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BD3E-AP Servo System

User Manual

Revision History

Document Revision Number	Date	Notes
0.1	March 2025	BD3E Series Pulse Type Servo – Initial Release.
0.2	June 2025	Modify the DO channel identification in Figure 5-5

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Preface

Document Overview

The BD3E series pulse-type servo is a high-performance medium and small power servo drive. The BD3E series pulse-type servo drive can match servo motors ranging from 50W to 3000W, ensuring that machine manufacturers achieve optimal motion control performance, machine operation efficiency, and high output. The pulse-type servo supports the Modbus communication protocol, allowing multiple servo drives to be networked and operated in conjunction with a higher-level computer.

The BD3E series pulse-type servo kit also includes the PM2 series high-performance AC servo motors. The PM2 series motors are designed to meet the requirements of advanced automation, featuring low torque ripple at low speeds, low temperature rise, high torque density, and strong overload capacity; the PM2 motors are equipped with 20-bit magnetic absolute encoders that support single-turn or multi-turn configuration options. All motor encoder units have a set of motor parameters (Motor Electronic Nameplate MTP, stored in the encoder EEPROM) built-in. When the drive starts and detects the MTP, these parameter values are directly loaded from the encoder memory to the drive memory, enabling automatic recognition and matching of the drive and motor without additional operations, ensuring simplicity and reliability in use.

Suitable for automated equipment in industries such as electronics manufacturing, robotics, packaging, and machine tools, providing rapid and precise position control, speed control, and torque control with high cost-effectiveness.

1Installation

1.1Driver Installation

Please read the following safety instructions carefully; failure to comply with these instructions can result in serious consequences. Note:BD3EImproper handling can cause personal injury and/or damage to equipment.

Will BD3EWhen connecting to other control devices, ensure that two basic principles are followed to prevent damage to the drive:

●BD3EThe drive must be safely grounded through the AC main power ground wire.

●Any motion controller, PLC, or PC connected to the BD3E must have its ground wire connected to the same ground as the BD3E.

- Installation or Commissioning BD3EBefore installation or commissioning, please review all relevant product documentation.
- Install strictly according to the product specifications and installation instructions.
- All system components must be grounded. Provide electrical safety through a low-resistance grounding connection (protection class 1 as specified in EN/IEC 61800-5-1). The motor should be connected to the protective earth conductor via a separate grounding wire with a rating not less than that of the motor cables.
- As part of machine design, the machine manufacturer must prepare a machine hazard analysis and take appropriate measures to ensure that unintended movements will not cause bodily injury and/or equipment damage.
- The drive meets IP20 (IEC 60529 standard) requirements; therefore, the machine manufacturer must select an appropriate enclosure. The enclosure must meet at least IP54 (IEC 60529 standard) requirements, be made of metal or material with a flammability rating of 5VA, and have no openings at the bottom.
- The protective earth leakage current exceeds 3.5 mA; therefore, to comply with IEC61800-5-1 standard requirements, a dual PE connection (one through the main power ground wire, the other through the heat sink connected to the grounded equipment base) can be used, or a copper connection cable with a cross-sectional area greater than 10mm^2 can be used. Use the drive installation screws and PE connection screws to meet this requirement.

●In addition to being used for protective grounding, yellow-green wires must not be used for any other wiring.

●The power cable rating should be at least 600V/70°C.

●The motor and cables must be properly installed to avoid ground short circuits. Use a residual current circuit breaker to enhance system safety.

1.1.1Installation Precautions

• When installing near heat sources, control the temperature rise around the servo unit due to heat radiation or convection from the heat source to ensure that the environmental conditions are met.

• When installing near vibration sources, install anti-vibration devices on the mounting surface of the servo unit to prevent vibration from being transmitted to the servo unit.

• Do not expose this product to environments containing moisture, corrosive gases, flammable gases, or other such substances, as this may cause electric shock or fire.

• Ensure that wiring is performed correctly and reliably. Failure to do so can result in motor malfunction, personal injury, or machine failure.

• Do not connect commercial power sources to the servo motor connection terminals U, V, W of the servo drive, as this can cause injury or fire.

• Ensure that the power terminal and motor connection terminals are securely connected; otherwise, a fire may occur.

• Do not use the same conduit for the main circuit cables and the input/output signal cables/encoder cables, nor should they be bundled together. When wiring, maintain a separation of at least 30cm between the main circuit cables and the input/output signal cables.

• Use twisted pair wire or multi-core twisted pair overall shielded wire for the input/output signal cable and encoder cable.

• The wiring length of the input/output signal cable: maximum 3m; encoder cable: maximum 20m.

• Even after the power is turned off, high voltage may still remain inside the servo driver. Therefore, do not touch the power terminals while the charging indicator (CHARGE) light is on. Confirm that the charging indicator (CHARGE) light has gone out before performing wiring and inspection work.

• When using in the following locations, appropriate shielding measures should be taken.

- ◆ When interference is generated due to static electricity, etc.
- ◆ Locations where strong electric fields or strong magnetic fields are generated
- ◆ Locations where there may be radiation

• When connecting the battery, pay attention to the polarity; otherwise, it can cause damage and explosion of the battery, servo driver, and servo motor.

1.1.2Unpacking

After delivery, check if the outer box is intact to avoid damage during transportation. Please open the package and remove all packaging materials.

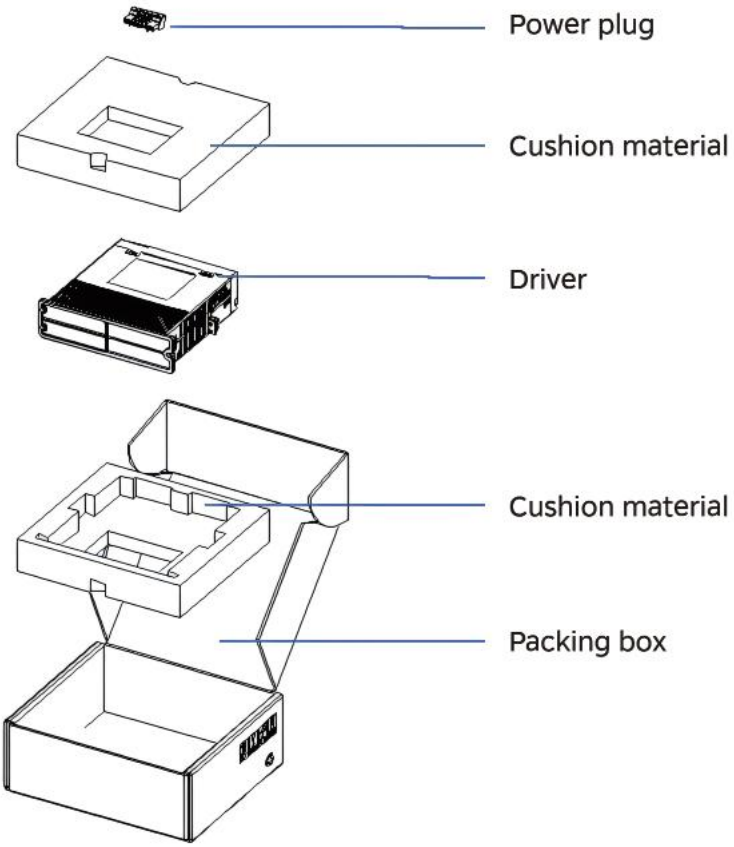


Figure 1–1 Schematic Diagram of Driver Packaging Components

The package includes one BD3E series pulse-type driver and one each of the power plug and IO plug.

Inspect the product to ensure BD3Ethere is no visible damage to the driver. If any damage is found, notify the carrier immediately.

Verify that the model label on the driver matches the order to ensure the product meets the application requirements.

1.1.3Installation Environmental Requirements

Table 1–1 Environmental Requirements

Item	Requirement
Installation Location	Indoor
Overvoltage Category	Overvoltage Category III (OVC III)
Altitude	No derating required for use at altitudes up to 1000m. For altitudes above 1000m, derate by 1% for every additional 100m. Contact the manufacturer if the altitude exceeds 2000m.
Ambient Temperature	Storage temperature: -20 to 70°C. Operating temperature: -20°C to 55°C; no derating required from -20°C to 45°C. For temperatures above 45°C, derate by 2% for each additional 1°C.
Environmental Humidity	Below 90%RH, No Condensation
Vibration Requirements	Below 1g
Protection Rating	IP20
Other Environmental Requirements	Pollution Degree 2 or Below Please install the product in the following locations: Away from direct sunlight, free from dust, corrosive gases, flammable and explosive gases, oil mist, water vapor, dripping water or salt, radioactive substances, flammable materials, and other harmful gases and liquids, and areas with minimal salt corrosion. Please install in a location that does not vibrate easily (especially away from stamping machines and similar equipment). Foreign objects such as metal powder, oil, and water must not enter the interior of the product. Do not use in a vacuum environment; it is recommended to use at an air pressure of 89.9kPa (1000m altitude) or above.

1.1.4Installation Space Requirements

When installing a single driver in the control cabinet, as shown in the left image of Figure 1-2, it is recommended to leave at least 10mm of space on both sides horizontally and at least 50mm of space on both sides vertically between the driver and the control cabinet.

When installing multiple drivers in the control cabinet, the installation space requirements around each driver vary depending on the power rating. To ensure good heat dissipation conditions for the drivers, it is recommended to leave at least 10mm of space on both sides horizontally between drivers, and at least 20mm of space on both sides horizontally and at least 50mm of space on both sides vertically between the drivers and the control cabinet.

Please estimate the temperature rise inside the control cabinet and install appropriate fans.

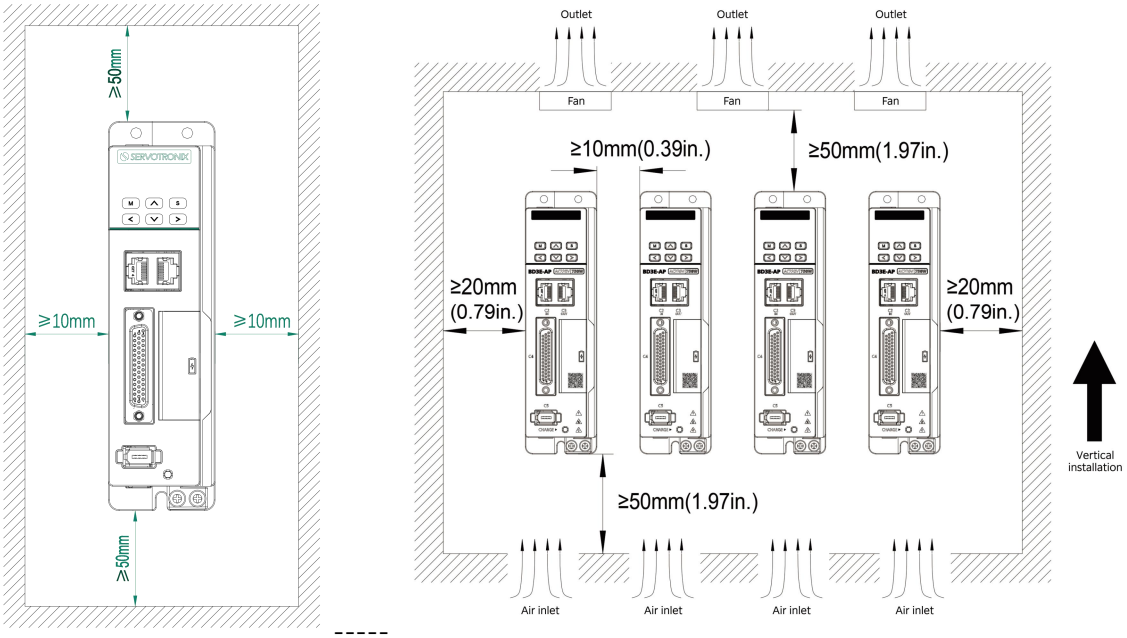


Figure 1-2 Installation Diagram

1.1.5Installation Dimension Requirements

When designing the control cabinet, consider the internal space based on wiring. The following are the recommended cable lengths and installation dimensions provided by Gozuk.

The dimensions of BD3E-1D62AAP / BD3E-2D82AAP are shown in the figure below.

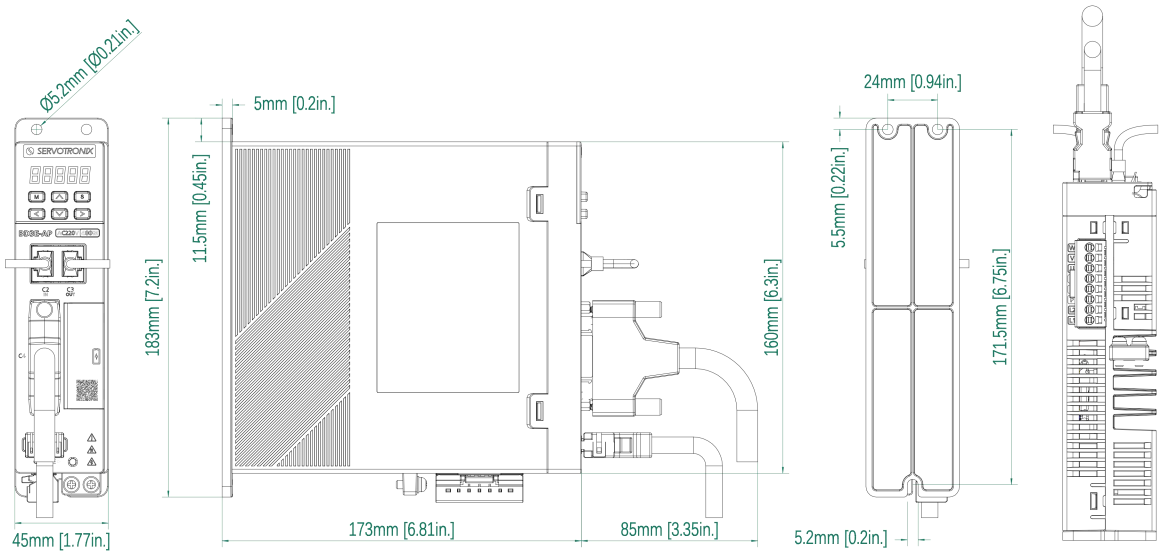


Figure 1-3 Dimensions of BD3E-1D62AAP / BD3E-2D82AAP

The dimensions of BD3E-5D52AAP are shown in the figure below:

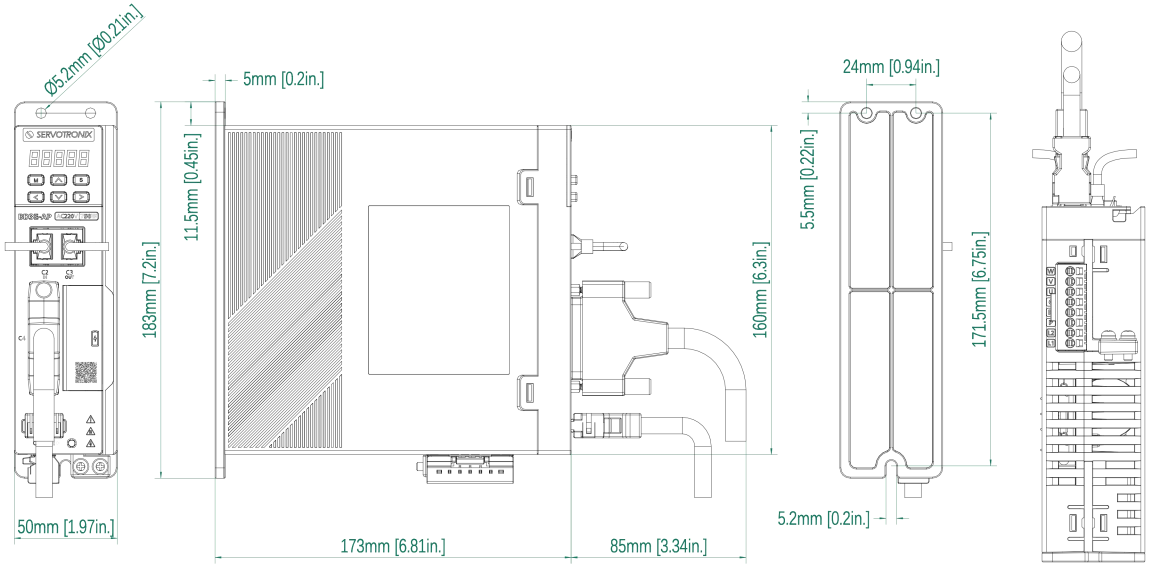


Figure 1-4 Dimensions of BD3E-5D52AAP

The dimensions of BD3E-3D54DAP / BD3E-5D44DAP are shown in the figure below:

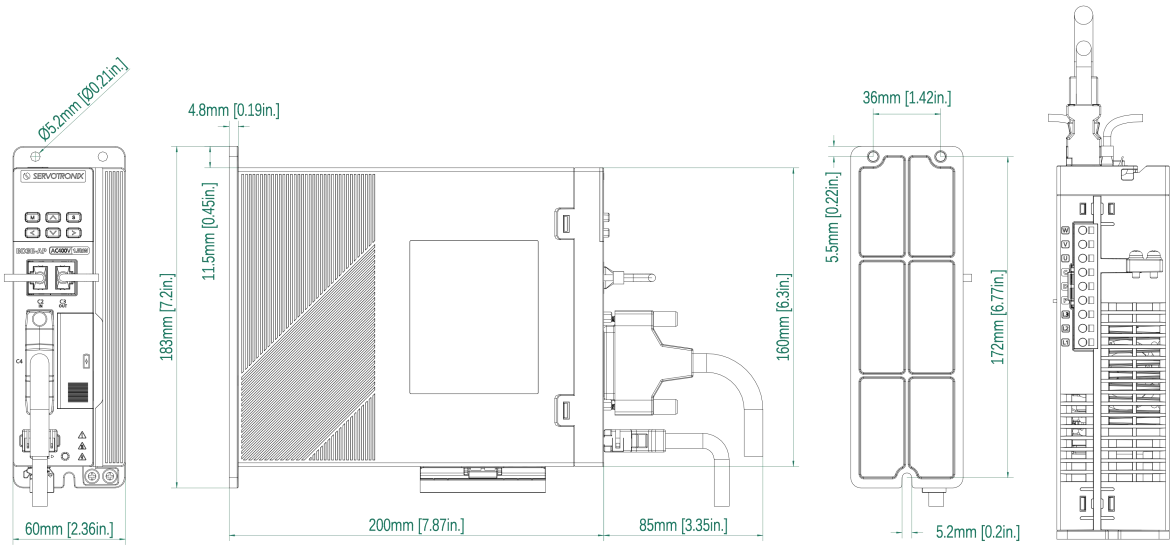


Figure 1–5 Dimensions of BD3E-3D54DAP/BD3E-5D44DAP

The dimensions of BD3E-8D44DAP/BD3E-0124DAP are shown in the figure below:

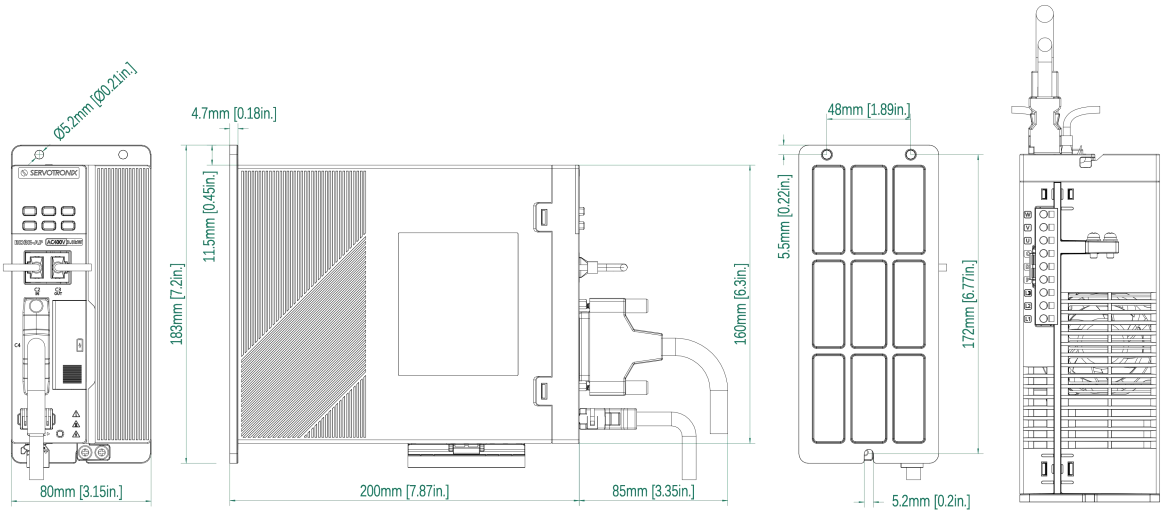


Figure 1–6 Dimensions of BD3E-8D44DAP/BD3E-0124DAP

1.2Installation of Optional Accessories

1.2.1Fuses and Circuit Breaker Installation Instructions

To comply with EU safety standards EN 6180051 and UL6180051, it is essential to connect a fuse/circuit breaker on the input side.----
Circuit breaker, to prevent accidents caused by internal circuit short-circuiting. Circuit protection must also comply with the local National Electrical Code and/or regulations set by national, state, provincial, and/or local authorities.

- US fuse: RK5, CC, J or T type, AC 600 V 200 kA, time-delay. It must be UL and CSA certified; UR recognition alone is not sufficient.

- EU Fuse: Type gRL or gL, 400 V/500 V, time-delay.
- Fuse Holder: Standard fuse holder, or finger-safe fuse holder compliant with IEC 60529 standards. For example:
- Bussmann: CH series modular fuse holder, fuse rating below 30A, Class J, 3-pole: CH30J3.
- Ferraz: Ultrasonic fuse, fuse rating below 30A, Class J, 3-pole: US3J3I.
- Circuit Breaker: Type D tripping curve.

1.2.2AC Input Reactor Installation Instructions

To effectively filter out higher harmonic pollution on the input side, suppress sudden changes in grid voltage and instantaneous surges, and protect the driver's power module from damage, it is recommended to install an AC reactor on the input side of the control cabinet.

The metal enclosure of the reactor must be effectively grounded.

1.2.3EMC Filter Installation Instructions

E MC filter should be installed close to the servo driver, and the wire length between the filter and the driver's input terminals should be kept within 30cm.

The manufacturers and part numbers of the recommended filters for BD3E are listed in the table below.

Table 1-2 Recommended Filters for BD3E

Driver	Manufacturer Part Number
BD3E-1D62A BD3E-2D82A	LCR：055M.80601.00
	LCR：092.00623.00
	Schaffner：FN2070-6
BD3E-5D52A	LCR：0923.01021.00
	LCR：092.01023.00
	LCR：055.81011.00
	Schaffner：FN2070-10
BD3E-3D54D BD3E-5D44D BD3E-8D44D BD3E-0124D	LCR：096B.02001.00
	LCR：097.01601.00
	Schaffner：FN3258-16-44

The implementation of the input power filter must follow the guidelines below:

- Keep the wires entering and exiting the power filter separate.

- The filter must be installed on the same panel as the driver.
- The filter must be installed as close to the driver as possible to prevent capacitive coupling to other signal lines and cables, which can generate noise.
- When mounting the filter on a panel, remove all paint or material coatings. If possible, use an unpainted metal backplate.
- The filter is equipped with a grounding terminal, which must be grounded.

Ferrite Core Installation Instructions

Installing a ferrite core on the motor power line at the driver side can effectively reduce electromagnetic noise. It is recommended to use an amorphous ferrite core, installed as shown in the figure below. The ground wire does not pass through the ferrite core.

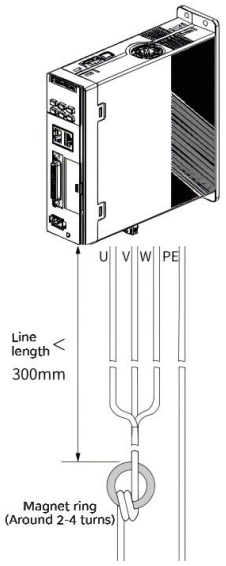


Figure 1–7 Schematic Diagram of Ferrite Core Installation

Installation Instructions for Residual Current Protective Switch

The leakage current of the PE conductor comes from the combination of leakage currents from equipment and cables. Please install a residual current device (RCD) on the primary side of the power supply and select it according to the following conditions:

- Please use a Type B (DC-sensing type) RCD as specified in IEC60947-2 and JISC8201-2-2.
- When the servo driver is operating, it generates a certain amount of high-frequency leakage current. To avoid false tripping of the RCD, please select an RCD with an operating current of no less than 100mA for each servo driver.

- When multiple servo drivers share one RCD, an RCD with an operating current of no less than 300mA should be selected. RCDs from brands such as Chint and Schneider are recommended.

2System Wiring Diagram

2.1System Wiring Instructions

To meet the requirements of the CE standard in industrial environments, an electromagnetic interference filter must be installed on the input power line of the BD3E series pulse-type servo system components.

It is essential to properly size the system. Select the appropriate filter model based on the system's rated voltage, rated current, and whether it is single-phase or three-phase input.

When installing the input power filter, the following principles must be observed:

- Separate the input and output lines of the power filter from each other.
- The filter must be installed on the same backplate as the driver.
- The filter should be installed as close as possible to the driver to prevent noise from interfering with other signal wires and cables through capacitive coupling.
- When installing the filter on the back panel, all paint or coatings must be removed. Where possible, choose a metal back panel that has not been painted.
- The grounding terminal supplied with the filter must be grounded.
- The filter may generate significant leakage current. The filter must be grounded before connecting the power supply.

2.2System Wiring Diagram

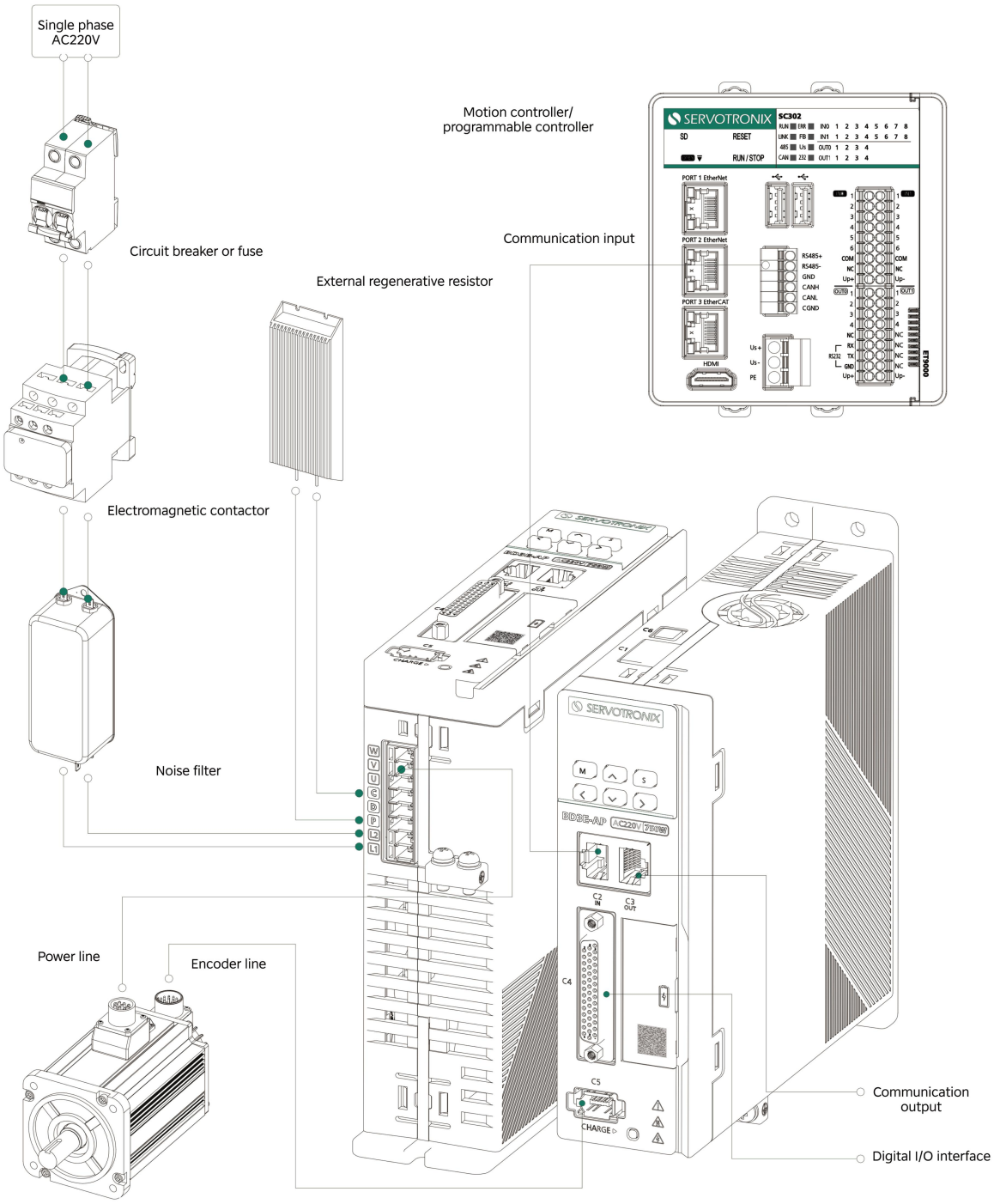


Figure 2-1 Single-phase 220V Model System Wiring Diagram

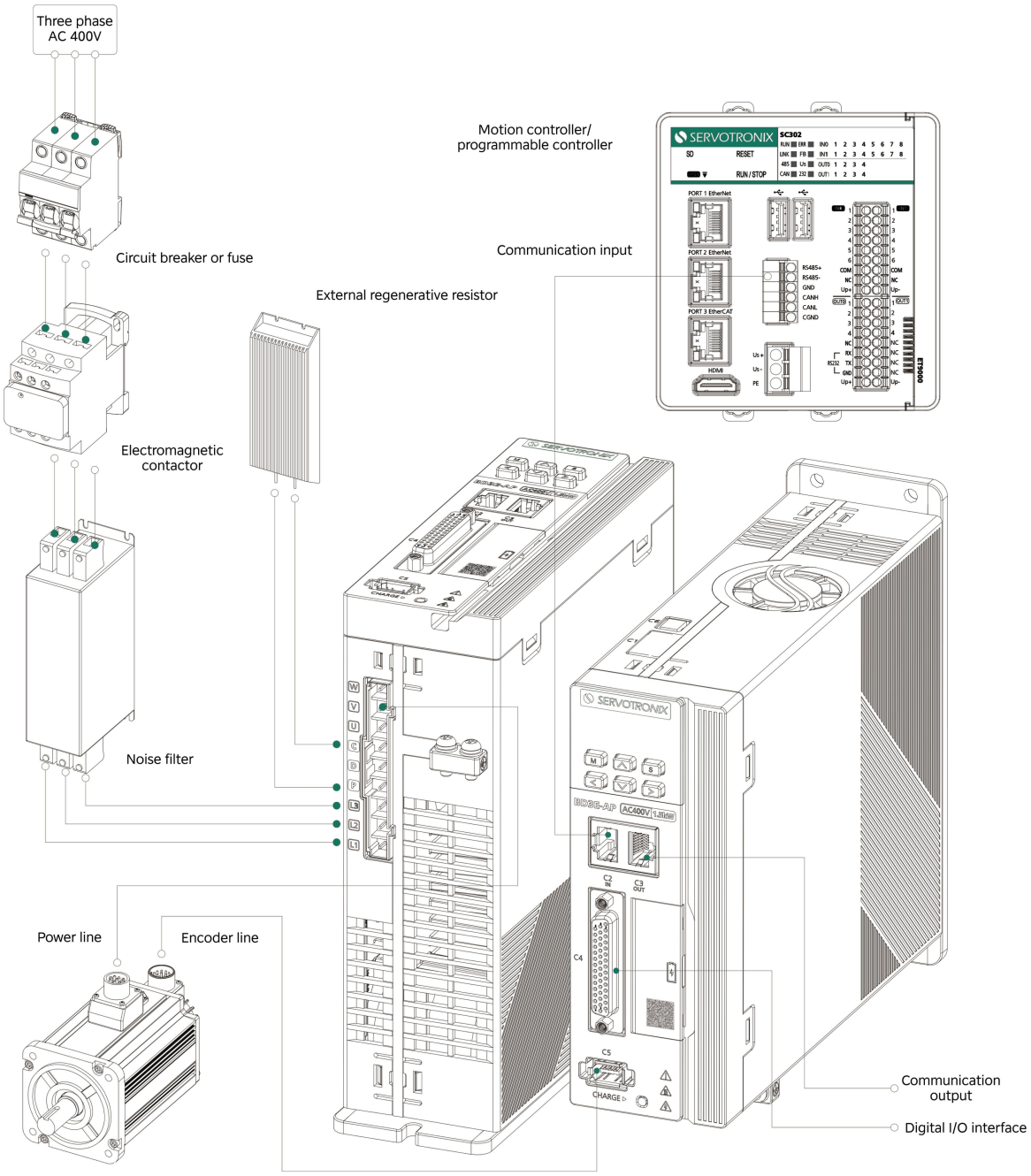


Figure 2-2 Three-phase 380V Input System Wiring Diagram

Note: When an external regeneration resistor is required, connect the resistor to terminals P and C, and open the circuit between terminals P and D (remove the shorting link between P and D). If no external braking resistor is needed, keep the shorting link between P and D, except for SIZE A which does not come standard with an internal resistor.

2.3System Grounding Diagram

When connecting the BD3E series pulse-type servo to other control devices, it is essential to follow the two fundamental principles below to prevent damage to the driver:

●The BD3E series pulse-type servo must be grounded through the main AC power ground terminal.

●Any motion controller or PLC connected to the BD3E series pulse-type servo must also be grounded through the same ground terminal, just like the BD3E series pulse-type servo.

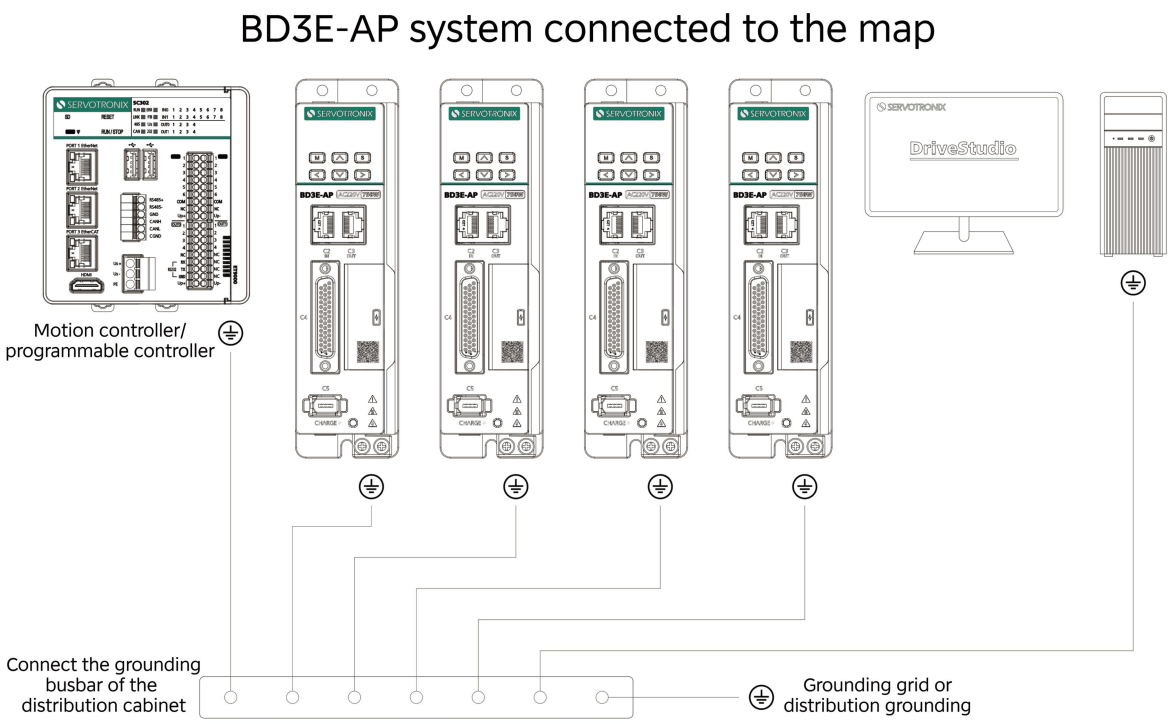


Figure 2-3 System Grounding Wiring Diagram

3External Pulse Command Position Mode Wiring Diagram

3.1Differential Command Input

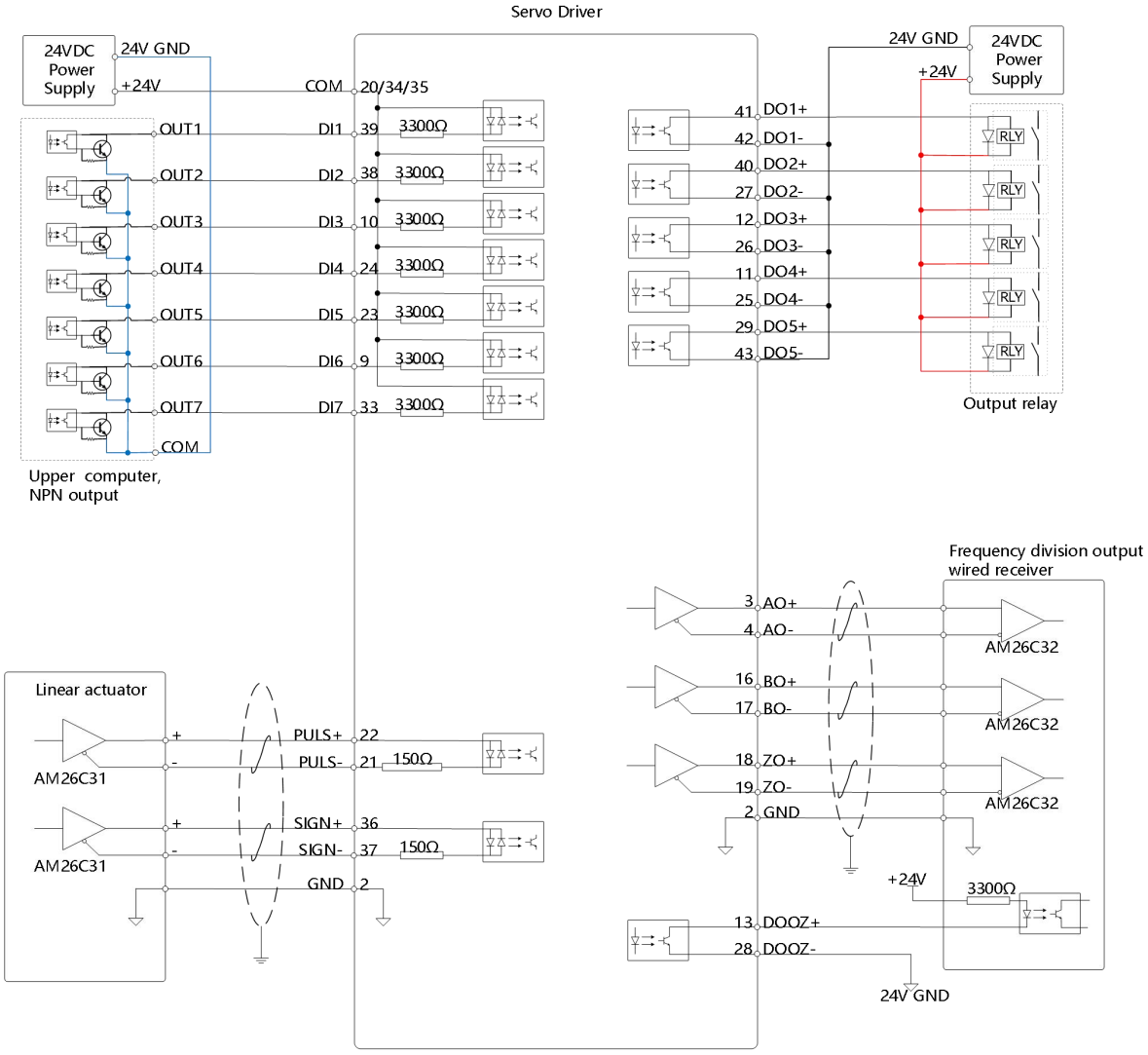


Figure 3-1 Differential Pulse Command Position Mode Wiring Diagram

3.2Open Collector Command Input

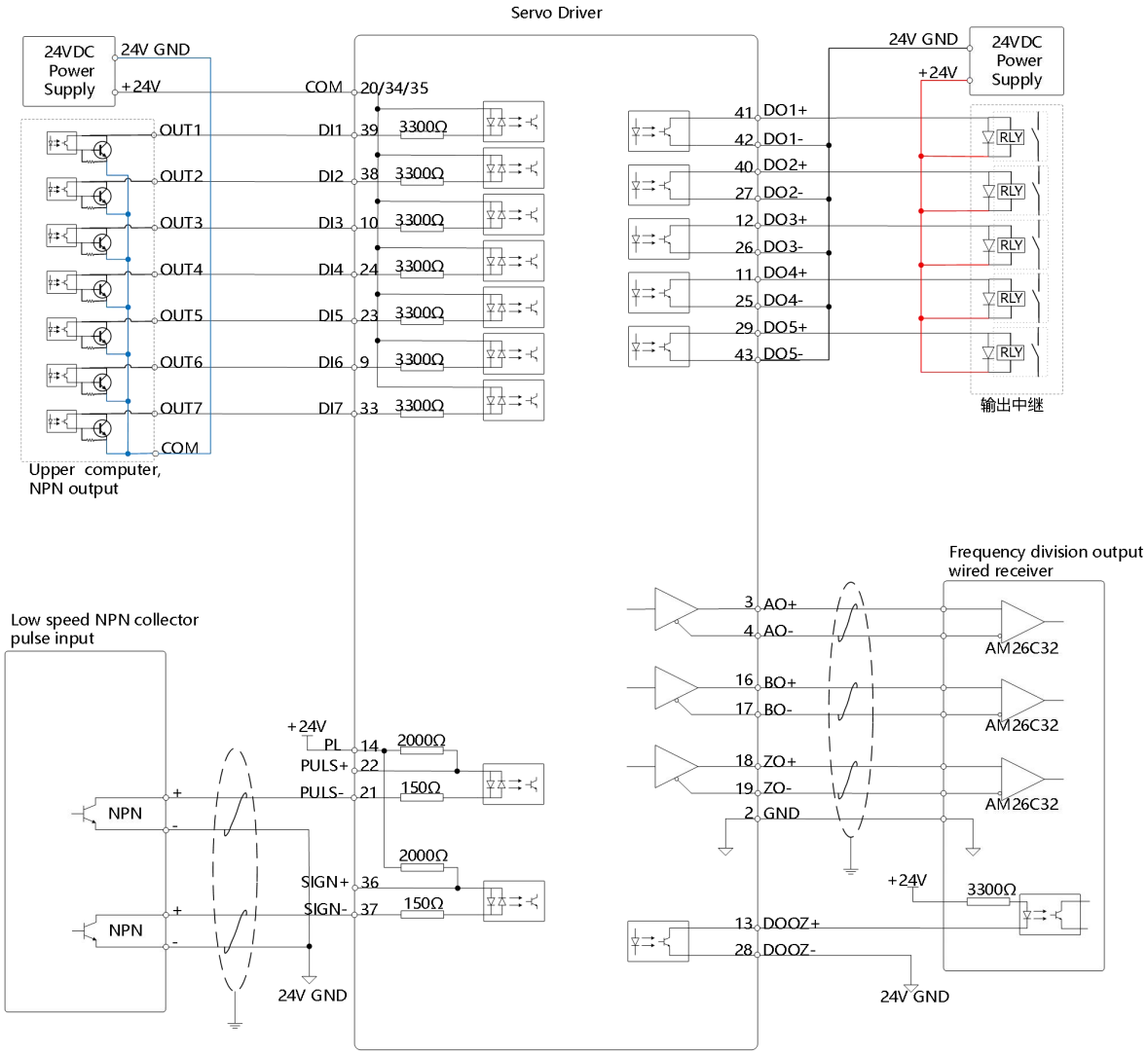


Figure 3-2 Open Collector Pulse Command Position Mode Wiring Diagram

3.3Wiring Instructions for External Pulse Command Position Mode

●The internal 24V power supply voltage range is 20.7V~27.6V, with a maximum operating current of 200mA.

●DI1 and DI7 are low-speed DI; please select and use them according to their functions.

●For pulse port wiring, use twisted pair shielded cable, and the shielding layer must be connected to PE at both ends. The GND should be reliably connected to the signal ground of the higher-level machine. The high-speed pulse command input and low-speed pulse command input (differential input method) share the same interface in hardware. Set the corresponding function code based on the frequency of the input pulse.

●The DO output power supply must be provided by the user, with a voltage range of 5V~24V. The maximum allowable voltage for the DO port is 30V DC, and the maximum allowable current is 50mA.

●For frequency division output cables, use twisted pair shielded cables, and the shielding layer must be connected to PE at both ends. GND should be reliably connected to the signal ground of the higher-level machine.

4Driver Connection

4.1Driver Connector Distribution

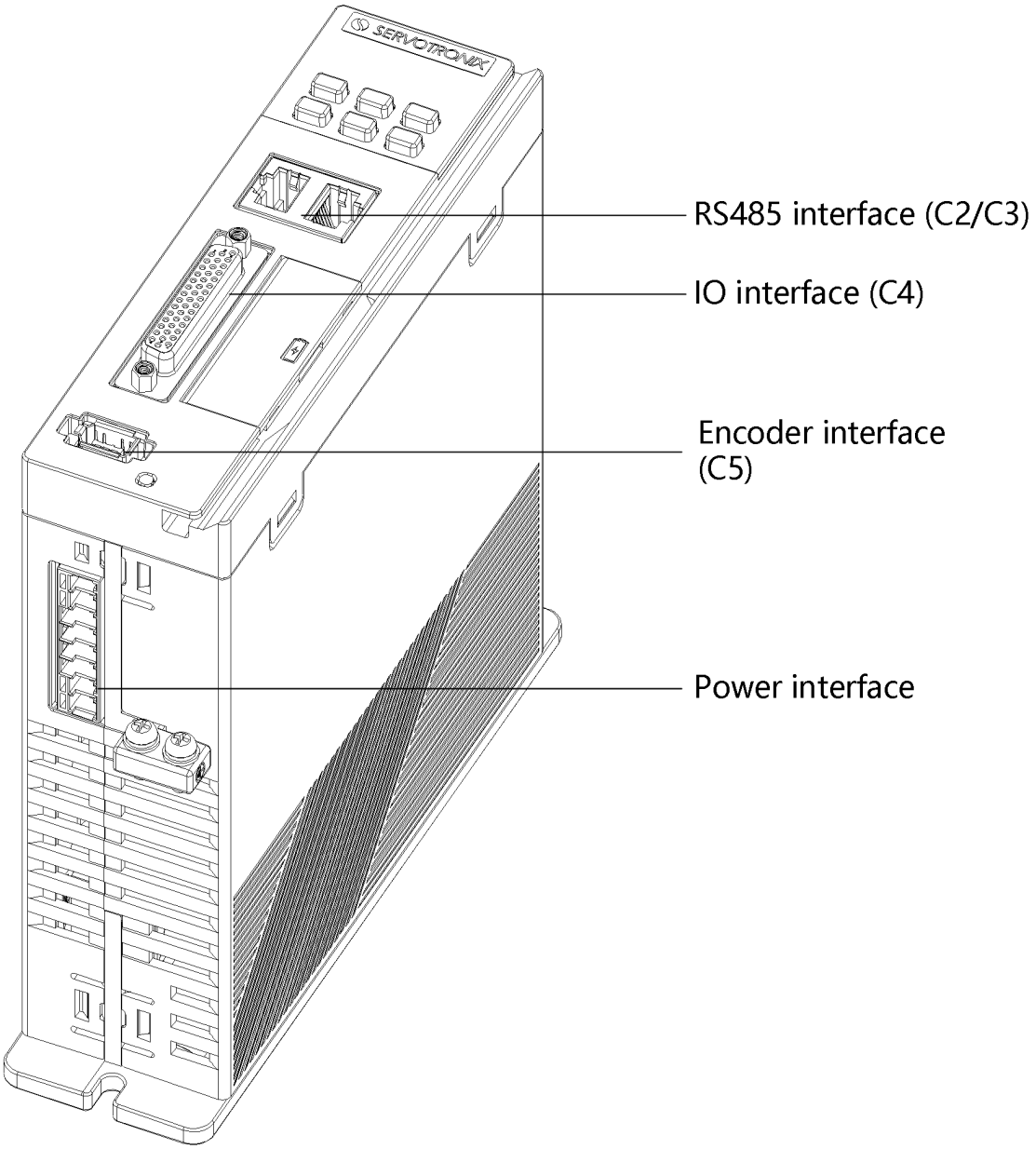


Fig. 4-1 Connector Distribution for Single-phase 220V Model

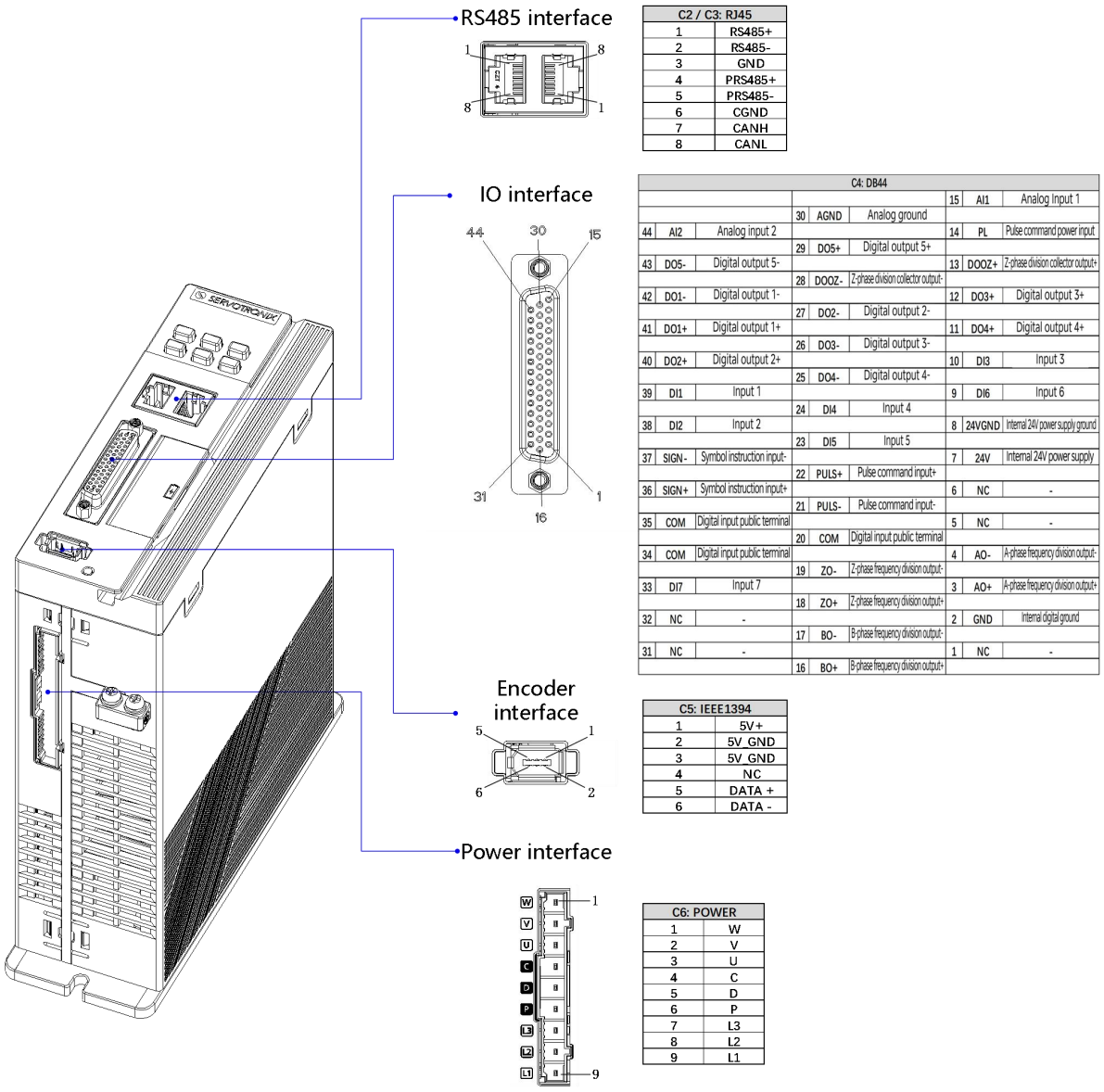


Fig. 4-2 Connector Distribution for Three-phase 380V Model

4.2Main Circuit Terminal (C6)

4.2.1Port Definitions

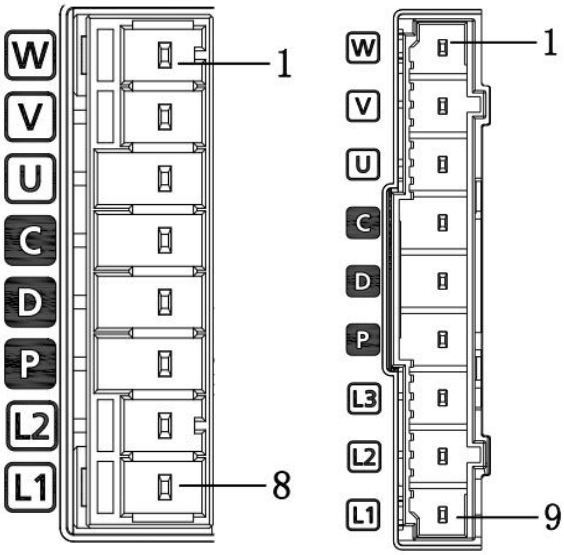


Fig. 5-1 Power Interface

Table 4-1 Power Interface

Terminal Marking	Name	Description
L1，L2，(L3)	Main Circuit Power Input Terminal	Connect to single-phase or three-phase AC power (select the appropriate voltage specification according to the product model, refer to the driver label for wiring).
P，D，C	External Regenerative Resistor Connection Terminal	If using the built-in regenerative resistor, short between P and D. When the built-in regenerative resistor capacity is insufficient, place P and D in an open circuit (remove the shorting wire) and connect the external regenerative resistor between P and C. The external regenerative resistor must be purchased separately.
U，V，W	Servo Motor Connection Terminal	Connect to the servo motor.

4.2.2Wiring Precautions

The power interface is used to connect the AC power supply to the BD3E. This interface also supplies power to each phase of the motor.

In addition, this interface provides a function to connect an external regenerative power resistor, which dissipates energy generated by the motor during deceleration.

Ensure that the main power rating matches the driver specifications. Using the wrong voltage can cause the driver to malfunction.

Make sure all hardware connections are completed before powering on.

Prevent surge currents: Bus power (L1-L2-(L3)): After turning off the bus power, wait 1 minute before turning it back on.

4.2.3Cable Specifications Requirements

Table 4-2 Main Circuit Cable Specifications

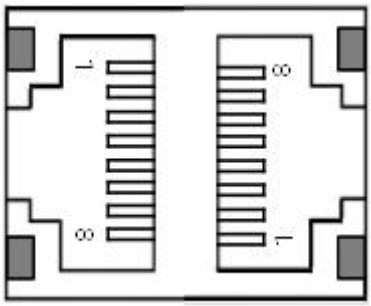
Specifications		1D6	2D8	5D5	3D5	5D4	8D4	012
Power Input	Input Voltage (Single Phase V rms)	220V			380V			
	Continuous Current (Single Phase A rms)	2.3	4	7.9	2.4	3.6	5.6	8.0
Driver Output	Continuous Output Current (A rms)	1.6	2.8	5.5	3.5	5.4	8.4	11.9
	Continuous Output Current (A peak)	2.26	3.96	8.48	4.9	7.6	11.9	16.8
	Peak Output Current (A rms)	5.8	9.8	18	11	14	20	29.75
	Peak Output Current (A peak)	8.20	13.86	25.45	15.6	19.8	28.3	42.1
Cable Specifications	Control Circuit (AWG) (Up to 3 meters)	24–26	24–26	24–26	24–26	24–26	24–26	24–26
	Main Circuit Motor Wiring (AWG)	20	20	20	20	20	20	16
	Main Circuit AC Input (AWG)	20	20	20	20	20	16	16

4.3Communication Interface (C2\C3)

4.3.1Port Definitions

Connectors CN2 and CN3 are communication plugs, and the BD3E-AP servo driver supports RS485 communication. CN2 is RS485 IN, and CN3 is RS485 OUT.

The signals on CN2 and CN3 are mirrored, so when cascading multiple servo



drivers, standard straight-through Ethernet cables can be used.

Figure 5-2. RS485 Interface

Table 4-3. Communication Interface Signal Definitions

Terminal Marking	Name	Description
1	RS485+	RS485 Positive Signal
2	RS485-	RS485 Negative Signal
3	GND	Digital Ground
4	PRS485+	Floating, Do Not Connect
5	PRS485-	Floating, Do Not Connect

Terminal Marking	Name	Description
6	NC	Reserved, Do Not Connect
7	NC	Reserved, Do Not Connect
8	NC	Reserved, Do Not Connect
Enclosure	FG	Shielded Wire

Note: NC is Not Used, Do Not Connect.

4.3.2Wiring Precautions

RS485 communication cables must use twisted pair shielded cables, with both ends of the shielding grounded.

When cascading multiple drivers, 120Ω terminal resistors must be connected at both ends of the bus.

4.3.3Cable Specifications Requirements

Cable Specifications: AWG24~26 twisted pair shielded cable, maximum length not exceeding 100 meters.

4.3.4Wiring Examples

4.4I/O Interface (C4)

Table 4-5. Digital Input/Output Specifications

Item			Specifications
Digital Input	Quantity		7
	Signal Format		Optical Isolation Function Configurable Configurable NPN or PNP Connection Configurable Active Level
	Voltage Rating		24V
	Maximum Input Current		6mA
	Transmission Delay Time		1ms
Digital Output	Quantity		5
	Signal Format		Optical Isolation Function Configurable NPN Transistor Output Configurable Active Level
	Voltage Rating		24V
	Maximum Output Current		50mA per Output (Total 100mA)
	Transmission Delay Time		1 ms
Position	Low	Maximum Pulse	200KHz

Item			Specifications
Command Input	Speed	Frequency	
		Minimum Pulse Width	2.5us
		Signal Format	Differential, Open Collector
		Voltage Specifications	Differential: >3.0V Open Collector: 24 V
	High Speed	Maximum Pulse Frequency	4MHz
		Minimum Pulse Width	0.125us
		Signal Format	Differential
		Voltage Specifications	Differential: >3.0V
Frequency Division Pulse Output	Pulse	Signal Format	AB Quadrature
		Signal Type	Differential Driver Output
		Maximum Output Current	20mA
	Z Signal	Signal Type	Differential Driver Output, Open Collector
		Maximum Output Current	20mA

4.4.1Port Definitions

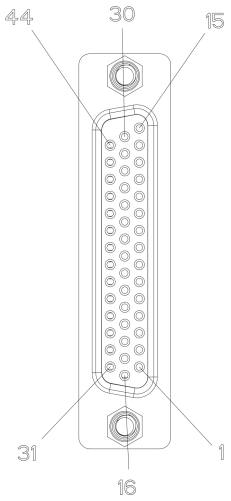


Figure 5-3. IO Interface

Table 4-4. IO Interface Signal Definitions

						15	NC	-
			30	NC	-			
44	NC	-				14	PL	Pulse Command Power Input
			29	DO5+	Digital Output 5+			
43	DO5-	Digital Output 5-				13	DOOZ+	Z Phase Frequency Division Collector Output+

			28	DOOZ-	Z Phase Frequency Division Collector Output-			
42	DO1-	Digital Output 1-				12	DO3+	Digital Output 3+
			27	DO2-	Digital Output 2-			
41	DO1+	Digital Output 1+				11	DO4+	Digital Output 4+
			26	DO3-	Digital Output 3-			
40	DO2+	Digital Output 2+				10	DI3	Input Input 3
			25	DO4-	Digital Output 4-			
39	DI1	Input Input 1				9	DI6	Input Input 6
			24	DI4	Input Input 4			
38	DI2	Input Input 2				8	24VGND	Internal 24V Power Ground
			23	DI5	Input Input 5			
37	SIGN-	Sign Command Input-				7	24V	Internal 24V Power
			22	PULS+	Pulse Command Input+			
36	SIGN+	Sign Command Input+				6	NC	-
			21	PULS-	Pulse Command Input-			
35	COM	Digital Input Common Terminal				5	NC	-
			20	COM	Digital Input Common Terminal			
34	COM	Digital Input Common Terminal				4	AO-	A Phase Frequency Division Output-
			19	ZO-	Z Phase Frequency Division Output-			
33	DI7	Input 7				3	AO+	A Phase Frequency Division Output+
			18	ZO+	Z Phase Frequency Division Output+			
32	NC	-				2	GND	Internal Digital Ground
			17	BO-	B Phase Frequency Division Output-			
31	NC	-				1	NC	-
			16	BO+	B Phase Frequency Division Output+			

(Note)

1) Do not use vacant terminals.

2) Connect the shield of the input/output signal cable to the connector housing. Perform frame grounding (FG) through the connector on the servo driver side.

3) All input/output pins can be assigned signals via parameter settings.

4.4.2Wiring Precautions

Connect inputs and outputs according to the requirements of your application.

Unused pins must remain unconnected.

All inputs on the I/O interface (C4) share a common input terminal, and all outputs are not grounded together.

All digital inputs and digital outputs on BD3E models are optically isolated.

When configuring the digital output channel as a brake function, refer to the motor brake wiring section.

The motor brake requires a separate power supply; do not share it with digital inputs or pulse inputs.

4.4.3Cable Specifications Requirements

The cable length should fully consider the voltage drop caused by cable resistance and signal attenuation due to distributed capacitance. It is recommended to use twisted pair shielded cables of UL2464 standard, 26AWG or larger, within a length of 3m.

4.4.4Wiring Examples

Example of IO Connection to External Devices

A relay or open-collector transistor circuit can be connected to the DI port. The DO output can also be used to control a relay or open-collector transistor circuit. See connection diagrams in Figures 5-4 and 5-5.

When DO is used to control a relay, the relay must be used with a flyback diode. The maximum power supply voltage is 30VDC, and the maximum output current of DO is 50mA.

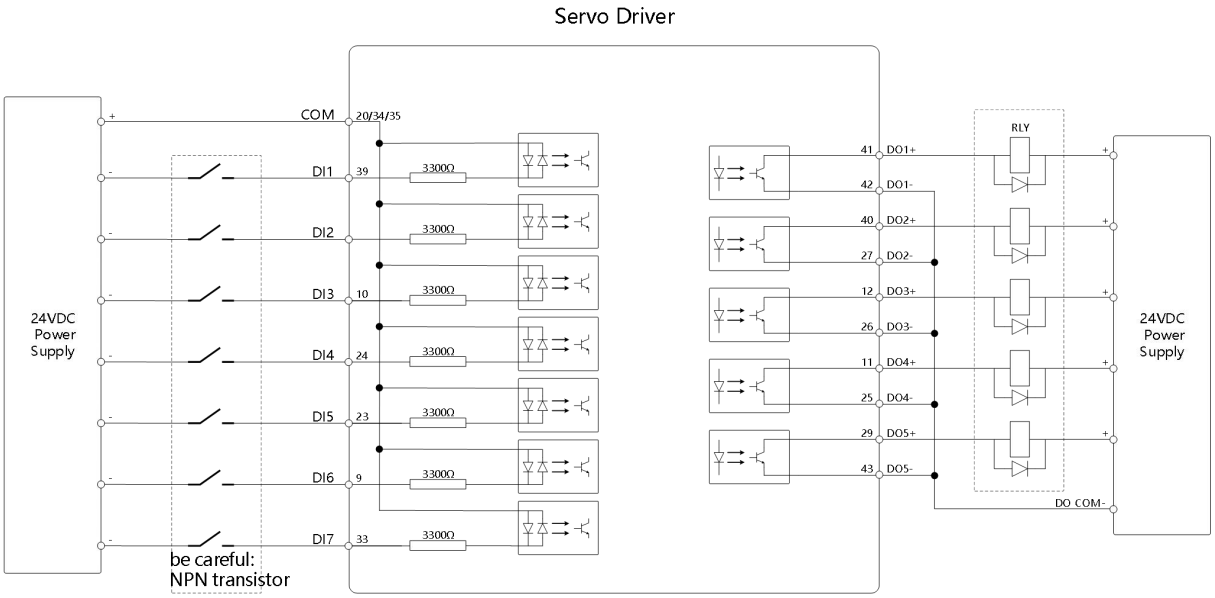


Figure 5-4. Relay or NPN Connection Example

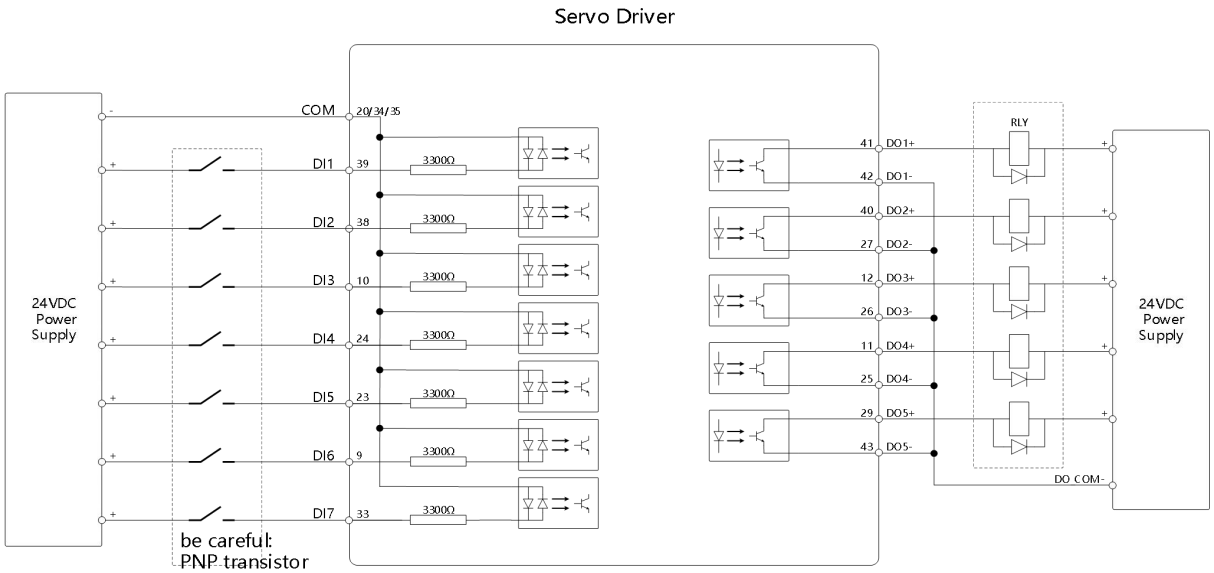


Figure 5-5. PNP Connection Example

Example of Pulse Connection to External Equipment

The following describes the terminals 21-22 (command pulse input) and 36-37 (command direction input) of the CN4 connector.

The command pulse output circuit on the higher-level device side can be selected from one of three options: linear driver output, open collector output (NPN or PNP). Each is described below.

For a higher-level machine using a linear driver output, the connection example for command signals and divided pulse outputs is as follows:

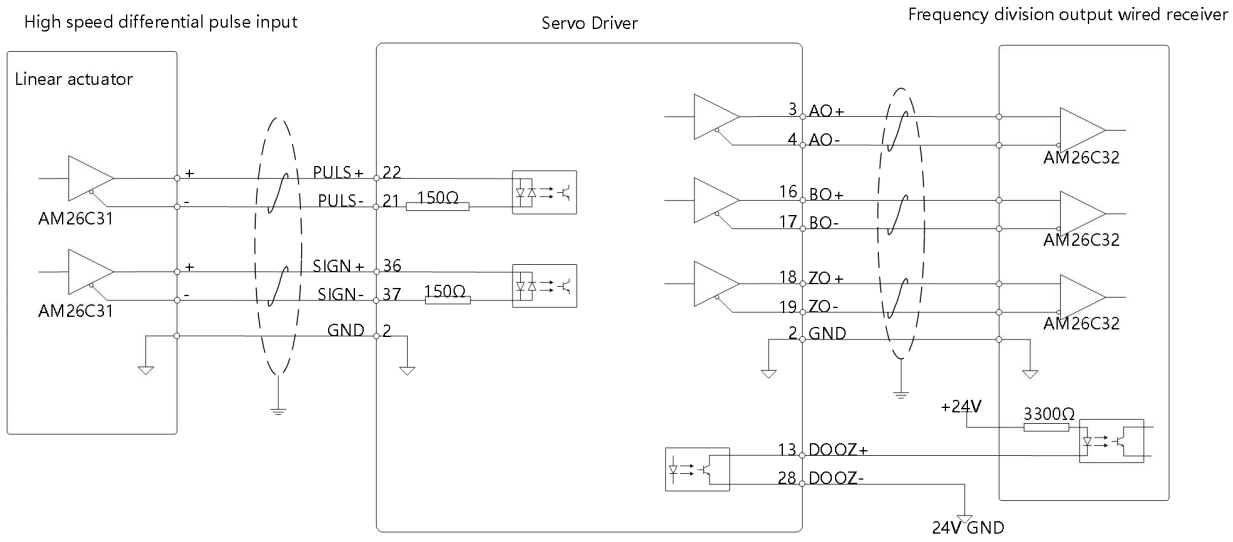


Figure 5-6. Linear Driver Connection Example

When the higher-level machine has an NPN type open collector output and a 24VDC signal power supply, the connection example for the command signal and frequency division pulse output is shown in Figure 5-5.

The BD3E-AP internally provides a 24V power supply for IO use. When using the internal 24V power supply, connect CN4-7 to CN4-14. Connect the common terminal of the higher-level machine's output to the ground of the internal 24V power supply at CN4-8.

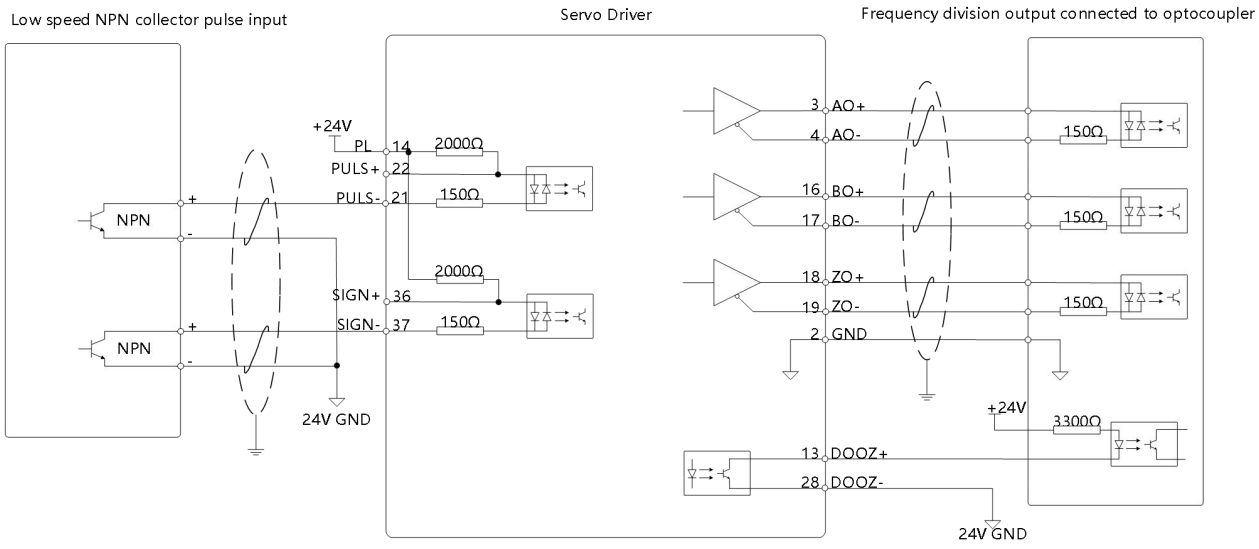


Figure 5-5. NPN Connection Example

When the higher-level machine has a PNP type open collector output and a 24VDC signal power supply, the connection example for the command signal and frequency division pulse output is shown in Figure 5-6.

The BD3E-AP internally provides a 24V power supply for IO use. When using the internal 24V power supply, connect CN4-7 to the common terminal of the higher-level machine's output. Connect the ground of the internal 24V power supply at CN4-8 to CN4-14.

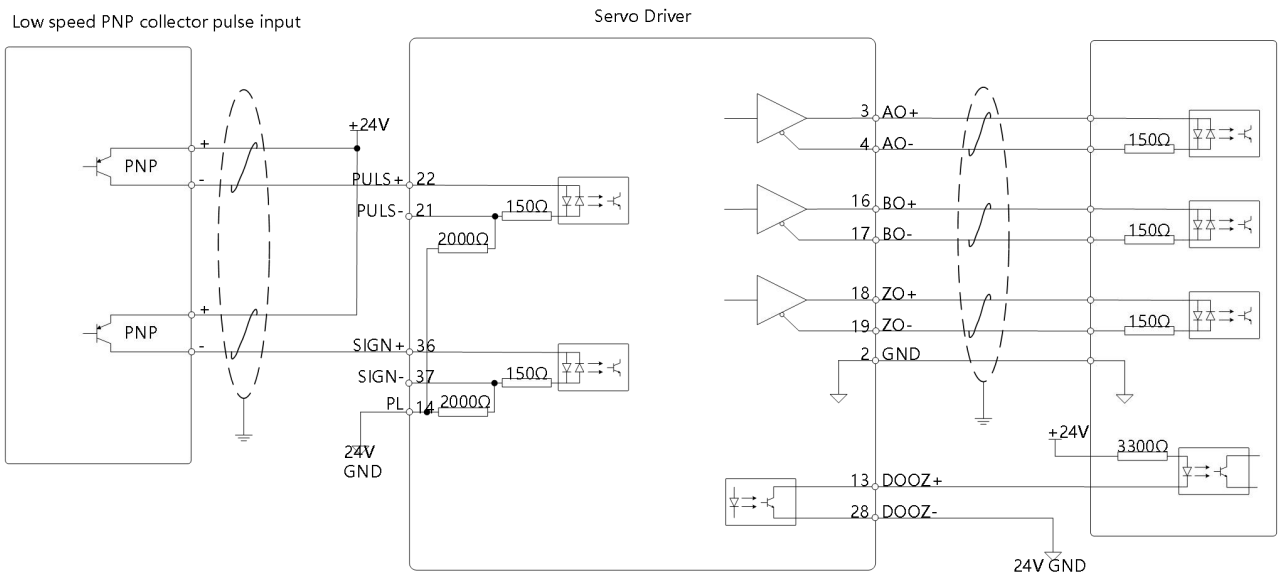


Fig. 5-6. PNP Connection Example

4.5Encoder Interface (C5)

Table 3-6. Motor Feedback Specifications

Item		Specifications
Power Supply	Driver Power Voltage	DC Voltage 5 V±10%
	Maximum Current from Driver to Encoder	200mA
Cable	Recommended Cable Parameters	Twisted Shielded Copper Wire
Protocol		Tamagawa Protocol
Encoder Support		Absolute Encoder Based on Tamagawa Protocol

4.5.1Port Definitions

BD3E-AP supports Tamagawa protocol feedback; the following pin assignments describe the connection between the feedback and the driver.

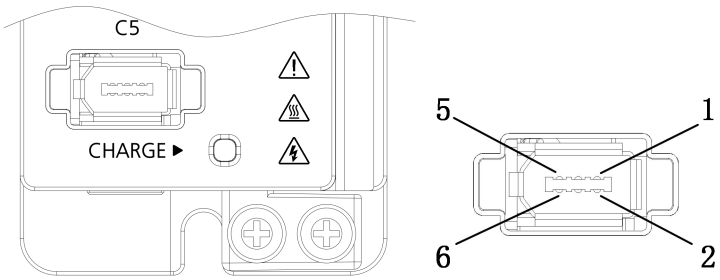


Fig. 5-7 Feedback Interface (C5)

Table 5-7 Feedback Interface (C5)

Pin #	Function	Pin #	Function
1	5V Power	4	NC (Open)
2	GND	5	Data +
3	GND	6	Data -
Shield	FG: Earth		

4.5.2Wiring Precautions

Connect the motor feedback interface according to the encoder being used. Refer to the table of port definitions. Unused pins must remain unconnected.

Ensure that the shielding mesh layers on both the driver side and the motor side are reliably grounded; otherwise, it may cause false alarms in the driver.

4.5.3Cable Specifications Requirements

The length of the encoder cable should take into account the voltage drop caused by cable resistance and signal attenuation due to distributed capacitance. It is recommended to use UL2464 standard 26AWG or larger gauge twisted pair shielded cable within 20m cable length.

4.5.4Wiring Examples

The table below shows the feedback wiring for the BD3E servo kit.

Wiring - Single-turn Absolute 20-bit Magnetic Encoder

Table 5- 4-1 Feedback Wiring - Single-turn Absolute 20-bit Magnetic Encoder - AMP Connector

C5 Pin #	Twisted Pair Wire	Motor Interface Pin #	Signal Description
5	Twisted Pair Wire	1	Serial Data +
6		2	Serial Data -
1	Twisted Pair Wire	6	DC Voltage 5 V
2		7	GND
Metal Housing		8	Shielding

Table 5- 4-2 Feedback Wiring - Single-turn Absolute 20-bit Magnetic Encoder - MIL Connector

C5 Pin #	Twisted Pair Wire	Motor Interface Pin #	Signal Description
5	Twisted Pair Wire	E	Serial Data +
6		F	Serial Data -
1	Twisted Pair Wire	H	DC Voltage 5 V
2		G	GND

C5 Pin #	Twisted Pair Wire	Motor Interface Pin #	Signal Description
See Note 1		J	Shielding

Wiring - 20-bit Multi-turn Absolute Encoder

Table 5- 4-3 Feedback Wiring – Multi-turn Absolute 20-bit Magnetic Encoder - AMP Connector

C5 Pin #	Twisted Pair Wire	Motor Interface Pin #	Signal Description
5	Twisted Pair Wire	1	Serial Data +
6		2	Serial Data -
1	Twisted Pair Wire	6	DC Voltage 5V
2		7	GND
See Note 1		8	Shielding
See Note 2		4	Battery+
See Note 2		5	Battery-

Table 5- 4-4 Feedback Wiring – Multi-turn Absolute 20-bit Magnetic Encoder - MIL Connector

C5 Pin #	Twisted Pair Wire	Motor Interface Pin #	Signal Description
5	Twisted Pair Wire	E	Serial Data +
6		F	Serial Data -
1	Twisted Pair Wire	H	DC Voltage 5V
2		G	GND
See Note 1		J	Shielding
See Note 2		T	Battery+
See Note 2		S	Battery-

Note 1: The shield wire must be connected to the metal housing of the connector plug.

Note 2: It must be connected to the battery.

The encoder battery is located in the battery compartment of the BD3E driver.

The recommended battery is a 3.6V, 2500mAh lithium battery.

Use the spare battery recommended by the encoder manufacturer.

5Maintenance and Care

5.1Safety in Maintenance and Care

Improper handling of the BD3E can cause injury and/or equipment damage.

●To avoid arcing, personal injury, and electrical contact damage, do not disconnect or connect the product while it is powered on.

●After the device is powered off, wait at least 5 minutes before touching or disconnecting parts that are normally energized (such as capacitors, switch contacts, screw connections).

5.2 Daily Maintenance Items

Normal operating conditions: annual average ambient temperature 30°C, average load rate below 80%, daily operating time less than 20 hours.

Inspection Type	Inspection Cycle	Inspection Items	Handling During Faults
Routine Inspection	Routine	· Confirm the temperature, humidity, dust, foreign objects, etc., in the usage environment · Check for abnormal vibrations or unusual sounds · Verify if the input power voltage is normal · Check for any unusual odors · Check if the ventilation ports are clogged with fibers, threads, or other foreign objects · Cleanliness of the front of the driver and the connectors · Whether there is any looseness or pin misalignment in the connection part between the control device and the motor · Whether there are any foreign objects embedded in the load section	Please wipe with a cloth or clean with an air gun.

5.2Periodic Maintenance

5.2.1Regular Inspections

The servo driver does not require regular maintenance, but the following items should be inspected at least once a year.

Inspection Items	Inspection Cycle	Inspection Points	Handling During Faults
Check Appearance	At least once a year	There must be no debris, dust, oil stains, etc.	Please wipe with a cloth or clean with an air gun.

Loose Screws	At least once a year	Screws on terminal blocks, connectors, etc., must not be loose.	Please tighten further.
Terminal Connections	At least once a year	Check if terminals are damaged or loose	Reconnect

5.2.2Regular Maintenance

The electrical and electronic components inside the servo unit will experience mechanical wear and aging. Please confirm the standard replacement time using any of the following methods.

Component Name	Standard Replacement Period	Notes
Cooling Fan	4 ~ 5 years	The replacement standard times shown on the left are values under the following usage conditions. Ambient Temperature: Annual average 45°C Load Factor: 70% or less Operating Rate: 20 hours or less/day
Bus Filter Electrolytic Capacitor	About 5 years	
Aluminum Electrolytic Capacitor of Power Supply	About 5 years	
Power-on Soft Start Relay	Number of Power-On Cycles: 100,000 (Life varies depending on usage conditions)	Power-On Frequency: About once per hour
Battery	3 years in unpowered state	Environmental temperature in unpowered state: 20°C

When the standard replacement period is reached, please contact the nearest company agent, sales office, or after-sales service department. After inspection, it will be determined whether parts need to be replaced.

6Certification Standards

The BD3E series servo drivers have been tested and certified according to the following standards.

Table 6-1 Standard Certifications

Standard	Command/Instruction	Certification Mark
EN 61800-5-1	Low Voltage Directive 2014/35/EU Speed-controlled electric drive systems	CE
EN IEC 61800-3	Electromagnetic Compatibility (EMC) Directive 2014/30/EU Speed-controlled electric drive systems	CE

Standard	Command/Instruction	Certification Mark
EN 50581	European Regulation 2011/65/EU RoHS (Restriction of Hazardous Substances) Declare the technical documentation required to comply with substance restriction requirements.	CE
SJ/T 11364	Restriction of Hazardous Substances in Electrical and Electronic Products (China RoHS 2.0) Hazardous substances in electrical and electronic products; environmental protection usage period and recyclability.	20

IEC International Electrotechnical Commission

EN European Standard (European Norm)

EU European Parliament and Council of the European Union

6.1CE Certification

6.1.1Conditions for compliance with L VD Low Voltage Directive

The BD3E Series Driver has been tested according to IEC/EN61800-5-1 and confirmed to comply with the Low Voltage Directive. To ensure that machinery and equipment installed with this product comply with the Low Voltage Directive, the user must meet the following conditions.

●Installation Environment

Install the product in locations that comply with Overvoltage Category III and Pollution Degree 2 or lower as specified in IEC60364-4-44 and IEC 606641. For more detailed requirements, see Section 1.1.2 of this manual.-

●Protective Conditions

This product is designed for installation inside control cabinets and must be installed within the final system. The final system should provide appropriate fire-resistant enclosures, electrical protective enclosures, and mechanical protective enclosures, and comply with local laws and regulations and relevant IEC standards.

When installing IP20-rated products inside cabinets, ensure they are installed in structures where foreign objects cannot enter from the top or front.

●Protective Devices

To comply with EU safety standard EN 61800-5-1, it is essential to connect a fuse/circuit breaker on the input side to prevent accidents caused by internal circuit short circuits.--

6.1.2Conditions for compliance with the EMC directive

To ensure compliance with EMC standards during the matching tests between the servo unit and servo motor, ferrite cores, filters, and surge suppressors must be used. This product is a matching device, so confirmation must be made through user terminal machinery that has implemented EMC countermeasures. Supported standards include EN55011 Group 1 Class A, EN61000-6-2, EN61000-6-4, EN61800-3 (Category C2, Second Environment).

This product is not designed for residential environments; in such environments, it may cause radio wave interference, in which case auxiliary measures, such as additional shielding, should be taken.

7Common EMC Issues

7.1Residual Current Device Malfunction

The leakage current of the PE conductor comes from the combination of leakage currents from equipment and cables. Please install a residual current device (RCD) on the primary side of the power supply and select it according to the following conditions:

- Please use a Type B (DC-sensing type) RCD as specified in IEC60947-2 and JISC8201-2-2.
- When the servo driver is operating, it generates a certain amount of high-frequency leakage current. To avoid false tripping of the RCD, please select an RCD with an operating current of no less than 100mA for each servo driver.
- When multiple servo drivers share an RCD, an RCD with an operating current of at least 300mA should be selected.
- RCDs from brands such as Chint and Schneider are recommended.

When a circuit breaker with leakage protection is used and a malfunction occurs, please resolve it using the following methods.

Table 7–1 Leakage Current Countermeasures

Leakage Trip	Influencing Factors	Resolution Measures
Leakage Trip on Power-On	Poor Residual Current Protection Performance Against Interference	● Use a residual current circuit breaker of the recommended brand. ● It is recommended to replace with a residual current circuit breaker with a higher operating current. ● Move the unbalanced load to the front end of the residual current circuit breaker. ● Move devices with large ground capacitance, such as filters, to the front end of the residual current circuit breaker.
	Residual Current Circuit Breaker Operating Current Too Low	
	Unbalanced Load Connected to the Rear End of the Residual Current Circuit Breaker	
	Large Ground Capacitance at the Front End of the Driver	
Residual Current Circuit Breaker Trips During Operation	Poor Residual Current Protection Performance Against Interference	● Use a residual current circuit breaker of the recommended brand. ● It is recommended to replace with a residual current circuit breaker with a higher operating current. ● Install a simple filter on the input side of this product, and wind a ferrite core around the LN and RST lines near the residual current circuit breaker. ● Appropriately reduce the carrier frequency if it can ensure performance requirements. ● Reduce the length of the motor cable.
	Residual Current Circuit Breaker Operating Current Too Low	
	Unbalanced Load Connected to the Rear End of the Residual Current Circuit Breaker	
	The distributed capacitance to ground of the motor cable, motor, etc., is too large.	

7.2Control Circuit Interference

7.2.1High-speed pulse signal interference

Please make the following corrections:

①, use shielded twisted pair cables for IO cables and ground both ends.

②, connect the motor housing to the driver PE terminal.

③, connect the driver PE terminal to the power grid PE.

④, add an equal potential bonding ground wire between the higher-level machine and the driver.

⑤, maintain a separation distance of at least 30cm between signal wires and power cables. Signal wires and power cables should be routed as perpendicularly as possible.

⑥、Install an amorphous ferrite core on the driver output UVW, winding 2~4 turns.

⑦、Use shielded power cables, and ensure the shielding is properly grounded.

⑧、Add a ferrite core around the signal wire, winding 1~2 turns.

⑨、Adjust the filter time constant of the signal wire.

7.2.2General IO Signal Interference

The driver product is a high-interference device. During use, interference may occur due to issues such as wiring and grounding. When there is mutual interference with other equipment, the following methods can be used for rectification.

Please make the following corrections:

①, use shielded twisted pair cables for IO cables and ground both ends.

②, connect the motor housing to the driver PE terminal.

③, connect the driver PE terminal to the power grid PE.

④, add an equal potential bonding ground wire between the higher-level machine and the driver.

⑤, maintain a separation distance of at least 30cm between signal wires and power cables. Signal wires and power cables should be routed as perpendicularly as possible.

⑥、Install an amorphous ferrite core on the driver output UVW, winding 2~4 turns.

⑦、Use shielded power cables, and ensure the shielding is properly grounded.

⑧、Add a ferrite core around the signal wire, winding 1~2 turns.

⑨、Increase the filter time constant of the signal wire.

⑩、Install a filter at the power input end.

7.2.3RS485 Communication Interference

Please make the following corrections:

①Add 120Ω termination resistors at both ends of the bus.

②Replace with multi-core shielded twisted pair cable, with both ends of the shielding grounded.

③Connect the motor housing to the driver PE terminal.

④Connect the driver PE terminal to the power grid PE.

⑤Add an equal potential bonding ground wire between the higher-level machine and the driver.

⑥Maintain a separation distance of at least 30cm between signal wires and power cables. Signal wires and power cables should be routed as perpendicularly as possible.

⑦Add an amorphous ferrite core to the driver output UVW, winding 2 to 4 turns.

⑧Use shielded power cables, and ensure the shielding is well grounded.

⑨Add a ferrite core to the communication lines, winding 1 to 2 turns.

8Accessories

8.1Mating Connector

Note: The power supply and motor connection connectors are provided with the driver.

Table 8-1 C4–I/O Connector

Manufacturer	Name	Manufacturer Part Number	Servotronix Part Number
Shanghai Nanshi Technology	Mating Plug	DB-44-A(DBH-44P)	12119400000163
Shanghai Nanshi Technology	Connector Housing	DHP-25P	12119400000329

Table 8-2 C5–Encoder Feedback Mating Connector

Manufacturer	Name	Manufacturer Part Number	Servotronix Part Number
San Zhu	Soldered Plug Connector	SC-06-4	12119400000273

Table 8-3 P1–Power and Motor Mating Connector

Driver Model	Manufacturer	Name	Manufacturer Part Number	Servotronix Part Number
BD3E-1D62AEB BD3E-2D82AEB BD3E-5D52AEB	San Zhu	Plug with Removable Terminal Block	SC-T3005008SB0XT-45	11201707001675
BD3E-3D54DEB BD3E-5D44DEB BD3E-8D44DEB BD3E-0124DEB	Kosong	Plug with Removable Terminal Block	9EDGK-7.5-09P-13-1051Z(H)	11201707002135

8.2Cable

Table 8-4 C5–PM2 Motor Encoder Cable

Encoder Type	Connector Type	Length	Servotronix Part Number
Single-turn Magnetic Encoder	D、A	3 meters 5 meters 10 meters 15 meters 20 meters	CBL-FBPH21S301D0xx (non-flexible) CBL-FBPH22S301D0xx (flexible) CBL-FBPH21S301A0xx (non-flexible) CBL-FBPH222S301A0xx (flexible)
Multi-turn magnetic encoder	D、A	3 meters 5 meters 10 meters 15 meters 20 meters	CBL-FBPH21T203D0xx (non-flexible) CBL-FBPH22T203D0xx (flexible) CBL-FBPH21T203A0xx (non-flexible) CBL-FBPH22T203A0xx (flexible)

Note: Encoder type

S3: Single-turn absolute 20-bit magnetic encoder

T2: Multi-turn absolute 20-bit magnetic encoder connector type
D: 300mm cable with AMP connector, suitable for flange sizes: 04, 06, 08

A: MIL connector (aviation plug), suitable for flange sizes: 10, 13 length

xx: 03/05/10/15/20, representing 3/5/10/15/20 meters respectively;

Table 8-5 Cables for P2–PM2 Motors

Encoder Type	Connector Type	Length	Servotronix Part Number
Single-turn Magnetic Encoder	D、A	3 meters 5 meters 10 meters 15 meters 20 meters	CBL-FBPH21S301D0xx (non-flexible) CBL-FBPH22S301D0xx (flexible) CBL-FBPH21S301A0xx (non-flexible) CBL-FBPH222S301A0xx (flexible)
Multi-turn magnetic encoder	D、A	3 meters 5 meters 10 meters 15 meters 20 meters	CBL-FBPH21T203D0xx (non-flexible) CBL-FBPH22T203D0xx (flexible) CBL-FBPH21T203A0xx (non-flexible) CBL-FBPH22T203A0xx (flexible)

8.3Regenerative Resistor

The resistance value (ohms) is defined by the BD3E servo driver, and the required power is defined by the application. Therefore, there are multiple regenerative resistor options for each driver.Ω

The recommended manufacturers and part numbers for regenerative resistors used with BD3E are listed in the following table.

Table 8-6 BD3ERecommended Regenerative Resistors

Driver	Power (W)	Resistance Value	Manufacturer Part Number
BD3E-1D62AAP BD3E-2D82AAP BD3E-5D52AAP	150	40Ω	Liaofu: RXLG-150W-40RJ
	300		Liaofu: RXLG-300W-40RJ
	600		Liaofu: RXLG-600W-40RJ
	1000		Liaofu: RXLG-1000W-40RJ
	2000		Liaofu: RXLG-2000W-40RJ
BD3E-3D54DAP BD3E-5D44DAP	150	100Ω	Liaofu: RXLG-150W-100RJ
	300		Liaofu: RXLG-300W-100RJ
	600		Liaofu: RXLG-600W-100RJ
	1000		Liaofu: RXLG-1000W-100RJ
	2000		Liaofu: RXLG-2000W-100RJ
BD3E-8D44DAP BD3E-0124DAP	150	50Ω	Liaofu: RXLG-150W-50RJ
	300		Liaofu: RXLG-300W-50RJ
	600		Liaofu: RXLG-600W-50RJ
	1000		Lifoo: RXLG-1000W-50RJ
	2000		Lifoo: RXLG-2000W-50RJ

9Trial Operation

9.1Pre-Operation Check

Servo Driver and Servo Motor Commissioning Before the Following Checks Must be Performed:

Table 10–1 Pre-commissioning Check List

Record	No.	Content
Wiring		
□	1	The power input terminals (L1, L2) / (L1, L2, L3) of the servo driver must be correctly connected.
□	2	The output terminals (U, V, W) of the servo driver and the main circuit cables (U, V, W) of the servo motor must have consistent phase and be correctly connected.
□	3	The power input terminals (L1, L2) / (L1, L2, L3) and the main circuit output terminals (U, V, W) of the servo driver must not be short-circuited.
□	4	All control signal wiring for the servo driver is correct, and external signal lines such as the holding brake and overtravel protection have been reliably connected.
□	5	The servo driver and servo motor must be reliably grounded.
□	6	The tension on all cables is within the specified range.

□	7	The wiring terminals have been insulated.
Environment and Machinery		
□	8	There are no loose wire ends, metal shavings, or other foreign objects inside or outside the servo driver that could cause short circuits in signal or power lines.
□	9	The servo driver and external braking resistor are not placed on flammable materials.
□	10	The installation of the servo motor, the connection of the shaft, and the mechanical linkage must be reliable.
□	11	The servo motor and the connected machinery must be in a condition suitable for operation.

9.2Power On

- Connect the input power

For single-phase 220V input, power terminals are L1 and L2.

For three-phase input, power terminals are L1, L2, and L3.

After connecting the input power, the bus voltage indicator shows no abnormalities, and the panel display sequentially shows " Reset "→" Nrd "→" Rdy ", indicating that the servo driver is in a ready state awaiting enabling signal from the higher-level machine.

- Set the servo enable (S-ON) to invalid (OFF)

When using servo enable, first configure one DI terminal of the servo driver to function 1 (FunIN.1: S-ON, servo enable), and determine the effective logic of the DI terminal. Then set it to invalid through communication with the higher-level machine or an external switch.

9.3Operation Panel

9.3.1Panel Composition Introduction

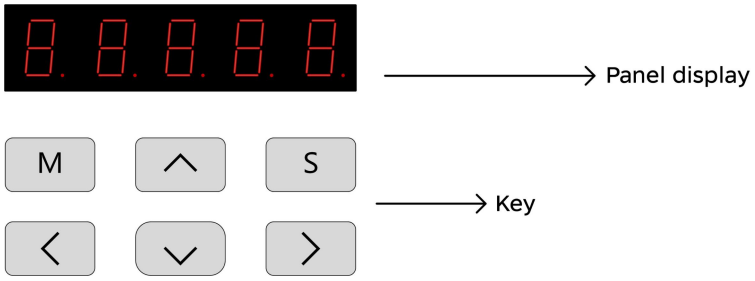


Figure 9- X. Driver Panel Schematic Diagram

The panel of the BD3E series driver consists of a display (5-digit 8-segment LED numeric display) and 6 buttons. It can be used for mode switching, parameter changes, confirmation, monitoring display, and the execution of general functions such as auxiliary functions. Taking the modification and setting of driver parameters as an example, the conventional use of the buttons is described in Table 9.x Panel Button Introduction.

Table 9.x Panel Button Introduction

Button Name	Legend	Function Description
MODE Key	M	Switch Between Modes Return to Servo Status Display Interface

UP Key	∧	Increase LED Digital Tube Flashing Value
DOWN Key	∨	Decrease LED Digital Tube Flashing Value
LEFT-SHIFT Key	<	Change LED Digital Tube Flashing Position to Left View High 5 Bits of Data (If Data Length Exceeds Five Bits)
RIGHT-SHIFT Key	>	Change LED Digital Tube Flashing Position to Right View Low 5 Bits of Data
SET Key	S	Enter Current Parameter Setting Mode Write Panel Settings Value

9.3.2Panel Display

Table 9- X. LED Display and Actual Corresponding Characters Table

Digital Tube Display	Meaning	Digital Tube Display	Meaning	Digital Tube Display	Meaning	Digital Tube Display	Meaning
0	0	1	1	2	2	3	3
4	4	5	5	6	6	7	7
8	8	9	9	A	A	b	B
C	C	d	D	E	E	F	F
G	G	H	H	J	J	L	L
n	N	o	O	P	P	r	R
S	S	t	T	u	U	y	Y
—	Minus Sign	.	Decimal Point				

The actual display status of the digital tube and the corresponding characters are shown in Table 9- X , including both numeric and alphabetic states. When the servo driver is operating, the panel display can be used for driver status display, fault display, parameter display, monitoring display, and auxiliary functions. (For details on auxiliary functions, see Chapter 14 - Auxiliary Function Description)

- Status Display: Displays the current state of the servo, including power-on display interface, servo ready, servo enable, etc.
- Parameter Display: Displays the current servo parameter number and parameter setting value.
- Fault Display: Shows the current faults and warnings that have occurred in the servo.
- Monitoring Display: Shows the status of the current servo monitoring variables.

9.3.3Panel Operation Logic

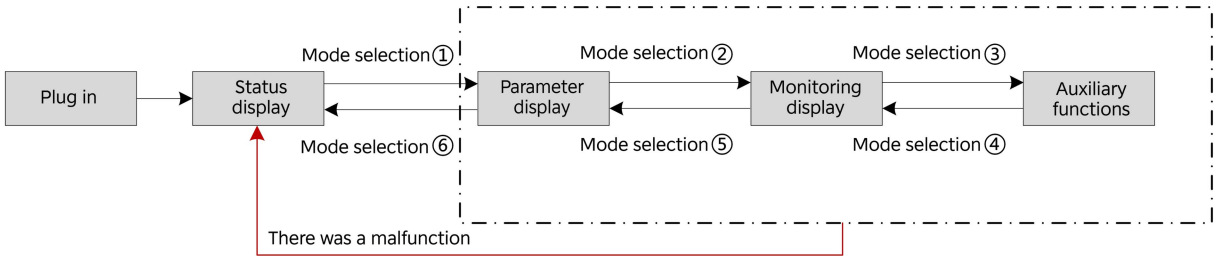


Fig. 9-y. Panel Operation Logic Flowchart

- When the power is turned on, the panel display directly enters the status display mode.
- Press the "M" key to switch between different modes, as shown in Fig. 9-y.

Mode Switch ①: Servo Status Display enters Parameter Display State (View or Set P Group Parameters)

Mode Switch ②: Parameter Display State enters Monitoring Display State (View D Group Variable Values)

Mode Switch ③: Monitoring Display State enters Auxiliary Function Interface (Auxiliary functions can be executed via the panel)

Mode Switch ④: Enter Monitoring Display Status from Auxiliary Functions Interface (View D Group Variable Values)

Mode Switch ⑤: Enter Parameter Display Status from Monitoring Display Status (View or Set P Group Parameters)

Mode Switch ⑥: Enter Servo Status Display from Parameter Display Status (View Current Servo Status)

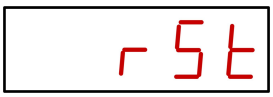
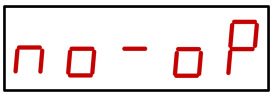
Note: *In Any Panel State, Once an Alarm or Warning Occurs, the Servo Driver Panel Will Switch to Servo Status Display and Indicate the Alarm Information.*

9.3.4Status Display

When the Driver is in Different States, the Panel Can Provide Prompts, as Specifically Described in Table 9.x Panel Status Display Reference Table.

Table 9.x Panel Status Display Reference Table

Panel Digital Display	Name	Display Occasions	Explanation
bd3E	BD3E BD3E Initialization	Power-on of Servo	After power-on, the servo is in the initialization state, waiting for initialization to complete, then it automatically switches to another state

	RDY Servo Ready	Driver is Ready	Servo is ready, waiting for enable command to enter operation mode
	RUN Servo Enable State	Driver enters enable state, running	Servo driver is currently in operation
	NRD Servo Not Ready	Abnormal Main Circuit Power Supply of Servo	Abnormal main circuit power supply, servo self-check failed
	ERR Servo Alarm	Various faults occur	Fault occurred, check specific cause Fault Code Explanation and Alarm Code Explanation
	Parameter Restart Effective Software Reset Status	Modify parameters that require power cycling to take effect; Currently performing software reset	Parameters require reboot to take effect Or software reset flag
	Servo state machine abnormality	Improper driver operation	Servo state machine output abnormality, reboot can restore
	Parameter write successful	After completing parameter write	Modify parameters and long press SET key to confirm, prompt parameter write successful
	Current settings not effective	Misoperation or unsupported operation	Prompt current parameter settings not effective, or unsupported operation
	Alarm cleared	After an alarm occurs, clear it through DI or panel	Clearing alarm signal

9.3.5Parameter Display

All driver-related parameters are located in the P group, divided into 1 0 groups based on different parameter functions, allowing users to locate parameters according to their category. See the parameter list in section Chapter 15 "PUser Parameters"。

➢Parameter Group Display

Display	Name	Content
PXABC	Parameter	X: Parameter Group Number ABC: Group Parameter Code

Example: P 0-301 Display as follows

Display	Name	Content

P0301	Parameter	0: Parameter Group Number 301: Group Parameter Code

Actual Panel Status as Follows:

Display of Data of Different Lengths and Negative Numbers

① Unsigned Numbers Less Than 5 Digits

Displayed Using a Single Page (5-digit Display)

Example: 10000 Displayed as Follows

② Unsigned Numbers More Than 5 Digits

Displayed Using Multiple Pages (4-digit Display), Page Turning Through Left and Right SHIFT Keys.

Example: 2147483647 Displayed as Follows

First page

The second page

Third page

③ Signed Number

Multi-page (4-digit display) is used, and pages can be changed using the left and right SHIFT keys. The highest bit of each page and the highest bit of the data both have negative sign indicators.

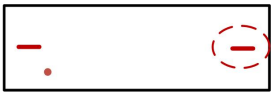
Example: -1000 is displayed as follows:

First page

Negative sign prompt

Negative sign prompt

The second page



9.3.6Monitoring Display

BD3E 's D-group parameters can be used to monitor the operating status of the servo driver. See Chapter 15Section "Dxxx Monitoring Parameters"For example, motor speed monitoring is explained as follows:

Parameter	Name	Unit	Meaning	Display Status
D0-001	Motor Speed	rpm	Motor Feedback Speed	0 1000

The driver also supports the LED initialization state function: default state display. By setting the parameter value of configuration parameter P0-601, the corresponding D-group parameter monitoring channel variable can be displayed in the default state (when the driver fails, the current panel displays the alarm code). The operation process is shown in Figure 9.x LED Initial State Setting Flow.

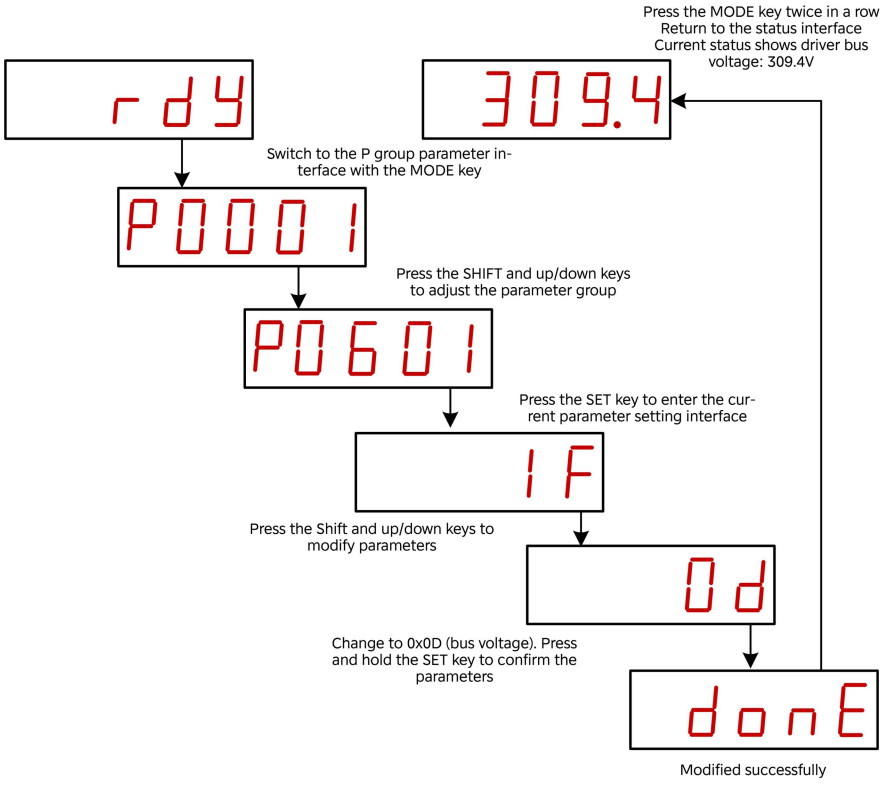


Figure 9.x LED Initial State Setup Flow

9.3.7Parameter Setting

Use the B D3E driver panel and buttons to set parameters. For example, to modify the internal speed command of the motor, the parameter modification process is shown in Figure 9. x:

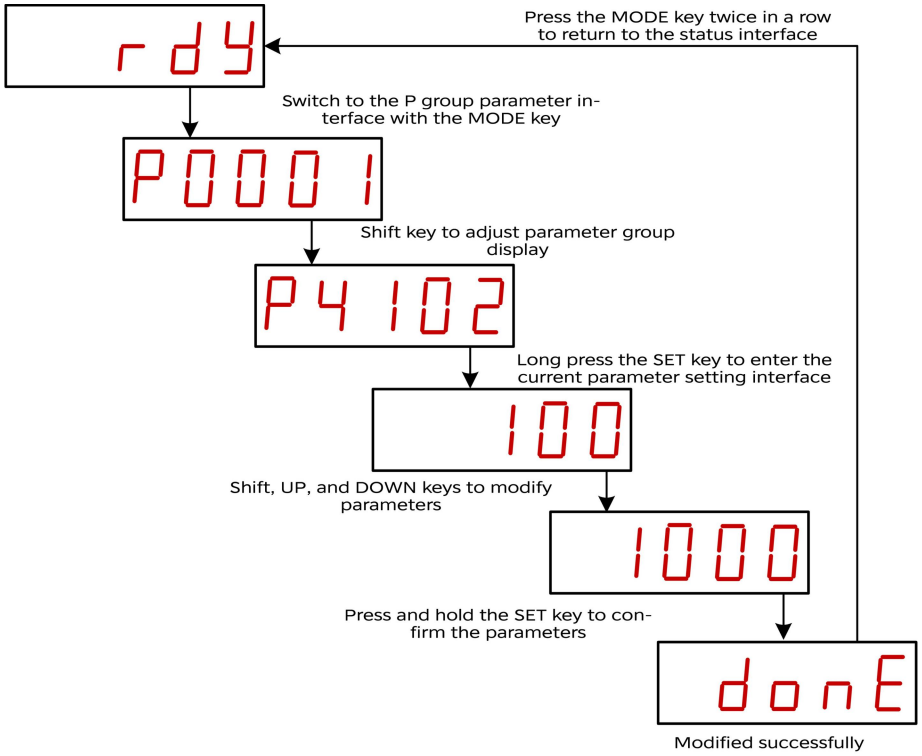


Figure 9.x Parameter Setting Steps Diagram

9.4Shutdown Setting

Shutdown settings include shutdown methods and the motor state after shutdown. The specific methods are as follows:

Table 9. x Shutdown Settings Explanation

Shutdown Parameter Settings	Explanation of Stopping Methods	Explanation of Shutdown States
0: D B Shutdown-D B Status	The servo motor's three phases are short-circuited via a relay, relying on the feedback current generated by the motor's back EMF to brake. The braking speed is relatively slow.	After the shutdown is complete, the driver remains in D B status, at which point the motor shaft has a slight braking force.
1: Zero Speed Stop-D B Status	After the stop occurs, the internal speed setpoint of the servo is 0, and the driver quickly outputs reverse braking torque, causing the motor to immediately decelerate to 0.	After the shutdown is complete, the driver remains in D B status, at which point the motor shaft has a slight braking force.
2: Emergency Stop Torque Shutdown- DB Status	Pre-set the emergency stop torque level; after the stop occurs, the reverse torque brakes according to the set value, and the shutdown time depends on the emergency stop torque setting.	After the shutdown is complete, the driver remains in D B status, at which point the motor shaft has a slight braking force.
3: Ramp Shutdown- DB Status	Pre-set the ramp deceleration time, and complete the shutdown process according to the set time.	After the shutdown is complete, the driver remains in D B status, at which point the motor shaft has a slight braking force.
4: Quick Stop- DB Status	Pre-set the quick stop deceleration time, and complete the shutdown process according to the set time.	After the shutdown is complete, the driver remains in D B status, at which point the motor shaft has a slight braking force.

Shutdown Parameter Settings	Explanation of Stopping Methods	Explanation of Shutdown States
5：DB Shutdown - Free State	The servo motor's three phases are short-circuited via a relay, relying on the feedback current generated by the motor's back EMF to brake. The braking speed is relatively slow.	After shutdown, the driver exits the enable status and remains in the free state, allowing the motor shaft to rotate freely.
6：Free Shutdown - Free State	The motor stops relying on the friction of the main shaft, which is affected by the load and inertia, making the stopping process uncontrolled.	After shutdown, the driver exits the enable status and remains in the free state, allowing the motor shaft to rotate freely.
7：Ramp Shutdown - Free State	Pre-set the ramp deceleration time, and complete the shutdown process according to the set time.	After shutdown, the driver exits the enable status and remains in the free state, allowing the motor shaft to rotate freely.
8：Quick Stop - Free State	Pre-set the quick stop deceleration time, and complete the shutdown process according to the set time.	After shutdown, the driver exits the enable status and remains in the free state, allowing the motor shaft to rotate freely.
9：Emergency Stop Torque Shutdown - Free State	Pre-set the emergency stop torque level; after the stop occurs, the reverse torque brakes according to the set value, and the shutdown time depends on the emergency stop torque setting.	After shutdown, the driver exits the enable status and remains in the free state, allowing the motor shaft to rotate freely.
10：Zero Speed Stop - Free State	After the stop occurs, the internal speed setpoint of the servo is 0, and the driver quickly outputs reverse braking torque, causing the motor to immediately decelerate to 0.	After shutdown, the driver exits the enable status and remains in the free state, allowing the motor shaft to rotate freely.
11：Ramp Shutdown - Position Locking*1	Pre-set the ramp deceleration time, and complete the shutdown process according to the set time.	After shutdown, the driver maintains the enable status, and the motor shaft is locked.
12：Quick Stop - Position Locking*1	Pre-set the quick stop deceleration time, and complete the shutdown process according to the set time.	After shutdown, the driver maintains the enable status, and the motor shaft is locked.
13: Emergency Stop Torque Shutdown - Position Locking*1	Pre-set the emergency stop torque level; after the stop occurs, the reverse torque brakes according to the set value, and the shutdown time depends on the emergency stop torque setting.	After shutdown, the driver maintains the enable status, and the motor shaft is locked.
14: Zero Speed Stop - Position Locking*1	After the stop occurs, the internal speed setpoint of the servo is 0, and the driver quickly outputs reverse braking torque, causing the motor to immediately decelerate to 0.	After shutdown, the driver maintains the enable status, and the motor shaft is locked.

Note:*1 Only Overtravel Function Optional*

Note: *DB (Dynamic Brake, Dynamic Braking)*

In Ramp Shutdown, Quick Stop, and Emergency Stop Torque functions, by configuring different parameter values, you can customize the motor's shutdown time or brake force. Relevant parameters are shown in Table 9. x.

➢Relevant Parameters

Table 9. Shutdown-Related Parameter Settings

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method
P0-306	Shutdown Switch	10-7000	100	rpm	Shutdown Change

	Speed Threshold				
P0-307	Emergency Stop Torque	0-300.0	100.0	%	Shutdown Change
P0-308	Ramp Shutdown Deceleration Time	0-65535	0	ms	Immediate Effect
P0-309	Quick Stop Deceleration Time	0-65535	0	ms	Immediate Effect

Note:

Parameter P 0-306(Shutdown Speed Switching Threshold): When the motor is decelerating during shutdown and its speed falls below this threshold, the driver will cut off the current output to the motor, at which point the motor stops relying on the friction force of the shaft system. This parameter is effective in any shutdown mode.

Parameter P 0-307(Emergency Stop Torque): The brake torque size during the emergency stop torque shutdown process can be set. The greater the torque, the faster the shutdown process. Before the end of the shutdown, a constant braking torque is maintained.

Parameter P 0-308(Ramp Shutdown Deceleration Time): The deceleration time from the current speed to 0 in ramp shutdown mode can be set.

Parameter P 0-309(Quick Stop Deceleration Time): Can set the deceleration time from the current speed to 0 during quick stop mode.

9.4.1Disable Servo Enable Shutdown

By D I terminal or parameter setting, shutdown occurs after exiting enable. Parameters for disabling servo enable shutdown are listed in Table 9.x.

➢Relevant Parameters

Table 9.x Parameters for Disabling Servo Enable Shutdown

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method
P0-302	Parameters for Disabling Servo Enable Shutdown	0: DB Shutdown-DB Status 1: Zero Speed Stop-DB Status 2: Emergency Stop Torque Shutdown-DB Status 3: Quick Stop, DB Status 4: Ramp Shutdown, DB Status 5: DB Shutdown-Free State 6：Free Shutdown - Free State 7：Ramp Shutdown - Free State 8：Quick Stop - Free State 9：Emergency Stop Torque Shutdown - Free State 10：Zero Speed Stop - Free State	0	-	Shutdown Change

9.4.2Fault Shutdown

B D3E Driver categorizes faults into No .1 and No.2. Parking methods need to be set separately for these two categories of faults. For fault classification, refer to Chapter 16 "FaultsCodeDescription" 。

➢Relevant Parameters

Table 9.x Fault Shutdown Related Parameter Settings

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method
P0-303	No.1 Alarm Shutdown Method	0: DB Shutdown-DB Status 1: Zero Speed Stop-DB Status 2: Emergency Stop Torque Shutdown-DB Status 3: Quick Stop, DB Status 4: Ramp Shutdown, DB Status 5: DB Shutdown-Free State 6：Free Shutdown - Free State 7：Ramp Shutdown - Free State 8：Quick Stop - Free State 9：Emergency Stop Torque Shutdown - Free State 10：Zero Speed Stop - Free State	0	-	Shutdown Change
P0-304	No.2 Alarm Shutdown Method	0: DB Shutdown-DB Status 1: Zero Speed Stop-DB Status 2: Emergency Stop Torque Shutdown-DB Status 3: Quick Stop, DB Status 4: Ramp Shutdown, DB Status 5: DB Shutdown-Free State 6：Free Shutdown - Free State 7：Ramp Shutdown - Free State 8：Quick Stop - Free State 9：Emergency Stop Torque Shutdown - Free State 10：Zero Speed Stop - Free State	0	-	Shutdown Change

Note: *Some fault sources can affect the execution of the shutdown process, such as when the encoder cable breaks, the driver cannot obtain the speed at the moment of fault occurrence, and thus cannot perform ramp-down or quick stop. In this case, the motor will exhibit zero-speed stop.*

9.4.3Overtravel Shutdown

Overtravel refers to the situation where the motor load movement exceeds the safe range, causing the DI level corresponding to positive or negative overtravel to change, which triggers the driver to force the motor to stop as a safety function. The overtravel device is shown in Figure 9.x.

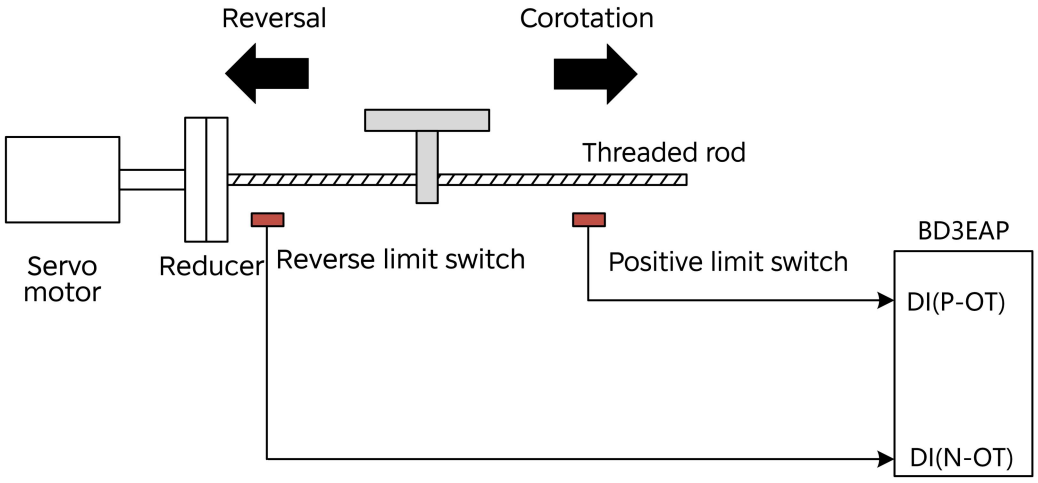


Figure 9.x Schematic Diagram of Overtravel Device

➢Related Function Settings

DI Function Assignment	Function Name	Function Description
4	Forward Overtravel Switch	When the mechanical movement reaches the forward overtravel limit Simultaneously triggers alarm E-605
5	Reverse Overtravel Switch	When the mechanical movement reaches the reverse overtravel limit Simultaneously triggers alarm E-606

When configuring the overtravel function, it is necessary to set the two DI terminals of the driver to the forward overtravel switch (DI:4) and the reverse overtravel switch (DI:5), and set the effective logic of the DI terminals.

Overtravel state shutdown parameter settings as shown in Table 9.x:

➢Relevant Parameters

Table 9.x Overtravel State Shutdown Parameter Settings

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method
P0-305	Overtravel Shutdown Method	0: DB Shutdown-DB Status 1: Zero Speed Stop-DB Status 2: Emergency Stop Torque Shutdown-DB Status 3: Quick Stop, DB Status 4: Ramp Shutdown, DB Status	0	-	Shutdown Change

		5: DB Shutdown-Free State 6：Free Shutdown - Free State 7：Ramp Shutdown - Free State 8：Quick Stop - Free State 9：Emergency Stop Torque Shutdown - Free State 10：Zero Speed Stop - Free State 11: Ramp Shutdown - Position Locking 12: Quick Stop - Position Locking 13: Emergency Stop Torque Shutdown - Position Locking 14: Zero Speed Stop - Position Locking			

Note: *When the servo motor drives a vertical axis, if it is in an overtravel state, to prevent the load from falling, please ensure that the overtravel stop method is configured as zero speed stop - position locking. In cases where the load moves linearly, please ensure that limit switches are connected to prevent collisions. In an overtravel state, reverse linear motion can be achieved through motor reversal to return to a safe zone.*

9.4.4Emergency Shutdown

BD3 E settings have two methods for triggering emergency stops:

- Using D I function 3: Emergency Stop
- Using auxiliary functions: Emergency Stop (C0-009)

The emergency stop method is consistent with the disable enable stop method (P 0-302).

➢Related Function Settings

Emergency Stop Trigger Method	Function Name	Function Description
DI Trigger	Emergency Shutdown	Assign the specified D I terminal to the emergency stop function (corresponding to D I function code 3), and trigger the emergency stop function through changes in the D I level.
Auxiliary Function Trigger	Emergency Shutdown	On the operation panel or higher-level machine, set the auxiliary function code C 0-009 to 1 to achieve the emergency stop function.

9.4.5Brake Setting

The main function of the motor holding brake is to quickly and reliably lock the motor shaft when the motor stops running, preventing the motor shaft from continuing to rotate. Specific functions include:

- Safety Function: When the motor stops running, the holding brake prevents the motor shaft from rotating accidentally, protecting the safety of the operator.
- Positioning Function: In applications that require precise positioning, the holding brake ensures that the motor remains in the predetermined position when stopped, preventing movement due to inertia or external forces.

- ***The holding brake mechanism built into the servo motor is a non-energized actuation type dedicated fixing device, not suitable for braking purposes, and is only used when the servo motor is in a stopped state.***
- ***The holding brake coil has no polarity.***
- ***When the holding brake coil is energized (holding brake released state), magnetic flux leakage may occur at parts such as the shaft end. Please be cautious when using magnetic sensors or other instruments near the motor.***
- ***Prevent Sliding: In vertically or inclined installed motors, the holding brake prevents the load from sliding due to gravity, ensuring the stability of the equipment.***
- ***Make sure that the holding brake is released during normal motor operation!***

For servo motors with a holding brake, one D O terminal of the driver must be configured as function 4 (external brake release signal), and the effective logic of the D O terminal must be determined. Configure the motor holding brake via parameter number P 0-301. When the motor does not have a holding brake, set P 0-301 to 0 (no brake state); when the motor is equipped with a holding brake, set P 0-301 to 1 (brake state).

Table 9-X. Holding Brake Function Parameter Comparison Table

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method
P0-301	Holding Brake Enable Signal	0-1	0	-	Effective on Shutdown
P0-30B	Delay from Holding Brake Power-On to Command Acceptance	0-500	250	ms	Immediate Effect
P0-30C	Delay from Holding Brake Power-Off to Servo OFF in Stopped State	1-1000	150	ms	Immediate Effect
P0-30D	Delay from Servo OFF to Holding Brake Power-Off in Operating State	1-1000	500	ms	Immediate Effect
P0-30E	Speed Threshold for Holding Brake Power-Off in Operating State	0-3000	20	rpm	Immediate Effect

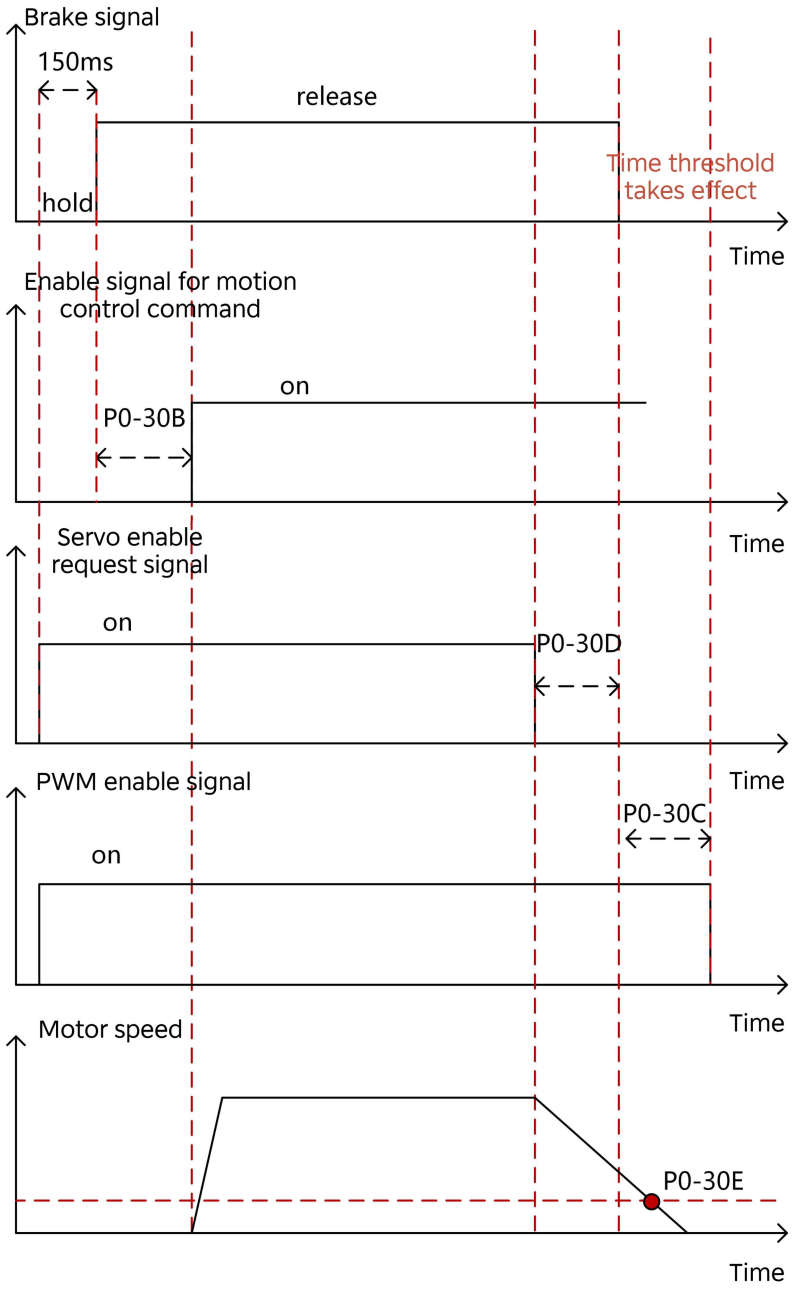


Fig. 9. x Example 1 of Holding Brake Timing Diagram

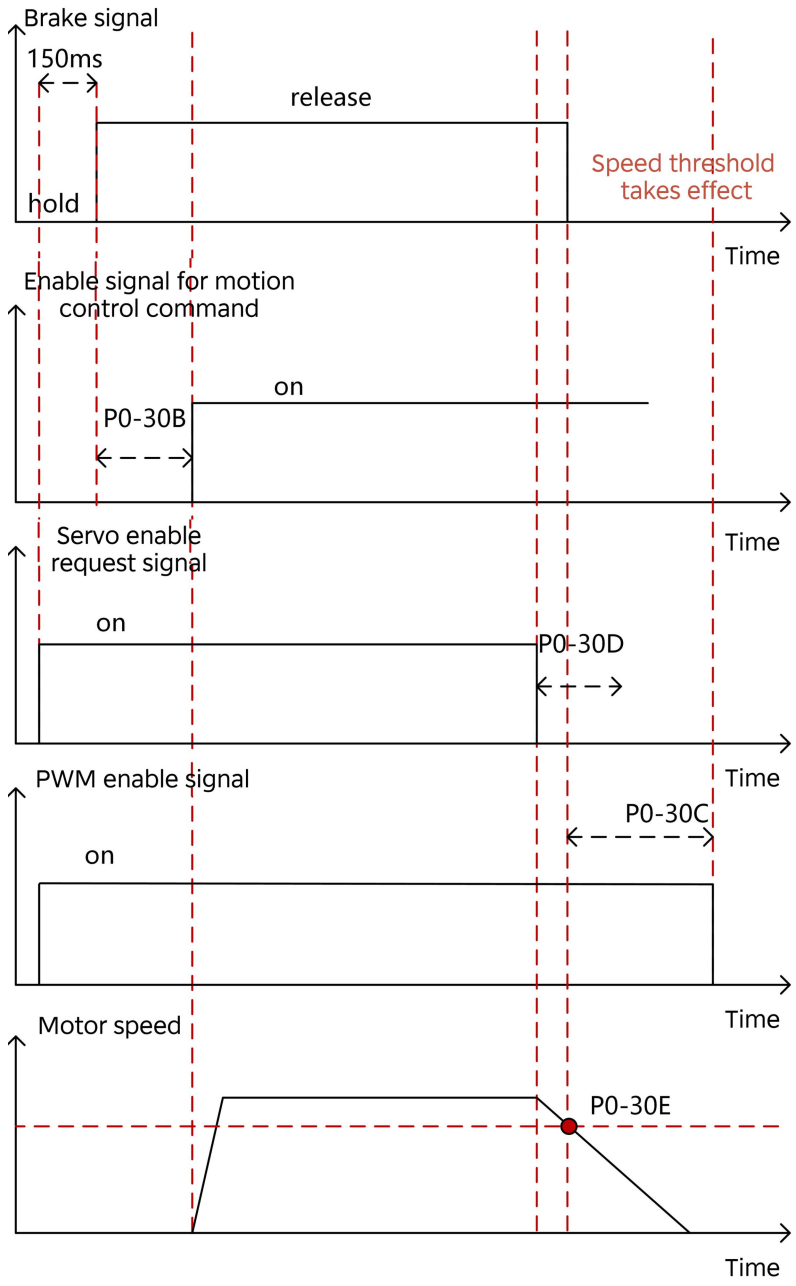


Fig. 9. y Example 2 of Holding Brake Timing Diagram

The timing relationships described in Table 9. x and the control signals of the driver are shown in Fig. 9.x and Fig. 9.y.

Note:

- *After the servo issues the enable signal, there is approximately a 1 50 ms delay before the holding brake transitions from the engaged state to the released state.*
- *Time interval from holding brake release to the activation of motion control commands (position-speed-torque): based on parameter P 0-30B.*
- *When the motor is rotating, the time interval from the deactivation of the servo enable signal to the engagement of the holding brake, or the speed threshold: based on parameter P 0-30D*

or P 0-30E. (According to Figure 9. x and Figure 9. y, the engagement of the holding brake is controlled by P 0-30D and P 0-30E ; whichever condition is met first, the holding brake will engage.)

- *When the motor is stationary, the time interval from the engagement of the holding brake to the servo entering the servo-off state (p wm off): based on parameter P0-30C.*

9.5Jog Operation

To prevent enable signal conflicts, when using the jog function, ensure that the current servo is in the R DY (Servo Ready) state; otherwise, the panel will display N O-OP (no operation), and it will not be possible to enter the jog mode!

BD3E features position jogging (PJOG) and speed jogging (SJOG) functions. Users can use the jogging function to confirm whether the servo motor can rotate normally and check for any abnormal noise during rotation. The jogging function can be used through the panel auxiliary functions and the DriveStudio debugging platform.

9.5.1Jog Function Specifications

The position jogging function involves three parameter groups (P 5-601 to P5-603), and the speed jogging function involves seven parameter groups (P 5-601 to P5-608). For specific information, refer to Table 9-X. Jog Function Parameter Reference Table.

Table 9-X. Jog Function Parameter Comparison Table

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method
P5-601	Jog Speed Command Value	0-6000	100	rpm	Immediate Effect
P5-602	Jog Acceleration Time	0-65535	100	ms	Immediate Effect
P5-603	Jog Deceleration Time	0-65535	100	ms	Immediate Effect
P5-604	Position Jog Target Position Command (Relative Position Command)	0-2147483647	0	User Command Unit	Effective on Shutdown
P5-606	Position Jog Operation Direction	0-3	0	-	Effective on Shutdown
P5-607	Position Jog Cycle Operation Count	0-65535	0	-	Immediate Effect
P5-608	Operation Wait Time	0-65535	0	ms	Immediate Effect

Note: *JOG indicates jogging*

In Position J OG mode, the operation direction function specifications are as follows:

➢Related Function Settings

Table 9-X. Position J OG Operation Direction Settings

Position J OG Operation Direction	Function Description
P5-606=0: Forward	In Position J OG mode, the motor moves forward
P5-606=1: Reverse	In Position J OG mode, the motor moves backward
P5-606=2: Forward and Reverse	In Position J OG mode, the motor first rotates forward and then reverses.
P5-606=3: Negative to Positive	In Position J OG mode, the motor first reverses and then rotates forward.

Taking the jog function as an example, set seven groups of parameters (P 5-601 to P5-608, where the running direction P 5-606=2, and the number of cycles P 5-607=2) sequentially. After setting these parameters, the motor speed command and position command are planned according to the given values, as shown in Figure 9.x, which illustrates the command planning and position feedback under the jog mode.

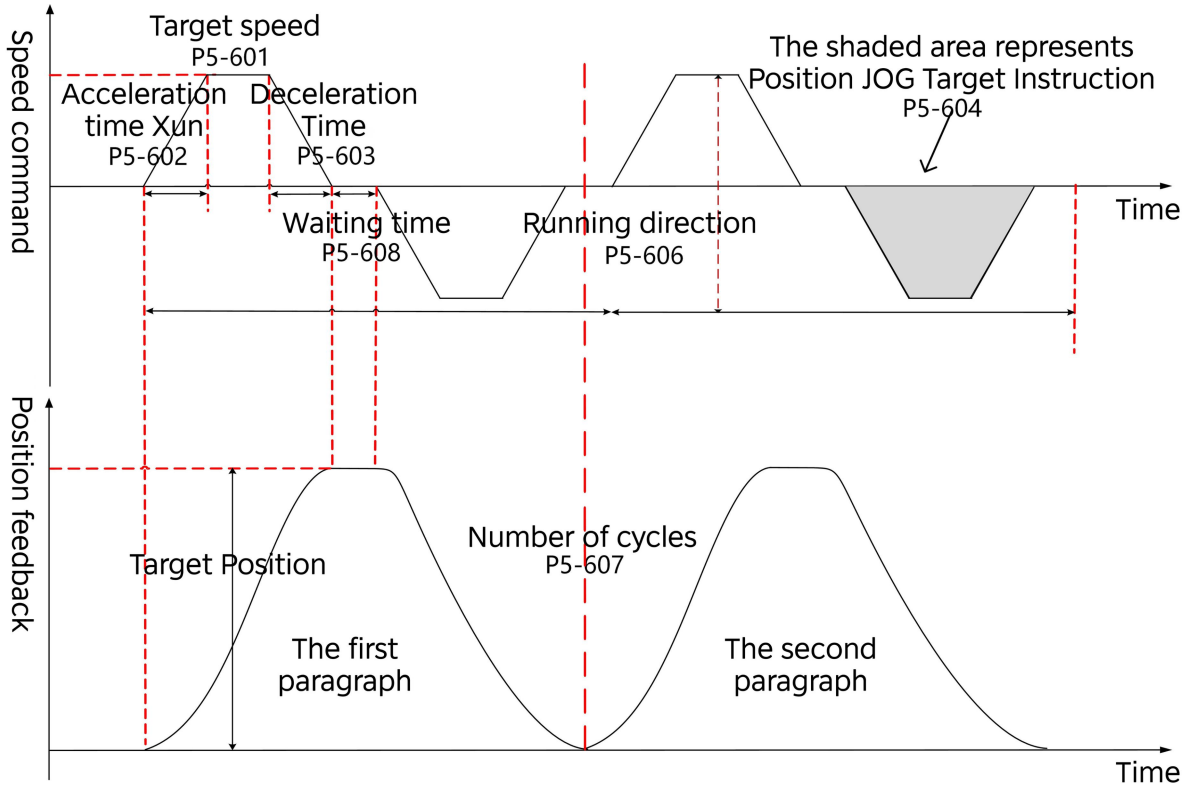


Figure 9.x Jog Command Planning and Position Feedback

Note: *Position J OG is only available in relative position mode. Please ensure the current position of the load before use.*

9.5.2Panel Jog

• Position JOG Debugging Steps as Shown in Figure 9.x

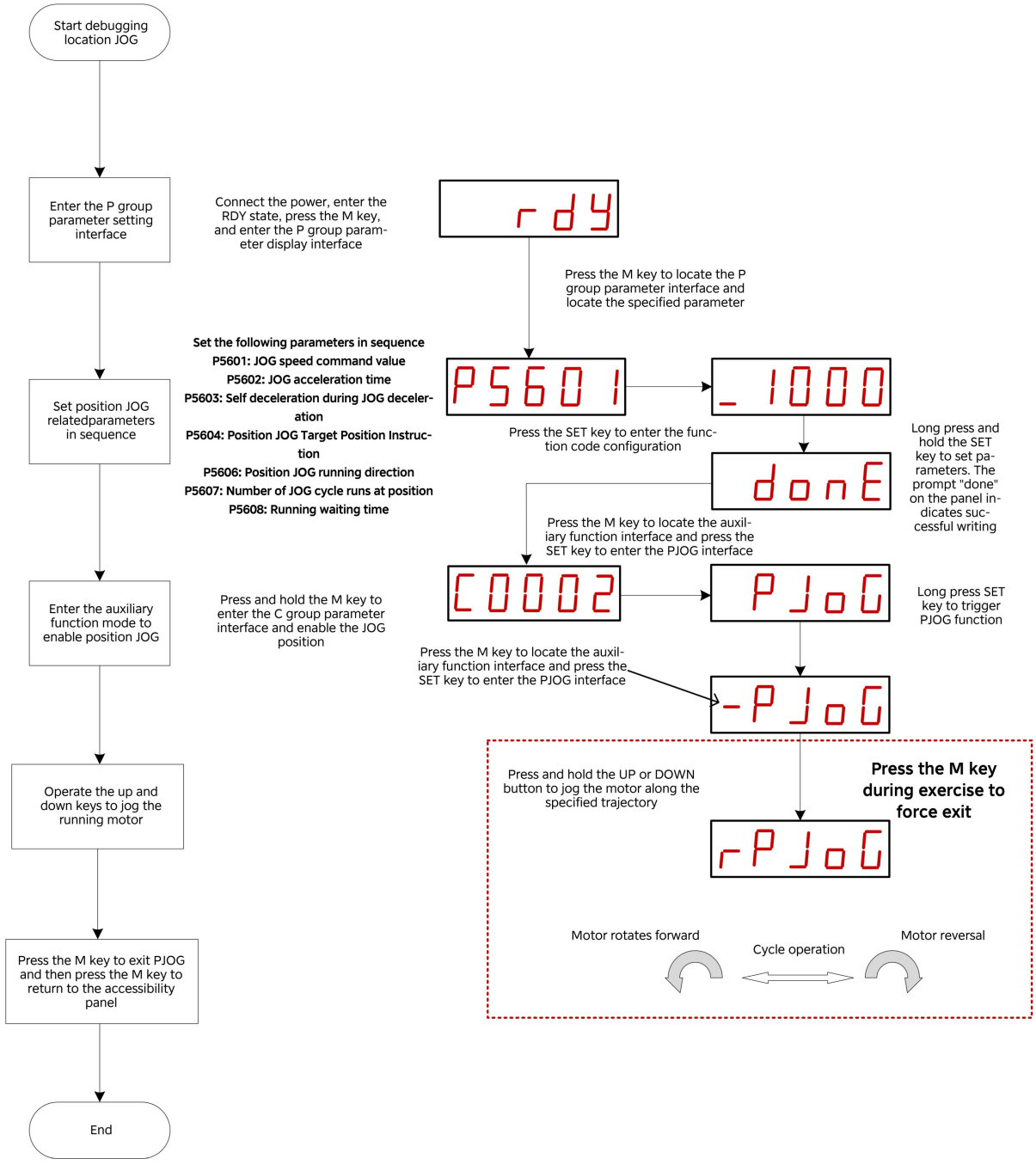


Figure 9. x Position JOG Debugging Steps Illustration

• Speed JOG Debugging Steps as Shown in Figure 9.x

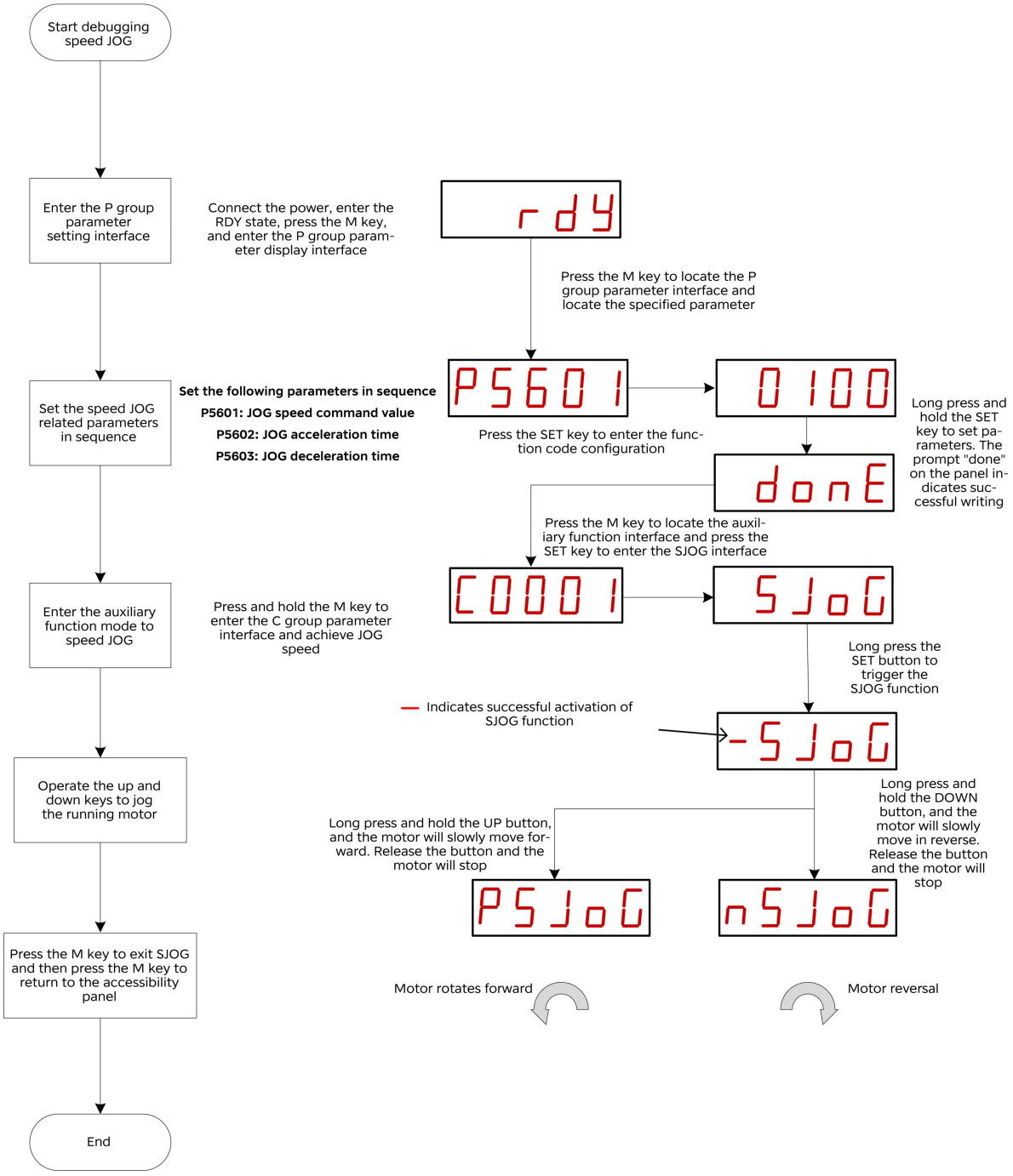


Figure 9.x Speed JOG Debugging Steps Schematic

9.5.3Host Computer Jog

Open the Galil servo debugging higher-level machine: Drive Studio, enter the JOG debugging interface, and perform speed JOG debugging through the higher-level machine.

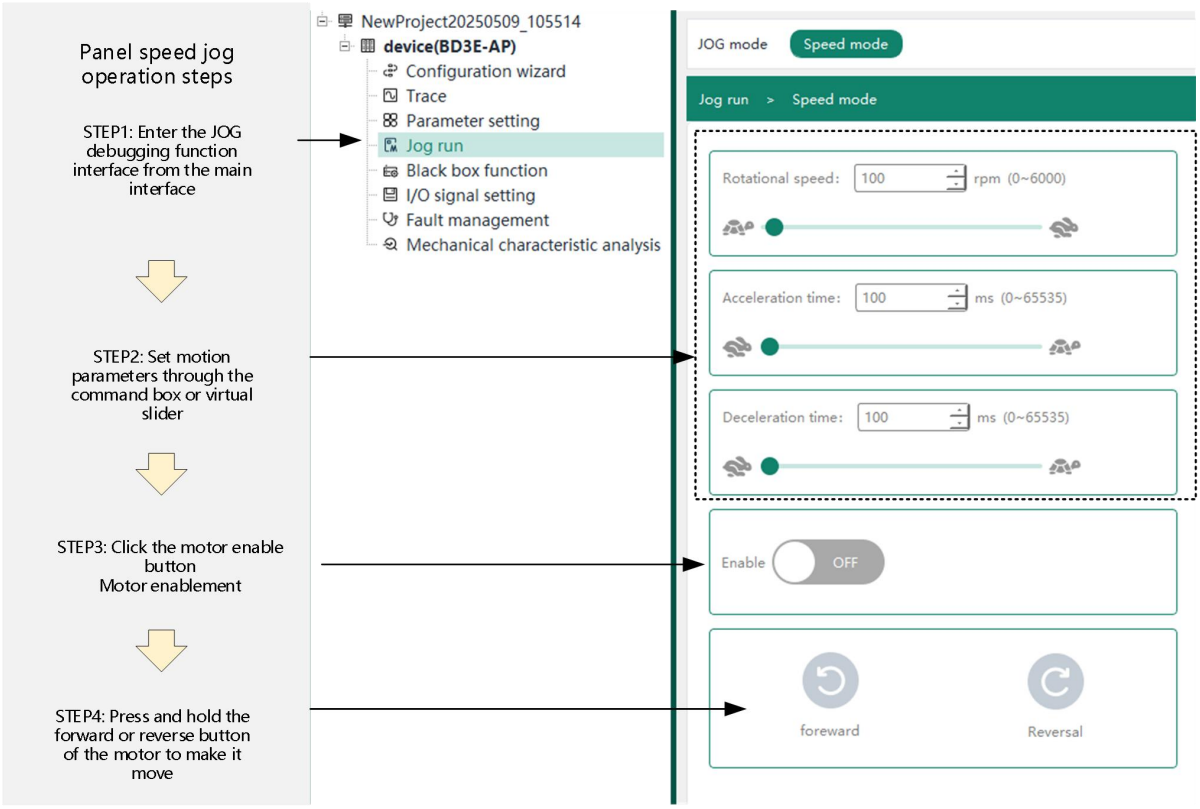


Figure 9. x Higher-level Machine Speed JOG Debugging Steps

Note: *The rotation speed, acceleration time, and deceleration time set in the higher-level machine interface correspond to parameters P 5-601, P 5-602, and P 5-603, respectively. When the higher-level machine modifies these parameters, the values in the corresponding registers will also be modified and saved. Therefore, after exiting the JOG debugging function in the higher-level machine, it is necessary to restore the above parameters to a safe range to prevent excessive speed when users use the panel for jogging debugging!*

10Performance Tuning

10.1Inertia Identification

10.1.1Offline Inertia Identification

Offline inertia identification method, which primarily uses motor forward and reverse commands to identify the load inertia ratio; the inertia ratio (the ratio of load inertia to motor inertia) measured here is the reference parameter for gain adjustment, and it should be set as accurately as possible.

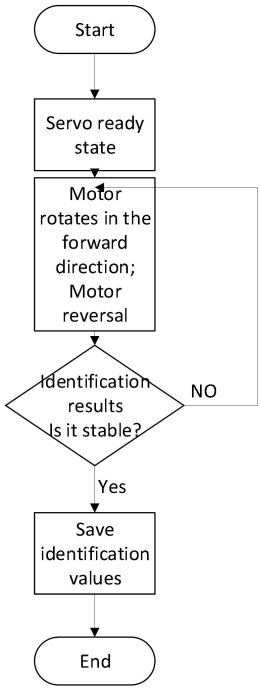


Figure 10-1Offline Inertia Identification Procedure

Before performing offline inertia identification, first confirm the following:

Meet the P5-005 (number of motor revolutions required for single inertia identification) requirement. Check the current maximum speed for inertia identification (P5-002), the time to accelerate to the maximum speed during inertia identification (P5-003), and the number of motor revolutions required to complete inertia identification (P5-005). Ensure that the travel range available at the motor's stop position is greater than the P5-005 setting value; otherwise, appropriately reduce the P5-002 or P5-003 setting values until this requirement is met.

- Operation Steps:

1. Disable the servo enable, the servo status should be “rdy”;
2. In parameter display mode, switch to “C0-003”, press the “SET” key to activate the offline inertia identification function;
3. Briefly press the “∧” key or “∨” key to execute the offline identification action;

4. The motor runs, after the execution ends, the panel displays the identification result P1-102 and saves it;

Press the "MODE" button to exit.

For applications where the load inertia is relatively large (inertia ratio > 30), set an initial value for the load moment of inertia (P1-102) that is close to the actual value. This avoids abnormal vibrations during system identification due to a low initial inertia setting.

➢ Related Parameters:

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method
P5-002	Inertia Identification Maximum Speed	100~3000	800	rpm	Effective on Shutdown
P5-003	Inertia Identification Acceleration/Deceleration Time	20~800	100	ms	Effective on Shutdown
P5-004	Inertia Identification Waiting Time	50~10000	500	ms	Effective on Shutdown
P5-005	Inertia Identification Running Trajectory Distance	0~655.35	3	rev	Effective on Shutdown

10.2Automatic Gain Adjustment

10.2.1Stiffness Table Selection

By selecting the stiffness value, adjust the parameters of the servo driver to meet the system requirements for the speed and stability of the servo system.

This function is enabled by default at the factory, adjustment mode selection (P1-001) is set to 1.

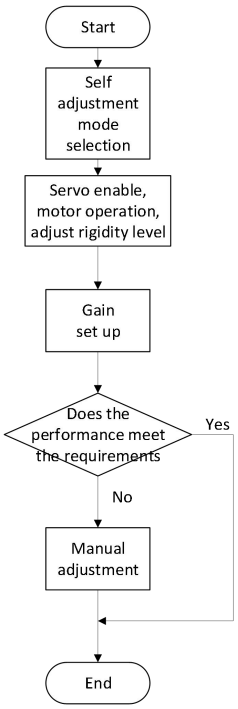


Figure 10-2 Stiffness Level Parameter Gain Setting Procedure

The adjustment mode (P1-001) can be set through the panel or debugging software.

Adjustment Modes are as Follows Table 10-1:

Table 10-1Adjustment Mode List

Mode	Name	Description
0	Invalid	Keep Parameters Unchanged
1	Standard Stiffness Table Mode	Stiffness Table Gain Adjustment Parameters
2	Positioning Mode	Stiffness Table Adjustment Parameters, with Gain Switching Function

The stiffness level setting range is set to 0~31; the higher the stiffness value, the stronger the stiffness; the stronger the stiffness, the faster the servo response.

Based on the stiffness level parameter P1-102, update the corresponding gain parameters and store them in the corresponding function codes, as Table 10-2shown:

Table 10-2Stiffness Table Update Parameter List

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method
P1-201	First Position Loop Gain	0.1~2000.0	40.0	rad/s	Immediate Effect
P1-202	First Velocity Loop Gain	0.1~2000.0	25.0	Hz	Immediate Effect
P1-203	First Velocity Loop Integral Time Constant	0.15~512.00	31.83	ms	Immediate Effect

P1-204	First Torque Command Filter Time Constant	0.00~30.00	0.79	ms	Immediate Effect

According to the setting of parameter P1-001 for auto-tuning mode, as Table 10-1shown, there are a total of 3 tuning modes:

1) When the auto-tuning mode is invalid (P1-001=0), maintain the current parameters unchanged, only switch manual gain auto-tuning;

2) When the auto-tuning mode is set to standard stiffness table mode (P1-001=1), the stiffness table updates gains only when the stiffness level changes, without using gain switching, updating parameters based on changes in stiffness level, and not updating the second gain parameter values.

3) When the auto-tuning mode is set to positioning mode (P1-001=2), add gain switching function, update the second gain parameters on the basis of updating the Table 10-2listed parameters, as Table 10-3as shown, where the 2nd position loop gain parameter is one level higher than the 1st position gain parameter.

Table 10-3Positioning Mode Parameter Update List

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method
P1-301	2nd Position Loop Gain	0.1~2000.0	64.0	rad/s	Immediate Effect
P1-302	2nd Velocity Loop Gain	0.1~2000.0	40.0	Hz	Immediate Effect
P1-303	2nd Velocity Loop Integral Time Constant	0.15~512.00	20.00	ms	Immediate Effect
P1-304	2nd Torque Command Filter Time Constant	0.00~30.00	0.79	ms	Immediate Effect

At the same time, the velocity feedforward parameters are set to fixed values, such as Table 10-4as shown

Table 10-4Velocity Feedforward Parameter List

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method
P1-503	Velocity Feedforward Gain Parameter	0.0~100.0	0.0	%	Immediate Effect

To ensure parameter consistency and synchronization, whenever the position loop gain P1-201 changes, the storage function code must be re-output; and during system initialization, an initial stiffness level parameter of 12 must be set for parameter configuration.

Table 10-5Stiffness Table List

Stiffness Level	Position Loop Gain (rad/s)	Velocity Loop Gain (Hz)	Velocity Integral Time Constant (ms)	Torque Filter Time Constant (ms)
0	2.4	1.5	500	13.26

Stiffness Level	Position Loop Gain (rad/s)	Velocity Loop Gain (Hz)	Velocity Integral Time Constant (ms)	Torque Filter Time Constant (ms)
1	3.2	2	397.89	9.95
2	4	2.5	318.31	7.96
3	4.8	3	265.26	6.63
4	5.6	3.5	227.36	5.68
5	7.2	4.5	176.84	4.42
6	9.6	6	132.63	3.32
7	12	7.5	106.1	2.65
8	14.4	9	88.42	2.21
9	17.6	11	72.34	1.81
10	22.4	14	56.84	1.42
11	28.8	18	44.21	1.11
12	40	25	31.83	0.79
13	48	30	26.53	0.66
14	56	35	22.74	0.57
15	64	40	19.89	0.5
16	80	50	15.92	0.4
17	96	60	13.26	0.33
18	120	75	10.61	0.27
19	144	90	8.84	0.22
20	184	115	6.92	0.17
21	224	140	5.68	0.14
22	272	170	4.68	0.12
23	336	210	3.79	0.09
24	400	250	3.18	0.08
25	448	280	2.84	0.07
26	496	310	2.57	0.06
27	544	340	2.34	0.06
28	592	370	2.15	0.05
29	640	400	1.99	0.05
30	720	450	1.77	0.05
31	800	500	1.59	0.05

➢ Related Parameters:

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method
P1-001	Adjustment Mode Selection	0: Manual Adjustment Mode 1: Standard Stiffness Table Mode 2: Stiffness Table + Positioning Mode	1	-	Immediate Effect
P1-102	Stiffness Level Selection	0~31	12	-	Immediate Effect

10.3Manual Gain Adjustment

When automatic gain adjustment does not achieve the desired effect, the gain can be manually fine-tuned. Through more detailed adjustments, the performance can be optimized. The servo system consists of three control loops, which are the position loop, velocity loop, and current loop, from outer to inner. The basic control block diagram is shown in the following figure.

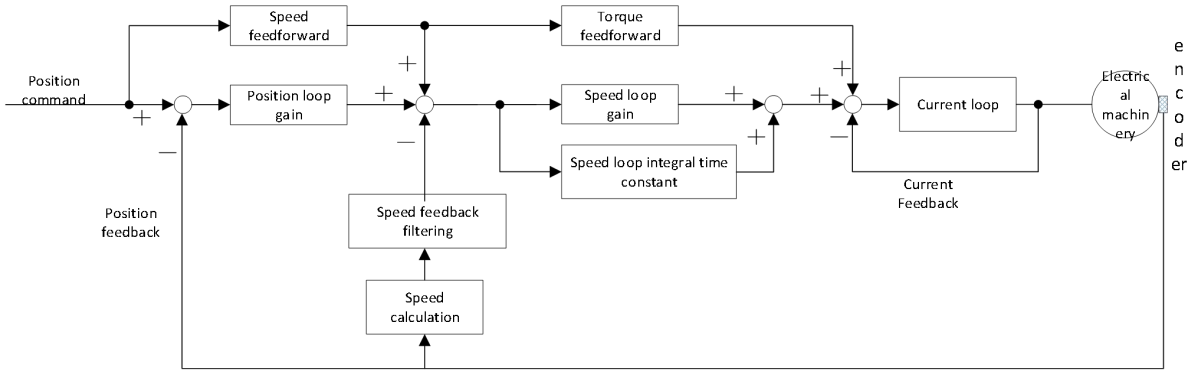


Figure 3 Basic Control Block Diagram for Manual Gain Adjustment

10.3.1Basic Parameters

The default current loop gain of the servo driver has been set to ensure adequate responsiveness ability, generally no adjustment is needed, only position loop gain, speed loop gain, and other auxiliary gains need to be adjusted. Therefore, when adjusting gains under position control mode, to ensure system stability, while increasing the position loop gain, the speed loop gain should also be increased, ensuring that the response of the position loop is lower than that of the speed loop.

The basic gain parameter adjustment method is as follows.

1. Speed Loop Gain (P1-202)

This parameter determines the motor's feedback speed tracking capability for the given speed. Assuming the load inertia ratio (P 1-101) is accurate, it can be considered that the fastest frequency at which the speed loop can follow the speed command is equal to P 1-202. Increasing

this parameter can reduce positioning time, provide smaller speed fluctuations, and improve speed command tracking. However, setting this parameter too high can cause mechanical noise or vibration. If mechanical vibration still occurs after reducing this parameter, refer to "10.4 Vibration Suppression Refer to the "Chapter for further adjustments.

2. Speed Loop Integral Time Constant (P 1-203)

This parameter is mainly used to eliminate steady-state errors in the speed loop. Reducing the set value can enhance the integral action of the speed regulator, shorten the positioning time, but setting it too low can also cause mechanical vibration; if the set value is too high, it will result in the average feedback speed not equaling the given speed under steady-state conditions.

3. Position Loop Gain (P 1-201)

This parameter determines the fastest frequency at which the position loop can follow position commands. To ensure the response characteristics of the position loop, the following frequency corresponding to the speed loop gain is typically set to 3~5 times the following frequency corresponding to the position loop gain, i.e.,

$$3 \leq \frac{2\pi \times (\mathbf{P1\text{-}202})}{\mathbf{P1\text{-}201}} \leq 5$$

Increasing this parameter can shorten the positioning time and improve the motor's ability to resist external disturbances when stationary; however, setting this parameter too high may lead to system instability and oscillation.

4. Torque Filter Time Constant (P 1-204)

This parameter is primarily used to eliminate high-frequency noise and suppress mechanical resonance to some extent. To ensure the response characteristics of the speed loop, the low-pass filter cutoff frequency corresponding to this parameter is typically set to more than four times the speed loop bandwidth, i.e.,

$$\frac{1000}{\mathbf{P1\text{-}204}} \geq 2\pi \times (\mathbf{P1\text{-}202}) \times 4$$

Setting this parameter too high can slow down the response of the speed loop; if the motor vibrates excessively when stopped, try reducing the value of this parameter; setting this parameter too low can increase high-frequency noise in the motor.

➢Related Parameters:

Parameter	Parameter Name	Set Value	Default Value	Unit	Effective Method
P1-201	Position Loop Gain	0.0~2000.0	40.0	rad/s	Immediate Effect
P1-202	Speed Loop Gain	0.1~2000.0	25.0	Hz	Immediate Effect
P1-203	Speed Loop Integral Time Constant	0.15~512.00	31.83	ms	Immediate Effect
P1-204	Torque Filter Time Constant	0.00~30.00	0.79	ms	Immediate Effect

10.3.2Gain Switching

Triggered by the internal state of the servo system and only valid in speed control and position control modes, using this function can achieve the following effects:

- In the motor stopped (servo enabled) state, reduce the gain to suppress vibration;
- In the motor stopped action, increase the gain to shorten the positioning time;
- In the motor real-time operation state, increase the gain to improve system command tracking;
- Based on the status of the system load equipment, use external signals to switch gains.

The gain switching function uses the mode selection of gain switching as the criterion for selecting the gain switching condition, and its implementation and switching process are as follows: Figure 10-4shown:

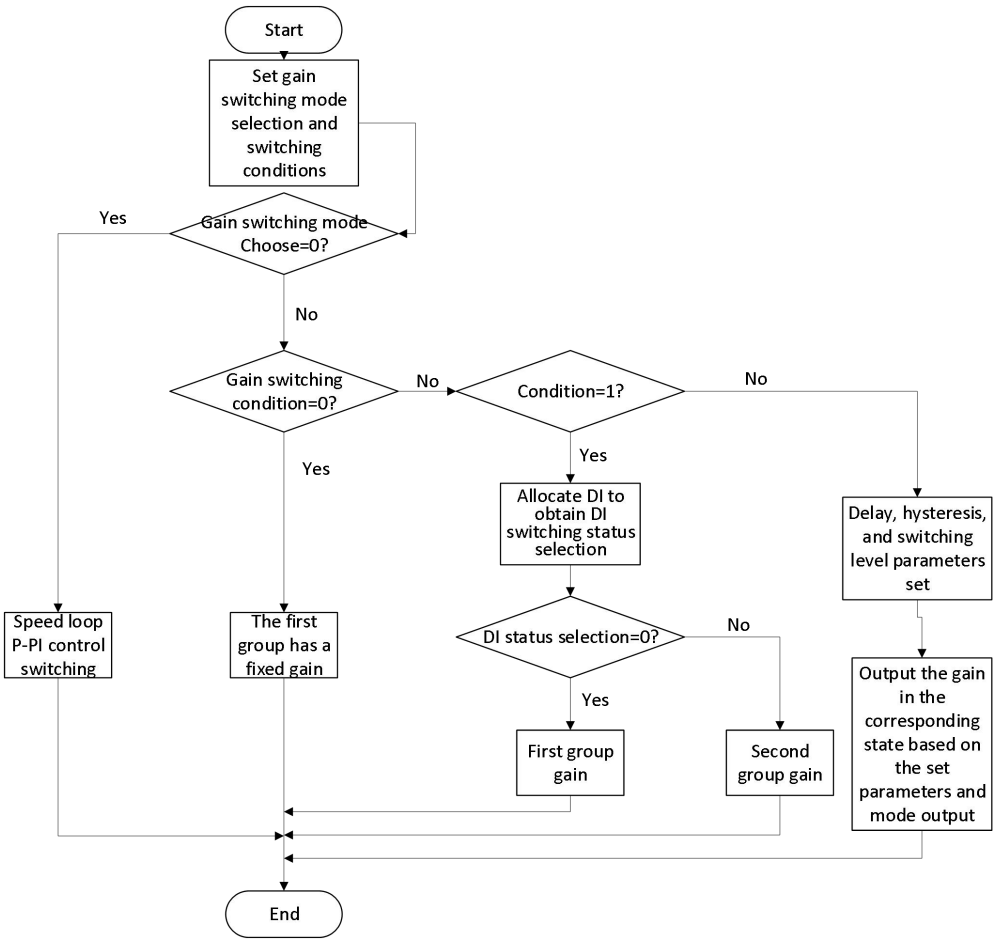


Figure 10-4Gain Switching Process

Specific explanations for mode switching conditions as Table 10-6shown, where "×" indicates invalid, and "√" indicates valid.

Table 10-6 Gain switching mode list

Name				Default Value		
Gain switching method selection	Gain Switching Condition Selection	Condition	Schematic Diagram	Delay Time	Switching Level	Switching Lag
1	0	First Group Gain Fixed	/	×	×	×
	1	Gain Switching Terminal	/	×	×	×
	2	Torque Command	Figure 10-5	√	√(%)	√

Name				Default Value		
Gain switching method selection	Gain Switching Condition Selection	Condition	Schematic Diagram	Delay Time	Switching Level	Switching Lag
	3	Speed Command	Figure 10-6	√	√	√
	4	Speed Command Change Rate	Figure 10-7	√	√(10rpm/s)	√(10rpm/s)
	5	Speed Command High and Low Thresholds	Figure 10-8	×	√	√
	6	Position Deviation	Figure 10-9	√	√	√
	7	Position Command	Figure 10-10	√	√	√
	8	Positioning Completion	Figure 10-11	√	√	√
	9	Speed Feedback	Figure 10-6	√	√	√
	10	Position Command + Speed Feedback	Figure 10-12	√	√	√
0	/	P-PI Switching	/	×	×	×

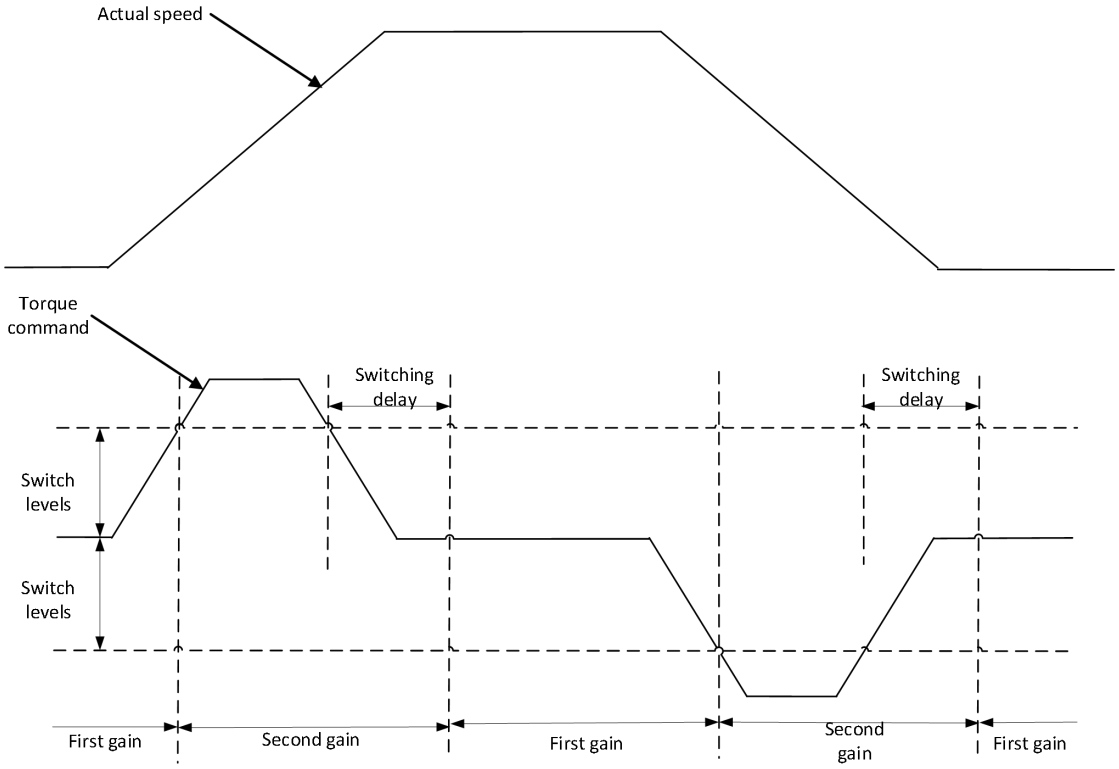


Figure 10-5 Torque Command Gain Switching Diagram

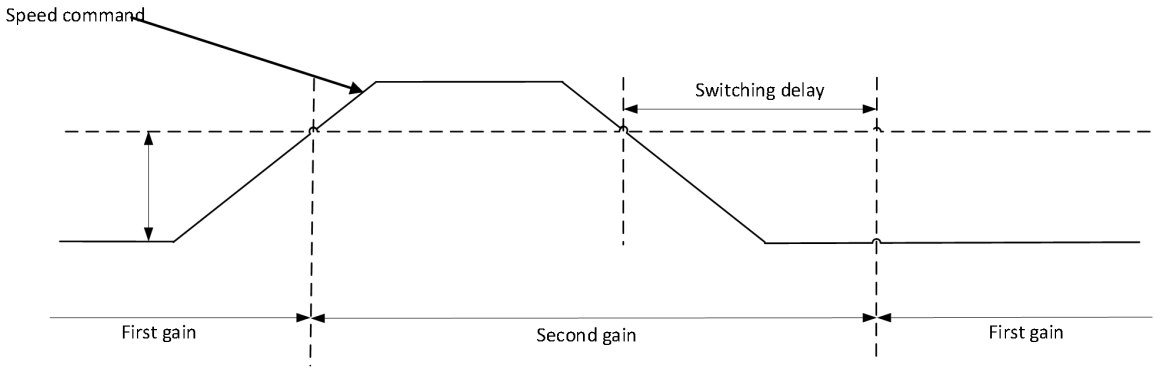


Figure 10-6 Speed Command Gain Switching Diagram

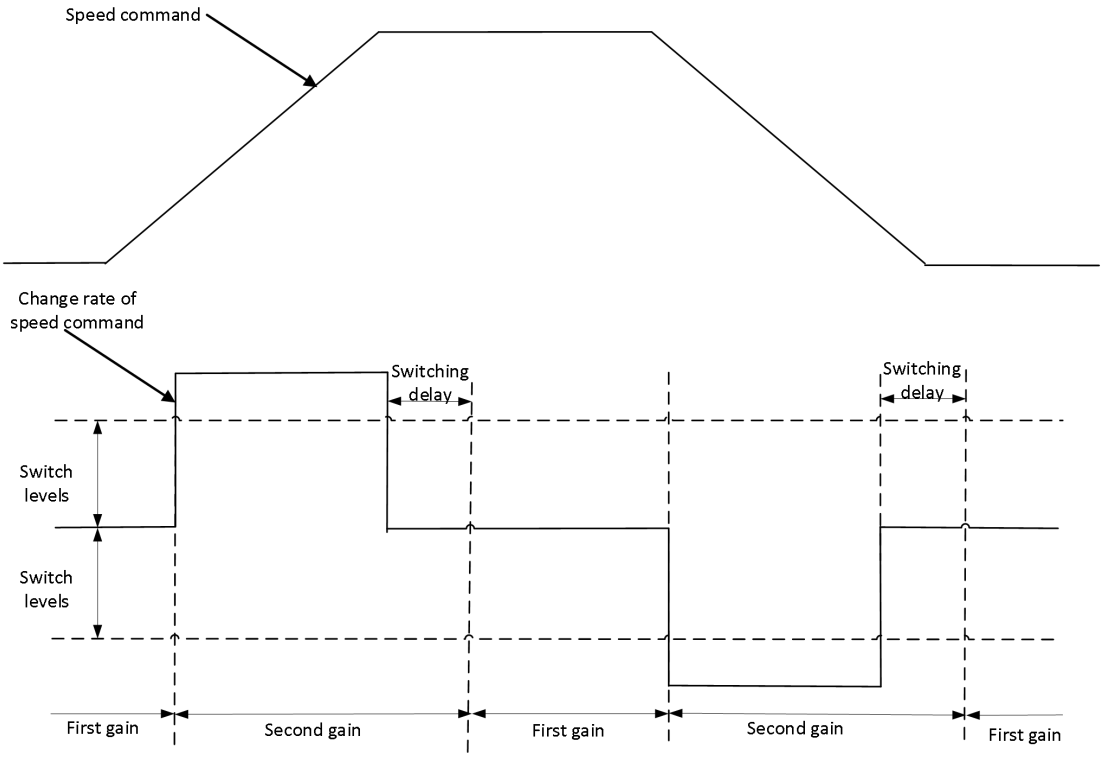


Figure 10-7 Speed Command Change Rate Gain Switching Diagram

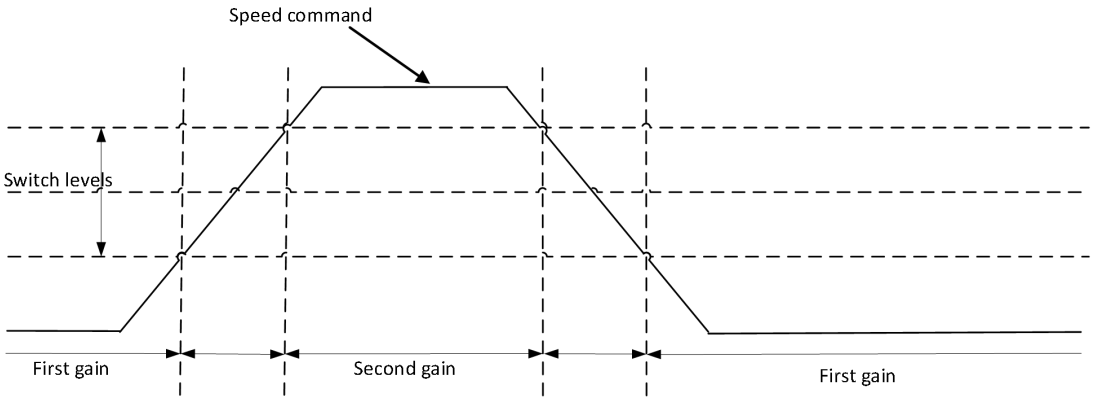


Figure 10-8 Speed High and Low Threshold Gain Switching Diagram

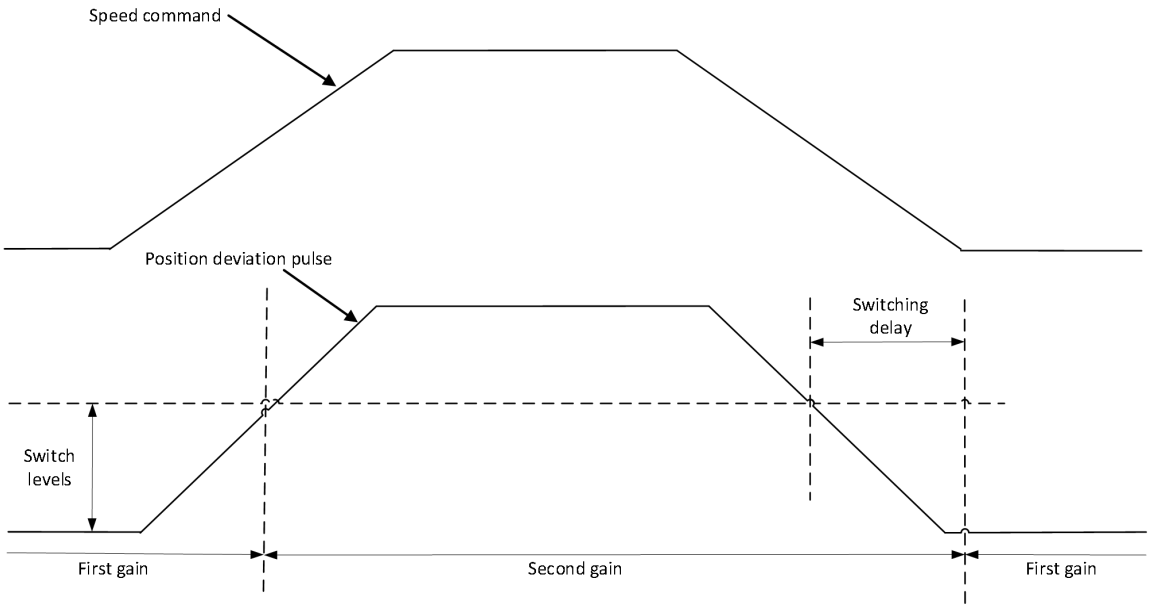


Figure 10-9 Position Deviation Gain Switching Diagram

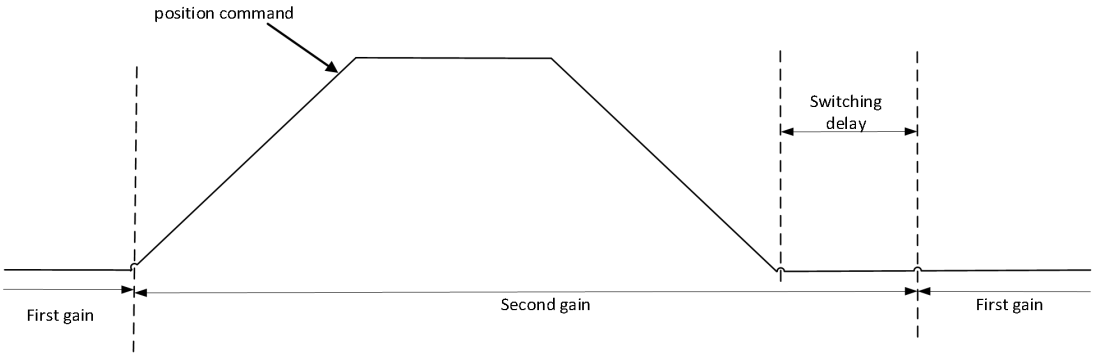


Figure 10-10 Position Command Gain Switching Diagram

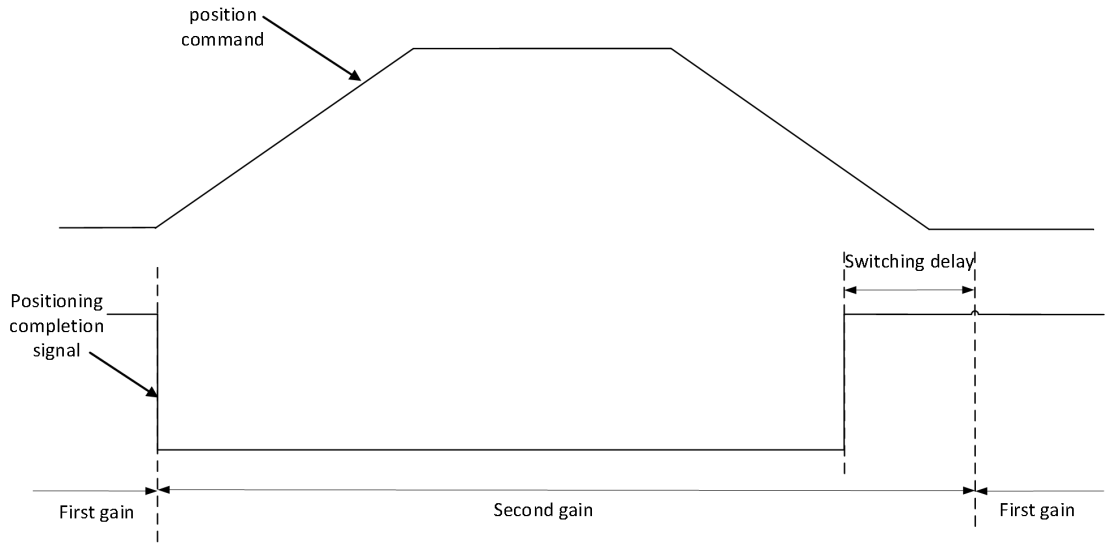


Figure 10-11 Positioning Completion Gain Switching Diagram

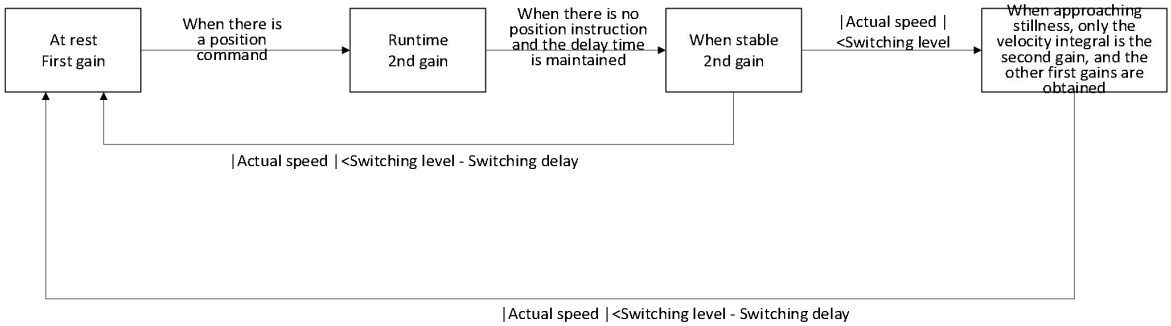


Figure 10-12 Position Command + Speed Feedback Gain Switching Diagram

➢Related Parameters:

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method
P1-401	Gain switching method selection	0: Speed Loop PI-P Switching 1: Gain Switching Based on Conditions	1	/	Immediate Effect
P1-402	Gain Switching Condition Selection	0~10	0	/	Immediate Effect
P1-403	Gain Switching Delay Time	0.0~1000.0	0.5	ms	Immediate Effect
P1-404	Gain Switching Level	0~20000	50	/	Immediate Effect
P1-405	Gain Switching Hysteresis	0~20000	30	/	Immediate Effect
P1-406	Position Gain Switching Time	0.0~1000.0	2.0	ms	Immediate Effect

10.3.3Command Filtering

Position Command Filtering involves filtering the position command after it has been divided or multiplied by the electronic gear ratio, in encoder units. This includes mean filtering and first-order low-pass filtering.

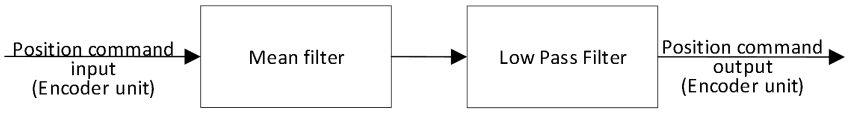


Fig. 10-13 Block Diagram of Position Command Filter Control

Mean filtering or first-order low-pass filtering of the position command should be considered in the following situations:

1. The position command output by the higher-level machine has not undergone acceleration or deceleration processing;
2. Pulse command frequency is low;
3. The electronic gear ratio is more than 10 times.

Step-type Position Command First-order Low-pass Filter and Average Filter as shown in the following figure:

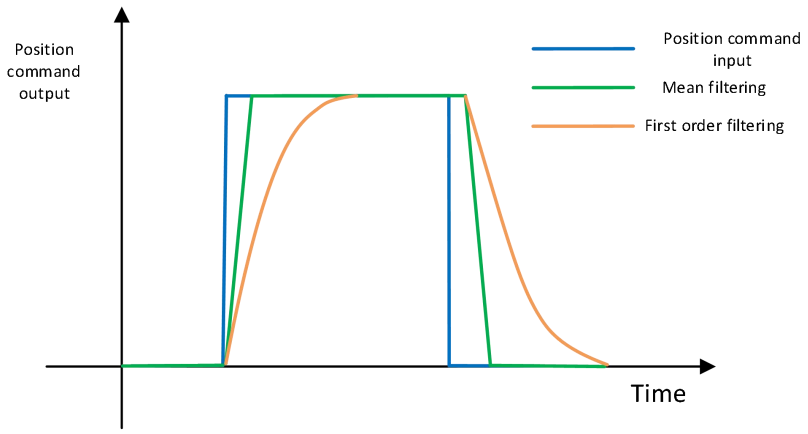


Fig. 10-14 Schematic Diagram of First-order Position Command Filtering and Mean Filtering

➢Related Parameters:

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method
P3-001	Position Command I IR Low-pass Filter Time Constant	0.0~6553.5	0.0	ms	Effective on Shutdown
P3-002	Position Command Moving Average Filter Time Constant	0.0~128.0	0.0	ms	Effective on Shutdown

10.3.4Feedforward Gain

Velocity Feedforward

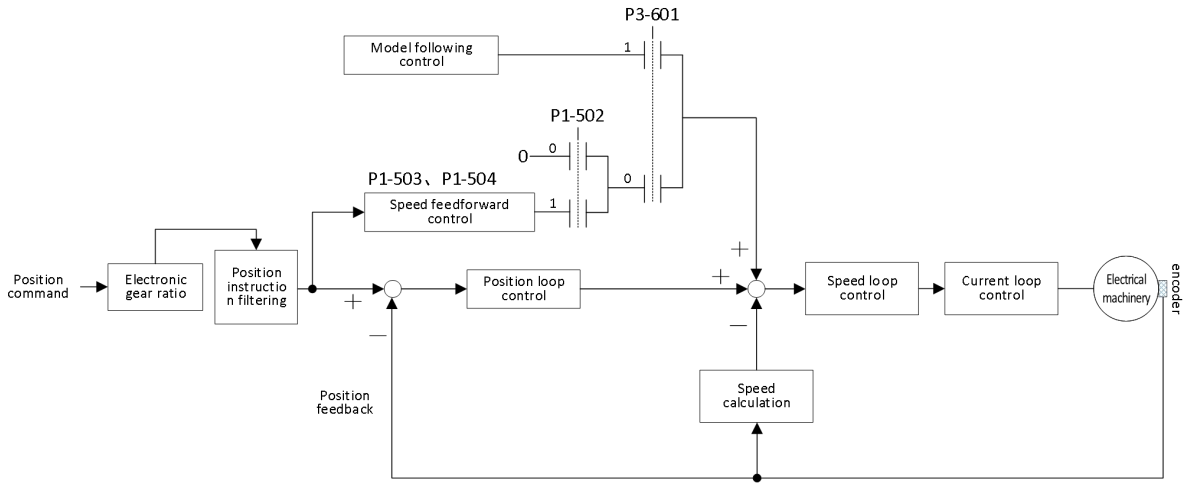


Fig. 10-15 Velocity Feedforward Control Block Diagram

Velocity feedforward control is generally used in position control mode. Velocity feedforward control helps improve the response of the position loop and reduce position deviation at constant speed. The setup steps for this function are as follows:

1. Set Speed Feedforward Method

- When P 3-601 is set to 1, model tracking control is enabled, at which point the speed feedforward value is calculated by the model tracking control, and the user does not need to adjust the feedforward parameters;
- When P 3-601 is set to 0, P 1-502 determines whether speed feedforward control is enabled:
  - If P1-502 is set to 0, speed feedforward control is not effective, and the feedforward value is zero;
  - If P 1-502 is set to 1, speed feedforward control is effective, and the user sets the feedforward parameters through P 1-503 and P 1-504.

2. Set Speed Feedforward Parameters

Speed feedforward parameters include speed feedforward gain (P 1-503) and speed feedforward filter time constant (P 1-504). Increasing the feedforward gain or decreasing the speed feedforward filter time constant can help accelerate the position loop response, but it can also easily cause overshoot.

Torque Feedforward

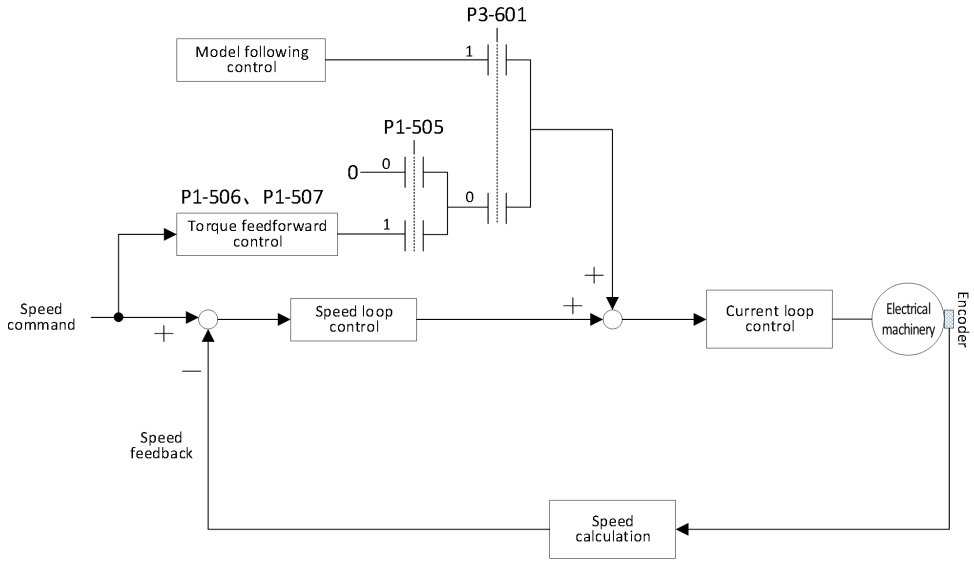


Fig. 10-16 Torque Feedforward Control Block Diagram

The torque feedforward control function can be used in position control mode or speed control mode, which helps improve the response of the speed loop. The setup steps for this function are as follows:

1. Set the Torque Feedforward Method

- When P 3-601 is set to 1, model tracking control is enabled, at which point the torque feedforward value is forcibly calculated by the model tracking control, and the user does not need to adjust the feedforward parameters;
- When P 3-601 is set to 0, then P 1-50 5 controls whether the torque feedforward control is enabled:
  - If P1-505 is set to 0, the torque feedforward control is not effective, and the feedforward value is zero;

- If P 1-50 5 is set to 1, torque feedforward control is enabled, and the user sets the feedforward parameters through P 1-50 6 and P 1-50 7.

2. Set Torque Feedforward Parameters

Torque feedforward parameters include torque feedforward gain (P 1-50 6) and torque feedforward filter time constant (P 1-50 7). Increasing the feedforward gain or decreasing the torque feedforward filter time constant helps to speed up the response to speed commands, but can easily cause overshoot.

➢Related Parameters:

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method
P1-502	Speed Feedforward Mode Selection	0: Disable Speed Feedforward 1: Enable Speed Feedforward	0		Immediate Effect
P1-503	Speed Feedforward Gain	0.0~100.0	0.0	%	Immediate Effect
P1-504	Speed Feedforward Filter Time Constant	0.00~64.00	0.00	ms	Immediate Effect
P1-505	Torque Feedforward Method Selection	0: Disable Torque Feedforward 1: Enable Torque Feedforward	0		Immediate Effect
P1-506	Torque Feedforward Gain	0.0~100.0	0.0	%	Immediate Effect
P1-507	Torque Feedforward Filter Time Constant	0.00~64.00	0.00	ms	Immediate Effect
P3-601	Model Tracking Enable	0: Not Enabled 1: Enabled	0		Immediate Effect

10.3.5Model Tracking

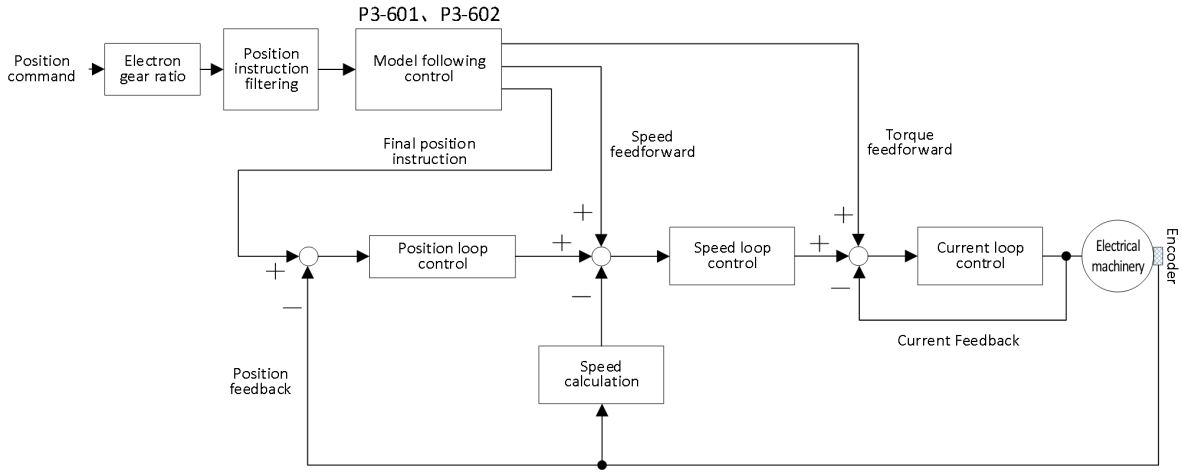


Fig. 10-17 Model Tracking Control Block Diagram

Model tracking control is generally used in position control mode. This algorithm can simultaneously achieve position command planning, speed feedforward, and torque feedforward functions, effectively improving position overshoot and reducing positioning time. When this function is enabled (P 3-601=1), traditional speed feedforward control and torque feedforward control (See Section 10.3.4) is no longer effective. The bandwidth of model tracking control can be adjusted through the model tracking gain (P 3-602). The smaller the P 3-602, the smoother the final commands of the position loop and speed loop will be, effectively improving the overshoot of position control and speed control. However, reducing the parameter P 3-602 also results in a slower response of the motor's actual position to the user's original command.

➢Related Parameters:

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method
P3-601	Model Tracking Enable	0: Not Enabled 1: Enabled	0	/	Immediate Effect
P3-602	Model Tracking Gain	10~65535	100	%	Immediate Effect

10.3.6Disturbance Observation

When external disturbance signals are present, the speed response of traditional servo control systems can be significantly affected. Therefore, the external disturbance torque applied to the system is calculated using the system output torque signal and speed signal, and the obtained disturbance torque is compensated into the current loop command value input, correcting the closed-loop torque command and optimizing the current command value, thereby suppressing system disturbances, reducing the impact of disturbances on the servo system, and reducing vibration.

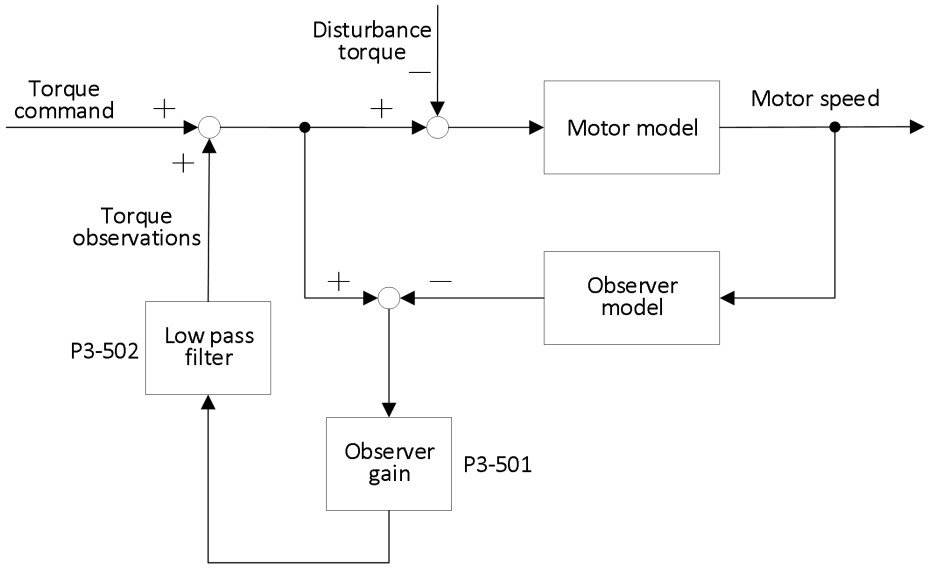


Fig. 10-18 Disturbance Observer Function Block Diagram

Instructions for Adjusting Parameters Related to the Disturbance Observer are as Follows:

1. Disturbance Torque Compensation Gain (P 3-501)

Increasing this parameter increases the proportion of observed torque compensated to the torque command, which can enhance the ability to suppress disturbances, but increases noise.

2. Disturbance Torque Low-pass Filter Time Constant (P 3-502)

Increasing this parameter reduces the noise of the observed torque superimposed on the torque command, suitable for situations where the actual system load torque changes slowly; decreasing this parameter makes the observation of load torque more sensitive, but the corresponding noise increases.

Overall, first set P 3-502 to a large value, then gradually increase the setting of P3-501 from 0 until the disturbance observer shows significant effects; finally, under the premise of ensuring that the disturbance observer remains effective, gradually reduce the setting of P3-502.

➢Related Parameters:

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method
P3-501	Disturbance Torque Compensation Gain	-500.0~500.0	0.0	%	Immediate Effect
P3-502	Disturbance Torque Low-pass Filter Time Constant	0.10~25.00	1.00	ms	Immediate Effect

10.3.7Speed Estimation

The speed estimation function block diagram is shown in Figure 10-19. There are three options for speed estimation:

1. Low-pass Filter (P 3-401 = 0)

This setting is the default speed estimation method. After differentiating the encoder position feedback, it passes through a first-order low-pass filter to obtain the final speed feedback. The cutoff frequency of the low-pass filter is directly set by P 3-405.

2. Speed Observer (P 3-401 = 1)

In situations where inertia does not change much, if there is significant high-frequency noise in the encoder feedback, a speed observer can be used to estimate speed, automatically filtering out high-frequency noise, thereby increasing the speed loop gain (reducing positioning time) without causing high-frequency vibration.

3. Disturbance Observer (P 3-401 = 2)

In cases of flexible loads, if there is significant high-frequency noise in the encoder feedback, a disturbance observer can be used to estimate speed, automatically filtering high-frequency noise, thereby increasing the speed loop gain (reducing positioning time) without causing high-frequency vibration.

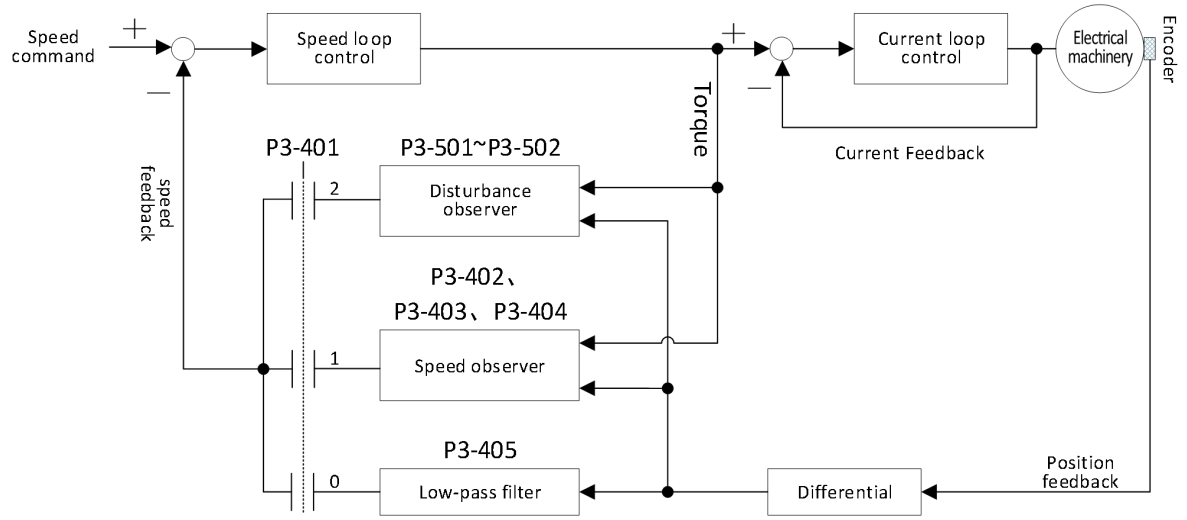


Fig. 10-19 Speed Observer Function Block Diagram

➢Related Parameters:

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method
P3-401	Speed Observer Selection	0: Low-pass Filter 1: Speed Observer 2: Disturbance Observer	0	/	Immediate Effect
P3-402	Speed Observer Cutoff Frequency	10~2000	300	Hz	Immediate Effect
P3-405	Speed Feedback Low-pass Filter Frequency	1~4000	1000	Hz	Immediate Effect
P3-502	Disturbance Torque Low-pass Filter Time Constant	0.10~25.00	1.00	ms	Immediate Effect

10.4Vibration Suppression

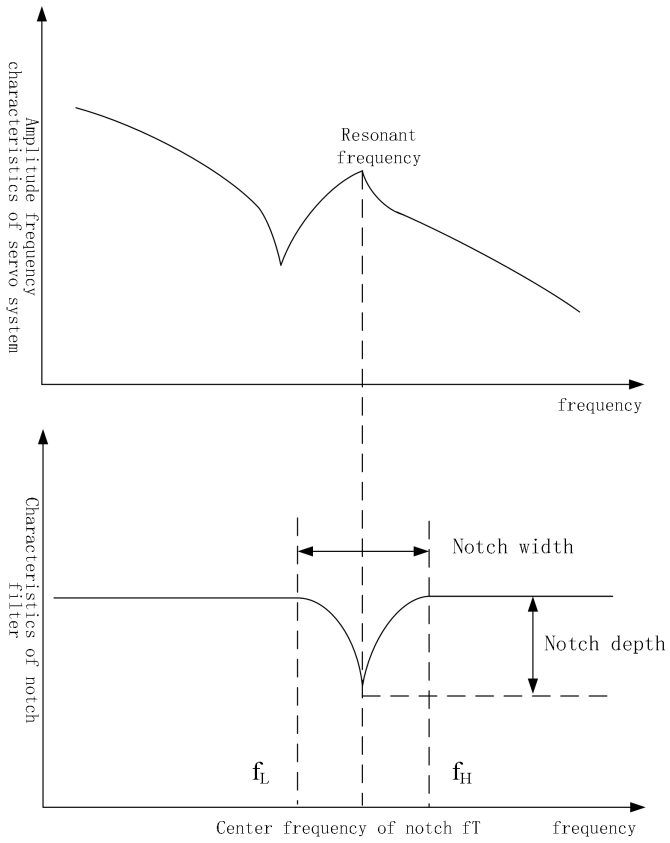
10.4.1Mechanical Resonance Suppression

The mechanical system has a certain resonant frequency. When the servo gain is increased, resonance may occur near the mechanical resonant frequency, preventing the gain from being further increased.

There are two methods to suppress mechanical resonance: torque command filtering and notch filters

Notch Filter

A notch filter reduces the gain at the characteristic frequency, which can effectively suppress mechanical resonance. After correctly setting the notch filter, vibration can be effectively suppressed, and it is possible to attempt to increase the servo gain further. The principle of the notch filter is shown in the following figure.



Principle of Notch Filter Suppression

The servo driver has 4 sets of notch filters, each set having 3 parameters, which are the notch filter frequency, notch filter bandwidth level, and notch filter attenuation ratio.

1. Notch Filter Bandwidth Level

The notch filter bandwidth level represents the ratio of the notch filter width to the notch filter center frequency:

Notch Filter Bandwidth Level= $\frac{f_H - f_L}{f_T}$

Where:

f_T: Notch filter center frequency, i.e., mechanical resonance frequency.

f_H-f_L: Notch filter width, indicating the frequency bandwidth where the amplitude attenuates to -3dB relative to the notch filter center frequency.

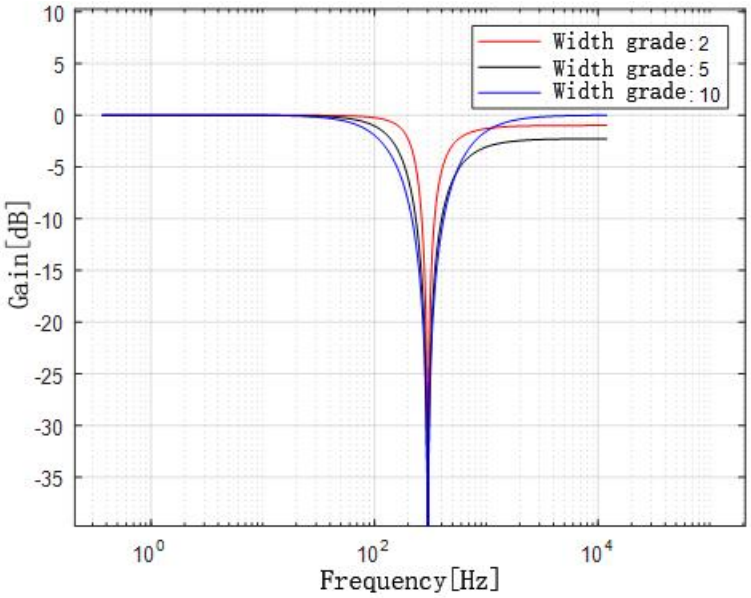


Figure Relationship between Notch Width Level and Notch Filter Frequency Characteristics (Attenuation Ratio Set to 0)

1. Notch Filter Attenuation Ratio

The notch filter attenuation ratio represents the relationship between the input and output at the center frequency.

When the notch filter attenuation ratio is 0, the input is completely suppressed at the center frequency. When the notch filter attenuation ratio is 100, the input can pass through completely at the center frequency. Therefore, the smaller the notch filter attenuation ratio setting, the deeper the notch depth, and the stronger the suppression of mechanical resonance, but it may also lead to system instability, which should be noted during use.

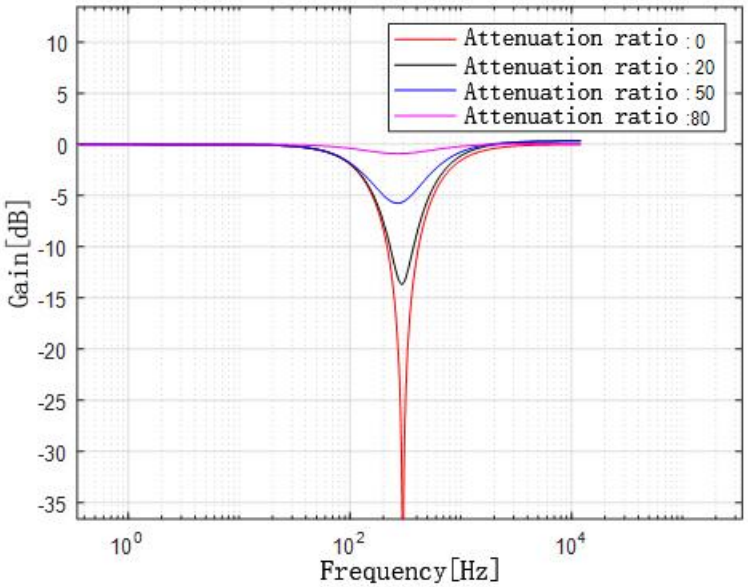


Figure Relationship between Notch Attenuation Ratio and Notch Filter Frequency Characteristics (Width Setting to 10)

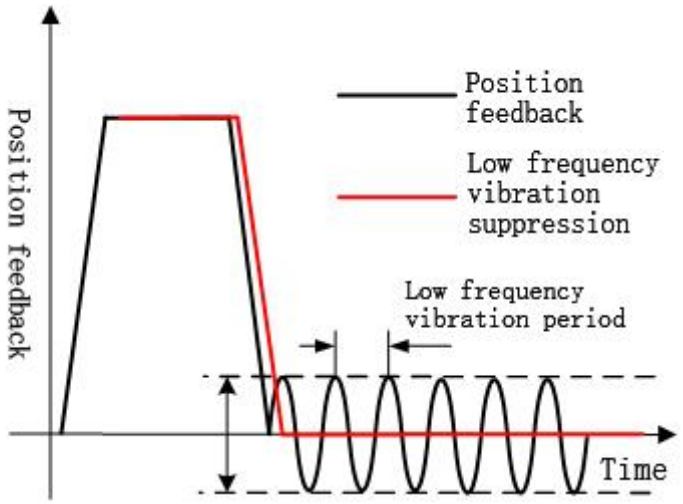
➢Relevant Parameters

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method
P3303	First Group Notch Filter Center Frequency	50~8000	8000	Hz	Immediate Effect
P3304	First Group Notch Filter Bandwidth Level	0~20	2	-	Immediate Effect
P3305	First Group Notch Filter Attenuation Ratio	0~99	0	%	Immediate Effect
P3306	Second Group Notch Filter Center Frequency	50~8000	8000	Hz	Immediate Effect
P3307	Second Group Notch Filter Bandwidth Level	0~20	2	-	Immediate Effect
P3308	Second Group Notch Filter Attenuation Ratio	0~99	0	%	Immediate Effect
P3309	Third Group Notch Filter Center Frequency	50~8000	8000	Hz	Immediate Effect
P330A	Third Group Notch Filter Bandwidth Level	0~20	2	-	Immediate Effect
P330B	Third Group Notch Filter Attenuation Ratio	0~99	0	%	Immediate Effect
P330C	Fourth Group Notch Filter Center Frequency	50~8000	8000	Hz	Immediate Effect
P330D	Fourth Group Notch Filter Bandwidth Level	0~20	2	-	Immediate Effect
P330E	Fourth Group Notch Filter Attenuation Ratio	0~99	0	%	Immediate Effect

Note: *When the "Center Frequency" is set to the default value of 8000, the notch filter is ineffective.*

10.4.2Low-Frequency Suppression at the End

If the end of the mechanical load is long and heavy, it may vibrate at the end when an emergency stop occurs, affecting positioning accuracy. This vibration frequency is generally below 100Hz, which is lower than the "mechanical resonance" frequency, hence it is referred to as low-frequency resonance. The low-frequency resonance suppression function can effectively reduce this vibration.



Low-frequency Vibration Suppression Filter Position Waveform Diagram

Set the suppression frequency based on the low-frequency vibration period (the low-frequency vibration suppression frequency is the reciprocal of the low-frequency vibration period) to suppress low-frequency vibrations, thereby obtaining a stable and non-shaking position feedback waveform.

➢Related Parameters:

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method
P3-103	Low-frequency Vibration Suppression Frequency	1~100	100	Hz	Effective on Shutdown
P3-104	Low-frequency Vibration Suppression Compensation	1.2~3.0	1.2	-	Effective on Shutdown
P3-105	Low-frequency Vibration Suppression Frequency Width	0~10	2	-	Effective on Shutdown

11Servo Function

11.1Control Mode and Control Mode Switching

As shown in Figure 11-1, the control mode of the servo is specified by P0- 101 . When the mode is set to 3~6, the corresponding I O terminals can be used to switch modes in real time (see specific terminals in **DI/DOSetting Chapter**)

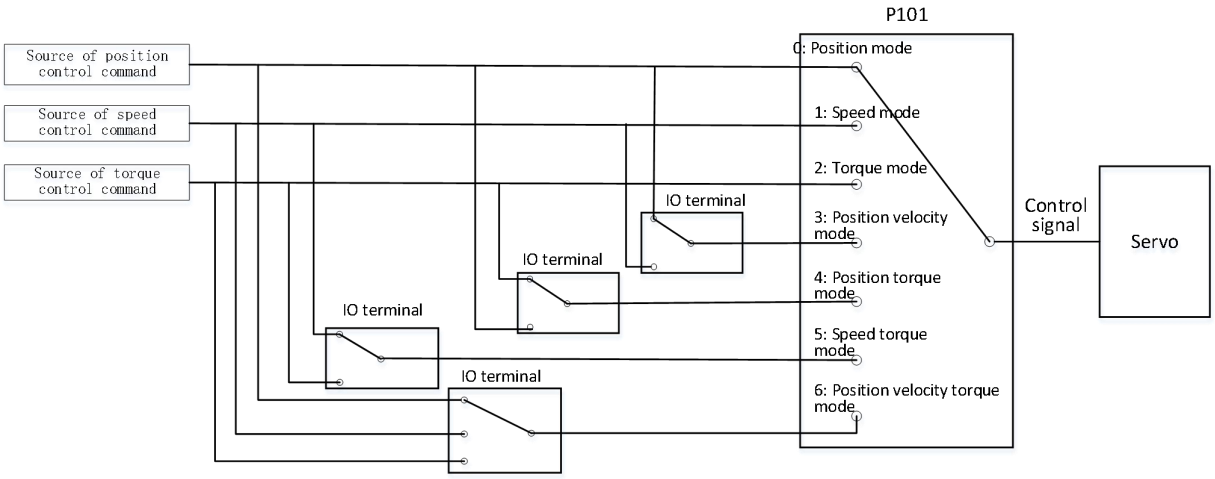


Figure 11-1 Control Modes and Mode Switching Diagram

For details on position command sources, see **Position Control Mode Chapter** For details on speed command sources, see **Speed Control Mode Chapter** For details on torque command sources, see **Torque Control Mode Chapter** 。

➢Relevant Parameters

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method
P0-101	Mode Selection 0: Position Mode 1: Speed Mode 2: Torque Mode 3: Position-Speed Switching Mode 4: Position-Torque Switching Mode 5: Speed-Torque Switching Mode 6: Position-Speed-Torque Switching Mode	0~6	0	Unitless	Effective on Shutdown
P4-001	Position Command Selection 0: Pulse Command 1: Internal Multi-segment Position	0~1	0	Unitless	Effective on Shutdown
P4-101	Speed Command Selection 0: Internal Speed 1: Reserved	0~1	0	Unitless	Effective on Shutdown
P4-201	Torque Command Selection	0~1	0	Rev/	Effective on

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method
	0: Internal Torque 1: Reserved			Minute	Shutdown

Table 11-1

11.2Position Control Mode

11.2.1Position Control Command Selection

The source of position commands can be selected from different position planning modules, primarily controlled and set by the position selection module. Users can configure and use different position functions according to their specific needs, such as pulse control, internal position control, etc. The method of setting up position command selection and parameter configuration is detailed in Figure 11-2.

Note:

"Command Unit": This refers to the smallest value that the higher-level machine (or user) can input to the servo driver that it can distinguish.

"Encoder Unit": This refers to the smallest unit that interacts with the encoder after the input command has been processed by the electronic gear ratio.

Position control command selection, there are 2 options: pulse control and multi-segment internal position, as shown in Figure 11-2:

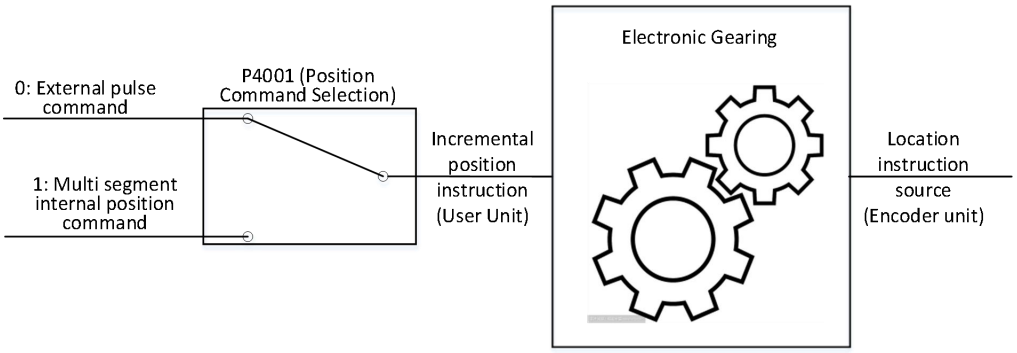


Figure 11-2 Position Command Selection

Position command selection is set via P 4-001 (0: select external pulse as command, 1: select multi-segment internal position as command), the incremental command output by the position command selection module is in user units, this incremental command then passes through the electronic gear module, and the output is in encoder units, serving as the final source of position commands, as shown in Figure 11-2.

11.2.2Pulse Command Setting

When the position command source is selected as pulse command, pulse command-related settings need to be performed, mainly including: input terminal selection, command shape selection, and pulse filter level setting.

Pulse Input Terminal Selection

The servo driver has two types of pulse input terminals, namely open-collector and high-speed differential input. For specific hardware interfaces and wiring, see 4-4.

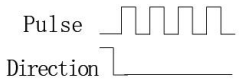
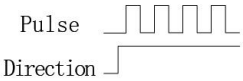
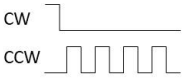
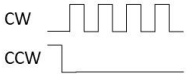
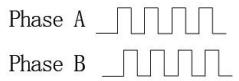
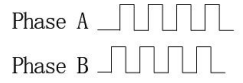
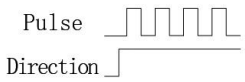
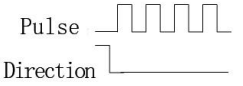
Pulse Command Shape Selection

The servo driver supports the following three types of pulse shapes

1. Pulse + Direction (divided into forward and reverse directions)
2. CW + CCW (Forward Pulse + Reverse Pulse)
3. A Phase + B Phase Quadrature Pulse (Optional one times, two times, and four times frequency multiplication)

➢Relevant Parameters

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method
P4-006	Pulse Command Shape	0：Pulse+ Direction 1：CW+CCW 2：A Phase+B Phase Quadrature Pulse- Input Multiplication 1 3：A Phase+B Phase Quadrature Pulse- Input Multiplication 2 4：A Phase+B Phase Quadrature Pulse- Input Multiplication 4 5 ： Pulse+ Direction (Reverse)	0	-	Effective After Restart

P4006	Command pulse form	Input doubling	Forward instruction	Reverse instruction
0	Pulse+direction	-		
1	CW+CCW	-		
2	A-phase+B-phase orthogonal pulse	1		
3		2		
4		4		
5	Pulse+direction (opposite direction)	-		

Explanation of Pulse Command Shape

Selection of Pulse Command Filter Level

After determining the pulse command shape, it is necessary to select the pulse command filter level to prevent position command anomalies caused by noise interference. The pulse input filter level is divided into ten levels from 0 to 9, covering multiple filtering frequencies from 16M hz to 1 0kHz. Specifically, the setting value correspondence is as follows:

➢Relevant Parameters

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method
P4-007	Pulse Command Filter Level	0：16MHz 1：6.25MHz 2：2.5MHz 3：1MHz 4：500 kHz 5：250 kHz 6：100 kHz 7：50 kHz 8：25 kHz 9：10 kHz	4	-	Effective After Restart

Pulse Command Count Observation

When the control mode is set to pulse position control, the cumulative number of pulse commands received by the servo driver can be observed on the panel.

11.2.3Electronic Gear Ratio

The electronic gear ratio is the relationship between the input position command in command units and the motor position command in encoder units. Through the conversion of the electronic gear ratio, one input position command can be converted into the corresponding actual motor rotation position command.

There are two methods for representing the electronic gear ratio in a servo driver: the number of position commands per motor revolution and the numerator-denominator method of the electronic gear ratio.

The parameters related to the electronic gear ratio are shown in the table below. When the number of position commands per motor revolution (P 0201) is not zero and within a reasonable range, the actual electronic gear ratio used is the encoder resolution divided by the number of position commands per motor revolution, making the numerator and denominator of the electronic gear ratio 1 invalid. When the number of position commands per motor revolution is zero, the numerator and denominator of the electronic gear ratio 1 take effect.

➢Relevant Parameters

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method

P0-201	Number of Position Commands per Motor Revolution	0~4294967295	10000	-	Effective on Shutdown
P0-203	Electronic Gear Ratio 1 (Numerator)	1~4294967295	8388608	-	Effective on Shutdown
P0-205	Electronic Gear Ratio 1 (Denominator)	1~4294967295	10000	-	Effective on Shutdown

➢Explanation of Single Revolution Command Pulse Count and Electronic Gear Ratio Selection Logic

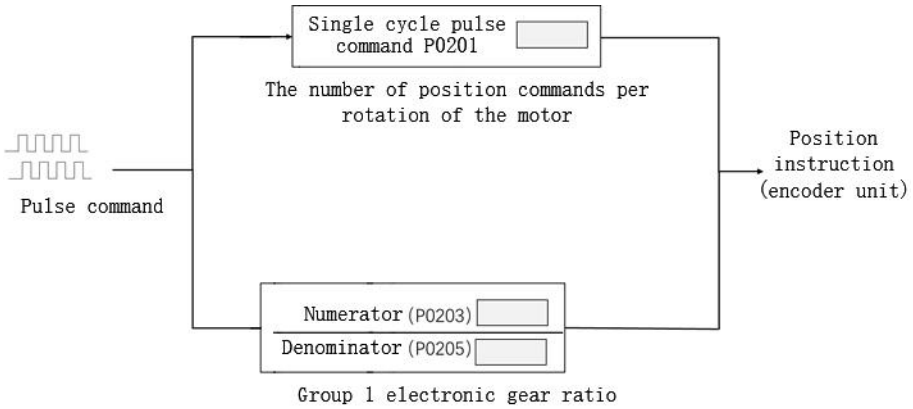


Figure 11-3 Logic for Setting Parameters Related to Electronic Gear Ratio

Based on the actual operating conditions of the electronic gear ratio, there are certain range limitations for setting the above parameters. There are two ways to express the upper and lower limits of the electronic gear ratio. One is that the numerator/denominator of the electronic gear ratio has an upper limit of 1 31072 and a lower limit of 0.01 ; the second is the number of command pulses per motor revolution, with an upper limit of 838860800 and a lower limit of 6 4. When the parameter combination in the parameter list exceeds this upper and lower limit range, the driver will report E 706, indicating an electronic gear ratio out-of-range alarm.

➢Electronic Gear Ratio Related Alarm Codes:

Fault Code	Fault Name	Fault Level	Can Reset
E-706	Electronic Gear Ratio Out of Range	Class 2	1

11.2.4Frequency Division Output

The frequency division output function refers to the output of position information feedback from the encoder in the form of A phase B phase quadrature pulses. The main parameters that need to be configured include the number of pulses per revolution for frequency division output, frequency division output phase setting, and O Z output pulse width setting.

Frequency Division Output Related Parameters

Parameter	Parameter Name	Setting	Default	Unit	Effective

Number		Range	Value		Method
P0-701	Number of Pulses per Revolution for Frequency Division Output	4~16384	2500	-	Effective After Restart
P0-702	Frequency Division Output Phase Setting	0~1	0	-	Effective After Restart
P0-703	OZ Output Pulse Width Setting	1~8	1	-	Effective Immediately

Number of Pulses per Revolution

The number of pulses per revolution for frequency division output is the number of pulses output on the A phase or B phase when the motor rotates one revolution. If it corresponds to 4x frequency counting, the count value for one revolution should be four times the number of pulses per revolution.

Frequency Division Output Phase Setting

The default setting for the frequency division output phase is 0, which means that when the motor rotates forward, phase A leads phase B by 90 degrees, and when the motor rotates backward, phase A lags phase B by 9 0 degrees; when the frequency division output phase is set to 1, phase B leads phase A by 9 0 degrees when the motor rotates forward, and phase B lags phase A by 9 0 degrees when the motor rotates backward.

OZ Output Pulse Width Setting

OZ Output pulse width is D OOZ output low-level width level, default is 1 corresponding to 1 25us, the maximum can be set to 8, corresponding to 1ms.

11.2.5Excessive Position Deviation Detection

Position deviation alarm is an effective protective function when performing position control on the servo driver.

When the motor action does not match the command, by setting an appropriate position deviation alarm value, abnormal conditions can be detected, causing the motor to stop running. Position deviation refers to the difference between the position command value and the actual position.

When a position deviation is too large, the driver reports an E- 608 fault, which can be reset.

Position deviation related signals as shown in Fig. 1 1-3:

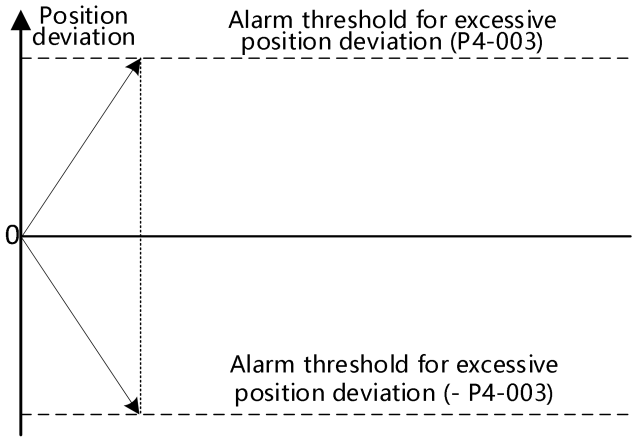


Fig. 11- 4 Position Deviation Related Signals

➢Related Parameters:

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method
P4-003	Position Deviation Overlimit Alarm Threshold	0~1073741824	838860800	Encoder Unit	Effective on Shutdown
P4-005	Duration of Position Error Overlimit Detection	1~1000	25	ms	Effective on Shutdown

11.2.6Position Completion Detection

In position control mode, when the position deviation meets the user-defined conditions (configured via parameter P4-010), the servo driver determines that the positioning process has ended and outputs a positioning completion (COIN) signal. The higher-level machine, upon receiving this signal, can confirm that the servo driver has completed the positioning as shown in Fig. 11-4.

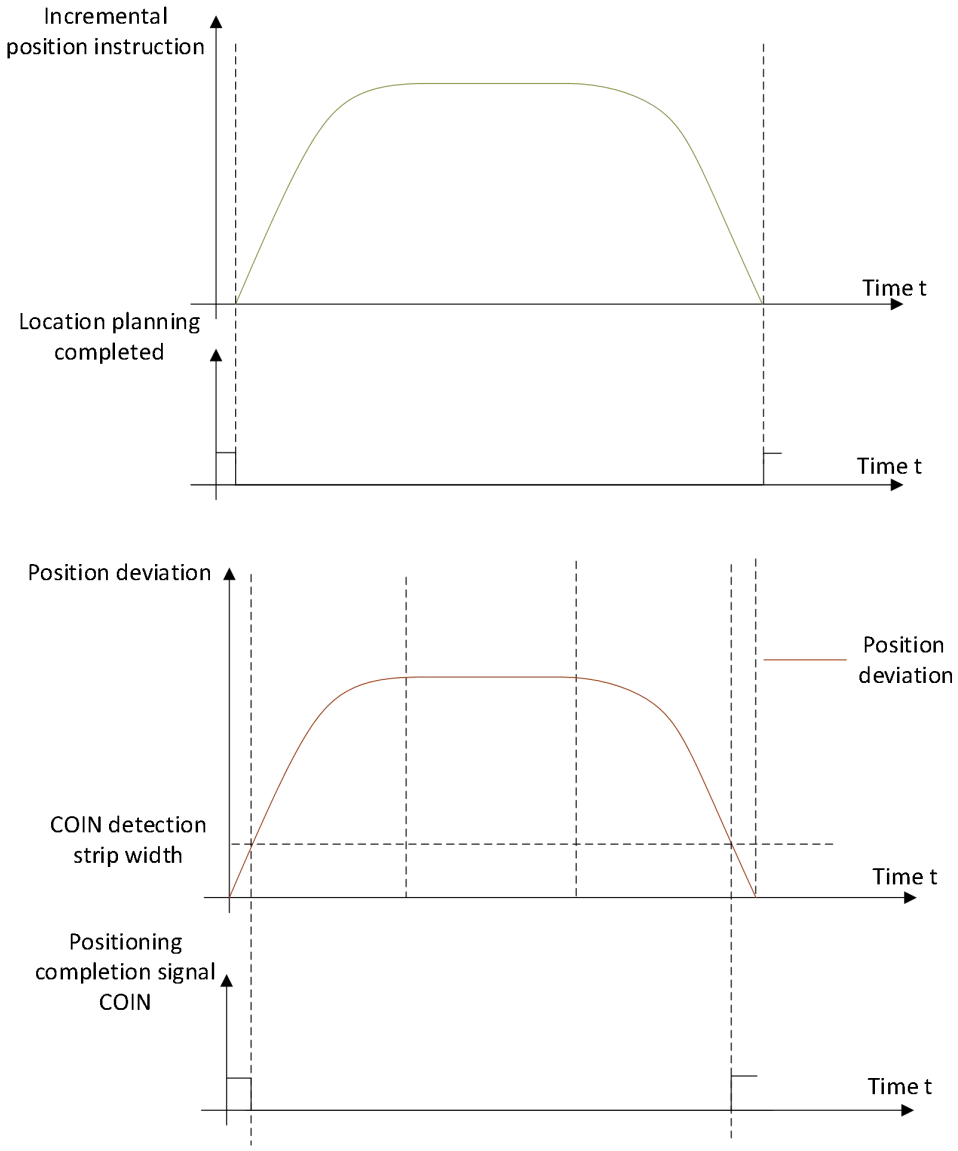


Figure 11- 5 Schematic Diagram of Positioning Completion Window

The determination of positioning completion is based on whether the position deviation is 0. Users can select one of the following three modes via parameter P4-010 as shown in Figure 11-5:

- P4-010 = 0: Positioning completion is determined only when the position deviation is 0.
- P4-010 = 1: Positioning completion is determined when the position deviation is 0 and the pre-filter command is 0.
- P4-010 = 2: Positioning completion is determined when the position deviation is 0 and the post-filter command is 0.

Configure parameters P4-008 to P4-00F according to actual requirements to ensure that parameters such as position deviation filtering, detection bandwidth, hysteresis, and delay filtering meet the application scenario as shown in Figure 11-6.

- Position Deviation Filter Constant (P4-008) Used to smooth the position deviation signal, reduce noise interference, and ensure the accuracy of the judgment.
- Detection Bandwidth (P4-009) Defines the allowable range of position deviation. When the position deviation is within this range, the system considers the deviation to be 0.
- Hysteresis (P4-00A) Used to prevent the COIN signal from frequently toggling near the critical point. A larger hysteresis value can improve signal stability but will slightly increase response time.
- Time Delay (P4-00B) Adds a time delay to the judgment of the COIN signal to avoid misjudgment due to instantaneous fluctuations.
- Zero Speed Command Filter Constant (P4-00F) Used to smooth the zero speed command signal, ensuring command stability.

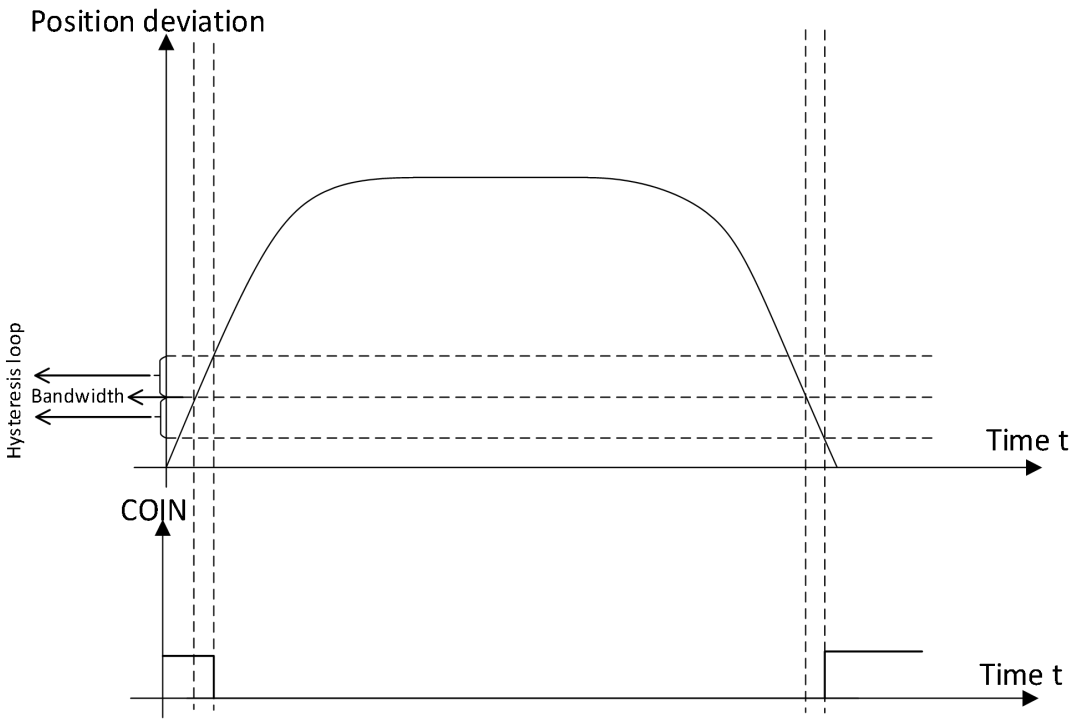


Figure 11-6 COIN Signal Hysteresis Window Effect Diagram

11.2.7Approach to Position Detection

The principle and usage of the Position Proximity (NEAR) signal are similar to those of the Position Arrival signal, as shown in Figure 11- 7 (NEAR Signal Window Principle Diagram). The main difference lies in the judgment criteria: the position proximity signal only requires that the position deviation be 0.

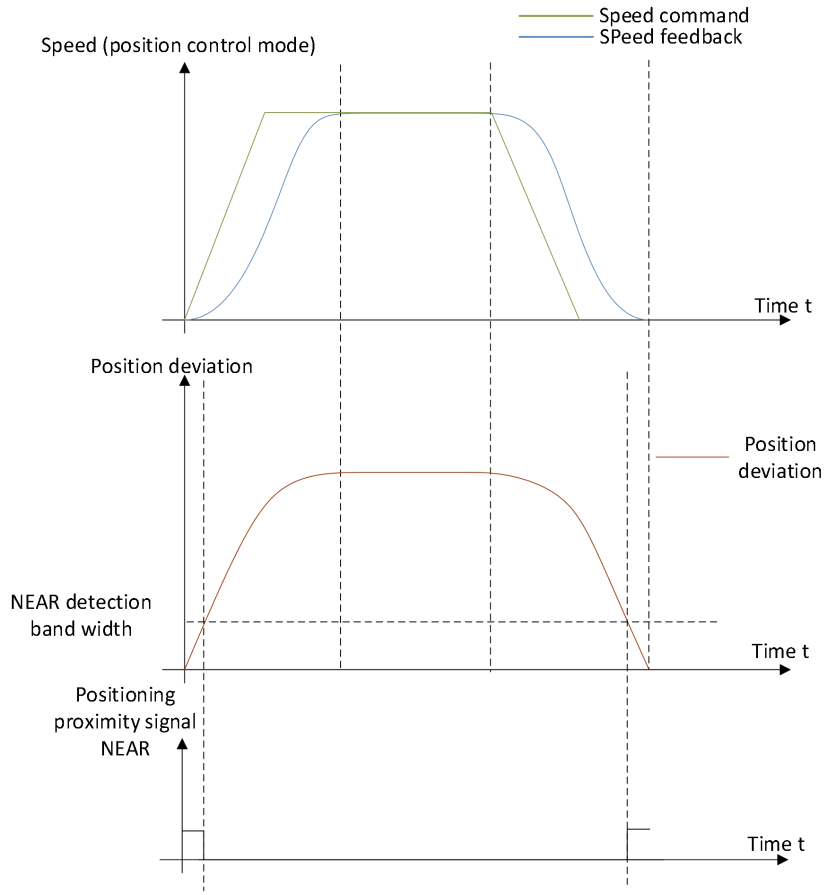


Figure 11-7 Position Proximity (NEAR) Signal Window Principle Diagram

11.2.8Multi-Segment Internal Position

When the servo driver is in position control mode (P0-101 set to 0, 3, 4, 6, or any mode including position control) and the position command source is selected as internal multi-segment position command source (P4-001 set to 1), the multi-segment internal position control function can be enabled. In this mode, the driver has single-axis motion control capability without the need for higher-level machine control and supports 16 segments of position control. Each segment can independently set displacement, speed, acceleration/deceleration time, and stop time after reaching the position.

Parameter Settings

P0-101: Control Mode Selection, set to 0, 3, 4, 6, etc., for position control modes or switching modes that include position control.

P4-001: Position Command Source Selection, set to 1 to select internal multi-segment position command source.

P5-301: Specifies IPOS Position Mode (0 for relative position, 1 for absolute position).

P5-302: Specifies IPOS Segment Logic Mode (0 for DI step mode, 1 for DI direct selection mode, 2 for continuous automatic modal mode, 3 for single automatic modal mode, 4 for real-time DI direct selection mode).

P5-303: Specifies the starting segment number in IPOS automatic mode.

P5-304: Specifies the ending segment number in IPOS automatic mode.

P5-301~P5-354: By setting position, speed, acceleration/deceleration, and delay time parameters, you can configure the specific operation parameters for 0~16 segments.

Note: *Speed settings and acceleration/deceleration times must not exceed the maximum speed of the motor and the control performance limits of the driver; otherwise, tracking errors and other alarms may occur.*

DI Terminal Selection

CMD2_STEPF, CMD3_STEPB, CMD4_STEPH are composite function terminals:

- DI Step Mode: CMD2_STEPF is used for segment number increment, CMD3_STEPB is used for segment number decrement, and CMD4_STEPH is used to return to the first segment.
- DI Direct Selection Mode: These three terminals, combined with the CMD1 terminal, form 16 segment numbers, allowing the internal multi-segment position control quantity to be set directly via the PosInSen terminal.

IPOS supports combinations of multi-segment logic modes (5 types) and position planning modes (2 types), forming a total of 10 control modes, see **Table 11-6**. Please select the appropriate mode based on actual requirements and configure the relevant parameters.

Name	Direction	Function	Type
CMD1_STEPF	Input	Segment command bit 1, or plan the next segment number	Standard terminal
CMD2_STEPB	Input	Segment command bit 2, or plan the previous segment number	Standard terminal
CMD3_STEPH	Input	Segment command bit 3, or plan the first segment number	Standard terminal
CMD4	Input	Segment command bit 4	Standard terminal
PosInSen	Input	Multi-segment position command enable	Standard terminal

一、Position planning mode

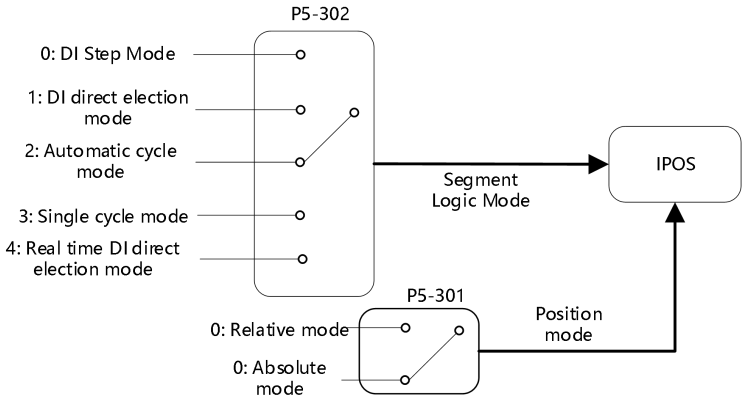


Figure 1 1- 8 Multi-segment position sub-mode selection

Position planning modes are divided into the following two types:

- Relative Position Mode: Using the current position as the reference point (origin), move forward or backward to the incremental position.
- Absolute Position Mode: Using the zero return position as the reference point, move forward or backward to the specified position.

Note: *If a single-turn encoder or the battery of a multi-turn encoder is abnormal, and in absolute position mode, the multi-turn information will be lost after power loss, which may cause abnormal absolute position control (multi-turn loss) upon re-powering.*

➢Related Parameters:

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method
P5-301	Internal Position Mode 0: Relative Position Mode 1: Absolute Position Mode	0~1	0	None	Effective on Shutdown

二、Segment Logic Mode

It can be divided into manual and automatic types, including a total of 5 sub-modes, as follows:

- Manual mode (switched via DI signal) is divided into DI segment number stepping mode, DI direct designation of segment number mode, and real-time DI direct selection of segment number mode, three types.

Non-real-time switching (scheduled switching) mode: The system does not accept new DI segment number commands during the current segment operation; new DI commands take effect only after the current segment has completed its operation.

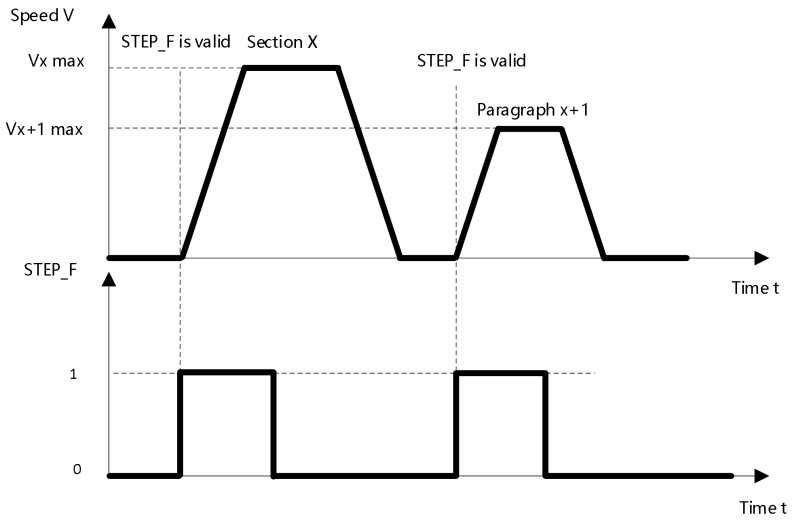
Real-time switching (unscheduled switching) mode: It can forcibly terminate and switch to a new segment during the current segment operation, but there may be speed fluctuations during the switching process.

➢DI segment number stepping mode

DI stepping mode (P5-302=0)

CMD2_STEPF, CMD3_STEPB, CMD4_STEPH are all triggered by rising edges, controlling the increment, decrement, or return to the first segment of the current segment number through DI terminals; new commands are accepted only after the current segment number has been completed, and any commands received while it is incomplete will be discarded.

The following diagram shows that when STEPF is valid, the operation segment number increases by 1 ; when STEPB is valid, the operation segment number decreases by 1 and runs; when STEPH is valid, the operation segment number is set to 0 and segment 0 begins to run.

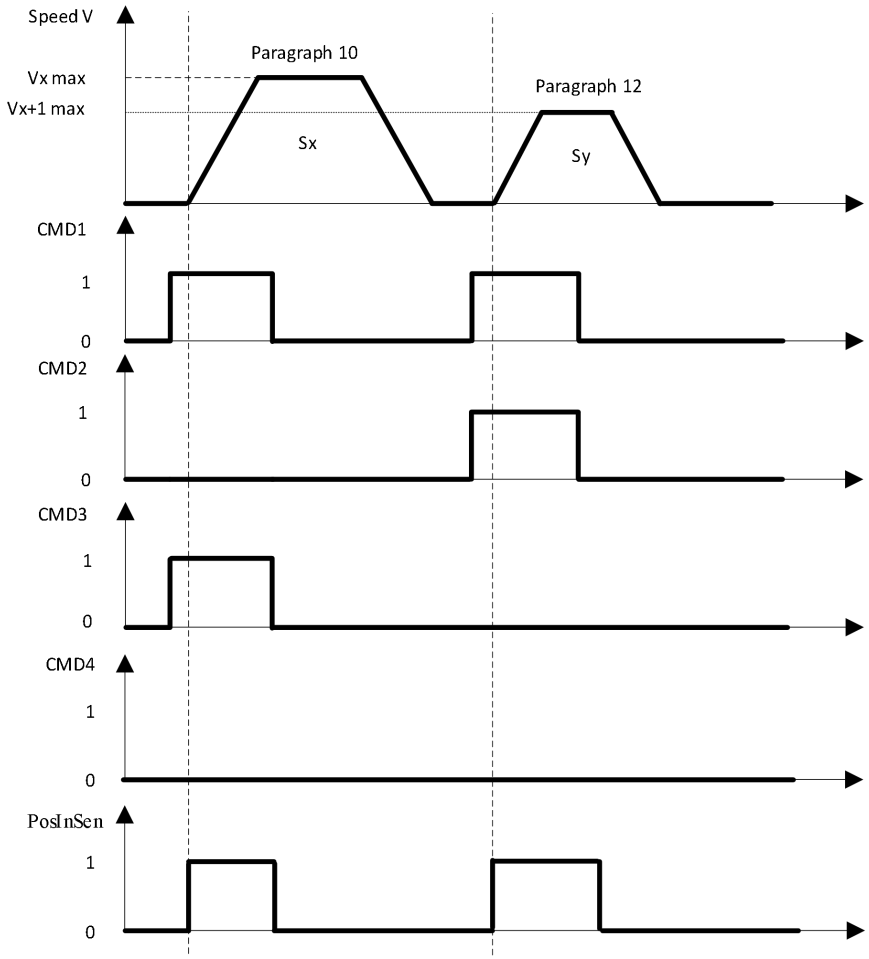


➢DI Direct Segment Number Assignment Mode

DI Direct Selection Mode (P5-302=1)

When the system is running, the level signals of CMD1~CMD4 are combined into a segment number X (with CMD1 as the most significant bit and CMD4 as the least significant bit), and this segment number is sent for execution upon detection of a rising edge by PosInSen. If the current segment number has not been completed, the system will automatically discard newly received commands and only process new commands after the current segment number is completed.

The following diagram shows the first segment number is CMD1~CMD4=b1010=10, and the second segment number is CMD1CMD4=b1100=12

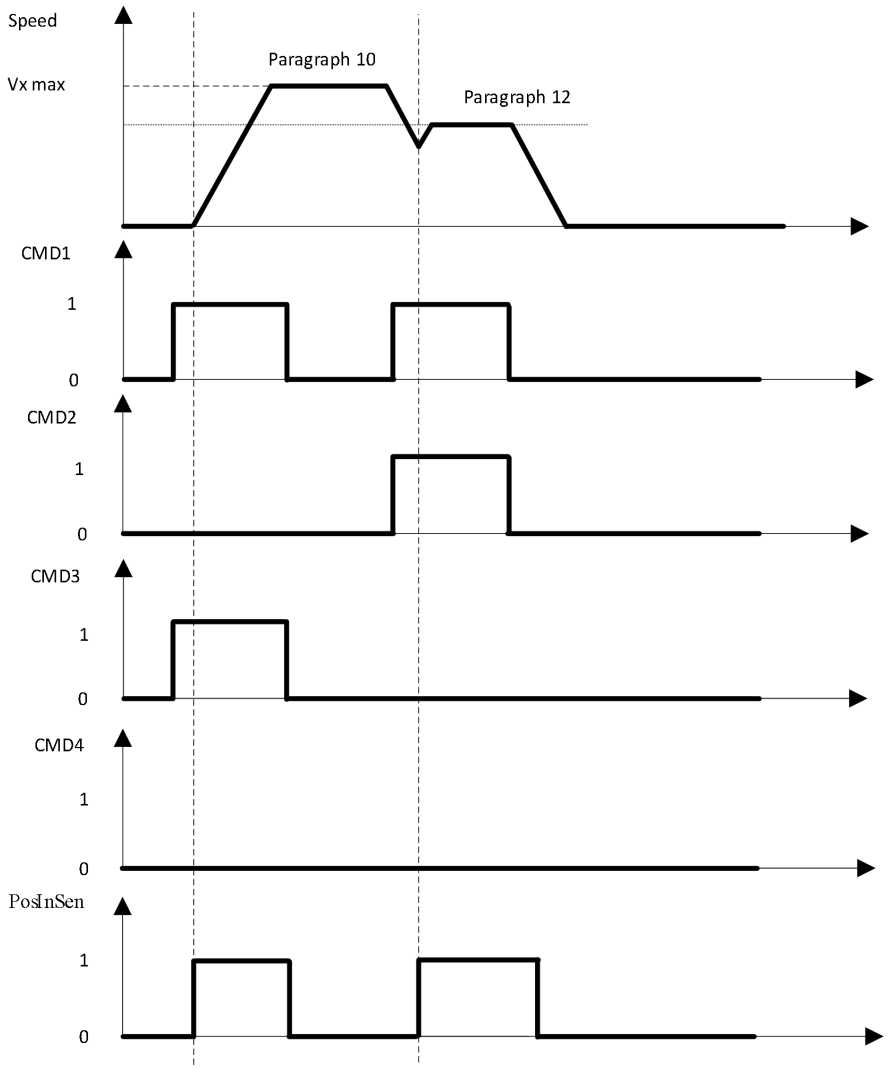


➢Real-time DI Direct Selection Segment Number Mode

DI Real-time Direct Selection Mode (P5-302= 4)

CMD1~CMD4 form a binary segment number X through level signals (CMD1 is the most significant bit, CMD4 is the least significant bit). When PosInSen detects a rising edge, the segment number X is executed; during the execution of the segment number, users can input new commands at any time. If the servo receives a new command and the original segment number has not been completed, the incomplete position command is discarded, and the new command is executed with priority.

The following figure shows the first segment number as CMD1~CMD4=b1010=10 and the second segment number as CMD1~CMD4=b1100=12



- Automatic mode (without switching via DI signals) is divided into single-run sub-mode and loop-run sub-mode.

Automatic Mode Description:

When PosInSen is high, it operates automatically; when low, it discards the current segment command and stops.

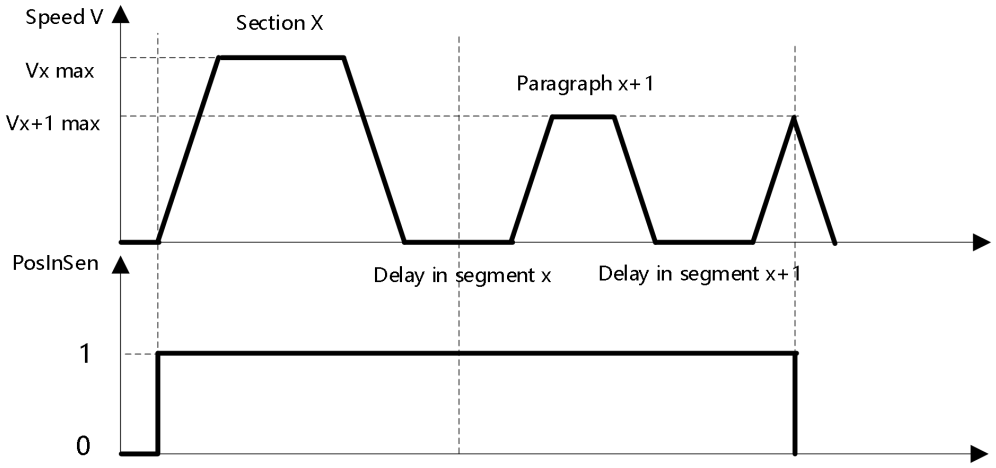
After the current segment ends, it automatically runs the next segment until the final segment (specified by parameter P5-304).

If it is a loop sub-mode and PosInSen remains high, it will automatically jump back to segment 1 (segment number specified by P5-303) after reaching the last segment.

➢Automatic Loop Mode

DI Automatic Loop Mode (P5-302=2)

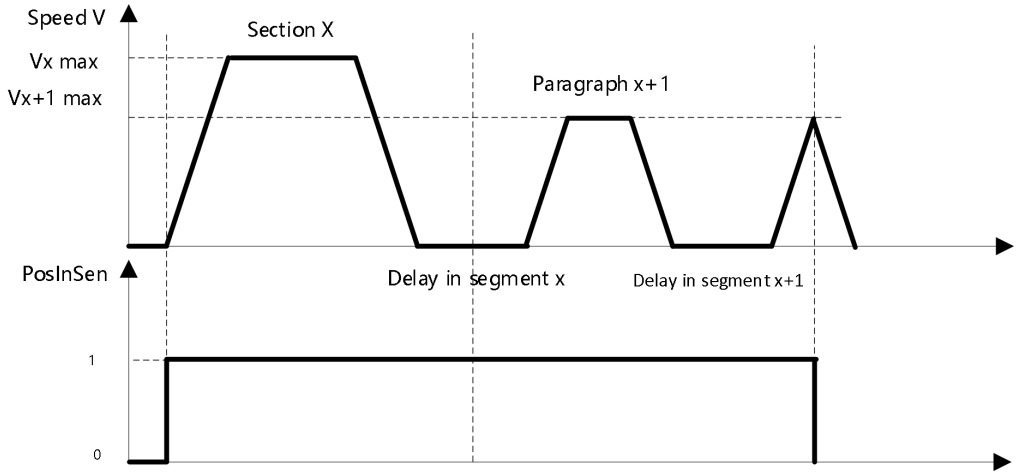
When PosInSen remains high, the system will automatically execute the multi-segment position function, starting from the first segment and incrementing sequentially to the final segment, then returning to the first segment and running in a loop; if PosInSen is low, the system will stop the current segment and shut down.



➢Automatic Single Mode

DI Single Word Loop Mode (P5-302=3)

When PosInSen is at a high level, the system will automatically start the multi-segment position function, incrementing sequentially from the first segment number to the last segment number and then stopping; if PosInSen switches to a low level, the system will immediately interrupt the current segment number command and stop.



Note: *During multi-segment position operation, if you need to change the electronic gear, you must first perform a mechanical zero return operation to ensure normal system operation.*

➢Related Parameters:

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method
P5-302	Segment Logic Mode 0: DI Segment Number	0~4	0	None	Effective on Shutdown

	Stepping Mode 1: DI Direct Selection Mode 2: Automatic Loop Mode 3: Single Loop Mode 4: Real-time DI Direct Selection Mode				
P5-303	Start Segment Number	1~16	1	None	Effective on Shutdown
P5-304	End Segment Number	1~16	1	None	Effective on Shutdown

Based on the multi-segment logic modes (5 types) and position planning modes (2 types), IPOS can combine into the following 10 modes as shown in the table below, where the real-time direct selection mode can be switched during operation:

Combination	Position Mode	Segment Logic Mode	Current Position	Current Segment Number	Current Segment Position	Target Segment Position	Trigger Operation	Segment Number After Trigger	Position After Trigger
1	Relative	Step	1000	1	5000	10000	STEPF=↑	2	15000
2		Direct Selection	1000	1	5000	10000	CMD1:CMD4=0011 PosInSen=↑	3	15000
3		Automatic Loop	1000	1	5000	10000	PosInSen=1 Automatic	2	15000
4		Automatic Single	1000	1	5000	10000	PosInSen=1 Automatic	2	15000
5		Real-time Direct Selection	1000	1	5000	10000	CMD1:CMD4=0011 PosInSen=↑	3	11000
6	Absolute	Step	1000	1	5000	10000	STEPF=↑	2	10000
7		Direct Selection	1000	1	5000	10000	CMD1:CMD4=0011 PosInSen↑	3	10000
8		Automatic Loop Mode	1000	1	5000	10000	PosInSen=1 Automatic (Next Segment)	2	10000
9		Automatic Single Mode	1000	1	5000	10000	PosInSen=1 Automatic (Next Segment)	2	10000
10		Real-time Direct Selection Mode	1000	1	5000	10000	CMD1:CMD4=0011 PosInSen↑	3	10000

The multi-segment internal position function includes 16 segments, each configured with an independent set of parameters, including position setting (pulse count), speed setting (rotational speed, rpm), acceleration/deceleration time (ms), and delay time (ms). Among these, the position setting, speed setting, and acceleration/deceleration time form the basic operating parameters of

the segment: the speed setting defines the maximum operating speed of the segment, and the acceleration/deceleration time determines the slope of the speed change. Please note that the speed setting and acceleration/deceleration time should be reasonably set according to the motor parameters and drive performance to avoid exceeding the maximum rotational speed of the motor or the control limits of the driver, which could otherwise result in tracking errors and other alarms. Additionally, the delay time is used to set the waiting time after the end of the current segment's motion; the segment's motion is only officially completed after the delay ends.

Number	Name	Setting Range	Default Value	Unit	Effective Method
P5-301	Internal Position Mode	0~1	0	None	Effective on Shutdown
P5-302	Segment Logic Mode	0~4	0	None	Effective on Shutdown
P5-303	Start Segment Number	1~16	1	None	Effective on Shutdown
P5-304	End Segment Number	1~16	1	None	Effective on Shutdown
P5-305	First Segment Position	-2147483648~2147483647	0	User Command Unit	Effective on Shutdown
P5-307	First Segment Speed	1~7000	300	rpm	Effective on Shutdown
P5-308	First Segment Acceleration/Deceleration Time	0~65535	200	ms	Effective on Shutdown
P5-309	First Segment Waiting Time	0~65535	0	ms	Effective on Shutdown
P5-30A	Second Segment Position	-2147483648~2147483647	0	User Command Unit	Effective on Shutdown
P5-30C	Second Segment Speed	1~7000	300	rpm	Effective on Shutdown
P5-30D	Second Segment Acceleration/Deceleration Time	0~65535	200	ms	Effective on Shutdown
P5-30E	Second Segment Waiting Time	0~65535	0	ms	Effective on Shutdown
P5-30F	Third Segment Position	-2147483648~2147483647	0	User Command Unit	Effective on Shutdown
P5-311	Third Segment Speed	1~7000	300	rpm	Effective on Shutdown
P5-312	Third Segment Acceleration/Deceleration Time	0~65535	200	ms	Effective on Shutdown
P5-313	Third Segment Waiting Time	0~65535	0	ms	Effective on Shutdown
P5-314	Fourth Segment Position	-2147483648~2147483647	0	User Command Unit	Effective on Shutdown
P5-316	Fourth Segment Speed	1~7000	300	rpm	Effective on Shutdown
P5-317	Fourth Segment Acceleration/Deceleration Time	0~65535	200	ms	Effective on Shutdown

Number	Name	Setting Range	Default Value	Unit	Effective Method
P5-318	Fourth Segment Waiting Time	0~65535	0	ms	Effective on Shutdown
P5-319	Fifth Segment Position	-2147483648~2147483647	0	User Command Unit	Effective on Shutdown
P5-31B	Fifth Segment Speed	1~7000	300	rpm	Effective on Shutdown
P5-31C	Fifth Segment Acceleration/Deceleration Time	0~65535	200	ms	Effective on Shutdown
P5-31D	Fifth Segment Waiting Time	0~65535	0	ms	Effective on Shutdown
P5-31E	Sixth Segment Position	-2147483648~2147483647	0	User Command Unit	Effective on Shutdown
P5-320	Sixth Segment Speed	1~7000	300	rpm	Effective on Shutdown
P5-321	Sixth Segment Acceleration/Deceleration Time	0~65535	200	ms	Effective on Shutdown
P5-322	Sixth Segment Waiting Time	0~65535	0	ms	Effective on Shutdown
P5-323	Seventh Segment Position	-2147483648~2147483647	0	User Command Unit	Effective on Shutdown
P5-325	Seventh Segment Speed	1~7000	300	rpm	Effective on Shutdown
P5-326	Seventh Segment Acceleration/Deceleration Time	0~65535	200	ms	Effective on Shutdown
P5-327	Seventh Segment Waiting Time	0~65535	0	ms	Effective on Shutdown
P5-328	Eighth Segment Position	-2147483648~2147483647	0	User Command Unit	Effective on Shutdown
P5-32A	Eighth Segment Speed	1~7000	300	rpm	Effective on Shutdown
P5-32B	Eighth Segment Acceleration/Deceleration Time	0~65535	200	ms	Effective on Shutdown
P5-32C	Eighth Segment Waiting Time	0~65535	0	ms	Effective on Shutdown
P5-32D	Ninth Segment Position	-2147483648~2147483647	0	User Command Unit	Effective on Shutdown
P5-32F	Ninth Segment Speed	1~7000	300	rpm	Effective on Shutdown
P5-330	Ninth Segment Acceleration/Deceleration Time	0~65535	200	ms	Effective on Shutdown
P5-331	Segment Nine Waiting Time	0~65535	0	ms	Effective on Shutdown
P5-332	Segment Ten Position	-2147483648~2147483647	0	User Command Unit	Effective on Shutdown
P5-334	Segment Ten Speed	1~7000	300	rpm	Effective on Shutdown

Number	Name	Setting Range	Default Value	Unit	Effective Method
P5-335	Segment Ten Acceleration/Deceleration Time	0~65535	200	ms	Effective on Shutdown
P5-336	Segment Ten Waiting Time	0~65535	0	ms	Effective on Shutdown
P5-337	Segment Eleven Position	-2147483648~2147483647	0	User Command Unit	Effective on Shutdown
P5-339	Segment Eleven Speed	1~7000	300	rpm	Effective on Shutdown
P5-33A	Segment Eleven Acceleration/Deceleration Time	0~65535	200	ms	Effective on Shutdown
P5-33B	Segment Eleven Waiting Time	0~65535	0	ms	Effective on Shutdown
P5-33C	Segment Twelve Position	-2147483648~2147483647	0	User Command Unit	Effective on Shutdown
P5-33E	Segment Twelve Speed	1~7000	300	rpm	Effective on Shutdown
P5-33F	Segment Twelve Acceleration/Deceleration Time	0~65535	200	ms	Effective on Shutdown
P5-340	Segment Twelve Waiting Time	0~65535	0	ms	Effective on Shutdown
P5-341	Segment Thirteen Position	-2147483648~2147483647	0	User Command Unit	Effective on Shutdown
P5-343	Segment Thirteen Speed	1~7000	300	rpm	Effective on Shutdown
P5-344	Segment Thirteen Acceleration/Deceleration Time	0~65535	200	ms	Effective on Shutdown
P5-345	Segment Thirteen Waiting Time	0~65535	0	ms	Effective on Shutdown
P5-346	Segment Fourteen Position	-2147483648~2147483647	0	User Command Unit	Effective on Shutdown
P5-348	Speed of Segment 14	1~7000	300	rpm	Effective on Shutdown
P5-349	Acceleration/Deceleration Time of Segment 14	0~65535	200	ms	Effective on Shutdown
P5-34A	Waiting Time of Segment 14	0~65535	0	ms	Effective on Shutdown
P5-34B	Position of Segment 15	-2147483648~2147483647	0	User Command Unit	Effective on Shutdown
P5-34D	Speed of Segment 15	1~7000	300	rpm	Effective on Shutdown
P5-34E	Acceleration/Deceleration Time of Segment 15	0~65535	200	ms	Effective on Shutdown
P5-34F	Waiting Time of Segment 15	0~65535	0	ms	Effective on Shutdown
P5-350	Position of Segment 16	-2147483648~2147483647	0	User Command Unit	Effective on Shutdown

Number	Name	Setting Range	Default Value	Unit	Effective Method
P5-352	Speed of Segment 16	1~7000	300	rpm	Effective on Shutdown
P5-353	Acceleration/Deceleration Time of Segment 16	0~65535	200	ms	Effective on Shutdown
P5-354	Waiting Time of Segment 16	0~65535	0	ms	Effective on Shutdown

Table 1 1-3 IPOS Parameter Setting Comparison

11.2.9Position Command Inversion Function

As follows, configure the DI terminal to **8: Command Inversion Function (CmdInv):**

Name	Direction	Function	Type
8：CmdInv	Input	Invert the position command	Standard terminal

When DI is at an active level, if the servo is in pulse control mode and receives a positive pulse command, the servo automatically converts the positive command to a negative pulse command and runs in reverse; if the servo receives a negative pulse command, it automatically inverts the negative pulse command to a positive pulse command and runs forward.

11.2.10Pulse Prohibition Function

As follows, configure the DI terminal to **9: Disable Pulse Input function.**

Name	Direction	Function	Type
9：PulseInhibit	Input	Disable Pulse Input	Standard terminal

In pulse control mode, when this DI is active, it inhibits the pulse command. At this time, even though the controller continues to issue pulses, the servo does not execute the pulse command despite receiving the pulses normally and being in an enabled state.

11.2.11Pulse Prohibition Function

As follows, configure the DI terminal to **10: Clear Position Deviation Counter function.**

Name	Direction	Function	Type
10：CntClc	Input	Clear Position Deviation Counter	Standard

			terminal

In pulse control mode, when this DI is active, it clears the position deviation counter of the loop.

11.3Speed Control Mode

11.3.1Speed Command Selection

Select the velocity command source through parameter P 4-101

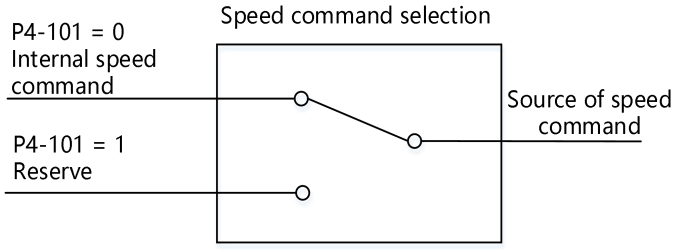


Figure 11-9 Speed Command Selection

➢Related Parameters:

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method
P4-101	Position Deviation Overlimit Alarm Threshold	0: Internal Speed Command 1: Parameter Value Retained	0	\	Effective on Shutdown

11.3.2Internal Speed Setting

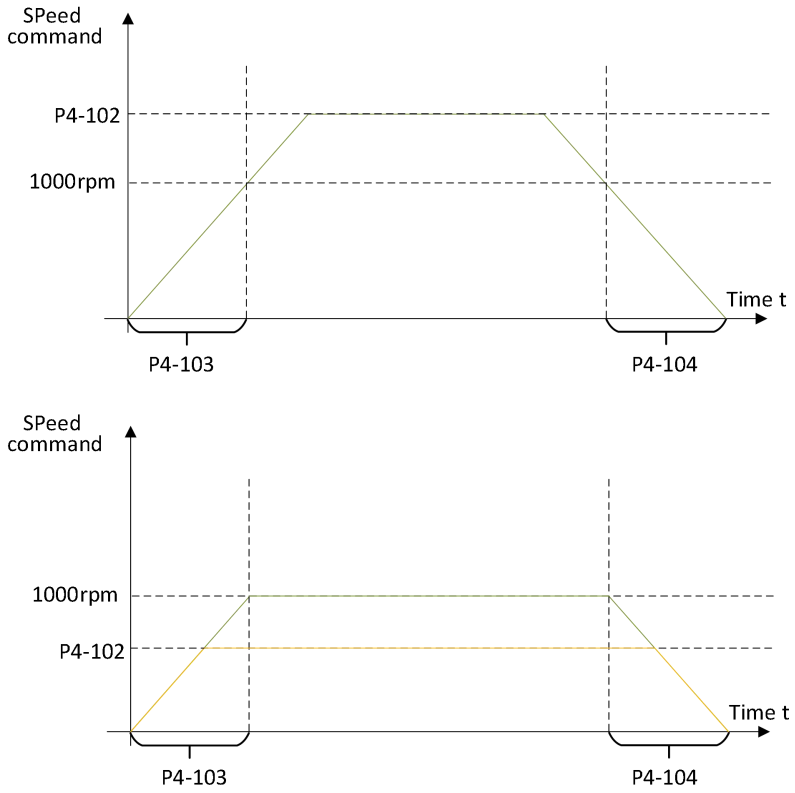


Figure 11-10 Internal Speed Setting

As shown in Figure 11-10, the parameter settings for the internal speed function include P 4-102(Speed Setting), P4-103(Soft Start Acceleration Time), P4-104(Soft Start Deceleration Time), a total of 3 parameters. Among them, P 4-103(Soft Start Acceleration Time) and P 4-104(Soft Start Deceleration Time) are calculated based on the time to reach 1000rpm, with the unit being ms.

➢Related Parameters:

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method
P4-102	Internal Speed Command Value	-7000~7000	100	rpm	Effective Immediately
P4-103	Soft Start Acceleration Time	1~65535	100	ms	Effective Immediately
P4-104	Soft Start Deceleration Time	1~65535	100	ms	Effective Immediately

11.3.3Speed Deviation Over Limit Detection

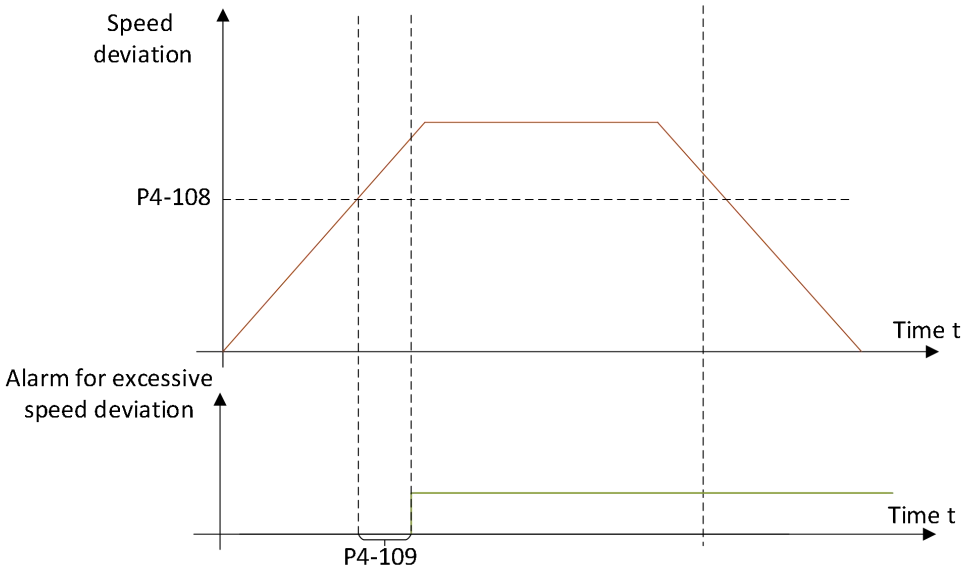


Figure 11-11 Speed Deviation Detection

The speed deviation is the difference between the loop speed command (after speed limitation) and the speed feedback. As shown in Figure 11-11, the speed deviation over detection alarm: the deviation alarm threshold is set by parameter P 4-108, ranging from 0-7000r/min, with a default value of 0r/min. When the speed deviation exceeds the setting of P 4-108 and remains above this value for more than a certain period (the specific time is set by P 4-109), an excessive deviation alarm is triggered. The time unit for P 4-109 is ms, ranging from 0-3000ms, with a default value of 100ms.

When the motor speed deviates from the set speed by more than the P4-108 speed error too large alarm threshold, and this condition persists for longer than the P4-109 speed error too large detection duration, the driver will report an E-609 fault and shut down; this fault can be reset. When P4-108 is set to zero, the speed error too large alarm detection can be disabled. In torque mode, P4-108 should be kept at zero.

➢Related Parameters:

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method
P4-108	Speed Error Exceeds Limit Alarm Threshold	0~7000	0	rpm	Effective Immediately
P4-109	Duration of Speed Error Exceeds Limit Detection	0~3000	100	ms	Effective Immediately

11.3.4Speed Consistency Detection

Define speed error as: the difference between the user speed command (before limiting) and the speed feedback. Speed consistency checks whether the actual speed feedback matches the

user speed command, i.e., whether the speed error is 0. In practical use, filtering and hysteresis can be set.

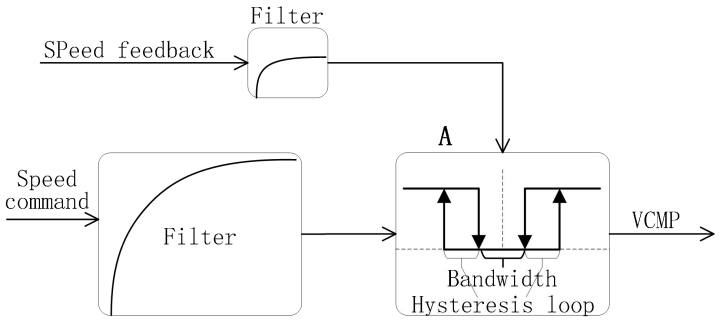


Figure 11-12 Principle of Speed Consistency Detection

As shown in Figure 11-12, the speed command and speed feedback pass through identical filters and are sent to the hysteresis comparator A for determining the output of whether the speed is consistent.

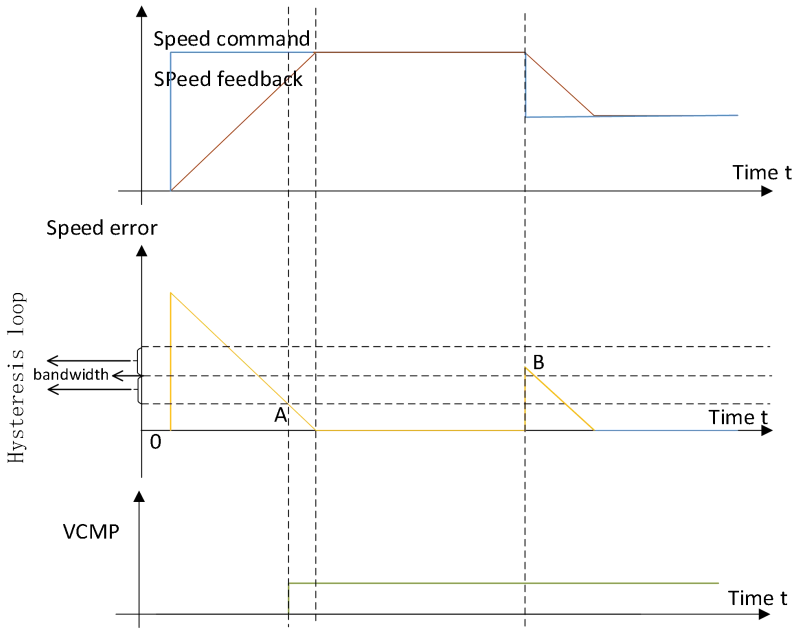


Figure 11-13 Method of Setting Speed Consistency Detection

As shown in Figure 11-13, the speed consistency detection can set the speed consistency comparator bandwidth P4-110 (detection bandwidth Belt), speed consistency output comparator hysteresis value P4-111(hysteresis Hysteresis). In the figure, point A crosses the hysteresis, so the speed consistency (VCMP) signal output becomes valid; point B does not cross the hysteresis, so VCMP remains valid. The speed consistency filter setting parameter is P4- 10F. **Note: The speed consistency signal is only effective in speed mode.**

➢Related Parameters:

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method

P4-10F	Speed Consistency Filter Time	0~65535	0	ms	Effective Immediately
P4-110	Speed Consistency Comparator Bandwidth	0~65535	20	rpm	Effective Immediately
P4-111	Speed Consistency Comparator Hysteresis Value	0~65535	0	rpm	Effective Immediately

11.3.5 Speed Arrival Detection

Similar to the speed arrival signal, the speed consistency signal checks whether the actual speed feedback matches the user's speed command, i.e., whether the speed error is 0. In practical use, filtering and hysteresis can be set. The speed arrival signal is not restricted by the control mode.

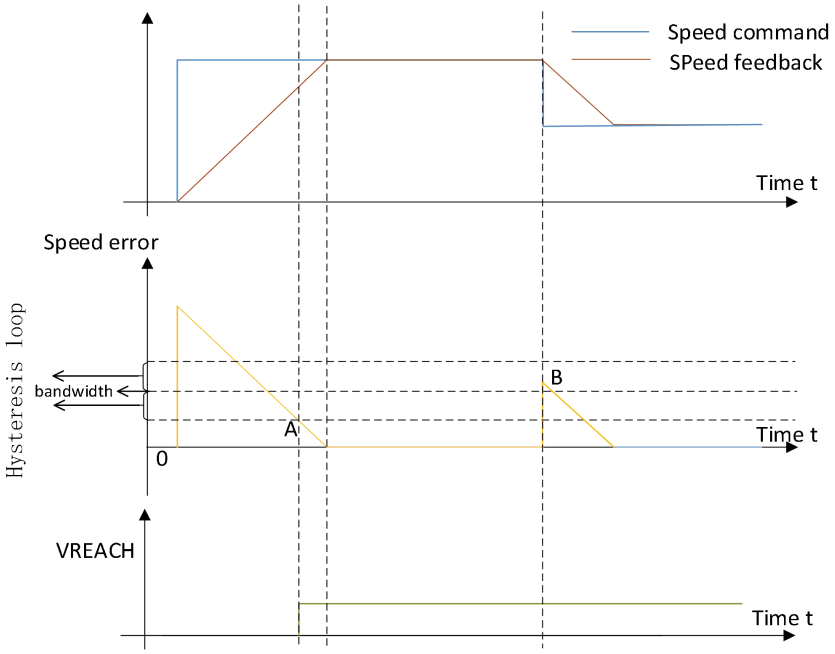


Figure 11-14 Speed Arrival Detection Settings

As shown in Figure 11-14, the speed arrival detection can set the speed arrival comparator bandwidth P4-113 (Detection Bandwidth Belt), and the speed arrival output comparator hysteresis value P4-114(Hysteresis Hysteresis). When point A crosses the hysteresis, the speed arrival (VREACH) signal becomes active; at point B, since it has not fully crossed the hysteresis, the VREACH remains active. The speed arrival filter setting parameter is P4- 112.

➢Related Parameters:

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method
P4-112	Speed Arrival Filter Time	0~65535	0	ms	
P4-113	Speed Arrival Comparator Bandwidth	0~65535	20	rpm	Effective Immediately

P4-114	Speed Arrival Comparator Hysteresis Value	0~65535	0	rpm	Effective Immediately

11.3.6Speed Limit

The speed limit function can restrict the maximum and minimum system speeds by setting the speed limit parameters. As shown in Figure 11-15-a and Figure 1 1-15-b, the speed limit function combines the set speed limit parameters with the motor's maximum speed to comprehensively limit the system's maximum speed. Among these, parameters p 0- 503 and p 0- 504 take effect in position mode and speed mode; parameters p 0- 507 and p 0- 508 take effect in torque mode.

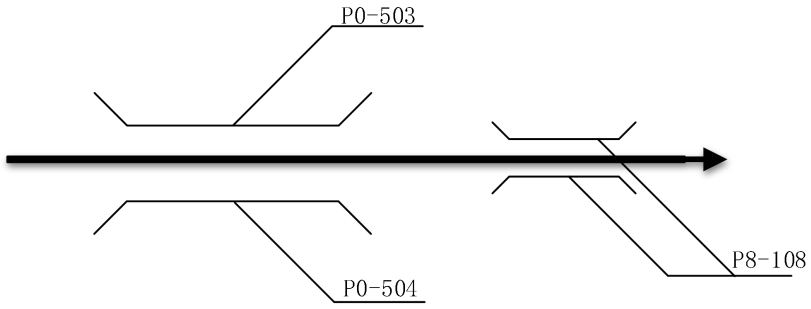


Figure 11-15- a Speed Limit

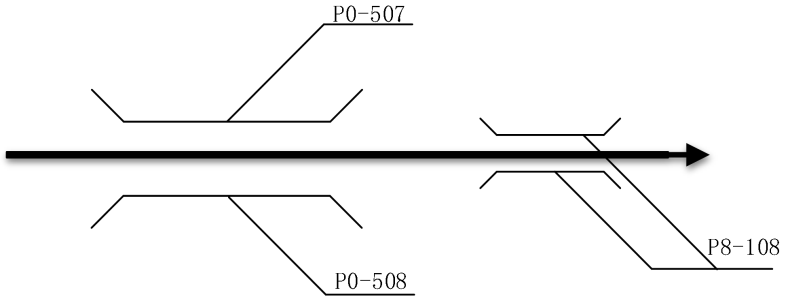


Fig. 11-15-b Speed Limitation in Torque Mode

➢Related Parameters:

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method
P0-503	Positive Speed Limit Value	0~7000	6000	rpm	Effective Immediately
P0-504	Negative Speed Limit Value	0~7000	6000	rpm	Effective Immediately
P0-507	Positive Speed Limit Value in Torque Mode	0~7000	6000	rpm	Effective Immediately
P0-508	Negative Speed Limit Value in Torque Mode	0~7000	6000	rpm	Effective Immediately

11.3.7Speed Limit Status Detection

Speed Limitation Status Detection (Corresponding D O Signal: Speed Limitation Active), When the speed reaches the speed limit value, the servo outputs a speed limitation active signal. If this D O is configured, when speed limitation occurs, this D O output is valid. As shown in Fig. 11-16, at point A, speed limitation occurs, and the speed limitation active signal is valid; at point B, the speed limitation is released, and the signal becomes invalid.

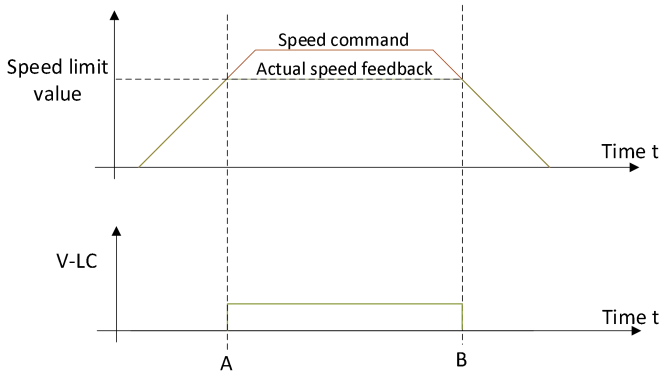


Fig. 11-1 6 Speed Limitation Status Detection

11.3.8Zero Speed Clamp Function

The zero position hold function works in speed control mode. When the zero position hold DI signal (ZCLAMP) is valid, if the magnitude of the speed command is less than or equal to the zero position hold speed threshold set by parameter P4-105, the servo motor will enter the zero position lock state. In this state, the servo driver internally establishes a position loop, and the position setting is fixed at the current position, ignoring the speed command. The servo motor will be fixed within the minimum quantization error range of the encoder, and even if it rotates due to external force, it will automatically return to the zero position. If the magnitude of the speed command exceeds the threshold set by P4-105, the servo motor will exit the zero position lock state and continue to operate according to the current input speed command. Note: If the zero position hold DI signal (ZCLAMP) is invalid, the zero position hold function will also be ineffective. See Figure 11-17:

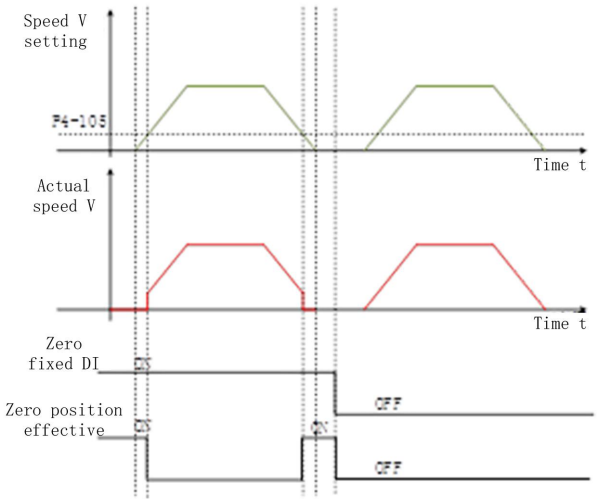


Fig. 11-1 Zero Speed Clamp Function Diagram

This function involves the following parameters:

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method
P4-105	Zero Position Fix (/ZCLAMP) Speed Threshold	0~7000	10	rpm	Effective Immediately

11.4 Torque Control Mode

11.4.1Torque Command Selection

Select the torque command source via parameter P 4-201

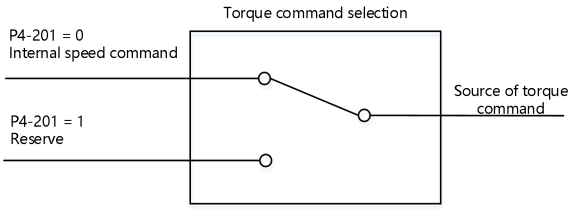


Fig. 11-17 Torque Command Selection

➢Related Parameters:

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method
P4-201	Torque Command Selection 0: Internal Torque 1: Reserved	0~1	0	-	Effective on Shutdown

11.4.2Internal Torque Setting

The internal torque function is set through the internal torque setting value (panel or serial port) parameter P 4-202, which takes effect immediately, with the unit being 0.1%.

➢Related Parameters:

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method
P4-202	Internal Torque Command Value Setting	-400.0~400.0	0.0	%	Effective Immediately

11.4.3 Torque Limit Status Detection

Torque Limit Status Detection (corresponding DO signal: Torque Limit Active), when the torque reaches the torque limit value, the servo outputs a torque limit active signal. If this DO is configured, when torque limiting occurs, this DO output becomes active. As shown in the figure, at point A, torque limiting occurs, and the torque limit active signal is valid; at point B, torque limiting ends, and the signal becomes invalid.

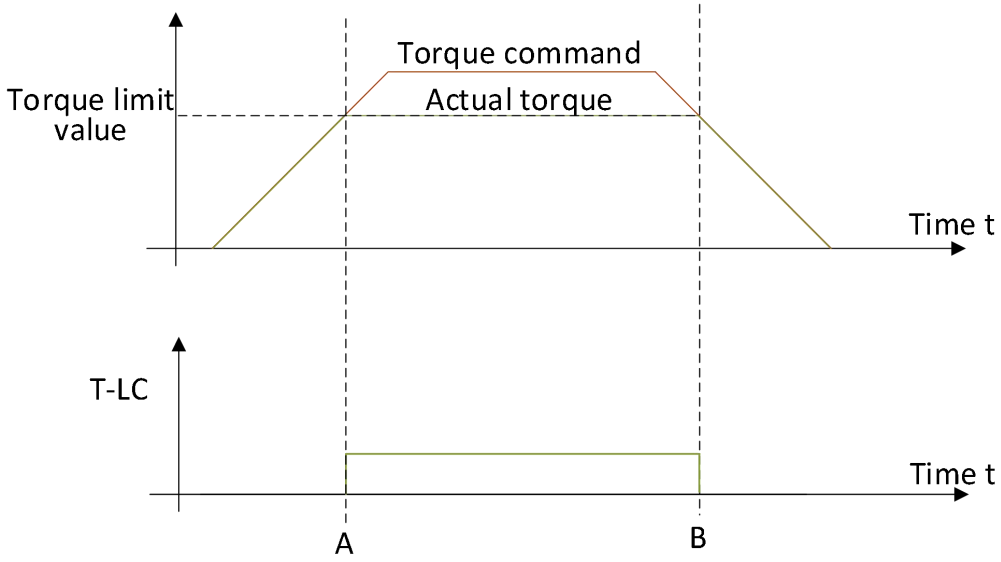


Fig. 11- 18 Torque Limit Status Detection

11.4.4Torque Arrival Detection

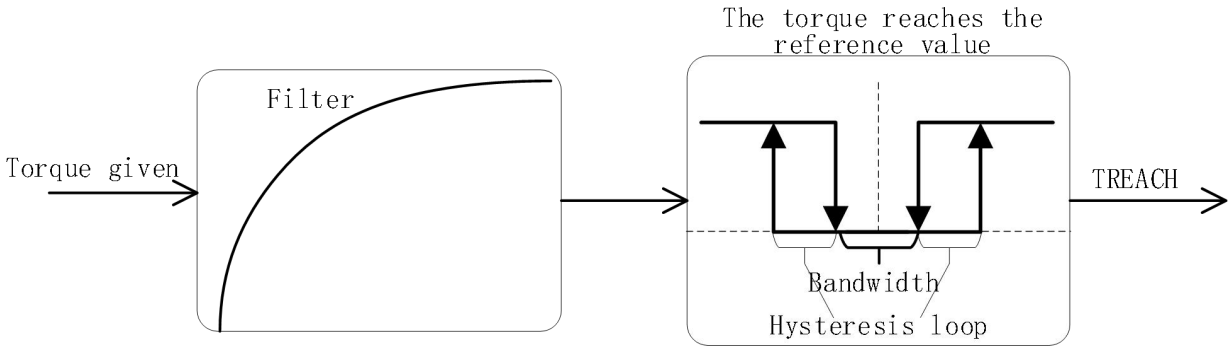


Fig. 11- 19 Torque Arrival Detection

After the torque reaches the specified reference value (P4-208), a torque arrival signal will be output. The corresponding filtering and hysteresis can be set through the filter parameter (P4-205), amplitude bandwidth (P4-206), and hysteresis parameter (P4-207).

➢Related Parameters:

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method
P4-205	Torque Arrival Filter Time	0~65535	0	ms	Effective Immediately
P4-206	Torque Arrival Amplitude Bandwidth	0~6553.5	0.5	%	Effective Immediately
P4-207	Torque Arrival Hysteresis Parameter	0~6553.5	0	%	Effective Immediately
P4-208	Torque Arrival Specified Reference Value	0~6553.5	0	%	Effective Immediately

11.5Encoder Mode (Absolute System Mode)

In absolute system mode, a motor equipped with an absolute encoder and a battery must be selected. The absolute encoder not only detects the position of the motor within one revolution but also counts the number of revolutions and retains the multi-turn position even after power loss. In absolute system mode, the driver can calculate the mechanical absolute position through the encoder's absolute position upon re-powering, eliminating the need for repeated mechanical origin reset operations.

●Absolute Value System Mode Selection and Alarm Configuration

The absolute value system mode supports incremental position mode and absolute linear position mode, corresponding to 0 and 1 in parameter P0103 (the default absolute value system mode is 0).

➢Relevant Parameters

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method
P0103	Absolute Value System Mode	0~1	0	-	Effective After Restart

When incremental position mode is selected, the driver automatically masks all alarm bits related to multi-turn absolute value systems. In this mode, even if a multi-turn encoder is connected without a battery, alarms such as low battery voltage and multi-turn overflow will not be triggered. This ensures stable operation of the system in incremental position mode, unaffected by alarms related to the multi-turn absolute value system.

When the absolute position linear mode is selected, the driver first reads from the internal storage of the encoder whether it supports multi-turn functionality. If a single-turn encoder is detected, the system will directly trigger alarm E0518, indicating an encoder type mismatch, preventing further operation. In this case, the user can only resolve the issue by modifying the absolute value system mode or selecting a motor with a multi-turn capable encoder.

Absolute Value System Related Alarm Codes

Fault Code	Fault Name	Fault Level	Resettable
E-518	Encoder Type Mismatch	Class 2	No
E-519	Encoder Multi-Turn Value Overflow	Class 2	Yes
E-502	Encoder Battery Error	Class 2	Yes
E-503	Encoder Battery Warning	Class 1	Yes

When using the absolute position linear mode with a motor connected to a multi-turn encoder, an encoder battery undervoltage fault may be reported during the first power-up after connecting the battery. In this case, the corresponding configuration must be performed in the auxiliary functions on the panel to send a command to clear the internal alarm of the encoder, ensuring normal system operation. Setting C108 to 1 in the panel's auxiliary functions enables the encoder alarm reset function.

●Logic for Obtaining Absolute System Position Feedback

Whether in incremental position mode or absolute linear position mode, after the driver is powered on or a software reset occurs, the process of establishing a coordinate system is required, with the main difference lying in the logic for establishing the coordinate origin.

For incremental position mode, the system establishes the coordinate system upon receiving the first valid single-turn position return frame. When establishing the coordinate system, the current origin, i.e., the current absolute position, is set to zero, the single-turn position and the previous single-turn position are set as the current values, and the incremental position feedback is cleared.

For absolute linear position mode, the system establishes the coordinate system upon receiving the first valid multi-turn position return frame. Based on the current encoder multi-turn position and single-turn position, a 64-bit length absolute position origin is generated, the single-

turn position and the previous single-turn position are set as the current values, and the incremental position feedback is cleared.

Regardless of which mode is used, the incremental position feedback always represents the incremental value of the single-turn position.

●Logic for obtaining absolute system position commands

After selecting the absolute linear position mode, the system can only operate in position control mode and only supports pulse position commands and internal multi-segment position command values.

For pulse position command control, after establishing the initial coordinate system internally, the current absolute position will be transmitted to the higher-level controller via protocols such as Modbus. The higher-level controller then calculates and issues incremental commands through pulses.

For internal multi-segment position command values, since the internal absolute position mode already exists, it is only necessary to pass the absolute position after the coordinate system is established to the multi-segment position module to achieve absolute position control.

12DI/DO Settings

12.1IO Settings

12.1.1DI Configuration Information Function Selection

Function I O Includes Standard D I, D O, and High-Speed D I, Communication Configuration D I,DO Three Main Parts, Standard D I and High-Speed D I are Determined by Different Refresh Frequencies, Where High-Speed D I is Suitable for Applications Requiring Higher Execution Efficiency, Such as Interrupt Length-Related Functions. The D I Functions and Their Setting Values Are Defined in the Following Table.

Name	Set Value	Function Name
S-ON	1	Servo Enable
A-RST	2	Faults and Alarms
E-STOP	3	Emergency Shutdown
P-OT	4	Forward Overtravel Switch
N-OT	5	Reverse Overtravel Switch
M1-SEL	13	Mode Switch 1
M2-SEL	14	Mode Switch 2
POSINSEL	19	Internal Position Trigger
POSINCMD1	21	Internal Position Selection 1
POSINCMD2	22	Internal Position Selection 2
POSINCMD3	23	Internal Position Selection 3
POSINCMD4	24	Internal Position Selection 4

DI Based on the Set Hardware Input Terminals, Each Terminal Needs to Be Assigned Its Function and Logical Signal Separately Through Parameters, Where the Function Is from the Above Table, and the Setting Value Is Decimal; the Logical Signals of the Hardware Terminals Include 0 and 1, as Shown in the Following Table:

Set Value	Terminal logic signal when DI function is effective
0	Low level
1	High level

Refer to parameters in the parameter table 6001-600E.

12.1.2DO configuration information function selection

The DO output states are defined as follows, totaling 1 4 states output.

Name	Set Value	Function Name
S-RDY	1	Servo ready output
ALM	2	Alarm signal output
WARN	3	Warning output
BRAKE	4	External brake release signal
T-LC	5	Torque limit active signal
V-LC	6	Speed limit active signal
COIN	7	Positioning Completion
NEAR	8	Approaching position
VCMP	10	Speed consistency output
VREACH	11	Speed reached
TREACH	12	Torque reached

DO output logic selection is defined as 0 and 1, where 0 indicates that the output is low level when the D O function is effective, and 1 indicates that the output is high level when the D O function is effective. Refer to parameters in the parameter table P 6101-P610A.

12.2Communication IO Settings

The communication IO in the servo driver is a software-simulated input/output signal used to replace physical IO pins during debugging or simulation phases, enabling real-time monitoring and logical control of the driver's internal status (such as triggering position/speed mode switching, modifying register parameters, or simulating sensor signals). The configuration of the communication DI function and logical settings relies entirely on corresponding parameters to set terminal levels, functions, and effective logic. For specific function selections, refer to the configurations in the physical IO.

Function Name	Parameter Modbus Address
Enable Communication DI	0x6401
Set Values for 16 Communication DIs	0x6402
Default Values for 16 Communication DIs	0x6403
Functions and Polarities of 16 Communication DIs	0x6404 - 0x6423
Enable Communication DO	0x6501
Default Values for 16 Communication DOs	0x6502
Functions and Polarities of 16 Communication DOs	0x6503 - 0x6522
Communication DO Status	0x6523
Enable Communication DI	0x6401
Set Values for 16 Communication DIs	0x6402
Default Values for 16 Communication DIs	0x6403

Functions and Polarities of 16 Communication DIs	0x6404 - 0x6423

Before using communication DI, the enable parameter for communication DI must be set to 1, and then each DI's function and polarity should be configured as needed. After configuration, the default values and set values for communication DI must be configured. The set values for communication DI are not stored in the driver and will be lost upon power loss. Both the default values and set values for communication DI are bit-effective, with 16 bits corresponding to 16 DIs.

Before using communication DO, the enable parameter for communication DO must also be set to 1, and then each DO's function and polarity should be configured. After configuration, the corresponding function status can be obtained through the communication DO status parameter, with 16 bits corresponding to 16 DOs.

12.3Force IO Settings

Forced IO refers to the ability to forcibly set the status of external input DI functions and internal output DO functions through parameter configuration. Before configuration, it is necessary to select whether to enable DI and DO. It should be noted that after enabling forced DI, the input state of the external terminals will not take effect; after enabling DO, the DO status will only be output according to the forced setting value of the DO terminal.

The corresponding forced setting values for DI terminals and DO terminals are bit-effective. For the forced setting value of DI terminals, the setting range is 0-0x7F, where bit0-bit6 each represent the value of physical DI1-DI7; for the forced setting value of DO terminals, the setting range is 0-0x1F, where bit0-bit4 each represent the value of physical DO1-DO5.

Panel Parameter Number	Parameter Description	Parameter Range	Default Value	Effective Method
C0-00A	DI/DO Forced Setting Mode	0 = No Operation; 1 = Force DI Enable, DO Disable; 2 = Force DO Enable, DI Disable; 3 = Force Both DI and DO Enable	0	Immediate Effect
C0-00B	DI Terminal Forced Setting Value	0 -0x7F	0	Immediate Effect
C0-00C	DO Terminal Forced Setting Value	0 -0x1F	0	Immediate Effect

13Communication Settings

13.1RS485 Communication Connection

Connectors CN2 and CN3 are communication connectors, and the BD3-AP servo driver supports RS485 communication. CN2 is RS485 IN, and CN3 is RS485 OUT.

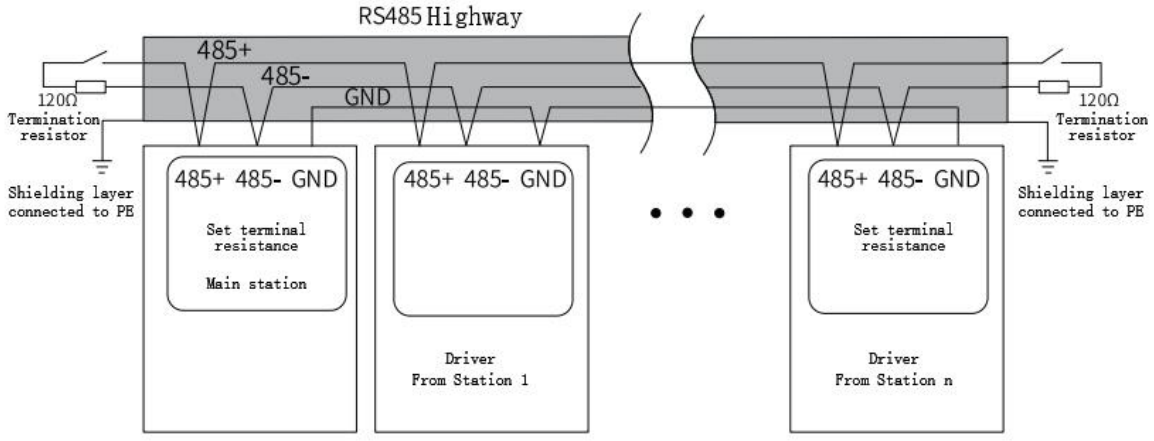
The signals on CN2 and CN3 are mirrored, so when cascading multiple servo drivers, standard straight-through Ethernet cables can be used.

RS485 communication cables must use twisted-pair shielded cables, with the shielding grounded at both ends.

Multi-unit parallel communication cable pin connections (only using the 485 group pins)

Driver-side RJ45 (A end)		Driver-side RJ45 (B end)	
Pin Number	Definition	Pin Number	Definition
1	RS485+	1	RS485+
2	RS485-	2	RS485-
3	GND	3	GND
Enclosure	FG: Shield Wire	Enclosure	FG: Shield Wire

When connecting multiple drivers in series, 120Ω terminal resistors must be connected at



both ends of the bus. As shown in the following figure:

Figure 2-2 Installation Method for Terminal Resistors in Multi-Unit Connections

13.2RS485 Communication Parameters

P0-004	User 485 Station Number	1 ~ 255	1	-	Effective on Shutdown

P0-005	User 485 Configuration	1=9600bps 2=19200bps 3=38400bps 4=57600bps 5=115200bps 6=192000bps 7=256000bps 8=288000bps 9=384000bps 10=512000bps 11=921600bps 12=2Mbps 13=3Mbps 14=4Mbps 15=5Mbps	5	-	Effective on Shutdown
P0-006	User 485 Configuration	0=8_N_2 1=8_E_1 2=8_O_1 3=8_N_1	3	-	Effective on Shutdown

13.3RS485 Communication Protocol

The driver supports Modbus RTU communication protocol function codes 0x03, 0x06, and 0x10.

- 0x03 is used to read data from register addresses. Since parameter numbers are not consecutive, it is recommended to read one register address at a time. The length of the read can be determined based on the length of the parameter type corresponding to the register address in the parameter list.
- 0x06 is used for writing parameters of 2-byte length.
- 0x10 is used for writing parameters of 4-byte length. (Currently, the driver does not support writing parameters longer than 4 bytes.)

  The Modbus CRC check code has the low byte first.

Refer to the parameter list for the register address corresponding to the panel parameter number. The relationship between the panel parameter number and the Modbus register address is as follows:

Parameter Number	Modbus Register Address (Hex)
PX-XXX	XXXX
C0-XXX	CXXX
D0-XXX	DXXX

Example communication format:

Reading data from a Modbus device with address 1, parameter number P0-001, data length 2, register 0x0001:

Device request command

Modbus device address	Function code	High byte of register address	Low byte of register address	High byte of number of registers	Number of Registers Low Byte	CRC Low Byte	CRC High Byte
0x01	0x03	0x00	0x01	0x00	0x01	0xD5	0xCA

Driver Normal Response Data: 0x 0001

Modbus device address	Function code	Number of Bytes	Register Data High Byte	Register Data Low Byte	CRC Low Byte	CRC High Byte
01	0x03	0x02	0x00	0x01	0x79	0x84

Driver Abnormal Response: Error Code 0x02

Modbus device address	Function code	Error Code	CRC Low Byte	CRC High Byte
01	0x83	0x02	0xC0	0xF1

Read Modbus Device Address 1, Parameter Number P0-203, Data Length 4, Register 0x0203 Data:

Device request command

Modbus device address	Function code	High byte of register address	Low byte of register address	High byte of number of registers	Number of Registers Low Byte	CRC Low Byte	CRC High Byte
0x01	0x03	0x02	0x03	0x00	0x02	0x35	0xB3

Driver Normal Response Data: 0x00800001

Modbus device address	Function code	Number of Bytes	Register Data Low Byte High - Low		Register Data High Byte High - Low		CRC Low Byte	CRC High Byte
01	0x03	0x04	0x00	0x01	0x00	0x80	0xAA	0x53

Write Modbus Device Address 1, Parameter Number P0-001, Data Length 2, Register 0x0001, Data Value 2:

Modbus device address	Function code	High byte of register address	Low byte of register address	Data High Byte	Data Low Byte	CRC Low Byte	CRC High Byte
0x01	0x06	0x00	0x01	0x00	0x02	0x59	0xCB

Driver write success response:

Modbus device address	Function code	High byte of register address	Low byte of register address	Data High Byte	Data Low Byte	CRC Low Byte	CRC High Byte
0x01	0x06	0x00	0x01	0x00	0x02	0x59	0xCB

Driver abnormal response

Modbus device address	Function code	Error Code	CRC Low Byte	CRC High Byte
01	0x86	0x02	0xC3	0xA1

Write to Modbus device address 1, parameter number P0-203, data length 4, register 0x0203, data is 0x87654321:

Modbus device address	Function code	Register address High-Low		Number of registers High – Low		Number of bytes	Register data Low word (High-Low) High word (High-Low)				CRC Low-High	
01	0x10	0x02	0x03	0x00	0x02	0x04	0x43	0x21	0x87	0x65	0x4C	0x8F

Driver write success response:

Modbus device address	Function code	High byte of register address	Low byte of register address	High byte of number of registers	Number of Registers Low Byte	CRC Low Byte	CRC High Byte
01	**0x10**	**0x02**	**0x03**	**0x00**	**0x02**	**0xB0**	**0x70**

Driver abnormal response:

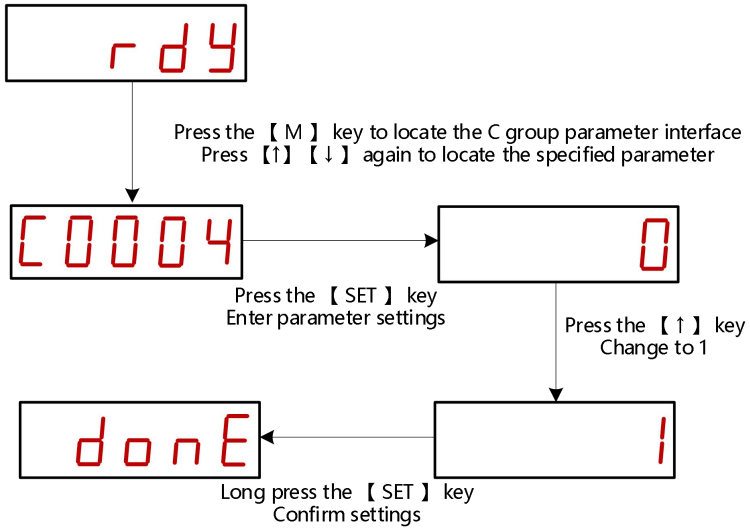
Modbus device address	Function code	Error Code	CRC Low Byte	CRC High Byte
01	0x90	0x02	0xCD	0xC1

14Auxiliary Functions

14.1Parameter Initialization

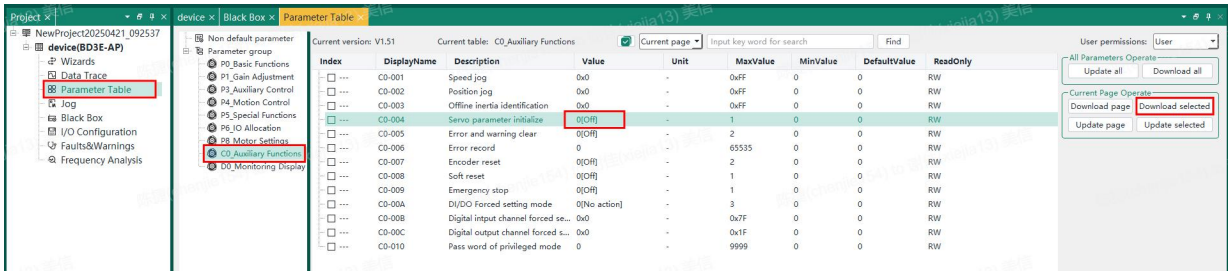
There are two methods for parameter initialization: panel setting of driver parameters initialization, higher-level machine setting of driver parameters initialization.

- **Panel driver parameter initialization:** Ensure the driver is in a non-operational state, enter [C0004] and modify the set value to 1, press and hold the [SET] key to confirm the set value. The driver panel will display [done], as shown in the figure below:



- **Higher-level Machine sets driver parameter initialization:** To ensure the driver connects normally to the higher-level machine and is in a non-operational state, click on the higher-level machine's [Parameter Setting] -> [Auxiliary Functions], change the value of [C0-004] Software Reset to [1 Start], then click [Download Selected]. The driver panel will display [done].

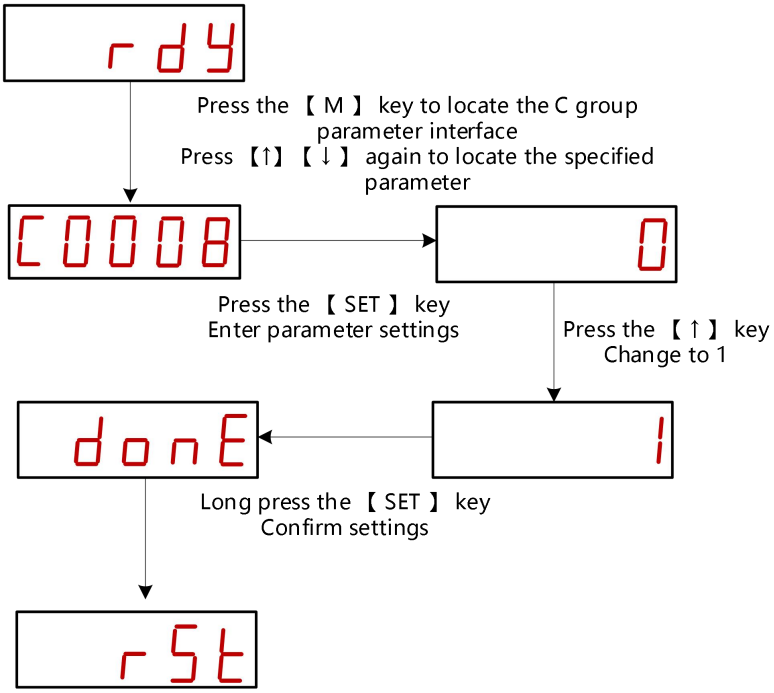
  Note: If there are parameters that require reset to take effect after modification during parameter initialization, the driver panel status will flash [rst].



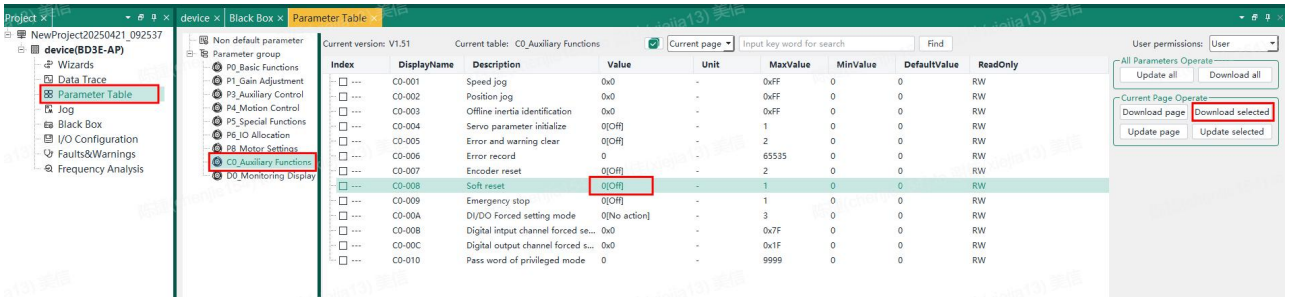
14.2Software Reset

There are two methods for software reset: panel reset and higher-level machine parameter setting reset.

- Panel reset operation: Ensure the driver is in a non-operational state, enter [C0008] and modify the set value to 1, press and hold the [SET] key to confirm the set value. The driver panel will display [done] -> [rst], then restart.



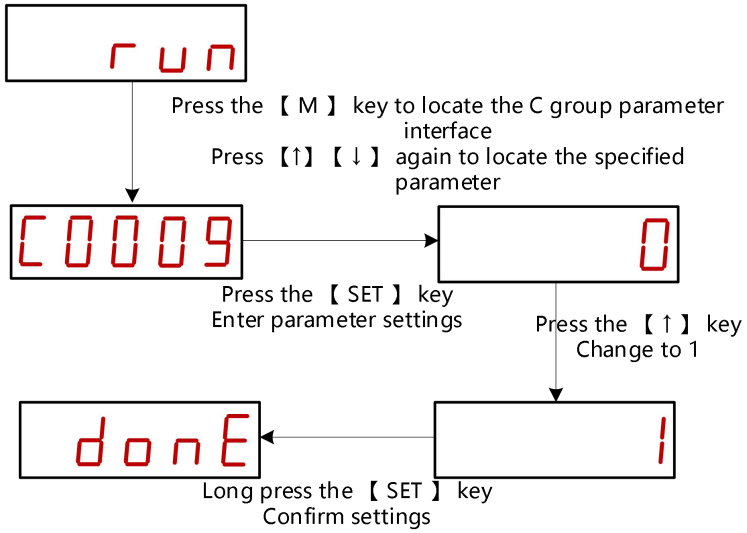
- Higher-level Machine Reset Operation: To connect the driver normally to the higher-level machine and ensure the driver is in a non-operational state, click on the higher-level machine's [Parameter Setting] -> [Auxiliary Functions] in the project, change the value of [C0-008] Software Reset to [1 Start], then click [Download Selected]. The driver panel will display [rst] and then restart.



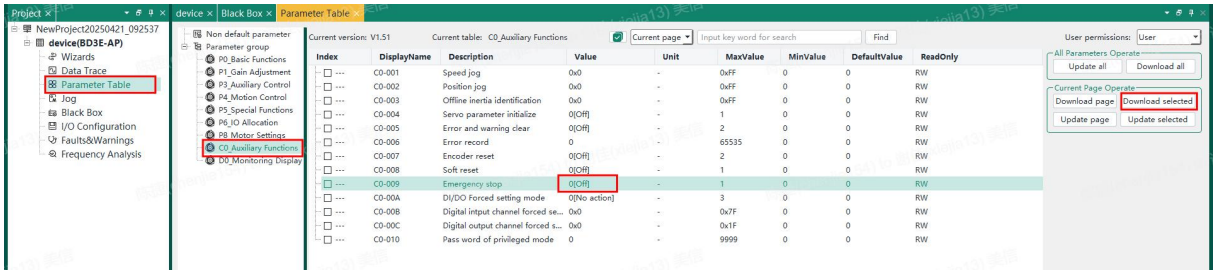
14.3Emergency Shutdown

There are three emergency stop methods: Panel Emergency Stop, Higher-level Machine Parameter Emergency Stop, and DI Triggered Emergency Stop.

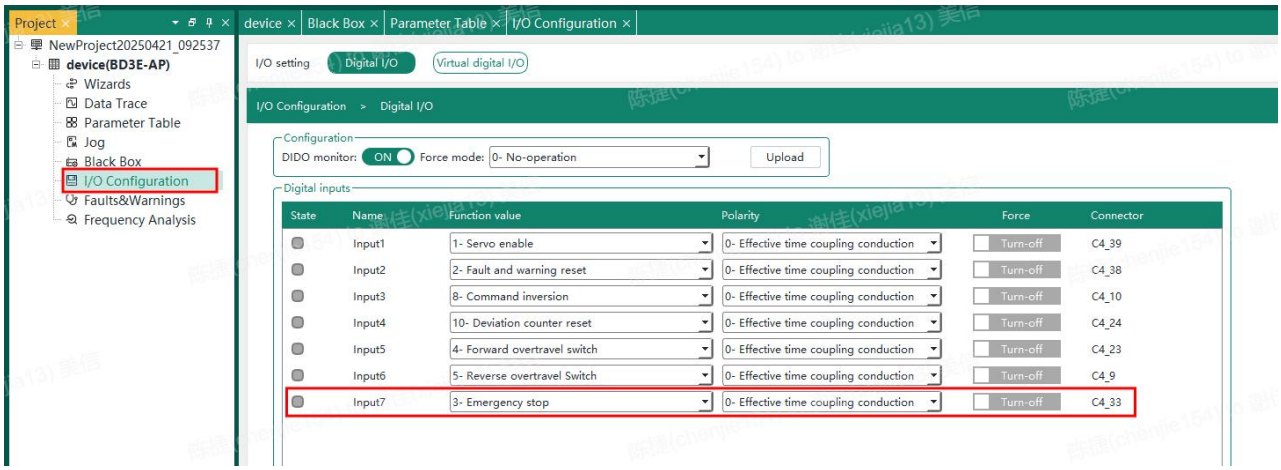
- **Panel Emergency Stop**: Enter [C0009] and modify the set value to 1, hold down the [SET] key to confirm the set value. The driver panel will display [done]. As shown in the figure below:



- **Higher-level Machine Emergency Stop**: To connect the driver normally to the higher-level machine, click on the higher-level machine's [Parameter Setting] -> [Auxiliary Functions] in the project, change the value of [C0-009] Software Reset to [1 Start], then click [Download Selected].



- **DI Trigger Emergency Stop**: In the higher-level machine IO signal settings, DI7 terminal is set as emergency stop by default, which can be triggered by applying an external level to DI7.



15 Parameter Overview

15.1 Parameter Category Overview

Parameter Classification	Module Name	Function Name
P0	Basic Functions	Higher-level Machine Settings
		Basic Parameters
		Electronic Gear
		Stop Control
		Regenerative Braking
		Limits
		Others
		Frequency Division Output
P1	Gain Adjustment	Control Method
		Stiffness Level Selection
		First Gain and Integration (+ Torque Filter)
		Second Gain and Integration (+ Torque Filter)
		Gain Switching Method
		Feedforward Control
P3	Auxiliary Control	Smoothing Filter
		Low-frequency Vibration Suppression
		Mechanical Resonance Suppression
		Speed Feedback
		Model Tracking, etc.
P4	Motion Control	Position Mode
		Speed Mode
		Torque Mode
P5	Special Functions	Inertia Identification
		Multi-Segment Position
		JOG Setting
P6	IO Allocation	DI Configuration
		DO Configuration
		Communication DI Configuration
		Communication DO Configuration
P8	Motor Setup	Motor Monitoring
C	Auxiliary Functions	Function Switches
D	Monitoring Display	Status Display

15.2D Group Monitoring Parameters

Parameter Number	Parameter Name	Setting Range	Default Value	Unit
D0-001	Motor Speed	-32768 ~ 32767	0	rpm
D0-002	Average Load Rate	0 ~ 800.0	0	%
D0-003	Position Command Counter	-2147483648~ 2147483647	0	User Command Unit
D0-00A	Speed Command	-32768~ 32767	0	rpm
D0-00B	Torque Command	-3276.8 ~ 3276.7	0	%
D0-00C	Phase Current RMS	0 ~ 655.35	0	A
D0-00D	DC Bus Voltage Value	0 ~ 6553.5	0	V
D0-00F	DI Terminal Status	0 ~ 0xFFF	0	-
D0-010	DO Terminal Status	0 ~ 0xF	0	-
D0-013	Single-turn Data of Absolute Encoder	0 ~ 8388608	0	-
D0-015	Multi-turn Data of Absolute Encoder	-32768 ~ 32767	0	-
D0-016	Lower 4 Bytes of Absolute Position Counter	-2147483648 ~ 2147483647	0	Encoder Unit
D0-018	Upper 4 Bytes of Absolute Position Counter	-2147483648 ~ 2147483647	0	Encoder Unit
D0-01C	Rectifier Module Temperature Value	-3276.8 ~ 3276.7	0	℃
D0-01D	Total Power-On Time of Servo	0 ~ 429496729.5	0	s
D0-01F	Servo Operation Status	0=Not Ready 1=Ready 2=In Operation 3=Operation Error	0	-
D0-020	Current Alarm Number	0 ~ 0xFFFF	0	-
D0-021	Class 1 Alarm Flag	0=No Class 1 Alarm 1=Class 1 Alarm	0	-
D0-022	Class 2 Alarm Flag	0=No Class 2 Alarm 1=Class 2 Alarm	0	-
D0-108	Firmware Version Number	0 ~ 0xFFFFFFFF	1	-

15.3P Group User Parameters

15.3.1 P0 Basic Functions

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method
P0-001	Higher-level Machine 485 Station Number	1 ~ 255	1	-	Effective on Shutdown
P0-002	Higher-level Machine 485 Baud Rate Configuration	1=9600bps 2=19200bps 3=38400bps 4=57600bps 5=115200bps 6=192000bps 7=256000bps 8=288000bps 9=384000bps 10=512000bps 11=921600bps 12=2Mbps 13=3Mbps 14=4Mbps 15=5Mbps	5	-	Effective on Shutdown
P0-003	Higher-level Machine 485 Configuration	0=8_N_2 1=8_E_1 2=8_O_1 3=8_N_1	3	-	Effective on Shutdown
P0-004	User 485 Station Number	1 ~ 255	1	-	Effective on Shutdown
P0-005	User 485 Configuration	1=9600bps 2=19200bps 3=38400bps 4=57600bps 5=115200bps 6=192000bps 7=256000bps 8=288000bps 9=384000bps 10=512000bps 11=921600bps 12=2Mbps 13=3Mbps 14=4Mbps 15=5Mbps	5	-	Effective on Shutdown
P0-006	User 485 Configuration	0=8_N_2 1=8_E_1 2=8_O_1 3=8_N_1	3	-	Effective on Shutdown
P0-101	Control Mode Selection	0=Position Mode 1=Speed Mode	0	-	Effective on Shutdown

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method
		2=Torque Mode 3=Position-Speed Mode 4=Position-Torque Mode 5=Speed-Torque Mode 6=Position-Speed-Torque Mode			
P0-102	Direction Selection	0=Counterclockwise as Positive Direction 1=Clockwise as Positive Direction	0	-	Effective on Shutdown
P0-103	Absolute Value System Mode	0=Do Not Use Absolute Value System 1=Use Absolute Value Linear System	0	-	Effective After Restart
P0-201	Number of Position Commands per Motor Revolution	0 ~ 4294967295	10000	-	Effective on Shutdown
P0-203	Electronic Gear Ratio 1 (Numerator)	1~4294967295	8388608	-	Effective on Shutdown
P0-205	Electronic Gear Ratio 1 (Denominator)	1 ~ 4294967295	10000	-	Effective on Shutdown
P0-301	Holding Brake Enable Signal	0=No Holding Brake 1=With Holding Brake	0	-	Effective on Shutdown
P0-302	Disable Enable Stop Method	0=DB Shutdown, DB Status 1=Zero Speed Shutdown, DB Status 2=Emergency Stop Torque Shutdown, DB Status 3=Quick Shutdown, DB Status 4=Ramp Shutdown, DB Status 5=DB Shutdown, Free State 6=Free Shutdown, Free State 7=Ramp Speed Shutdown, Free State 8=Quick Shutdown, Free State 9=Emergency Stop Torque Shutdown, Free State 10=Zero Speed Stop, Free State	0	-	Effective on Shutdown
P0-303	No.1 Alarm Shutdown Method	0=DB Shutdown, DB Status 1=Zero Speed Shutdown, DB Status 2=Emergency Stop Torque Shutdown, DB Status 3=Quick Shutdown, DB Status 4=Ramp Shutdown, DB Status	0	-	Effective on Shutdown

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method
		5=DB Shutdown, Free State 6=Free Shutdown, Free State 7=Ramp Speed Shutdown, Free State 8=Quick Shutdown, Free State 9=Emergency Stop Torque Shutdown, Free State 10=Zero Speed Stop, Free State			
P0-304	No.2 Alarm Shutdown Method	0=DB Shutdown, DB Status 1=Zero Speed Shutdown, DB Status 2=Emergency Stop Torque Shutdown, DB Status 3=Quick Shutdown, DB Status 4=Ramp Shutdown, DB Status 5=DB Shutdown, Free State 6=Free Shutdown, Free State 7=Ramp Speed Shutdown, Free State 8=Quick Shutdown, Free State 9=Emergency Stop Torque Shutdown, Free State 10=Zero Speed Stop, Free State	0	-	Effective on Shutdown
P0-305	Overtravel Shutdown Method	0=DB Shutdown, DB Status 1=Zero Speed Shutdown, DB Status 2=Emergency Stop Torque Shutdown, DB Status 3=Quick Shutdown, DB Status 4=Ramp Shutdown, DB Status 5=DB Shutdown, Free State 6=Free Shutdown, Free State 7=Ramp Speed Shutdown, Free State 8=Quick Shutdown, Free State 9=Emergency Stop Torque Shutdown, Free State 10=Zero Speed Stop, Free State 11=Ramp Speed Stop, Position Locking 12=Quick Stop, Position Locking 13=Emergency Stop Torque Shutdown, Position Locking 14=Zero Speed Stop, Position Locking	0	-	Effective on Shutdown

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method
P0-306	Shutdown Switch Speed Threshold	10 ~ 7000	100	rpm	Effective on Shutdown
P0-307	Emergency Stop Torque	0.0 ~ 300.0	100.0	%	Effective on Shutdown
P0-308	Ramp Shutdown Deceleration Time	0 ~ 65535	100	ms	Immediate Effect
P0-309	Quick Stop Deceleration Time	0 ~ 65535	0	ms	Immediate Effect
P0-30B	Delay from Holding Brake Power-On to Command Reception	0 ~ 500	250	ms	Immediate Effect
P0-30C	Delay from Holding Brake Power-Off to Servo OFF in Stopped State	1 ~ 1000	150	ms	Immediate Effect
P0-30D	Delay from Servo OFF to Holding Brake Power-Off in Operation State	1 ~ 1000	500	ms	Immediate Effect
P0-30E	Speed Threshold for Holding Brake Power-Off in Operating State	0 ~ 3000	20	rpm	Immediate Effect
P0-401	Continuous Operation Time at Rated Power	0 ~ 65535	20000	ms	Effective on Shutdown
P0-402	Value of Built-in Regenerative Resistor	0 ~ 1000	50	Ω	Effective on Shutdown
P0-403	Capacity of Built-in Regenerative Resistor	0 ~ 65535	50	W	Effective on Shutdown
P0-404	Regenerative Braking Method	0=Use Built-in Dissipation Resistor 1=Use External Dissipation Resistor 2=Reserved 3=Do Not Use Dissipation Resistor	0	-	Effective on Shutdown
P0-405	Regenerative Resistor Heat Dissipation Coefficient	10 ~ 100	50	%	Effective on Shutdown
P0-406	Minimum Value of Regenerative Resistor	1 ~ 1000	40	Ω	Effective on Shutdown
P0-407	Value of External Regenerative Resistor	1 ~ 1000	50	Ω	Effective on Shutdown
P0-408	Capacity of External Regenerative Resistor	1 ~ 65535	40	W	Effective on Shutdown
P0-503	Forward Speed Limit Value	0 ~ 7000	6000	rpm	Immediate

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method
					Effect
P0-504	Reverse Speed Limit Value	0 ~ 7000	6000	rpm	Immediate Effect
P0-505	Positive Speed Limit Value in Torque Mode	0 ~ 7000	6000	rpm	Immediate Effect
P0-506	Negative Speed Limit Value in Torque Mode	0 ~ 7000	6000	rpm	Immediate Effect
P0-507	Positive Torque Limit Value	0.0 ~ 400.0	350.0	%	Immediate Effect
P0-508	Negative Torque Limit Value	0.0 ~ 400.0	350.0	%	Immediate Effect
P0-601	Initial State of LED	1 ~ 0x1F	0x1F	-	Immediate Effect
P0-701	Number of Pulses per Revolution for Frequency Division Output	4 ~ 16384	2500	-	Effective After Restart
P0-702	Frequency Division Output Phase Setting	0 ~ 1	0	-	Effective After Restart
P0-703	OZ Output Pulse Width Setting	1 ~ 8	1	-	Immediate Effect

15.3.2 P1 Gain Adjustment

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method
P1-001	Adjustment Mode Selection	0: Manual Adjustment Mode 1: Standard Stiffness Table Mode 2: Stiffness Table + Positioning Mode	1	-	Immediate Effect
P1-101	Load Inertia Ratio	0 ~ 5000	100	%	Immediate Effect
P1-102	Stiffness Level Selection	0 ~ 31	12	-	Immediate Effect
P1-201	Position Loop Gain	0.1 ~ 2000.0	40.0	rad/s	Immediate Effect
P1-202	Speed Loop Gain	0.1 ~ 2000.0	25.0	Hz	Immediate Effect
P1-203	Speed Loop Integral Time Constant	0.15 ~ 512.00	31.83	ms	Immediate Effect
P1-204	Torque Filter Time Constant	0.00 ~ 30.00	0.79	ms	Immediate Effect
P1-205	High-Frequency Attenuation Ratio of Second-Order Low-Pass Filter	0 ~ 50	16	%	Immediate Effect
P1-206	Torque Filter Type	0: First-Order Low-Pass Filter 1: Second-Order Low-Pass	0	-	Immediate Effect

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method
		Filter			
P1-301	2nd Position Loop Gain	0.1 ~ 2000.0	64.0	rad/s	Immediate Effect
P1-302	2nd Velocity Loop Gain	0.1 ~ 2000.0	40.0	Hz	Immediate Effect
P1-303	2nd Velocity Loop Integral Time Constant	0.15 ~ 512.00	20.00	ms	Immediate Effect
P1-304	Second Torque Filter Time Constant	0.00 ~ 30.00	0.79	ms	Immediate Effect
P1-401	Gain switching method selection	0: Speed Loop PI-P Switching 1: Gain Switching Based on Conditions	1	-	Immediate Effect
P1-402	Gain Switching Condition Selection	0: Maintain First Group Gain 1: Terminal Switching Gain 2: Torque Command Switching Gain 3: Speed Command Switching Gain 4: Speed Command Rate Change Switching Gain 5: Speed Command High/Low Threshold Switching Gain 6: Position Deviation Switching Gain 7: Position Command Switching Gain 8: Positioning Completion Switching Gain 9: Speed Feedback Switching Gain 10: Position Command + Speed Feedback Switching Gain	0	-	Immediate Effect
P1-403	Gain Switching Delay Time	0.0 ~ 1000.0	5.0	ms	Immediate Effect
P1-404	Gain Switching Level	0 ~ 20000	50	-	Immediate Effect
P1-405	Gain Switching Hysteresis	0 ~ 20000	30	-	Immediate Effect
P1-406	Position Gain Switching Time	0.0 ~ 1000.0	2.0	ms	Immediate Effect
P1-501	PDFF Gain	0.0 ~ 100.0	100.0	%	Immediate Effect
P1-502	Speed Feedforward Mode Selection	0: Disable Speed Feedforward 1: Enable Speed Feedforward	0	-	Immediate Effect
P1-503	Speed Feedforward Gain	0.0 ~ 100.0	0.0	%	Immediate Effect
P1-504	Speed Feedforward Filter Time Constant	0.00 ~ 64.00	0.00	ms	Immediate Effect

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method
P1-505	Torque Feedforward Method Selection	0: Disable Torque Feedforward 1: Enable Torque Feedforward	0	-	Immediate Effect
P1-506	Torque Feedforward Gain	0.0 ~ 200.0	0.0	%	Immediate Effect
P1-507	Torque Feedforward Filter Time Constant	0.00 ~ 64.00	0.00	ms	Immediate Effect

15.3.3 P3 Auxiliary Control

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method
P3-001	Position Command IIR Low-Pass Filter Time Constant	0.0 ~ 6553.5	0.0	ms	Effective on Shutdown
P3-002	Position Command Moving Average Filter Time Constant	0.0 ~ 128.0	0.0	ms	Effective on Shutdown
P3-103	Low-frequency Vibration Suppression Frequency	1.0 ~ 100.0	100.0	Hz	Immediate Effect
P3-104	Low-frequency Vibration Suppression Compensation	1.2 ~ 3.0	1.2	-	Immediate Effect
P3-105	Low-frequency Vibration Suppression Frequency Width	0 ~ 10	2	-	Immediate Effect
P3-302	Resonance Detection Value	0 ~ 2000	0	Hz	Immediate Effect
P3-303	First Notch Filter Center Frequency	50 ~ 8000	8000	Hz	Immediate Effect
P3-304	First Notch Filter Bandwidth Level	0 ~ 20	2	-	Immediate Effect
P3-305	First Notch Filter Attenuation Ratio	0 ~ 99	0	%	Immediate Effect
P3-306	Second Notch Filter Center Frequency	50 ~ 8000	8000	Hz	Immediate Effect
P3-307	Second Notch Filter Bandwidth Level	0 ~ 20	2	-	Immediate Effect
P3-308	Second Notch Filter Attenuation Ratio	0 ~ 99	0	%	Immediate Effect
P3-309	Third Notch Filter Center Frequency	50 ~ 8000	8000	Hz	Immediate Effect
P3-30A	Third Notch Filter Bandwidth Level	0 ~ 20	2	-	Immediate Effect
P3-30B	Third Notch Filter Attenuation Ratio	0 ~ 99	0	%	Immediate Effect
P3-30C	Fourth Notch Filter Center Frequency	50 ~ 8000	8000	Hz	Immediate Effect
P3-30D	Fourth Notch Filter Bandwidth Level	0 ~ 20	2	-	Immediate Effect
P3-30E	Fourth Notch Filter	0 ~ 99	0	%	Immediate

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method
	Attenuation Ratio				Effect
P3-401	Speed Observer Selection	0: Low-pass Filter 1: Speed Observer 2: Disturbance Observer	0	-	Immediate Effect
P3-402	Speed Observer Cutoff Frequency	10 ~ 2000	300	Hz	Immediate Effect
P3-405	Speed Feedback Low-pass Filter Frequency	1 ~ 4000	1000	Hz	Immediate Effect
P3-501	Disturbance Torque Compensation Gain	-500.0 ~ 500.0	0.0	%	Immediate Effect
P3-502	Disturbance Torque Low-pass Filter Time Constant	0.10 ~ 25.00	1.00	ms	Immediate Effect
P3-601	Model Tracking Enable	0: Not Enabled 1: Enabled	0	-	Immediate Effect
P3-602	Model Tracking Gain	10 ~ 65535	100	%	Immediate Effect

15.3.4 P4 Motion Control

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method
P4-001	Position Command Selection	0=Pulse Control 1=Internal Position	0	-	Effective on Shutdown
P4-002	Excessive Position Command Increment Count	1 ~ 7	2	-	Immediate Effect
P4-003	Position Deviation Overlimit Alarm Threshold	1 ~ 1073741824	83886080	Encoder Unit	Immediate Effect
P4-005	Duration of Position Error Overlimit Detection	0 ~ 1000	25	ms	Immediate Effect
P4-006	Pulse Command Shape	0=Pulse + Direction 1=CW+CCW 2=A Phase + B Phase Quadrature Pulse - Input Multiplied by 1 3=A Phase + B Phase Quadrature Pulse - Input Multiplied by 2 4=A Phase + B Phase Quadrature Pulse - Input Multiplied by 4 5=Pulse + Direction (Reversed)	0	-	Effective After Restart
P4-007	Pulse Command Filter Level	0=25000KHZ 1=5000KHZ 2=2500KHZ 3=1000KHZ 4=500KHZ	4	-	Effective After Restart

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method
		5=250KHZ 6=100KHZ 7=50KHZ 8=25KHZ 9=10KHZ			
P4-008	Position Completion Filter Time	0 ~ 65535	0	ms	Immediate Effect
P4-009	Position Completion Comparator Bandwidth	0 ~ 65535	1000	Encoder Unit	Immediate Effect
P4-00A	Position Completion Comparator Hysteresis Value	0 ~ 65535	0	Encoder Unit	Immediate Effect
P4-00B	Position Completion Delay Time Setting (125us Unit)	0 ~ 65535	0	-	Immediate Effect
P4-00C	Position Approach Filter Time	0 ~ 65535	0	ms	Immediate Effect
P4-00D	Position Approach Comparator Bandwidth	0 ~ 65535	5000	-	Immediate Effect
P4-00E	Position Approach Comparator Hysteresis Value	0 ~ 65535	0	-	Immediate Effect
P4-00F	Position Command Zero Speed Hysteresis Filter Time	0 ~ 65535	0	ms	Immediate Effect
P4-010	Position Arrival Proximity Mode	0=Position Deviation is 0 1=Position Deviation is 0 and Pre-filter Command is 0 2=Position Deviation is 0 and Post-filter Command is 0	0	-	Immediate Effect
P4-101	Speed Command Selection	0=Internal Speed 1=Reserved	0	-	Effective on Shutdown
P4-102	Internal Speed Command Value	-7000 ~ 7000	100	rpm	Immediate Effect
P4-103	Soft Start Acceleration Time	1 ~ 65535	100	ms	Immediate Effect
P4-104	Soft Start Deceleration Time	1 ~ 65535	100	ms	Immediate Effect
P4-105	Zero Position Fix (/ZCLAMP) Speed Threshold	0 ~ 7000	0	ms	Immediate Effect
P4-108	Speed Error Exceeds Limit Alarm Threshold	0 ~ 7000	0	rpm	Immediate Effect
P4-109	Duration of Speed Error Exceeds Limit Detection	0 ~ 3000	100	ms	Immediate Effect
P4-10B	Motor Rotation Detection Filter Time	0 ~ 65535	0	ms	Immediate Effect
P4-10C	Motor Rotation Detection Comparator Hysteresis Width	0 ~ 65535	20	rpm	Immediate Effect
P4-10D	Motor Rotation Detection Comparator Hysteresis Value	0 ~ 65535	0	rpm	Immediate Effect
P4-10F	Speed Consistency Filter Time	0 ~ 65535	0	ms	Immediate Effect

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method
P4-110	Speed Consistency Comparator Bandwidth	0 ~ 65535	20	rpm	Immediate Effect
P4-111	Speed Consistency Comparator Hysteresis Value	0 ~ 65535	0	rpm	Immediate Effect
P4-112	Speed Arrival Filter Time	0 ~ 65535	0	ms	Immediate Effect
P4-113	Speed Arrival Comparator Bandwidth	0 ~ 65535	20	rpm	Immediate Effect
P4-114	Speed Arrival Output Comparator Hysteresis Value	0 ~ 65535	0	rpm	Immediate Effect
P4-201	Torque Command Selection	0=Internal Torque 1=Reserved	0	-	Effective on Shutdown
P4-202	Internal Setting (Panel or Serial Port) Torque Command Value	-400.0 ~ 400.0	0.0	%	Immediate Effect
P4-205	Torque Arrival Filter Time	0 ~ 65535	0	ms	Immediate Effect
P4-206	Torque Arrival Comparator Hysteresis Width	0.0 ~ 6553.5	0.5	%	Immediate Effect
P4-207	Torque reaches the hysteresis value of the output comparator	0.0 ~ 6553.5	0.0	%	Immediate Effect
P4-208	Torque reaches the hysteresis reference of the output comparator	0.0 ~ 6553.5	0.0	%	Immediate Effect

15.3.5 P5 Special Function

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method
P5-002	Inertia Identification Maximum Speed	100 ~ 3000	800	rpm	Effective on Shutdown
P5-003	Inertia identification acceleration time	20 ~ 800	100	ms	Effective on Shutdown
P5-004	Inertia Identification Waiting Time	50 ~ 10000	500	ms	Effective on Shutdown
P5-005	Number of motor revolutions for single inertia identification	0.00 ~ 655.35	3.00	-	Effective on Shutdown
P5-301	Internal Position Mode	0=Relative Mode 1=Absolute Mode	0	-	Effective on Shutdown
P5-302	Segment Logic Mode	0=Stepping Mode 1=Direct Selection Mode 2=Automatic Loop Mode	0	-	Effective on Shutdown

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method
		3=Single Loop Mode 4=Real-time Direct Selection Mode			
P5-303	Start Segment Number	1 ~ 16	1	-	Effective on Shutdown
P5-304	End Segment Number	1 ~ 16	1	-	Effective on Shutdown
P5-305	First Segment Position	-2147483648 ~ 2147483647	0	User Command Unit	Effective on Shutdown
P5-307	First Segment Speed	1 ~ 7000	300	rpm	Effective on Shutdown
P5-308	First Segment Acceleration/Deceleration Time	0 ~ 65535	200	ms	Effective on Shutdown
P5-309	First Segment Waiting Time	0 ~ 65535	0	ms	Effective on Shutdown
P5-30A	Second Segment Position	-2147483648 ~ 2147483647	0	User Command Unit	Effective on Shutdown
P5-30C	Second Segment Speed	1 ~ 7000	300	rpm	Effective on Shutdown
P5-30D	Second Segment Acceleration/Deceleration Time	0 ~ 65535	200	ms	Effective on Shutdown
P5-30E	Second Segment Waiting Time	0 ~ 65535	0	ms	Effective on Shutdown
P5-30F	Third Segment Position	-2147483648 ~ 2147483647	0	User Command Unit	Effective on Shutdown
P5-311	Third Segment Speed	1 ~ 7000	300	rpm	Effective on Shutdown
P5-312	Third Segment Acceleration/Deceleration Time	0 ~ 65535	200	ms	Effective on Shutdown
P5-313	Third Segment Waiting Time	0 ~ 65535	0	ms	Effective on Shutdown
P5-314	Fourth Segment Position	-2147483648 ~ 2147483647	0	User Command Unit	Effective on Shutdown
P5-316	Fourth Segment Speed	1 ~ 7000	300	rpm	Effective on Shutdown
P5-317	Fourth Segment	0 ~ 65535	200	ms	Effective

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method
	Acceleration/Deceleration Time				on Shutdown
P5-318	Fourth Segment Waiting Time	0 ~ 65535	0	ms	Effective on Shutdown
P5-319	Fifth Segment Position	-2147483648 ~ 2147483647	0	User Command Unit	Effective on Shutdown
P5-31B	Fifth Segment Speed	1 ~ 7000	300	rpm	Effective on Shutdown
P5-31C	Fifth Segment Acceleration/Deceleration Time	0 ~ 65535	200	ms	Effective on Shutdown
P5-31D	Fifth Segment Waiting Time	0 ~ 65535	0	ms	Effective on Shutdown
P5-31E	Sixth Segment Position	-2147483648 ~ 2147483647	0	User Command Unit	Effective on Shutdown
P5-320	Sixth Segment Speed	1 ~ 7000	300	rpm	Effective on Shutdown
P5-321	Sixth Segment Acceleration/Deceleration Time	0 ~ 65535	200	ms	Effective on Shutdown
P5-322	Sixth Segment Waiting Time	0 ~ 65535	0	ms	Effective on Shutdown
P5-323	Seventh Segment Position	-2147483648 ~ 2147483647	0	User Command Unit	Effective on Shutdown
P5-325	Seventh Segment Speed	1 ~ 7000	300	rpm	Effective on Shutdown
P5-326	Seventh Segment Acceleration/Deceleration Time	0 ~ 65535	200	ms	Effective on Shutdown
P5-327	Seventh Segment Waiting Time	0 ~ 65535	0	ms	Effective on Shutdown
P5-328	Eighth Segment Position	-2147483648 ~ 2147483647	0	User Command Unit	Effective on Shutdown
P5-32A	Eighth Segment Speed	1 ~ 7000	300	rpm	Effective on Shutdown
P5-32B	Eighth Segment Acceleration/Deceleration Time	0 ~ 65535	200	ms	Effective on Shutdown
P5-32C	Eighth Segment Waiting Time	0 ~ 65535	0	ms	Effective on

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method
					Shutdown
P5-32D	Ninth Segment Position	-2147483648 ~ 2147483647	0	User Command Unit	Effective on Shutdown
P5-32F	Ninth Segment Speed	1 ~ 7000	300	rpm	Effective on Shutdown
P5-330	Ninth Segment Acceleration/Deceleration Time	0 ~ 65535	200	ms	Effective on Shutdown
P5-331	Segment Nine Waiting Time	0 ~ 65535	0	ms	Effective on Shutdown
P5-332	Segment Ten Position	-2147483648 ~ 2147483647	0	User Command Unit	Effective on Shutdown
P5-334	Segment Ten Speed	1 ~ 7000	300	rpm	Effective on Shutdown
P5-335	Segment Ten Acceleration/Deceleration Time	0 ~ 65535	200	ms	Effective on Shutdown
P5-336	Segment Ten Waiting Time	0 ~ 65535	0	ms	Effective on Shutdown
P5-337	Segment Eleven Position	-2147483648 ~ 2147483647	0	User Command Unit	Effective on Shutdown
P5-339	Segment Eleven Speed	1 ~ 7000	300	rpm	Effective on Shutdown
P5-33A	Segment Eleven Acceleration/Deceleration Time	0 ~ 65535	200	ms	Effective on Shutdown
P5-33B	Segment Eleven Waiting Time	0 ~ 65535	0	ms	Effective on Shutdown
P5-33C	Segment Twelve Position	-2147483648 ~ 2147483647	0	User Command Unit	Effective on Shutdown
P5-33E	Segment Twelve Speed	1 ~ 7000	300	rpm	Effective on Shutdown
P5-33F	Segment Twelve Acceleration/Deceleration Time	0 ~ 65535	200	ms	Effective on Shutdown
P5-340	Segment Twelve Waiting Time	0 ~ 65535	0	ms	Effective on Shutdown
P5-341	Segment Thirteen Position	-2147483648 ~ 2147483647	0	User Command Unit	Effective on Shutdown

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method
P5-343	Segment Thirteen Speed	1 ~ 7000	300	rpm	Effective on Shutdown
P5-344	Segment Thirteen Acceleration/Deceleration Time	0 ~ 65535	200	ms	Effective on Shutdown
P5-345	Segment Thirteen Waiting Time	0 ~ 65535	0	ms	Effective on Shutdown
P5-346	Segment Fourteen Position	-2147483648 ~ 2147483647	0	User Command Unit	Effective on Shutdown
P5-348	Speed of Segment 14	1 ~ 7000	300	rpm	Effective on Shutdown
P5-349	Acceleration/Deceleration Time of Segment 14	0 ~ 65535	200	ms	Effective on Shutdown
P5-34A	Waiting Time of Segment 14	0 ~ 65535	0	ms	Effective on Shutdown
P5-34B	Position of Segment 15	-2147483648 ~ 2147483647	0	User Command Unit	Effective on Shutdown
P5-34D	Speed of Segment 15	1 ~ 7000	300	rpm	Effective on Shutdown
P5-34E	Acceleration/Deceleration Time of Segment 15	0 ~ 65535	200	ms	Effective on Shutdown
P5-34F	Waiting Time of Segment 15	0 ~ 65535	0	ms	Effective on Shutdown
P5-350	Position of Segment 16	-2147483648 ~ 2147483647	0	User Command Unit	Effective on Shutdown
P5-352	Speed of Segment 16	1 ~ 7000	300	rpm	Effective on Shutdown
P5-353	Acceleration/Deceleration Time of Segment 16	0 ~ 65535	200	ms	Effective on Shutdown
P5-354	Waiting Time of Segment 16	0 ~ 65535	0	ms	Effective on Shutdown
P5-601	Jog Speed Command Value	0 ~ 6000	100	rpm	Immediate Effect
P5-602	Jog Acceleration Time	1 ~ 65535	100	ms	Immediate Effect
P5-603	Jog Deceleration Time	1 ~ 65535	100	ms	Immediate Effect

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method
P5-604	Position Jog target position command	0 ~ 2147483647	0	User Command Unit	Effective on Shutdown
P5-606	Position Jog operation direction	0=Forward 1=Reverse 2=Forward and Reverse 3=Reverse and Forward	0	-	Effective on Shutdown
P5-607	Position Jog Loop Operation Count	0 ~ 65535	0	-	Immediate Effect
P5-608	Operation Wait Time	0 ~ 65535	0	ms	Immediate Effect

15.3.6 P6 IO Configuration

DIDO Function Parameter Range Overview Table

Function Description	Parameter Description
DI Function Selection	0 = Reserved 1 = Servo Enable 2 = Fault and Alarm Reset 3 = Emergency Stop 12 = Gain Switching 13 = Mode Switching 1 14 = Mode Switching 2 19 = Internal Position Trigger 20 = Internal Position Selection 1 21 = Internal Position Selection 2 22 = Internal Position Selection 3 23 = Internal Position Selection 4
DO Function Selection	0 = Reserved 1 = Servo Ready Output 2 = Alarm Signal Output 3 = Warning Output 4 = External Brake Release Signal 5 = Torque Limit Signal 6 = Speed Limit Signal 7 = Positioning Complete 8 = Approaching Position 9 = Motor Rotation Detected 10 = Speed Consistency Output 11 = Speed Reached Torque reached

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method
P6-001	DI1 Function Assignment	See D IDO Function Parameter Range Table	1	-	Immediate Effect
P6-002	DI1 Logic Level	0 = Light Coupler Conducts When Active 1 = Light Coupler Cuts Off When Active	0	-	Immediate Effect
P6-003	DI2 Function Assignment	See D IDO Function Parameter Range Table	2	-	Immediate Effect

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method
P6-004	DI2 Logic Level	0 = Light Coupler Conducts When Active 1 = Light Coupler Cuts Off When Active	0	-	Immediate Effect
P6-005	DI3 Function Assignment	See D IDO Function Parameter Range Table	8	-	Immediate Effect
P6-006	DI3 Logic Level	0 = Light Coupler Conducts When Active 1 = Light Coupler Cuts Off When Active	0	-	Immediate Effect
P6-007	DI4 Function Assignment	See D IDO Function Parameter Range Table	10	-	Immediate Effect
P6-008	DI4 Logic Level	0 = Light Coupler Conducts When Active 1 = Light Coupler Cuts Off When Active	0	-	Immediate Effect
P6-009	DI5 Function Assignment	See D IDO Function Parameter Range Table	4	-	Immediate Effect
P6-00A	DI5 Logic Level	0 = Light Coupler Conducts When Active 1 = Light Coupler Cuts Off When Active	0	-	Immediate Effect
P6-00B	DI6 Function Assignment	See D IDO Function Parameter Range Table	5	-	Immediate Effect
P6-00C	DI6 Logic Level	0 = Light Coupler Conducts When Active 1 = Light Coupler Cuts Off When Active	0	-	Immediate Effect
P6-00D	DI7 Function Assignment	See D IDO Function Parameter Range Table	3	-	Immediate Effect
P6-00E	DI7 Logic Level	0 = Light Coupler Conducts When Active 1 = Light Coupler Cuts Off When Active	0	-	Immediate Effect
P6-00F	DI Pin Filter Time	0 ~ 1000	1	ms	Immediate Effect
P6-010	DI Power-On Default Function Setting Low 32 Bits	Each Bit Represents a Function bit 0 =1 Indicates Servo Enable bit 1 =1 Indicates Fault Reset bit 2 =1 Emergency Stop bit 11 =1 Gain Switch Selection bit 12 =1 Mode Switch 1 bit 13 =1 Mode Switching 2 bit 18 =1 Internal Position Trigger bit 19 =1 Internal Position Selection 1 bit 20 =1 Internal Position Selection 2	0	-	Effective After Restart

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method
		bit 21 =1 Internal Position Selection 3 bit 22 =1 Internal Position Selection 4			
P6-101	DO1 Function Assignment	See D IDO Function Parameter Range Table	1	-	Immediate Effect
P6-102	DO1 Logic Level	0 = Light Coupler Conducts When Active 1 = Light Coupler Cuts Off When Active	0	-	Immediate Effect
P6-103	DO2 Function Assignment	See D IDO Function Parameter Range Table	7	-	Immediate Effect
P6-104	DO2 Logic Level	0 = Light Coupler Conducts When Active 1 = Light Coupler Cuts Off When Active	0	-	Immediate Effect
P6-105	DO3 Function Assignment	See D IDO Function Parameter Range Table	4	-	Immediate Effect
P6-106	DO3 Logic Level	0 = Light Coupler Conducts When Active 1 = Light Coupler Cuts Off When Active	0	-	Immediate Effect
P6-107	DO4 Function Assignment	See D IDO Function Parameter Range Table	2	-	Immediate Effect
P6-108	DO4 Logic Level	0 = Light Coupler Conducts When Active 1 = Light Coupler Cuts Off When Active	0	-	Immediate Effect
P6-109	DO5 Function Assignment	See D IDO Function Parameter Range Table	9	-	Immediate Effect
P6-10A	DO5 Logic Level	0 = Light Coupler Conducts When Active 1 = Light Coupler Cuts Off When Active	0	-	Immediate Effect
P6-401	Communication DI Enable	0 = Not Enabled 1 = Enable	0	-	Immediate Effect
P6-402	Communication DI Set Level	0 ~ 0xFFFF (each bit represents the value of a D I, bit 0~ bit 15 represent DI1~DI16)	0	-	Immediate Effect
P6-403	Communication DI Power-On Default Value	0 ~ 0xFFFF (each bit represents the value of a D I, bit 0~ bit 15 represent DI1~DI16)	0	-	Effective After Restart
P6-404	Communication DI1 Function Selection	See D IDO Function Parameter Range Table	0	-	Immediate Effect
P6-406	Communication DI2 Function Selection	See D IDO Function Parameter Range Table	0	-	Immediate Effect
P6-408	Communication DI3 Function Selection	See D IDO Function Parameter Range Table	0	-	Immediate Effect
P6-40A	Communication DI4 Function Selection	See D IDO Function Parameter Range Table	0	-	Immediate Effect

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method
P6-40C	Communication DI5 Function Selection	See D IDO Function Parameter Range Table	0	-	Immediate Effect
P6-40E	Communication DI6 Function Selection	See D IDO Function Parameter Range Table	0	-	Immediate Effect
P6-410	Communication DI7 Function Selection	See D IDO Function Parameter Range Table	0	-	Immediate Effect
P6-412	Communication DI8 Function Selection	See D IDO Function Parameter Range Table	0	-	Immediate Effect
P6-414	Communication DI9 Function Selection	See D IDO Function Parameter Range Table	0	-	Immediate Effect
P6-416	Communication DI10 Function Selection	See D IDO Function Parameter Range Table	0	-	Immediate Effect
P6-418	Communication DI11 Function Selection	See D IDO Function Parameter Range Table	0	-	Immediate Effect
P6-41A	Communication DI12 Function Selection	See D IDO Function Parameter Range Table	0	-	Immediate Effect
P6-41C	Communication DI13 Function Selection	See D IDO Function Parameter Range Table	0	-	Immediate Effect
P6-41E	Communication DI14 Function Selection	See D IDO Function Parameter Range Table	0	-	Immediate Effect
P6-420	Communication DI15 Function Selection	See D IDO Function Parameter Range Table	0	-	Immediate Effect
P6-422	Communication DI16 Function Selection	See D IDO Function Parameter Range Table	0	-	Immediate Effect
P6-501	Communication DO Enable	0 = Not Enabled 1 = Enable	0	-	Immediate Effect
P6-502	Communication DO Default Level	0 ~ 0xFFFF (Each bit represents the value of a D O, bit 0~ bit 15 represent DO1~DO16)	0	-	Effective After Restart
P6-503	Communication DO1 Function Selection	See D IDO Function Parameter Range Table	0	-	Immediate Effect
P6-505	Communication DO2 Function Selection	See D IDO Function Parameter Range Table	0	-	Immediate Effect
P6-507	Communication DO3 Function Selection	See D IDO Function Parameter Range Table	0	-	Immediate Effect
P6-509	Communication DO4 Function Selection	See D IDO Function Parameter Range Table	0	-	Immediate Effect
P6-50B	Communication DO5 Function Selection	See D IDO Function Parameter Range Table	0	-	Immediate Effect
P6-50D	Communication DO6 Function Selection	See D IDO Function Parameter Range Table	0	-	Immediate Effect
P6-50F	Communication DO7 Function Selection	See D IDO Function Parameter Range Table	0	-	Immediate Effect
P6-511	Communication DO8 Function Selection	See D IDO Function Parameter Range Table	0	-	Immediate Effect
P6-513	Communication DO9 Function Selection	See D IDO Function Parameter Range Table	0	-	Immediate Effect
P6-515	Communication DO10	See D IDO Function Parameter	0	-	Immediate

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method
	Function Selection	Range Table			Effect
P6-517	Communication DO11 Function Selection	See D IDO Function Parameter Range Table	0	-	Immediate Effect
P6-519	Communication DO12 Function Selection	See D IDO Function Parameter Range Table	0	-	Immediate Effect
P6-51B	Communication DO13 Function Selection	See D IDO Function Parameter Range Table	0	-	Immediate Effect
P6-51D	Communication DO14 Function Selection	See D IDO Function Parameter Range Table	0	-	Immediate Effect
P6-51F	Communication DO15 Function Selection	See D IDO Function Parameter Range Table	0	-	Immediate Effect
P6-521	Communication DO16 Function Selection	See D IDO Function Parameter Range Table	0	-	Immediate Effect
P6-523	Communication DO Status	0 ~ 0xFFFF (each bit represents a value of D O, bit 0~ bit 15 represent DO1~DO16)	0	-	Immediate Effect

15.3.7 P8 Motor Settings

Parameter Number	Parameter Name	Setting Range	Default Value	Unit	Effective Method
P8-005	Motor Stall Detection Speed	0 ~ 6000	50	rpm	Effective on Shutdown
P8-006	Motor Stall Detection Time	10 ~ 65535	200	ms	Effective on Shutdown
P8-007	Motor Overspeed Threshold Setting	0 ~ 10000	7200	rpm	Effective on Shutdown
P8-008	Motor Runaway Detection Function Switch	0 = Off 1 = On	1	-	Effective on Shutdown

15.4Group C Auxiliary Parameters

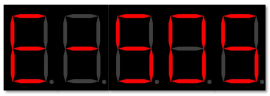
Parameter Number	Parameter Name	Setting Range	Default Value	Effective Method
C0-001	Speed JOG Enable	Reserved	Reserved	Immediate Effect
C0-002	Position JOG Enable	Reserved	Reserved	Immediate Effect
C0-003	Start Offline Inertia Identification	Reserved	Reserved	Immediate Effect
C0-004	Parameter Initialization	0 = Off 1 = Start	0	Effective on Shutdown

Parameter Number	Parameter Name	Setting Range	Default Value	Effective Method
C0-005	Alarm cleared	0 = Off 1 = Clear Alarm Status Only 2 = Clear alarm status and history	0	Effective on Shutdown
C0-006	Alarm history	Reserved	Reserved	Immediate Effect
C0-007	Encoder reset	0=Off 1=Reset encoder alarm 2=Reset encoder alarm and multi-turn data	0	Effective on Shutdown
C0-008	Software Reset	0 = Off 1 = Start	0	Effective on Shutdown
C0-009	Emergency Shutdown	0 = Off 1 = Start	0	Immediate Effect
C0-00A	DI/DO Forced Setting Mode	0 = No operation 1 = Force DI enable, DO not enabled 2 = Force DO enable, DI not enabled 3 = Force Both DI and DO Enable	0	Immediate Effect
C0-00B	DI Terminal Forced Setting Value	0 ~ 0x7F(each bit represents the value of one physical D I, bit 0~6 represent DI1~DI7)	0	Immediate Effect
C0-00C	DO Terminal Forced Setting Value	0 ~ 0x1F(each bit represents the value of one physical D O, bit 0~4 represent DO1~DO5)	0	Immediate Effect
C0-010	Privileged mode password	0 ~ 9999	0	Immediate Effect

16Fault Handling Instructions

16.1Fault Classification Description

Faults and alarms of the servo driver can be categorized into three levels based on severity, Level 1 faults, Level 2 faults, and Level 3 alarms. The smaller the number, the higher the severity. Among them, Level 1 faults can be further divided into non-resettable and resettable categories. When a fault or alarm occurs, the panel will enter the fault state and display the corresponding fault number, as shown in the figure below.



The specific classification is as follows:

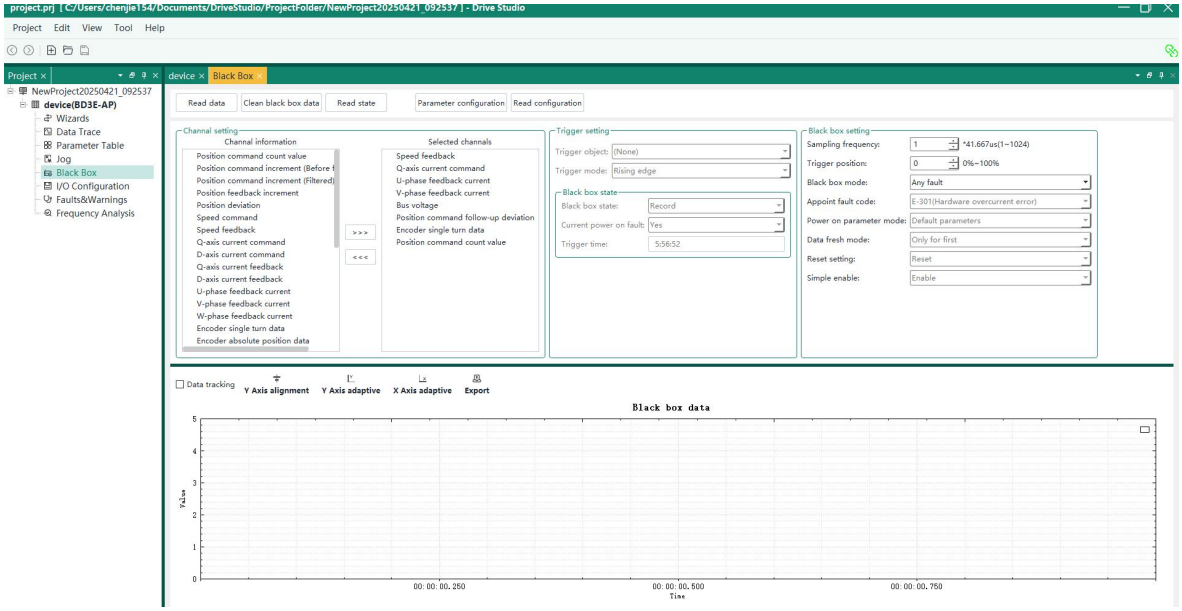
- Class 1 non-resettable faults;
- Class 1 resettable faults;
- Class 2 resettable faults;
- Class 3 resettable alarms.

"Resettable" means that the panel can stop displaying the fault status by providing a "reset signal".

16.2Black Box

16.2.1Operating Procedures

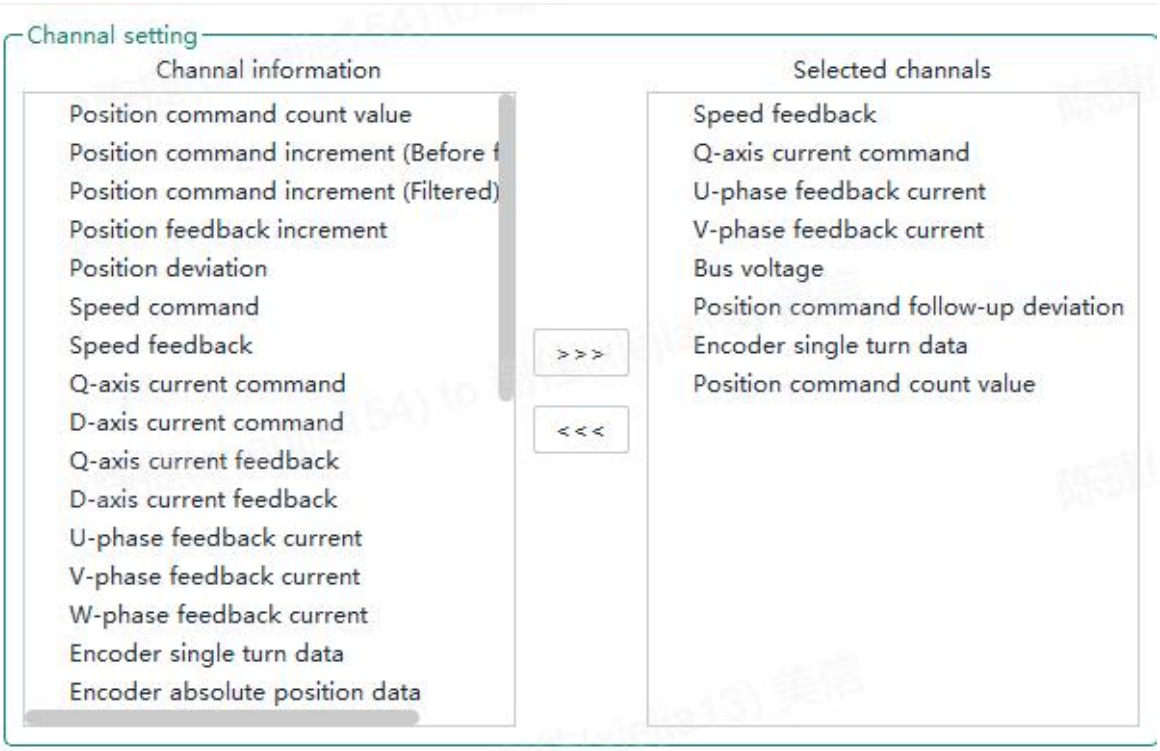
1. Click on the "Black Box Function" item in the left tree window to open the Black Box interface, as shown in the figure below.



2. To read the Black Box configuration, click the Read Configuration button to read the current Black Box configuration.
3. To read the Black Box status, click the Read Black Box Status button to update the Black Box status.
4. To clear the Black Box data, click the Clear Black Box Data button to clear the current Black Box data.
5. Read black box data, click the read black box data button, read the black box data, and display the data in the black box data graph window.
6. Modify parameter configuration, after modifying the black box channel and black box settings, click the write configuration parameters button, which will update the black box configuration and delete existing black box data.

16.2.2Black Box Channel Configuration

The black box can be configured with up to 8 channels and the number of bytes must be less than or equal to 3 2. If the black box has not been configured before, it defaults to having 8 configured channels displayed in the selected channels, as shown in the figure below:



1. Channel deletion: Click the channel in the selected channels to delete. <<< Click the delete icon to remove unnecessary channels.
2. Channel addition: Select a channel from the channel information list and click the add button to add it to the selected channels.

16.2.3Black Box Settings

Sampling frequency: n*41.667 us cycle. (n is 1 ~1024)

Trigger position: indicates the ratio of data displayed before the trigger position.

Black box mode: not enabled (black box function off), any fault, specific fault, specific condition trigger.

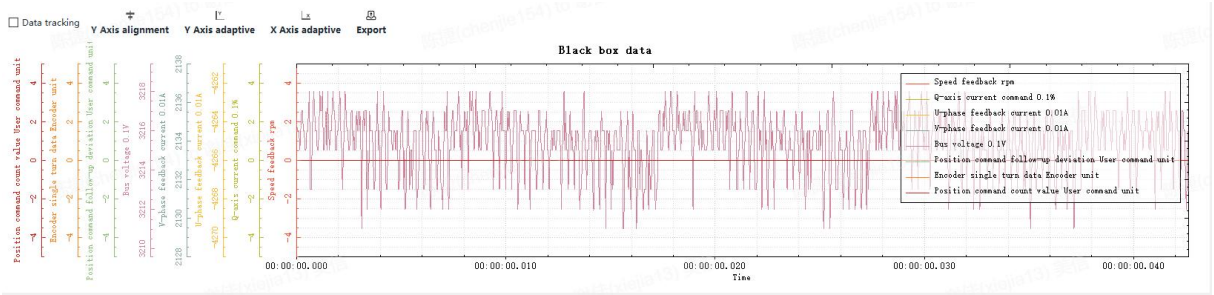
When selecting specific fault, you can set a specific fault code to trigger it.

When setting a specific condition trigger, you can set trigger parameters in the trigger settings to trigger it.

16.2.4Black Box Data

After reading the black box status, if the black box status has records, you can click the read black box data button to read the black box data.

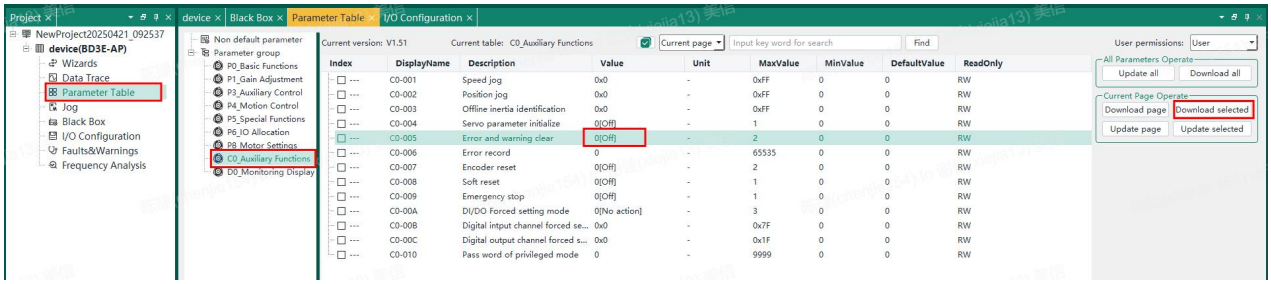
You can also perform data tracking, Y-axis alignment, Y-axis auto-scaling, X-axis auto-scaling, export, and other functions. As shown in the figure below.



16.3Alarm Reset

Alarm reset can be performed via the panel alarm reset or the higher-level machine alarm reset.

- Panel Alarm Reset
  1. In the error display state, press and hold the 【↑】 【↓】 keys simultaneously; the panel will display 【clear】.
  2. The panel enters 【C0-005】, set it to 1 (to clear only the alarm status) or 2 (to clear the alarm status and history), then long press 【SET】 to confirm. After the panel displays 【clear】, it will show the current operating status.
- Higher-level Machine Alarm Reset
  1. On the higher-level machine, enter 【Parameter Setting】 -> 【Auxiliary Functions】, set the value of 【C0-005】 to 1 (to clear only the alarm status) or 2 (to clear the alarm status and history), then click 【Download Selected】.



2. Clearing through Alarm History

   Refer to the Alarm History Section

16.4Fault Code Explanation

E-001: Inverter Module Unrecognized

Cause of Fault	Confirmation Method	Solution
PowerID Recognition Error	Check if the values of the driver's rated power, rated current, and maximum current parameters are accurate	Power cycle the system; if the issue persists, contact technical support

E-00 3: Encoder Unrecognized

Cause of Fault	Confirmation Method	Solution
Incorrect Encoder Model	Confirm whether the current driver model and motor model are compatible	Replace the Motor

E- 106: EEPROM Write Failure

Cause of Fault	Confirmation Method	Solution
EEPROM Write Failure	None	Restart the driver; if the issue persists, contact technical support

E- 107: EEPROM Read Failure

Cause of Fault	Confirmation Method	Solution
EEPROM Read Failure	None	Restart the driver; if the issue persists, contact technical support

E- 201: Overvoltage

Cause of Fault	Confirmation Method	Solution
Bus voltage exceeds overvoltage threshold	Check the bus voltage level to see if it is higher than the overvoltage threshold	Check if a regenerative resistor is required for the application Ensure the driver is fully discharged before reapplying power

E- 202: Undervoltage

Cause of Fault	Confirmation Method	Solution
Bus voltage is below the undervoltage threshold	Check the bus voltage level to see if it is lower than the undervoltage threshold	Check if the main circuit power supply is disconnected from the driver Ensure the driver is fully discharged before reapplying power

E- 203: Main Circuit Power Phase Missing

Cause of Fault	Confirmation Method	Solution
At least one phase of the main circuit power supply is not connected	Check if the power supply lines are normal	Inspect the power supply lines and restore normal power if any abnormalities are found

E- 204: Control Power Loss

Cause of Fault	Confirmation Method	Solution
Main Power Failure	Check if the power supply lines are normal	Inspect the power supply lines and restore normal power if any abnormalities are found

E- 205: Power Board Overtemperature

Cause of Fault	Confirmation Method	Solution
NTC Resistance Sampling Temperature Exceeds Driver Overtemperature Protection Threshold	Check Whether the Module Temperature Exceeds the Overtemperature Protection Threshold	Check if the Ambient Temperature Exceeds the Driver Specifications. Otherwise, Contact Technical Support.

E- 208: Regenerative Braking Resistor Overload

Cause of Fault	Confirmation Method	Solution
Regenerative Braking Resistor Load Exceeds Its Allowed Power. Continuous Overload or Repeated Overload of the Brake Tube.	Check if the Motor is in a Long-term Power Generation Condition and Check if the Regenerative Resistor Parameters (P0-402~P0-408) are Correct	Please Check if the Regenerative Resistor Value is Appropriate

E- 209: Regenerative Braking Resistor Too Small

Cause of Fault	Confirmation Method	Solution
The user-input braking resistor value is less than the minimum required value	Check if the P0-407 regenerative braking resistor value is less than the P0-406 minimum regenerative resistor value	Check if the input braking resistor value is incorrect, and replace it with a suitable braking resistor

E- 301: Hardware Overcurrent Error

Cause of Fault	Confirmation Method	Solution
1. Short Circuit Occurred 2. Excessive Load 3. Inappropriate Loop Gain Parameters	None	1. Power Cycle the System 2. Check for Ground Short Circuits 3. Reduce the Gain

E- 302: Power Module Overtemperature

Cause of Fault	Confirmation Method	Solution
High Ambient Temperature, Long-term Operation Under Heavy Load	None	Enhance cabinet cooling to ensure the driver operating temperature is less than 90 degrees Celsius, or restart the driver if the issue persists, please contact technical support

E- 304: Software Overcurrent Error

Cause of Fault	Confirmation Method	Solution

1. Excessive load 2. Inappropriate loop gain parameters	None	1. Power Cycle the System 2. Check for Ground Short Circuits 3. Reduce the Gain

E- 306: Current Sensor Bias Abnormality

Cause of Fault	Confirmation Method	Solution
1. Abnormal current sampling circuit 2. Motor enabled while rotating	None	1. Power Cycle the System 2. Ensure the servo is not rotating when enabled 3. Return to factory for repair

E- 307: Current Sensor Precharge Abnormality

Cause of Fault	Confirmation Method	Solution
Current sampling calibration timeout	None	Ensure the motor is stationary when enabled, or restart the driver if the issue persists, please contact technical support

E- 308: Inverter Module Overload

Cause of Fault	Confirmation Method	Solution
Excessive load or too short acceleration/deceleration time, etc.	Check if the load is too large or if the acceleration/deceleration time is too short, causing the driver to output a high current	Reduce the load, increase the acceleration/deceleration time, or replace with a higher capacity driver

E- 30A: Fan Blockage

Cause of Fault	Confirmation Method	Solution
The built-in cooling fan of the servo cannot operate normally and has stalled	None	Check if any foreign objects are blocking the fan, or restart the driver. If the issue persists, contact technical support

E- 403: Motor Overload

Cause of Fault	Confirmation Method	Solution
Excessive load or too short acceleration/deceleration time, etc.	Check if the load is too large or if the acceleration/deceleration time is too short, causing the driver to output a high current	Reduce the load or increase the acceleration/deceleration time

E- 501: Encoder Multi-turn Error

Cause of Fault	Confirmation Method	Solution
Encoder Fault	Clear the fault using Auxiliary Function C0007, but the alarm persists after power-on	Replace the Motor

E- 502: Encoder Battery Failure

Cause of Fault	Confirmation Method	Solution
Battery not connected to the encoder during power-off of the driver	Confirm whether the battery is connected during power-off	After connecting the battery, clear the fault using Auxiliary Function C0007

E- 503: Encoder Battery Alarm

Cause of Fault	Confirmation Method	Solution
Encoder battery voltage too low	Measure battery voltage	Replace battery

E- 504: Encoder Communication Error

Cause of Fault	Confirmation Method	Solution
Encoder wiring error	Check encoder wiring	Rewire

E- 505: Encoder Disconnection Error

Cause of Fault	Confirmation Method	Solution
Encoder cable loose	1. Check if the encoder is wired 2. Check if the connection port is loose 3. Try again after replacing the cable	Rewire

E- 506: Encoder Overheating

Cause of Fault	Confirmation Method	Solution
Encoder Temperature Too High	Measure the temperature of the motor or encoder	Wait for the temperature to drop after cooling for a while

E- 507: Encoder Incremental Counting Abnormality

Cause of Fault	Confirmation Method	Solution
Encoder Fault	Clear the fault using Auxiliary Function C0007, but the alarm persists after power-on	Replace the cable or motor

E- 509: Encoder CRC Check Error

Cause of Fault	Confirmation Method	Solution
Communication data is interfered	Check if there is interference in the wiring harness	Check grounding or replace with shielded cable

E- 510: Encoder SCI Communication Frame Error

Cause of Fault	Confirmation Method	Solution
Communication data is interfered	Check if there is interference in the wiring harness	Check grounding or replace with shielded cable

E- 512: Encoder Parity Bit Error

Cause of Fault	Confirmation Method	Solution
Encoder Fault	Clear the fault using Auxiliary Function C0007, but the alarm persists after power-on	Replace the cable or motor

E- 513: Encoder Stop Bit Error

Cause of Fault	Confirmation Method	Solution
Encoder Fault	Clear the fault using Auxiliary Function C0007, but the alarm persists after power-on	Replace the cable or motor

E- 518: Encoder Multi-turn Type Mismatch Error

Cause of Fault	Confirmation Method	Solution
After selecting absolute mode in P0103, connect a single-turn motor	Confirm whether the current setting is in absolute mode and verify the type of single-turn or multi-turn motor	Replace with a multi-turn motor or select incremental mode

E- 519: Multi-turn Encoder Overflow

Cause of Fault	Confirmation Method	Solution
The number of multi-turns of the absolute encoder exceeds the upper limit	Confirm whether the current absolute position exceeds the range	Set C0007 to 2 to reset the multi-turn count and alarm, then power on again for use

E- 603: Stall Fault

Cause of Fault	Confirmation Method	Solution
Motor stall occurs when the motor speed is below the stall threshold and the actual current is greater than the motor rated current or the stall current, and this condition persists for the stall time threshold	Observe whether the motor speed is low and the driver output current is high	Clear the stall condition and pay attention to avoiding the occurrence of stall conditions

E- 604: Motor Runaway

Cause of Fault	Confirmation Method	Solution
The algebraic signs of actual current, acceleration, and speed do not match	Observe whether the motor rotation direction is consistent with the set direction	Clear the motor runaway condition

E- 608: Position Error Exceeded

Cause of Fault	Confirmation Method	Solution
Position error has exceeded the position error limit	Check the parameters related to the position loop and whether the P4-003 position error too large alarm threshold is appropriate	Adjust the driver tuning to improve position tracking performance, or modify the parameters to allow for greater position error

E- 609: Speed Over Deviation

Cause of Fault	Confirmation Method	Solution
Speed error has exceeded the speed error limit	Check the parameters related to the speed loop and whether the P4-108 speed error over alarm threshold is appropriate	Adjust the driver tuning to improve speed tracking performance, or modify the parameters to allow for greater speed error

E- 610: Overspeed

Cause of Fault	Confirmation Method	Solution
Actual speed exceeds the speed limit	Check the parameters related to the speed loop and whether the P8-007 motor overspeed threshold setting is appropriate	Check if the overspeed detection threshold setting meets the application requirements; or use speed loop tuning to check if the speed overshoot is too large.

E- 701: DI Function Setting Failure

Cause of Fault	Confirmation Method	Solution
DI function setting repeated	Check if there are any duplicate settings for DI terminal functions and virtual DI functions.	Modify the physical DI and virtual function settings to ensure there are no duplicate functions.

E- 702: DO function setting failed

Cause of Fault	Confirmation Method	Solution
DO function setting duplicated	Check if there are any duplicate settings for DO terminal functions and virtual DO functions.	Modify the physical DO and virtual function settings to ensure there are no duplicate functions.

E- 706: Electronic gear ratio out of range

Cause of Fault	Confirmation Method	Solution
The number of position commands per motor rotation or the electronic gear ratio setting exceeds the limit; the electronic gear ratio range is [0.01, 131072]	Determine the settings for parameters related to the electronic gear ratio	Adjust the settings for parameters related to the electronic gear ratio

16.5Alarm Code Explanation

E-004: Motor Inverter Module Power Mismatch

Cause of Fault	Confirmation Method	Solution
Motor Power Exceeds Driver Power	Check if the rated power of the motor (P8-102) exceeds the rated output power of the driver (P7-302)	1. Replace the motor or driver; 2. Shield this alarm by setting bit 4 (fifth bit) of parameter P7-401 "Alarm Bit Mask Parameter 1"

E-108: Flash Read Error

Cause of Fault	Confirmation Method	Solution
Flash Read Error	None	Restart the driver; if the issue persists, contact technical support

E-60 1: Emergency Stop

Cause of Fault	Confirmation Method	Solution
Emergency stop terminal provides valid output	None	Check the emergency stop terminal

E-602: Servo ON Command Invalid Fault

Cause of Fault	Confirmation Method	Solution
Repeated ON commands, such as giving SON from DI and then repeating SON from auxiliary functions	None	Check SON signal

E-605: Forward Overtravel Alarm

Cause of Fault	Confirmation Method	Solution

Forward overtravel POT terminal provides valid input	None	Check forward overtravel POT terminal input

E-606: Reverse Overtravel Alarm

Cause of Fault	Confirmation Method	Solution
Reverse overtravel NOT terminal provides valid input	None	Check reverse overtravel NOT terminal input

16.6Fault Code List

➢First Class Non-Resettable Faults:

Fault Code	Fault Name	Fault Level	Can Reset
E-001	Inverter module not recognized	Class 1	No
E-003	Encoder not recognized	Class 1	No
E-106	EEPROM Write Failure	Class 1	No
E-107	EEPROM Read Failure	Class 1	No
E-301	Hardware overcurrent error	Class 1	No
E-505	Encoder open circuit error	Class 1	No
E-604	Motor runaway	Class 1	No

➢First Class Resettable Faults:

Fault Code	Fault Name	Fault Level	Can Reset
E-201	Overvoltage	Class 1	Yes
E-202	Undervoltage	Class 1	Yes
E-302	Power module overheating	Class 1	Yes
E-304	Software overcurrent error	Class 1	Yes
E-306	Current Sensor Bias Abnormality	Class 1	Yes
E-307	Current Sensor Precharge Abnormality	Class 1	Yes
E-308	Inverter Module Overload	Class 1	Yes
E-403	Motor Overload	Class 1	Yes
E-501	Encoder Multi-turn Error	Class 1	Yes
E-502	Encoder Battery Failure	Class 1	Yes

E-503	Encoder Battery Warning	Class 1	Yes
E-504	Encoder Communication Error	Class 1	Yes
E-506	Encoder Overheating	Class 1	Yes
E-507	Encoder Incremental Counting Abnormality	Class 1	Yes
E-509	Encoder CRC Check Error	Class 1	Yes

➢Second Type of Resettable Fault:

Fault Code	Fault Name	Fault Level	Can Reset
E-203	Main Circuit Power Phase Loss	Class 2	Yes
E-204	Control Power Dropout	Class 2	Yes
E-205	Power Board Overtemperature	Class 2	Yes
E-208	Regenerative Braking Resistor Overload	Class 2	Yes
E-209	Regenerative Braking Resistor Too Small	Class 2	Yes
E-30A	Fan Stalled	Class 2	Yes
E-510	Encoder SCI Communication Frame Error	Class 2	Yes
E-512	Encoder Parity Bit Error	Class 2	Yes
E-513	Encoder Stop Bit Error	Class 2	Yes
E-518	Encoder Multi-turn Type Mismatch Error	Class 2	Yes
E-519	Encoder Multi-turn Overflow	Class 2	Yes
E-603	Stall Fault	Class 2	Yes
E-608	Position Out of Tolerance	Class 2	Yes
E-609	Speed Out of Tolerance	Class 2	Yes
E-610	Over-speed	Class 2	Yes
E-701	DI Function Setting Failure	Class 2	Yes
E-702	DO Function Setting Failure	Class 2	Yes
E-706	Electronic Gear Ratio Out of Range	Class 2	Yes

16.7Alarm Code List

Fault Code	Fault Name	Fault Level	Can Reset

E-004	Motor Inverter Module Power Mismatch	Class 3	Yes
E-108	Flash Read Error	Class 3	Yes
E-601	Emergency Stop	Class 3	Yes
E-602	Servo ON Command Invalid Fault	Class 3	Yes
E-605	Forward Overtravel Alarm	Class 3	Yes
E-606	Reverse Overtravel Alarm	Class 3	Yes

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