Maxsine

EP5 Pulse series

AC servo driver

Operating Instructions

(2nd edition)

Driver TL04/TL08/TL10/TL15/TL25/TL35/TL55/TH15
TH20/TH30/TH50/TH75/TH90/TH110/TH150

Wuhan Maxsine Electric Co., Ltd

DECLARATION

There will not be extra notice if the specification or size of products is changed because of improvement etc.

Safety Precautions

In order to ensure proper use of this product safely, the user should be familiar with and observes the following important items before proceeding with storage, installation, wiring, running, inspection or maintenance for the product.

⚠ Danger	Indicates a disoperation possibly can cause danger and physical injury or death.
⚠ Caution	Indicates a disoperation possibly can cause danger and physical injure, and may result in damage to the product.
⊘ Stop	Indicates a prohibited actions, otherwise can cause damage, malfunction to the product.

1. Use occasions

⚠ Danger
● Do not expose the product in moisture, caustic gas, and ignitable gas situation. Otherwise can cause an electric shock or fire. ● Do not use the product in direct-sunlight, dust, salinity and metal powder places. ● Do not use the product in the places that has water, oil and drugs drops.

2. Wiring

⚠ Danger
● Connect the earth terminal (PE) to earth reliably, otherwise can cause an electric shock or fire. ● Do not connect the 220V driver to 380V power supply. Otherwise it will cause equipment damage, electric shock or fire. ● Do not connect the servo motor output terminals (U, V, W) to 3 phase AC power supply, otherwise can cause personnel casualty or fire. ● The output terminals (U, V, W) must be connected with the servo motor connections (U, V, W) correspondently, otherwise can result in the motor flying speed that may cause equipment damage and the personnel casualty. ● Please fasten the input power terminals (L1, L2, and L3) and the output terminals (U, V, W). Otherwise may cause fire. ● Please refer to the wire material to select the wiring, otherwise it may cause fire.

3. Operation

⚠ Caution
● Before operating the mechanical device, it is necessary to set the parameters with appropriate values. Otherwise, can cause the mechanical device to out of control or break down. ● Before running the mechanical device, make sure the emergency stop switch can work at any time. ● Performing trial run without load, make sure that the motor is in normal operation. Afterwards joins again the load. ● Please do not turn on and off the main power supply more frequently, otherwise can cause the servo driver overheat.

4. Running

⊘ Stop
● Do not touch any moving parts of the mechanical device while the motor is running, otherwise can cause personnel casualty. ● Do not touch the driver or motor when the device is running, otherwise it may cause electric shock or burn. ● Do not move the cables when the device is running. Otherwise, personnel may be injured or the device may be damaged.

5. Maintenance and inspection

⊘ Stop
● Do not touch any portion inside of the driver and motor, otherwise it will cause electric shock. ● Do not remove the front cover of the servo driver while power is on, otherwise can cause an electric shock. ● Please wait at least 5 minutes after power has been removed before touching any terminal, otherwise the remaining high voltage possibly can cause an electric shock. ● Do not change the wiring while the power is on, otherwise can cause an electric shock. ● Do not disassemble the motor, otherwise can cause an electric shock.

6. Service range

⚠ Caution
The products involved in this manual are for general industrial use. Do not use them on devices that may directly endanger personal safety, such as nuclear power devices, aerospace equipment, life support and maintenance equipment, and other safety equipment. If you need the above, please contact our company.

CONTENTS

Chapter 1 Product inspection and installation

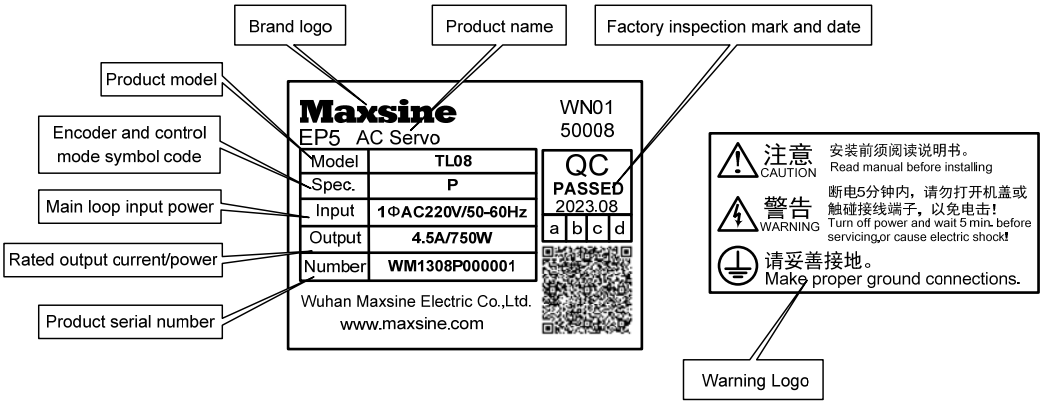
1.1 Product inspection

This product has undergone a complete functional test before delivery. In order to prevent the product from being abnormal due to negligence during the delivery process, please inspect the following items in detail after unpacking:

- Inspect whether the models of the servo driver and servo motor are the same as those ordered.
- Inspect whether the appearance of the servo driver and servo motor is damaged or scratched. When damage is caused during transportation, please do not connect wires for power transmission.
- Inspect whether the servo driver and servo motor are loose. Whether there are loose screws, whether the screws are not locked or fall off.
- Inspect whether the rotor shaft of the servo motor can rotate smoothly by hand. The motor with brake cannot rotate directly.

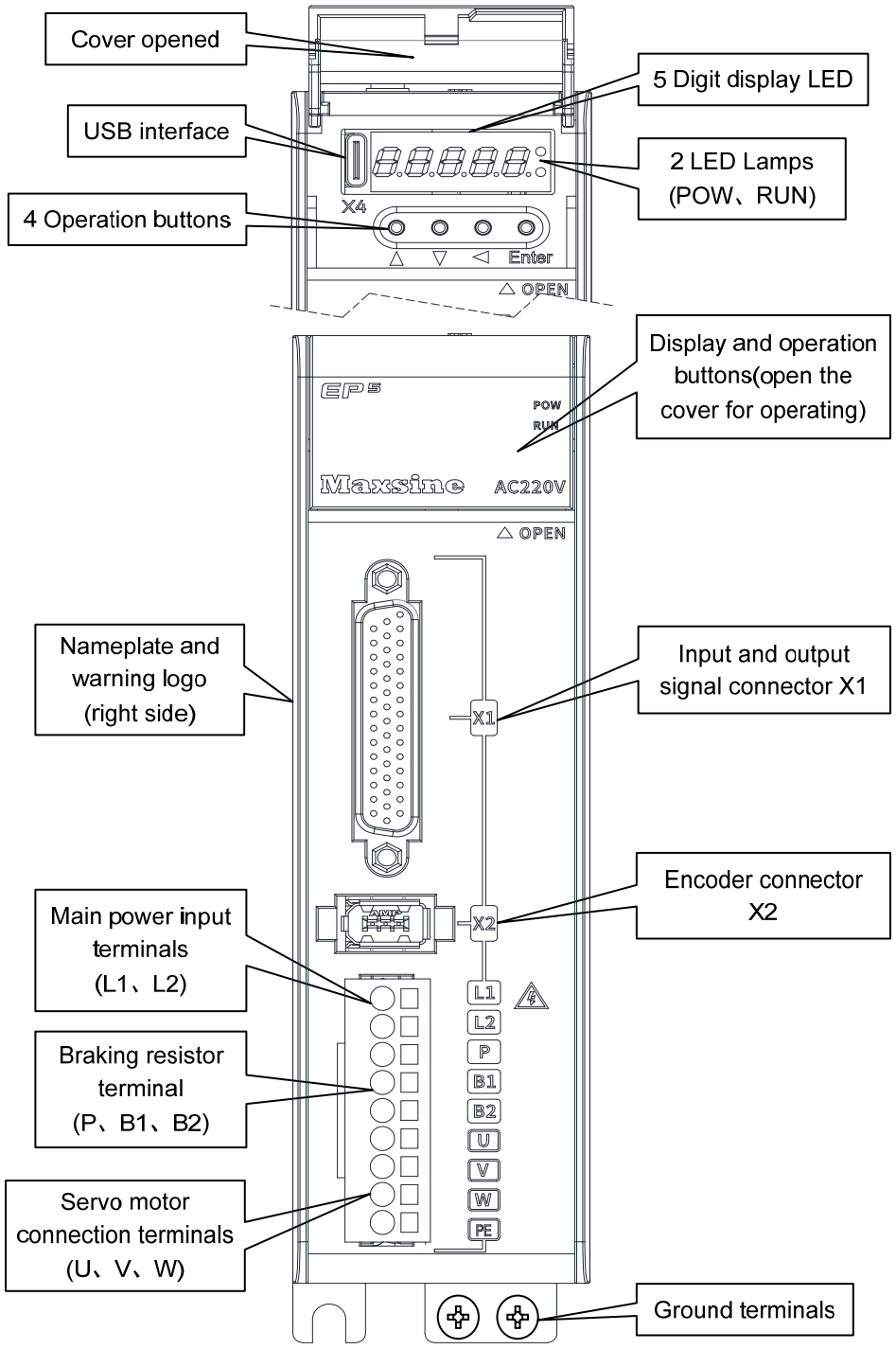
  If the above items have faults or abnormal phenomena, please contact the dealer immediately.

1.2 Product nameplate

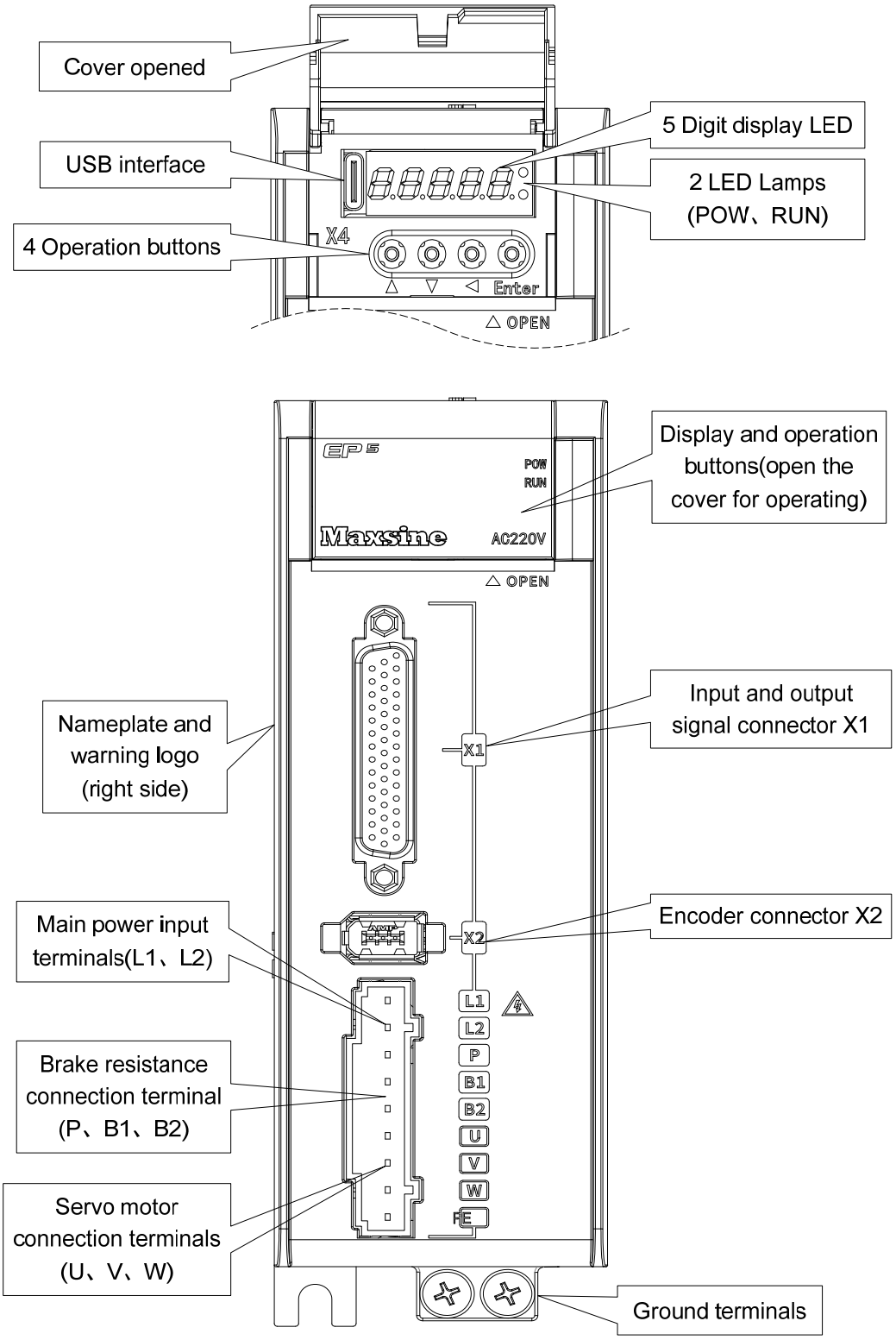


1.3 Product front panel

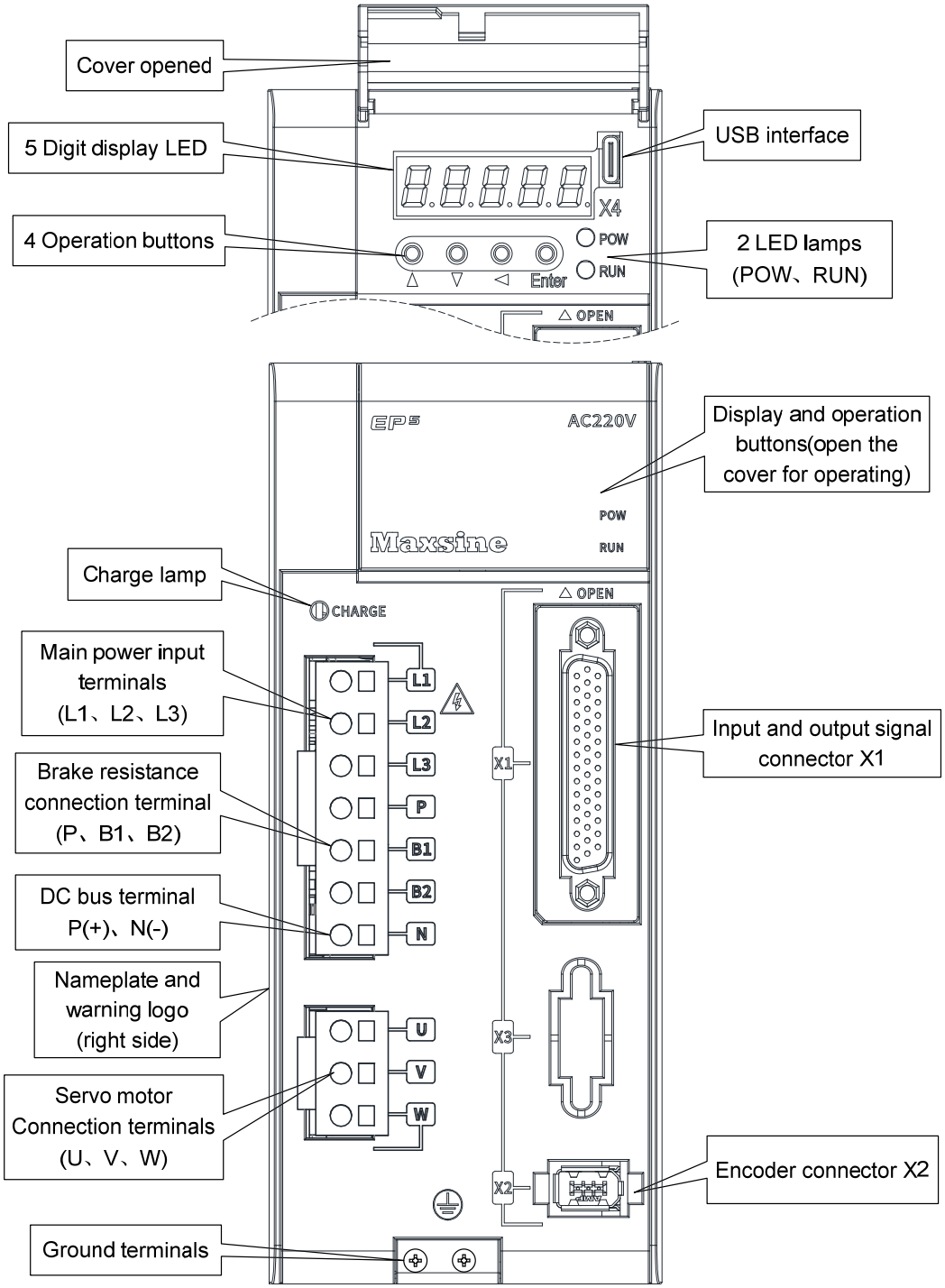
Applicable models: TL04、TL08



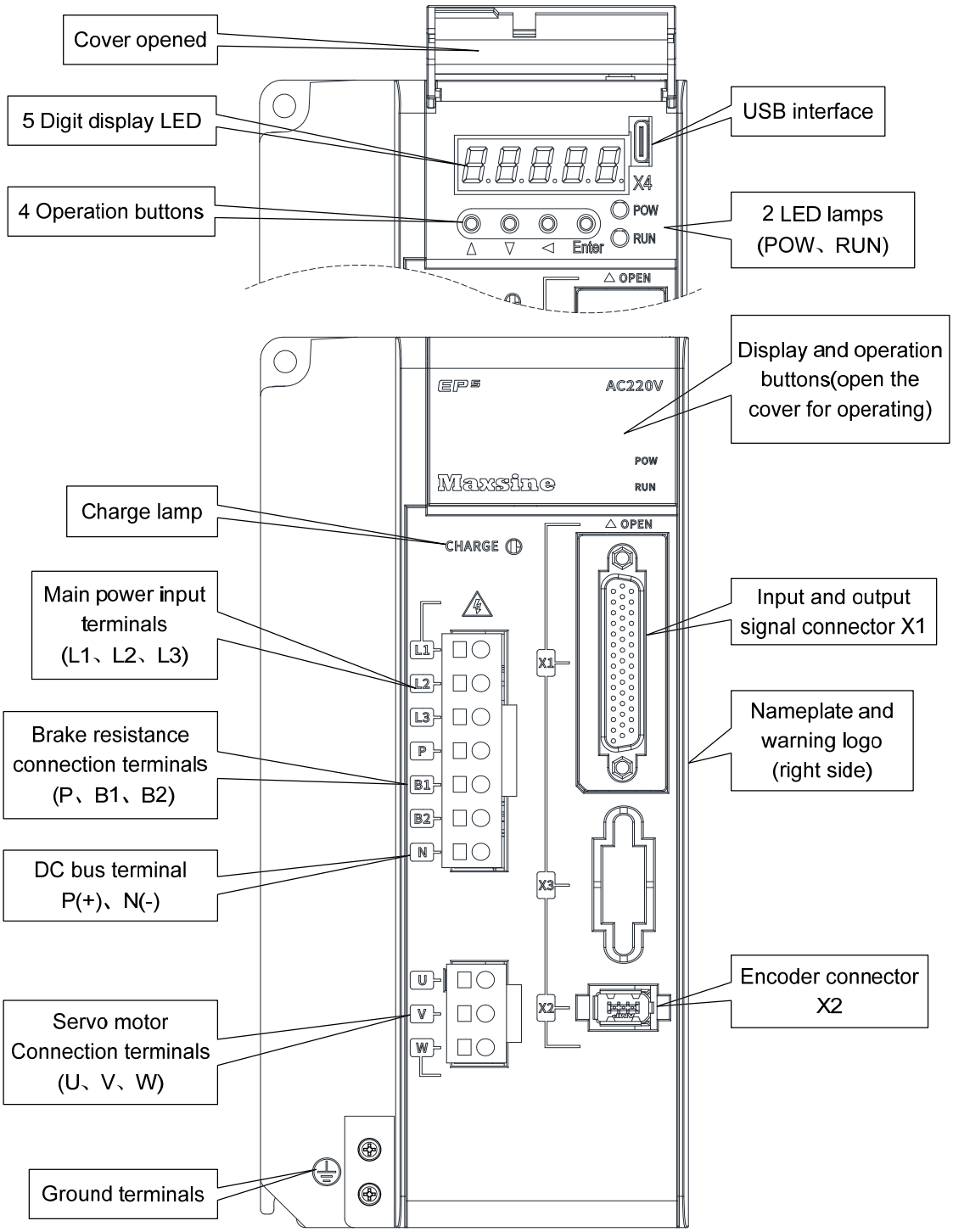
Applicable model: TL10



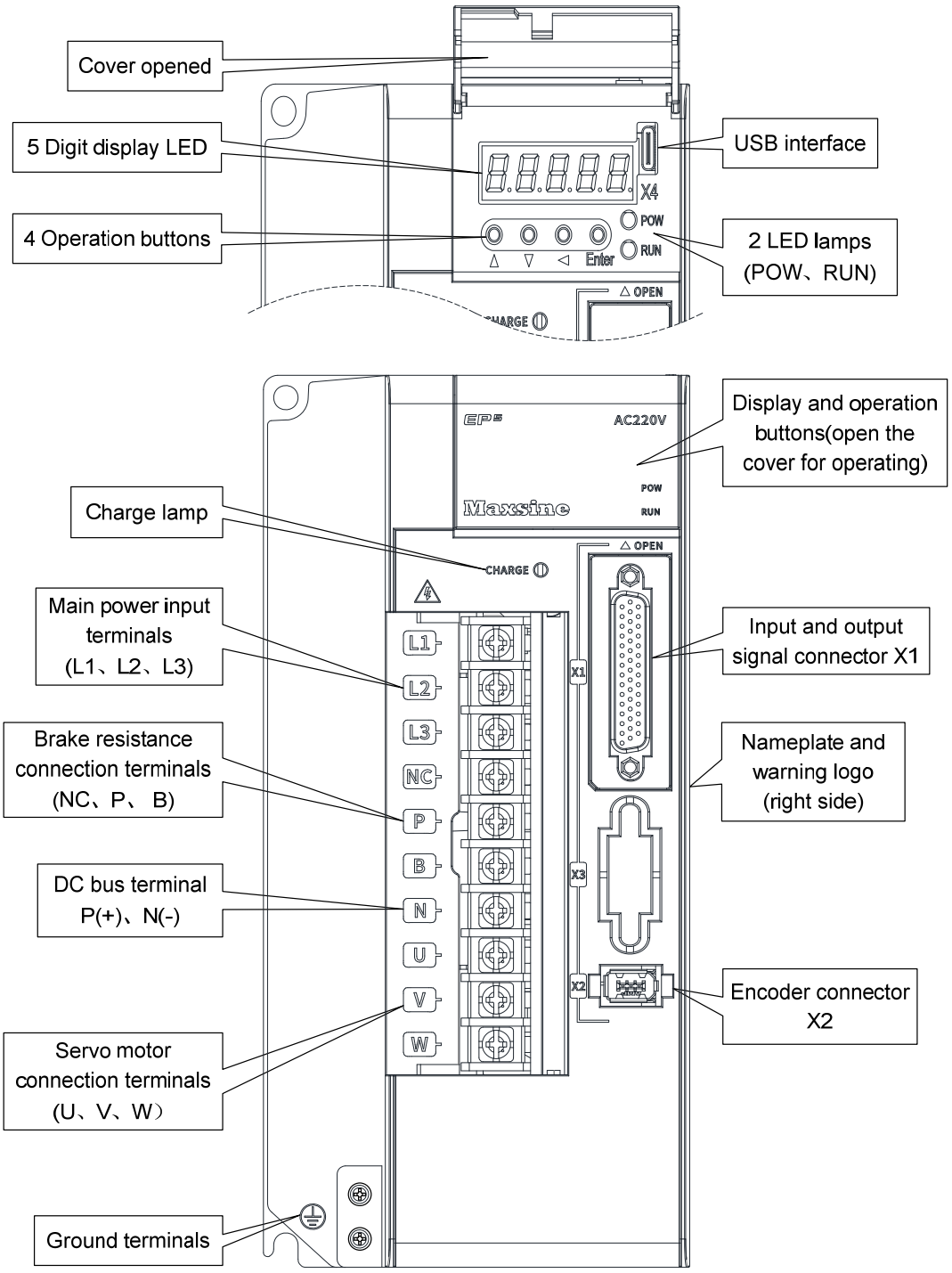
Applicable model: TL15



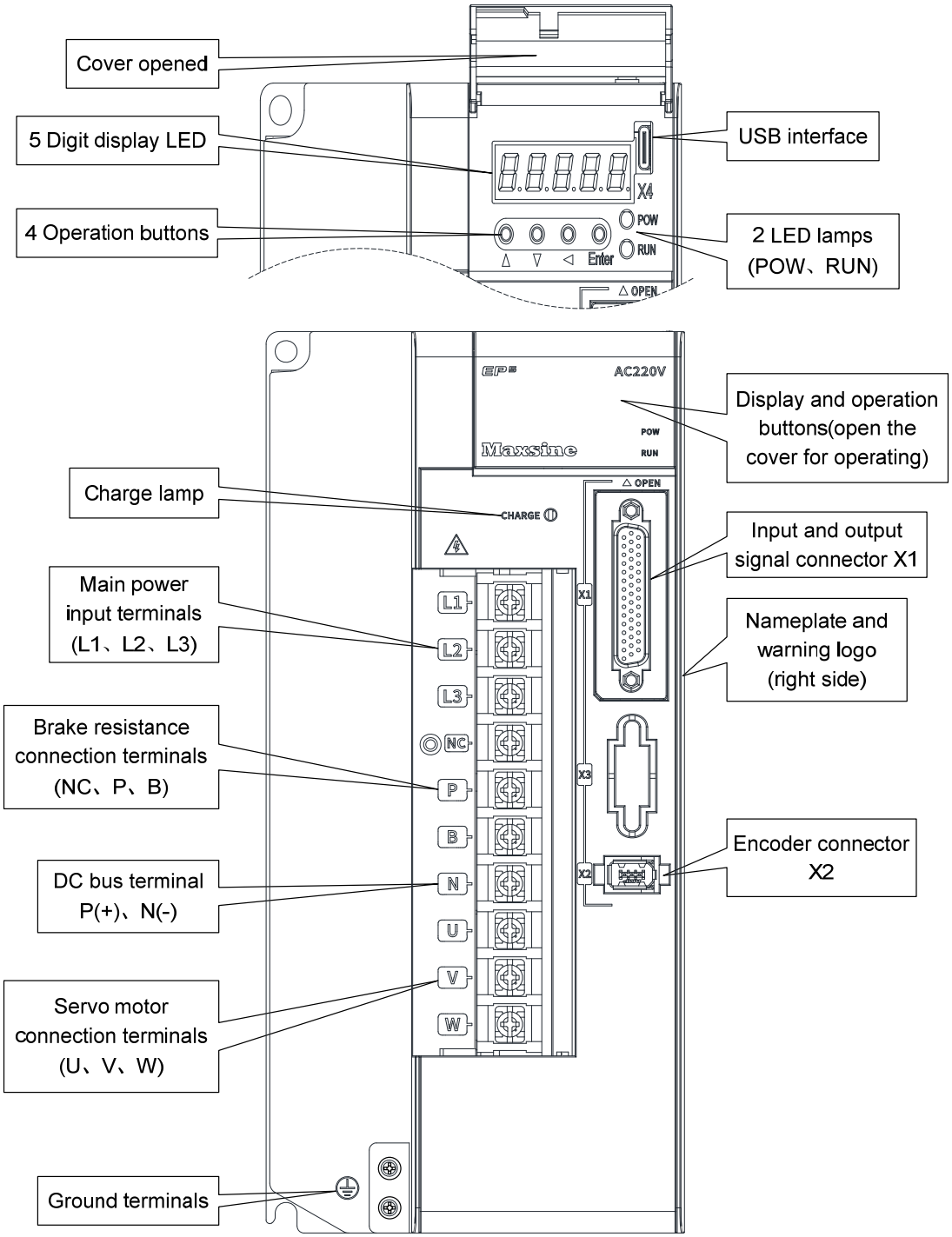
Applicable model: TL25



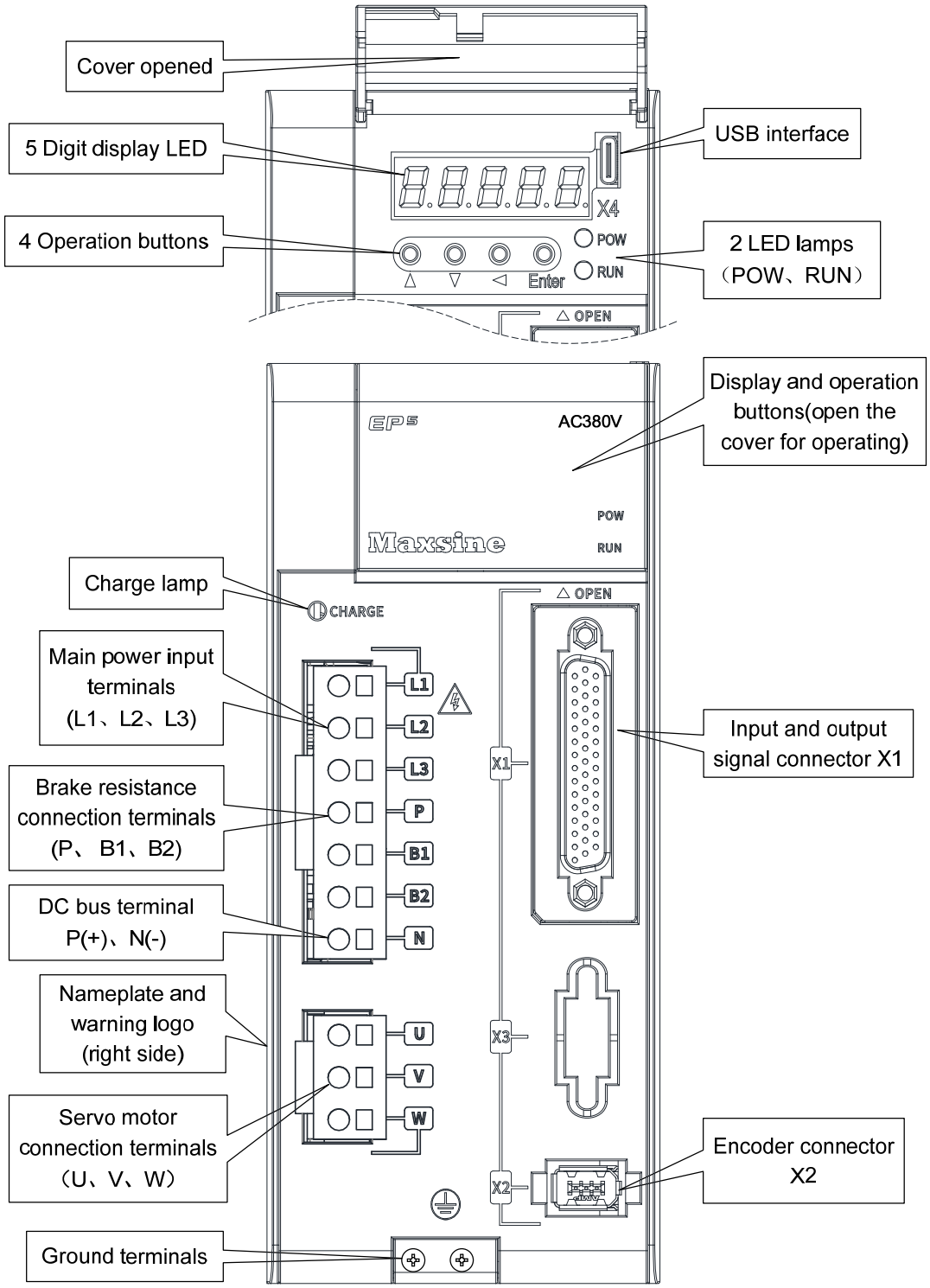
Applicable model: TL35



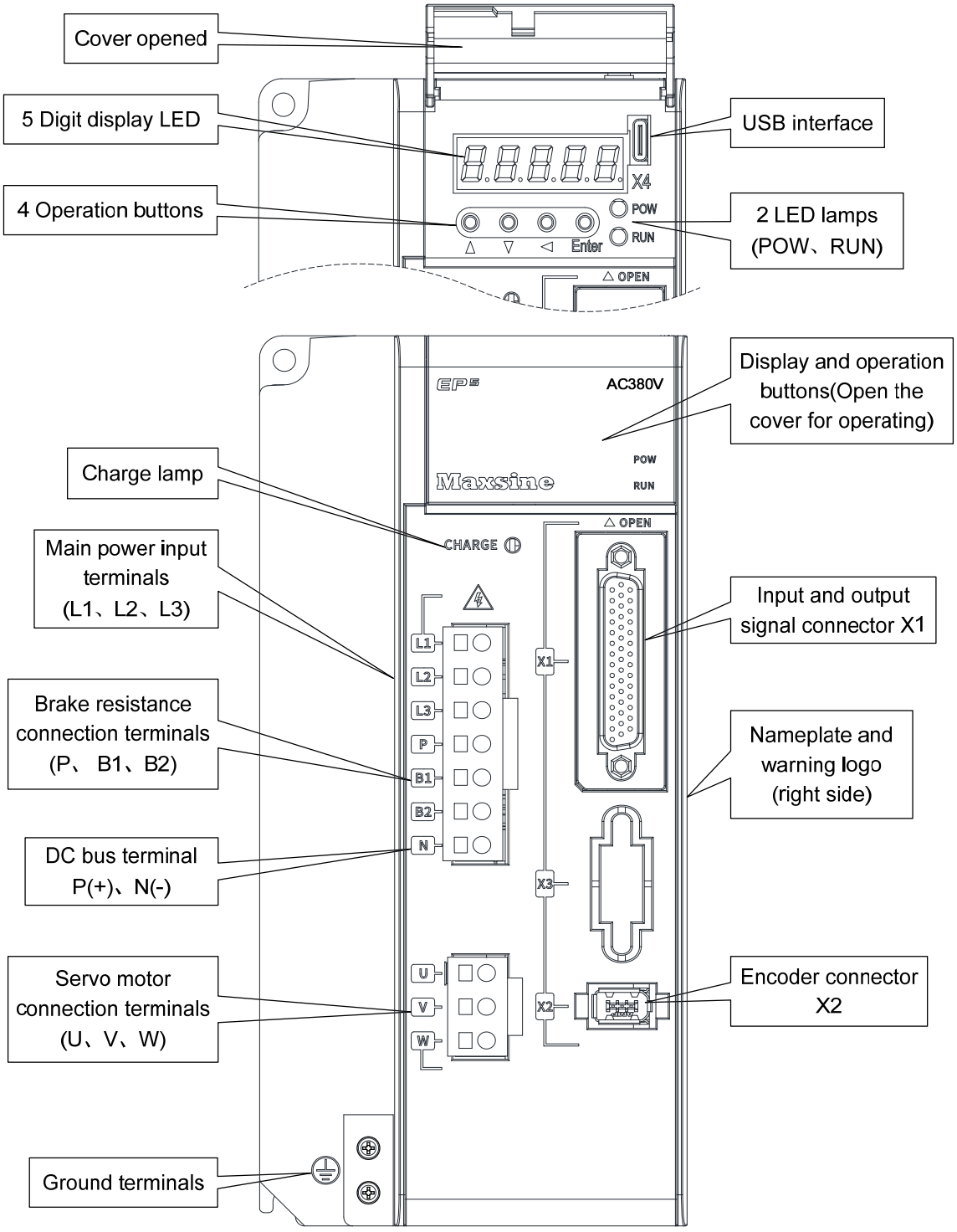
Applicable model: TL55



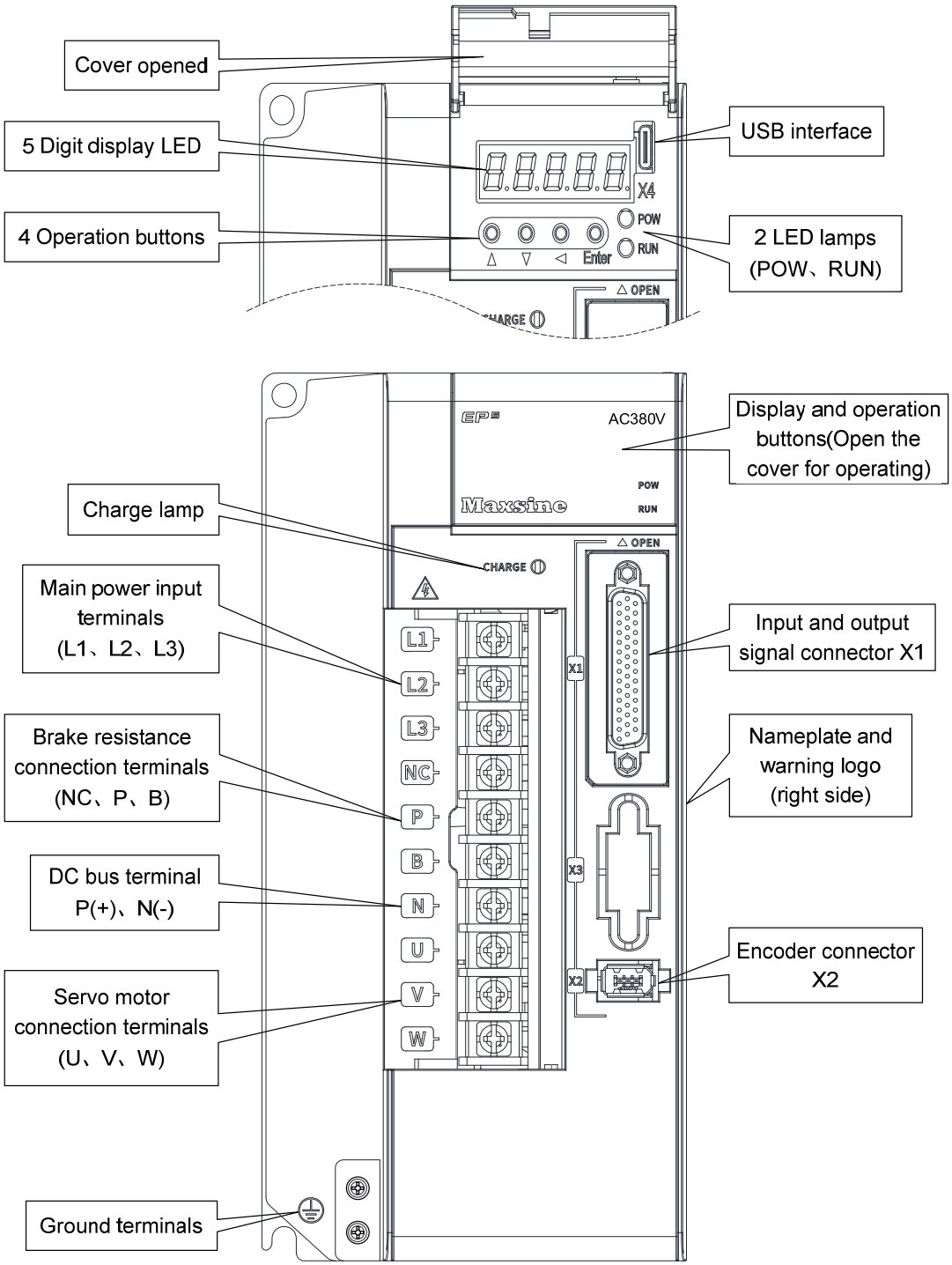
Applicable model: TH15



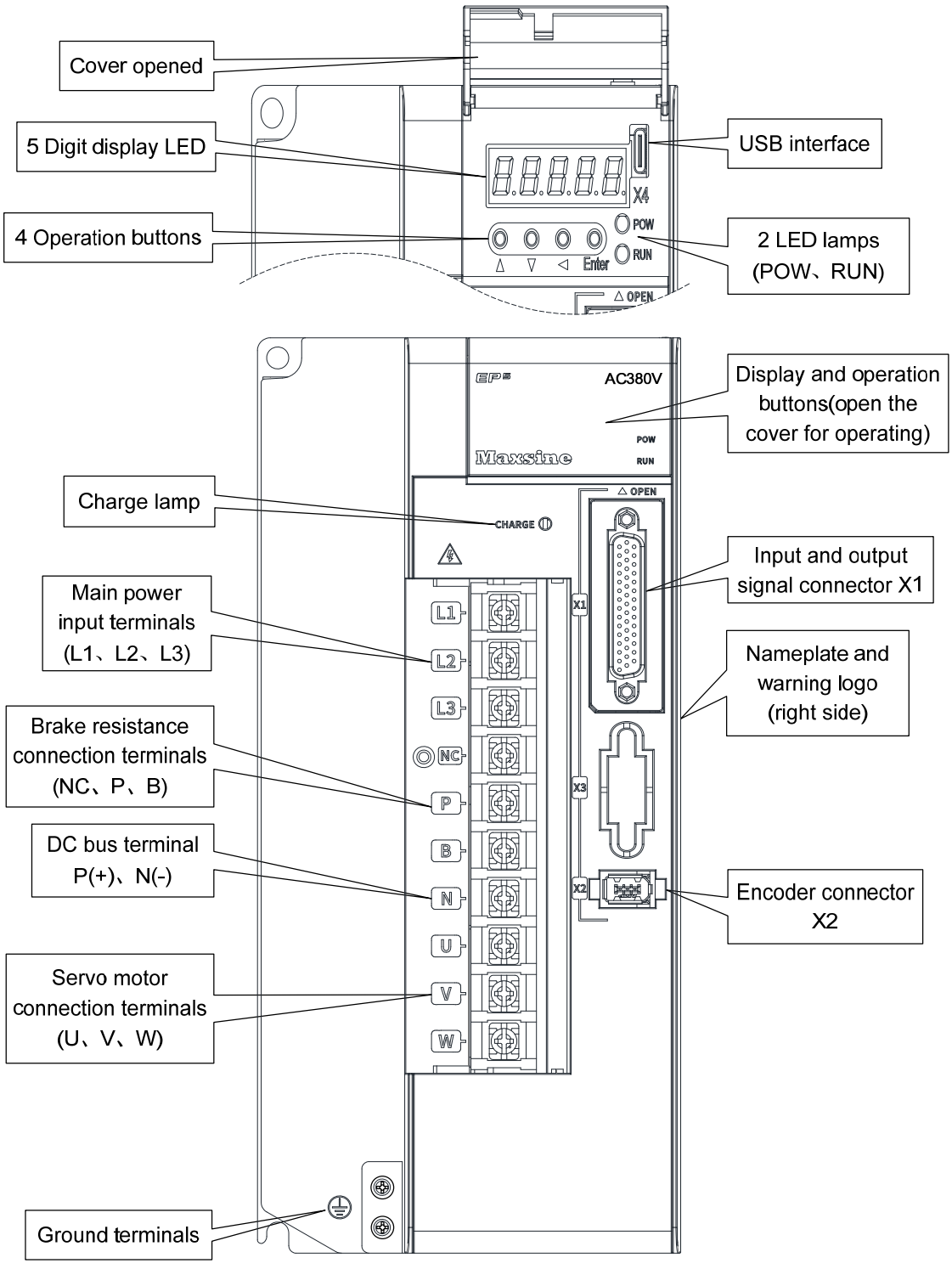
Applicable model: TH20



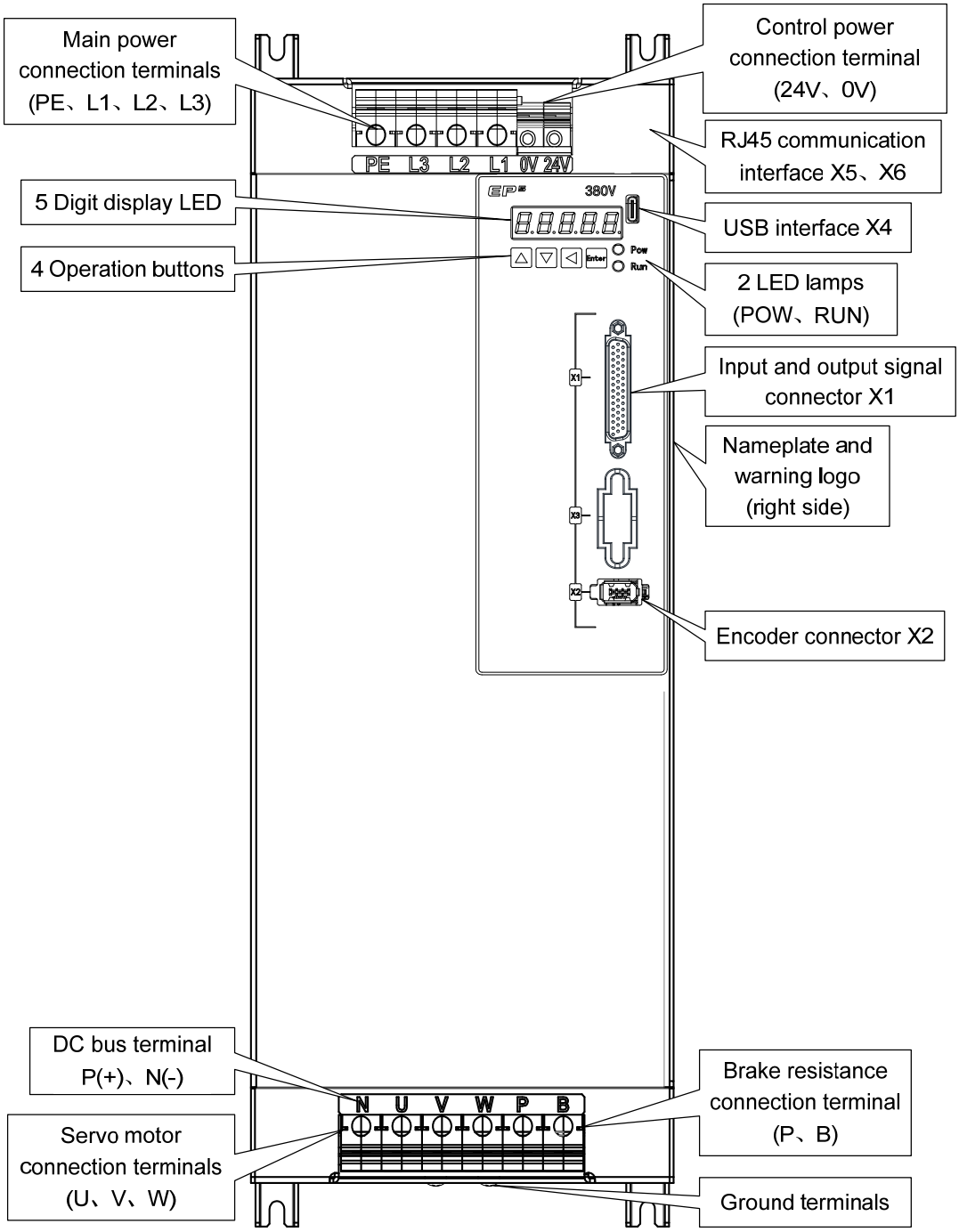
Applicable model: TH30



Applicable models: TH50、TH75



Applicable model: TH90、TH110、TH150



1.4 Servo driver installation

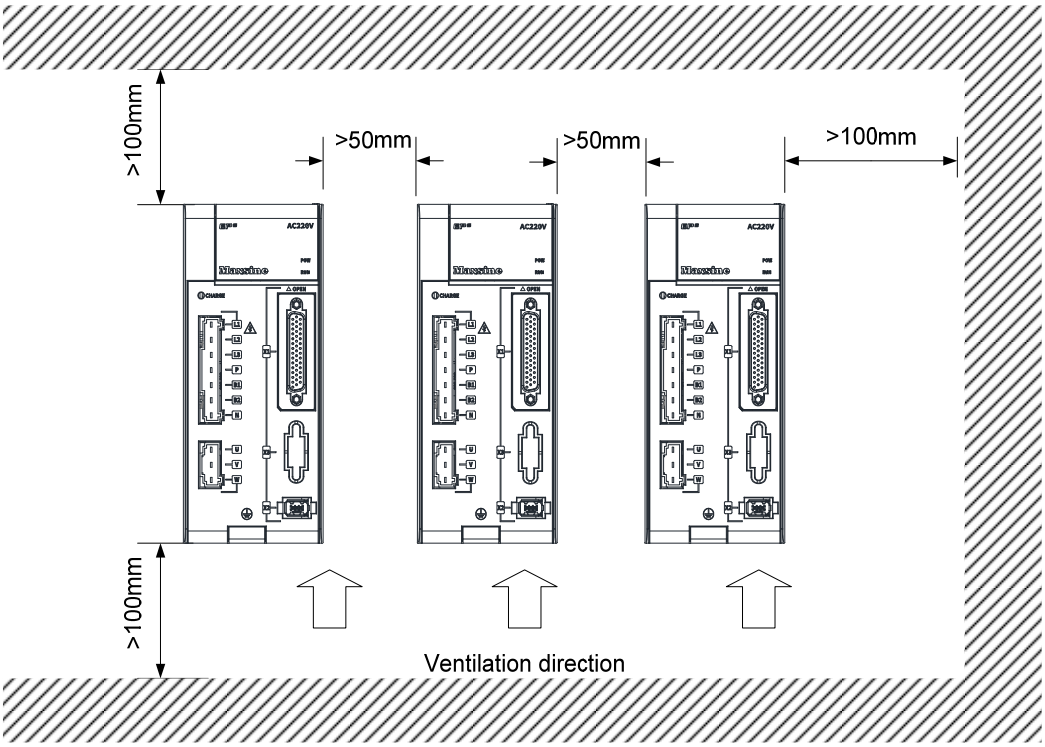
1.4.1 Installation environmental conditions

Since the environment conditions for servo driver installation have the direct influence to the normal function and service life of the servo driver, therefore the environment conditions must be conformed to the following conditions:

- Ambient temperature: 0～40℃; Ambient humidity: below 40%～80% (no dew).
- Storage temperature: -40～50℃; Storage humidity: below 93% (no dew).
- Vibration: below 0.5G.
- Prevent rain dripping or humid environment.
- Avoid direct sunlight.
- Prevent oil mist and salt erosion.
- Prevent corrosive liquid and gas erosion.
- Prevent dust, cotton wadding and metal debris from invading.
- Keep away from radioactive substances and combustibles.
- When several drivers are installed in the control cabinet, please note that enough space should be reserved for placement to facilitate air flow and heat dissipation. Please additionally configure a cooling fan to reduce the temperature around the servo driver. The long-term safe working temperature is below 40 ℃.
- When there is a vibration source nearby (such as a punch press), if it is unavoidable, please use a vibration absorber or install anti vibration rubber gaskets.
- When there is interference equipment nearby, there is interference to the power line and control line of the servo driver, which may cause the driver to malfunction. Noise filter and other anti-interference measures can be added to ensure the normal operation of the driver. However, the noise filter will increase the leakage current, so it is necessary to install an isolation transformer on the power input end of the driver.

1.4.2 Installation method

- The normal installation direction of servo driver is vertical and upright, with the top facing up to facilitate heat dissipation.
- During installation, tighten the M5 fixing screws at the rear of the servo driver.
- The installation intervals between servo drivers and other equipment are shown in the figure. In order to ensure the service performance and service life of the driver, please leave sufficient installation intervals as far as possible.
- A cooling fan must be installed in the electrical control cabinet to ensure that the vertical wind dissipates heat to the radiator of the servo driver.
- When installing the electrical control cabinet, prevent dust or iron filings from entering the servo driver.



1.5 Servo motor installation

1.5.1 Installation environmental conditions

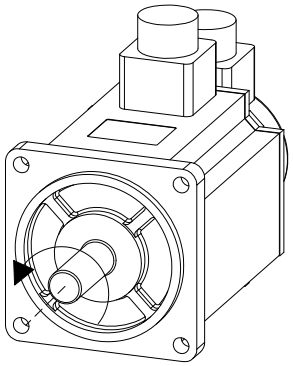
- Ambient temperature: 0～40℃; Ambient humidity: below 80 %(no dew).
- Storage temperature: -40～50℃; Storage humidity: below 80 %(no dew).
- Vibration: below 0.5G.
- Places with good ventilation and less moisture and dust.
- No corrosive, igniting gas, oil and gas, cutting fluid, cutting powder, iron powder and other environments.
- Places without water vapor and direct sunlight.

1.5.2 Installation method

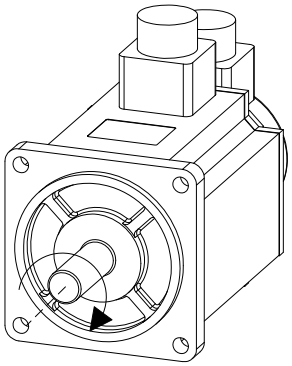
- Horizontal installation: to prevent water, oil and other liquids from flowing into the motor from the outlet end of the motor, please place the cable outlet below.
- Vertical installation: if the motor shaft is installed upward and the reducer is attached, pay attention to and prevent oil stains in the reducer from penetrating into the motor through the motor shaft.
- The extension of the motor shaft should be sufficient. If the extension is insufficient, it will easily cause vibration when the motor moves.
- When installing and disassembling the motor, do not knock the motor with a hammer, otherwise it is easy to cause damage to the motor shaft and encoder.

1.6 Motor rotation direction definition

The definition of rotation direction of the motor described in this manual: facing the motor shaft extension, counterclockwise rotation of the rotating shaft (CCW) is positive rotation, and clockwise rotation of the rotating shaft (CW) is reverse rotation.



Positive Rotation
(CCW)



Reversal Rotation
(CW)

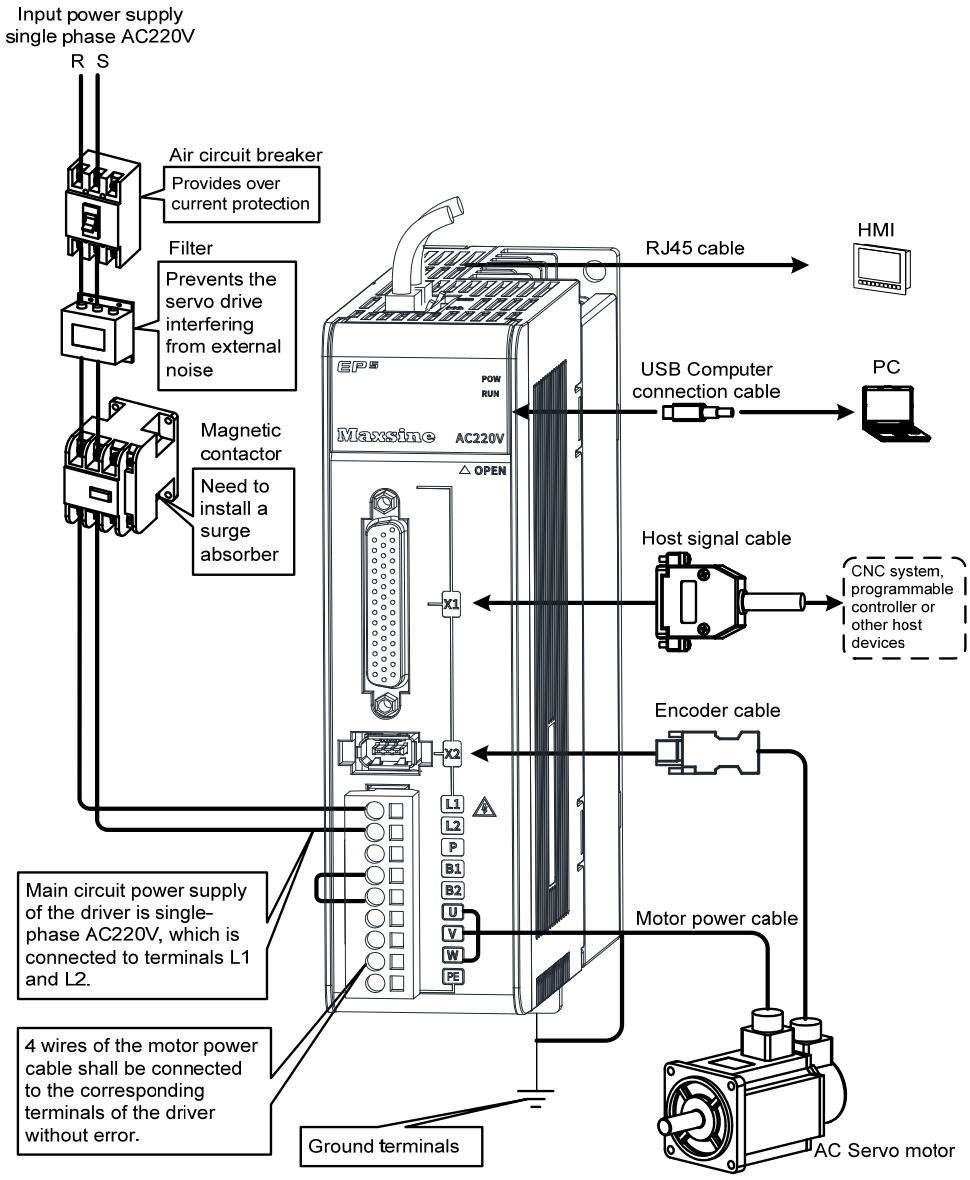
Chapter 2 Wiring

2.1 System construction and wiring

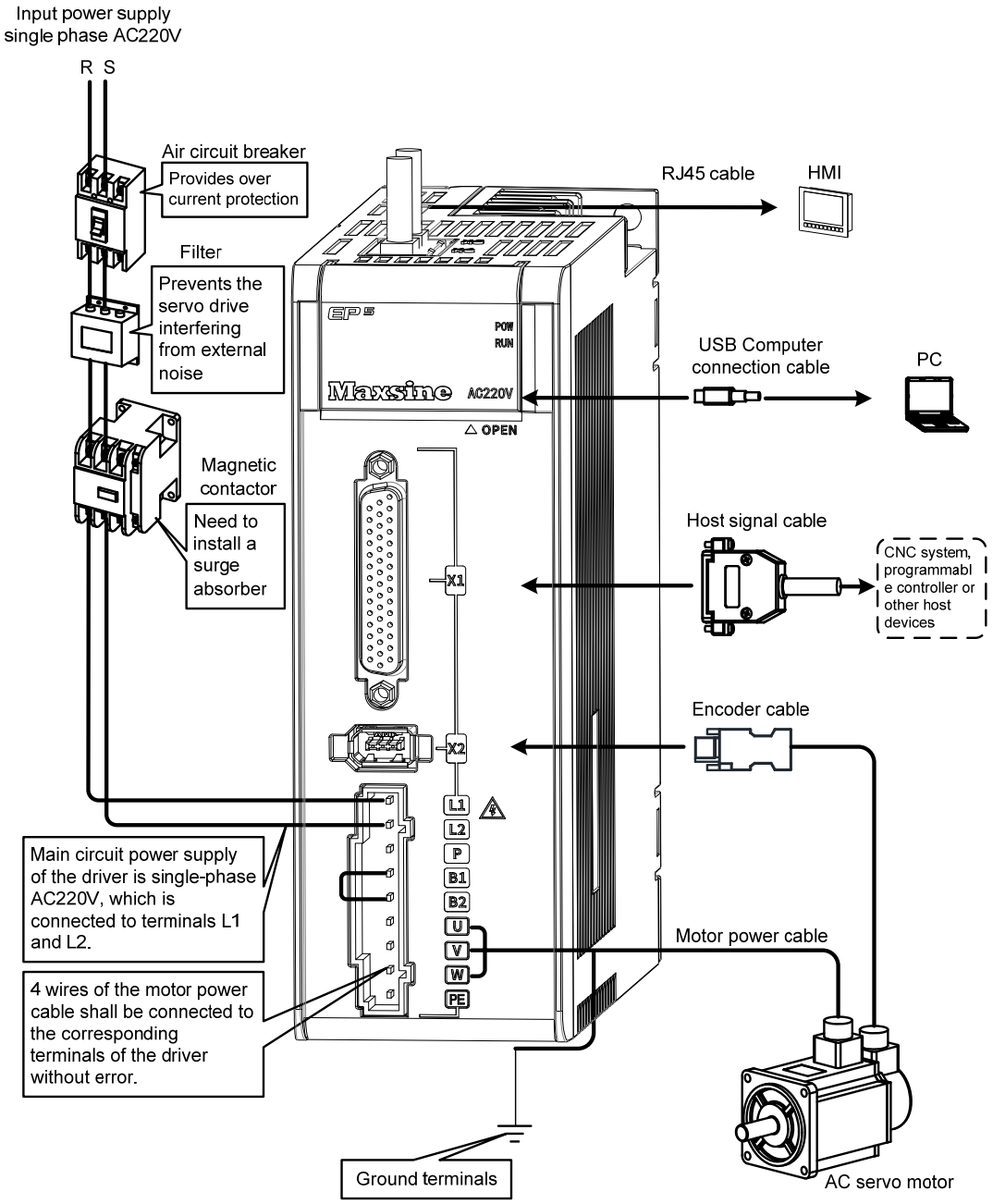
2.1.1 Servo driver wiring diagram

1. EP5-TL series servo driver wiring diagram

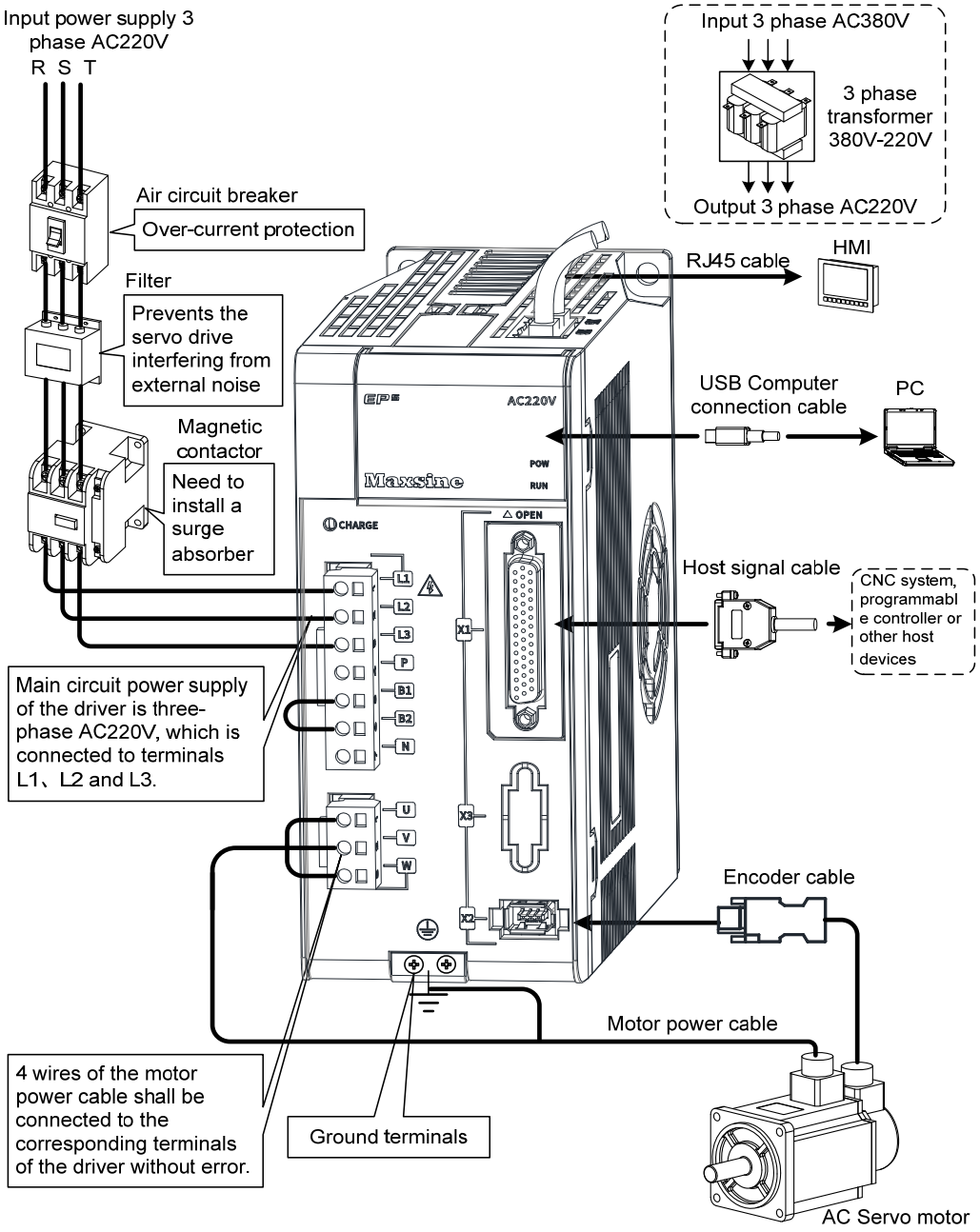
Applicable models: TL04、TL08



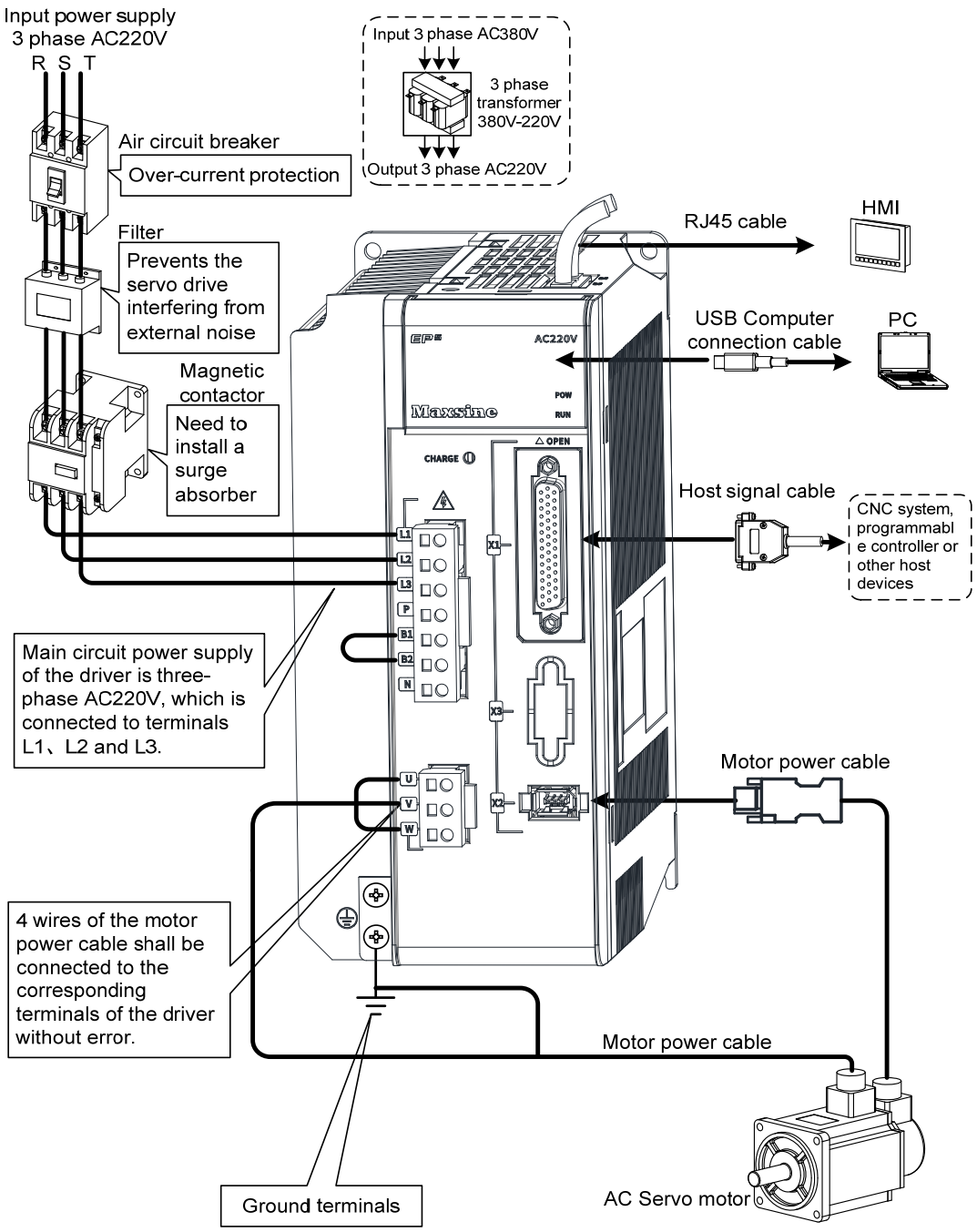
Applicable model: TL10



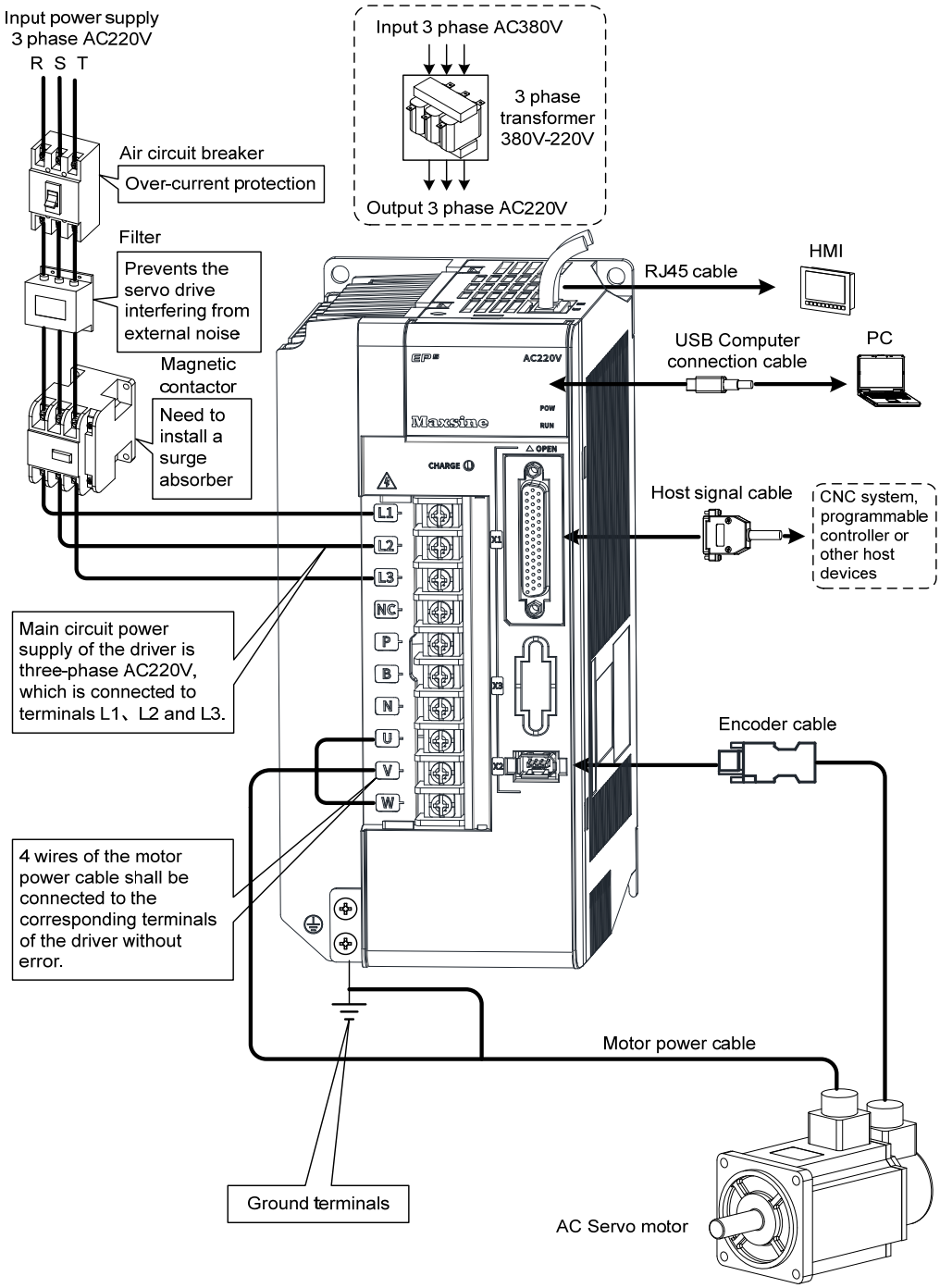
Applicable model: TL15



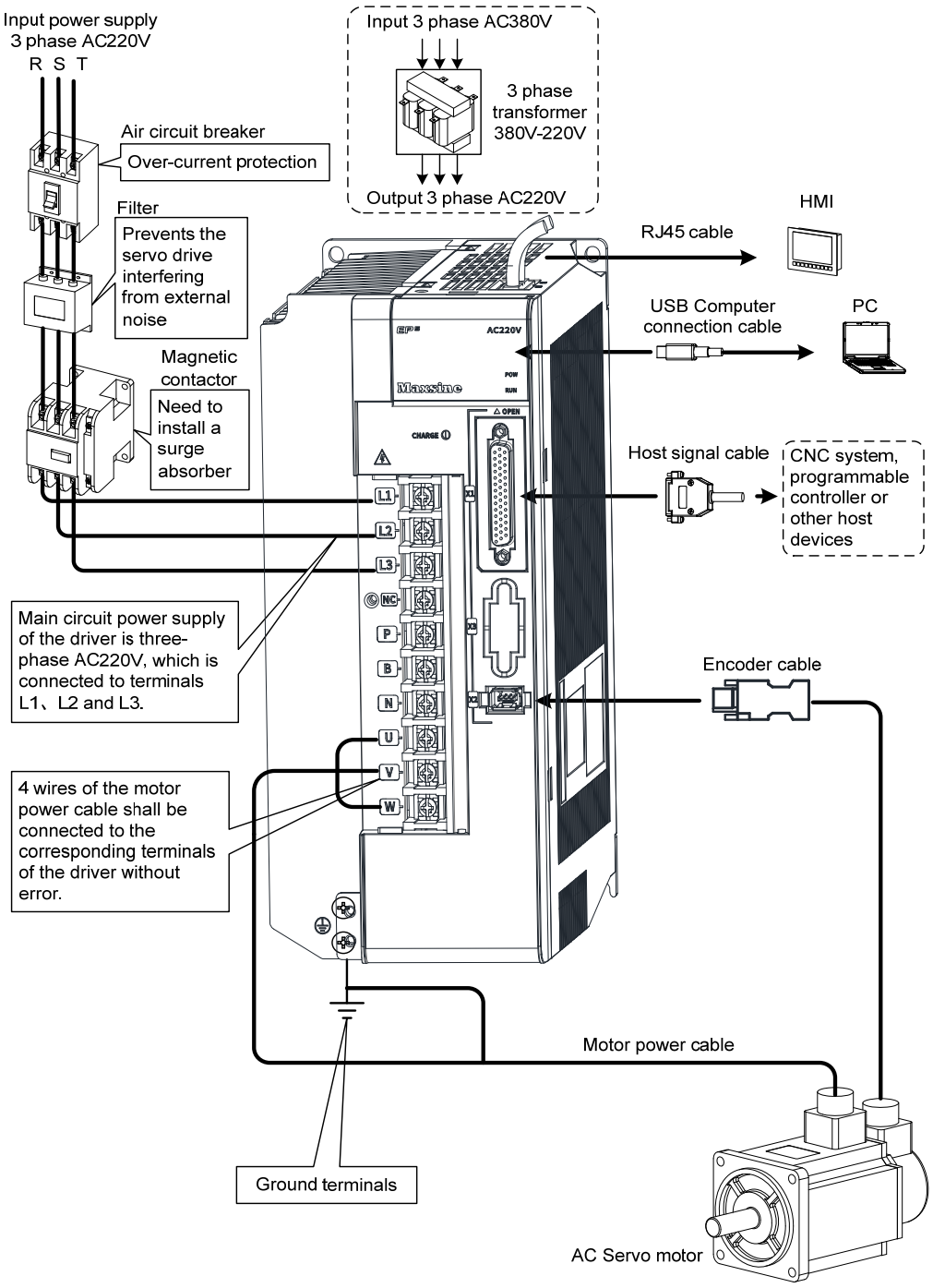
Applicable model: TL25



Applicable model: TL35

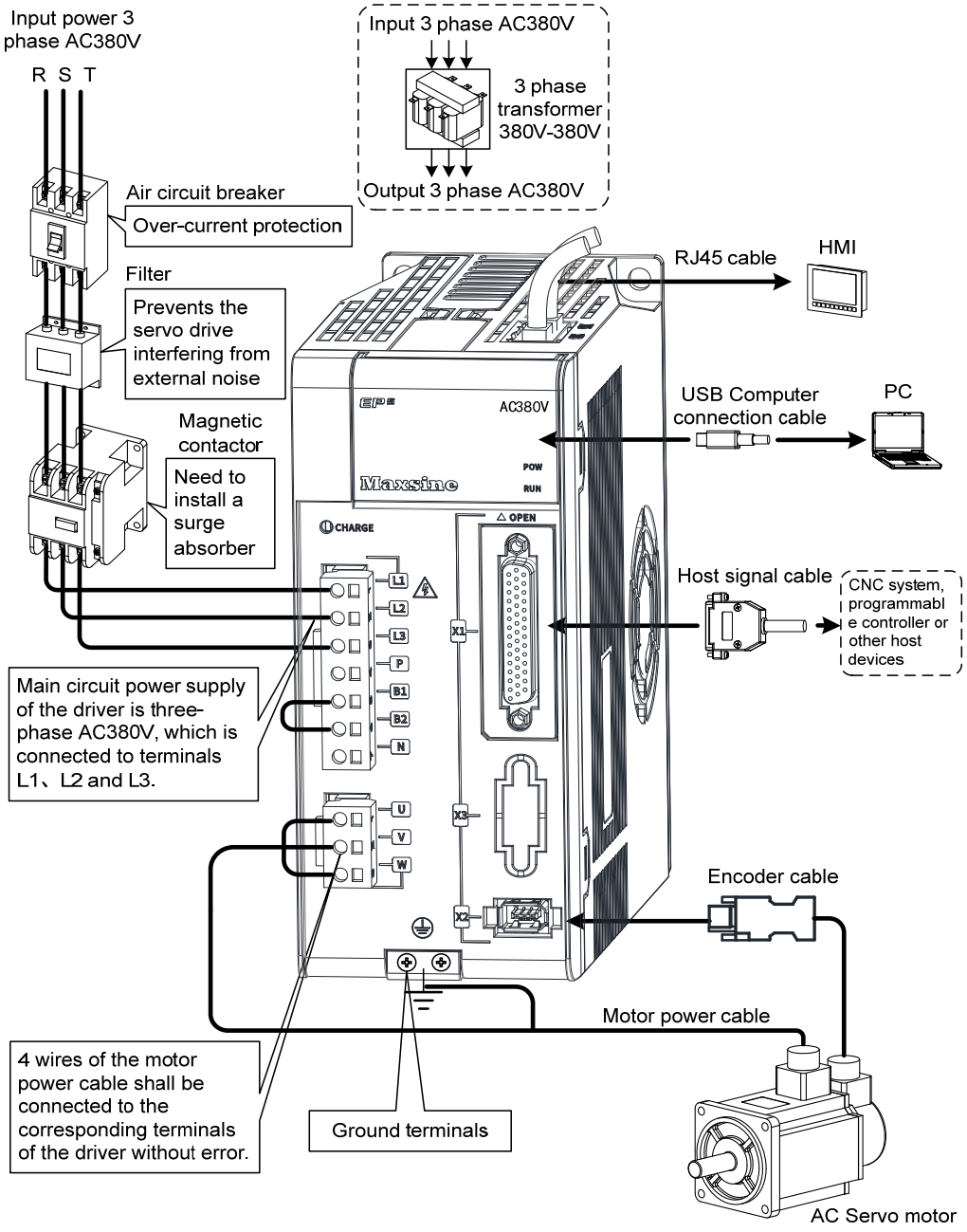


Applicable model: TL55

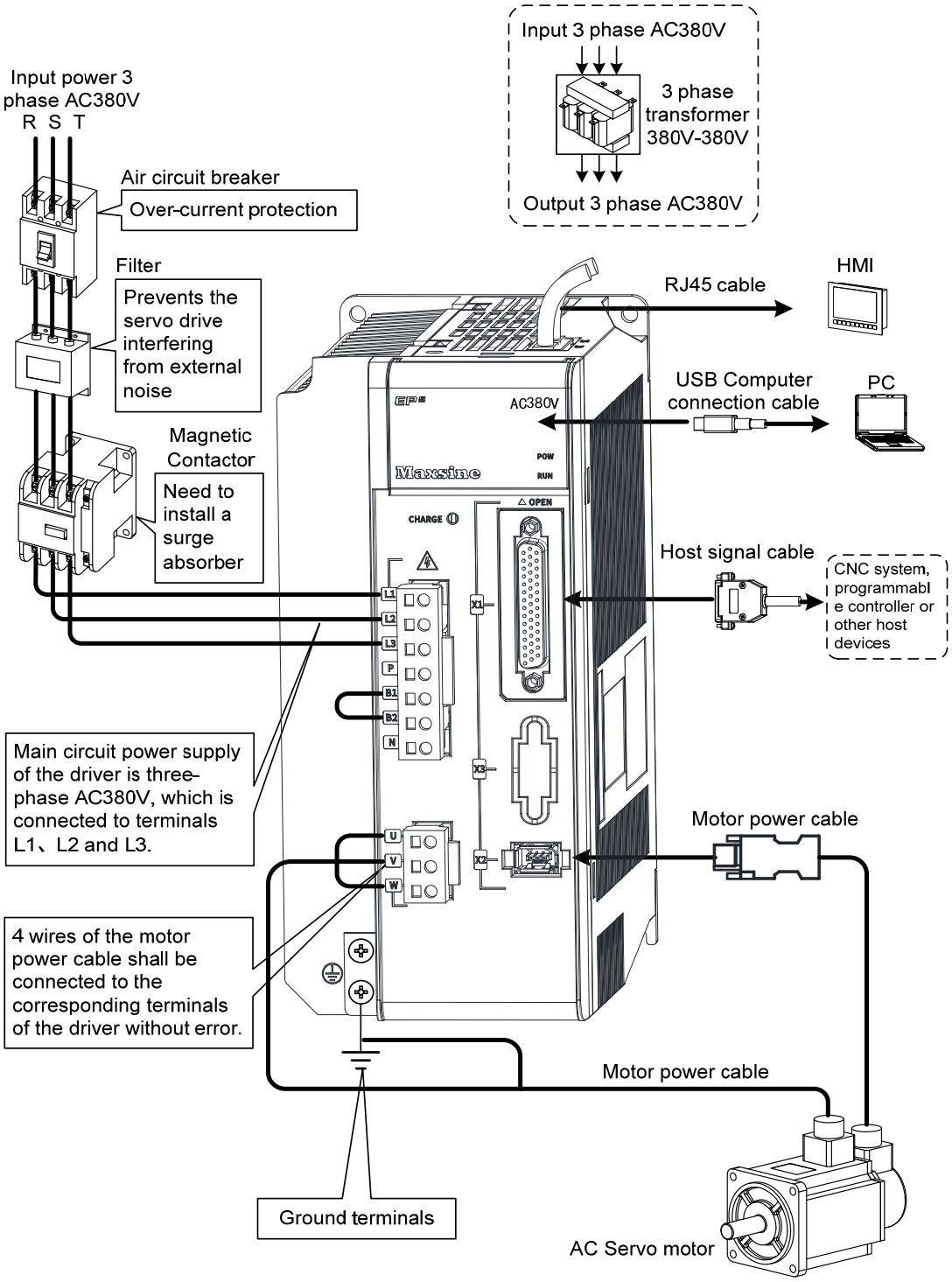


2. EP5-TH series servo driver wiring diagram

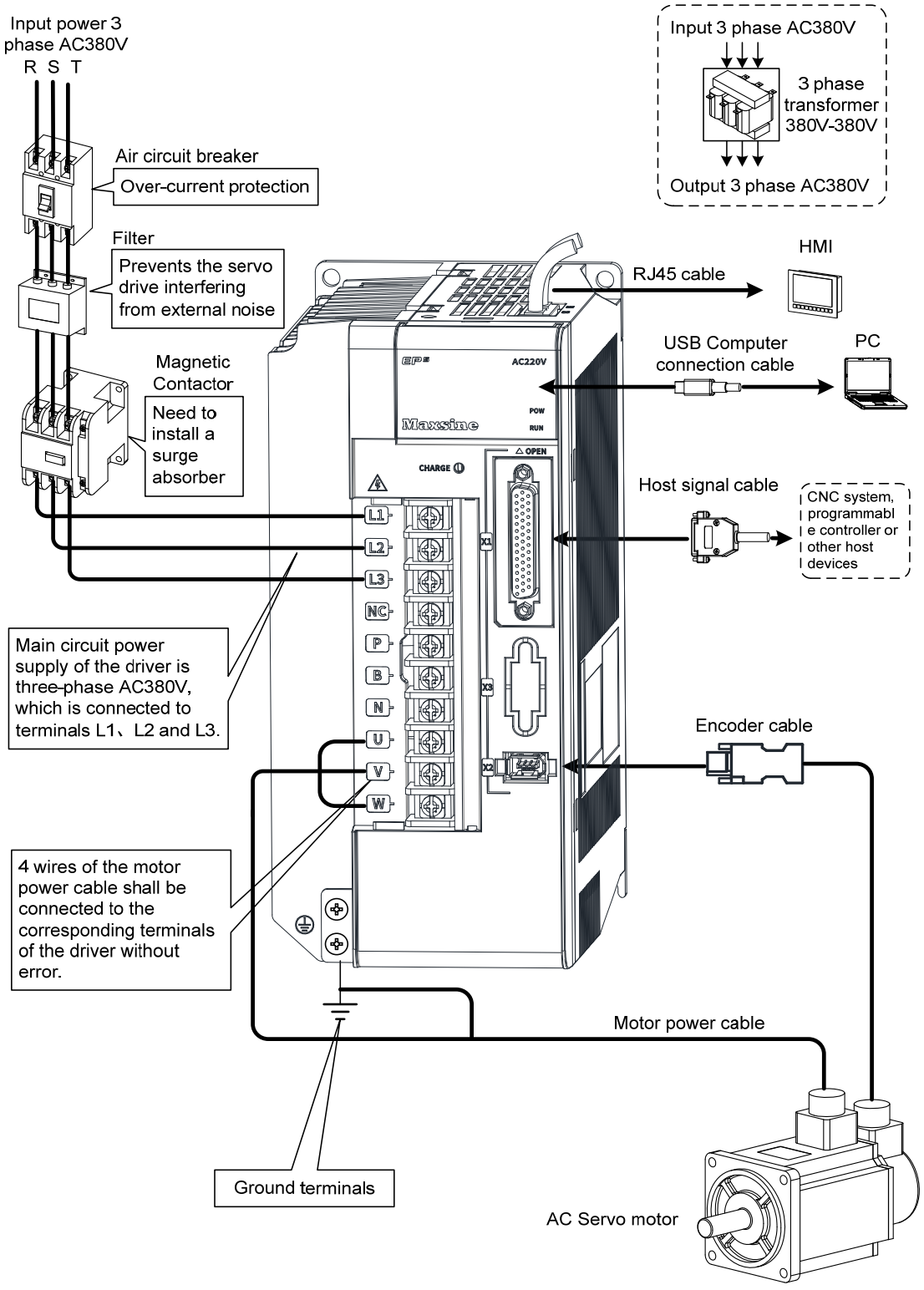
Applicable model: TH15



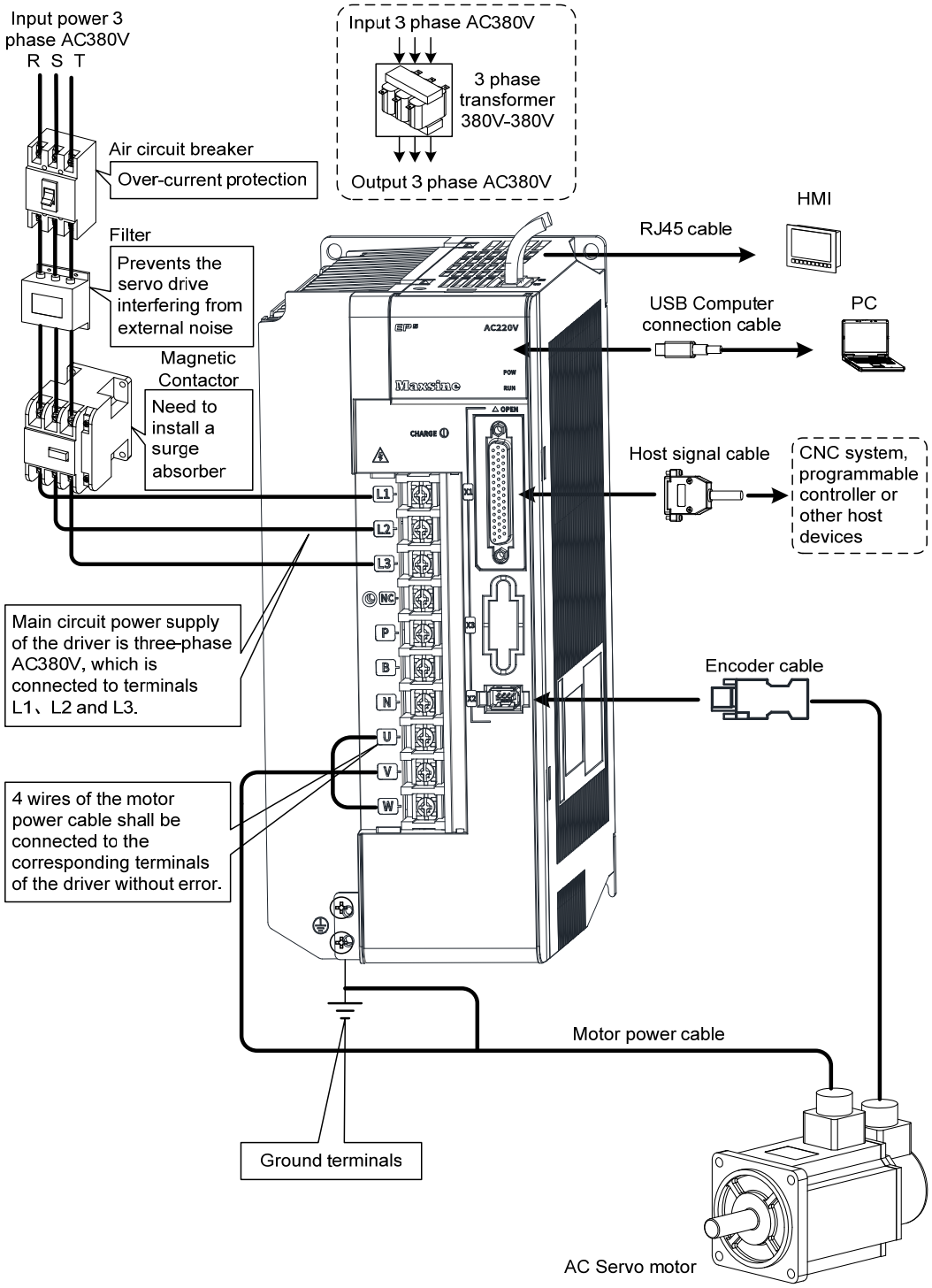
Applicable model: TH20



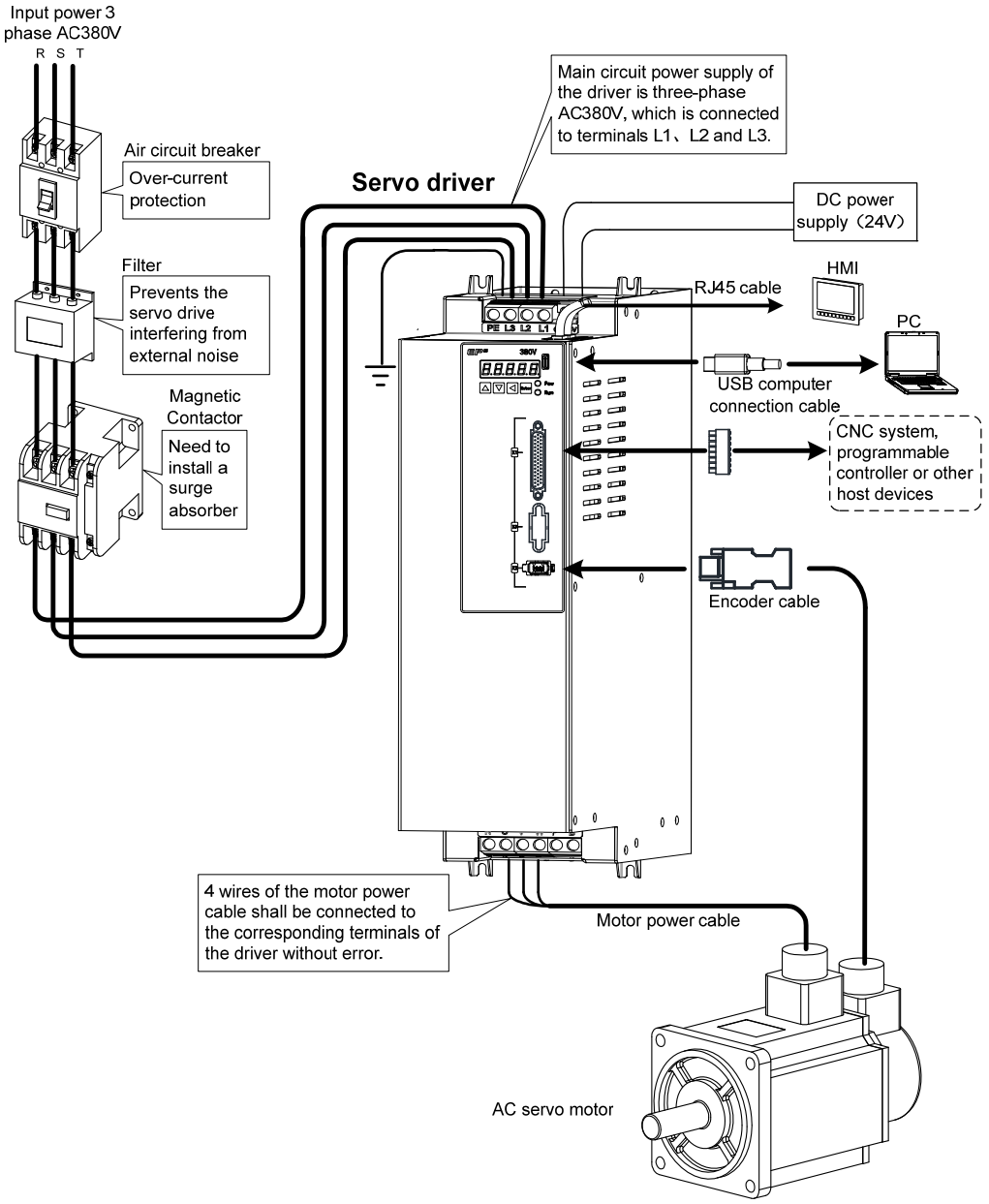
Applicable model: TH30



Applicable models: TH50、TH75



Applicable models: TH90、TH110、TH150



2.1.2 Wiring instruction

Wiring notice:

- Please use according to the wire specifications.
- Cable length, command cable within 3m, encoder cable within 20m.
- Check whether the power supply and wiring of L1, L2 and L3 are correct. Do not connect the low-voltage servo driver (TL series) to the 380V power supply.
- The output terminals(U、V、W) must be connected with the servo motor connections(U、V、W) correspondently, otherwise the servo motor will stop or over speed. However, by exchanging three-phase terminal cannot cause the motor to reverse; this point is different from an asynchronous motor.
- It must be reliably grounded and single point grounded.
- To control the output of the relay coil, a protective diode needs to be installed, and the direction of the diode should be connected correctly, otherwise it may cause a malfunction and prevent the output of the signal.
- To prevent incorrect actions caused by electromagnetic noise, please add isolation transformers and noise filters to the power supply.
- Please wire the power line (power supply line, main circuit lines, etc.) more than 30cm away from the signal line, and do not place it in the same wiring pipe.
- Please install non fusible circuit breaker to cut off external power supply in time when the driver fails.

2.1.3 Electric wire specification

Connect terminal	Symbol	Wire specification	
Main power supply	L1、L2、L3	400W～1.5kW	0.75～1.5mm^2
		1.5kW～3.5kW	1.5～2.5mm^2
		3.5kW～5.5kW	2.5～4mm^2
		5.5kW～7.5kW	4～6mm^2
		7.5kW～11kW	6～10mm^2
		11kW～15kW	10mm^2
Motor connection terminal	U、V、W	400W～1.5kW	0.75～1.5mm^2
		1.5kW～3.5kW	1.5～2.5mm^2
		3.5kW～5.5kW	2.5～4mm^2
		5.5kW～7.5kW	4～6mm^2
		7.5kW～11kW	6～10mm^2
		11kW～15kW	10mm^2
Ground terminal	⏚	1.5～4mm^2	
Control signals	X1	≥0.14mm^2(AWG26),shielded	
Encoder signals	X2	≥0.14mm^2(AWG26),shielded	
USB communication	X4	≥0.14mm^2(AWG26)	
RJ45 communication	X5、X6	Class 5 (CAT 5) or above shielded network cables	
Brake resistor terminal	P、B、B1、B2	1.5～4mm^2	

Must use a twisted pair wire cable for the encoder signal wiring. If the encoder signal cable is too long (>20m), in which the encoder power supply can be insufficient, may use multi-wire or thick wire for the power supply wiring.

2.1.4 Main circuit terminal explanation

Name	Terminal symbol	model	Detailed instructions
Main power supply	L1、L2	TL04、TL08、TL10	Connect external AC power supply: single-phase 220VAC - 15% ～ + 10% 50/60 Hz
	L1、L2、L3	TL15、TL25、TL35、TL55	Connect external AC power supply: three-phase 220VAC -15%～+10% 50/60Hz
	L1、L2、L3	TH series	Connect external AC power supply: three-phase 380VAC - 15% ～ + 10% 50/60 Hz
Brake resistor terminal	P、B1、B2	TL04、TL08、TL10、TL15、TL25、TH15、TH20	When external brake resistance is needed, disconnect B1、B2[Note 2], and the external brake resistance is connected to the P and B1 ends to make B2 suspended.
	NC、P、B	TL35、TL55、TH30、TH50、TH75、TH90、TH110、TH150	When using external braking resistor, must first be open between P and B in braking resistance line, at the same time the two braking resistor inside thread on NC, then the external braking resistor jumper on the P、B.
DC bus terminal	P（+）、N（-）	TL15、TL25、TL35、TL55、TH15、TH20、TH30、TH50、TH75、TH90、TH110、TH150	DC bus terminal, used for multiple servo common DC bus.
Motor connection terminal	U	EP5 series	Output to motor U phase power supply
	V		Output to motor V phase power supply
	W		Output to motor W phase power supply
Ground terminal	⏚	EP5 series	Grounding terminal of motor housing
	⏚		Driver grounding terminal

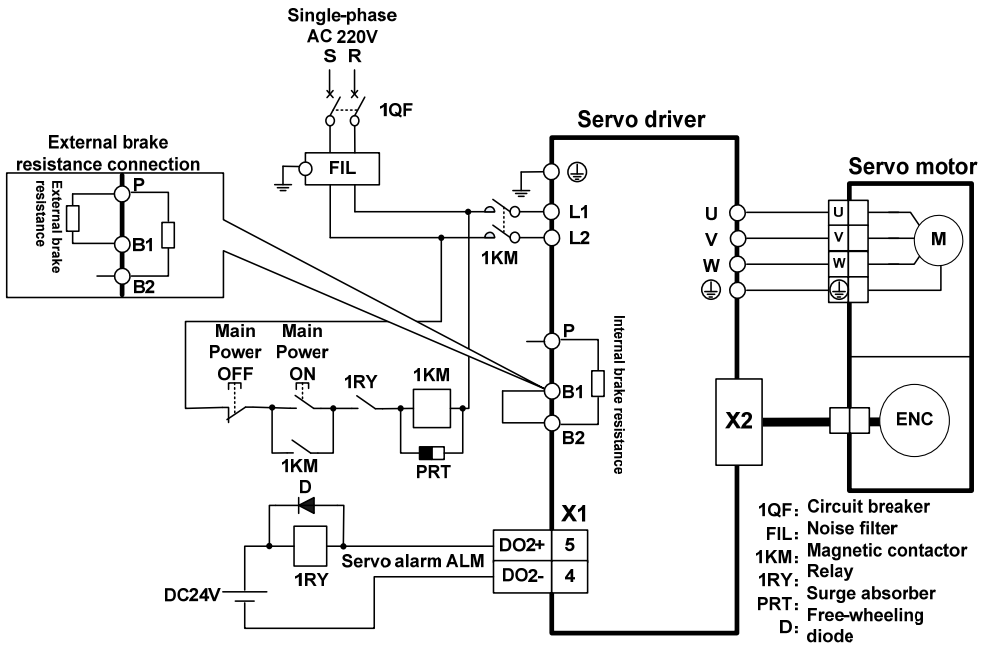
Note 1: TL55、TH50、TH75、TH90、TH110 and TH150 have no internal braking resistance. When TL55、TH50、TH75、TH90、TH110 and TH150 need to be connected with external braking resistance, the external braking resistance should be bridged at the P and B ends.

Note 2: Except for TL55、TH50 、TH75、TH90、TH110 and TH150, the manufacturer defaults to the internal braking resistor connection when leaving the factory, and B1 and B2 are in short circuit. It is recommended that TL55、TH50、TH75、TH90、TH110 and TH150 drivers be equipped with dynamic resistors.

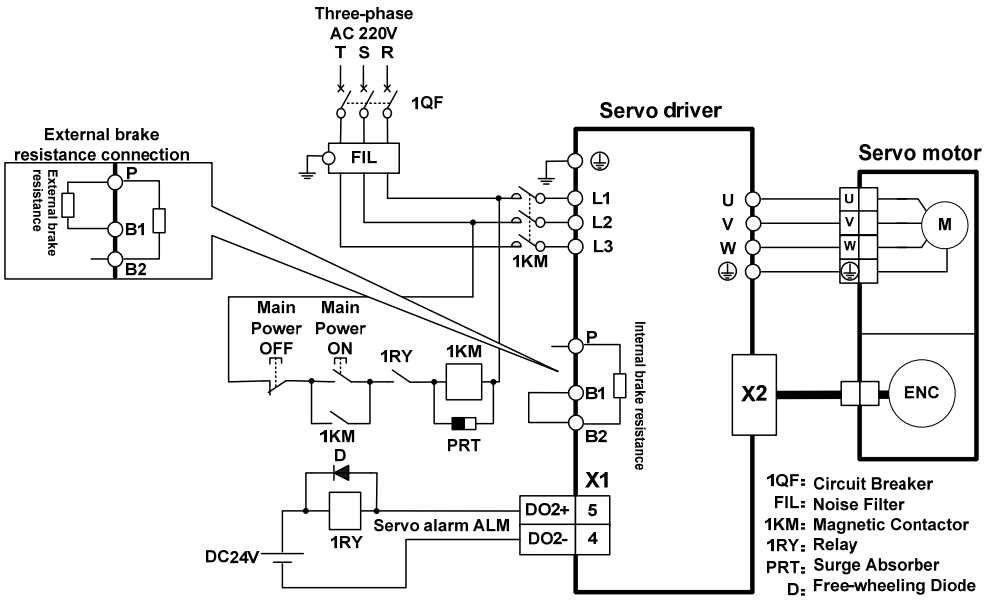
2.1.5 Motor and power wiring diagram

1. TL series servo driver power supply adopts three-phase AC 220V, generally obtained from three-phase AC 380V through transformer. In special cases, motors less than 750W can use single-phase 220V

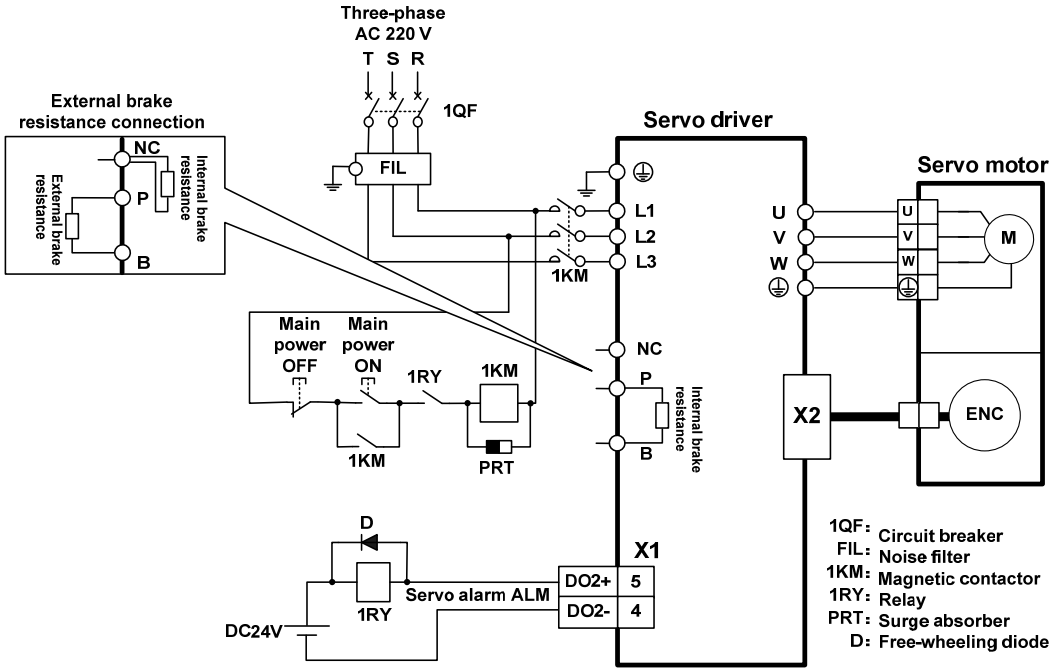
Applicable models: TL04、TL08、TL10



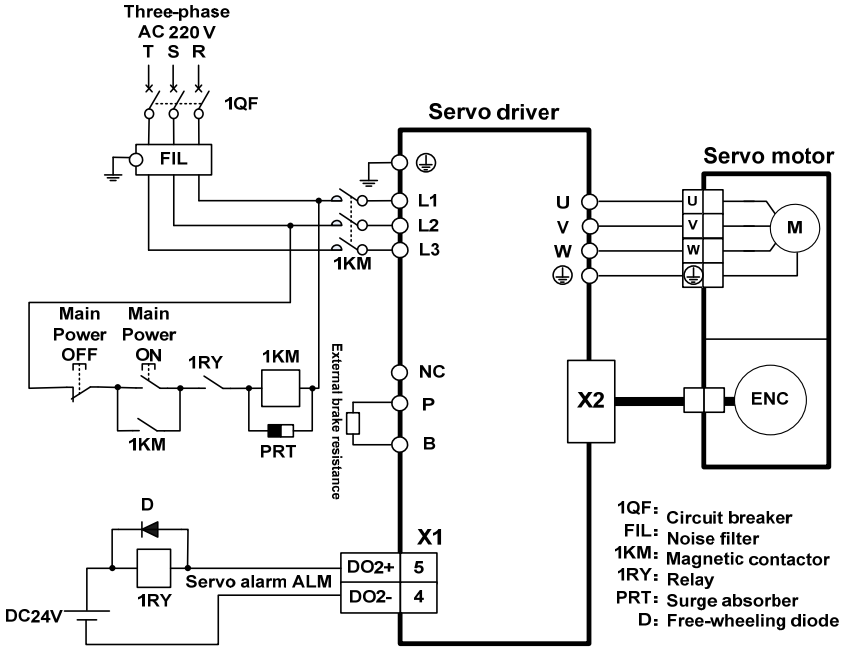
Applicable models: TL15、TL25



Applicable model: TL35



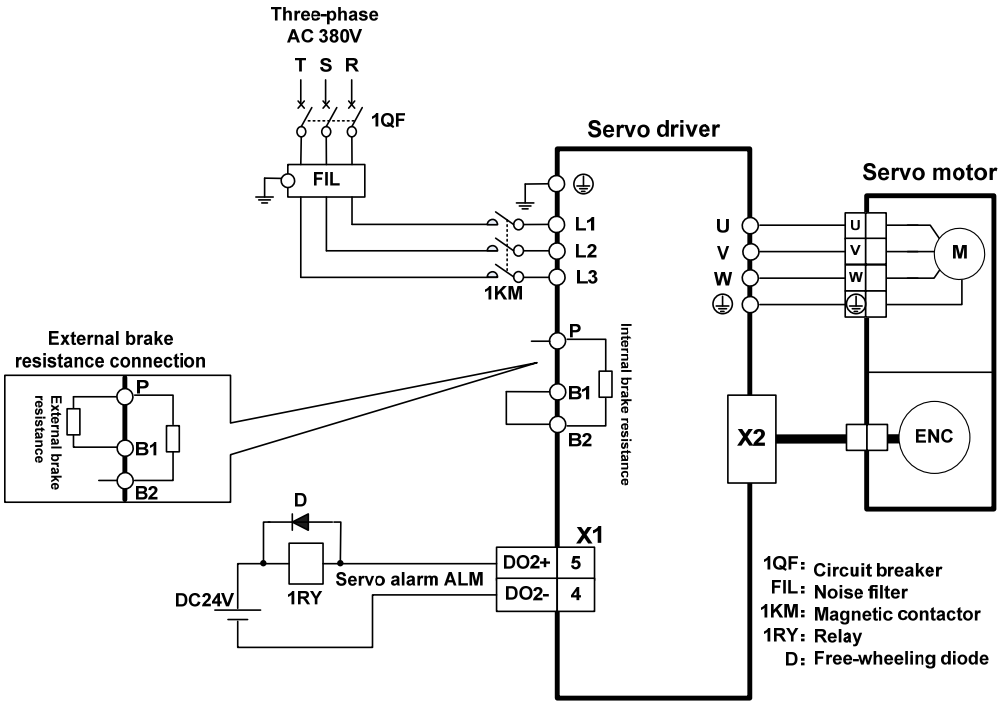
Applicable model: TL55 [Note]



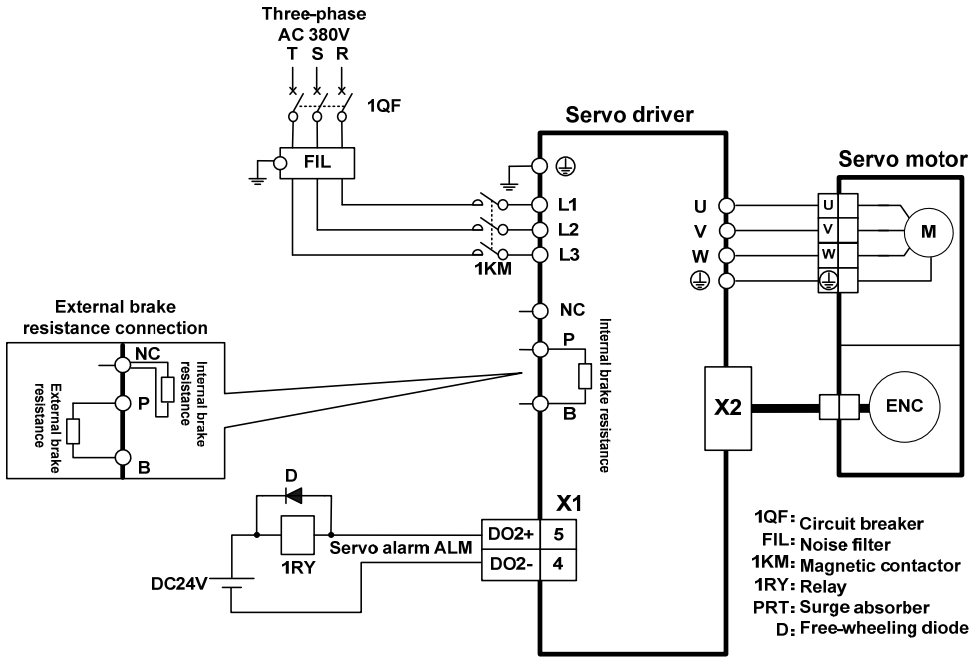
Note: TL55 has no internal brake resistance, so it needs to be connected to external brake resistance.

2. TH series two different wiring modes:

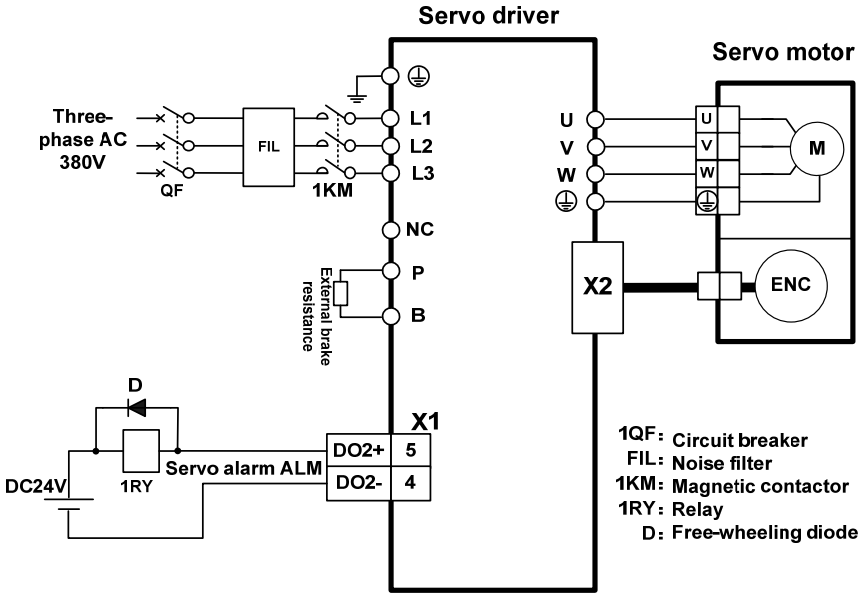
Applicable models: TH15、TH20



Applicable model: TH30

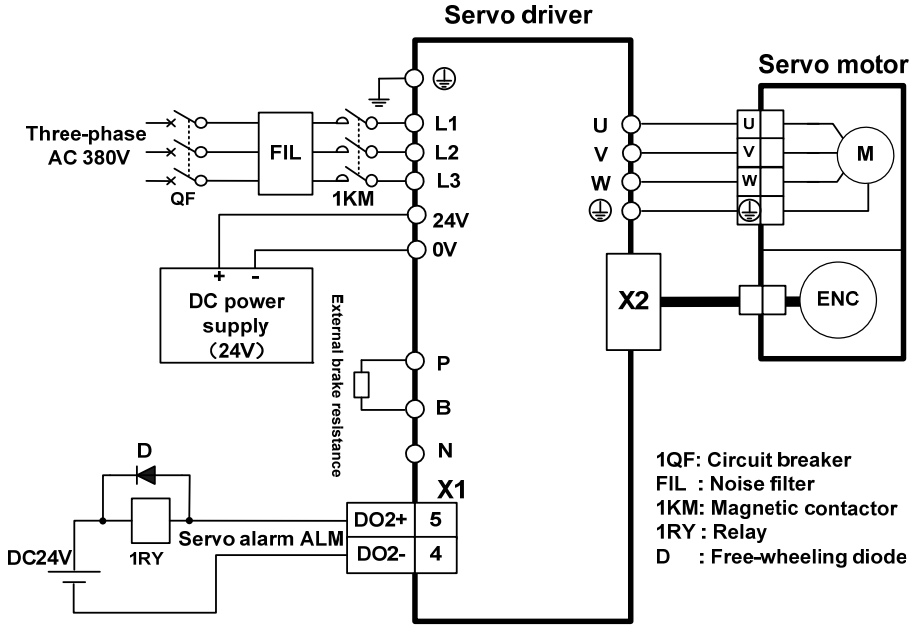


Applicable models: TH50、TH75 [Note]



Note: TH50、TH75 have no internal brake resistance and need to be connected with external brake resistance.

Applicable models: TH90、TH110、TH150 [Note]



Note: TH90、TH110、TH150 have no internal brake resistance, and need to be connected with external brake resistance for use.

2.2 Brake resistance adaptation

Drive series		Internal brake resistance specification	Recommended specification for external brake resistance	Minimum external brake resistance
AC220V	TL04	47Ω/50W	36Ω/200W	25Ω
	TL08	47Ω/50W	36Ω/200W	25Ω
	TL10	47Ω50W	36Ω/200W	25Ω
	TL15	47Ω/100W	25Ω/200W	20Ω
	TL25	47Ω/100W	25Ω/200W	20Ω
	TL35	47Ω/100W	20Ω/200W	12Ω
	TL55	None	20Ω/500W	12Ω
AC380V	TH15	117Ω/100W	50Ω/500W	45Ω
	TH20	47Ω/100W	50Ω/500W	40Ω
	TH30	47Ω/100W	36Ω/750W	30Ω
	TH50	None	36Ω/750W	30Ω
	TH75	None	20Ω/1000W	15Ω
	TH90	None	20Ω/1000W	15Ω
	TH110	None	20Ω/1000W	15Ω
	TH150	None	20Ω/1000W	12Ω

Note 1: The resistances recommended in the table can be used in most applications. In practical application, if the demand cannot be met, please contact the manufacturer.

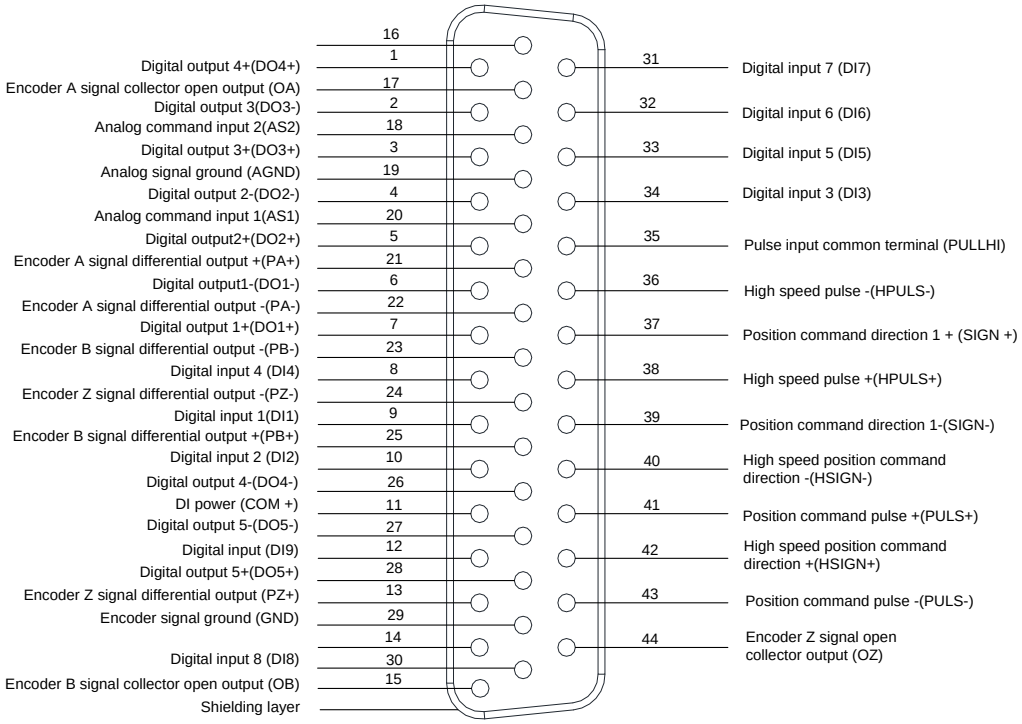
Note 2: When all drivers are changed to external brake resistance, parameters P084/P085/P086 should be modified accordingly. Refer to the corresponding parameter description in chapter 5.4.1 for specific modification.

2.3 X1 control signal terminal

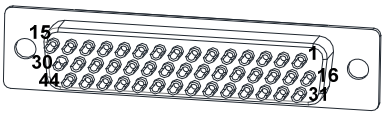
X1 control signal terminals for connected to the host controller signal, using DB44 socket, signs include:

- 9 programmable inputs(Note: TL04、TL08、TL10 series do not have DI6、DI7);
- 5 programmable outputs;
- Analog command input;
- Command pulse input;
- Encoder signal output.

2.3.1 X1 terminal plug



Driver X1 plug



X1 plug welding pin distribution

2.3.2 X1 terminal signal explanation

Signal name		Pin number	Functions	Inter face
Digital inputs	DI1/DI2 DI3/DI4 DI5/DI6 DI7/DI8 DI9 [note 1]	9/10 34/8 33/32 31/30 12	Photoelectric isolation input, programmable function, defined by parameters P100～P107、P380.	C1
	COM+	11	DI power supply (DC12V～24V)	
Digital outputs	DO1+/DO1- DO2+/DO2- DO3+/DO3- DO4+/DO4- DO5+/DO5-	7/6 5/4 3/2 1/26 28/27	Photoelectric isolation output, maximum output capacity of 50mA/25V, programmable function, defined by parameters P130 ～ P134.	C2
Position command pulse	PULS+ PULS- SIGN+ SIGN-	41 43 37 39	Pulse input, when P043=0, the highest pulse frequency=500kHz; When P043=1, the highest pulse frequency=4MHz. Working mode set by parameter P035: ● Pulse + direction; ● Positive/reverse pulse; ● Orthogonal pulse.	C3
	PULLHI	35	External power input interface for command pulse	
Analog command inputs	AS1 AS2	20 18	Speed/torque analog quantity input; the range is -10V～10V.	C4
	AGND	19	Analog signal ground.	
Encoder signal differential output	PA+/PA- PB+/PB- PZ+/PZ-	21/22 25/23 13/24	Differential driver (Line Driver) output after frequency division of encoder signal.	C5
	OA OB OZ	17 15 44	Encoder A signal collector open output Encoder B signal collector open output Encoder Z signal collector open output	C6
	GND	29	Encoder signal ground.	
Shielding layer	Metal case of connector		Shielded wire connecting shielded cable	

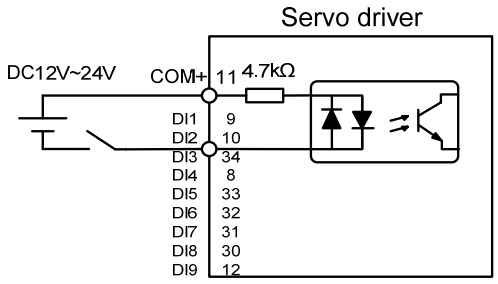
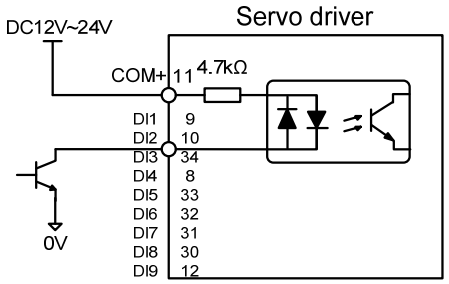
Note 1: TL04、TL08and TL10 series do not have DI6 and DI7.

2.3.3 X1 terminal interface type

The following describes the interface circuits of X1 and how to connect to the host control device.

1. Digital input interfaces (C1)

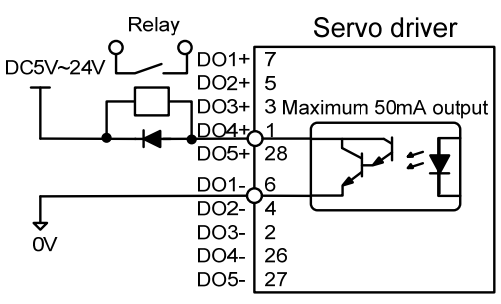
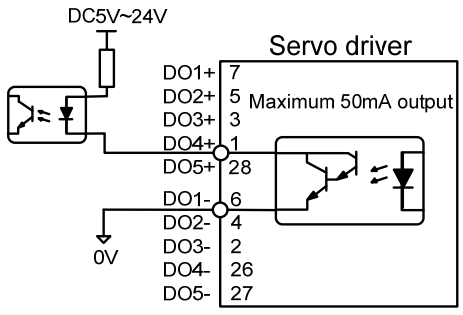
Digital input interface circuit can be controlled by switch, relay, open collector triode, photoelectric coupler, etc. Low current relay shall be selected to avoid poor contact. The external voltage range is DC12V～24V.

C1-1: Switch input	C1-2: Open collector triode
	

2. Digital output interfaces (C2)

Output circuit adopts Darlington photoelectric coupler, which can be connected with relay and photoelectric coupler. Precautions:

- The power supply is provided by the user. If the power supply is reversed, the drive will be damaged.
- The maximum external power supply is 25V, the maximum output current is 50mA, and the sum of the five currents does not exceed 200mA.
- When using inductive loads such as relays, add diodes in parallel with inductive loads. If the polarity of diodes is opposite, the driver will be damaged.
- When conducting, there is a voltage drop of about 1V, which cannot meet the low level requirements of TTL, so it cannot be directly connected to the TTL circuit.

C2-1: Relay	C2-2: Photoelectric coupler
	
● Freewheel diode must be connected.	

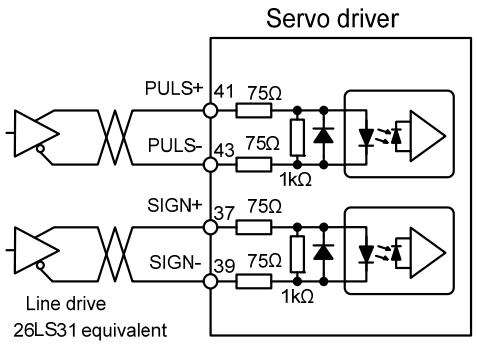
3. Position command pulse interfaces (C3)

There are three connection methods: differential drive, common single-end drive and 24V single-end drive. The differential drive connection method is recommended. The wiring should be twisted pair, with the driving current of 8～15mA.

When P043=0, the maximum pulse frequency is 500kHz; When P043=1, the maximum pulse frequency is 4MHz.

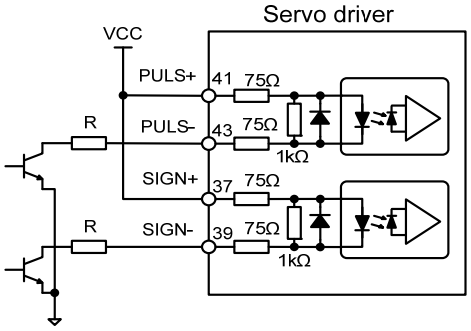
The working mode is set by parameter P035: Pulse + direction、Positive/Reverse pulse、A phase + B phase (orthogonal pulse).

C3-1: 5V differential drive

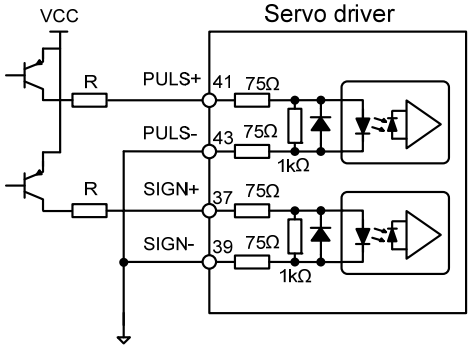


- Maximum pulse frequency 500kHz/4MHz;
- It is not easily disturbed. This connection is recommended.

C3-2: NPN Single end drive



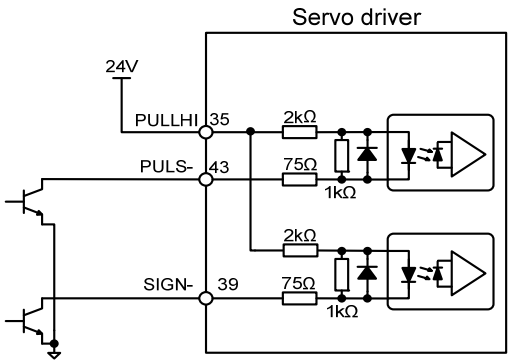
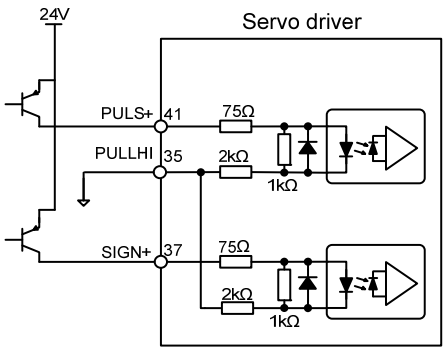
C3-3: PNP Single end drive



- Maximum pulse frequency 200kHz;
- Recommended resistance R value:

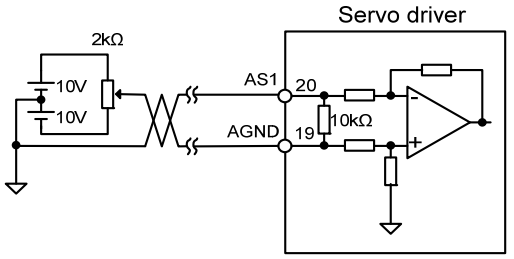
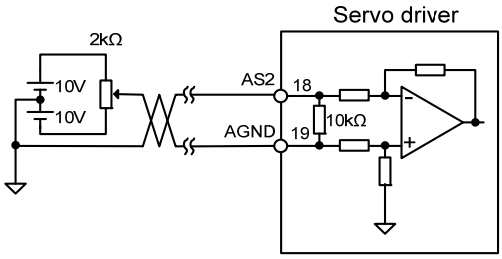
VCC	R
5V	82Ω～120Ω
12V	510Ω～820Ω
24V	1.5kΩ～2kΩ

- Support NPN or PNP interface mode

C3-4: NPN single terminal pulse command interface	C3-5: PNP single terminal pulse command interface
	
● Maximum pulse frequency 200kHz； ● **Note: the power supply of the pulse interface must be 24V, supporting 24V NPN or PNP interface mode.**	

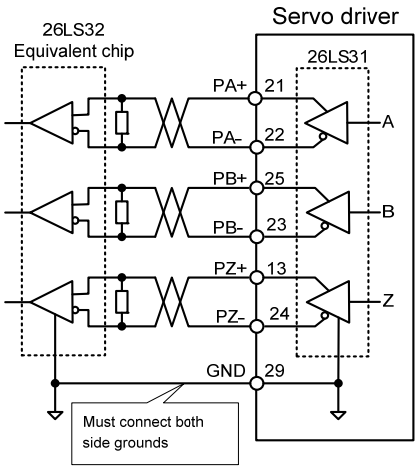
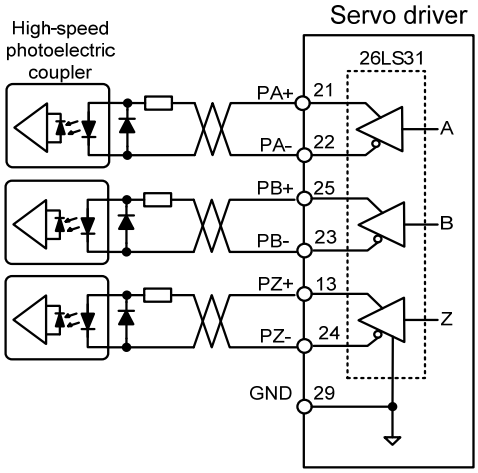
4. Analog command input interfaces (C4)

There are two analog inputs, both of which are single-ended input connection. The input range is -10V～+10V, the input impedance is about 10KΩ. It is normal for analog input to have zero offset, which can be compensated by parameters.

C4-1: Speed analog command single-ended input	C4-2: Torque analog command single-ended input
	
● Needs 2 line connections with the host controller; ● Recommends using shielded cable.	

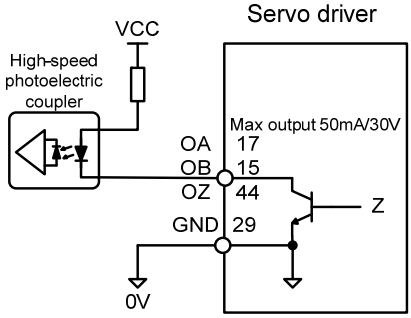
5. Encoder signal line drive output (C5)

The encoder signal is output to the host controller through line driver after frequency division.

C5-1: Long line receiver	C5-2: Photoelectric coupler receiver
	
● On the host controller uses AM26LS32(or equivalent) to make the receiver, must connect the terminal resistance, the value is 220Ω～470Ω; ● Encoder signal (GND) of servo driver must connect with the ground terminal on host controller.	● On host controller use high-speed photo coupler (e.g. 6N137); Current limiting resistor is about 220Ω.

6. Encoder signal collector open circuit output (C6)

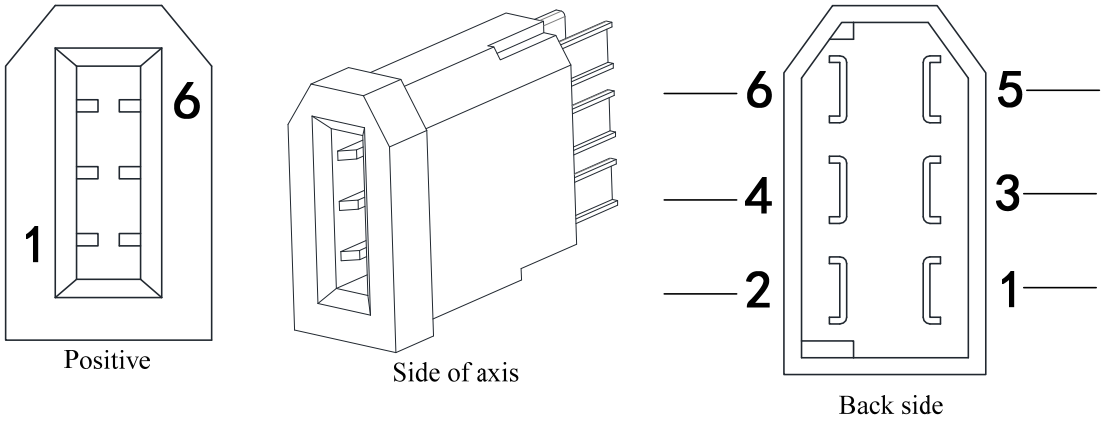
The encoder ABZ signal is output to the host controller through the collector. As the encoder signal pulse width is narrow, please use high-speed photoelectric coupler to receive.

C6: Encoder ABZ signal collector open circuit output

● 30V is the maximum voltage of external power supply; 50mA is the maximum current output.

2.4 X2 encoder signal terminal

2.4.1 X2 terminal connector

X2 encoder signal terminals connected to the motor encoder diagram:



X2 connector core pin diagram

Driver X2 plug

2.4.2 X2 terminal signal description

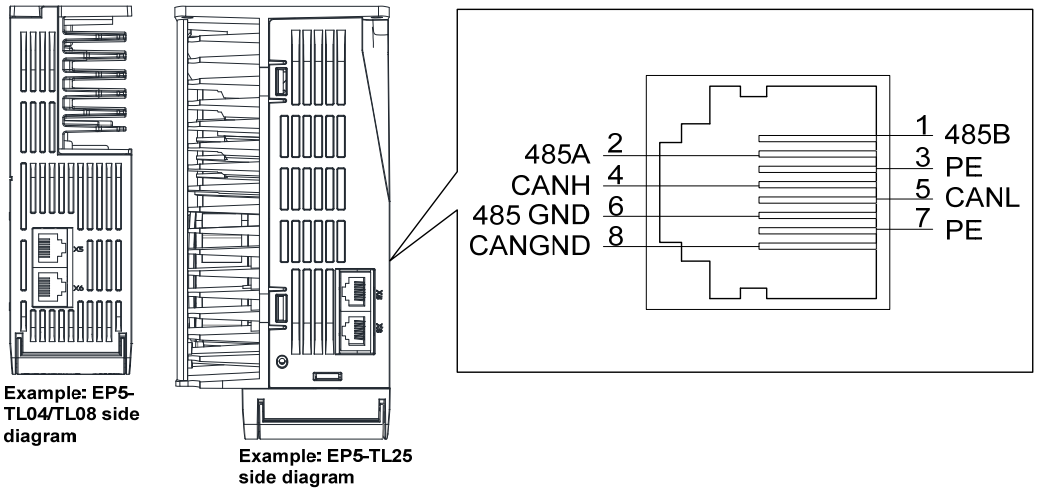
Signal name		Pin number Absolute type （6 core）	Functions
Encoder power supply	5V	1	Use 5VDC power supply (provided by servo driver).If the cable is longer than 20m, in order to prevent encoder from voltage drop down, it is better to use multi wire or thick wire for power line and ground line.
	0V	2	
Signal input	SD+	5	Connect with absolute encoder signal output.
	SD-	6	
Shielding layer	FG	Metal shell	Connect with signal cable shield wire.

Note: Maxsine supplies finished cables, including model E□□□-1394□□A09(for 60mm and 80mm motor) and model E□□□-1394□□H15(for motor whose seat size is over 110mm).

2.5 X5、X6 terminals

2.5.1 X5、X6 terminal sockets

This function is optional. If it is ordered, the order number is needed to be confirmed. Please refer to Chapter 8.1.



2.5.2 X5、X6 terminal signal description

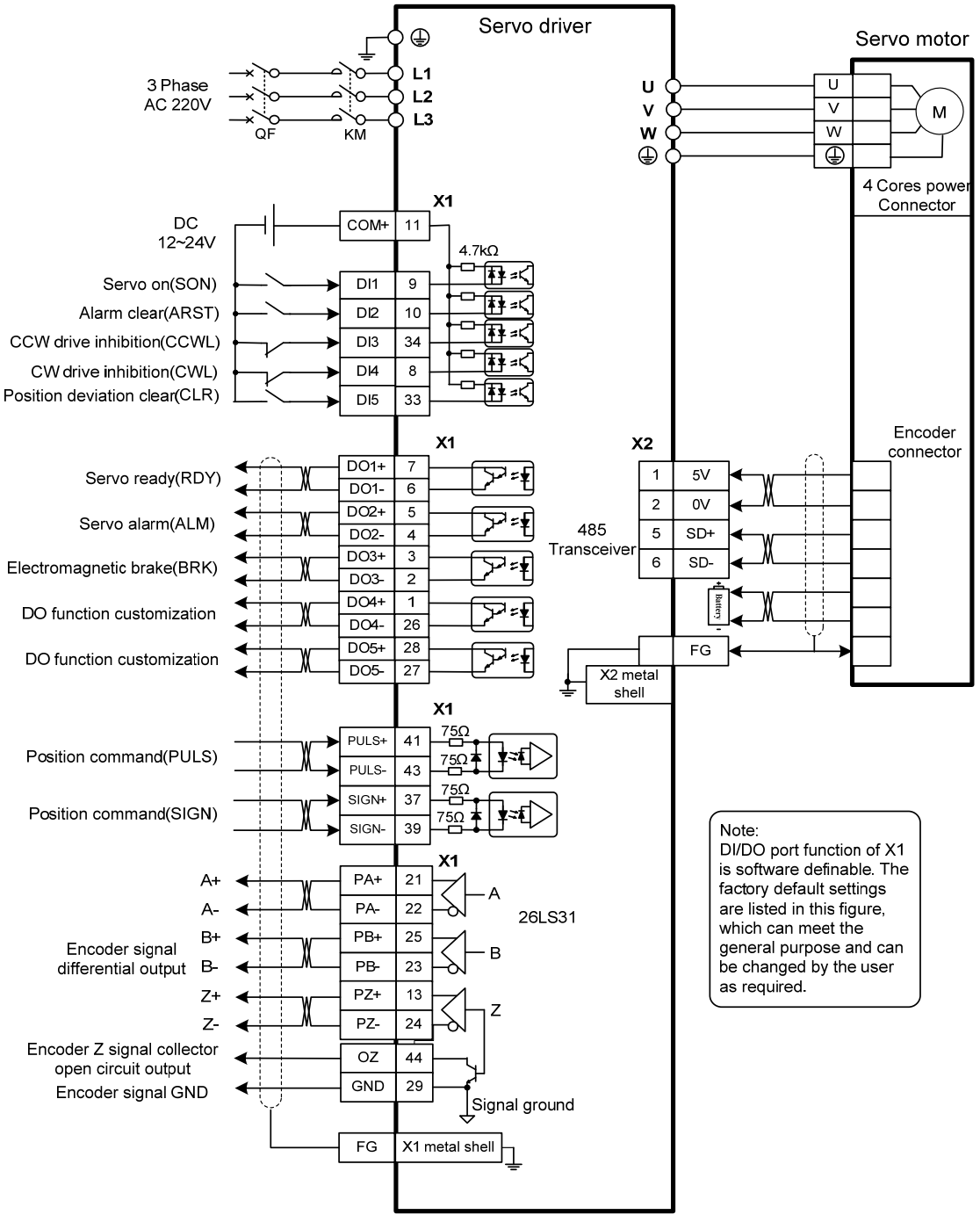
Signal name		Pin number	Function
RS485 input output signal line	485B	1	Isolating 485B
	485A	2	Isolating 485A
	485 GND	6	RS485 ground
CAN input/output signal line	CANH	4	Isolating CAN high level voltage input/output
	CANL	5	Isolating CAN low level voltage input/output
	CAN GND	8	CAN GND
Shield ground	PE	7	GND
	PE	3	GND

Note: 1. This interface wiring is defined as the driver terminal.

2. Maxsine provides finished cable with model L□□□-ETH for RS485 communication.

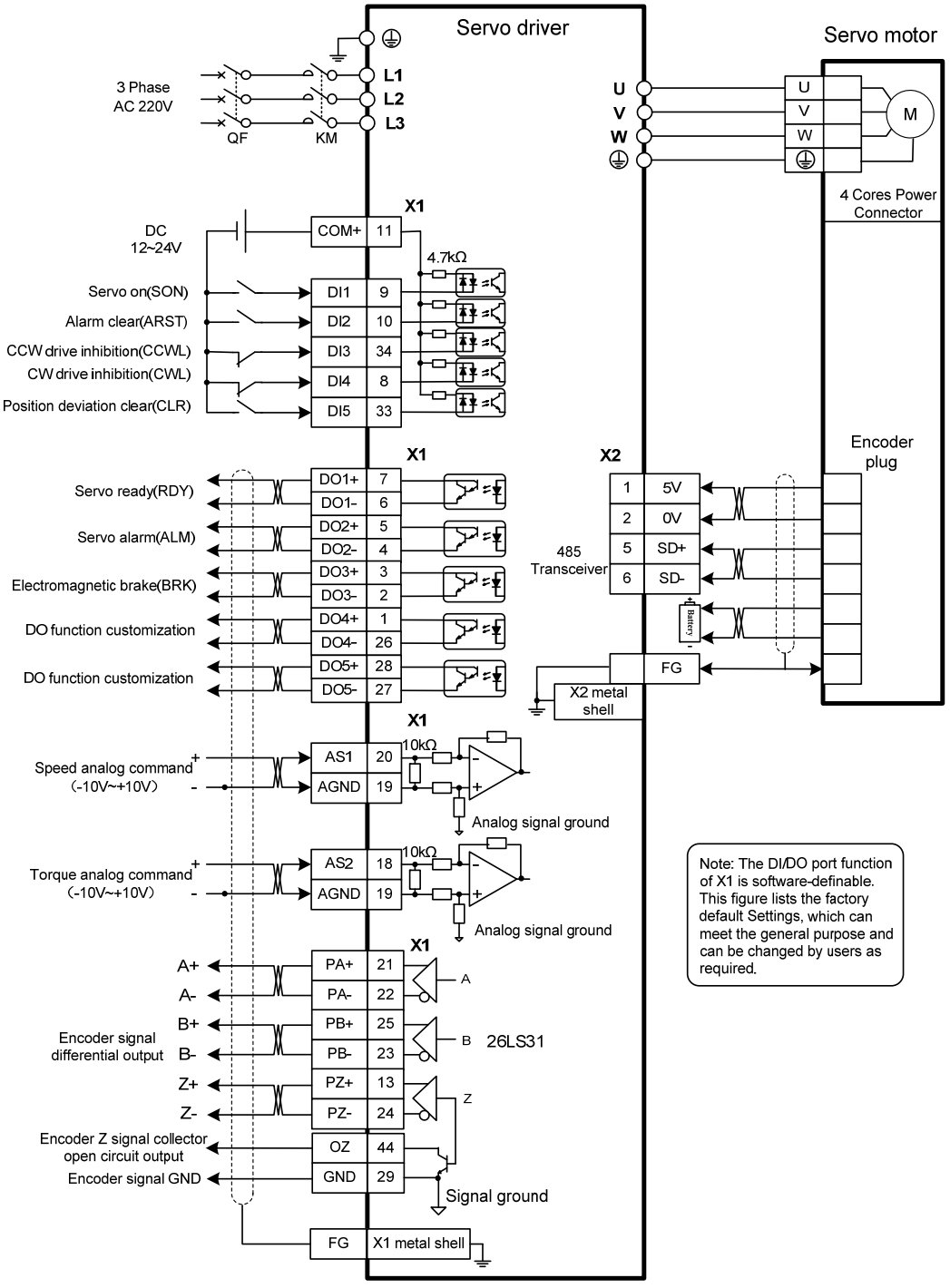
2.6 Standard wiring diagram

2.6.1 Position control wiring diagram



Note: The above wiring diagram takes TL15 as an example.

2.6.2 Speed control or torque control wiring diagram



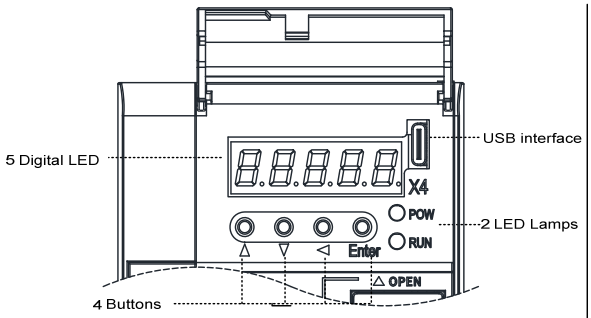
Note: The above wiring diagram takes TL15 as an example.

Chapter 3 Front panel operation

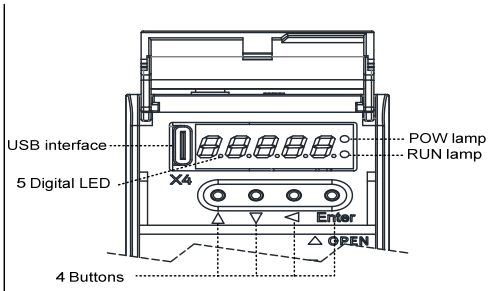
3.1 Driver front panel description

3.1.1 Front panel compositions

The front panel is composed of 5 LED digital tube displays, 4 buttons ▲、▼、◄、Enter and one USB interface, which are used to display various states of the system and set parameters. Operation is a hierarchical operation, which is expanded layer by layer from the main menu.



Panel applicable model：TL15、TL25、TL35、TL55、TH10、TH15、TH20、TH30、TH50、TH75、TH90、TH110、TH150



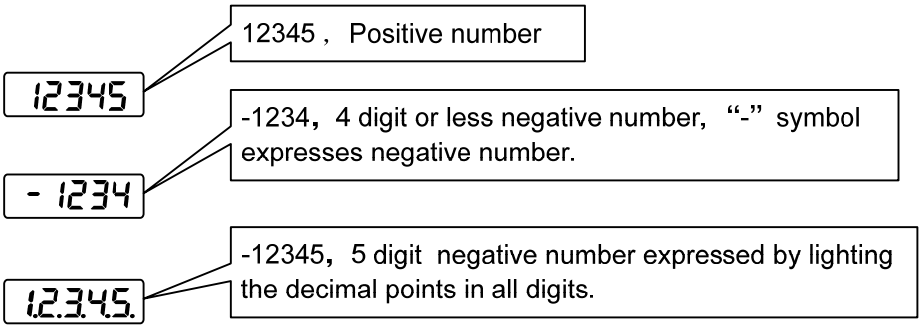
Panel applicable model：TL04、TL08、TL10

3.1.2 Front panel explanation

Symbol	Name	Functions
POW	Main power lamp	Lit: Main power supply already turn on; Go out: Main power supply did not turn on.
RUN	Running lamp	Lit: Motor is active; Go out: Motor is not active.
▲	Increasing button	Increase sequence number or value; Long press has repetitive effect.
▼	Decreasing button	Decrease sequence number or value; Long press has repetitive effect.
◄	Exit button	Menu exit; cancel the operation.
Enter	Confirm button	Menu entered; the operation confirmed.
	USB interface	Equipment connected to the computer interface.

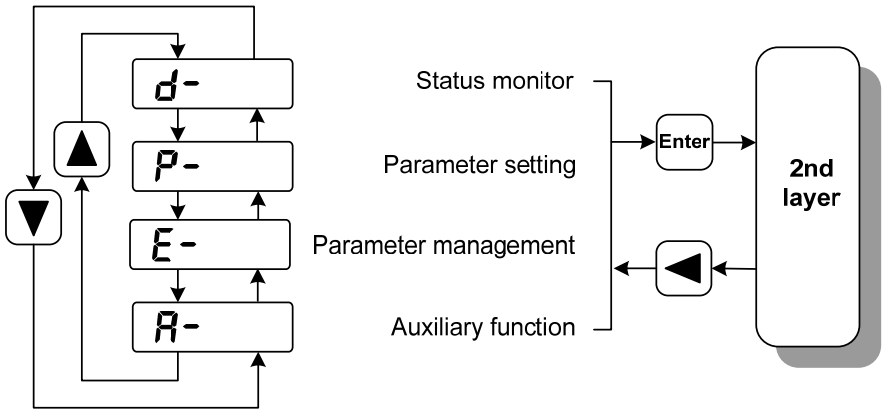
3.1.3 Data display

A number is shown by five digital displays; a minus symbol in front of the value represents a negative value; the lit decimal points in all the digits indicate a negative 5-digit value. Some displays have a prefix character. If the value is full-scale, then the prefix character can be omitted.



3.2 Main menu

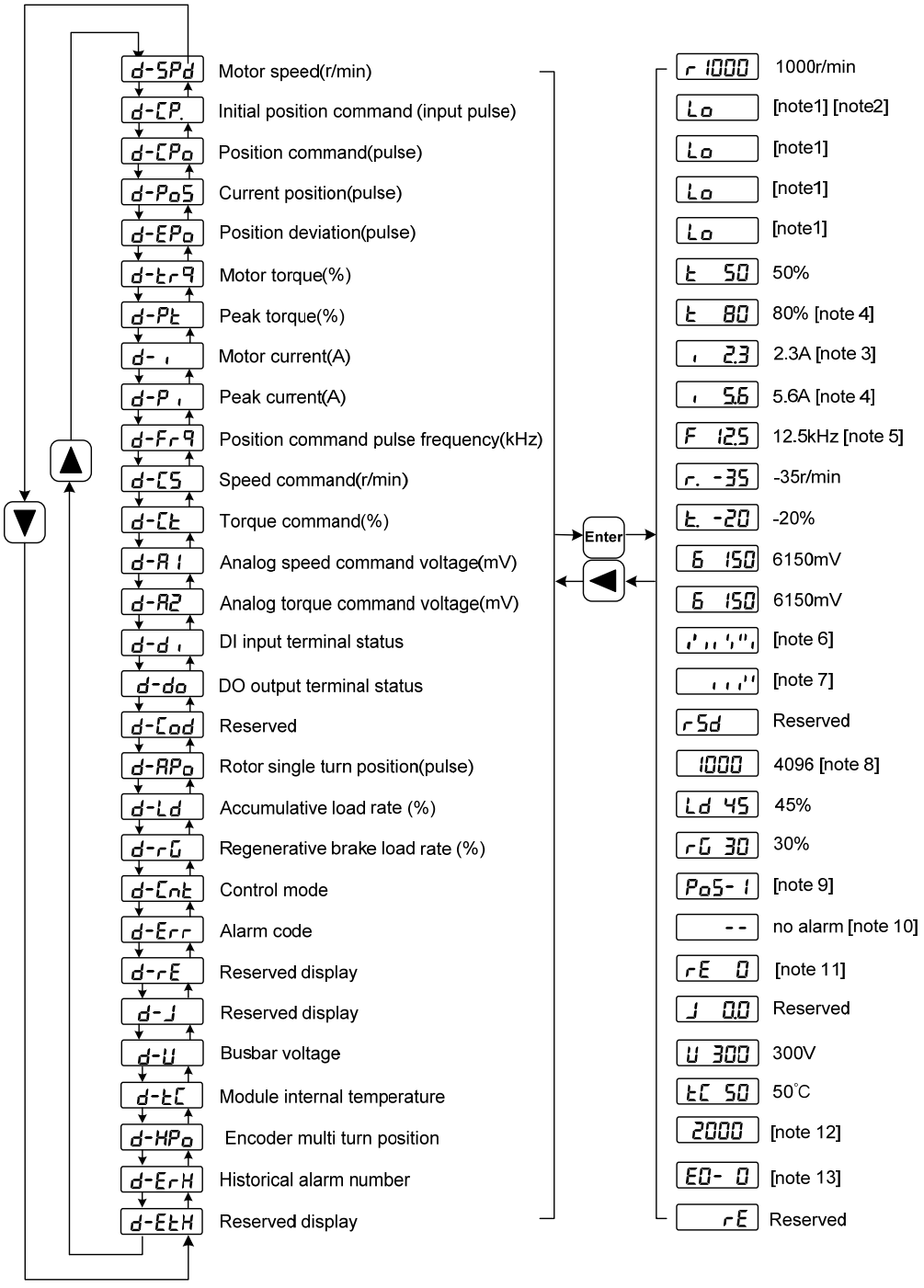
The first layer is the main menu and has four operating modes. Pressing ▲、▼ button changes the operation mode. Pressing the Enter button enters the second layer and then executes a concrete operation. Pressing ◄ button returns to the main menu from the second layer.



1st layer（Main menu）

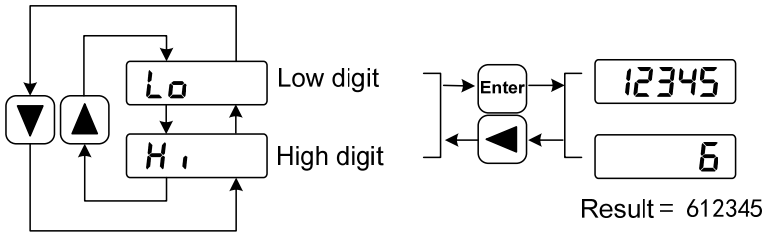
3.3 Status monitor

Choose status monitor "d- " under the main menu. Pressing the Enter button enters the monitor mode. There are many kinds of monitor's project; Use ▲、▼ button to select the needing project. Pressing the Enter button again enters the concrete status display.



1. 32 binary bits value display [note1]

The range of 32-bit binary number is -2147483648～2147483647, which is represented by the combination of low and high digit. Select low digit and high digit through the menu, and use the formula in the figure to synthesize the complete value.



32bit number=High digit number×100000+Low digit number

2. Pulse unit [note2]

The pulses of the initial position command refer to the number of pulses input without electronic gear transformation.

Other items of the pulse (position command, current position, position deviation, rotor absolute position) are uniform pulse units.

$$\text{Uniform pulse unit} = 65536\ (pulse\ /\ rev)$$

Uniform pulse unit indicates that the encoder rotates one cycle and the number of pulses increases by 65536. The driver panel display and the host software of the driver all use this unit.

3. Motor current [note3]

Motor phase current effective value.

4. Peak torque and peak current [note 4]

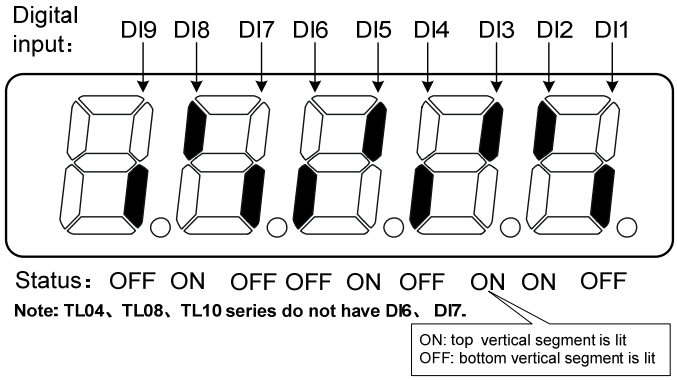
Maximum torque and maximum effective phase current of the motor in the past 10 seconds.

5. Position command pulse frequency [note5]

Input the actual pulse frequency of the electronic gear before amplification (the pulse of the initial position command). The positive number is displayed in the forward direction and the negative number is displayed in the reverse direction.

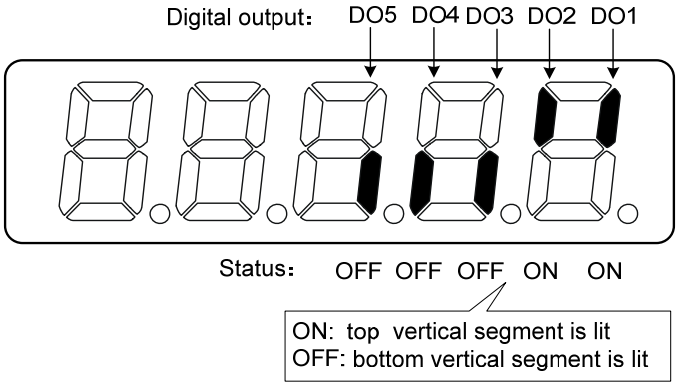
6. Input terminals DI [note6]

A vertical segment of LED shows an input status. The lit top vertical segment shows the DI input to be “ON” and the lit bottom vertical segment to be “OFF”. Note: **The TL04、TL08 andTL10 series do not have DI6 and DI7.**



7. Output terminals DO [note7]

A vertical segment of LED shows an output status. The lit top vertical segment shows the DO output to be "ON" and the lit bottom vertical segment to be "OFF".

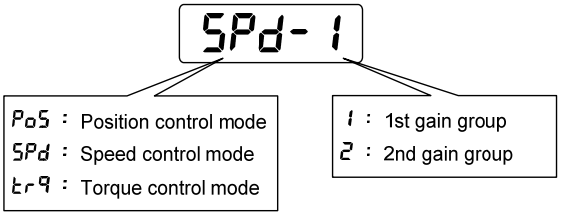


8. Rotor absolute position [note8]

Represents the position of the rotor relative to the stator in a revolution, and turns one into a period. The unified pulse unit takes the encoder Z pulse as the origin. The range is 0～65535, Z pulse appears when the value is 0.

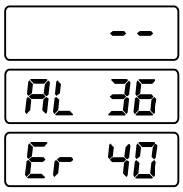
9. Control mode [note9]

The first three characters show the control mode, the final character shows gain combination.



10. Alarm code [note10]

No alarm shows two minus signs " --". When there is an alarm, it will display the alarm number and blink at the interval of on 0.3s and off 0.3s; if there is a warning, it will display the warning number and blink at the interval of on for 1.8s and off for 0.6s. When the alarm or warning appears, the error code number displays automatically on the front panel LED. During the error status, the monitor mode can be changed to other mode by pressing buttons, but the decimal point of the last LED is still flickering and shows existence of an alarm.



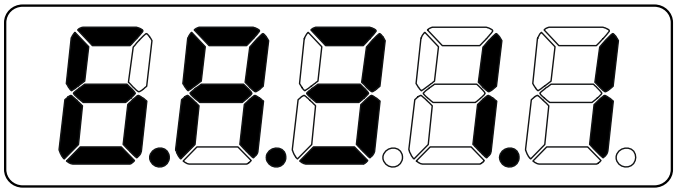
No alarm

flickering No.36 alarm

flickering No.40 alarm

11. RE reserved display [note11]

1) re-0 menu displays the date information of the software version:
   The first digital tube shows the last digit of the year, such as: 2016 shows 6, 2017 shows 7, and so on;
   The second digital tube display month (note: October is indicated by "A", November by "B", December by "C");
   The 3-4 digital tube display day;
   The fifth digital tube manufacturer retains the display, which is generally the serial number of the internal control version.



   For example, the above icon indicates: October 31, 2016, Internal Control Version 1.
2) re-7 code dial communication count error.
3) Other re values are reserved by the manufacturer.

12. Encoder multi turn position [note12]

This status shows that only absolute value drives are valid. Record the multi turn position of the encoder. With the single turn absolute position of the APo rotor, the absolute position of the rotor can be obtained:

Absolute position=multi turn position $\times 2^{16}$ + single turn position

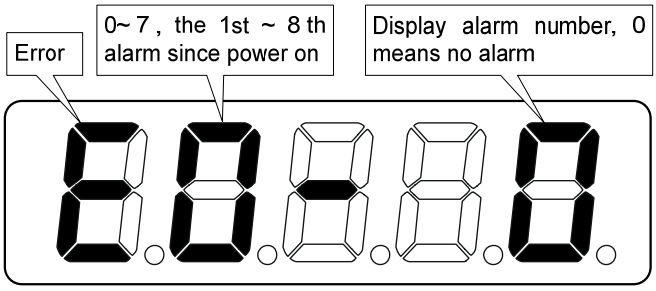
For example, the multi turn position displays 2000, and the single turn position displays 1000, both of which are decimal numbers

The absolute position of the encoder is (2000 ×2^{16}+1000) (decimal) = 131073000

When the absolute value encoder is set to single turn mode (P090=0), the multi turn position is displayed as 0, which does not change with the rotor position.

13. Historical alarm number [note13]

Display alarm number, use ▲、▼ button to view the historical alarm number. After the servo restarts after power-off, only the first four alarm numbers from E0 to E3 are recorded.



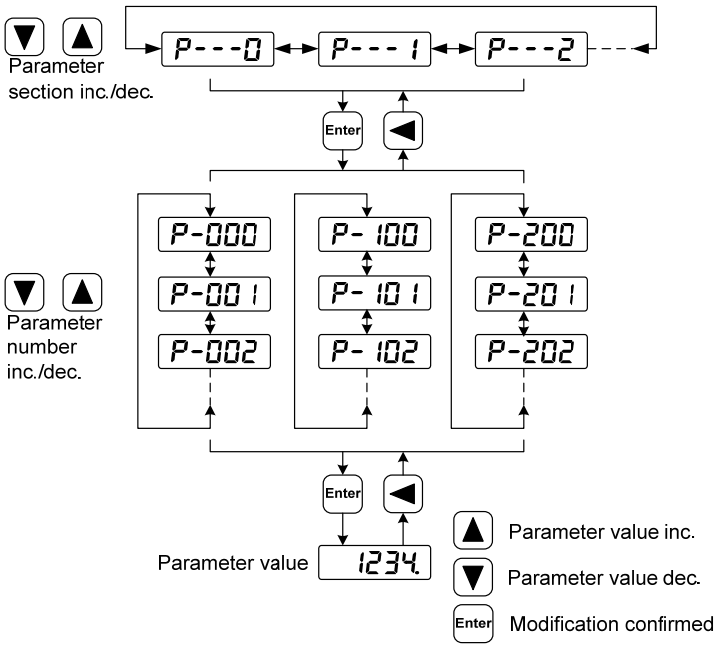
3.4 Parameters setting

The parameter number expression uses a parameter section name combined with a parameter name. The three figures are the section name and two figures and one figure are the parameter name. Take P102 parameter as an example, '**1**' is the section name and '**02**' the parameter name. "P- 102" displays on the front panel LED.

Choose the parameter mode under the main menu "P- ". Pressing the Enter button enters the parameter-setting mode. First use ▲、▼ button to select the parameter section name and then pressing Enter button enters the parameter name selection. Again, use ▲、 ▼ button to select the parameter name and then pressing Enter button shows the parameter value.

Use ▲、 ▼ button to alter a parameter value. Pressing ▲ or ▼ button once to increase or decrease the parameter value by one. Pressing down and hold the ▲ or ▼ button, the parameter value can increase or decrease continuously. When the parameter value is modified, the decimal point on the most right sides LED is lit. Press the Enter button to confirm the parameter value to be effective, meanwhile the decimal point turns off. The modified parameter value is immediately active to influence on the control action (but some parameters needs to preserve firstly and then turn off and on the power supply). Hereafter pressing ◄ button returns to the parameter number selection and can continue to modify a parameter. If the value is not satisfied, do not press the Enter button and can press the ◄ button to cancel it for resuming the original parameter value.

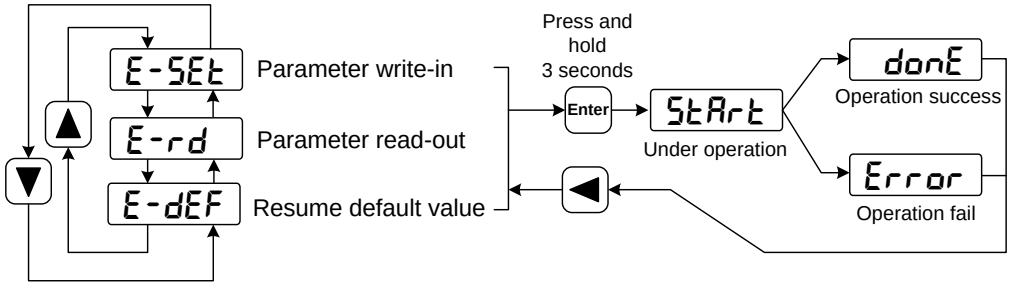
The modified parameter is not saved to EEPROM. If it needs to be saved permanently, please use the parameter write operation in parameter management. Parameter segments and Numbers are not necessarily contiguous, and unused segments and Numbers are skipped and cannot be selected.



3.5 Parameter management

Choose the parameter management mode under the main menu "E- ". Pressing the Enter button enters the parameter management mode. The operation is performed between parameter list and the EEPROM.

There are three operation modes. Use ▲、▼ button to select an operation mode and then pressing down and hold the Enter button at least three seconds to active the operation mode. After finished the operation and then pressing ◄ button returns to the operation mode selection.



- **Parameter write-in**

  This operation indicates that the parameter in parameter list will write to the EEPROM. When user has made change to a parameter, it only change the parameter value in parameter list, but for the next time when the power supply is on the parameter value will restore its original value. Making permanent change to a parameter value, it is the need to carry out the parameter write operation and write the parameter value to the EEPROM. Hereafter, when the power supply is on again will be able to use the new parameter value.

- **Parameter read-out**

  This operation indicates that the data in EEPROM is read into the parameter list. This process will be automatically executed once when the power is turned on. At the beginning, the parameter values of the parameter list are the same as those in the EEPROM. However, if the user modifies the parameters, the parameter values in the parameter list will be changed. When the user is not satisfied with the modified parameters or the parameters are scrambled, the parameter read-out operation will be executed, and the data in the EEPROM can be read into the parameter list again to restore to the parameters just powered on.

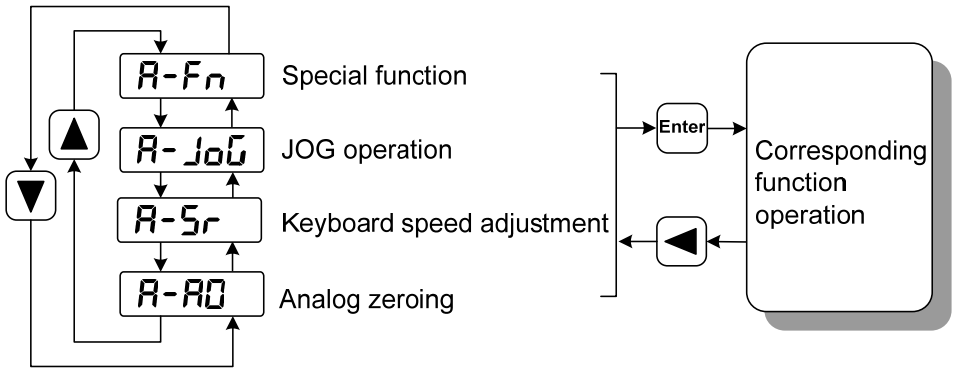
- **Resume default value**

  This operation indicates that the default values (factory values) of all parameters are read out in the parameter list and written in the EEPROM, and the default parameters will be used for the next power on. When the user adjusts the parameters disorderly and cannot work normally, use this operation to restore all parameters to the factory state. Because the default values of parameters corresponding to different driver models and motor models are different, the correctness of the motor code (parameter P002) must be ensured before using the default parameters to restore.

E-SEt	Parameter write-in：	Parameter list	⇨	EEPROM
E-rd	Parameter read-out：	Parameter list	⇦	EEPROM
E-dEF	Resume default value：	Ex-factory default value	⇨	Parameter list、EEPROM

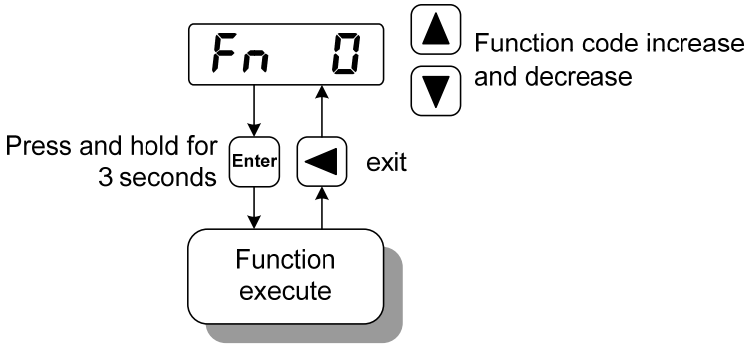
3.6 Auxiliary functions

Select the auxiliary function "A-" in the main menu, and press the Enter button to enter the auxiliary function mode. Select the operation mode with ▲、▼ button. After selecting the operation, press the Enter button to enter the corresponding function, and then press the ◄ button to return to the operation mode selection state.



3.6.1 Special function

Select special functions and press the Enter button to enter. Set the function code with ▲、▼ button, press the Enter button and hold it for more than 3 seconds to activate the operation. After that, press the ◄ button to exit.

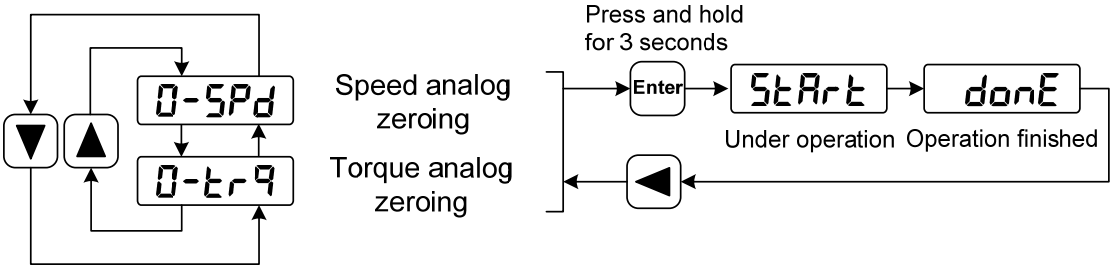


Fn number	functions	explanation
Fn36	reset the encoder (multi-turn absolute encoder is valid)	Encoder RESET command, is used for encoder initialization, encoder alarm reset, and multi-turn information to zero. Perform this function after replacing the battery.
Fn37	Encoder alarm clearing	Encoder alarm clearing command is used to clear various encoder alarms. Executing this command will not clear the encoder multi turn information. Perform this function after replacing the battery.

3.6.2 Analog zeroing

After using this operation, the driver automatically detects the analog zero offset and writes the zero offset to the parameter P047 (or P054). This operation has saved the zero offset parameter to EEPROM, so there is no need to write the parameter.

Select analog zeroing "A-AO", press Enter button to enter. First select speed analog zeroing or torque analog zeroing through the menu, select the operation, press Enter button and hold for more than 3 seconds to activate the operation. After that, press the ◄ button to return to the menu selection state.



3.7 Resume the parameter default value

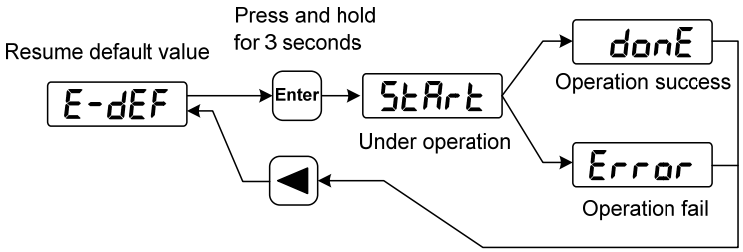
Please use the restore default parameters (factory parameters) function in the following cases:

- The parameters are scrambled, and the system cannot work normally.
- Replace the motor. The new motor is different from the original motor.

The steps to restore the default parameters are as follows:

Resume all of the parameter default value

All parameters are restored to their default values, and all user-modified parameters are restored to their factory defaults. Restore the default values in parameter management.



Resume all of the parameter default value

Turn off and on the power supply, then an operation can be performed again.

Chapter 4 Running

4.1 Trial running with no load

The purpose of the trial run is to confirm whether the following matters are correct:

- Driver power wiring;
- Servo motor power wiring;
- Encoder wiring;
- Servo motor running direction and speed.

4.1.1 Wiring and inspection

Before turn on the power supply, confirms the motor:

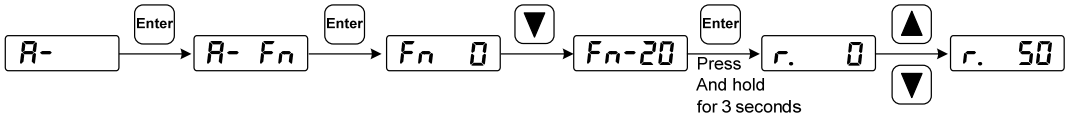
- When the motor is unloaded, do not add load to the motor shaft, and disconnect the connector if it has been installed on the machine.
- Since the acceleration and deceleration of the motor have impact, the motor must be fixed.

Inspect the following items before turn on power supply:

- Is the connection correct? In particular, whether the driver U, V, W is one-to-one corresponding to the motor U, V, W wiring and whether the driver L1, L2, L3 wiring.
- Is the input voltage correct?
- Is the encoder cable connected correctly?

4.1.2 Trial running in JOG mode

1. Before performing this operation, confirm that the motor has been disconnected from the load.
2. Turn on the power supply (AC 220V or AC 380V). The front panel display is lit and the POWER indicating LED is lit. If any error alarm, please inspect the wiring.
3. After confirming that there is no alarm or abnormality, perform the following operations as shown below:



Change the speed command by ▲、▼ button, and the motor runs at the given speed. Positive number indicates forward rotation (CCW), negative number indicates reverse rotation (CW), and the minimum given speed is 0.1r/min.

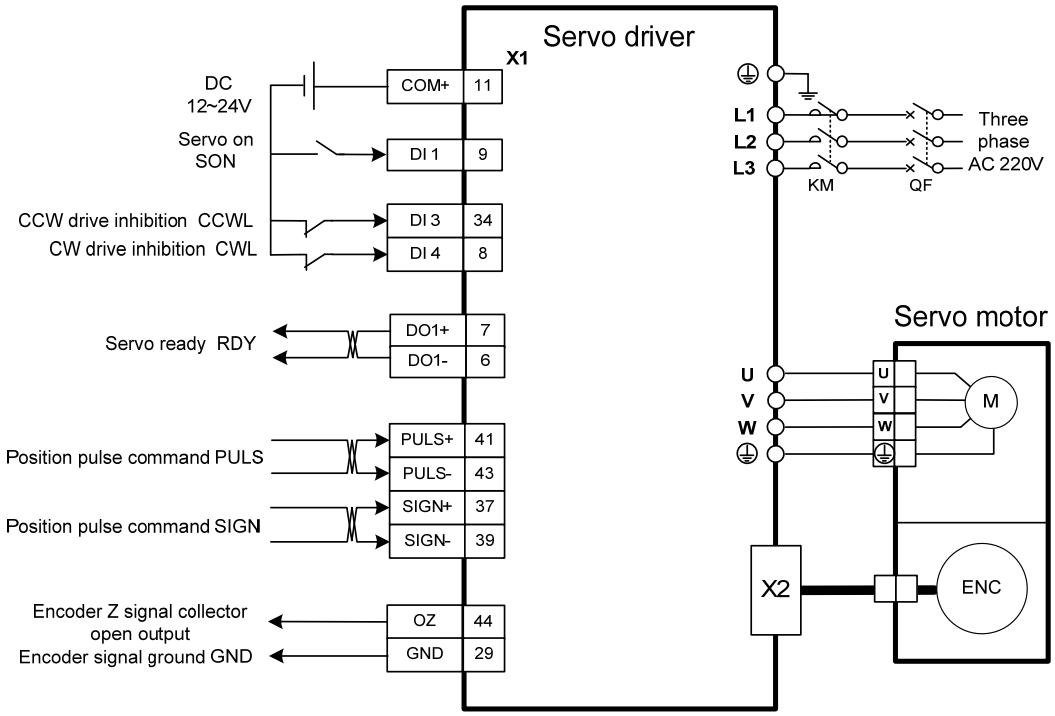
Note: After the Fn function is executed, the E-SET saving operation cannot be performed, and the power must be turned off and restarted, otherwise the state of Fn will be saved.

4.2 Position control mode

Position control mode is applied to the systems requiring precise positioning, such as CNC machine tools, textile machinery, etc. The source of position command is pulse command.

4.2.1 Simple example of position control mode

This is a simple example of the position control mode. The following figure is the wiring diagram.



Example parameter settings:

Para meter	Name	Setting value	Default value	Parameter explanation
P004	Control mode	0	0	Set position control mode
P043	Pulse input frequency selection	1	0	Select high speed pulse
P097	Ignore drive inhibit	3	3	Use forward drive inhibit (CCWL) and reverse drive inhibit (CWL). If set to ignore, did not connect CCWL、CWL.
P100	Digital input DI1 function	1	1	Set DI1 for servo enable (SON)
P130	Digital output DO1 function	2	2	Set DO1 for servo is ready(RDY)

4.2.2 Position command

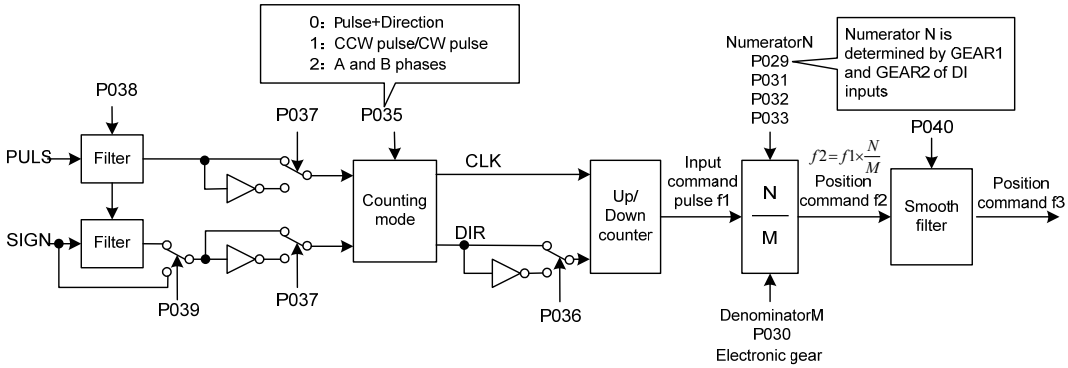
1. Parameters related to position command

Parameter	Name	Range	Default value	Unit	Usage
P027	Encoder pulse factor 1 [note]	1～32767	10000		P
P028	Encoder pulse factor 2 [note]	1～32767	1		P
P029	1st numerator of command pulse electronic gear	1～32767	1		P
P030	Command pulse electronic gear denominator	1～32767	1		P
P031	2nd numerator of command pulse electronic gear	1～32767	1		P
P032	3rd numerator of command pulse electronic gear	1～32767	1		P
P033	4th numerator of command pulse electronic gear	1～32767	1		P
P034	Command pulse input signal filtering	0～31	1		P
P035	Command pulse input mode	0～2	0		P
P036	Command pulse input direction	0～1	0		P
P037	Command pulse input signal logic	0～3	0		P
P039	Command pulse input filtering mode	0～1	0		P
P040	Position command exponential smoothing filtering time	0～1000	0	ms	P
P041	Position command exponential linear filtering time	0～256	0	ms	P
P043	Pulse input frequency selection	0～1	0		P

Note: By default (the electronic gear ratio is 1:1), the number of command pulses required for the motor to rotate for one cycle=P027 × P028.

Users need to make sure the result of P027×P028 is less than or equal to 131072.

2. Command pulse transmission path



3. Command pulse input mode

The input mode is determined by parameter P035. The input signal PULS and SIGN signal phases can be set by parameter P037 to adjust the counting edge. Parameter P036 is used to change the counting direction.

Pulse command form	CCW	CW	Parameter P035
Pulse + direction	PULS SIGN		0
CCW pulse/ CW pulse	PULS SIGN		1
Orthogonal pulse	PULS SIGN		2

Note: The arrow indicates the counting edge, and P036=0, P037=0.

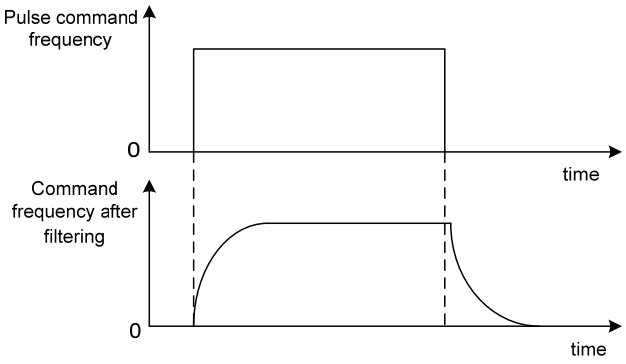
4. Signal filter

Parameter P034 sets the input signal PULS and SIGN digital filtering the larger the value, the larger the filtering time constant. The maximum pulse input frequency is 1000kHz(kpps) by default. The higher the value, the lower the maximum pulse input frequency will be.

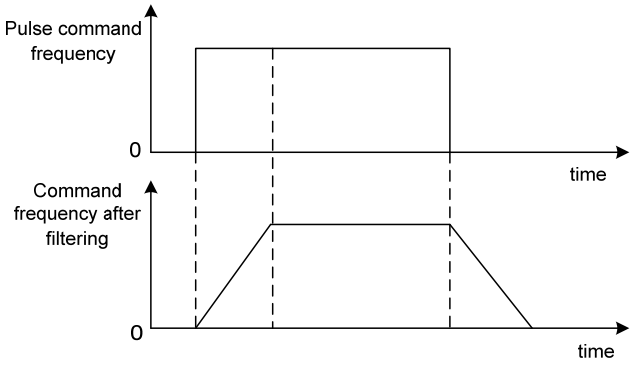
It is used to filter the noise on the signal line to avoid counting errors. In case of inaccurate counting, increase the parameter value appropriately. Parameter P039 turns off the filtering of the SIGN signal.

5. Smooth filter

As shown in the figure below, parameter P040 is used to smooth filter the command pulse, with exponential acceleration and deceleration. The filter will not lose the input pulse, but the command delay will occur. When set to 0, the filter does not work. The parameter value represents the time when the frequency rises from 0 to 63.2% of the position command frequency.



As shown in the figure below, parameter P041 is used to smooth filter the command pulse, with linear acceleration and deceleration. When set to 0, the filter does not work. The parameter value represents the time from when the frequency rises from 0 to 100% of the position command frequency.



The filter smoothes the input pulse frequency. This filter is used in situations where the host controller has no acceleration and deceleration function, the electronic gear ratio is large, and the command frequency is low.

4.2.3 Input electronic gear

The unit pulse command input to the device can be defined through the electronic gear to make the transmission device move any distance. The pulse command generated by the host controller does not need to consider the gear ratio, reduction ratio of the transmission system or the number of motor encoder lines. The following table describes the electronic gear variables:

Variable	Explanation	Value of this driver
P_t	Resolution of motor every turn (pulse/rev)	P027×P028 =10000×1 =10000(pulse/rev)
R	Reduction ratio	As the incremental type
ΔP	One command pulse travel equivalent	
P_c	Command pulse numbers in one turn of load shaft	
$Pitch$	Pitch of ball bearing screw (mm)	
D	Diameter of rolling cylinder (mm)	

Calculating formula：

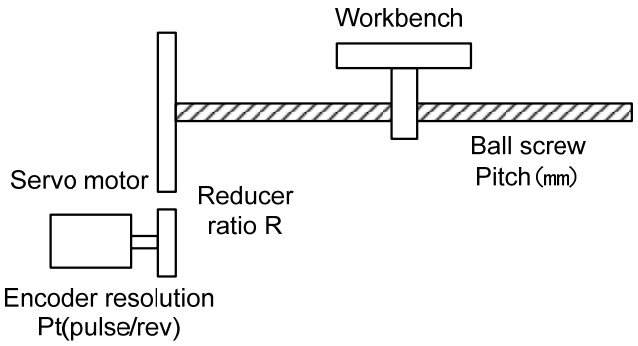
$$\text{Electronic gear ratio}(\frac{N}{M}) = \frac{\text{Resolution of motor every turn(Pt)}}{\text{Command pulse number in one turn of load shaft(Pc)} \times \text{Reduction ratio(R)}}$$

Here,

$$\text{command pulse number in one turn of load shaft}(P_c) = \frac{\text{Movement quantity in one turn of load shaft}}{\text{Movement quantity in one command pulse}(\Delta P)}$$

The calculated result will be abbreviated and make the numerator and the denominator smaller or equal to 32767 integer values. At last, the result must be in the range of 1/50<N/M<200 and write to the parameter list.

1. Electronic gear in ball screw applications



The ball bearing screw load has

$$\text{Electronic gear ratio}(\frac{N}{M}) = \frac{P_t}{P_c \times R}$$

Here,

$$\mathrm{P_c} = \frac{Pitch}{\Delta P}$$

For example:

Known, reduction ratio 1/1, Pitch=8mm, one pulse travel equivalent ΔP=0.001mm, calculate the electronic gear ratio.

Calculation step:

- Calculate the resolution of motor every turn (P_t)

$$\mathrm{P_t} = \mathrm{P027} \times \mathrm{P028} = 10000 \times 1 = 10000\ (pulse / rev)$$

- Calculate the command pulse number in one turn of load shift (Pc)

$$\mathrm{P_c} = \frac{Pitch}{\Delta P} = \frac{8mm}{0.001mm} = 8000$$

- Calculate the electronic gear ratio.

$$\text{Electronic gear ratio}(\frac{N}{M}) = \frac{P_t}{P_c \times R} = \frac{10000}{8000 \times (1/1)} = \frac{5}{4}$$

- Set parameters (By first numerator as an example)

  Numerator N=5，denominator M=4，set P029=5 and P030=4.

2. Relationship between number of the motor rotation turns and electronic gear ratio

The relationship between the number of motor rotation turns and the electronic gear is:

$$\text{Motor rotations turn number} = \frac{pulse \times N}{P_t \times M}$$

Among them, pulse is the number of input pulses. For example, the motor resolution every turn P_t=10000, N=20, M=3, pulse=1000, calculated as:

$$\text{Motor rotations turn number} = \frac{1000 \times 20}{10000 \times 3} = \frac{2}{3}(\text{Turn})$$

3. Relationship between motor rotation speed and electronic gear ratio

The relationship between motor rotation speed and electronic gear is:

$$\text{Motor speed}(r/\min) = \frac{f(Hz) \times 60 \times N}{P_t \times M}$$

Among them, f is the input pulse frequency, in Hz (pps), for example, the resolution of motor every turn P_t=10000, N=3, M=1, f=100kHz(kpps), calculated as:

$$\text{Motor speed}(r/\min) = \frac{100 \times 10^3 \times 60 \times 3}{10000 \times 1} = 1800(r/\min)$$

4. Electronic gear ratio switching

The driver provides four groups of electronic gear numerator N, which can be changed online and determined by GEAR1 and GEAR2 input by DI. The denominator M is the same.

DI signal[note]		Input electronic gear numerator N	Input electronic gear denominator M
GEAR2	GEAR1		
0	0	1st numerator(parameterP029)	Denominator(parameterP030)
0	1	2nd numerator(parameterP031)	
1	0	3rd numerator(parameterP032)	
1	1	4th numerator(parameterP033)	

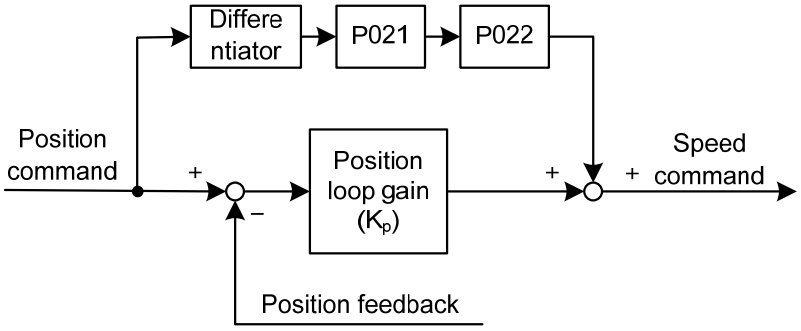
Note: 0 indicates OFF; 1 indicates ON.

4.2.4 Gains related to position control mode

Parameter	Name	Range	Default value	Unit	Usage
P009	1st position loop gain	1～1000	40	1/s	P
P021	Position loop feedforward gain	0～100	0	%	P
P022	Position loop feedforward filtering time constant	0.20～50.00	1.00	ms	P

Because the position loop includes the speed loop, first set the load moment of inertia ratio, then adjust the speed loop gain, speed loop integration time constant, and finally adjust the position loop gain according to the order of inner loop to outer loop.

The following is the position controller of the system. Increasing the gain K_p of the position loop can improve the bandwidth of the position loop, but it is limited by the bandwidth of the speed loop. To increase the gain of position loop, the bandwidth of speed loop must be increased first.



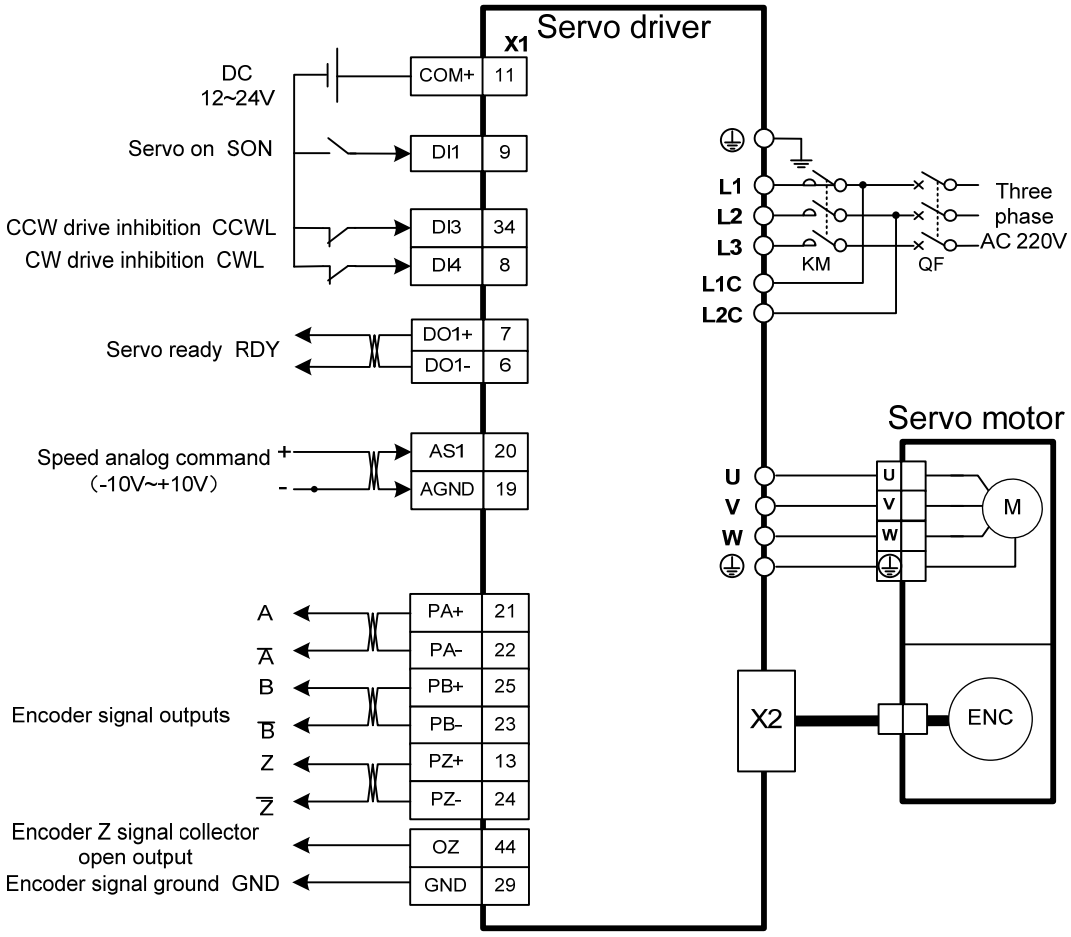
Feedforward can reduce the phase lag of position loop control, reduce the position tracking error and shorten the positioning time. With the increase of feedforward, the tracking error of position control is reduced, but if it is too large, the system will be unstable and overshoot. If the electronic gear ratio is greater than 10, it is also easy to generate noise. In general applications, P021 can be set to 0%. When high response and low tracking error are required, they can be increased appropriately, and should not exceed 80%. At the same time, it may be necessary to adjust the position loop feedforward filter time constant (parameter P022).

4.3 Speed control mode

Speed control mode is applied to the occasions requiring precise speed control, such as braider, drill, CNC machine. Position control can also be formed by host device.

4.3.1 Simple example of speed control mode

This is a simple example of speed control mode (analog speed command input). The following figure is the wiring diagram.



Example parameter settings:

Para meter	Name	Setting value	Parameter explanation
P004	Control mode	1	Set speed control mode.
P025	Speed command source	0	Set analog input.
P045	Analog channel selection	0	Set as AS1 channel, corresponding to speed command
P060	Speed command acceleration time	suitable	
P061	Speed command deceleration time	suitable	
P097	Ignore drive inhibit	3	Use forward drive inhibit (CCWL) and reverse drive inhibit (CWL). If set to ignore, did not connect CCWL、CWL.
P100	Digital input DI1 function	1	Set DI1 for servo enable (SON)
P130	Digital output DO1 function	2	Set DO1 for servo is ready(RDY)

4.3.2 Parameters related to speed command

The following table is the parameters related to the speed command:

Param eter	Name	Range	Default value	Unit	Usage
P025	Speed command source	0～6	0		S
P045	Analog channel selection	0～1	0		S,T
P046	Analog speed command gain	10～3000	300	r/min/V	S
P047	Analog speed command zero offset compensation	-1500.0～ 1500.0	0.0	mv	S
P048	Analog speed command direction	0～1	0		S
P049	Analog speed command filter time constant	0.20～50.00	2.00	ms	S
P050	Analog speed command polarity	0～2	0		S
P051	Analog speed command dead zone 1	0～13000	0	mv	S
P052	Analog speed command dead zone 2	-13000～0	0	mv	S
P076	JOG running speed	0～7500	100	r/min	S

4.3.3 Speed command source

Speed command has several different sources, which are set by parameter P025:

P025	Explanation	Interpret
0	Analog speed command	The source of the analog command is selected by the P045 parameter as AS1 or AS2
1	Internal speed command	Determined by SP1, SP2 DI input
3	JOG speed command	Set for JOG operation.
4	Keyboard speed command	Set for Keyboard speed adjustment (Sr) operation
5	Demonstration speed command	Set for speed regulation demonstration
6	External speed command	From external pulse frequency

Note: Internal speed command:

DI Signals		Speed command
SP2	SP1	
0	0	Internal speed 1 (parameter P141)
0	1	Internal speed 2 (parameter P142)
1	0	Internal speed 3 (parameter P143)
1	1	Internal speed 4 (parameter P144)

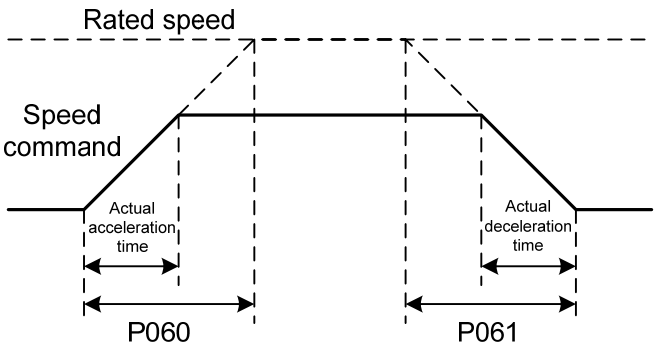
Above 0 indicates OFF; 1 indicates ON. Two DI inputs CZERO (zero command) and CINV (reverse command) can provide special functions. When CZERO is ON, the speed command is forced to zero; When CINV is ON, the speed command is reversed.

4.3.4 Acceleration and deceleration

The following parameters relate to acceleration and deceleration:

Para meter	Name	Range	Default value	Unit	Usage
P060	Speed command acceleration time	0～30000	0	ms	S
P061	Speed command deceleration time	0～30000	0	ms	S
P063	EMG(emergency shutdown) deceleration time	0～10000	1000	ms	ALL

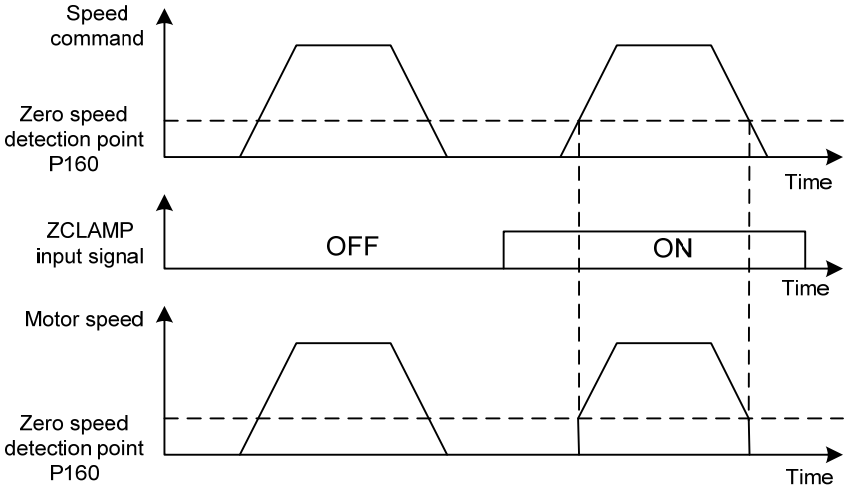
Acceleration and deceleration can slow down sudden changes in speed, making the motor run smoothly. As shown in the following figure, parameter P060 sets the acceleration time of the motor from zero speed to rated speed, and P061 sets the deceleration time of the motor from rated speed to zero speed. If the commanded speed is lower than the rated speed, the required acceleration and deceleration time will also be shortened accordingly. If the driver is operating in speed mode and the host (PLC, etc.) performs position closed-loop control, the parameter should be set to 0.



4.3.5 Zero speed clamp

Parameters related to zero speed clamp:

Para meter	Name	Range	Default value	Unit	Usage
P160	Zero speed detection point	0～1000	10	r/min	ALL
P161	Zero speed detection hysteresis	0～1000	5	r/min	ALL
P162	Zero speed clamp mode	0～1	0		S



In speed control mode, even if the motor is at zero speed, external force may rotate and cause position change. If the analog speed command is input, the absolute zero speed command is not easy to implement. To solve these two problems, the zero speed clamping function can be considered. The zero speed clamping function is enabled when the following conditions are met:

Condition 1: Speed control mode;

Condition 2: ZCLAMP (zero speed clamping) in DI is ON;

Condition 3: Speed command is lower than parameter P160.

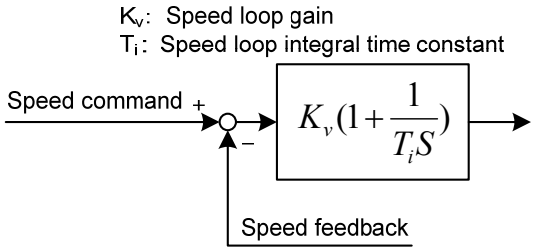
If any of the above conditions are not met, normal speed control shall be performed. There are two modes of zero speed clamping:

P162	Explanation
0	The motor position is fixed at the moment when the function is turned on. At this time, the internal access position control will return to the zero fixed point even if the rotation occurs due to external force.
1	When the function is turned on, the speed command is forced to zero speed. The internal control is still speed control, which may rotate due to external forces.

4.3.6 Speed control mode related gain

Para meter	Name	Range	Default value	Unit	Usage
P005	1st speed loop gain	1～3000	40	Hz	P,S
P006	1st speed loop integral time constant	1.0～1000.0	20.0	ms	P,S
P010	2nd speed loop gain	1～3000	40	Hz	P,S
P011	2nd speed loop integral time constant	1.0～1000.0	20.0	ms	P,S
P017	Load moment of inertia ratio	0.0～200.0	1.0	times	P,S
P018	Speed loop PDFF control coefficient	0～100	100	%	P,S

First, set the load moment of inertia ratio, and then adjust the speed loop gain and speed loop integration time constant. The following is the speed controller of the system. Increasing the speed loop gain K_V can improve the speed response bandwidth, and decreasing the speed loop integration time constant T_i can increase the system rigidity and reduce the steady-state error.



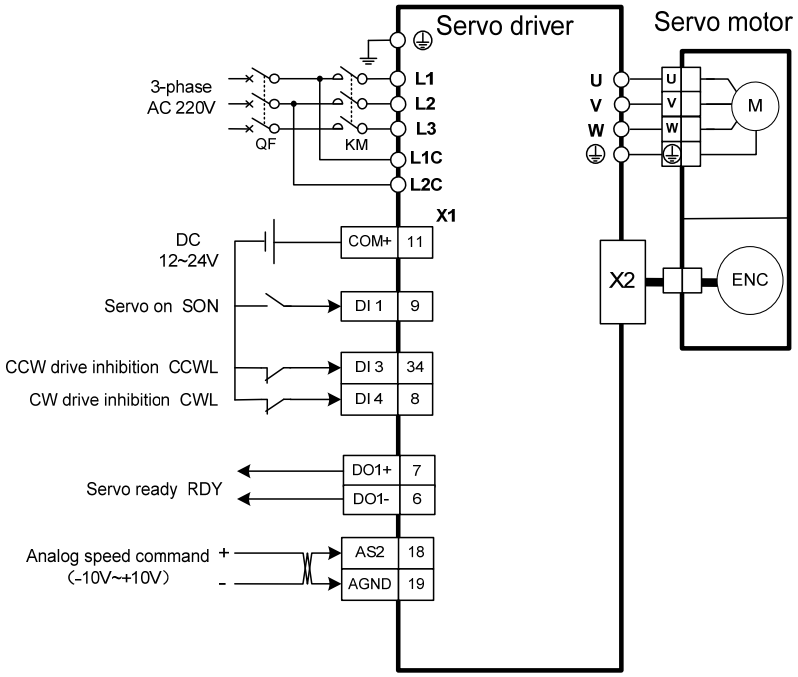
P018 can choose the speed controller structure. 0 is the IP regulator, 100 is the PI regulator, 1～99 is the PDFF regulator. If the parameter value of P018 is too large, the system has high frequency response; if the parameter value is too small, the system has high stiffness (resistance to deviation); if the parameter value is too small, both frequency response and stiffness are considered.

4.4 Torque control mode

Torque control mode is used for printing, winding machines, injection molding machines and other occasions. The motor output torque is proportional to the input command.

4.4.1 Simple example of torque control mode

This is a simple example of torque control mode (analog torque command input). The following figure is the wiring diagram.



Example parameter settings:

Para meter	Name	Setting value	Default value	Parameter explanation
P004	Control mode	2	0	Set for torque control mode.
P026	Torque command source	0	0	Set for analog input.
P045	Analog channel selection	0	0	AS2 channel, corresponding torque command
P097	Ignore drive inhibit	3	3	Use forward drive inhibit (CCWL) and reverse drive inhibit (CWL). If set to ignore, did not connect CCWL、CWL.
P100	Digital input DI1 function	1	1	Set DI1 for servo enable (SON)
P130	Digital output DO1 function	2	2	Set DO1 for servo is ready(RDY)

4.4.2 Parameters related to torque command

The following table shows the parameters related to torque command:

Para meter	Name	Range	Default value	Unit	Usage
P026	Torque command source	0～2	0		T
P045	Analog channel selection	0～1	0		S,T
P053	Analog torque command gain	1～300	30	%/V	T
P054	Analog torque command zero offset compensation	-1500.0～1500.0	0.0	mv	T
P055	Analog torque command direction	0～1	0		T
P056	Analog torque command filter time constant	0.20～50.00	2.00	ms	T
P057	Analog torque command polarity	0～2	0		T

4.4.3 Torque command source

Torque command has several different sources, which are set by parameter P026:

P026	Explanation	Interpret
0	Analog torque command	The source of analog quantity command is selected from AS1 or AS2 by P045 parameter
1	Internal torque command	It is determined by TRQ1 and TRQ2 inputted by DI [Note 1].
2	Analog torque command + Internal torque command	When TRQ1 and TRQ2 are OFF, it is an analog command, and the rest is determined by TRQ1 and TRQ2 [Note 2].

Note 1: Internal torque command:

DI Signals		Torque command
TRQ2	TRQ1	
0	0	Internal torque 1(parameterP145)
0	1	Internal torque 2(parameterP146)
1	0	Internal torque 3(parameterP147)
1	1	Internal torque 4(parameterP148)

Note 2: Analog torque command + Internal torque command:

DI Signals		Torque command
TRQ2	TRQ1	
0	0	Analog torque command
0	1	Internal torque 2(parameterP146)
1	0	Internal torque 3(parameterP147)
1	1	Internal torque 4(parameterP148)

Above 0 indicates OFF; 1 indicates ON. Two DI inputs CZERO (zero command) and CINV

(reverse command) can provide special functions. When CZERO is ON, the torque is forced to zero; When CINV is ON, the torque command is reversed.

4.4.4 Speed limit of torque control mode

In the torque control mode, the motor torque output is controlled by the command, but the motor speed is not controlled. Therefore, over-speed may occur under light load. In order to protect the machinery, the speed must be limited. The parameters related to speed limit are:

Para meter	Name	Range	Default value	Unit	Unit
P077	Speed limit selection	0～2	0		T
P078	Speed limit in torque control mode	0～5000	3000	r/min	T

There are three speed limits for torque control mode:

P077	Explanation	Interpret
0	Basic limit	Limited by parameter P078.
1	Basic limit +Analog limit	In addition to the basic limit, it is also limited by the analog speed command.
2	Basic limit +Internal speed limit	In addition to the basic limit, it is also limited by the internal speed command, which is determined by the SP1 and SP2 input by DI.

Note: 1. Speed limit regardless of direction.

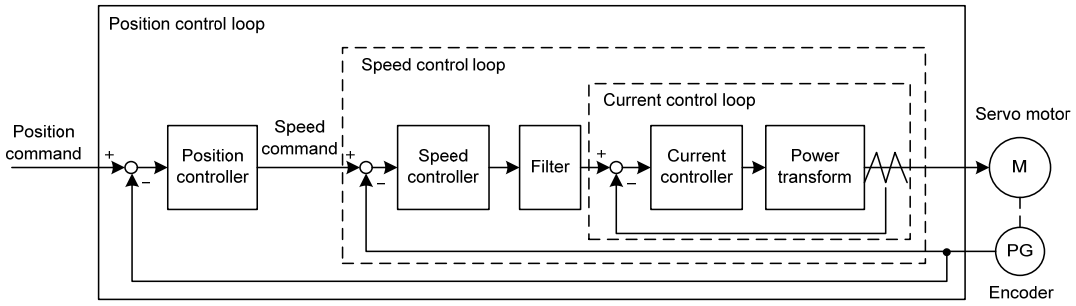
2. If many limits occur, the final limit value is the value with smaller absolute value.
3. Even if the set value exceeds the maximum speed allowed by the system, the actual speed will be limited to the maximum speed.
4. Internal speed command is determined by SP1 and SP2 input by DI:

Signal [Note]		Speed command
SP2	SP1	
0	0	Internal speed 1 (parameter P141)
0	1	Internal speed 2 (parameter P142)
1	0	Internal speed 3 (parameter P143)
1	1	Internal speed 4 (parameter P144)

Note: 0 indicates OFF; 1 indicates ON.

4.5 Gain adjustment

Driver includes three control loops: current control loop, speed control loop and position control loop. The control block diagram is as follows:



Theoretically, the bandwidth of the inner control loop must be higher than that of the outer control loop. Otherwise the whole control system will be unstable and cause vibration or poor response. Therefore, the relationship between the bandwidth of the three control loops is as follows:

Current loop bandwidth>speed loop bandwidth>position loop bandwidth

Since the driver has adjusted the current control loop to the best state, the user only needs to adjust the parameters of the speed control loop and the position control loop.

4.5.1 Gain parameter

Parameters related to gain are:

Para meter	Name	Range	Default value	Unit	Usage
P005	1st speed loop gain	1～3000	40	Hz	P,S
P006	1st speed loop integral time constant	1.0～1000.0	20.0	ms	P,S
P009	1st position loop gain	1～1000	40	1/s	P
P010	2nd speed loop gain	1～3000	40	Hz	P,S
P011	2nd speed loop integral time constant	1.0～1000.0	20.0	ms	P,S
P013	2nd position loop gain	1～1000	40	1/s	P
P017	Load moment of inertia ratio	0.0～200.0	1.0	times	P,S

Symbols are defined as follows:

K_v: Speed loop gain;

T_i: Speed loop integral time constant;

K_p: Position loop gain;

G: Load moment of inertia ratio (P017);

J_L: Load moment of inertia converted to motor shaft;

J_M: Moment of inertia of motor rotor.

1. Speed loop gain K_v

Speed loop gain K_v directly determines the response bandwidth of the speed loop. On the premise that the mechanical system does not produce vibration or noise, increasing the gain value of the speed loop will accelerate the speed response and the better the following of the speed command. However, excessive settings are easy to cause mechanical resonance. The bandwidth of the speed loop is expressed as:

$$\text{Speed loop bandwidth}\,(Hz) = \frac{1+G}{1+J_L/J_M} \times K_v(Hz)$$

If the load moment of inertia ratio G is set correctly ($G=J_L/J_M$), the speed loop bandwidth is equal to the speed loop gain K_v.

2. Speed loop integral time constant T_i

Speed loop integration can effectively eliminate the steady-state error of speed and quickly respond to subtle speed changes. On the premise that the mechanical system does not produce vibration or noise, reduce the speed loop integral time constant T_i to increase the system rigidity and reduce the steady-state error. If the load inertia ratio is large or the mechanical system has resonance factors, it must be confirmed that the integral time constant of the speed loop is large enough. Otherwise the mechanical system is easy to produce resonance. If the load moment of inertia ratio G is set correctly ($G=J_L/J_M$), the speed loop integral time constant T_i is obtained by using the following formula:

$$T_i(ms) \geq \frac{4000}{2\pi \times K_V(Hz)}$$

3. Position loop gain K_p

Position loop gain directly determines the reaction speed of the position loop. On the premise that the mechanical system does not produce vibration or noise, increase the gain value of the position loop to speed up the reaction speed, reduce the position tracking error and shorten the positioning time. However, excessive setting will cause mechanical system jitter or positioning overshoot. The bandwidth of the position loop shall not be higher than that of the speed loop, generally

$$\text{Position loop bandwidth}\,(Hz) \leq \frac{\text{Speed loop bandwidth (Hz)}}{4}$$

If the load moment of inertia ratio G is set correctly ($G= J_L/J_M$), the position loop gain K_p is calculated as follows:

$$K_p(1/s) \leq 2\pi \times \frac{K_v(Hz)}{4}$$

4.5.2 Gain adjustment steps

The choice of position and speed bandwidth must be determined by the rigidity of the machinery and the application situation; the conveying machinery connected by the belt has low rigidity and can be set to a lower frequency bandwidth; the mechanical stiffness of the ball screw driven by the reducer is medium, which can be set to medium bandwidth; Direct drive ball screw or linear motor has high rigidity and can be set as high frequency bandwidth. If the mechanical characteristics are unknown, gradually increase the gain to increase the bandwidth until resonance, and then lower the gain.

In servo gain, if one parameter is changed, other parameters also need to be readjusted. Please do not make major changes to only one parameter. For the change steps of servo parameters, please generally follow the following principles:

Increase response	Decrease response，restrain vibration and overshoot
1.Increase speed loop gain K_v	1.Decrease position loop gain K_p
2.Decrease speed loop integral time constant T_i	2.Increase speed loop integral time constant T_i
3.Increase position loop gain K_p	3.Decrease speed loop gain K_v

Speed control gain adjustment steps:

1. Set the load moment of inertia ratio.
2. Set the speed loop integral time constant to a larger value.
3. Increase the speed loop gain in the range without vibration and abnormal sound, and slightly decrease if vibration occurs.
4. Speed loop integral time constant should be decrease in the range without vibration, and slightly increased if vibration occurs.
5. If the gain cannot be increased due to the resonance of the mechanical system and the desired responsiveness cannot be obtained, adjust the torque filter time constant (P007), and then repeat the above steps to improve responsiveness.

Position control gain adjustment steps:

1. Set the moment of inertia ratio of the load.
2. Set the speed loop integral time constant to a larger value.
3. Increase the speed loop gain in the range without vibration and abnormal sound, and slightly decrease if vibration occurs.
4. Speed loop integration time constant should be reduced within the range without vibration, and slightly increased if vibration occurs.
5. Increase the position loop gain and slightly decrease the vibration if it occurs.
6. If the gain cannot be increased due to the resonance of the mechanical system and the desired responsiveness cannot be obtained, adjust the torque filter time constant (P007), and then repeat the above steps to improve responsiveness.
7. If shorter positioning time and smaller position tracking error are required, position feedforward can be adjusted appropriately, please refer to Section 4.2.4.

4.5.3 Parameter self-tuning

The self-tuning mode used is selected by parameter P296: 0 is the manual setting mode, 1 is the automatic setting mode, and 3 is the feedforward setting mode. The parameters set in the manual setting mode and automatic setting mode in the auto-tuning process include five parameters: P005、P006、P007、P009 and P019. The feedforward setting mode is used to set P021 feedforward gain. The relevant parameters of the motion path configuration in the self-tuning process are as follows:

Para meter	Name	Range	Default value	Unit	Usage
P472	Number of forward turns of round-trip motion	1～32767	3		P
P473	Number of reverse turns of round-trip motion	1～32767	3		P
P474	Round-trip speed	1～32767	1000	rpm	P
P475	Round-trip acceleration time	0～32767	50	ms	P
P476	Round-trip deceleration time	0～32767	50	ms	P

In addition, if it is necessary to have the automatic suppression function of vibration points in the parameter self-tuning process, it is necessary to turn on the automatic notch filter or enable the automatic intermediate frequency vibration suppression function. The automatic trap function can be turned on by setting P213 parameter to 1, and the automatic IF suppression function can be turned on by setting P229 parameter to 2.

Before the parameter self-tuning process, it is necessary to ensure that the entire motion path has enough available displacement to avoid equipment damage and other problems. After setting the self-tuning mode through parameter P296, use the Fn 2 function to enter the parameter self-tuning process.

In the manual setting mode, adjust the set gain level through the up and down keys on the keyboard. Each gain level corresponds to a set of speed loop and position loop parameters. The last two digits of the screen display the current gain level. Exit the Fn 2 mode through the back key. At this time, you can view the relevant parameters after setting. If you need to save, you need E-SET operation;

In the automatic setting mode, the gain level of the speed loop and the position loop is automatically set. The sequence is to set the speed loop parameters first, and then the position loop parameters. The last two digits of the same screen display the current gain level. After all settings are completed, "--" is displayed in the middle of the screen, which means the automatic setting process is over. Exit the Fn 2 mode by pressing the Back key. At this time, you can view the relevant parameters after setting. If you need to save, you need E-SET operation;

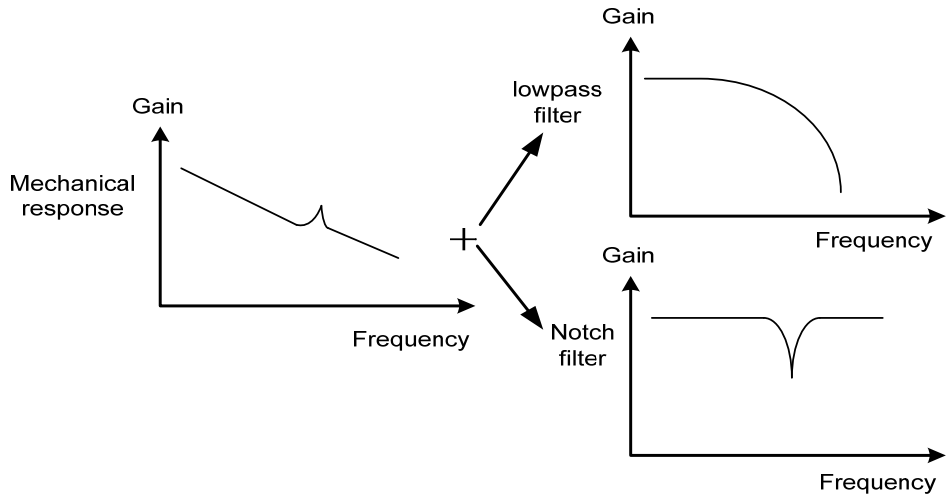
In the feedforward setting mode, set the feedforward percentage parameter P021. The last two digits of the screen display the current feedforward percentage. After setting, the middle two digits of the screen display "--", indicating the end of automatic setting. Exit the Fn 2 mode by pressing the Back key. At this time, you can view the relevant parameters after setting. If you need to save, you need E-SET operation.

4.6 Resonance suppression

When resonance occurs in the mechanical system, it may be caused by the servo system being too large and responding too fast. Reducing the gain may improve it. The driver provides a low-pass filter and a notch filter to suppress resonance without changing the gain. Parameters related to resonance suppression are as follows:

Para meter	Name	Range	Default value	Unit	Usage
P007	1st torque filter time constant	0.01～50.00	1.00	ms	ALL
P012	2nd torque filter time constant	0.01～50.00	1.00	ms	ALL
P200	1st notch filter frequency	50～5000	5000	Hz	ALL
P201	1st notch filter quality factor	1～100	7		ALL
P202	1st notch filter depth	0～60	0	dB	ALL
P203	2nd notch filter frequency	50～5000	5000	Hz	ALL
P204	2nd notch filter quality factor	1～100	7		ALL
P205	2nd notch filter depth	0～60	0	dB	ALL
P206	2nd torque filter frequency	100～5000	5000	Hz	ALL
P207	2nd torque filter quality factor	1～100	50		ALL
P214	3rd notch filter frequency	50～5000	5000	Hz	ALL
P215	3rd notch filter quality factor	1～100	7		ALL
P216	3rd notch filter depth	0～60	0	dB	ALL
P217	4th notch filter frequency	50～5000	5000	Hz	ALL
P218	4rth notch filter quality factor	1～100	7		ALL
P219	4th notch filter depth	0～60	0	dB	ALL

The principle of resonance suppression is to use a filter to suppress the formant of the mechanical response. The schematic diagram is as follows:



The characteristics of the two filters are:

Filter type	Suitable case	Advantage	Disadvantage
Low pass filter	High frequency resonance	Do not need to know the exact resonance frequency	Bring phase delay; reduce bandwidth of the system. Do not suitable for the case of medium and low frequency resonance.
Notch filters	Medium and low frequency resonance	Do not affect the bandwidth of the system.	It is important to know the exact resonance frequency. If make mistake of frequency setting, will affect the performance. It is not suitable that if the resonance frequency drifts all the time.

4.6.1 Low pass filter

Set by parameters P007 and P012, and select one of them for gain switching, which cannot be used at the same time. The low-pass filter is valid by default. Low pass filter has good attenuation to high frequency, and can better restrain high frequency resonance and noise. For example, when using a ball screw machine to improve the driver gain, high-frequency resonance sometimes occurs, and using a low-pass filter has a better effect. However, the system response bandwidth and phase margin are also reduced, and the system may become unstable. If the system is medium low frequency resonance, the low-pass filter cannot suppress it.

When the high frequency vibration of the machine is caused by the servo drive, adjust the time constant T_f of the torque filter. This may eliminate the vibration. The smaller the numerical value, the more responsive the control can be, but it is limited by mechanical conditions. The larger the value, the more high-frequency vibration can be suppressed. If the value is too large, the phase margin will be reduced, causing oscillation. If the load moment of inertia ratio G is set correctly ($G=J_L/J_M$), it shall meet the following requirements:

$$T_f(ms) \le \frac{1000}{2\pi \times 2 \times K_v(Hz)}$$

4.6.2 Notch filter

Set by parameters P200～P205 and P214～P219, multiple notch filters can be used at the same time to suppress various frequency resonances. The default notch filter is turned off. If the resonance frequency can be known, the notch filter can directly eliminate the resonance. Generally, if the resonant frequency is determined, the notch filter is better than the low-pass filter. When the resonance frequency is unknown, the suppression frequency can be reduced gradually from high to low, and the suppression frequency at the minimum vibration point is the optimal setting value. However, if the resonance frequency shifts with time or other factors and the shift is too large, the notch filter is not suitable for use.

In addition to frequency, the notch depth and quality factor can also be adjusted, but pay attention to proper settings. The notch depth is deep, and the effect of mechanical resonance suppression may be good, but it will cause a large phase change, and sometimes it will strengthen the vibration. Small quality factor, wide notch width, mechanical resonance suppression may be very good, but it will cause large phase change area, sometimes it will strengthen the vibration.

When setting the notch filter, the parameter setting process can be simplified through the "mechanical analysis" function or the "automatic notch filter" function. See the corresponding content in the "4.5.3 Parameter self-tuning" chapter for the detailed description of these two functions.

4.6.3 Automatic notch filter

Select whether to enable the automatic notch filter function by parameter P213: 0 indicates disabled, 1 indicates enabled. The function of automatic notch filter is applicable to the vibration of frequency above 300Hz bandwidth, and can realize the vibration suppression function of this frequency range.

When the parameter P213 is set to 1, the automatic notch filter function will be turned on. When mechanical vibration above 300Hz occurs, the driver will automatically detect the vibration frequency point and set the parameters of the notch filter, and complete the suppression of the vibration point. There is no need to manually set the relevant parameters of the notch filter. The frequency of the detected vibration point is stored in parameter P200.

4.6.4 Notch filter automatic medium frequency vibration suppression

When the parameter P229 medium frequency vibration suppression switch parameter is set to 2, the automatic medium frequency vibration suppression function is enabled. The vibration judgment level can be modified through parameter P289, which is 10rpm by default. When the automatic medium frequency vibration suppression function is enabled, the vibration frequency of 100Hz～1500Hz mechanical vibration can be detected and suppressed. And the detected vibration point frequency value will be stored in P226.

4.7 Gains switching

Gain switching through internal state or external signal to achieve the following purposes:

- Switching to a lower gain when the motor stops (servo locking) to suppress vibration and sharp noise;
- Switching to a higher gain when the motor stops to increase the rigidity of the servo;
- Switching to higher gain when the motor is running to obtain better command tracking performance and smaller positioning time;
- Switching different gains according to the load equipment to achieve the best control.

1st gain and the 2nd gain are combined forms, each group has four parameters, and they are switched at the same time. The following is the gain combination:

1st gain		2nd gain	
Para meter	Name	Para meter	Name
P005	1st speed loop gain	P010	2nd speed loop gain
P006	1st speed loop integral time constant	P011	2nd speed loop integral time constant
P007	1st torque filter time constant	P012	2nd torque filter time constant
P009	1st position loop gain	P013	2nd position loop gain

4.7.1 Gain switching parameters

Parameters related to gain switching are:

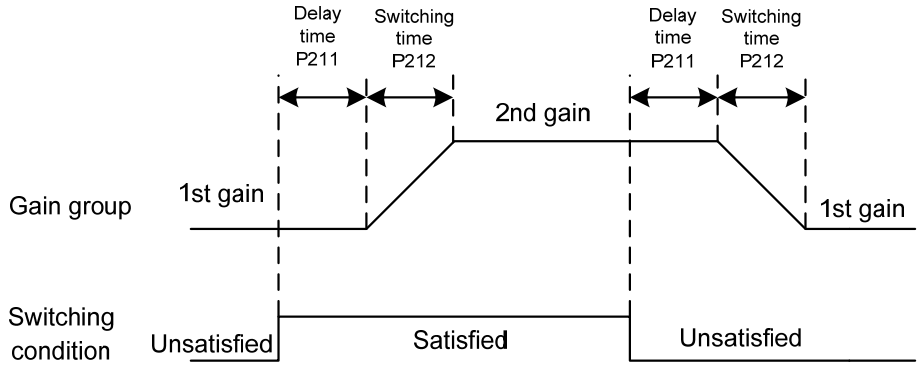
Para meter	Name	range	Default value	Unit	Usage
P208	Gain switching selection	0～15	0		ALL
P209	Gain switching level	0～32767	100		ALL
P210	Gain switching level hysteresis	0～32767	5		ALL
P211	Gain switching delay time	0～3000	5	ms	ALL
P212	Gain switching time	0～3000	5	ms	ALL

4.7.2 Gain switching action

Gain switching action conditions are:

P208	P209	Condition of gain switching
0	Unacted	Fixed 1st gain
1	Unacted	Fixed 2nd gain
2	Unacted	DI input GAIN terminal determines that OFF is the 1st gain and ON is the 2nd gain.
3	Frequency(×0.1kpps)	Input command pulse frequency exceeds P209 the switching condition is satisfied.
4	Position(pulse)	Pulse deviation exceeds P209, the switching conditions is satisfied
5	Speed(r/min)	Motor speed exceeds P209, the switching conditions is satisfied.
Other	Reserved by manufacturer	Reserved by manufacturer, please do not set

As shown in the figure below, when the switching conditions are satisfied, the gain is switched to the 2nd gain; when the switching conditions are unsatisfied, the gain is switches to the 1st gain. The change state of switching conditions must be maintained for more than the set time of parameter P211 before switching, so as to avoid false switching due to interference. When switching, the current gain combination will change linearly and smoothly to the target gain combination according to the setting time of parameter P212, and each parameter in the combination will change at the same time to avoid mechanical impact caused by sudden change of parameters. To prevent frequent switching, the comparator has a hysteresis (parameter P210).



Speed PI/P control switching function can be realized. Set the 2nd speed loop integral time constant (P011) to the maximum (1000.0), which is equivalent to canceling the integration. Other parameters of the 2nd gain are the same as those of the 1st gain. As a result, the gain switching is equivalent to the speed PI/P control switching.

4.8 Homing

Homing is to let the machine move to a specified starting point as a reference home for future actions.

4.8.1 Homing parameter

The parameters related to homing are:

Para meter	Name	range	Default value	Unit	Usage
P178	Homing trigger mode	1～3	1		ALL
P179	Homing mode	0～42	0		ALL
P181	Homing position offset high digit	-8192～8192	0	65536 pulse	ALL
P182	Homing position offset low digit	-32768～32767	0	pulse	ALL
P183	Homing first speed	1～3000	500	r/min	ALL
P184	Homing second speed	1～3000	50	r/min	ALL
P185	Homing acceleration time	0～30000	0	ms	ALL
P186	Homing deceleration time	0～30000	0	ms	ALL
P187	Homing positioning delay time	0～3000	500	ms	ALL
P188	Homing completes signal delay	1～3000	100	ms	ALL

4.8.2 Homing running steps

Homing running in two steps:

1. Find reference point (Rough home)

After starting the homing function, find the reference point according to the homing first speed. You can use the input terminal REF (external detector input), CCWL or CWL as the reference point, or use the Z pulse as the reference point. You can select the forward or reverse direction to find.

2. Find home

When the reference point is found, search for home according to the home second speed. You can choose to continue to turn forward or backward to find the Z pulse, or you can directly use the reference point as home.

In the execution of homing, acceleration and deceleration can be set according to parameters P185 and P186 to prevent mechanical impact caused by rapid speed change. The found home plus the offset is used as the actual home. The offset is P181×65536+P182, the pulse here is a unified pulse unit, 65536 pulses per turn of the motor, and P181 parameter value is the number of turns of the motor.

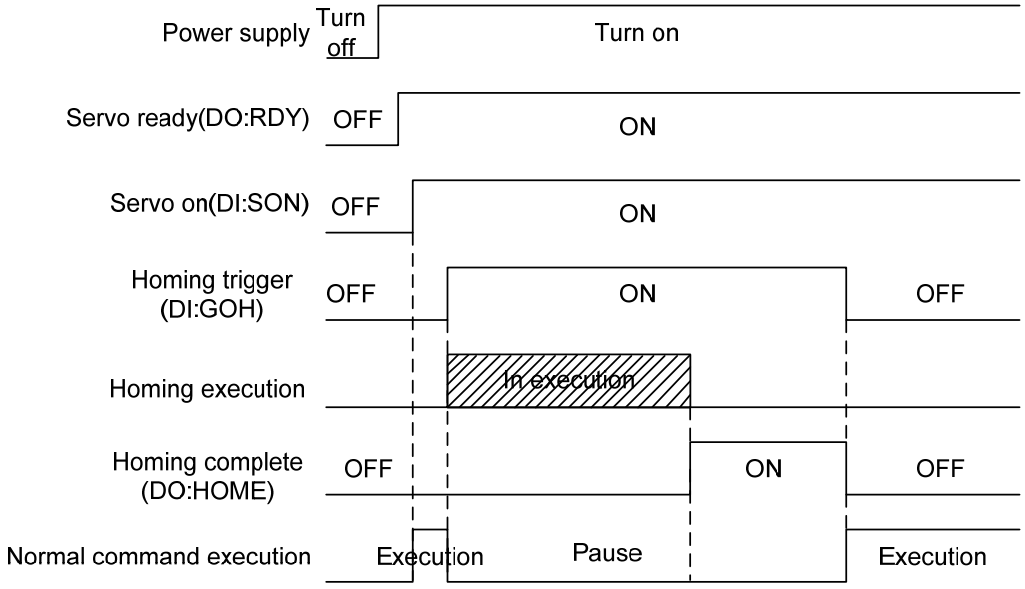
4.8.3 Homing timing chart

1. Level trigger (P178=1)

After the SON is ON, the input terminal GOH triggers homing execution and suspends normal command execution. GOH is always ON. After homing is completed, the position and position deviation are cleared, and the output terminal HOME becomes ON. Until GOH becomes OFF, HOME becomes OFF.

After the homing is completed, wait for the HOME signal to turn OFF before executing the command. During the waiting period, the motor stays at home and does not accept the command.

If the servo enable SON is canceled, any alarm is generated, and GOH is turned OFF in advance during homing, the homing function is stopped and the output terminal HOME does not act.

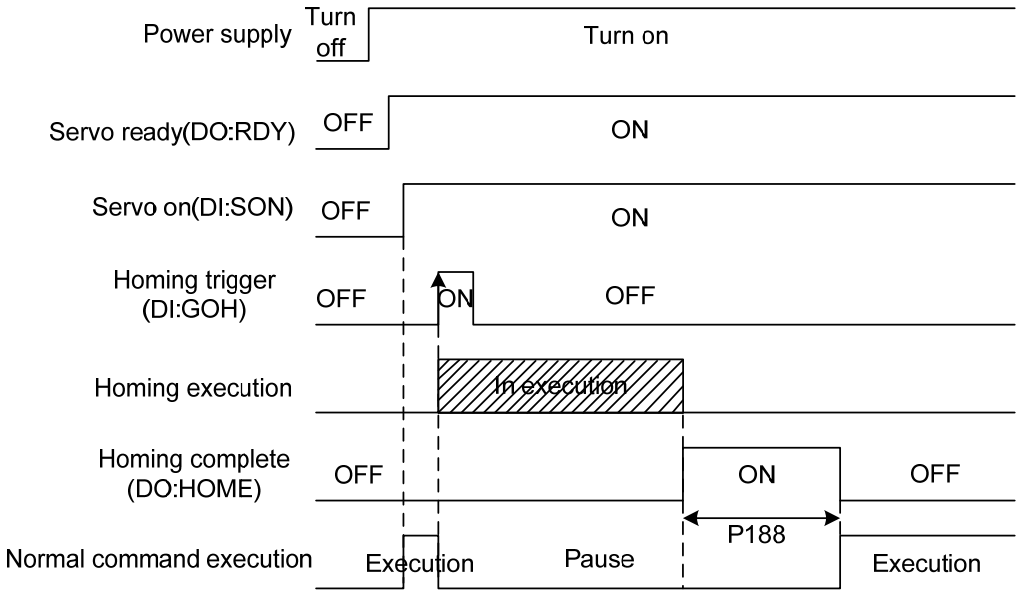


2. Rising edge trigger (P178=2)

After the SON is ON, the rising edge of the input terminal GOH triggers the homing execution and suspends the normal command execution. After homing is completed, the position and position deviation are cleared, and the output terminal HOME is turned ON. After the time delay P188 is set, HOME becomes OFF.

After the homing is completed, wait for the HOME signal to turn OFF before executing the command. During the waiting period, the motor stays at home and does not accept the command.

If the SON is OFF, any alarm is generated and GOH is turned OFF in advance during homing, the homing function is stopped and the output terminal HOME does not act.



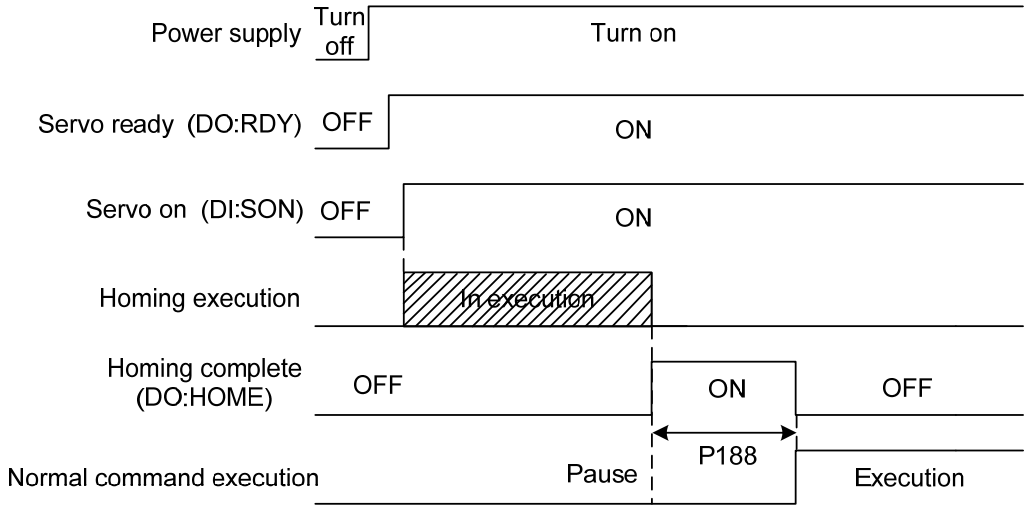
3. Turn on automatic execution (P178=3)

This function only uses in the condition that the power supply turn on and the SON is ON for the first time. Each time carries out homing operation once and will not need to execute homing operation later. Using this function can abbreviate a GOH input terminal.

After the initial enabling of servo, homing is executed. After homing is executed, the position and position deviation are cleared, and the output terminal HOME becomes ON. After the delay time set by P188 has completed, then HOME signal becomes OFF. Then can carry out the normal command execution again.

After the homing is completed, wait for the HOME signal to turn OFF before executing the command. During the waiting period, the motor stays at home and does not accept the command.

If the SON becomes OFF, or any alarm is generated during homing, the homing function is stopped and the output terminal HOME does not act. If the servo-on is not valid for the first time, homing cannot be triggered again.

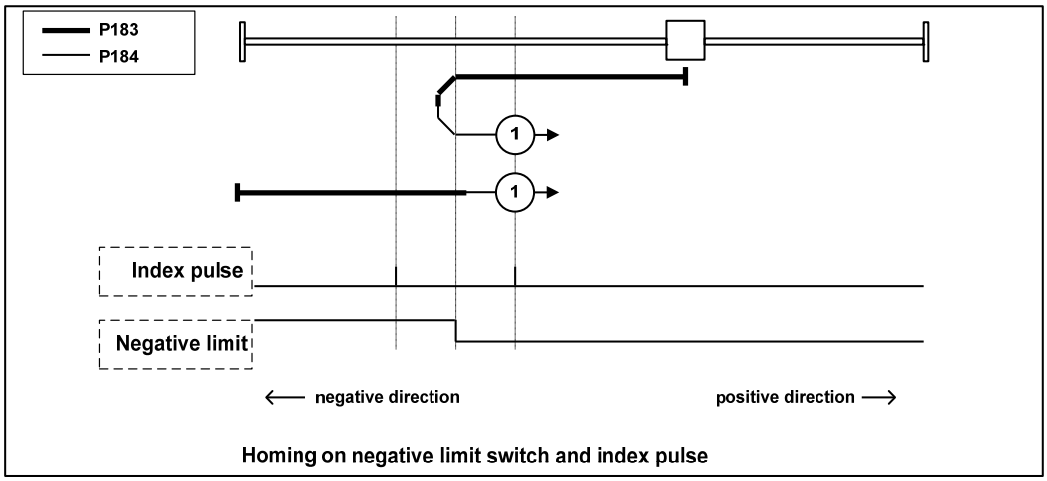


4.8.4 Homing mode timing chart

Homing mode is specified by (P179).

Mode 1 (P178=1/2/3, P179=1, DI=23=GOH, DI=4= negative limit)

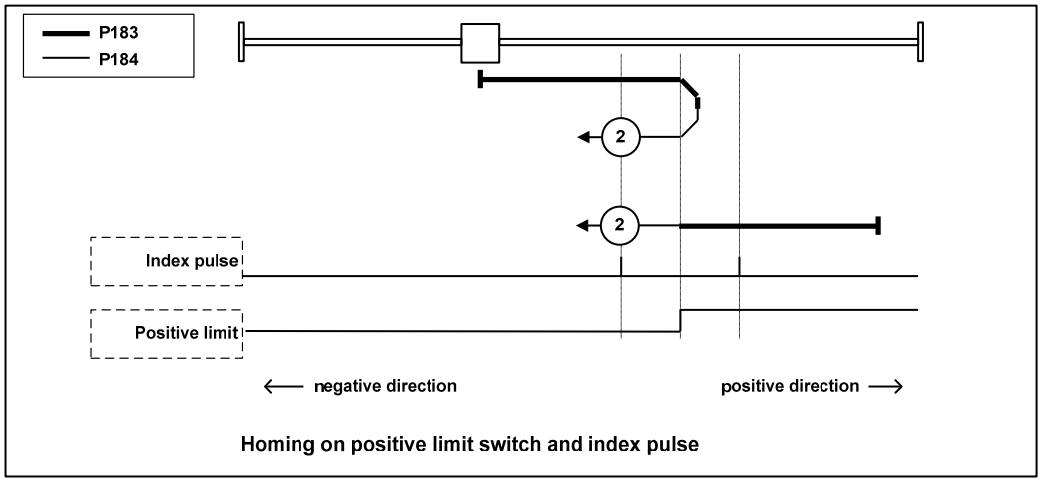
- In this mode, if the negative limit switch is not activated, the initial action direction is negative. (Figure shows inactive state at low level state)
- The homing detection position is the initial index pulse detection position in the positive direction after the negative limit signal is inactive.



Homing on negative limit switch and index pulse

Mode 2 (P178=1/2/3, P179=2, DI=23=GOH, DI=3= positive limit)

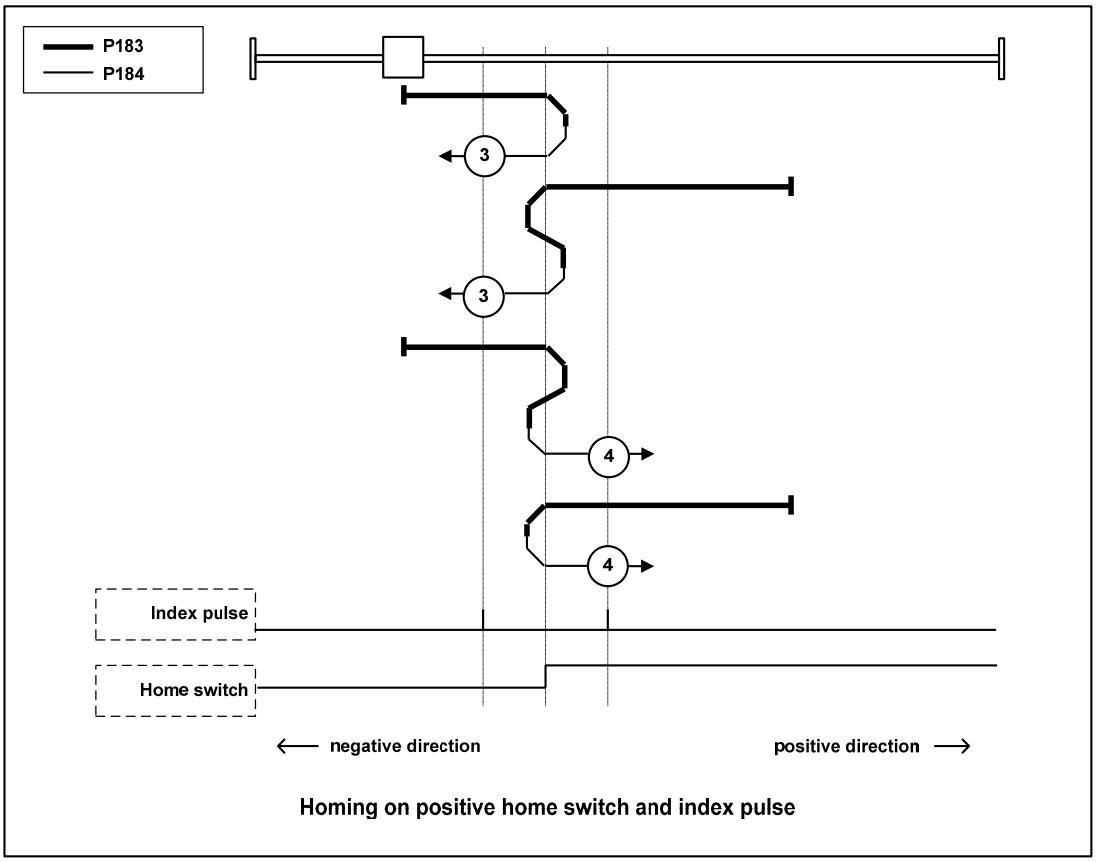
- In this mode, if the positive limit switch is not activated, the initial action direction is positive. (Figure shows inactive state at low level state)
- The homing detection position is the initial index pulse detection position in the negative direction after the positive limit signal is inactive. (Please refer to the following figure)



Homing on positive limit switch and index pulse

Mode 3，4 (P178=1/2/3，P179=3/4，DI=23=GOH，DI=24=REF)

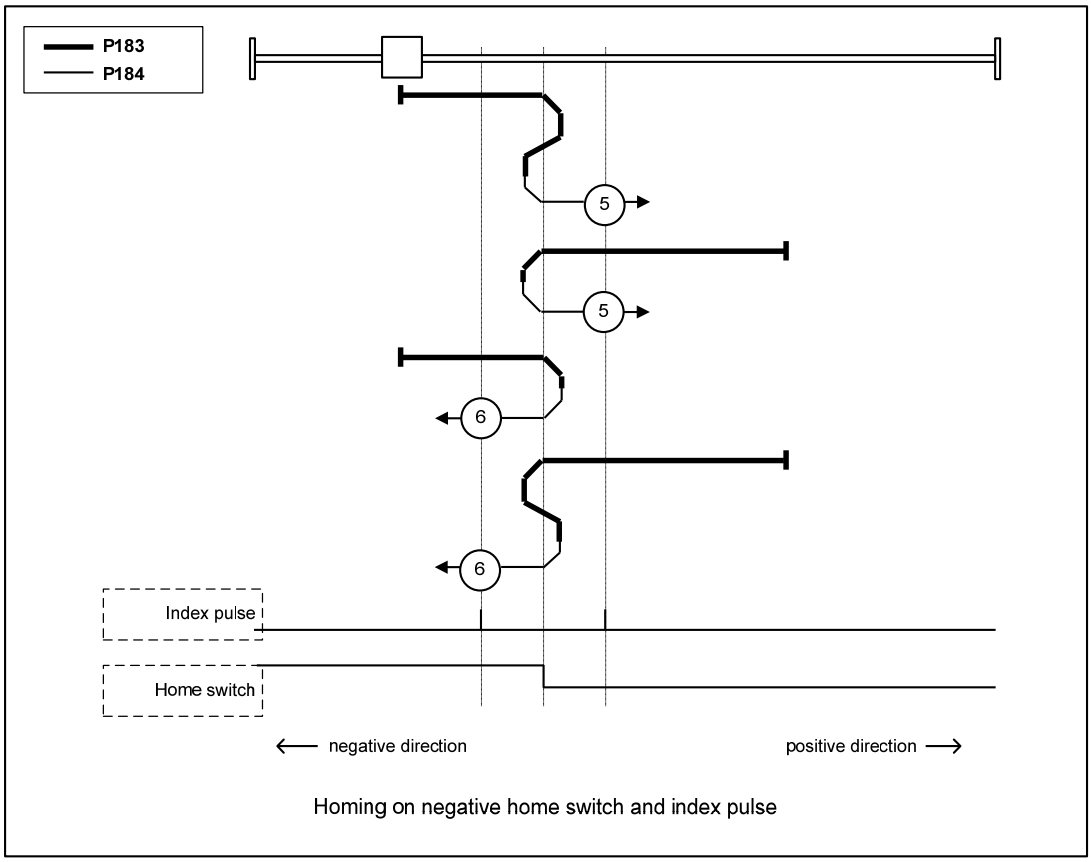
- In this mode, the action direction change is initialized based on the state of the home switch at startup.
- The homing detection position is the negative direction side after the state of the home switch changes, or the initial index pulse detection position on the negative direction side. (Please refer to the following figure)



Homing on positive home switch and index pulse

Mode 5，6 (P178=1/2/3，P179=5/6，DI=23=GOH，DI=24=REF)

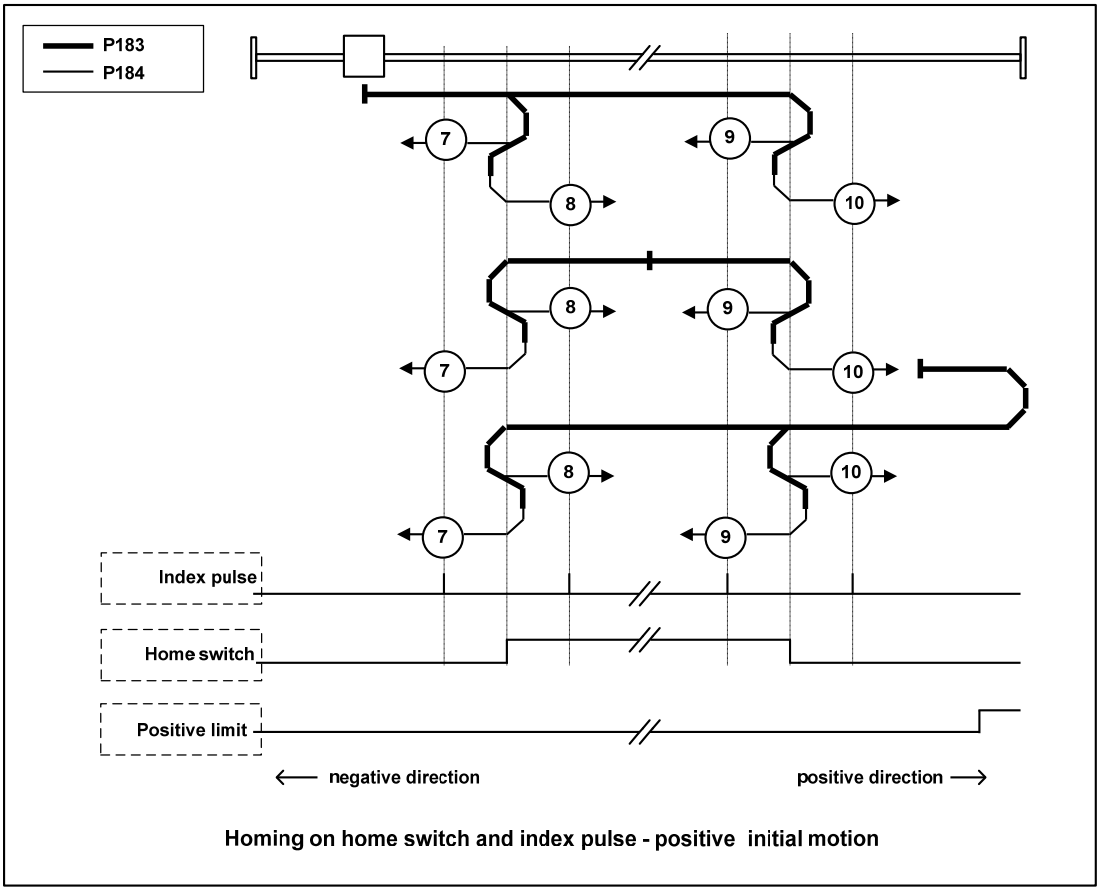
- In this mode, the action direction change is initialized based on the state of the home switch at startup.
- The homing detection position is the initial index pulse detection position on the negative direction side or the positive direction side after the state of the home switch changes. (Please refer to the following figure)



Homing on negative home switch and index pulse

Mode 7，8，9，10 (P178=1/2/3，P179=7/8/9/10，DI=23=GOH，DI=24=REF)

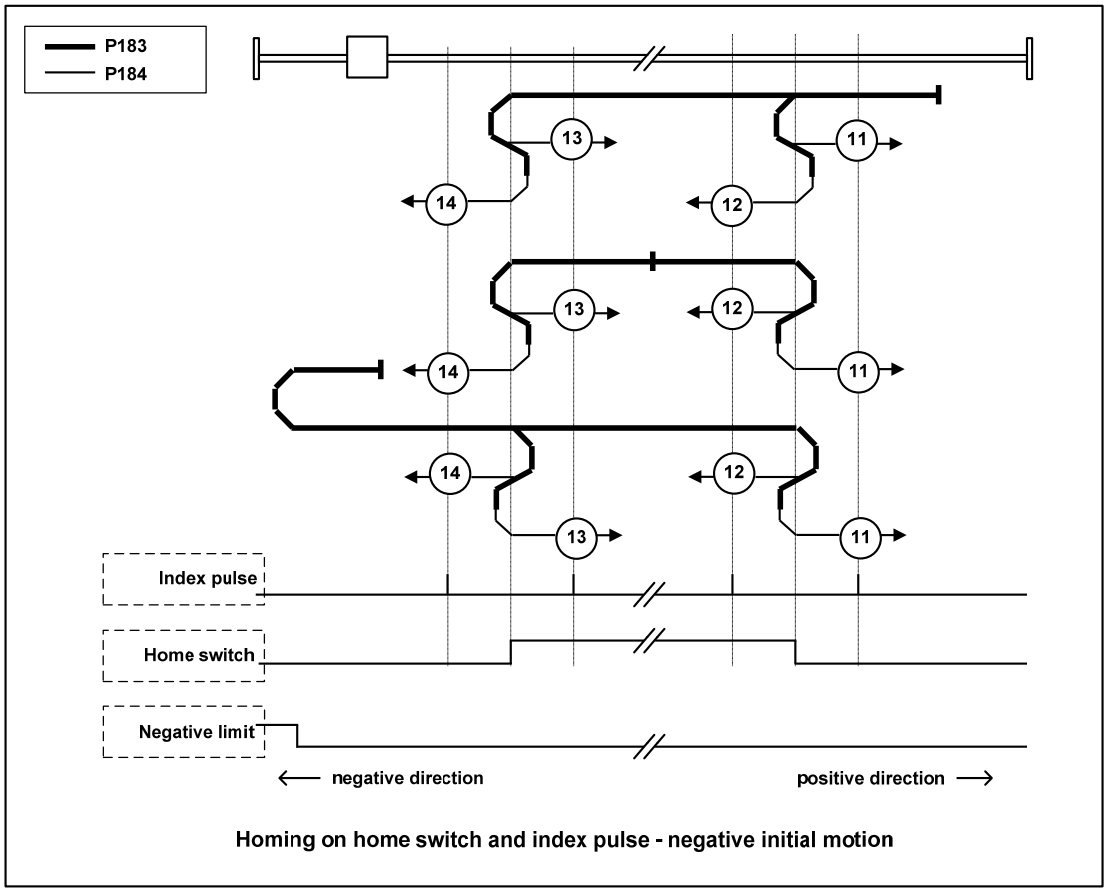
- In this mode, use the home switch and index pulse.
- The initial action direction of modes 7 and 8 is the negative direction if the home switch has been activated at the beginning of the action.
- The initialization action direction of modes 9 and 10 is the positive direction if the home switch has been activated at the beginning of the action.
- The homing detection position is the index pulse near the rising or falling edge of the home switch. (Please refer to the following figure)



Homing on home switch and index pulse - positive initial motion

Mode 11，12，13，14 (P178=1/2/3，P179=11/12/13/14，DI=23=GOH，DI=4=negative limit，DI=24=REF)

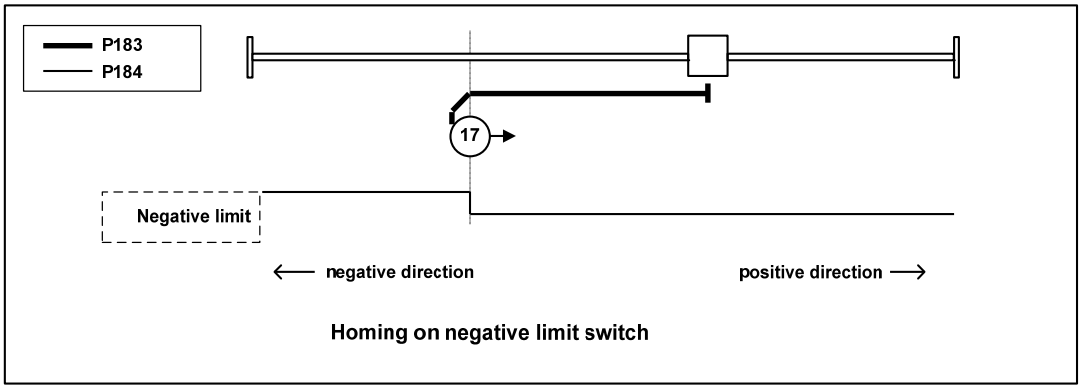
- In this mode, use the home switch and index pulse.
- The initialization action direction of modes 11 and 12 is the positive direction if the home switch has been activated at the beginning of the action.
- The initial action direction of modes 13 and 14 is the negative direction if the home switch has been activated at the beginning of the action.
- The homing detection position is the index pulse near the rising or falling edge of the home switch. (Please refer to the following figure)



Homing on home switch and index pulse - negative initial motion

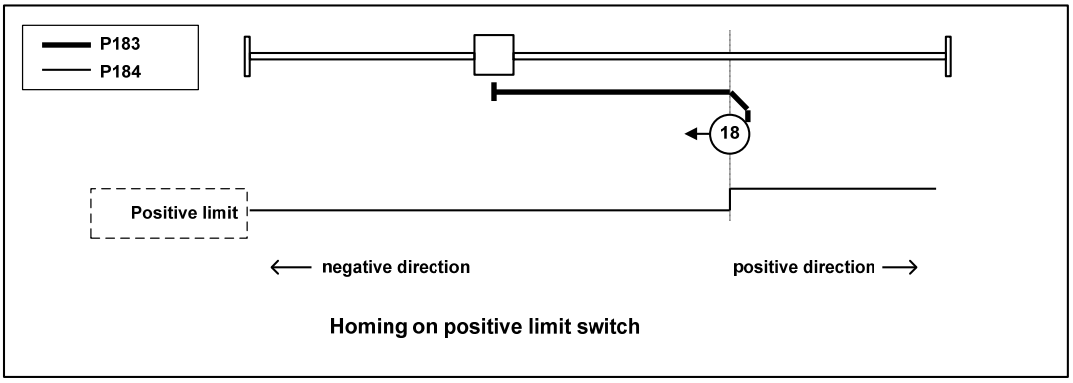
Mode 17 (P178=1/2/3，P179=17，DI=23=GOH，DI=4=negative limit)

- This mode is similar to mode 1. The difference is that the homing detection position is not the index pulse, but the position where the limit switch changes. (Please refer to the following figure)



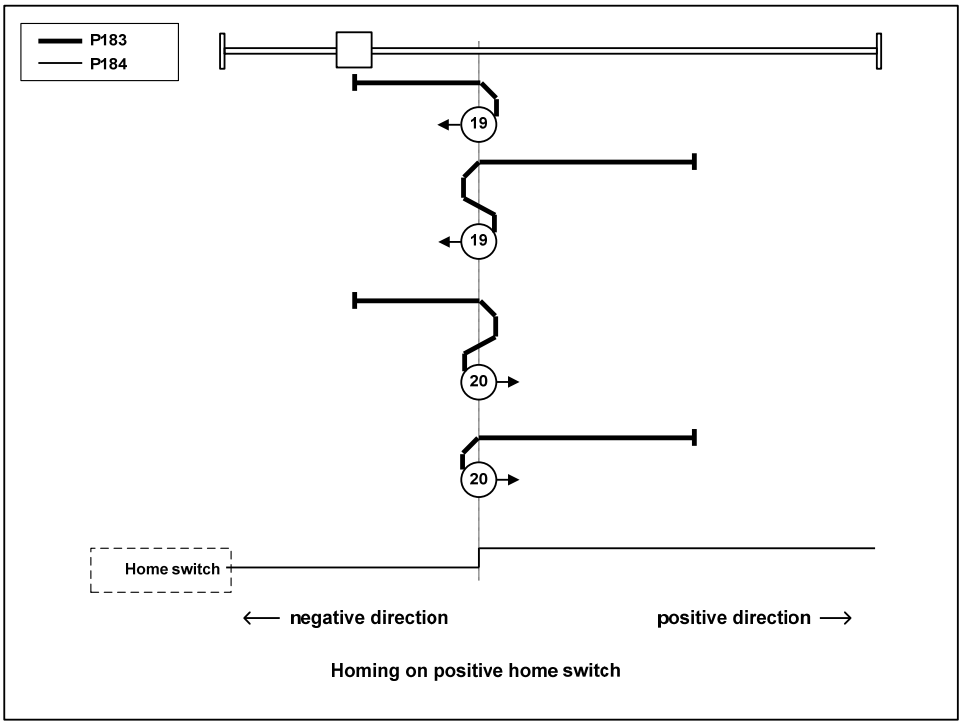
Mode 18 (P178=1/2/3，P179=18，DI=23=GOH，DI=3=positive limit)

- This mode is similar to mode 2. The difference is that the homing detection position is not the index pulse, but the position where the limit switch changes. (Please refer to the following figure)



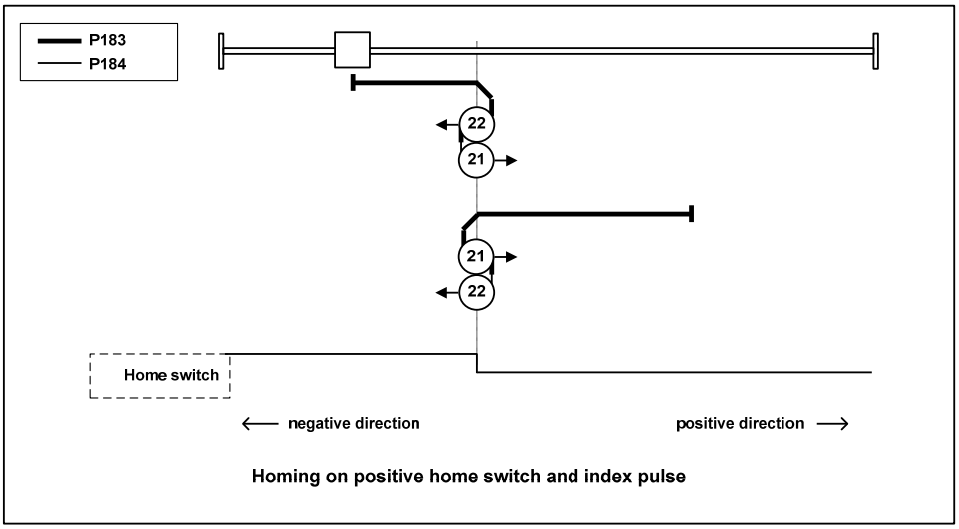
Mode 19，20 (P178=1/2/3，P179=19/20，DI=23=GOH，DI=24=REF)

- This mode is similar to modes 3 and 4. The difference is that the homing detection position is not the index pulse, but the position where the home switch changes. (Please refer to the following figure)



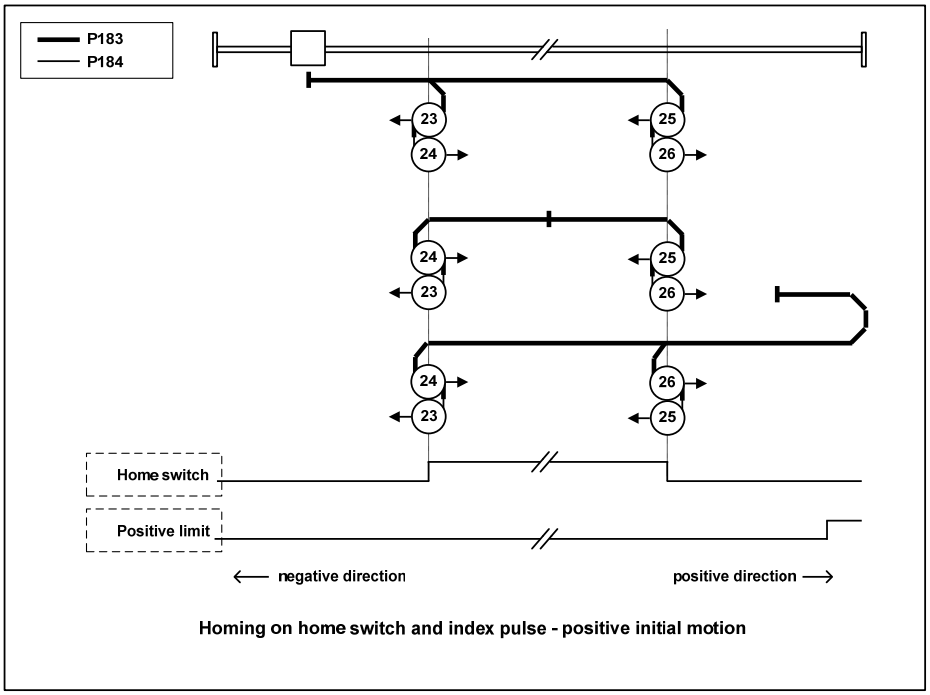
Mode 21，22 (P178=1/2/3，P179=21/22，DI=23=GOH，DI=24=REF)

- This mode is similar to modes 5 and 6. The difference is that the homing detection position is not the index pulse, but the position where the home switch changes. (Please refer to the following figure)



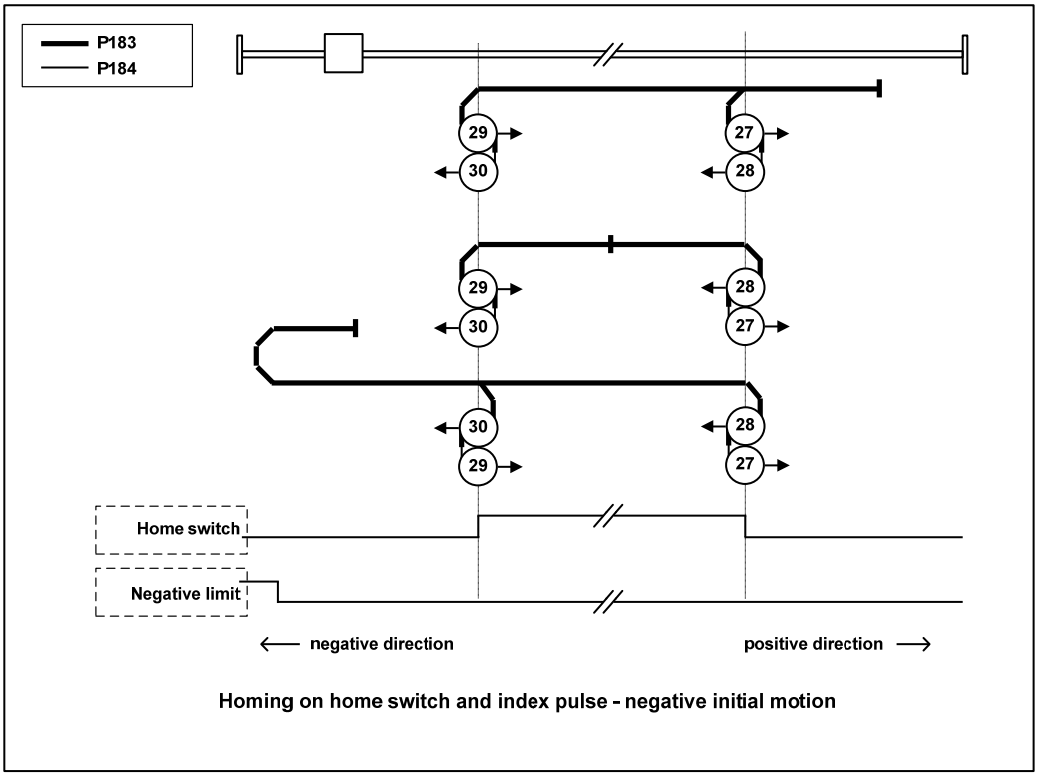
Mode 23，24，25，26 (P178=1/2/3，P179=23/24/25/26，DI=23=GOH，DI=24=REF)

- This mode is similar to modes 7, 8, 9 and 10. The difference is that the homing detection position is not the index pulse, but the position where the home switch changes. (Please refer to the following figure)



Mode 27，28，29，30 (P178=1/2/3，P179=27/28/29/30，DI=23=GOH，DI=4= Negative limit，DI=24=REF)

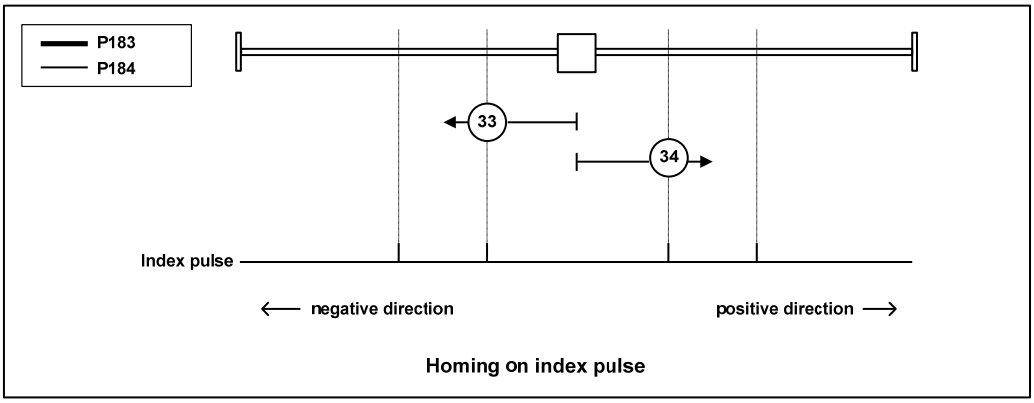
- This mode is similar to modes 11, 12, 13 and 14. The difference is that the homing detection position is not the index pulse, but the position where the home switch changes. (Please refer to the following figure)



Homing on home switch and index pulse - negative initial motion

Mode 33，34 (P178=1/2/3，P179=33/34，DI=23=GOH)

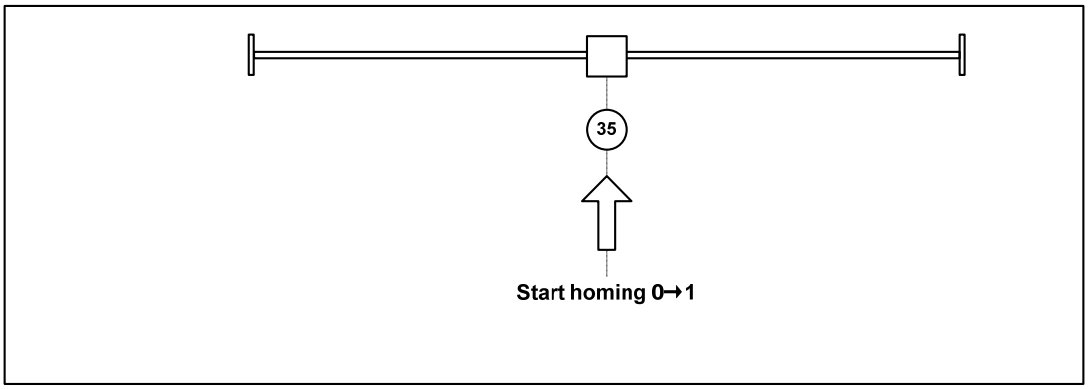
- This mode only uses index pulses.
- After the action in the direction shown in the figure, the index pulse is detected as the home detection position.



Homing on index pulse

Mode 35 (P178=1/2/3，P179=35，DI=23=GOH)

- Used when setting the coordinate system of the servo driver (setting the position information).
- At the point when homing starts, initialize (preset) the following objects based on this position.



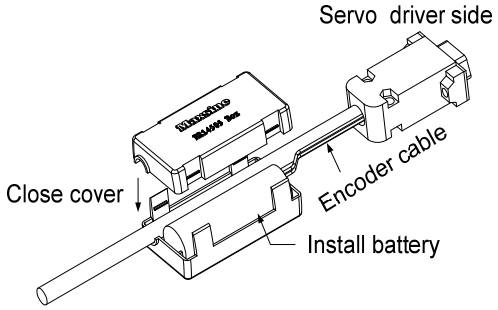
4.9 Absolute value encoder setting

4.9.1 Absolute value encoder multi turn information backup

Absolute value encoder defaults to single turn absolute value. If the user needs multi turn position value, set parameter P090 to 1, save and restart the drive.

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

Signal input SD+、SD- (wire color is brown, brown and white), encoder power supply 0V、5V (wire color is black + black and white, red + red and white) are connected to the DB head, and the external battery pins E+、E- (wire color is yellow, yellow and white) are connected to the battery box.



Note: Please set the battery unit on the servo driver side. Please set the battery unit on either side of the servo driver.

Battery voltage requirements: 3.2VDC～4.8VDC

When the battery voltage exceeds the range, the servo driver will give an alarm (Er 48) when it is turned on. At this time, please replace the battery. **The battery needs to be replaced when the driver is turned on, otherwise the drive multi turn information will be initialized!** After replacing the battery, in order to remove the display of "Encoder battery alarm (Er 48)", please ensure that the servo driver is not enabled. Connect the power supply of the servo driver control part and initialize the absolute encoder. After initialization, the multi turn value is 0. Confirm that the error display disappears and the servo driver can work normally.

4.9.2 Initialization of the absolute value encoder

In the following cases, the absolute encoder must be initialized through Fn36. For details, please refer to Section 3.6.1.

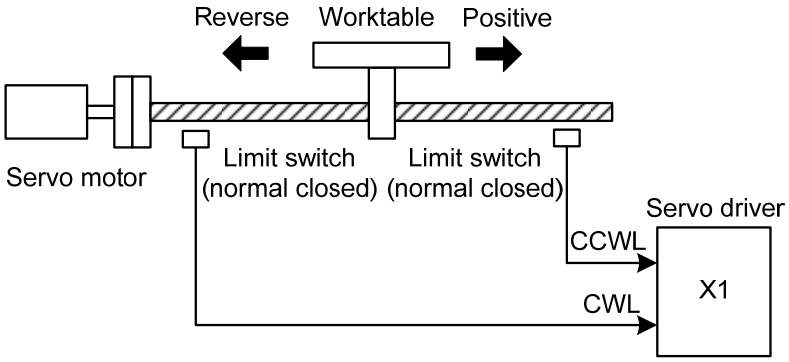
- When the machine is initially started;
- When the rotation amount data of the absolute encoder is to be set to 0.

In the following cases, the encoder alarm must be cleared through Fn37. Please refer to Section 3.6.1 for details.

- When "Encoder battery alarm (Er 48)" occurs;
- When "encoder internal fault alarm (Er 41)" occurs.

4.10 Over-travel protection

Over-travel protection function refers to the safety function that the limit switch acts to force the motor to stop when the moving part of the machine exceeds the designed safe movement range. The diagram of over-travel protection is as follows:



It is recommended to use the normally closed contact for the limit switch, which is closed within the safety range, and open if it is over-travel. Connected to forward drive inhibit (CCWL) and reverse drive inhibit (CWL), it can also be set to use and ignore through parameter P097. If it is set to use, the limit signal must be connected; set to ignore, the signal is not required. The default value of the parameter is that CCWL and CWL are ignored. If it needs to be used, the parameter P097 must be modified. Even in the over-travel state, it is still allowed to exit the over-travel state by inputting the reverse command.

P097	Reverse drive inhibit (CWL)	Forward drive inhibit (CCWL)
0	Use	Use
1	Use	Ignore
2	Ignore	Use
3(Default)	Ignore	Ignore

4.11 Torque limit

For the purpose of protecting machinery, the output torque can be limited.

4.11.1 Torque limit parameters

Parameters related to torque limit are:

Para meter	Name	Range	Default value	Unit	Usage
P064	Torque limit selection	0～2	0		ALL
P065	Internal torque limit in CCW direction	0～500	300	%	ALL
P066	Internal torque limit in CW direction	-500～0	-300	%	ALL
P067	External torque limit in CCW direction	0～500	100	%	ALL
P068	External torque limit in CW direction	-500～0	-100	%	ALL
P069	Torque limit in trial running	0～300	100	%	ALL

4.11.2 Torque limit mode

P064	Explanation	(CCW)	(CW)
0	Basic limit	Determined by DI input TCCW, TCCW=OFF: parameter P065 TCCW=ON: parameter P067	Determined by DI input TCW, TCW=OFF: parameter P066 TCW=ON: parameter P068
1	Basic limit +analog limit	In addition to the basic limit, it is also limited by the analog torque command (this limit is regardless of directional).	
2	Basic limit +internal torque limit	In addition to the basic limit, it is also limited by the internal torque command (this limit is regardless of directional), which is determined by the TRQ1 and TRQ2 input by DI.	

Note: 1. If many limits occur, the final limit value is the value with smaller absolute value.

2. The limits of P065 and P066 are valid at any time.

3. Even if the setting value exceeds the maximum torque allowed by the system, the actual torque will be limited within the maximum torque.

The internal torque command is:

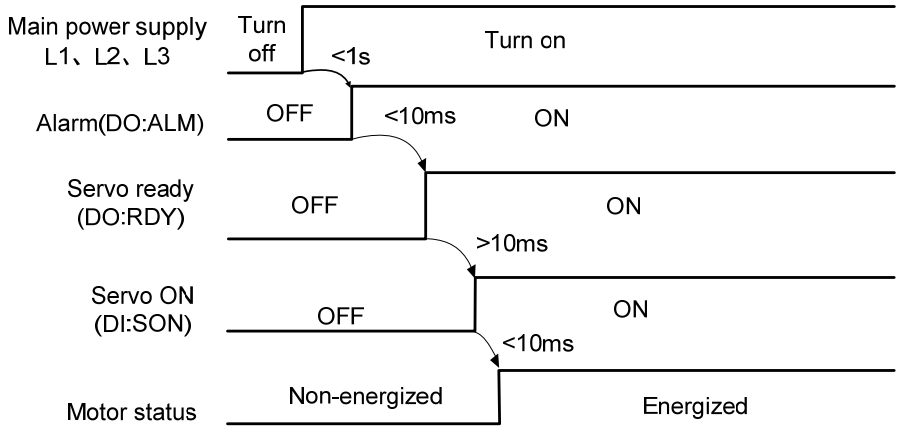
DI Signals[Note]		Torque command
TRQ2	TRQ1	
0	0	Internal torque 1 (parameter P145)
0	1	Internal torque 2 (parameter P146)
1	0	Internal torque 3 (parameter P147)
1	1	Internal torque 4 (parameter P148)

Note: 0 indicates OFF, 1indicates ON.

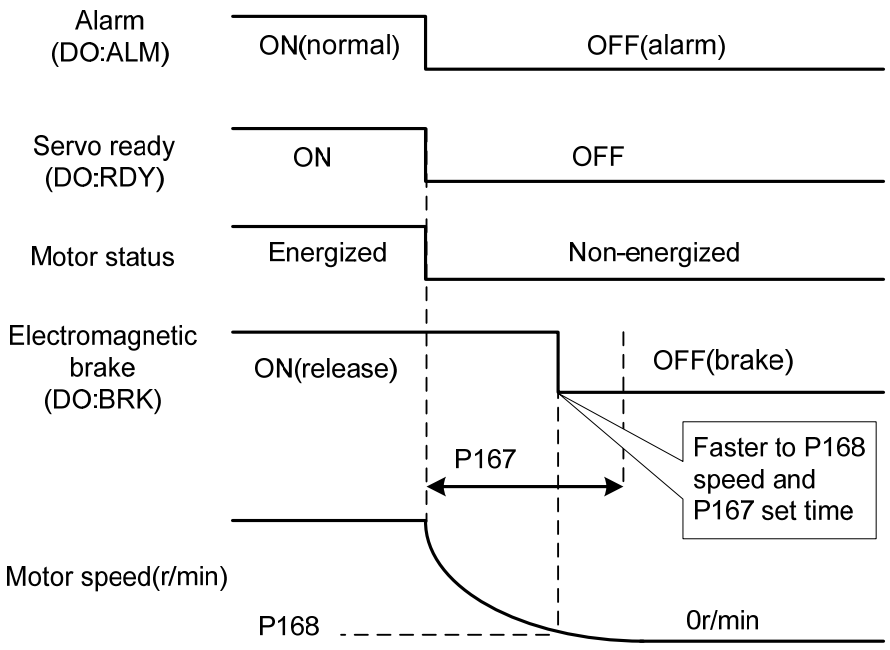
4.12 Timing chart of operation

4.12.1 Timing chart when power supply switch on

- After the main power supply turn on, the delay is about 1.5 seconds, and the servo ready signal (RDY) is ON. At this time, the servo enable (SON) signal can be received. The servo enable signal is detected to be effective, the power circuit is turned on, and the motor is excited, and it is in the running state. The servo enable is invalid or there is an alarm, the power circuit is shut down, and the motor is in a free state.

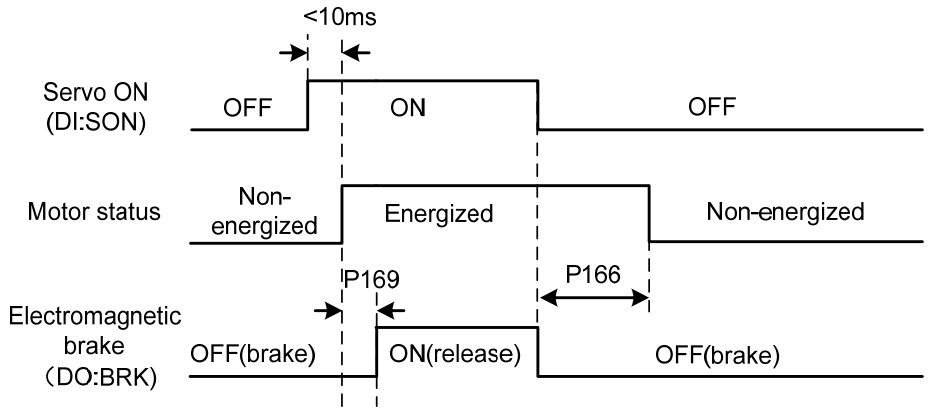


4.12.2 Alarm timing chart while servo-ON is executed



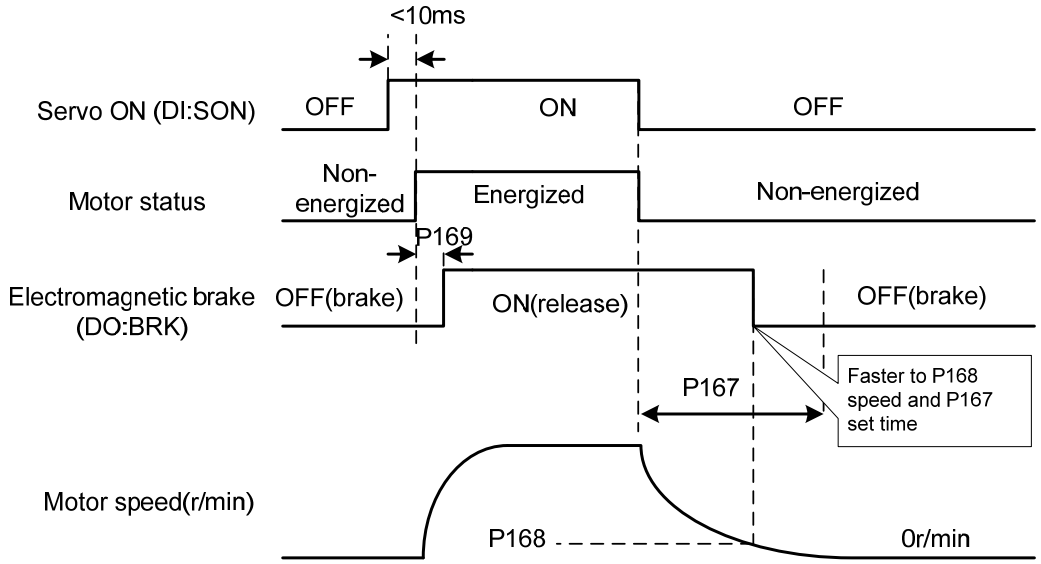
4.12.3 Servo ON/OFF action timing when the motor is stationary

When the motor speed is lower than parameter P165, the action-timing chart is:



4.12.4 Servo ON/OFF action timing when the motor is running

When the motor speed is higher than parameter P165, the action-timing chart is:



4.13 Electromagnetic brake

The electromagnetic brake (holding brake, lost power brake) is used in locking the vertical or the inclined worktable of machine tool, which connected with the motor. When the power supply lost or SON is OFF, prevent the worktable from fall and break. Realizes this function, must select and purchase the motor with electromagnetic brake. The brake only can use for holding the worktable and cannot use for decelerating and or stopping machine movement.

4.13.1 Electromagnetic brake parameter

Electromagnetic brake related parameters:

Para meter	Name	Range	Default value	Unit	Usage
P165	Motor static speed detection point	0～1000	5	r/min	ALL
P166	Electromagnetic brake delay time when motor is stationary	0～2000	150	ms	ALL
P167	Waiting time of electromagnetic brake when motor is running	0～2000	0	ms	ALL
P168	Action speed of electromagnetic brake when motor is running	0～3000	100	r/min	ALL
P169	Delay time of electromagnetic brake opening	0～1000	0	ms	ALL

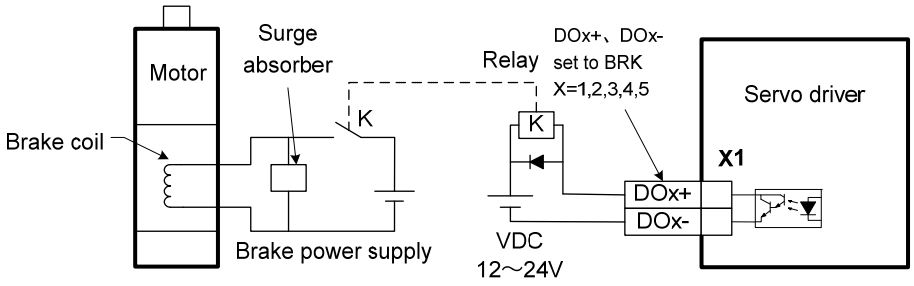
4.13.2 Use of electromagnetic brake

The following figure is the brake wiring diagram. The brake release signal BRK of the driver is connected to the relay coil. And the relay contact is connected to the brake power supply. The brake power supply is provided by the user and has sufficient capacity. It is recommended to install a surge absorber to suppress the surge voltage caused by the on/off action of the relay. Diodes can also be used as surge absorbers, which may cause a little braking delay.

After the motor stops stationary (speed is less than P165) and the servo is OFF. At this time, the motor continues to be turned on to maintain the position. The brake is released to brake. After a period of stability (the time is determined by parameter P166), remove the motor power supply.

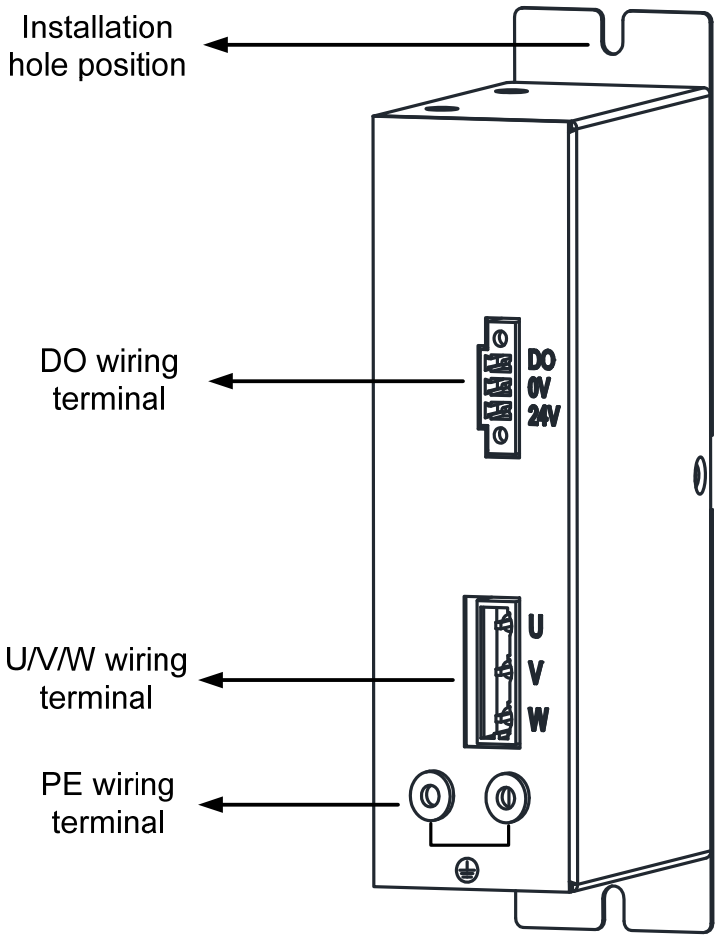
When the motor changes from the non-enable state to the enable state, the delay time from the motor current opening to the electromagnetic brake release (DO output terminal BRK ON) is determined by parameter P169.

When the motor is running (speed is greater than P165), the servo is OFF. At this time, the motor current is cut off, and the brake continues to be released. After a period of delay, the brake is brake. This is to make the motor decelerate from high speed to low speed, and then make the mechanical brake act to avoid damage to the brake. The delay time is the minimum value of parameter P167 or the time required for the motor speed to decelerate to the speed of parameter P168.



4.14 DB servo dynamic brake

Servo dynamic brake is a servo system shutdown auxiliary device. It realizes the quick stop of the servo motor by shorting the electrical circuit of the servo motor, so as to achieve the safety purpose of fast stop and shortening the stop stroke.



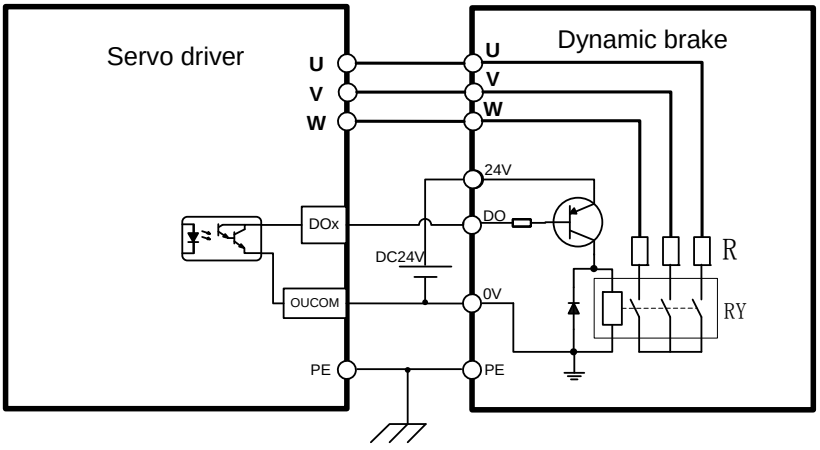
DB - XX

Mark	Mark description
DB	Dynamic brake

Mark	Mark description
L1	Applicable to AC220V servo products
H1	Applicable to AC380V servo products

4.14.1 Wiring diagram

Dynamic brake is internally composed of a normally closed contact relay, which short-circuits the three-phase UVW phase line of the servo motor; When the servo motor works normally, the closed contact will be disconnected. The servo end needs to plan a DO port as a dynamic braking function, which is used to control the opening and closing of the relay; the connection between dynamic brake and servo is shown in the figure below, where DC24V is external DC24V ± 5%.



4.14.2 Application principle and software setting

When the dynamic brake is effective (DB ON), the relay is closed, and the three-phase winding of the servo motor UVW is short-connected through the brake resistor. At this time, if the rotor rotates, the torque will be generated to stop the motor.

Since this resistance torque is generated due to the rotation of the motor rotor, when the rotor does not move, it will not generate resistance torque. Therefore, when the motor shaft is continuously subjected to external force, the dynamic brake cannot keep the motor stopped, so the dynamic brake cannot be used to replace the motor holding brake function.

When using the dynamic brake function, you need to set the software as follows:

Para meter	Name	Range	Default value	Setting value	Unit	Usage
P130	Digital output DO1 function	-30～30	2	30		ALL

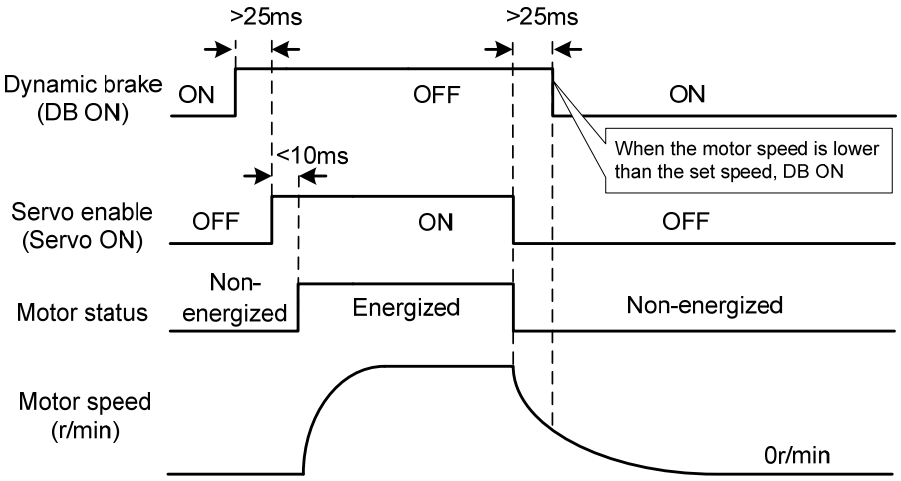
P130=30, set digital output DO1 as dynamic brake function; If you want to use other DO ports to achieve dynamic brake, you need to plan the corresponding DO ports as dynamic brake functions. See the "5.4 Parameter details" section in the description for details.

The servo driver has planned the dynamic brake function, and has correctly connected the dynamic brake. If the control power is not cut off, the motor will enter the dynamic brake deceleration process after the enable is cut off, and the dynamic brake will stop after the stop.

When the control power supply is interrupted during operation, whether the dynamic brake function is planned or not, the servo motor will enter the dynamic brake deceleration process. After the motor stops, it will enter the dynamic brake stop state.

When the servo system is in the power off state, the dynamic brake function state is always effective.

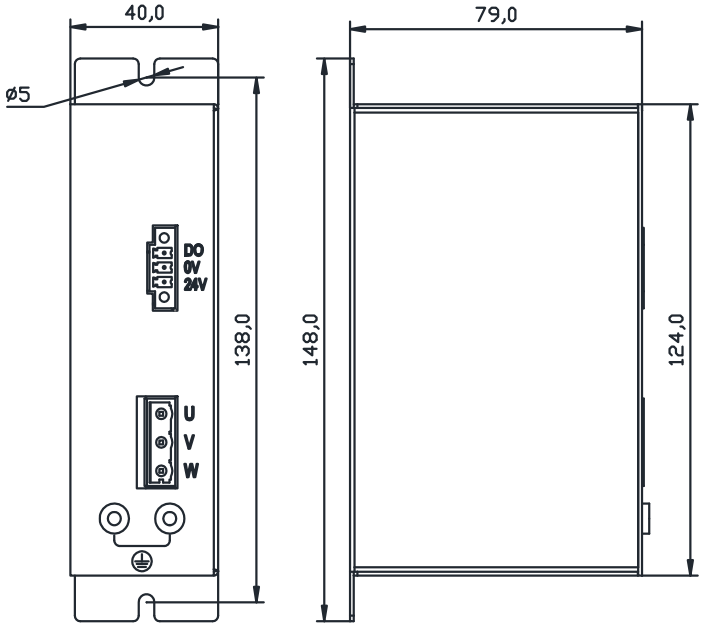
The dynamic brake function timing chart is as follows:



Matters needing attention:

1. This product is a general industrial product and is not intended for the use of machines and systems that affect human life.
2. Do not start and stop the motor rotation through the ON/OFF operation of the SERVO ON signal, otherwise the dynamic brake may be damaged.
3. Do not drive the motor continuously from outside. When the motor is driven externally, it is a generator, which is not affected by the power on/off state. When the dynamic brake works, it passes the short-circuit current. Therefore, if the motor is continuously driven externally, the dynamic brake may smoke or catch fire;
4. Dynamic brake is divided into L1 and H1 models, which are used for AC220V servo products and AC380V servo products respectively. The two cannot be mixed, otherwise the brake may be damaged or the purpose of fast shutdown may not be achieved.

4.14.3 Dynamic brake mounting dimensions



4.15 DB dynamic brake function

Dynamic brake related parameters:

Para meter	Name	Range	Default value	Unit	Usage
P083	Dynamic braking mode	0～1	0		ALL

The dynamic brake function refers to the quick stop of the servo motor by shorting the electrical circuit of the servo motor. When the dynamic brake is effective (DB ON), the rotation of the servo motor rotor will produce a resistance moment that prevents the rotor from rotating. When the speed of the servo motor is not 0, the dynamic brake can make the motor stop quickly; When the motor is stopped and the motor shaft rotates due to external force, the servo motor will also stop quickly due to the resistance torque.

However, this resistance torque is generated due to the rotation of the motor rotor. If the rotor does not move, no resistance torque will be generated. Therefore, when the motor shaft is continuously subjected to external forces, the dynamic brake cannot keep the motor stopped, so the dynamic brake cannot be used to replace the motor holding brake function.

When the dynamic brake function is invalid (P083=0), and the control power supply is not cut off, decelerate freely when decelerating, and stop freely after stopping.

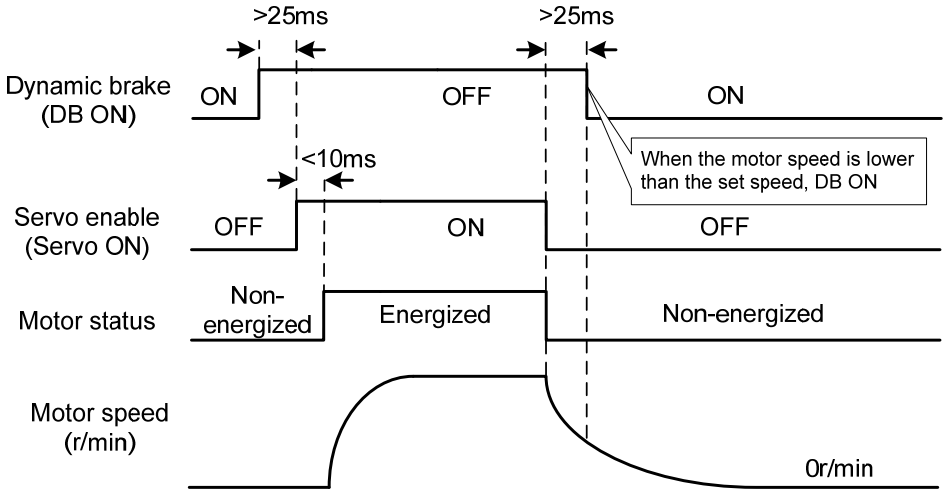
When the dynamic brake function is effective (P083=1), and the control power supply is not cut off, the dynamic brake decelerates when decelerating, and the dynamic brake stops after stopping.

When the control power supply is interrupted during operation, whether the dynamic brake function

is effective or not, the servo motor will enter the dynamic brake deceleration process. After the motor stops, it will enter the dynamic brake stop state.

When the servo system is in the power off state, the dynamic brake function state is always effective.

The dynamic brake function timing chart is as follows:



Note: Model TL04/TL08/TL10 comes with an onboard dynamic braking relay, which only supports internal dynamic braking function and is controlled by P083, without external dynamic braking function; Other models do not have onboard dynamic brake relays, only external dynamic brake functions.

Chapter 5 Parameter

5.1 Parameter list

The usage item in the table indicates the suitable control mode. “P” is the position control mode; “S” is the speed control mode; “T” is the torque control mode; “All” is the position, speed, and torque applicable. If the parameter value is "*", the factory default value may be different.

5.1.1 Parameters of section 0

Parameter	Name	Range	Default value	Effective mode	Unit
P000	Password	0～9999	315		
P001	Driver code	*	*		
P003	Software version	*	*		
P004	Control mode	0～5	0	Immediately	
P005	1st speed loop gain	1～3000	40		Hz
P006	1st speed loop integral time constant	1.0～1000.0	20.0		ms
P007	1st torque filter time constant	0.01～50.00	1.00		ms
P008	Rigidity class	0～21	0		
P009	1st position loop gain	1～1000	40		l/s
P010	2nd speed loop gain	1～3000	40		Hz
P011	2nd speed loop integral time constant	1.0～1000.0	20.0		ms
P012	2nd torque filter time constant	0.01～50.00	1.00		ms
P013	2nd position loop gain	1～1000	40		1/s
P017	Load moment of inertia ratio	0.0～200.0	1.0	Save restart	times
P018	Speed loop PDFF control coefficient	0～100	100	Immediately	%
P019	Speed detection filter time constant	0.01～50.00	2.00		ms
P021	Position loop feedforward gain	0～100	0		%
P022	Position loop feedforward filter time constant	0.20～50.00	1.00		ms
P023	Speed loop feedforward gain	0～100	0		%
P024	Speed loop feedforward filtering time constant	0.20～50.00	1.00		ms
P025	Speed command source	0～6	0		
P026	Torque command source	0～2	0		
P027	Encoder pulse factor 1	1～32767	10000	Save restart	
P028	Encoder pulse factor 2	1～32767	1		

Para meter	Name	Range	Default value	Effective mode	Unit
P029	1st numerator of command pulse electronic gear	1～32767	1	Save restart	
P030	Command pulse electronic gear denominator	1～32767	1		
P031	2nd numerator of command pulse electronic gear	1～32767	1		
P032	3rd numerator of command pulse electronic gear	1～32767	1		
P033	4th numerator of command pulse electronic gear	1～32767	1		
P034	Command pulse input signal filtering	0～31	1		
P035	Command pulse input mode	0～2	0		
P036	Command pulse input direction	0～1	0	Immediately	
P037	Command pulse input signal logic	0～3	0	Save restart	
P039	Command pulse input filtering mode	0～1	0		
P040	Position command exponential smoothing filtering time	0～1000	0	Save restart	ms
P041	Position command exponential linear filtering time	0～256	0		ms
P042	CWL,CCWL direction prohibited mode	0～1	0	Immediately	
P043	Pulse input frequency selection	0～1	0	Save restart	
P045	Analog channel selection	0～1	0	Immediately	
P046	Analog speed command gain	10～3000	300		r/min/V
P047	Analog speed command zero offset compensation	-1500.0 ～1500.0	0.0		mv
P048	Analog speed command direction	0～1	0		
P049	Analog speed command filter time constant	0.20～ 50.00	2.00	Save restart	ms
P050	Analog speed command polarity	0～2	0	Immediately	
P051	Analog speed command dead zone 1	0～13000	0		mv
P052	Analog speed command dead zone 2	-13000～0	0		mv
P053	Analog torque command gain	1～300	30		%/V
P054	Analog torque command zero offset compensation	-1500.0 ～1500.0	0.0		mv
P055	Analog torque command direction	0～1	0		
P056	Analog torque command filter time constant	0.20～ 50.00	2.00	Save restart	ms

Parameter	Name	Range	Default value	Effective mode	Unit
P057	Analog torque command polarity	0～2	0	Immediately	
P060	Speed command acceleration time	0～30000	0		ms
P061	Speed command deceleration time	0～30000	0		ms
P063	EMG (emergency shutdown) deceleration time	0～10000	1000		ms
P064	Torque limit selection	0～2	0		
P065	Internal torque limit in CCW direction	0～500	300		%
P066	Internal torque limit in CW direction	-500～0	-300		%
P067	External torque limit in CCW direction	0～500	100		%
P068	External torque limit in CW direction	-500～0	-100		%
P069	Torque limit in trial running	0～300	100		%
P070	Positive (CCW) torque overload alarm level	0～300	300	Save restart	%
P071	Reverse (CW) torque overload alarm level	-300～0	-300		%
P072	Torque overload alarm detection time	0～10000	0		10ms
P075	Maximum speed limit	0～7500	5000	Immediately	r/min
P076	JOG running speed	0～7500	100		r/min
P077	Speed limit selection	0～2	0		
P078	Speed limit in torque control mode	0～5000	3000		r/min
P080	Position deviation detection	0.00～327.67	4.00	Save restart	circle
P083	Dynamic braking mode	0～1	0		
P084	Brake resistance selector switch	0～1	0		
P085	Resistance value of external brake resistor	1～750	50		Ω
P086	Power of external brake resistor	1～10000	60		W
P088	Main encoder manufacturer	0～31	0		
P089	Secondary encoder manufacturer	1～31	11		
P090	Main absolute position encoder type	0～2	0		
P091	Sub absolute position encoder type	0～2	0		
P094	Fan on temperature point	25～125	50	Immediately	℃
P096	Initial display item	0～29	0	Save restart	
P097	Ignore drive inhibit	0～3	3	Immediately	
P098	Forced enable	0～1	0		

5.1.2 Parameters of section 1

Para meter	Name	Range	Default value	Effective mode	Unit
P100	Digital input DI1 function	-37～37	1	Immediately	
P101	Digital input DI2 function	-37～37	2		
P102	Digital input DI3 function	-37～37	3		
P103	Digital input DI4 function	-37～37	4		
P104	Digital input DI5 function	-37～37	20		
P105	Digital input DI6 function	-37～37	0		
P106	Digital input DI7 function	-37～37	0		
P107	Digital input DI8 function	-37～37	0		
P110～P117	Digital input DI1～DI8 filtering	0.1～100.0	2.0		ms
P120～P127	Digital input DI forced valid 1～8	00000～11111	00000		
P130	Digital output DO1 function	-30～30	2		
P131	Digital output DO2 function	-30～30	3		
P132	Digital output DO3 function	-30～30	8		
P133	Digital output DO4 function	-30～30	0		
P134	Digital output DO5 function	-30～30	0		
P138	Digital output DO forces selection 1	0～31	0		
P139	Digital output DO force content 1	0～31	0		
P141～P144	Internal speed 1～4	-5000～5000	0		r/min
P145～P148	Internal torque1～4	-300～300	0		%
P149	Dynamic braking delay time	30～1000	100		ms
P150	Positioning completion range	0～32767	10		pulse
P151	Positioning completion hysteresis	0～32767	5		pulse
P152	Positioning approach range	0～32767	500		pulse
P153	Positioning approach hysteresis	0～32767	50		pulse
P154	Arrival speed	-5000～5000	500		r/min
P155	Arrival speed hysteresis	0～5000	30		r/min
P156	Arrival speed polarity	0～1	0		
P157	Arrival torque	-300～300	100		%
P158	Arrival torque hysteresis	0～300	5		%
P159	Arrival torque polarity	0～1	0		
P160	Zero speed detection point	0～1000	10		r/min
P161	Zero speed detection hysteresis	0～1000	5		r/min
P162	Zero speed clamp mode	0～1	0		
P163	Position deviation clearing mode	0～1	0		

Para meter	Name	Range	Default value	Effective mode	Unit
P164	Emergency shutdown mode	0～1	0	Immedia tely	
P165	Motor static speed detection point	0～1000	5		r/min
P166	Electromagnetic brake delay time when motor is stationary	0～2000	150		ms
P167	Waiting time of electromagnetic brake when motor is running	0～2000	0		ms
P168	Action speed of electromagnetic brake when motor is running	0～3000	100		r/min
P169	Delay time of electromagnetic brake opening	0～1000	0		ms
P172	Encoder output lines	1～16384	2500	Save restart	
P173	Encoder outputs B pulse phase	0～1	0		
P174	Encoder outputs Z pulse phase	0～1	0		
P175	Encoder outputs Z pulse width	0～1	0		
P178	Homing trigger mode	1～3	1	Disable immedia tely	
P179	Homing mode	0～42	0		
P181	Homing position offset high digit	-8192～8192	0		65536 pulse
P182	Homing position offset low digit	-32768～32767	0		pulse
P183	Homing first speed	1～3000	500		r/min
P184	Homing second speed	1～3000	50		r/min
P185	Homing acceleration time	0～30000	0		ms
P186	Homing deceleration time	0～30000	0		ms
P187	Homing positioning delay time	0～3000	500		ms
P188	Homing completes signal delay	1～3000	100		ms
P195	Encoder multi turn overflow alarm shielding	0～1	1	Save restart	

5.1.3 Parameters of section 2

Para meter	Name	Range	Default value	Effective mode	Unit
P200	1st notch filter frequency	50～5000	5000	Immediately	Hz
P201	1st notch filter quality factor	1～100	7		
P202	1st notch filter depth	0～60	0		dB
P203	2nd notch filter frequency	50～5000	5000		Hz
P204	2nd notch filter quality factor	1～100	7		
P205	2nd notch filter depth	0～60	0		dB
P206	2nd torque filter frequency	100～5000	5000		Hz
P207	2nd torque filter quality factor	1～100	50		
P208	Gain switching selection	0～15	0		
P209	Gain switching level	0～32767	100		
P210	Gain switching level hysteresis	0～32767	5		
P211	Gain switching delay time	0～3000	5		ms
P212	Gain switching time	0～3000	5		ms
P213	Automatic notch filter on	0～FFFF	0		
P214	3rd notch filter frequency	50～5000	5000		Hz
P215	3rd notch filter quality factor	1～100	7		
P216	3rd notch filter depth	0～60	0		dB
P217	4th notch filter frequency	50～5000	5000		Hz
P218	4th notch filter quality factor	1～100	7		
P219	4th notch filter depth	0～60	0		dB
P220	End vibration detection filter frequency	10～2000	200		Hz
P221	Minimum detection amplitude of end vibration	3～32767	5		pulse
P222	Compensation coefficient of end vibration suppression	1.0～100.0	1.0		
P223	End vibration suppression switch	0～3	0		
P224	Manual setting of end vibration suppression period	0～1000	0		ms
P225	Reserved by the manufacturer	0～1	0		
P226	Medium frequency vibration 1 frequency	50～2000	100		Hz
P227	Compensation coefficient of medium frequency vibration suppression 1	1～1000	100		%
P228	Damping coefficient of medium frequency vibration suppression 1	0～300	100		%

Para meter	Name	Range	Default value	Effective mode	Unit
P229	Medium frequency vibration suppression 1 switch	0～2	0		
P231	Medium frequency vibration 2 frequency	50～2000	100		Hz
P232	Compensation coefficient of medium frequency vibration suppression 2	1～1000	100		%
P233	Damping coefficient of medium frequency vibration suppression 2	0～300	100		%
P234	Medium frequency vibration suppression 2 switch	0～2	0		
P236	Speed feedback source	0～1	0		
P237	Medium frequency vibration suppression mode in high response mode	0～1	1		
P238	High immunity mode gain percentage in high response mode	0～1000	50		%
P239	High immunity mode switch in high response mode	0～2	0		
P240	High response mode tracking gain	10～1000	100		%
P241	Friction compensation gain percentage	10～1000	100	Immedia	%
P242	Friction compensation ratio	0～1000	0	tely	%
P243	Friction compensation observer gain	0～1200	400		Hz
P244	Current loop mode selection in high response mode	0～3	0		
P245	High response mode speed observer nonlinear mode	0～1	1		
P246	High response mode speed feedback source	0～1	0		
P247	High response mode enable	0～2	0		
P248	High response mode speed observer bandwidth	100～2000	150		Hz
P249	High response mode speed observer bandwidth parameter setting is valid	0～1	1		
P250	High response mode current observer bandwidth	50～400	180		10Hz
P251	High response mode current observer bandwidth parameter setting is valid	0～1	0		
P252	High response mode 1st torque filtering time constant	0.05～5.00	0.10		ms

Para meter	Name	Range	Default value	Effective mode	Unit
P253	High response mode speed observer type	0～5	0	Immediately	
P254	High response mode speed observer non exponential gain multiple	0.0～10.0	1.5		times
P255	Speed observer gain	10～1000	120		Hz
P256	Speed observer compensation coefficient	0～1000	150		%
P258	Inertia identification	0～9	0		
P269	Inertia estimation mode	0～10	0		
P270	Model tracking control switch	0～3	0		
P271	Model tracking control gain	10～2000	40		Hz
P272	Model tracking damping ratio	50～200	100		
P273	Model tracking positive direction output ratio	0～1000	100		%
P274	Model tracking reverse direction output ratio	0～1000	100		%
P277	Model tracking speed compensation feedforward	0～100	100		%
P280	Model tracking speed compensates feedforward filtering time	0.10～50.00	0.50		ms
P281	Model tracking speed loop gain	1～3000	40		Hz
P282	Model tracking speed loop integral time constant	1.0～1000.0	20.0		ms
P283	Inertia estimation gain level	0～2	0		
P285	Vibration alarm time	0～100	0		s
P289	Vibration detection level	0～2000	60		Hz
P296	Self tuning mode	0～3	0		

5.1.4 Parameters of section 3

Parameter	Name	Range	Default value	Effective mode	Unit
P300	Site address	1～32	1	Save restart	
P301	MODBUS communication baud rate	1～6	2		
P302	MODBUS communication protocol selection	0～5	3		
P305	Speed return filtering time constant	0.1～300.0	0.1		ms
P380	Digital input DI9 function	-37～37	0	Immediately	

5.1.5 Parameters of section 4

Parameter	Name	Range	Default value	Effective mode	Unit
P472	Number of forward turns of round-trip motion	1～32767	3	Immediately	
P473	Number of reverse turns of round-trip motion	1～32767	3		
P474	Round-trip speed	1～32767	1000		rpm
P475	Round-trip acceleration time	0～32767	100		ms
P476	Round-trip deceleration time	0～32767	100		ms

5.2 DI function list

Ordinal	Symbol	DI Function	Ordinal	Symbol	DI Function
0	NULL	No function	13	TRQ1	Internal torque selection 1
1	SON	Servo enable	14	TRQ2	Internal torque selection 2
2	ARST	Clear alarm	15	EMG	Emergency shutdown
3	CCWL	CCW drive inhibit	16	CMODE	Control mode switch
4	CWL	CW drive inhibit	17	GAIN	Gain switch
5	TCCW	CCW torque limit	18	GEAR1	Electronic gear selection 1
6	TCW	CW torque limit	19	GEAR2	Electronic gear selection 2
7	ZCLAMP	Zero speed clamp	20	CLR	Position deviation clearing
8	CZERO	Zero command	21	INH	Pulse input inhibit
9	CINV	Reverse command	22	PC	Proportional control
10	SP1	Internal speed selection 1	23	GOH	Homing trigger
11	SP2	Internal speed selection 2	24	REF	Homing reference point

5.3 DO function list

Ordinal	Symbol	DO Function	Ordinal	Symbol	DO Function
0	OFF	Always invalid	7	ATRQ	Arrival torque
1	ON	Always valid	8	BRK	Electromagnetic brake
2	RDY	Servo ready	10	NEAR	Near positioning
3	ALM	Alarm	11	TRQL	In torque limit
4	ZSP	Zero speed	12	SPL	In speed limit
5	COIN	Positioning complete	30	DBC	Dynamic braking
6	ASP	Arrival speed			

5.4 Parameter details

5.4.1 Parameters of section 0

Para meter	Name	Range	Default value	Unit	Usage
P000	Password	0～9999	315		ALL

- Hierarchical parameter management can guarantee the parameters cannot modify by mistake.
- Setting this parameter as 315 can examine, modify the parameters of the 0、1、2 and 3 sections. For other setting only can examine, but cannot modify parameters.
- Some special operations need to set a suitable password.

Para meter	Name	Range	Default value	Unit	Usage
P001	Driver code	*	*		ALL

- The drive model currently in use. It has been set in the factory and cannot be modified by the user.

Para meter	Name	Range	Default value	Unit	Usage
P003	Software version	*	*		ALL

- The software version number cannot be modified.

Para meter	Name	Range	Default value	Unit	Usage
P004	Control mode	0～5	0		ALL

- Parameter meaning:
  0：Position control mode; 1：Speed control mode
  2：Torque control mode; 3：Position/speed control mode
  4：Position/torque control mode; 5：Speed/torque control mode
- When set to 3, 4, 5, the specific control mode is determined by the CMODE input by DI:

P004	CMODE[Note]	Control mode
3	0	Position control mode
	1	Speed control mode
4	0	Position control mode
	1	Torque control mode
5	0	Speed control mode
	1	Torque control mode

Note: 0 indicates OFF; 1 indicates ON.

Para meter	Name	Range	Default value	Unit	Usage
P005	1st speed loop gain	1～3000	40	Hz	P,S

- The proportional gain of the speed regulator can accelerate the speed response by increasing the parameter value. If it is too large, it is easy to cause vibration and noise.
- If P017 (moment of inertia ratio) is set correctly, the parameter value is equal to the speed response bandwidth.

Para meter	Name	Range	Default value	Unit	Usage
P006	1st speed loop integral time constant	1.0～1000.0	20.0	ms	P,S

- The integral time constant of the speed regulator can reduce the speed control error and increase the rigidity by reducing the parameter value. If it is too small, it is easy to cause vibration and noise.
- Setting to the maximum value (1000.0) means canceling integration, and the speed regulator is a P controller.

Para meter	Name	Range	Default value	Unit	Usage
P007	1st torque filter time constant	0.01～50.00	1.00	ms	ALL

- Torque low-pass filter can suppress mechanical vibration.
- The larger the value is, the better the vibration suppression effect will be. If the value is too large, the response will become slower, which may cause oscillation; the smaller the value, the faster the response, but limited by mechanical conditions.
- When the load inertia is small, a smaller value can be set; when the load inertia is large, a larger value can be set.

Para meter	Name	Range	Default value	Unit	Usage
P008	Rigidity class	0～21	0		ALL

- Parameter meaning:
  0: Rigidity level setting is invalid
  1～21: The higher the level setting, the faster the system response, but too high rigidity may cause vibration

Para meter	Name	Range	Default value	Unit	Usage
P009	1st position loop gain	1～1000	40	1/s	P

- Proportional gain of position regulator; Increasing the parameter value can reduce the position tracking error and improve the response. Overshoot or oscillation may occur if the parameter value is too large.

Para meter	Name	Range	Default value	Unit	Usage
P010	2nd speed loop gain	1～3000	40	Hz	P,S

- Refer to the description of parameter P005. Only when the gain switching function is enabled, it needs to be set.

Para meter	Name	Range	Default value	Unit	Usage
P011	2nd speed loop integral time constant	1.0～1000.0	20.0	ms	P,S

- Refer to the description of parameter P006. Only when the gain switching function is enabled, it needs to be set.

Para meter	Name	Range	Default value	Unit	Usage
P012	2nd torque filter time constant	0.01～50.00	1.00	ms	ALL

- Refer to the description of parameter P007. Only when the gain switching function is enabled, it needs to be set.

Para meter	Name	Range	Default value	Unit	Usage
P013	2nd position loop gain	1～1000	40	1/s	P

- Refer to the description of parameter P009. Only when the gain switching function is enabled, it needs to be set.

Para meter	Name	Range	Default value	Unit	Usage
P017	Load moment of inertia ratio	0.0～200.0	1.0	times	P,S

- Ratio of mechanical load moment of inertia (converted to motor shaft) to motor rotor moment of inertia.

Para meter	Name	Range	Default value	Unit	Usage
P018	Speed loop PDFF control coefficient	0～100	100	%	P,S

- For the PDFF coefficient of the speed regulator, the speed controller structure can be selected. 0 is the IP regulator, 100 is the PI regulator. And 1～99 is the PDFF regulator.
- If the parameter value is too large, the system will have high frequency response; if the parameter value is too small, the system will have high stiffness (resistance to deviation); if the parameter value is too small, both frequency response and stiffness will be considered.

Para meter	Name	Range	Default value	Unit	Usage
P019	Speed detection filter time constant	0.01～50.00	2.00	ms	P,S

- This parameter takes effect when the speed feedback comes from the filter. See P236 Parameter description for details.
- The larger the parameter value is, the smoother the detection will be. The smaller the parameter

value is, the faster the detection response will be. Too small may cause noise; Too large may cause oscillation.

Para meter	Name	Range	Default value	Unit	Usage
P021	Position loop feedforward gain	0～100	0	%	P

- Feedforward can reduce the position tracking error in position control mode. When set to 100, the position tracking error is always 0 at any frequency of command pulse.
- When the parameter value increases, the position control response will be improved. If the parameter value is too large, the system will be unstable and easy to oscillate.

Para meter	Name	Range	Default value	Unit	Usage
P022	Position loop feedforward filter time constant	0.20～50.00	1.00	ms	P

- The function of filter the feedforward of position loop is to increase the stability of feedforward control.

Para meter	Name	Range	Default value	Unit	Usage
P023	Speed loop feedforward gain	0～100	0	%	P

- When the parameter value increases, the speed control response will be improved. If the parameter value is too large, the system will be unstable and easy to oscillate.

Para meter	Name	Range	Default value	Unit	Usage
P024	Speed loop feedforward filtering time constant	0.20～50.00	1.00	ms	P

- The filtering of the speed loop feedforward is used to increase the stability of the feedforward control.

Para meter	Name	Range	Default value	Unit	Usage
P025	Speed command source	0～6	0		S

- In speed control mode, set the source of speed command. Parameter meaning:

  0: Analog speed command, come from terminal AS1 and AGND.

  1: Internal speed command, determined by SP1、SP2 input by DI:

DI Signals[note]		Speed command
SP2	SP1	
0	0	Internal speed 1 (parameter P141)
0	1	Internal speed 2 (parameter P142)
1	0	Internal speed 3 (parameter P143)
1	1	Internal speed 4 (parameter P144)

Note: 0 indicates OFF; 1 indicates ON.

2: Analog speed command + internal speed command:

DI Signals[note]		Speed command
SP2	SP1	
0	0	Analog speed command
0	1	Internal speed 2 (parameter P142)
1	0	Internal speed 3 (parameter P143)
1	1	Internal speed 4 (parameter P144)

Note: 0 indicates OFF; 1 indicates ON.

3: JOG speed command, which needs to be set during JOG operation.

4: Keyboard speed command, which needs to be set during keyboard speed adjustment (Sr) operation.

5: Demonstrate speed command. When speed regulation demonstration is carried out, it needs to be set, and the speed command will change automatically.

6: The speed command comes from the external pulse frequency.

Para meter	Name	Range	Default value	Unit	Usage
P026	Torque command source	0～2	0		T

- In torque control mode, set the source of torque command.
- Parameter meaning:

0：Analog torque command come from terminal AS2 and AGND inputs.

1：Internal torque command is determined by TRQ1 and TRQ2 from DI inputs.

DI Signals[note]		Torque command
TRQ2	TRQ1	
0	0	Internal torque 1 (parameterP145)
0	1	Internal torque 2 (parameterP146)
1	0	Internal torque 3 (parameterP147)
1	1	Internal torque 4 (parameterP148)

Note: 0 indicates OFF; 1 indicates ON.

2: Analog torque command + internal torque command:

DI Signal[note]		Torque command
TRQ2	TRQ1	
0	0	Analog torque command
0	1	Internal torque 2 (parameterP146)
1	0	Internal torque 3 (parameterP147)
1	1	Internal torque 4 (parameterP148)

Note: 0 indicates OFF; 1 indicates ON.

Para meter	Name	Range	Default value	Unit	Usage
P027	Encoder pulse factor 1	1～32767	10000		P

- In position control mode, set the command pulse number needed by the motor rotating for one circle under the default circumstance (electronic gear ratio is 1:1)
  The default value of P027 is 10000, and P028 is 1
  PLUSE= P027×P028=10000×1=10000 means that the motor rotating for one circle needs 10000 command pulse when the electronic gear ratio is 1:1
- Users should ensure the result of P027×P028 is not more than 131072.

Para meter	Name	Range	Default value	Unit	Usage
P028	Encoder pulse factor 2	1～32767	1		P

- For encoder pulse factor 2, refer to the description of parameter P027.

Para meter	Name	Range	Default value	Unit	Usage
P029	1st numerator of command pulse electronic gear	1～32767	1		P
P030	Command pulse electronic gear denominator	1～32767	1		P
P031	2nd numerator of command pulse electronic gear	1～32767	1		P
P032	3rd numerator of command pulse electronic gear	1～32767	1		P
P033	4th numerator of command pulse electronic gear	1～32767	1		P

- Use the frequency division or multiplication for the input pulse and can conveniently match with each kind of pulse source, also can achieve the pulse resolution for the user needs.
- The command pulse electronic gear molecule N is determined by GEAR1 and GEAR2 input from DI. The denominator M is set by parameter P030.

DI Signals [note]		Command pulse electronic gear molecule N
GEAR2	GEAR1	
0	0	1st numerator(P029)
0	1	2nd numerator(P031)
1	0	3rd numerator(P032)
1	1	4th numerator(P033)

Note: 0 indicates OFF; 1 indicates ON.

- The input pulse command becomes the position command by the N/M factor. The ratio range is: 1/50<N/M<200.

Para meter	Name	Range	Default value	Unit	Usage
P034	Command pulse input signal filtering	0～31	1		P

- For digital filtering of pulse input signals PULS and SIGN, the larger the value, the larger the

filtering time constant.

- By default, the maximum pulse input frequency is 500kHz (kpps). The larger the value, the lower the maximum pulse input frequency will be.
- It is used to filter the noise on the signal line to avoid counting errors. In case of inaccurate counting, increase the parameter value appropriately.
- After the parameter is modified, it must be saved and powered on again to be effective.

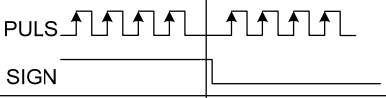
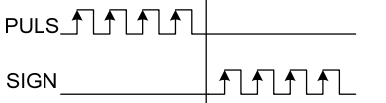
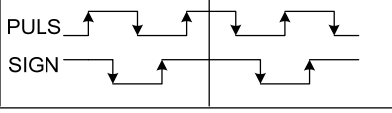
Para meter	Name	Range	Default value	Unit	Usage
P035	Command pulse input mode	0～2	0		P

- Set the command pulse input mode. Parameter meaning:

  0：Pulse + direction

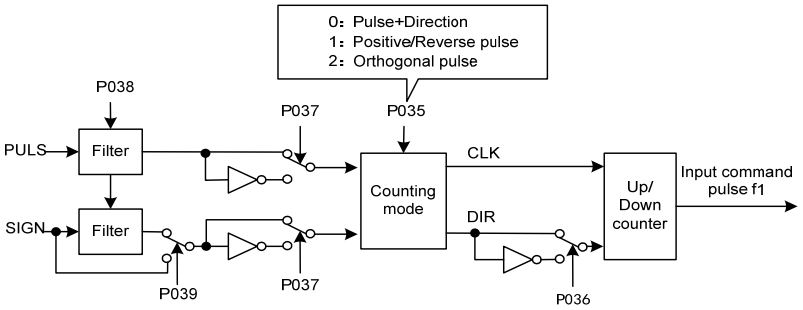
  1：Positive/Reverse pulse

  2：Orthogonal pulse

Command pulse type	CCW	CW	Parameter P035
Pulse + direction			0
Positive /Reverse pulse			1
Orthogonal pulse			2

Note: The arrow indicates the counting edge when P036=0, P037=0.

- Command pulse input block diagram



- After the parameter is modified, it must be saved and powered on again to be effective.

Para meter	Name	Range	Default value	Unit	Usage
P036	Command pulse input direction	0～1	0		P

- Parameter meaning:

  0: Normal direction

  1: Reverse direction

Para meter	Name	Range	Default value	Unit	Usage
P037	Command pulse input signal logic	0～3	0		P

- Set the pulse input signal PULS and SIGN signal phases to adjust the counting edge and counting direction.

P037	PULS signal phase	SIGN signal phase
0	In phase	In phase
1	Opposite phase	In phase
2	In phase	Opposite phase
3	Opposite phase	Opposite phase

- After the parameter is modified, it must be saved and powered on again to be effective.

Para meter	Name	Range	Default value	Unit	Usage
P039	Command pulse input filtering mode	0～1	0		P

- Parameter meaning:

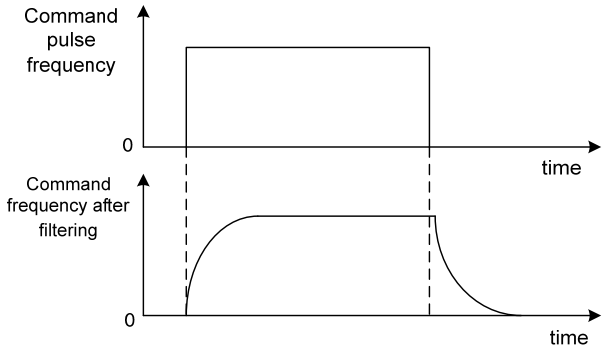
  0: Digital filtering of PULS and SIGN signals.

  1: Only PULS digital filtering, SIGN does not filter.

- After the parameter is modified, it must be saved and powered on again to be effective.

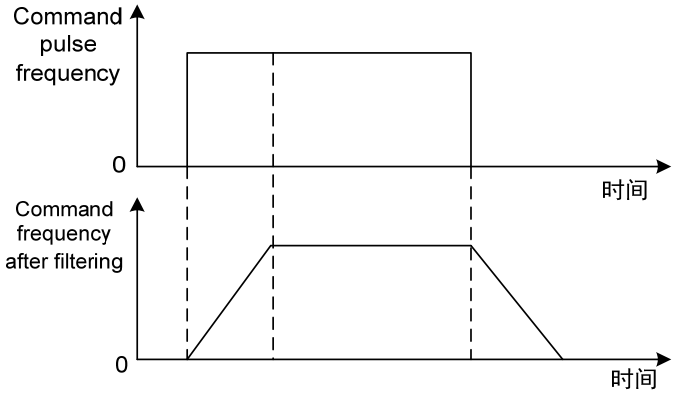
Para meter	Name	Range	Default value	Unit	Usage
P040	Position command exponential smoothing filtering time	0～1000	0	ms	P

- The command pulse is smoothed and filtered with exponential acceleration and deceleration. The filter will not lose the input pulse, but the command delay will occur. When it is set to 0, the filter will not work.
- This filter is used to:
  1. The host controller has no acceleration and deceleration function;
  2. The electronic gear ratio is large (N/M>10);
  3. Low command frequency;
  4. When the motor is running, the phenomenon of step jumping and instability occurs.



Para meter	Name	Range	Default value	Unit	Usage
P041	Position command exponential linear filtering time	0～256	0	ms	P

- The command pulse is smoothed and filtered with linear acceleration and deceleration. The filter will not lose the input pulse, but the command delay will occur. When it is set to 0, the filter will not work. The parameter value represents the time from frequency 0 to 100% of the position command frequency.
- This filter is used to:
  1. The host controller has no acceleration and deceleration function;
  2. The electronic gear ratio is large (N/M>10);
  3. Low command frequency;
  4. Stepping jump and unsteadiness occur when the motor is running.



Para meter	Name	Range	Default value	Unit	Usage
P042	CWL,CCWL direction prohibited mode	0～1	0		P

- When the machine touches the mechanical limit switch and triggers CWL and CCWL limits, this parameter is used to select the prohibited mode.
- Parameter meaning:
  0: Limit the torque in this direction to 0.
  1: Pulse input in this direction is prohibited.

Para meter	Name	Range	Default value	Unit	Usage
P043	Pulse input frequency selection	0～1	0		P

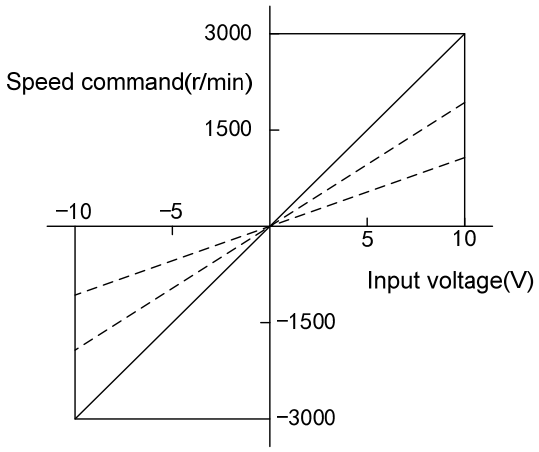
- Parameter meaning:
  0: Low speed pulse input, maximum frequency 500K
  1: High speed pulse input, maximum frequency 4M

Para meter	Name	Range	Default value	Unit	Usage
P045	Analog channel selection	0～1	0		S,T

- Parameter meaning:
  0: AS1 and AS2 channels correspond to speed and torque commands respectively
  1: AS1 and AS2 channels correspond to torque and speed commands respectively

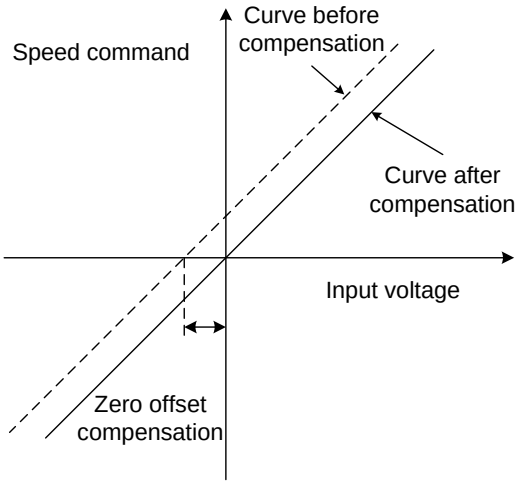
Para meter	Name	Range	Default value	Unit	Usage
P046	Analog speed command gain	10～3000	300	r/min/V	S

- Set the proportional relationship between the analog speed input voltage and the actual running speed of the motor.
- The analog input range is - 10V～10V.



Para meter	Name	Range	Default value	Unit	Usage
P047	Analog speed command zero offset compensation	-1500.0～ 1500.0	0.0	mv	S

- Zero offset compensation of analog speed input. The actual speed command is the input analog minus this parameter value.
- Automatic analog zero offset function can be used, and this parameter is automatically set, refer to Section 3.6.2.



Para meter	Name	Range	Default value	Unit	Usage
P048	Analog speed command direction	0～1	0		S

- Parameter meaning:

P048	Positive polarity (positive voltage) analog input	Negative polarity (negative voltage) analog input
0	CCW speed command	CW speed command
1	CW speed command	CCW speed command

Para meter	Name	Range	Default value	Unit	Usage
P049	Analog speed command filter time constant	0.20～50.00	2.00	ms	S

- Low pass filter for analog speed input.
- The larger the setting is, the slower the response speed of input analog quantity is, which is conducive to reducing high-frequency noise interference; the smaller the setting is, the faster the response speed is. But the high-frequency noise interference is large.

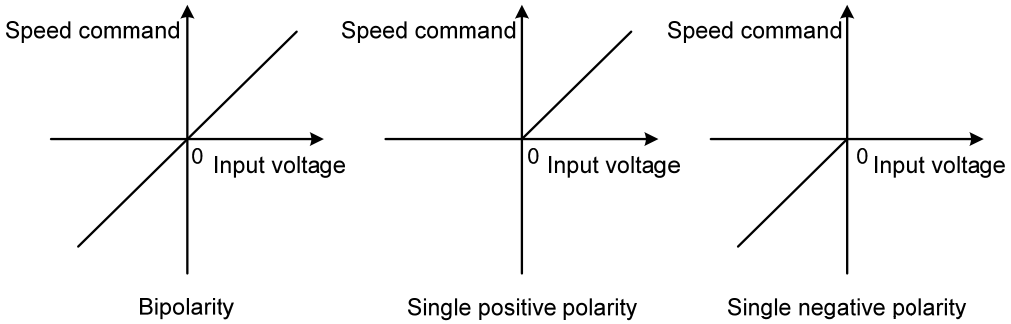
Para meter	Name	Range	Default value	Unit	Usage
P050	Analog speed command polarity	0～2	0		S

- Parameter meaning:

  0: Bipolarity.

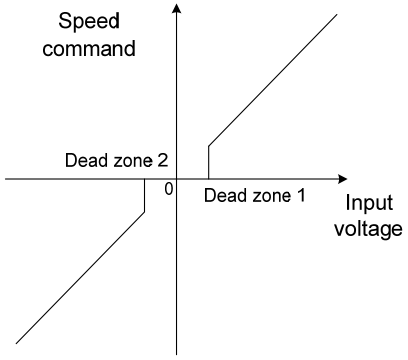
  1: Single positive polarity. Input positive polarity is valid, and negative polarity is forced to 0.

  2: Single negative polarity. Negative input polarity is valid, and the positive polarity is forced to 0.



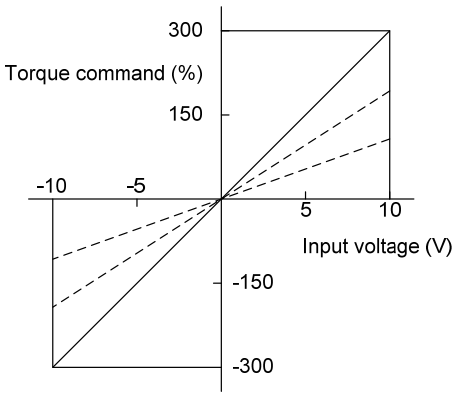
Para meter	Name	Range	Default value	Unit	Usage
P051	Analog speed command dead zone 1	0～13000	0	mv	S
P052	Analog speed command dead zone 2	-13000～0	0	mv	S

- When the input voltage is between dead zone 2(P052) and dead zone 1(P051), the command is forced to 0.



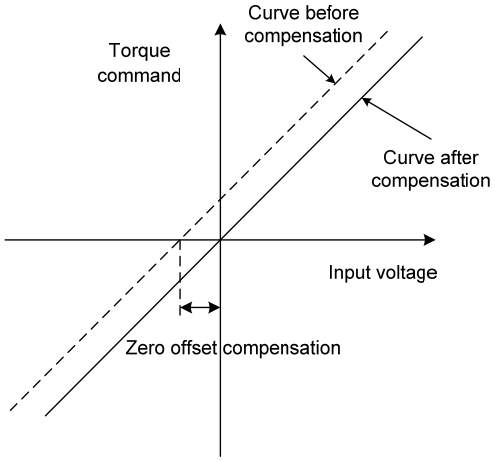
Para meter	Name	Range	Default value	Unit	Usage
P053	Analog torque command gain	1～300	30	%/V	T

- Set the proportional relationship between the analog torque input voltage and the actual running torque of the motor, and the unit of the set value is 1% / V;
- Analog input range is -10V～10V.



Para meter	Name	Range	Default value	Unit	Usage
P054	Analog torque command zero offset compensation	-1500.0～1500.0	0.0	mv	T

- Zero offset compensation of analog torque input. The actual torque command is the input analog minus this parameter value.
- Automatic analog quantity zero offset function can be used. This parameter is automatically set. Refer to Section 3.6.2.



Para meter	Name	Range	Default value	Unit	Usage
P055	Analog torque command direction	0～1	0		T

- Parameter meaning:

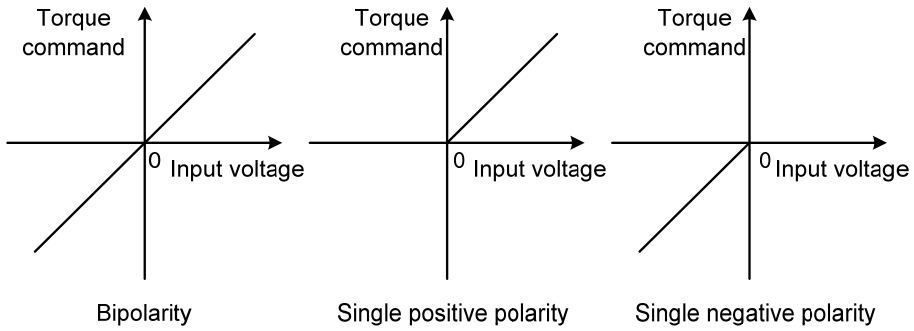
P055	Positive polarity (positive voltage) analog input	Negative polarity (negative voltage) analog input
0	CCW torque command	CW torque command
1	CW torque command	CCW torque command

Para meter	Name	Range	Default value	Unit	Usage
P056	Analog torque command filter time constant	0.20～50.00	2.00	ms	T

- Analog torque input low pass filter.
- The larger the setting is, the slower the response speed of input analog quantity is, which is conducive to reducing high-frequency noise interference; the smaller the setting is, the faster the response speed is, but the high-frequency noise interference is large.

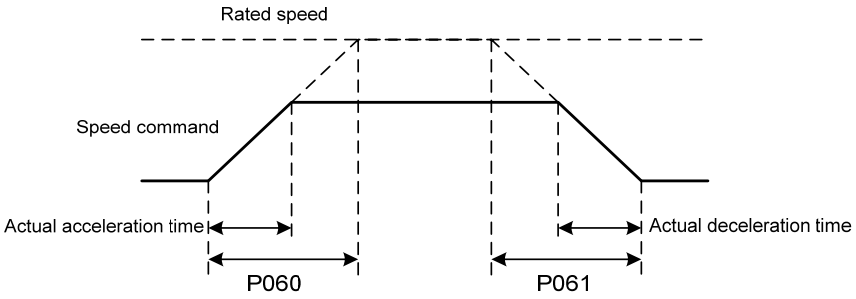
Para meter	Name	Range	Default value	Unit	Usage
P057	Analog torque command polarity	0～2	0		T

- Parameter meaning:
  0: Bipolarity.
  1: Single positive polarity. Input positive polarity is valid, and negative polarity is forced to 0.
  2: Single negative polarity. Negative input polarity is valid, and the positive polarity is forced to 0.



Para meter	Name	Range	Default value	Unit	Usage
P060	Speed command acceleration time	0～30000	0	ms	S

- Set the acceleration time of motor from zero speed to rated speed.
- If the command speed is lower than the rated speed, the required acceleration time will be reduced accordingly.
- Only for speed control mode, position control mode is invalid.
- If the driver is operating in speed mode and the host (PLC, etc.) performs position closed-loop control, this parameter should be set to 0, otherwise it will affect position control performance.



Para meter	Name	Range	Default value	Unit	Usage
P061	Speed command deceleration time	0～30000	0	ms	S

- Set the deceleration time of motor from rated speed to zero speed.
- If the command speed is lower than the rated speed, the deceleration time required will be reduced accordingly.
- Only for speed control mode, position control mode is invalid.
- If the driver is used in combination with the external position loop, this parameter should be set to 0. Otherwise the position control performance will be affected.

Para meter	Name	Range	Default value	Unit	Usage
P063	EMG(emergency shutdown) deceleration time	0～10000	1000	ms	ALL

- It works when the EMG (emergency shutdown) mode is deceleration stop (P164=1).
- Set the deceleration time of the EMG (emergency shutdown) motor from the current speed to zero speed.

Para meter	Name	Range	Default value	Unit	Usage
P064	Torque limit selection	0～2	0		ALL

- Set torque limit mode:

P064	Explanation	CCW	CW
0	Basic limit	Determined by DI input TCCW: TCCW =OFF: parameter P065 TCCW =ON : parameter P067	Determined by DI input TCW: TCW =OFF: parameter P066 TCW =ON : parameter P068
1	Basic limit + Analog limit	In addition to the basic limit, it is also limited by the analog torque command (this limit is regardless of direction).	
2	Basic limit + Internal torque limit	In addition to the basic limit, it is also limited by the internal torque command (this limit is regardless of direction), which is determined by the TRQ1 and TRQ2 input by DI.	

Note: 1. If many limits occur, the final limit value is the value with smaller absolute value.

2. The limits of P065 and P066 are valid at any time.

3. Even if the setting value exceeds the maximum torque allowed by the system, the actual torque will be limited within the maximum torque.

Para meter	Name	Range	Default value	Unit	Usage
P065	Internal torque limit in CCW direction	0～500	300	%	ALL
P066	Internal torque limit in CW direction	-500～0	-300	%	ALL

- This limit is valid at any time.
- If the set value exceeds the maximum overload capacity allowed by the system, the actual limit is the maximum overload capacity allowed by the system.

Para meter	Name	Range	Default value	Unit	Usage
P067	External torque limit in CCW direction	0～500	100	%	ALL
P068	External torque limit in CW direction	-500～0	-100	%	ALL

- When parameter P067 is DI input TCCW (torque limit in CCW direction) ON, this limit is valid.
- When parameter P068 is DI input TCW (torque limit in CW direction) ON, this limit is valid.
- When the limit is valid, the actual torque limit is the minimum of the maximum overload capacity, internal CCW torque limit and external CCW torque limit allowed by the system.

Para meter	Name	Range	Default value	Unit	Usage
P069	Torque limit in trial running	0～300	100	%	ALL

- Set the torque limit value for trial running mode (JOG running speed, keyboard speed adjustment, demonstration mode).
- Regardless of the direction of rotation, forward CCW and reverse CW are limited.
- The internal and external torque limits are still valid.

Para meter	Name	Range	Default value	Unit	Usage
P070	Positive (CCW) torque overload alarm level	0～300	300	%	ALL
P071	Reverse (CW) torque overload alarm level	-300～0	-300	%	ALL
P072	Torque overload alarm detection time	0～10000	0	10ms	ALL

- When the positive (CCW) torque of the motor exceeds P070 and the duration is greater than P072, the driver gives an alarm, the alarm number is Er 29, and the motor stops.
- When the reverse (CW) torque of the motor exceeds P071 and the duration is greater than P072, the driver gives an alarm, the alarm number is Er 29, and the motor stops running.
- When parameter P072 is set to 0, the shielding torque overload alarm will occur.

Para meter	Name	Range	Default value	Unit	Usage
P075	Maximum speed limit	0～7500	5000	r/min	ALL

- Set the maximum allowable speed limit of the servo motor.
- Independent of the direction of rotation.
- If the set value exceeds the maximum speed allowed by the system, the actual speed will also be limited to the maximum speed.

Para meter	Name	Range	Default value	Unit	Usage
P076	JOG running speed	0～7500	100	r/min	S

- Set the running speed for JOG operation.

Para meter	Name	Range	Default value	Unit	Usage
P077	Speed limit selection	0～2	0		T

- Set the speed limit mode when torque control, and the speed limit is regardless of direction.

P077	Explanation	Interpret
0	Basic limit	Limited by parameter P078.
1	Basic limit +Analog limit	In addition to the basic limits, it is also limited by the analog speed command.

P077	Explanation	Interpret
2	Basic limit + Internal speed limit	In addition to the basic limit, it is also limited by the internal speed command, which is determined by SP1、SP2 input by DI. Refer to DI description.

Note: If many limits occur, the final limit value is the value with smaller absolute value. Even if the set value exceeds the maximum speed allowed by the system, the actual speed will be limited to the maximum speed.

Para meter	Name	Range	Default value	Unit	Usage
P078	Speed limit in torque control mode	0～5000	3000	r/min	T

- In torque control mode, the motor running speed is limited within this parameter.
- It can prevent overspeed under light load.
- In case of overspeed, speed negative feedback is connected to reduce the actual torque, but the actual speed will be slightly higher than the speed limit value.

Para meter	Name	Range	Default value	Unit	Usage
P080	Position deviation detection	0.00～327.67	4.00	circle	P

- Set the position deviation alarm detection range.
- In the position control mode, when the count value of the position deviation counter exceeds the pulse corresponding to this parameter value, the servo driver gives a position deviation alarm (Er 4).
- The unit is a circle. Multiply the resolution of each turn of the motor by the number of pulses.

Para meter	Name	Range	Default value	Unit	Usage
P083	Dynamic braking mode	0～1	0		ALL

- Parameter meaning:
  0: Do not use dynamic braking
  1: Use dynamic braking

Para meter	Name	Range	Default value	Unit	Usage
P084	Brake resistance selector switch	0～1	0		ALL

- Parameter meaning:
  0: Adopting internal brake resistance.
  1: Adopting external brake resistance.

Para meter	Name	Range	Default value	Unit	Usage
P085	Resistance value of external brake resistor	1～750	50	Ω	ALL

- Set this parameter according to the resistance value of the actual external brake resistor.
- If the internal brake resistor (P084=0) is used, this parameter is invalid.

Para meter	Name	Range	Default value	Unit	Usage
P086	Power of external brake resistor	1～10000	60	W	ALL

- This parameter is set according to the actual power of external brake resistor.
- If internal brake resistor (P084=0) is used, this parameter is invalid.

Para meter	Name	Range	Default value	Unit	Usage
P088	Main encoder manufacturer	0～31	0		ALL

- Parameter meaning:
  0: Automatic recognition
  1: Tamagawa 2.5M, 17/23Bit
  6: Magnetic encoder

Para meter	Name	Range	Default value	Unit	Usage
P089	Secondary encoder manufacturer	1～31	11		ALL

- Parameter meaning:
  1: Tamagawa 2.5M, 17/23Bit
  6: Magnetic encoder
- The secondary encoder cannot be set to automatic recognition.
- This parameter is invalid in the TL04, TL08, and TL10 series, and is valid in all other series.

Para meter	Name	Range	Default value	Unit	Usage
P090	Main absolute position encoder type	0～2	0		ALL

- Parameter meaning:
  0: Single turn absolute encoder
  1: Multi turn absolute encoder
  2: Incremental use
- When the encoder has no external battery, the encoder cannot save multi turn information. Please set this parameter to 0.

Para meter	Name	Range	Default value	Unit	Usage
P091	Sub absolute position encoder type	0～2	0		ALL

- Parameter meaning:
  0: Single turn absolute encoder
  1: Multi turn absolute encoder
  2: Incremental use
- This parameter is invalid in the TL04, TL08, and TL10 series, and is valid in all other series.

Para meter	Name	Range	Default value	Unit	Usage
P094	Fan on temperature point	25～125	50	℃	ALL

- When the power module temperature is ＞P094, the driver cooling fan starts to work.
- When the power module temperature is ＜P094, the driver cooling fan stops working.
- When P094=25℃, the driver cooling fan will work all the time.

Para meter	Name	Range	Default value	Unit	Usage
P096	Initial display item	0～29	0		ALL

- Set the display status on the front panel after turn on the power supply.
- Parameter meaning:

P096	Display item	P096	Display item
0	Motor speed	15	Digital Output DO
1	Initial position command	16	Reserved
2	Position command	17	Absolute position in one turn
3	Motor position	18	Cumulative load rate
4	Position deviation	19	Braking load rate
5	Torque	20	Control mode
6	Peak torque	21	Alarm number
7	Current	22	Reserved display
8	Peak current	23	Reserved display
9	Pulse input frequency	24	Bus voltage
10	Speed command	25	Reserved
11	Torque command	26	Module internal temperature
12	Speed command analog voltage	27	Multi turn position
13	Torque command analog voltage	28	Error history information display
14	Digital input DI	29	Reserved

Para meter	Name	Range	Default value	Unit	Usage
P097	Ignore drive inhibit	0～3	3		ALL

- The forward drive inhibit (CCWL) and reverse drive inhibit (CWL) in DI input are used for limit travel protection. The normally closed switch is adopted. When the input is ON, the motor can run in this direction, and when it is OFF, it cannot run in this direction.
- If the limit travel protection is not used, it can be ignored through this parameter, so it can operate without connecting the driver inhibit signal.
- The default value is to ignore the drive inhibit. If you need to use the drive inhibit function, please modify this value first.

- Parameter meaning:

P097	Reverse drive inhibit (CWL)	Forward drive inhibit (CCWL)
0	Use	Use
1	Use	Ignore
2	Ignore	Use
3	Ignore	Ignore

Use: When the input signal is ON, the motor can run in this direction; When OFF, the motor cannot run to this side.

Ignore: The motor can run in this direction, and the drive inhibit signal has no effect, so the signal may not be connected.

Para meter	Name	Range	Default value	Unit	Usage
P098	Forced enable	0～1	0		ALL

- Parameter meaning:

  0: Enable SON control of DI input

  1: Software Force Enable

5.4.2 Parameters of section 1

Parameter	Name	Range	Default value	Unit	Usage
P100	Digital input DI1 function	-37～37	1		ALL
P101	Digital input DI2 function	-37～37	2		ALL
P102	Digital input DI3 function	-37～37	3		ALL
P103	Digital input DI4 function	-37～37	4		ALL
P104	Digital input DI5 function	-37～37	20		ALL
P105	Digital input DI6 function	-37～37	0		ALL
P106	Digital input DI7 function	-37～37	0		ALL
P107	Digital input DI8 function	-37～37	0		ALL

- Digital input DI function planning, parameter absolute value represents function, and symbol represents logic. Please refer to chapter 5.5 for functions. P105 and P106 are invalid in the TL04/TL08/TL10 series, while other series are valid.
- Symbols represent input logic, positive numbers represent positive logic, negative numbers represent negative logic, ON is valid, OFF is invalid:

Parameter	DI input signal	DI Result
Positive number	Turn off	OFF
	Turn on	ON
Negative number	Turn off	ON
	Turn on	OFF

- When multiple input channels have the same function selection, the function result is logic or relationship. For example, if P100 and P101 are both set to 1 (SON function), then when either DI1 or DI2 is ON, SON is valid.
- The input functions not selected by the parameters P100～P104、P107 and P380, that is, the unplanned functions, are OFF (invalid). However, there are exceptions. Setting parameters P120～P127 can force the input function ON (valid), regardless of whether the function is planned or not.
- DI9 input function is set by P380.

Parameter	Name	Range	Default value	Unit	Usage
P110～P117	Digital input DI1～DI8 filtering	0.1～100.0	2.0	ms	ALL

- DI input digital filtering time constant. DI9 filtering is controlled by parameter P110.
- The smaller the parameter value is, the faster the signal response speed is; the larger the parameter value is, the slower the signal response speed is, but the stronger the noise filtering ability is.
- Note: P115 and P116 are invalid in the TL04/TL08/TL10 series, while other series are valid.

Parameter	Name	Range	Default value	Unit	Usage
P120～P127	Digital input DI forced valid 1～8	00000～11111	00000		ALL

- P120 corresponding function by the 5-bit binary representation is as follows:

Bit number	bit4	bit3	bit2	bit1	bit0
Function	CWL	CCWL	ARST	SON	NULL

- P121 corresponding function by the 5-bit binary representation is as follows:

Bit number	bit4	bit3	bit2	bit1	bit0
Function	CINV	CZERO	ZCLAMP	TCW	TCCW

- P122 corresponding function by the 5-bit binary representation is as follows:

Bit number	bit4	bit3	bit2	bit1	bit0
Function	TRQ2	TRQ1	NC	SP2	SP1

- P123 corresponding function by the 5-bit binary representation is as follows:

Bit number	bit4	bit3	bit2	bit1	bit0
Function	GEAR2	GEAR1	GAIN	CMODE	EMG

- P124 corresponding function by the 5-bit binary representation is as follows:

Bit number	bit4	bit3	bit2	bit1	bit0
Function	REF	GOH	PC	INH	CLR

- P125 corresponding function by the 5-bit binary representation is as follows:

Bit number	bit4	bit3	bit2	bit1	bit0
Function	Reserved	Reserved	Reserved	Reserved	Reserved

- P126 corresponding function by the 5-bit binary representation is as follows:

Bit number	bit4	bit3	bit2	bit1	bit0
Function	Reserved	Reserved	Reserved	Reserved	Reserved

- P127 corresponding function by the 5-bit binary representation is as follows:

Bit number	bit4	bit3	bit2	bit1	bit0
Function	Reserved	Reserved	Reserved	Reserved	Reserved

- The function used to force DI input is valid. If the corresponding bit of the function is set to 1, the function is forced ON (valid).
- Refer to Section 5.5 for the meaning of DI symbol. Parameter meaning:

A bit in this parameter	Function[note]	Function result
0	Unplanned	OFF
	Planned	Determined by input signal
1	Unplanned or planned	ON

Note: Planned refers to the function selected by parameters P100～P104、P107、P380.

Unplanned refers to the function not selected by parameters P100～P104、P107、P380.

Para meter	Name	Range	Default value	Unit	Usage
P130	Digital output DO1 function	-30～30	2		ALL
P131	Digital output DO2 function	-30～30	3		ALL
P132	Digital output DO3 function	-30～30	8		ALL

Para meter	Name	Range	Default value	Unit	Usage
P133	Digital output DO4 function	-30～30	0		ALL
P134	Digital output DO5 function	-30～30	0		ALL

- Digital output DO function planning, absolute value of parameter represents function, and symbol represents logic. Please refer to chapter 5.6 for functions.
- 0 is forced OFF and 1 is forced ON.
- Symbols represent output logic, positive numbers represent positive logic, and negative numbers represent negative logic:

Parameter value	Function	DO output signal
Positive number	ON	Turn on
	OFF	Turn off
Negative number	ON	Turn off
	OFF	Turn on

Para meter	Name	Range	Default value	Unit	Usage
P138	Digital output DO forces selection 1	0～31	0		ALL

- Corresponding functions are represented by 5-bit binary:

Bit number	bit4	bit3	bit2	bit1	bit0
Function	DO5	DO4	DO3	DO2	DO1

- The force used to select DO output is valid.

  1: The DO output force ON and force OFF are set by P139.

  0: This DO outputs normally.

Para meter	Name	Range	Default value	Unit	Usage
P139	Digital output DO force content 1	0～31	0		ALL

- Corresponding functions are represented by 5-bit binary:

Bit number	bit4	bit3	bit2	bit1	bit0
Function	DO5	DO4	DO3	DO2	DO1

  1: Indicates that the corresponding DO output is forced ON (valid), and the P138 parameter takes effect when the bit is set to 1.

  0: Indicates that the corresponding DO output is forced to be OFF (invalid), and takes effect when the bit corresponding to the P138 parameter is set to 1.

Parameter	Name	Range	Default value	Unit	Usage
P141～P144	Internal speed 1～4	-5000～5000	0	r/min	S

- Refer to the description of parameter P025.

Parameter	Name	Range	Default value	Unit	Usage
P145～P148	Internal torque1～4	-300～300	0	%	T

- Refer to the description of parameter P026.

Para meter	Name	Range	Default value	Unit	Usage
P149	Dynamic braking delay time	30～1000	100	ms	P

- Parameter meaning:
  When the dynamic braking delay time is set to 0, the dynamic braking function is invalid.

Para meter	Name	Range	Default value	Unit	Usage
P150	Positioning completion range	0～32767	10	pulse	P
P151	Positioning completion hysteresis	0～32767	5	pulse	P

- Set the positioning completion pulse range in the position control mode.
- When the number of remaining pulses in the position deviation counter is less than or equal to the set value of this parameter, the COIN (positioning completion) of the digital output DO is ON, otherwise it is OFF.
- The comparator has the function of hysteresis, which is set by parameter P151.

Para meter	Name	Range	Default value	Unit	Usage
P152	Positioning approach range	0～32767	500	pulse	P
P153	Positioning approach hysteresis	0～32767	50	pulse	P

- Set the positioning approach pulse range in the position control mode.
- When the number of remaining pulses in the position deviation counter is less than or equal to the set value of this parameter, the NEAR of the digital output DO NEAR (near positioning) is ON, otherwise it is OFF.
- The comparator has the function of hysteresis, which is set by parameter P153.
- When the positioning is about to be completed, the host receives the NEAR signal to prepare for the next step. Generally, the parameter value should be greater than P150.

Para meter	Name	Range	Default value	Unit	Usage
P154	Arrival speed	-5000～5000	500	r/min	ALL
P155	Arrival speed hysteresis	0～5000	30	r/min	ALL
P156	Arrival speed polarity	0～1	0		ALL

- When the motor speed exceeds this parameter, the ASP (arrival speed) of the digital output DO is ON, otherwise it is OFF.
- The comparator has the hysteresis function, which is set by parameter P155.
- With polarity setting function:

P156	P154	Comparator
0	>0	detect CCW or CW speed
1	>0	Only detect CCW speed
	<0	Only detect CW speed

Para meter	Name	Range	Default value	Unit	Usage
P157	Arrival torque	-300～300	100	%	ALL
P158	Arrival torque hysteresis	0～300	5	%	ALL
P159	Arrival torque polarity	0～1	0		ALL

- When the motor torque exceeds this parameter, the ATRQ (arrival torque) of the digital output DO is ON, otherwise it is OFF.
- The comparator has the hysteresis function, which is set by parameter P158.
- With polarity setting function:

P159	P157	Comparator
0	>0	detect CCW or CW torque
1	>0	Only detect CCW torque
	<0	Only detect CW torque

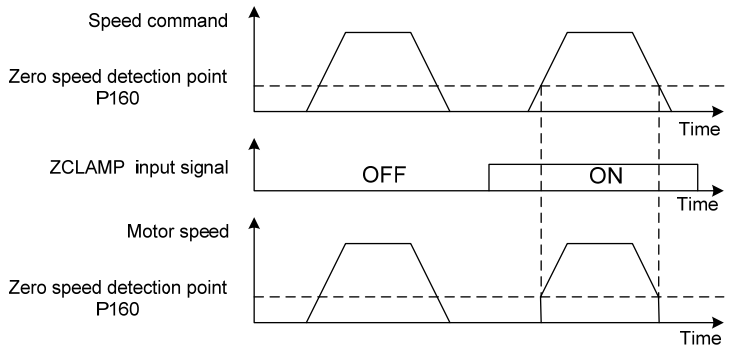
Para meter	Name	Range	Default value	Unit	Usage
P160	Zero speed detection point	0～1000	10	r/min	ALL
P161	Zero speed detection hysteresis	0～1000	5	r/min	ALL

- When the motor speed is lower than this parameter, the ZSP (zero speed) of the digital output DO is ON, otherwise it is OFF.
- The comparator has the hysteresis function, which is set by parameter P161.

Para meter	Name	Range	Default value	Unit	Usage
P162	Zero speed clamp mode	0～1	0		S

- When the following conditions are met, the zero speed clamping function is turned on:
  Condition 1: Speed control mode
  Condition 2: ZCLAMP (Zero Speed clamp) in DI is ON
  Condition 3: Speed command is lower than parameter P160
- When any of the above conditions is not met, the normal speed control is executed.
- When the zero speed clamping function is turned on, the meaning of this parameter is:
  0: The motor position is fixed at the moment when the function is turned on. At this time, the internal access position control will return to the zero fixed point even if it rotates due to external force.

1: When the function is turned on, the speed command is forced to zero speed. The internal control is still speed control, which may rotate due to external forces.



Para meter	Name	Range	Default value	Unit	Usage
P163	Position deviation clearing mode	0～1	0		P

- In position control mode, clear the position deviation counter and use CLR (position deviation clear) in DI.
- Parameter meaning, position deviation clearing occurs in:
  0: CLR ON level
  1: CLR rising edge (when OFF changes to ON)

Para meter	Name	Range	Default value	Unit	Usage
P164	Emergency shutdown mode	0～1	0		P

- When EMG (emergency shutdown) in DI is ON, the meaning of this parameter is:
  0: The driver turns off the motor current directly, and the motor stops freely
  1: The driver remains enabled, and the control motor stops at the acceleration and deceleration time defined in P063.

Para meter	Name	Range	Default value	Unit	Usage
P165	Motor static speed detection point	0～1000	5	r/min	ALL

- Motor static detection: if the motor speed is lower than the parameter value, the motor is considered to be static.
- It is only used for timing judgment of electromagnetic brake.

Para meter	Name	Range	Default value	Unit	Usage
P166	Electromagnetic brake delay time when motor is stationary	0～2000	150	ms	ALL

- When the SON of the servo driver is from ON go to OFF or an alarm occurs, define the delay time from electromagnetic brake braking (DO output terminal BRK OFF) to motor current turn off during motor standstill.
- This parameter enables the brake to turn off the current after reliable braking to avoid small

displacement of the motor or work piece drop. The parameter shall not be less than the delay time of mechanical braking.

- Refer to chapter 4.12 for corresponding timing.

Parameter	Name	Range	Default value	Unit	Usage
P167	Waiting time of electromagnetic brake when motor is running	0～2000	0	ms	ALL
P168	Action speed of electromagnetic brake when motor is running	0～3000	100	r/min	ALL

- When the SON of the servo driver is from ON go to OFF or an alarm occurs, define the delay time from the motor current turn off to the electromagnetic brake braking (DO output terminal BRK OFF) during motor operation.
- This parameter is used to make the motor decelerate from high speed rotating state to low speed, and then let the brake braking to avoid damaging the brake.
- The actual action time is P167 or the time required for the motor to decelerate to P168, whichever is the minimum.
- Refer to chapter 4.12 for corresponding timing.

Parameter	Name	Range	Default value	Unit	Usage
P169	Delay time of electromagnetic brake opening	0～1000	0	ms	ALL

- When the SON of the servo driver is from OFF to ON, define the delay time from the motor current turn on to the electromagnetic brake release (DO output terminal BRK ON).
- Refer to chapter 4.12 for corresponding timing.

Parameter	Name	Range	Default value	Unit	Usage
P172	Encoder output lines	1～16384	2500		ALL

- Parameter meaning set parameters to determine the resolution of driver output pulse.
- The default value is 2500, which means that per revolution of the motor shaft, the output is 2500 × 4=10000 pulses.

Parameter	Name	Range	Default value	Unit	Usage
P173	Encoder outputs B pulse phase	0～1	0		ALL

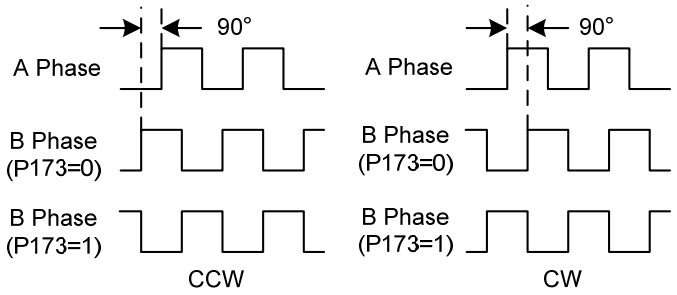
- Parameter meaning:

  0: In-phase

  1: Reverse phase

- This parameter can adjust the phase relationship between B-phase signal and A-phase signal.

P173	CCW	CW
0	A phase lags B phase for 90 degree	A phase advances B phase for 90 degree
1	A phase advances B phase 90 degree	A phase lags B phase 90 degree



Para meter	Name	Range	Default value	Unit	Usage
P174	Encoder outputs Z pulse phase	0～1	0		ALL

- Parameter meaning:
  0: In-phase;
  1: Reverse phase

Para meter	Name	Range	Default value	Unit	Usage
P175	Encoder outputs Z pulse width	0～1	0		ALL

- Parameter meaning:
  0: Width is the parameter value multiplied by 1 times the width of the output A (or B) signal;
  1: Width is the parameter value multiplied by 4 times the width of the output A (or B) signal.
- Expand the Z pulse. When the host device cannot capture a narrow Z pulse, it can be widened. Note that it is best to use the leading edge of Z pulse.

Para meter	Name	Range	Default value	Unit	Usage
P178	Homing trigger mode	1～3	1		ALL

- Parameter meaning:
  1: Triggered by GOH level of DI input
  2: Triggered by GOH rising edge of DI input
  3: Turn on automatic execution
- Refer to chapter 4.8 for details.

Para meter	Name	Range	Default value	Unit	Usage
P179	Homing mode	0～42	0		ALL

- Homing mode selection, please select mode values other than 15、16、31、32、36、37~41.

Para meter	Name	Range	Default value	Unit	Usage
P181	Homing position offset high digit	-8192～8192	0	65536 pulse	ALL
P182	Homing position offset low digit	-32768～32767	0	pulse	ALL

- The found home plus the offset is used as the actual home. The offset is P181×65536+P182。

Para meter	Name	Range	Default value	Unit	Usage
P183	Homing first speed	1～3000	500	r/min	ALL

- In homing, find the reference point speed.

Para meter	Name	Range	Default value	Unit	Usage
P184	Homing second speed	1～3000	50	r/min	ALL

- In homing, after reaching the reference point, find the speed of home, which should be less than home first speed (P183).

Para meter	Name	Range	Default value	Unit	Usage
P185	Homing acceleration time	0～30000	0	ms	ALL

- Acceleration time of motor from zero speed to rated speed in homing execution.
- If the command speed is lower than the rated speed, the acceleration time required is also reduced accordingly.
- Only used in homing execution.

Para meter	Name	Range	Default value	Unit	Usage
P186	Homing deceleration time	0～30000	0	ms	ALL

- Deceleration time of motor from rated speed to zero speed in homing execution.
- If the initial command speed is lower than the rated speed, the required deceleration time is also shortened accordingly.
- Only used in homing execution.

Para meter	Name	Range	Default value	Unit	Usage
P187	Homing positioning delay time	0～3000	500	ms	ALL

- The delay time after reaching home stops the motor completely. After the delay is completed, DO output HOME changes to ON.

Para meter	Name	Range	Default value	Unit	Usage
P188	Homing completes signal delay	1～3000	100	ms	ALL

- For the case of P178=2 or 3, the effective time of HOME after homing is completed.

Para meter	Name	Range	Default value	Unit	Usage
P195	Encoder multi turn overflow alarm shielding	0～1	1		ALL

- Parameter meaning:

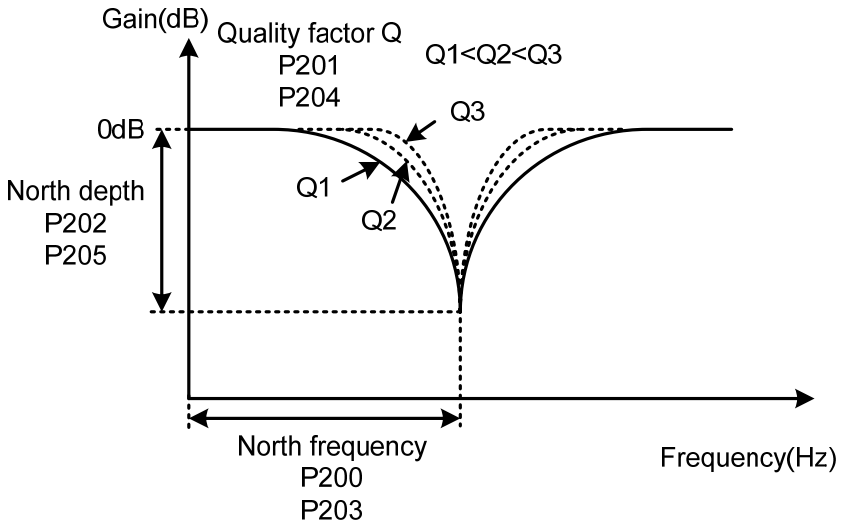
  0: When the encoder multi turn counting overflow alarm occurs, the servo will handle it according to the alarm.

  1: When the encoder multi turn counting overflow alarm occurs, the servo operates normally.

5.4.3 Parameters of section 2

Para meter	Name	Range	Default value	Unit	Usage
P200	1st notch filter frequency	50～5000	5000	Hz	ALL

- Notch filter is a filter used to eliminate the resonance of specific frequency caused by machinery.
- If parameter P202 is set to 0, this notch filter will be turned off.



Para meter	Name	Range	Default value	Unit	Usage
P201	1st notch filter quality factor	1～100	7		ALL

- The quality factor Q indicates the notch filter shape. The larger the Q, the sharper the notch filter shape, and the narrower the notch filter width (-3dB).

$$\text{Quality factor Q} = \frac{\text{North filter frequency}}{\text{North filter width}}$$

Para meter	Name	Range	Default value	Unit	Usage
P202	1st notch filter depth	0～60	0	dB	ALL

- Set the notch depth of the notch filter. The larger the parameter, the greater the notch depth, that is, the greater the filter gain attenuation. Set to 0 to turn off the notch filter.
- The relationship between P202 parameter and input/output ratio D is:

$$P202 = 20\log D(dB)$$

dB	I/O ratio	dB	I/O ratio	dB	I/O ratio	dB	I/O ratio	dB	I/O ratio
0	1	-13	0.224	-26	0.050	-39	0.011	-52	0.003
-1	0.891	-14	0.200	-27	0.045	-40	0.010	-53	0.002
-2	0.794	-15	0.178	-28	0.040	-41	0.009	-54	0.002
-3	0.708	-16	0.158	-29	0.035	-42	0.008	-55	0.002
-4	0.631	-17	0.141	-30	0.032	-43	0.007	-56	0.002
-5	0.562	-18	0.126	-31	0.028	-44	0.006	-57	0.001
-6	0.501	-19	0.112	-32	0.025	-45	0.006	-58	0.001
-7	0.447	-20	0.10	-33	0.022	-46	0.005	-59	0.001
-8	0.398	-21	0.089	-34	0.020	-47	0.004	-60	0.001
-9	0.355	-22	0.079	-35	0.018	-48	0.004		
-10	0.316	-23	0.71	-36	0.016	-49	0.004		
-11	0.282	-24	0.063	-37	0.014	-50	0.003		
-12	0.251	-25	0.056	-38	0.013	-51	0.003		

Para meter	Name	Range	Default value	Unit	Usage
P203	2nd notch filter frequency	50～5000	5000	Hz	ALL

- Notch filter is a filter used to eliminate specific frequency resonance caused by machinery.
- If P205 is set to 0, this notch filter will be turned off.

Para meter	Name	Range	Default value	Unit	Usage
P204	2nd notch filter quality factor	1～100	7		ALL

- Refer to the description of parameter P201.

Para meter	Name	Range	Default value	Unit	Usage
P205	2nd notch filter depth	0～60	0	dB	ALL

- Set the notch depth of the notch filter. Setting it to 0 means turn off the notch filter. Refer to the explanation of parameter P202 for others.

Para meter	Name	Range	Default value	Unit	Usage
P206	2nd torque filter frequency	100～5000	5000	Hz	ALL

- The cut-off frequency of 2nd torque filter (second order type) acts as 1st torque command filter.

Para meter	Name	Range	Default value	Unit	Usage
P207	2nd torque filter quality factor	1～100	50		ALL

- The quality factor of 2nd torque filter (2nd-order type) acts as 1st torque command filter.

Para meter	Name	Range	Default value	Unit	Usage
P208	Gain switching selection	0～15	0		ALL

- Parameter meaning:
  0: Fixed 1st gain.
  1: Fixed 2nd gain.
  2: DI input GAIN terminal control, 'OFF' is the 1st gain; 'ON' is the 2nd gain.
  3: Command pulse frequency control. When the input command pulse frequency exceeds P209, it switches to the 2nd gain.
  4: Pulse deviation control: switch to the 2nd gain when the position pulse deviation exceeds P209.
  5: Motor speed control. When the motor speed exceeds P209, it will switch to the second gain.
- 1st gain and 2nd gain are combined forms. Each group has four parameters, which are switched at the same time.

1st gain group		2nd gain group	
Para meter	Name	Para meter	Name
P005	1st speed loop gain	P010	2nd speed loop gain
P006	1st speed loop integral time constant	P011	2nd speed loop integration time constant
P007	1st torque filter time constant	P012	2nd torque filter time constant
P009	1st position loop gain	P013	2nd position loop gain

Para meter	Name	Range	Default value	Unit	Usage
P209	Gain switching level	0～32767	100		ALL
P210	Gain switching level hysteresis	0～32767	5		ALL

- According to the setting of parameter P208, the switching conditions and units are different.
- Parameter P210 and P209 have the same unit.
- The comparator has the hysteresis function, which is set by parameter P210.

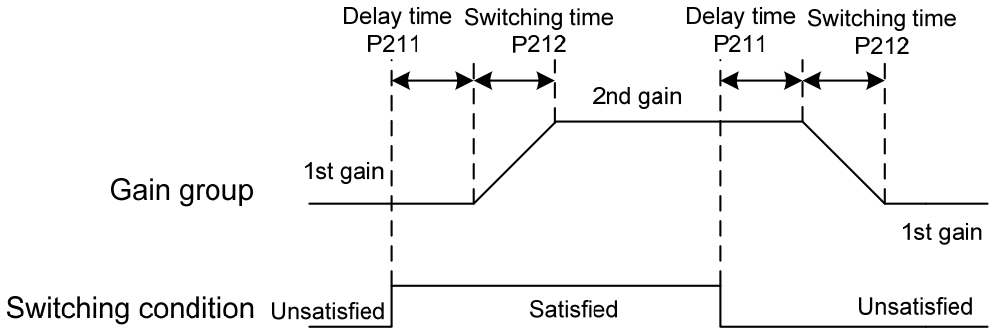
P208	Gain switching condition	unit
3	Command pulse frequency	0.1kHz(kpps)
4	Pulse deviation	pulse
5	Motor speed	r/min

Para meter	Name	Range	Default value	Unit	Usage
P211	Gain switching delay time	0～3000	5	ms	ALL

- The delay time from when the gain switching condition is satisfied to when the switching is started.
- Cancel the handover if it is detected that the handover condition is not satisfied in the delay phase.

Para meter	Name	Range	Default value	Unit	Usage
P212	Gain switching time	0～3000	5	ms	ALL

- During gain switching, the current gain combination will be linearly and smoothly transferred to the target gain combination in this time, and all parameters in the combination will change simultaneously.
- It can avoid impact caused by sudden change of parameters.



Para meter	Name	Range	Default value	Unit	Usage
P213	Automatic notch filter on	0～FFFF	0		ALL

- Parameter description:

Bit	Explanation
Bit0	1st notch filter automatic setting,0: OFF; 1: ON
Bit1	2nd notch filter automatic setting, as above
Bit2	3rd notch filter automatic setting, as above
Bit3	4th notch filter automatic setting, as above
Bit4	1st notch filter automatic setting mode, 0: Turn off the automatic setting function after the automatic setting is successful; 1: Always working
Bit5	2nd notch filter automatic setting mode is the same as above
Bit6	3rd notch filter automatic setting mode is the same as above
Bit7	4th notch filter automatic setting mode is the same as above
Bit8～Bit15	Reserved

Para meter	Name	Range	Default value	Unit	Usage
P214	3rd notch filter frequency	50～5000	5000	Hz	ALL

- Notch filter is used to eliminate the specific frequency resonance caused by machinery.
- If P205 is set to 0, turn off the notch filter.

Para meter	Name	Range	Default value	Unit	Usage
P215	3rd notch filter quality factor	1～100	7		ALL

- Refer to the description of parameter P201.

Para meter	Name	Range	Default value	Unit	Usage
P216	3rd notch filter depth	0～60	0	dB	ALL

- Set the notch depth of the notch filter. Set to 0 to turn off the notch filter. Refer to the explanation of parameter P202 for others.

Para meter	Name	Range	Default value	Unit	Usage
P217	4th notch filter frequency	50～5000	5000	Hz	ALL

- Notch filter is used to eliminate the specific frequency resonance caused by machinery.
- If P205 is set to 0, turn off the notch filter.

Para meter	Name	Range	Default value	Unit	Usage
P218	4th notch filter quality factor	1～100	7		ALL

- Refer to the description of parameter P201.

Para meter	Name	Range	Default value	Unit	Usage
P219	4th notch filter depth	0～60	0	dB	ALL

- Set the notch depth of the notch filter. Set to 0 to turn off the notch filter. Refer to the explanation of parameter P202 for others.

Para meter	Name	Range	Default value	Unit	Usage
P220	End vibration detection filter frequency	10～2000	200	Hz	P

- Parameter meaning:
  Set the filtering bandwidth frequency of the filter used for the end vibration detection function.

Para meter	Name	Range	Default value	Unit	Usage
P221	Minimum detection amplitude of end vibration	3～32767	5	pulse	P

- Minimum detection value of low-frequency vibration suppression.

Para meter	Name	Range	Default value	Unit	Usage
P222	Compensation coefficient of end vibration suppression	1.0～100.0	1.0		P

- Valid when the vibration suppression switch is turned on.
- The larger the value is, the more obvious the suppression effect is. However, too large a value is easy to bring mechanical noise.

Para meter	Name	Range	Default value	Unit	Usage
P223	End vibration suppression switch	0～3	0		P

- Parameter meaning:

  0: Vibration suppression function is invalid.

  1: Vibration suppression mode 1, which automatically detects vibration frequency, is suitable for occasions where inertia changes little.

  2: Vibration suppression mode 2, which automatically detects vibration frequency, is suitable for occasions where inertia always changes.

  3: Vibration suppression mode 3, manually set the vibration frequency, is suitable for occasions where the vibration frequency is known.

Para meter	Name	Range	Default value	Unit	Usage
P224	Manual setting of end vibration suppression period	0～1000	0	ms	P

- When (P223) is set to 3, this parameter is used to set the vibration cycle to be suppressed.

Para meter	Name	Range	Default value	Unit	Usage
P225	Reserved by the manufacturer	0～1	0		P

Para meter	Name	Range	Default value	Unit	Usage
P226	Medium frequency vibration 1 frequency	50～2000	100	Hz	P

- It is valid when the medium vibration suppression 1 switch is turned on (P229≠0).
- In the frequency point manual setting mode (P229=1), it is necessary to find the intermediate

frequency vibration point through the wave recording function of the servo host software.

Parameter	Name	Range	Default value	Unit	Usage
P227	Compensation coefficient of medium frequency vibration suppression 1	1～1000	100	%	P

- It is recommended to first use the Fn1 function to estimate the load inertia.
- If the servo inertia (P017) is set properly, it is recommended to set this parameter to 100.
  If the inertia cannot be estimated, the value is inversely proportional to the actual load inertia.

Parameter	Name	Range	Default value	Unit	Usage
P228	Damping coefficient of medium frequency vibration suppression 1	0～300	100	%	P

- Increasing the damping coefficient can improve the anti vibration effect, but excessive damping coefficient will increase the vibration.

Parameter	Name	Range	Default value	Unit	Usage
P229	Medium frequency vibration suppression 1 switch	0～2	0		P

- Parameter meaning:
  0: Invalid
  1: Valid
  2: Automatic setting;

Parameter	Name	Range	Default value	Unit	Usage
P231	Medium frequency vibration 2 frequency	50～2000	100	Hz	P

- It is valid when the medium vibration suppression 2 switch is turned on (P234 is not 0).
- In the frequency point manual setting mode (P234=1), it is necessary to find the intermediate frequency vibration point through the wave recording function of the servo host software.

Parameter	Name	Range	Default value	Unit	Usage
P232	Compensation coefficient of medium frequency vibration suppression 2	1～1000	100	%	P

- It is recommended to first use the Fn1 function to estimate the load inertia.
- If the servo inertia (P017) is set properly, it is recommended to set this parameter to 100.
  If the inertia cannot be estimated, the value is inversely proportional to the actual load inertia.

Parameter	Name	Range	Default value	Unit	Usage
P233	Damping coefficient of medium frequency vibration suppression 2	0～300	100	%	P

- Increasing the damping coefficient can improve the anti vibration effect, but excessive damping

coefficient will increase the vibration.

Para meter	Name	Range	Default value	Unit	Usage
P234	Medium frequency vibration suppression 2 switch	0～2	0		P

- Parameter meaning:
  0: Invalid
  1: Valid
  2: Automatic setting

Para meter	Name	Range	Default value	Unit	Usage
P236	Speed feedback source	0～1	0		P

- Parameter meaning:
  0: Speed feedback comes from filter
  1: Speed feedback comes from the observer

Para meter	Name	Range	Default value	Unit	Usage
P237	Medium frequency vibration suppression mode in high response mode	0～1	1		P

- Parameter meaning:
  0: External compensation
  1: Internal compensation

Para meter	Name	Range	Default value	Unit	Usage
P238	High immunity mode gain percentage in high response mode	0～1000	50	%	P,S

- This parameter only takes effect when the high response mode is enabled (P237=1) and is used to adjust the gain percentage of the high response mode. Generally, it is set to 20～80 to meet the needs. Setting the value too high can easily cause mechanical vibration.

Para meter	Name	Range	Default value	Unit	Usage
P239	High immunity mode switch in high response mode	0～2	0		P

- Parameter meaning:
  0: Turn off this mode
  1: Turn on this mode and maintain the default gain
  2: Gain percentage adjustable

Para meter	Name	Range	Default value	Unit	Usage
P240	High response mode tracking gain	10～1000	100	%	P

- The recommended value is 75～150.

Para meter	Name	Range	Default value	Unit	Usage
P241	Friction compensation gain percentage	10～1000	100	%	P

- It is recommended to first use the Fn 1 function to estimate the load inertia.
- If the servo inertia (P017) is set properly, it is recommended to set this parameter to 100.
  If the inertia cannot be estimated, the value is inversely proportional to the actual load inertia.

Para meter	Name	Range	Default value	Unit	Usage
P242	Friction compensation ratio	0～1000	0	%	P

- Increasing the damping coefficient can improve the anti vibration effect, but excessive damping coefficient will increase the vibration. When the parameter is set to 0, the friction compensation function is turned off.

Para meter	Name	Range	Default value	Unit	Usage
P243	Friction compensation observer gain	0～1200	400	Hz	P

- Increasing the observer gain can compensate the external disturbance more quickly, but if the gain is too large, vibration will occur when the machine has a resonant frequency.

Para meter	Name	Range	Default value	Unit	Usage
P244	Current loop mode selection in high response mode	0～3	0		P,S

- This parameter only takes effect when P247=1.
  0: Current loop does not adopt high response mode
  1: Current loop adopts a high response mode
  2: The current loop uses a high response current observer
  3: The current loop uses a standard current observer

Para meter	Name	Range	Default value	Unit	Usage
P245	High response mode speed observer nonlinear mode	0～1	1		P

- Parameter meaning:
  0: The nonlinear function type in high response mode adopts structure 0
  1: The nonlinear function type in high response mode adopts structure 1

Para meter	Name	Range	Default value	Unit	Usage
P246	High response mode speed feedback source	0～1	0		P

- Parameter meaning:
  0: In high response mode, the feedback speed source is the original speed
  1: In high response mode, the feedback speed source is the filtered speed

Para meter	Name	Range	Default value	Unit	Usage
P247	High response mode enable	0～2	0		P

- Parameter meaning:
  0: Servo loop controller adopts traditional control mode
  1: Servo loop controller adopts high response mode
  2: Servo loop controller adopts disturbance observer for disturbance compensation

Para meter	Name	Range	Default value	Unit	Usage
P248	High response mode speed observer bandwidth	100～2000	150	Hz	P,S

- High response mode speed observer bandwidth, increasing the parameter value can enhance the speed following ability and anti-interference ability, and being too large is prone to noise interference.

Para meter	Name	Range	Default value	Unit	Usage
P249	High response mode speed observer bandwidth parameter setting is valid	0～1	1		P,S

- Parameter meaning:
  0: High response mode speed observer bandwidth parameter setting is invalid
  1: High response mode speed observer bandwidth parameter setting is valid

Para meter	Name	Range	Default value	Unit	Usage
P250	High response mode current observer bandwidth	50～400	180	10Hz	P,S

- High response mode current observer bandwidth, increasing the parameter value can enhance the current following ability and anti-interference ability, and being too large is prone to noise interference.

Para meter	Name	Range	Default value	Unit	Usage
P251	High response mode current observer bandwidth parameter setting is valid	0～1	0		P,S

- Parameter meaning:
  0: High response mode current observer bandwidth parameter setting is invalid
  1: High response mode current observer bandwidth parameter setting is valid

Para meter	Name	Range	Default value	Unit	Usage
P252	High response mode 1st torque filtering time constant	0.05～5.00	0.10	ms	ALL

- Torque low pass filter, inhibits the mechanical vibration, decrease the torque current fluctuation.
- The larger the value is, the better the vibration suppression effect is, and the smaller the torque current fluctuation is. If it is too large, the response will become slower, which may cause oscillation. The smaller the value, the faster the response, but limited by mechanical conditions.
- It is recommended that the setting range is 0.05～0.15. If it exceeds this range, it will easily cause system oscillation.

Para meter	Name	Range	Default value	Unit	Usage
P253	High response mode speed observer type	0～5	0		ALL

- Parameter meaning:
  0: Linear
  1: Low-level nonlinearity
  2: Intermediate nonlinearity
  3: Medium to advanced nonlinearity
  4: Advanced nonlinearity
  5: Super advanced nonlinearity

Para meter	Name	Range	Default value	Unit	Usage
P254	High response mode speed observer non exponential gain multiple	0.0～10.0	1.5	times	ALL

- High response mode non exponential gain multiple, the larger the value, the stronger the speed following and anti-interference ability.

Para meter	Name	Range	Default value	Unit	Usage
P255	Speed observer gain	10～1000	120	Hz	P

- The improvement of the speed observer gain can make the observer output track the actual speed feedback faster.

Para meter	Name	Range	Default value	Unit	Usage
P256	Speed observer compensation coefficient	0～1000	150	%	P

- Default value is not recommended to be modified.

Para meter	Name	Range	Default value	Unit	Usage
P258	Inertia identification	0～9	0		P

- Parameter meaning:
  0: Turn off;
  1: Reserved, used by the manufacturer;
  2: Online mode

Para meter	Name	Range	Default value	Unit	Usage
P269	Inertia estimation mode	0～10	0		P

- Set the inertia estimation mode. The greater the setting value, the greater the default inertia setting value.

Para meter	Name	Range	Default value	Unit	Usage
P270	Model tracking control switch	0～3	0		P

- It is recommended to use the Fn1 function to estimate the load inertia first.
- It is applicable to position control, and the system response can be improved by selecting appropriate parameters according to different loads.
- Parameter meaning:
  0: Invalid model tracking
  1: Applicable rigid load
  2: Reserved
  3: Universal

Para meter	Name	Range	Default value	Unit	Usage
P271	Model tracking control gain	10～2000	40	Hz	P

- Model tracking control gain, mode 1～3 are valid.
- The larger the value, the faster the response. If it is too large, it may cause noise.

Para meter	Name	Range	Default value	Unit	Usage
P272	Model tracking damping ratio	50～200	100		P

Para meter	Name	Range	Default value	Unit	Usage
P273	Model tracking positive direction output ratio	0～1000	100	%	P

- Model tracking positive direction control deviation, mode 1～3 are valid.
- By adjusting this parameter, the response speed of forward rotation and reverse rotation can be adjusted separately.
- The larger the value, the greater the feedforward effect of the torque loop, which may cause noise.

Para meter	Name	Range	Default value	Unit	Usage
P274	Model tracking reverse direction output ratio	0～1000	100	%	P

- The description is the same as P273.

Para meter	Name	Range	Default value	Unit	Usage
P277	Model tracking speed compensation feedforward	0～100	100	%	P

- Model tracking speed compensation feedforward, the larger the value, the greater the speed loop feedforward effect, too large may cause noise.
- Modes 1～3 are valid.

Para meter	Name	Range	Default value	Unit	Usage
P280	Model tracking speed compensates feedforward filtering time	0.10～50.00	0.50	ms	P

- Model tracking speed compensates the filtering time of feedforward. The larger the value is, the smaller the noise is. If the value is too large, the compensation lag will be caused.
- Only mode 3 is valid.

Para meter	Name	Range	Default value	Unit	Usage
P281	Model tracking speed loop gain	1～3000	40	Hz	P

- Parameter meaning:
  Model tracking speed loop gain (unit: Hz).

Para meter	Name	Range	Default value	Unit	Usage
P282	Model tracking speed loop integral time constant	1.0～1000.0	20.0	ms	P

- Parameter meaning:
  Model tracking speed loop integral time constant (unit: ms).

Para meter	Name	Range	Default value	Unit	Usage
P283	Inertia estimation gain level	0～2	0		P

- Parameter meaning:
  0: Low rigidity
  1: Medium rigidity
  2: High rigidity

Para meter	Name	Range	Default value	Unit	Usage
P285	Vibration alarm time	0～100	0	s	P

- It does not take effect when it is set to 100, and every 3 corresponds to 1s.

Para meter	Name	Range	Default value	Unit	Usage
P289	Vibration detection level	0～2000	60	Hz	ALL

- When the maximum and minimum speed error reaches the set value, it is determined as vibration.

Para meter	Name	Range	Default value	Unit	Usage
P296	Self tuning mode	0～3	0		

- Parameter meaning:
  0: Manual mode
  1: Automatic mode
  2: Setting completed
  3: Feedforward mode

5.4.4 Parameters of section 3

Parameter	Name	Range	Default value	Unit	Usage
P300	Site address	1～32	1		M

- Site address is a parameter used to set the MODBUS communication station number.
- If MODBUS communication is used, the communication address of the servo driver shall be set with different servo driver station numbers based on this parameter. The setting range of station numbers is 1～32. One group of servo drivers can only set one station number. Repeated setting of station numbers will lead to failure of normal communication.

Parameter	Name	Range	Default value	Unit	Usage
P301	MODBUS communication baud rate	1～6	2		M

- Set MODBUS communication baud rate
- Parameter meaning: (unit: bit/s)

  1: Baud rate is 4800

  2: Baud rate is 9600

  3: Baud rate is 19200

  4: Baud rate is 38400

  5: Baud rate is 57600

  6: Baud rate is 115200

Parameter	Name	Range	Default value	Unit	Usage
P302	MODBUS communication protocol selection	0～5	3		M

- Select the communication protocol of MODBUS through this parameter. The selected communication protocol must be consistent with the communication protocol of the host controller. The specific setting value is as follows, and the initial value is 4.
- Parameter meaning:

  0～2: Reserved

  3：8，N，1（MODBUS, RTU）

  4：8，E，1（MODBUS, RTU）

  5：8，O，1（MODBUS, RTU）
- Parameter details:

  The number 8 represents that the transmitted data bits are 8; The English letters N, E, O represent parity bit, N represents not to use this bit, E represents 1 even bit, and O represents 1 odd bit; The number 1 indicates that the ending bit is 1.

Para meter	Name	Range	Default value	Unit	Usage
P305	Speed return filtering time constant	0.1～300.0	0.1	ms	ALL

- Set the filtering time constant for the speed return value. The larger the value, the better the filtering effect, and the smoother the feedback value.

Para meter	Name	Range	Default value	Unit	Usage
P380	Digital input DI9 function	-37～37	0		ALL

- Refer to the description of parameter P100.
- DI9 input filtering time constant is set by P110.

5.4.5 Parameters of section 4

Para meter	Name	Range	Default value	Effective mode	Unit
P472	Number of forward turns of round-trip motion	1～32767	3	Immediately	
P473	Number of reverse turns of round-trip motion	1～32767	3		
P474	Round-trip speed	1～32767	1000		rpm
P475	Round-trip acceleration time	0～32767	100		ms
P476	Round-trip deceleration time	0～32767	100		ms

- When using the parameter self-tuning function, you can set P472 and P473 to limit the total displacement of the motor, but it is not recommended that the number of turns be less than 3. Too small turns are not conducive to the result of parameter self-tuning.
- In addition, when the mechanical connection stiffness is not enough, or the load inertia ratio is too large, the values of P475 and P476 can be appropriately increased, and the value of P474 can be reduced to achieve the purpose of making the acceleration and deceleration and uniform motion process smoother, reducing potential damage to the machinery.

5.5 DI function details

<table>
<tr><th>Ordinal</th><th>Symbol</th><th>DI Function</th><th>Functional explanation</th></tr>
<tr><td>0</td><td>NULL</td><td>No function</td><td>Input state had no effect on the system.</td></tr>
<tr><td>1</td><td>SON</td><td>Servo enable</td><td>OFF: Servo driver is not enabled and the motor is not energized;
ON: Servo driver is enabled and the motor is energized.</td></tr>
<tr><td>2</td><td>ARST</td><td>Clear alarm</td><td>When there is an alarm, if the alarm is allowed to be cleared, input the rising edge (OFF to ON moment) to clear the alarm. Note that only some alarms are allowed to be cleared.</td></tr>
<tr><td>3</td><td>CCWL</td><td>CCW drive inhibit</td><td>OFF：CCW rotation is prohibited;
ON ： CCW rotation is allowed.
It is used for mechanical limit travel protection and its function is controlled by parameter P097. Note that the default value of P097 is to ignore this function. If you need to use this function, you need to modify P097.
<table>
<tr><th>P097</th><th>Explanation</th></tr>
<tr><td>0</td><td rowspan="2">To use the CCW drive inhibit function, the normally closed contact of the travel switch must be connected.</td></tr>
<tr><td>2</td></tr>
<tr><td>1</td><td rowspan="2">Ignore the CCW drive inhibit function, the motor can run in the positive direction. This signal has no effect and does not need to be connected.</td></tr>
<tr><td>3 (default)</td></tr>
</table>
Inhibit mode:
<table>
<tr><th>P042</th><th>Explanation</th></tr>
<tr><td>0</td><td>In CCW drive inhibit function, CCW torque is limited as 0.</td></tr>
<tr><td>1</td><td>In CCW drive inhibit function, CCW pulse input is inhibited.</td></tr>
</table></td></tr>
<tr><td>4</td><td>CWL</td><td>CW drive inhibit</td><td>OFF：CW rotation is prohibited;
ON ： CW rotation is allowed.
It is used for mechanical limit travel protection and its function is controlled by parameter P097. Note that the default value of P097 is to ignore this function. If you need to use this function, you need to modify P097.</td></tr>
</table>

<table>
<tr><th>Ordinal</th><th>Symbol</th><th>DI Function</th><th>Functional explanation</th></tr>
<tr><td>4</td><td>CWL</td><td>CW drive inhibit</td><td>
<table>
<tr><th>P097</th><th>explain</th></tr>
<tr><td>0</td><td rowspan="2">To use the CW drive inhibit function, the normally closed contact of the travel switch must be connected.</td></tr>
<tr><td>2</td></tr>
<tr><td>1</td><td rowspan="2">Ignore the CW drive inhibit function, the motor can run in the positive direction. This signal has no effect and does not need to be connected.</td></tr>
<tr><td>3 (default)</td></tr>
</table>
Inhibit mode:
<table>
<tr><th>P042</th><th>explain</th></tr>
<tr><td>0</td><td>In CW drive inhibit function, CW torque is limited as 0.</td></tr>
<tr><td>1</td><td>In CW drive inhibit function, CW pulse input is inhibited.</td></tr>
</table>
</td></tr>
<tr><td>5</td><td>TCCW</td><td>CCW torque limit</td><td>OFF: CCW direction torque is not limited by parameter P067;
ON: CCW direction torque is limited by parameter P067.
Note: Whether TCCW is valid or invalid, the torque in CCW direction is also limited by parameter P065.</td></tr>
<tr><td>6</td><td>TCW</td><td>CW torque limit</td><td>OFF: CW direction torque is not limited by parameter P068;
ON: CW direction torque is limited by parameter P068.
Note: Whether TCW is valid or invalid, the torque in CW direction is also limited by parameter P066.</td></tr>
<tr><td>7</td><td>ZCLAMP</td><td>Zero speed clamp</td><td>When the following conditions are met, the zero speed clamp function is enabled :
Condition 1: speed control mode;
Condition 2: ZCLAMP ON;
Condition 3: Speed command is lower than parameter P160.
If any of the above conditions are not met, normal speed control shall be performed. Refer to parameter P162 for specific application.</td></tr>
<tr><td>8</td><td>CZERO</td><td>Zero command</td><td>In speed or torque control mode, speed or torque commands are:
OFF: Normal command;
ON: Zero command.</td></tr>
<tr><td>9</td><td>CINV</td><td>Reverse command</td><td>In speed or torque control mode, speed or torque commands are:
OFF: Normal command;
ON: Reverse command.</td></tr>
</table>

<table>
<tr><th>Ordinal</th><th>Symbol</th><th>DI Function</th><th>Functional explanation</th></tr>
<tr><td>10</td><td>SP1</td><td>Internal speed selection 1</td><td rowspan="2">Speed control, speed limit, SP1, SP2 combination select internal speed 1～4:
<table>
<tr><th colspan="2">DI signal[note]</th><th rowspan="2">Speed command</th></tr>
<tr><th>SP2</th><th>SP1</th></tr>
<tr><td>0</td><td>0</td><td>Internal speed 1(parameter P141)</td></tr>
<tr><td>0</td><td>1</td><td>Internal speed 2(parameter P142)</td></tr>
<tr><td>1</td><td>0</td><td>Internal speed 3(parameter P143)</td></tr>
<tr><td>1</td><td>1</td><td>Internal speed 4(parameter P144)</td></tr>
</table>
Note: 0 indicates OFF; 1 indicates ON.</td></tr>
<tr><td>11</td><td>SP2</td><td>Internal speed selection 2</td></tr>
<tr><td>13</td><td>TRQ1</td><td>Internal torque selection 1</td><td rowspan="2">Torque control, torque limit, TRQ1, combining TRQ2 torque within 1～4:
<table>
<tr><th colspan="2">DI signal[note]</th><th rowspan="2">Torque command</th></tr>
<tr><th>TRQ2</th><th>TRQ1</th></tr>
<tr><td>0</td><td>0</td><td>Internal torque 1(parameter P145)</td></tr>
<tr><td>0</td><td>1</td><td>Internal torque 2(parameter P146)</td></tr>
<tr><td>1</td><td>0</td><td>Internal torque 3(parameter P147)</td></tr>
<tr><td>1</td><td>1</td><td>Internal torque 4(parameter P148)</td></tr>
</table>
Note: 0 indicates OFF; 1 indicates ON.</td></tr>
<tr><td>14</td><td>TRQ2</td><td>Internal torque selection 2</td></tr>
<tr><td>15</td><td>EMG</td><td>Emergency shutdown</td><td>OFF: Allow the servo driver to work;
ON: Stop the motor according to the mode set by parameter 164.</td></tr>
<tr><td>16</td><td>CMODE</td><td>Control mode switch</td><td>When parameter P004=3, 4, 5, the control mode can be switched:
<table>
<tr><th>P004</th><th>CMODE</th><th>Control mode</th></tr>
<tr><td rowspan="2">3</td><td>0</td><td>Position</td></tr>
<tr><td>1</td><td>Speed</td></tr>
<tr><td rowspan="2">4</td><td>0</td><td>Position</td></tr>
<tr><td>1</td><td>Torque</td></tr>
<tr><td rowspan="2">5</td><td>0</td><td>Speed</td></tr>
<tr><td>1</td><td>Torque</td></tr>
</table></td></tr>
<tr><td>17</td><td>GAIN</td><td>Gain switch</td><td>When parameter P208=2, switch gain combination through GAIN:
OFF: 1st gain;
ON: 2nd gain.</td></tr>
</table>

<table>
<tr><th>Ordinal</th><th>Symbol</th><th>DI Function</th><th>Functional explanation</th></tr>
<tr><td>18</td><td>GEAR1</td><td>Electronic gear selection 1</td><td rowspan="2">GEAR1 and GEAR2 combined selection command pulse electronic gear molecules 1-4:
<table>
<tr><th>GEAR2</th><th>GEAR1</th><th>Electron gear molecule N</th></tr>
<tr><td>0</td><td>0</td><td>1st numerator(parameterP029)</td></tr>
<tr><td>0</td><td>1</td><td>2nd numerator(parameterP031)</td></tr>
<tr><td>1</td><td>0</td><td>3rd numerator(parameterP032)</td></tr>
<tr><td>1</td><td>1</td><td>4th numerator(parameterP033)</td></tr>
</table>
Note: 0 indicates OFF; 1 indicates ON.</td></tr>
<tr><td>19</td><td>GEAR2</td><td>Electronic gear selection 2</td></tr>
<tr><td>20</td><td>CLR</td><td>Position deviation clearing</td><td>Clear the position deviation counter. The clearing mode is selected by parameter P163. The position deviation clearing occurs at:
P163=0: CLR ON level;
P163=1: CLR rising edge (OFF to ON moment).</td></tr>
<tr><td>21</td><td>INH</td><td>Pulse input inhibit</td><td>OFF: Position command pulse is allowed to pass;
ON: Position command pulse is inhibited.</td></tr>
<tr><td>22</td><td>PC</td><td>Proportional control</td><td>OFF: Speed loop PI control;
ON: Speed loop P control.</td></tr>
<tr><td>23</td><td>GOH</td><td>Homing trigger</td><td>Start the homing function. Refer to the description of parameter P178 and chapter 4.8.</td></tr>
<tr><td>24</td><td>REF</td><td>Homing reference point</td><td>Homing external reference point, refer to the description of parameter P179 and chapter 4.8.</td></tr>
</table>

5.6 DO function details

Ordinal	Symbol	DO Function	Functional explanation
0	OFF	Always invalid	Force output OFF.
1	ON	Always valid	Force output ON.
2	RDY	Servo ready	OFF: Servo main power supply is off, or alarm occurs; ON: Servo main power supply is normal, no alarm occurs.
3	ALM	Alarm	OFF: Alarm occurs; ON: No alarm occurs.
4	ZSP	Zero speed	OFF: Motor speed is higher than parameter P160 (in CCW or CW); ON: Motor speed is lower than parameter P160 (in CCW or CW).
5	COIN	Positioning complete	In position control mode OFF: Position deviation is bigger than parameter P150; ON: Position deviation is smaller than parameter P150.
6	ASP	Arrival speed	OFF: Motor speed is lower than parameter P154; ON: Motor speed is higher than parameter P154. With polarity setting function, refer to the description of parameter P154.
7	ATRQ	Arrival torque	OFF: Motor torque is lower than parameter P157; ON: Motor torque is higher than parameter P157. With polarity setting function, refer to the description of parameter P157.
8	BRK	Electromagnetic brake	OFF: Electromagnetic brake braking; ON: Electromagnetic brake is released.
10	NEAR	Near positioning	In position control mode OFF: Position deviation is bigger than parameter P152; ON: Position deviation is smaller than parameter P152.
11	TRQL	In torque limit	OFF: Motor torque does not reach the limit value; ON: Motor torque reaches the limit value. The torque limit method is set by parameter P064.
12	SPL	In speed limit	In torque control mode OFF: Motor speed does not reach the limit value; ON: Motor speed reaches the limit value. The speed limit method is set by parameter P077.
13	HOME	Homing completed	After the homing is completed, output ON, and refer to Chapter 4.8 for specific timing
30	DBC	Dynamic braking	OFF: External dynamic brake is invalid; ON: External dynamic brake takes effect.

Chapter 6 Communication functions

6.1 Communication hardware interface

Servo driver

With RS-485 serial communication function, using MODBUS protocol, it can realize servo system drive, parameter change, servo system status monitoring and other functions.

With USB communication function, it needs to be used together with PC software to change parameters. Please refer to PC software instructions and other relevant documents for specific information.

6.2 Communication parameter

Refer to section 5.1.4.

6.3 MODBUS communication protocol

When using RS-485 serial communication, each servo driver must set its servo driver station number on parameter P300 in advance. The computer or host controller communicates with the corresponding servo driver according to the station number. The communication baud rate needs to refer to the communication parameters of the host controller to set the driver P301 parameter. The mode that MODBUS can use: RTU (Remote Terminal Unit) mode. The user can set the required communication protocol on parameter P302. The following describes MODBUS communication.

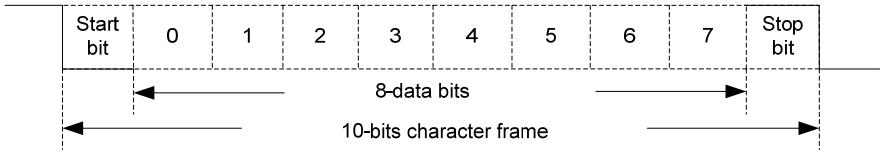
Coding meaning

- RTU mode:

  Each 8-data bits consist of two 4bits hexadecimal characters. For example: 1 byte data 64H.

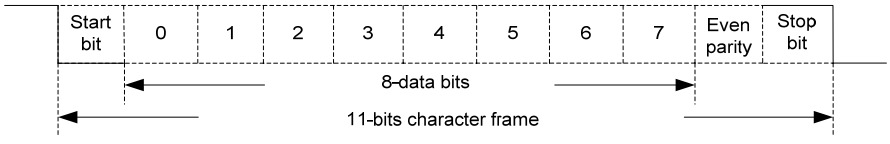
  Character structure:

  10-bits character frame (used for 8-data bits character without verification)

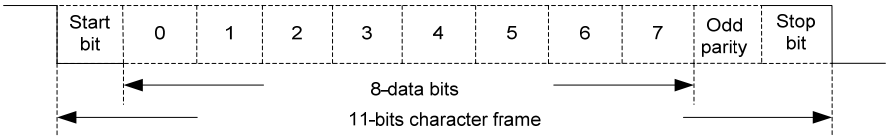


8, N, 1

  11-bits character frame (used for 8-data bits character with verification)



8，E，1



8，O，1

Communication data structure：

- RTU mode：

STX	The minimum time interval from the previous frame is 3.5 characters
ADR	Communication address : 1byte
CMD	Command code : 1byte
DATA(n-1)	Data content: Nword=2Nbyte，N<=100
……..	
DATA(0)	
CRC	Verification code: 2byte
End1	The minimum time interval with the next frame is 3.5 characters

The items in the communication data format box are described as follows:

1、STX (communication starting)

- RTU mode: the minimum time interval with upper frame is 3.5 character time.

2、ADR (communication address)

Legal communication address ranges from 1 to 32, as the follow picture: communication with the servo drive of station number 16 (hexadecimal 10H)：

- RTU mode: ADR = 10H

3、CMD (command code) and DATA (data character)

The format of data characters depends on the command code. Common command codes are described as follows:

(1) Command code 03H, could read N words (16bit). N max. 100.

For example, two parameters are read continuously from the No. 5 parameter of section 0 of the 01H servo driver.

- RTU mode:

Command information：

ADR	01H
CMD	03H
Initial data position	20H (high byte)
	05H (low byte)
Data number	00H (high byte)
	02H (low byte)
CRC Low	DFH (high byte)
CRC High	CAH (low byte)

Respond information：

ADR	01H
CMD	03H
Data number (count by byte)	04H
0 section number 5 parameter content	00H (high byte)
	28H (low byte)
0 section number 6 parameter content	00H (high byte)
	C8H (low byte)
CRC Low	7BH (high byte)
CRC High	FDH(low byte)

(2) Command code 06H, write 1 parameter, N max. 100.

For example, write 100 (0064H) to the No. 05 parameter of section 0 of the servo driver whose station number is 01H.

- RTU mode:

Command information：

ADR	01H
CMD	06H
Initial data position	20H (high byte)
	05H (low byte)
Data content	00H (high byte)
	64H (low byte)
CRC Low	93H (high byte)
CRC High	E0H (low byte)

Respond information：

ADR	01H
CMD	06H
Initial data position	20H (high byte)
	05H (low byte)
Data content	00H (high byte)
	64H (low byte)
CRC Low	93H (high byte)
CRC High	E0H (low byte)

Every operational parameter is only limited to the same parameter section. Different parameter section needs to be operated respectively.

4、CRC(RTU mode) frame check calculation:

- RTU mode:

RTU mode adopts CRC (Cyclical Redundancy Check) frame check. The CRC frame check calculation is described in the following steps:

Step 1: Initialize a 16bit register containing FFFFH, called CRC register.

Step 2: XOR the first byte of the command information with the low byte of the 16 bits CRC register, and save the result back to the CRC register.

Step 3: Check the lowest bit (LSB) of CRC register. If this bit is 0, move it right by one bit. If this bit is 1, the CRC register value is shifted one bit to the right, and then XOR with A001H is performed.

Step 4: Go back to step 3 until the step 3 has been executed 8 times, and then go to step 5.

Step 5: Repeat steps 2 to 4 for the next byte of the command information until all the bytes have completed the above processing. At this time, the content of the CRC register is the CRC frame check.

Note: After CRC frame check is calculated, the low bit of CRC must be filled in first, and then the high

bit of CRC must be filled in the command information. Please refer to the following example.

For example: read the No. 05 parameter of section 0 of the servo driver with station No. 01H. The last content of CRC register calculated from ADR to the last byte of data is CADFH, and its command information is as follows. It should be noted that byte DFH should be transmitted before byte CAH.

ADR	01H
CMD	03H
Initial data position	20H (high byte)
	05H (low byte)
Data number	00H (high byte)
	02H (low byte)
CRC Low	DFH (high byte)
CRC High	CAH (low byte)

5、End 1, End 0 communication end:

- RTU mode: the minimum time interval with the next frame is 3.5 characters.

6.4 Write in and read out parameter

For all parameters of the servo driver, please refer to the parameter chapter. The parameters are divided according to the parameter section. Each parameter is represented by 16 bits data. The communication address of each parameter is determined by the parameter offset address 2000H, parameter section number and parameter serial number. The address is 16 bits. For example, the communication address of parameter P330=0x2000+0x14A (330) =0x214A, and so on for other parameters.

Description of the parameter format of write in and read out through the communication station (refer to chapter 6.6 for status reading): the parameters of read out and write in must be decimal integer numbers. The parameters with decimal points are marked on the driver display panel and in the instruction manual. During the operation of read out and write in, the corresponding multiples are magnified to make them decimal integer numbers. The parameters in binary format are displayed, and the decimal integer numbers actually used in the process of read out and write in operations are their equivalent. The details are as follows. See the description in the parameter section of the instruction manual for the transformation mode of each parameter:

Parameter No.	Communication address	Instruction display value	Communication operating value	Transformation mode
P005(0005H)	0x2005	40	40	invariant
P006(0006H)	0x2006	20.0	200	Magnify by 10 times
P007(0007H)	0x2007	1.00	100	Magnify 100 times
P120(0078H)	0x2078	00000(Binary)	0(Decimal)	Binary to decimal

All parameters described in the parameter section can be read out and written in through communication. For details, please refer to Chapter 5 parameters of the description.

6.5 Common operation commands

The internal parameters of the servo driver can be read and written through the RS-485 communication port. After reading and writing, the driver parameter list can be operated as a whole through specific operation commands.

First, write the operation code into the operation command code register. After a certain delay time, read out operates the status register. The specific value of read out indicates that the operation is successfully completed. The operation address is as follows:

Operation register description	Communication address	Data size
Operation command code register	27FEH	16bit
Operation status register	27FFH	16bit

The command codes supported in the current version include "Parameter operation is valid", "Parameter write in EEPROM", and "Restore default value". The specific description of each command code is as follows:

Command code description	Command code	Completion status	Operational meaning
Parameter operation	BB00H	Succeeded: 44FFH	Indicates that the modified parameter in the parameter list will take effect
Parameter write in EEPROM	F03CH	Succeeded: 3CF0H; Failed: 3C80H	Indicates that the parameter in the parameter list is written in EEPROM
Restore default value	F03EH	Succeeded: 3EF0H；Failed: 3E80H	Indicates that the default values of all parameters are read into the parameter list
Encoder reset	F024H	Succeeded: 24F0H；Failed: 2480H	Indicates that the encoder multi turn position is cleared and takes effect after power failure
Encoder alarm clear	F025H	Succeeded: 25F0H；Failed:：2580H	Indicates that the encoder alarm is cleared

6.6 Status monitoring

The internal status of the servo driver can be read out through the RS-485 communication port, and the write in operation cannot be performed. The status is stored in 16bit data. The value accurate to the decimal place will be magnified by 10 times and 100 times when it is read out through the communication port. This is the same as the read out parameter. The organization order of the related status is as follows:

2640H：Motor speed, unit “r/min”；

2641H：Initial position command (input pulse) low 16 bit;

2642H：Initial position command (input pulse) high 16 bit;

2643H：Position command (pulse) low 16 bit;

2644H：Position command (pulse) high 16 bit;

2645H：Current position (pulse) low 16 bit;

2646H：Current position (pulse) high 16 bit;

2647H：Positional deviation (pulse) low 16 bit;

2648H：Positional deviation (pulse) high 16 bit;

2649H：Motor torque, unit “%”;

264AH：Peak torque, unit “%”;

264BH：Motor current, unit “A”;

264CH：Peak current, unit “A”;

264DH：Position command pulse frequency, unit “kHz”;

264EH：Speed command, unit “r/min”;

264FH：Torque command, unit “%”;

2650H：Speed analog command voltage, unit “mV”;

2651H：Torque analog command voltage, unit “mV”;

2652H：Input terminal DI state, note 1;

2653H：Output terminal DO state, note 2;

2654H：Rotor absolute position (single turn);

2655H：Rotor absolute position (multi turn);

2656H：Accumulative load rate, unit “%”;

2657H：Regenerative brake load rate, unit “%”;

2658H：Alarm code;

265AH：Busbar voltage, unit "V";

265BH：Module internal temperature, unit “℃”;

265CH：Multi turn position (when there is no multi-turn information, read out value 0).

Note 1. The data read out by this address is 16bit, in which bit4～bit0 indicates the input state of DI5～DI1, "1" indicates the input high level, and "0" indicates the input low level; Bit15～bit5 bits are reserved for future use.

Note 2. The data read out by this address is 16bit, in which bit2～bit0 indicates the output state of DO3～DO1, "1" indicates the output high level, and "0" indicates the output low level; Bit15～bit3 bits are reserved for future use.

Chapter 7 Alarm

7.1 Alarm list

Alarm code	Alarm name	Alarm content	Alarm clear
--	No alarm	Normal operation	
Er 1	Over speed	Motor speed exceeds the maximum limit	Can
Er 2	Main circuit over-voltage	The main circuit supply voltage exceeds the specified value	Can
Er 4	Position deviation	Position deviation counter value exceeds the set value	Can
Er 6	Limit alarm	Hit hard limit switch or soft limit position	Can
Er 7	Drive inhibition abnormal	CCWL, CWL driver prohibited input are invalid	Can
Er 8	Position deviation counter overflow	The absolute value of position deviation counter exceeds 2^{30}	Can
Er 11	Power module over-current	Power module failure	No
Er 12	Over-current	Excessive motor current	No
Er 13	Over-load	Motor overload	No
Er 14	Brake peak power overload	Brake instantaneous short time load is too large	No
Er 16	Motor thermal overload	Motor calorific value exceeds the set value (I^2t detection)	No
Er 17	Average braking power overload	Excessive average load after braking for a long time	No
Er 18	IGBT model over-load	Average output load of power model is too big	No
Er 20	EEPROM error	EEPROM read/write error	No
Er 21	Logic circuit error	Logic circuit fault outside DSP	No
Er 23	AD conversion error	Circuit or current sensor fault	No
Er 24	Low control power supply voltage	Control circuit LDO failure	No
Er 25	FPGA verification error	FPGA verification error	No
Er 27	Phase loss alarm	Check whether the power line is three-phase input	No
Er 29	Torque overload alarm	Motor load exceeds user set value and duration	Can
Er 35	Inter board connection failure	Drive internal connection path failure	No
AL36	Fan alarm	Fan fault	No
Er 40	Absolute value encoder communication error	Drive and encoder cannot communicate	No
Er 41	Absolute value encoder handshake error	Absolute value encoder handshake error	No
Er 42	Absolute value encoder internal count error	Absolute value encoder count exception	No

Alarm code	Alarm name	Alarm content	Alarm clear
Er 43	Absolute value encoder communication response error	Absolute value encoder communication response abnormal	No
Er 44	Absolute value encoder verification error	Absolute value encoder communication content error	No
Er 45	Absolute value encoder EEPROM error	EEPROM fault of absolute value encoder	No
Er 46	Encoder parameter error	Encoder parameters are damaged	No
Er 47	Absolute value encoder external battery error	Battery voltage is too low	No
Er 48	Absolute value encoder external battery alarm	Low battery voltage	No
Er 50	Motor parameters do not match driver	Motor and drive power do not match	No
Er 51	Encoder automatic recognition failed	Encoder automatic recognition failed	No
Er 80	Internal error 1	Internal calculation error, electronic gear set is illegal	No
Er 81	Internal error 2	Internal calculation error, parameter set to 0 exception	No
Er 82	Internal error 3	Internal calculation error, illegal homing parameter setting	No
Er 90	Dynamic brake error	Error opening or closing of dynamic brake	No
Er 91	Vibration detection	System vibration	No
Er 998	Authorization exception	Authorization exception	No

7.2 Alarm causes and handling

Er 1 (Over speed)

Potential cause	Check	Handle
Motor U、V、W connection is not correct	Check U、V、W wiring	Connect the U、V、W wires correctly and correspond to the U、V、W marks of the driver plug one by one
Motor speed overshoot	Check the operation status and parameters	Adjust the servo gain to reduce the overshoot; In speed control mode can increase acceleration/deceleration time
Encoder wiring error	Check encoder wiring	Correct wiring.

Er 2 (Main circuit over-voltage)

Potential cause	Check	Handle
Input AC power supply is too high	Check the power supply voltage	Make the voltage meet the product specification
Regenerative braking failure	Whether regenerative braking resistance and brake pipe fail or wiring is disconnected	Repair.
Excessive regenerative braking energy	Check the brake load rate	● Reduce start and stop frequency ● Increase acceleration/deceleration time ● Reduce torque limit ● Reduce load inertia ● Replace higher power driver and motor ● Replace the larger brake resistance

Er 4 (Position deviation)

Potential cause	Check	Handle
Motor U、V、W connection is not correct	Check U、V、W wiring	Connect the U、V、W wiring of the motor correctly and correspond to the U、V、W marks of the driver plug one by one
Encoder zero point variation	Check encoder zero point	Reinstall the encoder and adjust the zero point
Motor stuck	Check the motor and mechanical connection	Repair
Command pulse frequency too high	Check input frequency and pulse division and multiplication parameters	● Reduce input frequency ● Adjust pulse frequency division and multiplication parameters
Position loop gain is too small	Check parameter P009	Increase position loop gain
Deviation detection range is too small	Check parameter P080	Increase the value of parameter P080
Insufficient torque	Check torque	● Increase torque limit ● Increase position command smoothing filter time ● Reduce load ● Replace higher power drive and motor

Er 6 (Limit alarm)

Potential cause	Check	Handle
This alarm is output when hard limit switch or soft limit position is encountered	Check whether it touches the limit switch or the soft limit value	● Adjust the position of the servo motor and move out of the limit interval or soft limit parameter value

Er 7 (Drive inhibition abnormal)

Potential cause	Check	Handle
When the servo enable, CCWL、CWL drive inhibit inputs are invalid	Check CCWL、CWL wiring	● Correctly input CCWL、CWL signal ● If CCWL、CWL signal are not used, set parameter P097 to shield

Er 8 (Position deviation counter overflow)

Potential cause	Check	Handle
Motor stuck	Check the motor and mechanical connection	Repair.
Abnormal command pulse	Check pulse command	

Er 11 (Power module over-current)

Potential cause	Check	Handle
Motor wiring U、V、W short circuit	Check U、V、W wiring	Correctly connect U、V、W wiring
Motor winding insulation damage	Check the motor	Replace the motor
Driver damaged	Check driver	Motor no problem, turn on again or alarm, may be the driver damage
Poor grounding	Check the grounding wire	Correct grounding
Disturbed	Check interference source	Add line filter to keep away from interference source

Er 12 (Over-current)

Potential cause	Check	Handle
Motor wiring U、V、W short circuit	Check U、V、W wiring	Correctly connect U、V、W wiring
Motor winding insulation damage	Check the motor	Replace the motor
Driver damaged	Check driver	Motor no problem, turn on again or alarm, may be the driver damage

Er 13 (Over-load)

Potential cause	Check	Handle
Continuous operation over rated load	Check load rate	Reduce the load or replace with a higher power driver
System instability	Check whether the motor is oscillating	Reduce system gain
Acceleration and deceleration are too fast	Check whether the motor runs smoothly	Increase acceleration and deceleration time
Encoder zero point variation	Check encoder zero point	Reinstall the encoder and adjust the zero point

Er 14 (Brake peak power overload)

Potential cause	Check	Handle
High input AC power	Check the power supply voltage	Make the voltage meet the product specification
Regenerative braking fault	Whether regenerative braking resistance and brake pipe fail or wiring is disconnected	Repair
Excessive regenerative braking energy	Check the brake load rate	● Reduce start and stop frequency ● Increase acceleration and deceleration time ● Replace higher power driver and motor ● Replace the larger brake resistance

Er 16 (Motor thermal overload)

Potential cause	Check	Handle
Long time operation over rated load	Check load rate and motor temperature rise	Reduce the load or replace with a higher power driver
Encoder zero point variation	Check encoder zero point	Reinstall the encoder and adjust the zero point

Er 17 (Average braking power overload)

Potential cause	Check	Handle
High input AC power	Check the power supply voltage	Make the voltage meet the product specification
Excessive regenerative braking energy	Check the brake load rate	● Reduce start and stop frequency ● Increase acceleration and deceleration time ● Reduce torque limit ● Reduce load inertia ● Replace higher power driver and motor ● Replace the larger brake resistance

Er 18 (IGBT model over-load)

Potential cause	Check	Handle
Long time operation over rated load	Check current	Reduce the load or replace with a higher power driver
Encoder zero point variation	Check encoder zero point	Reinstall the encoder and adjust the zero point

Er 20 (EEPROM Error)

Potential cause	Check	Handle
EEPROM chip damaged	Power on again for inspection	If the fault persists, replace the driver

Er 21 (Logic circuit error)

Potential cause	Check	Handle
Control circuit fault	Power on again for inspection	If the fault persists, replace the driver

Er 23 (AD conversion error)

Potential cause	Check	Handle
Current sensor and connector problems	Check the main circuit	Replace the driver
AD converter and analog amplifier circuit problems	Check the control circuit	Replace the driver

Er 24 (Low control power supply voltage)

Potential cause	Check	Handle
Control circuit LDO fault	Check the power supply of the control board	Replace the driver

Er 25 (FPGA verification error)

Potential cause	Check	Handle
FPGA verification error	Power on again for inspection	If the fault persists, replace the driver

Er 27 (Phase loss alarm)

Potential cause	Check	Handle
Phase loss of power supply	Check L1、L2、L3 wiring	Correct wiring
Power supply undervoltage	Check supply power voltage	Ensure correct voltage input
Phase loss checking return circuit error	Check optocoupler, power on again	If the fault persists, replace the driver

Er 29 (Torque overload alarm)

Potential cause	Check	Handle
Unexpected large load occurs	Check load condition	Adjust the load
Parameters P070、P071、P072 are set unreasonably	Check parameters	Adjust the parameters

Er 35 (Inter board connection failure)

Potential cause	Check	Handle
Flat cable failure of inter board connection	Check the flat wire and its terminals	If the fault persists, replace the driver
Connection path failure	Check the optocoupler	If the fault persists, replace the driver

AL 36 (Fan alarm)

Potential cause	Check	Handle
Cooling fan failure	Check the fan	Replace the fan
Fan detection circuit fault	Check wiring	Correct wiring
Fan detection circuit fault	Check the optocoupler	If the fault persists, replace the driver

Er 40 (Absolute value encoder communication error)

Potential cause	Check	Handle
Different types of motors have been replaced	Whether the replaced motor encoder is of the same type	Set P088=0 to automatically identify the encoder
Encoder wiring error	Check encoder wiring	Correct wiring
Poor encoder cable and connector	Check cables and connectors	Replace cable and connector
Encoder damaged	Check encoder	Replace encoder

Er 41 (Absolute value encoder handshake error)

Potential cause	Check	Handle
Encoder wiring error	Check encoder wiring	Correct wiring
Poor encoder cable and connector	Check cables and connectors	Replace cable and connector
Encoder damaged	Check encoder	Replace encoder

Er 42 (Absolute value encoder internal count error)

Potential cause	Check	Handle
Poor encoder cable and connector	Check cables and connectors	Replace cable and connector
Encoder damaged	Check encoder	Replace encoder

Er 43 (Absolute value encoder communication response error)

Potential cause	Check	Handle
Poor encoder cable and connector	Check cables and connectors	Replace cable and connector
Encoder damaged	Check encoder	Replace encoder

Er 44 (Absolute value encoder verification error)

Potential cause	Check	Handle
Poor encoder cable and connector	Check cables and connectors	Replace cable and connector
Encoder damaged	Check encoder	Replace encoder

Er 45 (Absolute value encoder EEPROM error)

Potential cause	Check	Handle
Poor encoder cable and connector	Check cables and connectors	Replace cable and connector
Encoder EEPROM is damaged	Check encoder	Replace encoder

Er 46 (Encoder parameter error)

Potential cause	Check	Handle
Poor encoder cable and connector	Check cables and connectors	Replace cable and connector
Encoder EEPROM is damaged	Check encoder	Replace encoder

Er 47 (Absolute value encoder external battery error) ☆

Potential cause	Check	Handle
External battery out of power	External battery voltage	Replace the battery
Power on for the first time after replacing the battery	Battery voltage	If the voltage is normal, please restart the encoder, refer to chapter 3.6.1

Er 48 (Absolute value encoder external battery alarm) ☆

Potential cause	Check	Handle
External battery out of power	External battery voltage	Replace the battery
Power on for the first time after replacing the battery	Battery voltage	If the voltage is normal, please restart the encoder, refer to chapter 3.6.1

Er 50 (Motor parameters do not match with driver)

Potential cause	Check	Handle
Motor and driver power mismatch	Check the motor adaptation table of the driver	Replace the appropriate driver or motor

Er 51 (Encoder automatic recognition failed)

Potential cause	Check	Handle
Encoder wiring error	Check the encoder wiring	Correct wiring
Encoder automatic recognition failed	Confirm whether the encoder type is supported by the driver	Replace the type of encoder supported by the driver

Er 80 (Internal error 1)

Potential cause	Check	Handle
Relevant parameters of electronic gear are set illegally	Setting of relevant parameters of electronic gear	Set legal electronic gear parameters

Er 81 (Internal error 2)

Potential cause	Check	Handle
Division "0" occurs in internal operation	Relevant parameter settings, such as rated current, rated voltage, rated speed, etc	Set the parameter value of "legal" (not "0")

Er 82 (Internal error 3)

Potential cause	Check	Handle
Illegal setting of "homing" related parameters	Setting of "homing" related parameters	Set legal "homing" parameters

Er 90 (Dynamic brake error)

Potential cause	Check	Handle
Dynamic brake open or close error	Check whether the power board communication is normal	Power on again

Er 91 (Vibration detection)

Potential cause	Check	Handle
System vibration	Check the mechanical installation; Servo gain related parameter setting	Check the mechanical structure; Reduce servo gain related parameters

Er 998 (Authorization exception)

Potential cause	Check	Handle
Authorization exception	Authorization exception	Contact the manufacturer

Chapter 8 Specifications

8.1 Driver model

EP5 - T L 15 P X

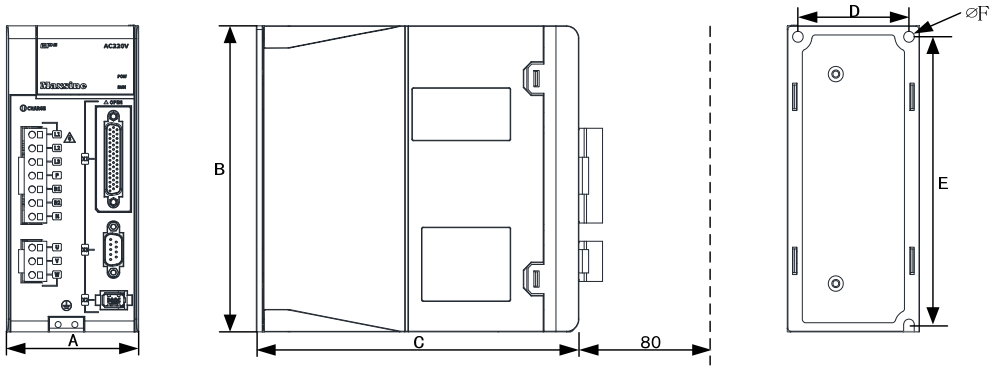
Mark	Main circuit supply voltage
L	AC220V
H	AC380V

Mark	Output Power	Mark	Output Power
TL04	0.4kW	TH20	2.0kW
TL08	0.75kW	TH30	3.0kW
TL10	1.0kW	TH50	5.0kW
TL15	1.5kW	TH75	7.5kW
TL25	2.5kW	TH90	9.0kW
TL35	3.5kW	TH110	11.0kW
TL55	5.5kW	TH150	15.0kW
TH15	1.5kW		

Mark	Communication protocol
P	Pulse type
M	Support MODBUS
C	Support CANopen
EC	Support EtherCAT bus
PN	Support PROFINET bus

Mark	Encoder type
Blank	Standard machine
***	Other customized models

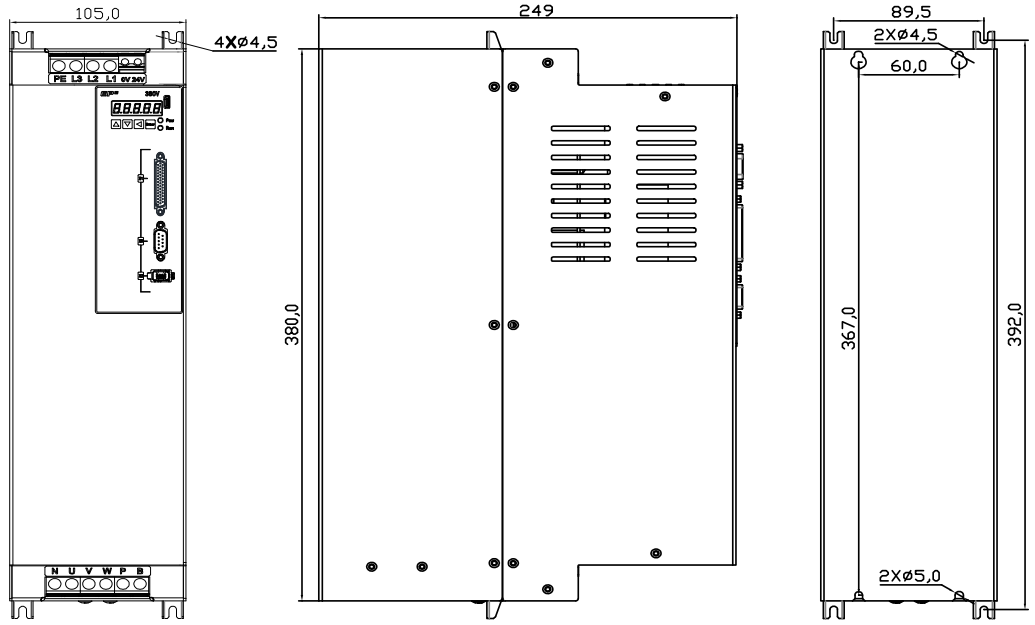
8.2 Driver size



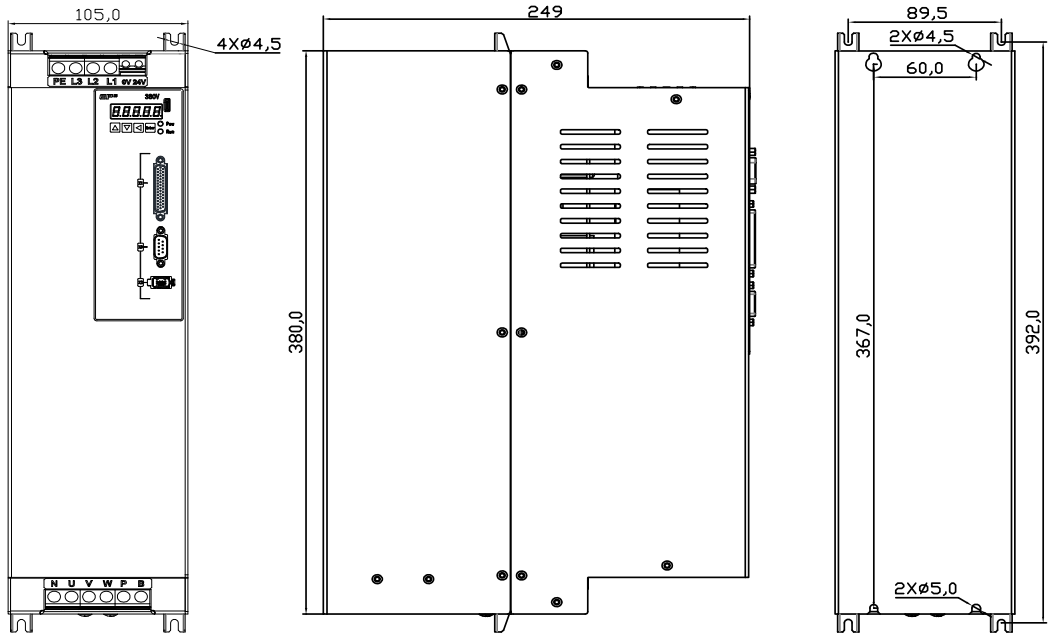
Model / Size (mm)	TL04	TL08	TL10	TL15	TL25	TL35	TL55
A	45	45	55	75	95	105	115
B	170	170	170	168	200	220	250
C	156	156	171	183	182	182	212
D	34.5	34.5	43	63	84	94	104
E	161	161	161	158	189	209	239
F	5.2	5.2	5.2	5.2	5.2	5.2	5.2

Model / Size (mm)	TH15	TH20	TH30	TH50	TH75
A	75	95	105	115	115
B	168	200	220	250	250
C	183	182	182	212	212
D	63	84	94	104	104
E	158	189	209	239	239
F	5.2	5.2	5.2	5.2	5.2

TH90 installation dimension drawing



TH110、TH150 installation dimension drawing



8.3 Driver specifications

Type		TL 04	TL 08	TL 10	TL 15	TL 25	TL 35	TL 55	TH 15	TH 20	TH 30	TH 50	TH 75	TH 90	TH 110	TH 150
Rated output current (A)		3.0	4.5	5.5	7.5	12.0	19.0	24.0	5.4	8.5	13.0	17.0	21.0	25.5	32.0	39.0
Maximum output current (A)		9.0	11.3	12.0	16.9	26.0	31.0	43.0	12.7	17.0	28.0	35.0	39.6	44.0	55.0	78.0
Input power	Main power supply	Single phaseAC220V -15%～+10% 50/60Hz			Three-phaseAC220V -15%～+10% 50/60Hz				Three-phaseAC380V -15%～+10% 50/60Hz							
Environment	Temperature	Operation：0℃～40℃ Storage：-40℃～50℃														
	Humidity	Operation：40%～80%(non-condensing) Storage：93% or less(non-condensing)														
	Atmospheric pressure	86kPa～106kPa														
IP rating		IP20														
Regenerative braking		Built-in/built-out						built-out	Built-in/built-out			built-out				
Feedback way		Absolute value encoder (65536 turns)														
Control modes		Position, Speed, Torque														
Digital input		7 programmable input terminals (photoelectric isolation) : servo enabling, alarm clearance, forward drive prohibition, reverse drive prohibition, forward torque limit, reverse torque limit, emergency shutdown, electronic gear selection 1, electronic gear selection 2, position deviation clearance, pulse input prohibition, etc														
Digital output		5 programmable output terminals (photoelectric isolation) functions: servo ready, alarm, positioning completed, speed arrival, electromagnetic brake, torque limit, etc														
Encoder signal outputs		A、B、Z Differential output，A、B、Z signal open-collector output														
Position	Input frequency	differential input：≤1000kHz(kpps); single-ended input：≤200kHz(kpps)														
	Command modes	Pulse+ direction，CCW Pulse/CW Pulse, orthogonal Pulse														
	Electronic gear ratio	1～32767/1～32767														
Speed	Analog command input	-10V～+10V， Input impedance10kΩ														
	Acceleration/deceleration command	Parameter setting														
	Command source	Analog quantity, pulse frequency														
Torque	Analog command input	-10V～+10V， Input impedance10kΩ														
	Speed limit	Parameter setting														
	Command source	Analog quantity														
Monitor function		Speed, current position, position deviation, motor torque, motor current, command pulse frequency, bus voltage, module internal temperature, etc														
Protection function		Over-speed, overpressure, over-current, overload, brake anomaly, encoder anomaly, position deviation, etc														

8.4 Motor adaptation table of the driver

Motor Type (220V series)		Rated power KW	Rated torque N·m	Rated speed/ Maximum speed r/min	Rated current A	Recommend adaptation	Adaptable
BSL series	060BSL00630	0.20	0.64	3000/6000	1.6	TL04	
	060BSL01330	0.40	1.27	3000/6000	2.8	TL04	
	080BSL02430	0.75	2.39	3000/6000	4.4	TL08	
	080BSL03230	1.0	3.18	3000/6000	6.3	TL15	
GSL series	060GSL00630	0.20	0.64	3000/6000	1.6	TL04	
	060GSL01330	0.40	1.27	3000/6000	2.8	TL04	
	080GSL01330	0.40	1.27	3000/6000	2.5	TL04	
	080GSL02430	0.75	2.39	3000/6000	4.4	TL08	
	110GSL04030	1.26	4.00	3000/4000	6.0	TL15	TL10
	110GSL06025	1.57	6.00	2500/4000	8.7	TL15	
	130GSL04025	1.00	4.00	2500/4000	5.8	TL15	TL08
	130GSL04820	1.00	4.77	2000/4000	6.6	TL15	TL10
	130GSL05025	1.30	5.00	2500/4000	6.9	TL15	TL10
	130GSL05415	0.85	5.39	1500/3000	6.7	TL15	TL10
	130GSL06025	1.57	6.00	2500/4000	7.7	TL15	
	130GSL07725	2.00	7.70	2500/4000	10.1	TL25	TL15
	130GSL08315	1.30	8.34	1500/3000	9.9	TL25	TL15
	130GSL10025	2.60	10.00	2500/4000	15	TL25	
	130GSL11515	1.80	11.50	1500/3000	12	TL25	
	130GSL15015	2.36	15.00	1500/3000	14.7	TL25	
GAL series	110GAL04020	0.84	4.00	2000/3000	4.4	TL08	
	110GAL06020	1.26	6.00	2000/3000	6.4	TL15	TL10
	130GAL05415	0.85	5.39	1500/2000	5.1	TL08	
	130GAL08315	1.30	8.34	1500/2000	6.4	TL15	TL10
	130GAL10015	1.57	10.00	1500/2000	6.4	TL15	TL10
	130GAL11515	1.80	11.50	1500/2000	7.4	TL25	TL15
	130GAL15015	2.36	15.00	1500/2000	9.5	TL25	

Motor Type （380V series）		Rated power KW	Rated torque N·m	Rated speed/ Maximum speed r/min	Rated current A	Recommend adaptation	Adaptable
GSH series	110GSH04025	1.05	4.00	2500/4000	3.3	TH15	
	110GSH06025	1.57	6.00	2500/4000	4.5	TH15	
GAH series	130GAH04025	1.00	4.00	2500/3000	2.4	TH15	
	130GAH04820	1.00	4.77	2000/3000	2.8	TH15	
	130GAH05025	1.30	5.00	2500/3000	2.9	TH15	
	130GAH05415	0.85	5.39	1500/3000	3.1	TH15	
	130GAH06025	1.57	6.00	2500/3000	4.1	TH15	
	130GAH07725	2.02	7.70	2500/3000	5.0	TH20	TH15
	130GAH08315	1.30	8.34	1500/3000	4.9	TH15	
	130GAH10015	1.57	10.00	1500/2000	3.9	TH15	
	130GAH10025	2.62	10.00	2500/3000	5.4	TH20	TH15
	130GAH11515	1.80	11.50	1500/2000	4.3	TH15	
	130GAH15015	2.36	15.00	1500/2000	6.6	TH20	
BAH series	180BAH19015	3.00	19.00	1500/2000	7.1	TH30	TH20
	180BAH27015	4.30	27.00	1500/2000	10.7	TH50	TH30
	180BAH35015	5.50	35.00	1500/2000	13.3	TH50	
	180BAH48015	7.50	48.00	1500/2000	17.5	TH75	
BSH series	180BSH19015	3.00	19.00	1500/3000	10.7	TH30	
	180BSH27015	4.30	27.00	1500/3000	14.8	TH50	
	180BSH35015	5.50	35.00	1500/3000	19.0	TH75	TH50
	180BSH48015	7.50	48.00	1500/3000	25.7	TH75	

8.5 Servo motor model

060 BS L 006 30 M N C 1 MC
① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩

①

Mark	Seat No.
040	40mm
060	60mm
080	80mm
110	110mm
130	130mm
180	180mm

②

Mark	Series
BS	B series high speed
BA	B-series medium and low speed
GS	G series high speed
GA	G series medium and low speed
MS	M series high speed
MA	M series medium and low speed

③

Mark	Voltage
L	220V
H	380V

④

Mark	Rated torque	Mark	Rated torque
003	0.32 N.m	100	10.00 N.m
006	0.64 N.m	115	11.50 N.m
013	1.27 N.m	143	14.30 N.m
024	2.39 N.m	150	15.00 N.m
032	3.18 N.m	170	17.20 N.m
040	4.00 N.m	190	19.00 N.m
048	4.77 N.m	220	21.50 N.m
050	5.00 N.m	260	26.30 N.m
054	5.39 N.m	270	27.00 N.m
060	6.00 N.m	350	35.00 N.m
077	7.70 N.m	480	48.00 N.m
083	8.34 N.m		

⑤

Mark	Rated speed
15	1500rpm
20	2000rpm
25	2500rpm
30	3000rpm

⑦

Mark	Brake
N	Not configured
Z	Configure power loss brake

⑧

Mark	Keyway specifications
O	Circular axis
A	Closed key
C	Open key(standard configuration)

⑨

Mark	Specifications
1	Default value
2	Customer customization

⑩ B series model description:

Mark	Interface description	Notes
MC	Direct connected	(omitted) Standard
MCA	MC to A Amp	(Optional) Amp
MC1	MC to Y1	(Optional) 4-core metal circular plug
MC2	MC to Y2	(Optional) 4-core waterproof round plug
MC3	MC to Y3	(Optional) 6-core waterproof round plug
MC4	MC to Y4	(Optional) 6-core metal circular plug

⑩ M/G series model description:

Mark	Plug type	
Y3	G series 60/80	(Optional) Waterproof round plug
Y4		(Optional) Metal round plug
A[Note]		Standard Amp plug
H[Note]	All series 110/130/180	Standard aviation plug

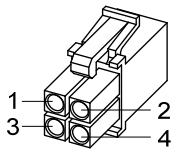
⑥

Mark	Encoder	Mark	Pulse count	Number of wires
C	Magnetic multi turn absolute value	17bit	131072	7
D	Magnetic single turn absolute value	17bit	4,096	5
M	Optical multi turn absolute value	23bit	8,388,608	7
B	Optical single turn absolute value	23bit	8,388,608	5
F	Standard incremental	2500ppr	10, 000	15
R	Rotating transformer	12bit	4,096	7
P	Multi turn absolute value	23bit	33,554,432	7

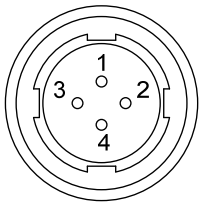
Note: "G" is standard for all series motors of 40/60/80, "H" is standard for all series motors of 110/130/180. The symbol of standard configuration is omitted when ordering.

8.6 Servo motor wiring

8.6.1 Winding wiring



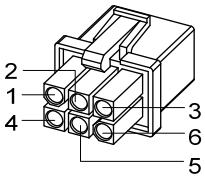
40/60/80 motor power supply plug



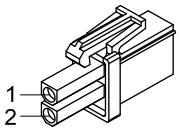
110/130/180 motor power supply plug

Terminal symbol	Terminal number		Terminal description
	40/60/80 motor	110/130/180 motor	
U	1	2	Motor U phase power input
V	2	3	Motor V phase power input
W	3	4	Motor W phase power input
⏚	4	1	Motor housing grounding terminal

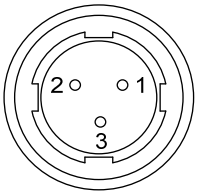
8.6.2 Brake wiring



40 motor with brake power plug



60/80 motor brake plug



110/130/180 motor brake plug

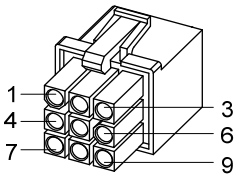
40 motor with brake power supply wiring:

Terminal symbol	Terminal number	Terminal description
U	1	Motor U phase power input
V	2	Motor V phase power input
W	3	Motor W phase power input
PE	4	Grounding terminal
BK+	5	Brake terminal
BK-	6	

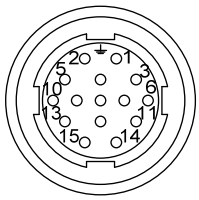
60、80、110、130、180 motor brake wiring:

Terminal symbol	Terminal number		Terminal description
	60/80 series motors	110/130/180 series motors	
DC+	1	1	Brake power supply is DC power supply with no polarity connection requirements
DC-	2	2	
PE	——	3	

8.6.3 Encoder



40/60/80 motor encoder plug



110/130/180 motor encoder plug

40、60、80、110、130、180 motor encoder wiring:

Terminal symbol	Terminal number					Terminal description
	40motor	60/80motor		110/130/180motor		
	Absolute value	Absolute value	Incremental	Absolute value	Incremental	
SD+	1	1	1	6	6	Encoder signal wire
SD-	2	2	2	7	7	
VCC	6	6	6	2	2	Encoder 5V power input
GND	7	7	7	3	3	
Battery+	3	3	——	4	——	3.6V battery powered
Battery -	8	8	——	5	——	
PE	9	9	9	1	1	Ground terminal

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