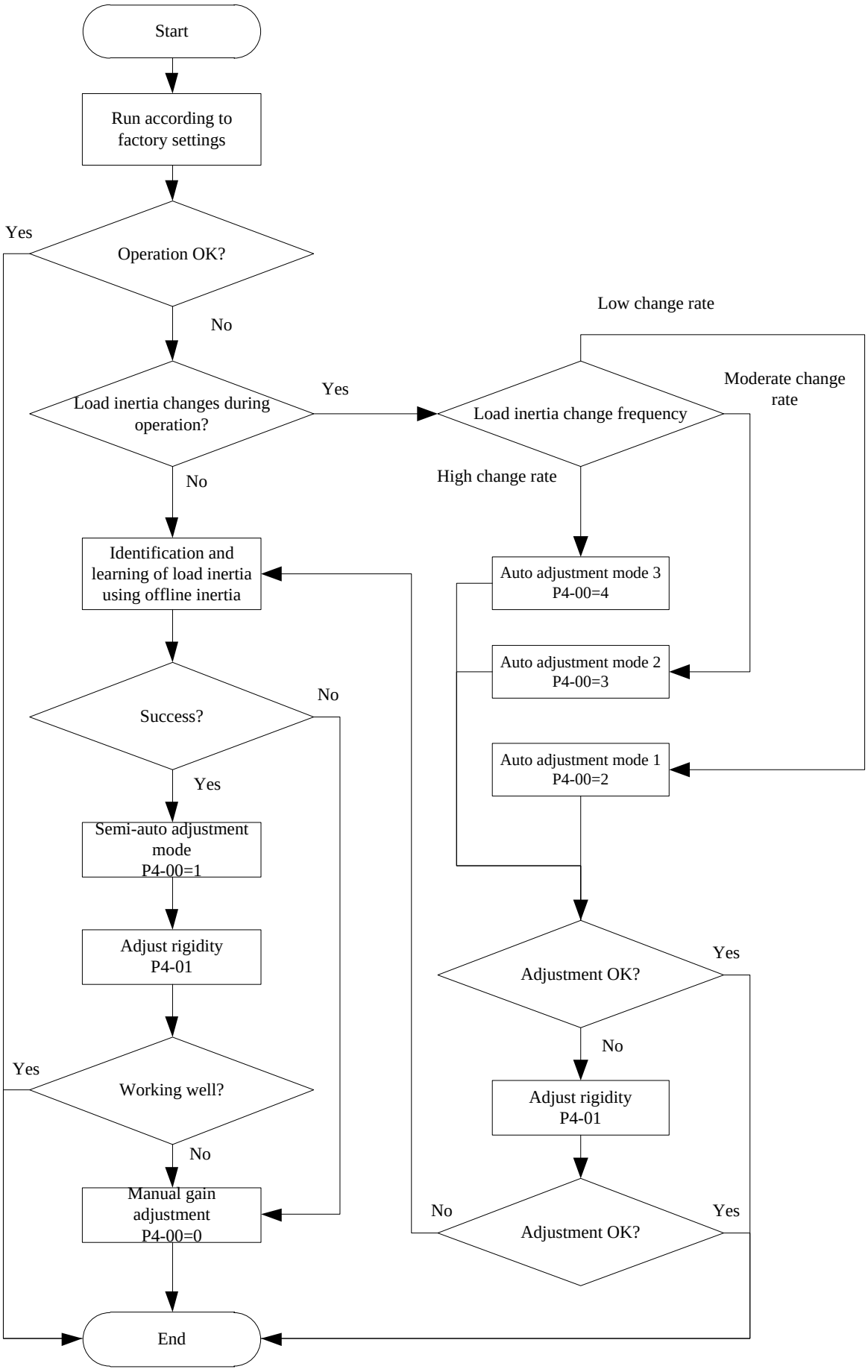
Attention☞

1 Load inertia changes slowly: Load inertia changes from minimum to maximum linearly in tens of seconds.
2 Load inertia changes a bit fast: Load inertia changes from minimum to maximum linearly in seconds.
3 Load inertia changes fast: Load inertia changes from minimum to maximum linearly in hundreds of milliseconds.
4 Auto modes 1, 2 and 3 cannot be used if the load inertia will change abruptly.

6.4.2 Functions of gain adjustment modes

Function		Description
Auto adjustment	Real-time auto gain adjustment	Deduce the inertia of mechanical load in real time, and automatically set the matching gain.
	Real-time auto gain adjustment	Measure the inertia of load offline, and automatically generate gain by setting an appropriate rigidity.
	Adaptive filter	In the actual running state, deduce the resonant frequency through the analysis of the motor speed, automatically set the coefficient of the notch filter, and remove the resonant component from the torque command, thus reducing the vibration of the resonant point.
Manual adjustment	Basic steps	Position control mode adjustment
		Speed control mode adjustment
		Torque control mode adjustment
	Gain switching	Perform gain switching using internal data or external signals to achieve the effects of reducing vibration when stopping, shortening setting time, improving command follow-up, etc.
	Mechanical resonance suppression	In the case of low mechanical rigidity, vibration or noise occurs due to resonance caused by the distortion of shaft, the flexibility of belt, etc., and the gain setting cannot be improved. At this time, resonance can be suppressed by a notch filter.
	Feedforward function	In position control mode, the responsiveness can be improved through speed feedforward. Acceleration feedforward can improve the responsiveness of speed control.
	External disturbance suppression	Suppress the change of motor speed and improve the stability by changing the addition range of external interference torque and load variation calculation values.
	Friction torque compensation	Reduce the influence of mechanical frictions, including dynamic friction compensation, viscous friction compensation and vertical axis gravity compensation.
	Inertia ratio switching	Switch between the two inertia ratios, which can cope with two loads with phase changes in actual inertia ratio.
	Torque command filter	It can adjust filtering of torque commands to reduce vibration.

6.4.3 **Steps**


Start
Run according to factory settings
Operation OK?
Yes
No
Load inertia changes during operation?
Yes
No
Load inertia change frequency
Low change rate
Moderate change rate
High change rate
Identification and learning of load inertia using offline inertia
Success?
No
Yes
Semi-auto adjustment mode P4-00=1
Adjust rigidity P4-01
Working well?
Yes
No
Manual gain adjustment P4-00=0
Auto adjustment mode 3 P4-00=4
Auto adjustment mode 2 P4-00=3
Auto adjustment mode 1 P4-00=2
Adjustment OK?
Yes
No
Adjust rigidity P4-01
Adjustment OK?
No
Yes
End

6.5 Real-time auto gain adjustment

6.5.1 Overview

The drive detects the load inertia of the device in real time during operation and automatically adjusts the basic gain value according to the result and the set rigidity value. There are 3 options for different load characteristics

6.5.2 Scope of application

Real-time automatic gain adjustment is applicable to position control mode and speed control mode.

6.5.3 Operating method

1) Servo enable OFF
2) Set P4-00 to 2-4; factory default is 1.

Set value	Real-time auto adjustment
2	Applicable to occasions with a slow change rate of load inertia (tens of seconds)
3	Applicable to occasions with a medium change rate of load inertia (seconds)
4	Applicable to occasions with a rapid change rate of load inertia (hundreds of milliseconds)

3) Set P4-01 to a low value
4) Properly set the settings such as clearing the position deviation count, prohibiting command input, torque limit, etc. to enable the motor to rotate normally without obstacles.
5) Enable the servo (ON) and make the device operate as normal.
6) The drive begins to detect the inertia characteristics of the load.
7) Improve the responsiveness of the motor by increasing the set value of P4-01 (rigidity).
8) Please observe the positioning time or vibration state and adjust them to an appropriate value.

6.5.4 Precautions

Under the following conditions, real-time automatic gain adjustment may not be used normally. Please change the load conditions or use semi-automatic gain adjustment/manual gain adjustment (P4-00=1, 0)

	Conditions affecting real-time automatic gain adjustment
Load inertia	◆ When the total load inertia is less than 2 times or more than 20 times the motor rotor inertia
Load	◆ When the mechanical rigidity is extremely low ◆ When there are nonlinear characteristics such as back lash
Motion model	◆ When the speed is less than 100rpm and the device runs at a continuous low speed ◆ When the acceleration/deceleration is below 2000rpm/s ◆ When the acc/dec torque is less than the eccentric load and viscous friction torque ◆ When the speed is above 100rpm and the acceleration/deceleration is above 2000rpm/s, and the duration is not more than 50ms

- After the servo is enabled ON for the first time after power-on, or when the P4-01 rigidity value is increased, abnormal sounds or oscillations may occur before the load characteristic detection is stable. If it can become stable immediately, it is normal. If there is continuous oscillation or repeated action for more than 3 times, and there are still abnormal sounds, please take the following measures:
  - ◆ Lower the setting value of P4-01.
  - ◆ Set P4-00 to 1 or 0 to invalidate real-time automatic adjustment
- After abnormal sound or oscillation occurs, sometimes P4-10 (inertia ratio) will have an extreme value. At this time, please set P4-10 as the inertia ratio calculated by yourself.
- In the result of the automatic gain adjustment, the P4-10 is written to the EEPROM every 30 minutes. When the power is turned on again, this data is used as the initial value for automatic adjustment.
- The gain is updated when the motor is stopped, and even if the value of P4-01 (rigidity) is modified, it will not take effect if the motor is not stopped.
- The following functions are not valid when using real-time automatic gain adjustment:
  - ■ Acceleration feedback
  - ■ Disturbance observer
  - ■ Speed observer
  - ■ Torque feedforward
  - ■ Gain switching
  - ■ Offline inertia identification

6.6 Offline inertia identification

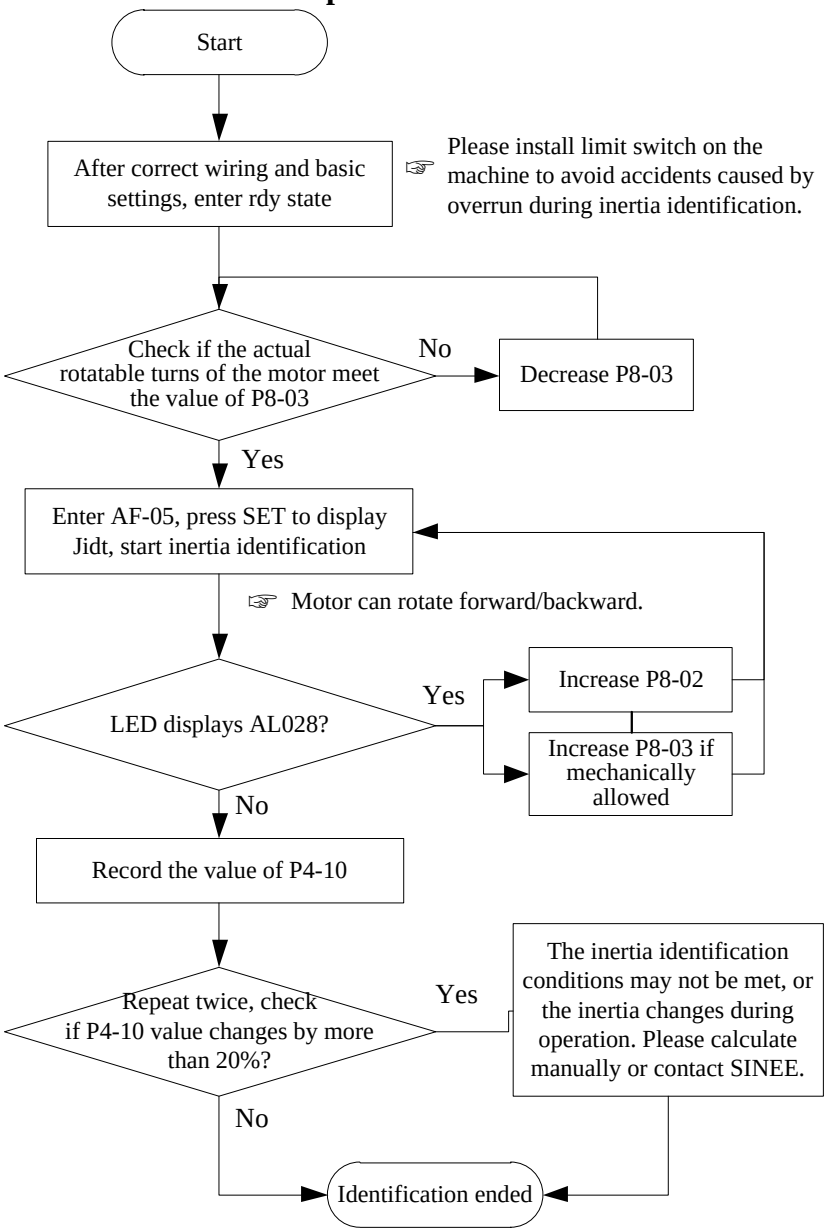
6.6.1 Overview

The load inertia ratio will directly intervene in the calculation of the speed loop gain, and various feedforward functions are based on the correct load inertia ratio. Therefore, before using semi-automatic gain adjustment and manual gain adjustment, if the conditions are met, it is strongly recommended to use offline inertia identification to obtain the correct load inertia ratio.

6.6.2 Conditions for valid offline Inertia Identification

- The actual maximum motor speed is higher than 150rpm;
- The actual acceleration during acceleration/deceleration is above 2000rpm/s;
- The load torque is relatively stable without drastic changes;
- The load inertia is not more than 120 times of the motor rotor inertia;
- There is no situation where the mechanical rigidity is extremely low or the transmission mechanism has large back lash.

6.6.3 Offline inertia identification steps



6.7 Real-time auto gain adjustment

6.7.1 Overview

After getting the accurate load inertia ratio, select the appropriate rigidity value according to the actual mechanical situation, and the drive automatically sets the basic gain value according to the load inertia ratio P4-10 and rigidity value P4-01.

6.7.2 Scope of application

Applicable to situations where the load inertia basically has no change or changes little.

6.7.3 Operating method

1) Servo enable OFF
2) Set P4-00 to 1
3) Servo enable ON (no command input)
4) Properly set the settings such as clearing the position deviation count, prohibiting command input, torque limit, etc. to enable the motor to rotate normally without obstacles.
5) Confirm that the P4-10 value is basically consistent with the actual mechanical situation, or first carry out offline inertia identification.
6) Set the rigidity value P4-01 according to the mechanical conditions (please first set a low value of about 1 ~ 4), and the following parameters will be set automatically.
   P4-02 position loop gain
   P4-03 speed loop gain
   P4-05 integral time constant of speed loop
   P4-29 torque command low pass smoothing constant
7) Improve the responsiveness of the motor by increasing the set value of P4-01.
   Please observe the positioning time or vibration state and gradually adjust them to an appropriate value.

6.8 Rigidity adjustment coefficient

When using real-time automatic gain adjustment and semi-automatic gain adjustment, for mechanical systems with poor responsiveness (low mechanical rigidity), P4-01 must be set to a low value if vibration, abnormal sound, etc. occurs when rigidity (P4-01) is set high. If the rigidity adjustment coefficient is enabled, the speed loop gain can be forcibly increased at a lower rigidity value to improve the responsiveness of the overall mechanical system, but it may also lead to increased vibration.

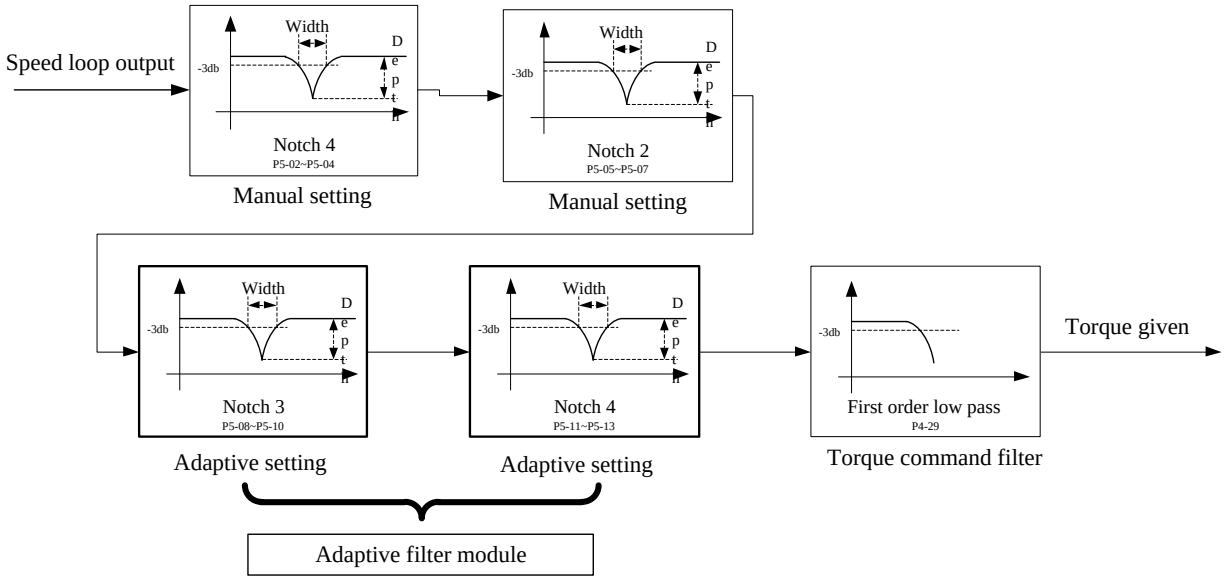
- Associated parameters

Function code	Parameter name	Function
P4-13	Rigidity adjustment coefficient	When P4-00 ≠ 0, forcibly adjust the speed loop gain $\text{Speed loop gain} = \frac{\text{P4-03}}{\text{P4-13}}$

6.9 Mechanical resonance suppression

In case of low mechanical rigidity, vibration or noise occurs due to resonance caused by the distortion of shaft, the flexibility of belt, etc., and the gain setting cannot be improved. In this case, higher gain can be set or vibration can be reduced by suppressing the resonance point through the notch filter.

6.9.1 EA180 resonance suppression block diagram



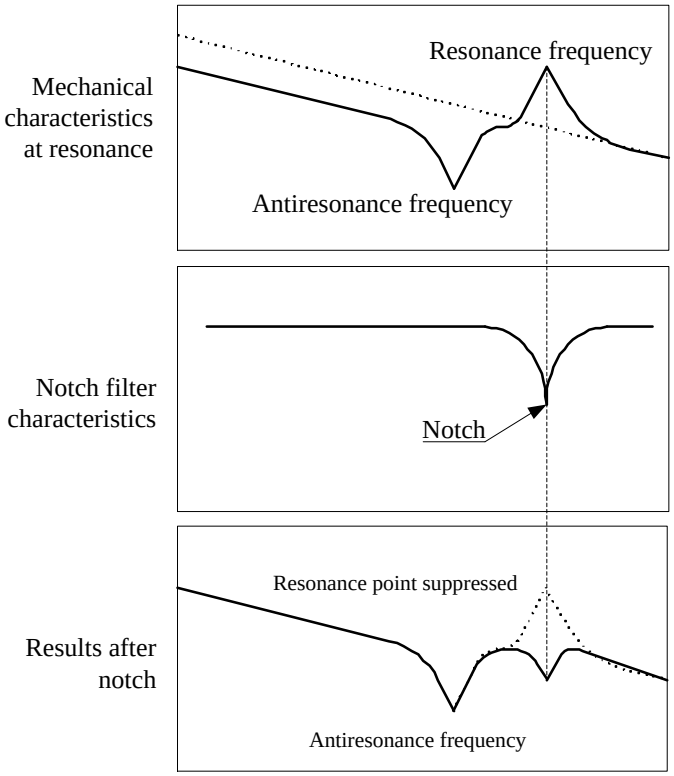
6.9.2 **Torque command filter (P4-29)**

- Set the filter time constant so that the gain attenuates near the resonant frequency.
- The cutoff frequency of the torque command filter can be calculated by the following formula:

$$\text{Cut-off frequency(Hz)} = \frac{1}{2\pi \times \text{Set parameter value} \times 0.00001}$$

6.9.3 **Notch filter**

- EA180 servo drive has 4 notch filters, and the frequency, width and depth can be adjusted manually. The 3rd and 4th notch filters can use auto mode.
- Set P5-00 as 1, input motion command; automatically set the center frequency and notch depth parameters of the 3rd and 4th notch filters when the resonance point affects the motor speed.
- If resonance point fails to be detected, users can appropriately decrease the value of P5-01 (automatic vibration detection level sensitivity) to find a vibration point with a small amplitude when vibration occurs.



- Notch width and depth

The notch filter width and the ratio if notch center frequency at the depth of 0 to the frequency bandwidth at attenuation rate of -3dB are shown on the left side of the following table.

When the notch filter depth is set as 0, the center frequency input is completely cut off; when it is set as 100, and the center frequency input completely passes (output to input ratio = 1). When expressed as dB, the values are shown on the right side of the following table.

Notch width	Bandwidth/center frequency
0	0.1
1	0.59
2	0.71
3	0.84
4	1.0
5	1.19
6	1.41
7	1.68
8	2.0
9	2.38
10	2.83

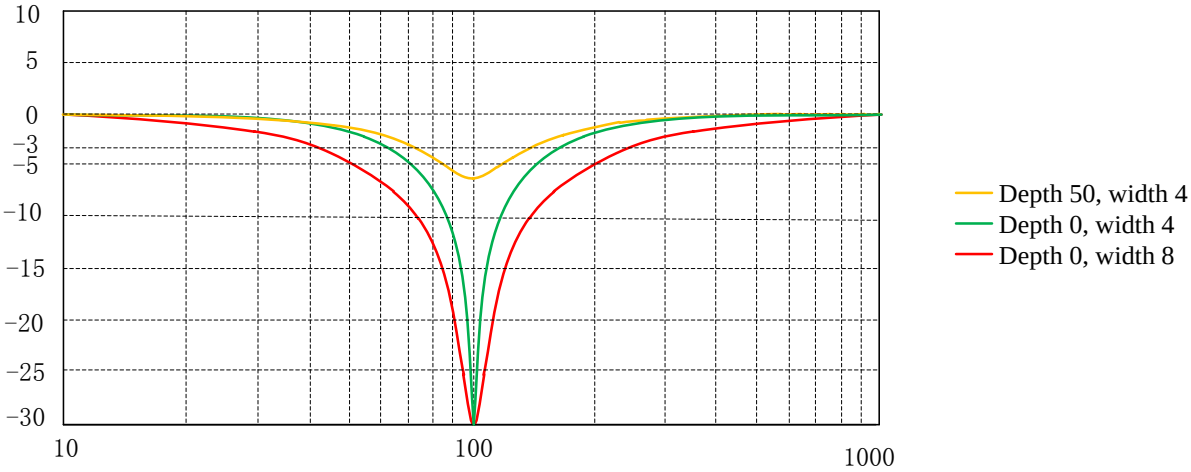
Notch width	Output-to-input ratio	dB
0	0	-∞
1	0.01	-40
2	0.02	-34
3	0.03	-30.5
4	0.04	-28
5	0.05	-26
6	0.06	-24.4
7	0.07	-23.1
8	0.08	-21.9
9	0.09	-20.9
10	0.1	-20

11	3.36
12	4.0
13	4.76
14	5.66
15	6.73
16	8.0
17	9.51
18	11.31
19	13.45
20	16.0

The factory value (2) of notch filter width is generally used.

15	0.15	-16.5
20	0.2	-14
25	0.25	-12
30	0.3	-10.5
35	0.35	-9.1
40	0.4	-8
45	0.45	-6.9
50	0.5	-6
60	0.6	-4.4
70	0.7	-3.1
80	0.8	-1.9
90	0.9	-0.9
100	1	0

➢ Notch width and depth relationship diagram



➢ Notes for using notch filter

- Notch filter cannot be used in torque control mode.
- When the notch frequency is set as 5000, the notch filter is invalid.
- For the setting of the first and second notch filters, you can first obtain the third and fourth notch filters using the automatic mode, and then copy their parameters.
- Although there are 4 notch filters, it is recommended to use up to 2 notch filters at the same time, otherwise the vibration may increase.
- When using an adaptive notch filter, if the vibration cannot be eliminated for a long time, please disable the drive in a timely manner.

➢ The relationship between gain adjustment and mechanical rigidity

In order to improve mechanical rigidity,

- The machine should be firmly placed on the foundation so that it does not vibrate.
- High-rigidity couplings should be used.
- Use a wide synchronous belt, and the tension of the synchronous belt should be set within the allowable axial load range of the motor.
- Use a special reducer for servo or gears with small clearance.
  The low rigidity of the machine means that its inherent vibration (resonance frequency) is low.
  Low mechanical rigidity will greatly affect the gain adjustment of servo. For machines with low rigidity, the responsiveness of servo cannot be adjusted too high (high gain).

Attention☞	**Not all vibrations are mechanical resonance. If the servo gain adjustment reaches the limit, vibration will also be caused. This can be improved only by reducing the gain or the torque command filter time.**

6.10 Manual gain adjustment (basic)

EA180 series servo drive has automatic gain adjustment function, but automatic gain adjustment may not meet the requirements due to constraints by load conditions, etc. Manual gain adjustment is recommended when the coordination between servo system and machinery is expected to have the best responsiveness and stability.

6.10.1 Position control mode adjustment

The position control mode of the EA180 series is shown in the position control mode block diagram in Section 6.1.

The position control mode is performed in the following order.

1) Enable the servo drive.
2) Set P4-00 to 0.
3) Use default values for all gain parameters
4) Input P4-10 load inertia ratio. It can be identified by the drive through the AF-05 function (with restrictions) or calculated by users.
5) The values in the following table are used as a standard for adjustment.

Sequence	Parameter	Parameter name	Standard value	Adjustment method
1	P4-03	Speed loop gain	18.0	Increase the value within the range where no abnormal sound or vibration occurs. Decrease the value when noise occurs.
2	P4-31	Torque command filter	1.26	In order to suppress the vibration after motor stops, increase P4-03 and decrease P4-31. In the case of too severe vibration at the moment of stop, try to decrease P4-31.
3	P4-02	Position loop gain	32.0	Observe the positioning time and adjust the value. If the value is increased, the positioning time will be shortened. However, vibration will occur when the value is too large.
4	P4-05	Integral time constant of speed loop	31.0	No need to adjust if there is no problem with the action. When the value is decreased, the positioning time will become shortened, and if the value is too small, vibration will occur. If the value is too large, the position deviation may diverge. Increase the value within the range where no abnormal movements and sounds occur.
5	P4-06	Speed feedforward gain	30.0	When the feedforward is set too large, the setting time may not be shortened due to the occurrence of overshoot and the jitter of the positioning completion signal. When the command pulse input is uneven, it can be improved by increasing the set value of P4-07.

6.10.2 Speed control mode adjustment

The speed control mode of the EA180 series is shown in the speed control mode block diagram in Section 6.2.

The adjustment of the speed control mode is basically the same as that of the position control mode, except that the adjustment of the position loop gain P4-02 and the speed feedforward gain P4-06 are not required.

6.10.3 Torque control mode adjustment

The torque control mode of the EA180 series is shown in the torque control mode block diagram in Section 6.3.

The torque control is actually based on speed control, so users mainly set the torque limit and speed limit.

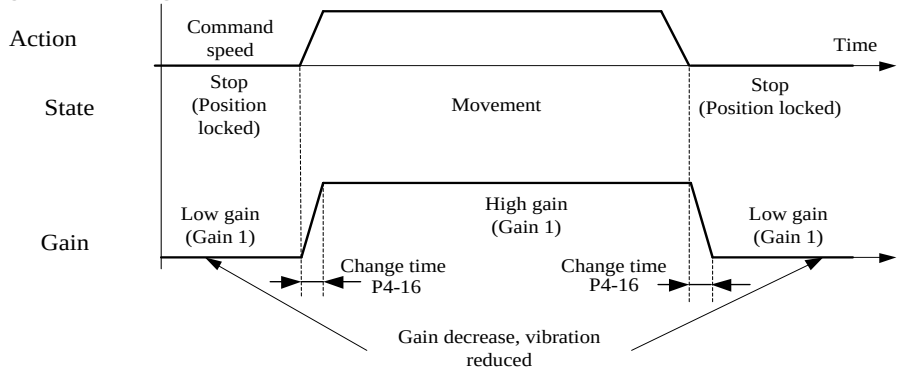
- In torque control, reverse direction means that the motor rotation direction is opposite to the torque command direction. This happens when an external device applies reverse traction force. In this case, the motor is in a continuous power generation state and the drive will give Al017 alarm. Please be sure to equip an appropriate external braking resistor and correctly set the values of P8-10, P8-11 and P8-13 according to the parameters of the braking resistor.
- The speed limit value works only in the torque command direction. When the motor is pulled back by an external device, the drive only controls the output torque of the motor, and the speed of the motor depends on the external device.
- In the torque command direction, when the motor speed reaches the limit value, the drive will switch from torque control based on the torque command to speed control based on the speed limit command.
- In order to ensure stable operation when the speed is limited, the speed loop parameters need to be set according to the speed control mode adjustment.
- When the speed limit value is too low, the speed loop gain is too low, or the speed loop integration time constant is 3000.0 (integration is invalid), sometimes the torque cannot be output as commanded if the torque limit input becomes small.

- In torque control, the following functions don't work:
  - Acceleration feedback
  - Disturbance observer
  - Speed observer
  - Torque feedforward
  - Online inertia identification
  - Gain switching
  - Adaptive filter
  - Friction compensation
  - Notch filter

6.10.4 Gain switching

When the gain is switched based on internal data or external signals, the following effects are achieved:

- Reduce the gain at stop (servo lock) to suppress vibration.
- Increase the gain at stop (when setting) to shorten the setting time.
- Increase the gain during action to improve command follow-up.
- Switching is performed with an external DI signal according to the mechanical state.



- Gain switching conditions

P4-15		Switching condition	Gain switching mode
bit1	bit0		
0	0	Fix the first gain	Always use the first gain
	1	DI terminal input	Use the second gain when the gain switching terminal (GAIN_SEL) is valid Use the first gain when the gain switching terminal (GAIN_SEL) is invalid * Always use the first gain when no terminal is defined as GAIN_SEL
	2	Large position deviation	If it is at the first gain and the absolute value of the position deviation exceeds P4_18 + lag, it shifts to the second gain. If it is at the second gain and the absolute value of the position deviation is smaller than P4_18 + lag, it returns to the first gain. * The lag value of position deviation is 100Pulse command units.
	3	Large speed command	If it is at the first gain and the absolute value of the speed command exceeds P4_18 + lag, it shifts to the second gain. If it is at the second gain and the absolute value of the speed command is smaller than P4_18 + lag, it returns to the first gain. * The lag value of speed command is 10rpm.
	4	High actual speed	If it is at the first gain and the absolute value of the motor speed exceeds P4_18 + lag, it shifts to the second gain. If it is at the second gain and the absolute value of the motor speed is smaller than P4_18 + lag, it returns to the first gain. * The lag value of motor speed is 10rpm.
1	0	Valid integral action	The speed loop integral time constant is always valid.

	1	DI terminal input	When the gain switching terminal (GAIN_SEL) is valid, the speed loop integral action is cancelled. When the gain switching terminal (GAIN_SEL) is invalid, the speed loop integral action is restored. * The integral action is always valid if no terminal is defined as GAIN_SEL.
	2	Large position deviation	If it is at the first gain and the absolute value of the position deviation exceeds P4_18 + lag, the speed loop integral action is cancelled. If it is at the second gain and the absolute value of the position deviation is smaller than P4_18 + lag, the speed loop integral action is restored. * The lag value of position deviation is 100Pulse command units.
	3	Large speed command	If it is at the first gain and the absolute value of the position deviation exceeds P4_18 + lag, the speed loop integral action is cancelled. If it is at the second gain and the absolute value of the speed command is smaller than P4_18 + lag, the speed loop integral action is restored. * The lag value of speed command is 10rpm.
	4	High actual speed	If it is at the first gain and the absolute value of the motor speed exceeds P4_18 + lag, the speed loop integral action is cancelled. If it is at the second gain and the absolute value of the motor speed is smaller than P4_18 + lag, the speed loop integral action is restored. * The lag value of motor speed is 10rpm.

- Canceling the speed loop integral action will reduce the possibility of speed overshoot, but the servo response will slow down.
- bit0=5, 6, 7, 8 are opposite, please see the description of function code P4-15.

➢ Associated parameters

Function code	Parameter name	Function
P4-16	Gain switching change time	When the gain switching condition is satisfied, the gain value will linearly switch from the current range to the target gain value within this time period.
P4-18	Gain switching threshold	A reference value for judging whether the gain switching condition is satisfied or not. * The unit of this parameter setting value is determined by the selection of P4-15.
P4-19	Second position loop gain change coefficient	Second position loop gain = P4_02*P4_19
P4-20	Second speed loop gain change coefficient	Second speed loop gain = P4_03*P4_20

6.11 Manual gain adjustment (application)

6.11.1 Feedforward function

In position control mode, the speed control command required for the action is calculated from the internal position command, and the speed command calculated by comparing with the position feedback is added to obtain the speed feedforward, which can reduce the position deviation and improve the responsiveness compared with the feedback control.

The torque command required for the action is calculated from the speed control command, and the torque command calculated by comparing with the speed feedback is added to obtain the torque feedforward, which can improve the responsiveness of the speed control system.

➢ Associated parameters

Function code	Parameter name	Function
P4-06	Speed feedforward gain	The speed control command calculated from the internal position command is multiplied by the ratio of this parameter, and the result is added to the speed command after the position control processing.

P4-07	Speed feedforward filter time constant	Set the time constant of the primary inertial filter required for the speed feedforward input to reduce harmonic components in the command.
P4-24	Torque feedforward gain	Position control mode: The torque command obtained by second-order differentiation of the external position command is multiplied by the ratio set by this parameter, and the result is added to the torque command after speed control processing.
		Speed control mode: The torque command calculated from the internal speed command is multiplied by the ratio of this parameter, and the result is added to the torque command after the speed control processing.
P4-25	Torque feedforward filter time constant	Set the time constant of the primary inertial filter required for the speed feedforward input to reduce harmonic components in the command.

- Example of speed feedforward use

When the factory value (5ms) is used for the speed feedforward smoothing filter, the speed feedforward gain is gradually increased to make the speed feedforward valid. At a certain speed, the position deviation during the action can be adjusted according to the following formula:

$$\text{Position deviation (command unit)} = \frac{\text{Speed corresponding to position command}}{\text{Position loop gain}} \times \frac{(100 - \text{Speed feedforward gain})}{100}$$

If the speed feedforward gain is adjusted to 100%, the position deviation is 0 in calculation, but this will produce huge overshoot during acceleration and deceleration.

In addition, when the pulse frequency of position command input is low or uneven, the speed feedforward gain may bring about large impact and sound during operation. Please use a position command filter (inertial filter P1-14, position FIR filter P5-23).

- Example of torque feedforward use

When torque feedforward is used, the load inertia ratio P4-10 needs to be correctly set. Please use offline inertia identification to obtain it, or calculate it according to the actual mechanical situation.

When the torque feedforward smoothing filter time constant is at the factory value (5ms), the torque feedforward gain is gradually increased to make the torque feedforward valid.

By providing torque feedforward gain, the position deviation can be close to 0 during fixed acceleration and deceleration, so under the ideal condition of no external interference torque, the position deviation of all actions areas during trapezoidal speed curve driving can be approximately close to 0.

Actually the external interference torque must exist, so the position deviation cannot be 0.

6.11.2 Friction torque compensation

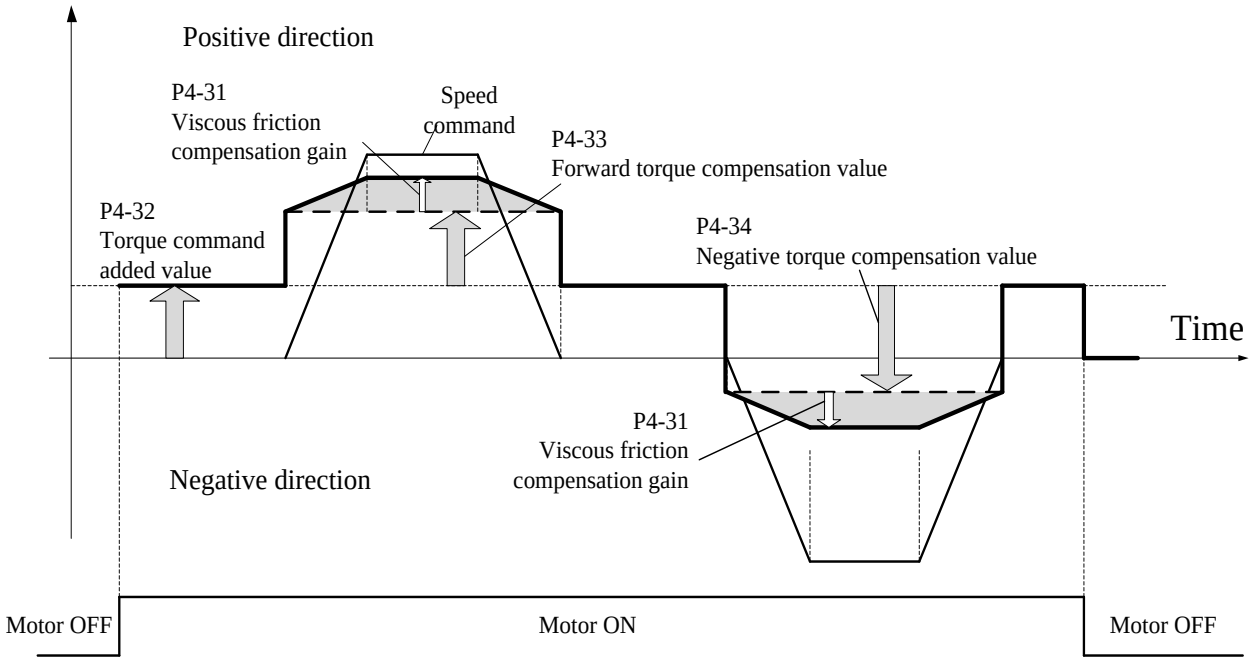
There must be friction in machinery. According to different machinery, there are mainly three forms of friction. EA180 provides compensation for the three types of friction.

- Associated parameters

Function code	Parameter name	Function
P4-30	Friction compensation smoothing time constant	Carry out one-time inertial filtering for the three torque compensation values to avoid vibration and other problems caused by a sudden change of torque command, but a large set value will cause a slow compensation effect.
P4-31	Viscous friction compensation gain	The product of the command speed and this set value is added to the torque command as a torque compensation value. * Used to compensate for the case where the friction force increases linearly with the increase of speed.
P4-32	Torque command added value	It is added to the torque command in a fixed direction. A positive value indicates that the added value direction is the forward direction of the motor rotation, while a negative value indicates that the added value direction is the reverse direction of the motor rotation. * As long as the servo drive is ON, torque will be added even if there is no command.

P4-33	Forward torque compensation	It is added to torque command when the motor is running in the forward direction to compensate for the forward dynamic friction. * The physical direction of forward and reverse rotation of the motor is determined by P0-01.
P4-34	Reverse torque compensation	It is added to torque command when the motor is running in the reverse direction to compensate for the reverse dynamic friction.

* The reference compensation value of each friction torque is the rated torque of the motor.



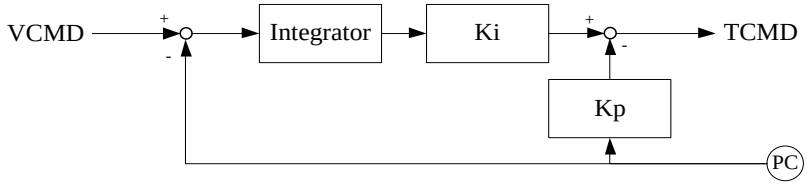
Assuming that the torque command is T, the compensated torque command Tb is:
Forward rotation direction: Tb=T+P4_32+P4_31* motor speed /1000+P4_33
Reverse rotation direction: Tb=T+P4_32+P4_31* motor speed /1000-P4_34

Attention☞ Friction torque compensation is invalid in torque control mode.

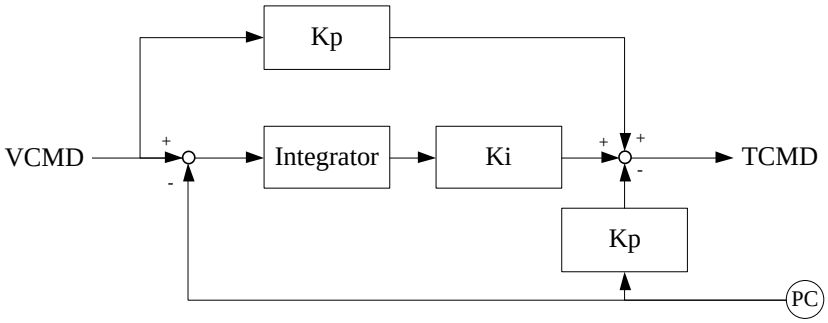
6.11.1 PDFF control

When the speed command drives the motor to rotate, the action characteristics of the motor shaft itself also depend on the response characteristics of the mechanical system because the shaft end of the servo motor has a mechanical load. Considering the needs of various mechanical systems, EA180 servo drive designs PDFF controller in speed loop and uses it in non-torque mode.
PDFF controller is a kind of controller between PI and IP controllers, which has the characteristics of both PI and IP controllers.

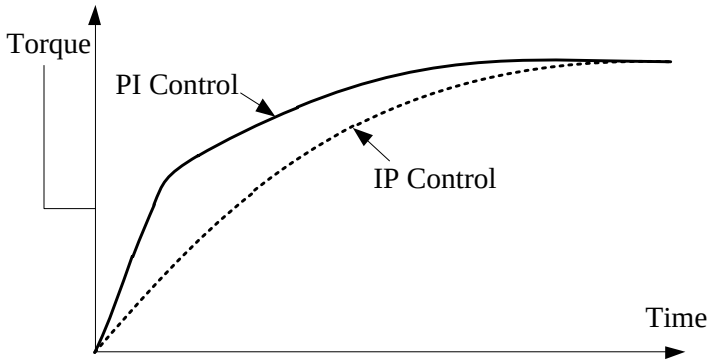
IP controller structure:



PI controller structure:



Comparison of IP controller and PI controller under the same proportional gain and integral time parameters



IP controllers are usually designed for small machines with good responsiveness (high mechanical rigidity). At the same time, for the step command of the position, it softens the torque rise characteristic at start-up, thereby reducing the vibration.

PI controllers are usually designed for large machines with poor responsiveness (high mechanical rigidity). At the same time, since large torque can be obtained in a relatively short time after receiving the speed command, it can improve the torque rise characteristic at start-up when used on machines with high rigidity (e.g., small machines using screw drive).

PDFF controller combines the characteristics of IP and PI controllers and can tend to IP controller or PI controller according to the PDFF coefficient, giving consideration to both responsiveness and low vibration in case of frequent start-stop.

- Associated parameters

Function code	Parameter name	Function
P4-12	PDFF control coefficient	The more the set value tends to 0, the more PDFF controller tends to IP controller. When the set value is 0, PDFF controller is completely an IP controller. The more the set value tends to 100, the more PDFF controller tends to PI controller. When the set value is 100, PDFF controller is completely a PI controller. When there is overshoot in speed feedback, gradually reduce P4-12 from 100 until the effect is achieved.

Chapter 7 Function Parameter Table

7.1 Function parameter definition

The first two bits (such as P0) of the starting code in the function parameter are the group number, and the next two parameters (such as 00) are the intra-group number.

dx-xx group: Monitor and query parameters, which are for display and reading only.

St-xx group: Status display parameters, which are for display and reading only.

Px-xx group: Parameters for setting

AF-xx group: Function switch parameters.

Function parameter setting attributes:

○:Set at any time, valid immediately

●:Set at any time and valid upon re-power-on

☆:Set at any time and valid after the motor is static for 1 second.

▲:Read-only

Data type description:

U16:The data length is 16bit, with no sign, and the communication address length is 1.

I16:The data length is 16bit, with signs, and the communication address length is 1.

U32:The data length is 32bit, with no sign, and the communication address length is 2.

I32:The data length is 32bit, with signs, and the communication address length is 2.

Description of letter following number:

H: The corresponding numbers are operated, displayed and set in a hexadecimal manner.

B: The corresponding numbers are operated, displayed and set in a binary manner.

Control mode description:

P: Position control mode

S: Speed control mode

T: Torque control mode

Unit description

rpm	revolutions per minute	kHz	thousand Hz	rad/s	radian per second
Pulse	Command pulse	mV	millivolts	%	percent
rev	revolution	V	Volt	ms/s	milliseconds per second
PUL	Encoder pulse	A	Ampere	min	minute
ppr	Can be set as command or encoder pulse	℃	Celsius degree	°	degree

7.2 Function parameter table

7.2.1 d0 group - universal monitoring parameters

Parameter	Function	Data type	Initial value (example)	Unit	Commu. addr.
d0-00	Motor speed	I16	0	rpm	2000H
d0-01	Motor load ratio	I16	0.0	%	2001H
d0-02	Total number of external pulses acquired	I32	0	Pulse	2002H
d0-04	Total number of feedback pulses (command pulse unit)	I32	0	Pulse	2004H
d0-06	Total number of feedback pulses (encoder unit)	I32	0	PUL	2006H
d0-08	Received external pulse frequency	I32	0.00	kHz	2008H
d0-10	Position deviation	I32	0	ppr	200AH
d0-12	DI terminal status 0: Invalid; 1: Valid	U16	000000000B	-	200CH
d0-13	DO output terminal status	U16	00000B	-	200DH

Parameter	Function	Data type	Initial value (example)	Unit	Commu. addr.
	0: Invalid; 1: Valid				
d0-14	AI1 command voltage value (after system processing)	I16	0	mV	200EH
d0-15	AI2 command voltage value (after system processing)	I16	0	mV	200FH
d0-16	Busbar voltage	U16	0	V	2010H
d0-17	Motor RMS current	U16	0.00	A	2011H
d0-18	Speed corresponding to pulse command	I16	0	rpm	2012H
d0-19	Speed command value	I16	0	rpm	2013H
d0-20	Torque command value	I16	0.0	%	2014H
d0-21	Maximum instantaneous load ratio of motor	I16	0.0	%	2015H
d0-22	IGBT module temperature	U16	0	℃	2016H
d0-23	Switching power supply bus voltage	U16	0	V	2017H
d0-24	Total operation time of the system	U32	0	min	2018H
d0-26	Brake load ratio	U16	0.0	%	201AH
d0-27	Current motor electrical angle	U16	0.0	°	201BH
d0-28	Incremental encoder sector number	U16	0	-	201CH
d0-29	Revolution number of absolute encoder	I16	0	rev	201DH
d0-30	Serial encoder current turn position value	U32	0	PUL	201EH
d0-32	Total number of external pulses acquired	I32	0	Pulse	2020H
d0-34	Servo motor current position (command pulse unit)	I32	0	Pulse	2022H
d0-36	Servo motor current position (encoder unit)	I32	0	PUL	2024H
d0-38	Positioning status 0: In positioning; 1: Positioning completed	U16	0	-	2026H
d0-39	Multi-speed current execution segment	U16	0	-	2027H
d0-40	Multi-position current execution segment	U16	0	-	2028H
d0-41	AI1 physical voltage (actual value)	I16	0	mV	2029H
d0-42	AI2 physical voltage (actual value)	I16	0	mV	202AH
d0-46	Motor average load ratio	U16	0.0	%	202EH
d0-47	Drive heat accumulation value	U16	0.000	-	202FH
d0-48	Motor heat accumulation value (transient)	U16	0.000	-	2030H
d0-49	Motor heat accumulation value (steady)	U16	0.000	-	2031H
d0-62	GBK detected position pulse value/length	I32	0	-	203EH

7.2.2 **d1 group - fault query parameters**

Parameter	Function	Data type	Initial value (example)	Unit	Commu. addr.
d1-00	Code of this fault	U16	Al000	-	2100H
d1-01	Speed at the current fault	I16	0	rpm	2101H
d1-02	Bus voltage at the current fault	U16	0	V	2102H
d1-03	RMS at the current fault	U16	0.00	A	2103H
d1-04	Runtime at the current fault	U32	0	min	2104H
d1-06	Previous fault code	U16	Al000	-	2106H
d1-07	Speed at the last fault	I16	0	rpm	2107H
d1-08	Bus voltage at the last fault	U16	0	V	2108H
d1-09	RMS at the last fault	U16	0.00	A	2109H
d1-10	Runtime at the last fault	U32	0	min	210AH
d1-12	Fault code before last	U16	Al000	-	210CH
d1-13	Speed at the fault before last	I16	0	rpm	210DH
d1-14	Bus voltage at the fault before last	U16	0	V	210EH
d1-15	RMS at the fault before last	U16	0.00	A	210FH

Parameter	Function	Data type	Initial value (example)	Unit	Commu. addr.
d1-16	Runtime at the fault before last	U32	0	min	2110H
d1-18	Fault code before last two	U16	Al000	-	2112H
d1-19	Speed at the fault before last two	I16	0	rpm	2113H
d1-20	Bus voltage at the fault before last two	U16	0	V	2114H
d1-21	RMS at the fault before last two	U16	0.00	A	2115H
d1-22	Runtime at the fault before last two	U32	0	min	2116H
d1-24	Current alarm status	U16	0	-	2118H
d1-25	Current warning status	U16	0	-	2119H

7.2.3 d2 group - product information query parameters

Parameter	Function	Data type	Initial value (example)	Unit	Commu. addr.
d2-00	2nd bit: Encoder type 0: 2500ppr incremental encoder 1: 17/23 bit serial communication encoder 1st bit: Command type 1: Analog pulse type (EA180) 2: EtherCAT bus type (EA180E) 3: CANopen bus type (EA180C)	U16	10	-	2200H
d2-01	Current motor code	U16	101	-	2201H
d2-02	CPUA software version number	U16	100	-	2202H
d2-03	CPUA software serial number	U16	0.101	-	2203H
d2-04	CPUB software version number	U16	100	-	2204H
d2-05	CPUB software serial number	U16	0.101	-	2205H
d2-06	Product serial number 1	U16	2.000	-	2206H
d2-07	Product serial number 2	U16	3.1	-	2207H
d2-08	Product serial number 3	U16	3	-	2208H

IMPORTANT: Auxiliary functions are parameters set to perform specific function operations, and the keypad display content is not the value of the internal register.
During operation with the keypad, the displayed symbol shall prevail. During operation with communication mode, the register value is written to the corresponding address. A register value of '-' indicates that the operation cannot be performed by communication.

7.2.4 Auxiliary function operation

AF-00	Software reset		Data size	16bit	Commu. addr.	3F00H
			Register value storage	Auto reset upon completion		
	Register value	Display	Operation			
	0	0	Press S, it displays -End-, no operation			
	1	rESEt	Press S to reset software (equivalent to power-on again of control power supply)			

AF-01	Alarm reset		Data size	16bit	Commu. addr.	3F01H
			Register value storage	Auto reset upon completion		
	Register value	Display	Operation			
	0	0	Press S, it displays -End-, no operation			
	1	AL.CLr	Press S to perform the alarm reset operation * It must be a resettable alarm and the cause of current alert has been eliminated.			

AF-02	JOG		Data size	16bit	Commu. addr.	3F02H
			Register value storage	-		
	Register	Display	Operation			

	value		
	-	-JoG	Press ∧, the motor rotates forward and it displays -JoG. Press ∨, the motor runs reversely and it displays -JoG. Do not press the key, motor is static, display -JoG * The speed of jog operation is determined by P8-00, and the acc/dec time is determined by P8-01. * Please operate in the -rdy (not enabled, and ready) state, and the jog process will automatically exit if a warning occurs.

AF-03	Internal S_ON command		Data size	16bit	Commu. addr.	3F03H
			Register value storage	Saved		
	Register value	Display	Operation			
	0	0	Press S to display -End-. If there is no other enable input, the drive will enter the enable OFF state.			
	1	S-on	If the enable condition is met, press S to display S-on, and the drive will enter the enable-ON state.			

* This parameter will be stored and the drive will be enabled ON immediately upon the next power-on. If this is not desired, please modify this parameter value to 0 before power-off.

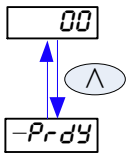
AF-04	FFT test		Data size	16bit	Commu. addr.	3F04H
			Register value storage	Auto reset upon completion		
	Register value	Display	Operation			
	0	0	Press S, it displays -End-, no operation			
	1	EYdFt	Press S, and it displays EYdFt and carries out speed bandwidth test with the upper device software identification system; after the test, automatically exit and upload the data to the upper device for analysis and display. * The motor has slight vibration and sound.			

AF-05	Offline inertia identification		Data size	16bit	Commu. addr.	3F05H
			Register value storage	Auto reset upon completion		
	Register value	Display	Operation			
	0	0	Press S, it displays -End-, no operation			
	1	JI dt	Press S, it displays JI dt and starts to identify the current system inertia. After successful identification, the inertia (multiple of the motor inertia) is automatically stored in P4-10. * Refer to Section 6.6 for detailed description of inertia identification.			

AF-06	AI channel self-correction		Data size	16bit	Commu. addr.	3F06H
			Register value storage	Auto reset upon completion		
	Register value	Display	Operation			
	0	0	Press S, it displays -End-, no operation			
	1	AI 1	The given AI1 external voltage source is 0V (the actual voltage may not be 0V); press S, it displays AI 1 and carries out zero drift learning, and the results will be automatically stored in P6-33 after completion.			
	2	AI 2	The given AI2 external voltage source is 0V (the actual voltage may not be 0V); press S, it displays AI 2 and carries out zero drift learning, and the results will be automatically stored in P6-34 after completion.			

Attention☞ **1: When performing zero drift automatic correction, it is necessary to ensure that the given command of the upper device itself is 0V (the actual voltage may not be 0)**
2: Zero drift automatic correction is only applicable to external power supply of -10 ~ 10V.
3: If that actual voltage at the AI terminal exceeds ±2 V while the correction is performed, an Al034 alarm will occur.

AF-07	**Status displayed by default upon power-on**	Data size	16bit	Commu. addr.	3F07H
		Register value storage	Stored		

Register value	Display	Operation
0000H	0000	Press S, it displays -End-; only display the drive status in status monitoring mode.
2001H (example)	2001	Press S, it displays -End-; if AF-07 is a non-0 value, the status monitoring mode displays function code at the corresponding communication address (such as D0-01) by default. You can switch between the monitoring value and the drive status with ∧ button.  First show the value of the parameter corresponding to the address set by AF-07; switch between the value and drive status by pressing UP key

Attention☞ **1: AF-07 is displayed in hexadecimal format, which means the correspondence address. If the set address has no corresponding function code, the display value is unknown.**
2: If it is not enabled, LED3 will display position control mode (P), and once enabled, it will display the actual operating control mode.

AF-08	**Non-factory value display**	Data size	16bit	Commu. addr.	3F08H
		Register value storage	Auto reset upon power-on		

Register value	Display	Operation
0	0	Press S, it displays -End-, display normally
1	1	Press S, it displays -End-; press M again to enter the changed parameter mode, where "-" in the middle flashes to be different from the normal function code display. You can press ∧ or ∨ to view the changed parameters in turn, and press S to view the new values.

AF-09	**System parameter initialization**	Data size	16bit	Commu. addr.	3F09H
		Register value storage	Auto reset upon power-on		

Register value	Display	Operation
1	1	If AF-09 ≠ 65535, press S, it displays Po-on; no operation
65535	65535	If AF-09=65535, press S, it displays Po-on and restore the function code to the default state.

Attention☞ **1: After using this function, the control power supply must be powered on again.**
2: This operation does not restore motor parameters.

AF-10	**Display motor parameters**	Data size	16bit	Commu. addr.	3F0AH
		Register value storage	Auto reset upon power-on		

Register value	Display	Operation
0	0	Press S, it displays -End- and hides Pd group parameters
1	1	Press S, it displays -End- and displays Pd group parameters

AF-15	**Serial encoder motor parameter reading**		Data size	16bit	Commu. addr.	3F0FH
			Register value storage	Auto reset upon power-on		
	Register value	Display	Operation			
	0	0	Press S, it displays -End-, no operation			
	1	1	Press S, it displays -End-, reads and uses the motor parameters stored in serial encoder If reading fails, still use the motor parameter set in Pb group.			

AF-16	**Multi-turn data and fault handling of absolute encoder**		Data size	16bit	Commu. addr.	3F10H
			Register value storage	Auto reset upon completion		
	Register value	Display	Operation			
	0	0	Press S, it displays -End-, no operation			
	1	1	Clear multi-turn encoder fault: Press S, it displays -End- and executes the corresponding operation.			
	2	2	Clear multi-turn data and fault of multi-turn encoder: Press S, it displays -End- and executes the corresponding operation.			
IMPORTANT: This function is operable only in a non-enabled state.						

7.2.5 **P0 group - basic setting parameters**

Parameter	**Function**	**Parameter range**	**Data type**	**Initial value**	**Unit**	**Applicable mode**	**Attribute**	**Commu. Addr.**
P0-00	Control mode selection:	0: Speed control mode 1: Position control mode 2: Torque control mode 3: Speed and position switching mode (zero speed) 4: Reserved 5: Position and torque switching mode (zero speed) 6: Speed and position switching mode (immediate) 7: Torque and speed switching mode (Immediate) 8: Position and torque switching mode (immediate)	U16	1	-	P S T	●	0000H
P0-01	Motor rotation direction	0: For a positive direction command, the motor runs counterclockwise (CCW) 1: For a positive direction command, the motor runs clockwise	U16	0	-	P S T	☆	0001H
P0-02	Maximum speed setting	0～10000	U16	3000	rpm	P S T	●	0002H
P0-03	Zero speed signal output value	10～1000	U16	10	rpm	P S T	○	0003H
P0-04	Rotation signal output value	10～1000	U16	20	rpm	P S T	○	0004H
P0-05	The first torque limit source selection	0: P0-06 limits positive torque and P0-07 limits negative torque; 1: AI1 limits positive and negative torques; 2: AI2 limits positive and negative torque; 3: AI1 limits the positive torque, and the P0-07 limits the negative torque; 4: AI2 limits the positive torque, and the P0-07	U16	0	-	P S T	○	0005H

Parameter	Function	Parameter range	Data type	Initial value	Unit	Applicable mode	Attribute	Commu. Addr.
		limits the negative torque; 5: P0-06 limits the positive torque, and the AI1 limits the negative torque; 6: P0-06 limits the positive torque, and the AI2 limits the negative torque; 7: AI1 limits the positive torque, and the AI2 limits the negative torque; 8: AI1 limits negative torque, and the AI2 limits the positive torque						
P0-06	First torque limit - forward maximum	0.0～500.0	U16	300.0	%	P S T	○	0006H
P0-07	First torque limit - reverse maximum	0.0～500.0	U16	300.0	%	P S T	○	0007H
P0-08	Stop mode selection	000H～311H Right 1: Stop mode when servo enable OFF 0: Coast to stop, motor in a free state after stop 1: Zero speed stop, motor in a free state after stop Right 2: Stop mode when second-level alarm occurs 0: Coast to stop, motor in a free state after stop 1: Zero speed stop, motor in a free state after stop Right 3: Handling when overtravel occurs 0: Coast to stop, motor in a free state after stop 1: Slow down and stop, motor in a free state after stop 1: Slow down and stop, motor locked in position 3: No handling	U16	200H	-	P S T	○	0008H
P0-09	Enable OFF - brake release command delay time	1～65535	U16	500	ms	P S T	○	0009H
P0-10	Brake release command speed threshold	1～1000	U16	20	rpm	P S T	○	000AH
P0-11	Brake release command - motor OFF delay time	0～500	U16	200	ms	P S T	○	000BH
P0-12	Re-enable condition for each stop mode	0: Enable according to P0-13 condition when coasting to stop 1: Enable according to P0-13 condition when coasting to stop or zero speed stop	U16	0	-	P S T	○	000CH
P0-13	Servo enable ON conditions	0: Enable ON when meeting P0-14 conditions 1: Enable ON when meeting P0-15 conditions 2: Enable ON when meeting both P0-14 and P0-15 conditions 3: Immediately enable ON	U16	3	-	P S T	○	000DH
P0-14	Delay for enable-ON again after enable-OFF	1～30000	U16	500	ms	P S T	○	000EH

Parameter	Function	Parameter range	Data type	Initial value	Unit	Applicable mode	Attribute	Commu. Addr.
P0-15	Enable-ON speed threshold	0～10000	U16	20	rpm	P S T	○	000FH
P0-16	Enable ON - command receiving delay time	0～500	U16	200	ms	P S T	○	0010H
P0-17	Zero speed stop deceleration time	1～65535	U16	200	ms	P S T	○	0011H
P0-18	Overtravel protection deceleration time	1～65535	U16	200	ms	P S T	○	0012H
P0-19	Emergency stop time	1～65535	U16	50	ms	P S T	○	0013H
P0-20	Pluse output setting definition	0: Before frequency quadrupling 1: After frequency quadrupling (only supported by 17/23bit encoder)	U16	0	-	P S T	●	0014H
P0-21	Number of output pulses per revolution	30-2500 (2500 linear incremental) 30-8192 (17/23bit encoder, and P0-20=0) 120-16383 (17/23bit encoder, and P0-20=1)	U16	2500	Pulse	P S T	●	0015H
P0-22	Pulse output logic selection	0: When the motor is rotating forward, A leads B 1: When the motor is rotating forward, B leads A	U16	0	-	P S T	●	0016H
P0-23	Z Pulse output width	0～3	U16	0	ms	P S T	●	0017H
P0-24	Pulse output source	0: Encoder feedback 1: Command pulse (P0-20, 21, 22 invalid)	U16	0	-	P S T	●	0018H

7.2.6 **P1 group - position control parameters**

Parameter	Function	Parameter range	Data type	Initial value	Unit	Applicable mode	Attribute	Commu. Addr.
P1-00	Position command source selection	0: External pulse command (pt) 1: Multi-position command (Pr)	U16	0	-	P	○	0100H
P1-01	External pulse command input mode	0: Pulse + direction, positive logic 1: Pulse + direction, negative logic 2: Two-phase orthogonal pulse (frequency quadrupling), positive logic 3: Two-phase orthogonal pulse (frequency quadrupling), negative logic 4: CW/CCW pulse, positive logic 5: CW/CCW pulse, negative logic	U16	0	-	P	●	0101H
P1-02	Number of command pulses per revolution	0～8388608	U32	10000	Pulse	P	○	0102H
P1-04	Electronic gear ratio numerator 1	0～1073741824	U32	0	-	P	○	0104H
P1-06	Electronic gear ratio denominator	1～1073741824	U32	10000	-	P	○	0106H
P1-08	Electronic gear ratio numerator 2	0～1073741824	U32	0	-	P	○	0108H
P1-10	Electronic gear ratio numerator 3	0～1073741824	U32	0	-	P	○	010AH

Parameter	Function	Parameter range	Data type	Initial value	Unit	Applicable mode	Attribute	Commu. Addr.
P1-12	Electronic gear ratio numerator 4	0～1073741824	U32	0	-	P	○	010CH
P1-14	External pulse command low-pass smoothing filter time	0.0～3000.0	U16	0.0	ms	P	●	010EH
P1-15	External pulse input high frequency filter time	0～255	U16	7	-	P S	●	010FH
P1-16	Position deviation clearing external DI signal selection	0: Clear by P-CLR rising edge 1: Clear by P-CLR low level 2: Clear by P-CLR high level 3: Clear by P-CLR falling edge	U16	0	-	P	○	0110H
P1-17	Reserved							
P1-18	Position following error warning threshold	0～1073741824	U32	80000	ppr	P	○	0112H
P1-20	Position following error alarm threshold	0～1073741824	U32	100000	ppr	P		0114H
P1-22	Positioning completion output setting	0～6	U16	1	-	P	○	0116H
P1-23	Positioning proximity width	1～65535	U16	20	ppr	P	○	0117H
P1-24	Positioning completion width	0～65535	U16	10	ppr	P	○	0118H
P1-25	INP hold time	0～3000	U16	10	ms	P	○	0119H
P1-26	Positive limit position	-2147483647～2147483647	I32	2147483647	ppr	P S T	○	011AH
P1-28	Negative limit position	-2147483647～2147483647	I32	-2147483647	ppr	P S T	○	011CH
P1-30	Pulse offset	0～65535	U16	100	Pulse	P S T	○	011EH
P1-31	Pulse offset exexcution time	1～65535	U16	100	ms	P S T	○	011FH

7.2.7 **P2 group - speed control parameters**

Parameter	Function	Parameter range	Data type	Initial value	Unit	Applicable mode	Attribute	Commu. Addr.
P2-00	Speed command source 1 selection	0: Digital speed given 1 (P2-01 given) 1: AI1 given 2: AI2 given 3: Multi-speed given 3: Pulse input (10.00kHz corresponds to P2-01)	U16	0	-	S	○	0200H
P2-01	Digital speed given 1	-30000～30000	I16	100	rpm	S	○	0201H
P2-02	Reserved							
P2-03	Reserved							
P2-04	Speed S-type acceleration time T_{SACC}	1～65535	U16	200	ms	S	○	0204H
P2-05	Speed S-type deceleration time T_{SDEC}	1～65535	U16	200	ms	S	○	0205H
P2-06	Speed S-type acc/dec smoothing time T_{SL}	0～10000	U16	50	ms	S	○	0206H
P2-07	Zero speed clamp threshold	0～3000	U16	10	rpm	S	○	0207H
P2-08	Arrival speed	1～10000	U16	1000	rpm	PST	○	0208H
P2-09	Speed consistency threshold	1～10000	U16	10	rpm	S	○	0209H

7.2.8 **P3 group - torque control parameters**

Parameter	Function	Parameter range	Data type	Initial value	Unit	Applicable mode	Attribute	Commu. Addr.
P3-00	Torque given command source selection	0: Torque P3-01 is given, positive and negative directions are symmetrical 1: Torque P3-01 is given, negative direction is limited by P3-02 2: Torque P3-01 is given, negative direction is limited by AI1 3: Torque P3-01 is given, negative direction is limited by AI2 4: Torque AI1 is given, positive and negative directions are symmetrical 5: Torque AI1 is given, negative direction is limited by P3-02 6: Torque AI1 is given, negative direction is limited by AI2 7: Torque AI2 is given, positive and negative directions are symmetrical 8: Torque AI2 is given, negative direction is limited by P3-02 9: Torque AI2 is given, negative direction is limited by AI1	U16	0	-	T	○	0300H
P3-01	Digital torque setting	-500.0～500.0	I16	100.0	%	T	○	0301H
P3-02	Reverse direction torque limit	0.0～500.0	U16	300.0	%	T	○	0302H
P3-03	Reserved							
P3-04	Torque command direction speed limit	0: Limit speed by P3-05 1: Limit speed by AI1	U16	0	-	T	○	0304H

Parameter	Function	Parameter range	Data type	Initial value	Unit	Applicable mode	Attribute	Commu. Addr.
	command source	2: Limit speed by AI2						
P3-05	Torque command direction speed limit value in torque control mode	0～10000	U16	100	rpm	T	○	0305H
P3-06	Torque consistency threshold	3.0～100.0	U16	5.0	%	T	○	0306H
P3-07	Arrival torque	3.0～500.0	U16	100.0	%	PST	○	0307H
P3-08	Torque acceleration slope	Torque acceleration slope is the percentage of torque increase per ms	U16	500.0	%	T	○	0308H
P3-09	Torque deceleration slope	Torque deceleration slope is the percentage of torque decrease per ms	U16	500.0	%	T	○	0309H

7.2.9 **P4 group - gain tuning parameters**

Parameter	Function	Parameter range	Data type	Initial value	Unit	Applicable mode	Attribute	Commu. Addr.
P4-00	Gain adjustment mode selection	0: Manual 1: Semi-auto adjustment mode 1 (rigidity table) 2: Auto adjustment mode 1 (inertia changes slowly) 3: Auto adjustment mode 2 (inertia changes a bit fast) 4: Auto adjustment mode 3 (inertia changes fast)	U16	1	-	P S T	○	0400H
P4-01	Rigidity	1～31	U16	13	-	P S T	○	0401H
P4-02	Position loop proportional gain APR_P	1.0～2000.0	U16	48.0	1/s	P	○	0402H
P4-03	Speed loop proportional gain ASR_P	0.1～5000.0	U16	27.0	Hz	P S	○	0403H
P4-04	Reserved							
P4-05	Speed loop integral time constant ASR_Ti	0.1～3000.0	U16	21.0	ms	P S	○	0405H
P4-06	Speed feedforward gain APR_Kp	0.0～300.0	U16	30.0	%	P	○	0406H
P4-07	Speed feedforward filter time constant	0～100	U16	5	ms	P	○	0407H
P4-08	Speed feedback filter time constant	0.00～20.00	U16	0.00	ms	P S	○	0408H
P4-09	Factory parameter	0～10000	U16	0	-	P S T	○	0409H
P4-10	First load inertia ratio (total inertia/motor rotor inertia)	1.00～120.00	U16	2.50	-	P S T	○	040AH
P4-11	Second load inertia ratio (total inertia/motor rotor inertia)	1.00～120.00	U16	1.00	-	P S T	○	040BH
P4-12	PDFF control coefficient	0～100	U16	100	%	P S T	○	040CH
P4-13	Rigidity adjustment coefficient	0.5～1.0	U16	0.5	-	P S T	○	040DH
P4-14	Control loop coefficient	10～100	U16	75	-	P S T	○	040EH
P4-15	Gain switching conditions	00H～18H	U16	00H	-	P S T	○	040FH
P4-16	Gain switching change time	0～3000	U16	5	ms	P S T	○	0410H

Parameter	Function	Parameter range	Data type	Initial value	Unit	Applicable mode	Attribute	Commu. Addr.
P4-17	Reserved							
P4-18	Gain switching threshold	0～32767	U16	100	rpm	P S T	○	0412H
P4-19	Second position loop gain change coefficient	10～500	U16	50	%	P S T	○	0413H
P4-20	Second speed loop gain change coefficient	10～500	U16	50	%	P S T	○	0414H
P4-21	Reserved							
P4-22	Suppression performance expansion	bit0: Acceleration feedback function bit1: Reserved bit2: Reserved bit3: Reserved bit4: Speed observer function bit 5: Low noise mode	U16	00000B	-	P S T	○	0416H
P4-23	Speed observer cutoff frequency level	0～13	U16	13		P S T	○	0417H
P4-24	Torque feedforward gain	0.0～200.0	U16	0.0	%	P S T	○	0418H
P4-25	Torque feedforward filter time constant	0～100	U16	5	ms	P S T	○	0419H
P4-26	Reserved							
P4-27	Reserved							
P4-28	External disturbance resistance gain	0.0～100.0	U16	0.0	%	P S T	○	041CH
P4-29	Torque command low pass smoothing constant	0.00～100.00	U16	0.84	ms	P S T	○	041DH
P4-30	Friction compensation smoothing time constant	10～1000	U16	50	ms	P S	○	041EH
P4-31	Viscous friction compensation gain	0～1000	U16	0.0	0.1%/1000rpm	P S	○	041FH
P4-32	Torque command added value	-100.0～100.0	I16	0.0	%	P S	○	0420H
P4-33	Forward torque compensation	-100.0～100.0	I16	0.0	%	P S	○	0421H
P4-34	Reverse torque compensation	-100.0～100.0	I16	0.0	%	P S	○	0422H

7.2.10 P5 group - vibration suppression parameters

Parameter	Function	Parameter range	Data type	Initial value	Unit	Applicable mode	Attribute	Commu. Addr.
P5-00	Adaptive filter mode setting	0: Manually set 4 notch filters 1: Manually set width of notch filters 3 and 4 and others are automatically set 2: Clear notch filters 3 and 4	U16	0	-	P	●	0500H
P5-01	Automatic vibration detection level sensitivity	10～30000	U16	100	-	P	○	0501H
P5-02	1st notch frequency	50～5000	U16	5000	Hz	P	●	0502H
P5-03	1st notch width	0～20	U16	2	-	P	●	0503H

Parameter	Function	Parameter range	Data type	Initial value	Unit	Applicable mode	Attribute	Commu. Addr.
P5-04	1st notch depth	0～99	U16	0	dB	P	●	0504H
P5-05	2nd notch frequency	50～5000	U16	5000	Hz	P	●	0505H
P5-06	2nd notch width	0～20	U16	2	-	P	●	0506H
P5-07	2nd notch depth	0～99	U16	0	dB	P	●	0507H
P5-08	3rd notch frequency	50～5000	U16	5000	Hz	P	●	0508H
P5-09	3rd notch width	0～20	U16	2	-	P	●	0509H
P5-10	3rd notch depth	0～99	U16	0	dB	P	●	050AH
P5-11	4th notch frequency	50～5000	U16	5000	Hz	P	●	050BH
P5-12	4th notch width	0～20	U16	2	-	P	●	050CH
P5-13	4th notch depth	0～99	U16	0	dB	P	●	050DH
P5-14	Reserved							
P5-15	Reserved							
P5-16	Reserved							
P5-17	Reserved							
P5-18	Reserved							
P5-19	Reserved							
P5-20	Reserved							
P5-21	Reserved							
P5-22	Reserved							
P5-23	Position FIR filter	0.0～128.0	U16	0.0	ms	P	○	0517H

7.2.11 **P6 group - 1/O parameters**

<table>
<tr><th>Parameter</th><th>Function</th><th>Parameter range</th><th>Data type</th><th>Initial value</th><th>Unit</th><th>Applicable mode</th><th>Attribute</th><th>Commu. Addr.</th></tr>
<tr><td>P6-00</td><td>DI filter time</td><td>0～20</td><td>U16</td><td>2</td><td>ms</td><td>P S T</td><td>○</td><td>0600H</td></tr>
<tr><td>P6-01</td><td>DI level logic</td><td>00000000B～11111111B
0: Positive logic; 1: Negative logic</td><td>U16</td><td>0000 0000B</td><td>-</td><td>P S T</td><td>○</td><td>0601H</td></tr>
<tr><td>P6-02</td><td>DI1 function number</td><td rowspan="9">Value | Name | Function
0 | Disabled | Terminal invalid
1 | S-ON | Servo enable
2 | ALM-RST | Alarm and fault reset
3 | P-CLR | Position error clear
4 | DIR-SEL | Speed command direction selection
5 | CMD0 | Internal command bit0
6 | CMD1 | Internal command bit1
7 | CMD2 | Internal command bit2
8 | CMD3 | Internal command bit3
9 | CTRG | Internal command trigger
10 | MSEL | Control mode switching
11 | ZCLAMP | Zero speed clamp enable
12 | INHIBIT | Pulse inhibit
13 | P-OT | Inhibit forward drive
14 | N-OT | Inhibit reverse drive
15 | GAIN_SEL | Gain switching
16 | J_SEL | Inertia switching
17 | JOG_P | Forward jog
18 | JOG_N | Reverse jog
19 | TDIR-SEL | Torque command direction selection
20 | GNUM0 | Electronic gear ratio numerator selection 0
21 | GNUM1 | Electronic gear ratio numerator selection 1
22 | ORGP | External detector input
23 | SHOM | Homing
24 | TL2 | External torque limiting
25 | EMGS | Emergency stop
33 | PDIR_SEL | Position command direction selection
34 | GBK | Position probe
35 | PUL_UP | Forward direction pulse offset
36 | PUL_DN | Reverse direction pulse offset</td><td>U16</td><td>1</td><td>-</td><td>P S T</td><td>●</td><td>0602H</td></tr>
<tr><td>P6-03</td><td>DI2 function number</td><td>U16</td><td>2</td><td>-</td><td>P S T</td><td>●</td><td>0603H</td></tr>
<tr><td>P6-04</td><td>DI3 function number</td><td>U16</td><td>13</td><td>-</td><td>P S T</td><td>●</td><td>0604H</td></tr>
<tr><td>P6-05</td><td>DI4 function number</td><td>U16</td><td>14</td><td>-</td><td>P S T</td><td>●</td><td>0605H</td></tr>
<tr><td>P6-06</td><td>DI5 function number</td><td>U16</td><td>3</td><td>-</td><td>P S T</td><td>●</td><td>0606H</td></tr>
<tr><td>P6-07</td><td>DI6 function number</td><td>U16</td><td>12</td><td>-</td><td>P S T</td><td>●</td><td>0607H</td></tr>
<tr><td>P6-08</td><td>DI7 function number</td><td>U16</td><td>20</td><td>-</td><td>P S T</td><td>●</td><td>0608H</td></tr>
<tr><td>P6-09</td><td>DI8 function number</td><td>U16</td><td>21</td><td>-</td><td>P S T</td><td>●</td><td>0609H</td></tr>
<tr><td>P6-10</td><td>DI forcibly valid</td><td>00000000B～11111111B
0: Determined by terminal status; 1: Forcibly valid</td><td>U16</td><td>0000 0000B</td><td>-</td><td>P S T</td><td>○</td><td>060AH</td></tr>
<tr><td>P6-11</td><td>DO level logic</td><td>00000B～11111B
0: Positive logic; 1: Negative logic</td><td>U16</td><td>00000B</td><td>-</td><td>P S T</td><td>○</td><td>060BH</td></tr>
<tr><td>P6-12</td><td>DO1 function number</td><td rowspan="2">Value | Name | Function
0 | Disable | Terminal invalid</td><td>U16</td><td>1</td><td>-</td><td>P S T</td><td>●</td><td>060CH</td></tr>
<tr><td>P6-13</td><td>DO2 function</td><td>U16</td><td>2</td><td>-</td><td>P S T</td><td>●</td><td>060D</td></tr>
</table>

Parameter	Function	Parameter range	Data type	Initial value	Unit	Applicable mode	Attribute	Commu. Addr.
	number	1 S-RDY Servo ready 2 BK Brake control 3 TGON Motor rotation 4 ZER0 Motor zero speed 5 V-CLS Speed close 6 V-CMP Speed comparison 7 PNEAR Position proximity 8 COIN Positioning completed 9 C-LT Torque limiting 10 V-LT Speed limiting 11 WARN Warning output 12 ALM Alarm output 13 Tcmp Torque compliance 14 Home Homing completed 15 S-RUN Servo enable 27 T_CLS Torque close 29 SPD_P Speed programming comparison output 30 TRQ_P Torque programming compares output 31 SPD_TRQ Speed programming compares output						H
P6-14	DO3 function number		U16	8	-	P S T	●	060EH
P6-15	DO4 function number		U16	12	-	P S T	▲	060FH
P6-16	DO1 valid delay	0～65535	U16	0	ms	P S T	○	0610H
P6-17	DO1 invalid delay	0～65535	U16	0	ms	P S T	○	0611H
P6-18	DO2 valid delay	0～65535	U16	0	ms	P S T	○	0612H
P6-19	DO2 invalid delay	0～65535	U16	0	ms	P S T	○	0613H
P6-20	DO3 valid delay	0～65535	U16	0	ms	P S T	○	0614H
P6-21	DO3 invalid delay	0～65535	U16	0	ms	P S T	○	0615H
P6-22	DO4 valid delay	0～65535	U16	0	ms	P S T	○	0616H
P6-23	DO4 invalid delay	0～65535	U16	0	ms	P S T	○	0617H
P6-24	DO forcibly valid output	00000B～111111B 0: Determined by terminal function status; 1: Forcibly valid	U16	00000B	-	P S T	○	0618H
P6-25	AI1 filter time	0～10000	U16	10	ms	P S T	○	0619H
P6-26	AI2 filter time	0～10000	U16	10	ms	P S T	○	061AH
P6-27	AI1 hysteresis	0～300	U16	2	-	P S T	○	061BH
P6-28	AI2 hysteresis	0～300	U16	2	-	P S T	○	061CH
P6-29	AI1 offset adjustment	-3000～3000	I16	0	mV	P S T	○	061DH
P6-30	AI2 offset adjustment	-3000～3000	I16	0	mV	P S T	○	061EH
P6-31	AI1 dead zone	0～3000	U16	10	mV	P S T	○	061FH
P6-32	AI2 dead zone	0～3000	U16	10	mV	P S T	○	0620H
P6-33	AI1 zero drift	-2000～2000	I16	0	mV	P S T	○	0621H
P6-34	AI2 zero drift	-2000～2000	I16	0	mV	P S T	○	0622H
P6-35	AO1 function	0～20	U16	0	-	P S T	●	0623H

Parameter	Function	Parameter range	Data type	Initial value	Unit	Applicable mode	Attribute	Commu. Addr.
	selection							
P6-36	AO2 function selection	0～20	U16	1	-	P S T	●	0624H
P6-37	AO1 gain adjustment	-10.00～10.00	I16	1.00	-	P S T	○	0625H
P6-38	AO2 gain adjustment	-10.00～10.00	I16	1.00	-	P S T	○	0626H
P6-39	AO1 offset adjustment	-10000～10000	I16	0	mV	P S T	○	0627H
P6-40	AO2 offset adjustment	-10000～10000	I16	0	mV	P S T	○	0628H
P6-41	AO direct output 1	-10000～10000	I16	0	-	P S T	○	0629H
P6-42	AO direct output 2	-10000～10000	I16	0	-	P S T	○	062AH
P6-43	DO5 function number	0～99	U16	0	-	P S T	●	062BH
P6-44	DO5 valid delay	0～65535	U16	0	ms	P S T	○	062CH
P6-45	DO5 invalid delay	0～65535	U16	0	ms	P S T	○	062DH
P6-46	VDI status selection	00000000B～11111111B 0: Determined by P6-55 1: Determined by VDOx	U16	00000000B	-	P S T	○	062EH
P6-47	VDI1 function number	Same as P6-02 ~ P6-09	U16	0	-	P S T	●	062FH
P6-48	VDI2 function number		U16	0	-	P S T	●	0630H
P6-49	VDI3 function number		U16	0	-	P S T	●	0631H
P6-50	VDI4 function number		U16	0	-	P S T	●	0632H
P6-51	VDI5 function number		U16	0	-	P S T	●	0633H
P6-52	VDI6 function number		U16	0	-	P S T	●	0634H
P6-53	VDI7 function number		U16	0	-	P S T	●	0635H
P6-54	VDI8 function number		U16	0	-	P S T	●	0636H
P6-55	VDI control	00000000B~11111111B	U16	00000000B	-	P S T	○	0637H
P6-56	VDI status	00000000B~11111111B	U16	00000000B	-	P S T	▲	0638H
P6-57	VDO1 function number	Same as P6-12 ~ P6-15	U16	0	-	P S T	●	0639H
P6-58	VDO2 function number		U16	0	-	P S T	●	063AH
P6-59	VDO3 function number		U16	0	-	P S T	●	063BH
P6-60	VDO4 function number		U16	0	-	P S T	●	063CH
P6-61	VDO5 function number		U16	0	-	P S T	●	063DH
P6-62	VDO6 function number		U16	0	-	P S T	●	063EH

Parameter	Function	Parameter range	Data type	Initial value	Unit	Applicable mode	Attribute	Commu. Addr.
P6-63	VDO7 function number		U16	0	-	P S T	●	063FH
P6-64	VDO8 function number		U16	0	-	P S T	●	0640H
P6-65	VDO1 valid delay	0～65535	U16	0	ms	P S T	○	0641H
P6-66	VDO1 invalid delay	0～65535	U16	0	ms	P S T	○	0642H
P6-67	VDO2 valid delay	0～65535	U16	0	ms	P S T	○	0643H
P6-68	VDO2 invalid delay	0～65535	U16	0	ms	P S T	○	0644H
P6-69	VDO3 valid delay	0～65535	U16	0	ms	P S T	○	0645H
P6-70	VDO3 invalid delay	0～65535	U16	0	ms	P S T	○	0646H
P6-71	VDO4 valid delay	0～65535	U16	0	ms	P S T	○	0647H
P6-72	VDO4 invalid delay	0～65535	U16	0	ms	P S T	○	0648H
P6-73	VDO forcibly valid output	00000000B~11111111B	U16	00000000B	-	P S T	○	0649H
P6-74	VDO status	00000000B~11111111B	U16	00000000B	-	P S T	▲	064AH
P6-75	VDI1 valid delay	0～65535	U16	0	ms	P S T	○	064BH
P6-76	VDI1 invalid delay	0～65535	U16	0	ms	P S T	○	064CH
P6-77	VDI2 valid delay	0～65535	U16	0	ms	P S T	○	064DH
P6-78	VDI2 invalid delay	0～65535	U16	0	ms	P S T	○	064EH
P6-79	VDI3 valid delay	0～65535	U16	0	ms	P S T	○	064FH
P6-80	VDI3 invalid delay	0～65535	U16	0	ms	P S T	○	0650H
P6-81	VDI4 valid delay	0～65535	U16	0	ms	P S T	○	0651H
P6-82	VDI4 invalid delay	0～65535	U16	0	ms	P S T	○	0652H
P6-83	VDI level logic	00000000B～11111111B 0: Positive logic; 1: Negative logic	U16	00000000B	-	P S T	○	0653H
P6-84	VDO level logic	00000000B～11111111B 0: Positive logic; 1: Negative logic	U16	00000000B	-	P S T	○	0654H
P6-85	VDO selection	00000000B～11111111B 0: Determined by function number 1: Determined by DIx	U16	00000000B	-	P S T	○	0655H

7.2.12 **P7 group - communication settings parameters**

Parameter	Function	Parameter range	Data type	Initial value	Unit	Applicable mode	Attribute	Commu.Addr.
P7-00	Modbus communication address setting	1～254	U16	1	-	P S T	○	-
P7-01	Modbus communication baud rate	0: 4800bps 1: 9600bps 2: 19200bps 3: 38400bps 4: 57600bps	U16	1	-	P S T	○	-

Parameter	Function	Parameter range	Data type	Initial value	Unit	Applicable mode	Attribute	Commu.Addr.
		5: 115200bps						
P7-02	Modbus communication data format	0: No check 1+8+N+1 1: Odd check 1+8+O+1 2: Even check 1+8+E+1 3: No check 1+8+N+2 4: Odd check 1+8+O+2 5: Even check 1+8+E+2	U16	0	-	P S T	○	-
P7-03	Modbus communication response delay	1～20	U16	2	ms	P S T	○	-
P7-04	Parameter storage options for Modbus communication	0: Determined by P7-05 1: Parameter not stored when communication changes	U16	0	-	P S T	○	-
P7-05	Address selection for Modbus communication	0: Address +8000H, stored 1: Address +8000H, not stored	U16	1	-	P S T	○	-
P7-06	Reserved							
P7-07	Reserved							
P7-08	Reserved							
P7-09	32bit function code high-low bit sequence setting for Modbus communication	0: First low 16-bit and then high 16-bit for both reading and writing 1: First high 16-bit and then low 16-bit for both reading and writing 2: First low 16-bit and then high 16-bit for reading; reverse sequence for writing 3: First high 16-bit and then low 16-bit for reading; reverse sequence for writing	U16	0	-	PST	○	0709H
P7-10~P9-29 reserved								
P7-30	Map SA 1 for Modbus communication	0000H ~ FFFFH	U16	FFFFH	-	PST	○	071EH
P7-31	Map DA 1 for Modbus communication	0000H ~ FFFFH	U16	FFFFH	-	PST	○	071FH
P7-32	Map SA 2 for Modbus communication	0000H ~ FFFFH	U16	FFFFH	-	PST	○	0720H
P7-33	Map DA 2 for Modbus communication	0000H ~ FFFFH	U16	FFFFH	-	PST	○	0721H
P7-34	Map SA 3 for Modbus communication	0000H ~ FFFFH	U16	FFFFH	-	PST	○	0722H
P7-35	Map DA 3 for Modbus communication	0000H ~ FFFFH	U16	FFFFH	-	PST	○	0723H
P7-36	Map SA 4 for Modbus communication	0000H ~ FFFFH	U16	FFFFH	-	PST	○	0724H
P7-37	Map DA 4 for Modbus communication	0000H ~ FFFFH	U16	FFFFH	-	PST	○	0725H
P7-38	Map SA 5 for Modbus communication	0000H ~ FFFFH	U16	FFFFH	-	PST	○	0726H
P7-39	Map DA 5 for Modbus communication	0000H ~ FFFFH	U16	FFFFH	-	PST	○	0727H
P7-40	Map SA 6 for Modbus communication	0000H ~ FFFFH	U16	FFFFH	-	PST	○	0728H
P7-41	Map DA 6 for Modbus communication	0000H ~ FFFFH	U16	FFFFH	-	PST	○	0729H
P7-42	Map SA 7 for Modbus communication	0000H ~ FFFFH	U16	FFFFH	-	PST	○	072AH
P7-43	Map DA 7 for Modbus communication	0000H ~ FFFFH	U16	FFFFH	-	PST	○	072BH

Parameter	Function	Parameter range	Data type	Initial value	Unit	Applicable mode	Attribute	Commu.Addr.
P7-44	Map SA 8 for Modbus communication	0000H ~ FFFFH	U16	FFFFH	-	PST	○	072CH
P7-45	Map DA 8 for Modbus communication	0000H ~ FFFFH	U16	FFFFH	-	PST	○	072DH
P7-46	Map SA 9 for Modbus communication	0000H ~ FFFFH	U16	FFFFH	-	PST	○	072EH
P7-47	Map DA 9 for Modbus communication	0000H ~ FFFFH	U16	FFFFH	-	PST	○	072FH
P7-48	Map SA 10 for Modbus communication	0000H ~ FFFFH	U16	FFFFH	-	PST	○	0730H
P7-49	Map DA 10 for Modbus communication	0000H ~ FFFFH	U16	FFFFH	-	PST	○	0731H

7.2.13 **P8 group - extended function parameters**

Parameter	Function	Parameter range	Data type	Initial value	Unit	Applicable mode	Attribute	Commu. Addr.
P8-00	JOG speed	0～10000	U16	100	rpm	P S T	○	0800H
P8-01	JOG acc/dec time	1～65535	U16	200	ms	P S T	○	0801H
P8-02	Auto tuning torque identified by offline inertia	10～200	U16	50	%	P S T	○	0802H
P8-03	Maximum number of revolutions identified by offline inertia	1～20	U16	10	rev	P S T	○	0803H
P8-04	Reserved							
P8-05	Maximum revolution number of absolute encoder	1～32767	U16	32767	rev	P S T	○	0805H
P8-06	Absolute encoder use method selection	0: Used as an incremental encoder 1: Used as an absolute encoder	U16	0	-	P S T	●	0806H
P8-07	Fan control	0: Fan runs when servo enabled or alarm/warning occurs 1: Fan runs when power-on 2: Fan runs according to drive temperature	U16	0	-	P S T	○	0807H
P8-08	Drive overload warning threshold	20～100	U16	80	%	P S T	○	0808H
P8-09	Motor overload warning threshold	20～100	U16	80	%	P S T	○	0809H
P8-10	Braking resistor resistance setting	20～30000	U16	50	Ω	P S T	○	080AH
P8-11	Braking resistor power setting	10～30000	U16	100	W	P S T	○	080BH
P8-12	Brake duty ratio	0～100	U16	100	%	P S T	○	080CH
P8-13	Braking resistor derating percentage	1～100	U16	40	%	P S T	●	080DH
P8-14	Minimum load for motor stall judgment	10.0～250.0	U16	150.0	%	P S T	○	080EH
P8-15	Speed for motor stall judgment	0～500 (0: Stall judgment function disabled)	U16	0	rpm	P S T	○	080FH
P8-16	Time for motor stall judgment	10～3000	U16	100	ms	P S T	○	0810H
P8-17	Torque limit for motor	0.0～150.0	U16	100.0	%	P S T	○	0811H

Parameter	Function	Parameter range	Data type	Initial value	Unit	Applicable mode	Attribute	Commu. Addr.
	stall protection							
P8-18	Function switch 1	bit0: Torque limiting at undervoltage bit1: Holding function at instantaneous power outage (PLRT) bit2: Power failure detection function (linked with bit1) bit3: Position judgment based on command unit and coder unit switching bit4: Speed command reverse (speed mode)	U16	00100B	-	P S T	○	0812H
P8-19	Function switch 2	bit0: Stop zero servo switch (speed mode)	U16	0B	-	P S T	○	0813H
P8-20	Reserved							
P8-21	Reserved							
P8-22	Torque limit value when main circuit voltage drops	1.0～100.0	U16	50.0	%	P S T	○	0816H
P8-23	Torque limit release time when main circuit voltage drops	10～1000	U16	100	ms	P S T	○	0817H
P8-24	Holding time at instantaneous power outage	10～1000	U16	100	ms	P S T	○	0818H
P8-25	External torque limiting	0.0～500.0	U16	100.0	%	P S T	○	0819H
P8-26	External torque limit switching rate 1	0.1～500.0	U16	300.0	%/ms	P S T	○	081AH
P8-27	External torque limit switching rate 2	0.1～500.0	U16	300.0	%/ms	P S T	○	081BH
P8-28	Position deviation alarm detection blocking when the external torque limit is valid	0: Normal detection 1: Block detection	U16	0	-	P S T	○	081CH
P8-29	Alarm blocking invalid delay when the external torque limit is invalid	1～10000	U16	10000	ms	P S T	○	081DH
P8-30	Reserved							
P8-31	Reserved							
P8-32	Reserved							
P8-33	Reserved							
P8-34	Reserved							
P8-35	Reserved							
P8-36	Speed DO judgment selection	0: Setting 1 > speed > setting 2 1: Speed > setting 1, or speed < setting 2 2: Speed > setting 1 3: Speed < setting 2	U16	0	-	P S T	○	0824H
P8-37	Speed DO judgment setting 1	-10000～10000	I16	100	rpm	P S T	○	0825H
P8-38	Speed DO judgment setting 2	-10000～10000	I16	-100	rpm	P S T	○	0826H
P8-39	Torque DO judgment selection	0: Setting 1 > torque > setting 2 1: Torque > setting 1, or torque < setting 2 2: Torque > setting 1	U16	0	-	P S T	○	0827H

Parameter	Function	Parameter range	Data type	Initial value	Unit	Applicable mode	Attribute	Commu. Addr.
		3: Torque < setting 2						
P8-40	Torque DO judgment setting 1	-500.0～500.0	I16	100.0	%	P S T	○	0828H
P8-41	Torque DO judgment setting 2	-500.0～500.0	I16	-100.0	%	P S T	○	0829H
P8-42	Special transmission ratio for GBK measurement	0.000~65.535	U16	0	mm	P S T	○	082AH
P8-43	Read motor parameters upon power-on	0: Disabled 1: Enabled	U16	0	-	P S T	○	082BH

7.2.14 P9 group - multi-position parameters

Parameter	Function	Parameter range	Data type	Initial value	Unit	Applicable mode	Attribute	Commu. Addr.
P9-00	Multi-position execution modes	0: Pr1 ~ Pr16, enable cycle operation selection segment 1: Pr1 ~ Pr16, enable execution selection segment 2: Pr1 ~ Pr16, trigger execution selection segment 3: External DI selection segment, trigger execution 4: Pr1 ~ Pr16, trigger execution segment 1, cycle operation 5: Pr1 ~ Pr16, trigger execution segment 1 6: P9-01 selection segment, trigger execution 7: P9-01 selection segment, and execute immediately 8: pr1 ~ pr16, enable cycle sequence operation selection segment 9: pr1 ~ pr16, trigger sequence execution selection segment P9-70: Cycle operation start segment P9-71: Cycle operation end segment	U16	0	-	P	●	0900H
P9-01	Multi-position execution segment selection	0: Wait for command 1 ~ 16: Execute corresponding segments (automatically reset to 0 after execution)	U16	0	-	P	○	0901H
P9-02	Multi-position command reference setting	Right 1: Relative position 0: Incremental position 1: Absolute position Right 2: Cycle operation pause selection 0: Not memorize 1: Pause through terminal and memorize 2: Memorize when S-OFF	U16	0	-	P	○	0902H
P9-03	Multi-position acceleration time $\mathbf{T_{PACC}}$	1～10000	U16	100	ms	P	○	0903H
P9-04	Multi-position deceleration time $\mathbf{T_{PDEC}}$	1～10000	U16	100	ms	P	○	0904H
P9-05	Reserved							
P9-06	Pulse number of	-2147483647～2147483647	I32	10000	Puls	P	○	0906H

Parameter	Function	Parameter range	Data type	Initial value	Unit	Applicable mode	Attribute	Commu. Addr.
	multi-position command Pr1			0	e			
P9-08	Movement speed of multi-position command Pr1	1～10000	U16	100	rpm	P	○	0908H
P9-09	Pr1 stop time	0～65535	U16	0	ms	P	○	0909H
P9-10	Pulse number of multi-position command Pr2	-2147483647～2147483647	I32	-100000	Pulse	P	○	090AH
P9-12	Movement speed of multi-position command Pr2	1～10000	U16	100	rpm	P	○	090CH
P9-13	Pr2 stop time	0～65535	U16	0	ms	P	○	090DH
P9-14	Pulse number of multi-position command Pr3	-2147483647～2147483647	I32	0	Pulse	P	○	090EH
P9-16	Movement speed of multi-position command Pr3	1～10000	U16	100	rpm	P	○	0910H
P9-17	Pr3 stop time	0～65535	U16	0	ms	P	○	0911H
P9-18	Pulse number of multi-position command Pr4	-2147483647～2147483647	I32	0	Pulse	P	○	0912H
P9-20	Movement speed of multi-position command Pr4	1～10000	U16	100	rpm	P	○	0914H
P9-21	Pr4 stop time	0～65535	U16	0	ms	P	○	0915H
P9-22	Pulse number of multi-position command Pr5	-2147483647～2147483647	I32	0	Pulse	P	○	0916H
P9-24	Movement speed of multi-position command Pr5	1～10000	U16	100	rpm	P	○	0918H
P9-25	Pr5 stop time	0～65535	U16	0	ms	P	○	0919H
P9-26	Pulse number of multi-position command Pr6	-2147483647～2147483647	I32	0	Pulse	P	○	091AH
P9-28	Movement speed of multi-position command Pr6	1～10000	U16	100	rpm	P	○	091CH
P9-29	Pr6 stop time	0～65535	U16	0	ms	P	○	091DH
P9-30	Pulse number of multi-position command Pr7	-2147483647～2147483647	I32	0	Pulse	P	○	091EH
P9-32	Movement speed of multi-position command Pr7	1～10000	U16	100	rpm	P	○	0920H
P9-33	Pr7 stop time	0～65535	U16	0	ms	P	○	0921H
P9-34	Pulse number of multi-position command Pr8	-2147483647～2147483647	I32	0	Pulse	P	○	0922H
P9-36	Movement speed of multi-position command Pr8	1～10000	U16	100	rpm	P	○	0924H

Parameter	Function	Parameter range	Data type	Initial value	Unit	Applicable mode	Attribute	Commu. Addr.
P9-37	Pr8 stop time	0～65535	U16	0	ms	P	○	0925H
P9-38	Pulse number of multi-position command Pr9	-2147483647～2147483647	I32	0	Pulse	P	○	0926H
P9-40	Movement speed of multi-position command Pr9	1～10000	U16	100	rpm	P	○	0928H
P9-41	Pr9 stop time	0～65535	U16	0	ms	P	○	0929H
P9-42	Pulse number of multi-position command Pr10	-2147483647～2147483647	I32	0	Pulse	P	○	092AH
P9-44	Movement speed of multi-position command Pr10	1～10000	U16	100	rpm	P	○	092CH
P9-45	Pr10 stop time	0～65535	U16	0	ms	P	○	092DH
P9-46	Pulse number of multi-position command Pr11	-2147483647～2147483647	I32	0	Pulse	P	○	092EH
P9-48	Movement speed of multi-position command Pr11	1～10000	U16	100	rpm	P	○	0930H
P9-49	Pr11 stop time	0～65535	U16	0	ms	P	○	0931H
P9-50	Pulse number of multi-position command Pr12	-2147483647～2147483647	I32	0	Pulse	P	○	0932H
P9-52	Movement speed of multi-position command Pr12	1～10000	U16	100	rpm	P	○	0934H
P9-53	Pr12 stop time	0～65535	U16	0	ms	P	○	0935H
P9-54	Pulse number of multi-position command Pr13	-2147483647～2147483647	I32	0	Pulse	P	○	0936H
P9-56	Movement speed of multi-position command Pr13	1～10000	U16	100	rpm	P	○	0938H
P9-57	Pr13 stop time	0～65535	U16	0	ms	P	○	0939H
P9-58	Pulse number of multi-position command Pr14	-2147483647～2147483647	I32	0	Pulse	P	○	093AH
P9-60	Movement speed of multi-position command Pr14	1～10000	U16	100	rpm	P	○	093CH
P9-61	Pr14 stop time	0～65535	U16	0	ms	P	○	093DH
P9-62	Pulse number of multi-position command Pr15	-2147483647～2147483647	I32	0	Pulse	P	○	093EH
P9-64	Movement speed of multi-position command Pr15	1～10000	U16	100	rpm	P	○	0940H
P9-65	Pr15 stop time	0～65535	U16	0	ms	P	○	0941H
P9-66	Pulse number of multi-position command Pr16	-2147483647～2147483647	I32	0	Pulse	P	○	0942H

Parameter	Function	Parameter range	Data type	Initial value	Unit	Applicable mode	Attribute	Commu. Addr.
P9-68	Movement speed of multi-position command Pr16	1～10000	U16	100	rpm	P	○	0944H
P9-69	Pr16 stop time	0～65535	U16	0	ms	P	○	0945H
P9-70	Cycle operation start segment	1～16 (only 2 and 9 are valid for first operation)	U16	1	-	P	○	0946H
P9-71	Cycle operation end segment	1～16	U16	16	-	P	○	0947H

7.2.15 PA group - multi-speed parameters

Parameter	Function	Parameter range	Data type	Initial value	Unit	Applicable mode	Attribute	Commu. Addr.
PA-00	Multi-speed execution modes	0: Spd1 ~ Spd16, enable cycle operation 1: Spd1 ~ Spd16, enable operation for one round 2: Spd1 ~ Spd16, trigger operation for one round 3: Run at the speed of external DI selection segment 4: Run at the speed of PA-01 selection segment	U16	0	-	S	●	0A00H
PA-01	Multi-speed command execution segment selection	0: Wait for command1 ~ 16: Execute the corresponding segment	U16	0	-	S	○	0A01H
PA-02	Multi-speed command Spd1	-10000～10000	I16	100	rpm	S	○	0A02H
PA-03	Multi-speed command Spd1 operation time	0.0～6553.5	U16	1.0	s	S	○	0A03H
PA-04	Multi-speed command Spd2	-10000～10000	I16	-100	rpm	S	○	0A04H
PA-05	Multi-speed command Spd2 operation time	0.0～6553.5	U16	1.0	s	S	○	0A05H
PA-06	Multi-speed command Spd3	-10000～10000	I16	0	rpm	S	○	0A06H
PA-07	Multi-speed command Spd3 operation time	0.0～6553.5	U16	0.0	s	S	○	0A07H
PA-08	Multi-speed command Spd4	-10000～10000	I16	0	rpm	S	○	0A08H
PA-09	Multi-speed command Spd4 operation time	0.0～6553.5	U16	0.0	s	S	○	0A09H
PA-10	Multi-speed command Spd5	-10000～10000	I16	0	rpm	S	○	0A0AH
PA-11	Multi-speed command Spd5 operation time	0.0～6553.5	U16	0.0	s	S	○	0A0BH
PA-12	Multi-speed command Spd6	-10000～10000	I16	0	rpm	S	○	0A0CH
PA-13	Multi-speed command Spd6 operation time	0.0～6553.5	U16	0.0	s	S	○	0A0DH
PA-14	Multi-speed command Spd7	-10000～10000	I16	0	rpm	S	○	0A0EH
PA-15	Multi-speed command Spd7 operation time	0.0～6553.5	U16	0.0	s	S	○	0A0FH
PA-1	Multi-speed command Spd8	-10000～10000	I16	0	rpm	S	○	0A10

Parameter	Function	Parameter range	Data type	Initial value	Unit	Applicable mode	Attribute	Commu. Addr.
6								H
PA-17	Multi-speed command Spd8 operation time	0.0～6553.5	U16	0.0	s	S	○	0A11H
PA-18	Multi-speed command Spd9	-10000～10000	I16	0	rpm	S	○	0A12H
PA-19	Multi-speed command Spd9 operation time	0.0～6553.5	U16	0.0	s	S	○	0A13H
PA-20	Multi-speed command Spd10	-10000～10000	I16	0	rpm	S	○	0A14H
PA-21	Multi-speed command Spd10 operation time	0.0～6553.5	U16	0.0	s	S	○	0A15H
PA-22	Multi-speed command Spd11	-10000～10000	I16	0	rpm	S	○	0A16H
PA-23	Multi-speed command Spd11 operation time	0.0～6553.5	U16	0.0	s	S	○	0A17H
PA-24	Multi-speed command Spd12	-10000～10000	I16	0	rpm	S	○	0A18H
PA-25	Multi-speed command Spd12 operation time	0.0～6553.5	U16	0.0	s	S	○	0A19H
PA-26	Multi-speed command Spd13	-10000～10000	I16	0	rpm	S	○	0A1AH
PA-27	Multi-speed command Spd13 operation time	0.0～6553.5	U16	0.0	s	S	○	0A1BH
PA-28	Multi-speed command Spd14	-10000～10000	I16	0	rpm	S	○	0A1CH
PA-29	Multi-speed command Spd14 operation time	0.0～6553.5	U16	0.0	s	S	○	0A1DH
PA-30	Multi-speed command Spd15	-10000～10000	I16	0	rpm	S	○	0A1EH
PA-31	Multi-speed command Spd15 operation time	0.0～6553.5	U16	0.0	s	S	○	0A1FH
PA-32	Multi-speed command Spd16	-10000～10000	I16	0	rpm	S	○	0A20H
PA-33	Multi-speed command Spd16 operation time	0.0～6553.5	U16	0.0	s	S	○	0A21H

7.2.16 **Pb group - homing parameters**

Parameter	Function	Parameter range	Data type	Initial value	Unit	Applicable mode	Attribute	Commu. Addr.
Pb-00	Homing failure alarm time	0～65535	U16	0	ms	P	○	0B00H
Pb-01	Homing start mode	0: Disable the homing function 1: Automatically perform homing when enabled 2: Trigger homing by SHOW terminal (No.23 function)	U16	0	-	P	○	0B01H
Pb-02	Homing mode	1～35	U16	1	-	P	○	0B02H
Pb-03	Homing 1st segment high speed setting	0～10000	U16	500	rpm	P	○	0B03H
Pb-04	Homing 2nd segment low speed setting	0～10000	U16	50	rpm	P	○	0B04H
Pb-05	Homing acc/dec time	1～65535	U16	100	ms	P	○	0B05H
Pb-06	Reserved							

Parameter	Function	Parameter range	Data type	Initial value	Unit	Applicable mode	Attribute	Commu. Addr.
Pb-07	Reserved							
Pb-08	Homing offset pulse number	-2147483647～2147483647	I32	0	Pulse	P	○	0B08H
Pb-10	Position after homing	-2147483647～2147483647	I32	0	PUL	P	○	0B0AH
Pb-12	Absolute position electrical origin offset	-2147483647～2147483647	I32	0	PUL	P	●	0B0CH

7.2.17 **Pd group - motor parameters**

Code	Function	Initial value	Unit	Attribute	Commu. addr.
Pd-00	Reserved				
Pd-01	Motor code	Corresponding motor code	-	●	0D01H
Pd-02	Motor rated power	Determined by motor code	kW	●	0D02H
Pd-03	Motor rated current	Determined by motor code	A	●	0D03H
Pd-04	Motor rated torque	Determined by motor code	Nm	●	0D04H
Pd-05	Motor rated voltage	Determined by motor code	V	●	0D05H
Pd-06	Motor rated speed	Determined by motor code	rpm	●	0D06H
Pd-07	Motor max. speed	Determined by motor code	rpm	●	0D07H
Pd-08	Motor pole pair number	Determined by motor code	-	●	0D08H
Pd-09	Q axis inductance	Determined by motor code	mH	●	0D09H
Pd-10	D axis inductance	Determined by motor code	mH	●	0D0AH
Pd-11	Line-to-line resistance	Determined by motor code	Ω	●	0D0BH
Pd-12	torque constant	Determined by motor code	N/A	●	0D0CH
Pd-13	BEMF	Determined by motor code	V	●	0D0DH
Pd-14	Motor rotor inertia	Determined by motor code	$kg.cm^2$	●	0D0EH
Pd-15	Encoder type 0: Standard-wire encoder, positive logic 1: Standard-wire encoder, negative logic 2: Wire-saving encoder, positive logic 3: Wire-saving encoder, negative logic 4: Serial encoder, positive logic 5: Serial encoder, negative logic	Determined by motor code	-	●	0D0FH
Pd-16	Encoder line number	Determined by motor code	Pulse	●	0D10H
Pd-18	Origin electrical angle	Determined by motor code	°	●	0D12H
Pd-19	Encoder U phase rising edge	Determined by motor	°	●	0D13H

Code	Function	Initial value	Unit	Attribute	Commu. addr.
	electrical angle	code			
Pd-20	Reserved				
Pd-21	Encoder supports absolute (multi-rev) application	Determined by motor code	-	●	0D15H
Pd-22	Phase A and B relationship of incremental encoder 0: A leads, B is CCW 1: A leads, B is CW	0	-	●	0D16H
Pd-23	Current regulator Q-axis proportional gain	Determined by motor code	-	●	0D17H
Pd-24	Current regulator D-axis proportional gain	Determined by motor code	-	●	0D18H
Pd-25	Current regulator Q-axis integral gain	Determined by motor code	-	●	0D19H
Pd-26	Current regulator D-axis integral gain	Determined by motor code	-	●	0D1AH
Pd-27	Current loop proportional tuning	100	%	●	0D1BH
Pd-28	Current loop gain tuning	100	%	●	0D1CH
Pd-29	Motor flange size	Determined by motor code	mm	●	0D1DH

Chapter 8 Warning, Alarm and Troubleshooting

8.1 Alarm diagnosis and troubleshooting

When the servo drive has an alarm, the fault display Al. " will appear on the LED display, and the electric machine will coast to stop or stop at zero speed (according to the setting of P0-08, but zero speed stop is only for second-level alarm). The drive records the last 4 alarms, which can be viewed through group d1. The alarm and troubleshooting are as follows:

AL.001: Short circuit

AL.002: Hardware overcurrent

AL.00C: Software overcurrent

Alarm Scenarios	Inspection	Troubleshooting
Motor wiring error	Check the phase sequence of the wiring between the motor and the drive	Re-wiring according to instructions
Control parameters setting exception	Check if the set value is much greater than the factory value	Restore to the default value and fix it step by step.
The commands have changed dramatically.	Check if the control input command changes too drastically	Correct the change rate of the input commands or enable the filtering function
Drive output short circuit	1: Check the wiring status of the motor and the drive or whether there is short circuit in the wire. 2: Check whether the motor is damaged	1: Eliminate short circuit and prevent metal parts from being exposed. 2: Replace the damaged motor
External braking resistance is too small or short-circuited	Check whether external braking resistor conforms to specifications	Use braking resistors that conform to the instructions and set the P8-10, P8-11 and P8-13 parameters correctly.
Drive hardware failure	The alarm still occur when all of that above faults have been eliminated	Send it to distributor or manufacturer for overhaul.

AL.003: AD initialization alarm

Alarm Scenarios	Inspection	Troubleshooting
Drive hardware failure	Check if this fault repeats after power cut and restart	Send it to distributor or manufacturer for overhaul.

AL.004: Memory exception alarm

Alarm Scenarios	Inspection	Troubleshooting
Parameter data write exception	Check if this fault repeats after power cut and restart	Replace the drive
Store too frequently	Check whether the host device program frequently writes to the EEPROM of the drive.	Correct the upper device program, please use RAM address for parameters that need to be written frequently. The P7 group can be used to adjust the address pointing.

AL.005: System parameters exception

Alarm Scenarios	Inspection	Troubleshooting
Parameters set have conflict	Check the parameters set before the alarm	Fixed parameter errors

AL.006: AD sampling alarm

Alarm Scenarios	Inspection	Troubleshooting
Excessive external analog sample deviation or conversion timeout	Check if this alarm repeats after power cut and restart	Send it to distributor or manufacturer for overhaul.

AL007: Encoder exception 1

Alarm Scenarios	Inspection	Troubleshooting
Encoder loose	Check CN5 and encoder connector on drive	Reinstall
Encoder wiring error	Check if the wiring of the encoder follows the recommended wiring in the instructions	Ensure correct wiring
Poor encoder wiring	Check whether the connection between CN5 on the drive and servo motor encoder is good, including whether the shielding layer is in good condition.	Do rewiring
Encoder is damaged	This alarm still occurs after wiring problems are eliminated	Replace motor

AL008: Encoder exception 2

Alarm Scenarios	Inspection	Troubleshooting
Incremental encoder AB signal exception	Same as Al007	Same as Al007
Absolute encoder CRC check error		

AL009: Encoder Exception 3

Alarm Scenarios	Inspection	Troubleshooting
Incremental encoder Z signal exception	Same as Al007	Same as Al007
Absolute encoder communication error		

AL00A: Undervoltage

Alarm Scenarios	Inspection	Troubleshooting
Input voltage of main circuit is lower than the allowable value	Check whether the input voltage and wiring of the main circuit are normal	Reconfirm power wiring
No input voltage in main circuit	Check whether the main circuit voltage is normal	Reconfirm power switch
Power error	Check whether the power supply conforms to the specification required	Use the correct power supply

AL00b: Overvoltage

Alarm Scenarios	Inspection	Troubleshooting
The input voltage of the main circuit exceeds the allowable value	Check if the main circuit voltage is within the allowable range	Use the correct power supply
Power input error	Check whether the power supply conforms to the specification required	Use the correct power supply
Motor decelerates too fast	Check if the system inertia is too large and decelerates too fast	Extend deceleration time or use an appropriate external braking resistor
The load inertia is large and no braking resistor is connected.	Check if overvoltage occurs at stop	Install a braking resistor with appropriate capacity and resistance value, and set the braking resistor parameters correctly.
Drive hardware failure	This alarm still occurs when the main circuit voltage is within the allowable range and the motor is not running	Send it to distributor or manufacturer for overhaul.

AL00C: Software overcurrent

See the description for Al002

AL.00d、r、AL.00E: Motor overload/drive overload

Alarm Scenarios	Inspection	Troubleshooting
Continuous use in excess of rated load	1: Monitor whether d0-01 continues to exceed 100% 2: Monitor whether d0-46 continues to exceed the rated value 3: Monitor whether d0-47 ~ 49 continues to increase	1: Increase motor capacity or reduce load 2: Increase drive capacity or reduce load
Wiring error of motor and encoder	Check U, V, W and encoder wiring	Ensure correct wiring
The power line of the motor is broken or has poor contact.	1: Check whether the motor power line is connected to the drive reliably 2: Check whether the connection between the power line and the motor is reliable, especially for the ones using plastic connectors.	1: Fasten the screws to eliminate problems such as poor contact and poor cable crimping. 2: Fix the connections so that they will not shake or be subjected to external pulling force. 3. Check whether the reeds in the plug are deformed or not and correct it.
Improper setting of control parameters	1: Whether the machine oscillates and whether the motor makes abnormal noise 2: The acceleration and deceleration is set too rapid	1: Adjust position and speed gain value 2: Decrease the acc/dec time
Drive or motor fault	Remove the above faults	Send it to distributor or manufacturer for overhaul.

AL.010: Drive overheating

Alarm Scenarios	Inspection	Troubleshooting
High ambient temperature	Check whether the ambient temperature and humidity are within the allowable range	Improve installation environment
Drive cooling fan is damaged	Check whether the cooling fan is running during operation	Replace the fan that does not work
The heat dissipation of the servo drive is affected	1: Check whether the drive installation meets the requirements 2: Check whether the radiator of the drive is blocked	1: Install the drive correctly according to the requirements of Chapter 2 2: Clean up the blockage

AL.012: Overspeed

Alarm Scenarios	Inspection	Troubleshooting
UVW phase sequence error	Check if the UVW phase sequence is correct	Do wiring according to correct phase sequence
Improper setting of over-speed judgment parameters	Check whether the over-speed parameter is set too small	Correctly set the over-speed parameter
The speed input command has changed dramatically.	Check whether the input analog voltage signal is abnormal	Adjust the change rate of the input signal or adjust the filtering
The encoder is disturbed	Whether the wiring layout is appropriate and whether the system is grounded	Adjust the wiring layout and ensure reliable grounding of the system

AL.013: Position deviation is too large

Alarm Scenarios	Inspection	Troubleshooting
Position following error alarm value is too small	Confirm whether P1-20 parameter is appropriate	Increase the set value of P1-20
The pulse command frequency is higher than the specification.	Detect the pulse command frequency	Adjust the pulse frequency to be lower than the specification.
Gain value is set too small	Check if the set value is appropriate	Set the gain value correctly

Torque limit is too low	Confirm the torque limit	Correctly adjust the torque limit value
Excessive load inertia	Calculate the ratio of load inertia to motor rotor inertia	Reduce load inertia or reevaluate motor capacity

AL014: Input phase loss

Alarm Scenarios	Inspection	Troubleshooting
Main circuit power supply is abnormal	Check L1, L2, L3 power cords for loose connection or single-phase input only	If three-phase power supply is connected correctly but there is still fault, send the device to the distributor or the manufacturer for overhaul.
Drive parameters setting error	Set the single-phase powered drive to three-phase powered	Set parameters correctly

AL015: Motor phase sequence error

Alarm Scenarios	Inspection	Troubleshooting
The rotation direction of the motor is not consistent with the given direction.	Check whether U, V, W wiring is correct	If the wiring is correct but there is still fault, send the device to the distributor or the manufacturer for overhaul.

AL016: Drive exception

Alarm Scenarios	Inspection	Troubleshooting
Drive parameters setting exception	-	Check d2-09 ~ d2-10 and drive nameplate and make a record, then contact the distributor or manufacturer

AL017: Braking resistor overload

Alarm Scenarios	Inspection	Troubleshooting
Braking resistor is not connected or capacity is too small.	1: Confirm the connection status of the braking resistor 2: Calculate braking resistance value	1: Reconnect the braking resistor 2: Use an appropriate brake resistor
Failure of IGBT for braking	Check for damage of IGBT for braking	Send it to distributor or manufacturer for overhaul.
Parameter setting error when an external braking resistor is connected	Confirm the setting values of the braking resistance (P8-10) and braking resistor power (P8-11) parameters	Set parameters correctly

AL018: Encoder overheating

Alarm Scenarios	Inspection	Troubleshooting
Absolute encoder overheating	Check whether the ambient temperature of the motor is too high	Reduce ambient temperature or force air cooling of motor

AL019: Absolute encoder battery low warning

Alarm Scenarios	Inspection	Troubleshooting
Absolute encoder battery voltage is below 3.1 V	Measure the battery voltage	Replace the battery (Please replace the battery while keeping the encoder well connected to the CN5 terminal and the drive is powered on. If the battery is replaced when the encoder is off, the Al01A alarm will occur when the encoder is powered on again.)

AL01A: Absolute encoder battery low

Alarm Scenarios	Inspection	Troubleshooting
Absolute encoder battery voltage is lower than 2.5 V, multi-turn position information has been lost.	Measure the battery voltage	Replace the battery and manually clear the multi-turn fault information through AF-16 function after power-on, and then power-on again.

AL016: Mismatch between drive and motor

Alarm Scenarios	Inspection	Troubleshooting
Drive does not match the motor	1: Check if the voltage level of the motor is consistent with that of the drive 2: Check if the motor code in the drive is consistent with that on the motor nameplate	1: Match drive and motor correctly 2: Enter the motor code correctly

AL01C: Homing failed

Alarm Scenarios	Inspection	Troubleshooting
Pb-00 parameter is set too small	Check whether the set value of Pb-00 is appropriate	Increase the value of Pb-00
External detector or limit switch failure	Check external detectors, limit switches and wires	Remove the fault

AL01d: Main power supply failure

Alarm Scenarios	Inspection	Troubleshooting
The power supply of the main circuit is cut off.	Check whether the power supply logic is correct	Adjust the power supply logic or maintain the status when it is really necessary to cut off the power supply to the main circuit.

AL01F: System restart

Alarm Scenarios	Inspection	Troubleshooting
After some operations are completed, the drive needs to be restarted	N/A	Turn off the drive and power it on again

AL027: UVW shorted to ground alarm

Alarm Scenarios	Inspection	Troubleshooting
Motor lead UVW shorted to ground	Check motor leads and connectors	Handle the insulation problem well.
Insulation damage of internal wire package occurred in motor	Check the insulation of motor windings	Send it to the distributor or the manufacturer for overhaul.

AL028: Inertia identification failed

Alarm Scenarios	Inspection	Troubleshooting
Excessive load inertia	Check if the load inertia is too large	Reduce the load inertia or replace with a motor with a larger inertia.
Abnormal mechanical connection between load and motor	Check if the load is connected correctly to the motor	Remove mechanical problems
The number of turns that the motor can run is too small.	Check if the number of turns the motor can rotate is greater than the set value of P8-03	Adjust P8-03 parameter Appropriately increase the set value of P8-02
P8-03 is set small	Check if the motor can rotate more turns	

AL032: Electronic gear ratio setting range error

Alarm Scenarios	Inspection	Troubleshooting
Unreasonable setting of electronic gear ratio	Check whether the setting values of the parameters related to the electronic gear ratio are appropriate.	Adjust the parameters

AL033: Input pulse frequency is too high

Alarm Scenarios	Inspection	Troubleshooting
Input pulse frequency exceeds 1MHz	Check if the input pulse frequency is too high	Adjust the output of the upper device
	Check if there is serious interference	Send pulse signals using qualified twisted pair shielded conductors

AL034: Analog zero drift correction error

Alarm Scenarios	Inspection	Troubleshooting
When performing zero drift self-learning, the collected external voltage exceeds 2V	When performing zero drift self-learning, whether to set the upper device command to 0	Set the upper device command to 0, and then carry out zero drift self-learning again.
	Check if the output voltage exceed 2V when the command of the upper device is 0	Correct the output of the upper device

AL038: The relay is not fully engaged

Alarm Scenarios	Inspection	Troubleshooting
The soft start relay of the servo main circuit is not fully engaged	Check if the alarm is eliminated after power-on again	Send it to the distributor or the manufacturer for overhaul.

AL039: Serial encoder line number setting error

Alarm Scenarios	Inspection	Troubleshooting
The number of serial encoder lines is set incorrectly by user	Check related parameters	Set them correctly The number of lines shall be one-fourth of the standard number of lines of encoder

AL040: Write motor encoder EEPROM error

Alarm Scenarios	Inspection	Troubleshooting
An error occurred while writing parameters to the motor encoder	1: Check whether the communication protocol of the encoder meets the requirements. 2: Check whether the encoder cable is correctly and well connected.	Re-perform the write operation

AL041: Read motor encoder EEPROM error

Alarm Scenarios	Inspection	Troubleshooting
An error occurred while reading parameters from the motor encoder	1: Check whether the communication protocol of the encoder meets the requirements. 2: Check whether the encoder cable is correctly and well connected.	Re-execute the read operation, if unsuccessful, use the motor CODE

AL042: Read motor encoder EEPROM check error

Alarm Scenarios	Inspection	Troubleshooting
The parameter read from the motor encoder is not checked correctly, or no parameter is written in the encoder.	1: Check whether the encoder cable is correctly and well connected.	Re-execute the read operation, if unsuccessful, use the motor CODE

AL043: Pulse given direction signal error

Alarm Scenarios	Inspection	Troubleshooting
When the pulse + direction given position command is used, the drive detects that the direction signal changes frequently during the power-on and initialization process, and the real state of the direction signal cannot be determined.	1: Check whether the pulse command cable is correctly and well connected. 2: Check whether there is serious interference. 3: Check whether the output of the upper device is normal	1: Take appropriate anti-interference measures. 2: Adjust the setting value of P1-15 to filter out interference.

8.2 Warning diagnosis and troubleshooting

When the servo drive gives a warning, the warning information "AL E" will appear on the LED display. The occurrence of a warning indicates that the system has detected an abnormality, but the motor will not stop running. Please immediately check the cause of the warning and remove the problem. The warning display and its handling measures are as follows:

AL.E.02: Drive overheating warning

Warning Scenarios	Inspection	Troubleshooting
High ambient temperature	Check whether the ambient temperature and humidity are within the allowable range	Improve the cooling condition of servo drive and reduce the ambient temperature.
Drive cooling fan is damaged	Check whether the drive cooling fan is running during operation	Replace the fan that does not work
The installation direction of the servo drive or the air inlet and outlet of the cooling fan are blocked.	1: Check whether the drive installation meets the requirements 2: Check whether the radiator of the drive is blocked	1: Install the drive according to Chapter 2 2: Clean up the blockage
Servo drive is faulty	Restart after power off for a period of time	If the fault is still reported, replace the servo drive

AL.E.03: Motor overload warning

Warning Scenarios	Inspection	Troubleshooting
Motor load reaches the motor overload warning threshold set by P8-09	1: Refer to AL.00d and AL.00E 2: P8-09 parameter is set too small	1: Refer to AL.00d and AL.00E 2: Appropriately increase the set value of P8-09

AL.E.04: Drive overload warning

Warning Scenarios	Inspection	Troubleshooting
Drive load reaches the drive overload warning threshold set by P8-08	1: Refer to AL.00d and AL.00E 2: P8-08 parameter setting is too small	1: Refer to AL.00d and AL.00E 2: Appropriately increase the set value of P8-08

AL.E.05: Excessive position deviation warning

Warning Scenarios	Inspection	Troubleshooting
Position following error alarm threshold is too small	Verify that P1-18 parameter is appropriate	Increase the set value of P1-18
The pulse command frequency is higher than the specification.	Detect the pulse command frequency	Adjust the pulse frequency to be lower than the specification.
Gain value is set too small	Check if the set value is appropriate	Set the gain value correctly
Torque limit is too low	Confirm the torque limit	Correctly adjust the torque limit value
Excessive load inertia	Calculate the ratio of load inertia to motor rotor inertia	Reduce load inertia or reevaluate motor capacity

AL.E.06: Brake overload warning

Warning Scenarios	Inspection	Troubleshooting
Braking resistor is not connected or capacity is too small.	1: Confirm the connection status of the braking resistor 2: Calculate braking resistance value	1: Reconnect the braking resistor 2: Use a braking resistor with appropriate resistance value
Excessive load inertia	Check whether the total load/rotor inertia ratio is appropriate.	Reduce load inertia or change to a motor with larger inertia
Incorrect parameter setting	Confirm the setting values of the braking resistor resistance (P8-10) and power (P8-11) parameters	Set the P8-10 and P8-11 parameters correctly
	Check if the brake resistance derating percentage (P8-13) is appropriate	When using an external brake resistor, increase the P8-13 set value if the power is sufficient
	Check if the deceleration time is too short	Extend deceleration time

-P.ot.-: Forward overrun warning

Warning Scenarios	Inspection	Troubleshooting
The P-OT terminal is valid and the command is positive	Confirm the position of the positive limit switch	1: Release positive limit switch 2: Give a negative command
Run beyond the positive limit position	Confirm the current position of the motor and the value of P1-26	Correct the command and P1-26 set value Set P1-26 to the maximum value and disable its function
The absolute encoder system operate in the positive direction beyond the allowable number of turns and the command is positive	Check if the setting value of P8-05 is appropriate	Adjust the set value of P8-05 Give a negative command
The servo system is not stable enough.	Confirm the set control parameters and load inertia	Re-correct control parameters or re-evaluate motor capacity

-n.ot.-: Reverse overrun warning

Warning Scenarios	Inspection	Troubleshooting
The N-OT terminal is valid and the command is a negative	Confirm the status of the negative limit switch	1: Release the negative limit switch 2: Give positive command
Run beyond the negative limit position	Confirm the current position of the motor and the value of P1-28	1: Correct the command and P1-28 set value 2: Set P1-28 to the maximum value and disable its function
The absolute encoder system operates in the opposite direction beyond the allowable number of turns and the command is negative	Check if the setting value of P8-05 is appropriate	1: Adjust the set value of P8-05 2: Give positive command
The servo system is not stable enough.	Confirm the set control parameters and load inertia	Re-correct control parameters or re-evaluate motor capacity

AL.E09: Warning of write communication parameters to EEPROM too many times (parameters can still be written normally after alarm)

Warning Scenarios	Inspection	Troubleshooting
After this power-on, the upper device/PLC/touch screen modifies parameters too many times.	Check whether the address used by the parameter that needs to be changed in real time corresponds to the RAM address.	Use the corresponding RAM address for parameters that need real-time change (not saved in EEPROM), as described in Section 9.5. 3 for details.

AL.E0A: Request for power-on again

Warning Scenarios	Inspection	Troubleshooting
Parameters that are valid upon re-power-on are changed	-	Power on again after the parameter setting is completed

AL.E0b: Braking resistor not connected (SIZE B, C models support)

Warning Scenarios	Inspection	Troubleshooting
Braking resistor not connected	1: Check if the internal braking resistor short connector is connected (P + and D) 2: When using an external braking resistor, check whether the wiring falls off 3: Check whether the braking resistor is normal in power-off state	After the wire is connected, power on again. Replacing braking resistor

Chapter 9 Specifications

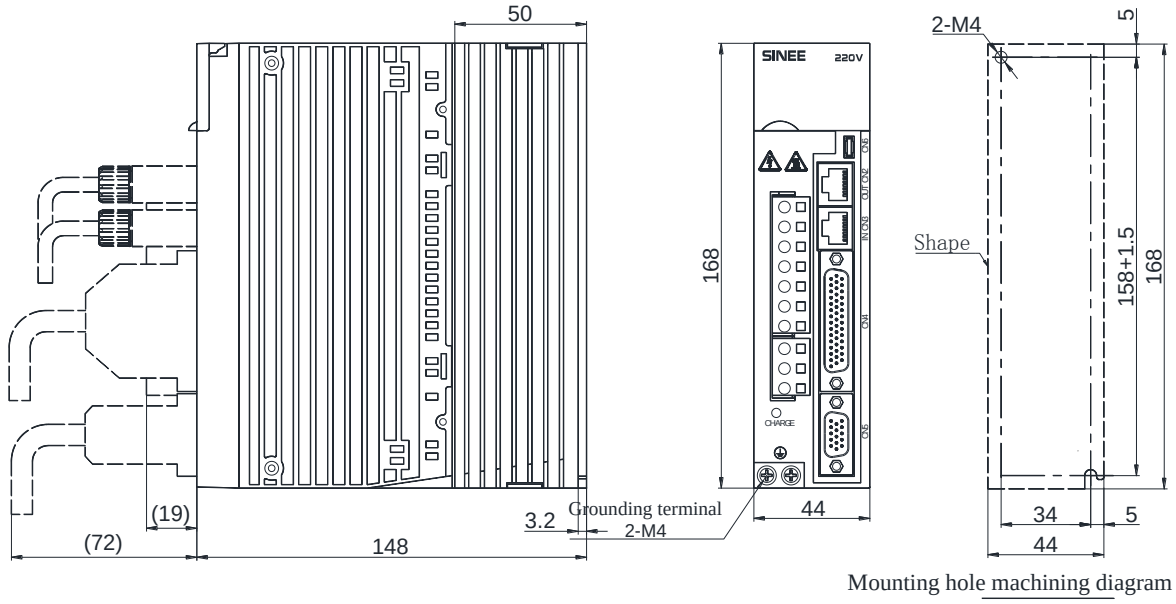
9.1 EA180 Servo drive specifications

Model EA180-		0R9-1A	1R6-1A	2R5-1A	4R8-2A	6R2-2A	011-2A	5R6-3A	8R5-3A	013-3A	017-3A	022-3A	028-3A
Applicable encoder		2500ppr /wire-saving/standard incremental											
Model EA180-		0R9-1B	1R6-1B	2R5-1B	4R8-2B	6R2-2B	011-2B	5R6-3B	8R5-3B	013-3B	017-3B	022-3B	028-3B
Applicable encoder		17bit incremental, 23bit absolute											
Frame		SIZE A			SIZE B		SIZE C				SIZE D		
Rated motor power (kW)		0.05	0.1/0.2	0.4	0.75	1.0	1.5	1.5	2.0	3.0	4.4	5.5	7.5
Rated output current (A)		0.9	1.6	2.5	4.8	6.2	11.0	5.6	8.5	13.0	17.0	22.0	28.0
Power supply	Main power supply 50/60Hz	Single-phase AC 220V±5%					-	Three-phase AC 380V ±10%					
		-			Three-phase AC 220V								
	Control power supply	Single-phase AC 220V±5%						Single-phase AC 380V ±10%					
Working conditions	Temperature	Working temperature 0-40 ℃; storage temperature -20～85 °											
	Humidity	Work/storage humidity: ≤ 90% RH (no condensation)											
	Altitude	≤ 1000 meters											
	Vibration	≤ 4. 9m/s^2, 10 ~ 60Hz (not allowed to work at resonance point)											
Cooling mode		Fan cooling											
Control mode		SVPWM, vector control											
Six control modes		Speed control, position control, torque control, speed/position control, torque/speed control, position/torque control.											
Front panel		5 keys, 5 LEDs											
Regenerative braking		Built-in brake unit and resistor, external braking resistor can be used											
Feedback mode		Supports wire-saving/standard incremental 2500 PPR encoders, 17-bit incremental encoders and 23-bit absolute encoders											
Digital I/O		input	Servo start, fault reset, position pulse deviation counter clearing, speed command direction selection, multi-position/speed switching, internal command trigger, control mode switching, pulse inhibit, positive drive inhibit, negative drive inhibit, positive jog, negative jog										
		output	Servo ready, brake output, motor rotation output, zero speed signal, speed approach, speed comparison, position approach, position comparison, torque limit, speed limit, warning output, fault output										
Protection function		Hardware	Overvoltage, undervoltage, overspeed, overheating, overload, overspeed, encoder failure, etc.										
		Software	Excessive position error, EEPROM failure, etc.										
Alarm data tracking function		Record 4 sets of historical alarm records and related data											
Communication function		Modbus RTU											
Encoder signal output	Signal type	A, B, Z differential output, Z signal open collector output, Z signal width can be set											
	Resolution	Programmable arbitrary frequency division, optional output before or after frequency quadrupling											
Position control mode	Maximum Input Pulse frequency	Differential input mode: 500Kpps Open collector input mode: 200Kpps											
	Pulse command mode	Pulse + sign, AB orthogonal pulse, CW/CCW											
	Command control mode	External pulse command											
	Command smoothing mode	Ladder smoothing for low pass filtering, FIR filtering, multi-position command											
	Electronic gear ratio	Electronic gear ratio: N/M times (0.001 < N/M < 64000 = N: 1 ~ 2^{30}, M: 1 ~ 2^{30}											
	Position accuracy	± 1 command pulse											
Speed	Command control mode	External analog command, digital speed command, multi-speed command, jog command											

control mode	Command smoothing mode	Low-pass filtering, S-curve smoothing		
	Analog command input	Voltage range	-10V ~ 10V	
		Input impedance	10K	
		Time constant	200 μs	
	Torque limiting	Digital settings or external analog limits		
	Speed ratio	1: 3000 (2500ppr encoder) 1: 5000 (23bit encoder)		Minimum speed/rated speed for continuous and smooth operation at rated load
	Bandwidth	Not less than 250Hz (2500ppr encoder), not less than 800Hz (23bit encoder)		
	Speed volatility	Load variation (0 ~ 100%)	Max. 0.1%	23-bit encoder, when the speed command is rated speed, (Speed at no load - speed at full load)/rated speed
		Power voltage variation ±10%	Max. 0.1%	
		Ambient temperature (0 ~ 50 ℃)	Max. 0.1%	
Torque control mode	Command control mode	External analog command, digital torque command		
	Command smoothing mode	Low-pass filtering		
	Analog command input	Voltage range	-10V ~ 10V	
		Input impedance	10K	
		Time constant	200 μs	
	Speed limit	Digital settings or external analog limits		
	Accuracy	±3% (current repetition accuracy)		

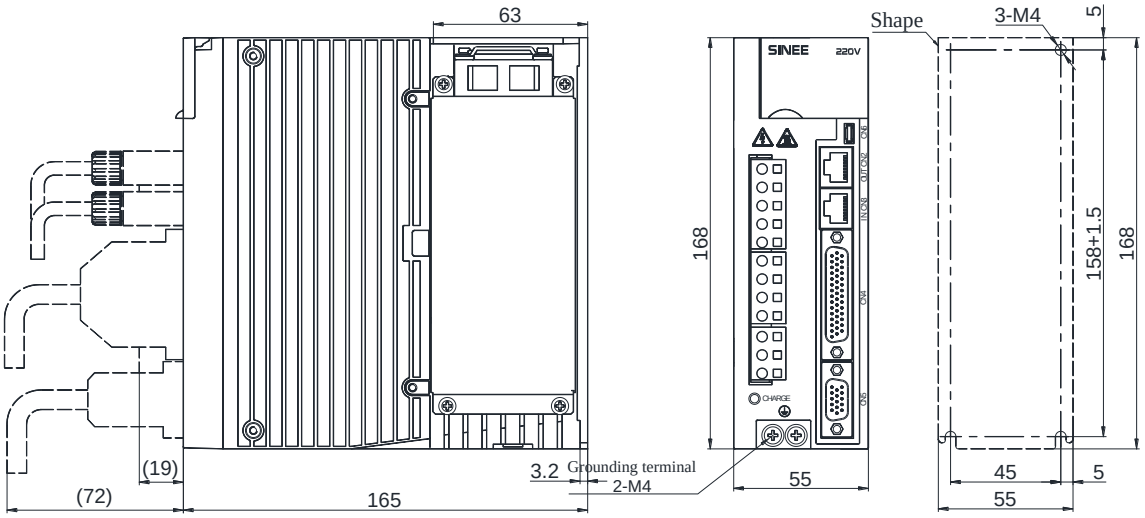
9.2 Dimensions of EA180 servo drive

SIZE A: EA180□-0R9-1□ EA180□-1R6-1□ EA180□-2R5-1□ Outline Dimensions



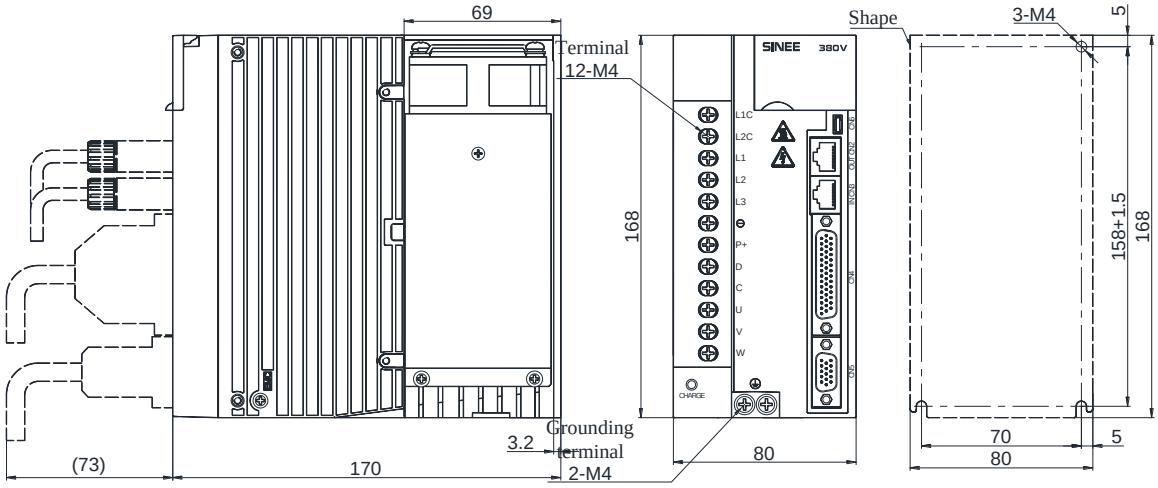
Mounting hole machining diagram

SIZE B: EA180□-4R8-2□ EA180□-6R2-2□ Outline Dimensions



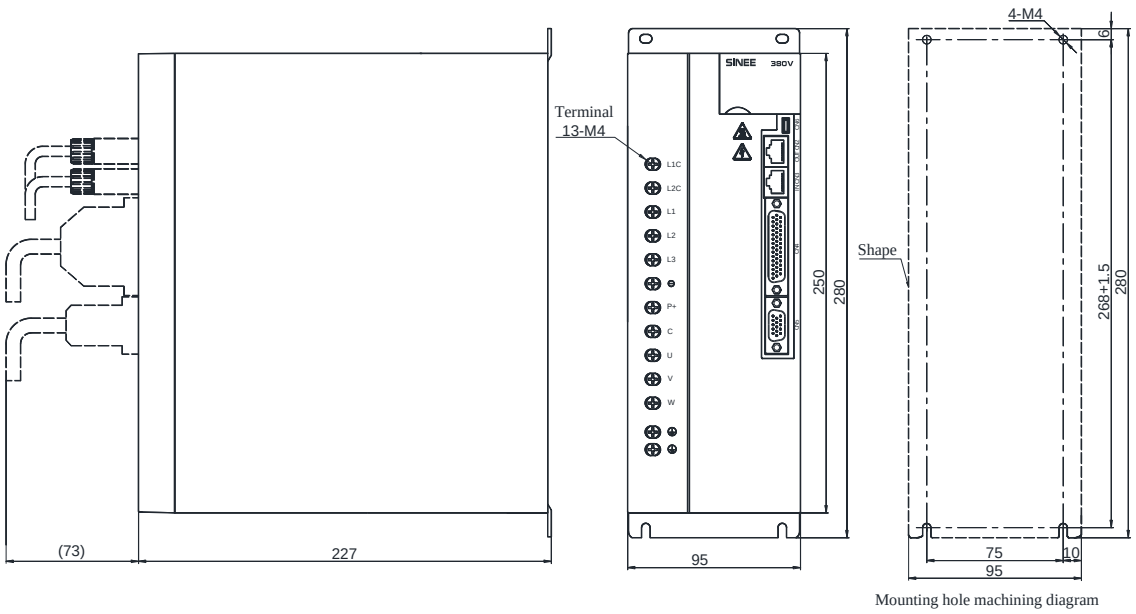
Mounting hole machining diagram

SIZE C: EA180□-5R6-3□ EA180□-8R5-3□ EA180□-013-3□ EA180□-011-2□ Outline Dimensions



Mounting hole machining diagram

SIZE D: EA180□-017-3□ EA180□-022-3□ EA180□-028-3□ Outline Dimensions



Mounting hole machining diagram

9.3 Servo motor specifications

SER ① 08 ② - 0R7 ③ - 30 ④ - 2 ⑤ F ⑥ A ⑦ Y ⑧ 1 ⑨ -XX ⑩

① Product series	② Motor flange size	③ Rated output power
SER: Standard servo motor SES: High performance servo motor	04: 40mm 06: 60mm 08: 80mm 09: 86mm 11: 110mm 13:130mm 18: 180mm 20: 200mm	005: 50W 0R1: 100W 0R2: 200W 0R4: 400W 0R7: 750W 1R0: 1000W 1R5: 1500W 2R0: 2000W 3R0: 3000W 4R4: 4400W 5R5: 5500W 7R5: 7500W 011: 11kW
④ Rated motor speed	⑦ Inertia type	⑨ Optional
10: 1000rpm 15: 1500rpm 20: 2000rpm 25: 2500rpm 30: 3000rpm	A: Low inertia B: Medium inertia C: High inertia	None: No option 1: With brake (DC24V) 2: With oil seal 3: With a brake and oil seal
⑤ Voltage level	⑧ Axis end	
2: 220V 3: 380V	X: Shaft without keyway[*1] Y: Shaft with U-shaped keyway and screw hole[*2] Z: Shaft with double round keyways and screw hole	⑩ Special specifications
⑥ Encoder type		
A: 2500ppr incremental B: 17-bit incremental F: 23-bit absolute G[*1]: 2500ppr wire-saving encoder		

*1: Non-standard product, not recommended.

*2: Some varieties may have double round keyways, but except the 130 flange motors, the width and height of the key are the same as those of the U keyway. See Chapter 10.

The above 10 elements are not optional, please refer to the selection guide or consult SINEE.

9.3.1 Common characteristics of servo motors:

Insulation grade of motor	F Class
Insulation withstand voltage	1500V 60s
Insulation resistance	DC500V, above 10MΩ
Temperature resistance grade of motor	B
Protection level	Fully enclosed self-cooling IP65 (except shaft through part)
Operating environment	Ambient temperature 0-40 °RH 20-80% (no condensation)
Installation method	Flange installation
Rotation direction	It rotates counterclockwise (CCW) when viewed from the load side under the forward rotation command.

9.3.2 Brake specifications:

Motor flange size	40	60	80	86	110	130	180	180
Rated voltage	DC 24 ~ 26.4 V							
Static friction torque	0.35 N.m	2 N.m	3 N.m	3 N.m	10 N.m	20 N.m	40 N.m	80 N.m*
Rated power	3.5 W ±7%	6.3 W ±7%	10.4 W ±7%	10.4 W ±7%	11.6 W ±7%	19.5 W ±7%	25W ±7% *	49W ±7% *
Closing voltage	18V DCmax							
Release voltage	1.5 V DCmin							
Standard action time	150ms							

*: For 7.5 KW servo motor only.

1: The brake is used to keep the motor locked after shutdown and cannot be used for braking.
2: The 24V power supply for the brake should be provided by the user. The 24V on the drive should never be used.
3: The action time of the brake varies with circuit, please confirm according to the actual product.
4. Static friction torque is provided by the brake when the motor is static. If there is external impact, the motor cannot be guaranteed to be static.

9.3.3 **Servo motor parameter table:**

Servo motor model	Voltage level V	Rated power W	Rated speed rpm	Maximum speed rpm	Rated current A	Instantaneous max. current A	Rated torque Nm	Instantaneous max. torque Nm	Torque constant Nm/A	Moment of inertia Kg.cm^2*10^{-4}	Applicable drive EA180-
SER06-0R2-30-2□AY□	AC 220	200	3000	5500	1.2	3.6	0.64	1.92	0.53	0.18(0.18)	1R6-1□
SER06-0R4-30-2□AY□		400	3000	4500	2.3	6.9	1.27	3.81	0.55	0.3(0.3)	2R5-1□
SER08-0R7-30-2□AY□		750	3000	4500	4.3	12.9	2.4	7.20	0.56	1.01(1.02)	4R8-2□
SER08-0R7-20-2□AY□			2000	3000	3.0	9.0	3.5	10.50	1.17	1.59(1.6)	
SER08-1R0-30-2□AY□		1000	3000	4000	4.0	12.0	3.2	10.50	0.88	1.59(1.6)	
SER09-0R7-30-2□BZ□		750	3000	4000	3.4	10.2	2.4	7.20	0.71	2.42(2.43)	
SER11-0R6-30-2□BY□		600	3000	4000	2.5	7.5	2.0	6.00	0.8	3.03(3.05)	2R5-1□
SER11-1R0-20-2□BY□		1000	2000	2500	5.0	15.0	5.0	15.00	1.0	7.22(7.24)	6R2-2□
SER11-1R2-30-2□BY□		1200	3000	3500	4.9	14.7	4.0	12.00	0.82	5.54(5.56)	
SER11-1R8-30-2□BY□		1800	3000	3500	6.6	19.8	6.0	18.00	0.91	8.55(8.57)	011-2□
SER13-0R7-20-2□BY□		750	2000	2500	3.88	11.6	3.65	10.95	0.94	6.17(6.19)	4R8-2□
SER13-1R0-10-2□BY□		1000	1000	1500	4.72	14.2	9.55	28.65	2.02	17.14(17.16)	6R2-2□
SER13-1R0-20-2□BY□			2000	2500	4.72	14.2	4.77	14.31	1.01	8.71(8.73)	
SER13-1R0-30-2□BY□			3000	3500	4.96	14.9	3.27	9.81	0.66	6.17(6.19)	
SER13-1R5-10-3□BY□	AC 380	1500	1000	1500	5.4	13.5	14.32	35.80	2.65	25.58(25.6)	5R6-3□
SER13-1R5-20-3□BY□			2000	2500	4.1	10.3	7.16	17.90	1.75	12.08(12.1)	
SER13-1R5-30-3□BY□			3000	3500	4.2	10.5	4.78	11.95	1.14	8.71(8.73)	
SER13-2R0-20-3□BY□		2000	2000	2500	6.5	16.3	9.55	23.88	1.47	17.14(17.16)	8R5-3□
SER13-2R0-30-3□BY□			3000	3500	5.8	14.5	6.5	16.25	1.12	12.08(12.1)	
SER13-3R0-20-3□BY□		3000	2000	2500	9.6	24.0	14.32	35.80	1.49	25.58(25.6)	013-3□
SER13-3R0-30-3□BY□			3000	3500	8.3	20.8	9.55	23.88	1.15	17.14(17.16)	

Note: 1. The value in () is the value with brake;
2. When oil seal is provided, 10% derating is required.
3. Rated torque is the continuous allowable torque on aluminum fins of the following sizes and at an ambient temperature of 40 ℃.
40, 60, 80 flange motors: 250*250*6mm 90; 110 flange motors: 300*300*10mm ; 130 flange motors: 400*400*15mm

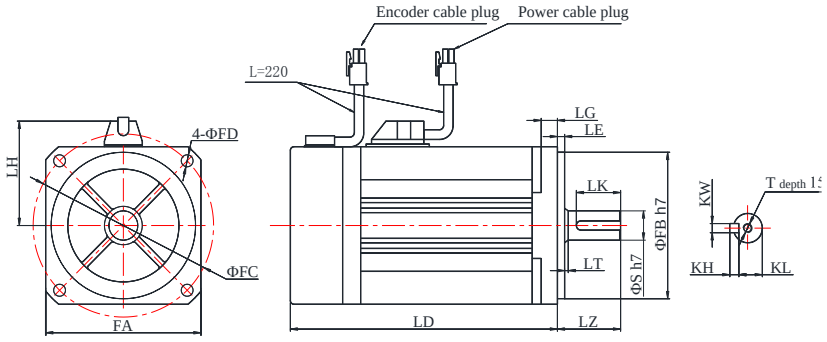
Servo motor model	Voltage level V	Rated power W	Rated speed rpm	Maximum speed rpm	Rated current A	Instantaneous max. current A	Rated torque Nm	Instantaneous max. torque Nm	Torque constant Nm/A	Moment of inertia Kg.cm2*10-4	Applicable drive EA180□-
SES04-005-30-2□AY□	AC 220	50	3000	6000	0.6	1.8	0.16	0.48	0.26	0.02(0.02)	0R9-1□
SES04-0R1-30-2□AY□		100	3000	6000	1.1	3.3	0.32	0.96	0.29	0.04(0.04)	1R6-1□
SES06-0R2-30-2□BY□		200	3000	6000	1.6	4.8	0.64	1.92	0.44	0.29 (0.34)	1R6-1□
SES06-0R4-30-2□BY□		400	3000	6000	2.3	6.9	1.27	3.81	0.59	0.56 (0.61)	2R5-1□
SES08-0R7-30-2□BY□		750	3000	5000	4.0	12	2.4	7.2	0.653	1.56 (1.66)	4R8-2□
SES08-1R0-30-2□BY□		1000	3000	5000	6.0	18	3.2	9.6	0.538	2.03 (2.13)	6R2-2□
SES13-0R8-15-2FBY□		850	1500	3000	6.9	17	5.39	13.8	1.72	13.95(16.1)	011-2B
SES13-0R8-15-3FBY□	AC 380	850	1500	3000	3.5	8.5	5.39	13.8	1.72	13.95(16.1)	5R6-3B
SES13-1R3-15-3FBY□		1300	1500	3000	5.4	14	8.34	23.3	1.78	19.95(22.1)	5R6-3B
SES13-1R8-15-3FBY□		1800			8.4	20	11.5	28.7	1.5	26.1(28.1)	8R5-3B
SES18-2R9-15-3FBY□		2900			11.9	28	18.6	45.1	1.7	46.0 (53.9)	013-3B
SES18-4R4-15-3FBY□		4400			16.5	40.5	28.4	71.1	1.93	67.5 (75.4)	017-3B
SES18-5R5-15-3FBY□		5500			20.8	52	35	87.6	1.8	89.0(96.9)	022-3B
SES18-7R5-15-3FBY□		7500			25.7	65	48	119	1.92	125.0(133)	028-3B
SES18-3R6-20-3FBY□		3600	2000	2500	9.5	28.5	16.7	50.16	2.1	46.0(53.9)	013-3B

Note: 1. The value in () is the value with brake;
2. When oil seal is provided, 10% derating is required.
3: Rated torque is the continuous allowable torque on aluminum fins of the following sizes and at an ambient temperature of 40 ℃.

40, 60, 80 flange motors: 250*250*6mm; 90, 110 flange motors: 300*300*10mm;
130 flange motors: 400*400*15mm; 180 flange motor: 550*550*20mm

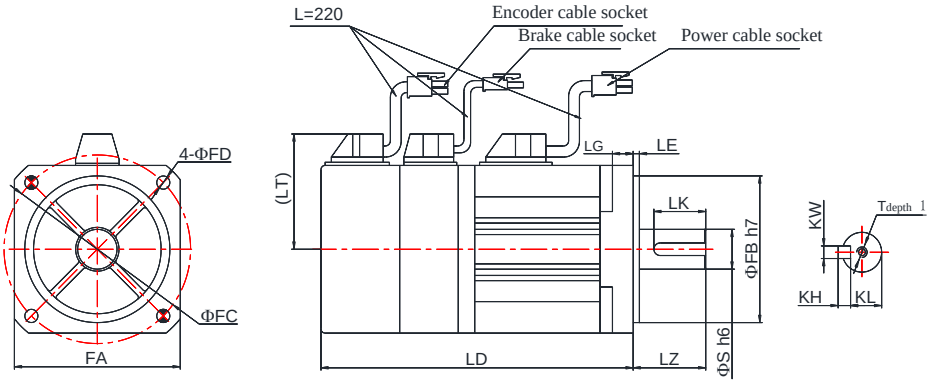
9.4 Servo motor dimensions

9.4.1 SER series 60, 80, 86 flange servo motor dimensions



Motor specifications and models	LD (mm)	FA (mm)	FB (mm)	FC (mm)	FD (mm)	LZ (mm)	LK (mm)	LE (mm)	LG (mm)	LH (mm)	S (mm)	KL (mm)	KH (mm)	kW (mm)	T (mm)	Mass (kg)
SER06-0R2-30-2□A□□	113.5 (147)	60	50	70	5.5	30	22.5	3	8	44	14	11	5	5	M5	1.01 (1.40)
SER06-0R4-30-2□A□□	134 (168)	60	50	70	5.5	30	22.5	3	8	44	14	11	5	5	M5	1.37 (1.78)
SER08-0R7-30-2□A□□	141.5 (173)	80	70	90	6.5	35	25	3	8	55	19	15.5	6	6	M5	2.47 (3.33)
SER08-0R7-20-2□A□□	171.5 (203)	80	70	90	6.5	35	25	3	8	55	19	15.5	6	6	M5	3.40 (4.10)
SER08-1R0-30-2□A□□	171.5 (203)	80	70	90	6.5	35	25	3	8	55	19	15.5	6	6	M5	3.40 (4.10)
SER09-0R7-30-2□B□□	148 (183)	86	80	100	6.5	35	25	3	9	58	16	13	5	5	M5	3.24 (3.94)

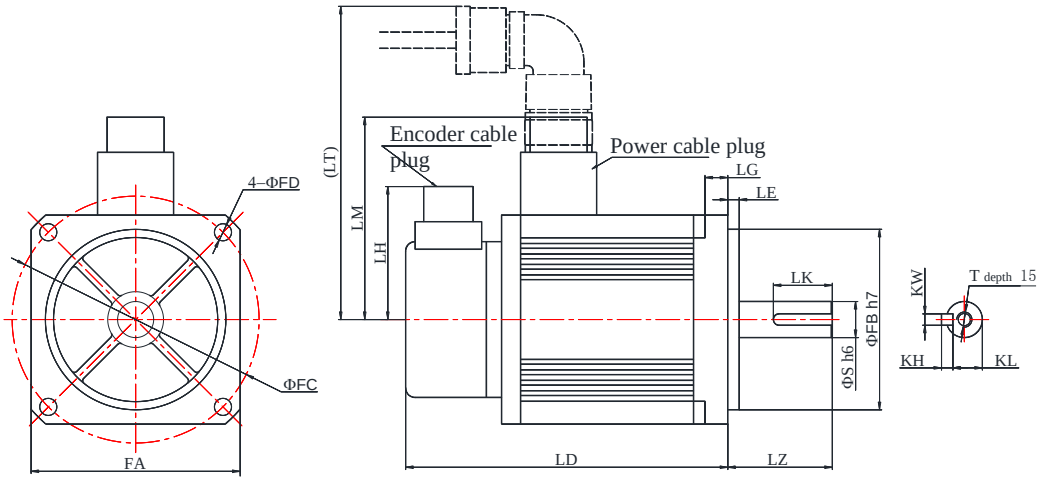
9.4.1 SES series 40, 60, 80 flange servo motor dimensions



Motor specifications and models	LD (mm)	FA (mm)	FB (mm)	FC (mm)	FD (mm)	LZ (mm)	LK (mm)	LE (mm)	LG (mm)	LT (mm)	S (mm)	KL (mm)	KH (mm)	kW (mm)	T (mm)	Mass (kg)
SES04-005-30-2□AY□	86.5 (119.5)	40	30	46	4.5	25.5	14	3	8	37	8	6.3	3	3	M3	0.4 (0.6)
SES04-0R1-30-2□AY□	100.5 (133.5)	40	30	46	4.5	25.5	14	3	8	37	8	6.3	3	3	M3	0.47 (0.67)
SES06-0R2-30-2□BY□	93.7 (120.2)	60	50	70	4.5	30	20	3	8	48	11	8.5	4	4	M4	1.01 (1.40)
SES06-0R4-30-2□BY□	110.7 (137.2)	60	50	70	4.5	30	25	3	8	48	14	11	5	5	M5	1.37 (1.78)
SES08-0R7-30-2□BY□	122.4 (150.6)	80	70	90	6.3	35	25	3	10	58	19	15.5	6	6	M5	2.4 (2.8)
SES08-1R0-30-2□BY□	136.4 (164.6)	80	70	90	6.3	35	25	3	10	58	19	15.5	6	6	M5	3.0 (3.4)

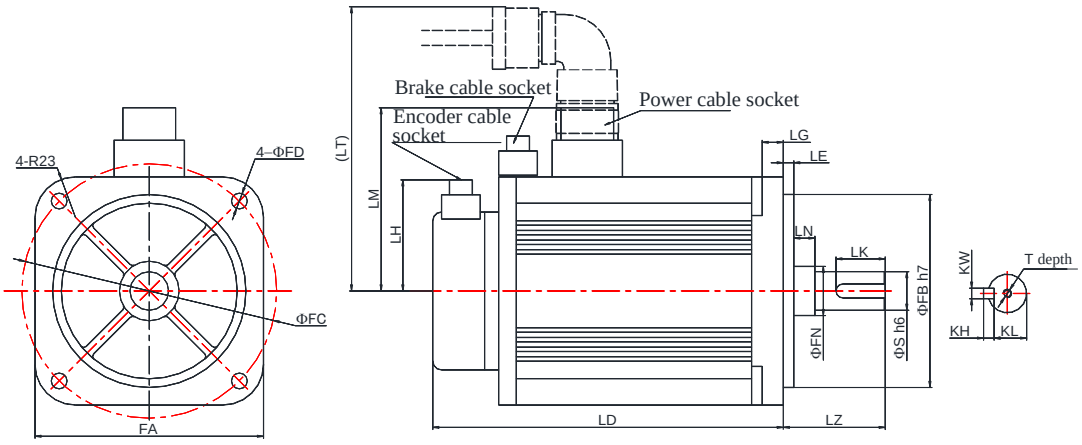
Note: SES04 motor has only two mounting holes shown in the shadow in the figure.

9.4.2 **SER series 110, 130 flange servo motor dimensions**



Motor specifications and models	LD (mm)	FA (mm)	FB (mm)	FC (mm)	FD (mm)	LZ (mm)	LK (mm)	LE (mm)	LG (mm)	LH (mm)	LM (mm)	LT (mm)	S	KL	KH	kW	T	Mass (kg)
SER11-0R6-30-2□B□□	155.5 (210.5)	110	95	130	9	55	31	6	9	-	107	176	19	15.5	6	6	M6	3.93 (5.39)
SER11-1R0-20-2□B□□	205.5 (260.5)	110	95	130	9	55	31	6	9	-	107	176	19	15.5	6	6	M6	6.42 (7.88)
SER11-1R2-30-2□B□□	185.5 (240.5)	110	95	130	9	55	31	6	9	-	107	176	19	15.5	6	6	M6	5.46 (6.92)
SER11-1R8-30-2□B□□	218.5 (273.5)	110	95	130	9	55	31	6	9	-	107	176	19	15.5	6	6	M6	7.26 (8.72)
SER13-0R7-20-2□C□□	150 (205)	130	110	145	9	58	45	6	12	-	117	186	22	18	7	8	M6	5.20 (6.90)
SER13-1R0-10-2□B□□	215 (270)	130	110	145	9	58	45	6	12	-	117	186	22	18	7	8	M6	10.12 (11.67)
SER13-1R0-20-2□B□□	165 (220)	130	110	145	9	58	45	6	12	-	117	186	22	18	7	8	M6	6.41 (7.94)
SER13-1R0-30-2□B□□	150 (205)	130	110	145	9	58	45	6	12	-	117	186	22	18	7	8	M6	5.31 (6.89)
SER13-1R5-10-□□B□□	265 (320)	130	110	145	9	58	45	6	12	-	117	186	22	18	7	8	M6	13.82 (15.40)
SER13-1R5-20-□□B□□	185 (240)	130	110	145	9	58	45	6	12	-	117	186	22	18	7	8	M6	7.89 (9.43)
SER13-1R5-30-□□B□□	165 (220)	130	110	145	9	58	45	6	12	-	117	186	22	18	7	8	M6	6.40 (7.96)
SER13-2R0-20-3□B□□	215 (270)	130	110	145	9	58	45	6	12	-	117	186	22	18	7	8	M6	10.12 (11.67)
SER13-2R0-30-3□B□□	185 (240)	130	110	145	9	58	45	6	12	-	117	186	22	18	7	8	M6	7.85 (9.47)
SER13-3R0-20-3□B□□	265 (320)	130	110	145	9	58	45	6	12	-	117	186	22	18	7	8	M6	13.81 (15.34)
SER13-3R0-30-3□B□□	215 (270)	130	110	145	9	58	45	6	12	-	117	186	22	18	7	8	M6	10.12 (11.67)

9.4.3 SES series 130, 180 flange servo motor dimensions



Motor specifications and models	LD (mm)	FA (mm)	FB (mm)	FC (mm)	FD (mm)	LZ (mm)	LK (mm)	LE (mm)	LG (mm)	LH (mm)	LM (mm)	LT (mm)	LN (mm)	FN (mm)	S (mm)	KL (mm)	KH (mm)	kW (mm)	T (mm)	Mass (kg)
SES13-0R8-15-3FBY□	150.9 (183.4)	130	110	145	9	58	27.5	6	12	63.3	105	230	12	28	19	16	5	5	M5	5.83 (17.8)
SES13-1R3-15-3FBY□	166.9 (199.4)	130	110	145	9	58	28	6	12	63.3	105	230	12	28	22	18.5	6	6	M5	7.25 (9.3)
SES13-1R8-15-3FBY□	184.9 (217.4)	130	110	145	9	58	29	6	12	63.3	105	230	12	28	24	20	8	8	M5	8.8 (10.8)
SES18-2R9-15-3FBY□	173.3 (231)	180	114.3	200	13.5	79	65	3.2	18	63.3	135.5	230	0	35	35	30	8	10	M12	13 (19.5)
SES18-3R6-20-3FBY□	197.3 (324)	180	114.3	200	13.5	79	65	3.2	18	63.3	135.5	230	0	35	35	30	8	10	M12	17.5 (24)
SES18-4R4-15-3FBY□	197.3 (324)	180	114.3	200	13.5	79	65	3.2	18	63.3	135.5	230	0	35	35	30	8	10	M12	17.5 (24)
SES18-5R5-15-3FBY□	236.3 (278)	180	114.3	200	13.5	113	96	3.2	18	114.3	145.5	230	0	42	42	37	10	12	M16	22 (27.8)
SES18-7R5-15-3FBY□	282.3 (324)	180	114.3	200	13.5	113	96	3.2	18	114.3	145.5	230	0	42	42	37	10	12	M16	29.5 (35)

9.5 Overload characteristics of servo motor

9.5.1 Definition of overload protection

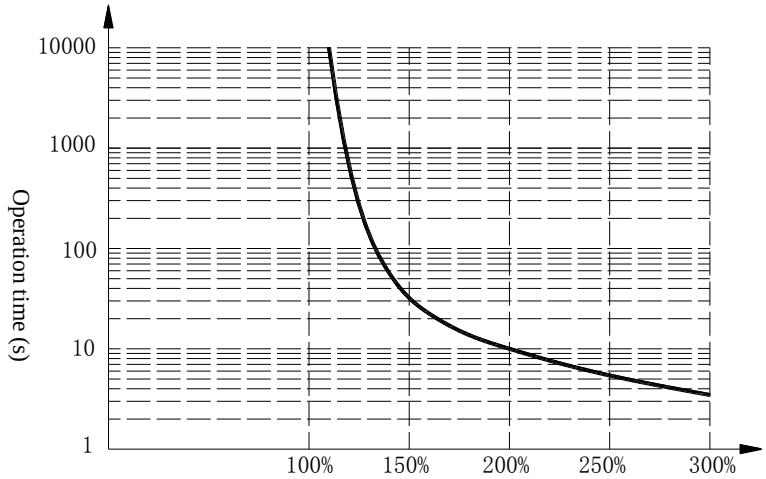
Overload protection of servo motor is a protection function to prevent motor overheating.

9.5.2 Reasons for overload of servo motor

1) The motor runs beyond the rated torque for too long.
2) The load and motor rotor inertia are too large, and acceleration and deceleration are too frequent.
3) Wrong wiring of motor power line or encoder
4) Improper gain setting of servo drive causes motor oscillation.
5) The motor with a brake is operated without enabling the brake.

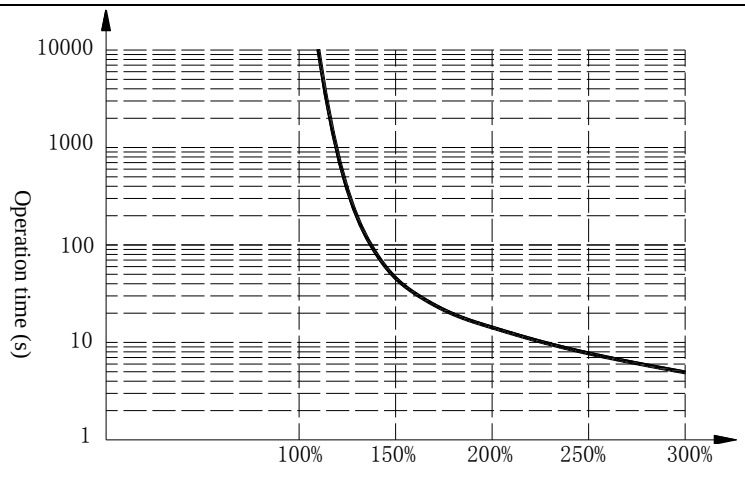
9.5.3 The Relationship between servo motor load and running time

40, 60, 80, 86 flange servo motors



Load rate (%)	Working hours (S)	
	40 Flange motor	60, 80, 86 Flange motor
120	235.5	327.3
140	31.4	44.0
160	15.7	22.0
180	10.0	14.0
200	7.1	10.0
220	5.4	7.6
240	4.3	6.0
260	3.5	4.9
280	2.9	4.1
300	2.5	3.5

110, 130, 180 flange servo motor



Load rate (%)	Working hours (S)	
	110, 130 Flange motor	180 Flange motor
120	471.1	608.8
140	62.9	81.2
160	31.4	40.6
180	20.0	25.8
200	14.3	18.5
220	10.9	14.1
240	8.6	11.1
260	7.0	9.0
280	5.9	7.8
300	5.0	6.4