Maxsine

EP5 series

PROFINET

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.

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Chapter 1 Product inspection and installation

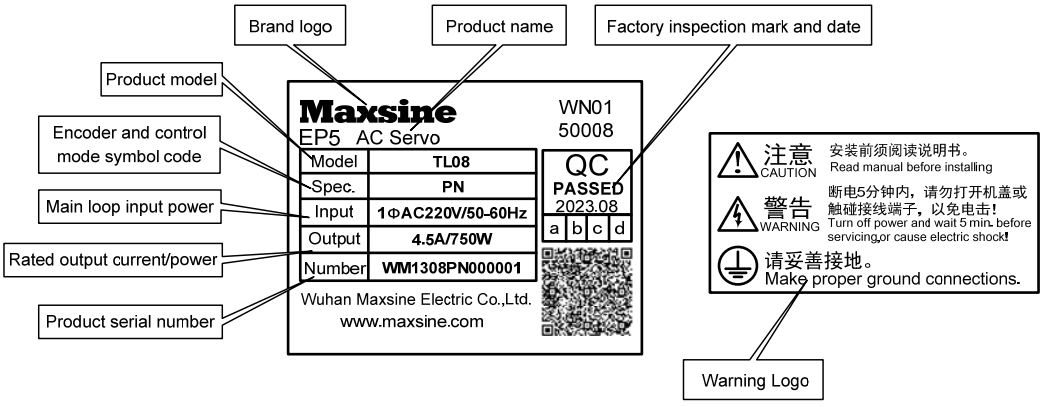
1.1 Product inspection

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.

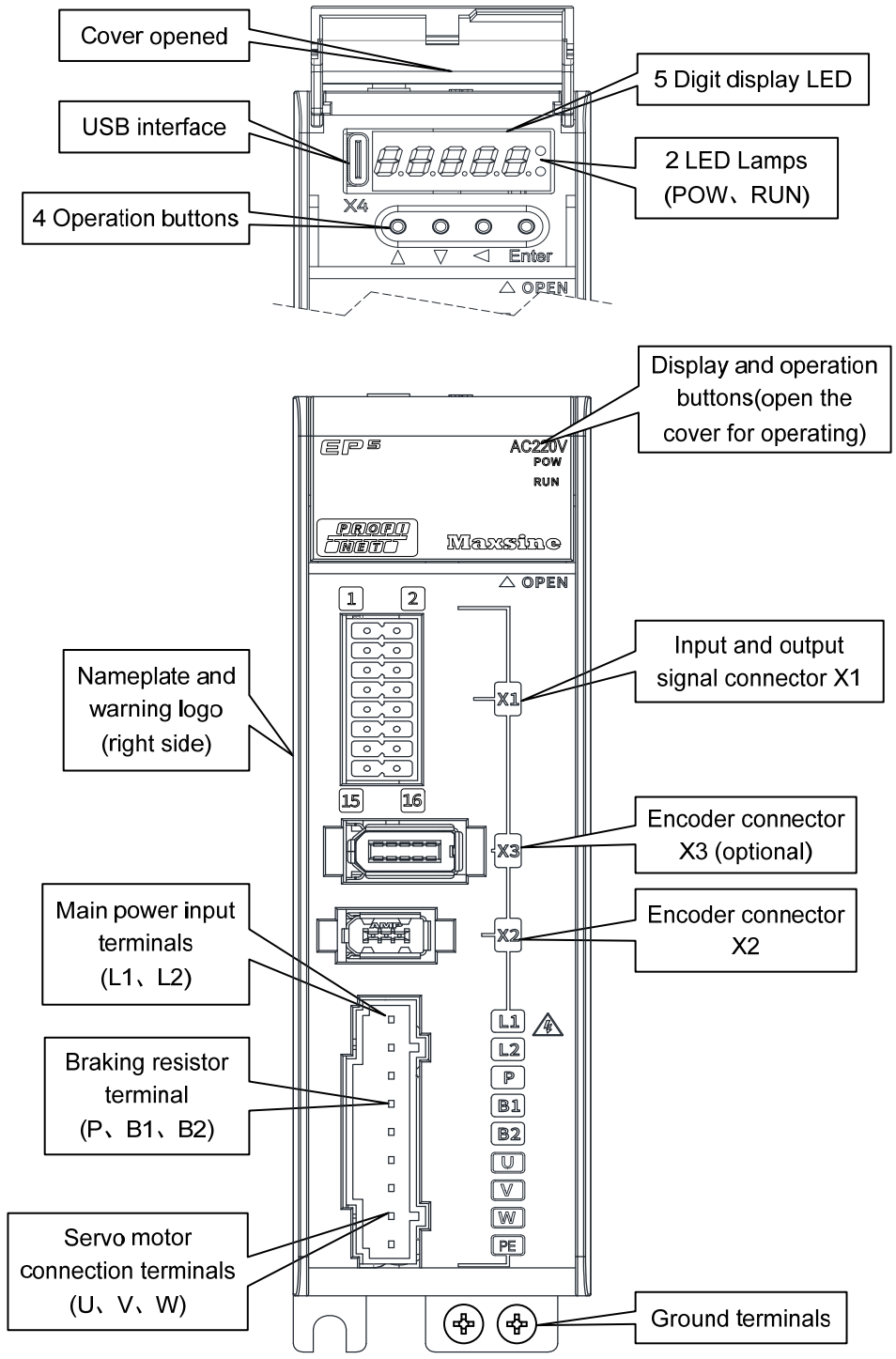
  If the above items have faults or abnormal phenomena, please contact the dealer immediately.

1.2 Product nameplate

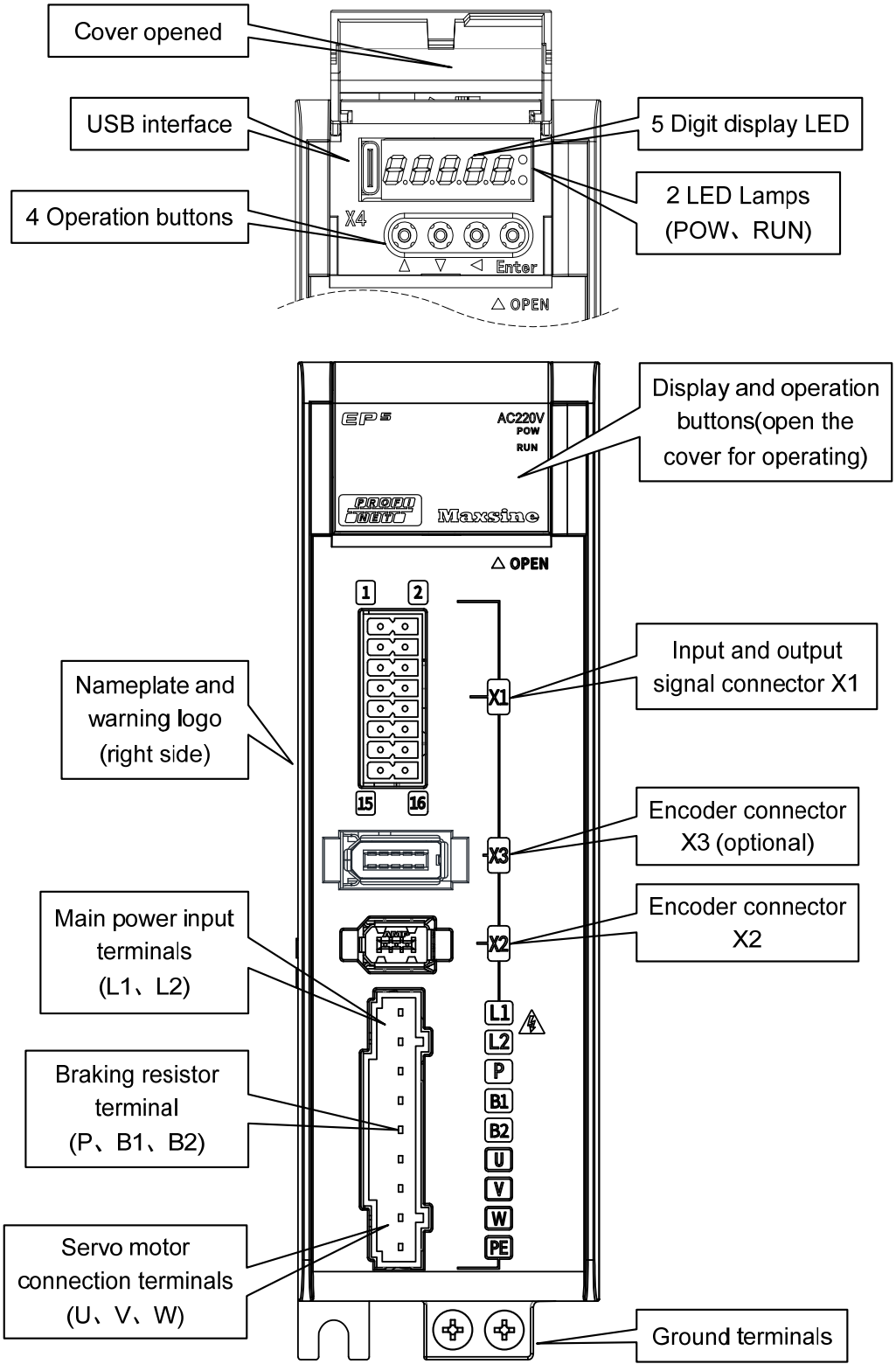


1.3 Product front panel

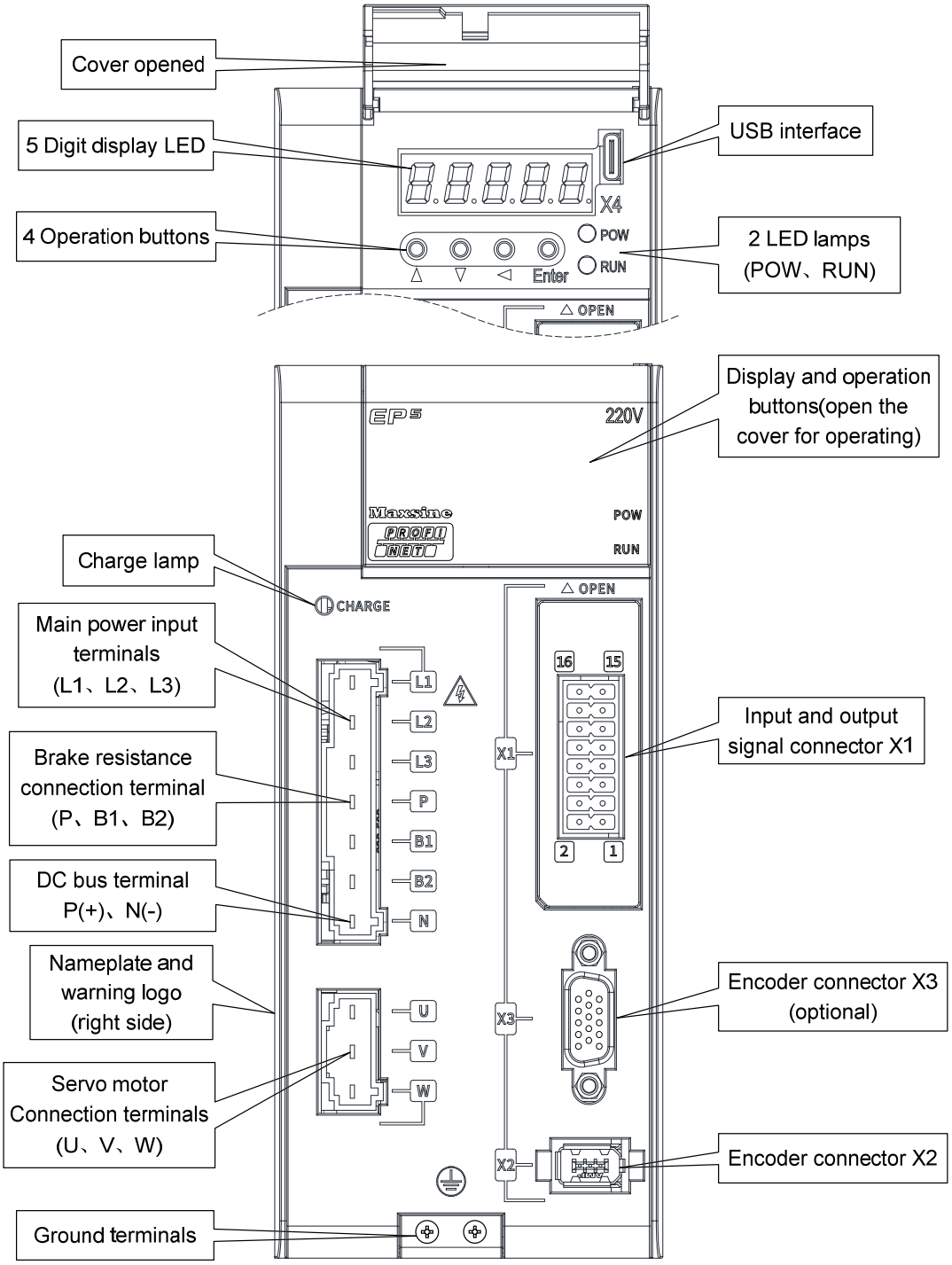
Applicable models: TL04、TL08



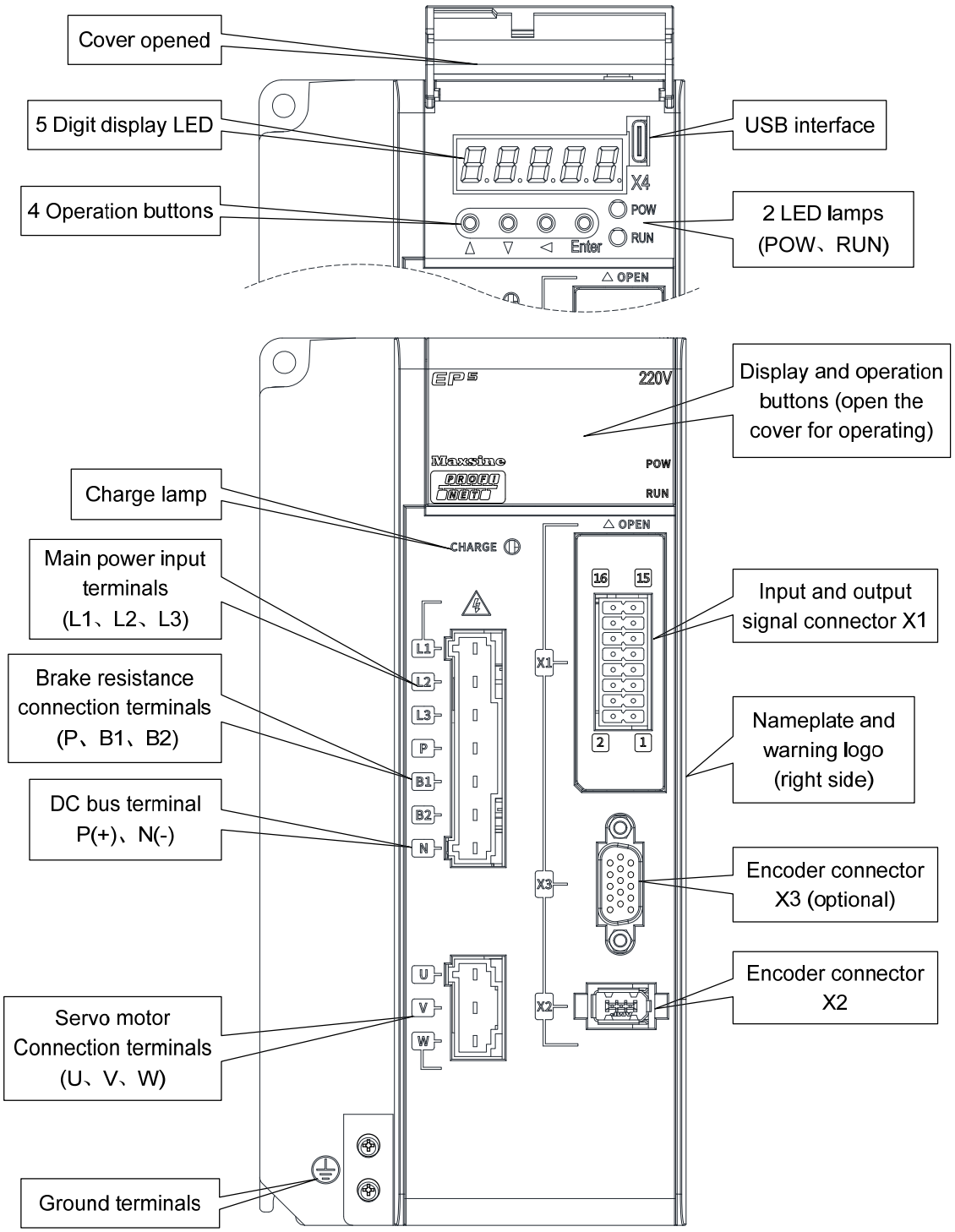
Applicable model: TL10



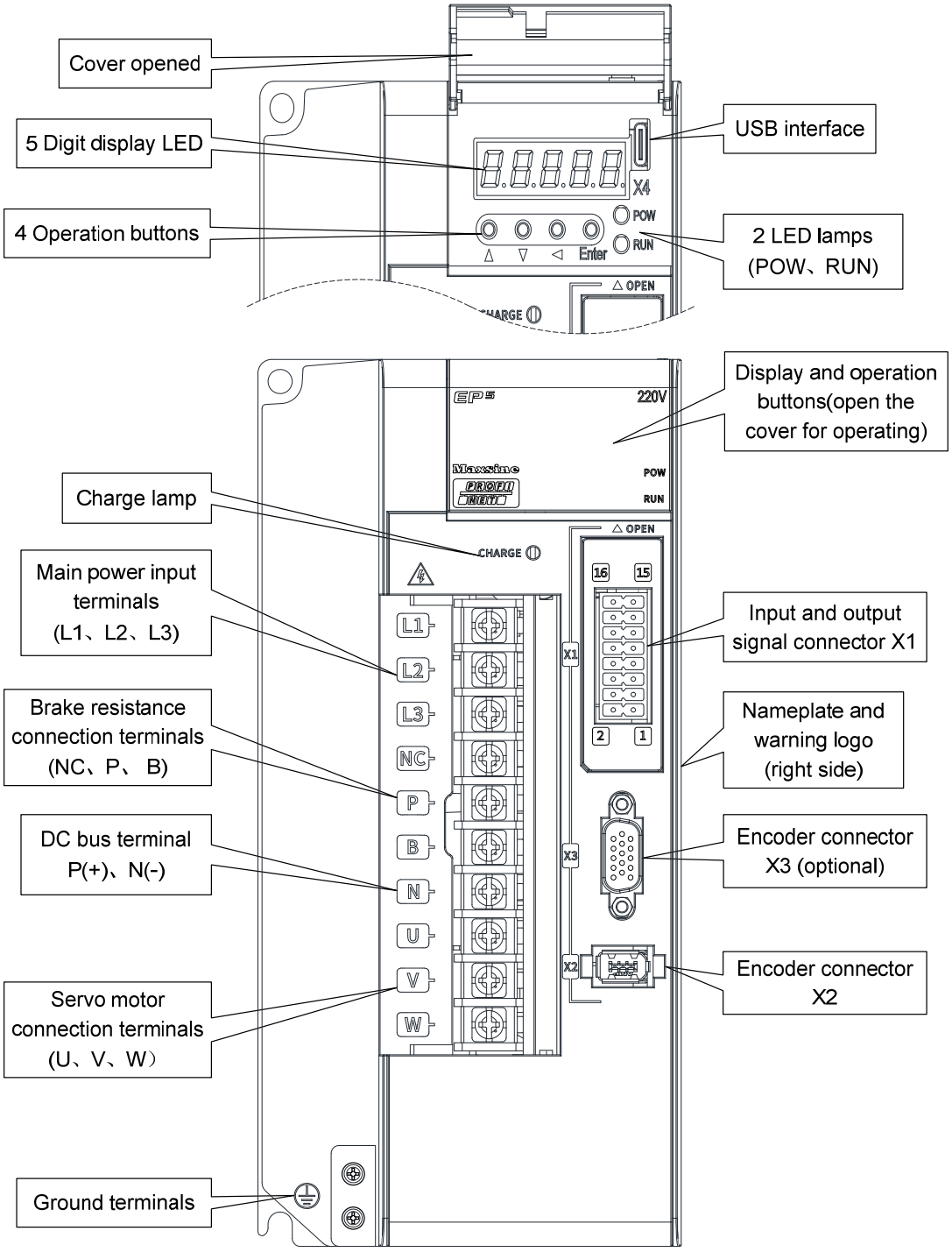
Applicable model: TL15



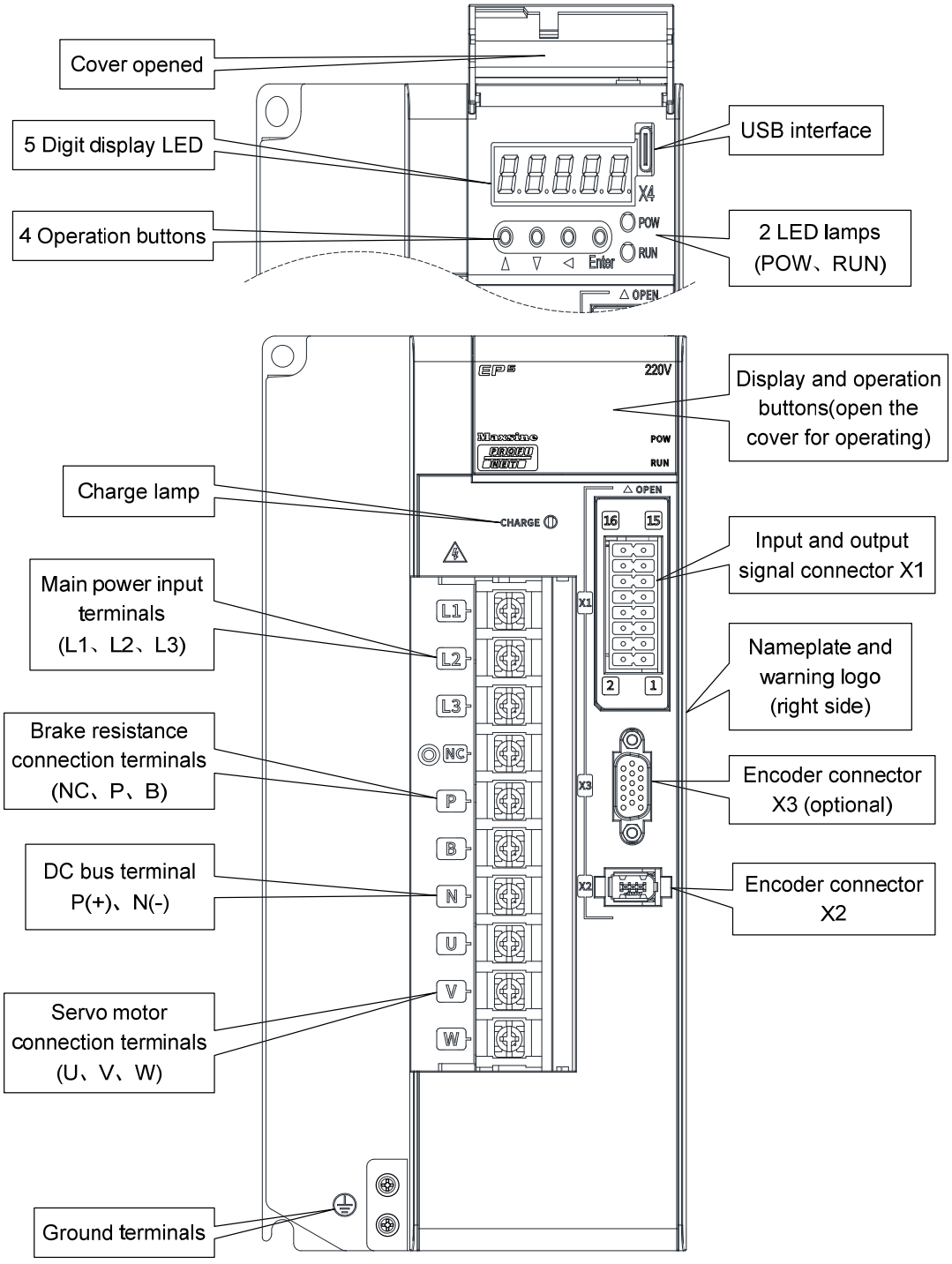
Applicable model: TL25



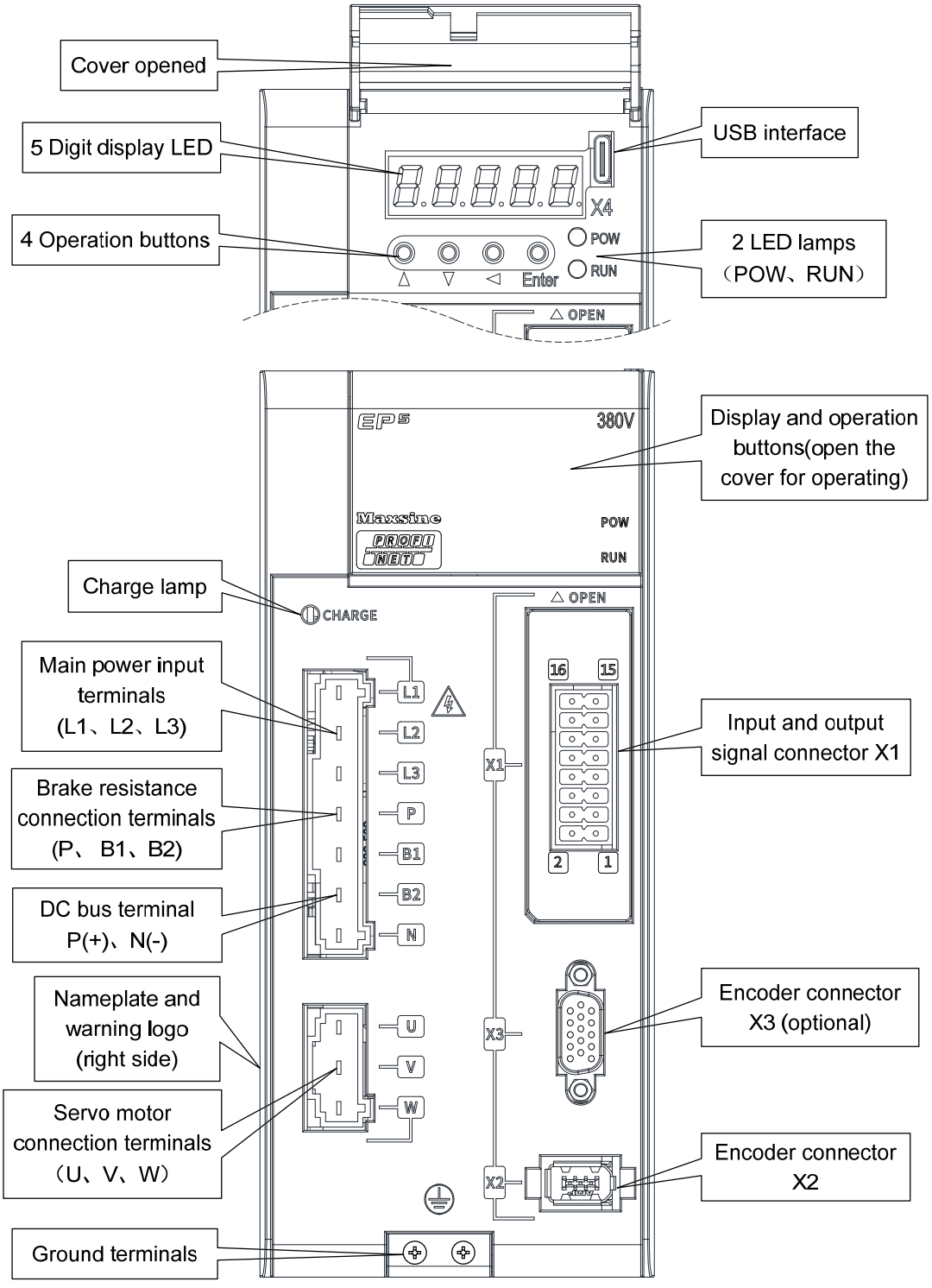
Applicable model: TL35



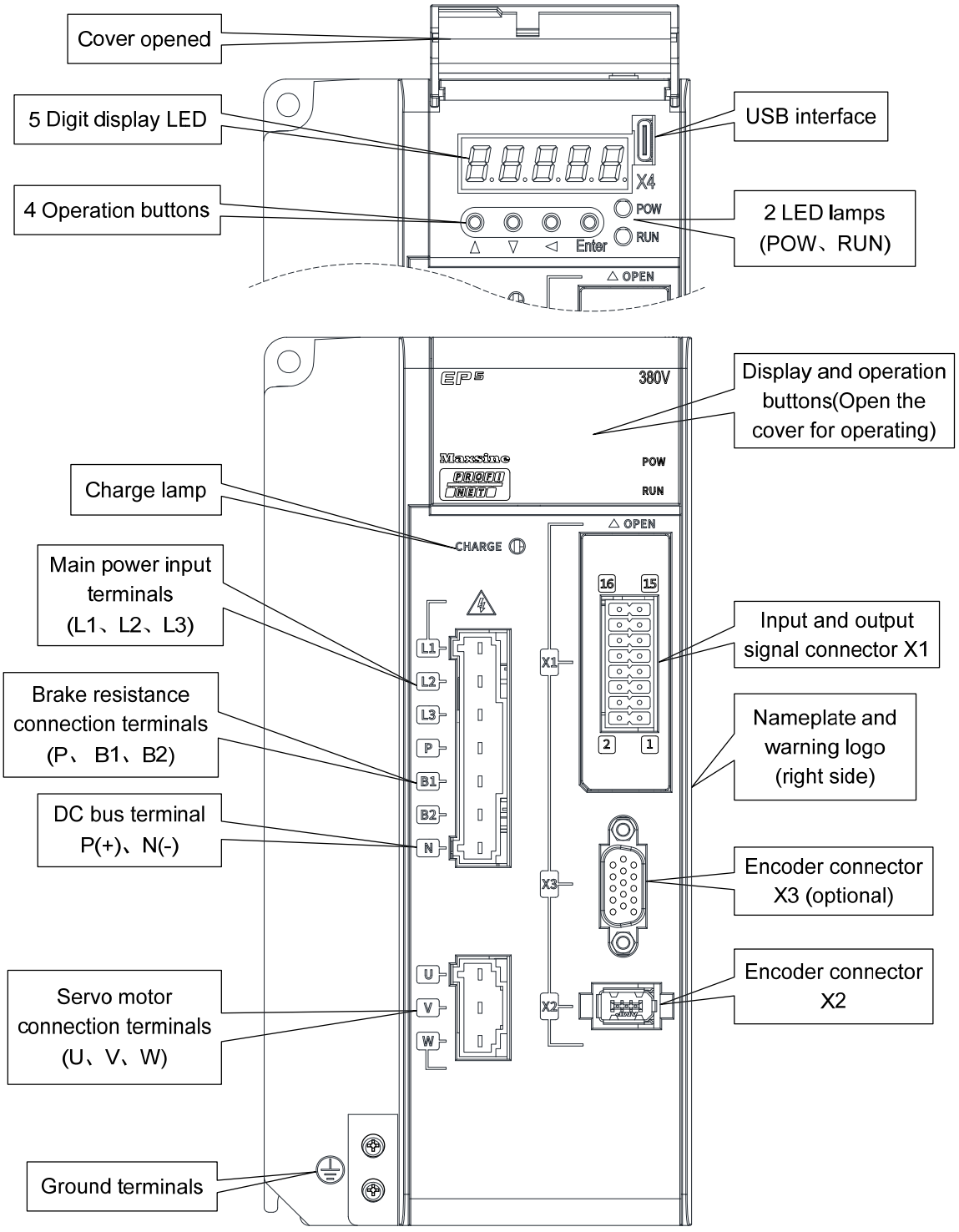
Applicable model: TL55



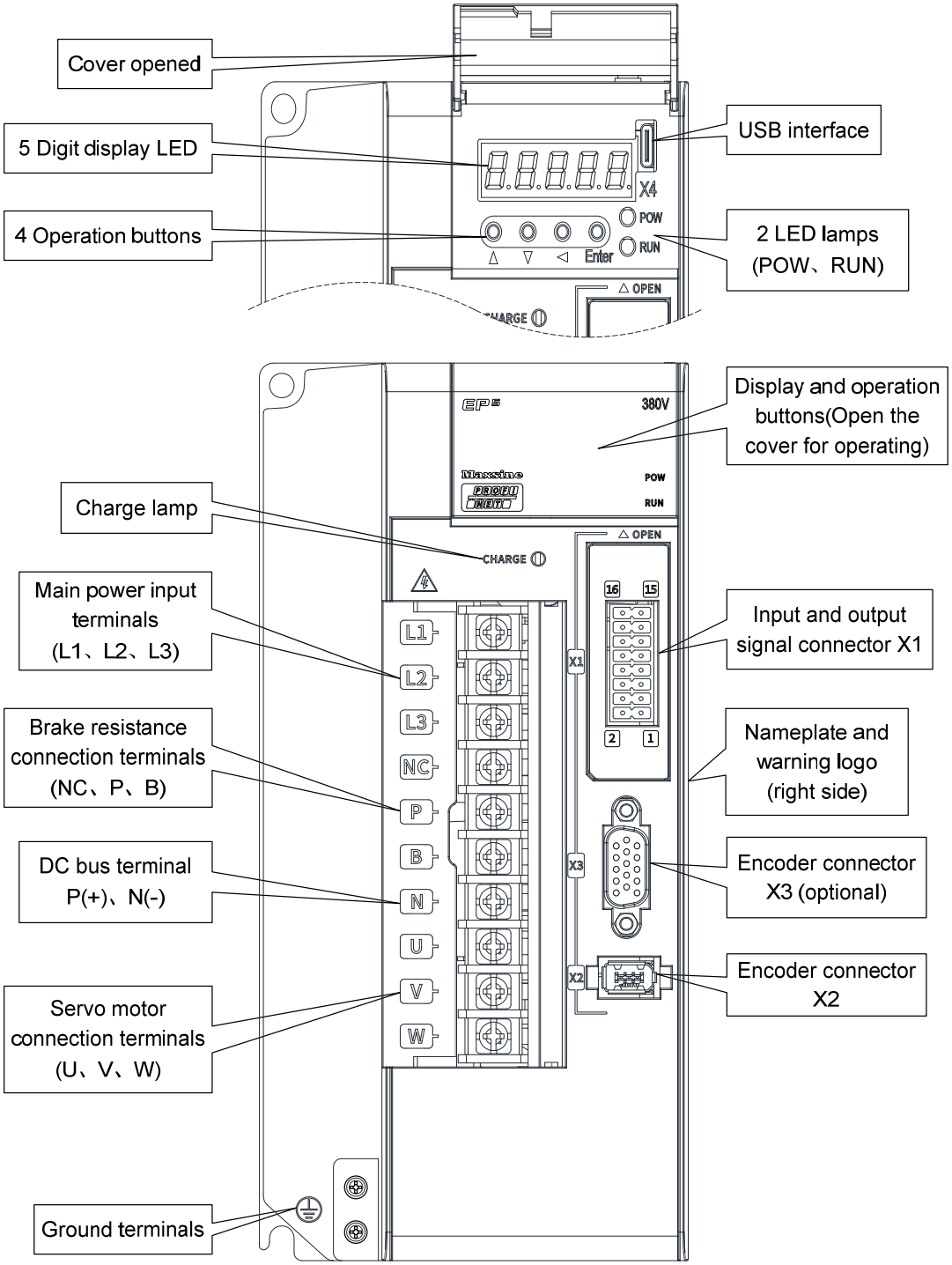
Applicable model: TH15



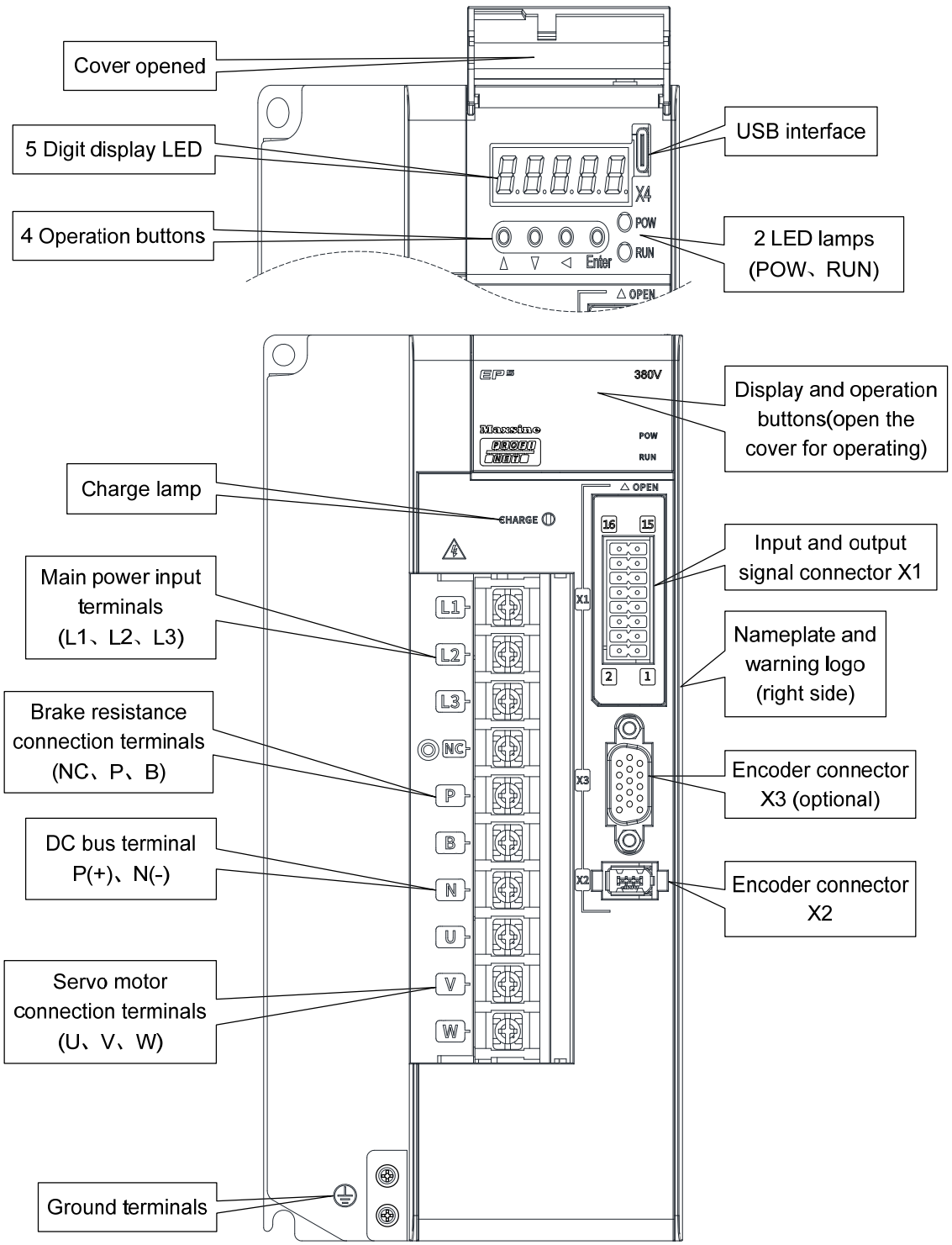
Applicable model: TH20



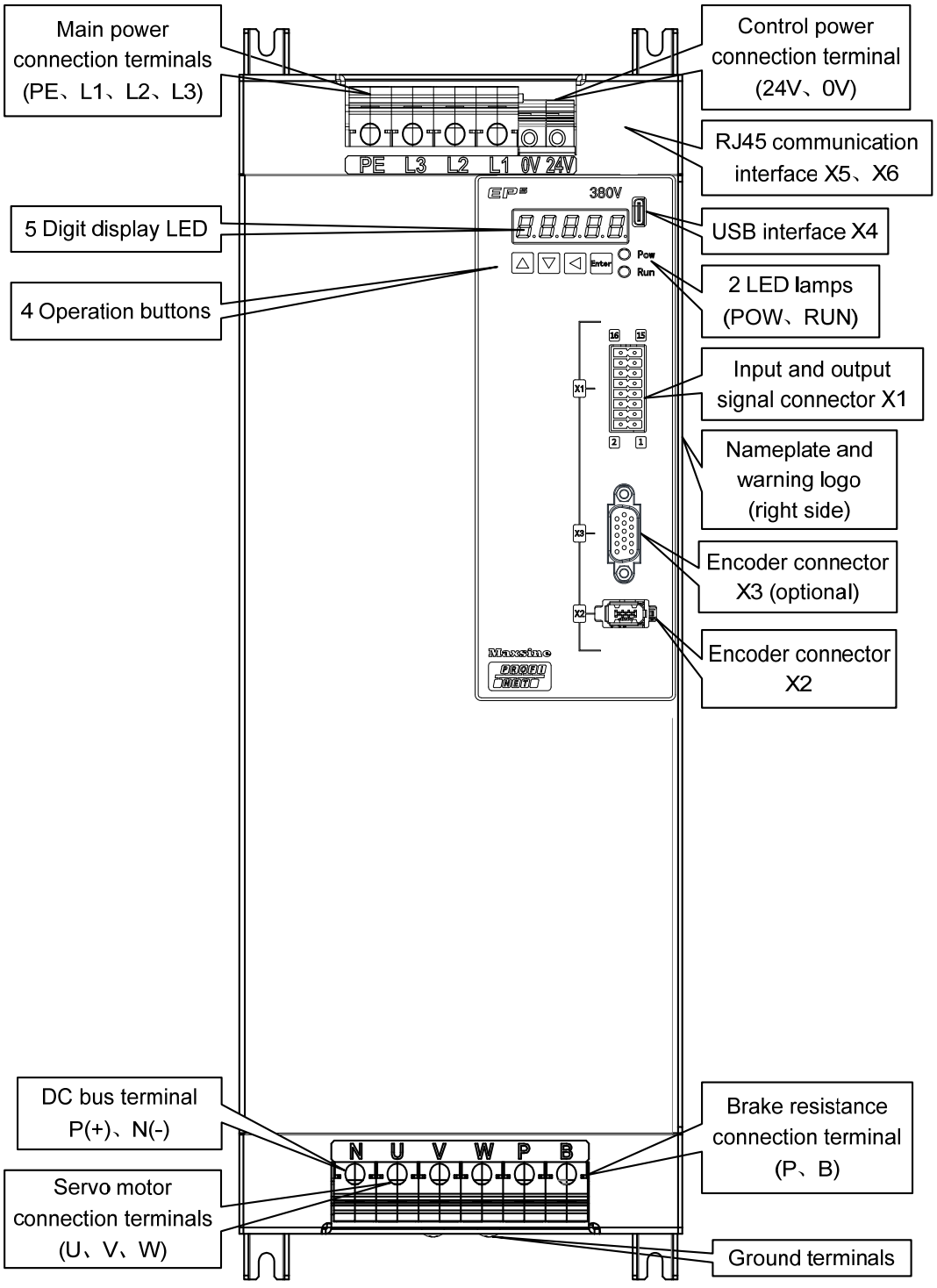
Applicable model: TH30



Applicable models: TH50、TH75



Applicable model: TH90、TH110、TH150



1.4 Servo driver installation

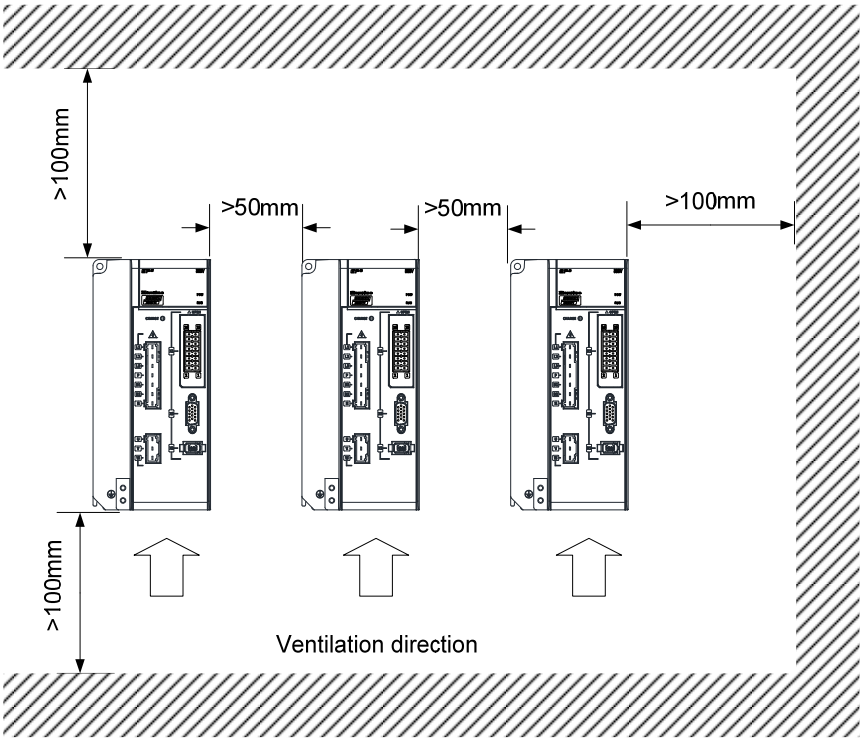
1.4.1 Installation environmental conditions

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

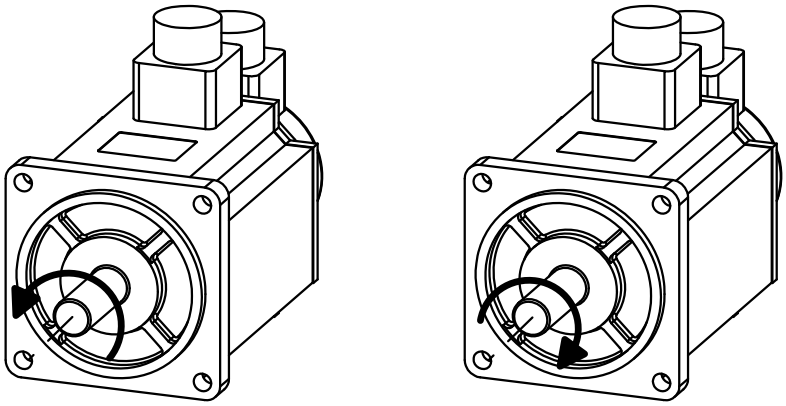
- Ambient temperature: 0～40℃; Ambient humidity: below 80 %(no dew).
- Storage temperature: -40～50℃; Storage humidity: below 80 %(no dew).
- Vibration: below 0.5G.
- Places with good ventilation and less moisture and dust.
- No corrosive, igniting gas, oil and gas, cutting fluid, cutting powder, iron 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)

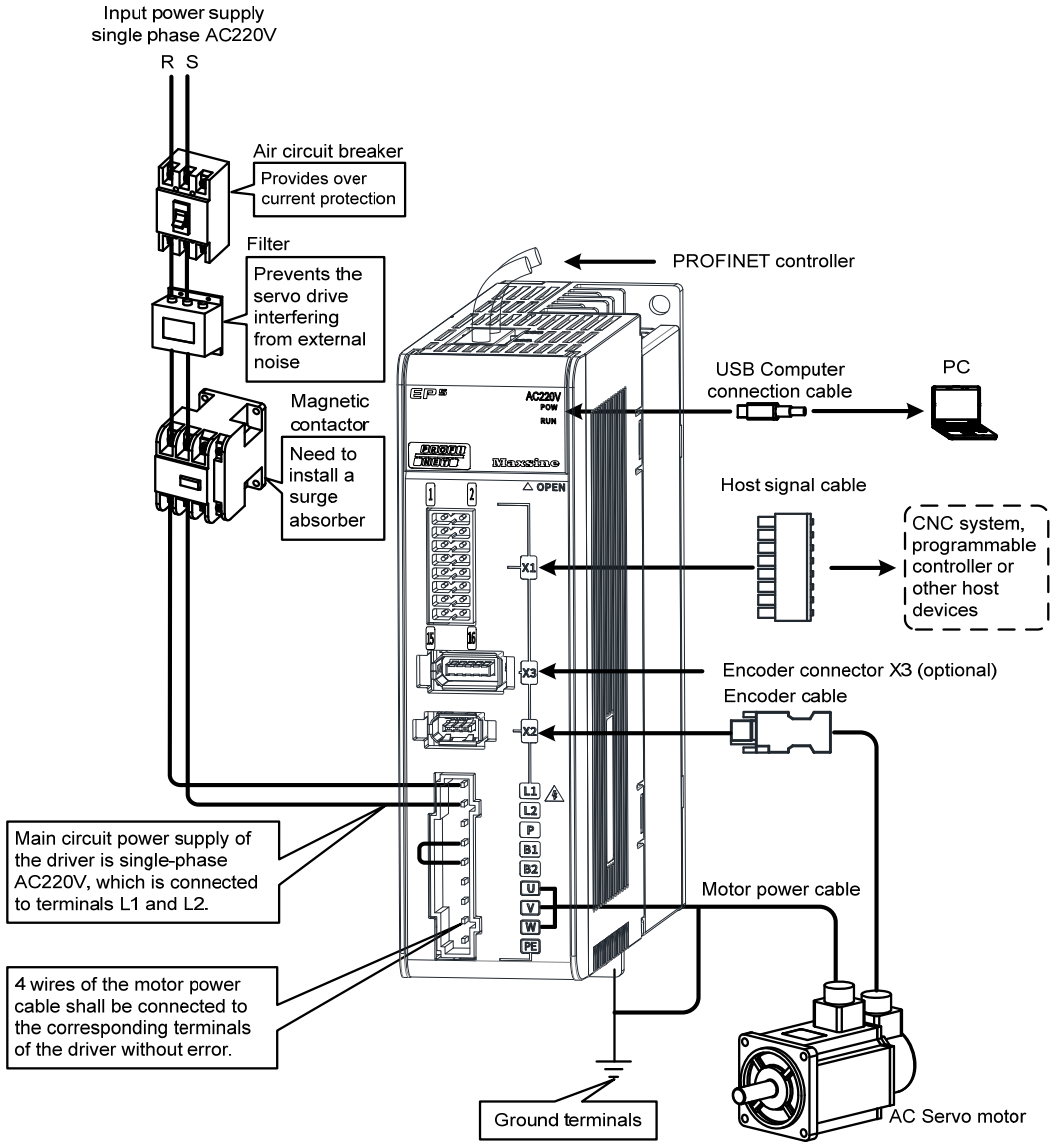
Chapter 2 Wiring

2.1 System construction and wiring

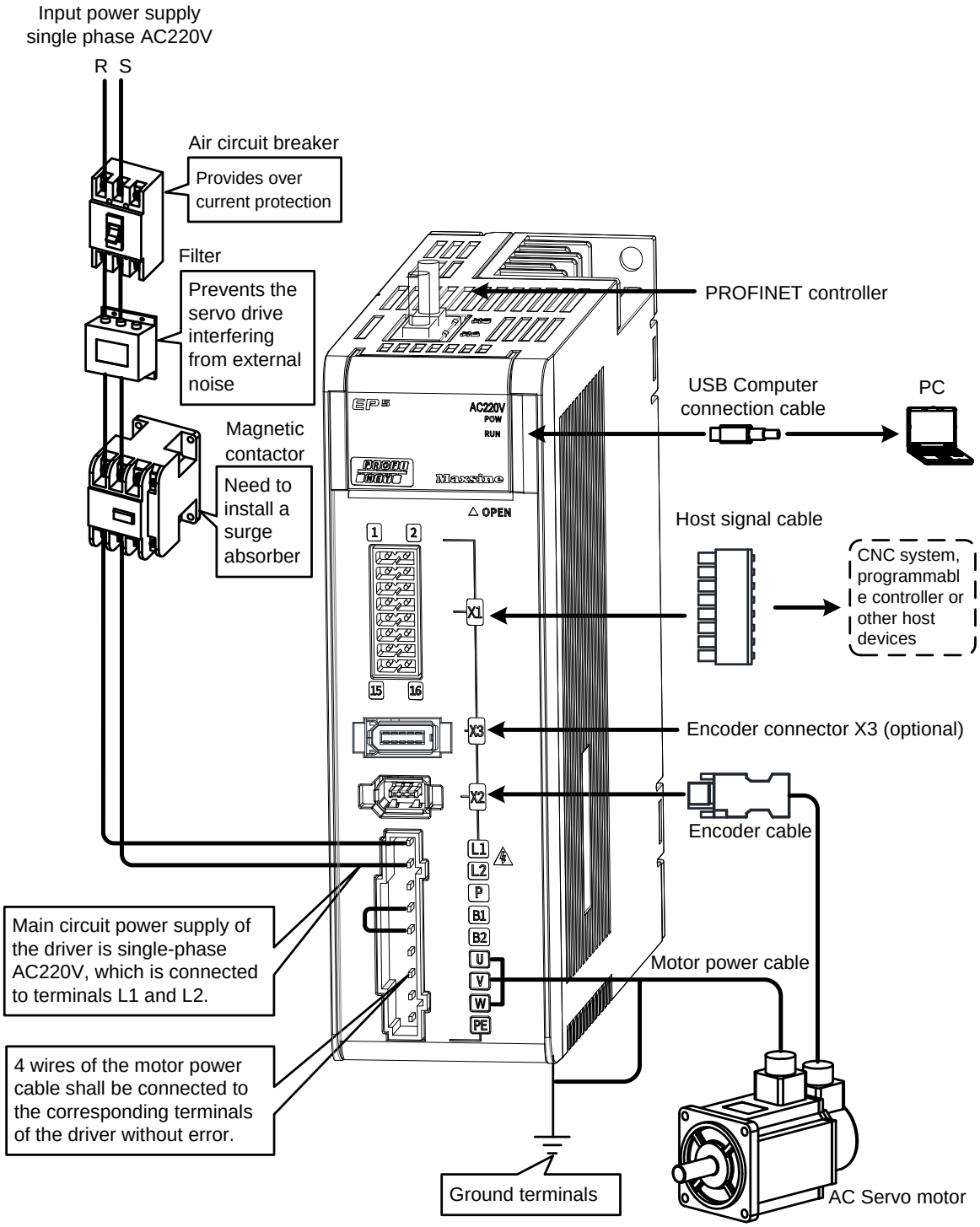
2.1.1 Servo driver wiring diagram

1. EP5-TL series servo driver wiring diagram

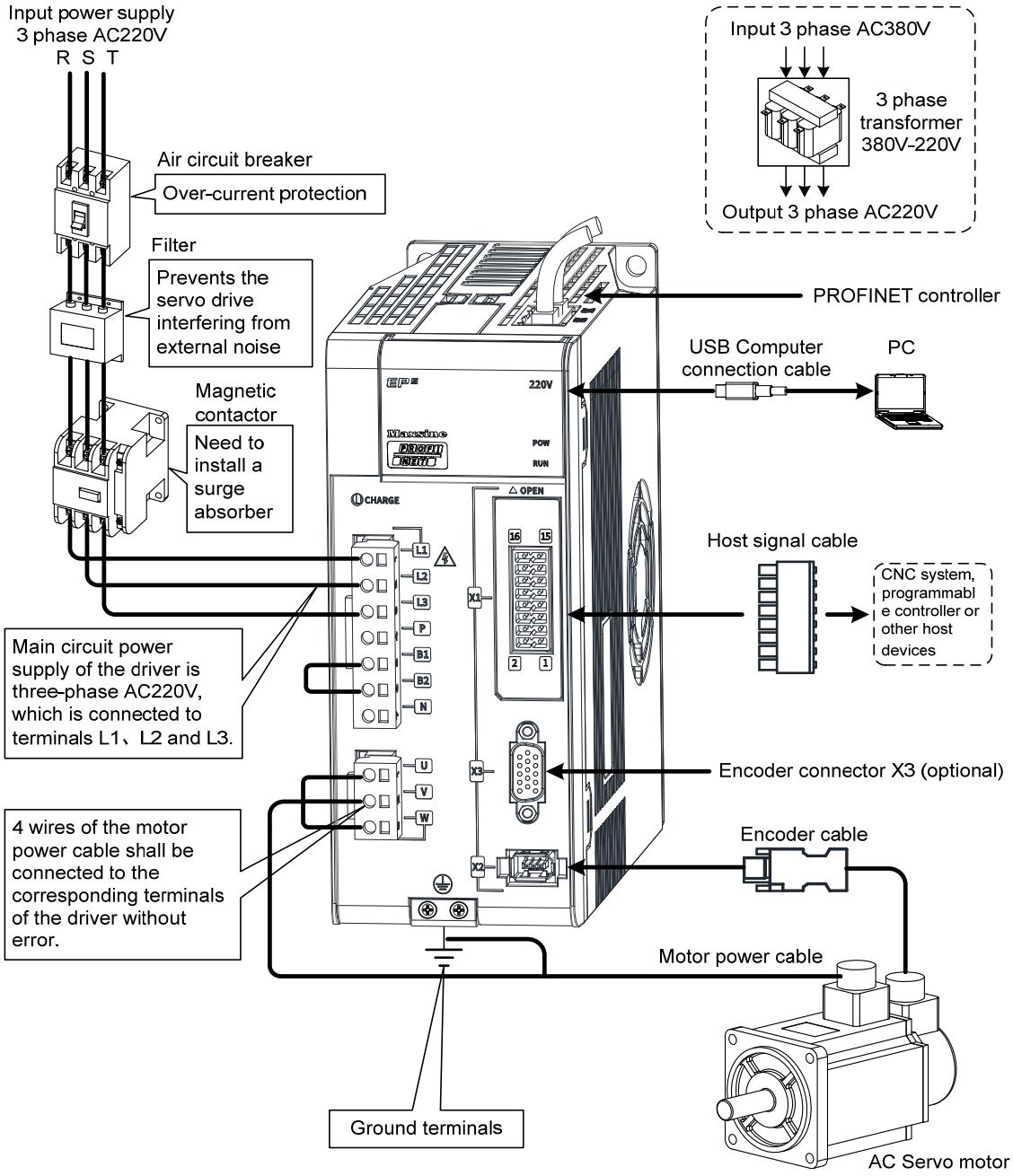
Applicable models: TL04、TL08



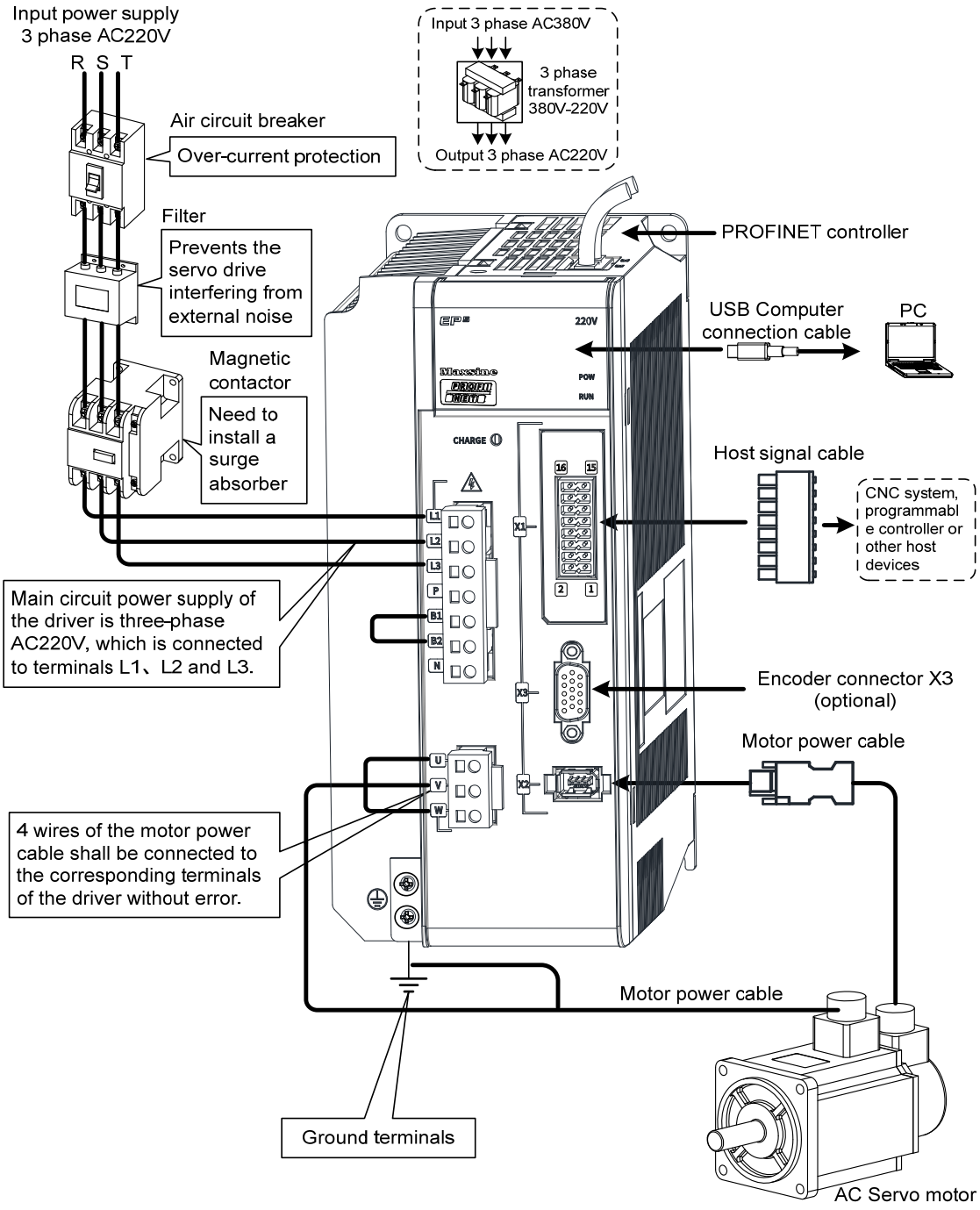
Applicable model: TL10



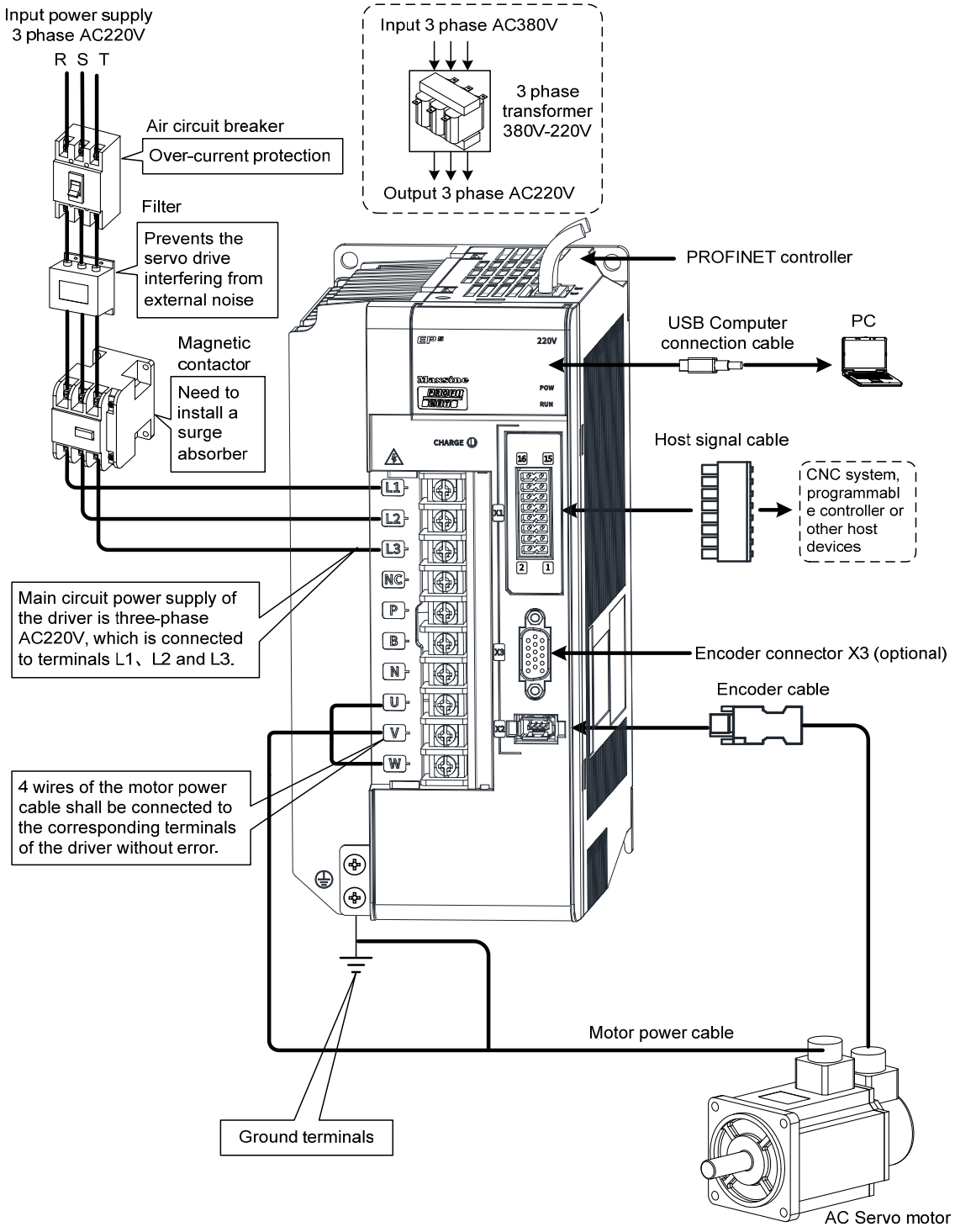
Applicable model: TL15



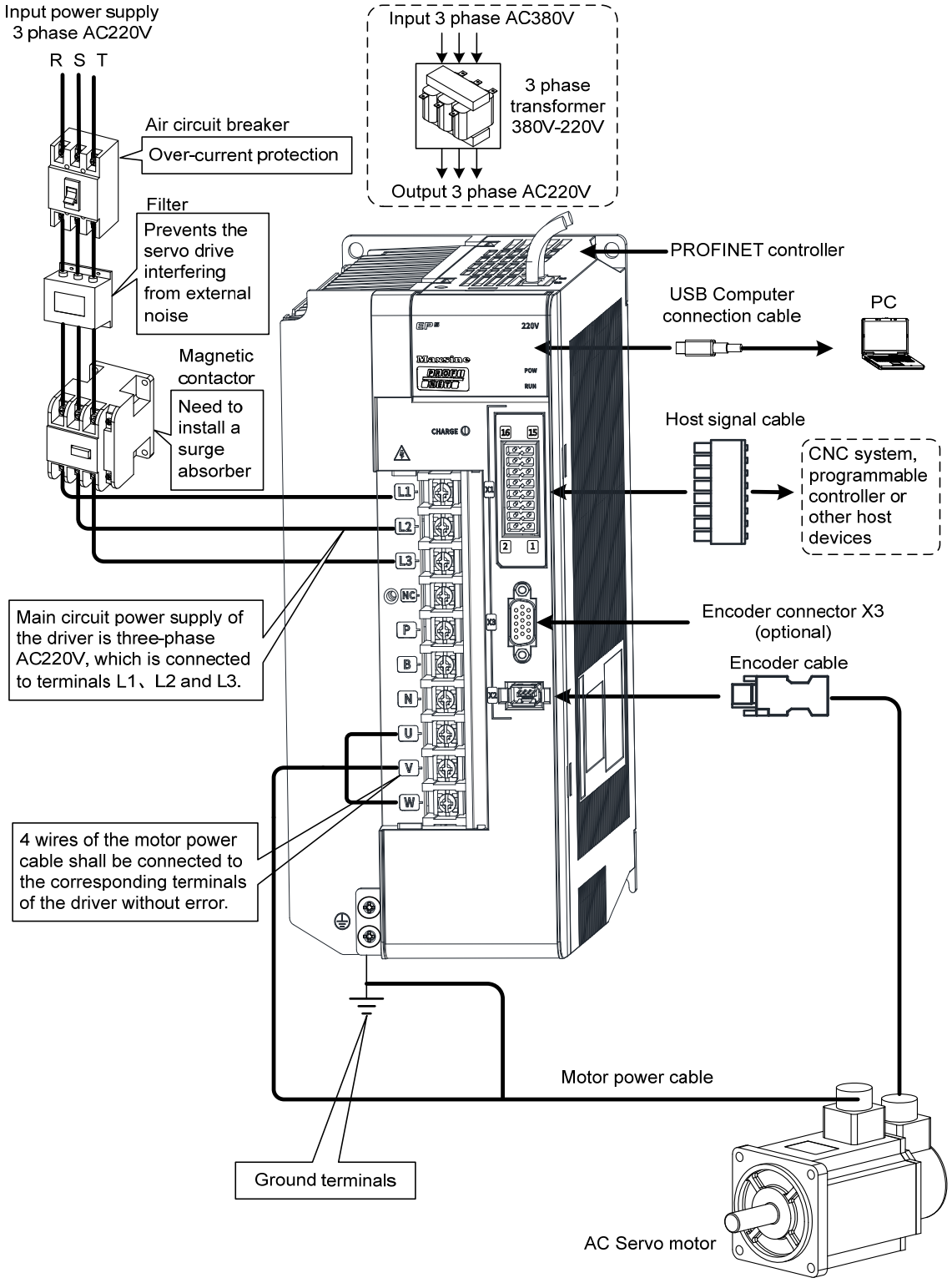
Applicable model: TL25



Applicable model: TL35

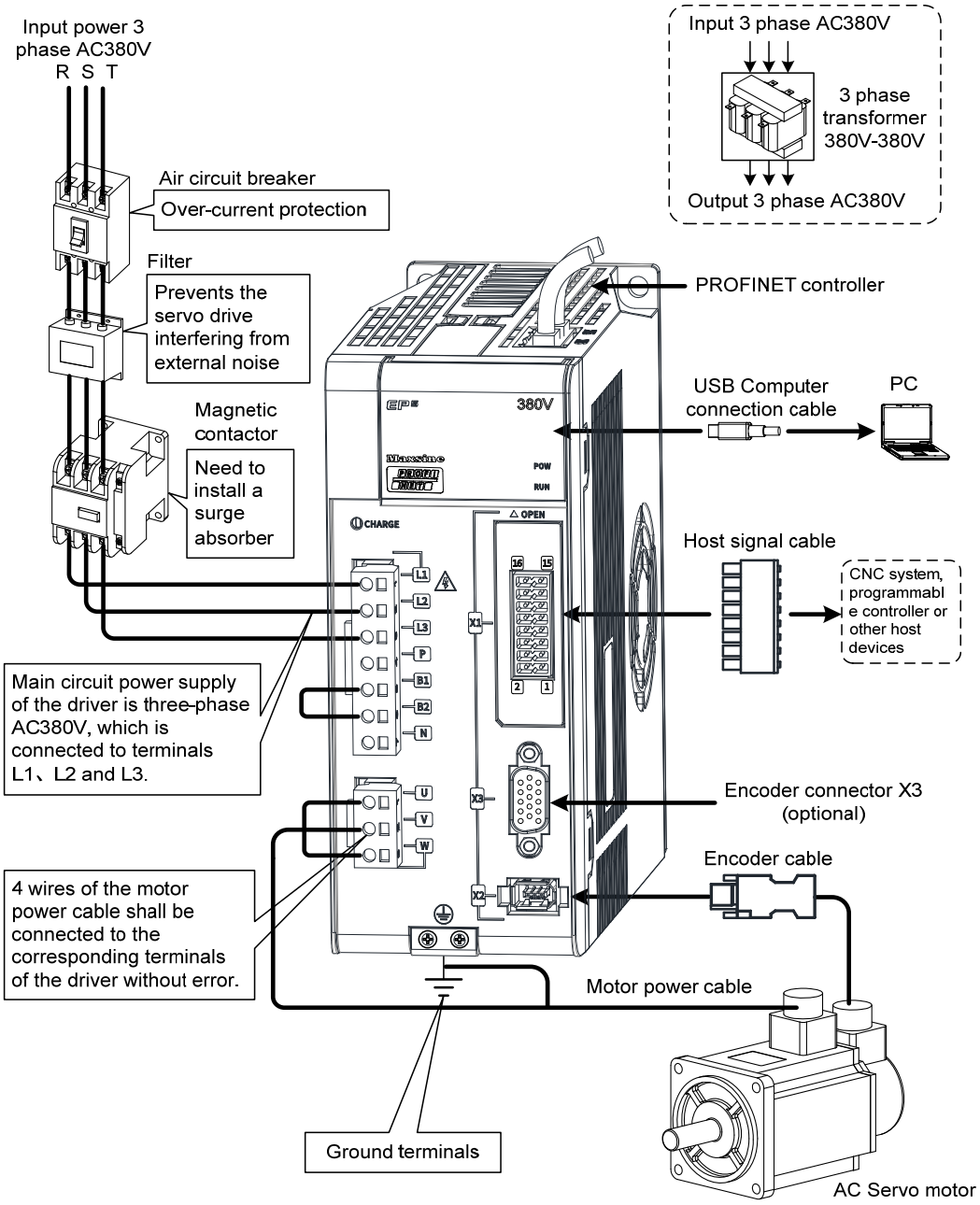


Applicable model: TL55

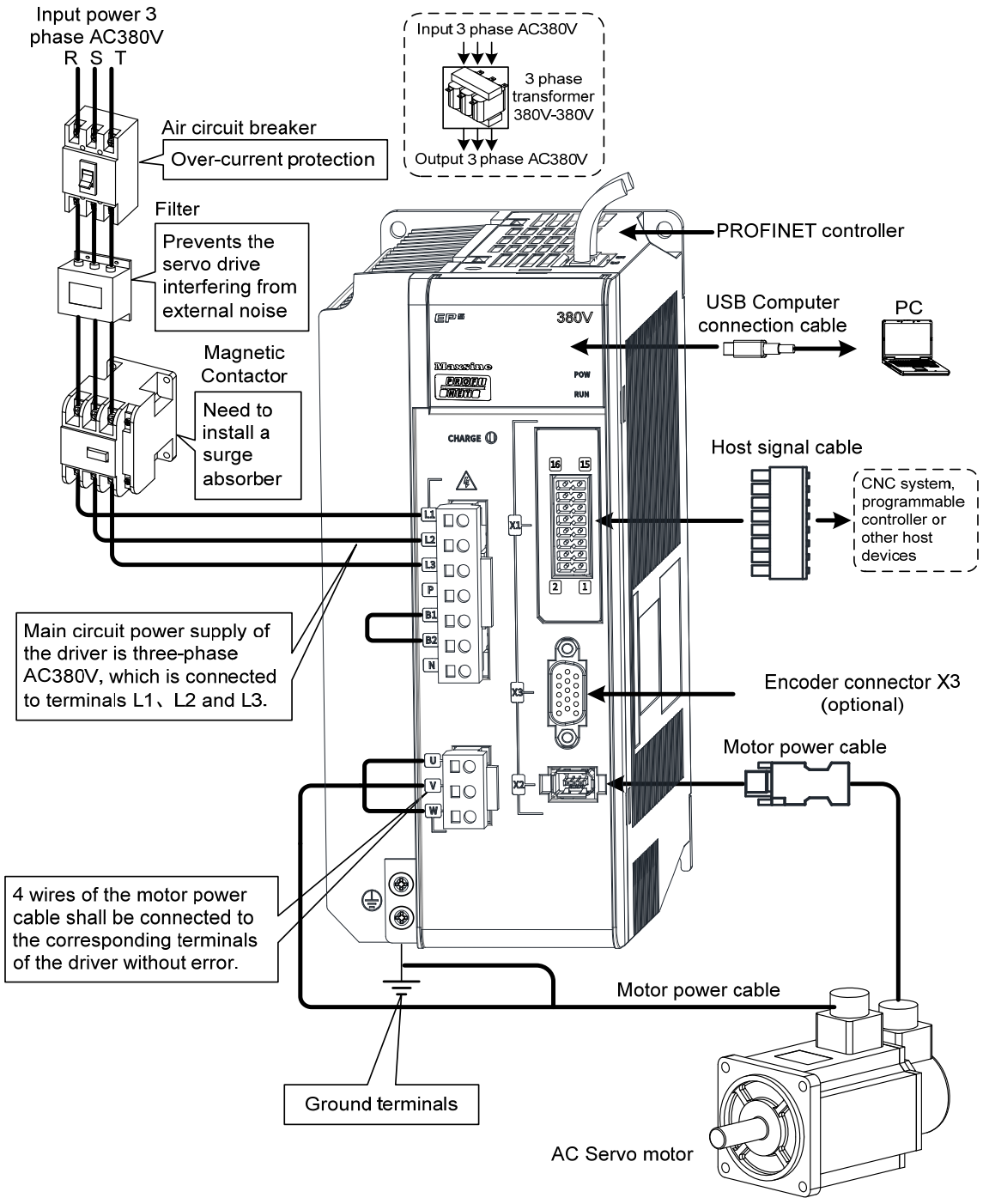


2. EP5-TH series servo driver wiring diagram

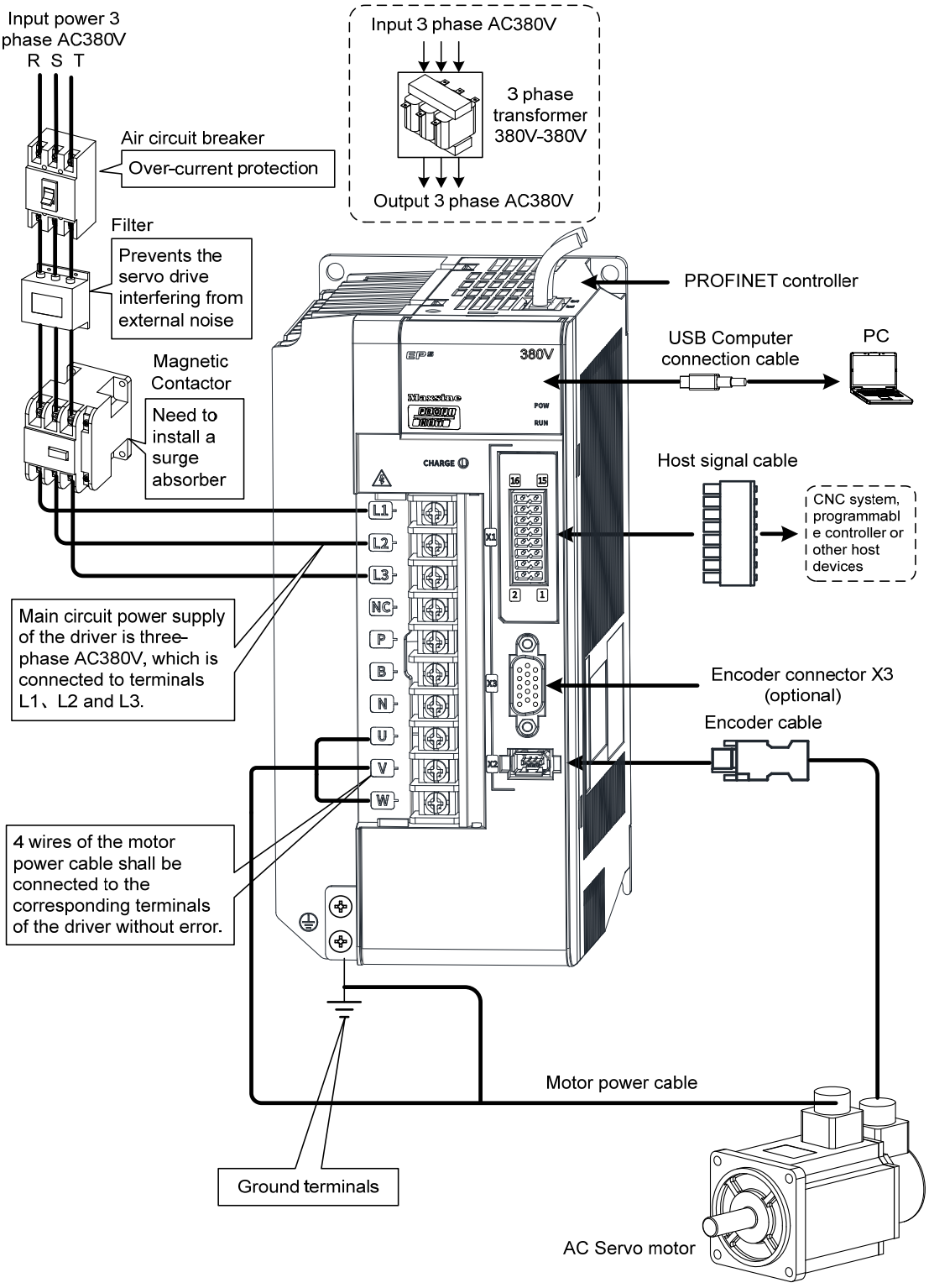
Applicable model: TH15



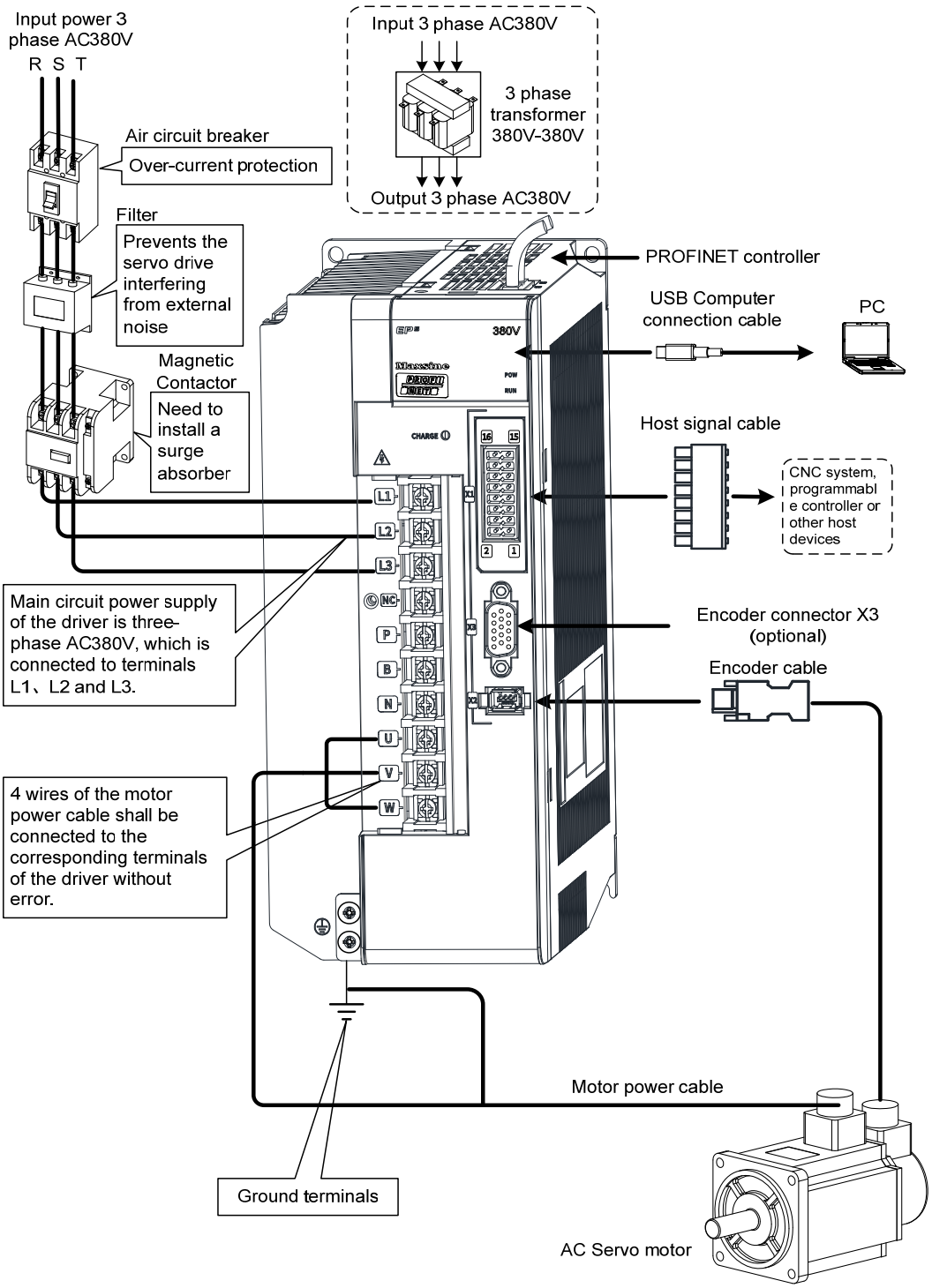
Applicable model: TH20



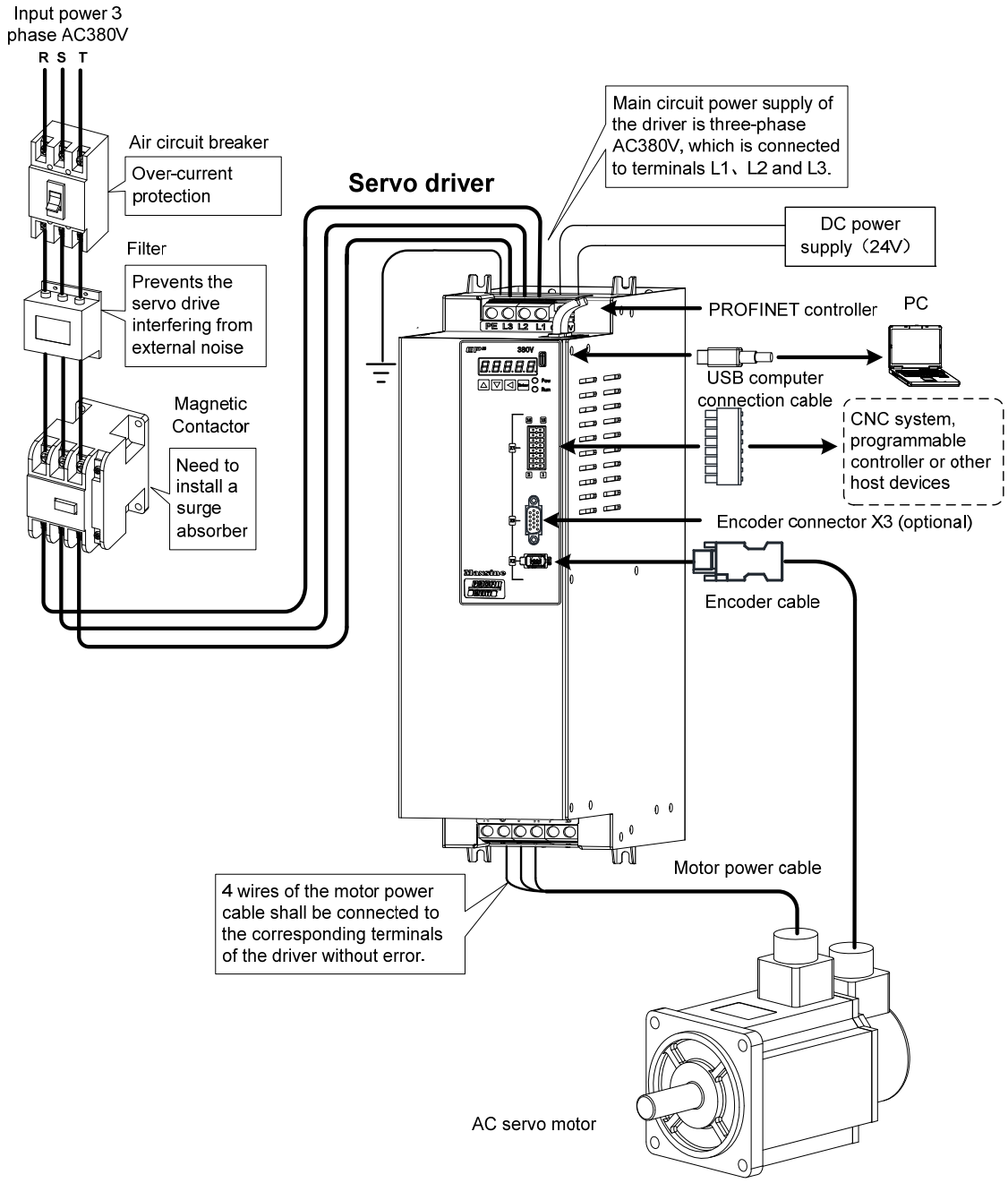
Applicable model: TH30



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.
- In order to prevent wrong action caused by electromagnetic noise, please add isolation transformer, noise filter and other devices 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	4～6mm2
		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	

Encoder cables must use shielded twisted pair cables. If the encoder cable is too long (>20m), it will cause insufficient power supply to the encoder. The power and ground wires can be connected using multiple wires or thick wires.

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

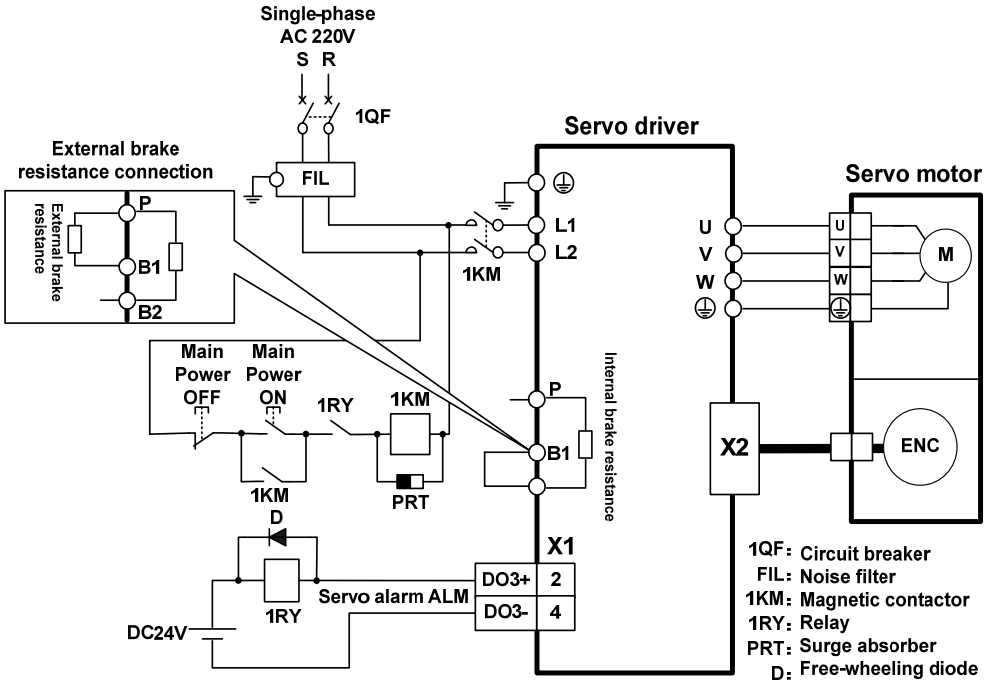
Note 1: TL55、TH50、TH75、TH90、TH110 and TH150 have no internal braking resistance. When TL55、TH50、TH75, TH90、TH110 and TH150 need to be connected with external braking resistance, the external braking resistance should be bridged at the P and B ends.

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.

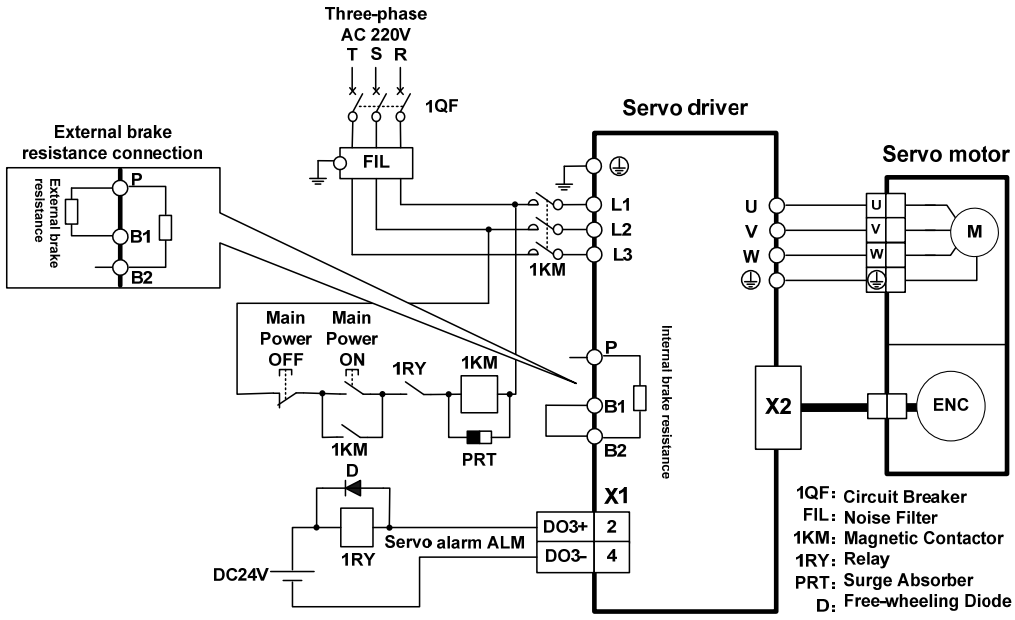
2.1.5 Motor and power wiring diagram

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.

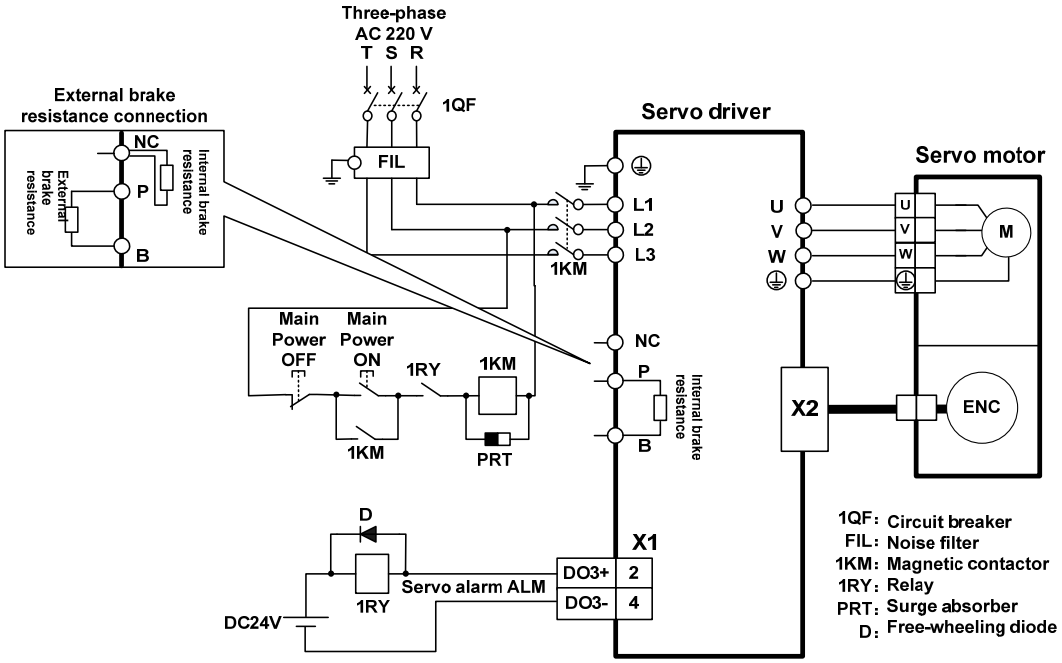
Applicable models: TL04、TL08、TL10



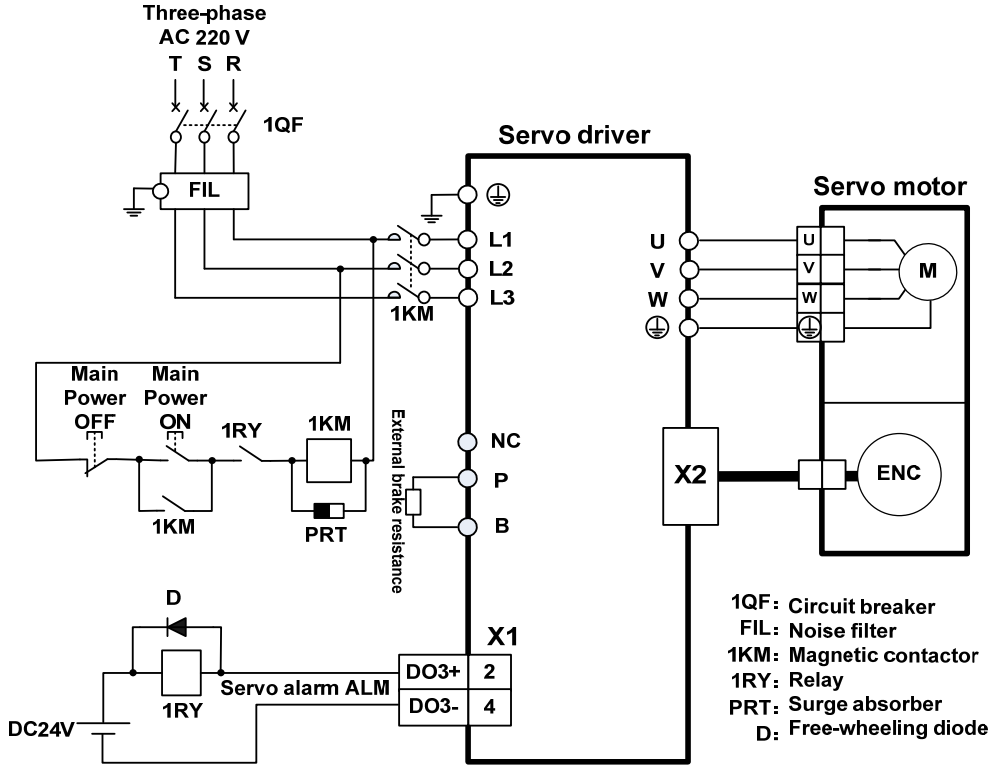
Applicable models: TL15、TL25



Applicable model: TL35



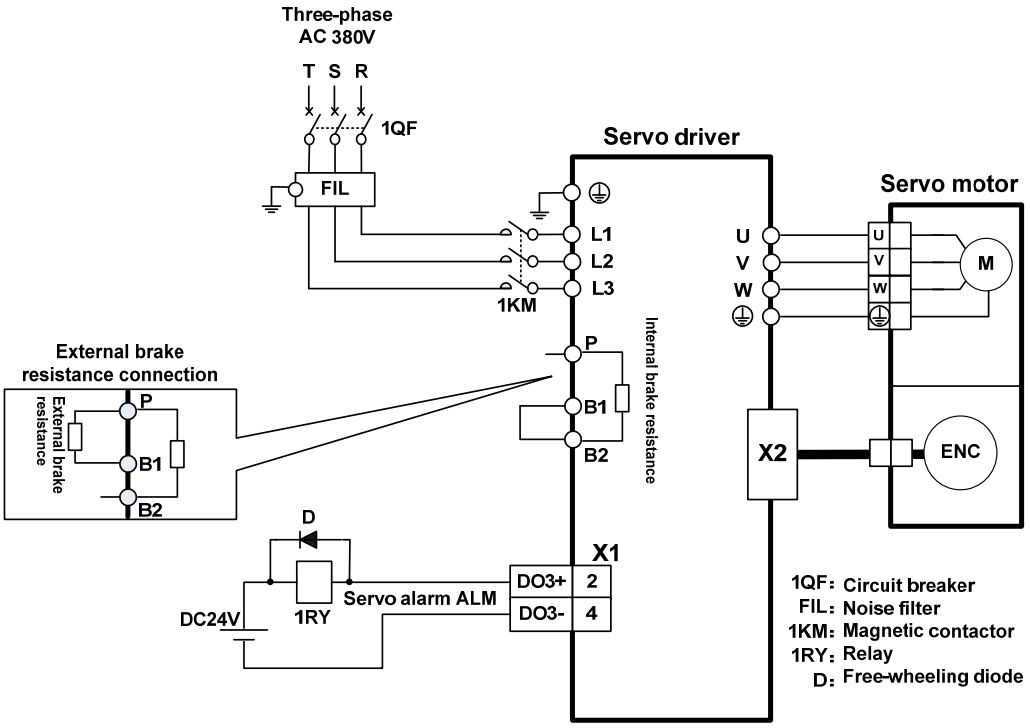
Applicable model: TL55 [Note]



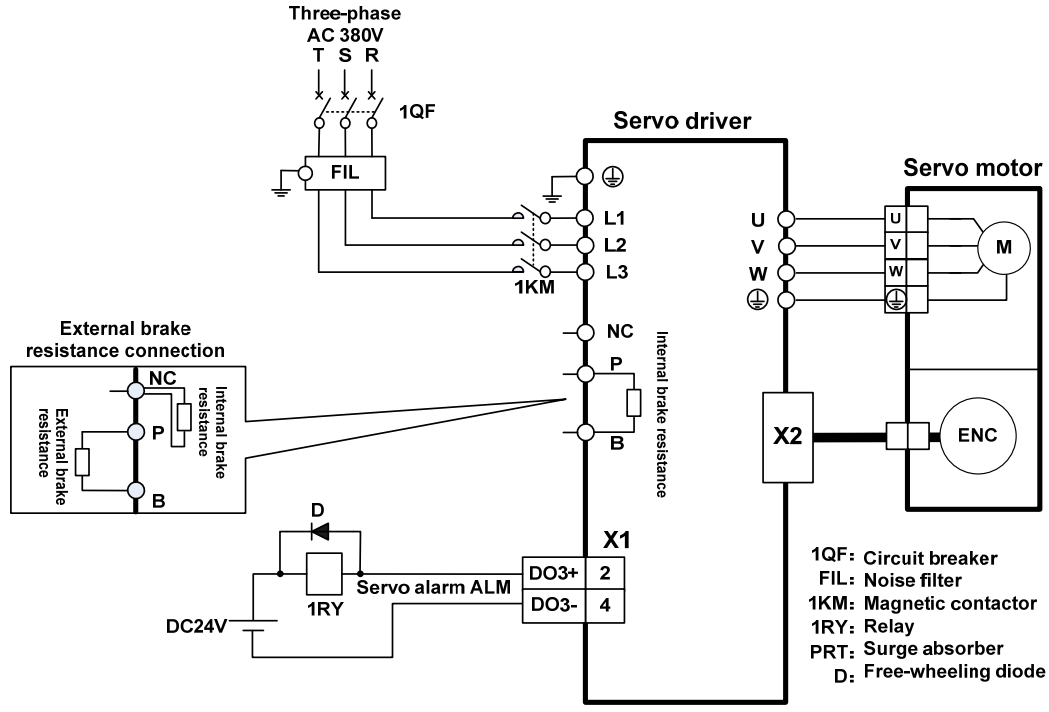
Note: TL55 has no internal brake resistance, so it needs to be connected to external brake resistance.

2. TH series two different wiring modes:

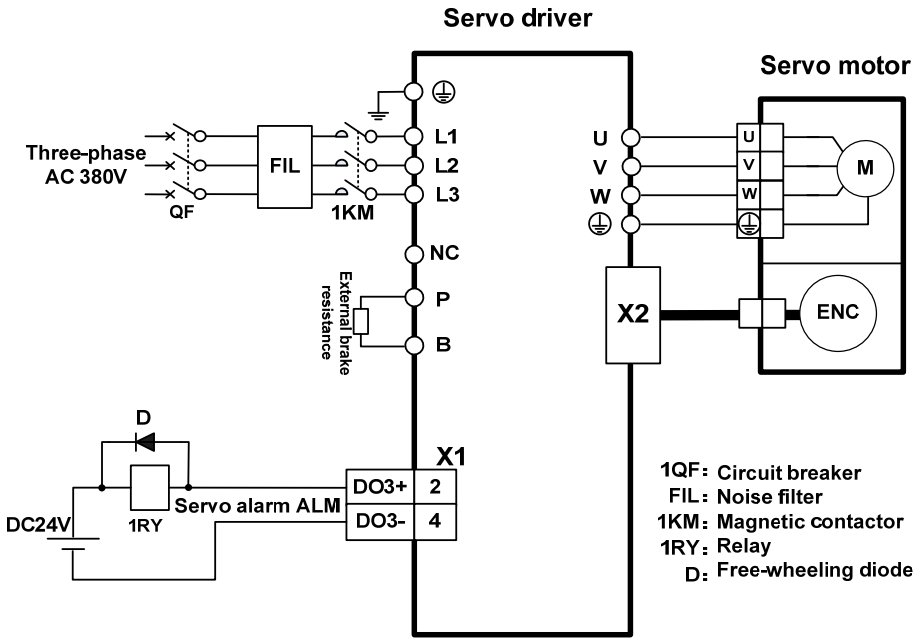
Applicable models: TH15、TH20



Applicable model: TH30

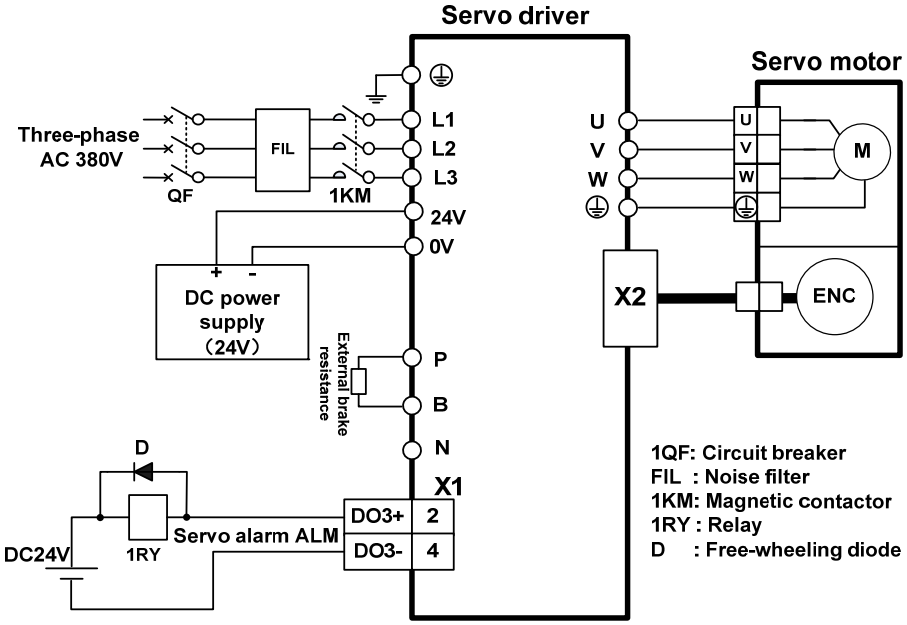


Applicable models: TH50、TH75 [Note]



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	47Ω50W	36Ω/200W	25Ω
	TL10	47Ω50W	36Ω/200W	25Ω
	TL15	47Ω/100W	25Ω/200W	20Ω
	TL25	47Ω/100W	25Ω/200W	20Ω
	TL35	47Ω/100W	20Ω/500W	12Ω
	TL55	无	20Ω/500W	12Ω
AC380V	TH15	117Ω/100W	50Ω/500W	45Ω
	TH20	47Ω/100W	50Ω/500W	40Ω
	TH30	47Ω/100W	36Ω/750W	30Ω
	TH50	无	36Ω/750W	30Ω
	TH75	无	20Ω/1000W	15Ω
	TH90	无	20Ω/1000W	15Ω
	TH110	无	20Ω/1000W	15Ω
	TH150	无	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.

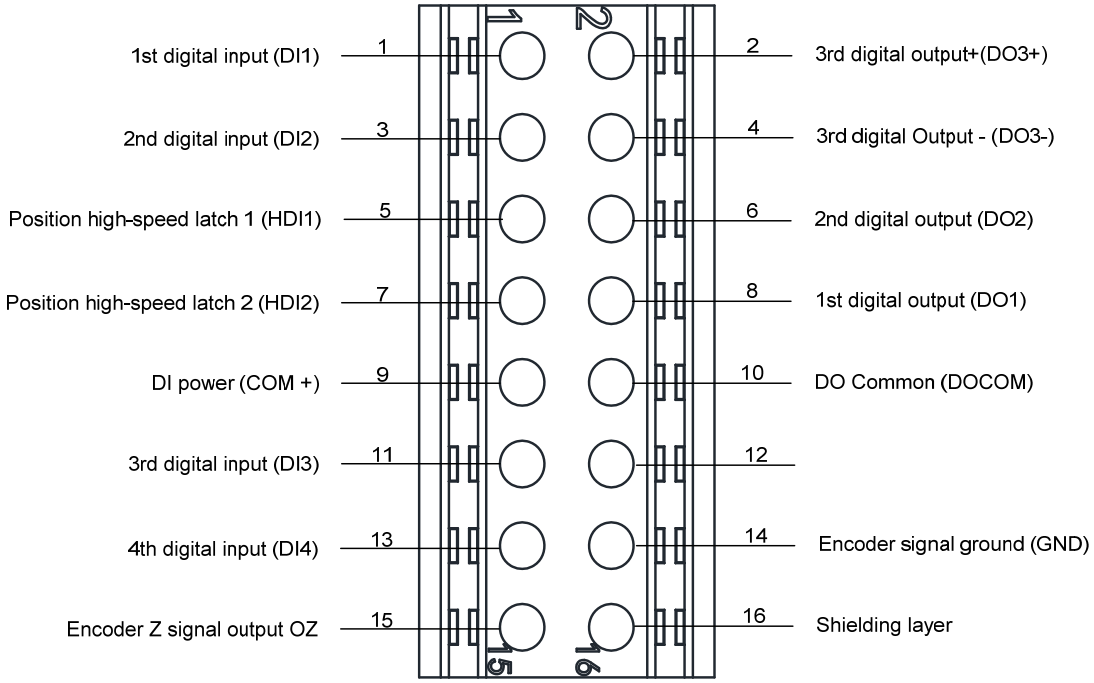
2.3 X1 control signal terminal

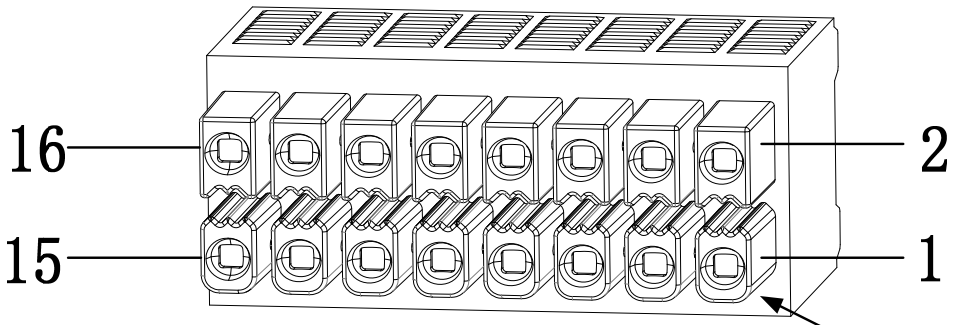
The X1 control signal terminal provides the signals required for external IO connection, using a 15EDGRHC-3.5-16P socket. The signals include:

- 4 programmable inputs;
- 3 programmable outputs;
- 2 high-speed latch inputs.

2.3.1 X1 terminal plug

The X1 terminal plug adopts a 15EDGKNH-3.5-16P male connector, with the following appearance and pin distribution:





X1 plug pin schematic diagram, pay careful attention to the wire hole number when wiring

Determine the hole sequence number based on the shape of the pins

2.3.2 X1 terminal signal explanation

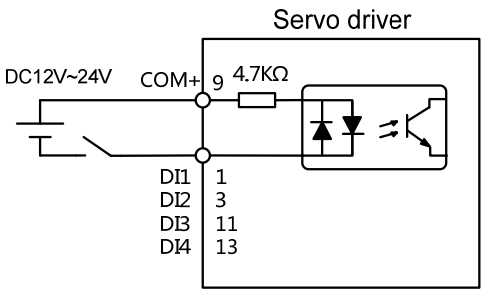
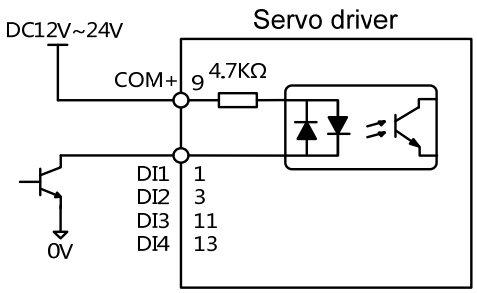
Signal name		Pin number	Functions	Inter face
Digital inputs	DI1 DI2 DI3 DI4	1 3 11 13	Photoelectric isolation input, programmable function, defined by parameters P100～P103	C1
	COM+	9	DI power supply (DC12V～24V)	
Digital outputs	DO1 DO2 DO3+ DO3-	8 6 2 4	Photoelectric isolation output, maximum output capacity of 50mA/25V, programmable function, defined by parameters P130～P132.	C2
	DOCOM	10	DO common terminal	
Position high-speed latch	HDI1 HDI2	5 7	High speed optoelectronic isolation input	C3
Encoder signal differential output	OZ	15	Encoder Z signal open collector output	C4
	GND	14	Encoder signal ground	
Shielding layer	Plug metal case	16	Shielded wire connecting shielded cable	

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)

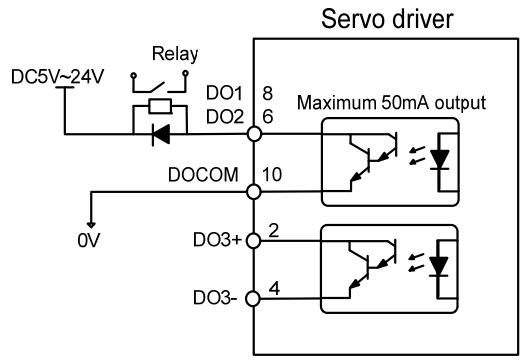
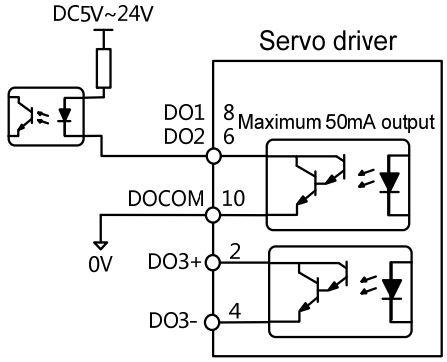
Digital input interface circuit can be controlled by switch, relay, open collector triode, photoelectric coupler, etc. Low current relay shall be selected to avoid poor contact. The external voltage range is DC12V～24V.

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

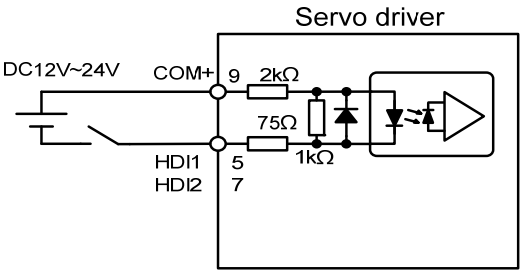
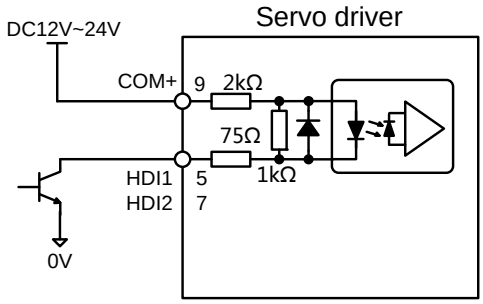
2. Digital output interfaces (C2)

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 three 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.	

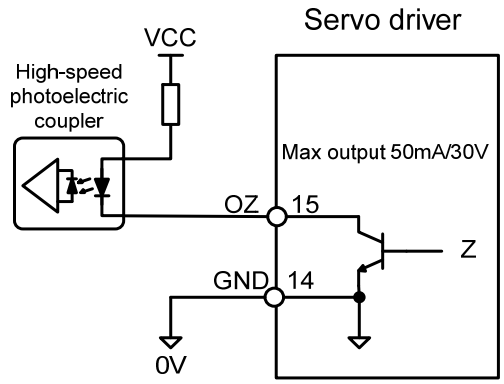
3. Position high-speed latch interfaces (C3)

C3：Position high-speed latch interface	
	
● Maximum pulse frequency 200kHz;	

4. Encoder signal open collector output (C4)

Output the encoder Z signal to the host controller through an open collector circuit. Due to the narrow pulse width of the encoder signal, please use a high-speed photoelectric coupler for reception.

C4: Encoder Z signal open collector output

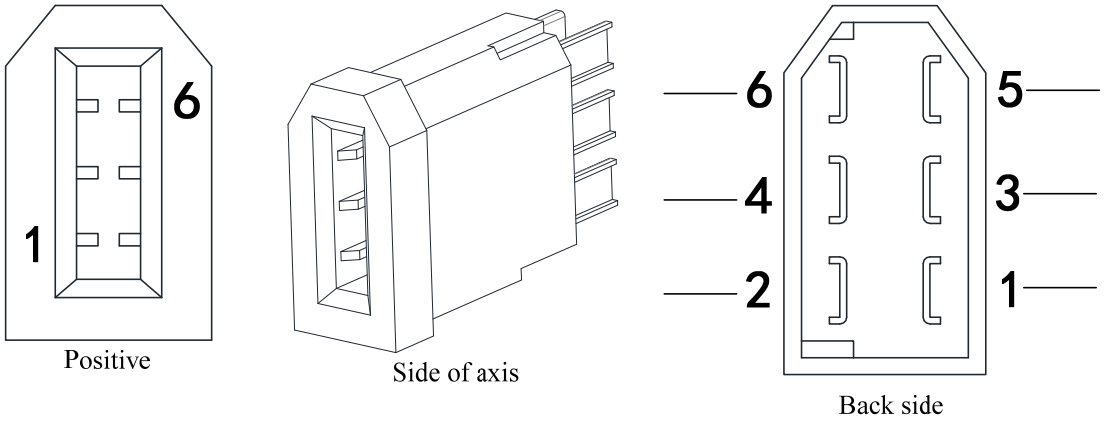


- The maximum external power supply is 30V, and the maximum output current is 50mA.

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.

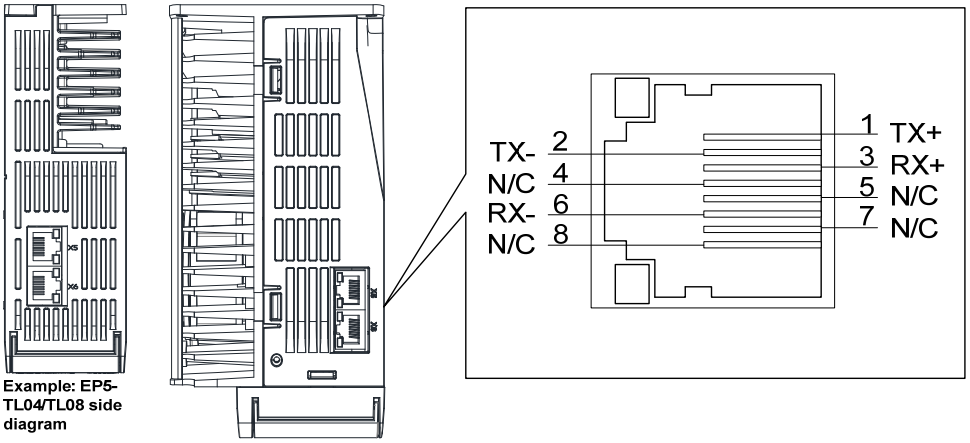
Note: Maxsine supplies finished cables, including model E□□□-1394□□A09 (for 60mm and 80mm motor) and model E□□□-1394□□H15(for motor whose seat size is over 110mm).

2.5 X5、X6 PROFINET network port

The PROFINET interface of the EP5 PN servo driver comes with two ports that can be physically connected, X5 corresponds to PN Port. PN X5, and X6 corresponds to PN Port. PN X6. PROFINET devices are uniquely identified in the network through their PROFINET interfaces, each with a unique MAC address, a device name, and an IP address.

When using X5 and X6 ports, it is necessary to ensure that the physical connections of the input and output are consistent with the topology structure in the configuration.

2.5.1 X5、X6 terminal sockets

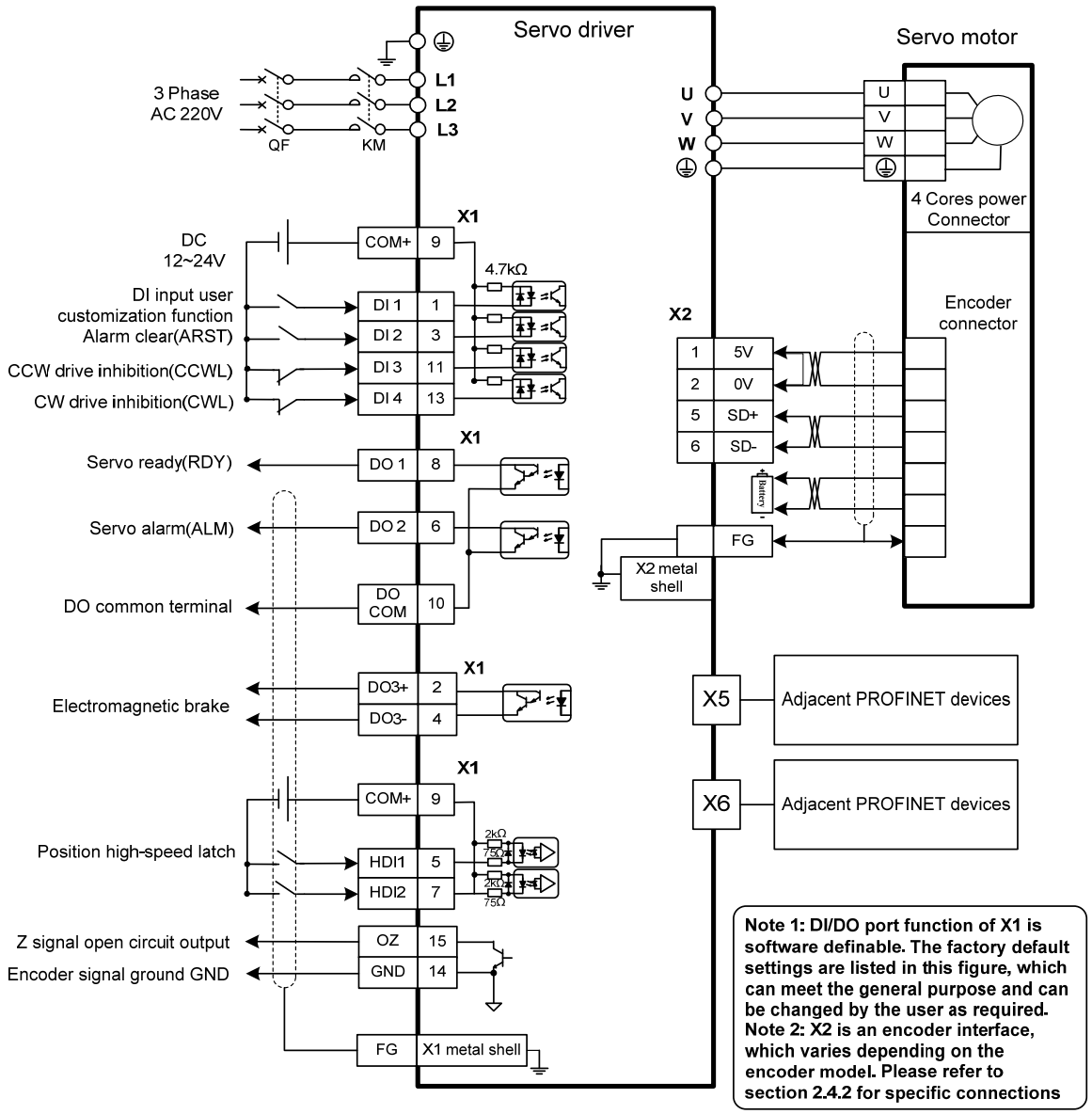


2.5.2 X5、X6 terminal signal description

Signal name	Pin number	Function
TX+	1	Sending signal +
TX-	2	Sending signal-
RX+	3	Receiving signal+
RX-	6	Receiving signal-

2.6 Standard wiring diagram

2.6.1 Control wiring



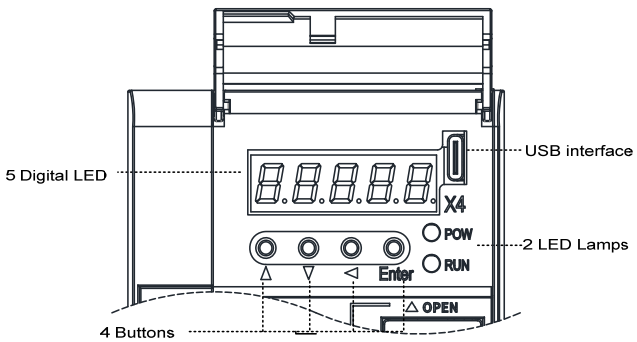
Note: The above wiring diagram takes TL15 as an example.

Chapter 3 Front panel operation

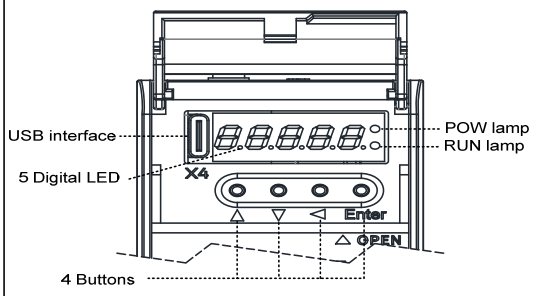
3.1 Driver front panel description

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、TH15、TH20、TH30、TH50、TH75、TH90、TH110、TH150



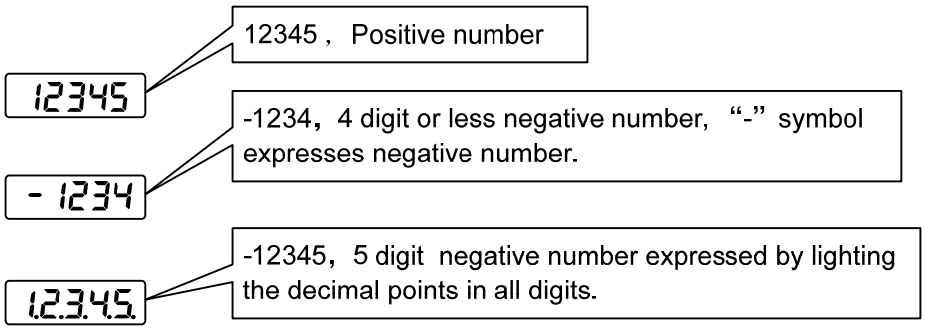
Panel applicable model：TL04、TL08、TL10

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.

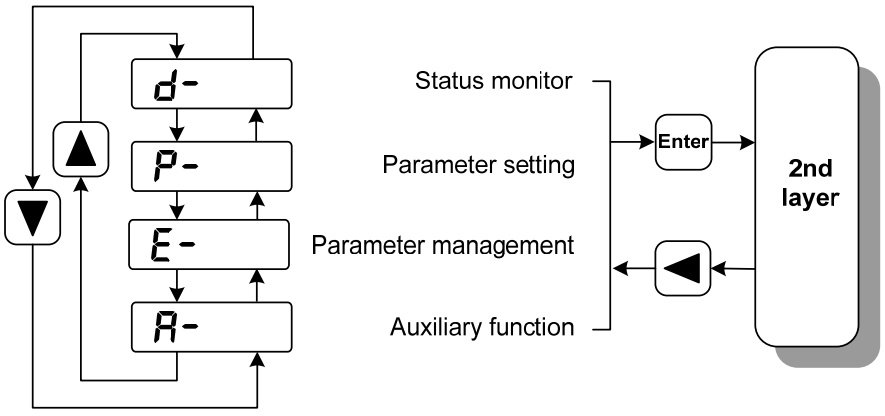
3.1.3 Data display

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

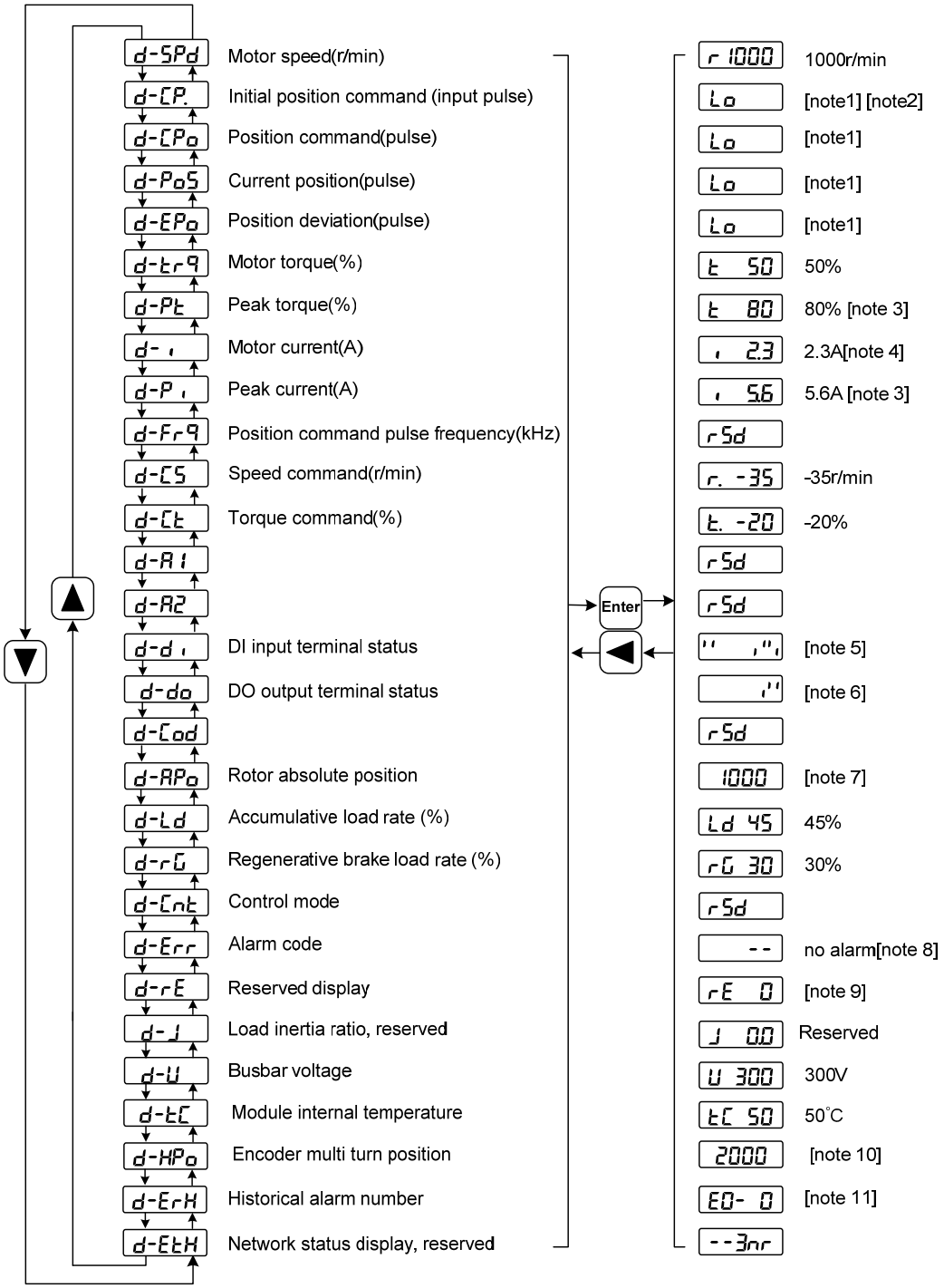
The first layer is the main menu and has four operating modes. Pressing ▲、▼ button changes the operation mode. Pressing the Enter button enters the second layer and then executes a concrete operation. Pressing ◄ button returns to the main menu from the second layer.



1st layer（Main menu）

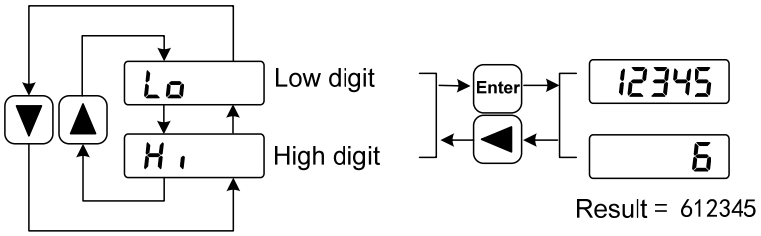
3.3 Status monitor

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.

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

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. Peak torque and peak current [note3]

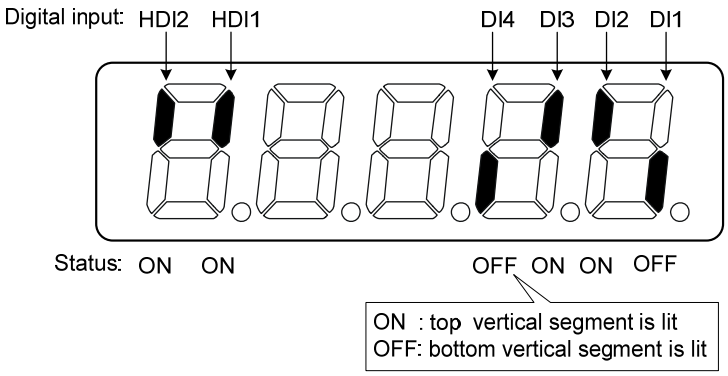
Maximum torque and maximum effective phase current of the motor in the past 10 seconds.

4. Motor current [note4]

Motor phase current effective value.

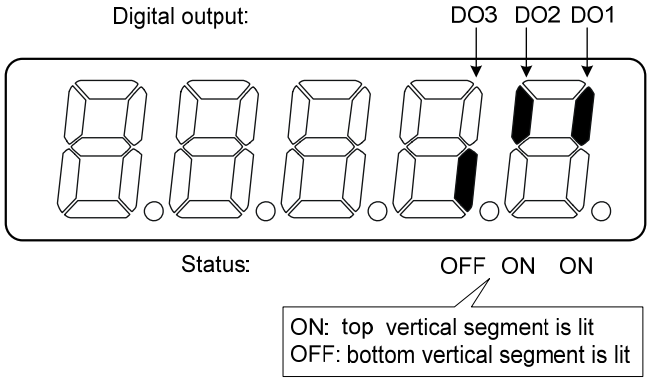
5. Input terminals DI [note5]

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”.



6. Output terminals DO [note6]

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”.

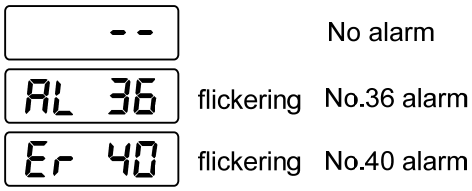


7. Rotor absolute position [note7]

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

8. Alarm code [note8]

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.



9. RE reserved display [note9]

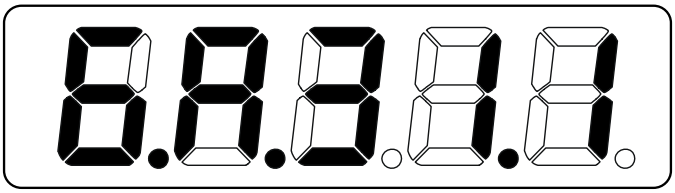
(1) re-0 menu displays the date information of the software version:

The 1st digital tube shows the last digit of the year, such as: 2016 shows 6, 2017 shows 7, and so on;

The 2nd digital tube displays the month (note: October is indicated by "A", November by "b", December by "c");

The 3rd-4th digital tube display day;

The 5th 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.

10. Encoder multi turn position [note10]

This status display is only valid for absolute value drives. Record the multi turn position of the encoder. The range is 0～65535. Combined with the absolute position of the APo rotor single turn, the absolute position of the rotor can be obtained:

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

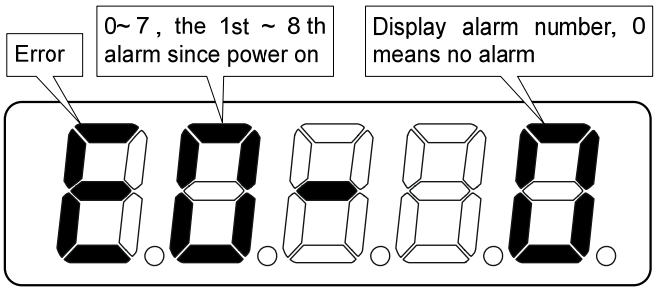
For example, the multi turn position displays 2000, and the single turn position displays 1000, both of which are decimal numbers

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

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

11. Historical alarm number [note11]

Display alarm number, use ▲、▼ button to view the historical alarm number. After the servo is powered off and restarted, only the first four alarm numbers from E0 to E3 are recorded.



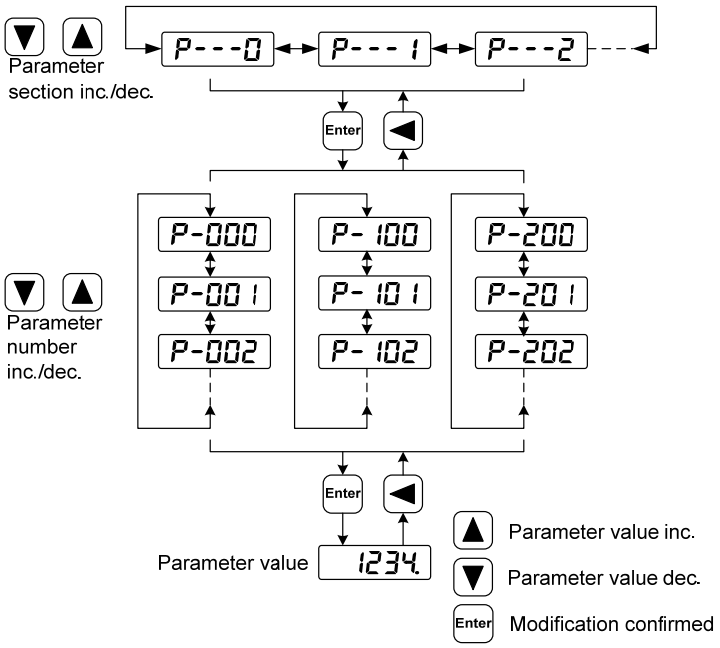
3.4 Parameters setting

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.

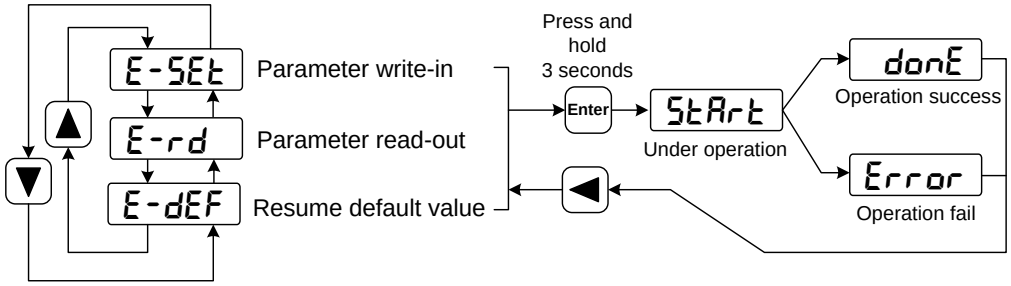
The modified parameter is not saved to EEPROM. If it needs to be saved permanently, please use the parameter write operation in parameter management. Parameter segments and numbers are not necessarily contiguous, and unused segments and numbers are skipped and cannot be selected.



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.

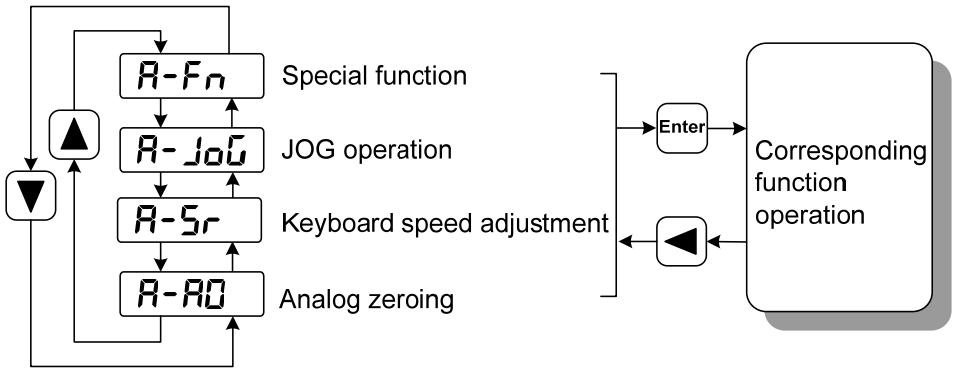
- **Resume default value**

  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

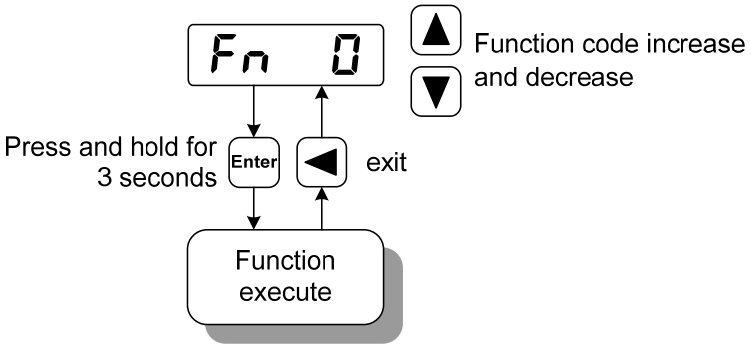
3.6 Auxiliary functions

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. **Note: The Fn function should be executed when the drive is not enabled.**



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.
Fn -2	Enter normal mode	The 999 warning is displayed on the screen, and the function can run normally
Fn -1	Exit normal mode	Exit normal mode and enter network mode

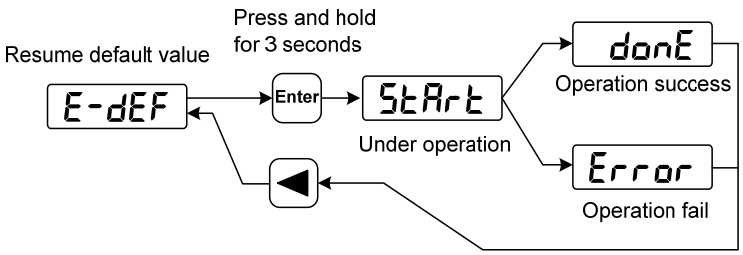
3.7 Resume the parameter default value

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.

Resume all of the parameter default value

1. 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

2. 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:

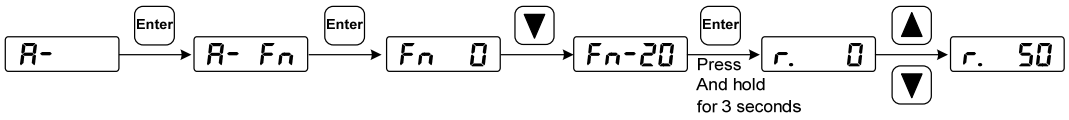
- Is the connection correct? In particular, whether the driver U, V, W is one-to-one corresponding to the motor U, V, W wiring and whether the driver L1, L2, L3 wiring.
- Is the input voltage correct?
- Is the encoder cable connected correctly?

4.1.2 Trial running in speed adjustment with keyboard

Note: The keyboard speed control trial run requires setting A-Fn→Fn -2 to enter normal mode before it can run! Fn -2 is on time for a long time, and the drive displays AL999 warning number 999, indicating normal operation.

When the driver is not enabled, long press Fn -2, and the panel displays "done". The driver switches to normal mode, which can be used for keyboard speed adjustment and trial operation functions; When the driver is not enabled, press and hold Fn-1, and the panel displays "done". The driver switches to PROFINET mode, and the control mode and instructions are sourced from the PROFINET bus.

1. Before performing this operation, confirm that the motor has been disconnected from the load.
2. Turn on the power supply (AC three-phase 220V or AC single-phase 220V). 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

See the section "6.3.2 AC3: Single axis positioning driver with local motion control" for instructions.

The position control mode is used in the systems requiring precise positioning, such as CNC machine tools, textile machinery, etc.

4.2.1 Parameter setting of position control mode

Parameter setting:

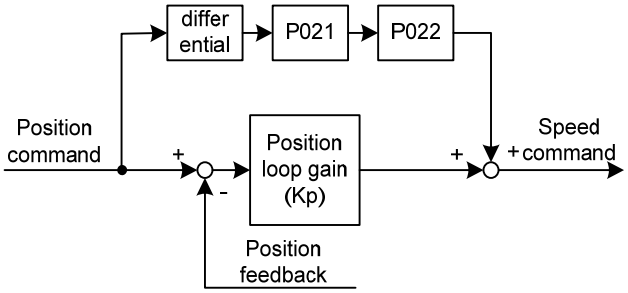
Para meter	Name	Setting value	Default value	Parameter explanation
P097	Ignore drive inhibit	3	3	Use forward drive inhibit (CCWL) and reverse drive inhibit (CWL). If set to ignore, did not connect CCWL、CWL.

4.2.2 Position control mode related gain

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

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

See the section "6.3.3 AC4: Motion control with central interpolation and speed setting interface" for instructions.

The speed control mode is applied to situations that require precise speed control, such as weaving machines, drilling machines, CNC machining machines. The position control mode can also be formed through the host device.

4.3.1 Parameter setting of speed control mode

Parameter setting:

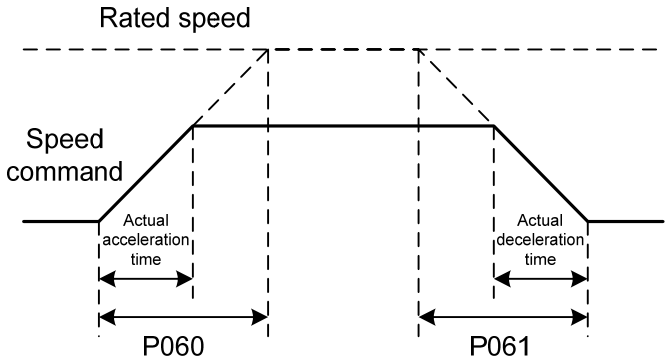
Para meter	Name	Setting value	Default value	Parameter explanation
P060	Speed command acceleration time	suitable	0	
P061	Speed command deceleration time	suitable	0	
P097	Ignore drive inhibit	3	3	Use forward drive inhibit (CCWL) and reverse drive inhibit (CWL). If set to ignore, did not connect CCWL、CWL.

4.3.2 Acceleration and deceleration

Acceleration and deceleration are related to the following parameters:

Para meter	Name	Range	Default value	Unit
P060	Speed command acceleration time	0～30000	0	ms
P061	Speed command deceleration time	0～30000	0	ms

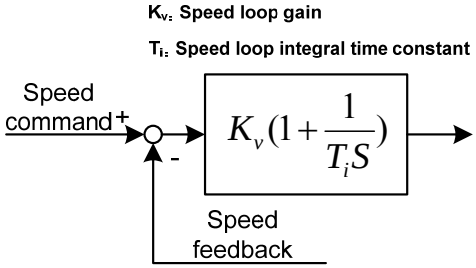
Acceleration and deceleration can slow down the sudden change of speed and make the motor run smoothly. As shown in the figure below, parameter P060 sets the acceleration time of the motor from zero speed to rated speed, and P061 sets the deceleration time of the motor from rated speed to zero speed. If the command 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.



4.3.3 Speed control mode related gain

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

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.



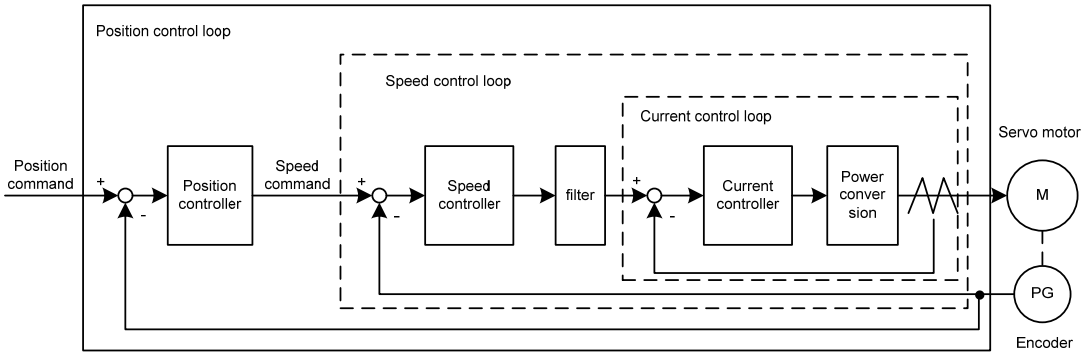
P018 can choose the speed controller structure. 0 is the IP regulator, 100 is the PI regulator, 1～99 is the PDFF regulator. If the parameter value of P018 is too large, the system has high frequency response; if the parameter value is too small, the system has high stiffness (resistance to deviation);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

4.4 Torque control mode

This part of the function needs to be improved.

4.5 Gain adjustment

The 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 parameters

Parameters related to the gain are:

Parameter	Name	Range	Default value	Unit
P005	1st speed loop gain	1～3000	40	Hz
P006	1st speed loop integral time constant	1.0～1000.0	20.0	ms
P009	1st position loop gain	1～1000	40	1/s
P017	Load moment of inertia ratio	0.0～200.0	1.0	times

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 Kv

The 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:

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

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 integral time constant T_i of the speed loop 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 ($G=J_L/J_M$), use the following formula to obtain the speed loop integral time constant T_i:

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

3. Position loop gain K_p

The 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 position loop gain value to speed up the reaction speed, reduce the position tracking error and shorten the positioning time. However, too large setting will cause mechanical system jitter or positioning overshoot. The bandwidth of the position loop cannot 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 2.Decrease the speed loop integration time constant T_i 3.Increase position loop gain K_p	1.Decrease position loop gain K_p 2.Increase the speed loop integration time constant T_i 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 integration 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. The speed loop integration 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 resonance of the mechanical system or other reasons, and the desired responsiveness cannot be obtained, adjust the torque low-pass filter or notch filter to suppress resonance, and then repeat the above steps to improve responsiveness. First, use torque low-pass filter, and then consider using notch filter if the effect is not good. Please refer to section 4.6.

Position control gain adjustment steps:

1. Set the load moment of inertia ratio.
2. Set the speed loop integration 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 in 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 resonance of the mechanical system and the desired responsiveness cannot be obtained, adjust the torque low-pass filter or notch filter to suppress the

resonance, and then repeat the above steps to improve responsiveness. First, use torque low-pass filter, and then consider using notch filter if the effect is not good. Please refer to section 4.6.

7. If shorter positioning time and smaller position tracking error are required, the position feedforward can be adjusted appropriately.

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
P472	Number of forward turns of round-trip motion	1～32767	3	
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

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 Fn2 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 Fn2 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 Fn2 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

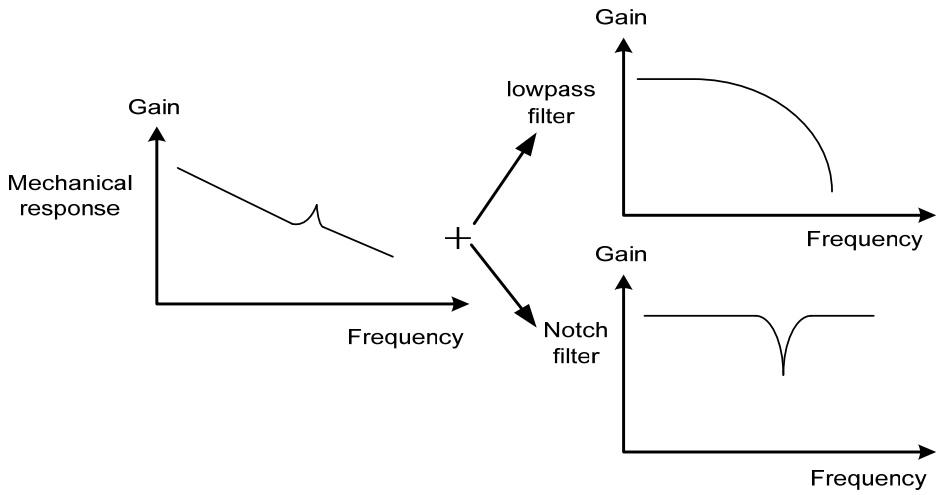
screen display "--", indicating the end of automatic setting. Exit the Fn2 mode by pressing the Back key. At this time, you can view the relevant parameters after setting. If you need to save, you need E-SET operation.

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
P007	1st torque filter time constant	0.01～50.00	1.00	ms
P200	1st notch filter frequency	50～5000	5000	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

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 parameter P007. The low-pass filter is valid by default. Low pass filter has good attenuation to high frequency, and can better suppress high frequency resonance and noise. For example, when using ball screw machinery to improve the driver gain, sometimes high-frequency resonance will occur, and the use of 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 is, 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, two notch filters can be used at the same time to suppress two different frequency resonances. By default, both notch filters are 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 the appropriate settings. The notch depth is deep, and the effect of mechanical resonance suppression

may be very 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.

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.

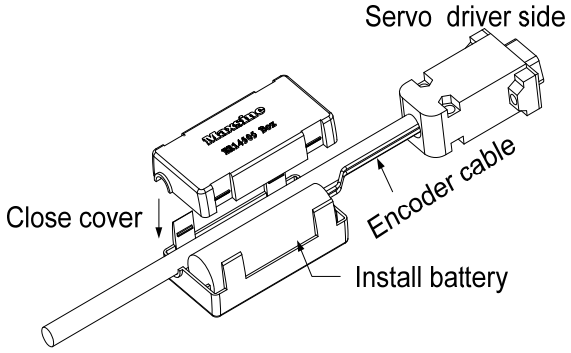
4.7 Absolute value encoder setting

4.7.1 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. 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.

4.7.2 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.

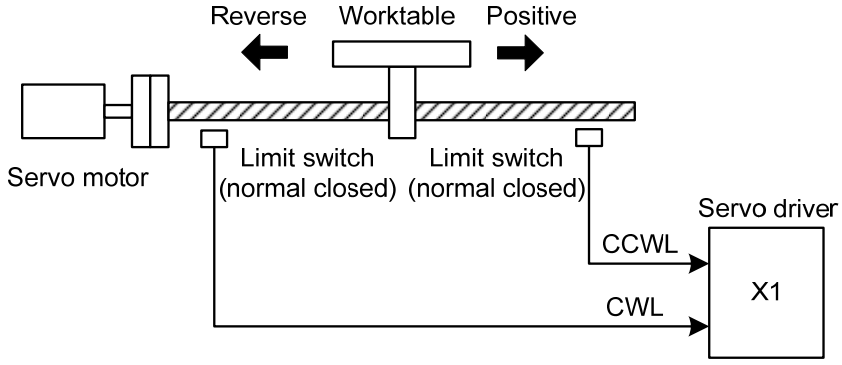
- When the machine is initially started;
- When the rotation amount data of the absolute encoder is to be set to 0.

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.

4.8 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 entering 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

4.9 Torque limit

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

4.9.1 Torque limit parameters

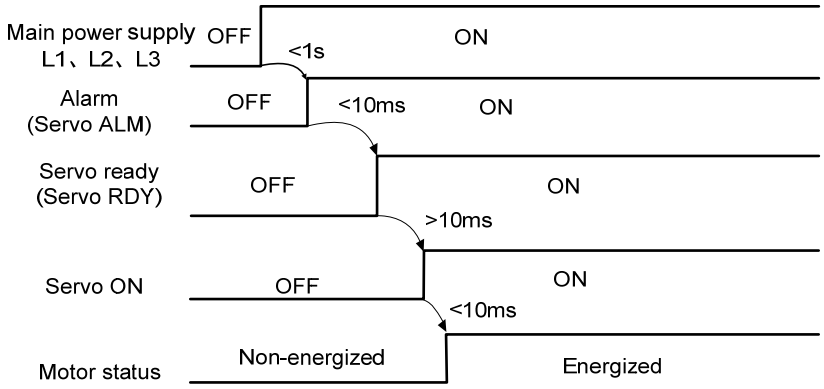
Torque limit related parameters are:

Para meter	Name	Range	Default value	Unit	Usage
P065	Internal forward (CCW) torque limit	0～300	300	%	ALL
P066	Internal reversal (CW) torque limit	-300～0	-300	%	ALL

4.10 Timing chart of operation

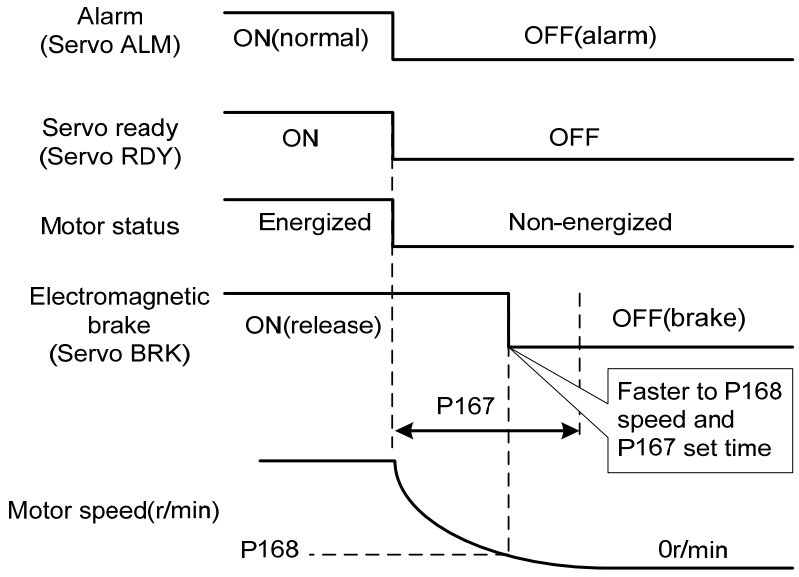
4.10.1 Timing chart when power supply switch on

- 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.



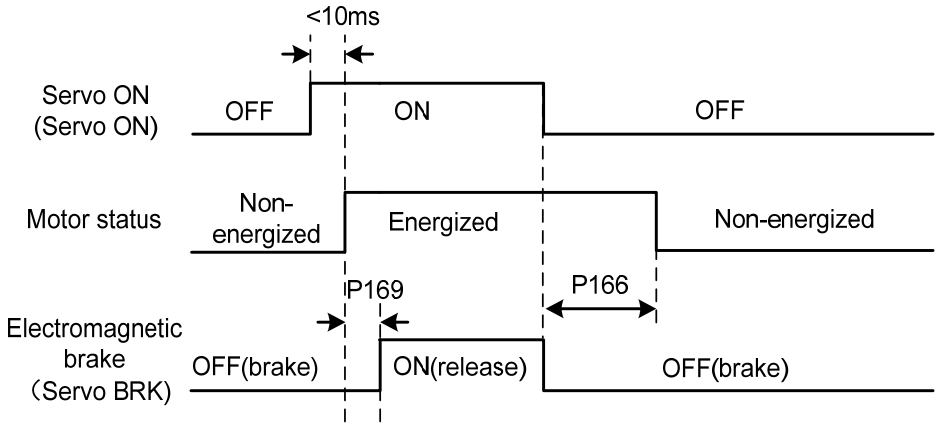
4.10.2 Alarm timing chart while servo-ON is executed

When the electromagnetic brake is servo controlled:



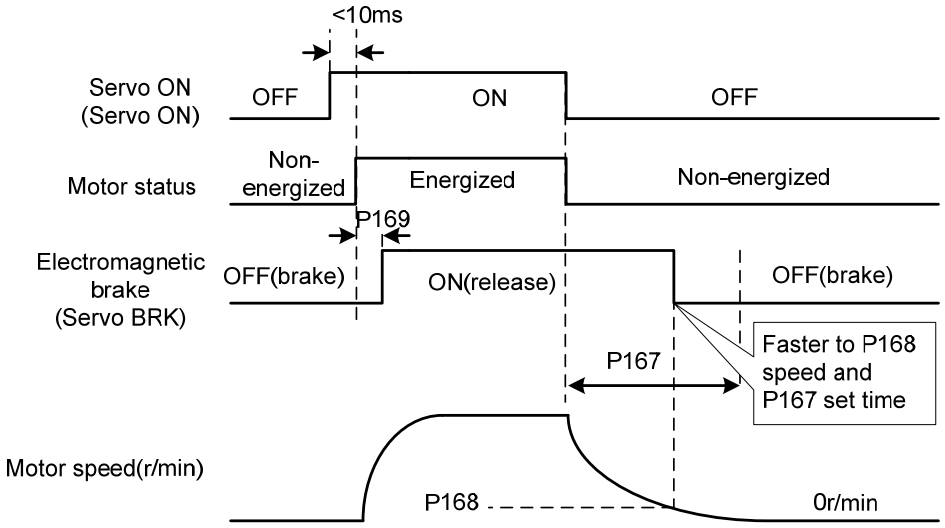
4.10.3 Servo ON/OFF action timing when the motor is stationary

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



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

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



4.11 Electromagnetic brake

Electromagnetic brake related parameters:

Para meter	Name	Range	Default value	Unit
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

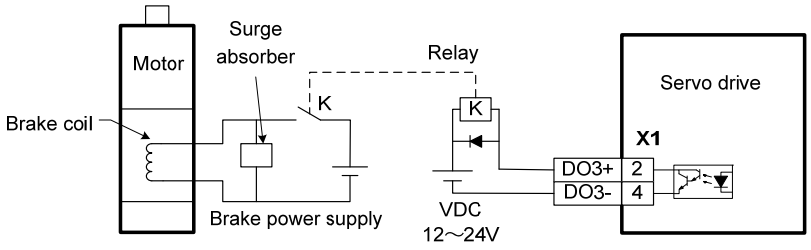
4.11.1 Use of electromagnetic brake

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.

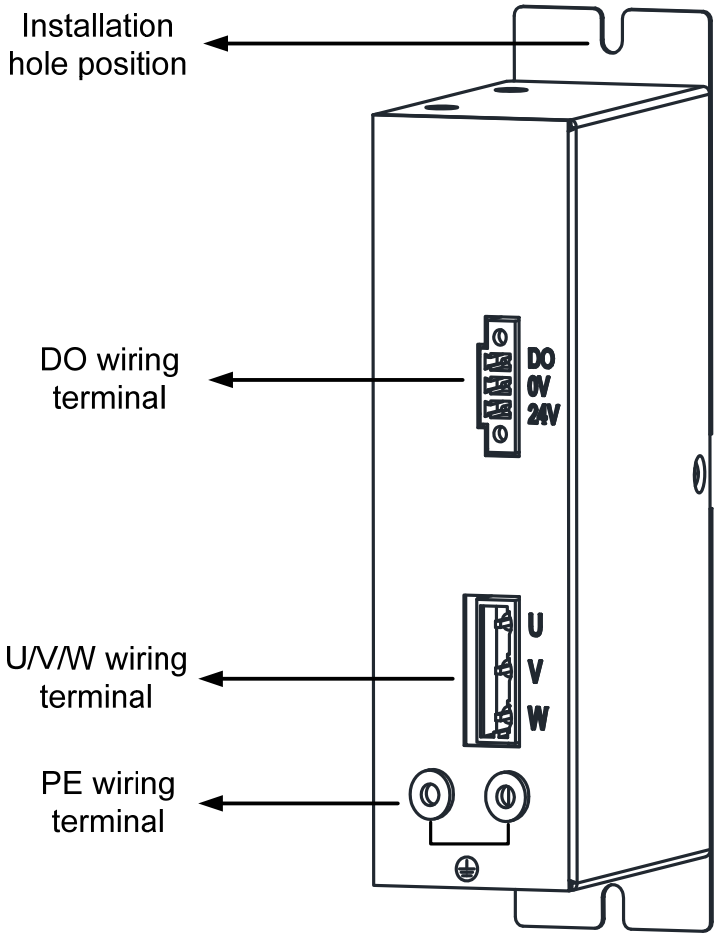
When the motor changes from the non-enable state to the enable state, the delay time from the motor current opening to the electromagnetic brake release (DO output terminal BRK ON) is determined by parameter P169.

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.



4.12 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.



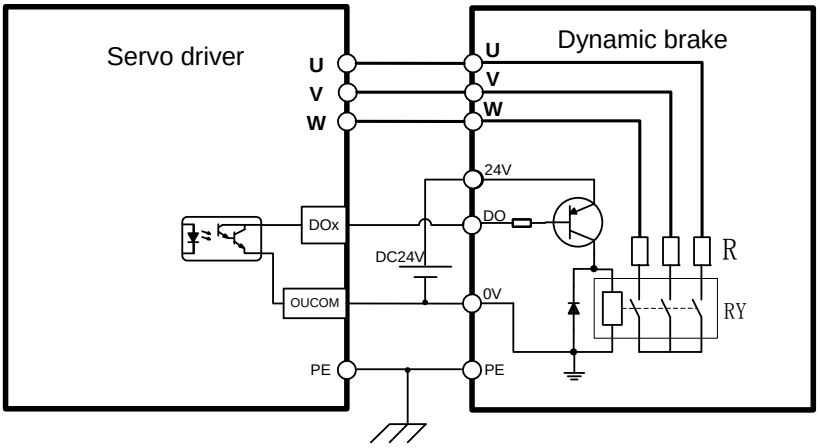
DB - XX

Mark	Mark description
DB	Dynamic brake

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

4.12.1 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%.



4.12.2 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
P130	Digital output DO1 function	-30～30	2	30	

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.

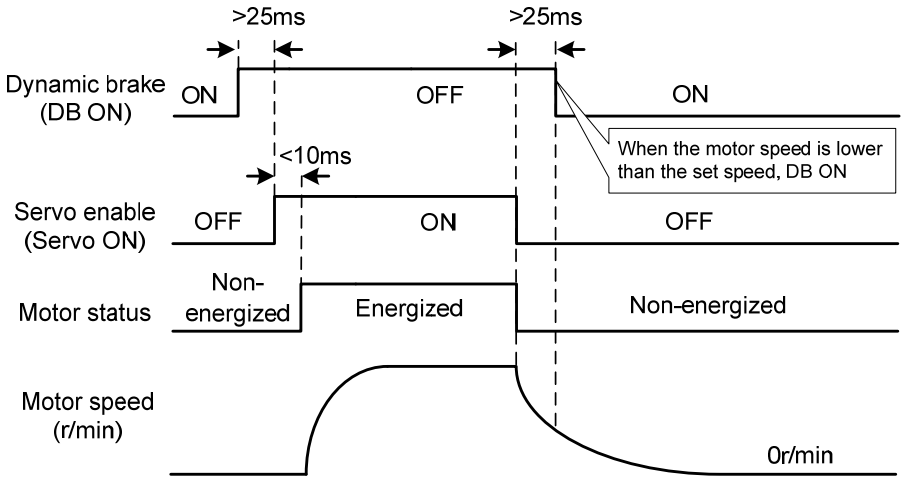
The servo driver has planned the dynamic brake function, and has correctly connected the dynamic brake. If the control power is not cut off, the motor will enter the dynamic brake deceleration process after the enable is cut off, and the dynamic brake will stop after the stop.

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.

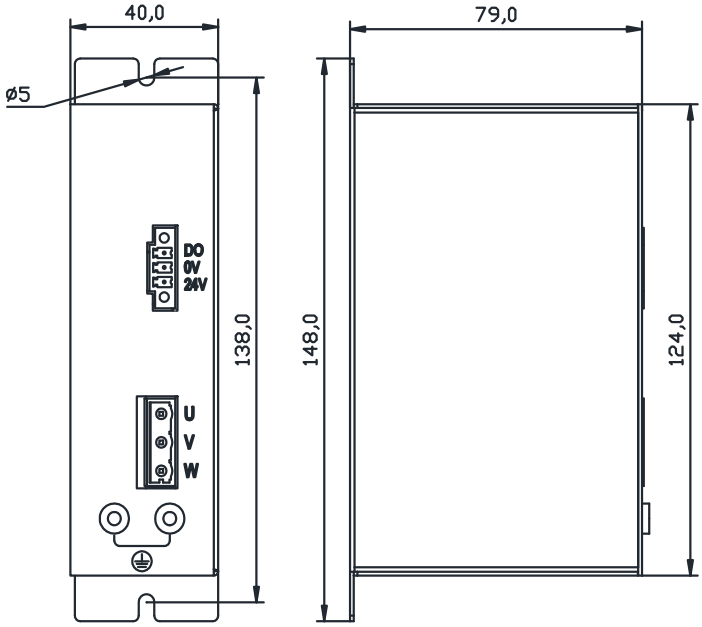
The dynamic brake function timing chart is as follows:



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.

4.12.3 Dynamic brake mounting dimensions



4.13 DB dynamic brake function

Dynamic brake related parameters:

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

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.

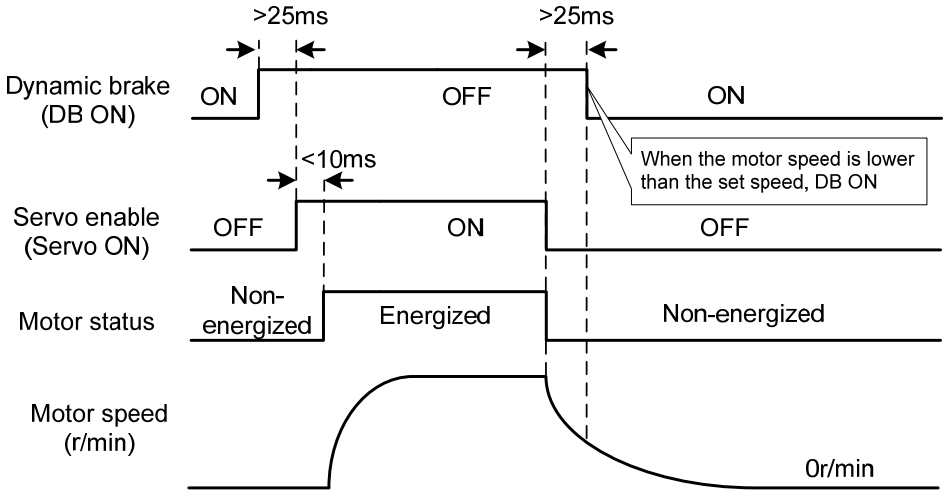
When the dynamic brake function is effective (P083=1), and the control power supply is not cut off, the dynamic brake decelerates when decelerating, and the dynamic brake stops after stopping.

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 overview

The parameter Data Type used in this manual is INT16, and the INT16 range is shown in the following table.

Name	Describe	Range
INT16	Signed 16bit	-32768～32767

5.1.1 Parameters of section 0

Para meter	Name	Range	Default value	Effective mode	Unit
P000	Password	0～9999	315	Immedia tely	
P001	Driver code	*	*		
P003	Software version	*	*		
P004	Control mode	0～5	0	Immedia tely	
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	Immedia tely	%
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
P040	Position command exponential smoothing filtering time	0～1000	0	Save restart	ms

Para meter	Name	Range	Default value	Effective mode	Unit
P041	Position command exponential linear filtering time	0～256	0	Save restart	ms
P042	CWL,CCWL direction prohibited mode	0～1	0	Immedia tely	
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	0～3	3		
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	Immedia tely	r/min
P076	JOG running speed	0～7500	100		r/min
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	Immedia tely	℃
P096	Initial display item	0～29	29	Save restart	
P097	Ignore drive inhibit	0～3	3	Immedia tely	
P098	Forced enable	0～1	0		

5.1.2 Parameters of section 1

Parameter	Name	Range	Default value	Effective mode	Unit
P100	Digital input DI1 function	-37～37	24	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		
P110	Digital input DI1 filtering	0.1～100.0	2.0		ms
P111	Digital input DI2 filtering	0.1～100.0	2.0		ms
P112	Digital input DI3 filtering	0.1～100.0	2.0		ms
P113	Digital input DI4 filtering	0.1～100.0	2.0		ms
P118	Digital high-speed input HDI1 filtering	1～8	4	Save restart	
P119	Digital high-speed input HDI2 filtering	1～8	4		
P120	Digital input DI forced valid 1	00000～11111	00000	Immediately	
P121	Digital input DI forced valid 2	00000～11111	00000		
P122	Digital input DI forced valid 3	00000～11111	00000		
P123	Digital input DI forced valid 4	00000～11111	00000		
P124	Digital input DI forced valid 5	00000～11111	00000		
P125	Digital input DI forced valid 6	00000～11111	00000		
P126	Digital input DI forced valid 7	00000～11111	00000		
P127	Digital input DI forced valid 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		
P138	Digital output DO forced selection 1	0～7	0		
P139	Digital output DO forced content 1	0～7	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		

Para meter	Name	Range	Default value	Effective mode	Unit
P160	Zero speed detection point	0～1000	10	Immedia tely	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		
P164	Emergency shutdown mode	0～2	0		
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		
P195	Encoder multi turn overflow alarm shielding	0～1	1		

5.1.3 Parameters of section 2

Parameter	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	Immediately	
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		%
P242	Friction compensation ratio	0～1000	0		%
P243	Friction compensation observer gain	0～1200	400		Hz
P244	Current loop mode selection in high response mode	0～1	1		
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

Parameter	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

Para meter	Name	Range	Default value	Effective mode	Unit
P305	Speed return filtering time constant	0.1～300.0	0.1	Save restart	ms
P308	Profinet main message	*	3		
P309	Profinet supplementary message	*	0		
P312	Reference speed	10～7500	3000		rpm
P314	Reference torque	0.1～400.0	400.0		nm
P315	User PZD1 receive word selection	0～2	0		
P316	User PZD1 Send Word Selection	0～3	0		
P322	Profinet speed threshold 3	0～30000	5	Immedia tely	rpm
P325	Profinet speed deviation range	0～100	10	Save restart	rpm
P326	Profinet speed deviation time	1～500	2		ms
P376	Profinet synchronization mode loss count threshold	0～32767	5	Immedia tely	

5.1.5 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	Immedia tely	
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
0	NULL	No function
2	ARST	Clear alarm
3	CCWL	CCW drive inhibit
4	CWL	CW drive inhibit
15	EMG	Emergency shutdown
20	CLR	Position deviation clearing
24	REF	Homing reference point

5.3 DO function list

Ordinal	Symbol	DO Function
0	OFF	Always invalid
1	ON	Always valid
2	RDY	Servo ready
3	ALM	Alarm
8	BRK	Electromagnetic brake
9	RUN	Servo running
11	TRQL	In torque limit
12	SPL	In speed limit
13	HOME	Homing complete
30	DBC	Dynamic Braking

5.4 Parameter details

5.4.1 Parameters of section 0

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

- 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 、3and 4 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
P001	Driver code	*	*	

- 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
P003	Software version	*	*	

- The software version number cannot be modified.

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

- Parameter meaning:
  0: Position control mode;
  1: Speed control mode;
  2: Torque control mode;
  3～5: Reserved.

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

- 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
P006	1st speed loop integral time constant	1.0～1000.0	20.0	ms

- 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
P007	1st torque filter time constant	0.01～50.00	1.00	ms

- 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
P008	Rigidity class	0～21	0	

- Parameter meaning:
  0: The rigidity level setting is not effective
  1～21: The higher the level setting, the faster the system response, but excessive rigidity may cause vibration

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

- 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
P010	2nd speed loop gain	1～3000	40	Hz

- 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
P011	2nd speed loop integral time constant	1.0～1000.0	20.0	ms

- 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
P012	2nd torque filter time constant	0.01～50.00	1.00	ms

- 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
P013	2nd position loop gain	1～1000	40	1/s

- 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
P017	Load moment of inertia ratio	0.0～200.0	1.0	times

- The ratio of the moment of inertia of a mechanical load (converted to the motor shaft) to the moment of inertia of the motor rotor.

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

- 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
P019	Speed detection filter time constant	0.01～50.00	2.00	ms

- The larger the parameter value, the smoother the detection, the smaller the parameter value, the faster the detection response, too small may lead to noise; Too large can cause oscillation.

Para meter	Name	Range	Default value	Unit
P021	Position loop feed forward gain	0～100	0	%

- Feed forward 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
P022	Position loop feed forward filter time constant	0.20～50.00	1.00	ms

- The function of filtering the feed forward of position loop is to increase the stability of feed forward control.

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

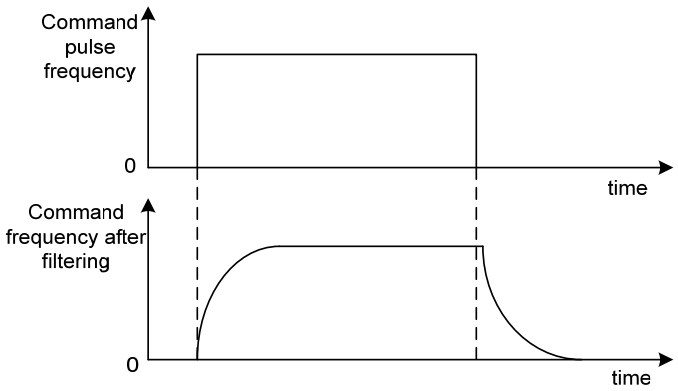
- When the parameter value increases, the speed control response will be improved. If the parameter value is too large, the system will be unstable and easy to oscillate.

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

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

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

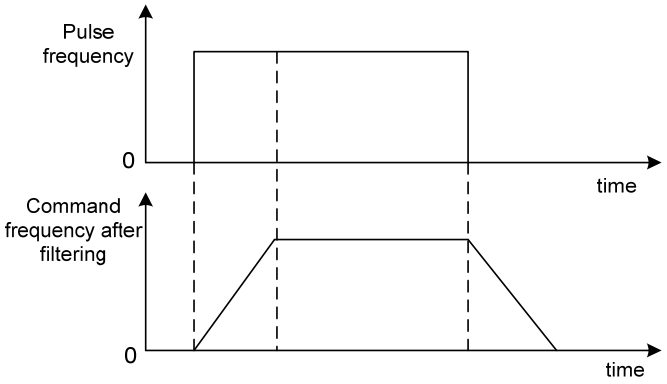
- The command pulse is smoothed and filtered with exponential acceleration and deceleration. The filter will not lose the input pulse, but the command delay will occur. When it is set to 0, the filter will not work.
- This filter is used to:
  1. The host controller has no acceleration and deceleration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



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

- 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 0 frequency 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. The command frequency is low;
4. When the motor is running, the phenomenon of step jumping and instability occurs.

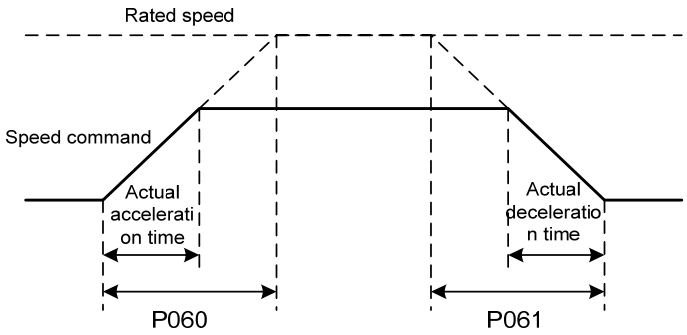


Para meter	Name	Range	Default value	Unit
P042	CWL,CCWL direction prohibited mode	0～1	0	

- 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
P060	Speed command acceleration time	0～30000	0	ms

- 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
P061	Speed command deceleration time	0～30000	0	ms

- 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
P063	EMG(emergency shutdown) deceleration time	0～10000	1000	ms

- It works when EMG (emergency shutdown) mode is deceleration stop (P164=2).
- Set the deceleration time of EMG (emergency shutdown) motor from current speed to zero speed.

Para meter	Name	Range	Default value	Unit
P064	Torque limit selection	0～3	3	

- Set torque limit mode:
  0: Internal torque limit
  1～2: Reserved
  3: The torque limit comes from the network

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

- 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
P067	External torque limit in CCW direction	0～500	100	%
P068	External torque limit in CW direction	-500～0	-100	%

- Parameter P067 is only valid when the TCCW (positive torque limit) of DI input is ON.
- Parameter P068 is only valid when the TCW (reverse torque limit) of DI input is ON.
- When the limit is effective, the actual torque limit is the minimum of the maximum overload capacity allowed by the system, internal positive torque limit, and external positive torque limit.

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

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

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

- When the CCW torque of the motor exceeds P070 and the duration is greater than P072, the driver alarms with the alarm number of Er 29 and the motor stops.
- When the CW torque of the motor exceeds P071 and the duration is greater than P072, the driver alarms with the alarm number of Er 29 and the motor stops.
- When parameter P072 is set to 0, shield the torque overload alarm.

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

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

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

- Set the running speed of JOG operation.

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

- 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.

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

- 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 circle. Multiply the resolution of each cycle of the encoder to obtain the number of pulses. If a 2500 lines encoder is used, the resolution of each turn of the encoder is 10000. When the parameter value is 4.00, it corresponds to 40000 encoder pulses.

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

- Parameter meaning:
  0: Do not use dynamic braking;
  1: Using dynamic braking;

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

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

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

- 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
P086	Power of external brake resistor	1～10000	60	W

- 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
P088	Main encoder manufacturer	0～31	0	

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

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

- 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
P090	Main absolute position encoder type	0～2	0	

- Parameter meaning:
  0: Single turn absolute encoder.
  1: Multi turn absolute encoder.
  2: Absolute value encoders are used incrementally.
- When the encoder does not have an external battery, the encoder cannot save multi turn information. Please set this parameter to 0.

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

- Parameter meaning:
  0: Single turn absolute encoder.
  1: Multi turn absolute encoder.
  2: Absolute value encoders are used incrementally.
- 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
P094	Fan on temperature point	25～125	50	℃

- 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
P096	Initial display item	0～29	29	

- 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 code
7	Current	22	Reserved display
8	Peak current	23	Load inertia ratio, reserved
9	Pulse input frequency	24	Bus voltage
10	Speed command	25	Reserved display
11	Torque command	26	Module internal temperature
12	Reserved	27	Encoder multi-turn position
13	Reserved	28	History alarm code display
14	Digital input DI	29	PROFINET status display

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

- 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 drive 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 it cannot be connected.

Para meter	Name	Range	Default value	Unit
P098	Force enable	0～1	0	

- P098 parameter is invalid in network mode. Press and hold Fn-2 to enter normal mode.
- Parameter meaning:
  0: Enable to be controlled by SON input by DI;
  1: Software forced enable.

5.4.2 Parameters of section 1

Parameter	Name	Range	Default value	Unit
P100	Digital input DI1 function	-37～37	24	
P101	Digital input DI2 function	-37～37	2	
P102	Digital input DI3 function	-37～37	3	
P103	Digital input DI4 function	-37～37	4	

- Digital input DI1 function planning, parameter absolute value represents function, and symbol represents logic. Please refer to chapter 5.5 for functions.
- Symbols indicate input logic, positive numbers indicate positive logic, negative numbers indicate negative logic, ON is valid, OFF is invalid:

Parameter value	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 both P100 and P101 are set to 1 (SON function), then SON is valid when either DI1 or DI2 is ON.
- If there is no input function selected by parameters P100～P103, that is, the function is not planned, the result is 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.

Parameter	Name	Range	Default value	Unit
P110～P113	Digital input DI1～DI4 filtering	0.1～100.0	2.0	ms

- DI input digital filtering time constant.
- The smaller the parameter value, the faster the signal response speed. The larger the parameter value is, the slower the signal response speed is, but the stronger the noise filtering ability is.

Parameter	Name	Range	Default value	Unit
P118	Digital high-speed input HDI1 filtering	1～8	4	
P119	Digital high-speed input HDI2 filtering	1～8	4	

- Parameter meaning:
  1-8: Enhanced filtering ability from low to high

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

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

A bit in this parameter	Function[note]	Function result
0	Not planned	OFF
	Planned	Determined by input signal
1	Not planned or planned	ON

Note: Planned refers to the function selected by parameters P100～P103;

Not planned refers to the function not selected by parameters P100～P103.

- 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	SP3	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

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

- Digital output DO function planning, parameter absolute value 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
P138	Digital output DO forced selection 1	0～7	0	

- Corresponding functions are represented by 5-bit binary:

Bit number	bit4	bit3	bit2	bit1	bit0
Function	Reserved	Reserved	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
P139	Digital output DO forced content 1	0～7	0	

- Corresponding functions are represented by 5-bit binary:

Bit number	bit4	bit3	bit2	bit1	bit0
Function	Reserved	Reserved	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.

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

- 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
P150	Positioning completion range	0～32767	10	pulse
P151	Positioning completion hysteresis	0～32767	5	pulse

- 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
P152	Positioning approach range	0～32767	500	pulse
P153	Positioning approach hysteresis	0～32767	50	pulse

- 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
P154	Arrival speed	-5000～5000	500	r/min
P155	Arrival speed hysteresis	0～5000	30	r/min
P156	Arrival speed polarity	0～1	0	

- 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
P157	Arrival torque	-300～300	100	%
P158	Arrival torque hysteresis	0～300	5	%
P159	Arrival torque polarity	0～1	0	

- 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:

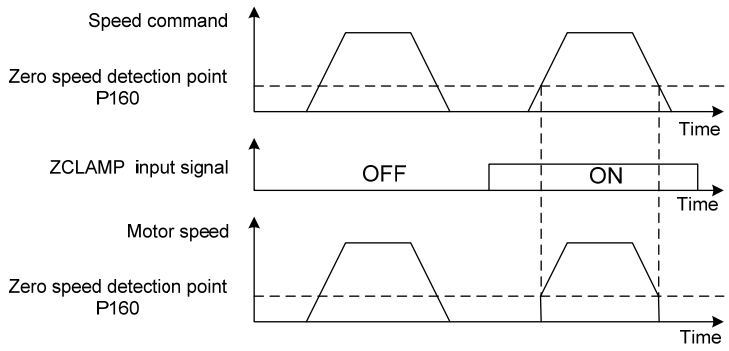
P159	P157	Comparator
0	>0	detect CCW or CW torque
1	>0	Only detect CCW torque
	<0	Only detect CW torque

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

- 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
P162	Zero speed clamp mode	0～1	0	

- 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
P163	Position deviation clearing mode	0～1	0	

- 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: Reserved
  1: CLR rising edge (OFF to ON moment)

Para meter	Name	Range	Default value	Unit
P164	Emergency shutdown mode	0～2	0	

- 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 defined by P063.
  2: Decelerate the machine for shutdown, and the deceleration time is determined by P063.

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

- 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
P166	Electromagnetic brake delay time when motor is stationary	0～2000	150	ms

- 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 4.10.3 for corresponding timing.

Para meter	Name	Range	Default value	Unit
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

- 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 4.10.4 for corresponding timing.

Para meter	Name	Range	Default value	Unit
P169	Delay time of electromagnetic brake opening	0～1000	0	ms

- 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 4.10 for corresponding timing.

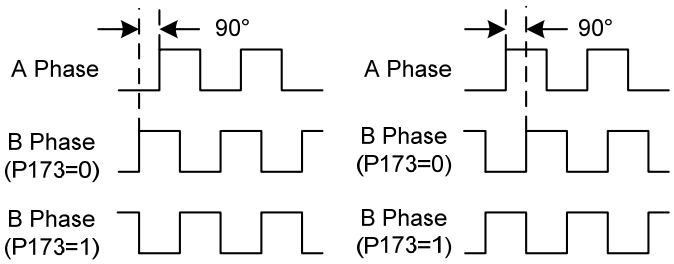
Para meter	Name	Range	Default value	Unit
P172	Encoder output lines	1～16384	2500	

- 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.

Para meter	Name	Range	Default value	Unit
P173	Encoder outputs B pulse phase	0～1	0	

- 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
P174	Encoder outputs Z pulse phase	0～1	0	

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

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

- 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.

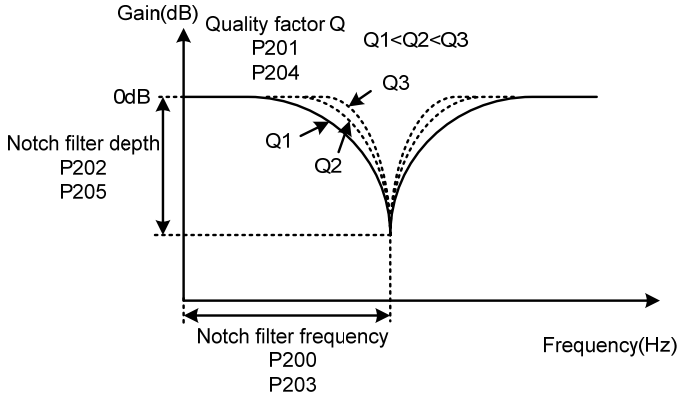
Para meter	Name	Range	Default value	Unit
P195	Encoder multi turn overflow alarm shielding	0～1	1	

- 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
P200	1st notch filter frequency	50～5000	5000	Hz

- 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
P201	1st notch filter quality factor	1～100	7	

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

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

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

- Set the notch depth of the notch filter. The greater the parameter value, the greater the notch depth, that is, the greater the filter gain attenuation. Set to 0 to turn off the notch filter.
- Notch depth D expressed in dB units is:

$$D = -20\log(1-\frac{P202}{100})(dB)$$

dB	Input /output ratio	dB	Input /output ratio	dB	Input /output ratio	dB	Input /output ratio	dB	Input /output 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
P203	2nd notch filter frequency	50～5000	5000	Hz

- 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
P204	2nd notch filter quality factor	1～100	7	

- Refer to the specification of parameter P201.

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

- 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
P206	2nd torque filter frequency	100～5000	5000	Hz

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

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

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

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

- Parameter meaning:
  0: Fixed 1st gain.
  1: Fixed 2nd gain.
  2～3: Reserved.
  4: Pulse deviation control: switch to 2nd gain when the position pulse deviation exceeds P209.
  5: Motor speed control, switch to 2nd gain when the motor speed exceeds P209.
- The 1st gain and the 2nd gain are combined, with 4 parameters for each group and switching at the same time.

First gain		Second 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 filtering time constant	P012	2nd torque filtering time constant
P009	1st position loop gain	P013	2nd position loop gain

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

- 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 function of hysteresis, which is set by parameter P210.

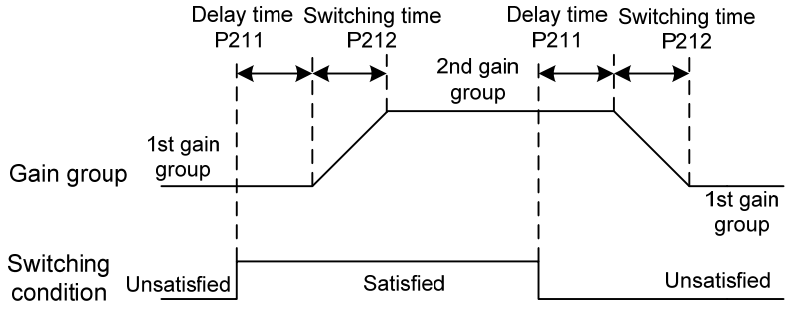
P208	Gain switching condition	Unit
3	Command pulse frequency	0.1kHz(kpps)
4	Pulse deviation	pulse
5	Motor speed	r/min

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

- 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
P212	Gain switching time	0～3000	5	ms

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



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

- Parameter description:

Bit	Explanation
Bit0	1st notch filter is automatically set, 0: OFF; 1: ON
Bit1	2nd notch filter is automatically set, as above
Bit2	3rd notch filter is automatically set, as above
Bit3	4th notch filter is automatically set, as above
Bit4	1st notch filter is automatically set 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
P214	3rd notch filter frequency	50～5000	5000	Hz

- 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
P215	3rd notch filter quality factor	1～100	7	

- Refer to the description of parameter P201.

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

- 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
P217	4th notch filter frequency	50～5000	5000	Hz

- 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
P218	4th notch filter quality factor	1～100	7	

- Refer to the description of parameter P201.

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

- 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
P220	End vibration detection filter frequency	10～2000	200	Hz

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

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

- Minimum detection value of low frequency vibration suppression.

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

- 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 likely to bring mechanical noise.

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

- 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, suitable for vibration frequency known occasions.

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

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

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

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

- It is valid when the IF vibration suppression 1 switch is turned on (P229≠0).
- The frequency point manual setting mode (P229=1) requires searching for intermediate frequency vibration points through the servo host software recording function.

Para meter	Name	Range	Default value	Unit
P227	Compensation coefficient of medium frequency vibration suppression 1	1～1000	100	%

- It is recommended to use the Fn1 function to estimate the load inertia first.
- 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
P228	Damping coefficient of medium frequency vibration suppression 1	0～300	100	%

- 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
P229	Medium frequency vibration suppression 1 switch	0～2	0	

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

Para meter	Name	Range	Default value	Unit
P231	Medium frequency vibration 2 frequency	50～2000	100	Hz

- It is valid when the IF vibration suppression 1 switch is turned on (P234≠0).
- The frequency point manual setting mode (P234=1) requires searching for intermediate frequency vibration points through the servo host software recording function.

Para meter	Name	Range	Default value	Unit
P232	Compensation coefficient of medium frequency vibration suppression 2	1～1000	100	%

- It is recommended to use the Fn1 function to estimate the load inertia first.
- 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
P233	Damping coefficient of medium frequency vibration suppression 2	0～300	100	%

- 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
P234	Medium frequency vibration suppression 2 switch	0～2	0	

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

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

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

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

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

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

- This parameter only takes effect when the high immunity mode is enabled (P239=2) in the high response mode. It is used to adjust the gain percentage of the advanced control high response mode, and is generally 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
P239	High immunity mode switch in high response mode	0～2	0	

- 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
P240	High response mode tracking gain	10～1000	100	%

- The recommended value is 75～150.

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

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

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

- 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
P243	Friction compensation observer gain	0～1200	400	Hz

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

Para meter	Name	Range	Default value	Unit
P244	Current loop mode selection in high response mode	0～1	1	

- This parameter only takes effect only when P247=1.
  0: Only the speed loop adopts high response mode
  1: Both speed loop and current loop adopt high response mode

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

- 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

Parameter	Name	Range	Default value	Unit
P246	High response mode speed feedback source	0～1	0	

- 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

Parameter	Name	Range	Default value	Unit
P247	High response mode enable	0～2	0	

- 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

Parameter	Name	Range	Default value	Unit
P248	High response mode speed observer bandwidth	100～2000	150	Hz

- 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.

Parameter	Name	Range	Default value	Unit
P249	High response mode speed observer bandwidth parameter setting is valid	0～1	1	

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

Parameter	Name	Range	Default value	Unit
P250	High response mode current observer bandwidth	50～400	180	10Hz

- 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.

Parameter	Name	Range	Default value	Unit
P251	High response mode current observer bandwidth parameter setting is valid	0～1	0	

- 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
P252	High response mode 1st torque filtering time constant	0.05～5.00	0.10	ms

- Low pass filter of torque can suppress mechanical vibration and reduce 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
P253	High response mode speed observer type	0～5	0	

- 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
P254	High response mode speed observer non exponential gain multiple	0.0～10.0	1.5	times

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

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

- 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
P256	Speed observer compensation coefficient	0～1000	150	%

- The default value is not recommended to be modified.

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

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

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

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

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

- It is suggested to use Fn1 function to infer load inertia first.
- Suitable for position control mode, according to different load to choose the appropriate parameters, can improve the response of the system.
- Parameter meaning:
  0: Model tracing is invalid
  1: Suitable for rigid load
  2: Suitable for flexible load
  3: Universal type

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

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

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

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

- Model tracking positive direction control deviation, mode 1～3 are effective.
- By adjusting this parameter, the response speed of forward and reverse can be adjusted separately.
- The greater the value, the greater the torque loop feed forward effect, too much noise may be caused.

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

- The description is the same as P273.

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

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

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

- Parameter meaning:
  The higher the value is, the lower the noise will be. If the value is too large, the compensation will be delayed.

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

- Parameter meaning:
  Model tracking speed loop gain, the unit is Hz.

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

- Parameter meaning:
  Model tracking speed loop integral constant, the unit is ms.

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

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

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

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

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

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

Para meter	Name	Range	Default value	Unit
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

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

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

Para meter	Name	Range	Default value	Unit
P308	Profinet main message	*	3	

- By setting the drive letter through this parameter, after the parameter is changed, the parameter must be stored in EEPROM, and the drive must be powered off before being powered on again for operation to take effect!
- The selection of messages needs to be consistent with the message type configured in the configuration.

Para meter	Name	Range	Default value	Unit
P309	Profinet supplementary message	*	0	

- By selecting additional through this parameter, after changing the parameter, the parameter must be saved in EEPROM, and the drive must be powered off before being powered on again for operation to take effect!
- After the P308 message selection is changed, this parameter is attached to the message parameter reset and needs to be re selected.
- The selection of messages needs to be consistent with the message type configured in the configuration.

Para meter	Name	Range	Default value	Unit
P312	Reference speed	10～7500	3000	rpm

- This parameter serves as the normalized reference variable for the speed setting in AC4.
- After the driver is initialized, the maximum value of this parameter is limited to the rated speed of the connected motor. The reference speed can be freely set within the rated speed range. If the current setting exceeds the rated speed of the motor, the current setting will be limited to the rated speed of the motor.

Para meter	Name	Range	Default value	Unit
P314	Reference torque	0.1～400.0	400.0	nm

- This parameter serves as the normalized reference variable for torque related settings.
- After the driver initialization, the maximum value of 400.0 for this parameter is limited to 3 times the rated torque of the connected motor. When using 102 and 105 messages, the reference torque

can be freely set within a range of 3 times the rated torque. If the current set value exceeds 3 times the rated torque of the motor, the current set value will be limited to 3 times the rated torque of the motor. When using other messages, the reference torque is automatically set internally at the maximum motor torque.

Para meter	Name	Range	Default value	Unit
P315	User PZD1 receive word selection	0～2	0	

- Select the user-defined PZD1 content in the received message through this parameter.
- Parameter meaning:
  0: meaningless;
  1: Additional torque (function to be improved);
  2: Additional speed (function to be improved).

Para meter	Name	Range	Default value	Unit
P316	User PZD1 Send Word Selection	0～3	0	

- Select the user-defined PZD1 content in the sent message through this parameter.
- Parameter meaning:
  0: meaningless; 1: Actual torque, unit:%; 2: Actual current, unit: 0.1A;
  3: DI status, Bit0 to Bit4 represent DI1 to DI5, respectively.

Para meter	Name	Range	Default value	Unit
P322	Profinet speed threshold 3	0～30000	5	rpm

- This parameter sets the speed threshold.
- When the actual speed of the motor is within the positive and negative speed threshold, Bit2 in the MELDW state is set.

Para meter	Name	Range	Default value	Unit
P325	Profinet speed deviation range	0～100	10	rpm
P326	Profinet speed deviation time	1～500	2	ms

- This parameter sets the speed deviation status.
- When the deviation between the actual speed of the motor and the command is within the positive and negative deviation range set by the P325 parameter, and the duration exceeds the time set by the P326 parameter, Bit8 of the ZSW1 state is set.

Para meter	Name	Range	Default value	Unit
P376	Profinet synchronization mode loss count threshold	0～32767	5	

- In the periodic synchronization mode, the reliability of data is ensured by the SOL signal of each cycle. When the SOL signal is continuously lost, the legitimacy of the data needs to be determined, and the maximum number of consecutive losses needs to be set through this parameter.

5.4.5 Parameters of section 4

Parameter	Name	Range	Default value	Unit
P472	Number of forward turns of round-trip motion	1～32767	3	
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, 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>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></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 the 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>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">Ignoring the CW drive inhibit function, the motor can run in the opposite direction. This signal has no effect and does not need to be connected.</td></tr>
<tr><td>3
(default)</td></tr>
</table></td></tr>
</table>

Ordinal	Symbol	DI Function	Functional explanation
15	EMG	Emergency shutdown	OFF: Allows the servo driver to work; ON: Stop the motor according to the mode set by parameter P164.
20	CLR	Position deviation clearing	Clear the position deviation counter. The clearing mode is selected by parameter P163. The position deviation clearing occurs at: P163=1: CLR rising edge (OFF to ON moment).
24	REF	Homing reference point	Homing external reference point

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.
8	BRK	Electromagnetic brake	OFF: Electromagnetic brake braking; ON: Electromagnetic brake is released. The output state is determined by the servo, see "4.11 Electromagnetic brake" for details
9	RUN	Servo running	OFF: Servo motor is not turned on for operation; ON: Servo motor is turned on and running.
11	TRQL	In torque limit	OFF: Motor torque does not reach the limit value; ON: Motor torque reaches the limit value.
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.
13	HOME	Homing complete	When homing is complete, output ON
30	DBC	Dynamic braking	OFF: External dynamic brake is invalid; ON: External dynamic brake takes effect.

Chapter 6 Communication functions

6.1 PROFINET communication

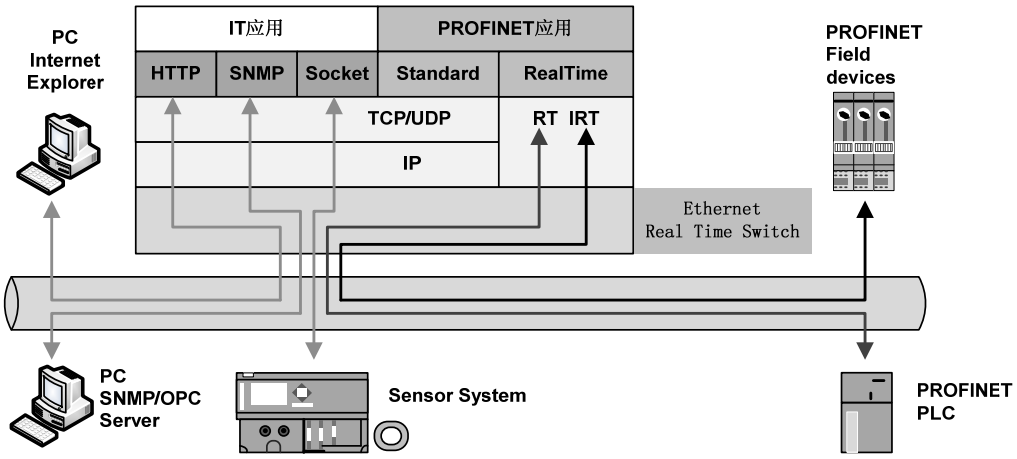
PROFINET communication consists of PROFINET IO and PROFIDrive.

6.1.1 PROFINET IO

PROFINET, launched by PFOFIBUS International (PI), is a new generation automation bus standard based on industrial Ethernet technology.

Communication between the PROFINET network and external devices is realized by PROFINET IO, which defines complete data exchange, parameter setting and diagnostic functions between the master controller and other slave devices, as shown in the figure below. A complete PROFINET IO network includes the following devices:

- IO controller: Used to control the operation of the entire system (for example, PLC).
- IO device: Typically a field device (for example, a driver, encoder, sensor, etc.) that is controlled and monitored by an IO controller. An IO device may consist of several modules or submodules.
- IO monitoring: HMI(Human machine interface) or a PIECE of PC software for diagnosis and debugging.



PROFINET provides two kinds of real-time communication, PROFINET IO RT and PROFINET IO IRT.

- PROFINET IO RT channel priority Ethernet frames for transmission of real-time data, no special hardware requirement, based on the priority level, its cycle can reach 4 ms.
- PROFINET IO IRT channel is suitable for data transmission has a more precise time requirement, the cycle of up to 250 us, but need to have special hardware support IO device and switches.

PROFINET all diagnostic and configuration in the data transmitted through non real-time (NRT) channels, using TCP/IP protocol, no sure cycle.

6.1.2 PROFIDrive

PROFIDrive is a protocol framework of PROFINET for driving technology applications. It is called application industry rules. Application industry rules help openness, interoperability, and interchangeability of devices. End users can determine whether similar devices provided by different manufacturers will have standardized functions and usage modes.

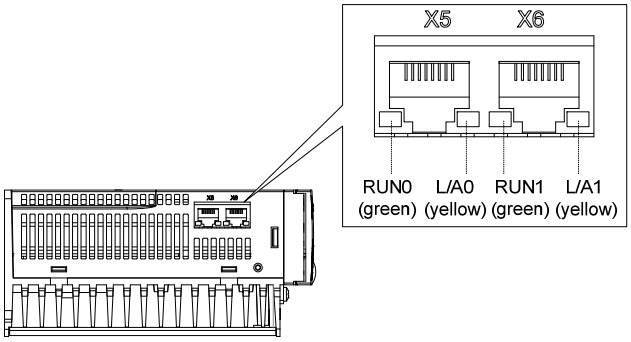
PROFIDrive defines six application classes (AC) based on typical examples in the field of electrical drive engineering:

- AC1: standard driver.
- AC2: Standard driver with distributed process controller.
- AC3: Single axis positioning drive with local motion control.
- AC4: Motion control with central interpolation and speed setting interface.
- AC5: Motion control with centralized interpolation and position setting interface.
- AC6: Motion control with clock handling or distributed angular synchronization.

PROFIDrive AC4 is temporarily supported in the current version of the servo drive.

6.1.3 Status LED

As shown in the following figure, the status LED of the EP5 driver is located on the X5 (IN) and X6 (OUT) sockets, and the status information of the PROFINET port can be displayed through the indicator light.



Name	Color	State	Meaning
Link	green	Light up	The transfer rate is 100Mbit/s
		Put out	No connection or connection error
Activity	yellow	Light up	Data interchange
		Put out	No data exchange

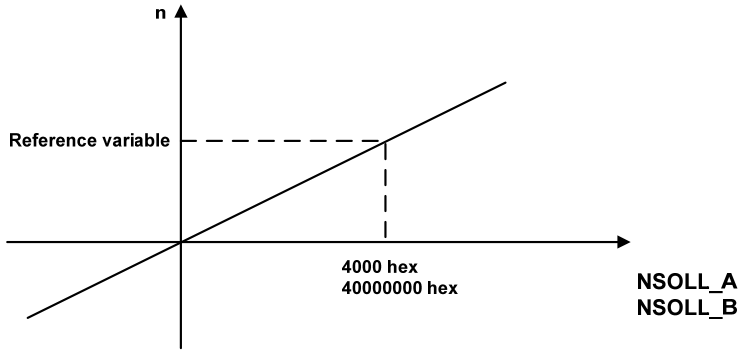
6.1.4 Data type definition

The contents and scope of Data types used in this manual are shown in the following table.

- General data type definitions

Name	Description	Range
I8	Signed 8bit	-128～127
U8	Unsigned 8bit	0～255
I16	Signed 16bit	-32768～32767
U16	Unsigned 16bit	0～65535
I32	Signed 32bit	-21247483648～21247483647
U32	Unsigned 32bit	0～4294967295

- The normalized data are defined as N2 and N4



As shown in the figure above: Linearly normalized values, 0% corresponds to 0, for N2 type data, 16 bits are used, and 100% corresponds to 214(i.e. 0x4000); For N4 type data, make the 32-bit representation, 100% corresponding to 230(that is, 0x40000000).

As shown in the following example, the base variable is 3000:
N2 data: 0x4000 corresponds to 3000
0x2000 corresponds to 1500
0xE000 corresponds to -1500

N4 type data: 0x20000000 corresponds to 1500
0xE0000000 corresponds to -1500
0xC0000000 corresponds to -3000

6.1.5 PROFINET support message and content explanation

The basic length of a packet field is PZD. A PZD is a word, that is, 16 bits. The sending and receiving words are the data content that the servo driver needs to send and receive.

Description of message 1 contents and fields:

Message 1 is suitable for the application class AC1 speed control mode, the message content as follows:

Message 1	P308=1	
	Receiving word (2 PZD)	Sending word (2 PZD)
PZD1	STW1	ZSW1
PZD2	NSOLL_A	NIST_A

Description of message 3 contents and fields:

Message 3 is suitable for the application class AC4 speed control mode, the message content as follows:

Message 3	P308=3	
	Receiving word (5 PZD)	Sending word (9 PZD)
PZD1	STW1	ZSW1
PZD2	NSOLL_B	NIST_B
PZD3		
PZD4	STW2	ZSW2
PZD5	G1_STW	G1_ZSW
PZD6		G1_XIST1
PZD7		
PZD8		G1_XIST2
PZD9		

Description of contents and fields of message 5:

Message 5 is suitable for the speed control mode of application CLASS AC4 with DSC dynamic servo control function. The message contents are as follows:

Message 5	P308=5	
	Receiving word (9 PZD)	Sending word (9 PZD)
PZD1	STW1	ZSW1
PZD2	NSOLL_B	NIST_B
PZD3		
PZD4	STW2	ZSW2
PZD5	G1_STW	G1_ZSW
PZD6	XERR	G1_XIST1
PZD7		
PZD8	KPC	G1_XIST2
PZD9		

Description of message 102 contents and fields:

Message 102 is suitable for the application class message AC4 real-time limit the speed of the positive and negative to the torque control mode, the message content is as follows:

Message 102	P308=102	
	Receiving word (6 PZD)	Sending word (10 PZD)
PZD1	STW1	ZSW1
PZD2	NSOLL_B	NIST_B
PZD3		
PZD4	STW2	ZSW2
PZD5	MOMRED	MELDW
PZD6	G1_STW	G1_ZSW
PZD7		G1_XIST1
PZD8		
PZD9		G1_XIST2
PZD10		

Description of message 105 contents and fields:

Message 105 is suitable for the speed control mode of AC4 application class with DSC dynamic servo control function and real-time limiting positive and negative torques. The message contents are as follows:

Message 105	P308=105	
	Receiving word (10 PZD)	Sending word (10 PZD)
PZD1	STW1	ZSW1
PZD2	NSOLL_B	NIST_B
PZD3		
PZD4	STW2	ZSW2
PZD5	MOMRED	MELDW
PZD6	G1_STW	G1_ZSW
PZD7	XERR	G1_XIST1
PZD8		
PZD9	KPC	G1_XIST2
PZD10		

STW1: Control word 1, U16.

	Signal	Describe
STW1	STW1.0	1: The main contact is closed and can be enabled. 0: Brake through ramp function generator, eliminate pulse, ready to be connected.
	STW1.1	1: No inertia stop command, enable. 0: The main contact is disconnected, the inertia deceleration brake, immediately eliminate the pulse and forbid the connection.
	STW1.2	1: The quick stop command is disabled. 0: Fast brake, eliminate pulse and disable connection.
	STW1.3	1: Allows the operation and can be enabled. 0: Disable or disable the operation.
	STW1.4	1: Enable ramp function generator. 0: Disables the ramp function generator and sets the output to zero.
	STW1.5	1: Continue the ramp function generator. 0: Freeze slope function generator, AC4, this bit is invalid.
	STW1.6	1: Set value is valid, ramp function generator input is normal. 0: Set value is invalid, ramp function generator input is 0.
	STW1.7	1: Fault confirmation (0→1 jump). 0: indicates nonsense.
	STW1.8～STW1.9	Reserved
	STW1.10	1: PLC control. 0: Non-PLC control.
	STW1.11～STW1.15	Reserved

NSOLL_A: set speed A(16Bit), N2.

Servo parameter P312 is used as the reference variable, and the speed instruction value corresponding to N2 normalized data sent by PLC is used as the speed instruction of the servo driver. See Section 6.1.4 for details.

NSOLL_B: set speed B(32Bit), N4.

Servo parameter P312 is used as the benchmark variable, and the speed instruction value corresponding to N4 type normalized data sent by PLC is used as the speed instruction of the servo driver. See Section 6.1.4 for details.

STW2: Control word 2, U16.

	Signal	Describe
STW2	STW2.0～STW2.11	Reserved
	STW2.12	Main life symbol, Bit0
	STW2.13	Main life symbol, Bit1
	STW2.14	Main life symbol, Bit2
	STW2.15	Main life symbol, Bit3

G1_STW: Encoder 1 control word, U16.

	Signal	Describe
G1_STW	G1_STW.0～G1_STW.11	Reserved
	G1_STW.13	1: Request the additional cycle cycle transmission for the absolute position in Gx_XIST2. 0: No request.
	G1_STW.14	1: Requests the resident shaft encoder. 0: No request.
	G1_STW.15	1: Encoder fault confirmation (0→1 hop). 0: Indicates nonsense.

MOMRED: Torque reduction set point, N2.

Servo parameter P314 is used as the reference variable. The torque reduction instruction corresponding to N2 type normalized data sent by PLC takes effect after recalculating the positive and negative torque limit value inside the servo. For details, see Section 6.1.4.

XERR: DSC position deviation, I32.

KPC: DSC position control gain, I32.

ZSW1: status word 1, U16.

	Signal	Describe
ZSW1	ZSW1.0	1: Server is ready. 0: servo is not ready.
	ZSW1.1	1: Servo run in place. 0: server is not running in place.
	ZSW1.2	1: Servo operation is enabled.0: The servo is not running.
	ZSW1.3	1: Server Error. 0: servo without Error.
	ZSW1.4	1: Inertia stop is invalid. 0: Inertial stop activation.
	ZSW1.5	1: Quick stop is invalid. 0: Quick stop activation.
	ZSW1.6	1: Disable the connection. 0: Disables connection.
	ZSW1.7	1: Waring exists for the servo. 0: The servo has no Waring.
	STW1.8	1: Velocity value and actual value deviation in the range of tolerance. 0: Velocity value and actual value deviation outside the tolerance range.
	STW1.9	1: PLC control request. 0: No PLC control request.
	STW1.10	1: Actual speed reaches or is beyond compare. 0: Actual speed did not reach or exceed the comparison value.
	STW1.11～ STW1.15	Reserved

NIST_A: actual rotational speed B(16Bit), N2.

Servo parameter P312 is used as the reference variable, and N2 normalized data corresponding to the current actual speed of the servo driver is used as the return value of the actual speed of PLC. See Section 6.1.4 for details.

NIST_B: actual rotational speed B(32Bit), N4.

The servo parameter P312 is used as the reference variable, and the N4 type normalization data corresponding to the current actual speed of the servo driver is used as the actual speed return value of the PLC. Please refer to Section 6.1.4 for specific correspondence.

ZSW2: Status word 2, U16.

	Signal	Describe
ZSW2	ZSW2.0～ ZSW2.10	Reserved
	ZSW2.11	1: Pulse is enabled. 0: Pulse disabled.
	ZSW2.12	Slave station life symbol, Bit0
	ZSW2.13	Slave station life symbol, Bit1
	ZSW2.14	Slave station life symbol, Bit2
	ZSW2.15	Slave station life symbol, Bit3

G1_ZSW: Encoder 1 status word, U16.

	Signal	Describe
G1_ZSW	G1_ZSW.0～ G1_ZSW.11	Reserved
	G1_ZSW.13	1: Gx_XIST2 transmission of absolute position data representation in the cycle. 0: Gx_XIST2 of transferring data does not represent cycle in absolute position.
	G1_ZSW.14	1: Reside shaft encoder activation. 0: Inactive reside shaft encoder.
	G1_ZSW.15	1: The data in Gx_XIST2 represents the encoder fault code. 0: Data in Gx_XIST2 does not represent an encoder fault code.

G1_XIST1: Encoder 1 actual position 1, U32.

G1_XIST1 is used to transmit the actual position value of the encoder periodically.

G1_XIST2: Encoder 1 actual position 2, U32.

	Bit state	Numerical significance
G1_XIST2	G1_ZSW.13=1	Transmission cycle of absolute position.
	G1_ZSW.15=1	Encoder failure code
	G1_ZSW. 13 = 0 at the same time G1_ZSW.15=0	0

MELDW：MELDW message word, U16.

	Signal	Describe
MELDW	MELDW.0～ MELDW.10	Reserved
	MELDW.11	1: Enables the driver. 0: Driver is not enabled.
	MELDW.12	1: Drive is ready. 0: Drive not ready.
	MELDW.13	1: Pulse is enabled. 0: Pulse is not enabled.
	MELDW.14～ MELDW.15	Reserved

Description of message 7 content and fields (not supported currently):

Message 7 is suitable for the application class AC3 position control mode, the message content as follows:

Message 7	P308=7	
	Receiving word (2 PZD)	Sending word (2 PZD)
PZD1	STW1	ZSW1
PZD2	SATZANW	AKTSATZ

Description of message 9 content and fields (not supported currently):

Message 9 is suitable for the application class AC3 position control mode, the message content as follows:

Message 9	P308=9	
	Receiving word (10 PZD)	Sending word (5 PZD)
PZD1	STW1	ZSW1
PZD2	SATZANW	AKTSATZ
PZD3	STW2	ZSW2
PZD4	MDI_TARPOS	XIST_A
PZD5		
PZD6	MDI_VELOCITY	
PZD7		
PZD8	MDI_ACC	
PZD9	MDI_DEC	
PZD10	MDI_MOD	

Description of the contents and fields of Message 111:

Message 111 is suitable for the application class AC3 position control mode, the message content as follows:

Message 111	P308=111	
	Receiving word (12 PZD)	Sending word (12 PZD)
PZD1	STW1	ZSW1
PZD2	POS_STW1	POS_ZSW1
PZD3	POS_STW2	POS_ZSW2
PZD4	STW2	ZSW2
PZD5	OVERRIDE	MELDW
PZD6	MDI_TARPOS	XIST_A
PZD7		
PZD8	MDI_VELOCITY	NIST_B
PZD9		
PZD10	MDI_ACC	FAULT_CODE
PZD11	MDI_DEC	WARN_CODE
PZD12	USER_RX	USER_TX

STW1: Control word 1, U16.

	Signal	Describe
STW1	STW1.0	1: The main contact is closed and can be enabled. 0: Brake through ramp function generator, eliminate pulse, ready to be connected.
	STW1.1	1: No inertia stop command, enable. 0: Main contact disconnect, inertia braking deceleration, eliminate pulse and ban on immediately.
	STW1.2	1: The quick stop command is disabled. 0: Fast brake, eliminate pulse and disable connection.
	STW1.3	1: Allows the operation and can be enabled. 0: Disable or disable the operation.
	STW1.4	1: Do not refuse to perform the task. 0: Refuse to perform the task (at maximum deceleration speed to stop).
	STW1.5	1: The task is not suspended. 0: Suspends the task (slowed to a stop at the set MDI_DEC).
	STW1.6	1: Activates the running task (0→1). 0: The running task is not activated.
	STW1.7	1: Fault confirmation (0→1 jump). 0: Indicates nonsense.
	STW1.8～ STW1.9	00: JOG channel is not activated. 01: JOG1 channel is activated. 10: JOG2 channel is activated. 11: JOG channel is not activated.
	STW1.10	1: PLC control. 0: Non-PLC control.
	STW1.11	1: Starts to return to the reference point (0→1 jump). 0: Stops returning to the reference point.
	STW1.12～ STW1.15	Reserved

POS_STW1: POS control word 1, U16.

	Signal	Describe
POS_STW1	POS_STW1.0	Run segment selection, bit 0.
	POS_STW1.1	Run segment selection, bit 1.
	POS_STW1.2	Run segment selection, bit 2.
	POS_STW1.3	Run segment selection, bit 3.
	POS_STW1.4～ POS_STW1.7	Reserved
	POS_STW1.8	1: Absolute positioning is selected. 0: Relative positioning is selected.
	POS_STW1.9～ POS_STW1.10	00: The shaft is stationary. 01: MDI direction selection, positive. 10: MDI direction selection, negative direction. 11: The shaft is stationary.
	POS_STW1.11～ POS_STW1.13	Reserved
	POS_STW1.14	1: Signal adjustment has been selected. 0: The signal location is selected.
	POS_STW1.15	1: Select MDI. 0: Select the program segment to run.

POS_STW2: POS control word 2, U16.

	Signal	Describe
POS_STW2	POS_STW2.0	Reserved
	POS_STW2.1	1: Sets the reference point. 0: The reference point is not set.
	POS_STW2.2	1: The reference point block is activated. 0: The reference block is not activated.
	POS_STW2.3～ POS_STW2.4	Reserved
	POS_STW2.5	1: JOG incremental mode. 0: JOG speed mode.
	POS_STW2.6～ POS_STW2.8	Reserved
	POS_STW2.9	1: Start searching for reference points in the negative direction. 0: Searches for a reference point in the positive direction.
	POS_STW2.10～ POS_STW2.13	Reserved
	POS_STW2.14	1: Soft limit activation. 0: The soft limit is not activated.
	POS_STW2.15	Reserved

STW2: Control word 2, U16.

	Signal	Describe
STW2	STW2.0～ STW2.11	Reserved
	STW2.12	Main life symbol, Bit0
	STW2.13	Main life symbol, Bit1
	STW2.14	Main life symbol, Bit2
	STW2.15	Main life symbol, Bit3

OVERRIDE: position velocity multiplier (16Bit), N2.

MDI_VELOCITY is used as the reference variable, and the proportional value corresponding to the N2 type normalized data sent by PLC is used as the multiplier of the MDI_VELOCITY velocity instruction. For details, see Section 6.1.4 (4000hex = 100%).

MDI_TARPOS: MDI position, I32.

The position instruction data sent by PLC is input as the position instruction of the servo driver position planning. For details, see section 6.4.3 (1hex = 1LU).

MDI_VELOCITY: MDI velocity, I32.

The velocity instruction data sent by the PLC is used as the velocity instruction input for the position planning of the servo driver. For details, see section 6.4.3 (1hex = 1000LU/min).

MDI_ACC: MDI acceleration multiplier, I16.

The maximum servo acceleration is used as the reference variable, and the proportional value corresponding to the N2 type normalized data sent by PLC is used as the multiplier input of the acceleration instruction for the position planning of the servo driver. For details, see Section 6.1.4 (4000hex= 100%).

MDI_DEC: MDI deceleration multiplier, I16.

The maximum deceleration of the servo is taken as the reference variable, and the proportion value corresponding to the N2 type normalized data sent by the PLC is taken as the multiplier input of the deceleration instruction of the servo driver's position planning. For details, see Section 6.1.4 (4000hex = 100%).

USER_RX: user-defined functions.

This part is being planned.

ZSW1: status word 1, U16.

	Signal	Describe
ZSW1	ZSW1.0	1: Server is ready. 0: Servo is not ready.
	ZSW1.1	1: Servo running ready 0: Servo not running ready
	ZSW1.2	1: Servo operation is enabled. 0: Servo is not enabled.
	ZSW1.3	1: Server Error. 0: Servo without Error.
	ZSW1.4	1: Inertia stop is invalid. 0: Inertial stop activation.
	ZSW1.5	1: Quick stop is invalid. 0: Quick stop activation.
	ZSW1.6	1: Disable the connection. 0: Disables connection.
	ZSW1.7	1: Servo Waring. 0: Servo without Waring.
	STW1.8	1: The position following error is within the tolerance range. 0: Position following error is outside the tolerance range.
	STW1.9	1: PLC control request. 0: No PLC control request.
	STW1.10	1: The target position is reached. 0: The target position is not reached.
	STW1.11	1: The reference point has been set. 0: The reference point is not set.
	STW1.12	1: Response activation running program segment (0→1 jump). 0: The running program segment is not activated.
	STW1.13～ STW1.15	Reserved

POS_ZSW1: POS status word 1, U16.

	Signal	Describe
POS_ZSW1	POS_ZSW1.0	Run segment activation, bit 0.
	POS_ZSW1.1	Run segment activation, bit 1.
	POS_ZSW1.2	Run segment activation, bit 2.
	POS_ZSW1.3	Run segment activation, bit 3.
	POS_ZSW1.4～ POS_ZSW1.9	Reserved
	POS_ZSW1.10	1: JOG activation. 0: JOG is not activated.
	POS_ZSW1.11	1: Back to the reference point activation. 0: The backreference point is not activated.
	POS_ZSW1.12～ POS_ZSW1.13	Reserved
	POS_ZSW1.14	1: Adjust the mode activation. 0: The positioning mode is activated.
	POS_ZSW1.15	1: MDI is activated. 0: program segment activation.

POS_ZSW2: POS status word 2, U16.

	Signal	Describe
POS_ZSW2	POS_ZSW2.0～ POS_ZSW2.1	Reserved
	POS_ZSW2.2	1: The set value is available. 0: The set value is unavailable.
	POS_ZSW2.3	Reserved
	POS_ZSW2.4	1: axial forward motion. 0: The axis is not moving forward.
	POS_ZSW2.5	1: The axis moves backward. 0: The axis does not move backward.
	POS_ZSW2.6～ POS_ZSW2.14	Reserved
	POS_ZSW2.15	1: The command is activated. 0: The running command is not activated.

ZSW2: Status word 2, U16.

	Signal	Describe
ZSW2	ZSW2.0～ZSW2.10	Reserved
	ZSW2.11	1: Pulse is enabled. 0: Pulse disabled.
	ZSW2.12	Slave station life symbol, Bit0
	ZSW2.13	Slave station life symbol, Bit1
	ZSW2.14	Slave station life symbol, Bit2
	ZSW2.15	Slave station life symbol, Bit3

MELDW: MELDW message word, U16.

	Signal	Describe
MELDW	MELDW.0～MELDW.10	Reserved
	MELDW.11	1: Drive enable. 0: Drive is not enabled.
	MELDW.12	1: Drive is ready. 0: Drive not ready.
	MELDW.13	1: Pulse is enabled. 0: Pulse is not enabled.
	MELDW.14～ MELDW.15	Reserved

XIST_A: actual value A, I32.

XIST_A is used to transmit the actual position value periodically. For details, see section 6.4.3 (1hex = 1LU).

NIST_B: Velocity Actual value B(32Bit), N4.

The servo parameter P312 is used as the reference variable, and the N4 type normalized data corresponding to the current actual velocity of the servo driver is used as the return value of the actual velocity of PLC. For details, see Section 6.1.4.

FAULT_CODE: Servo error code, U16.

The error code for the servo driver is returned to the PLC through this field. When no error occurs, the return value is 0x0000. When an error occurs, the lower 8 bits fill the error code and the higher 8 bits are fixed to fill 0xFF. See Chapter 7 for specific error codes.

WARN_CODE: Servo error code, U16.

This section is reserved.

USER_TX: user-defined functions.

Use parameter P316 to select feedback content. For details, see parameter P316 Definition.

Details of the contents and fields of Message 750:

The message 750 is applicable to torque limit related control, and the message content is as follows:

Message 750	P309 = 750	
	Receiving word (3 PZD)	Sending word (1 PZD)
PZD1	M_ADD1	M_ACT
PZD2	M_LIMIT_POS	
PZD3	M_LIMIT_NEG	

M_ADD1: Additional torque (function to be improved), N2.

M_LIMIT_POS: Positive torque limit, N2.

Servo parameter P314 is used as the benchmark variable. The positive torque limit instruction corresponding to N2 type normalized data sent by PLC is required to be greater than 0, which is used as the internal positive torque limit value of the servo driver. For details, see Section 6.1.4.

M_LIMIT_NEG: negative torque limit, N2.

Servo parameter P314 is used as the benchmark variable. The positive torque limit instruction corresponding to N2 type normalized data sent by PLC is required to be less than 0, which is used as the internal negative torque limit value of the servo driver. For details, see Section 6.1.4.

M_ACT: actual torque feedback value, N2.

The servo parameter P314 is used as the reference variable, and the N2 type normalized data corresponding to the current actual torque of the servo driver is used as the actual torque return value of PLC. For details, see Section 6.1.4.

Details of the contents and fields of Message 860:

Message 860 applies to the probe latch related applications, message content as follows:

Message 860	P309=860	
	Receiving word (1 PZD)	Sending word (9 PZD)
PZD1	TB_FUNCTION	TB_STATUS
PZD2		TB1_POS_VALUE
PZD3		
PZD4		TB1_NEG_VALUE
PZD5		
PZD6		TB2_POS_VALUE
PZD7		
PZD8		TB2_NEG_VALUE
PZD9		

TB_FUNCTION: Touch Probe latch function setting, U16.
For details, see 6.4.1 Touch Probe Functions.

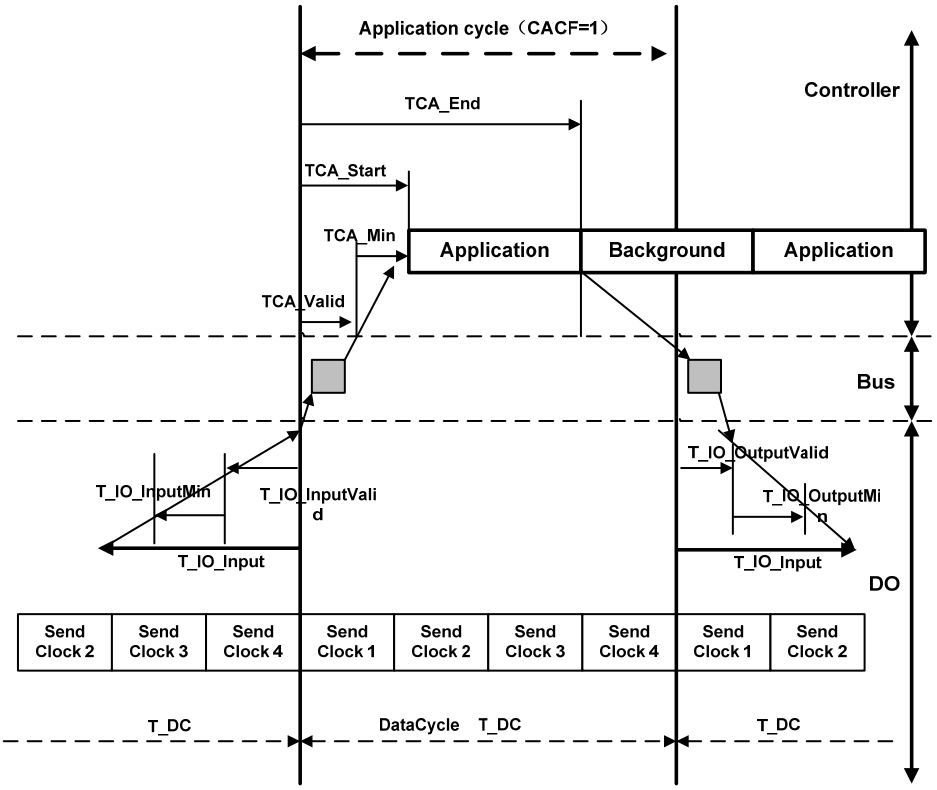
TB_STATUS: Touch Probe latch status, U16.
For details, see 6.4.1 Touch Probe Functions.

TB1_POS_VALUE: Touch Probe 1 Latch position value, U16.
TB1_NEG_VALUE: Touch Probe 1 latch position value, U16.
TB2_POS_VALUE: Touch Probe 2 latch position value, U16.
TB2_NEG_VALUE: latch position value of the falling edge of Touch Probe 2, U16.
For details, see 6.4.1 Touch Probe Functions.

6.1.6 Isochronous Mode

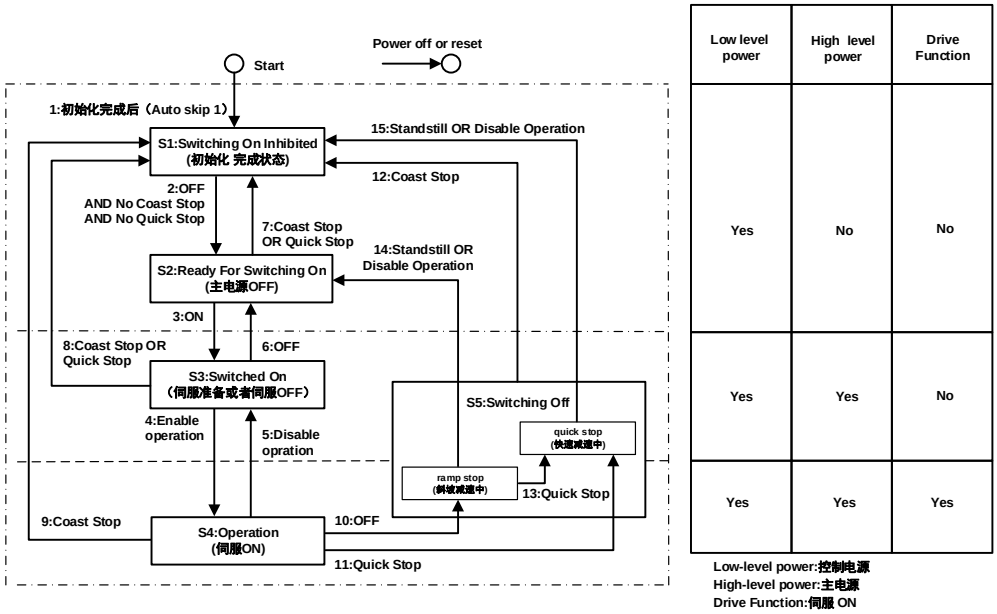
In PROFINET communication, in order to realize isochronic synchronization, each Slave device realizes cycle synchronization according to PNPLL output clock signal, and sets T_IO_Output Time and T_IO_Input Time of each Slave device. Ensure that all Slave devices in the synchronization domain collect data at the same time and set output values at the same time to ensure that all devices are in the same pace.

In the current version of the servo drive, the minimum isochronous synchronization period is 250us. The sequence of isochronous synchronization data cycles for PROFINET IO is shown below.



6.2 Drive mode

6.2.1 Servo state machine



Control command and status switchover

PROFIDrive state switch		STW1
1	Default →SwitchingOn Inhibited	Natural transition, no instructions
2	SwitchingOn Inhibited →Ready ForSwitchingOn	STW1.0 = 0 And STW1.1 = 1 And STW1.2 = 1
3	Ready ForSwitchingOn →Switched On	STW1.0 = 1
4	Switched On →Operation	STW1.3 = 1
5	Operation →Switched On	STW1.3 = 0
6	Switched On →Ready ForSwitchingOn	STW1.0 = 0
7	Ready ForSwitch On →SwitchingOn Inhibited	STW1.1 = 0 Or STW1.2 = 0
8	Switched On →SwitchingOn Inhibited	STW1.1 = 0 Or STW1.2 = 0
9	Operation →SwitchingOn Inhibited	STW1.1 = 0
10	Operation →Ramp Stop Switching Off	STW1.0 = 0
11	Operation →Quick stop Switching Off	STW1.2 = 0
12	Switching Off→SwitchingOn Inhibited	STW1.1 = 0
13	Ramp Stop Switching Off→Quick stop Switching Off	STW1.2 = 0
14	Ramp Stop Switching Off→Ready ForSwitch On	STW1.3 = 0 Or Deceleration completed
15	Quick stop Switching Off→SwitchingOn Inhibited	STW1.3 = 0 Or Deceleration completed

Status switchover and description

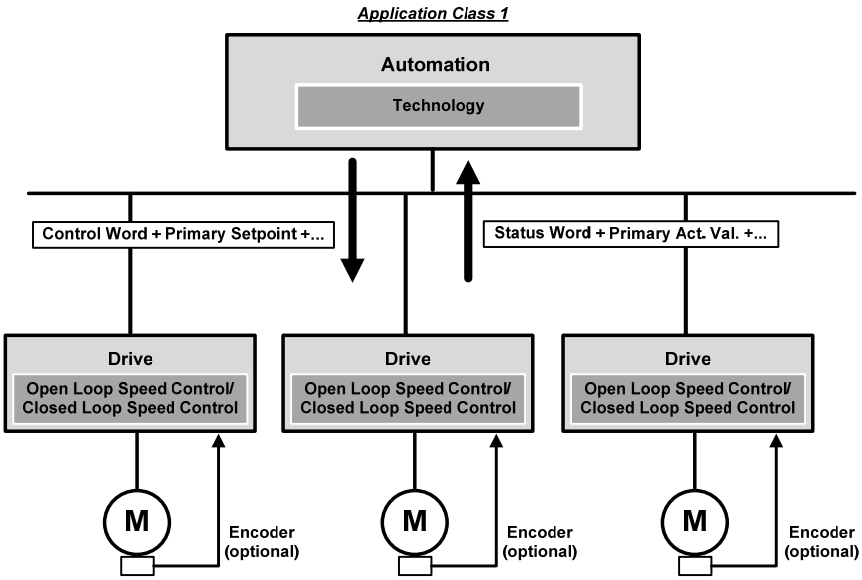
State	Explanation	ZSW1、ZSW2
SwitchingOn Inhibited	● After initialization, you can set servo parameters. ● The main power supply cannot be supplied in the current state.	ZSW1.0 = 0ZSW1.1 = 0 ZSW1.2 = 0ZSW1.6 = 1 ZSW2.11 = 0
Ready For Switching On	● In the current state, the main power can be turned on and servo parameters can be set. ● The drive is inactive.	ZSW1.0 = 1ZSW1.1 = 0 ZSW1.2 = 0ZSW1.6 = 0 ZSW2.11 = 0
Switched On	● The main power supply is On, and servo parameters can be set. ● The drive is inactive.	ZSW1.0 = 1ZSW1.1 = 1 ZSW1.2 = 0ZSW1.6 = 0 ZSW2.11 = 0
Operation	● In a non-fault state, start the driver function to apply torque to the motor. Servo parameters can also be set.	ZSW1.0 = 1ZSW1.1 = 1 ZSW1.2 = 1ZSW1.6 = 0 ZSW2.11 = 1
Ramp Stop Switching Off	● The Ramp stop function has been executed. ● Servo parameters can be set.	ZSW1.0 = 1ZSW1.1 = 1 ZSW1.2 = 0ZSW1.6 = 0 ZSW2.11 = 1
Quick stop Switching Off	● The Quick Stop function has been executed. ● Servo parameters can be set.	ZSW1.0 = 1ZSW1.1 = 1 ZSW1.2 = 0ZSW1.6 = 0 ZSW2.11 = 1

6.3 Operating mode

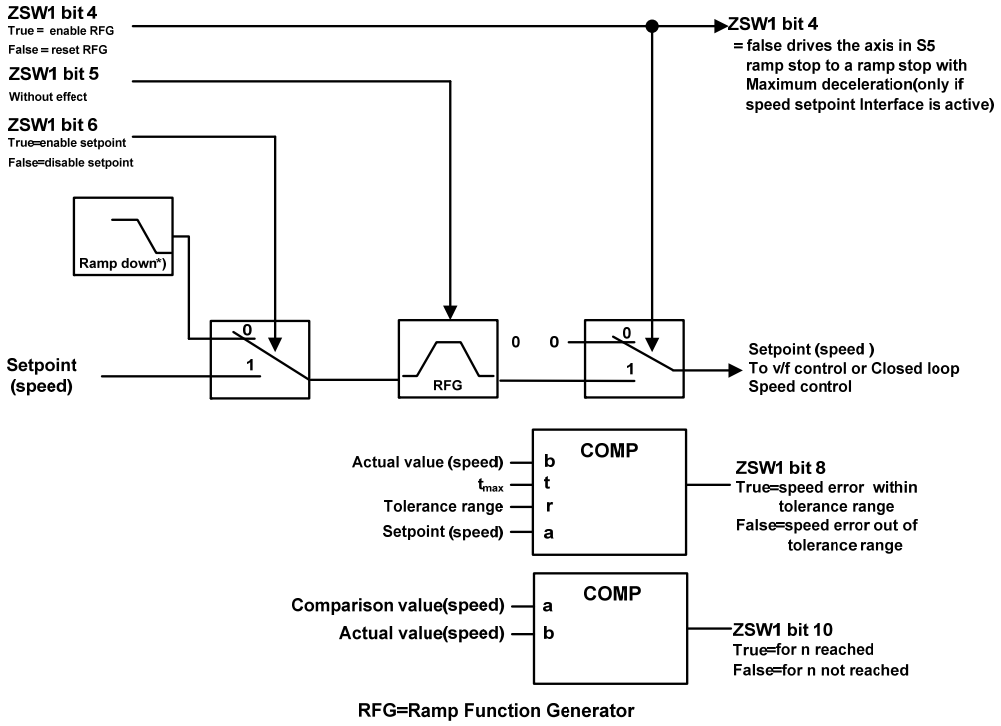
EP5 currently supports:
Application class AC1 message 1;
Application class AC4 message 3、5、102、105;
Application class AC3 message 111;
Auxiliary message 750、860.

6.3.1 AC1: Standard driver

Application class AC1(shown below) shows speed control through a communication system. The speed set value and actual value are transmitted through circular data exchange, and clock synchronization operation is not necessary.

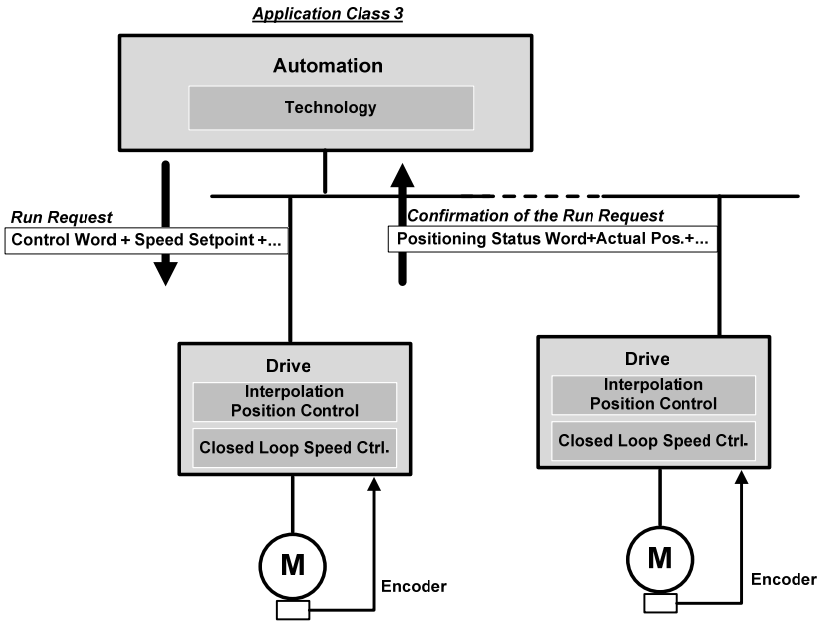


The ramp function generator is required in the speed set channel of application class AC1. The function of the speed set channel module in the slave device is illustrated below. STW1.5 controls the ramp function generator.



6.3.2 AC3: Single axis positioning driver with local motion control

Application class AC3 (as shown in the figure below), the process function of automatic process exists in PLC, positioning parameters and position speed feedback value are transmitted through cyclic data, positioning request is started through the command of the controller. Interpolation, position control and speed control are implemented directly in the driver. Clock synchronization is required only when multiple axes are required to work together.



1. Running program segment

This part of the function is being improved.

2. Value is directly given MDI

The MDI mode is positioned in absolute and relative terms by means of a set value given directly by the PLC, or adjusted in a position ring. In addition, the motion parameters are modified in real time during operation, and the "absolute positioning", "relative positioning" and "adjustment" modes can be switched quickly.

Activate the set value given function

When using Message 111, the function is given directly with the control word POS_STW1.15 set value:

Control word	Set up	Describe
POS_STW1.15	1	Choose the MDI
	0	Choose to run the program segment

When using Message 9, the function is given directly with the control word SATZANW.15 set value:

Control word	Set up	Describe
SATZANW.15	1	Choose the MDI
	0	Choose to run the program segment

Choose work mode

In the "positioning" mode, absolute and relative positioning of the servo axis is achieved according to the parameters (position、speed、acceleration、deceleration).
In the "adjustment" mode, the servo axis can realize closed-loop position control according to the parameters (speed、acceleration、deceleration).

When using Message 111, use the control word POS_STW1.14 to select the working mode:

Control word	Set up	Describe
POS_STW1.14	1	Signal adjustment selected
	0	Signal location has been selected [1)]

[1)] Message 9 works in signal location mode.

Select the positioning method in positioning mode

If Message 111 is used, use POS_STW1.8 to select the location mode:

Control word	Set up	Describe
POS_STW1.8	1	Absolute positioning selected
	0	Relative positioning has chosen

When using Message 9, select the location mode using MDI_MOD.0:

Control word	Set up	Describe
MDI_MOD.0	1	Absolute positioning selected
	0	Relative positioning has chosen

Select direction in Adjustment mode (Message 111 only)

The direction of operation in positioning mode is determined by MDI_TARPOS.

Control word	Set up	Describe
POS_STW1.9 POS_STW1.10	1	MDI direction selection, positive
	0	MDI direction selection, negative

Pause and reject MDI tasks

When using Message 9、111, the MDI task is rejected by STW1.4, and the servo decelerates the ramp at maximum deceleration.

Control word	Set up	Describe
STW1.4	1	Do not refuse to perform tasks
	0	Refuse to perform the task (perform slope descent at maximum deceleration)

When Message 9 and 111 are applicable, the task is suspended through STW1.5, and the servo decelerates on a slope at the current set deceleration and remains in the current state. When the suspended task signal is cancelled, the task that is currently waiting for execution or has been suspended is resumed.

Control word	Set up	Describe
STW1.5	1	Do not suspend the task
	0	The task is suspended by the set deceleration MDI_DEC (Message9, 10, and 111) or P2693 (Message7)

3. Back to the reference point

When using Message 9 and 111, use the STW1.11 setting to start the operation back to the reference point. There are three modes for returning to the reference point.

Control word	Set up	Describe
STW1.11	1	Start back to the reference point
	0	Stop back to the reference point

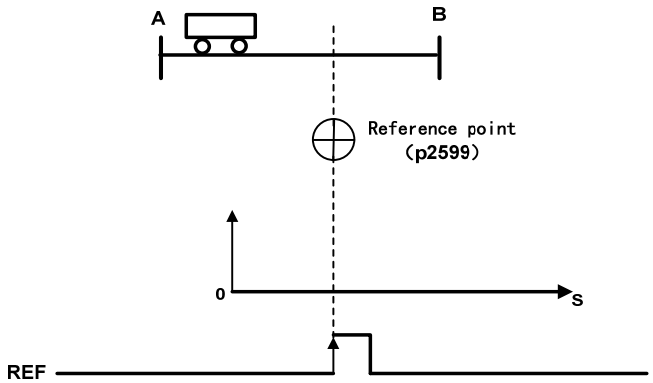
Parameter	Value	Describe
Return to reference point mode	0	REF back to reference point by external signal
	1 (default)	Zero pulses back to the reference point through an external reference block (signal REF) and the encoder
	2	Return to reference point through zero pulse only

REF back to reference point by external signal (mode 0)

If Message 111 is used, set external input signal to POS_STW2.1 and REF(0->1) :

Control word	Set up	Describe
POS_STW2.1	1	Setting reference Points
	0	No reference point is set

At the rising edge of signal REF, the current position is set to 0, and the servo drives back to the reference point.



External reference point block (signal REF) and encoder zero pulse (Mode 1)

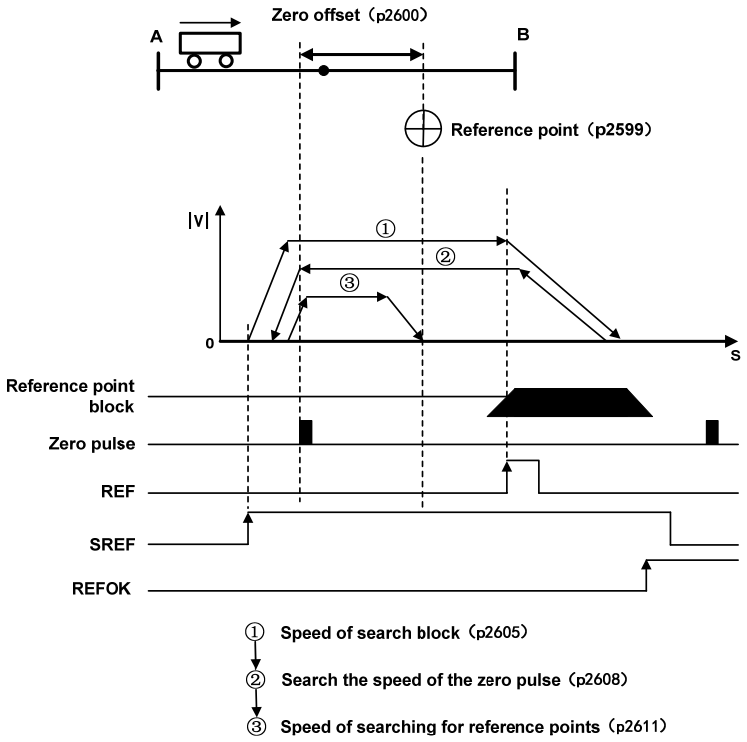
When using Message 111, set the external input signal REF via POS_STW2.1:

Control word	Set up	Describe
POS_STW2.2	1	Reference point block activation
	0	The reference point block is not activated

The back to reference process is triggered by STW1.11(0->1). Servo drive to find the reference point block by accelerating to the speed specified by the parameter "back to reference Search block speed", the direction of the search reference point block is specified by the parameter "back to reference direction"; When the reference point block is searched (signal REF: 0->1), the servo motor is slowed to the static state; Then, the servo drive is accelerated again to the speed specified in the parameter "return to reference search zero speed", and the direction is opposite to the direction specified in the parameter "return to reference direction", when leaving the reference block (signal REF: 1->0); When the first zero pulse is reached, the servo drive starts to run to the reference point defined by the parameter "back reference point offset value" at the speed specified by the parameter "back reference point approaching the reference point speed". When the servo drive reaches the reference point, the REFOK signal is output. Setting STW1.11 to 0 succeeds in returning to the reference point.

The whole process is shown as follows. The parameter "maximum distance back to the reference point block" is set to search the travel of the reference point block of path 1 in the figure. If the REF signal (0->1) is not found in the travel, the servo driver appears Er 77 alarm; The parameter "maximum distance back to the reference point zero" is set to search the zero stroke after leaving the reference point block (signal REF: 1->0) in path 2 in the figure. If no zero pulse signal is found in the stroke, the servo driver will alarm Er 78.

In the process of returning to the reference point, acceleration and deceleration are carried out with maximum acceleration and maximum deceleration.



Back to the reference point in the process of related parameters as shown below

Parameter	Range	Factory Settings	Unit	Describe
Back to the reference point offset value	-2147482648 ～2147482647	0	LU	Sets the position value of the reference axis
Return to reference point direction1)	0～1	0	-	Set the signal source for the start direction of the search block: ● 0: Starts in the positive direction ● 1: Starts in a negative direction
Search block speed back to reference point	1～40000000	5000	1000 LU/min	Speed of search block
Return to reference point block maximum distance	0～2147482647	2147482647	LU	Maximum distance to search blocks
Return to reference point to search for zero speed	1～40000000	300	1000 LU/min	Search the speed of the zero pulse
Maximum distance back to reference point zero	0～2147482647	20000	LU	Search the maximum distance of the zero pulse
Back to the reference point approach speed reference point	1～40000000	300	1000 LU/min	Speed of searching for reference points

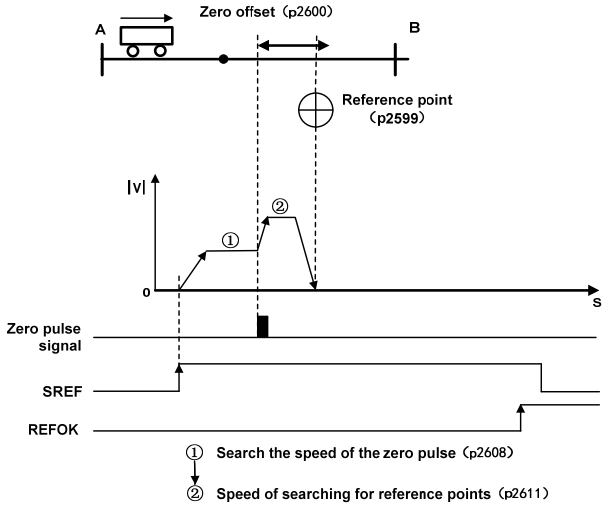
[1] When Message 111 is used, the direction back to the reference point is assigned by the control value POS_STW2.9

Encoder only zero pulse (Mode 2)

In this mode, the REF signal is not available and the return to the reference point process is triggered by STW1.11(0->1). The servo drive is accelerated to the speed specified by the parameter "return to reference search zero speed", and the running direction is specified by the parameter "return to reference direction"; When the first zero pulse is reached, the servo drive begins to run towards the reference point defined by the parameter "back reference offset value" at the speed specified by the parameter "back reference point approaching reference point speed"; When the servo drive reaches the reference point, the REFOK signal is output. Setting STW1.11 to 0 succeeds in returning to the reference point.

The whole process is shown as follows. The parameter "maximum distance back to the reference point zero" sets the travel of path 1 in the figure to search for zero. No zero pulse signal is found in the travel, and the servo driver generates an Er 78 alarm.

In the process of returning to the reference point, acceleration and deceleration are carried out with maximum acceleration and maximum deceleration.



Back to the reference point in the process of related parameters as shown below:

Parameter	Range	Factory Settings	Unit	Describe
Back to the reference point offset value	-2147482648 ～2147482647	0	LU	Offset of the reference point
Return to reference point direction 1)	0～1	0	-	Set the signal source for the start direction of the search block: ● 0: starts in the positive direction ● 1: Starts in a negative direction
Return to reference point to search for zero speed	1～40000000	300	1000 LU/min	Search the speed of the zero pulse
Maximum distance back to reference point zero	0～2147482647	20000	LU	Search the maximum distance of the zero pulse
Return to the reference point approaching the reference point velocity	1～40000000	300	1000 LU/min	Speed of searching for reference points

[1)] When Message 111 is used, the direction back to the reference point is assigned by the control value POS_STW2.9.

4. EJOG

When using Message 9, 111, select JOG channel through STW1.8 and STW1.9, corresponding to through is activated, the axis is accelerated to the specified JOG speed at the maximum acceleration; when deactivated, the axis slopes down from its current speed at maximum acceleration:

Control word	Set up	Describe
STW1.8 STW1.9	0	JOG channel is not active
	1	JOG1 source rise along has been activated
	2	JOG2 source rise along has been activated
	3	Reserved

Select JOG Mode

When using Message 111, via POS_ STW2.5 selects JOG mode, Message 9 only supports continuous JOG mode:

Control word	Set up	Describe
POS_STW2.5	1	JOG, incremental activation
	0	JOG, speed activation

Setting JOG parameters can be modified through the EPOS parameter editor in the host software.

When using Message 9, the following JOG Settings are set with the parameter:
JOG1 speed: the unit is 1000LU/min.
JOG2 speed: the unit is 1000LU/min.
When using Message 111, set the following JOG Settings as a parameter
JOG1 speed: the unit is 1000LU/min.
JOG1 Stroke: unit LU.
JOG2 speed: the unit is 1000LU/min.
JOG2 Travel: Unit: LU.

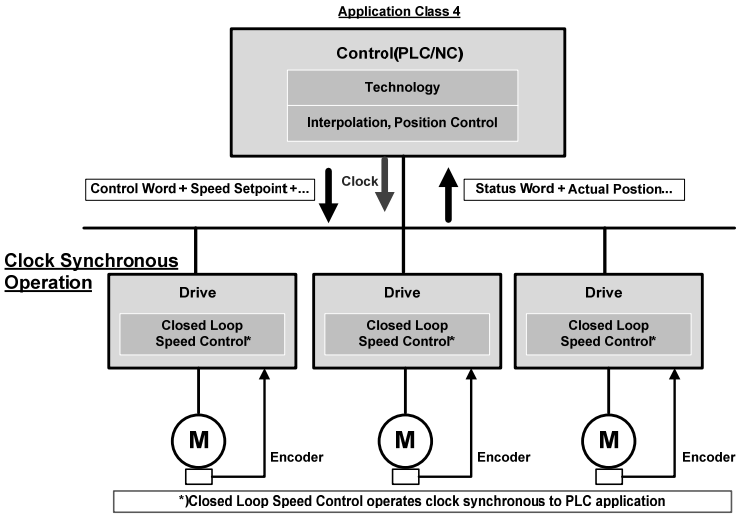
5. Software limit

When EJOG and MDI are running in position mode, run POS_STW2.5 or edit EPOS to enable the software limit function. When the actual position of the axis exceeds the position point of the software limit in the running direction, the axis decelerates the slope with the maximum acceleration of the corresponding mode, and Er 85 (negative soft limit exceeds the limit) and Er 86 (positive soft limit exceeds the limit) are reported. This error can be cleared by STW1.7. After the clearance, the servo can only receive the instructions in the opposite direction of the limit and run to the software limit range. Receiving the instructions in the same direction of the limit will trigger the limit alarm again.

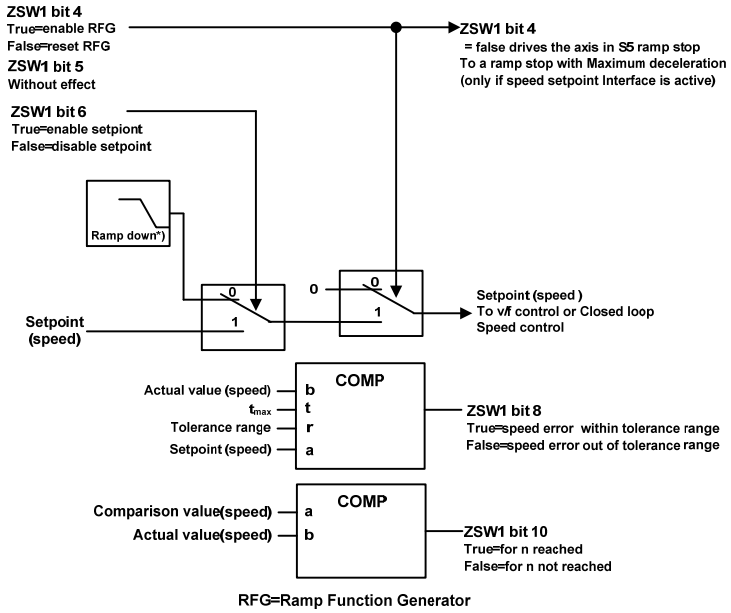
Setting soft limit parameters can be modified through the EPOS parameter editor in the host software.

6.3.3 AC4: Motion control with central interpolation and speed setting interface

Application class AC4(shown below) shows closed-loop position control through a communication system. The speed set and actual values as well as the actual position values are transmitted through a cyclic data exchange. The servo driver contains only closed-loop speed control and actual position sampling algorithms. Because position is controlled through the bus system, clock synchronization operations are necessary and should be precise.



Application class generally do not need the speed setting of the AC4 channel slope function generator, the following chart from out of the station equipment the speed setting of the simplified channel module function, to the speed set point STW1.5 channel has no effect.



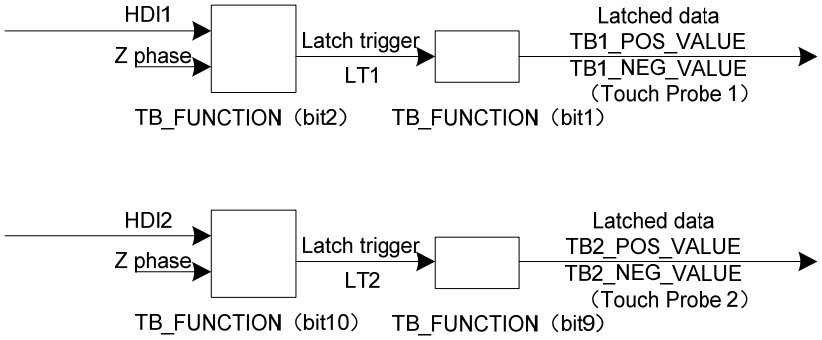
6.4 Pattern common function

6.4.1 Touch Probe Function

This function is to select the trigger signal from the external input (HDI1, HDI2) or the Z phase (the position of the data in the single turn of the rotary encoder is 0 during the semi-closed loop control) and lock the feedback position.

- The width of the trigger signal input ON and OFF should be kept above 2ms respectively.
- If the trigger selection is Z phase, do not select the falling edge.
- The Touch Probe function is only effective when the motor is enabled.

1. Composition of the Touch Probe function



- TB_FUNCTION

TB_FUNCTION			
bit10	LT2	Bit2	LT1
0	HDI2	0	HDI1
1	Z phase	1	Z phase

- TB1_POS_VALUE
- TB1_NEG_VALUE
- TB2_POS_VALUE
- TB2_NEG_VALUE

2. Touch Probe Associated object

Name	Unit	Range	Date Type	Access
TB_FUNCTION	-	0～65535	U16	RW
TB_STATUS	-	0～65535	U16	RO
TB1_POS_VALUE	Instruction unit	-2147483648～2147483647	I32	RO
TB1_NEG_VALUE	Instruction unit	-2147483648～2147483647	I32	RO
TB2_POS_VALUE	Instruction unit	-2147483648～2147483647	I32	RO
TB2_NEG_VALUE	Instruction unit	-2147483648～2147483647	I32	RO

（1）TB_FUNCTION

Start the Touch Probe action, the basic object used for various Settings, and the corresponding Bit description

bit	value	Note
0	0	Switch off touch probe 1
	1	Enable touch probe 1
1	0	Trigger first event
	1	Continuous
2	0	Trigger with touch probe 1 input
	1	Trigger with zero impulse signal of position encoder
3	-	Reserved
4	0	Switch off sampling at positive edge of touch probe 1
	1	Enable sampling at positive edge of touch probe 1
5	0	Switch off sampling at negative edge of touch probe 1
	1	Enable sampling at negative edge of touch probe 1
6～7	-	Not Supported
8	0	Switch off touch probe 2
	1	Enable touch probe 2
9	0	Trigger first event
	1	Continuous
10	0	Trigger with touch probe 2 input
	1	Trigger with zero impulse signal of position encoder
11	-	Reserved
12	0	Switch off sampling at positive edge of touch probe 2
	1	Enable sampling at positive edge of touch probe 2
13	0	Switch off sampling at negative edge of touch probe 2
	1	Enable sampling at negative edge of touch probe 2
14～15	-	Not Supported

- If the Z phase is selected according to the trigger setting, do not select the falling edge. There is no guarantee that the actions set above will be performed.
- The rising edge represents the time when the theoretical state of the object signal changes from OFF (inactive state) to ON (active state), and the falling edge represents the time when the theoretical state of the object signal changes from ON to OFF.

（2）TB_STATUS

Indicates the status of the Touch probe action, corresponding to the Bit description

bit	value	Note
0	0	Touch probe 1 is switch off
	1	Touch probe 1 is enabled
1	0	Touch probe 1 no positive edge value stored
	1	Touch probe 1 positive edge value stored
2	0	Touch probe 1 no negative edge value stored
	1	Touch probe 1 negative edge value stored
3～5	-	Reserved
6～7	-	Not Supported
8	0	Touch probe 2 is switch off
	1	Touch probe 2 is enabled
9	0	Touch probe 2 no positive edge value stored
	1	Touch probe 2 positive edge value stored
10	0	Touch probe 2 no negative edge value stored
	1	Touch probe 2 negative edge value stored
11～13	-	Reserved
14～15	-	Not Supported

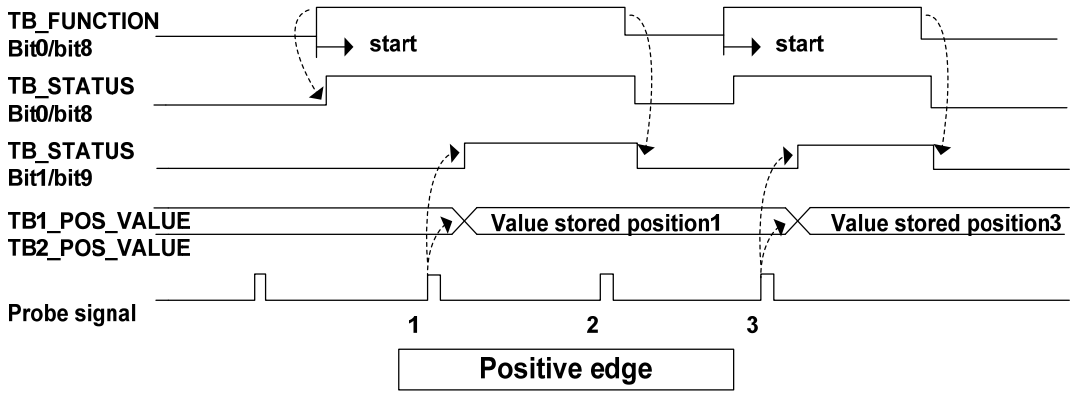
3. Start the Touch probe action

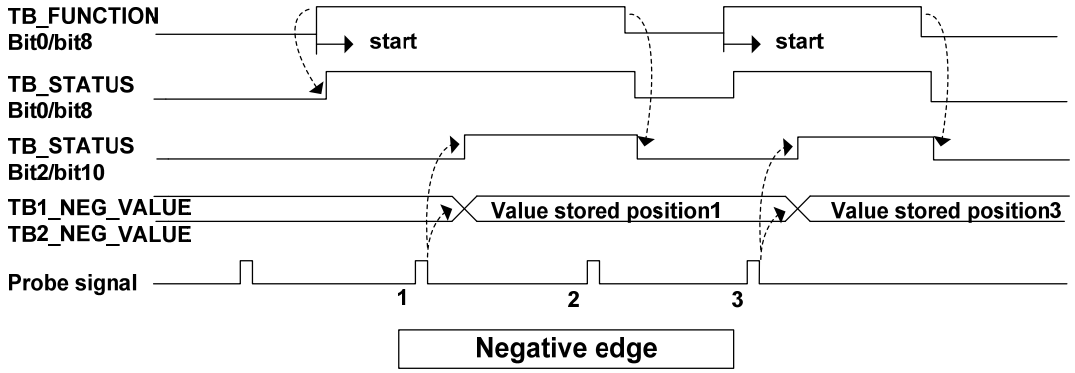
Bit0 /bit8 (Touch Probe execution/stop) of the TB_FUNCTION changes from 0 (stop) to 1 (start), obtains the set conditions (TB_FUNCTION: bit1-7 / BIT9-15), and starts the Touch Probe. Changes to various Settings are valid, please bit0/bit8 return once to "0 (stop)", and then again to "1 (start)".

According to the bit1 TB_FUNCTION/combination mode selection (events), you can choose to "0 (the Trigger First event mode)", "1" (Continuous mode).

- Trigger First Event mode (TB_FUNCTION: bit1=0 / bit9=0).

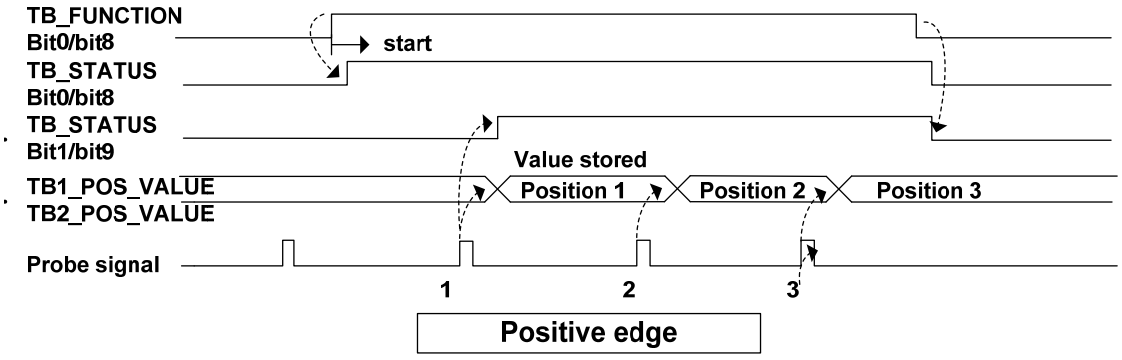
After starting, the mode is only embedded under the first trigger signal. In order to obtain it again, it is necessary to start the Touch Probe again.

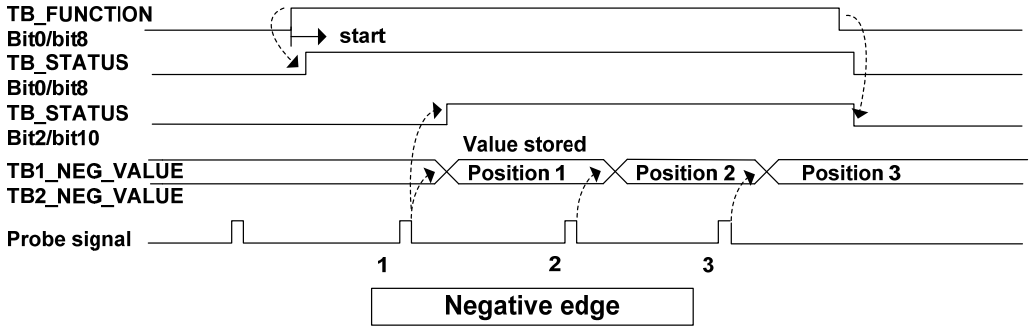




- Continuous mode（TB_FUNCTION：bit1=1 / bit9=1）

After starting, each time the trigger signal nesting mode is checked out. The obtained value is held until the next Probe latch signal is valid.





6.4.2 Stop function

When the servo driver needs to be stopped due to motion control or servo driver failure, the PROFIDrive defined deceleration function can be combined with servo deceleration function (EMG, dynamic brake stop, free running stop, instant stop, etc.) to achieve the "stop function".

1. EMG emergency stop

When EMG(emergency shutdown) in DI is ON, the driver directly cuts off the motor current, and the motor stops freely. After the motor stops, it switches to a Switching On Inhibited state.

2. OFF1 ramp parking

When STW1.0=1→0, execute the deceleration stop action from the current speed according to the setting of the parameter "ramp deceleration".

The "ramp deceleration" is set in units of "user units/s^2" through the host software. In speed modes such as AC4 and AC1, the user unit is fixed at 131072. In position modes such as AC3, the user unit is set through the "LU per revolution" in the host software.

The relevant actions during the deceleration process are as follows:

- During the deceleration process, when STW1.1=1→0, the deceleration process switches from slope parking to free parking. The driver directly cuts off the motor current, and after the motor stops, it switches to the Switching On Inhibited state.
- During the deceleration process, when STW1.2=1→0, it switches from Ramp Stop Switching Off to Quick Stop Switching Off. The deceleration process starts at the current speed, and the setting of the deceleration time switches from ramp deceleration time to fast deceleration time.
- When the deceleration is completed or STW1.3=1→0, switch from Ramp Stop Switching Off to Ready For Switching On.

3. OFF2 free parking

The driver directly cuts off the motor current and the motor stops freely. After the motor stops, it transitions to the Switching On Inhibited state.

4. OFF3 Quick Stop

When STW1.2=1→0, execute the deceleration stop action from the current speed according to the setting of the parameter "Quick stop deceleration".

The "Quick stop deceleration" is set in the unit of "user unit/s^2" through the host software. In speed modes such as AC4 and AC1, the user unit is fixed at 131072. In position modes such as AC3, the user unit is set through the "LU per revolution" in the host software.

The relevant actions during the deceleration process are as follows:

- During the deceleration process, when STW1.1=1→0, the deceleration process switches from slope parking to free parking. The driver directly cuts off the motor current, and after the motor stops, it switches to the Switching On Inhibited state
- When the deceleration is completed or STW1.3=1→0, switch from Ramp Stop Switching Off to Ready For Switching On.

6.4.3 Reference speed

The servo parameter P312 serves as the normalized reference variable for the speed setting value in AC4, and the parameter description is as follows:

Para meter	Name	Range	Default value	Unit
P312	Reference speed	10～7500	3000	rpm

After the driver is initialized, the maximum value of this parameter is limited to the rated speed of the connected motor. The reference speed can be freely set within the rated speed range. If the current setting exceeds the rated speed of the motor, the current setting will be limited to the rated speed of the motor.

6.4.4 Reference torque

The servo parameter P314 serves as the normalized reference variable for torque limitation and feedback applications, and the parameter description is as follows:

Para meter	Name	Range	Default value	Unit
P314	Reference torque	0.1～400.0	400.0	nm

After the driver initialization, the maximum value of 400.0 for this parameter is limited to 3 times the rated torque of the connected motor. When using 102 and 105 messages, the reference torque can be freely set within a range of 3 times the rated torque. If the current set value exceeds 3 times the rated torque of the motor, the current set value will be limited to 3 times the rated torque of the motor; When using other messages, the reference torque is automatically set internally at the maximum motor torque.

6.4.5 Position feedback interface

The position feedback interface is the interface between the axis and higher level control that enables the controller to get position feedback through the PROFIDrive interface. This position feedback comes from a sensor connected to the driver, where the functions described in the position feedback interface are implemented.

In current versions of drives, only rotary absolute value encoders are supported. **And the resolution format of the current position information returned by the encoder is fixed, including 17Bit single-loop data and 15Bit multi-loop data.** PROFIDrive specific parameter P979 (sensor format) structure and set values are described as follows:

subindex	Meaning	Set value
0	Prelude	0x00005111
1	Sensor type	0x80000002
2	Sensor resolution	131072
3	G1_XIST1 shift factor	0
4	G1_XIST2 absolute value of the shift factor	0
5	Determinable resolution	32768
6～N	Reserved	0

Chapter 7 Alarm

7.1 Diagnostic information

PROFIDrive classifies each alarm information of the servo drive. The specific category information is shown in the following table:

Class no.	Error class name	Reason statement
1	Hardware or software malfunction	A hardware or software fault occurs
2	Main power failure	The main power supply is faulty, with phase loss, overvoltage and undervoltage
3	Control power failure	Control power failure, 24V, 5V power supply is abnormal
4	Overvoltage of the DC bus	DC bus voltage threshold above normal
5	Power electronic component failure	Power electronic component failure, such as overheating, overcurrent or IGBT failure
6	Electronic component overheating	Electronic component temperature exceeds normal threshold
7	Grounding, interphase short circuit	Grounding or interphase short circuit found in power cable or motor winding
8	Motor overload	Motor over finite temperature, limit current or limit torque operation
9	Host controller communication failure	PROFINET communication failure between driver and controller
10	Security monitoring channel failure	Safety operation monitoring detects faults
11	Position feedback interface failure	Status error or signal loss occurs during encoder signal processing
12	Internal communication failure	Abnormal or interrupted communication between internal components of the driver
13	Power module failure	Power supply module fault or failure
14	Brake module failure	Internal or external brake module is abnormal or overheated
15	Power filter failure	Power filter temperature too high or abnormal state
16	Abnormal external signal	The external input signal exceeds the threshold or is abnormal
17	Failure of application and process function	Driver monitoring position, speed, and torque over set thresholds
18	Parameter setting or configuration fails	Drive parameters are incorrectly configured or incorrectly configured
19	Common Driver Faults	Device component failure
20	Auxiliary device failure	The monitoring of the auxiliary device is abnormal

7.2 Alarm list

Alarm code	Serial no.	Class no.	Alarm name	Alarm content	Alarm clear
--	0	0	No alarm	Normal operation	
Er 1	1	17	Over speed	Motor speed exceeds the maximum limit	Can
Er 2	2	4	Main circuit over-voltage	The main circuit supply voltage exceeds the specified value	Can
Er 3	3	1	Main circuit undervoltage	The main circuit supply voltage is below the specified value	Can
Er 4	4	17	Position deviation	Position deviation counter value exceeds the set value	Can
Er 7	7	17	Drive inhibition abnormal	CCWL, CWL driver prohibited input are invalid	Can
Er 8	8	17	Position deviation counter overflow	The absolute value of position deviation counter exceeds 2^{30}	Can
Er 9	9	11	Pulse encoder signal failure	Pulse encoder signal failure	No
Er 11	11	5	Power module over-current	Power module failure	No
Er 12	12	8	Over-current	Excessive motor current	No
Er 13	13	8	Over-load	Motor overload	No
Er 14	14	14	Brake peak power overload	Brake instantaneous short time load is too large	No
Er 15	15	11	Pulse encoder count error	Pulse encoder count error	No
Er 16	16	8	Motor thermal overload	Motor calorific value exceeds the set value (I^2t detection)	No
Er 17	17	14	Average braking power overload	Excessive average load after braking for a long time	No
Er 18	18	5	IGBT model over-load	Average output load of power model is too big	No
Er 20	20	1	EEPROM error	EEPROM read/write error	No
Er 21	21	1	Logic circuit error	Logic circuit fault outside DSP	No
Er 22	22	18	Mismatch between power board and control board	Replace the power board or control board	No
Er 23	23	1	AD conversion error	Circuit or current sensor fault	No
Er 25	25	1	FPGA verification error	FPGA verification error	No
Er 27	27	2	Phase loss alarm	Check whether the power line is three-phase input	No
Er 29	29	5	Torque overload alarm	Motor load exceeds user set value and duration	No

Alarm code	Serial no.	Class no.	Alarm name	Alarm content	Alarm clear
Er 30	30	11	Pulse encoder Z signal loss	Pulse encoder Z signal loss	No
Er 35	35	12	Connection failure between boards	Drive internal connection path failure	No
AL 36	36	1	Fan alarm	Fan fault	No
Er 40	40	11	Absolute value encoder communication error	Drive and encoder cannot communicate	No
Er 41	41	19	Absolute value encoder handshake error	Absolute value encoder handshake error	No
Er 42	42	11	Absolute value encoder internal count error	Absolute value encoder count exception	No
Er 43	43	11	Absolute value encoder communication response error	Absolute value encoder communication response abnormal	No
Er 44	44	11	Absolute value encoder verification error	Absolute value encoder communication content error	No
Er 45	45	19	Absolute value encoder EEPROM error	EEPROM fault of absolute value encoder	No
Er 46	46	19	Absolute value encoder parameter error	Absolute value encoder parameters are damaged	No
Er 47	47	19	Absolute value encoder external battery error	Battery voltage is too low	No
Er 48	48	19	Absolute value encoder external battery alarm	Low battery voltage	No
Er 49	49	8	Encoder overheating	Encoder overheating	No
Er 50	50	18	Motor parameters do not match the driver	Power mismatch between motor and drive	No
Er 51	51	18	Encoder automatic recognition failed	Encoder automatic recognition failed	No
Er 55	55	18	Encoder function not supported	Encoder function not supported	Can
Er 56	56	18	Encoder position value is invalid	Encoder position value is invalid	Can
Er 57	57	18	Encoder multi turn fault	Encoder multi turn fault	No
Er 61	61	1	Ethernet communication cycle deviation too large	Ethernet communication cycle deviation too large	No
Er 62	62	9	Ethernet command data out of range	Ethernet command data out of range	No
Er 63	63	19	Internal error	Internal error	No
Er 65	65	19	SYNC signal initialization error	SYNC signal initialization error	No

Alarm code	Serial no.	Class no.	Alarm name	Alarm content	Alarm clear
Er 66	66	19	SYNC signal and data receiving beat error	Sync signal and data receiving phase error	No
Er 67	67	9	SOL synchronous counting errors	SOL synchronous counting errors	Can
Er 71	71	18	Message setting error	Message setting error	No
Er 75	75	19	Ethernet bus interface data exchange error	Ethernet bus interface data exchange error	No
Er 77	77	19	Search for reference point block failed	Search for reference point block failed	Can
Er 78	78	19	Search for zero pulse failed	Search for zero pulse failed	Can
Er 80	80	1	Internal error 1	Internal calculation error, illegal electronic gear setting	No
Er 81	81	1	Internal error 2	Internal calculation error, parameter setting to 0 is abnormal	No
Er 82	82	1	Internal error 3	Internal calculation error, homing parameter setting illegal	No
Er 85	85	19	Negative soft limit exceeded	Axis position exceeds negative soft limit point	Can
Er 86	86	19	Positive soft limit exceeded	Axis position exceeds the positive soft limit point	Can
Er 90	90	1	Dynamic braking fault	Dynamic braking fault	Can
Er 91	91	19	Vibration fault	Vibration fault	Can
Er 92	92	6	Power module temperature warning	Power module temperature warning	Can
Er 93	93	6	Power module temperature alarm	Power module temperature alarm	No
Er100	100	18	Auxiliary encoder setting is abnormal	Auxiliary encoder setting is abnormal	No
Er998	998	1	Authorization exception	Authorization exception	No
AL 999	999	19	Local command validation warning	Local command validation warning	No

7.3 Alarm causes and handling

In this user manual, "☆" represents the unique function of the multi turn absolute value code disk, and "★" represents the unique function of the incremental code disk.

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 3 (Main circuit undervoltage)

Potential cause	Check	Handle
Main power supply is abnormal	Check the main power supply	Make the voltage meet the product specification
Drive hardware issues	Check drive hardware	Repair.

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
Encoder wiring error	Check encoder wiring	Correct wiring
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、P013	Increase position loop gain
Insufficient torque	Check torque	● Increase torque limit ● Increase position command smoothing filter time ● Reduce load ● Replace higher power drive and motor

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 9 (Pulse encoder signal failure)

Potential cause	Check	Handle
Encoder wiring error	Check encoder wiring	Correct wiring
Poor encoder cable and connector	Check cables and connectors	Replace cables and connectors
Motor model is not set correctly	Check the motor model	Reset the motor model
Encoder damaged	Check encoder	Replace encoder

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
Wiring error	Is B1 and B2 not short circuited Check the driver model and whether it is necessary to connect an external braking resistor for use	Short circuit B1 and B2 Connecting external braking resistors for use

Er 15 (Pulse encoder count error)

Potential cause	Check	Handle
Encoder wiring error	Check encoder wiring	Correct wiring, including shielded wires
Poor grounding	Check the grounding wire	Correct grounding
Disturbed	Check interference source	Stay away from interference
Encoder problem	● Wrong number of wires and poles ● Encoder Z signal error ● Encoder damaged	Replace encoder

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 22 (Mismatch between power board and control board)

Potential cause	Check	Handle
Control board and power board does not match	Whether the control panel has been replaced by itself	Use a control board that matches the power board

Er 23 (AD conversion error)

Potential cause	Check	Handle
Current sensor and connector problems	Check the main circuit	If the fault persists, replace the driver
AD converter and analog amplifier circuit problems	Check the control circuit	If the fault persists, 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 30 (Pulse encoder Z signal loss)

Potential cause	Check	Handle
Encoder problem	Encoder Z signal error	Replace encoder
Encoder cable and connector problems	Check cables and connectors	Replace cable and connector
Driver interface circuit failure	Check the control circuit	Replace driver

Er 35 (Connection failure between boards)

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 (Absolute value 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 49 (Encoder overheating)

Potential cause	Check	Handle
Encoder overheating	Whether the motor power is too small or the ambient temperature is too high	● Replace the motor with a suitable power or temperature rating ● Reduce ambient temperature

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 55 (Encoder function not supported)

Potential cause	Check	Handle
The requested encoder function is not supported	Check encoder function settings	Check encoder function settings

Er 56 (Encoder position value is invalid)

Potential cause	Check	Handle
Encoder status abnormal	Check encoder error codes	Clear encoder error

Er 57 (Encoder multi turn fault)

Potential cause	Check	Handle
Abnormal multi turn reading of encoder	Check encoder settings	Change encoder settings

Er 61 (Ethernet communication cycle deviation too large)

Potential cause	Check	Handle
Industrial Ethernet communication interruption	Check the Ethernet cable	Replacing the Ethernet cable
Ethernet communication cycle jitter is too large	● Increase communication cycle time ● Reduce the load on the master station	● Increase communication cycle time ● Reduce the load on the master station

Er 62 (Ethernet command data out of range)

Potential cause	Check	Handle
The current communication cycle command data exceeds the limit	● Check user unit settings ● Check electronic gear settings	● Change user unit settings ● Change electronic gear settings

Er 63 (Internal error)

Potential cause	Check	Handle
Internal error	Whether the servo firmware is a test version or an incompatible version	Perform firmware upgrade operation and refresh servo firmware

Er 65 (SYNC signal initialization error)

Potential cause	Check	Handle
No SYNC signal received after entering OP state	Check host configuration	Check host configuration

Er 66 (SYNC signal and data receiving beat error)

Potential cause	Check	Handle
No SYNC signal received after entering OP state	Check host configuration	Check host configuration

Er 67 (SOL synchronous counting errors)

Potential cause	Check	Handle
SOL cycle synchronization count error	● Check the configuration parameter configuration ● Check Ethernet cable	● Check the configuration parameter configuration ● Check Ethernet cable

Er 71 (Message setting error)

Potential cause	Check	Handle
Message setting error	Check message settings	Check message settings

Er 75 (Ethernet bus interface data exchange error)

Potential cause	Check	Handle
Ethernet bus interface data exchange error	Power on again for inspection	If the fault persists, replace the driver

Er 77 (Search for reference point block failed)

Potential cause	Check	Handle
No REF signal found during the search for reference point travel	● Check the REF signal wiring ● Check related configurations	● Check the REF signal wiring ● Check related configurations

Er 78 (Search for zero pulse failed)

Potential cause	Check	Handle
No zero pulse was found during the search for zero pulse travel	● Check related configurations	● Check related configurations

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 85 (Negative soft limit exceeded)

Potential cause	Check	Handle
Axis position exceeds negative soft limit point	● Clear the error and send a limit direction opposite command.	● Clear the error and send a limit direction opposite command.

Er 86 (Positive soft limit exceeded)

Potential cause	Check	Handle
Axis position exceeds the positive soft limit point	● Clear the error and send a limit direction opposite command.	● Clear the error and send a limit direction opposite command.

Er 90 (Dynamic braking fault)

Potential cause	Check	Handle
Abnormal status of dynamic brake relay	Power on again for inspection	If the fault persists, replace the driver

Er 91 (Vibration fault)

Potential cause	Check	Handle
Mechanical vibration occurs	Check mechanical structure or gain related parameters	Reduce gain related parameters

Er 92 (Power module temperature warning)

Potential cause	Check	Handle
Power module problem exceeds the parameter setting value	● Check the heat dissipation of the cabinet ● Check the load condition of the equipment	● Improve cabinet heat dissipation conditions ● Troubleshooting abnormal load issues

Er 93 (Power module temperature alarm)

Potential cause	Check	Handle
Power module temperature greater than 125 ℃	● Check the heat dissipation of the cabinet ● Check the load condition of the equipment	● Improve cabinet heat dissipation conditions ● Troubleshooting abnormal load issues

Er 100 (Auxiliary encoder setting is abnormal)

Potential cause	Check	Handle
Auxiliary encoder setting is abnormal	● Check whether the device is configured with an auxiliary encoder ● Check the auxiliary encoder settings	Change the auxiliary encoder settings

Er 998 (Authorization exception)

Potential cause	Check	Handle
Authorization exception	Authorization exception	Contact the manufacturer

AL 999 (Local command validation warning)

Potential cause	Check	Handle
Set invalid operation mode	Setting of operating mode	Set the valid operating mode according to 6502h

Chapter 8 Specifications

8.1 Driver model

EP5 - T L 15 PN X

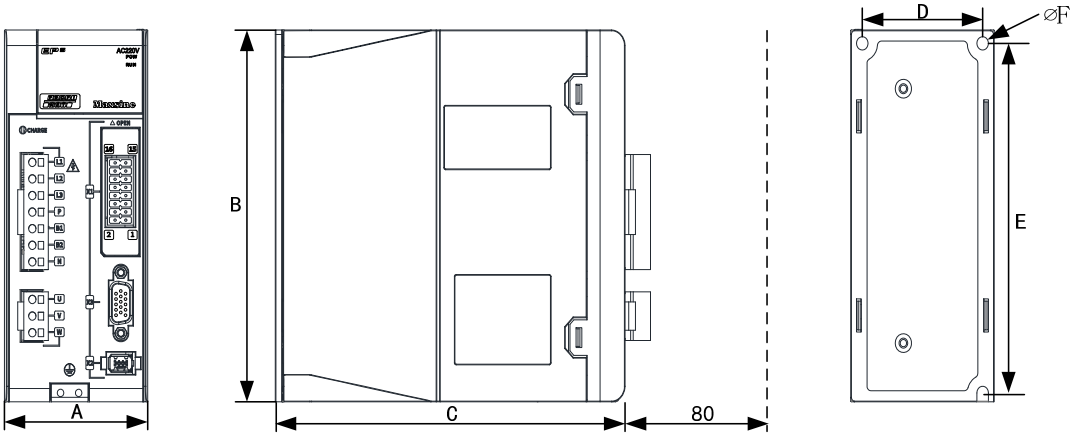
Mark	Main circuit supply voltage
L	AC220V
H	AC380V

Mark	Encoder type
Blank	Standard machine
***	Other customized models

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

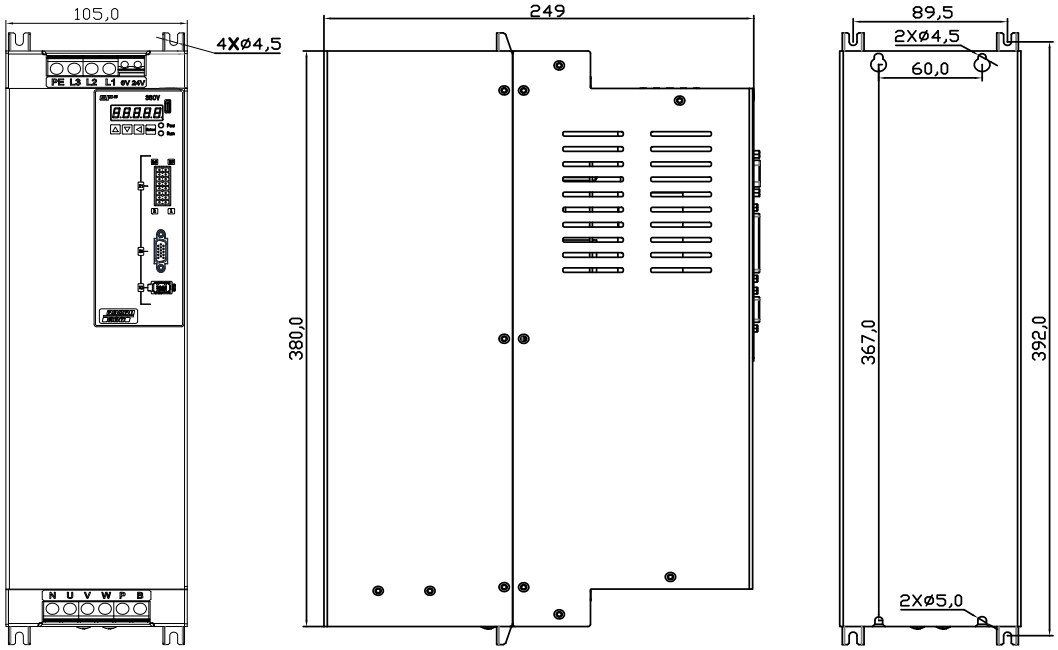
8.2 Driver size



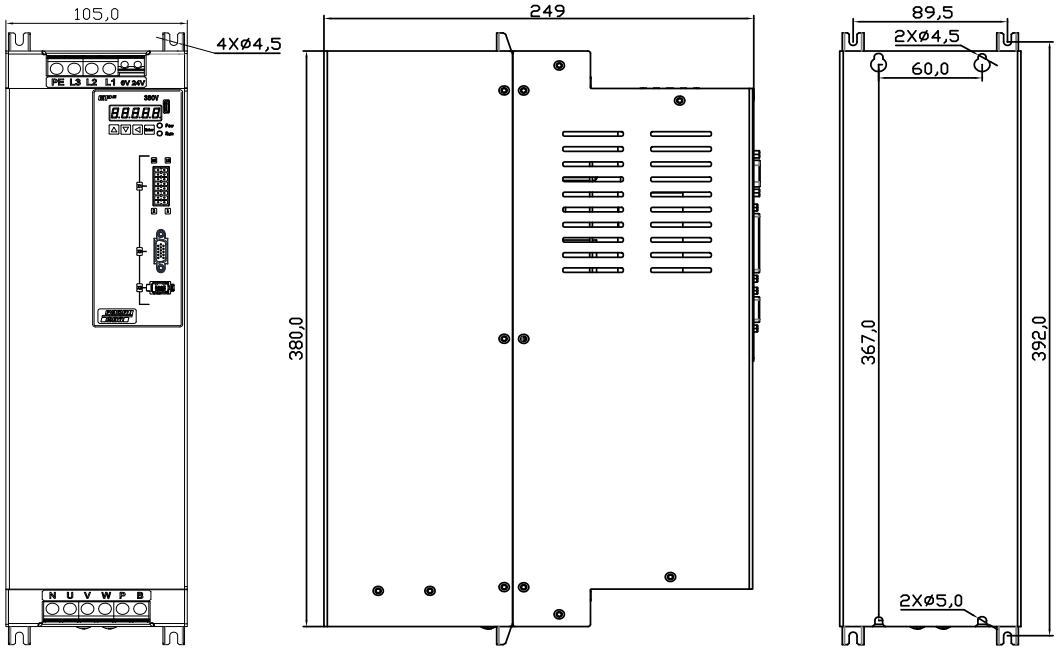
Model / Size (mm)	TL04	TL08	TL10	TL15	TL25	TL35	TL55
A	45	45	55	75	95	105	115
B	170	170	170	168	200	220	250
C	156	156	171	183	182	182	212
D	34.5	34.5	43	63	84	94	104
E	161	161	161	158	189	209	239
F	5.2	5.2	5.2	5.2	5.2	5.2	5.2

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

Model		TL04	TL08	TL10	TL15	TL25	TL35	TL55	TH15	TH20	TH30	TH50	TH75	TH90	TH110	TH150
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 phase AC220V -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														
Control mode		Vector control														
Regenerative braking		Built-in/built-out						built-out	Built-in/built-out			built-out				
Feedback mode		Standard 23 bit/multi turn absolute encoder, optional with other specifications														
Control mode		Cyclic Synchronous Position Mode （CSP）、Cyclic Synchronous Velocity Mode （CSV）、Cyclic Synchronous Torque Mode （CST）……														
Digital input		4 programmable input terminals (photoelectric isolation), 2 high-speed optocoupler inputs														
Digital output		3 programmable output terminals (photoelectric isolation)														
Special function		Mechanical resonance notch filter, vibration suppression, optional with STO														
Monitoring function		Speed, current position, position deviation, motor torque, motor current, command pulse frequency, etc														
Protection function		Overspeed, overvoltage, overcurrent, overload, abnormal braking, abnormal encoder, position deviation, etc														
Characteristic	Speed frequency response	1.2kHz														
	Speed fluctuation rate	＜±0.03%（负载 0～100%）；＜±0.02%（电源-15%～+10%）														
	Speed regulation ratio	1:5000														

8.4 Motor adaptation table of the driver

Motor model (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 model（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

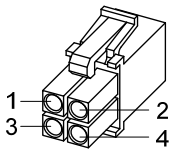
⑥

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

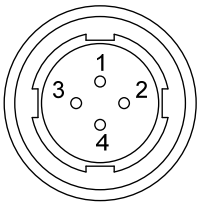
Note: "G" is standard for all series motors of 40/60/80, "H" is standard for all series motors of 110/130/180. The symbol of standard configuration is omitted when ordering.

8.6 Servo motor wiring

8.6.1 Winding wiring



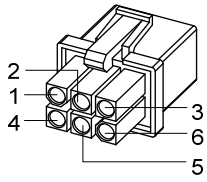
40/60/80 motor power supply plug



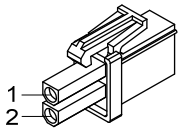
110/130/180 motor power supply plug

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

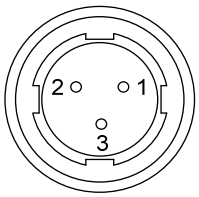
8.6.2 Brake wiring



40 motor with brake power plug



60/80 motor brake plug



110/130 motor brake plug

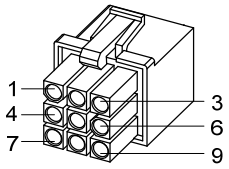
40 motor with brake power supply wiring:

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	

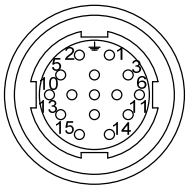
60、80、110、130、180 motor brake wiring:

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

In this user manual, "☆" represents the unique function of the multi turn absolute value code disk, and "★" represents the unique function of the incremental code disk.

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