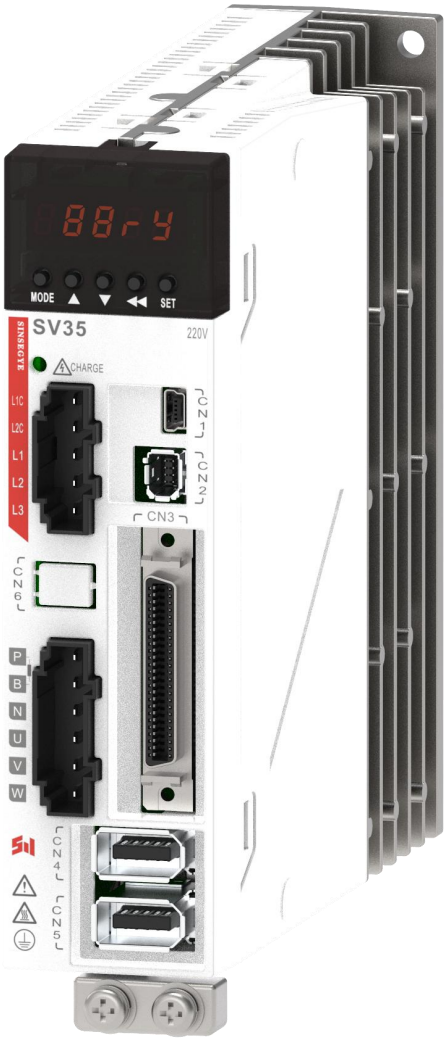
中科时代
SINSEGYE



SV35-P series AC servo driver

User Manual

- Thank you for purchasing SINSEGYE servo drivers.
- Before operating this product, please read the manual carefully.
- Please save this manual for future use.
- If there are some changes of this manual,it wouldn't inform users.

Preface

Thank you for utilizing our products. This manual provides information on SV35 servo drives and the corresponding motors.

Content

- Installation and inspection of servo drives & motors
- servo architecture and the wiring diagrams
- Steps of commissioning operation
- Training on servo tuning
- Description on parameters
- Description on communication protocol
- Alarm clear
- Inspection and maintenance

SV35 features

SV35 servo drive is flagship AC servo product independently developed by SINSEGYE, which provides inertia identification, automatic gain adjustment and other functions to make the drive simple and easy to use. With the latest development of servo motors, it achieves rapid and accurate control with cost-effective solutions in electronic manufacturing, robot, packaging, lathe and other industries of automation. The latest improved design for servo drive structure can save the inner space of cabinet. The new generation of motor design can meet the need on miniaturization of equipment structure and lightweight.

How to use this manual

This manual will tell you how to install, configure, use and maintain the product. Prior to tuning, read Chapter 1 to Chapter 7.

Technical service

If you still have problems with the application, please contact the distributor or our customer service center.

Version change log

Date of release	Version	Change
2025.03	V1.0	First edition release

Copyright statement

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Disclaimer

This product documentation is accurate and reliable at the time of release, and SINSEGYE reserves the right to change this manual without any additional notice.

About the manual

This manual is not attached to the product package. If you need to get electronic PDF files, download on SINSEGYE website (https://www.sinsegye.com.cn/). If you need consulting or assistance, please contact our company.

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Safety precautions

Safety Statement

● This chapter describes the safety precautions for proper use of the product. Before using this product, please read the instruction manual and correctly understand the relevant safety precautions. Failure to comply with the safety precautions may result in death, serious injury, or equipment damage.

● "Danger", "Alarm" and "attention" in the manual do not represent all the safety matters that shall be followed, but only supplement all the safety precautions.

● This product should be used in an environment that meets the requirements of the design specifications, otherwise it may cause failure, and functional abnormalities or component damage caused by failure to comply with the relevant regulations are not within the scope of product quality assurance.

● Our company will not bear any legal responsibility for personal safety accidents and property losses caused by non-compliance with the contents of this chapter and illegal operation of products.

Note for safety levels

Danger	The sign refers to "To result in death or serious injury".
Alarm	The sign refers to "The most probably to result in death or serious injury".
Attention	The sign refers to "The most probably to result in injury or damage to property".

Note for safety precautions

Unpacking acceptance
Alarm
● Do not install if product and the accessories are found while unpacking with damage, rust, trace of use,etc. ● Do not install if there is any water inside product, or missing part, or damanged part. ● Please check the packing list carefully. If the packing list does not match product name, do not install!
Attention
● Before unpacking, check if outer package of the device is intact, damaged, soaked, damp, or deformed. ● Please open the package in order. Do not knock it hard! ● Before unpacking, please check the surface of the equipment and accessories for damage, rust or damage. ● After unpacking, please check if quantity and information of equipment and accessories are complete in accordance with the packing list.
Storage and transport

Alarm

- Be sure to use professional lifting equipment and have qualified personnel operate large/heavy products. Otherwise, there is the risk of injury or product damage!
- Before lifting the product vertically, ensure that the front cover, terminal block and other components of product are firmly secured with screws. Otherwise, components might fall off, that results in personal injury or product damage.
- When the product is being lifted by lifting equipment, it is forbidden to stand or stay under the product.
- When lifting the product with wire rope, please lift it at a steady and uniform speed, prevent products from vibration or impact; Do not turn products over, nor make products in lifting state for a long time, or there is the risk of personal injury or product damage!

Attention

- While moving the product, be sure to handle it gently and always pay attention to any object under feet to prevent tripping or falling, or it may result in personal injury or product damage!
- When handling the product manually, be sure to grasp product shell firmly to avoid any component falling, or it might result in personal injury!
- Please store and transport in strict accordance with the required storage and transportation conditions of product, or there is a risk of product damage.
- Avoid storage and transportation in such places as water splashing and rain falling, direct sunlight, strong electric field, strong magnetic field, and strong vibration.
- Avoid product storage time above 3 months, if the period was too long, please take more stringent protection and necessary inspection.
- Please strictly package the product prior to vehicle transportation; For long distance transportation, it must use the enclosed cargo van.
- It's strictly prohibited to transport this product together with equipment or articles that may affect or damage this product.

Installation

Danger

- Operators must obtain electrical knowledge and have been trained on electrical equipment. Non-professional personnel are strictly prohibited for any operation!

Alarm

- Please read the user's manual and safety precautions carefully prior to installation!
- Do not install this product in places in strong electric field or with strong electromagnetic wave interference!
- Before installation, please make sure that the mechanical strength of installation positions is sufficient to support device weight. Otherwise, it might casue mechanical hazards.
- Do not wear loose clothing or accessories during installation, otherwise there might be a risk of electric shock!
- When installing the product in the enclosed environment (e.g., cabinet or chassis), please use the

cooling device (e.g., cooling fan or cooling AC.) to cool the product sufficiently in order to meet the environment requirement on installation. Otherwise, it might cause product overheart or even a fire.

- It's strictly prohibited to modify this product!
- It's strictly forbidden to screw the fixing bolts and red marked bolts of parts and components of product!
- When the product is installed in a cabinet or terminal equipment which shall be provided with fire protection shell, electrical protection shell and mechanical protection shell. The protection level shall comply with relevant IEC standards and local rules and regulations.
- When it's necessary to install the equipment with strong electromagnetic interference such as transformer, please install shielding protection device to avoid misoperation of this product!
- Please install the product on flame-retardant metal, do not make flammable substances contact the product or attach flammable substances to the product, otherwise there might be a risk of fire.

Attention

- During installation, please cover the top of product with cloth or paper to prevent foreign articles, such as scrap metal, oil and water, from entering the product that could result in Errors. After operation, please remove the cover to avoid blocking the ventilation and affecting heat radiation, that results in abnormal heating of product.
- Resonance may occur when a machine at a constant speed runs at variable speeds. Here, it can effectively weaken the resonance to mount the anti-vibration rubber under motor frame or to utilize vibration suppression function.

Wiring

Danger

- It's strictly prohibited for non-professional personnel to perform equipment installation, wiring, maintenance, inspection or part replacement!
- Before wiring, please power off all devices. As the power-off devices have built-in capacitors which have residual voltage, please wait at least the period specified in the Alarm label before wiring. Measure DC voltage of main loop and confirm that it's under the safe voltage, otherwise there is a risk of electric shock.
- Please perform wiring operation, remove the cover of product, or touch circuit board when it powers off. Otherwise, there is a risk of electric shock.
- Please ensure that devices and products are properly grounded; Otherwise, electric shocks might occur.

Alarm

- It's strictly prohibited to connect the input power to output of device or product; Otherwise, device might be damaged or even it starts a fire.
- When drive is connected to the motor, please ensure that the phase sequence of product and motor terminals are accurate and consistent so as to avoid reversing motor rotation.
- Cables used for wiring must meet the requirement on diameters and shielding, correspondingly. Shielding layer of shielded cables shall be reliably grounded at single end.
- Tighten terminal screws according to tightening torque specified in the manual. Insufficient or excessive tightening torque may cause overheating or damage to the connection, and even start a fire.

- After wiring operation ends, ensure that all cables are properly connected and no screw, gasket or exposed wire are found inside the product. Otherwise, there might be a risk of electric shock or product damage.

Attention

- To avoid damage to the equipment or built-in circuit of product, follow the steps specified in ESD preventive measures and wear a wrist strap to handle wiring operation.
- For wiring of control loop, use double-stranded shielding cables to connect the shielding layer to grounding terminal of the product. Otherwise, it might cause abnormal actions of the product.

Power-on

Danger

- Before power-on, please make sure that the product is installed properly, the wiring is firm, and the motor is allowed to re-start.
- Before power-on, please make sure that power supply meets the product requirement to avoid product damage or starting a fire.
- It is strictly forbidden to open cabinet doors or protective cover plates of product, to touch any terminal of product, to disassemble any device or component of product in the power-on state. Otherwise, there is a risk of electric shock!

Alarm

- After wiring and parameter setting ends, please do a test run to ensure that the machine can operate safely. Otherwise, it might result in human injury or device damage.
- Before power-on, please make sure that the rated voltage of product is consistent with power supply voltage. If power supply voltage used was incorrect, there is a risk of fire.
- Before power-on, please make sure that no one is around the product, motor or motor. Otherwise, it might result in personal injury or death.

Operation

Danger

- It is strictly forbidden for non-professional personnel to operate the product, otherwise it might lead to personal injury or death!
- It is strictly forbidden to touch any terminal of the equipment, to disassemble any device or component of the equipment and product during operation, otherwise there is a risk of electric shock!

Alarm

- Do not touch the device shell, fan or resistor to test the temperature, otherwise it may cause burns!
- During operation, prvent other articles or metal objects from falling into the equipment, otherwise it might start a fire or cause product damage!

Maintenance

Danger
● It's strictly prohibited for non-professional personnel to perform equipment installation, wiring, maintenance, inspection or part replacement! ● It is strictly prohibited to perform equipment maintenance in the power-on state, otherwise there is the risk of electric shock! ● After powering off all the equipment, wait at least the period specified on the Alarm label before maintenance. ● When using a motor, even if the product is powered off, induced voltage can be generated on motor terminals during motor rotation. Do not touch any terminal of motors, otherwise there may be a risk of electric shock.
Alarm
● Please perform daily and routine check and maintenance of the equipment and products according to the maintenance requirement, and make the maintenance records.
Repair
Danger
● It's strictly prohibited for non-professional personnel to perform equipment installation, wiring, maintenance, inspection or part replacement! ● It is strictly prohibited to perform maintenance in power-on state, otherwise there is a risk of electric shock! ● After powering off all devices, please wait at least the period specified in the Alarm label before checking or maintaining.
Alarm
● Please repair the equipment according to the product warranty. ● When fuse burn-out, circuit breaker trip or ELCB trip, wait at least the period specified on the Alarm label before powering on or operating the machine. Otherwise, it may cause personal injury or equipment damage. ● When the equipment is Errory or damaged, it is necessary for professional to troubleshoot and repair the equipment and products according to the maintenance guidance, and make a repair record. ● Please replace in accordance with the instructions for replacing consumable parts. ● Do not use the machine damaged, otherwise it might cause casualties or further damage to products. ● After replacing the device, be sure to check the wiring and set parameters again.
Scrap
Alarm
● Please scrap the equipment and products in accordance with the relevant national regulations and standards to avoid property losses or human casualties! ● Scrapped equipment and products should be recycled in accordance with industrial waste treatment

standards to avoid environmental pollution.

Chapter 1 Model selection and installation

1.1 Model Definition

1.1.1 Model Definition for Servo Drives

SV35 21 - E R 5R5 T 1 - S G HP

① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩

① Product series SV35:SV35 series servo drive	⑤ Rated current Single/3-phase 220V: 1R6:1.6A; 2R8:2.8A; 5R5:5.5A; 7R6:7.6A 3-phase 220V: 012:12A; 014:14A; 018:18A*1; 022:22A*1; 027:27A*1 3-phase 380V: 5R4:5.4A; 8R4:8.4A; 012:11.9A; 017:16.5A; 021:20.8A; 026:26A; 030:30A	⑦ Product Form 1：Single axis drive 2：2 axis drive ……
② Voltage level 20: Single phase 220V 21: Single/3-phase 220V 23: 3-phase 220V 43: 3-phase 380V		⑧ Safety function Blank: Standard model S: Safe torque Off (STO) *2
③ Communication method P: Pulse E:EtherCAT C:CANopen F:Profinet R:RS485		⑨ Custom function Blank: Standard model C: Full closed-loop function G: Gantry function
④ Suitable motor type R:Rotary motor	⑥ Encoder Communication Protocol T:tamagawa	⑩ Customized functions Blank: Standard model HP：High Protection

Note *1: 014, 018, 022, 027 models are coming soon.

*2: STO is not supported for CANopen and RS485

1.1.2 Model Definition for Motors

SM32 13 - H S 85B 15C - N H 1 B 1 -

① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩ ⑪ ⑫ ⑬

① Product series SM32:SM32 series motor SM33:SM33 series motor	⑥ Rated speed /rpm B:×10 C:×100 Example: 15C:1500rpm	⑪ Oil seal 0: Without oil seal 1: With oil seal
② Flange size 13:130mm flange 18:180mm flange	⑦ Encoder type M:17bit absolute value of single turn N:17bit absolute value of multiple turns P:23bit absolute value of multiple turns	⑫ Heat dissipation method Blank: natural heat dissipation F:Wind-cooling heat dissipation W:Water-cooling heat dissipation
③ Class of inertia A:Low inertia M:Medium inertia H:High inertia	⑧ Interface type C:Lead wire H:Aviation plug connector T:Connector type S:Screw terminal block	⑬ Customized functions Blank: Standard model
④ Voltage level S:AC220V T:AC380V	⑨ Keyway type 0: Round 1:Key way	……
⑤ Rated power /W B:×10 C:×100 Example: 85B:850W	⑩ Holding brake N: Without holding brake B: With holding brake	

1.1.3 Model Definition for Cable

SL 33 20 - M 1 1 F H - 030

① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

① Product type SL:Servo cable	② Application servo series 30: SV3 series 33: SV33 series 35: SV35 series	③ Version 20:20 Version	
④ Cable type M:Power cable B:Integrated cable for power and brake	⑤ Driver terminal type 1:U/V/W terminal I type, PE terminal O type 2:All terminal I type 3:U/V/W terminal U type, PE terminal O type	⑥ Cable specification 1: Cable current level 1 (0.5mm^2) 2: Cable current level 2 (0.75mm^2) 3: Cable current level 3 (1.5mm^2) 4: Cable current level 4 (2mm^2) 5: Cable current level 5 (12AWG) 6: Cable current level 6 (10AWG)	⑦ Motor terminal type C: 130 flange without brake aviation plug (4-pole aviation plug YD28K4TSL) D: 130 flange with brake aviation plug (7-hole aviation plug YD28K7TSL) E: 180 flange aviation plug (4-hole aviation plug YD32K4TSL) F: Facing forward connector (SC-MC6S-AP20-00) G: Facing backward connector (SC-MC6S-AP20-00)
E:Encoder cable	1:1394-10P 2:1394-6P	1：Incremental 2 ： Multi-turn (with battery connector) 3 ： Multi-turn (with battery box)	B: 130/180 flange aviation plug (7-hole aviation plug YD28K7TSLA) C: Facing forward connector (SC-MC7S-A620-10) D: Facing backward connector (SC-MC7S-A620-10)
H:Independent brake cable	2:All terminal U type	2: Cable current level 2 (0.75mm^2)	B: 180 flange brake aviation plug (4-pole aviation plug XS16K4TM)
G:Gantry	1:1394-10P	6: Cable (26AWG)	1:1394-10P
⑧ Cable flexibility B:Ordinary H:High Flexible	⑨ Length 003:0.3m 030:3m 100:10m	……	

1.2 Selection Table

Servo Motor				Servo Drive		
Flange	Output (kW)	Motor without brake	Motor with brake	Voltage	Size	Drive Model
SM33 Series（n_N=3000rpm，n_{max}=6000rpm）						
40	0.1	SM3304-HS10B30C-□T1N0	SM3304-HS10B30C-□T1B0	Single/3-phase 220V	A	1R6
60	0.2	SM3306-HS20B30C-□T1N1	SM3306-HS20B30C-□T1B1	Single/3-phase 220V	A	1R6
60	0.4	SM3306-HS40B30C-□T1N1	SM3306-HS40B30C-□T1B1	Single/3-phase 220V	A	2R8
80	0.75	SM3308-HS75B30C-□T1N1	SM3308-HS75B30C-□T1B1	Single/3-phase 220V	B	5R5
80	1.0	SM3308-HS10C30C-□T1N1	SM3308-HS10C30C-□T1B1	Single/3-phase 220V	C	7R6
SM32 Series（n_N=2000rpm，n_{max}=3000rpm）						
130	1.0	SM3213-MS10C20C-□H1N1	SM3213-MS10C20C-□H1B1	Single/3-phase 220V	C	7R6
130	1.5	SM3213-MS15C20C-□H1N1	SM3213-MS15C20C-□H1B1	Single/3-phase 220V	C	012
130	2.0	SM3213-MS20C20C-□H1N1	SM3213-MS20C20C-□H1B1	Single/3-phase 220V	C	014
130	3.0	SM3213-MS30C20C-□H1N1	SM3213-MS30C20C-□H1B1	Single/3-phase 220V	D	018
130	1.0	SM3213-MT10C20C-□H1N1	SM3213-MT10C20C-□H1B1	3-phase 380V	C	5R4
130	1.5	SM3213-MT15C20C-□H1N1	SM3213-MT15C20C-□H1B1	3-phase 380V	C	5R4
130	2.0	SM3213-MT20C20C-□H1N1	SM3213-MT20C20C-□H1B1	3-phase 380V	C	8R4
130	3.0	SM3213-MT30C20C-□H1N1	SM3213-MT30C20C-□H1B1	3-phase 380V	C	012
SM32 Series（n_N=1500rpm，n_{max}=3000rpm）						
130	0.85	SM3213-HS85B15C-□H1N1	SM3213-HS85B15C-□H1B1	Single/3-phase 220V	C	7R6
130	1.3	SM3213-HS13C15C-□H1N1	SM3213-HS13C15C-□H1B1	Single/3-phase 220V	C	012
130	1.8	SM3213-HS18C15C-□H1N1	SM3213-HS18C15C-□H1B1	Single/3-phase 220V	C	014
130	2.2	SM3213-HS22C15C-□H1N1	SM3213-HT22C15C-□H1B1	Single/3-phase 220V	C	014
130	0.85	SM3213-HT85B15C-□H1N1	SM3213-HT85B15C-□H1B1	3-phase 380V	C	5R4
130	1.3	SM3213-HT13C15C-□H1N1	SM3213-HT13C15C-□H1B1	3-phase 380V	C	8R4
130	1.8	SM3213-HT18C15C-□H1N1	SM3213-HT18C15C-□H1B1	3-phase 380V	C	012
130	2.2	SM3213-HT22C15C-□H1N1	SM3213-HT22C15C-□H1B1	3-phase 380V	C	012
180	2.9	SM3218-HT29C15C-□H1N1	SM3218-HT29C15C-□H1B1	3-phase 380V	C	012
180	4.4	SM3218-HT44C15C-□H1N1	SM3218-HT44C15C-□H1B1	3-phase 380V	D	017
180	5.5	SM3218-HT55C15C-□H1N1	SM3218-HT55C15C-□H1B1	3-phase 380V	D	021
180	7.5	SM3218-HT75C15C-□H1N1	SM3218-HT75C15C-□H1B1	3-phase 380V	D	026

1.3 Specifications

1.3.1 Basic Parameters of the Model

Table 1-1 Basic parameters of the model

Item			Description
Basic specification	Control mode		IGBT SVPWM control, sine wave current drive mode. 220V, 380V: single-phase or 3-phase full-wave rectification.
	Environment	Usage/storage temperature *1	0~+40 ℃/-20~+70℃
		Use/store humidity	Less than 90%RH (no condensation)
		Vibration strength	4.9m/s^2
		Impact strength	19.6m/s^2
		Class of protection	IP20
		Class of contamination	Class PD2
		Altitude	The highest altitude is 5,000m. Derating is unnecessary for 1,000m or below; Derating rate is 1% per 100m rise above 1,000m. Please contact the manufacturer in case of altitudes over 2,000m.
Position control Mode	Performance	Feedforward compensation	Support speed feedforward (0~100.0%) setting to eliminate following deviation
		Command shaping	Position instruction low-pass filtering, average filtering
	Frequency division Output	Output pattern	Phase A, Phase B, Phase Z: differential output
		Frequency division range	The motor rotates one circle, and the frequency can be divided into any pulse from 140 to 1,048,576.
Speed /Torque Control mode	Performance	Dynamic characteristics of current loop	Step response: 187.5us(0~100%) Frequency response: -3dB amplitude attenuation bandwidth, 2000Hz(command signal: ±25%) -90° phase shift bandwidth, 3500Hz(command signal: ±25%);
		Speed control range	from 0 to 12000rpm. In case of the requirement over 6000rpm, please contact the manufacturer.
		Dynamic characteristics of speed loop	Step response: 562.5us(0~1000rpm) Frequency response: -3dB amplitude attenuation bandwidth, 1000Hz(command signal: ±500rpm) -90° phase shift bandwidth, 630Hz(command signal: ±500rpm);
		Torque control accuracy	±2%
I/O	Digital input signal		Functions can be configured: forward overrange switch, reverse overrange switch, home switch, etc.
	Digital output signal		Functions can be configured: servo ready, zero speed signal, speed arrival, position arrival, positioning approach signal, torque limit, Alarm, servo Error, etc.
Support function	Electronic gear ratio		Built-in two sets of electronic gear ratio, support gear ratio switching function
	Position limitation		Stop immediately while positive/negative overrange switch operates.

	protection	
	Error detection	Overcurrent, overvoltage, undervoltage, overload, main circuit detection abnormal, radiator overheating, overspeed, encoder abnormal, parameter abnormal, etc.
	Display function	5-digit LED display, power indicator CHARGE
	Vibration suppression	With 4 notch filters, 50Hz~5000Hz, all 4 notch filters can be adaptive setting.
	Ease of use	Self-tuning, speed observer, model tracking
	Debugging interface	MiniUSB
	Other	Status display, alarm logging, JOG running, etc.
⚠ Attention		
Note *1: Install or store servo drives within this temperature range.		

1.3.2 Electrical Parameters of Models

Table 1-3 Electrical specifications of 220V servo drives

Structural dimension	SIZE A		SIZE B	SIZE C			SIZE D		
Model SV35	1R6	2R8	5R5	7R6	012	014	018*1	022*1	027*1
Rated output current Arms	1.6	2.8	5.5	7.6	11.6	14.0	18	22	27
Maximum output current Arms	5.8	10.1	16.9	23.0	32.0	42.0	45.0	55.0	72.0
Rated input current Arms	Single-phase 2.3/ 3-phase 1.4	Single-phase 4.0/ 3-phase 2.6	Single-phase 7.9/ 3-phase 4.4	Single-phase 9.6/ 3-phase 5.6	Single-phase 12.8/ 3-phase 8.0	Single-phase 16.0/ 3-phase 10.2	18.7	20.7	24.4
Main circuit power supply	Single/3-phase AC 200V ~ 240V, -10%～+10%，50/60Hz						3-phase AC 200V ~ 240V, -10%～+10%，50/60Hz		
Power supply of control loop	Single-phase AC200V~240V, -10%~+10%, 50/60Hz								
Regenerative resistance	No built-in regenerative resistance as standard		50Ω/50W	25Ω/80W			20Ω/100W		

⚠ Note:

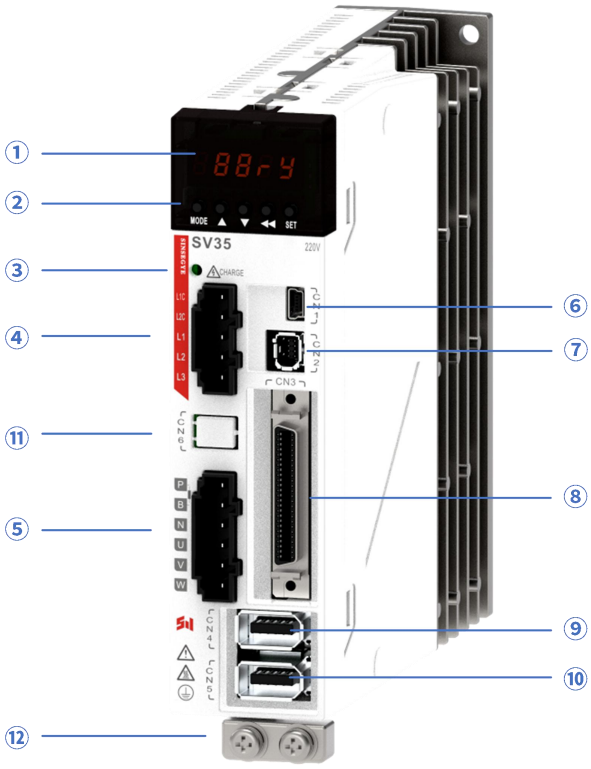
*1: 018/022/027 models are coming soon.

Table 1-4 Electrical specifications of 380V servo drives

Structural dimension	SIZE C			SIZE D			
Model SV35	5R4	8R4	012	017	021	026	030
Rated output current Arms	5.4	8.4	11.9	16.5	20.8	26.0	30.0
Maximum output current Arms	14.0	20.0	29.8	41.3	52.1	65.0	90.0
Rated input current Arms	3.6	6.6	8.0	12.0	16.0	21.0	30.0
Main circuit power supply	3-phase AC380V~440V, -10%~+10%, 50/60Hz						
Power supply of control loop	Single-phase AC380V~440V, -10%~+10%, 50/60Hz						
Regenerative resistance	100Ω/80W	50Ω/80W		35Ω/100W			

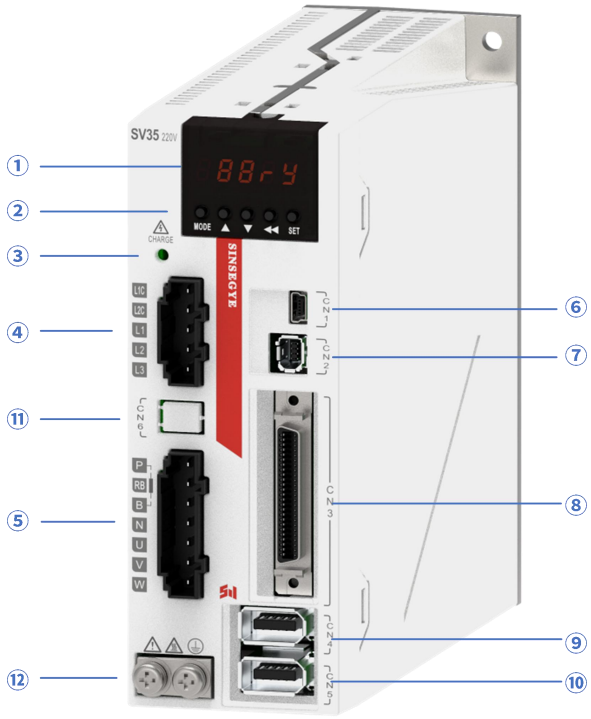
1.4 Description on Components

1.4.1 SIZE A Frame



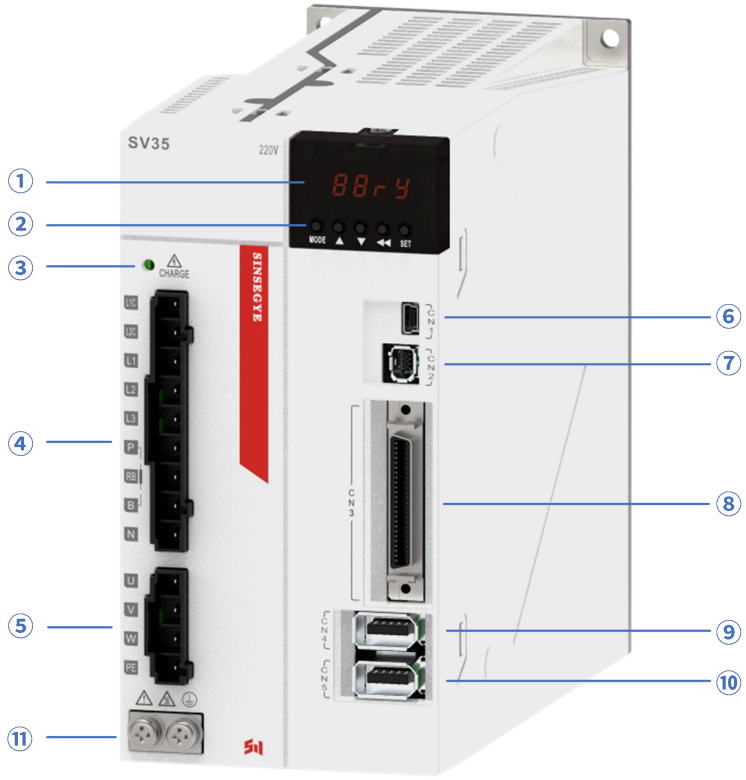
ID	Name	Remarks
①	Nixie tube display	5 digit 7 segment LED digital tube
②	Key-type operator	Operation mode, with settings of functions, parameters and monitoring
③	CHARGE(Bus voltage indicator)	Power indicator light
④	L1C, L2C(Control power input terminal)	Power supply of control loop, connected to single-phase power supply (AC200~240V,50/60Hz power supply)
	L1, L2, L3(Main power input terminal)	Power supply of main loop, connected to single/3-phase power supply (AC200~240V,50/60Hz power supply)
⑤	P/B(Regenerative resistor connection terminal)	P/B are connected to external regenerative resistors
	P/N(common DC bus terminal)	Common DC bus for multiple servos
	U/V/W(servo motor connection terminal)	Servo drive output, connected to motor power connector (U/V/W)
⑥	CN1(Mini USB)	Mini USB connector, connected to PC
⑦	CN2(Connector for safety function)	STO connector, only 'P/E/F' models support this option
⑧	CN3(I/O Connector)	I/O signals are connected to programmable controller (PLC) or control I/O with connectors
⑨	CN4(Encoder connector)	Encoder connector, connected to the encoder on servo motor
⑩	CN5(Fully Closed Loop Encoder Connector)	Fully closed loop connector, connected to th external second encoder. This function is supported by '-*C/*G' models
⑪	CN6(Reserved)	Reserved interface
⑫	Ground screw	Connect to earth wires of power supply and motors

1.4.2 SIZE B Frame



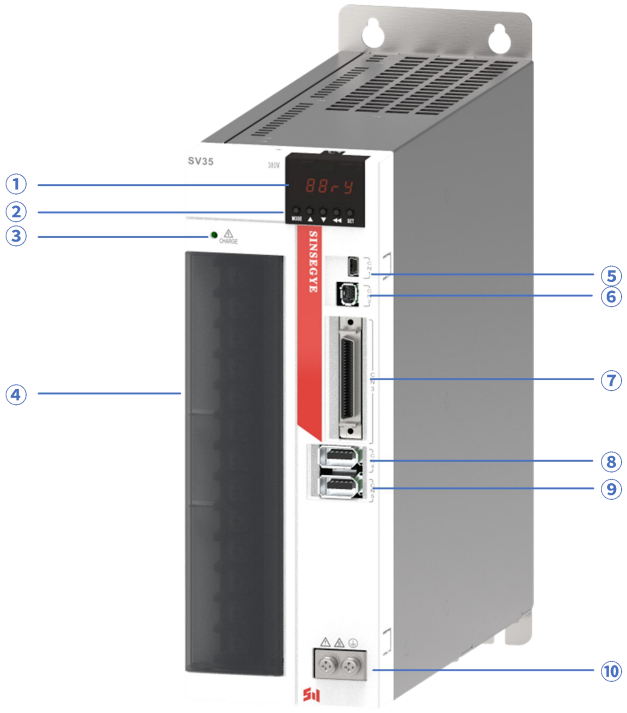
ID	Name	Remarks
①	Nixie tube display	5 digit 7 segment LED digital tube
②	Key-type operator	Operation mode, with settings of functions, parameters and monitoring
③	CHARGE(Bus voltage indicator)	Power indicator light
④	L1C, L2C(Control power input terminal)	Power supply of control loop, connected to single-phase power supply (AC200~240V,50/60Hz power supply)
	L1, L2, L3(Main power input terminal)	Power supply of main loop, connected to single/3-phase power supply (AC200~240V,50/60Hz power supply)
⑤	P, RB, B(Regenerative resistor connection terminal)	Use external regenerative resistor(remove the shorting cap of P and RB; Connect it to both ends of P and B)
	P/N(common DC bus terminal)	Common DC bus for multiple servos
	U/V/W(servo motor connection terminal)	Servo drive output, connected to motor power connector (U/V/W)
⑥	CN1(Mini USB)	Mini USB connector, connected to PC
⑦	CN2(Connector for safety function)	STO connector, only 'P/E/F' models support this option
⑧	CN3(I/O Connector)	I/O signals are connected to programmable controller (PLC) or control I/O with connectors
⑨	CN4(Encoder connector)	Encoder connector, connected to the encoder on servo motor
⑩	CN5(Fully Closed Loop Encoder Connector)	Fully closed loop connector, connected to th external second encoder. This function is supported by '-*C/*G' models
⑪	CN6(Reserved)	Reserved interface
⑫	Ground screw	Connect to earth wires of power supply and motors

1.4.3 SIZE C Frame



ID	Name	Remarks
①	Nixie tube display	5 digit 7 segment LED digital tube
②	Key-type operator	Operation mode, with settings of functions, parameters and monitoring
③	CHARGE(Bus voltage indicator)	Power indicator light
④	L1C, L2C(Control power input terminal)	Control power supply of loop, connect to single phase power supply(depending on model 200~240VAC or 380~440VAC, 50/60Hz power supply)
	L1, L2, L3(Main power input terminal) R/S/T(Main power input terminal)	Main loop power supply, connect to single/three phase power supply(depending on model 200~240VAC or 380~440VAC, 50/60Hz power supply)
	P, RB, B(Regenerative resistor connection terminal)	Use external regenerative resistor(remove the shorting cap of P and RB; Connect it to both ends of P and B)
	P/N(common DC bus terminal)	Common DC bus for multiple servos
⑤	U/V/W/PE(servo motor connection terminal)	Servo drive output, connected to motor power connectors(U/V/W/PE)
⑥	CN1(Mini USB)	Mini USB port, connected to PC
⑦	CN2(Connector for safety function)	STO connector, only 'P/E/F' models support this option
⑧	CN3(I/O Connector)	I/O signals are connected to programmable controller (PLC) or control I/O with connectors
⑨	CN4(Encoder connector)	Encoder connector, connected to the encoder on servo motor
⑩	CN5(Fully Closed Loop Encoder Connector)	Fully closed loop connector, connected to th external second encoder. This function is supported by '-*C/*G' models
⑪	Ground screw	Connect to earth wires of power supply and motors

1.4.4 SIZE D Frame



ID	Name	Remarks
①	Nixie tube display	5 digit 7 segment LED digital tube
②	Key-type operator	Operation mode, with settings of functions, parameters and monitoring
③	CHARGE(Bus voltage indicator)	Power indicator light
④	L1C, L2C(Control power input terminal)	Control power supply of loop, connect to single phase power supply(depending on model 200~240VAC or 380~440VAC, 50/60Hz power supply)
	R/S/T(Main power input terminal)	Main loop power supply, connect to single/three phase power supply(depending on model 200~240VAC or 380~440VAC, 50/60Hz power supply)
	P, RB, B(Regenerative resistor connection terminal)	Use external regenerative resistor(remove the shorting cap of P and RB; Connect it to both ends of P and B)
	P/N1/N2(Common DC bus terminals)	Do not remove the shorting cap between N1 and N2. Connect it between P and N1 for common DC bus of multiple servos
	U/V/W(servo motor connection terminal)	Servo drive output, connected to motor power connector (U/V/W)
⑤	CN1(Mini USB)	Mini USB port, connected to PC
⑥	CN2(Connector for safety function)	STO connector, only 'P/E/F' models support this option
⑦	CN3(I/O Connector)	I/O signals are connected to programmable controller (PLC) or control I/O with connectors
⑧	CN4(Encoder connector)	Encoder connector, connected to the encoder on servo motor
⑨	CN5(Fully Closed Loop Encoder Connector)	Fully closed loop connector, connected to th external second encoder. This function is supported by '-*C/*G' models
⑩	Ground screw	Connect to earth wires of power supply and motors

1.5 Installation of Drives

1.5.1 Installation Site

Table 1-5 Drive installation sites

Please install in an electric control cabinet free from sunshine and rain
Do not use this product in corrosive environment with hydrogen sulfide, chlorine gas, ammonia, sulfur, chlorinated gas, acid, alkali, salt
Do not use this product in the presence of flammable gases or near the combustible
Do not install in an environment with high temperature, humidity, dust, or metal dust
Vibration-free site
Installation site contamination level: PD2

1.5.2 Environmental Conditions

Table 1-6 Environment conditions of drive installation

Item	Description
Operating ambient temperature	0 ~ +40 °C
Ambient humidity	Less than 90%RH (no condensation)
Storage temperature	-20~70°C(non-freezing)
Storage humidity	Less than 90%RH (no condensation)
Vibration	Below 4.9m/s^2
Impulse	Below 19.6m/s^2
Class of protection	IP20 Note: Except Terminal (IP00)
Altitude	The highest altitude is 5,000m. Derating is unnecessary for 1,000m or below; Derating rate is 1% per 100m rise above 1,000m. Please contact the manufacturer in case of altitudes over 2,000m.

1.5.3 Installation Dimensions

1.5.3.1 SIZE A frame

Approx. weight: 0.77kg.

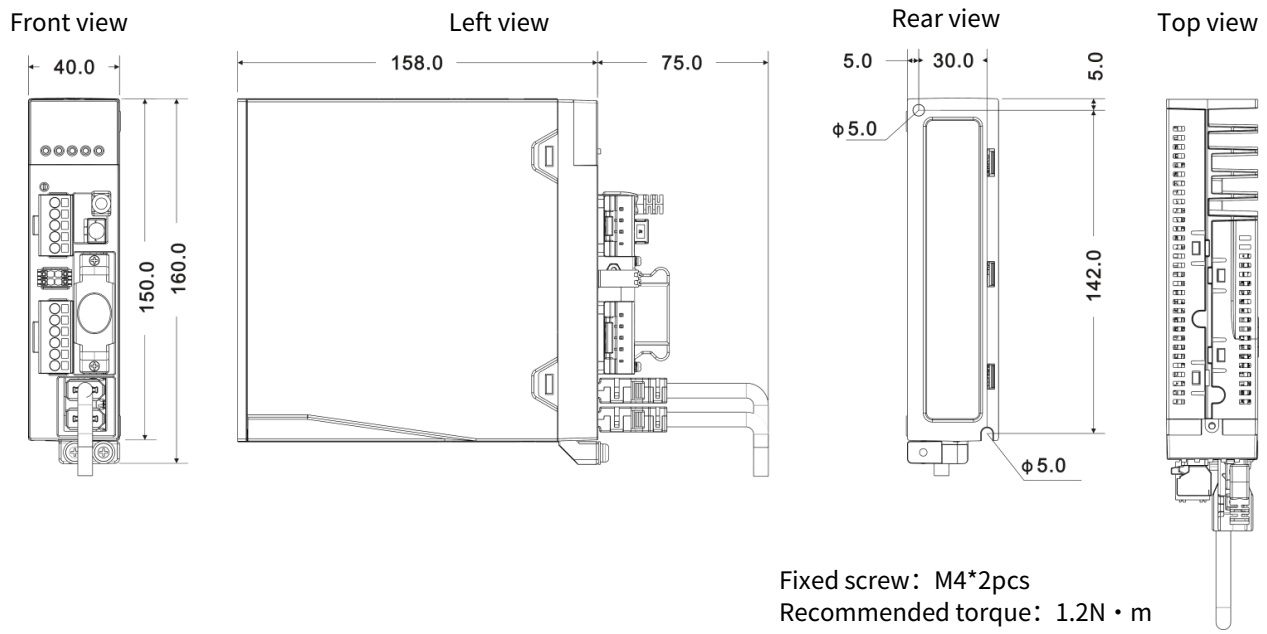


Figure 1-1 Appearance of SV35 SIZE A

1.5.3.2 SIZE B frame

Approx. weight: 1.10kg.

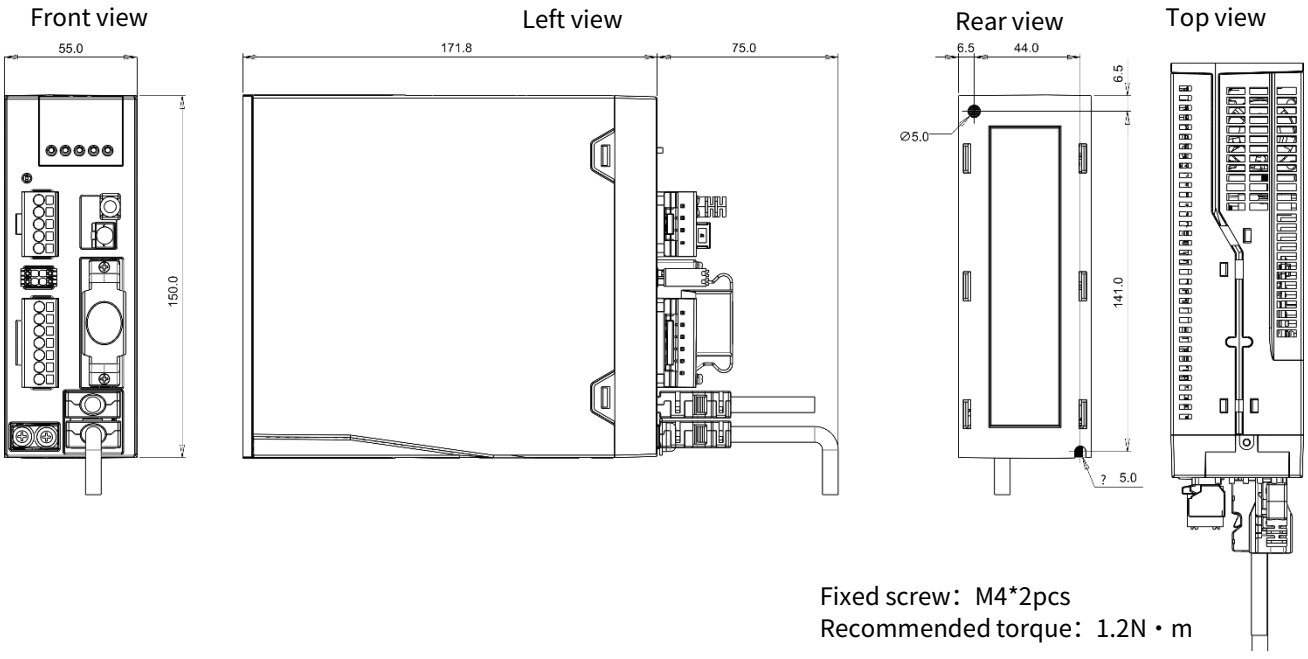
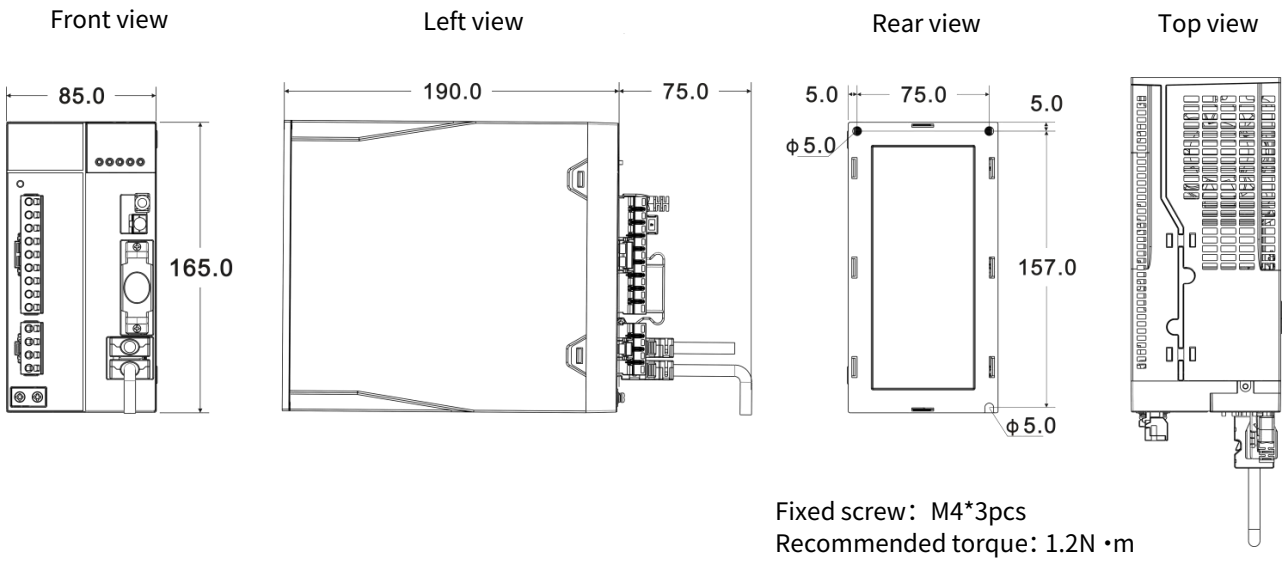


Figure 1-2 Appearance of SV35 SIZE B

1.5.3.3 SIZE C frame

Approx. weight: 1.75kg.

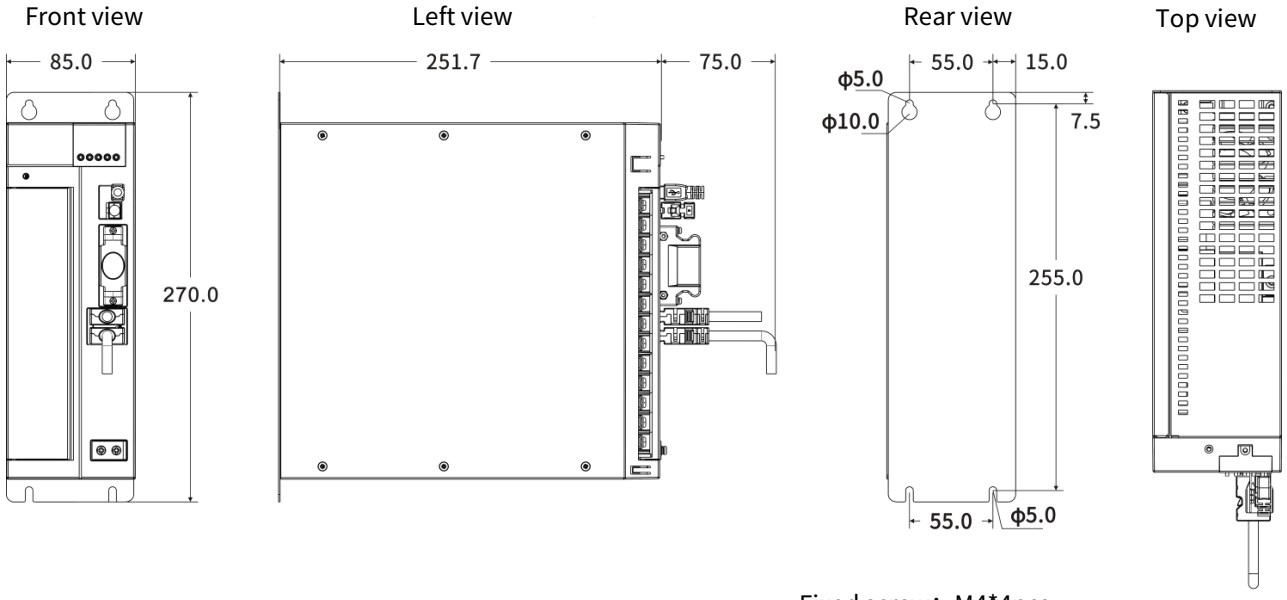


Fixed screw：M4*3pcs
Recommended torque：1.2N·m

Figure 1–3 Appearance of SV35 SIZE C

1.5.3.4 SIZE D frame

Approx. weight: 2.58kg.



Fixed screw：M4*4pcs
Recommended torque：1.2N・m

Figure 1-4 Appearance of SV35 SIZE D

1.5.4 Installation Precautions

Table 1-7 Notes for drive installation

Installation requirements	Ensure that mounting direction is perpendicular to the wall(drive mounting face is 90° from the bottom surface, vertically upward). Use natural convection or fan to cool servo drives. It is firmly fixed on mounting face through mounting holes of servo drive. Screws and torque used for installation see the above figure. While installing, the front of drive faces operational personnel for easy operation and maintenance.
The requirement for heat radiation	To ensure the heat radiation of drives, please design the heat radiation solution of control cabinet according to the following figure. Please install a cooling fan on the top of servo drive to ensure that temperature of servo drive is uniform without local overheat.
Space requirement	For installation with the spacing reserved, it's recommended to leave the transverse spacing more than 10mm on both sides of the drive and the longitudinal spacing more than 50mm on both sides of the drive. For compact installation, it's recommended to leave the transverse spacing more than 1mm on both sides of the drive and the longitudinal spacing more than 50mm on both sides of the drive. Here, please derate the rated load ratio to 75%.

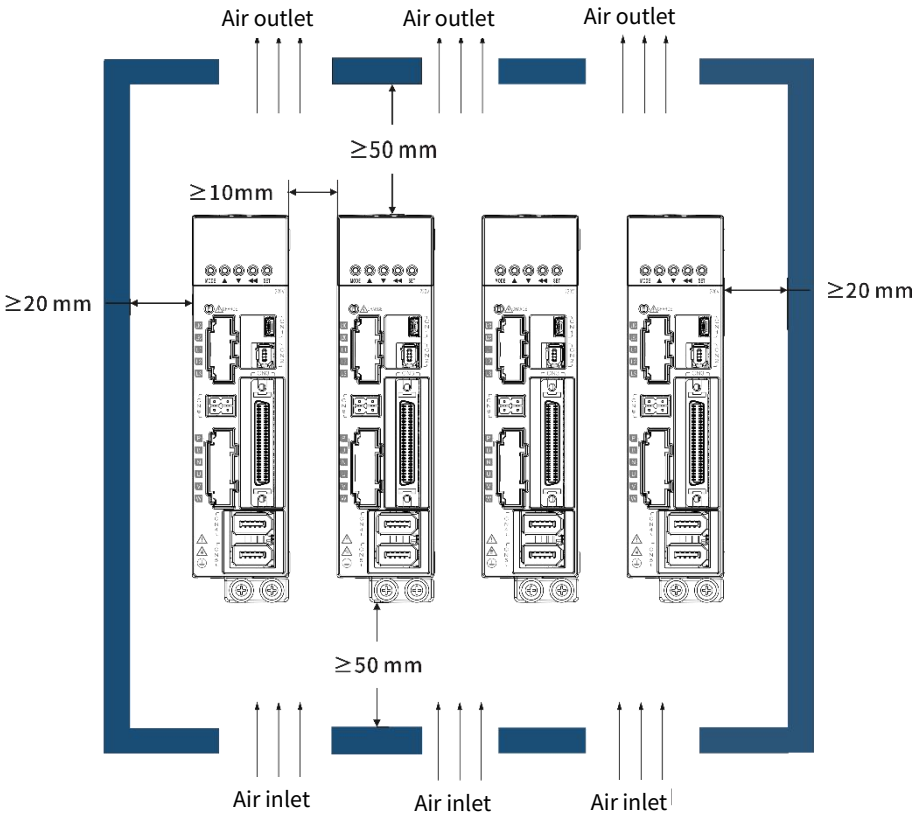


Figure 1-5 Servo drive installation diagram (for the spacing is reserved)

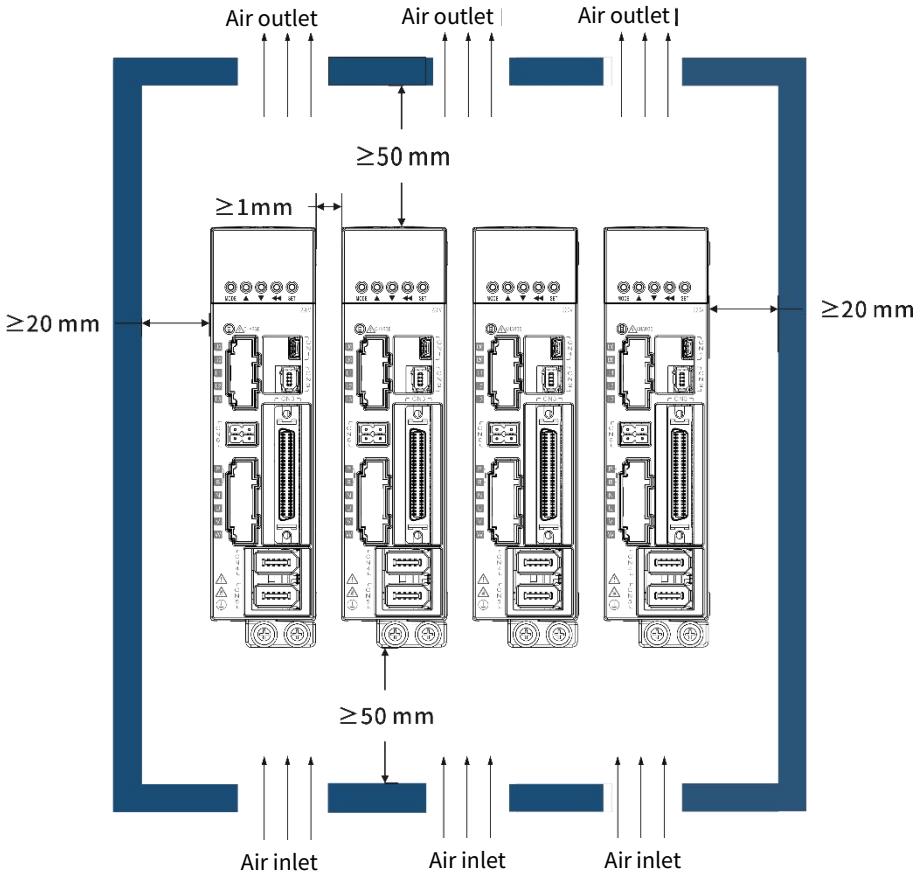


Figure 1-6 Servo drive installation diagram (for compact installation)

1.5.5 Grounding

Please ensure to ground the grounding terminal, otherwise there might be a risk of electric shock or misoperation from intreference.

For details on electrical ground, see 2.9 Grounding and anti-interference Measures.

1.5.6 Wiring Requirements

When connecting cables to the driver, route the cables downward (see the following figure) to prevent any liquid from flowing into drives that might cause damage.

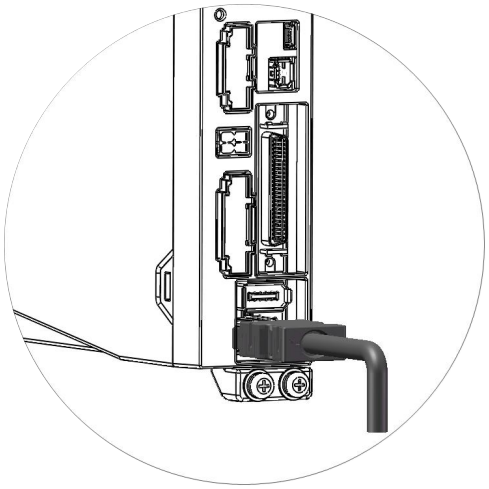


Figure 1-7 Requirement for servo drive routing

1.6 Motor Installation

1.6.1 Installation Site

Table 1-8 Installation site of motors

Please install motors in a room free from rain and direct sunlight.
Do not use this product in corrosive environment with hydrogen sulfide, chlorine gas, ammonia, sulfur, chlorinated gas, acid, alkali, salt,etc.
Do not use this product in the presence of flammable gases or near the combustible.
Places without cutting fluid, oil mist, iron powder, and iron filings.
Places in good ventilation, no moisture or oil or water intrusion, away from furnace and other heat sources.
Vibration-free place.
Place for easy inspection and cleaning.
Do not use a motor in the enclosed environment which will cause high temperature of motor and shorten the service life.

1.6.2 Environment Conditions

Table 1-9 Environmental conditions for motor use

Item	Description	
Operating ambient temperature	0 ~ +40 °C	
Ambient humidity	Less than 90%RH (no condensation)	
Storage temperature	-20~70°C(non-freezing)	
Storage humidity	Less than 90%RH (no condensation)	
Vibration	Only for motor	Below 49 m/s^2 when rotating, below 24.5m/s^2 when stopping
Impulse	Only for motor	Below 98 m/s^2
Class of protection	Connector-type motor	IP67(The cable used is specified, except for connection pins of output shaft rotation, motor connector, encoder connector)
	Leadwire-type motor	IP65(except for connection pins of output shaft rotation, motor connector, encoder connector)
Altitude	The highest altitude is 5,000m. Derating is unnecessary for 1,000m or below; Derating rate is 1% per 100m rise above 1,000m. Please contact the manufacturer in case of altitudes over 2,000m.	

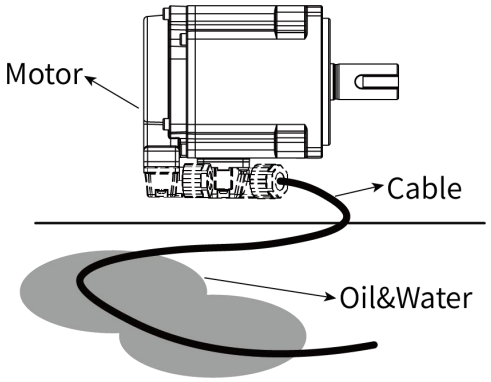
1.6.3 Installation Methods

Motor can be installed vertically or horizontally, but the following requirements must be followed.

Installation mode	Notes
Horizontal installation	Put cable outlet facing down to avoid oil and water infiltration inside motor.
Vertical installation	When a motor with reducer is installed axially, please use the motor with oil seal to avoid reducer oil seeping inside motor.

1.6.4 Protection Countermeasures for Oil and Water

Do not immerse the cable into oil or water, or use the special oil-proof cable
Set the cable outlet downwards.
Do not use in the environment where oil/water often splashes on motor body.
When equipped with a reducer, please use the motor with oil seal so as to avoid the oil seeping from shaft extension into motor.



1.6.5 Cable stress

① Do not stress the lead-in part and connection part of cable due to bending and self-weight.

② Particularly, when move motors and use a trunk cable that can be stored in cable tray, it shall minimize the bending stress of cable.

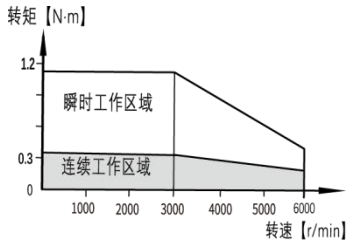
③ Try to increase the bending radius of cable.

1.7 Motor parameters

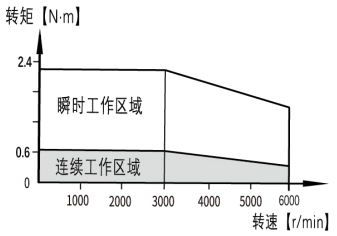
1.7.1 SM33 series

Motor model	SM3304-HS10B3 0C-□T1□0	SM3304-HS20B3 0C-□T1□0	SM3304-HS40B3 0C-□T1□0	SM3304-HS75B3 0C-□T1□0	SM3304-HS10C3 0C-□T1□0
Rated output(W)	100	200	400	750	1000
Rated voltaeg(V)	220	220	220	220	220
Rated current(A)	0.98	1.3	2.6	4.6	6.3
Rated torque(N.m)	0.32	0.64	1.27	2.39	3.18
Momentary Max. peak torque(r/min)	3000	3000	3000	3000	3000
Max. current(A)	3.9	4.4	8.6	16.3	20.9
Momentary Max. peak torque(N.m)	1.12	2.23	4.445	8.36	11.13
Max. rotational speed(r/min)	6000	6000	6000	6000	6000
BEF(V/1000r/min)	20	31.98	34.09	34.4	33.9
Moment coefficient(N.m/A)	0.327	0.492	0.49	0.52	0.505
Phase Resistance(Ω)	13.186	8.286	3.33	0.936	0.638
Q axis inductance(mH)	7.81	9.35	5.09	2.8	2.04
D axis inductance(mH)	5.39	7.8	4.13	2.25	1.675
Electrical time constant(ms)	1.01	2.07	2.77	5.4	11.646
Moment of inertia of rotor(kg.m^{2}X10^{-4})	0.031(0.034)	0.34(0.35)	0.59(0.60)	1.72(1.77)	2.23(2.28)
Weight(kg)	0.36(0.55)	0.8(1.17)	1.14(1.51)	2.15(2.83)	2.59(3.27)
Number of pole pairs	5 poles				
Insulation Class	F				
Protection grade	IP65				
Usage environment	Environmental temperature: -20 ℃ -40 ℃; Environmental humidity: Relative humidity<90% (under non frost conditions)				
Note: () represents the parameters of the motor with holding brake.					

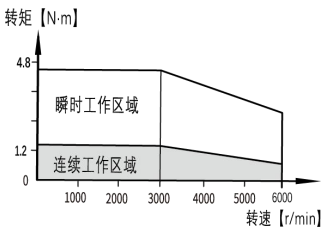
Torque characteristics



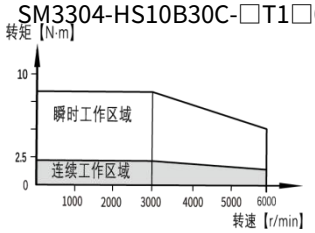
SM3304-HS10B30C-□T1□0



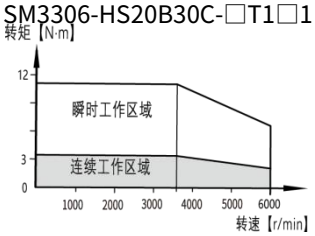
SM3306-HS20B30C-□T1□1



SM3306-HS40B30C-□T1



SM3308-HS75B30C-□T1□1

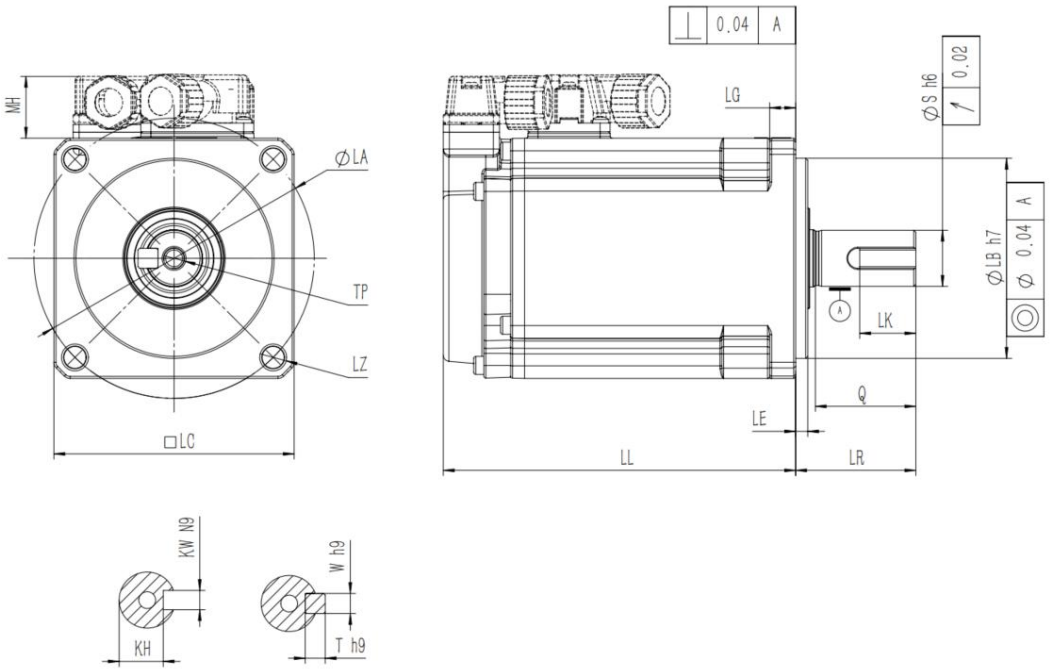


SM3308-HS10C30C-□T1□1

Dimensions

Motor model	LC	LL	LR	LA	LZ	MH	LG	LE
SM3304-HS10B30C-□T1□0	40	73.4(100.1)	25	46	4.3	16.8	5.5	3
SM3306-HS20B30C-□T1□1	60	70.5(99.7)	30	70	5.5	15.8	6.5	3
SM3306-HS40B30C-□T1□1	60	88(117.2)	30	70	5.5	15.8	6.5	3
SM3308-HS75B30C-□T1□1	80	94.4(128.6)	35	90	6.4	15.5	8	3
SM3308-HS10C30C-□T1□1	80	107.9(142.1)	35	90	6.4	15.5	8	3
Note: () represents the parameters of the motor with holding brake.								

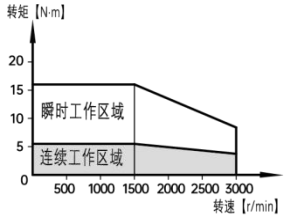
Motor model	Q	LB	S	TP	LK	KH	KW	W	T
SM3304-HS10B30C-□T1□0	20	30	8	M3*7	14	6.2	3	3	3
SM3306-HS20B30C-□T1□1	25.5	50	14	M5*10	14	10.5	5	5	5
SM3306-HS40B30C-□T1□1	25.5	50	14	M5*10	14	10.5	5	5	5
SM3308-HS75B30C-□T1□1	30.2	70	19	M6*12	22	15	6	6	6
SM3308-HS10C30C-□T1□1	30.2	70	19	M6*12	22	15	6	6	6



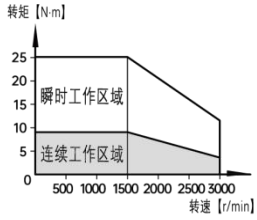
1.7.2 SM3213 series(850W~2kW)

Motor model	SM3213-H□85B15C-□H1□1		SM3213-H□13C15C-□H1□1		SM3213-H□18C15C-□H1□1		SM3213-H□22C15C-□H1□1	
Rated output(W)	850		1300		1800		2200	
Rated voltaeg(V)	220	380	220	380	220	380	220	380
Rated current(A)	6.9	4	10.7	6	13.8	8.5	14.5	11
Rated torque(N.m)	5.39	5.39	8.34	8.34	11.5	11.5	14.3	14.3
Momentary Max. peak torque(r/min)	1500	1500	1500	1500	1500	1500	1500	1500
Max. current(A)	20.7	12	32.1	18	41.4	25.5	40.6	30.7
Momentary Max. peak torque(N.m)	16.17	16.17	25.02	25.02	34.5	34.5	40	40
Max. rotational speed(r/min)	3000	3000	3000	3000	3000	3000	3000	3000
BEF(V/1000r/min)	50	85	52	92	52	90	67	90
Moment coefficient(N.m/A)	0.78	1.35	0.78	1.39	0.83	1.35	0.98	1.3
Phase Resistance(Ω)	0.5	1.3	0.25	0.77	0.175	0.6	0.3	0.425
Q axis inductance(mH)	2.5	8.1	1.6	5.25	1.25	4.15	1.75	2.8
D axis inductance(mH)	2.5	8.1	1.6	5.25	1.25	4.15	1.75	2.8
Electrical time constant(ms)	5	6.2	6.4	6.8	7.14	6.9	5.8	6.5
Moment of inertia of rotor($kg.m^2X10^{-4}$)	10.9 (12.13)		16.9 (18.13)		21.4 (22.63)		27.1 (28.33)	
Weight(kg)	5.7 (7.4)		8.0 (9.1)		9.3 (11.3)		10.5 (12.7)	
Number of pole pairs	5 poles							
Insulation Class	F							
Protection grade	IP65							
Usage environment	Environmental temperature: -20 ℃ -40 ℃; Environmental humidity: Relative humidity<90% (under non frost conditions)							
Note: () represents the parameters of the motor with holding brake.								

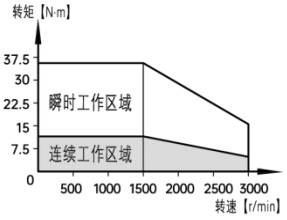
Torque characteristics



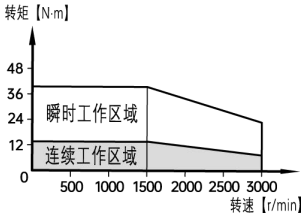
SM3213-H□85B15C-□H1□1



SM3213-H□13C15C-□H1□1



SM3213-H□18C15C-□H1□1



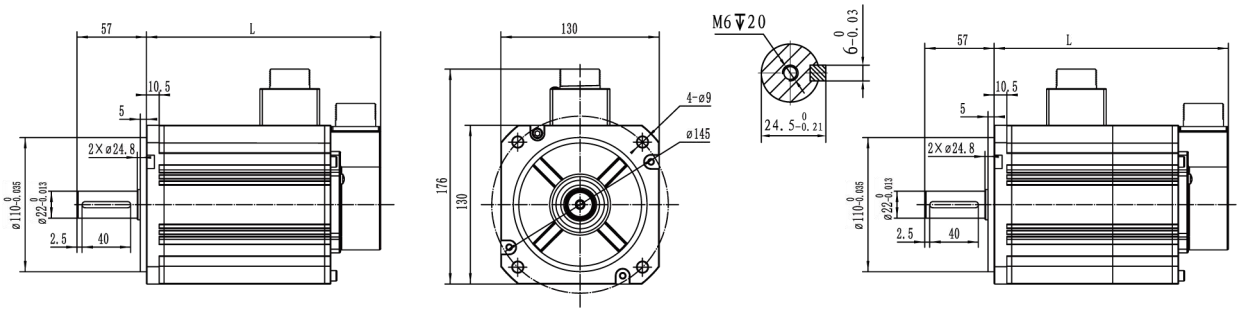
SM3213-H□22C15C-□H1□1

Dimensions

Dimension	850W	1300W	1800W	2200W
L without brake	135	152.5	170	200
L with brake	187	204.5	222	252

<without brake>

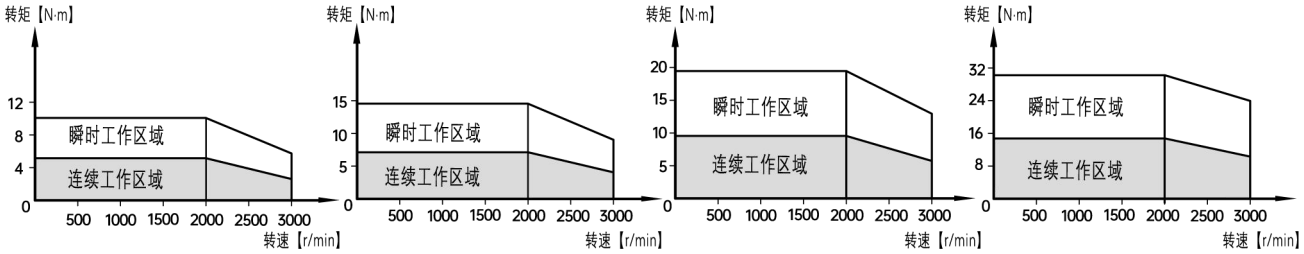
<with brake>



1.7.3 SM3213 series(1~3kW)

Motor model	SM3213-H□10C20C-□H1□1		SM3213-H□15C20C-□H1□1		SM3213-H□20C20C-□H1□1		SM3213-H□30C20C-□H1□1	
Rated output(W)	1000		1500		2000		3000	
Rated voltaeg(V)	220	380	220	380	220	380	220	380
Rated current(A)	5.8	3.5	8.0	4.7	10.2	6.2	16.5	11
Rated torque(N.m)	4.77	4.77	7.16	7.16	9.55	9.55	14.3	14.3
Momentary Max. peak torque(r/min)	2000	2000	2000	2000	2000	2000	2000	2000
Max. current(A)	11.6	7	16.0	9.4	20.4	12.4	33.0	22
Momentary Max. peak torque(N.m)	9.6	9.6	14.32	14.32	19.1	19.1	28.6	28.6
Max. rotational speed(r/min)	3000	3000	3000	3000	3000	3000	3000	3000
BEF(V/1000r/min)	53	89	58.5	98	60	100	55	89
Moment coefficient(N.m/A)	0.82	1.36	0.92	1.52	0.94	1.54	0.87	1.3
Phase Resistance(Ω)	0.425	1.2	0.325	0.92	0.29	0.645	0.15	0.4
Q axis inductance(mH)	6.25	17.75	4.75	14.75	3.75	11.75	1.585	7
D axis inductance(mH)	6.25	17.75	4.75	14.75	3.75	11.75	1.585	7
Electrical time constant(ms)	14.7	10.5	14.6	12	12.9	12.5	10.56	16.09
Moment of inertia of rotor(kg.m^{2}X10^{-4})	6.2 (7.41)		9.16 (10.39)		12.3 (13.33)		18.6 (19.83)	
Weight(kg)	5.4 (7.4)		7.1 (9.1)		8.3 (10.3)		10.7 (12.7)	
Number of pole pairs	5 poles							
Insulation Class	F							
Protection grade	IP65							
Usage environment	Environmental temperature: -20 ℃ -40 ℃; Environmental humidity: Relative humidity<90% (under non frost conditions)							
Note: () represents the parameters of the motor with holding brake.								

Torque characteristics



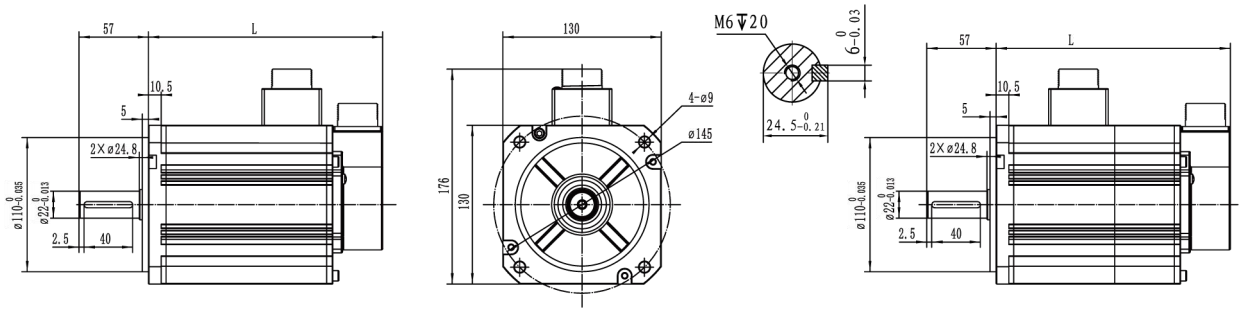
SM3213-H□10C20C-□H1□1 SM3213-H□15C20C-□H1□1 SM3213-H□20C20C-□H1□1 SM3213-H□30C20C-□H1□1

Dimensions

Dimension	1kW	1.5kW	2kW	3kW
L without brake	135	152.5	170	200
L with brake	187	204.5	222	252

<without brake>

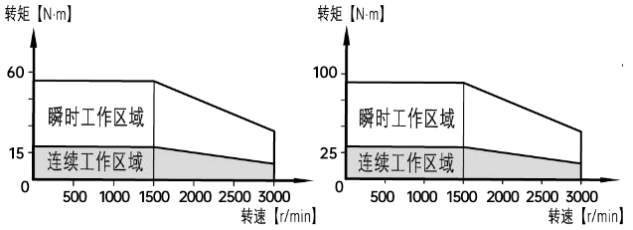
<with brake>



1.7.4 SM3218 series(2.9~4.4kW)

Motor model	SM3318-HT29C15C-□T1□1	SM3318-HT44C15C-□T1□1
Rated output(W)	2.9	4.4
Rated voltaeg(V)	380	380
Rated current(A)	11.9	16.5
Rated torque(N.m)	18.6	28.4
Momentary Max. peak torque(r/min)	1500	1500
Max. current(A)	35.7	49.5
Momentary Max. peak torque(N.m)	55.8	85.2
Max. rotational speed(r/min)	3000	3000
BEF(V/1000r/min)	100	104
Moment coefficient(N.m/A)	1.56	1.72
Phase Resistance(Ω)	0.175	0.155
Q axis inductance(mH)	2.15	1.85
D axis inductance(mH)	2.15	1.85
Electrical time constant(ms)	12.3	11.9
Moment of inertia of rotor(kg.m^{2}X10^{-4})	63.5 (69.5)	88.5 (94.5)
Weight(kg)	16.7 (21.2)	21.1 (25.6)
Number of pole pairs	5 poles	
Insulation Class	F	
Protection grade	IP65	
Usage environment	Environmental temperature: -20 ℃ -40 ℃; Environmental humidity: Relative humidity<90% (under non frost conditions)	
Note: () represents the parameters of the motor with holding brake.		

Torque characteristics

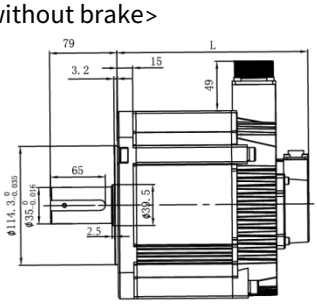


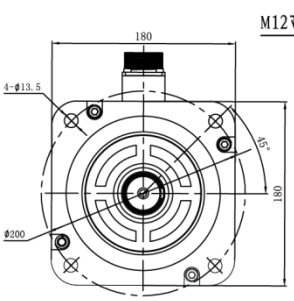
SM3318-HT29C15C-□T1□1 SM3318-HT44C15C-□T1□1

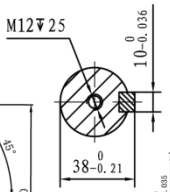
Dimensions

Dimension	2.9KW	4.4KW
L without brake	205	232
L with brake	252	279

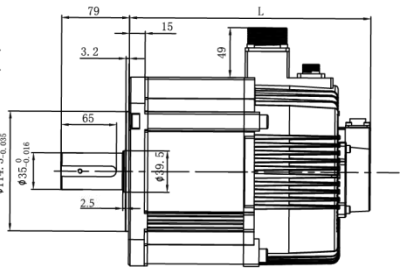
<without brake>







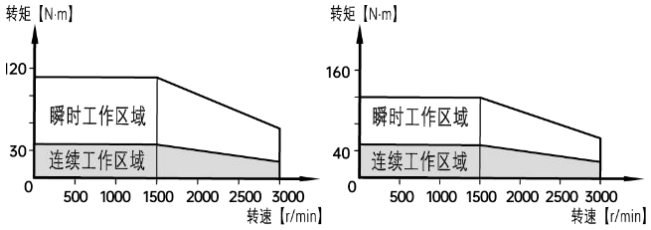
<with brake>



1.7.5 SM3218 series(5.5~7.5kW)

Motor model	SM3318-HT55C15C-□T1□1	SM3318-HT75C15C-□T1□1
Rated output(W)	5.5	7.5
Rated voltaeg(V)	380	380
Rated current(A)	20.8	26
Rated torque(N.m)	35	48
Momentary Max. peak torque(r/min)	1500	1500
Max. current(A)	62.4	65
Momentary Max. peak torque(N.m)	105	120
Max. rotational speed(r/min)	3000	3000
BEF(V/1000r/min)	100	106
Moment coefficient(N.m/A)	1.68	1.85
Phase Resistance(Ω)	0.09	0.095
Q axis inductance(mH)	1.15	1.15
D axis inductance(mH)	1.15	1.15
Electrical time constant(ms)	11.9	12.1
Moment of inertia of rotor(kg.m^{2}X10^{-4})	114.4 (120.4)	136.6 (142.6)
Weight(kg)	25.6 (30.1)	30.8 (35.3)
Number of pole pairs	5 poles	
Insulation Class	F	
Protection grade	IP65	
Usage environment	Environmental temperature: -20 ℃ -40 ℃; Environmental humidity: Relative humidity<90% (under non frost conditions)	
Note: () represents the parameters of the motor with holding brake.		

Torque characteristics

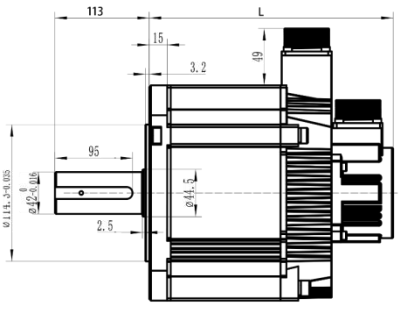


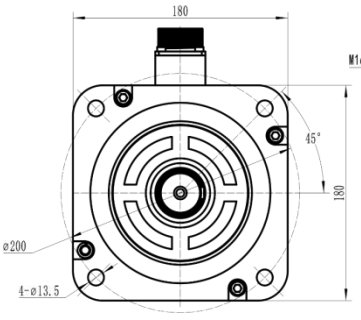
SM3318-HT55C15C-□T1□1 SM3318-HT75C15C-□T1□1

Dimensions

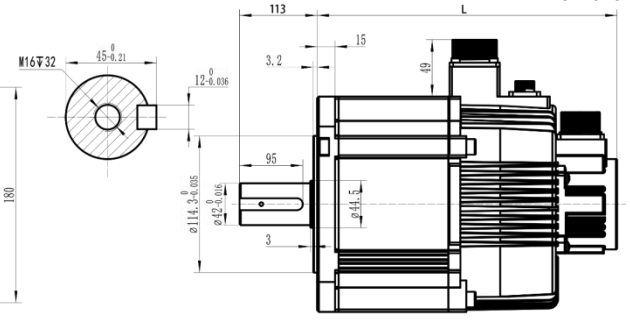
Dimension	5.5KW	7.5KW
L without brake	260	284
L with brake	307	331

<without brake>





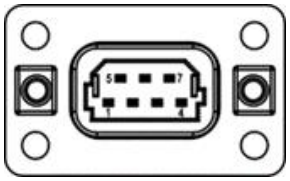
<with brake>



1.8 Definition of motor connector

1.8.1 SM33 series 40/60/80 flange

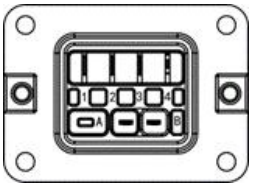
Encoder connector



Definition of motor side

Pin No.	Function
1	PS+
2	PS-
3	BAT+
4	BAT-
5	E5V
6	E0V
7	PE

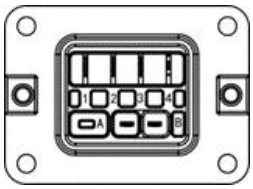
Power connector(Without brake)



Definition of motor side

Pin No.	Function
1	V
2	U
3	W
4	PE

Power connector(Witho brake)

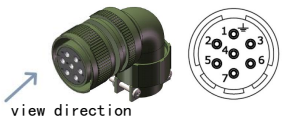


Definition of motor side

Pin No.	Function
1	V
2	U
3	W
4	PE
A	BK+
B	BK-

1.8.2 SM32 series 130 flange

Encoder connector



YDB28K7TSLa

Cable side

Pin No.	Function
1	PE
2	BAT-
3	BAT+
4	PS-
5	E0V
6	PS+
7	E5V

Power connector (Without brake)

YD28K4TSL

Cable side

Pin No.	Function
1	PE
2	U
3	V
4	W

Power connector (With brake)

YD28K7TSL

Cable side

Pin No.	Function
1	PE
2	U
3	V
4	W
5	BK+
6	BK-
7	-

1.8.3 SM32 series 180 flange

Encoder connector

YDB28K7TSLa

Cable side

Pin No.	Function
1	PE
2	BAT-
3	BAT+
4	PS-
5	E0V
6	PS+
7	E5V

Power connector (Without brake)

YD32K4TSL

Cable side

Pin No.	Function
1	PE
2	U
3	V
4	W

Brake connector

XS16K4TM

Cable side

Pin No.	Function
1	BK+
2	BK-
3	-
4	-

1.9 Drag chain installation cable

High-flex rag chain dcable plays an important role in signal, control and power transmission of the equipment. High-flex drag chain cable must be synchronized with other components in carrier. Furthermore, it must take care of installation and protection of high-flex drag chain cable in carrier particularly. Stable and effective use with a long service life depends on accurate installation.

1. Ensure that cable is completely free to move within the bending radius, i.e., the cable can move relative to each other and to guide device without any forced movement. When high-flex cable is routed in carrier, it can neither be too loose, nor too tight: the former might cause cable to bend and twist in carrier so as to affect its service life; The latter might lead in greater friction between the cable and inner wall of carrier so as to cause cable sheath wear and tear, and increase radial force of cable, as well as cable distortion that affects the service life.

Cable fixture must be mounted at both ends of cable carrier, and the fixing point can't be moved; The distance from the end of bending curve to the fixture shall be as large as possible, in general, greater than 20 to 30 times cable diameter.

It's forbidden to fix the high-flex drag chain cable in any moving part of cable carrier, or bundle the cables in cable carrier together, that would hinder the absorption and dispersion capability of cable for bending stress, and would affect the service life.

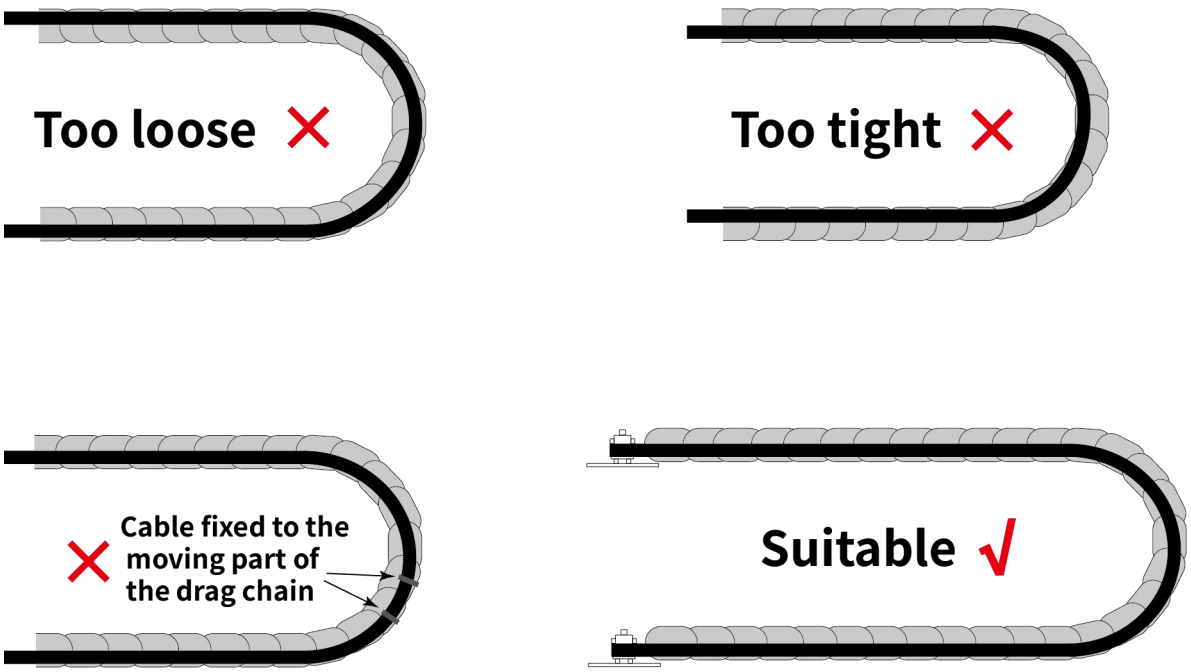


Figure 1-8 Installation status of cables in the drag chain

2. As for wiring of the high-flex cable in carrier, the cable should be laid side by side in the support of carrier as far as possible. There must be a certain gap between two adjacent cables; The gap betwee cables in carrier shall be at least 10% of cable diameter.

Avoid multi-layer routing of cable(i.e., avoid arranging one cable on another without using a spacer). If the space is limited and it need place one cable on another, it must utilize a spacer or shelves!

If there is a large difference in diameter of cables, and the diameter difference of cables is greater than 20% wiring size, it is necessary to utilize a partition between two cables to avoid the play of cables or winding each

other.

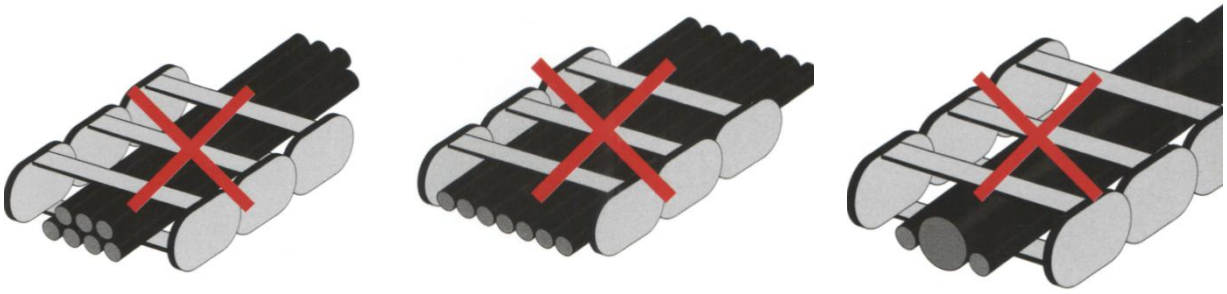
The filling coefficient of cables in carrier should be controlled below 60% (less than 30% is more ideal).

In order to ensure the balance of cable carrier in motion, the weight of the cable distributed on carrier should be as balanced as possible; It's recommended that the heavier cable be located on both sides and the lighter one be located in the middle.

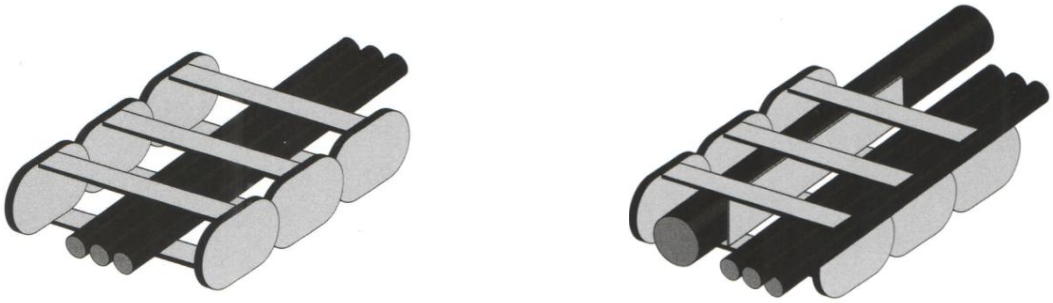
⚠ Note:

A:After a period of operation, periodically check the position of cable; The check must be performed after any push/pull movement; If there is any displacement, it shall be improved and adjusted in time.

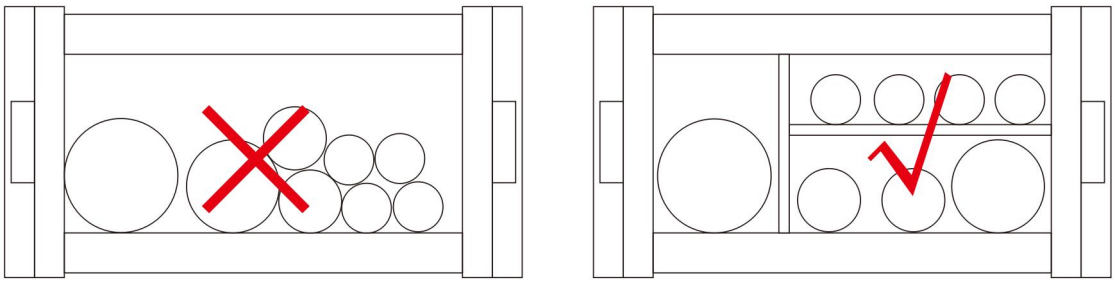
B: For vertically suspended cable carrier, there must be more free space inside the bracket, because the cable will be stretched during operation due to gravity. After a period of operation and use, regularly check the length and position of cable; The check must be performed after any push/pull movement; If there is any displacement, it shall be improved and adjusted in time.



Error Error Error



Right Right



3. If cable carrier is damaged or broken, the cable also needs to be replaced, because damages from excessive stretching can't be prevented or repaired.

4. Bending radius of the flexible cable used in cable carrier should conform to technical parameters in the product specification.

5. After a period of operation, regularly check the position of cable, and often confirm that the cable can follow the carrier movement without any force; The inspection must be performed after push-pull movement; If any displacement or force exists, it shall be improved and adjusted in time.

6. To lay multi-core high-flexible cables with a diameter less than 10mm, it's recommended to use a guide duct.

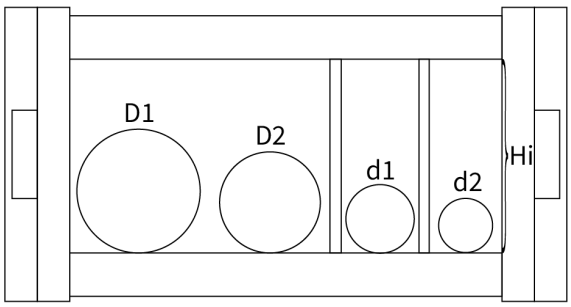
7. For freely moving pipes, guide duct or partition should be mounted.

8. Adjacent cables can't cross over each other, so the gap over cable should not be greater than 50% of the diameter of adjacent cables.

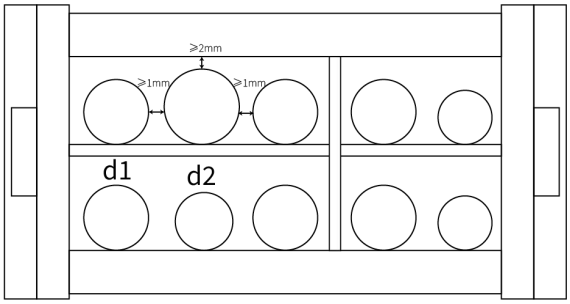
The rules below must be followed:

Rule 1: If D1+D2>1.2 times the inner height of cable carrier, it's unnecessary to separate the two cables. The cables can't cross over or wrap each other (shown as below).

Rule 2: If D1+D2<1.2 times the inner height of cable carrier, separator must be used to reduce the gap (shown as below).



D1+D2＞1.2×Hi　d1+d2≤1.2×Hi



d1+d2≤1.2×Hi

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Chapter 2 Wiring

2.1 Description on System Wiring

2.1.1 SIZE A overall wiring

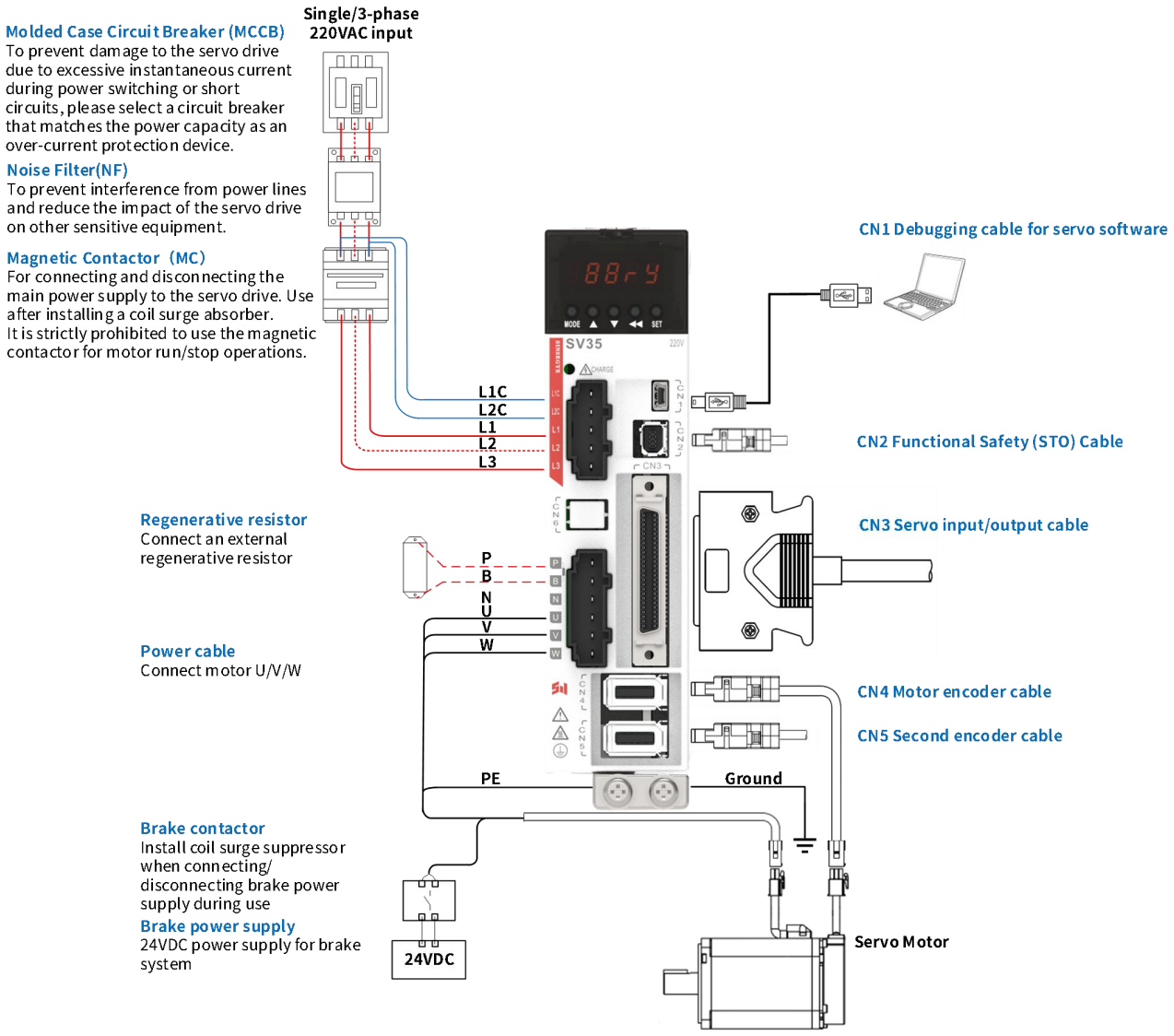


Figure 2-1 SV35 SIZE A wiring diagram

- As for single-phase power input, power supply can be connected to any 2 terminals of L1/L2/L3.
- Please use a circuit breaker with leakage protection and noise filter between power supply and the main power terminal;
- Voltage and power of holding brake power supply should meet the requirement on parameters of motor holding brake.
- SIZE A has no built-in regenerative resistor, in case of the application with external regenerative resistor, please select the appropriate resistance. It can't be less than the allowable minimum external resistance, otherwise it might cause damage to the driver.

2.1.2 SIZE B overall wiring

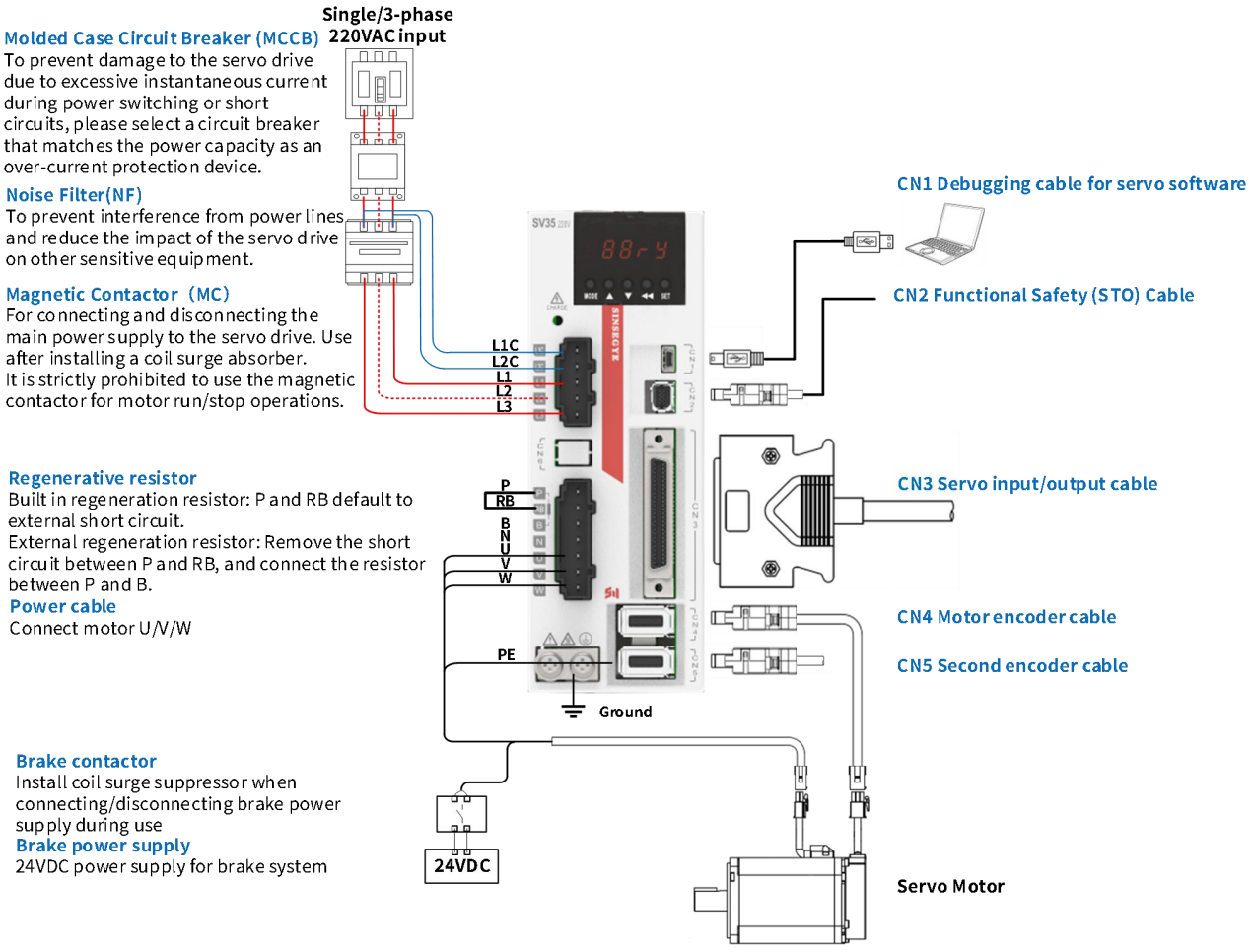


Figure 2-2 SV35 SIZE B wiring diagram

- As for single-phase power input, power supply can be connected to any 2 terminals of L1/L2/L3.
- Please use a circuit breaker with leakage protection and noise filter between power supply and the main power terminal;
- Voltage and power of holding brake power supply should meet the requirement on parameters of motor holding brake.
- SIZE B has the built-in regenerative resistor, in case of the application with external regenerative resistor, please select the appropriate resistance. It can't be less than the allowable minimum external resistance, otherwise it might cause damage to the driver. Remove jumper bar between P and RB, connect it to both ends of P and B.

2.1.3 SIZE C overall wiring

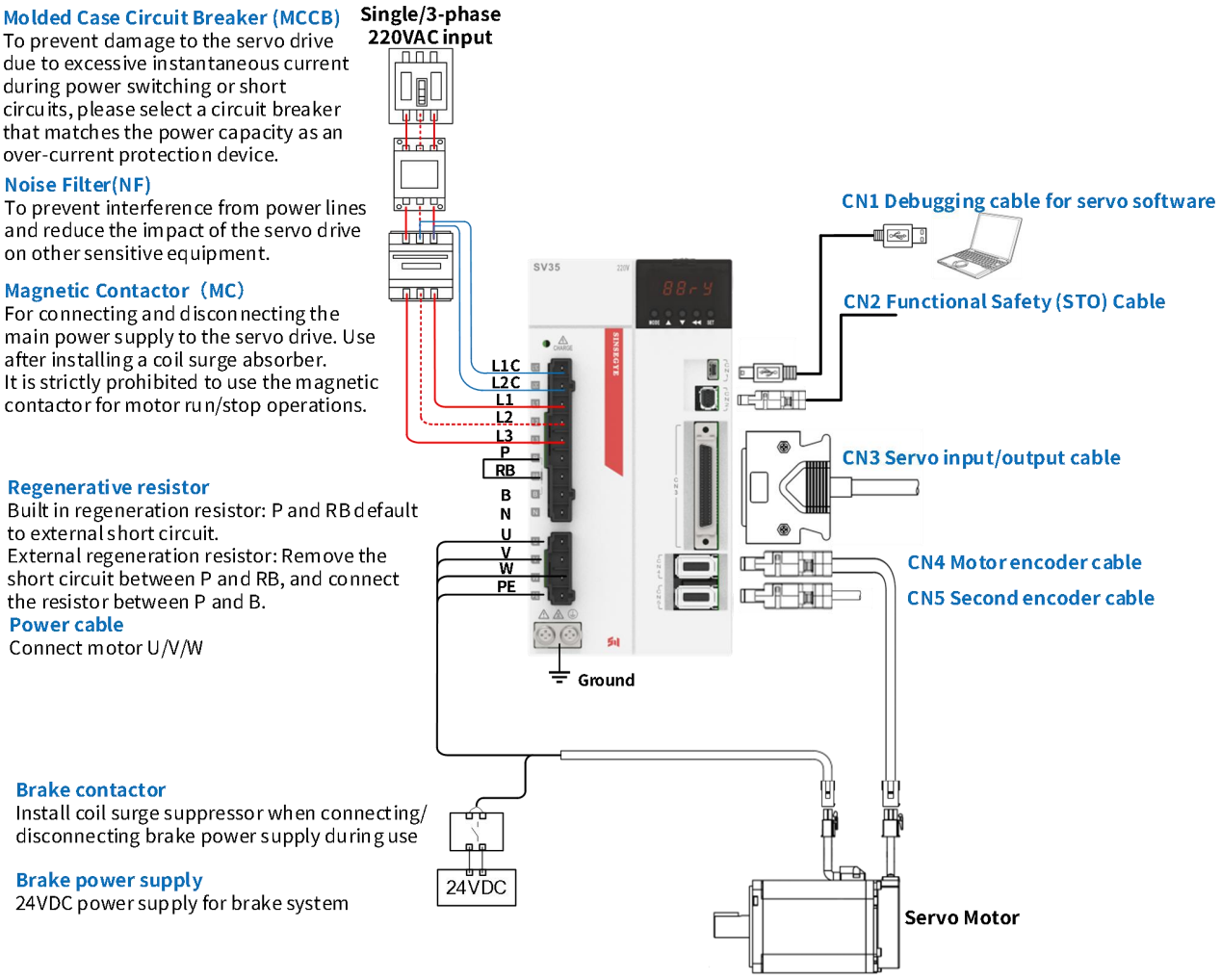


Figure 2-3 SV35 SIZE C system wiring diagram

- SIZE-C has 2 models: 220VAC and 380VAC. Please select the power supply voltage upon the actual model and specification. Wrong power supply may cause drive damage.
- As for single-phase power input, power supply can be connected to any 2 terminals of L1/L2/L3.
- Please use a circuit breaker with leakage protection and noise filter between power supply and the main power terminal;
- Voltage and power of holding brake power supply should meet the requirement on parameters of motor holding brake.
- SIZE C has the built-in regenerative resistor, in case of the application with external regenerative resistor, please select the appropriate resistance. It can't be less than the allowable minimum external resistance, otherwise it might cause damage to the driver. Remove jumper bar between P and RB, connect it to both ends of P and B.

2.1.4 SIZE D overall wiring

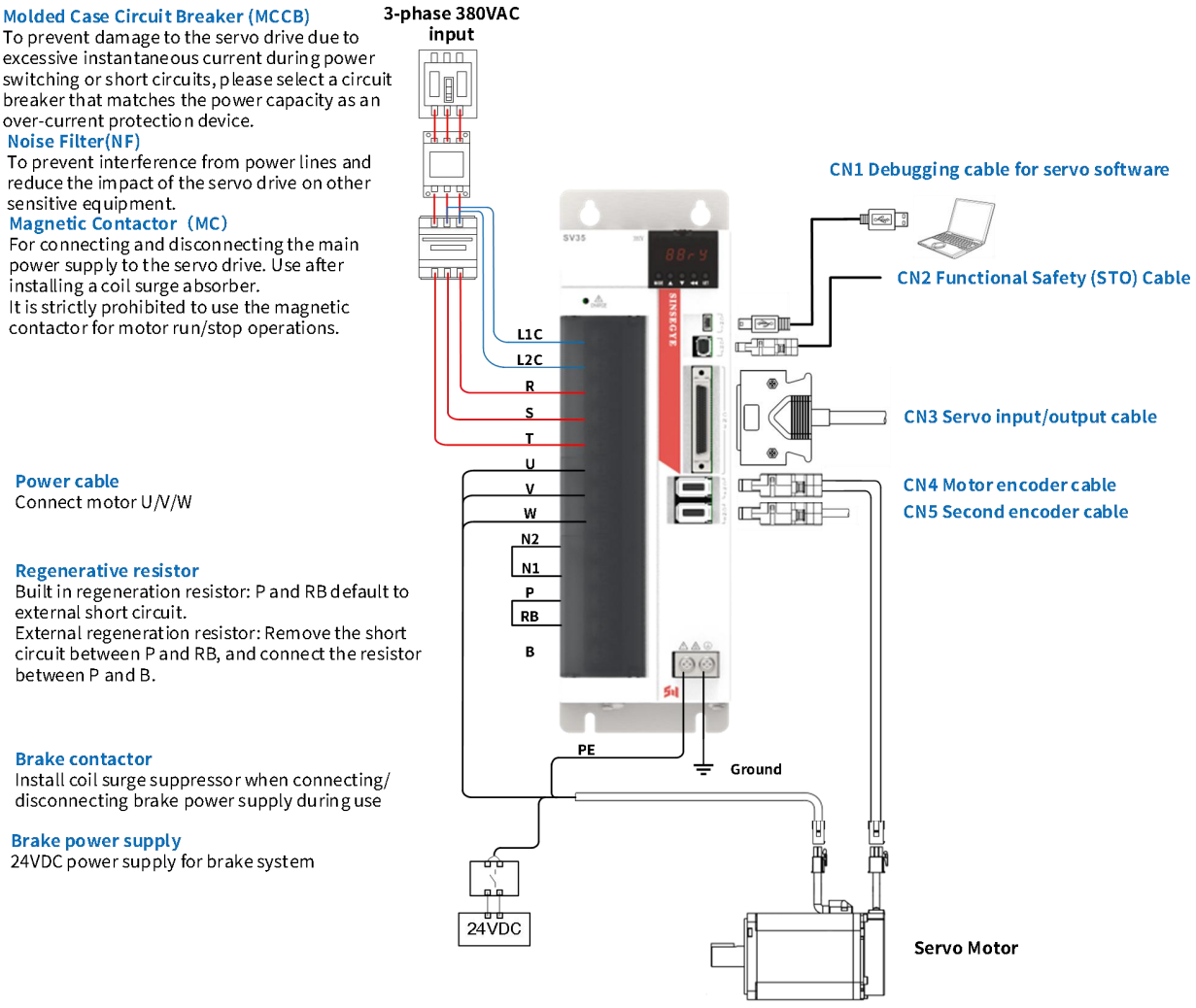


Figure 2-4 SV35 SIZE D wiring diagram

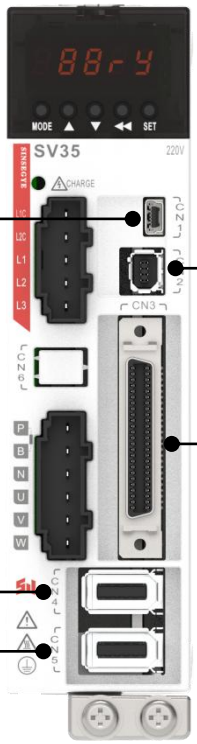
- Please use a circuit breaker with leakage protection and noise filter between power supply and the main power terminal;
- Voltage and power of holding brake power supply should meet the requirement on parameters of motor holding brake.
- SIZE D has the built-in regenerative resistor, in case of the application with external regenerative resistor, please select the appropriate resistance. It can't be less than the allowable minimum external resistance, otherwise it might cause damage to the driver. Remove jumper bar between P and RB, connect it to both ends of P and B.

2.2 Servo Drive Port Definition

CN1	Serial communication port	
	Pin No.	Symbol
MINI USB	1	VBUS
	2	D-
	3	D+
	4	-
	5	GND

CN4	Encoder port	
	Pin No.	Symbol
Recommended model 3M:36210-0100PL	1	5V
	2	GND
	3	-
	4	-
	5	-
	6	-
	7	-
	8	-
	9	SD+
	10	SD-

CN5	Second encoder port	
	Pin No.	Symbol
Recommended model 3M:36210-0100PL	1	5V
	2	GND
	3	SEC_A+
	4	SEC_A-
	5	SEC_B+
	6	SEC_B-
	7	SEC_Z+
	8	SEC_Z-
	9	-
	10	MTR_TEMP



CN2	Security port	
	Pin No.	Symbol
Recommended model TE: 2013595-1	1	Internal power negative
	2	Internal power positive
	3	STO1-
	4	STO1+
	5	STO2-
	6	STO2+
	7	STO_OUT-
	8	STO_OUT+

CN3	I/O signal port			
	Pin No.	Symbol	Pin No.	Symbol
Recommended model SCSI-50P	1	DI1	28	PBO-
	2	DI2	29	PBO+
	3	DI3	30	PAO-
	4	DI_COM	31	PAO+
	5	DI4	32	OCZ
	6	DI5	33	GND
	7	DI6	34	PULSE+
	8	DI7	35	PULSE-
	9	HDI1	36	SIGN+
	10	HDI2	37	SIGN-
	11	DO1-	38	PULLHI
	12	DO1+	39	GND
	13	DO2-	40	HPULSE+
	14	DO2+	41	HPULSE-
	15	DO3-	42	HSIGN+
	16	DO3+	43	HSIGN-
	17	DO4-	44	GND
	18	DO4+	45	AI1
	19	DO5-	46	AI2
	20	DO5+	47	AO2
	26	PZO-	48	AO1
	27	PZO+	49	GND

Figure 2–5 Servo Drive Port Definition

2.3 Definition and wiring description of power terminals

2.3.1 Definition of power supply and motor terminals

Table 2-1 Definition of SIZE A main loop ports

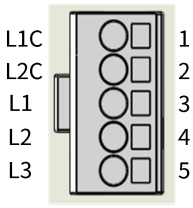
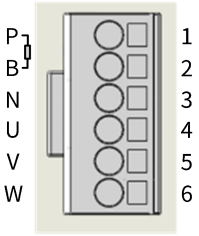
Port classification	Connector	Port No.	Port Code	Port function	Content
Power input		1	L1C	Control power input	Single-phase AC200V ~ 240V, -10 ~ +10%, 50/60Hz
		2	L2C		
		3	L1	Main power input	Single-phase/3-phase AC200V ~ 240V, -10 ~ +10%, 50/60Hz
		4	L2		
		5	L3		
Power output		1	P	Regenerative function and DC bus terminals	When the regeneration function is used, use Port P/B, as detailed in Section 2.5.
		2	B		For common DC bus applications, use P (DC+)/N (DC-) terminals, as described in Section 2.4.
		3	N		
		4	U	Motor drive	Connect U/V/W three phases of the servo motor.
		5	V		
		6	W		

Table 2-2 Definition of SIZE B main loop ports

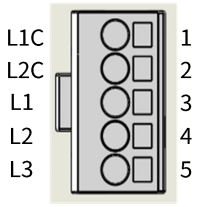
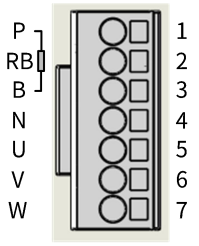
Port classification	Connector	Port No.	Port Code	Port function	Content
Power input		1	L1C	Control power input	Single-phase AC200V ~ 240V, -10 ~ +10%, 50/60Hz
		2	L2C		
		3	L1	Main power input	Single/3-phase AC200V ~ 240V, -10 ~ +10%, 50/60Hz
		4	L2		
		5	L3		
Power output		1	P	Regenerative function and DC bus terminals	When the regeneration function is used, use Port P/RB/B, as detailed in Section 2.5.
		2	RB		
		3	B		For common DC bus applications, use P (DC+)/N (DC-) terminals, as described in Section 2.4.
		4	N		
		5	U	Motor drive	Connect U/V/W three phases of the servo motor.
		6	V		
		7	W		

Table 2-3 Definition of SIZE C main loop ports

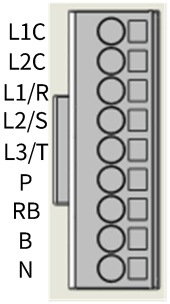
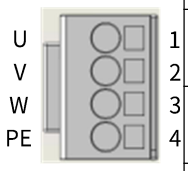
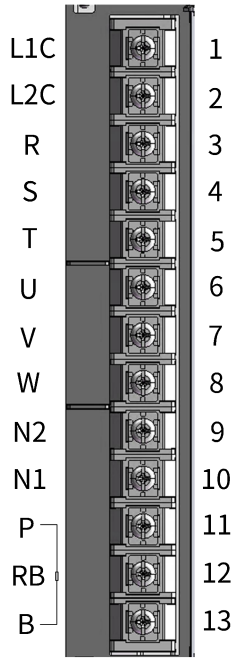
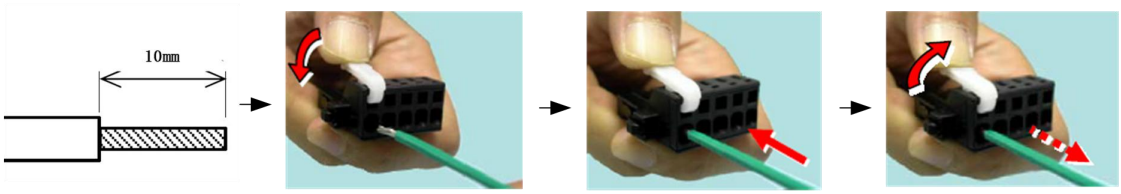
Port classification	Connector	Port No.	Port Code	Port Functions	Content
Power input		1	L1C	Control power supply Input	220V model: single-phase 200V~240VAC, -10 ~ +10%, 50/60Hz 380V model: single-phase 380V~440VAC, -10 ~ +10%, 50/60Hz
		2	L2C		
		3	L1/R	Main power input	220V model: single/3-phase 200V~240VAC, -10 ~ +10%, 50/60Hz 380V model: 3-phase 380V~440VAC, -10 ~ +10%, 50/60Hz
		4	L2/S		
		5	L3/T		
		6	P	Regenerative function and DC bus terminals	When the regeneration function is used, use Port P/RB/B, as detailed in Section 2.5.
		7	RB		
		8	B		For common DC bus applications, use P (DC+)/N (DC-) terminals, as described in Section 2.4.
		9	N		
Power output		1	U	Motor drive	Connect U/V/W three phases and earth PE terminal of servo motor.
		2	V		
		3	W		
		4	PE		

Table 2-4 Definition of SIZE D main loop ports

Connector	Port No.	Port Code	Port function	Remarks
	1	L1C	Control power input	Single-phase 380V~440VAC, -10 ~ +10%, 50/60Hz
	2	L2C		
	3	R	Main power input	3-phase 380V~440VAC, -10 ~ +10%, 50/60Hz
	4	S		
	5	T		
	6	U	Motor drive	Connect U/V/W three phases of the servo motor.
	7	V		
	8	W		
	9	N2	Regeneration function, Common DC bus port, external reactance	When the regeneration function is used, use Port P/RB/B, as detailed in Section 2.5.
	10	N1		For common DC bus applications, use P (DC+)/N2 (DC-) terminals, as described in Section 2.4.
	11	P		
	12	RB		N1/N2 are shorted by deError. It shall suppress high-order harmonics of power supply, remove the short-circuit wire and connect DC reactance between N1 and N2.
	13	B		

2.3.2 Wiring of circlip terminals

Power terminal is circlip connector for quick wiring. During wiring, perform the following process to ensure reliable connection.



Peel off the insulation layer of wires, and the bare wire length is 10mm.

Press operating lever to press down the internal spring.

Insert all bare wires into the connector.

Release operating lever, gently pull the wire, and confirm that the connection is firm, then the wiring is completed.

Figure 2-6 Circlip terminal wiring

2.3.3 Wiring of the Main Circuit

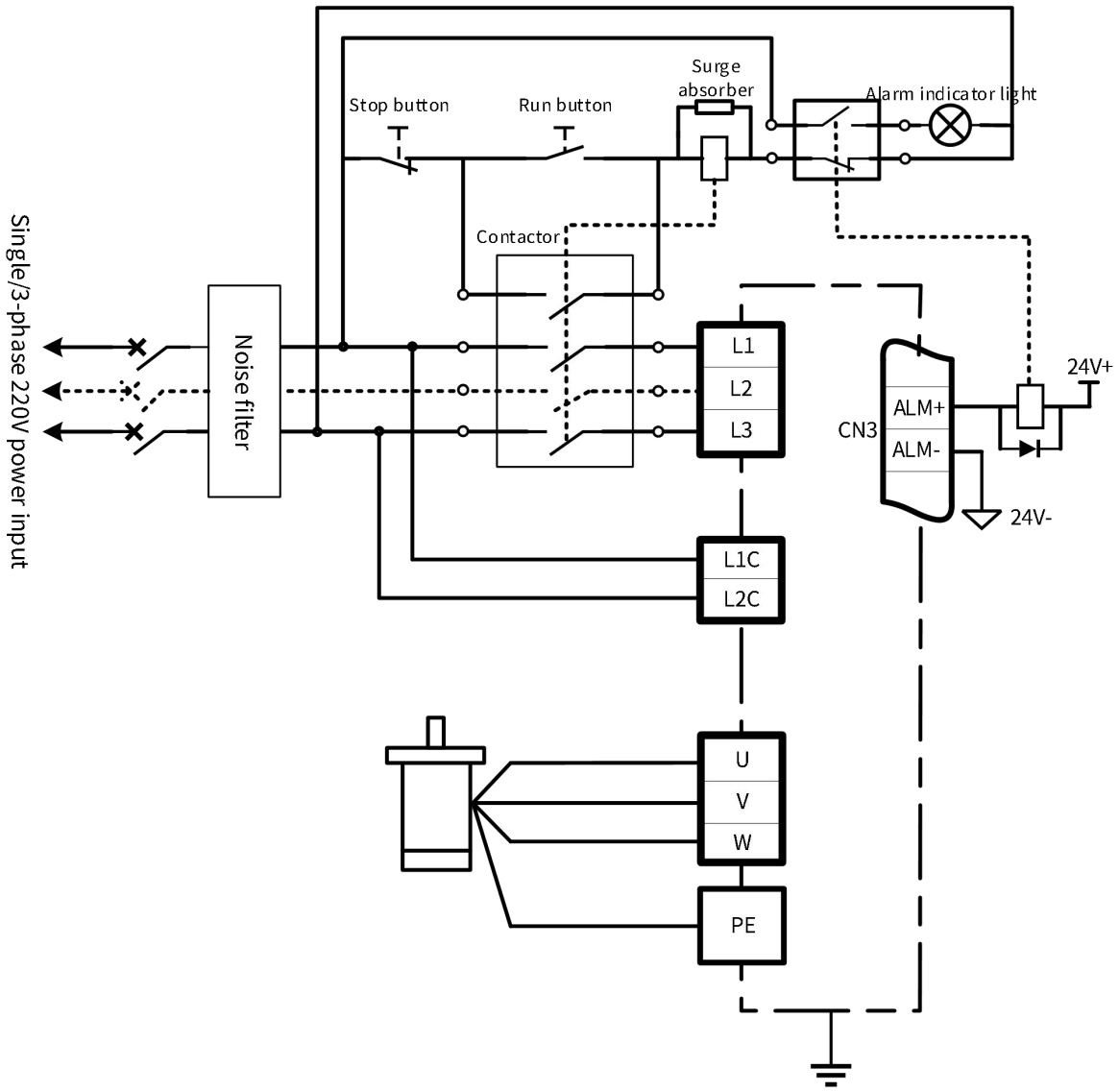


Figure 2-7 SIZE A main circuit wiring

- Do not connect power supply input (L1/L2/L3) to output terminal (U/V/W) for motor;
- Wiring of motor output terminal(U/V/W) is consistent with motor (U/V/W) wiring; The sequence can't be wrong;
- Do not put power cable and signal cable together, and keep a distance more than 30cm.
- Do not switch servo power supply frequently; Otherwise, capacitor will be charged frequently inside the servo, and pre-charging circuit will be overloaded, resulting in performance degradation. Please keep switching frequency below 1 time per minute;
- After the servo is powered off, there might still be residual high voltage inside servo. Only after power-off for 15 minutes and wait until the power indicator is off, can the wiring be executed.

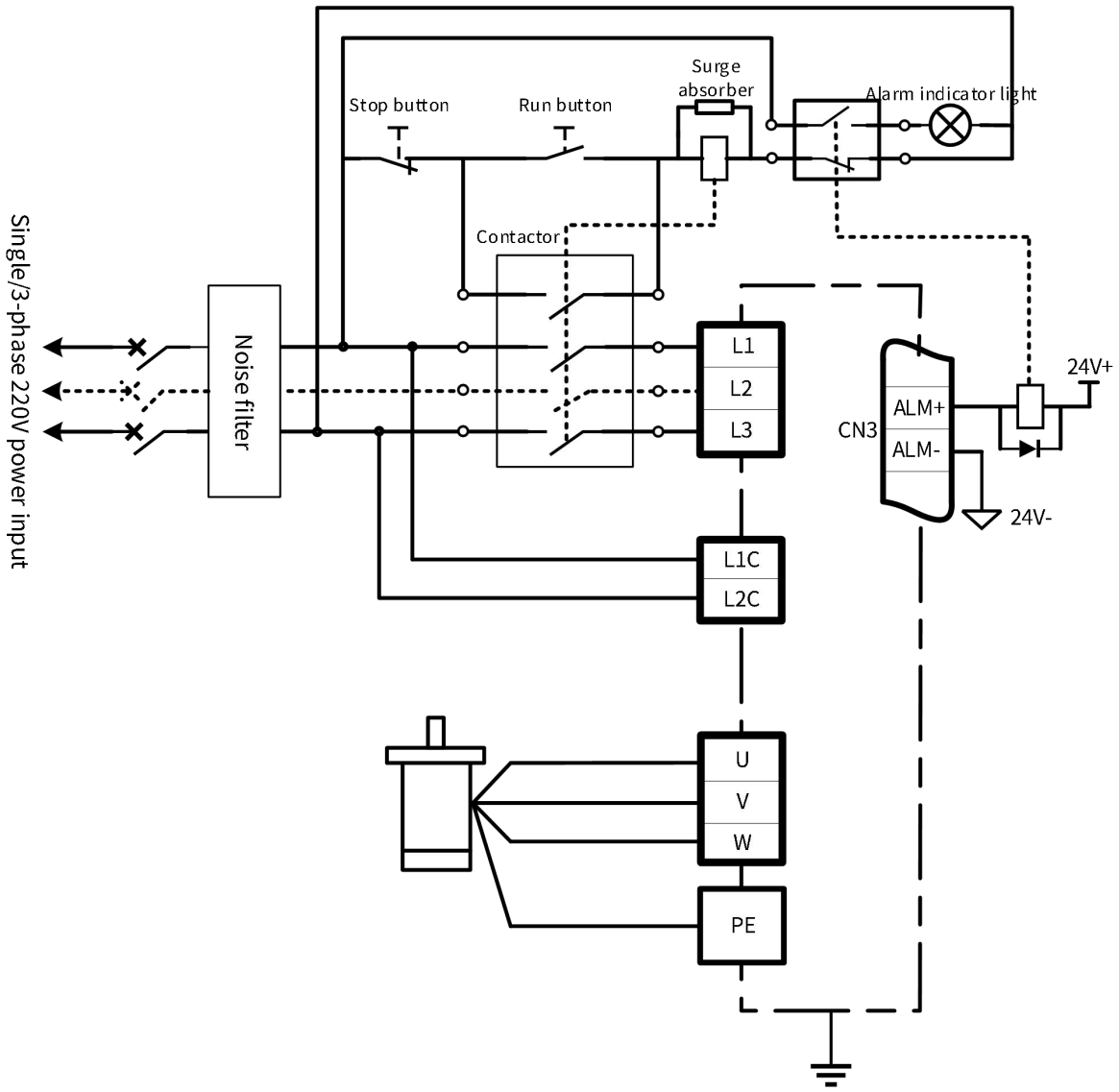


Figure 2-8 SIZE B main circuit wiring

- Do not connect power supply input (L1/L2/L3) to output terminal (U/V/W) for motor;
- Wiring of motor output terminal(U/V/W) is consistent with motor (U/V/W) wiring; The sequence can't be wrong;
- Do not put power cable and signal cable together, and keep a distance more than 30cm.
- Do not switch servo power supply frequently; Otherwise, capacitor will be charged frequently inside the servo, and pre-charging circuit will be overloaded, resulting in performance degradation. Please keep switching frequency below 1 time per minute;
- After the servo is powered off, there might still be residual high voltage inside servo. Only after power-off for 15 minutes and wait until the power indicator is off,can the wiring be executed.

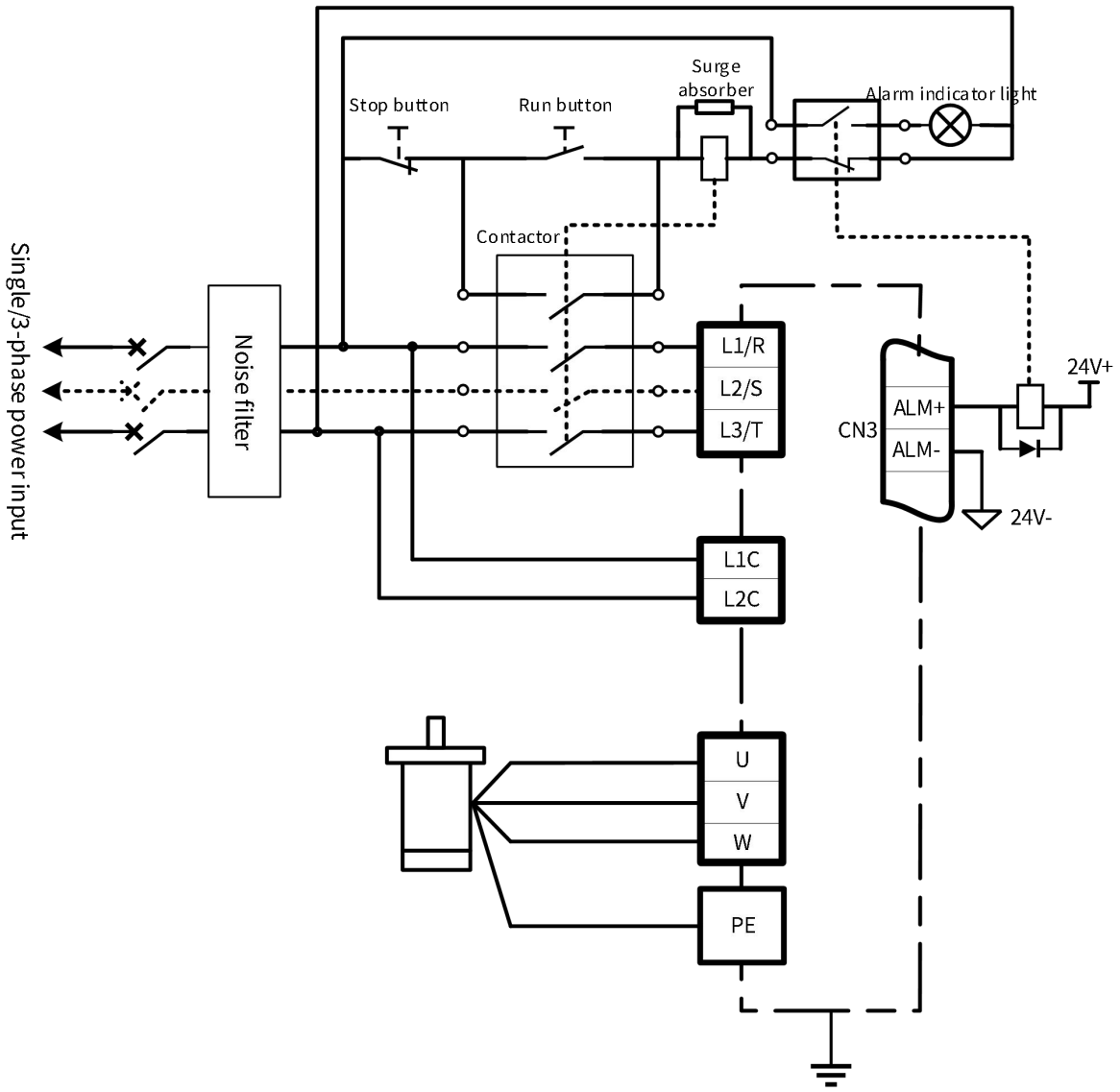


Figure 2-9 SIZE C main circuit wiring

- Do not connect power supply input (L1/R, L2/S, L3/T) to output terminal (U/V/W) of motor;
- Wiring of motor output terminal(U/V/W) is consistent with motor (U/V/W) wiring; The sequence can't be wrong;
- Do not put power cable and signal cable together, and keep a distance more than 30cm.
- Do not switch servo power supply frequently; Otherwise, capacitor will be charged frequently inside the servo, and pre-charging circuit will be overloaded, resulting in performance degradation. Please keep switching frequency below 1 time per minute;
- After the servo is powered off, there might still be residual high voltage inside servo. Only after power-off for 15 minutes and wait until the power indicator is off,can the wiring be executed.

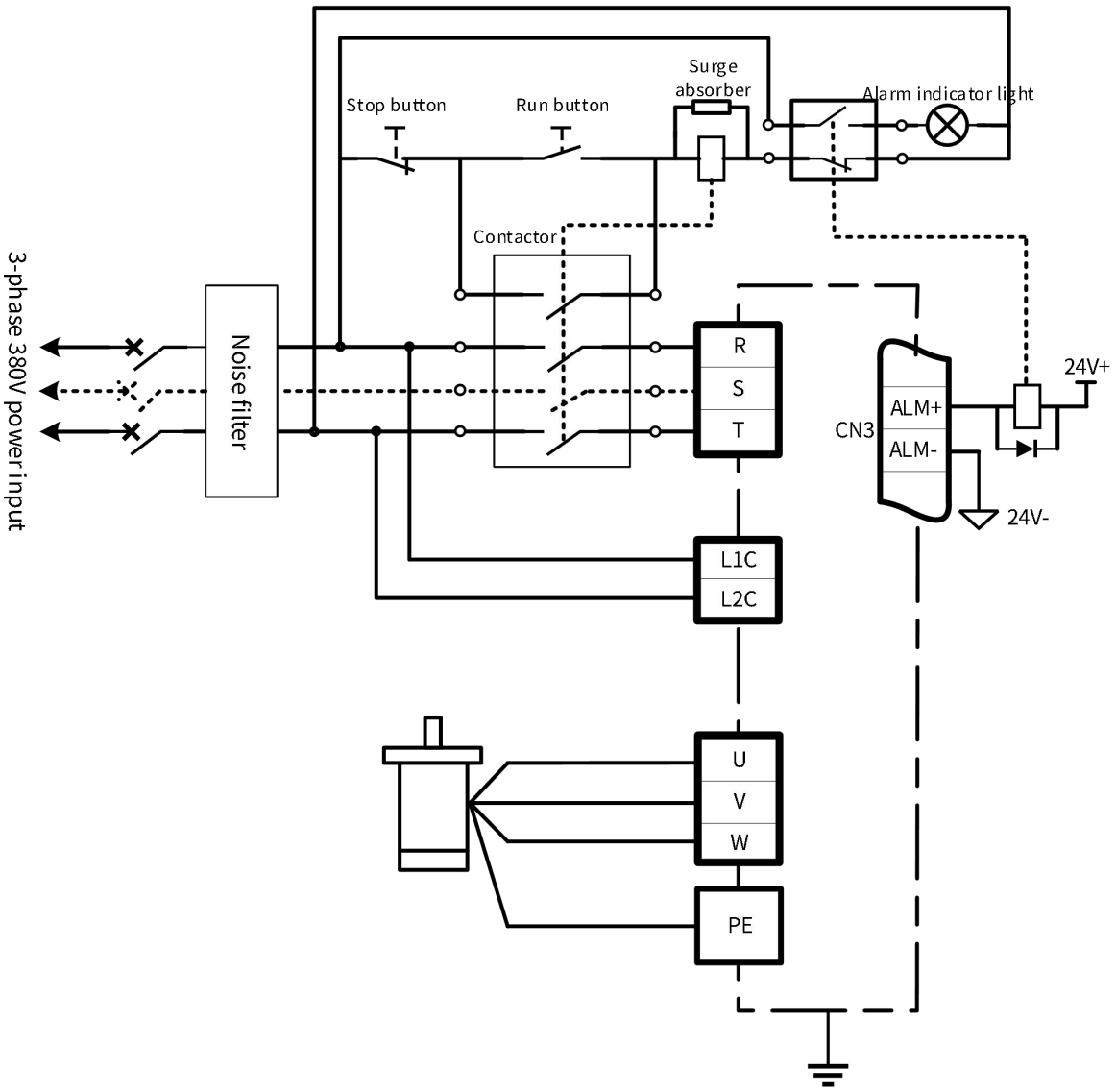


Figure 2-10 SIZE D main circuit wiring

- Do not connect the power input (R, S, T) to the output terminal (U, V, W) of motor;
- Wiring of motor output terminal(U/V/W) is consistent with motor (U/V/W) wiring; The sequence can't be wrong;
- Do not put power cable and signal cable together, and keep a distance more than 30cm.
- Do not switch servo power supply frequently; Otherwise, capacitor will be charged frequently inside the servo, and pre-charging circuit will be overloaded, resulting in performance degradation. Please keep switching frequency below 1 time per minute;
- After the servo is powered off, there might still be residual high voltage inside servo. Only after power-off for 15 minutes and wait until the power indicator is off, can the wiring be executed.

2.3.4 Specification of Main Loop Cable

Table 2-5 Recommended cable specifications for main loop

Frame	Drive Model	L1C、L2C		L1、L2、L3 (R、S、T)		P、B		U、V、W		PE	
		mm^2	AWG	mm^2	AWG	mm^2	AWG	mm^2	AWG	mm^2	AWG
Single-phase 220V power supply											
SIZE A	1R6	2x0.5	20	2x0.5	20	2x2.0	14	3x0.5	20	0.5	20
	2R8	2x0.5	20	2x0.5	20	2x2.0	14	3x0.5	20	0.5	20
SIZE B	5R5	2x0.75	18	2x0.75	18	2x2.0	14	3x0.75	18	0.75	18
SIZE C	7R6	2x0.75	18	2x1.5	15	2x2.0	14	3x1.5	15	1.5	15
	012	2x0.75	18	2x1.5	15	2x2.0	14	3x1.5	15	1.5	15
	014	2x0.75	18	2x2.0	14	2x2.0	14	3x2.0	14	2.0	14
3-phase 220V power supply											
SIZE A	1R6	2x0.5	20	3x0.5	20	2x2.0	14	3x0.5	20	0.5	20
	2R8	2x0.5	20	3x0.5	20	2x2.0	14	3x0.5	20	0.5	20
SIZE B	5R5	2x0.75	18	3x0.75	18	2x0.75	18	3x0.75	18	0.75	18
SIZE C	7R6	2x0.75	18	3x1.00	17	2x1.00	17	3x1.0	17	1.00	17
	012	2x0.75	18	3x1.5	15	2x2.0	14	3x1.5	15	1.5	15
	014	2x0.75	18	3x2.0	14	2x2.0	14	3x2.0	14	2.0	14
SIZE D	018	2x0.75	18	3x2.50	13	3x2.5	13	3x2.5	13	2.50	13
	022	2x0.75	18	3x4.0	11	3x4.0	11	3x4.0	11	4.00	11
	027	2x0.75	18	3x6.0	9	2x6.0	9	3x6.0	9	6.0	9
3-phase 380V power supply											
SIZE C	5R4	2x0.75	18	3x0.75	18	2x0.75	18	3x0.75	18	0.75	18
	8R4	2x0.75	18	3x0.75	18	2x1.0	17	3x1.0	17	1.0	17
	012	2x0.75	18	3x1.0	17	2x1.5	15	3x1.5	15	1.5	15
SIZE D	017	2x0.75	18	3x1.5	15	3x2.0	14	3x2.0	14	2.0	14
	021	2x0.75	18	3x4.0	11	2x4.0	11	3x4.0	11	2.5	11
	026	2x0.75	18	3x6.0	9	2x6.0	9	3x6.0	9	6.0	9
	030	2x0.75	18	3x8.0	8	2x8.0	8	2x8.0	8	8.0	8

2.4 Common DC Bus Cable Wiring

In some multi-axis application scenarios, the motion state of each axis is different, some servo motors work in the braking power-generation state, and other servo motors work in the energy-consumption state. Use the common DC bus technology for energy interaction, the energy generated by braking motor can be supplied to the energy-consuming motors, other than dissipating by regenerative resistors, so as to realize the energy-saving effect.

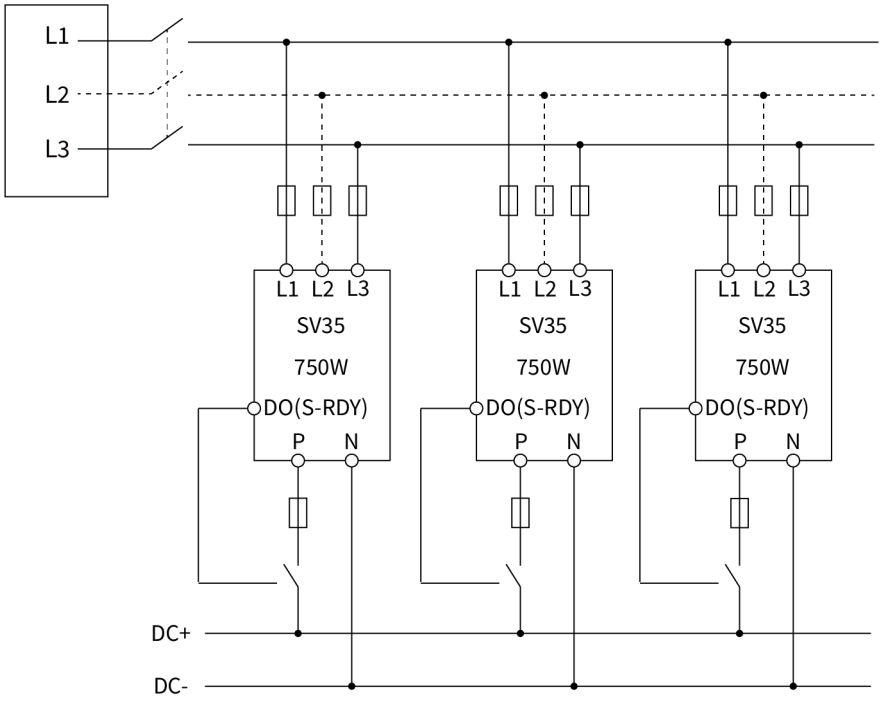


Figure 2-11 Sample of Servo Common Bus

Only those drivers of the same specification are allowed to share bus in this way. To utilize common bus with drivers of different specifications may burn the drivers directly. DC bus P and N of the servo are connected in parallel so as to realize energy transfer among drives;

All drives must use the same power input. It's forbidden to utilize the power supply of different voltage and phase number. Otherwise, it might cause drive damage;

All drives mu-st be powered ON/OFF at the same time. Otherwise, it might cause drive damage;

Voltage level and phase sequence of all drives with common bus shall be consistent. Otherwise, it might cause drive damage and start a fire.

While using common bus, only after completing the configuration of common bus for all drives, can it be allowed for servo drive operation;

After the drive is powered on, when drive Rdy state occurs, drive DO outputs the ready signal, control the relay swich-on so as to realize the common bus connection;

While drive PN is connected to bus, in order to avoid excessive current in case of single-drive exception, please connect a fast fuse between bus bars.

2.5 Description of regenerative resistance wiring

2.5.1 Connecting regenerative resistance wiring

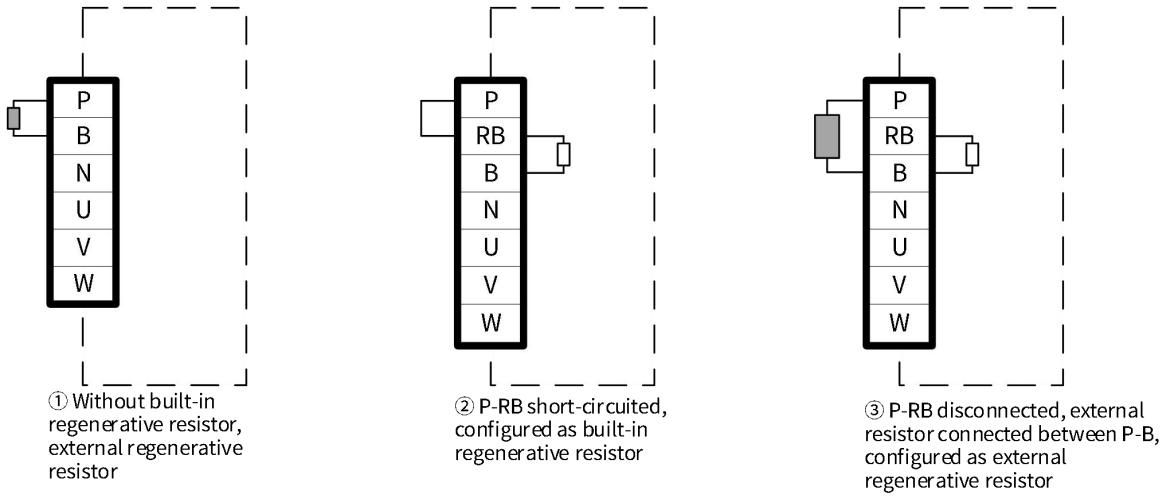


Figure 2-12 Regenerating resistor wiring

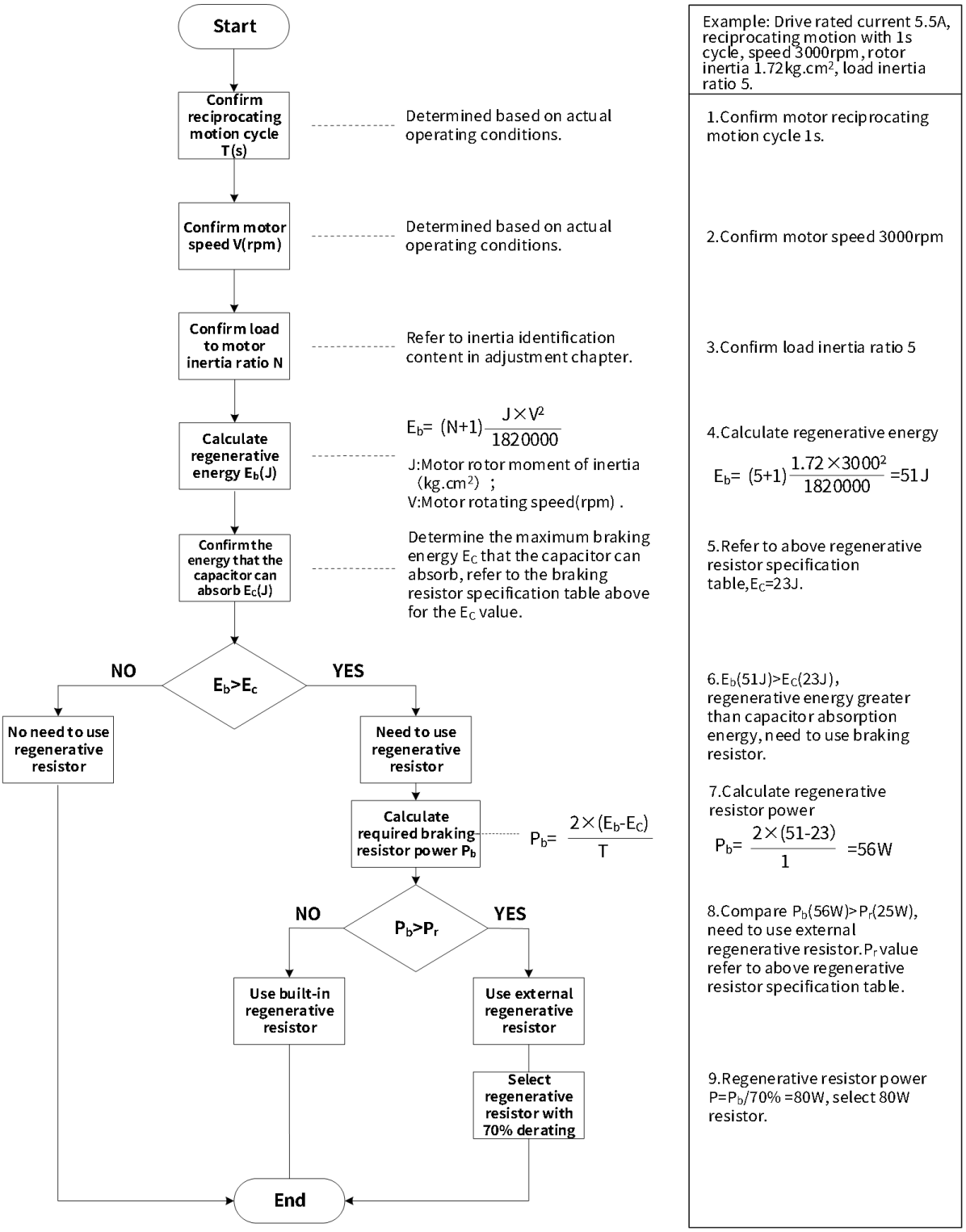
- For models without built-in regenerative resistor, external regenerative resistors are are connected between P-B;
- Do not connect any regenerated resistor between bus P and N, otherwise it might cause damage to drives and start a fire;
- For models with built-in regenerative resistor, short-circuit P-RB terminals while using the built-in resistor. While using the external resistor, remove terminal jumper between P-RB and connect the external resistor between P-B;
- In case of external regenerative resistor, select an appropriate resistor according to Section 2.5.3. Do not use any resitor below Min. external resistance allowed in Table 2-6. Otherwise, it might cause drive damage.
- Before using the servo, please confirm that the parameters related to external regeneration resistor have been properly set: P02.34 (regeneration resistor selection), P02.39 (power of external regeneration resistor), P02.40 (external regeneration resistance).

2.5.2 Specifications of regenerative resistors

Table 2-6 Specifications of regenerative resistors

Servo drive Rated voltage, current		Specifications on internal regenerative resistance			Minimum external resistance	Maximum braking energy absorption of capacitor/E_c
		Resistance value	Resistance power	Applicable power/P_r		
Single/3-phase 220V	1.6A	-	-	-	50Ω	10J
	2.8A	-	-	-	45Ω	15J
	5.5A	50Ω	50W	25W	40Ω	23J
	7.6A	25Ω	80W	40W	20Ω	32J
	12.0A	25Ω	80W	40W	15Ω	47J
	14.0A	25Ω	80W	40W	15Ω	57J
3-phase 220V	18.0A	20Ω	100W	50W	10Ω	64J
	22.0A	20Ω	100W	50W	10Ω	71J
	27.0A	20Ω	100W	50W	10Ω	95J
3-phase 380V	3.5A	100Ω	80W	40W	80Ω	39J
	5.4A	100Ω	80W	40W	60Ω	39J
	8.4A	50Ω	80W	40W	45Ω	57J
	12.0A	50Ω	80W	40W	45Ω	57J
	17.0A	35Ω	100W	50W	35Ω	114J
	21.0A	35Ω	100W	50W	25Ω	114J
	26.0A	35Ω	100W	50W	25Ω	114J
	30.0A	35Ω	100W	50W	25Ω	137J

2.5.3 Selection and calculation of regenerative resistance



Example: Drive rated current 5.5A, reciprocating motion with 1s cycle, speed 3000rpm, rotor inertia 1.72kg.cm², load inertia ratio 5.

1.Confirm motor reciprocating motion cycle 1s.

2.Confirm motor speed 3000rpm

3.Confirm load inertia ratio 5

4.Calculate regenerative energy

$E_b = (5+1)\frac{1.72\times3000^2}{1820000} = 51J$

5.Refer to above regenerative resistor specification table, E_C=23J.

6.E_b(51J)>E_C(23J), regenerative energy greater than capacitor absorption energy, need to use braking resistor.

7.Calculate regenerative resistor power

$P_b = \frac{2\times(51-23)}{1} = 56W$

8.Compare P_b(56W)>P_r(25W), need to use external regenerative resistor. P_r value refer to above regenerative resistor specification table.

9.Regenerative resistor power $P=P_b/70\% = 80W$, select 80W resistor.

Figure 2-13 Illustration of regenerative resistor selection

2.6 Wiring of holding brake

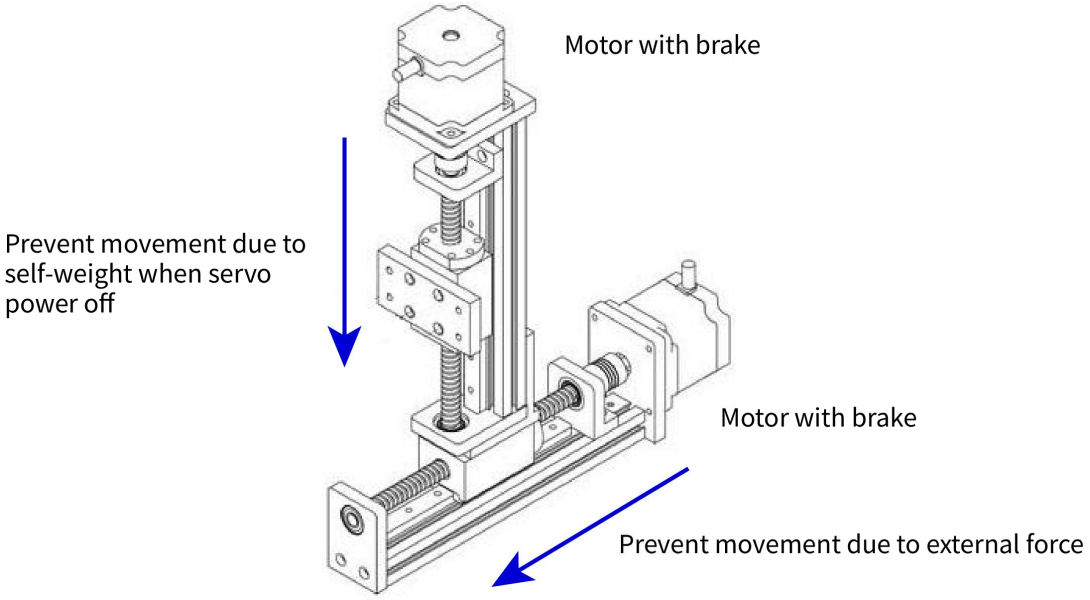


Figure 2-14 Schematic diagram of holdingbrake

Holding brake is used to stop the unexpected movement of moving load(e.g., falling under gravity) when servo system is not activated (e.g., the servo system is powered off) to prevent motors from moving unexpectedly after power off due to its own weight or external force.

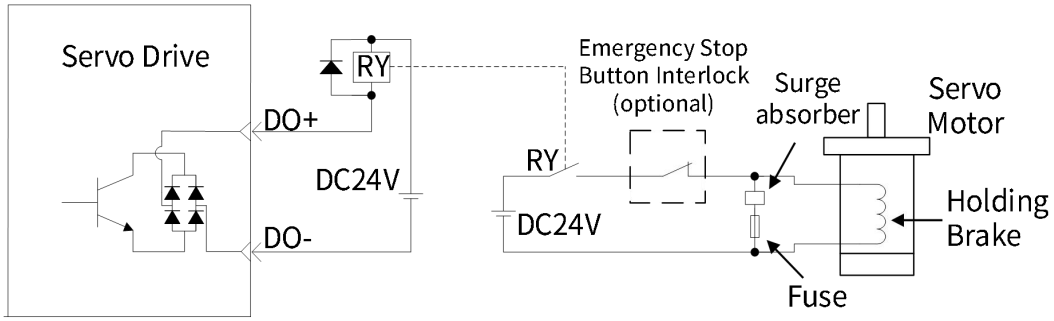


Figure 2-15 Layout diagram of holding brake

Built-in Holding brake of servo motor is only used for shutdown of motors, and frequent use for emergency stop would shorten its service life. Only if motor speed is less than 20rpm, Holding brake can be powered off;

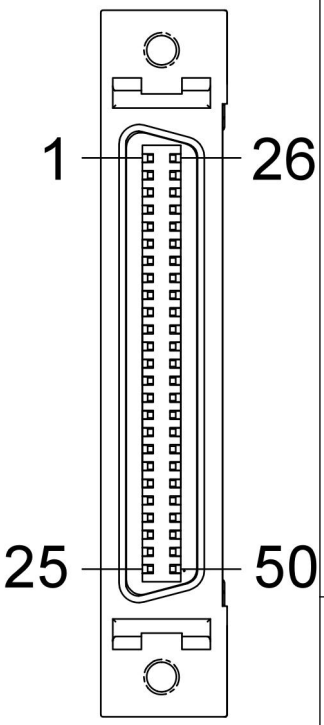
It's recommended to use independent power supply to prevent the abnormal voltage drop from other electrical appliances, that could result in misoperation of Holding brake.

Different power sources are used to power the brake and brake control signal separately in order to prevent electronic devices from electromagnetic interference.

2.7 Description of Control Signal CN3 Port Wiring

2.7.1 Definition of Control Signal CN3 Port

Table 2-7 Definition of CN5 on control signal

IO Connector (CN3)	Module name	Title of signal	Pin No.	Symbol
 SCSI 50P	Digital input	DI1	1	POT(Positive direction over-travel inhibition input)
		DI2	2	NOT(Negative direction over-travel inhibition input)
		DI3	3	HS(Home Switch)
		DI4	5	SRV-ON(Servo-ON input)
		DI5	6	A-CLR(Alarm clear input)
		DI6	7	CL(Counter clear input)
		DI7	8	Zero speed maintenance
		HDI1	9	Undefined
		HDI2	10	Undefined
		DI_COM	4	DI common port
	Digital output	DO1+	12	BRK-OFF(External brake release signal)
		DO1-	11	
		DO2+	14	S-RDY(Servo-Ready output)
		DO2-	13	
		DO3+	16	ALM(Servo-Alarm output)
		DO3-	15	
		DO4+	18	Position Reach
		DO4-	17	
		DO5+	20	Homing completion
		DO5-	19	
	Output Signals (Pulse Train)	PAO+	31	A-phase output
		PAO-	30	
		PBO+	29	B-phase output

IO Connector (CN3)	Module name	Title of signal	Pin No.	Symbol
		PBO-	28	
		PZO+	27	Z-phase output
		PZO-	26	
		OCZ	32	Open collector output of Z-phase signal
		GND	33	Signal ground
	Position command	PULSE+	34	Connection to sequence input signals (Pulse train interface)
		PULSE-	35	
		SIGN+	36	
		SIGN-	37	
		PULLHI	38	Power input interface for command pulse
		GND	39	Pulse command signal ground
		HPULSE+	40	Connection to sequence input signals (High speed pulse train interface)
		HPULSE-	41	
		HSIGN+	42	
		HSIGN-	43	
	Analog input	AI1	45	Analog command input 1
		AI2	46	Analog command input 2
		GND	44	Analog command input signal ground
	Analog output	AO1	48	Analog command output 1
		AO2	47	Analog command output 2
		GND	49	Analog command output signal ground
	Shell	—	—	Connect the cable shielding layer

2.7.2 Description of Digital Input Wiring

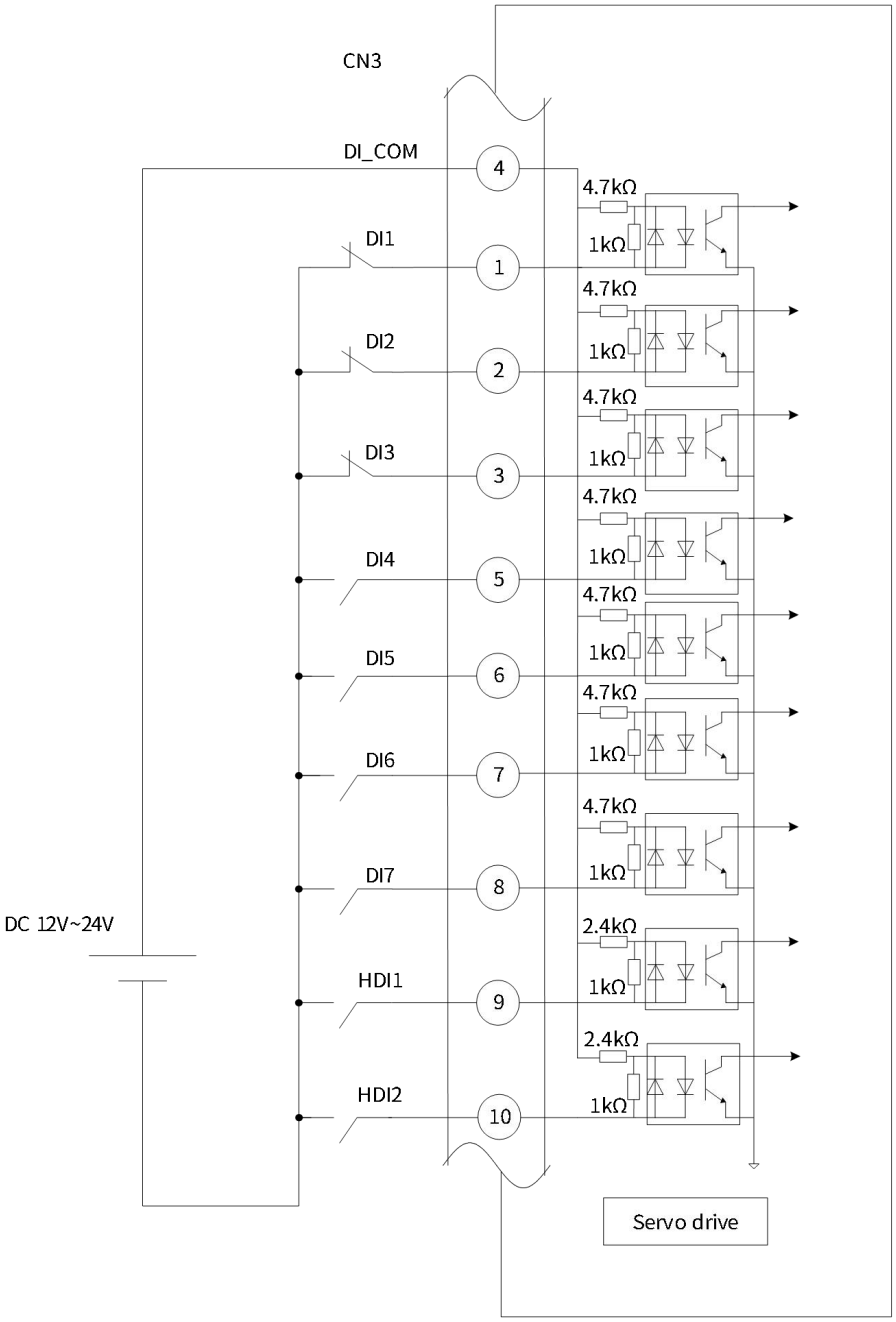


Figure 2-16 Connection wiring of digital input cable

(1) When upper device is relay output

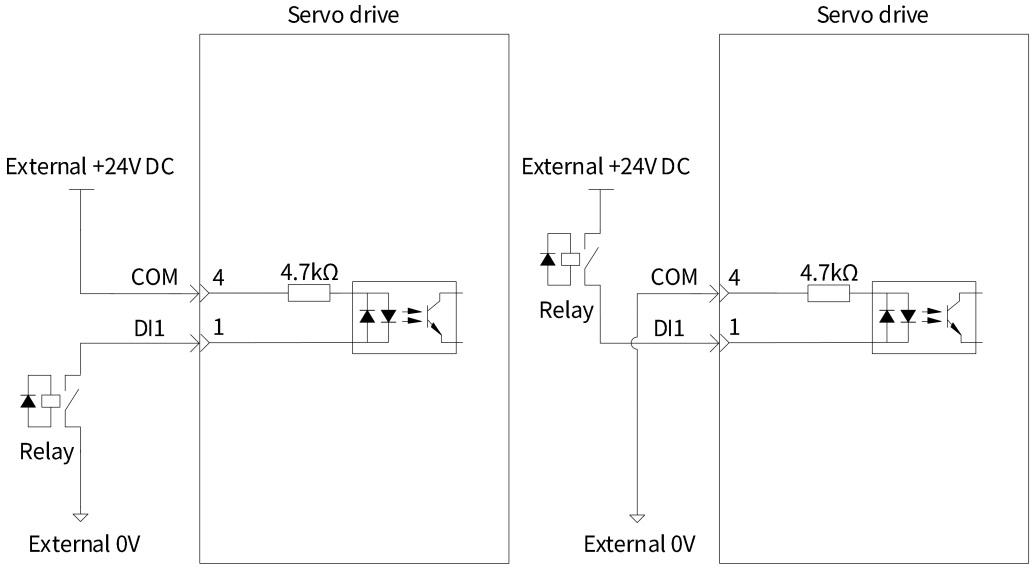
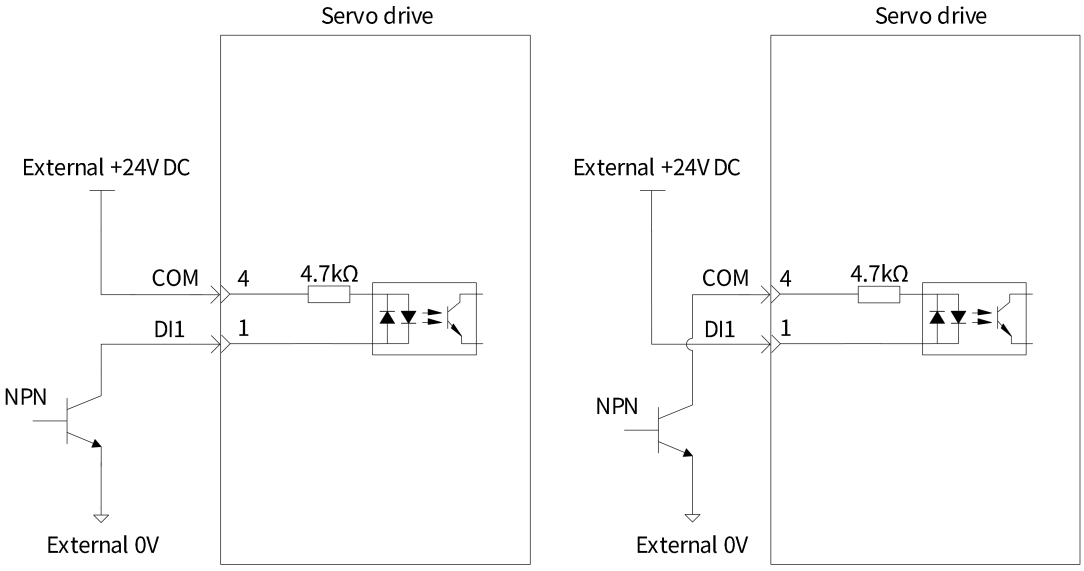


Figure 2-17 Digital input wiring diagram (relay output)

(2) When upper device is open collector



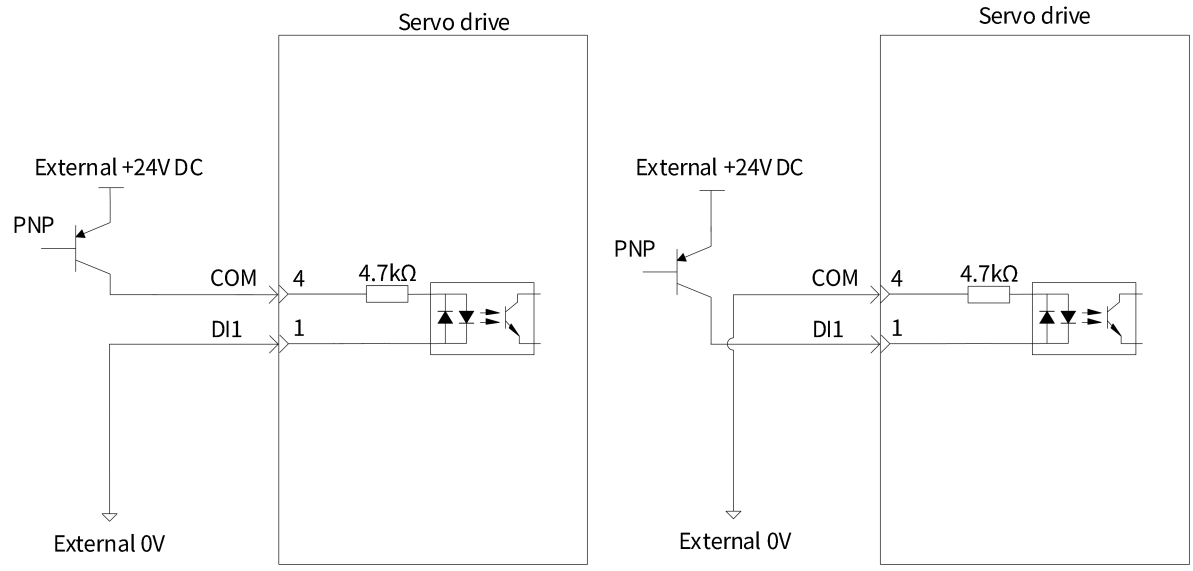


Figure 2-18 Wiring diagram of digital input(open collector)

Mixing input of PNP and NPN is not supported.

2.7.3 Description of Digital Output Wiring

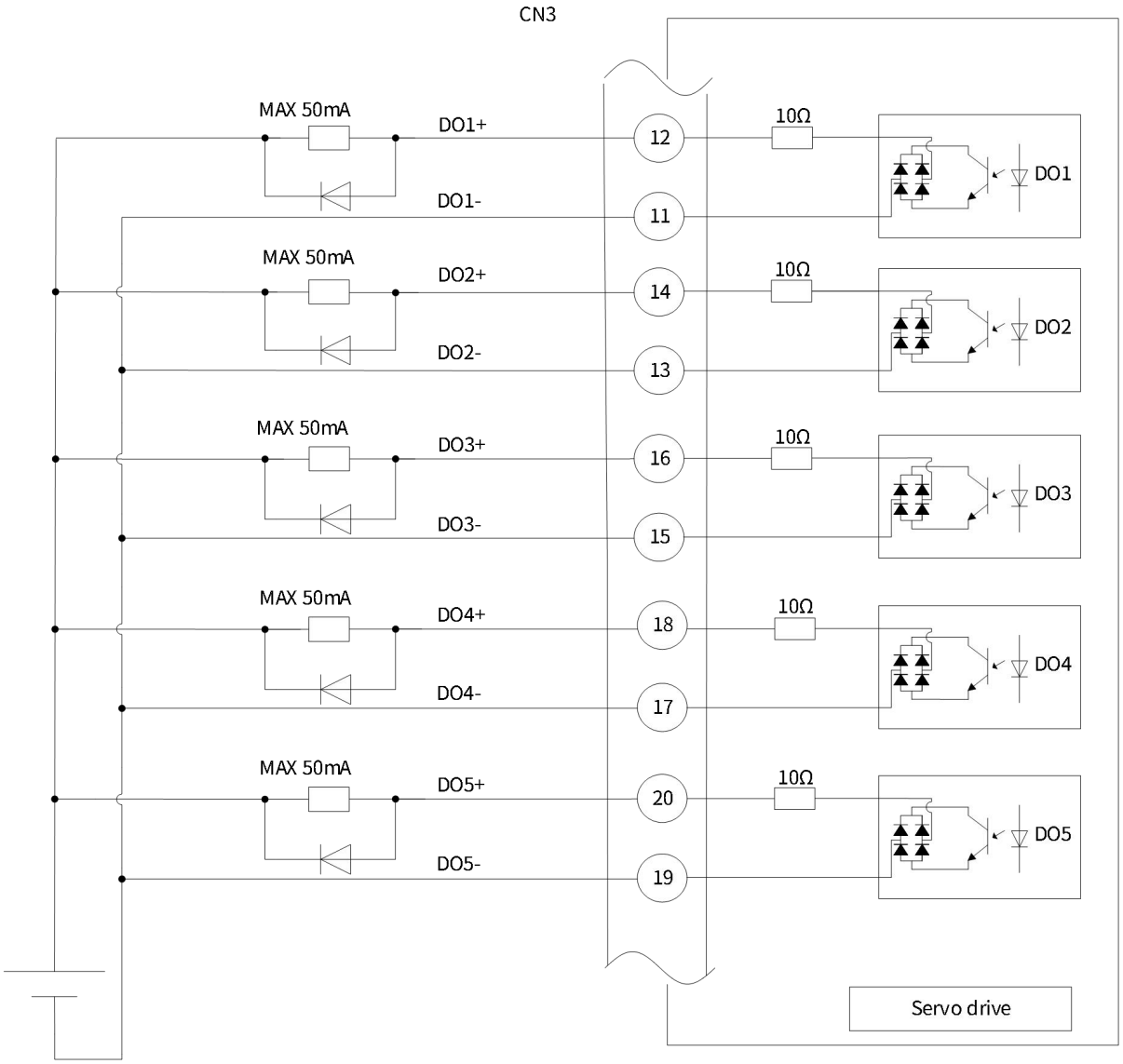


Figure 2-19 Digital output wiring

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

Voltage: DC 30V(Max);

Current: DC 50mA(Max.)

(1) When upper device is relay input

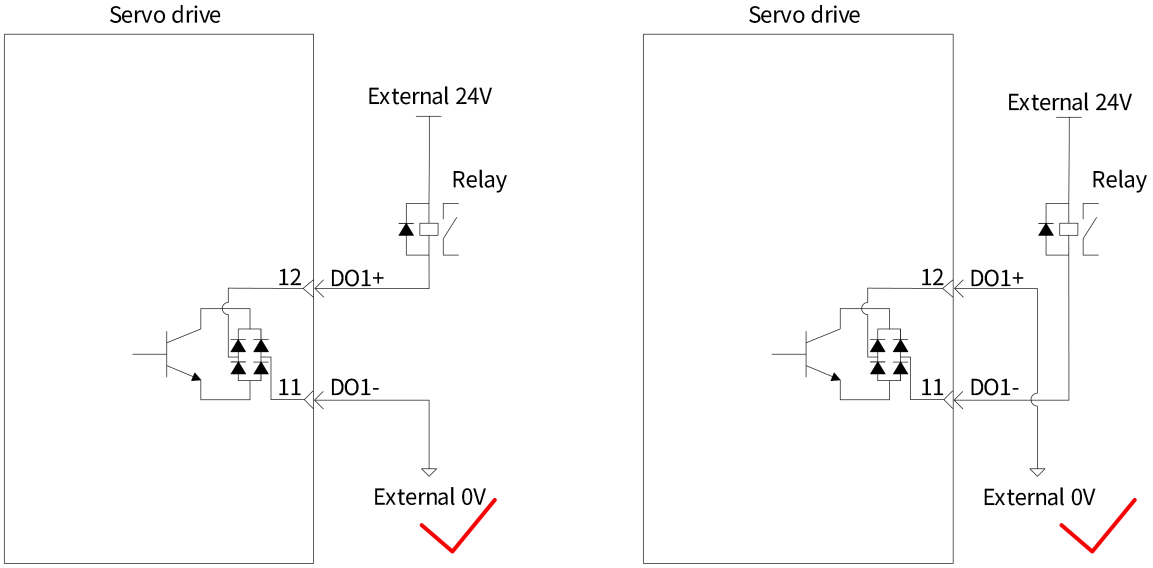


Figure 2-20 Schematic diagram of digital output wiring (relay input, correct wiring)

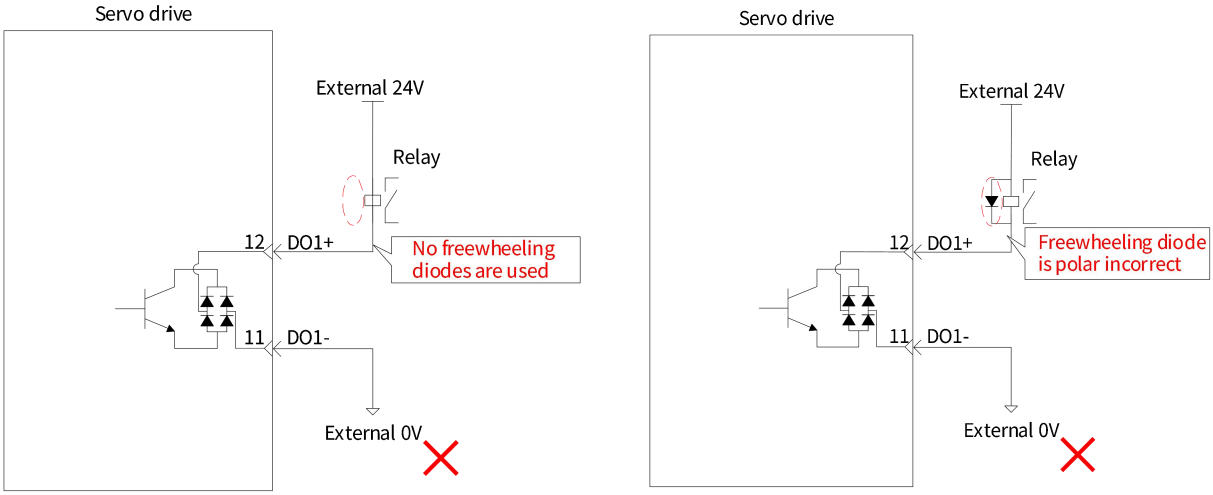


Figure 2-21 Schematic diagram of digital output wiring (relay input, error wiring)

(2) When upper device is optocoupler input

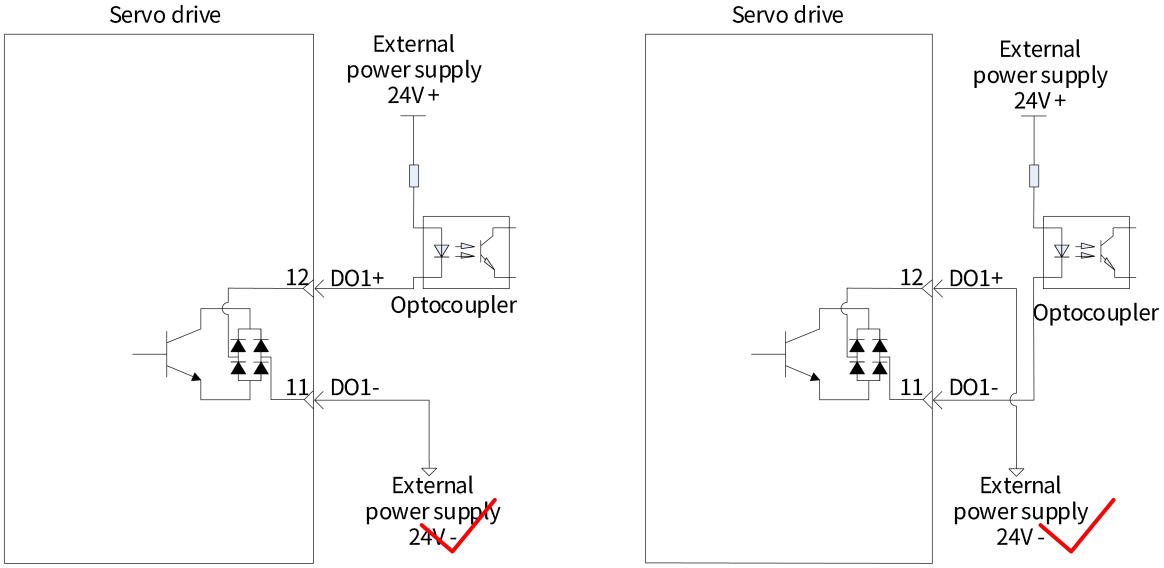


Figure 2-22 Wiring diagram of digital output(optical coupling input, correct wiring)

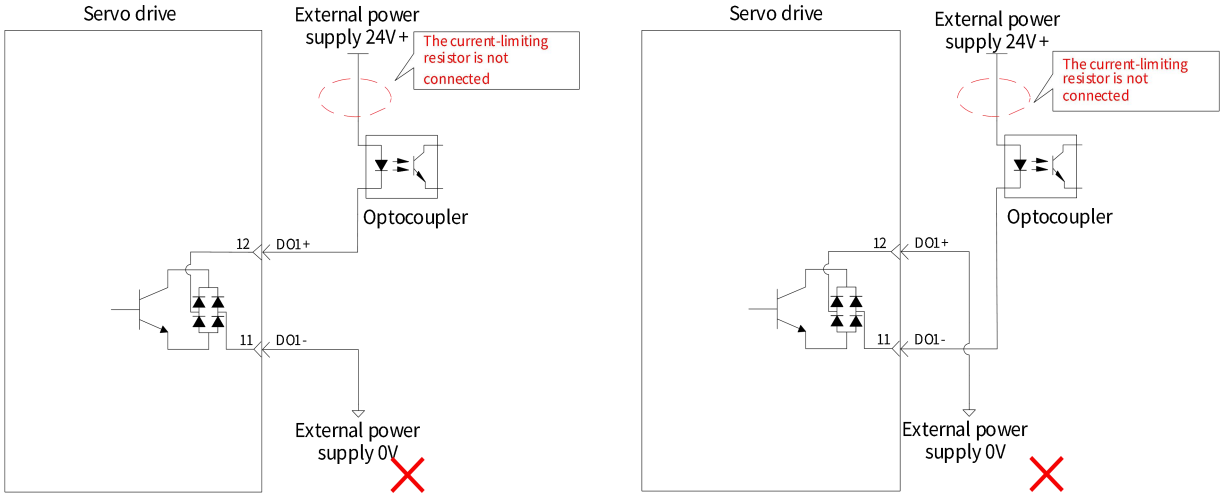


Figure 2-23 Wiring diagram of digital output(optocoupler input, error wiring)

2.7.4 Description of Frequency Division Output Wiring

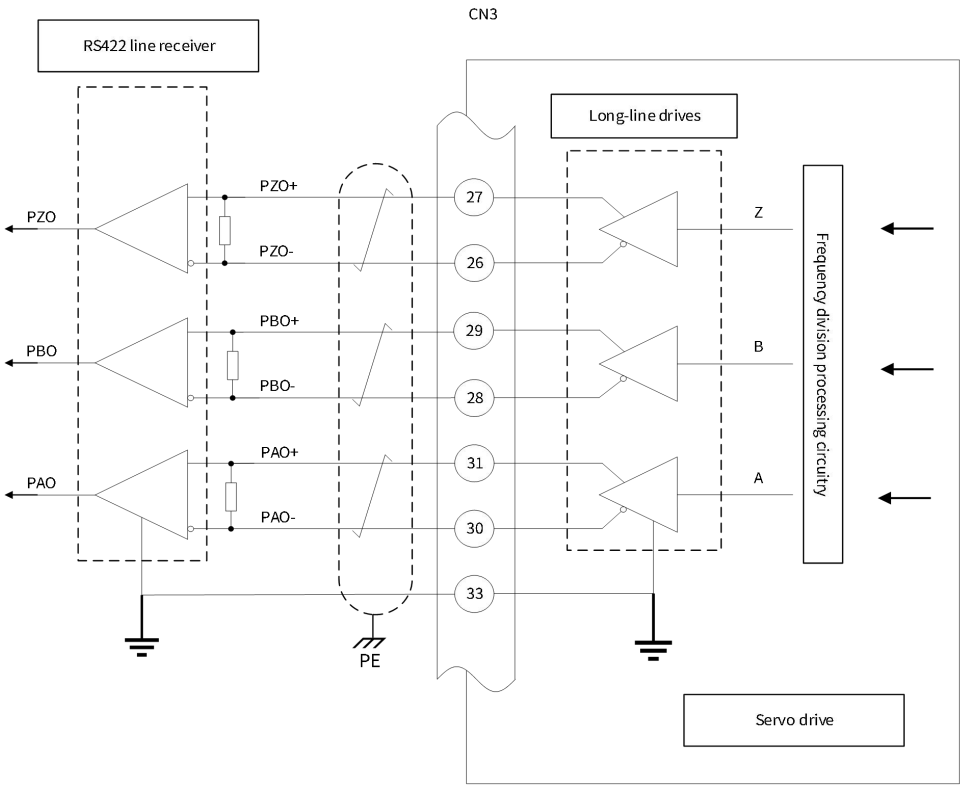


Figure 2-24 Frequency division output wiring

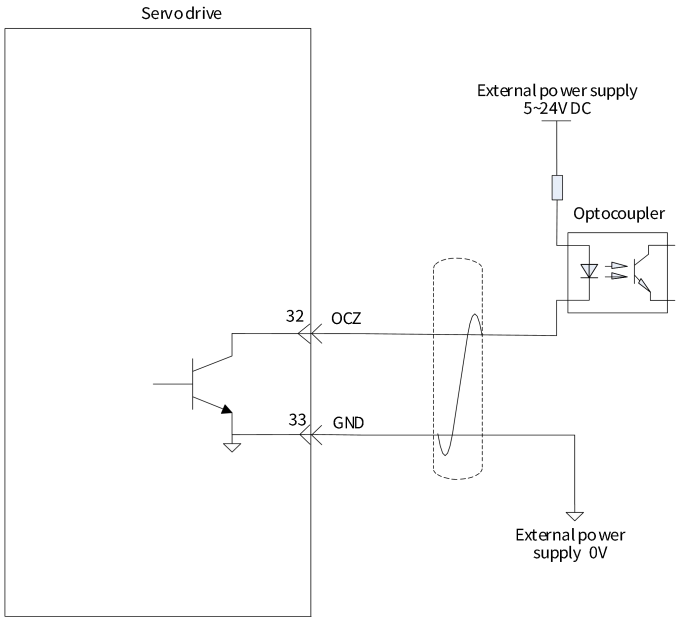


Figure 2-25 Encoder Z-phase collector electrode open circuit output wiring

For receiving signal of output pulse, please use RS422 long line receiver (AM26C32 or equivalent);

Max. output current of frequency division output is 20mA;

Shielded twisted-pair cable is used. The shielding layer is connected to PE; Ground of frequency division output signal is connected to the receiving terminal.

2.7.5 Wiring instructions for position commands

(1)Low speed pulse command input

1) When using differential mode

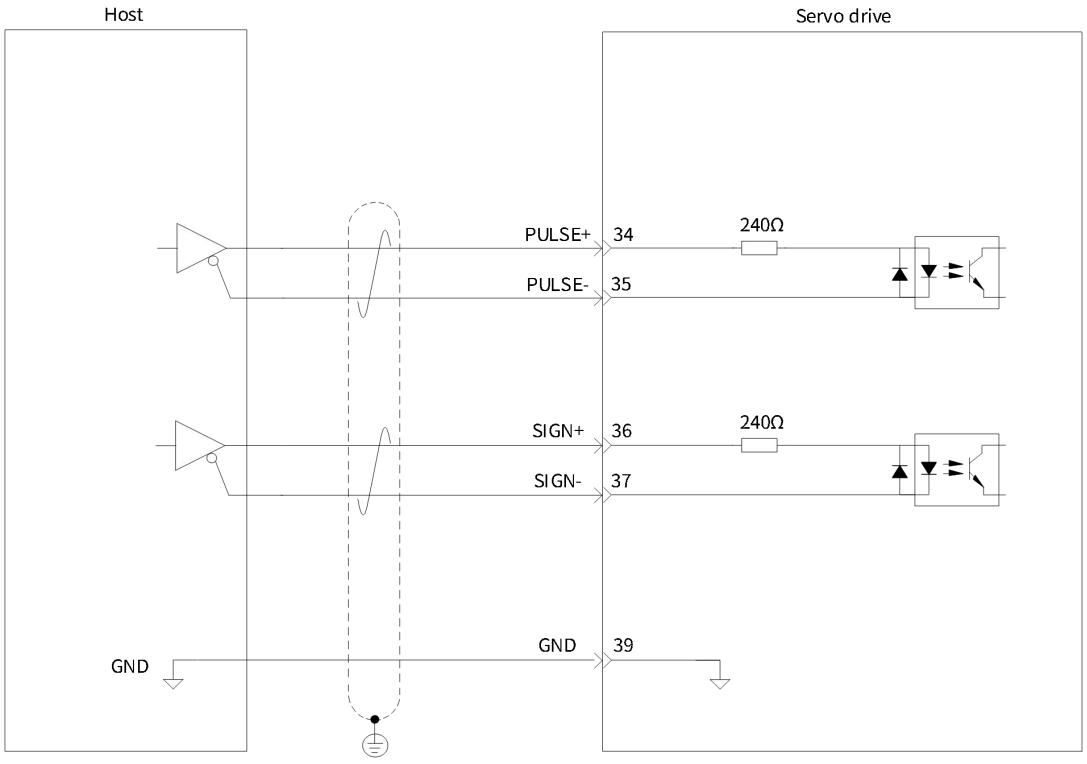


Figure 2–26 Schematic diagram of low-speed pulse command input wiring (differential mode)

2) When in open collector mode

Option 1: Use internal resistance of servo drive

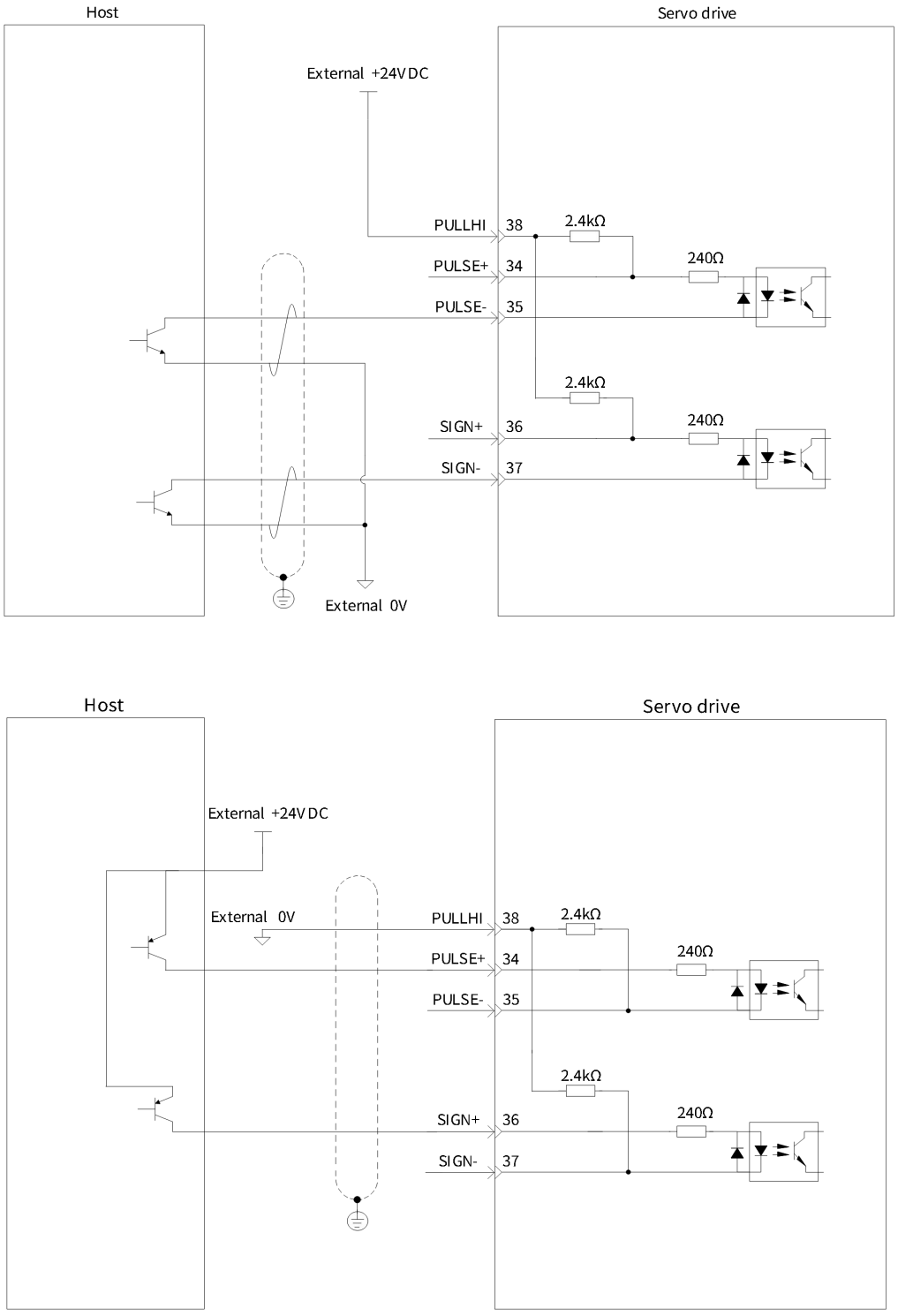


Figure 2–27 Schematic diagram of low-speed pulse command input wiring (open collector mode - using internal resistance)

Option 2: Use an external resistor

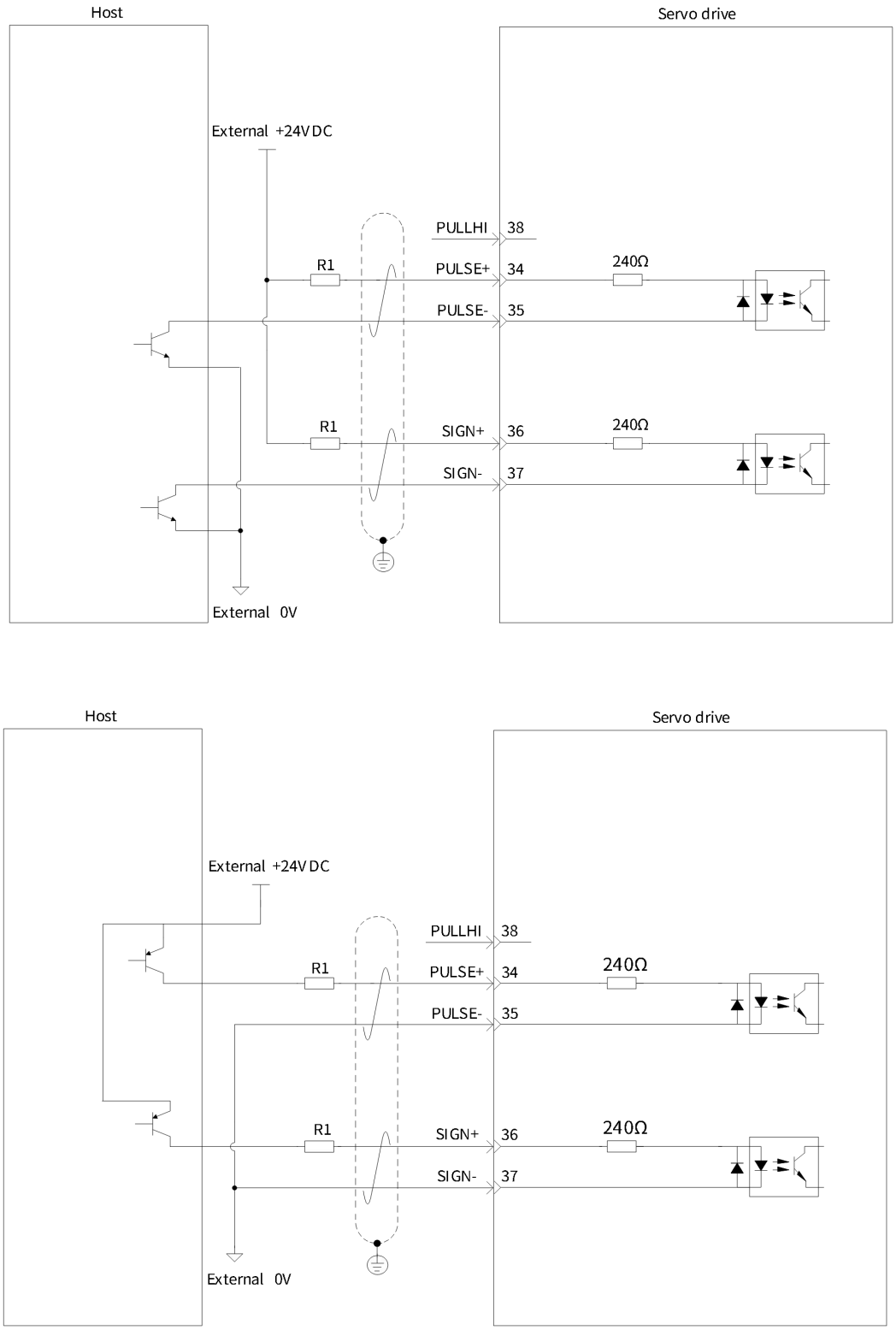


Figure 2–28 Schematic diagram of low-speed pulse command input wiring (open collector mode - external resistance)

The selection of resistor R1 must satisfy the formula: $\frac{V_{CC}-1.5}{R_1+240}$ = 10mA

Table 2–8 Recommended R1 resistance value

V_{cc} voltage	R_1 resistance	R_1 power
24V	2.4kΩ	0.5kΩ
12V	1.5kΩ	0.5kΩ

Example of wiring error:

- Error 1: Failure to connect current limiting resistor resulted in port burnout

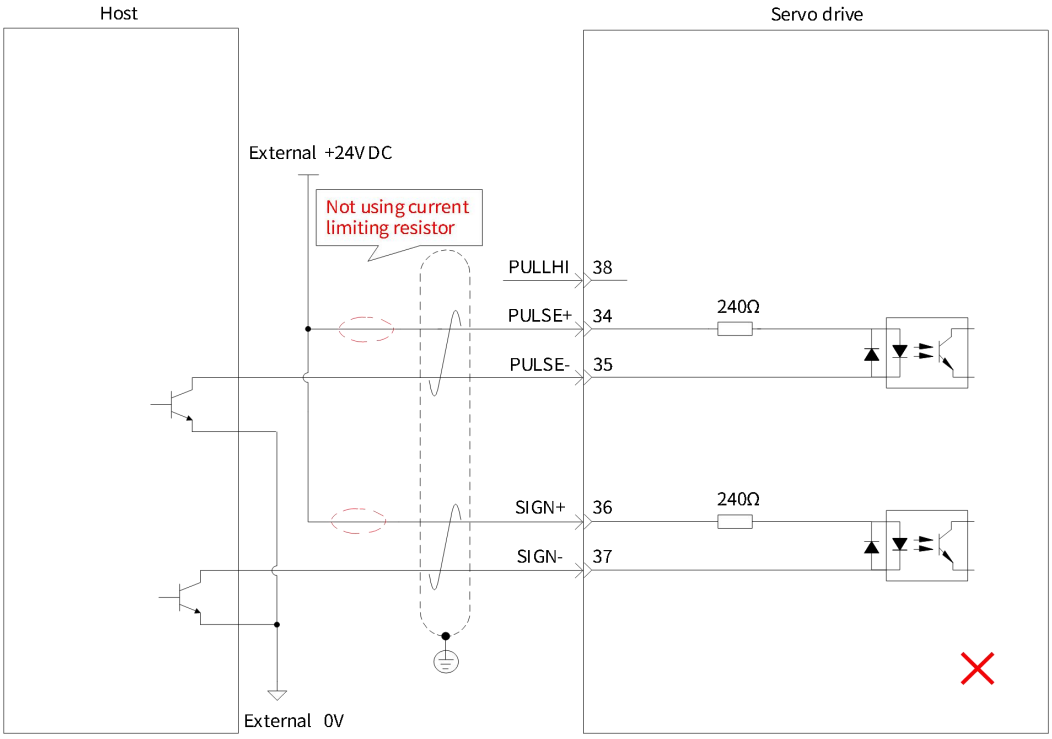


Figure 2–29 Schematic diagram of low-speed pulse command input wiring (incorrect connection 1)

- Error 2: Multiple ports share a current limiting resistor, resulting in incorrect pulse reception

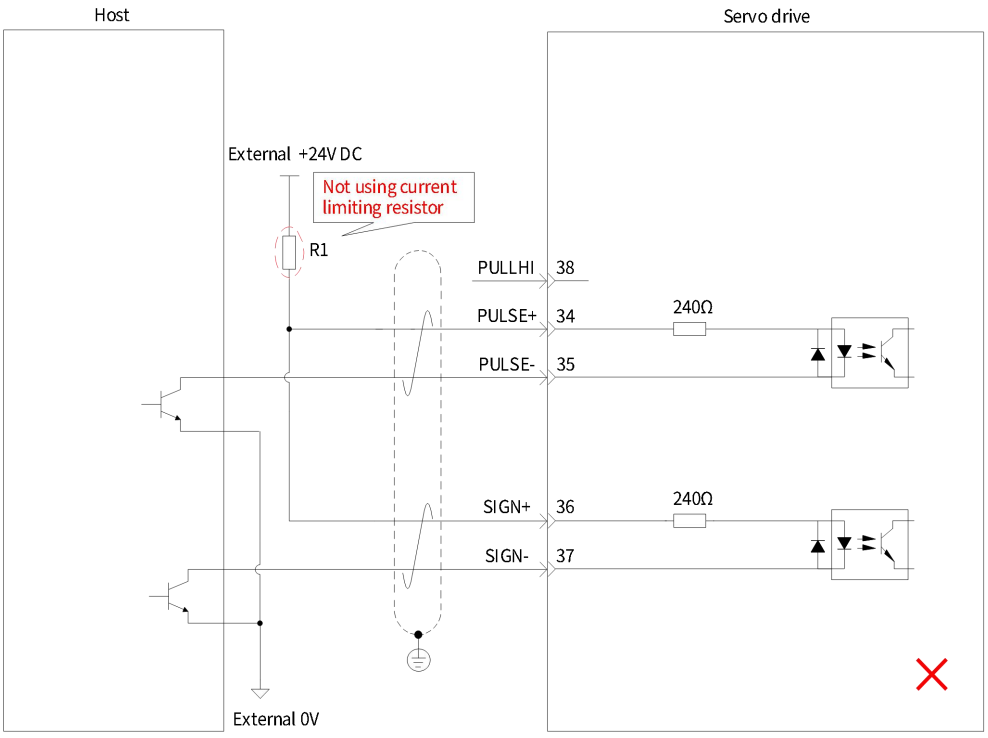


Figure 2–30 Schematic diagram of low-speed pulse command input wiring (incorrect connection 2)

- Error 3: SIGN port not connected, resulting in these two ports not receiving pulses

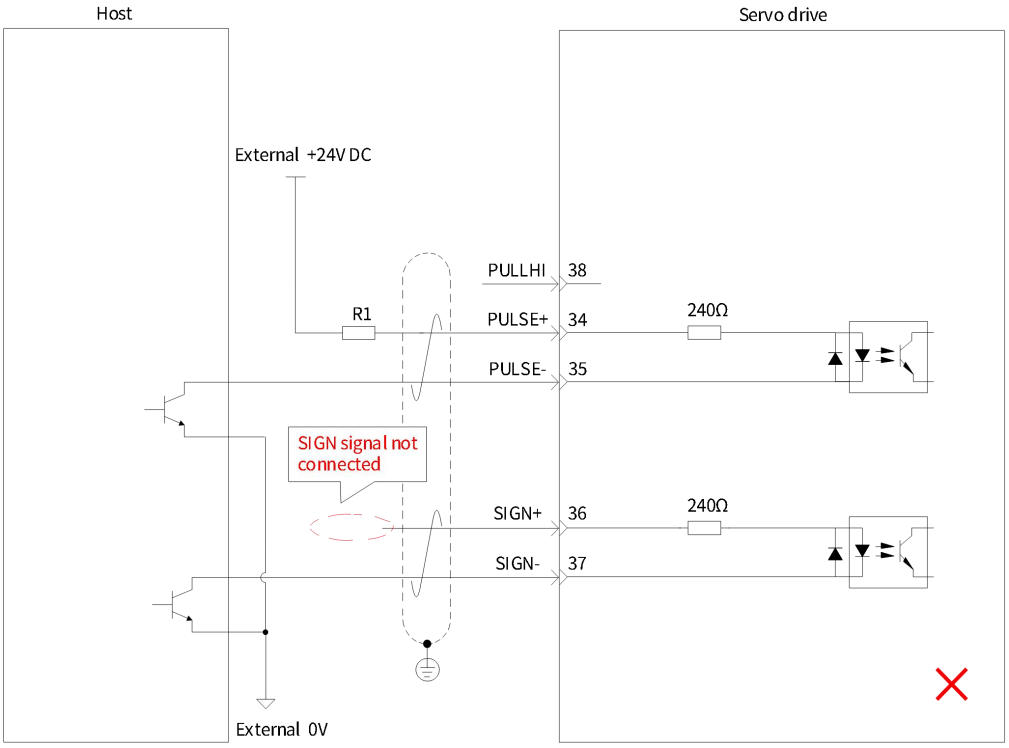


Figure 2–31 Schematic diagram of low-speed pulse command input wiring (incorrect connection 3)

- Error 4: Port misconnected, resulting in port burnout

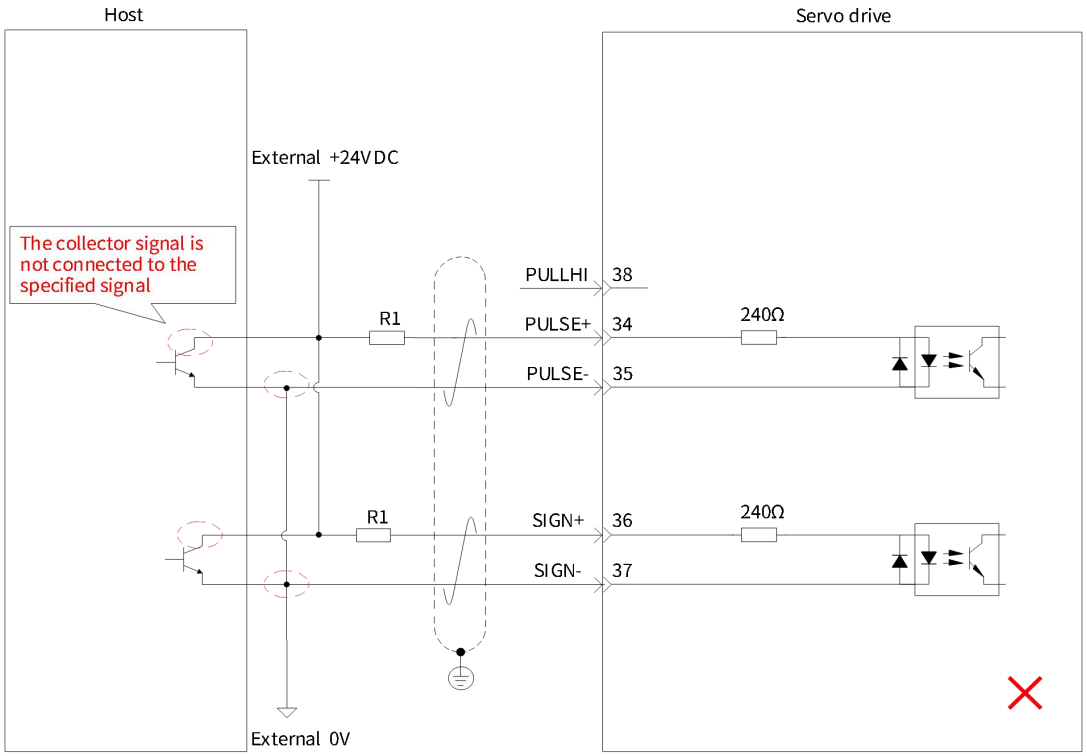


Figure 2–32 Schematic diagram of low-speed pulse command input wiring (incorrect connection 4)

- Error 5: Multiple ports share a current limiting resistor, resulting in incorrect pulse reception

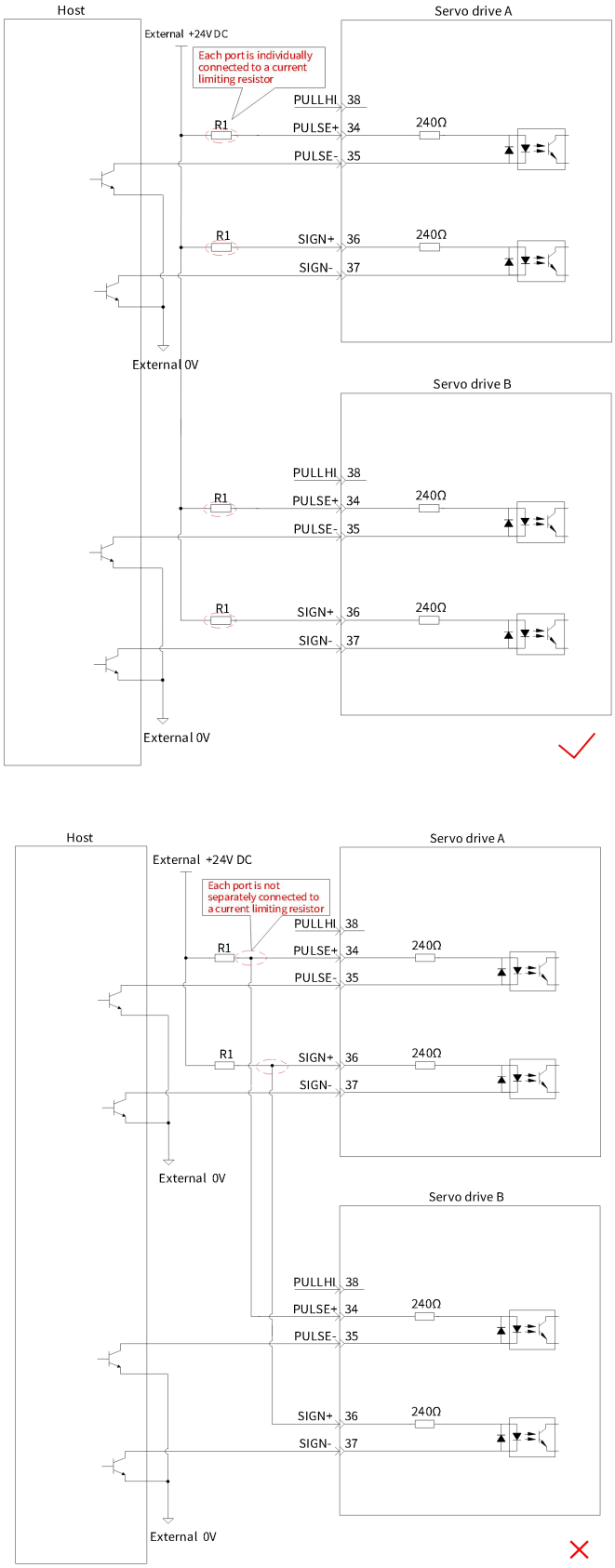


Figure 2–33 Schematic diagram of low-speed pulse command input wiring (incorrect connection 5)

(2)High speed pulse command input

The output circuit of high-speed command pulses and symbols on the upper device side can only be output to the servo driver through a differential driver.

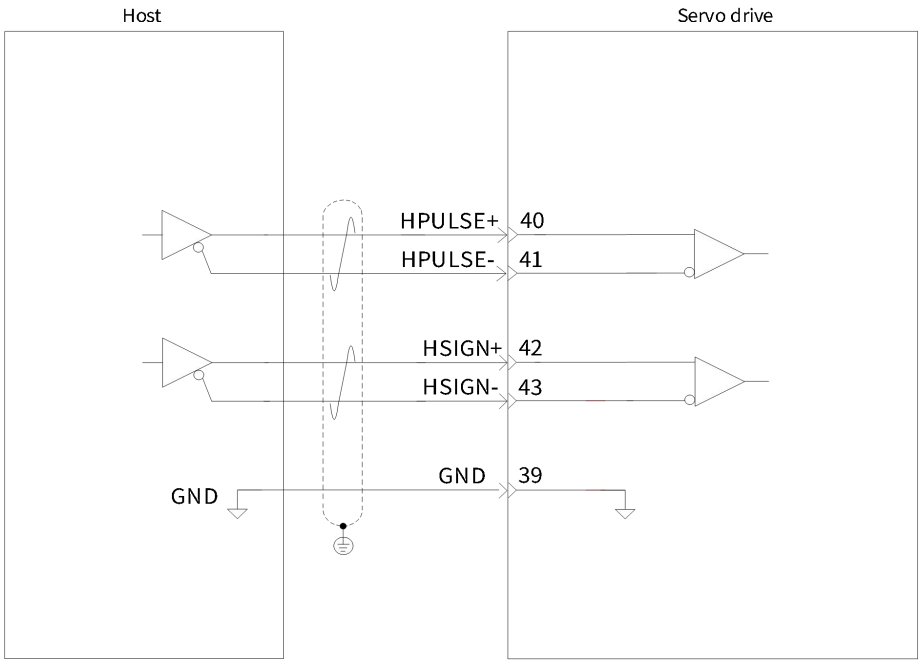


Figure 2–34 Schematic diagram of high-speed pulse command input wiring

Note:

Please ensure that the differential input is a 5V system, otherwise the input pulse of the servo driver will be unstable. This can lead to the following situations:

- Pulse loss phenomenon occurs when inputting command pulses;
- When inputting the direction of the instruction, there is a phenomenon of instruction reversal;
- Please make sure to connect the 5V system ground of the upper device to the GND of the driver to reduce noise interference.

2.7.6 Analog input wiring instructions

The input ports for speed and torque analog signals are AI1/AI2.

- Voltage input range：-10V～+10V；
- Maximum allowable voltage：±12V；
- Input impedance is approximately：9kΩ。

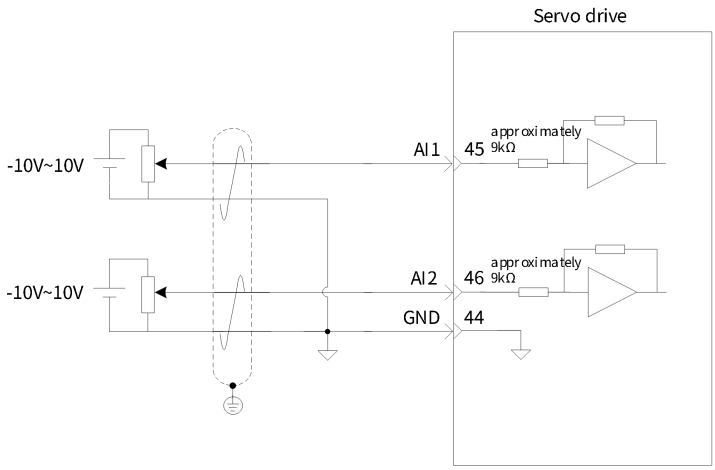


Figure 2–35 Schematic diagram of analog input wiring

2.7.7 Analog output wiring instructions

The output ports for speed and torque analog signals are AO1/AO2.

- Analog output：-10V～+10V；
- Maximum output：1mA；

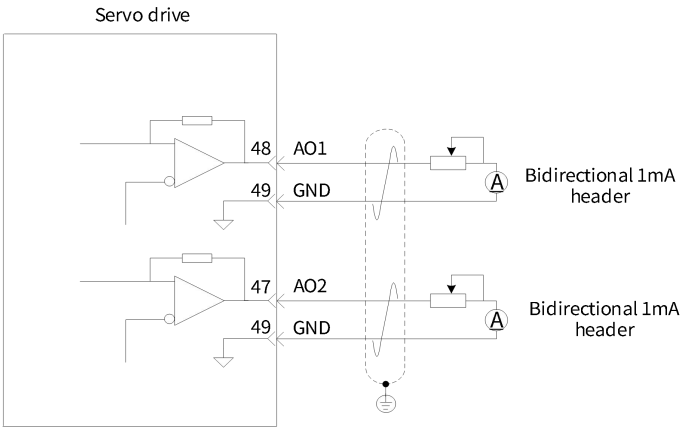
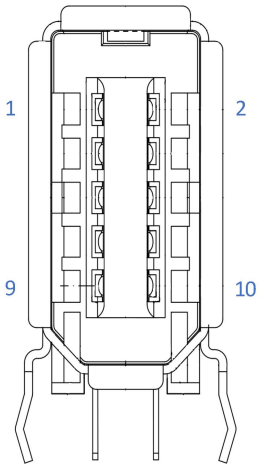


Figure 2–36 Schematic diagram of analog output wiring

2.8 Encoder interface definition and wiring description

2.8.1 CN4 Motor encoder

Table 2-8 Definition of drive encoder interfaces

Motor encoder Connector (CN4)	Module name	Signal name	Pin No.	Wiring method
 IEEE 1394 10P	Motor encoder	E5V	1	Twisted pair
		E0V	2	
		—	3	—
		—	4	—
		—	5	—
		—	6	—
		—	7	—
		—	8	—
		PS+	9	Twisted pair
		PS-	10	
		PE	Shell	Connect the cable shielding layer

- This port is used for connection between drive and motor encoder. During use, the distance between encoder cable and main circuit wire should be more than 30cm or above. Do not bundle them together with conduit.
- The cable length between drive and motor is less than 20m. In case of the requirement above 20m, please negotiate with sellers.
- Input voltage range of the encoder-end connector is 4.75V to 5.25V DC. Please select the appropriate wire. For 10m or less, use shielded twisted pair with a cross-sectional area of 0.18 mm^2(AWG24) or above; For 10m or above, use shielded twisted pair with a cross-sectional area of 0.32 mm^2(AWG22) or above.

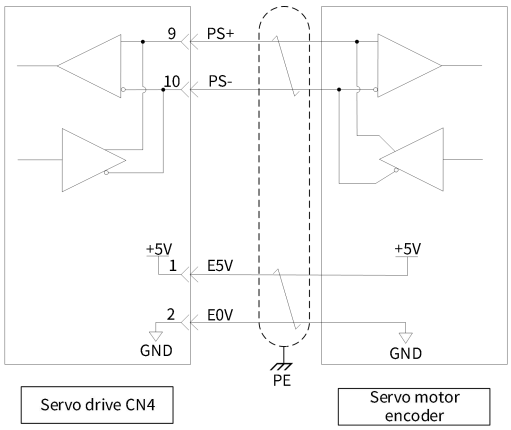
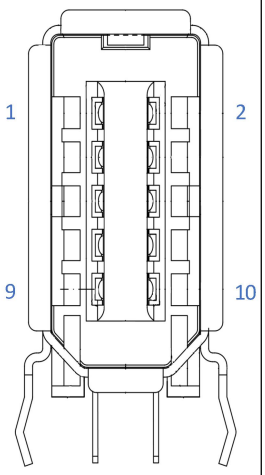


Figure 2-25 Motor encoder signal connection

2.8.2 CN5 Full closed-loop encoder

Table 2-9 Definition of fully closed-loop encoder interface

Fully Closed loop encoder Connector (CN5)	Module name	Signal name	Pin No.	Wiring method	Functions
 IEEE 1394 10P	Fully closed-loop encoder	5V	1	Twisted pair	Encoder power supply
		GND	2		
		SEC_A+	3	Twisted pair	Second encoder input interface
		SEC_A-	4		
		SEC_B+	5	Twisted pair	
		SEC_B-	6		
		SEC_Z+	7	Twisted pair	
		SEC_Z-	8		
		—	9		—
		MTR_TEMP	10		Input of motor temperature sensor
		Shell	—	Connect the cable shielding layer	Shielded

This port is used for connection between drive and motor encoder. During use, distance between the cable and main circuit wire should be 30cm;

Please use shielded twisted pair cable for encoders;

Input of fully closed-loop encoder is differential input, and its Max. input frequency and Min. pulse width are shown in the table below:

Table 2-10 Input signal features of fully closed loop encoder

Pulse method	Max. frequency (pps)	Min. pulse width (μs)
Differential input	4M	0.125

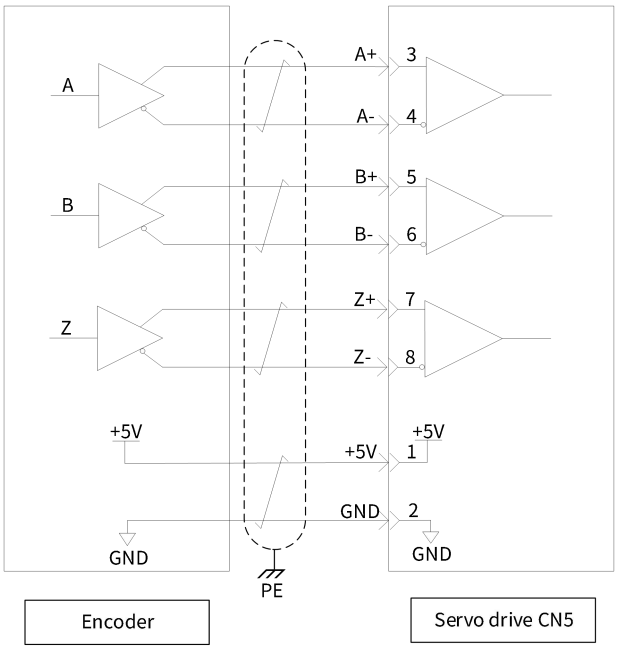


Figure 2-26 Differential signal input of fully closed loop encoder

2.8.3 CN5 Input of motor temperature sensor

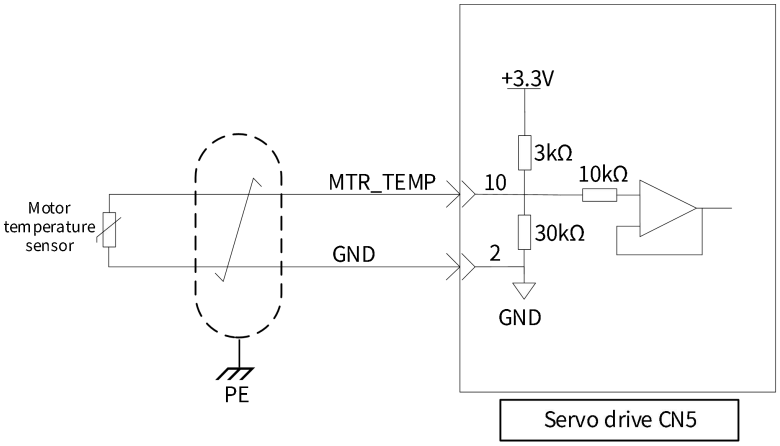


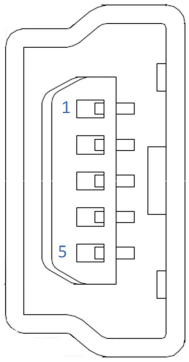
Figure 2-27 Wiring diagram of motor temperature sensor

Support PT/NTC/switch types of motor temperature sensors. Please ensure that function codes P00.05 /P08.31/P08.33/P08.34 are set properly.

2.9 Definition of Connector

2.9.1 CN1 Serial communication port

Table 2-11 Definition of serial communication ports

PC debugging connector(CN1)	Module name	Signal name	Pin No.	Functions
 Mini USB	Serial communication port	VBUS	1	Connect to serial communication port of PC upper computer debugging
		D-	2	
		D+	3	
		—	4	
		GND	5	
		Shell	—	

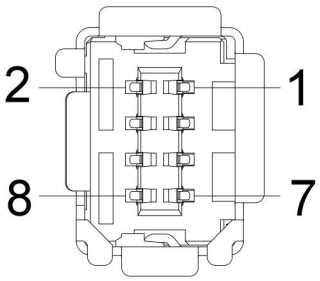
The port is used to connect drive to PC. It can execute test run, adjust parameters and collect waveform by debugging software of upper computer.

This serial communication port is Mini-USB Type B and compatible with USB 2.0.

2.10 CN2 Definition and Wiring Description of Functional Safety Connector

2.10.1 Definition of Functional Security Terminals

Table 2-13 Definition of functional security terminals

Functional Safety Connector (CN2)	Module name	Signal name	Pin No.	Functions
	Functional safety	Internal power negative	1	Built-in power supply (Do not use)
		Internal power positive	2	
		STO1-	3	STO1
		STO1+	4	
		STO2-	5	STO2
		STO2+	6	
		STO_OUT-	7	STO status output
		STO_OUT+	8	
		Shell	—	Shielded

2.10.2 Function Safety Wiring Description

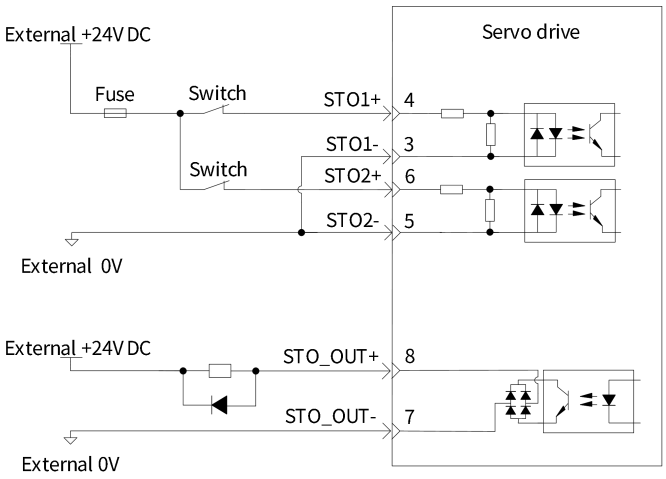


Figure 2-29 Description of functional safety wiring

2.10.3 Relationship of STO I/O Signals

Table 2-14 Relationship of STO input and output signal

STO1 status	STO2 status	STO_OUT status	Power status of motor
OFF	OFF	Power on	Power off
OFF	ON	Power off	Power off
ON	OFF	Power off	Power off
ON	ON	Power off	Power on

2.11 Grounding and anti-interference measures

2.11.1 Grounding Measures

Table 2-15 Precautions for grounding servo drives

Mount the drive on metal shell(control cabinet)
Please connect the ground terminal of servo motor to GND PE of servo drive, and ground PE terminal reliably
Drive must be single-point ground
Use thick cable(⩾2.0mm2) for grounding cables as much as possible; Use thick cable(⩾3.5mm2) for external grounding as braided copper wire as much as possible
Type D or above ground(grounding resistance below 100Ω) is recommended.
Ensure to connect ground terminal of drive and ground cable(PE) of control cabinet to avoid electric shock
As there are two protective ground terminals, do not connect all cables together

2.11.2 Anti-interference measures

Due to different application of peripheral wiring, grounding and anti-interference devices, switching noise may affect normal operation of servo drives. Therefore, it must adopt the correct grounding method and anti-interference measure. The following figure is schematic diagram of anti-interference measure for servo drive.

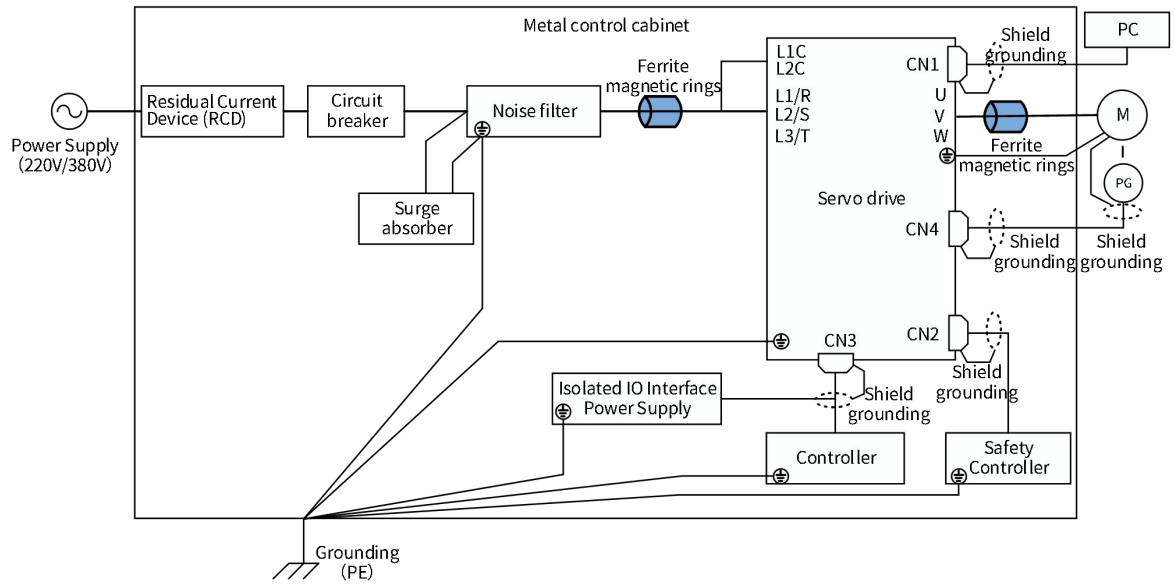


Figure 2-41 Schematic diagram of anti-interference measure of servo drive

The length of command input cable shall be less than 3m. That of encoder cable shall be below 20m and use twisted-pair shielded cable;

Separate strong current cable from weak current cable and keep a distance more than 30cm. Do not put in the same pipeline or tie together;

Cables, I/O lines and power lines of drive are equipped with ferrite magnetic rings;

Install surge suppressors on the coils of relay, solenoid and electromagnetic contactor;

Please install the noise filter at the input of power line, and do not share the power supply with welding machine, discharge processing equipment, etc.

Connect shielded wires of all cables to ground wire (PE).

Please ground both ends of shielded layer of motor encoder cable.

2.11.3 Noise filter

2.11.3.1 Use of noise filter

To prevent the interference of power line and reduce the influence of servo drive on other sensitive equipment. As for selection, installation and wire routing of noise filter, please obey the following guidelines:

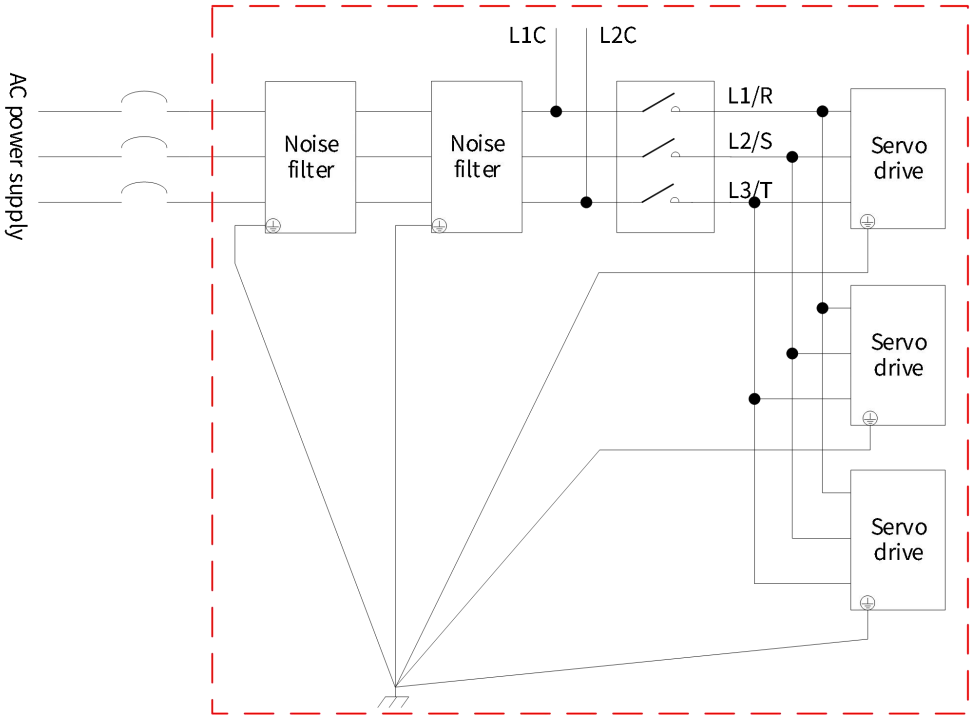


Figure 2-42 Schematic diagram for use, installation and ground of noise filters in series

Please select the corresponding noise filter according to input current;

Please arrange separately the input and output wires of noise filter; Do not put the both in the same pipeline or tie together;

Ground wire of noise filter is arranged separately from the output power line.

Noise filter should use the single-point ground, and grounding wire should be as short and thick as possible.

While noise filter and servo drive are installed in the same cabinet, it is recommended to fix the filter and the servo drive on the same metal plate, ensure that the contact is conductive and well-joint, and ground the metal plate.

For filter installation, the wire between filter and drive must be as short as possible, which shall be less than 30cm. At the same time, ensure that the filter and the drive are connected to the same grounding reference plane. Ensure the reliable ground of filter, or the filtering effect can't be achieved.

While using multiple drives and sharing a noise filter in the power supply department, please consult the noise filter manufacturer. If noises reach the limit, it would be better to use two in series(as shown in the figure above)

2.11.3.2 Model selection of noise filter

In order to meet the requirement of the product per EN/IEC 61800-3 standard on radiation and conducted emission EMC directive, please connect external EMC filter. SCHAFFNER's single-phase FN2090 and 3-phase FN3258 filters are recommended.

SCHAFFNER FN2090 filter

SCHAFFNER FN3258 filter

Figure 2-43 SCHAFFNER EMC filter outline

Servo drive model and recommended EMC filter model are shown in the following table:

Table 2-16 Recommended manufacturers and models of EMC filters

Series	Drive type	Rated input current (A)	Filter model
		In	(SCHAFFNER)
Single-phase 220V power supply			
SIZE A	SV3521-PR1R6**	2.3	FN2090-3-06
	SV3521-PR2R8**	4.0	FN2090-4-06
SIZE B	SV3521-PR5R5**	7.9	FN2090-8-06
SIZE C	SV3521-PR7R6**	9.6	FN2090-10-06
	SV3521-PR012**	12.8	FN2090-16-06
	SV3521-PR014**	16.0	FN2090-16-06
3-phase 220V power supply			
SIZE A	SV3521-PR1R6**	1.4	FN3258-7-44
	SV3521-PR2R8**	2.6	FN3258-7-44
SIZE B	SV3521-PR5R5**	4.4	FN3258-7-44
SIZE C	SV3521-PR7R6**	5.6	FN3258-7-44
	SV3521-PR012**	8.0	FN3258-16-44
	SV3521-PR014**	10.2	FN3258-16-44
SIZE D	SV3523-PR018**	18.7	FN3258-30-44
	SV3523-PR022**	20.7	FN3258-30-44
	SV3523-PR027**	24.4	FN3258-30-44
3-phase 380V power supply			
SIZE C	SV3543-PR5R4**	3.6	FN 3258-7-44
	SV3543-PR8R4**	6.6	FN 3258-7-44
	SV3543-PR012**	8	FN 3258-16-44

SIZE D	SV3543-PR017**	12	FN 3258-16-44
	SV3543-PR021**	16	FN 3258-16-44
	SV3543-PR026**	21	FN 3258-30-33
	SV3543-PR030**	30	FN 3258-30-33

Note for EMC filter installation dimensions recommended:

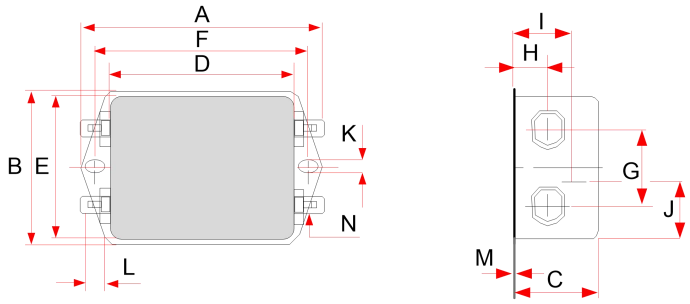


Figure 2-33 Dimensions of FN 2090 1~20A filters (unit: mm)

Table 2-17 Dimensions of FN 2090 1~20A filters (unit: mm)

Rated current (A)	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	71	46.6	22.3	50.5	44.5	61	21	10.8	16.8	25.25	5.3	6.3	0.7	6.3×0.8
3	85	54	30.3	64.8	49.8	75	27	12.3	20.8	19.9	5.3	6.3	0.7	6.3×0.8
4														
6														
8	113.5 ±1	57.5 ±1	45.4 ±1	94±1	56	103	25	12.4	32.4	15.5	4.4	6	0.9	6.3×0.8
10														
12														
16														

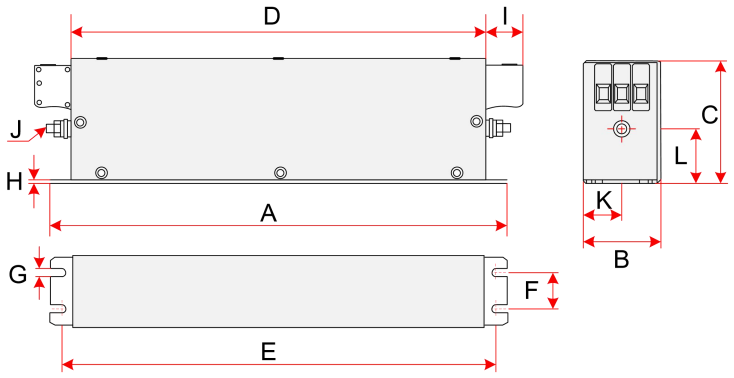


Figure 2-34 Drawing of FN3258 7~30A filter(unit: mm)

Table 2-18 Dimensions of FN3258 7~30A filter size(unit: mm)

Rated current (A)	A	B	C	D	E	F	G	H	I	J	K	L
7	190	40	70	160	180	20	4.5	1	22	M5	20	29.5
16	250	45	70	220	235	25	5.4	1	22	M5	22.5	29.5
30	270	50	85	240	255	30	5.4	1	25	M5	25	39.5

2.11.4 Leakage protection circuit breaker

Servo drive will generate high frequency leakage current during operation. The following matters should be noted in the configuration of cirtuit leakage protection while installing the drive:

The equipment can generate DC leakage current in protective conductor, and must use Type B (delay type) leakage protection circuit breaker;

If multiple drives are required for installation, each drive should be equipped with a leakage protection circuit breaker;

Capacity, carrier frequency, type and length of motor cable, and EMI filter of drive would affect leakage current, so the protection threshold should be set reasonably.

Suc brands as Chint and Schneider are recommended for leakage protection circuit breaker;

When the leakage current generated by drive results in action of leakage protection circuit breaker, the following measures can be taken:

Increase the rated operating current of leakage protection circuit breaker;

Replace the leakage protection circuit breaker to Type B (delay type) with the high-frequency suppression;

Reduce the carrier frequency;

Shorten the output drive cable length;

Install a leakage suppression device.

2.11.5 Cable and wiring Requirements

(1) Power cable requirement

To meet the requirement of CE mark EMC, motor power cable must be shielded witt shielding layer which must be well grounded. Shielded cable consists of a shielded cable with three phase conductors and shielded cable with four phase conductors. If conductive properties of the shielding layer can't meet the requirement, a separate PE line shall be added. Or shielded cable with four phase conductors, herein,one of which is PE line. To effectively suppress the emission and conduction of RF interference, the shielding layer of shielding cable is made of coaxial copper braided tape. To increase the shielding efficiency and conductivity, weaving density of the shielding layer shall be greater than 90%.

Recommended power cable type as shown in the following figure - symmetrical shielded cable:

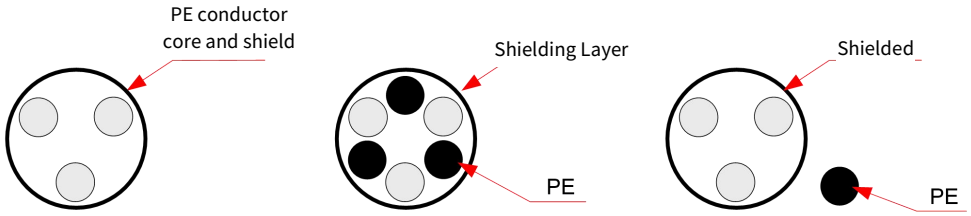


Figure 2-35 Recommended Power Cable Type

I/O cable shielding layer of main loop of servo drive is grounded with PE terminal on drives together(Please refer to the following figure for wiring).

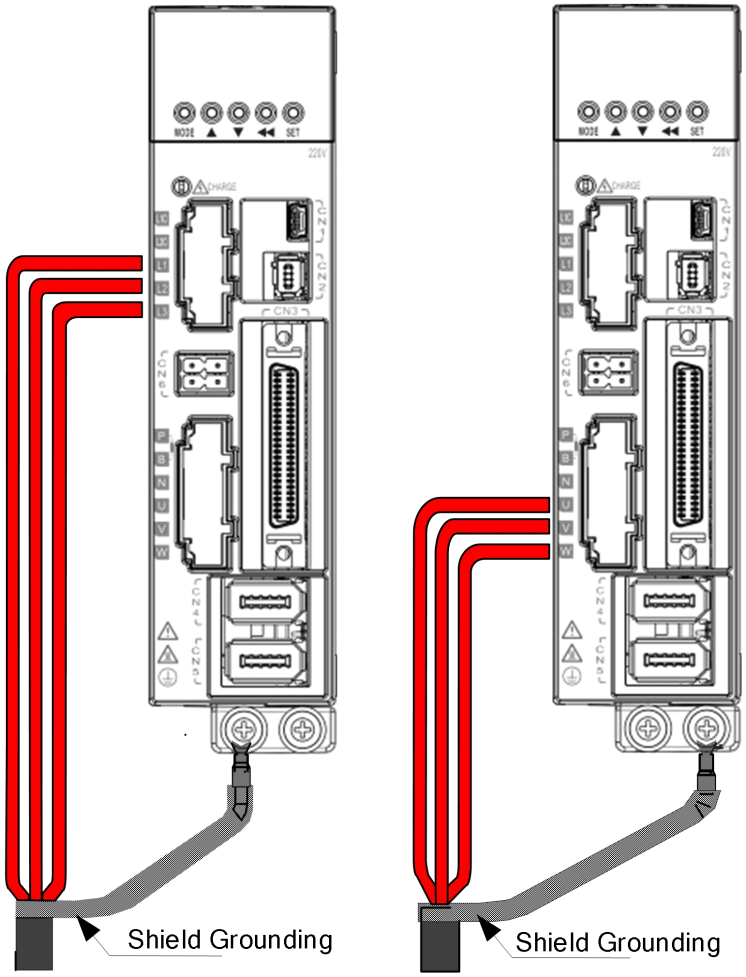


Figure 2-36 Wiring of shielding layer of I/O power cable

The following matters should be noted when selecting output cable of servo drive:

Do not connect any capacitor or surge absorber, otherwise it might activate servo drive regular protection or even damage servo drives;

When motor cable is too long, it's easy to result in electrical resonance due to distributed capacitance, then it might cause motor insulation damage or large leakage current which could activate servo drive overcurrent protection; When the length of motor cable is greater than 100m, AC output reactor must be installed near the servo drive.

Shielding cable is recommended for motor output. Shielding layer shall be bonded for 360°in the structure of grounding support, and shielding layer lead-in wire is crimpped to PE terminals.

The lead-in wire of shielding layer of motor cable should be as short as possible, and width b≥1/5 · a (see Figure 2-37).

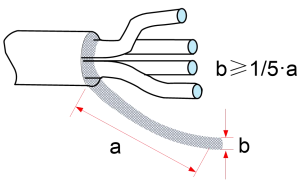


Figure 2-37 Lead-in diagram of motor cable shielding layer

(2) The requirement on encoder cable

The encoder cable must be shielded twisted pair.

Input voltage range of the encoder-end connector is 4.75V to 5.25V DC. Please select the appropriate wire. For 10m or less, use shielded twisted pair with a cross-sectional area of 0.18 mm^2(AWG24) or above; For 10m or above, use shielded twisted pair with a cross-sectional area of 0.32 mm^2(AWG22) or above.

(3) The requirement on USB cable

For connector on driver side, please use the commercially available USB mini-B that meets the specification of computers.

Use shielded USB cable;

While using the cable without any filtering measure, install signal ferrite magnetic rings at both ends of cable.

(4) The requirement on wiring layout

Pay attention to the following matters for routing, and it's recommended to use the routing mode and layout spacing:

Motor cable routing must be far away from other cables. Motor cables of several drives can be parallel wiring;

It is recommended to arrange the motor cable, input power cable, control cable, and encoder cable in different cable ducts. In order to avoid electromagnetic interference due to rapid changes of drive output voltage, long distance parallel wiring of motor cables and other cables should be avoided.

When control cable must pass through power cable, ensure that the angle between two cables is 90 degrees as far as possible. Do not pass other cables through drive;

Power input and output lines and weak current signal lines (e.g., control circuit) of drive shall not be in parallel as far as possible, and vertical layout shall be applied if possible;

It must be properly connected and grounded among cable ducts. Aluminum duct can be used to improve equipotential.

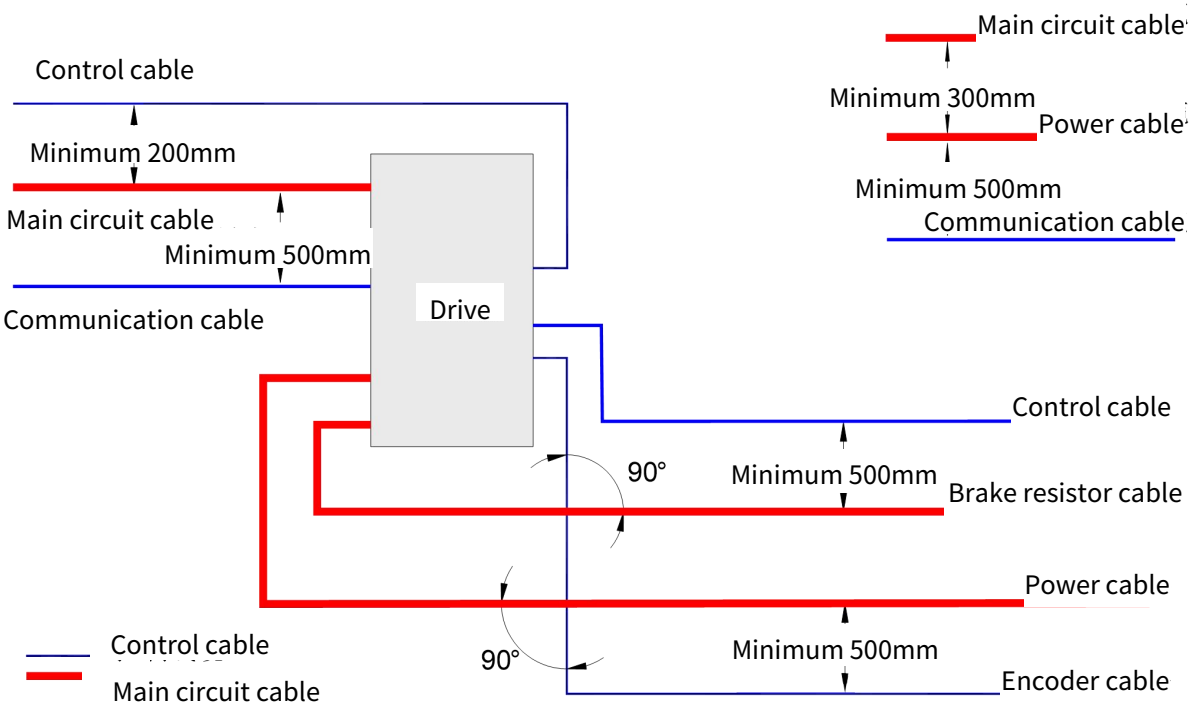


Figure 2-38 Recommended wiring layout

2.11.6 I/O magnetic ring selection

To reduce interference to adjacent devices, it's recommended to add a filter magnetic ring to 3-phase I/O power line of servo drive:

Input cable should be installed far away from servo drive;

Output cable should be installed close to servo drive.

The following table shows magnetic ring models recommended of manufacturer.

Table 2-19 Magnetic ring models recommended of manufacturer

External drawing	Magnetic ring models recommended of manufacturer	Dimensions (outer diameter × inner diameter × thickness) (mm)
	DY644020H	64×40×20
	DY805020H	80×50×20
	DY1207030H	120×70×30

2.11.7 Solutions to common EMC problems

Servo drive is a strong interference equipment, if Error from routing, grounding and protection in the use occurs, it might generate interference. If there is mutual interference with other devices, the following measures can be taken for improvement.

Table 2-20 Common EMC problems and solutions

Interference type	Improvement measure
Switch tripping of leakage protection circuit breaker	1. Under the premise of not affecting the performance, reduce carrier frequency; 2. Shorten the length of drive line; 3. Add magnetic ring around to drive line (not winding PE wire); 4. For power-on instantaneous tripping, it shall disconnect the input larger ground capacitor; (Disconnect the ground of external or built-in filter, and ground of ground Y capacitor at input port); 5. For potential tripping in operation, it shall take the leakage current suppression measure at input port(leakage current filter, safety capacitor + magnetic ring, magnetic ring);
Drive operation causes interference	1. Motor shell is connected to PE end of the driver; 2. Drive PE end is connected to power grid PE; 3. Input power line is equipped with magnetic ring; 4. Mount capacitors or magnetic loops to the interfered signal ports; 5. Add extra common ground among devices;
Communication interference	1. Motor shell is connected to PE end of the driver; 2. Drive PE end is connected to power grid PE; 3. Input power line is equipped with magnetic ring; 4. Communication line source and load end are equipped with matching resistance; 5. Communication line/differential line are equipped with external communication GND; 6. Communication line is shielded, and shielding layer is connected to communication GND; 7. Multi-node communication wiring needs to use Daisy chain; Branch length is less than 30cm;
I/O interference	1. Low speed DI increase capacitance filtering, recommended maximum 0.1uF; 2. AI increase capacitive filter, the recommended maximum 0.22uF;

2.12 Example of control mode specific wiring

2.12.1 Wiring Example of Position Control Mode

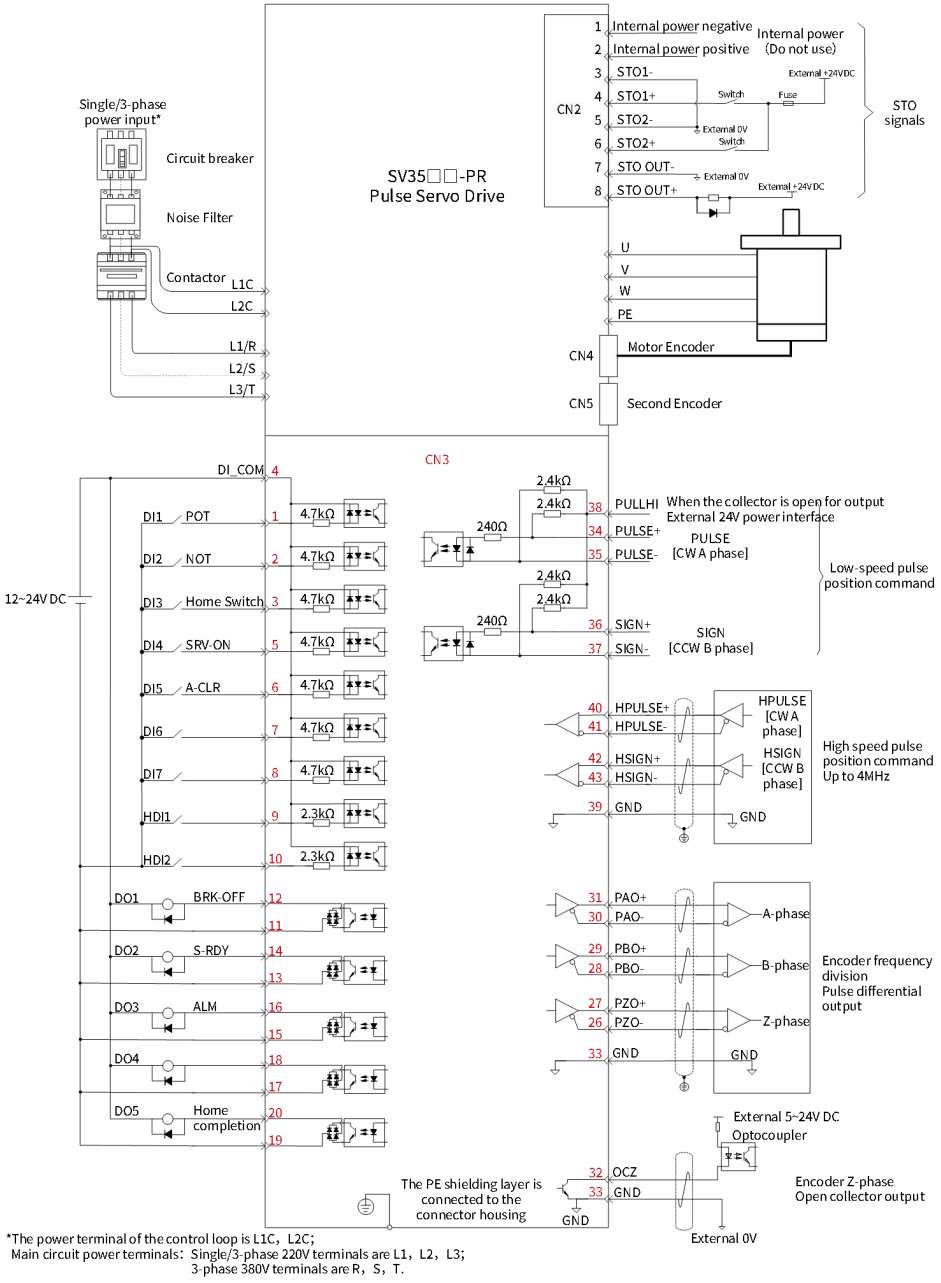


Figure 2-50 SV35 drive wiring example of position control mode

- Please use twisted pair shielded wire for AI/AO circuit wiring, and the shielding layer must be connected to PE at both ends.
- The DI input power supply needs to be externally connected, with a supply voltage range of DC 12~24V and a maximum of DC 30V.
- HDI1 and HDI2 are high-speed DI, please choose to use according to actual requirements.
- Please use twisted pair shielded wire for high-speed/low-speed pulse port wiring. The shielding layer must be connected to PE at both ends, and GND must be reliably connected to the signal ground of the upper

computer.

- The DO output power supply needs to be external, with a power range of 5-24V. The maximum allowable voltage for the DO port is DC 30V, and the maximum allowable current is 50mA.
- Please use twisted pair shielded wires for the encoder frequency division output cable. The shielding layer must be connected to PE at both ends, and GND must be reliably connected to the signal ground of the upper computer.

2.12.2 Wiring Example of Velocity Control Mode

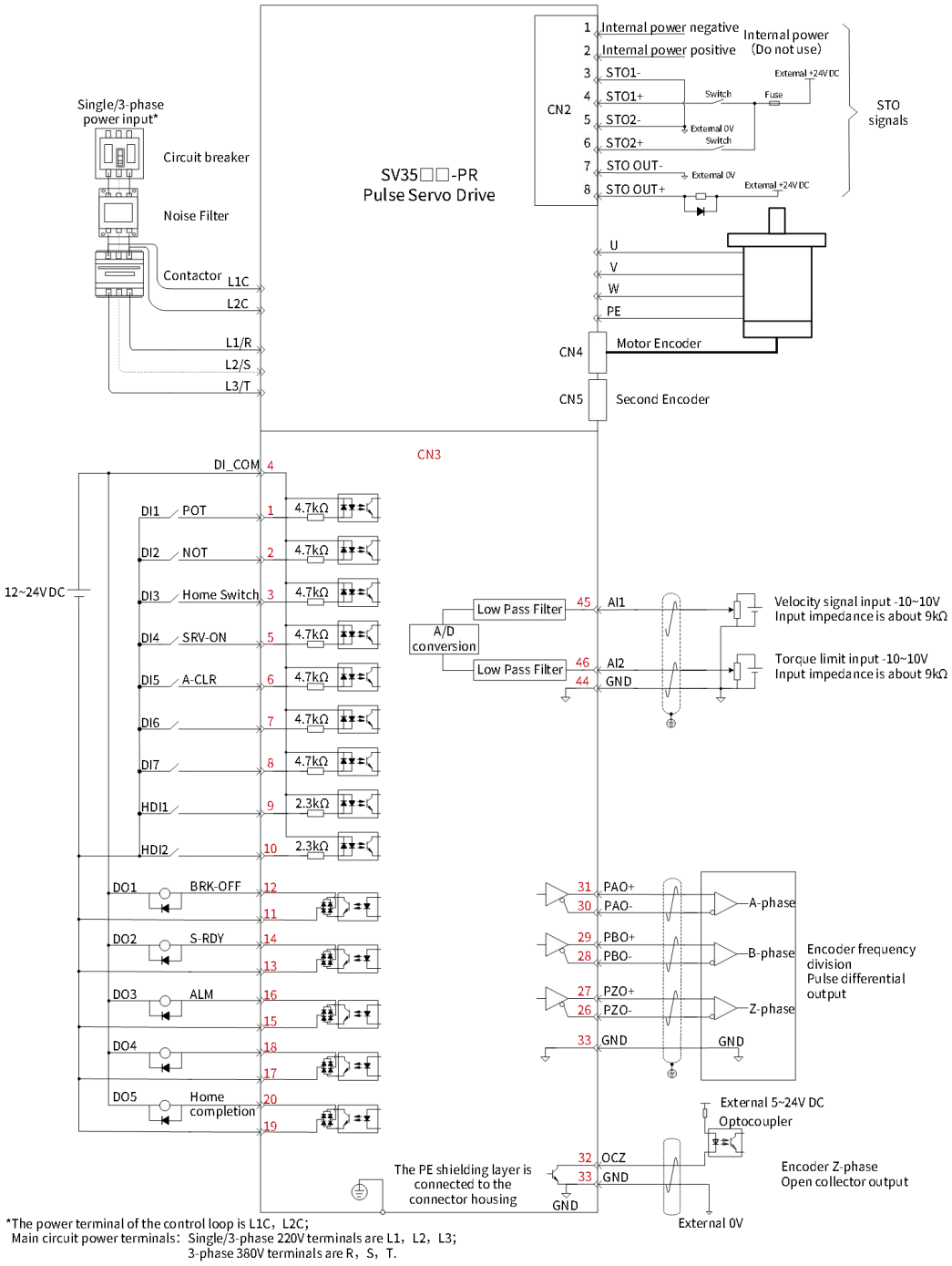


Figure 2–51 SV35 drive wiring example of velocity control mode

- Please use twisted pair shielded wire for AI/AO circuit wiring, and the shielding layer must be connected to PE at both ends.
- The DI input power supply needs to be externally connected, with a supply voltage range of DC 12~24V and a maximum of DC 30V.
- HDI1 and HDI2 are high-speed DI, please choose to use according to actual requirements.

- Please use twisted pair shielded wire for high-speed/low-speed pulse port wiring. The shielding layer must be connected to PE at both ends, and GND must be reliably connected to the signal ground of the upper computer.
- The DO output power supply needs to be external, with a power range of 5-24V. The maximum allowable voltage for the DO port is DC 30V, and the maximum allowable current is 50mA.
- Please use twisted pair shielded wires for the encoder frequency division output cable. The shielding layer must be connected to PE at both ends, and GND must be reliably connected to the signal ground of the upper computer.

2.12.3 Wiring Example of Torque Control Mode

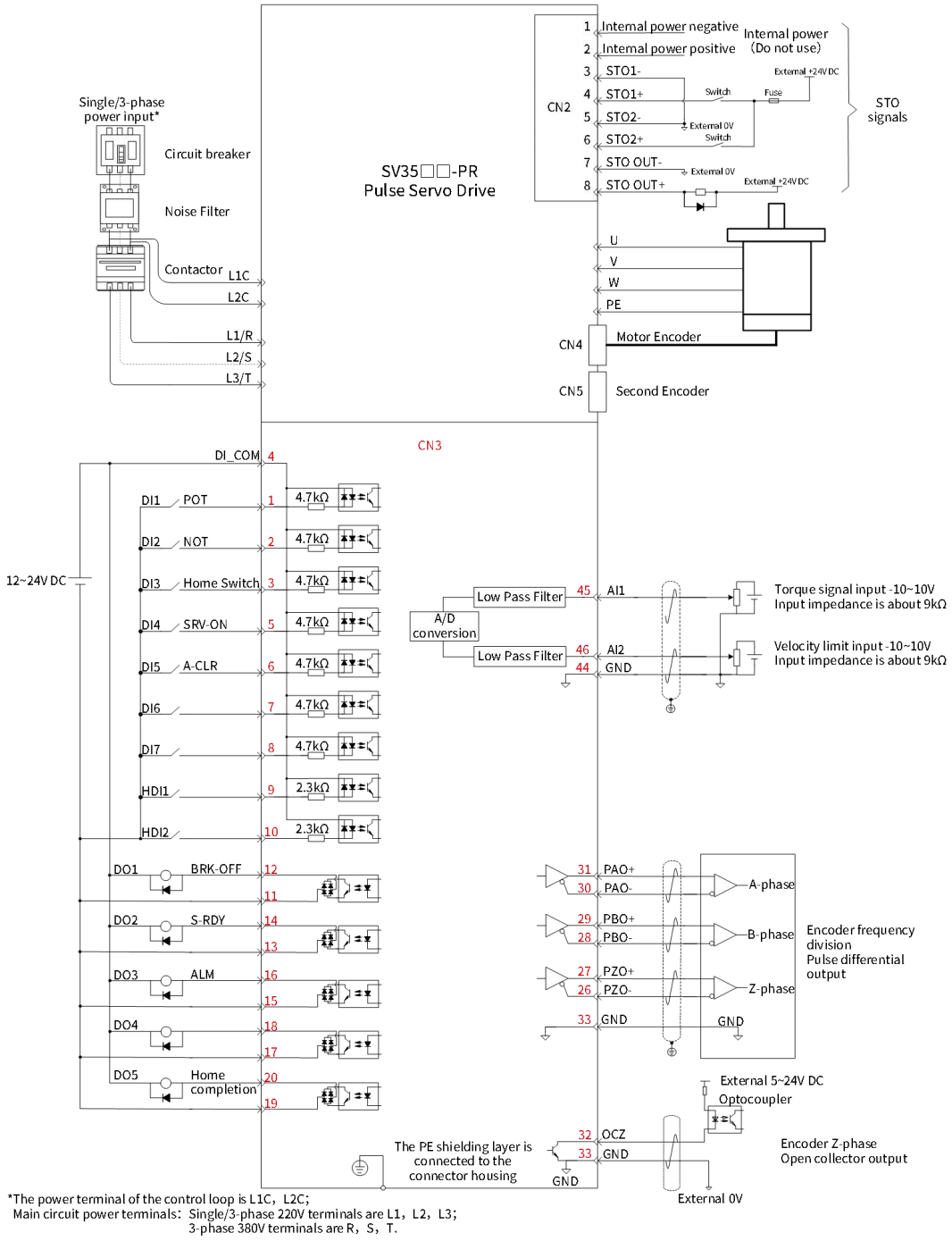


Figure 2–52 SV35 drive wiring example of torque control mode

- Please use twisted pair shielded wire for AI/AO circuit wiring, and the shielding layer must be connected to PE at both ends.
- The DI input power supply needs to be externally connected, with a supply voltage range of DC 12~24V and a maximum of DC 30V.
- HDI1 and HDI2 are high-speed DI, please choose to use according to actual requirements.
- Please use twisted pair shielded wire for high-speed/low-speed pulse port wiring. The shielding layer must be

connected to PE at both ends, and GND must be reliably connected to the signal ground of the upper computer.

- The DO output power supply needs to be external, with a power range of 5-24V. The maximum allowable voltage for the DO port is DC 30V, and the maximum allowable current is 50mA.
- Please use twisted pair shielded wires for the encoder frequency division output cable. The shielding layer must be connected to PE at both ends, and GND must be reliably connected to the signal ground of the upper computer

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Chapter 3 Commissioning

3.1 Settings of Basic Operation

3.1.1 Motor Tuning

Before servo system runs, it is necessary to enter the motor parameters and identify magnetic poles.

This section describes the panel operation process. For details about background operations, see 3.3 SV3 Designer.

(1)Entering motor parameters

The setting mode of motor parameters is shutdown operation, and the effective mode is power-on reset. List of motor parameters is as follows:

Table 3-1 Parameters of the Motor

Name	Function code	Uit	Default	Min.	Max.
Rated voltage	P00.10	V	0:220V	0:220V	65535
Rated current	P00.11	A	4.70	0.01	655.35
Rated power	P00.12	kW	0.75	0	655.35
Rated torque	P00.13	N.m	2.39	0	168427.51
Max. torque	P00.15	N.m	7.16	0	42949672.95
Rated speed	P00.17	rpm	3000	0	65535
Max. speed	P00.18	rpm	6000	0	65535
Inertia of motor	P00.19	kg • cm^2	1.30	0	42949672.95
Number of pole pairs	P00.21	-	4	0	65535
Phase resistance	P00.22	Ω	0.500	0	65.535
Inductance Lq	P00.23	mH	3.27	0	655.35
Inductive Ld	P00.24	mH	3.87	0	655.35
Counter potential	P00.25	mV/rpm	33.30	0	655.35
D-axis back potential compensation	P00.31	%	60.0	0.0	6553.5
Q-axis back potential compensation	P00.32	%	100.0	0.0	6553.5
Current sampling and extraction rate	P00.33	-	0- Extraction rate 32	0- Extraction rate 32	3- Extraction rate 256
D axis proportional gain 1	P00.34	Hz	2000	0	65535
D axis integral gain 1	P00.35	%	2.00	0.00	655.35
Q-axis proportional gain 1	P00.36	Hz	2000	0	65535
Q axis integral gain 1	P00.37	%	1.00	0.00	655.35
D axis proportional gain 2	P00.38	Hz	1000	0	65535
D axis integral gain 2	P00.39	%	2.00	0.00	655.35
Q-axis proportional gain 2	P00.40	Hz	1000	0	65535
Q axis integral gain 2	P00.41	%	1.00	0.00	655.35

Please check the model and parameters of motor used, and enter the motor parameters according to the following process.

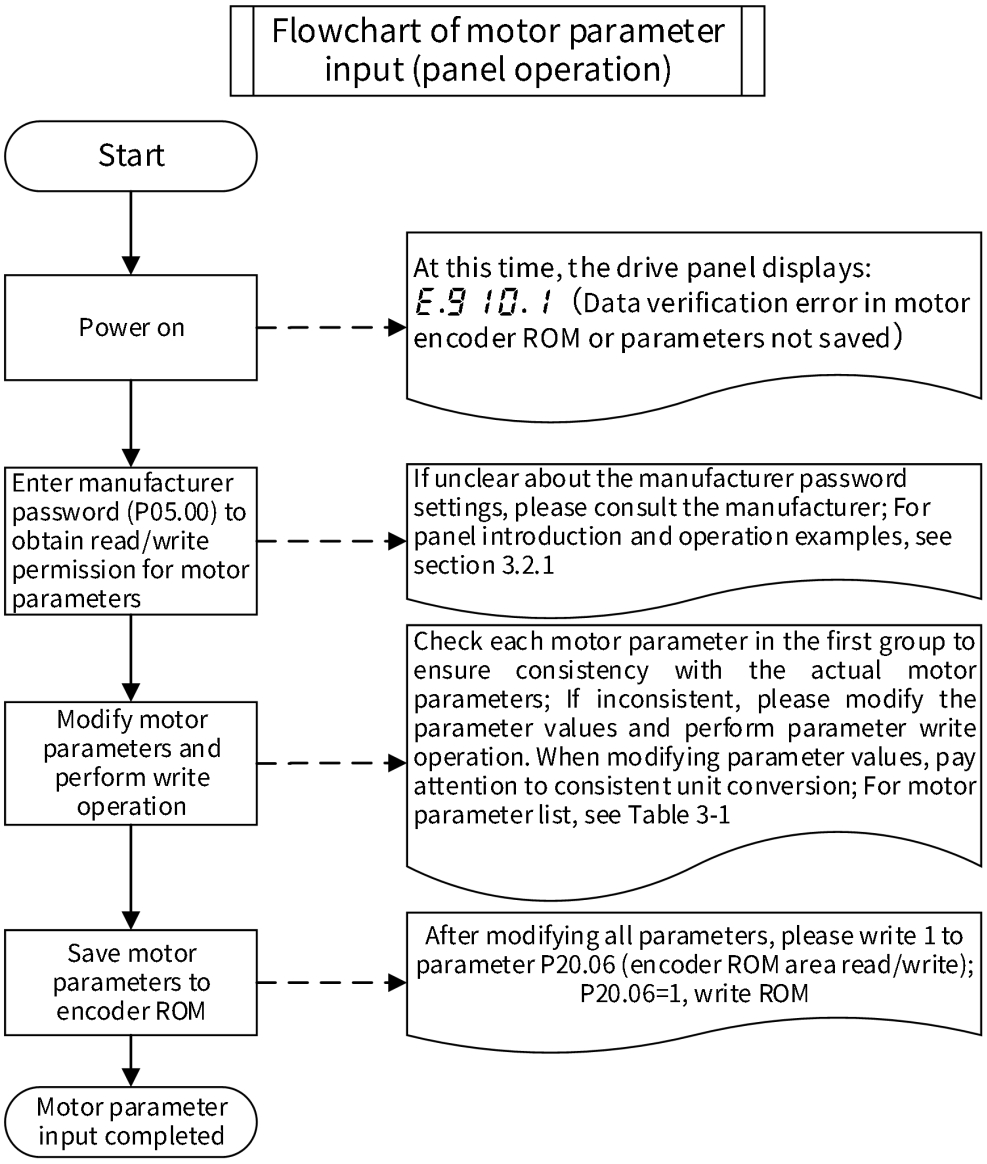


Figure 3-1 Panel operation process of motor parameter entering

(2)Magnetic pole identification

Operation process of magnetic pole identification is as follows.

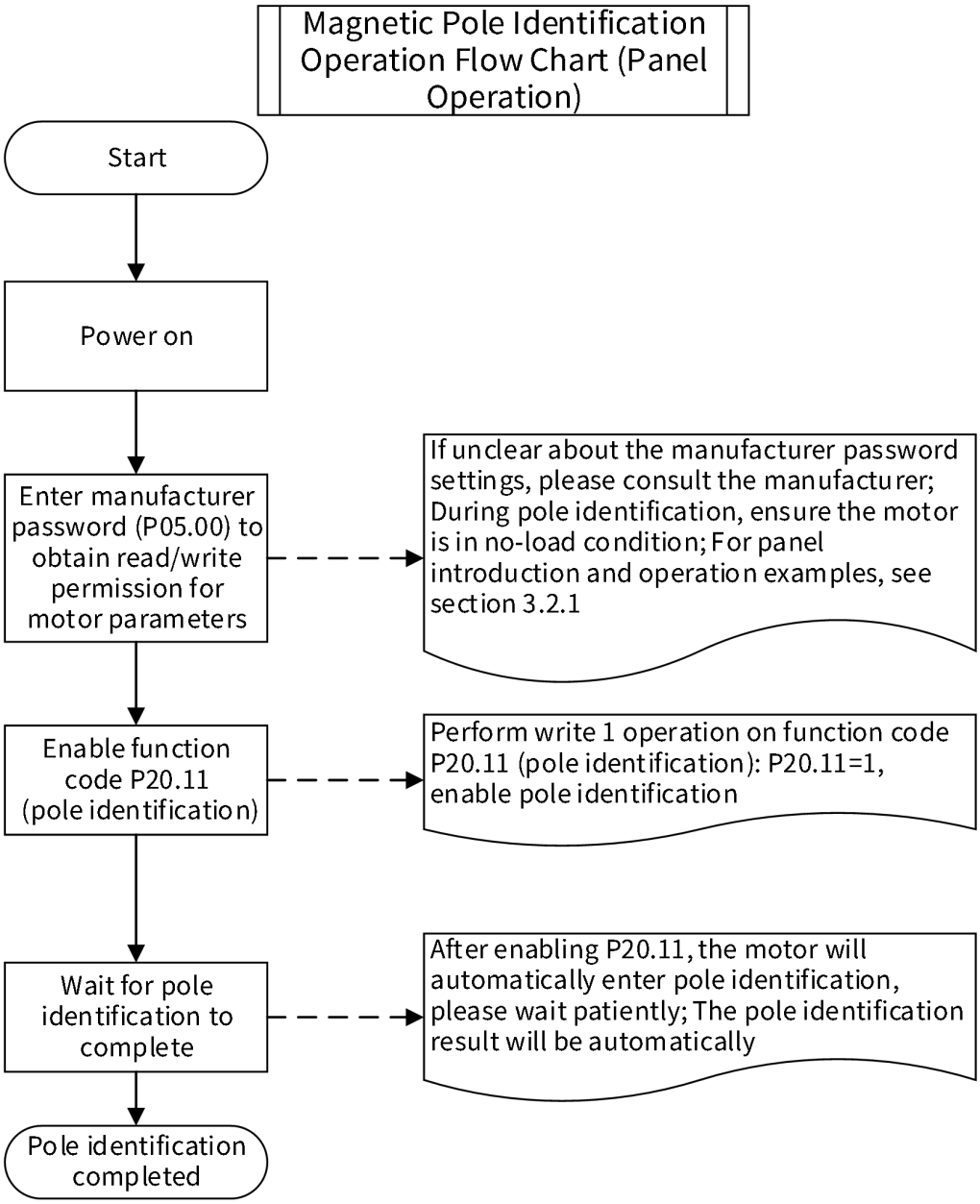


Figure 3-2 Operation process of magnetic pole identification

3.1.2 Brake Setting

Holding brake is used to stop the unexpected movement of moving loads(e.g., falling under gravity) when the servo system is not activated (e.g., servo system is powered off), to prevent servo motor from moving unexpectedly due to its own weight or external force after being powered off.

⚠ **Note:**

Holding brake is the non-powered action type special mechanism, which can't be used for braking, and can be used only when servo motor is in the stop state.

Non-polarity of Holding brake coil;

After servo motor stops, it shall switch off servo enable.

When the motor with built-in Holding brake runs, the brake might make the clicking, that doesn't affect any function;

When the brake coil is energized (the brake is ON), magnetic flux leakage may occur at shaft ends. When using the magnetic sensor near motors, please pay attention to the possibility of this situation.

3.1.2.1 Holding brake parameter setting

For applications with Holding brake, it must set Holding brake enable switch(P05.12) ON, and one of servo drive DO terminals must be configured to Function 17 (BK, Holding brake control), and ensure the valid logic for the corresponding DO terminal.

According to the current state of the servo drive, the working timing of the brake mechanism can be divided into two types: the normal state brake timing of the servo drive and the fault state brake timing of the servo drive.

Table 3-2 Function code of P05.12 Holding brake enable switch

P05.12- Lock Holding brake switch	
Accessibility	Readable/writable
Unit	-
Default	1
Min.	0
Max.	1
Setting and effective mode	Run settings/Effective immediately

Table 3-3 Holding brake output No.

Encoding	Name	Function name	Functions
17	BK	Holding brake control	Ineffective, the brake power supply is ON, the brake runs, motor is in the position stalled state; Effective, the brake power supply is OFF, the brake is cancelled, and motor can move;

3.1.2.2 Servo drive normal state brake timing

Holding brake sequence in the normal state can be divided into such 2 situations as motor static and motor dynamic:

Static: Motor actual speed is below 30rpm;

Dynamic: Motor actual speed reaches 30rpm and above.

(1) Timing of brake holding when servo motor is stationary

When servo enable is switched from ON to OFF, if the current motor speed is lower than 30rpm, the drive would run according to static brake sequence;

After the brake output is set from OFF to ON, do not enter any position/speed/torque instruction within P05.13 time, or instructions would be lost or it would run improperly;

Being used in vertical axis, self-weight or external force of mechanical moving part may cause the slight movement of machine. When servo motor is stationary, the servo enable switches OFF, and the brake output immediately turns OFF, but within P05.14 time, the motor is still in the power-on state to prevent mechanical moving part from moving due to self-weight or external force.

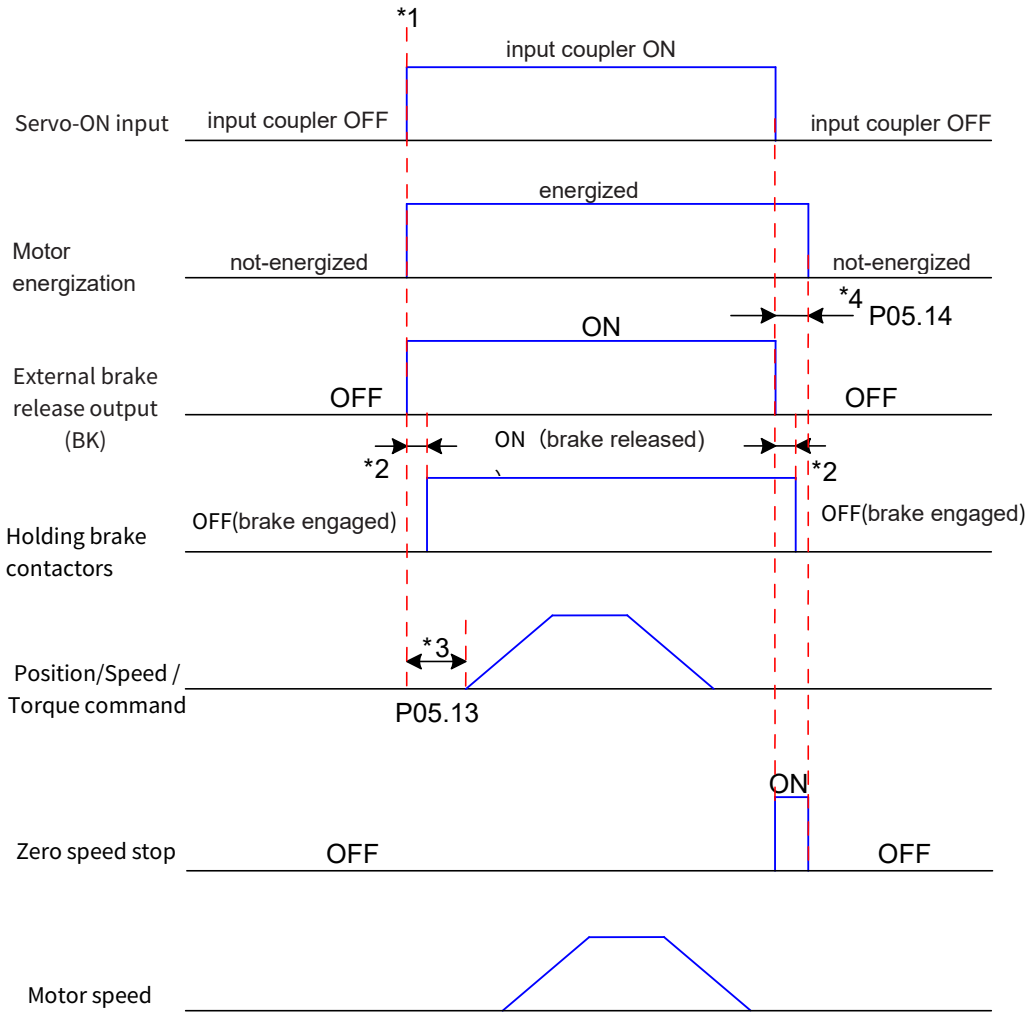


Figure 3-3 Timing diagram of Holding brake when motor is stationary

*1. When servo enable is ON, the brake output is set as ON; At the same time, the motor enters the power-on state;

*2. Please refer to the relevant specification for delay time of action of Holding brake contact part;

*3. From the brake output set as ON to inputing command, please leave an interval above P05.13 time;
*4. When servo motor is static(motor speed below 30rpm), when servo enable is OFF, brake output is set as OFF at the same time. By P05.14, motor enters the delay of non-power-on state after brake output is set as OFF.

Table 3-4 P05.13 Function code from the brake switch-off to receiving command delay(Stop state)

P05.13 - From the brake switch-off to receiving command delay	
Accessibility	Readable/writable
Unit	ms
Default	250
Min.	0
Max.	500
Setting and effective mode	Run settings/Effective immediately

Table 3-5 P05.14 Function code of zero speed holding time of Holding brake switched on (Stop state)

P05.14- Zero speed holding time for lock suction	
Accessibility	Readable/writable
Unit	ms
Default	150
Min.	1
Max.	1000
Setting and effective mode	Run settings/Effective immediately

(2) Timing of brake holding during servo motor movement

When servo enable is switched from ON to OFF, if the current motor speed is higher than or equal to 30rpm, the drive will operate according to the motion brake sequence.

When the servo enable is set from OFF to ON, do not enter position/speed/torque command within P05.13 time, or commands will be lost or operates improperly;

While servo motor is moving, servo enable OFF occurs, and servo motor enters zero speed stop state, but Holding brake output can be set as OFF only if any of the following conditions are met. I. P05.16 time hasn't expired, but it has reduced the motor speed to P05.15; ii . P05.16 time ends, but motor speed is still above P05.15.

Output of Holding brake ON change OFF then 50ms during the period, motor is still powered on and prevent mechanical parts from moving due to self-weight or external force.

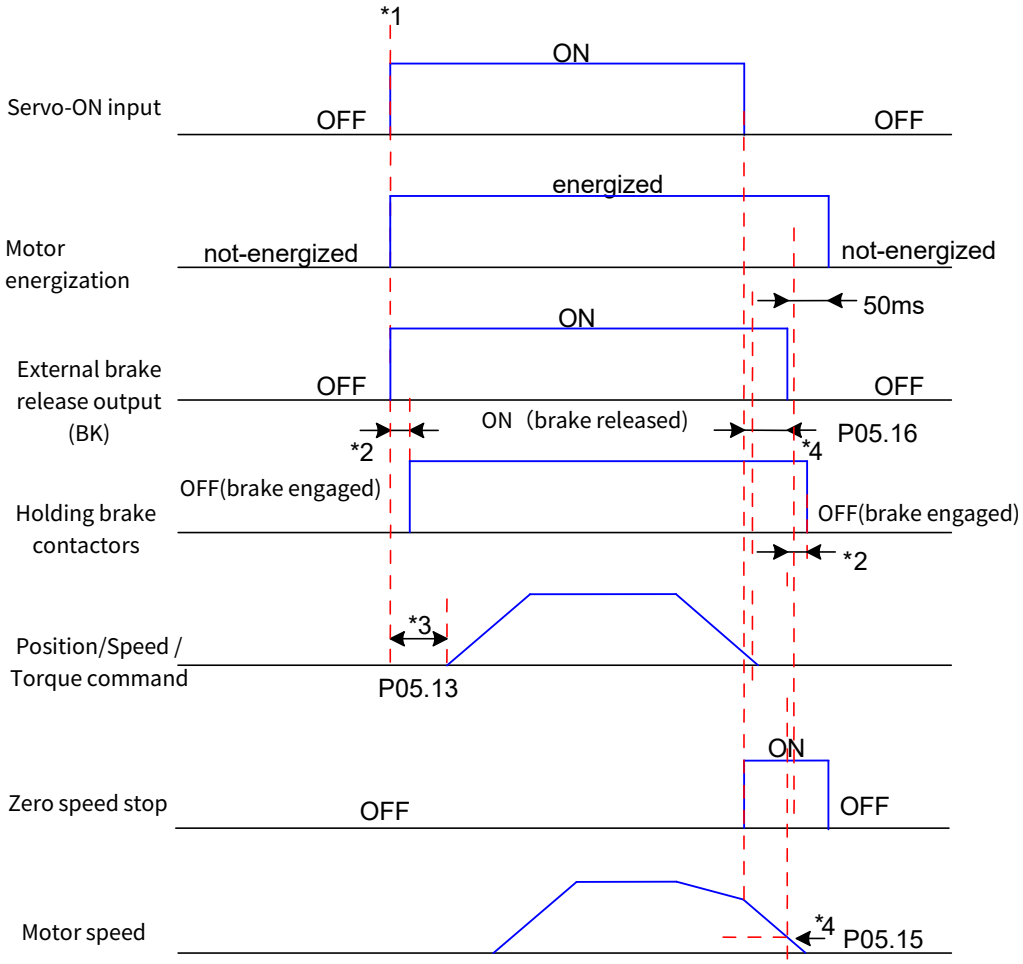


Figure 3-4 Sequence diagram of Holding brake when motor moves

*1. When servo enable is ON, the brake output is set as ON; At the same time, the motor enters the power-on state;

*2. Please refer to the relevant specification for delay time of actions of Holding brake contact part.

*3, From Holding brake output as ON to input command, please set an interval above P05.13.

*4. In the case of servo motor movement, when servo enable is OFF, it can set the delay of Holding brake output OFF after servo enable is OFF. It can be set through P05.15 and P05.16. After Holding brake outputs OFF, delay time is 50ms, then motor would enter the non-powered state.

Table 3-6 P05.15 Holding brake power-on speed threshold

P05.15 - Holding brake power-on speed threshold	
Accessibility	Readable/writable
Unit	rpm
Default	30
Min.	0
Max.	3000
Setting and effective mode	Run settings/Effective immediately

Table 3-7 P05.16 - Holding brake power-on speed threshold

P05.16 - Holding brake power-on speed threshold	
Accessibility	Readable/writable
Unit	ms
Default	500（ms）
Min.	1
Max.	1000
Setting and effective mode	Run settings/Effective immediately

3.1.2.3 Servo drive fault status brake timing

According to stop modes, servo Errors are classified into Type 1 fault(referred to as NO.1) and Type 2 fault (referred to as NO.2). For details, see Chapter 5 Troubleshooting and Alarm. Holding brake sequence of servo drive in Error state can be divided into the following 2 situations:

(1) Type 1 fault occurs

The output condition of the brake DO is the same as the brake timing when the servo motor moves under normal state of the servo driver. That is, the brake output must meet any of the following conditions to be set to OFF:

Ⅰ. P05.16 time has not yet arrived, but the motor has slowed down to P05.15;

Ⅱ. P05.16 time has passed, but the motor speed is still higher than P05.15.

(2) Type 2 fault occurs

When the second type of fault occurs and the brake is enabled, the shutdown mode for the second type of fault is forced to be "zero speed shutdown, free running state".

At this point, the servo motor first stops at zero speed. When the actual speed of the motor is below 30rpm, the output condition of the brake DO is the same as the "brake timing when the servo motor is stationary in the normal state of the servo driver", that is, the brake output immediately becomes OFF, but the motor is still powered on during P05.14 time.

3.1.3 Selection of Running Direction

By setting the running direction, the motor's running direction can be changed without changing the polarity of the input command. After modification, only when powering on the servo again, can it take effect.

When "Direction Selection" is changed, pulse form of servo drive output and positive/negative state of monitoring parameters won't change.

Setting of "Positive direction drive" in the overrun prevention is identical to that of "Motor operation direction selection (P04.01)".

The running direction can be set to "P04.01" on the panel or "P04 group - motor motion direction selection" on the backend software.

Table 3-8 P04.01- Selection of motor operation reversing

P04.01- Selection of motor operation reversing	
Accessibility	Readable/writable
Unit	1
Default	0
Min.	0
Max.	1
Setting and effective mode	Stop setting/power-on reset
Note	When viewed from motor shaft side.its rotation direction is defined as positive.

3.1.4 Absolute Value Function

(1)Instruction of absolute value system

Absolute encoder can simultaneously record the position of servo motor and turns of servo motor rotation. Single-turn resolution is 1048576, and turns of 16-bit Max. 65535 can be recorded. Absolute encoder will back up position data when the upper servo drive is powered off. After power-on reset, machine absolute position can be calculated without re-starting the original zero point(**When using incremental encoders in servo drives, the position feedback is 0 after power on. By resetting the origin to find the point where the mechanical position feedback is truly 0, the servo motor can operate correctly on the mechanical equipment; After using the absolute value encoder and powering it on again, the correct position feedback value will be calculated based on the information backed up by the encoder.**)

⚠ Note:

SV3 servo drives support absolute position linear mode and absolute position rotation mode, which is suitable for position, speed, and torque mode;

E.917 encoder battery Error occurs when battery is switched on for the first time. It shall set P20.05=1 to reset the encoder Error, and then perform the home.

To modify the direction reservsing selection of P04.01, it shall reset the home;

In absolute position mode, the servo automatically detects whether motor number is absolute encoder motor, if the setting is wrong, Error E.019 occurs(encoder matching Error).

(2) Object related to absolute value system

Function selection object:

Table 3-9 P04.02 - Selection of Position Feedback System

<table>
<tr><th colspan="2">P04.02 - Selection of Position feedback System</th></tr>
<tr><td>Accessibility</td><td>Readable/writable</td></tr>
<tr><td>Unit</td><td>-</td></tr>
<tr><td>Default</td><td>0</td></tr>
<tr><td>Min.</td><td>0</td></tr>
<tr><td>Max.</td><td>2</td></tr>
<tr><td>Setting and effective mode</td><td>Stop setting/power-on reset</td></tr>
<tr><td>Related mode</td><td>ALL</td></tr>
<tr><td>Note</td><td>Set absolute value system
<table>
<tr><th>Settings</th><th>Selection of absolute value system</th></tr>
<tr><td>0</td><td>Incremental mode</td></tr>
<tr><td>1</td><td>Absolutely linear model</td></tr>
<tr><td>2</td><td>Absolute rotation mode</td></tr>
</table></td></tr>
</table>

Table 3-10 P20.05- Encoder reset

P20.05- Encoder reset		
Accessibility	Readable/writable	
Unit	-	
Default	0	
Min.	0	
Max.	2	
Setting and effective mode	Stop setting/power-on reset	
Related mode	-	
Note	Encoder reset	
	Settings	**Description**
	0	No action
	1	Reset Error
	2	Reset Error and multi-turn data

Table 3-11 encoder feedback parameter objects

Parameter	Name	Unit	Range
P09.42	Number of encoder turns	Turn	0~65535
P09.43	Encoder single turn position	Encoder unit	0~(2^{31}-1)
P09.45	Encoder absolute position Low 32 bits	Encoder unit	(-2^{31})~(2^{31}-1)
P09.47	Encoder absolute position High 32 bits	Encoder unit	(-2^{31})~(2^{31}-1)

⚠ **Note:**

- P09.43 is the encoder single-turn position, and its range is 0 to encoder resolution. In case of 23-bit encoder, the range is 0~(2^{23}-1);
- P09.42/P09.43 are both encoder feedback data;
- As P09.42 is an unsigned number, absolute position of absolute encoder is calculated as follows:

  Encoder absolute position = P09.42×encoder resolution + P09.43(P09.42<32768)

  or

  Encoder absolute position = (P09.42-65536)×encoder resolution + P09.43 (P09.42≥ 32768)
- P09.45 and P09.47 are used to display the absolute position of encoder. The formula is as follows: absolute encoder absolute position = P09.47×232+ P09.45.

(3) Precautions for absolute value system

- If the battery is connected for the first time, E.917 (encoder battery Error) will occur. It requires to set P20.05=1 to reset the encoder Error, and then perform absolute position system operation;
- If the detected battery voltage is less than 3.1V, E.921 (encoder battery Alarm) will occur. Please replace the battery; Ensure that the servo drive is powered on but not running when replacing the battery;
- If the servo drive is powered off, the battery is detached or replaced, please use P20.05=1 to reset the encoder Error after powered-on, and then perform the homing operation;
- If the servo drive is powered off, Max. speed of the motor should not exceed 6000rpm, otherwise, encoder position data may be recorded improperly;
- Please ensure that battery SOC and storage conditions do not damage the battery.

3.1.5 Setting of Electronic Gear Ratio

3.1.5.1 The concept of electronic gear ratio

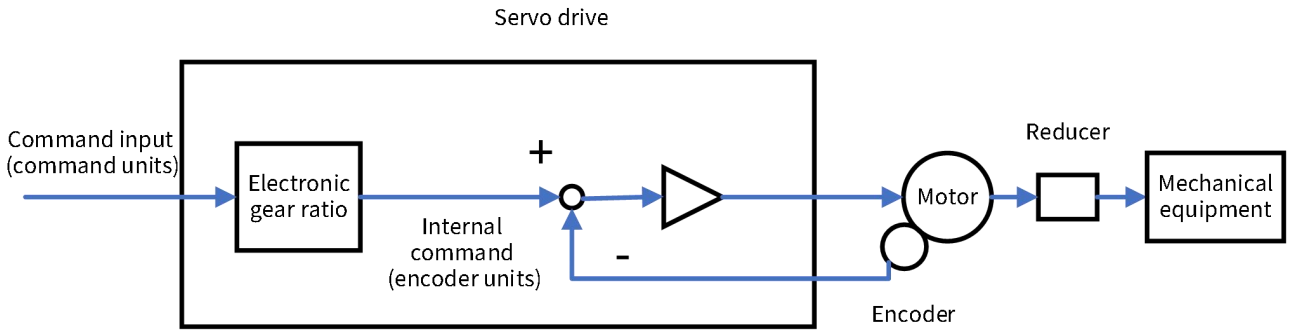


Figure 3–5 Electronic gear ratio

Electronic gear ratio: Electronic gear ratio is a simulated gear that converts control commands (command units) into actual motor displacement (encoder units), shown as the following formula:

$$\text{Encoder unit} = \text{Command unit} \times \frac{\text{Numerator of electronic gear ratio}}{\text{Denominator of electronic gear ratio}}$$

The range of electronic gear ratio setting is: $\frac{0.001 \times \text{Encoder resolution}}{10000} < B/A < \frac{4000 \times \text{Encoder resolution}}{10000}$. Otherwise, malfunction E.421 (electronic gear ratio setting error) will occur.

Electronic gear setting errors will result in incorrect operation. In this case, it is recommended to reset while the servo drive is stopped.

3.1.5.2 Steps for setting electronic gear ratio

The electronic gear ratio varies depending on the mechanical structure. Please follow the steps below to set up:

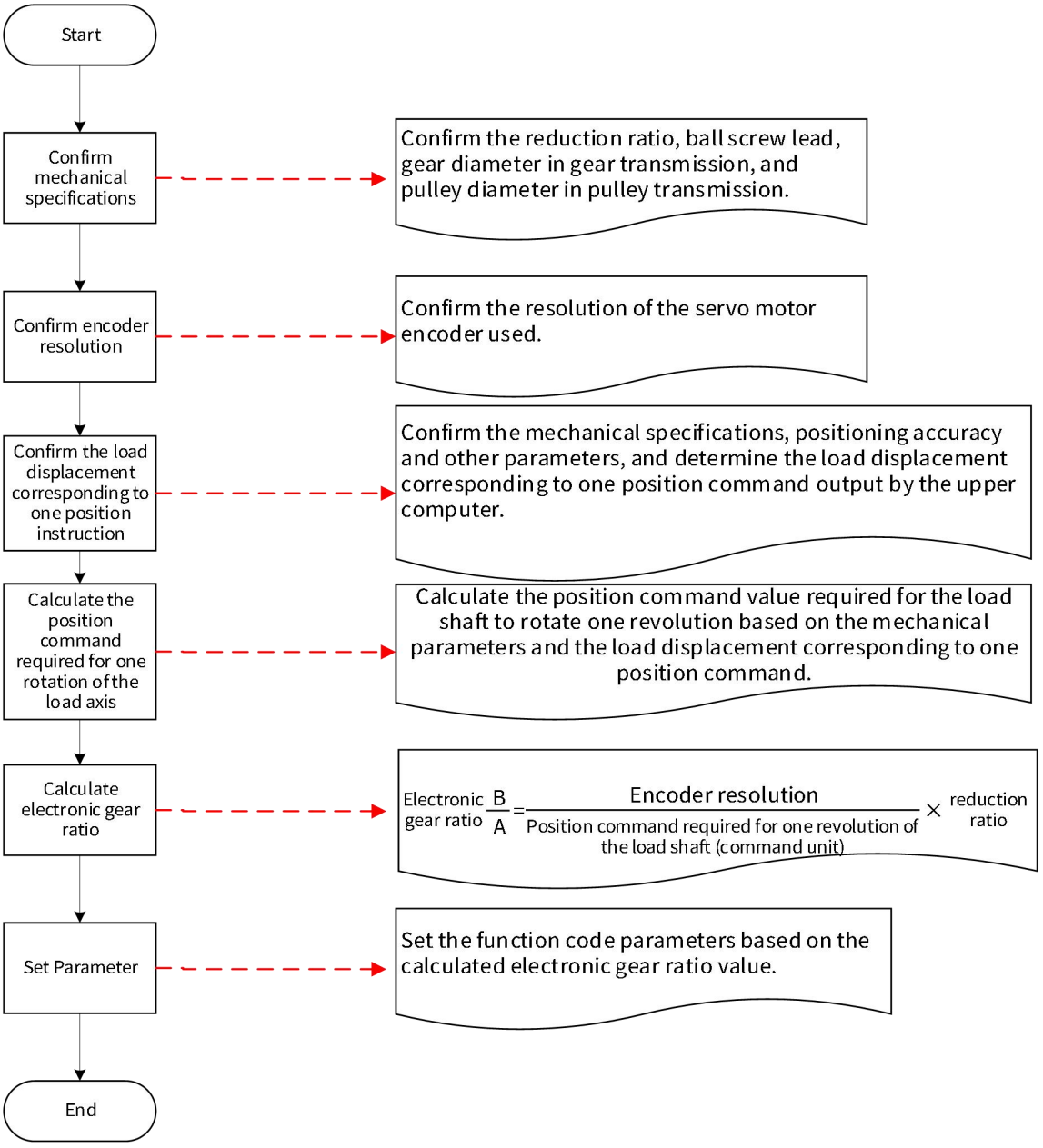


Figure 3-6 Steps for setting electronic gear ratio

Among them, the steps for setting parameters are as follows:

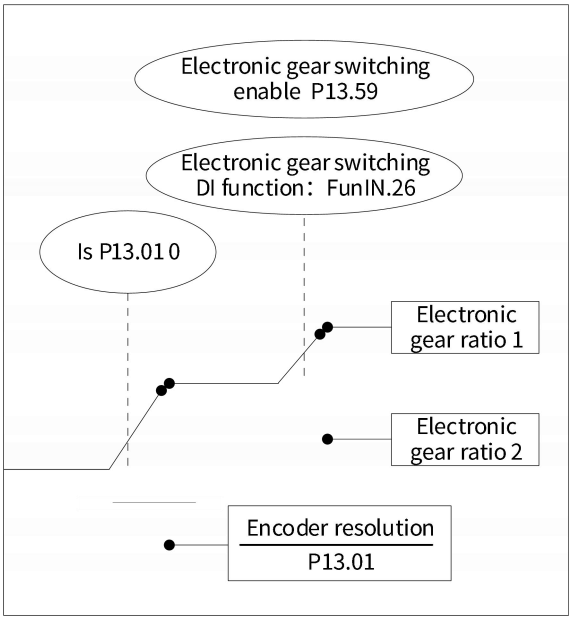


Figure 3-7 Electronic gear ratio setting operation process

When P13.01 is not 0, $\text{Electronic gear ratio}\frac{B}{A} = \frac{\text{Encoder resolution}}{P13.01}$, At this time, electronic gear ratio 1 and electronic gear ratio 2 have no effect.

3.1.5.3 Related function codes

（1）Electronic gear ratio numerical setting

Function code		Name	Range	Unit	Function	Setting method	Effective time	Default
P13	01	Command pulse counts per one motor revolution	0~1048576	P/r	Set the command pulses that causes single turn of the motor shaft.	Effective immediately	Power on again	0
P13	03	Numerator of electronic gear	1~1073741824	-	Set the 1st numerator of of electronic gear ratios	Run settings	Effective immediately	4
P13	05	Denominator of electronic gear	1~1073741824	-	Set the 1st denominator of of electronic gear ratios	Run settings	Effective immediately	1
P22	05	2nd numerator of electronic gear	1~1073741824	-	Set the 2nd numerator of of electronic gear ratios	Run settings	Effective immediately	4
P22	07	2nd denominator of electronic gear	1~1073741824	-	Set the 2nd denominator of of electronic gear ratios	Run settings	Effective immediately	1

（2）Electronic gear ratio switching setting

When P13.01 is 0, the electronic gear ratio switching function can be used. The need to switch between gear ratio 1 and gear ratio 2 should be determined based on the mechanical operation, and electronic gear ratio switching conditions should be set. At any given moment, there is only one set of electronic gears in operation. If the real-time modification of the electronic gear ratio parameters is effective, its effective time is also limited by the switching conditions.

When the real-time change value of electronic gear ratio changes significantly, or when switching between two sets of electronic gear ratios with significant differences, it will cause significant fluctuations in motor speed! At this point, position instruction FIR filtering (P07.00) can be used to smooth the switching of position instructions.

Function code		Name	Range	Function	Setting method	Effective time	Default
P13	59	Electronic gear switching enable	0: Position instruction equals 0 switch 1: Real time switching	Set electronic gear ratio switching conditions	Shutdown setting	Effective immediately	0

Meanwhile, please configure one DI terminal of the servo drive as function 26 (FunIN.26: electronic gear switch) and confirm the valid logic of the DI terminal.

Code	Name	Function
FunIN.26	Electronic gear switch	Ineffective, in position control mode, select the 1st set of electronic gear ratios; Effective, in position control mode, select the 2nd set of electronic gear ratios;

The electronic gear ratio ultimately selected for the servo drive should refer to the table below.

Table 3–12 Electronic gear ratio

P13.01	P13.59	DI terminal level corresponding to FunIN.26	Electronic gear ratio
0	0	Ineffective	$\frac{P13.03}{P13.05}$
		Effective	$\frac{P22.05}{P22.07}$
	1	Ineffective	$\frac{P13.03}{P13.05}$
		Effective	$\frac{P22.05}{P22.07}$

3.1.6 Time sequence diagram

(1) Power on subsequence diagram

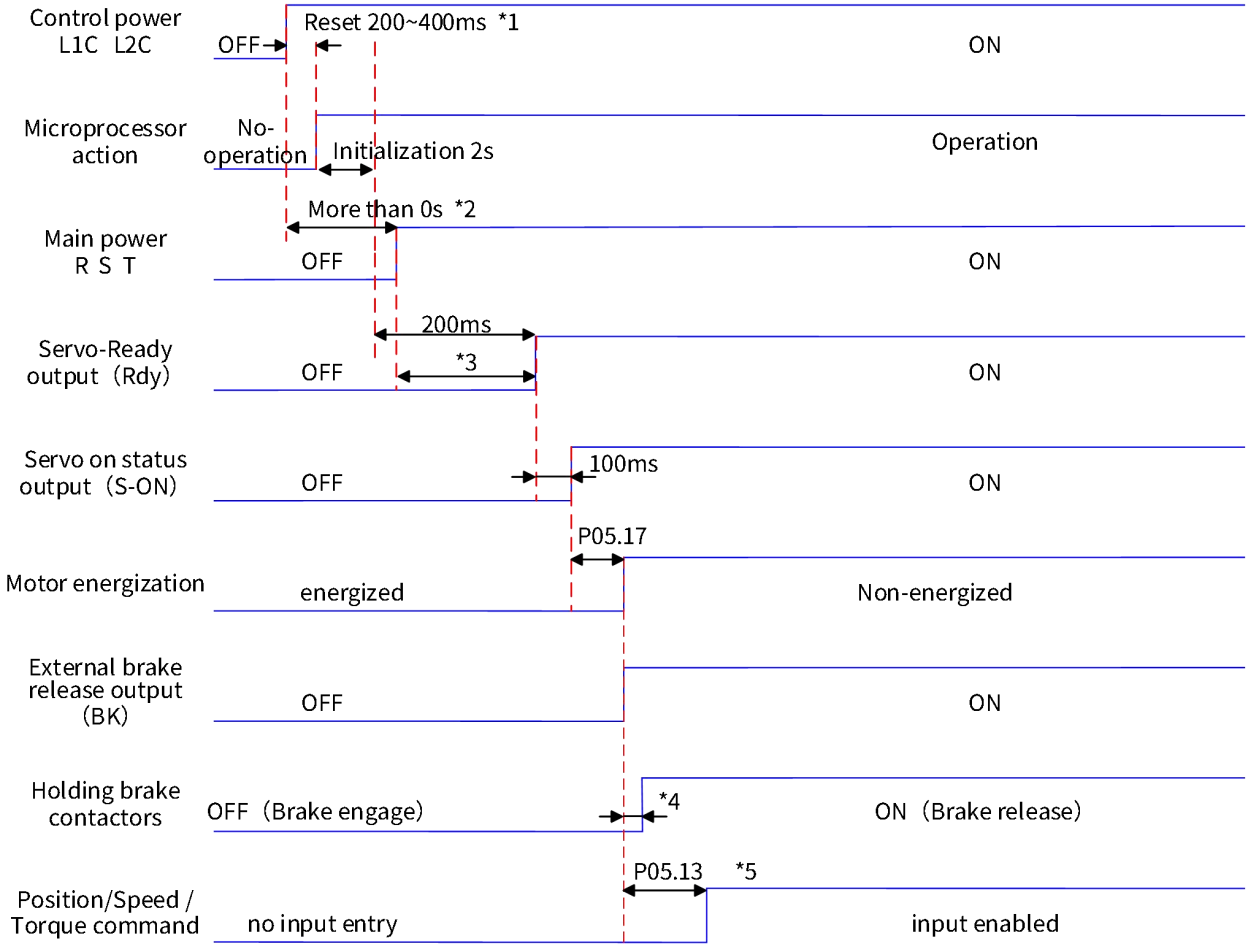


Figure 3-6 Power-on subsequence diagram

*1: The reset time is determined by the establishment time of microprocessor and 5V power supply.

*2: 0s above refers to the time determined by actual time when main power supply is turned on.

*3: When control power supply and main power supply are powered on simultaneously, the time is the same as the period from the completion of microprocessor initialization to Rdy enabled.

*4: Please refer to the relevant specification for delay time of Holding brake contact action.

*5: When Holding brake enable switch (P05.12) is OFF, P05.13 has no effect.

(2) Stop sequence diagram when Alarm or Error occurs

A) Error 1: Free stop, maintain a free running state;

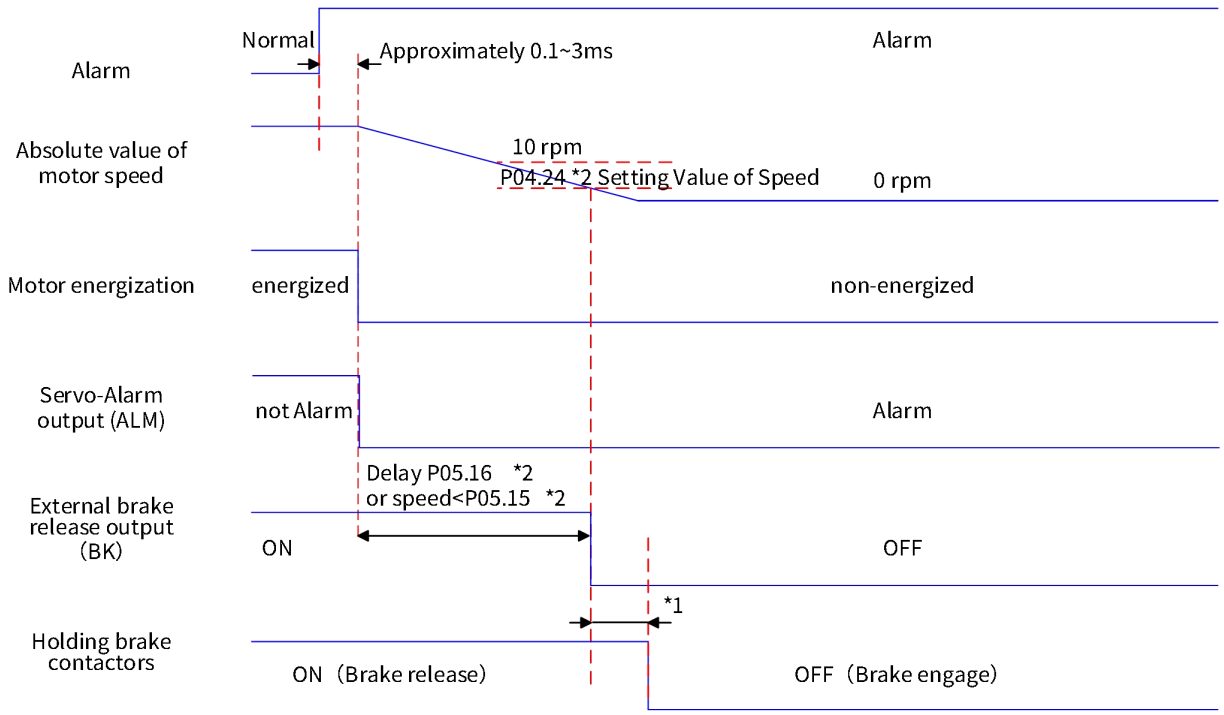


Figure 3-7 Sequence diagram of free stop and free running state during Error 1

*1: Please refer to the relevant specifications for delay time of Holding brake contact action.

*2: When the brake enable switch (P05.12) is OFF, P05.15 and P05.16 have no effect.

B)Error 2: Not a Holding brake. Free shutdown, maintaining a free running state.

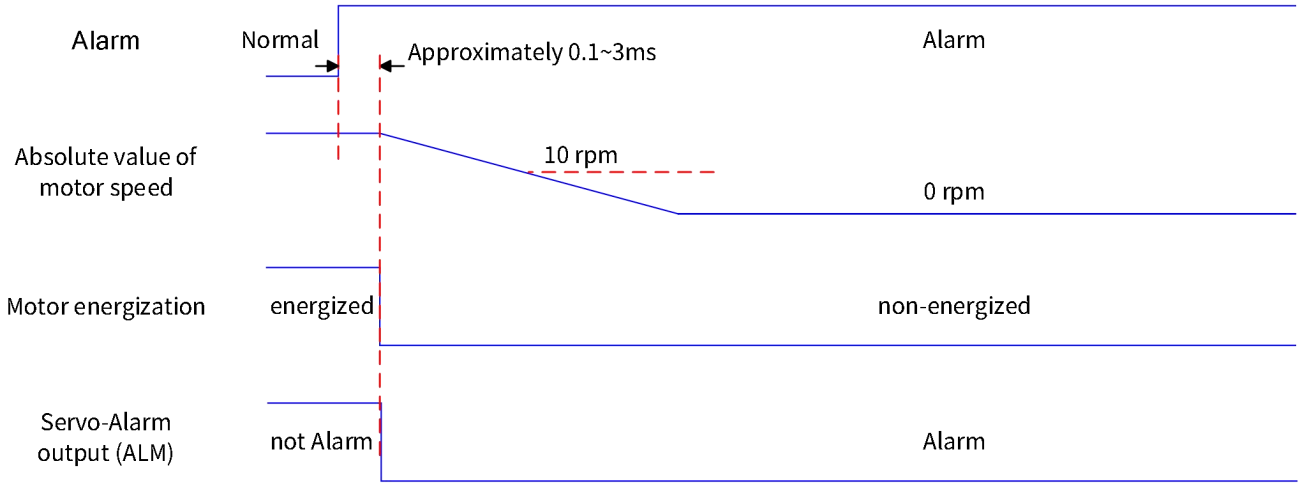


Figure 3-8 Sequence diagram of free stop and free running state during Error 2

C) Error 2: Not Holding brake: DB stop, maintain DB status

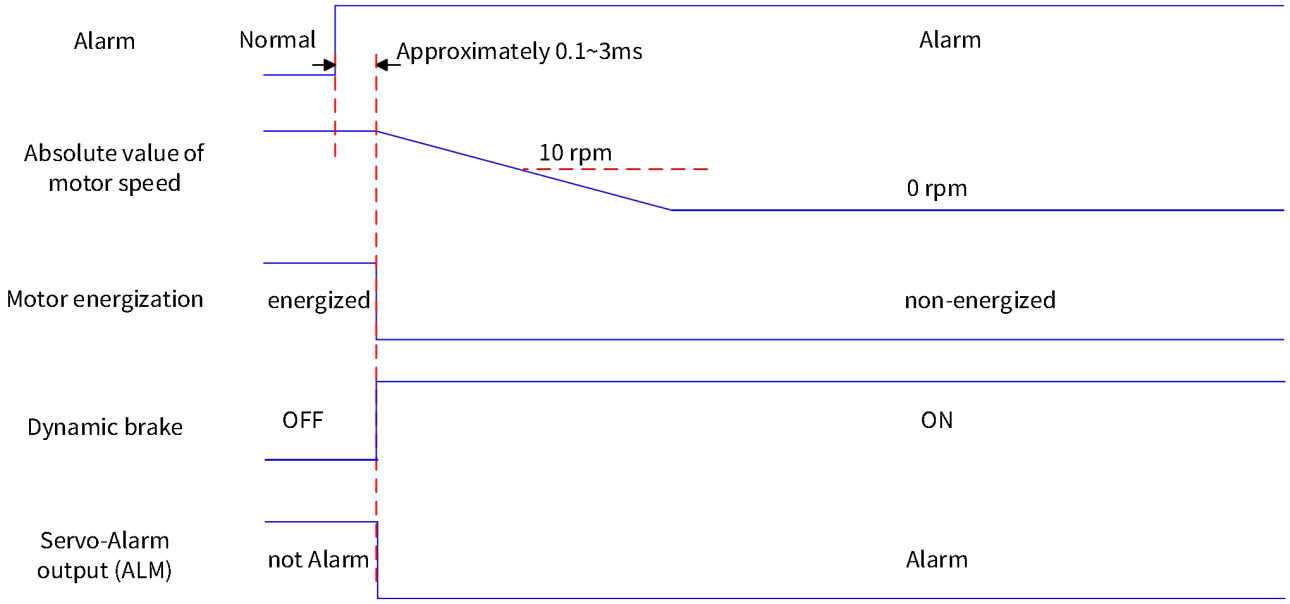


Figure 3-9 Sequence diagram of DB stop, maintain DB status during Error 2

D) Error 2: Not Holding brake: Zero speed stop, maintain free running status

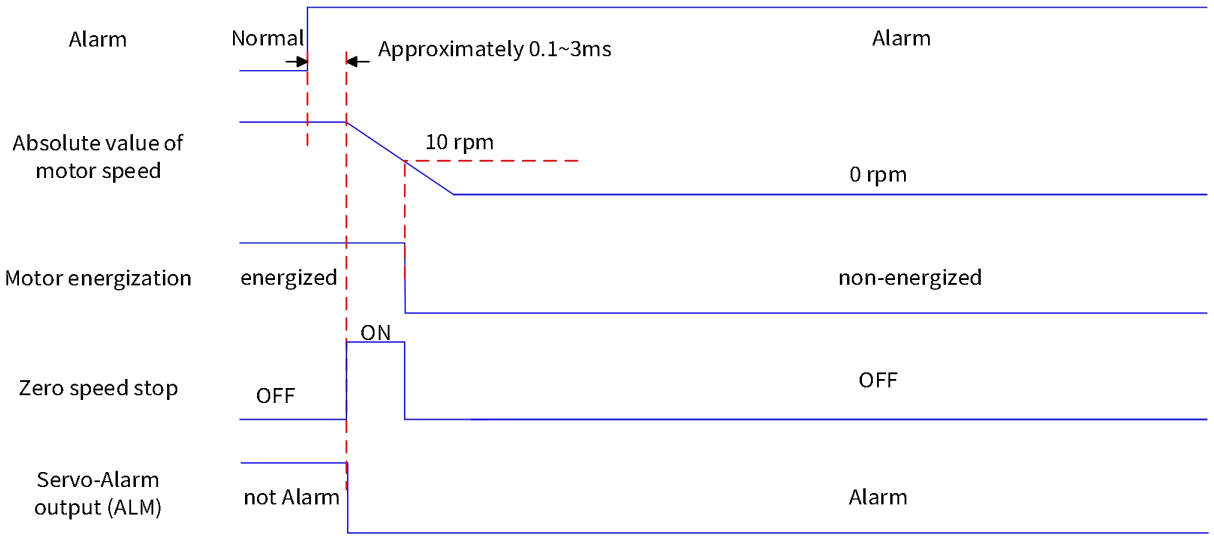


Figure 3-10 Sequence diagram of zero speed stop and free run state during Error 2 (not Holding brake)

E) Error 2 with Holding brake: forced to be zero speed stop, and maintain free run state

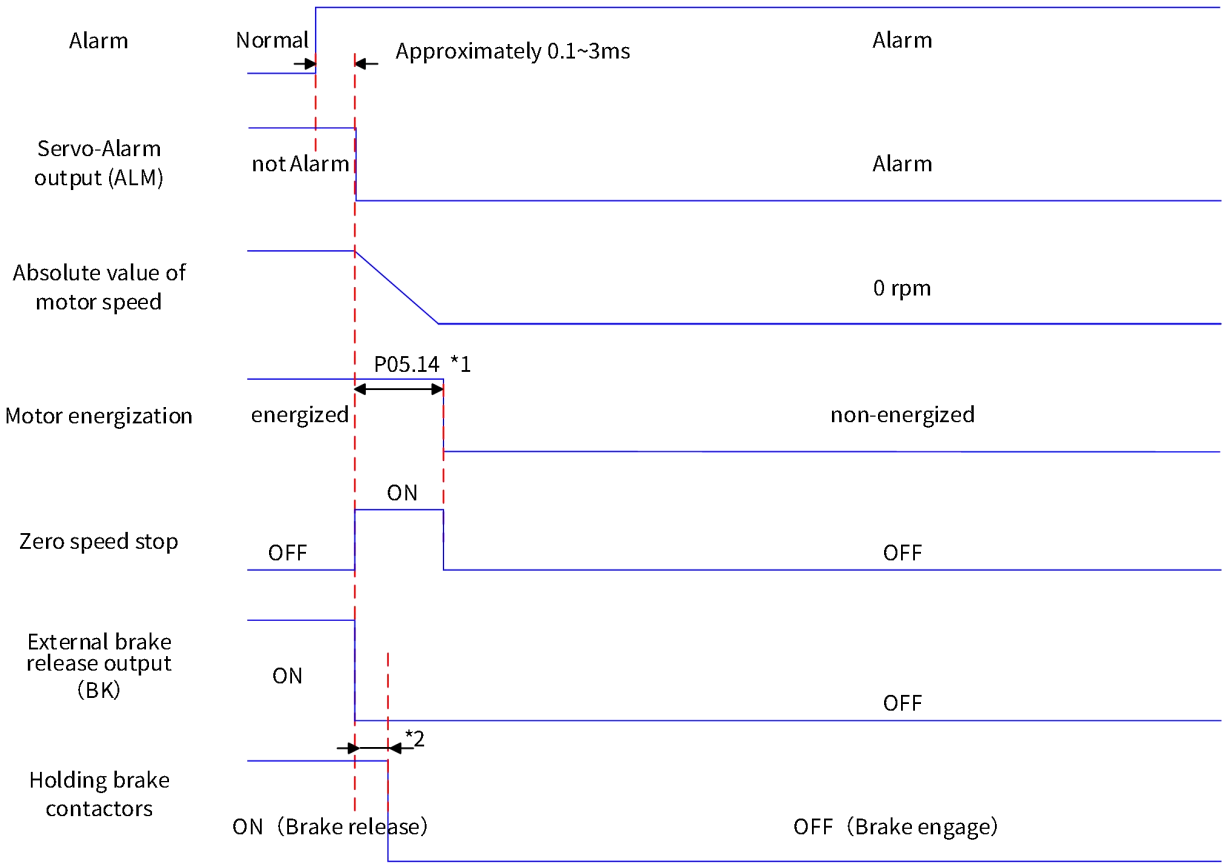


Figure 3-11 Sequence diagram of free stop state in zero speed stop mode during Error 2 (with Holding brake)

*1: When the brake enable switch(P05.12) is OFF, P05.14 has no effect;

*2: Please refer to the relevant specifications for delay time of Holding brake contact action.

When the servo encounters Type 3 Alarm: A.220 (Positive direction overtravel Alarm)/A.221 (Negative direction overtravel Alarm), the current operating state of servo will be interrupted, and its stop sequency is shown in F).

F) Overtravel stop Alarm: Zero speed stop, maintain position latched state

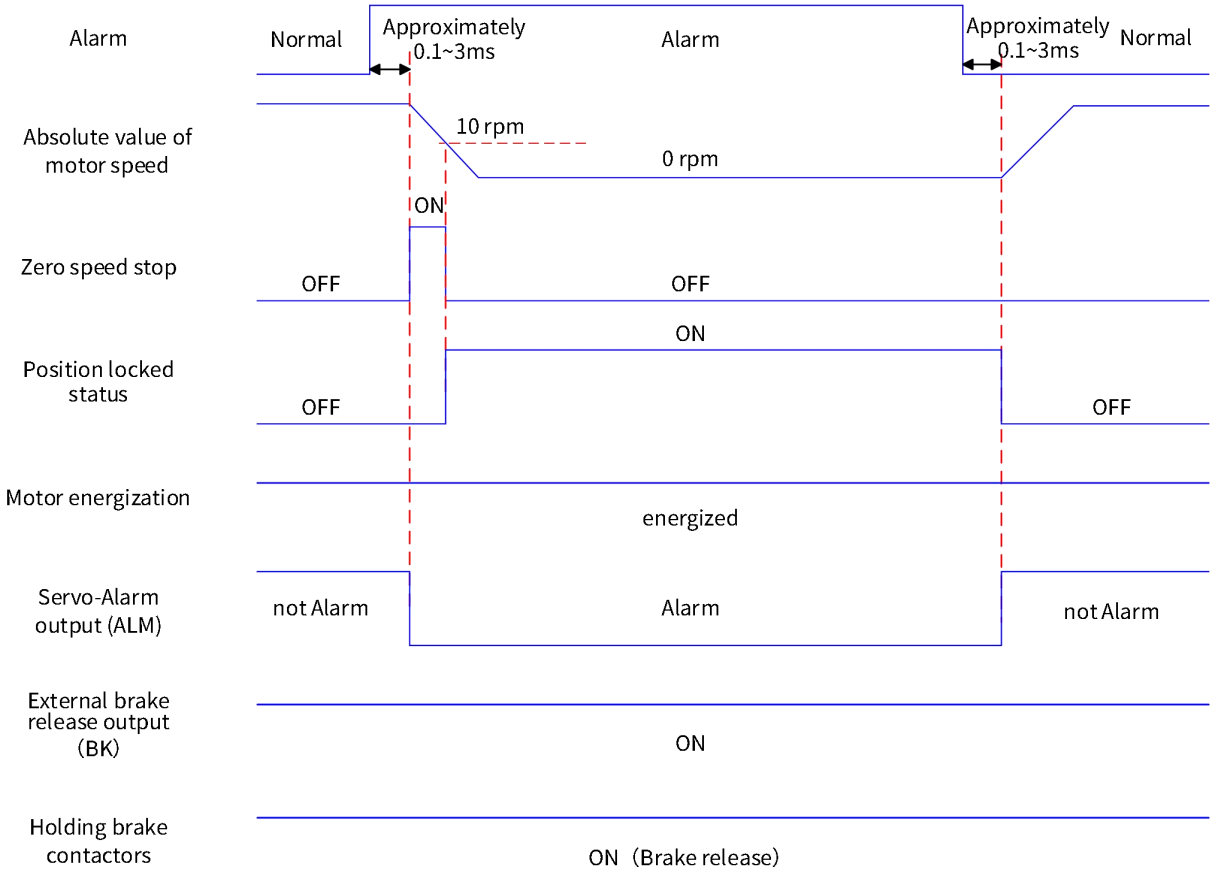


Figure 3-12 Timing diagram of shutdown Alarm

Except for the above two types of Class 3 Alarms, other Alarms have no impact on the current status of the servo, as shown in G).

G) Non shutdown Alarm:

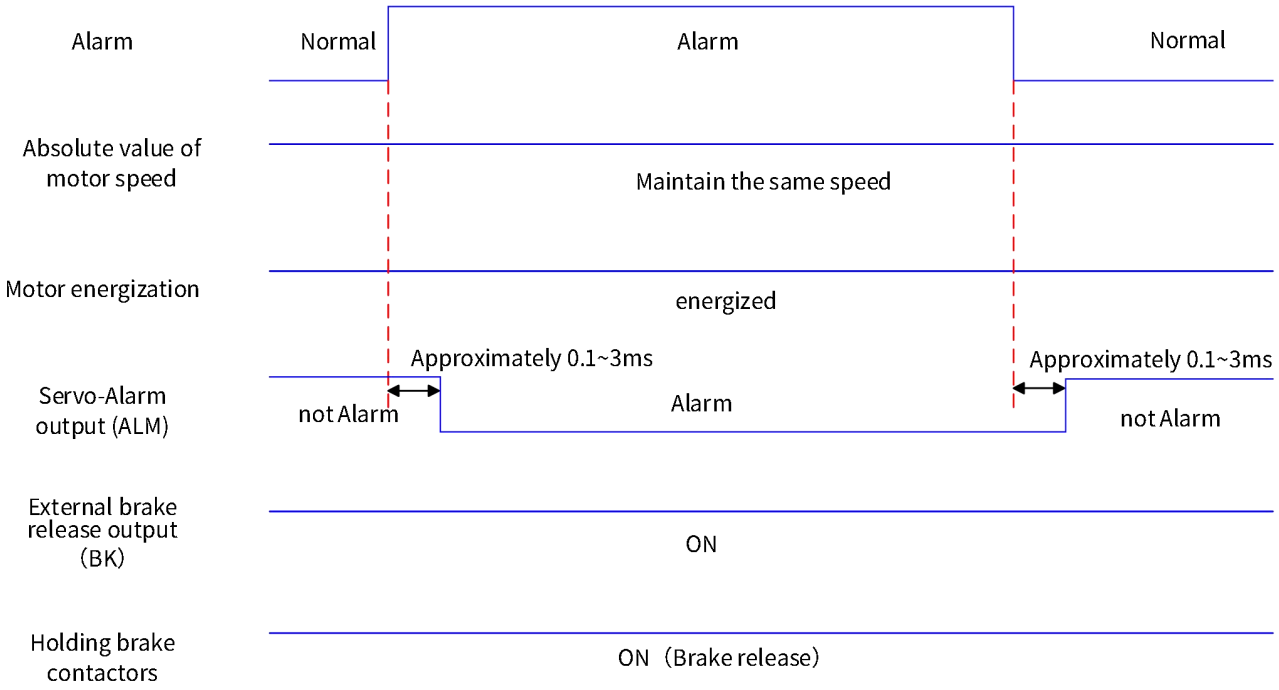


Figure 3-13 Non stop Alarm Sequence Diagram

H) Alarm reset:

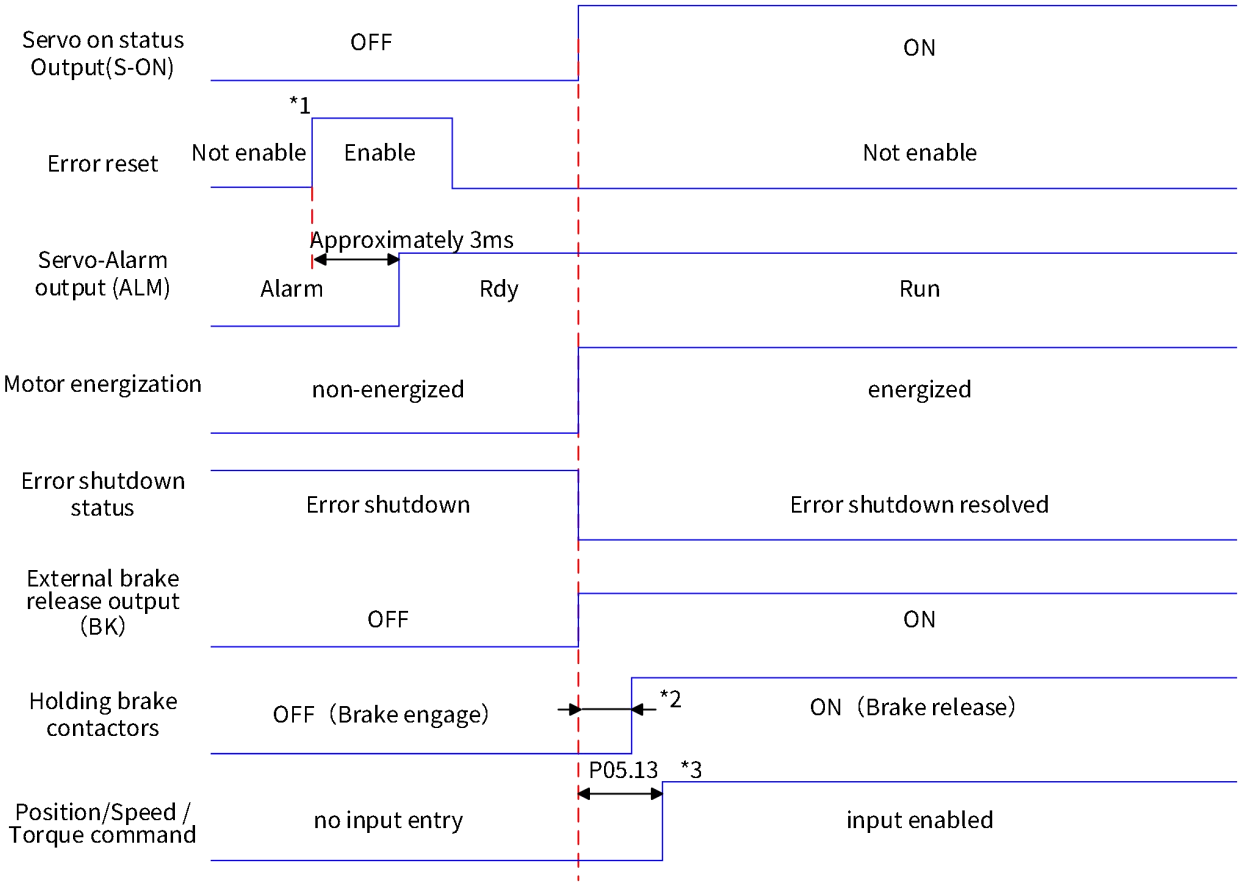


Figure 3-14 Error reset timing diagram

*1: The DI Error reset signal (5: Error reset) is valid along the variation.

*2: Please refer to the relevant specifications for delay time of Holding brake contact action.

*3: When the brake enable switch (P05.12) is not turned on, P05.13 has no effect.

3.1.7 Operation

(1) Check before operation

Table 3-13 Check procedure before operation

Item	Content
Wiring inspection	Motor power line UVW line sequence (Special attention) Whether GND is loose or short-circuited with UVW Whether encoder cable is loose
Mechanical connection inspection	Check if there are strict requirements for the direction of motor rotation by the mechanical part which is connected to motor. It's recommended that the motor should be unloaded prior to 'safe operation' execution
Environmental inspection	Do not operate any motor in high temperature/humidity

(2) Safe operation

Table 3-14 Safe operation procedures

Steps	Description
Power on and confirm the Panel display	After the servo controller is powered on, the last 3-digit of panel displays 'rdy' under normal conditions. If the panel flashes an alarm code, please troubleshoot it according to Chapter 5
Low-speed rotation	1) Operate the drive motor according Section 3.2.2 JOG 2) Observe the direction of motor movement. If the direction is wrong, stop driving the motor and check the drive parameters according to Section 3.2.1 Panel Introduction 3) Use SV3 Designer oscilloscope to observe the speed waveform. If the speed is incorrect, please check the electronic gear ratio setting according to section 3.1.5 or correct the upper computer unit conversion

(3) Operation

Table 3-15 Operational steps

Item	Description
Mechanical connection	Please connect motor to load after 'safe operation' is executed correctly. Multi-diaphragm coupler is recommended
Inertia recognition	Set proper inertia ratio by inertia recognition function
Gain adjustment	Adjust gain parameters, filter parameters, advanced adjustment parameters to realize high precision, high response speed control
Operation under program	Use the drive for devices, write control program, and complete specific functions

3.1.8 Stop

In order to meet the various working conditions of servo, servo drive supports different stop modes and stop states.

(1) Stop mode

Free stop: servo motor is not powered on, and the motor is free to reduce its speed to 0 by mechanical friction;

DB stop: stop the servo motor in motion state by the negative braking torque provided by UVW 3-phase short-circuit;

Ramp stop: Smoothly stop according to pre-set position/speed/current ramp instructions;

Zero speed stop: servo drive outputs negative braking torque, immediately set the target motor speed to zero and execute stop;

Emergency torque stop: servo drive outputs negative braking torque and quickly reduces the motor speed to 0.

(2) Stop state

Hold position state: after the motor stops, the motor shaft is locked and can't rotate freely;

Free motion state: after the motor stops, the motor is not powered on, and the motor shaft can rotate freely;

Hold DB state: after the motor stops, the motor is connected to the drive, UVW 3-phase short-circuit, and the motor shaft can slowly rotate by external force.

(3) Stop condition

Servo drive supports the following stop conditions:

Table 3-16 Stop modes of SV3 servo drives

Stop condition	Settings of related parameter		Stop action and status	Description
Type I Error stop	P04.10	0	Free stop, free movement	Stop conditions while type I failure occurs
		1	DB down, free movement	
		2	DB stop, keep DB	
Type II Error stop	P04.11	0	Free stop, free movement	Stop conditions while type II failure occurs
		1	Zero speed stop, free movement	
		2	Zero speed stop. Keep DB	
		3	DB down, free movement	
		4	DB stop, keep DB	
Disable stop mode	P04.12	0	Free stop	Stop condition when servo drive stops enabling
		1	DB stop	
		2	Zero speed stop	
Disable stop state	P04.13	0	Free movement	
		1	Hold DB	
Power-off stop	P04.14	0	Stop by disabled mode	Stop condition when servo drive is powered off
		1	Zero speed stop	
Over run stop	P04.15	0	Free stop, free movement	Stop condition when motor shaft position exceeds the pre-set one which can be the position limit value of the servo internal software or the position at external limit DI
		1	Zero speed stop, maintain the position	
		2	Zero speed stop, free	

			movement	triggering time

3.2 Panel Control Operation

3.2.1 Introduction of Panel

(1) Panel composition

SV3 servo panel consists of buttons and a digital display, which can be used for information and parameter display, parameter setting, user password setting, and general function execution.

(2) Button Introduction

Functions of each button are shown in the following figure:

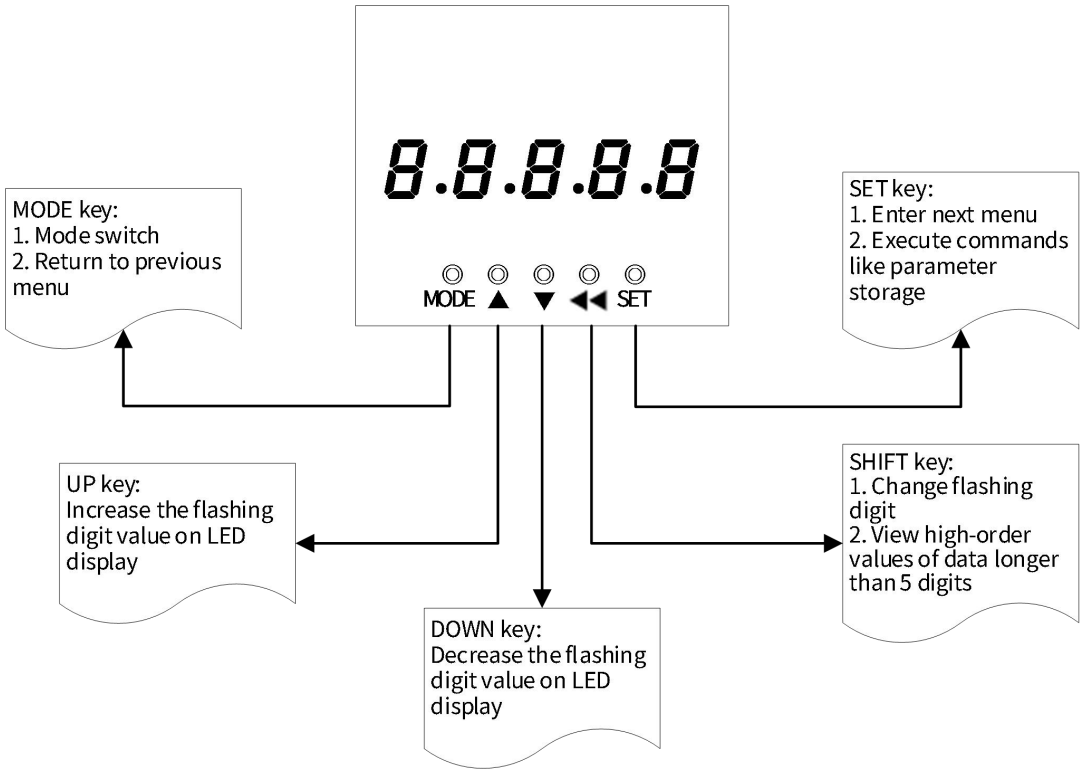


Figure 3-15 Introduction of Functions of Button

Take panel jog operation for example, the following case is for button usage:

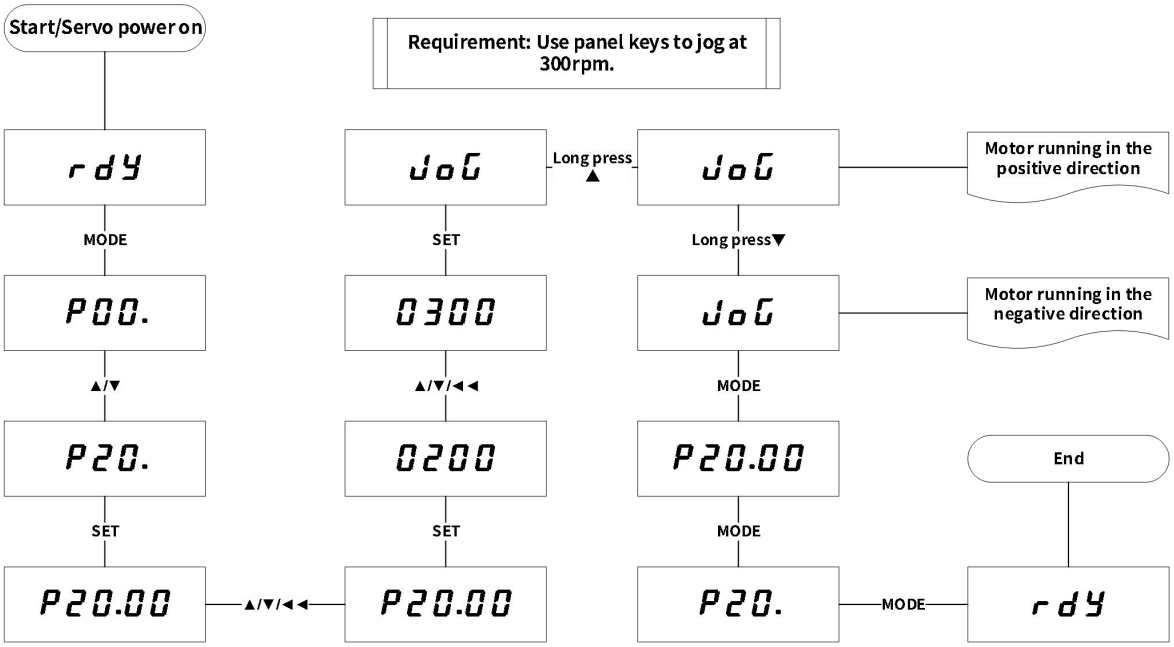


Figure 3-16 Case Operation and Display of Panel Jogging Operation

(3) Introduction of Panel Display

The panel display consists of 5-digit 7-segment digital tubes. When the servo drive is running, the display can be used for servo status display, parameter display, Error display and monitoring display.

(4) Type of Panel Displays

Table 3-19 Type of Panel Displays

Type of Displays	Function description	Entry method	Sample
Status display	Display the current status of the servo, e.g., servo ready, servo running, etc	1. While power on, enter immediately; 2. Under the parameter display, press MODE key to enter; 3. Under the monitoring display, enter when the motor is stationary;	rocco
Parameter display	Display function code and the setting value	1. Under the status display, press MODE key to enter; 2. Under the monitoring display, press MODE key to enter; 3. Under the Error display, first press SET key, then press MODE key to enter;	P20.00
Error display	Display the Error/Alarm codes of servo	1. Under the parameter display, press MODE key to enter; 2. Enter when a Error occurs;	E.910.1
Monitoring display	Display the current operating parameters of the servo	1. Under the parameter display, set function code of Group 21 and enter; Under the status display, set function code P05.03, enter after the motor runs;	200

(5) Introduction of panel display content

Table 3-20 Status description

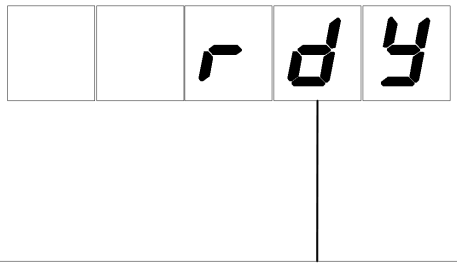
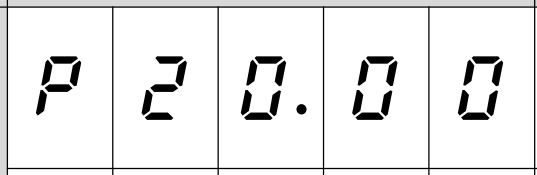
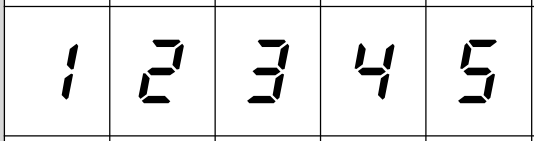
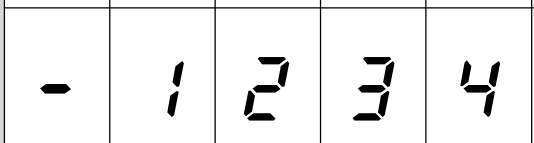
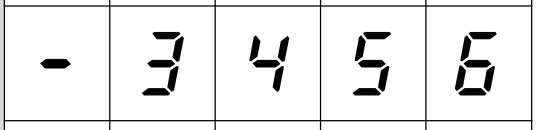
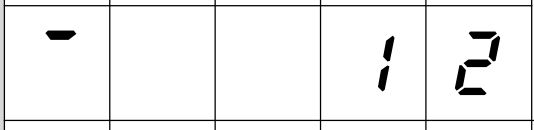
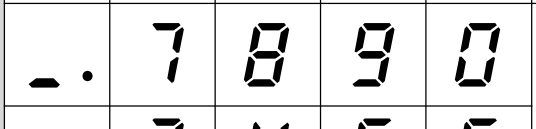
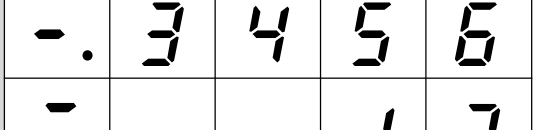
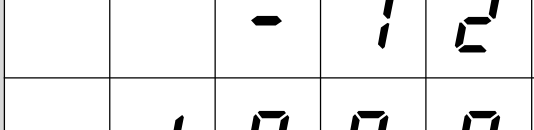
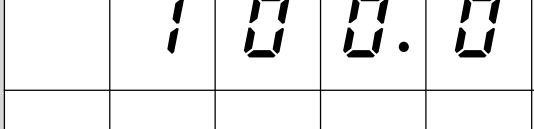
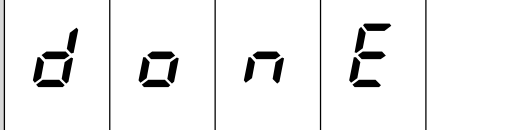
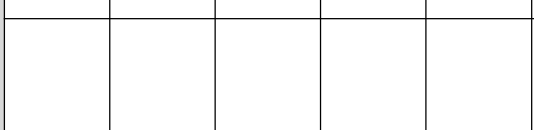
Type of Displays	Display content	Name	Display site	Meaning
Status Display	r o c c o	rocco: servo initialization	Servo power-on moment	The servo drive is in initialization or reset state, waits for the completion of initialization or reset, and automatically enters other state.
	r d y	rdy: Servo is ready	Servo is ready	The servo drive is in a runnable state.
				

Table 3-21 Parameter description

Type of Displays	Display content	Name	Display site	Meaning
Parameter display		Function code: P20.00		P: function code 20: function code group 00: Serial No. in function code group
		Data (5 digits or below) Display: 12345		
		Negative data (4 digits or below) Display: -1234		
		Data (above 5 digits) Display: 12345678 90		_: The lower four digits of multi-digit data -: The middle four digits of multi-digit data ¯:The top four digits of multi-digit data
				
				
		Negative data (5 or more digits) Display: -123456 7890		-: Indicates a negative sign _: The low four digits of multi-digit negative data -: The middle four digits of multi-digit negative data ¯: The top four digits of multi-digit negative data
				
				
		Decimal point Display: 100.0		.: Decimal point, non-flashing
		Done: Parameter setting completed	Parameter setting successful	Parameter setting completed, and stored into servo drive
		Parameter restored to Defaults	When using system parameter initialization (P05.01), set of 1	The servo drive is in the process of parameter initialization. Please wait for the completion of system parameter initialization, and power it on for use

Example of parameter display

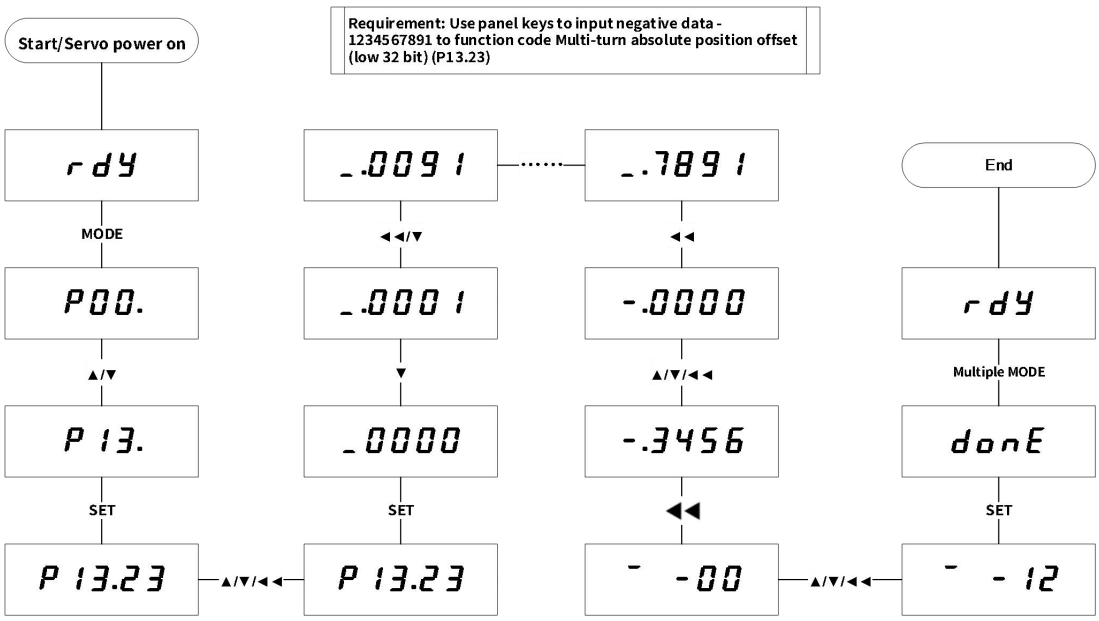
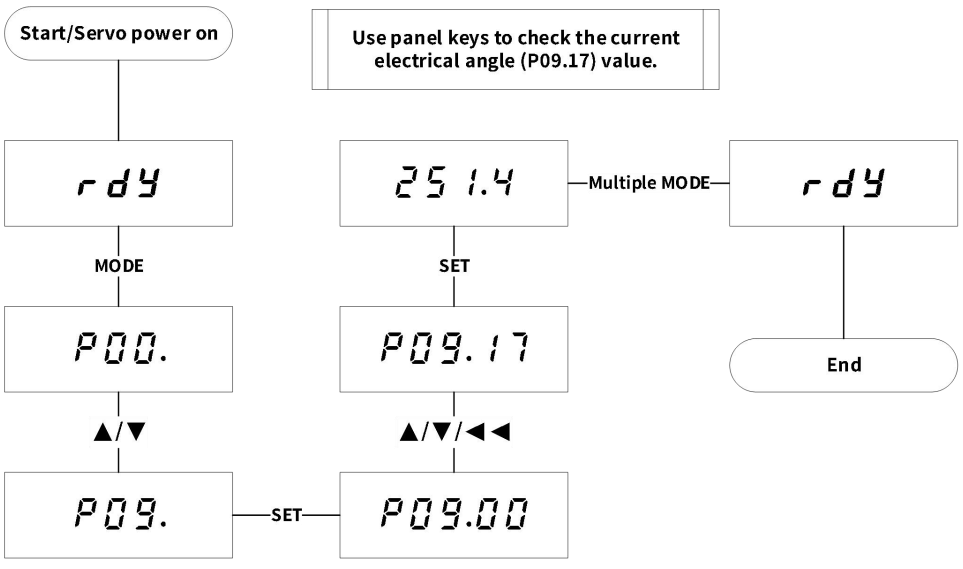


Table 3-22 Error Display and Monitoring Display

Display Type	Display content	Name	Display site	Meaning
Error Display	E.010.0	Error code: E.010.0	Software parameter error	E.:Error Before decimal point:error main code After decimal point: error sub code
Alarm Display	A.224.0	Alarm code: A.224.0	Regenerative resistor overload	A.: Alarm: Before decimal point: Alarm main code After decimal point: Alarm subcode
monitor Display	12345	Current parameter value: 12345		
monitor Display Sample				

3.2.2 Jog Operation

Before performing panel jog operation, please conduct a pre operation check on the servo system to confirm that the system is operating without interference. Connect the power supply, power on the servo system, and perform panel jog operation. The flowchart of panel jog operation is as follows:

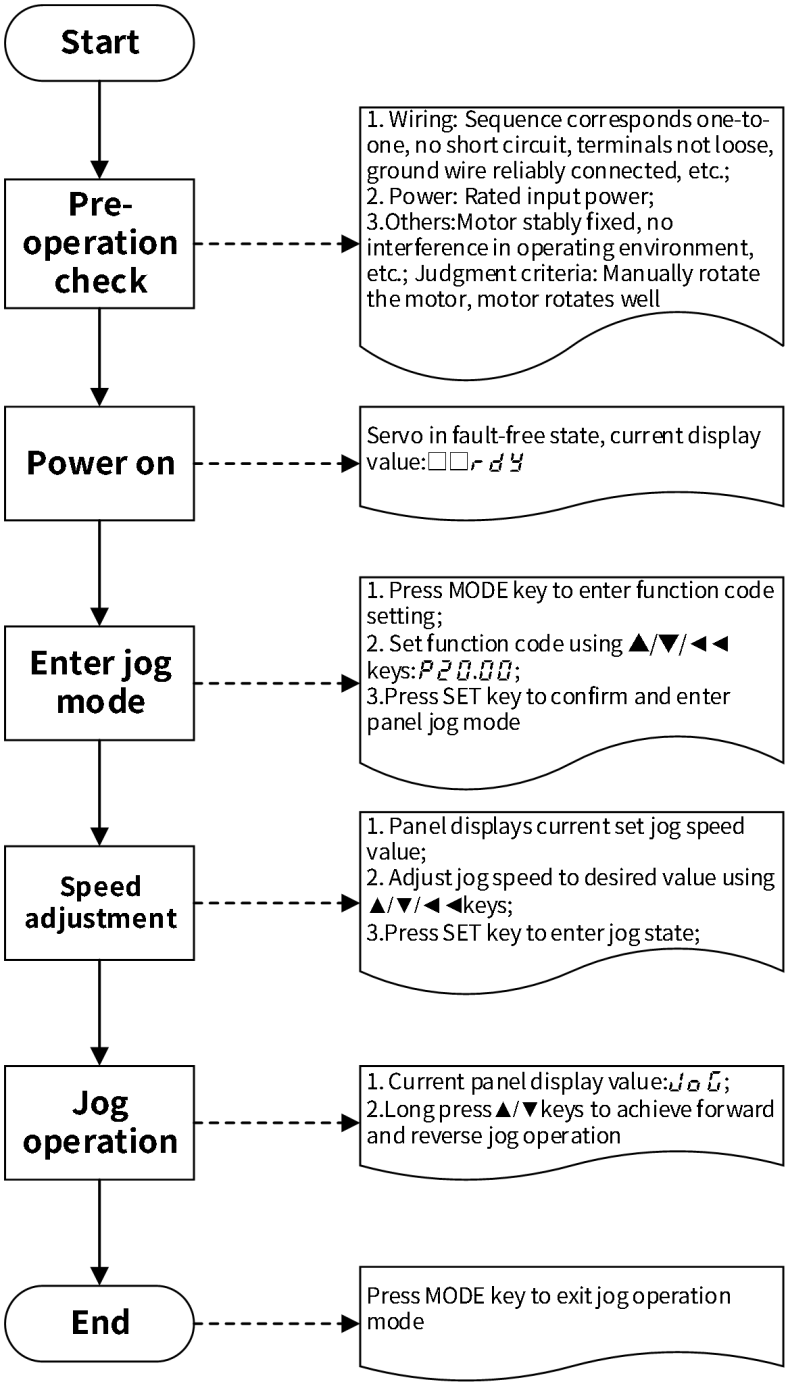


Figure 3-17 Panel jog operation flowchart

Use panel jog operation to confirm whether the servo system can operate normally, and whether there are any abnormal vibrations or sounds when the motor rotates.

3.3 Use the Servo3 Designer

Servo3 Designer is a debugging software for SV3 servo drives.

3.3.1 Overview

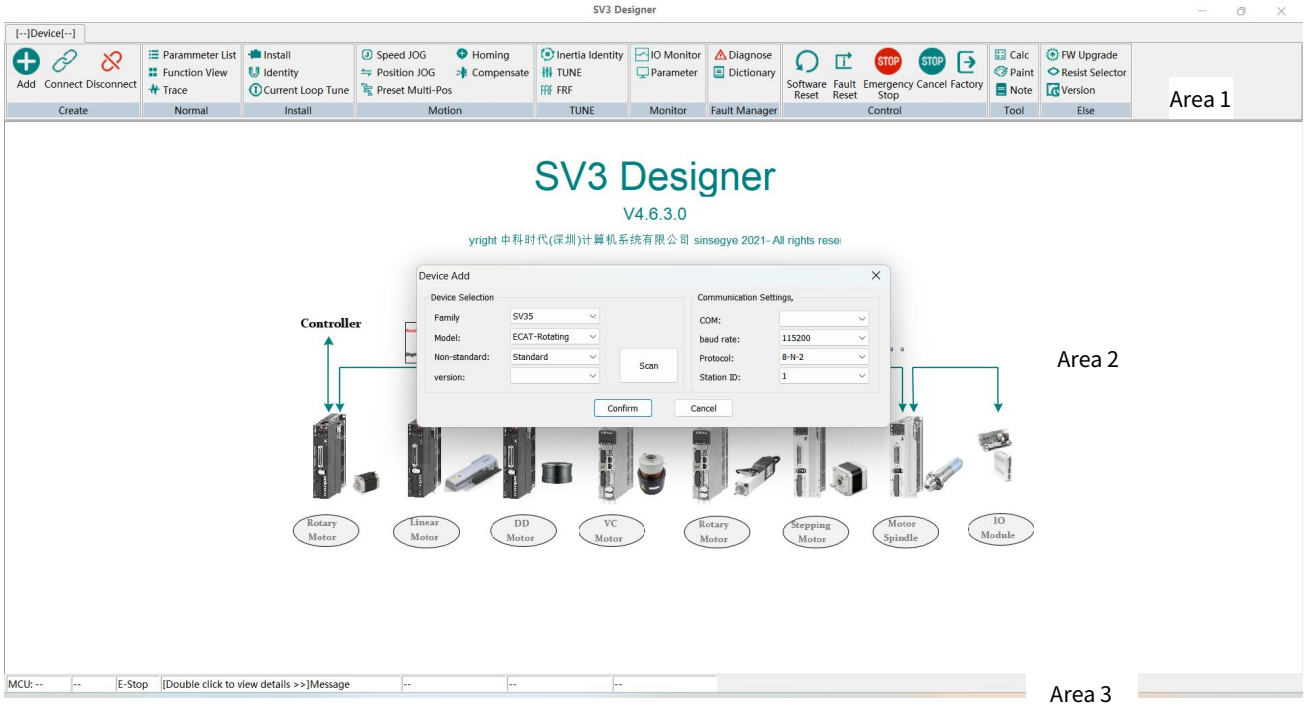


Figure 3-18 Main interface

The software is divided into three areas, as shown in the following figure:

Area 1: Toolbar area, entrance for servo debugging function, where users can click on relevant buttons to enter the corresponding function window;

Area 2: Function view layer, debugging function presentation area;

Area 3: Status bar area, displaying device status in real-time; Whether it is online, operating status, Error information, motor operation information, etc;

3.3.2 Operating Environment

This software is a green installation-free version.

Operational requirements

Hardware environment: PC

Operating System: Windows 7 x86&64 Windows10 x64、Windows11 x64

Dependency: Net Framework 4.5 and above

3.3.3 Parameter Management

Click on the toolbar

to access the function code parameter setting interface.

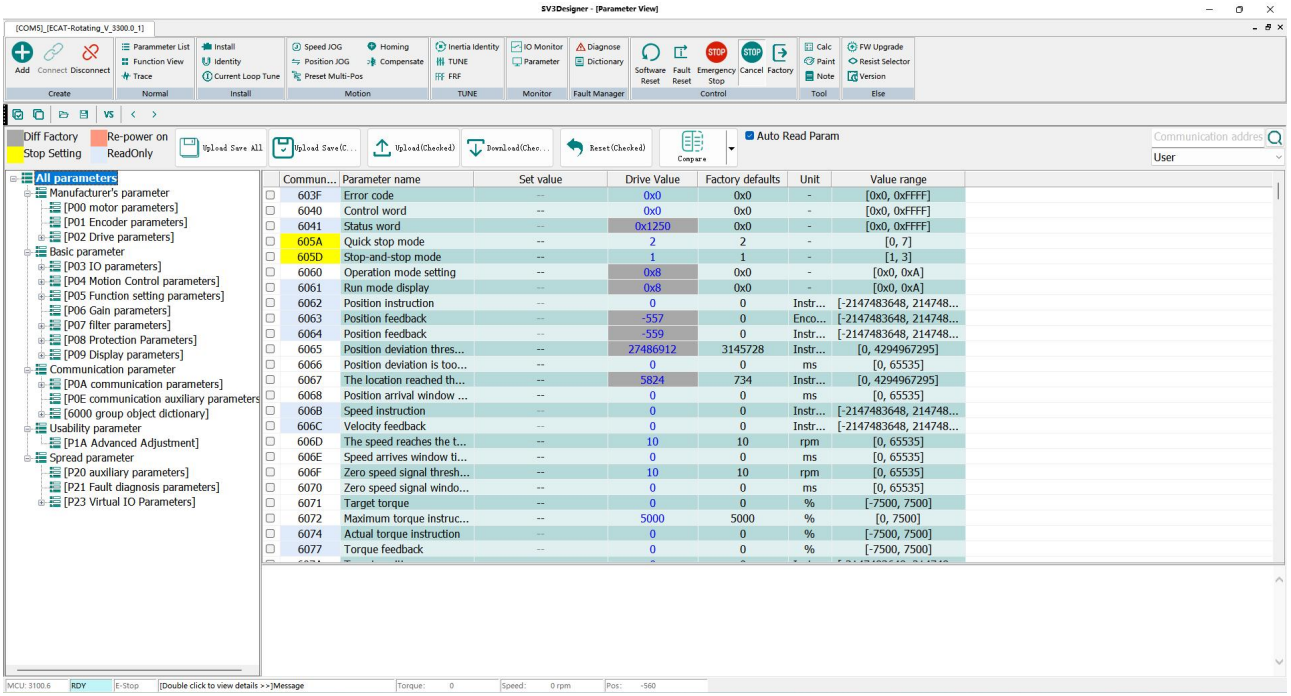


Figure 3-19 Parameter List

- Toolbar area

Select all or none of the function codes on the current page;

Open and save recipe file, saving recipe only saves the selected function codes on the current page;

Parameter formula comparison function, shown as in the following figure:

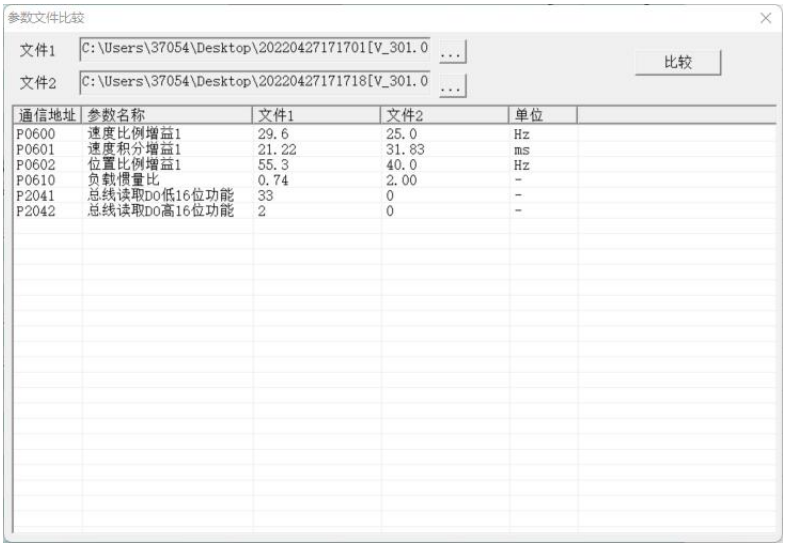


Figure 3-20 Parameter Comparison

The previous editing group and the next editing group;

Restore Defaults;

- View Area

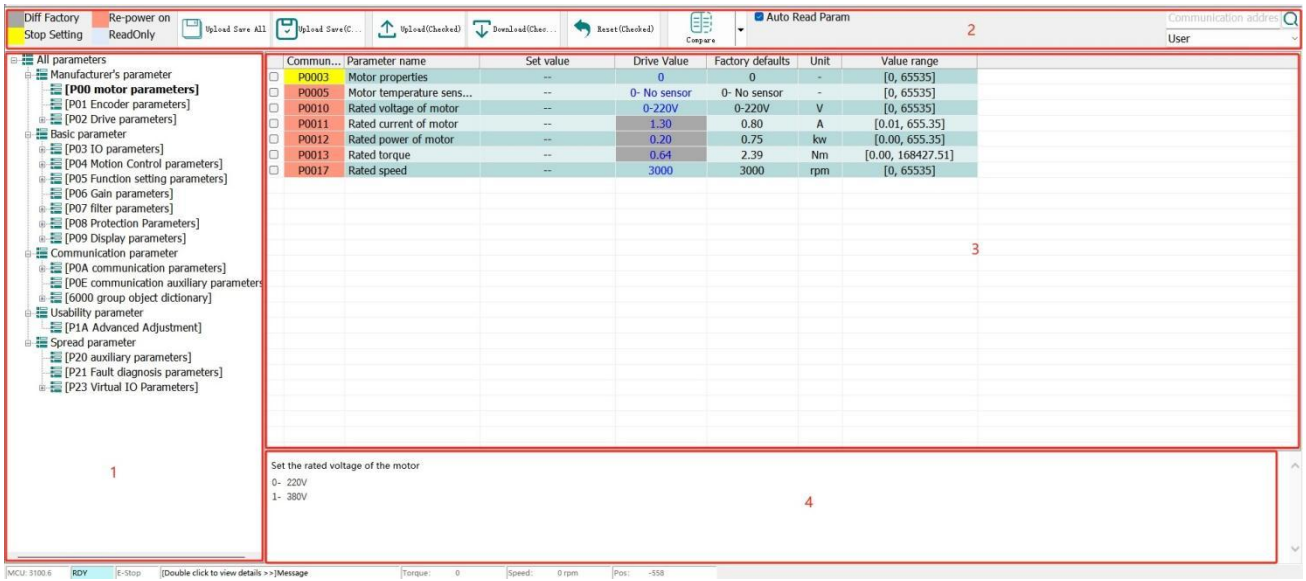


Figure 3-21 Parameter List View

1. Function code grouping area: From the user's perspective, functional groups are divided to make it more convenient for users to use;
2. Operation area:

Upload checkbox: Read the checked function code value of the current page from the drive and update it to the set value column;

Download checkbox: Download the selected function code settings on the current page to the driver;

Restore checkbox: Restore the set value column that has been checked on the current page to its factory default value;

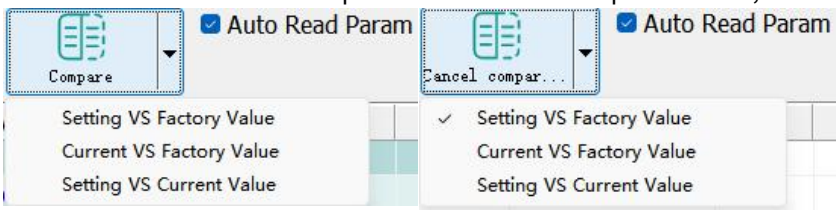
Real time refresh of current value: When checked, the current value column reads the function code value

from the driver in real-time;

: Function code search, supports fuzzy query of function code address, name, and drop-down items;

: Permission switching, supporting three types of permissions: User, admin, and factory. Different permissions display different function codes. Factory permissions are for factory use and are not recommended for customers to use;

Parameter comparison function: supports three comparison methods: set value and factory value, set value and current value, and current value and factory value. After clicking the comparison sub item, enter the comparison view, and users can click "Cancel Comparison" to exit the comparison view;



3. Function code list area

The list area will display different background colors based on the attribute of the function code;

- Set value: Users can edit parameters through this column. The read-only parameter font is grayed out and cannot be modified;
- Current value: After the user selects real-time refresh, the current value column displays the driver value in real-time;

4. Help: When the user selects the function code line with the mouse, the help area displays the help information for the selected function code;

- Right click menu: Right click in the parameter list area to support quick operations such as selecting all current pages, deselecting all current pages, reading and writing function codes, opening and saving recipes, and saving modified parameters.

Figure 3-22 Right click menu

3.3.4 Oscilloscope

■ Toolbar

Open the waveform file, file format is csv;

Save the current waveform file only, file format is csv;

Take a screenshot of the current waveform display area, picture format is bmp;

Measurement function: Click this button to perform measurement operations on the AB interval waveform by dragging A and B cursors in the waveform area;

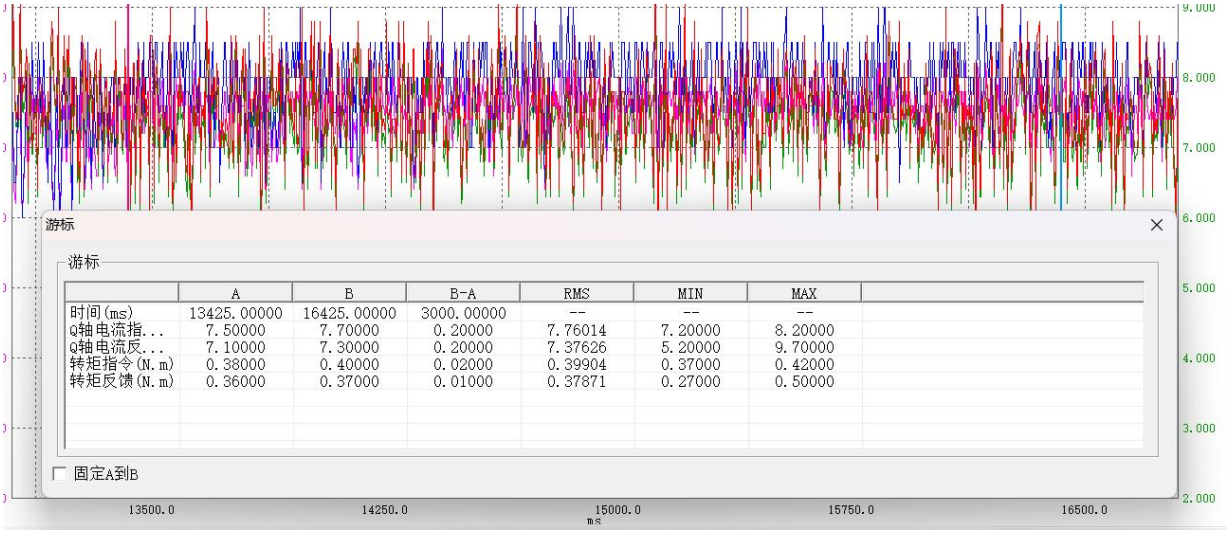


Figure 3-22 Vernier measurement

Vernier function: After clicking this button, the mouse hovers over the waveform area to display the values of each channel in the waveform at the current mouse position;

: Waveform amplification. Clicking this button will enable amplification function when the button is pressed down; Click the button again to disable the amplification function; Left click to circle the waveform and zoom in on the circled area;

Waveform Recovery: Click this button to restore the waveform to its original state;

Adaptive coordinate system. Clicking this button will automatically calculate Max./Min. values of the waveform for vertical axis adaptation;

FFT analysis: Click this button and use the left mouse button to circle the waveform area. When the left mouse button is lifted, the software makes FFT analysis and pops up the analysis result, identifies 3 resonance point frequencies shown as in the following figure:

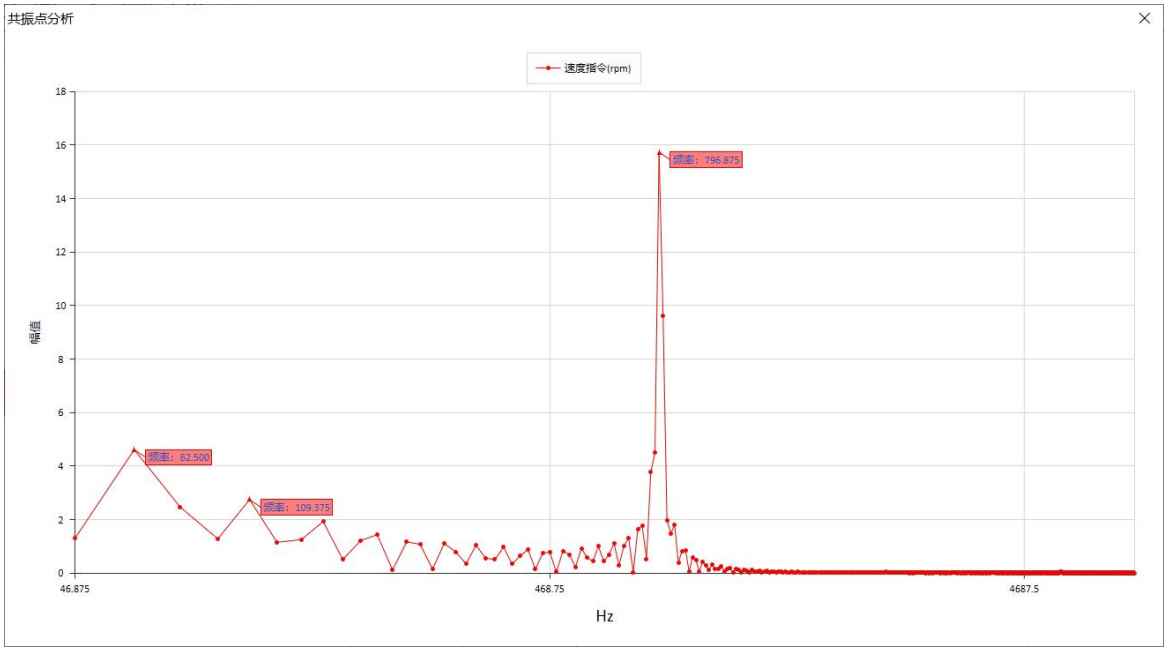


Figure 3-23 FFT resonance point analysis

Waveform comparison: Click this button and select the waveform to be compared, the waveform files in the file will be overlaid onto the existing waveform area

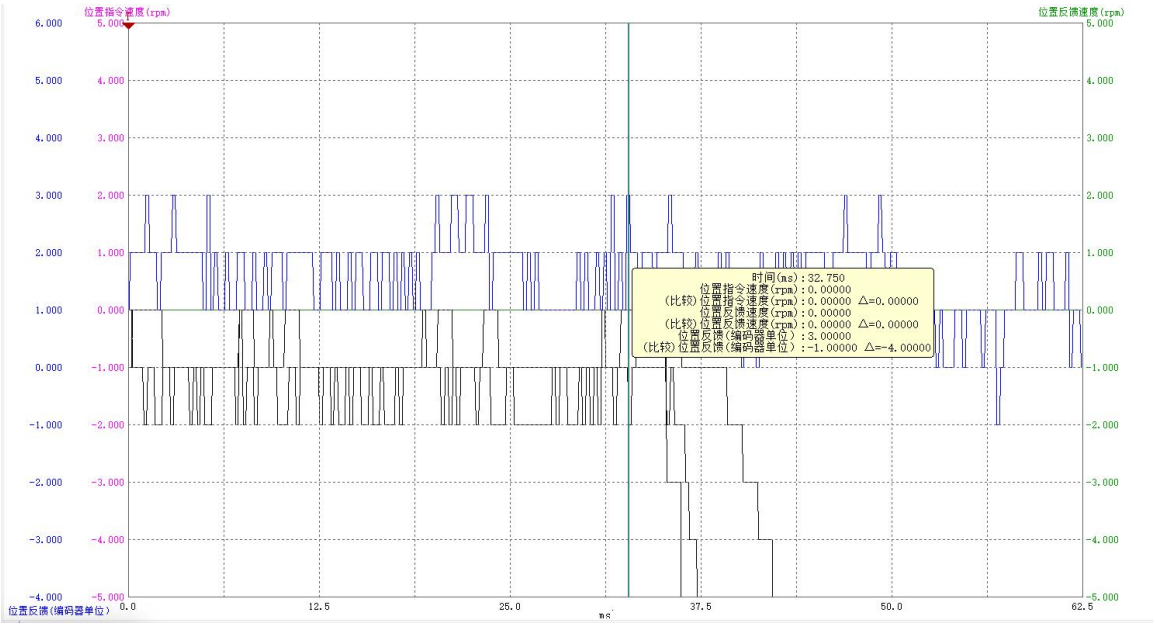


Figure 3-24 Waveform Comparison

: To cancel waveform comparison, click that button, the compared waveform is deleted from waveform area;

■ Configuration

Channel configuration: Oscilloscope supports up to four channels for acquisition. Users can quickly generate the corresponding channel configuration of its mode through such 3 buttons as "position acquisition", "speed acquisition" and "torque acquisition".

Sampling mode: Supports 2 ways of trigger sampling and continuous sampling.

Trigger sampling: The accuracy can be 1 times carrier frequency, but number of sampling points is few(1024 points per channel). Users can click Button "trigger condition" to enter trigger condition setting interface to set it;

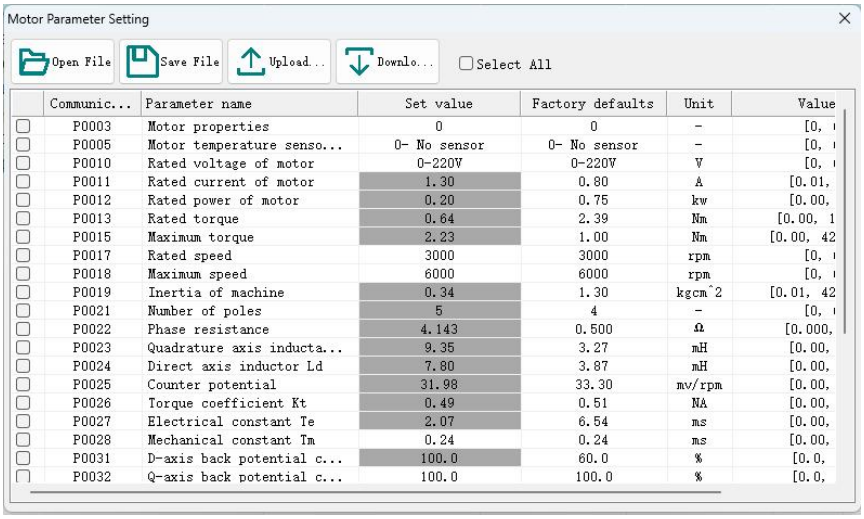
Continuous sampling: The precision of continuous sampling is millisecond level. It supports continuous sampling for a long time and wave form is automatically saved in Directory wavedata during sampling.

Figure 3-25 Sampling configuration interface

3.3.5 Initialization

(1) Motor parameter setting

Click toolbar Install to set the parameters of the motor encoder:



	Communic...	Parameter name	Set value	Factory defaults	Unit	Value
☐	P0003	Motor properties	0	0	-	[0,
☐	P0005	Motor temperature senso...	0- No sensor	0- No sensor	-	[0,
☐	P0010	Rated voltage of motor	0-220V	0-220V	V	[0,
☐	P0011	Rated current of motor	1.30	0.80	A	[0.01,
☐	P0012	Rated power of motor	0.20	0.75	kw	[0.00,
☐	P0013	Rated torque	0.64	2.39	Nm	[0.00, 1
☐	P0015	Maximum torque	2.23	1.00	Nm	[0.00, 42
☐	P0017	Rated speed	3000	3000	rpm	[0,
☐	P0018	Maximum speed	6000	6000	rpm	[0,
☐	P0019	Inertia of machine	0.34	1.30	kgcm^2	[0.01, 42
☐	P0021	Number of poles	5	4	-	[0,
☐	P0022	Phase resistance	4.143	0.500	Ω	[0.000,
☐	P0023	Quadrature axis inducta...	9.35	3.27	mH	[0.00,
☐	P0024	Direct axis inductor Ld	7.80	3.87	mH	[0.00,
☐	P0025	Counter potential	31.98	33.30	mv/rpm	[0.00,
☐	P0026	Torque coefficient Kt	0.49	0.51	NA	[0.00,
☐	P0027	Electrical constant Te	2.07	6.54	ms	[0.00,
☐	P0028	Mechanical constant Tm	0.24	0.24	ms	[0.00,
☐	P0031	D-axis back potential c...	100.0	60.0	%	[0.0,
☐	P0032	Q-axis back potential c...	100.0	100.0	%	[0.0,

Figure 3-26 Motor parameter management

Open the file: The formula of SV3 servo-related motor parameters has been integrated in the debugging software, and the user can directly select the formula corresponding to the motor model. Click the "Open" button after selecting the recipe as shown below.

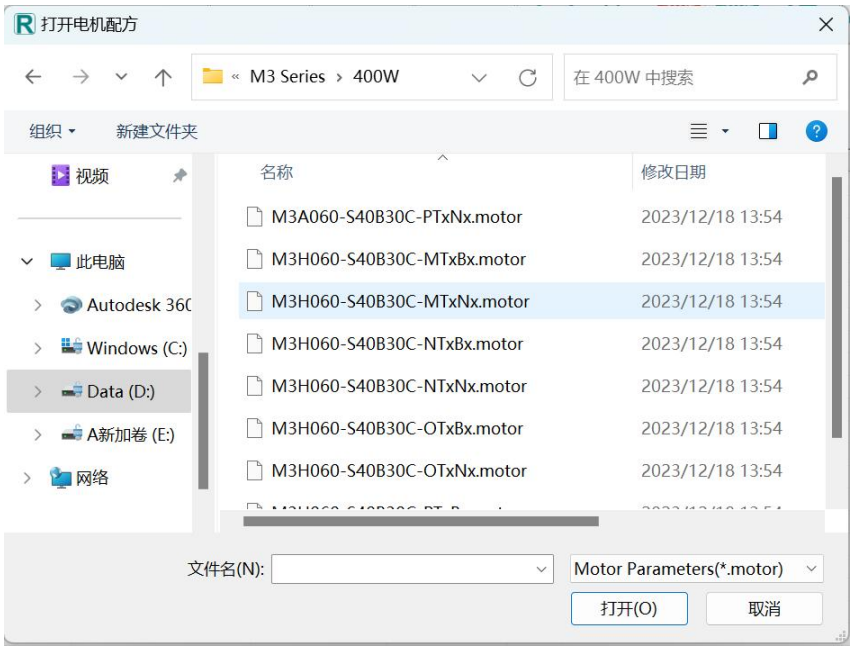


Figure 3-27 Opening the motor parameter formula

- Save the file: by editing the parameter value column, edit the parameters, after editing, click the "save file" button to save the motor formula;
- Upload check: Read all motor parameters from the encoder;
- Download check items: Check the parameters to be downloaded and click "Download" button to download the motor parameters to the encoder.

(2) Magnetic pole identification

This function is used to initialize the Angle of the motor during its initial operation.

Click toolbar

to enter the magnetic pole identification interface:

Figure 3-28 Magnetic pole identification

(3) DI/DO monitoring

This function displays DI/DO function, status, and pin wiring information. It also supports forced DI/DO output and can make DI/DO simulation.

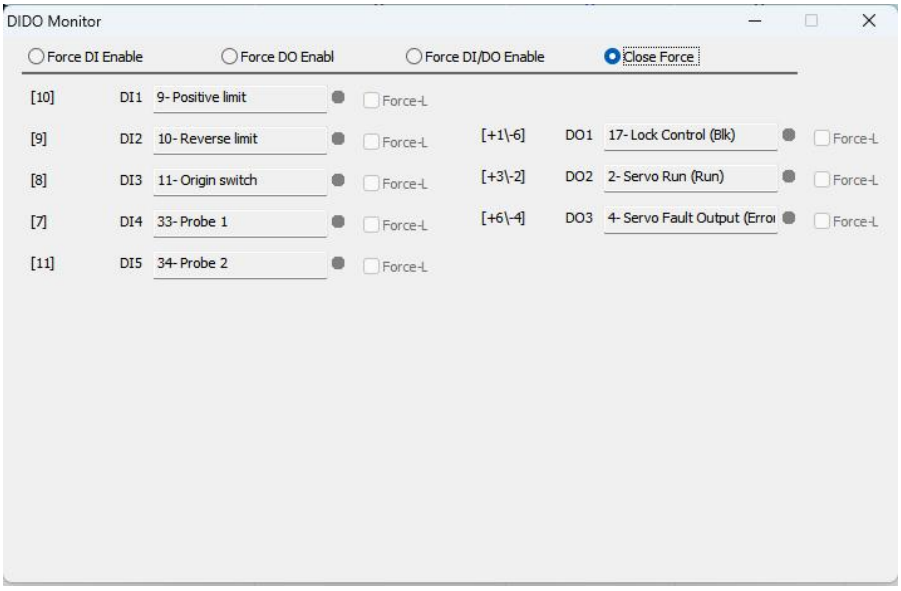


Figure 3-29 DI/DO monitoring

3.3.6 Commissioning

(1) Speed JOG

This function can be used to control motor rotation in jog mode to detect if the motor can run normally and if there is any abnormality during the rotation.

Click toolbar Speed JOG to enter the speed JOG interface:

Figure 3-30 Speed JOG

Steps are as follows:

1. Enter the parameters of motor operating speed and acceleration/deceleration time;

2. Click enable switch to enable the drive;

3. Long press Button "Long press positive direction" and Button "Long press negative direction" with the left mouse key to control the motor to move forward and negative; After releasing the mouse, stop running.

(2) Position JOG

This function is mainly used to control the motor to run in a reciprocating or fixed distance manner at a specified speed within a specified operating limit.

Click toolbar Position JOG to enter the JOG interface:

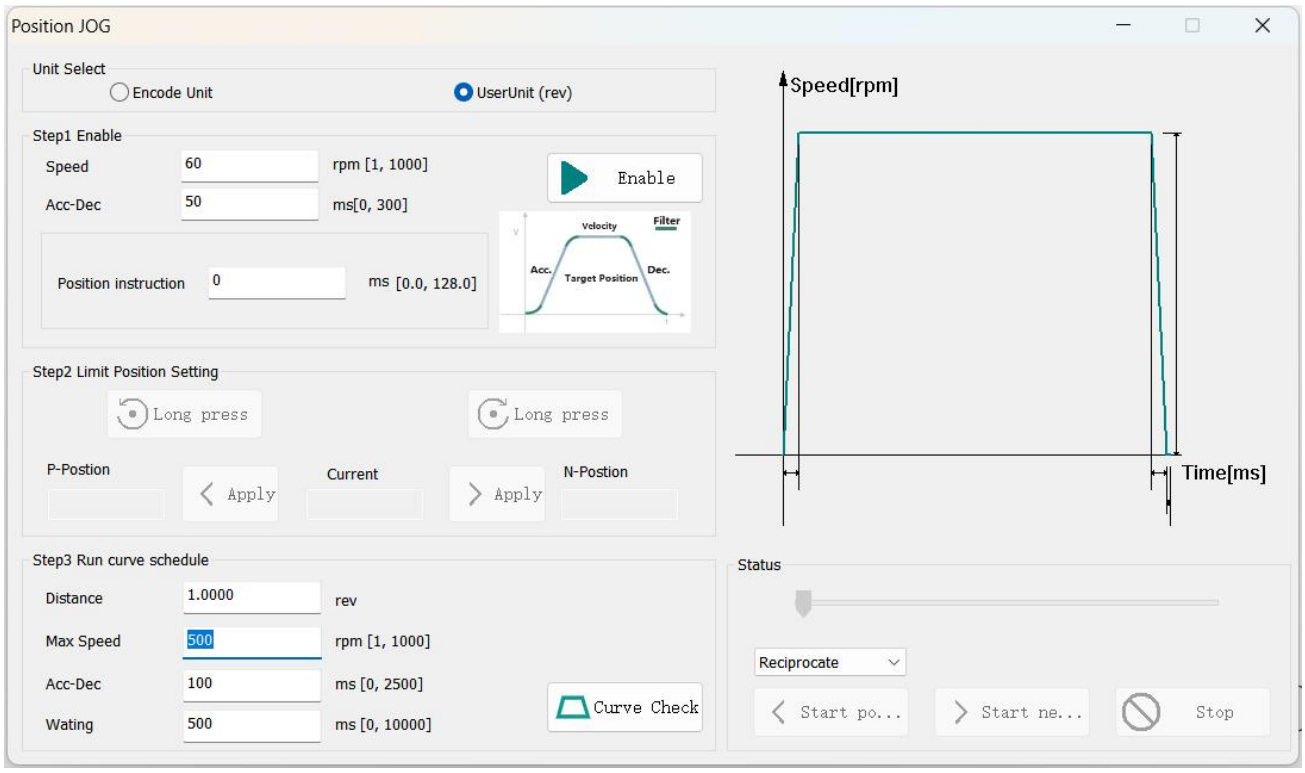


Figure 3-31 Position JOG

Steps are as follows:

1. Enter the parameters of motor operating speed and acceleration/deceleration time, and click Button Enable ON;

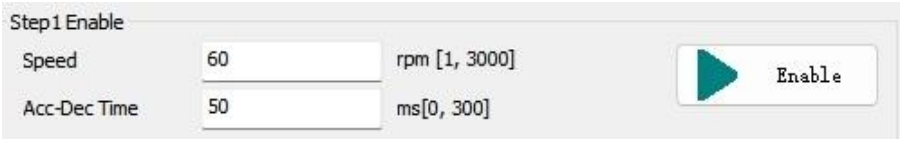


Figure 3-32 Enable ON

2. Setting of operating limit position:Button "Long press positive direction" and Button "Long press negative direction" with the left mouse key to set positive/negative limit positions

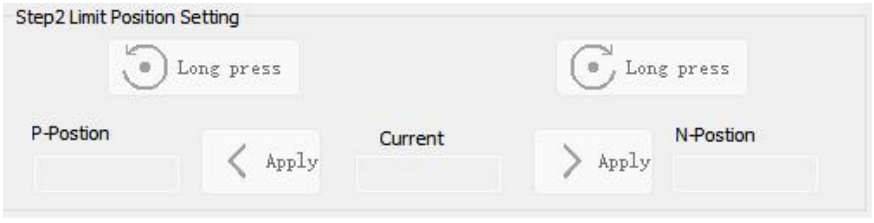


Figure 3-33 Setting of Positive/Negative Limit Positions

3. Operation curve planning: Set the trajectory parameters on operation curve;

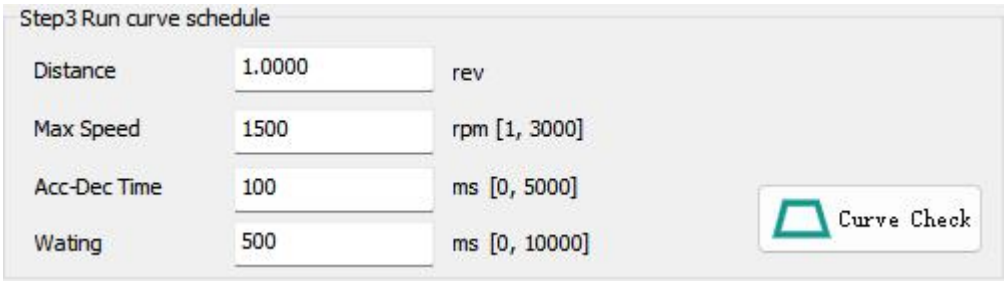


Figure 3-34 Operating Curve Configuration

Click

to generate a simulated curve;

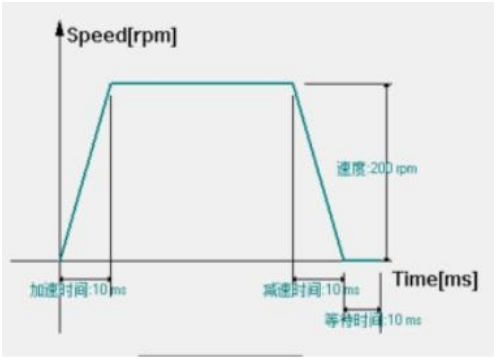


Figure 3-35: Generation of Running Trajectory

4. Run

Single time: The motor moves a specified distance within the operating limit.

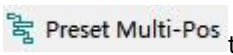
Reciprocating: The motor moves back and forth within the specified limit.

Click "Start positive" and "Start negative" for launch; Click Button "Stop" to stop the motor;

Figure 3-36 Run

(3) Preset position task

This function supports users to preset multiple running trajectories, up to 16 segments.

Click toolbar 

to enter the preset position task interface:

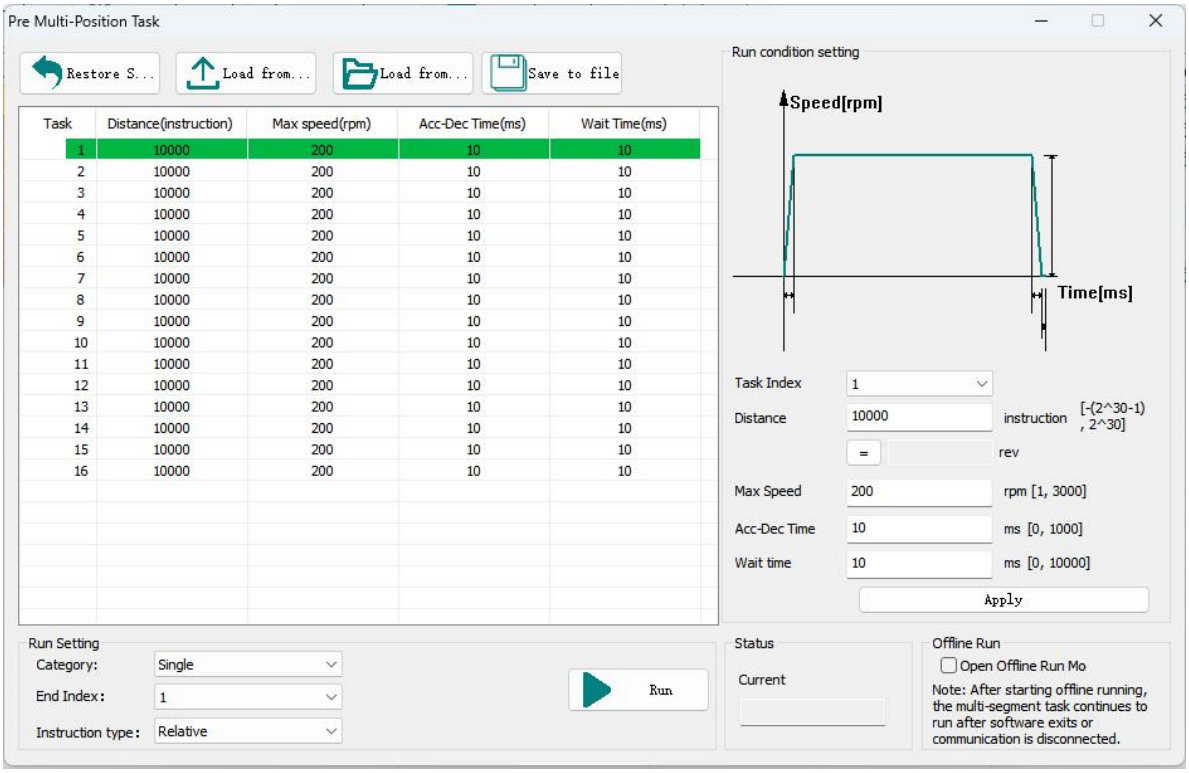


Figure 3-37 Position JOG

Steps are as follows:

1. Edit trajectory parameters for each segment: Select the specified task segment in the list, edit the running parameters, and click "Apply" to update the parameters to the list;

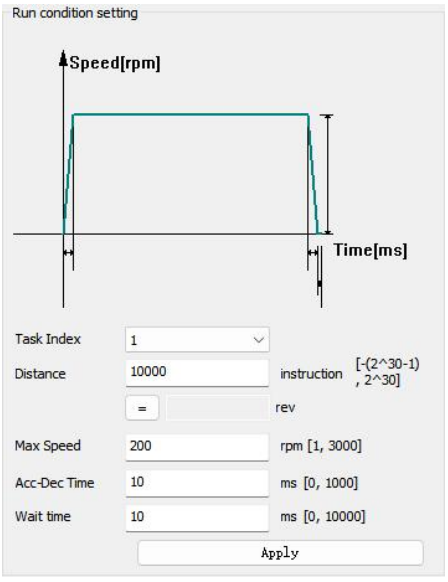


Figure 3-38 Position Segment Configuration

2. Operation settings

- Operation mode: Support single and loop operations. Multi-stage position task can only run once in single mode; Multi-stage position task operates cyclically in loop mode;
- Termination segment: The user can choose the number of segments to execute, and the program will run from the first segment to the termination segment;
- Instruction type: Support relative displacement instruction and absolute displacement instruction;
- Click 'Run' to start the multi-stage trajectory task, and the motor will run according to the preset trajectory;

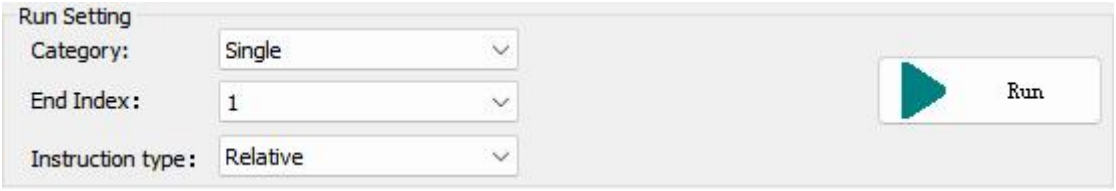


Figure 3-39 Operation

(4) homing

This function supports 35 homing modes, and users can directly select the mode or generate corresponding homing modes based on the origin return method, starting direction, encountering limit trajectory, homing completion position, etc.

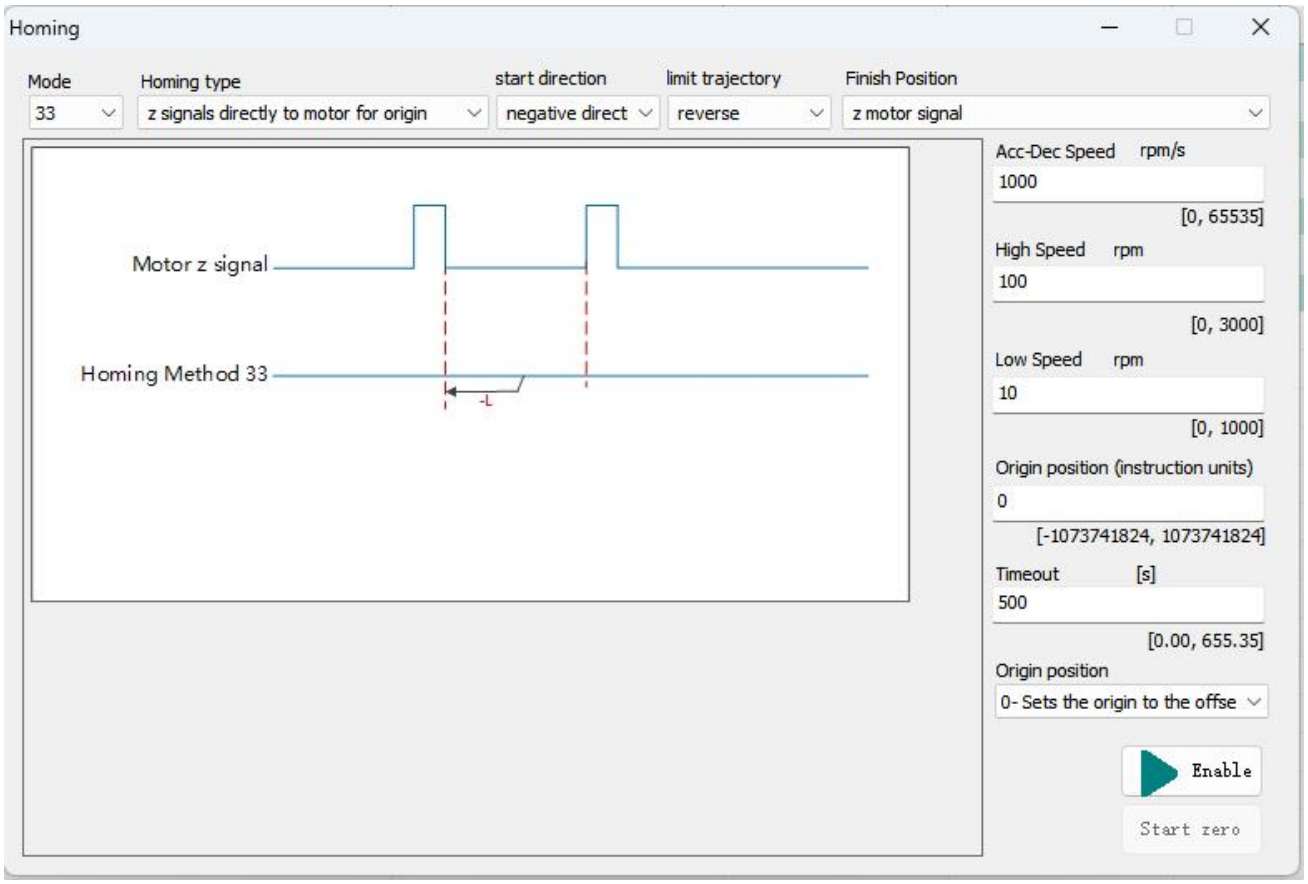


Figure 3-40 Homing

3.3.7 Tuning

(1) Offline inertia identification

This function is an offline inertia identification.

Click toolbar

to enter the offline inertia recognition interface:

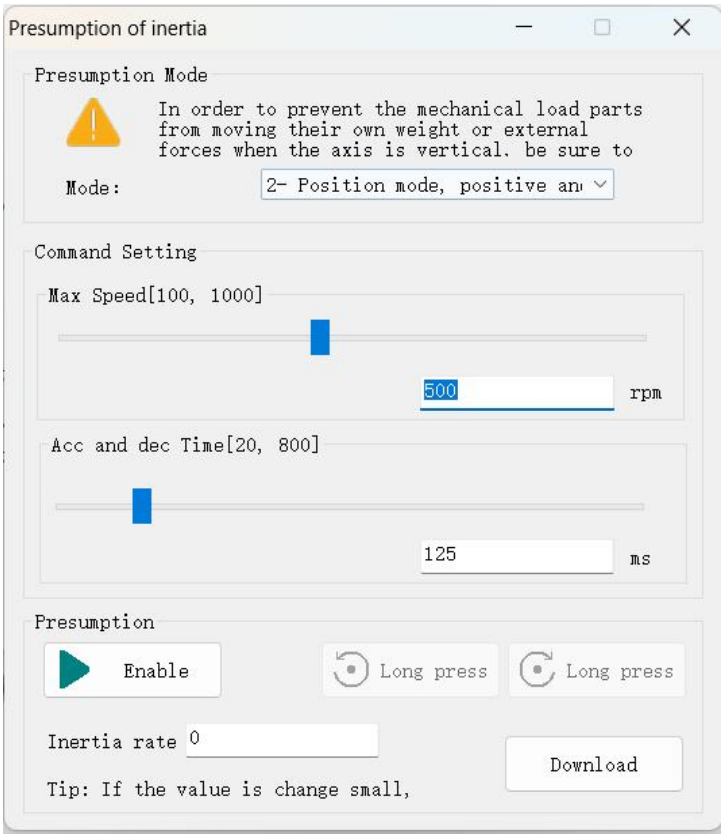


Figure 3-41 Inertia Identification

Steps are as follows:

1. Parameter settings: Set identification mode, maximum speed, acceleration time. The software supports 4 modes: "0: speed mode, forward/negative operation", "1: speed mode, electric operation", "2: position mode, forward/negative operation", and "3: position mode, unidirectional operation";

2. Click enable switch to enable the drive;

3. Long press the button "Long press positive direction" and button "Long press negative direction" with the left mouse button to identify inertia,

4.

Real time display of the current identification result. If the change in the identification results is small, it can be determined that the identification is complete. Click "Download" button to write the identification result to the drive.

(2) Gain adjustment

The software supports 2 gain adjustment modes: automatic gain adjustment and manual gain adjustment.

- Auto Tuning

Users can drag the slider with mouse or click "-" and "+" buttons to reduce or increase the rigidity level.

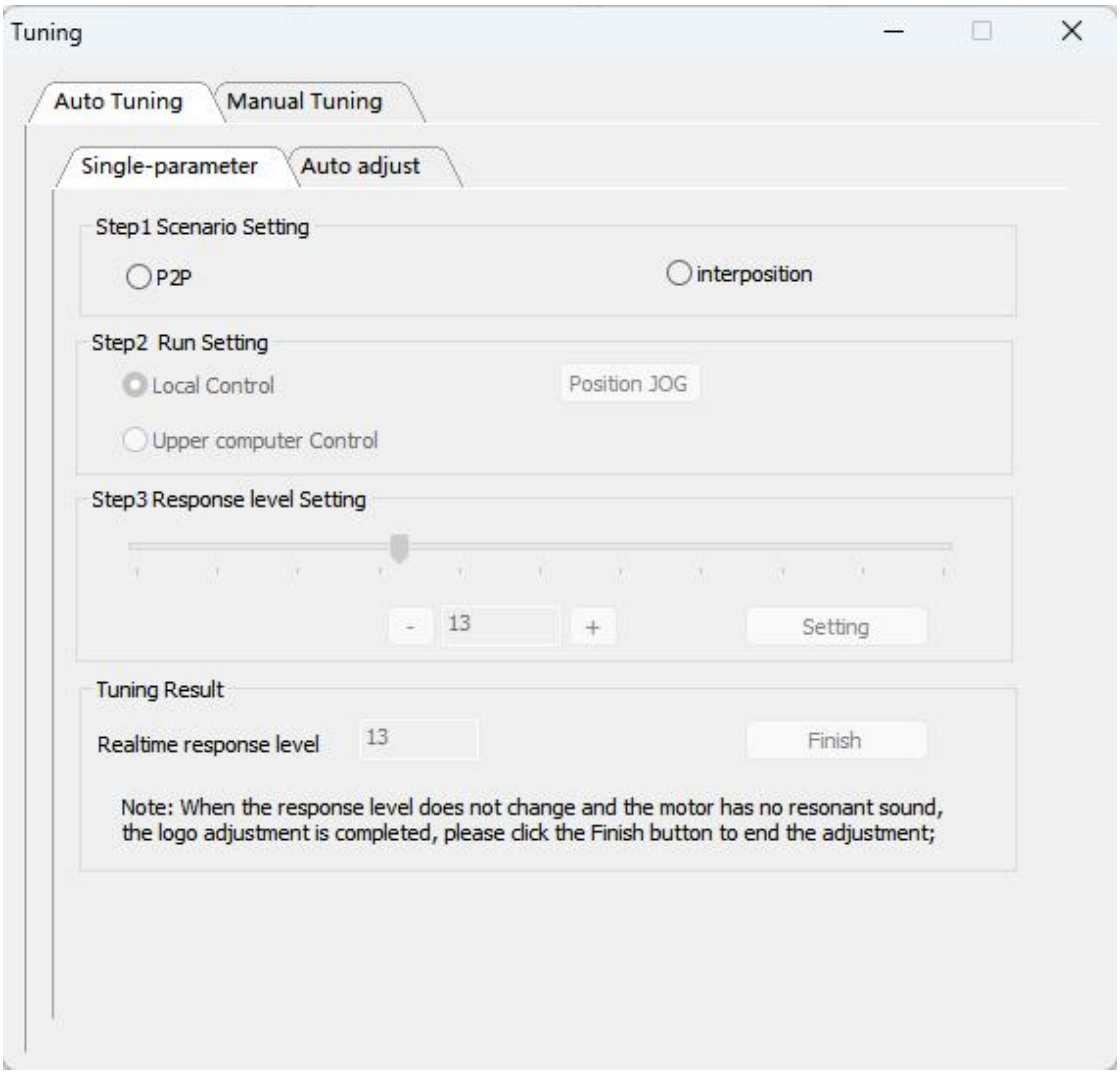


Figure 3-42 Rigid table settings

■ Manual Tuning

It supports both sine and step forms of command, supports the adjustment of the corresponding loop gain under 3 control modes of position/speed/torque.

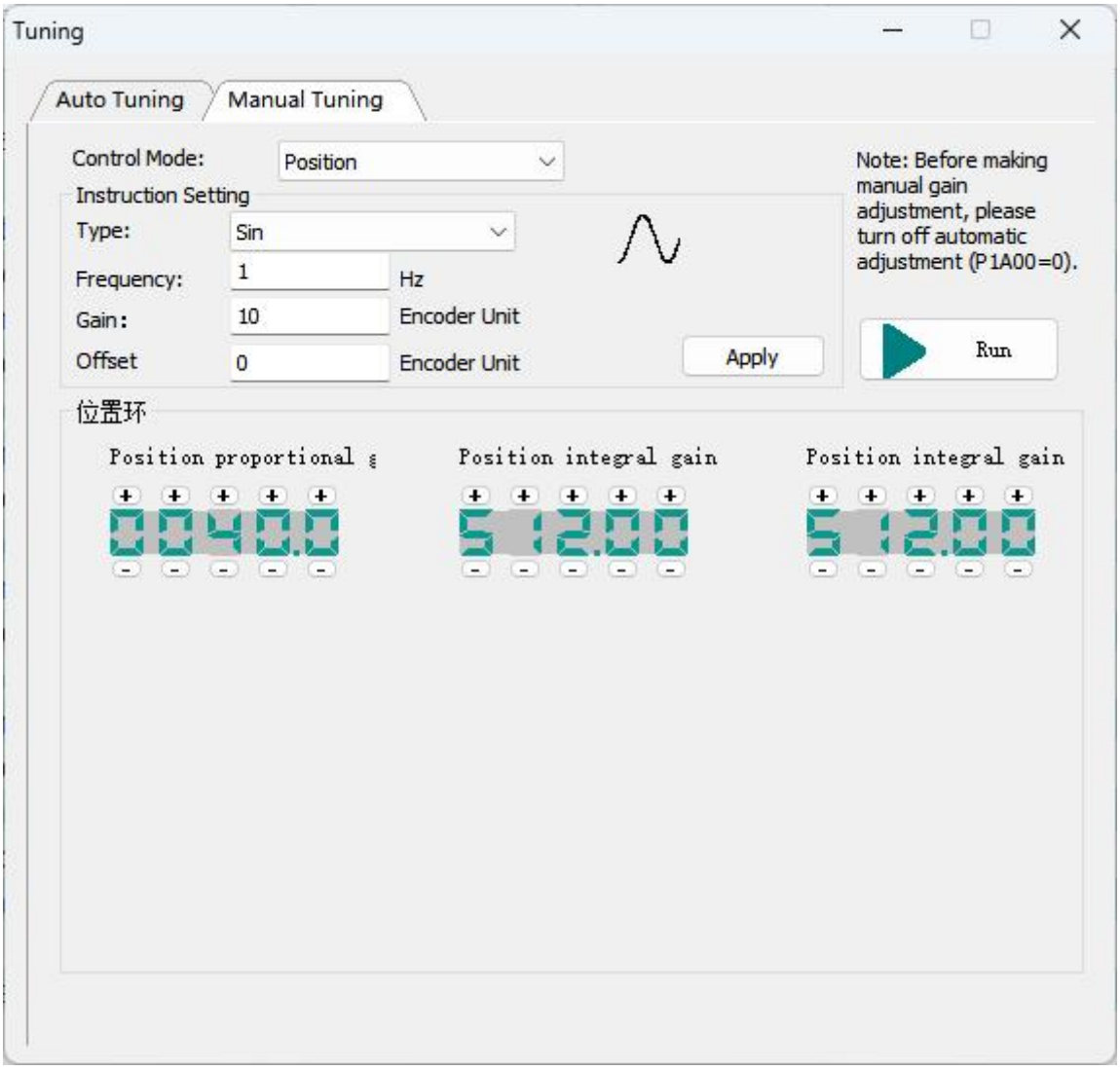


Figure 3-43 Adjust the speed loop gain

(3) Frequency domain analysis -FRF

Frequency domain analysis supports 3 modes: velocity closed loop, velocity open loop, and mechanical characteristics.

Velocity closed loop: automatically calculate and label the amplitude bandwidth and phase bandwidth.

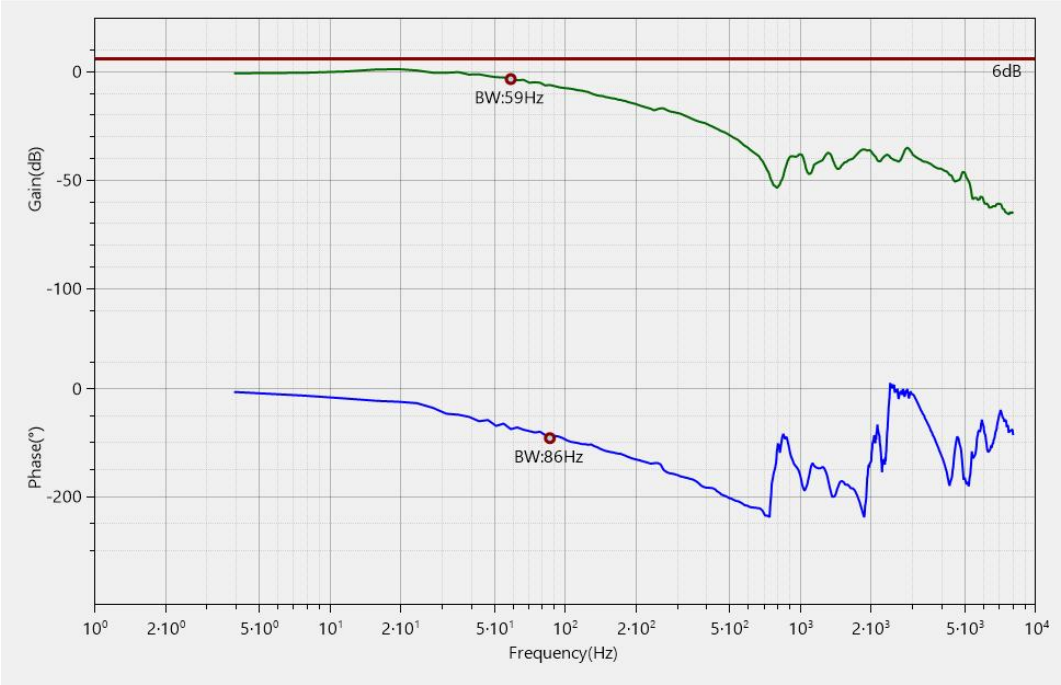


Figure 3-44 Velocity closed loop

Velocity open loop: automatically calculate and mark the amplitude margin and phase margin.

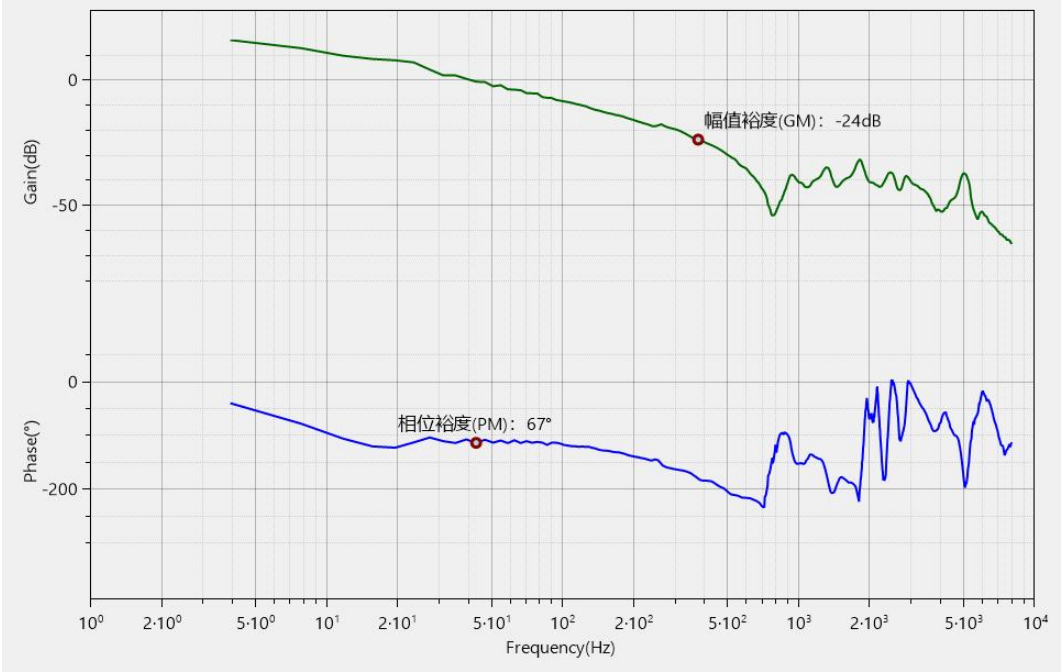


Figure 3-45 Velocity open loop

Mechanical characteristics: Automatic identification of resonance points and anti-resonance points. At present, the debugging software will automatically identify 2 resonance points. After identification, it will automatically update to the setting parameters of notch filter, and users can directly click download to write the

identified resonance point frequency to the drive.

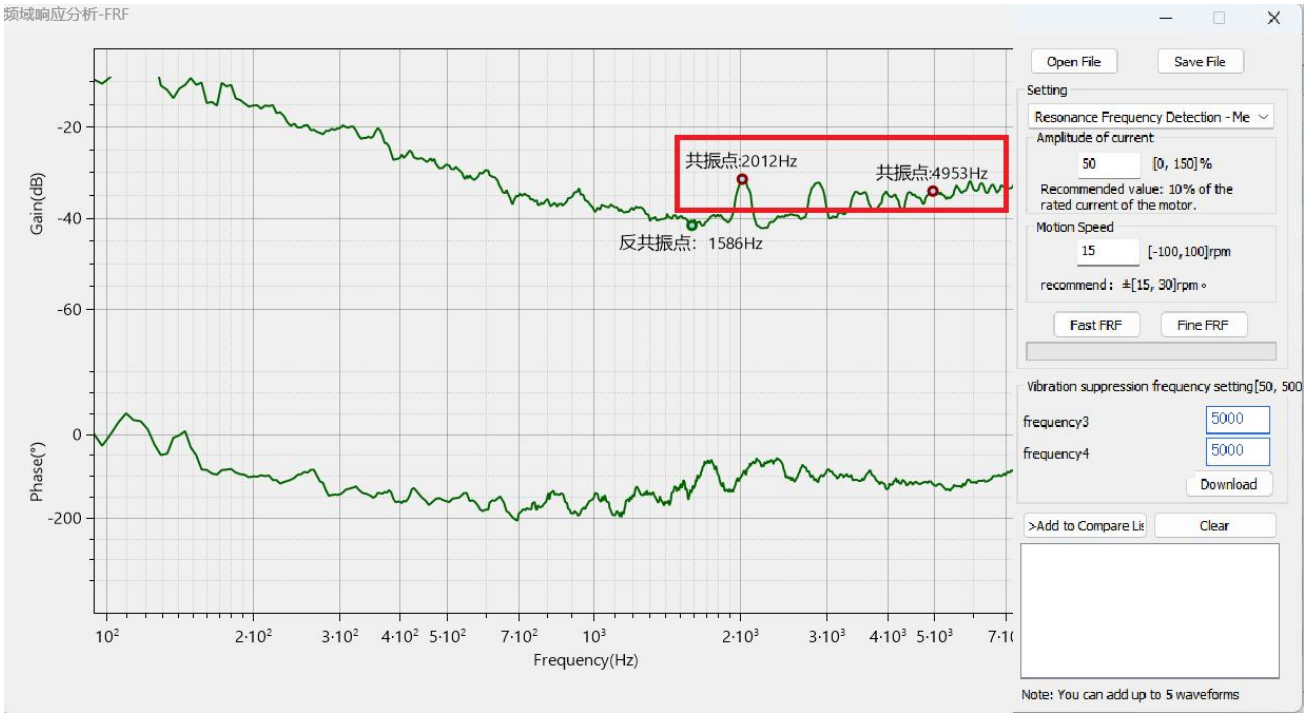


Figure 3-46 Mechanical Characteristics

3.3.8 Troubleshooting

(1) Real time Error

In case of equipment Error, the debugging software status bar will prompt users in real time (as shown below). User can double-click the Error area to view the Error details. Error is marked in red and Alarm is marked in yellow.

Figure 3-47 Error prompt

The Error details include: Error name, level, whether it can be reset, Error cause, detection method, and solution, etc., which facilitates users to quickly troubleshoot the Error.

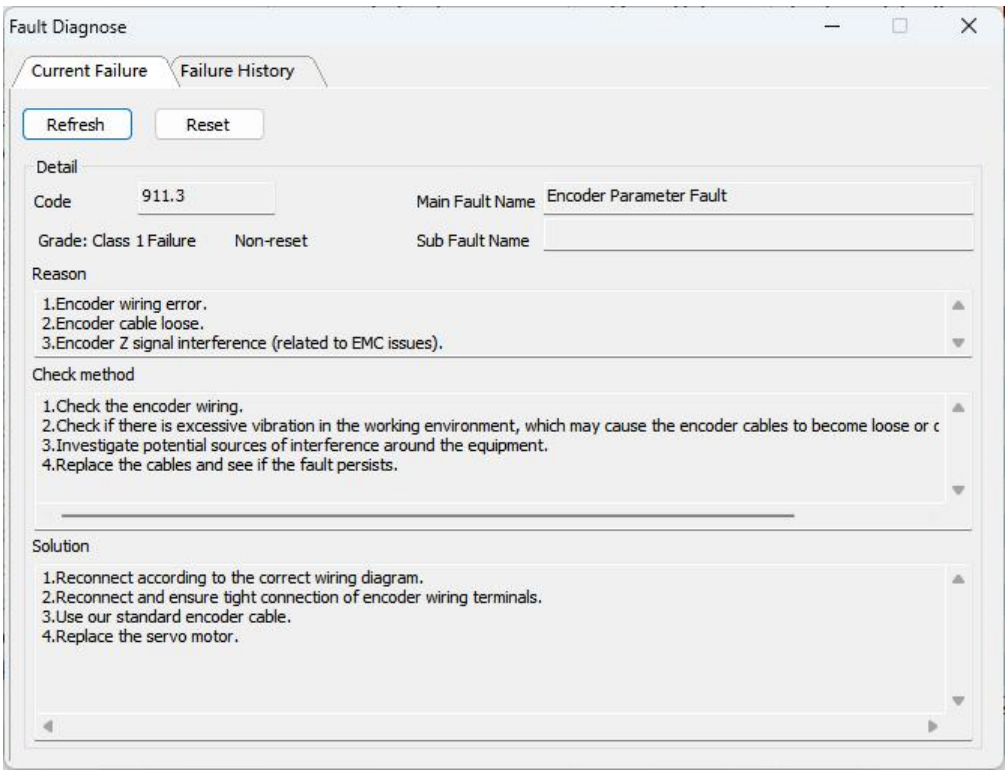


Figure 3-48 Error Diagnosis

(2) Error History

This function supports querying the lastest 10 errors, information shown as above figure.

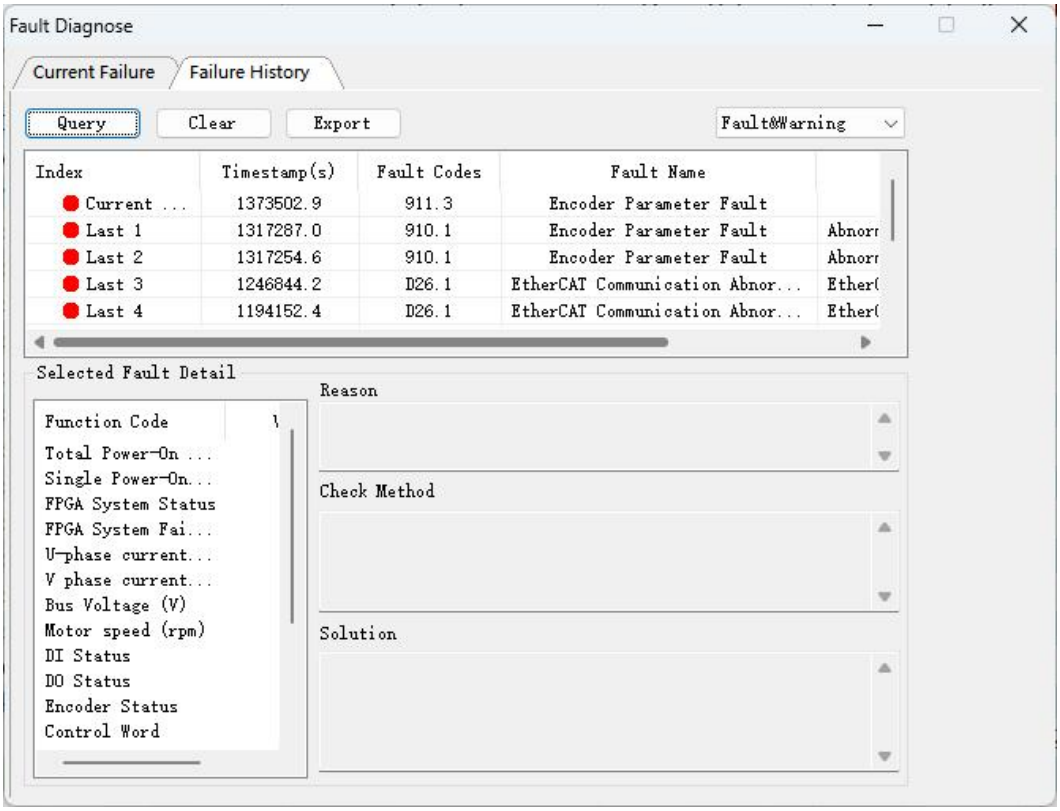


Figure 3-49 Error History

Query button: query the recent failure history of the device, as shown in the above figure;

Clear button: Clear the historical Error records in the drive;

Select the historical list row with the mouse, and the relevant parameter information and troubleshooting of the selected Error will be displayed below the list;

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Chapter 4 Basic Functions

4.1 Overview of functions

Function module	Function point	Function specification
I/O signal	5-digit LED and 5 key	Parameter setting and status display
	9-channel DI (including 2-channel HDI)	Sampling period: DI~1ms, HDI ~250μs
	5-channel DO output	Minimum holding time: 1 ms; load capacity: 50mA; voltage range:5V~30V
	2-channel AI input	Accuracy: 12 bit
	1-channel high-precision AI input	Accuracy: 16 bit（Optional）
	2-channel AO output	Voltage range: -10V~10V; maximum output: 1mA
	Low speed pulse input	Differential input: up to 500KHz
		Open collector: up to 200KHz
	High speed pulse input	Only differential input: up to 4MHz
	Frequency-division output	Differential output: up to 4MHz
	Second encoder input	ABZ type
	Encoder	Tamagawa, BISS, ABZ, sincos, etc.
	External brake release output	Brake-OFF DO signal
	Dynamic braking function (DB)	-
	Discharge control function	Power-off discharge/overvoltage discharge/discharge resistance disconnection detection
	STO function	-
	Motor PTC	Analog type
	Fan control	Built-in fan for 750W and above drives
	USB debugging	SV3 Designer
Position control mode	Position command source	Pulse input/preset position/position JOG
	Command filtering	Mean/low pass/command notch/command integer
	Position feedback	Incremental mode/absolute linearity/absolute rotation
	Electronic gear ratio	-
	Soft limit	-
	Status output	Positioning complete/position near/motion complete
Speed control mode	Speed command source	Keyboard/communication/preset speed /AI input/speed JOG
	Speed limit	-
	Speed feedforward	-
	Zero-speed clamp	-
	Status output	Motion signal/zero-speed signal/At-speed/velocity coincidence
Torque control mode	Torque command source	Keyboard/communication/AI input
	Command filtering	Two-way low-pass filter
	Torque limit	

Function module	Function point	Function specification
	Speed limit	
	Torque feedforward	
	Status processing	Torque reaching/torque limited/speed limited
Control algorithm	Standard rigidity table	Up to Grade 41 rigidity
	Adaptive gain adjustment	-
	Feedforward control	
	Gain switching	-
	Single parameter self-adjustment	-
	Offline and online inertia identification	-
	Adaptive notch filter	-
	Vibration suppression	A-type vibration suppression, full closed-loop vibration suppression, torque second-order low-pass filtering
	2 degree-of-freedom control	
	Speed observer	-
	Analysis of frequency domain characteristics	Open-loop and closed-loop Bode diagrams of control system
	Disturbance observer	-
	Model tracking control	-
	Dead zone compensation	-
	Motor parameter identification	-
	Magnetic pole identification	-
	Current loop self-tuning	-
Protection function	Troubleshooting	Fault display/storage/reset
	Protection detection of driver hardware abnormality	Input phase loss, overvoltage, undervoltage, overcurrent, soft start abnormality, leakage overload, driver overload, driver overheating, etc.
	Protection detection of driver software abnormality	Parameter storage failure detection, product matching failure detection, etc.
	Protection detection of motor abnormality	Short circuit to ground detection, motor overheating, motor overload, motor overspeed, phase sequence error, output phase loss, etc.
	Protection detection of encoder abnormality	Encoder disconnection, abnormal encoding communication, abnormal encoder battery, abnormal encoder count detection, etc.
	Protection detection of motion control abnormality	Forward and negative overstroke protection, runaway protection, command overspeed, excessive position deviation, homing overtime, etc.
	Protection detection of performance algorithm abnormality	Inertia identification fault, magnetic pole identification fault, motor parameter identification fault, etc.
SV3 Designer debugging	Debugging function support	Background speed Jog/ position Jog/preset position/homing /mechanical characteristic analysis/inertia identification/single parameter gain adjustment
		Time domain tuning/frequency domain characteristic

Function module	Function point	Function specification
		analysis/current loop parameter tuning/parameter identification/magnetic pole identification, etc.
	Electronic oscilloscope	Continuous oscilloscope/single sampling
	Fault diagnosis	Real-time fault/fault history/fault dictionary
	Running status monitoring function	Parameter running display
Other functions	Multiple stop modes	Zero-speed/sharp torque/ramp/DB/ free
	Real time mode switching	-
	Servo running status monitoring	Load rate, bus voltage, DIDO level, position feedback, position deviation, etc.
	CALL function	-
	Software reset	-
	User password setting	-
	Parameter power-off saving	-
	One-click factory return of parameter	-

4.2 Control mode

4.2.1 Position control mode

"Command unit": Refers to the minimum value that can be distinguished and input to the servo driver from the upper device.

"Encoder unit": Refers to the input command processed by electronic gear ratio.

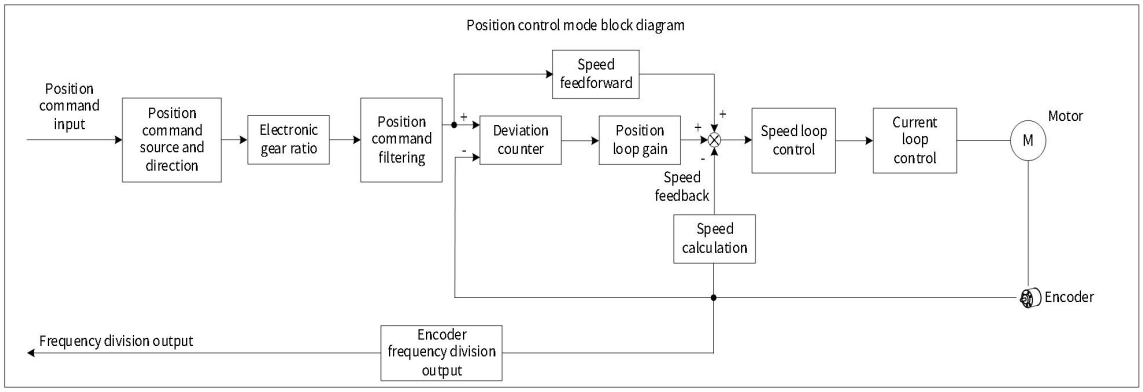


Figure 4-1 Position control block diagram

Set the value of Parameter P04.00 to 1 on the servo driver panel or SV3 Designer debugging platform. The servo driver will run in position control mode.

Please set the servo driver parameters based on the mechanical structure and indicator settings. The basic parameter settings in the position control mode is shown below.

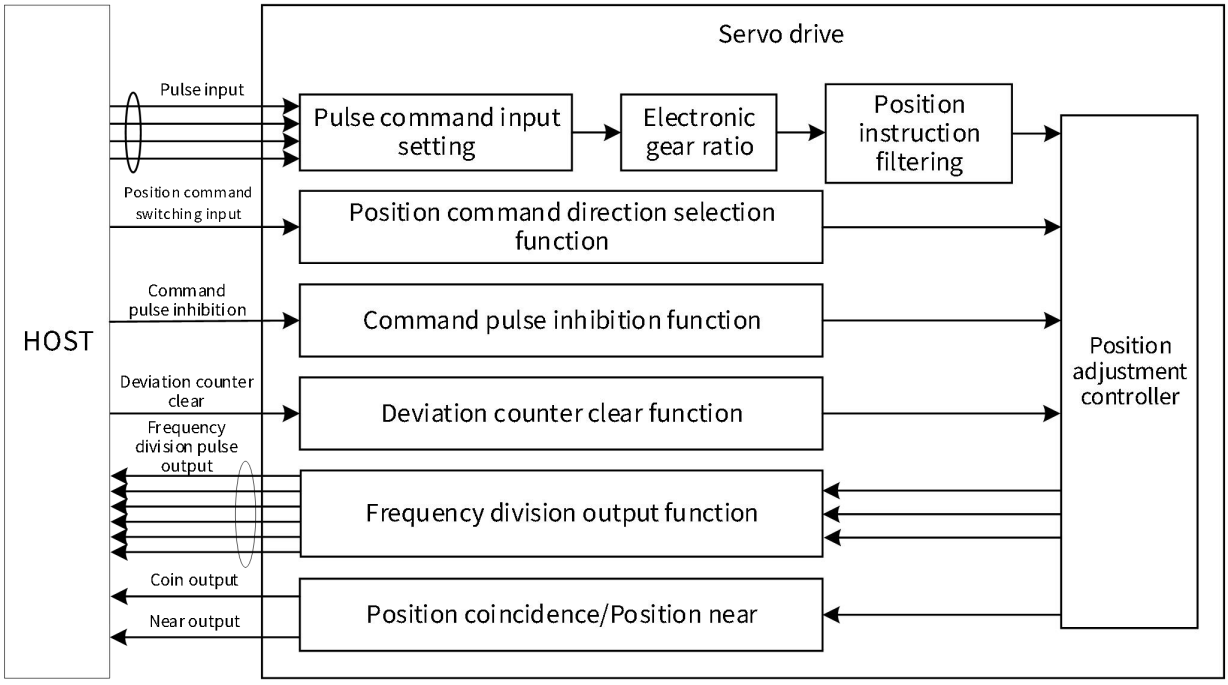


Figure 4-2 Signal interaction diagram between servo driver and host

4.2.1.1 Position command source selection

Position command input settings include: position command source, position command direction and position command inhibition.

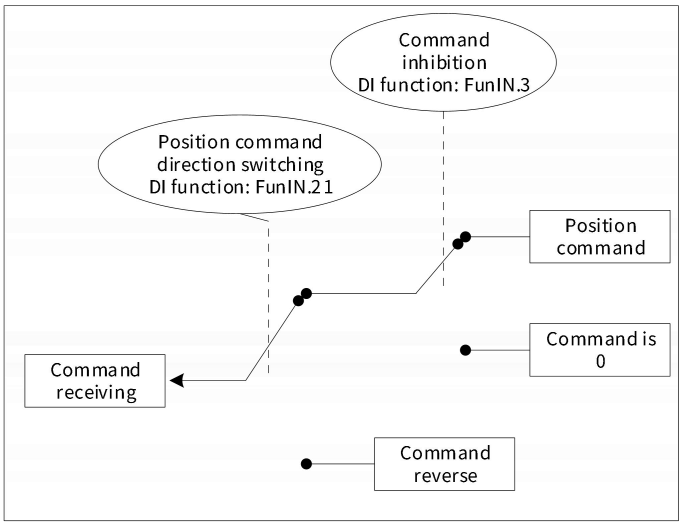


Figure 4-3 Position command input setting block diagram

(1) Position command source

In the position control mode, the position command source shall be set with the function code P13.00 firstly.

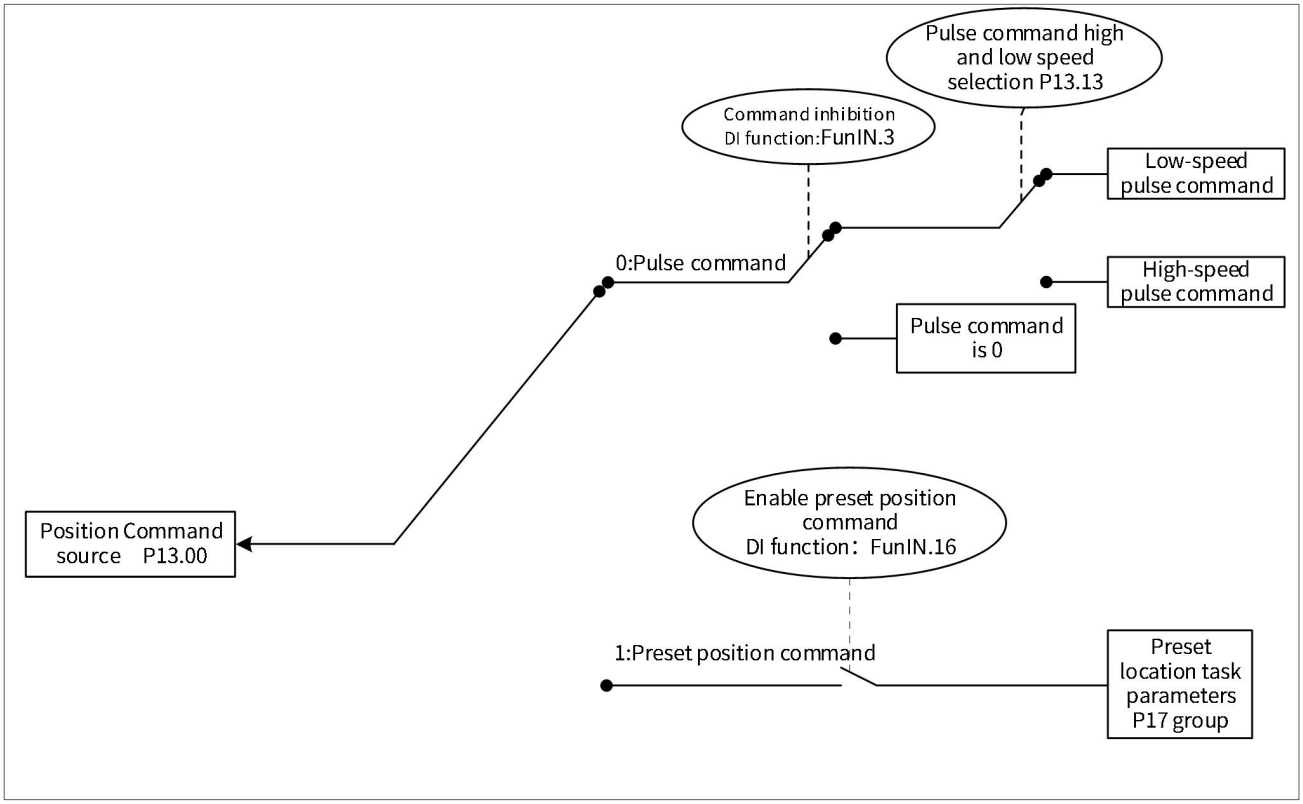


Figure 4-4 Position command source settings

Function code		Name	Range	Function	Setting mode	Effective time	Default
P13	00	Position command source	0: Pulse command 1: Preset position command	Set the position command source. The pulse command is an external position command and the preset position command is an internal position command.	Stop for setting	Effective immediately	0

a) Position command source (pulse command, P13.00=0)

When selecting the pulse command, please execute the following steps to get the correct pulse command form.

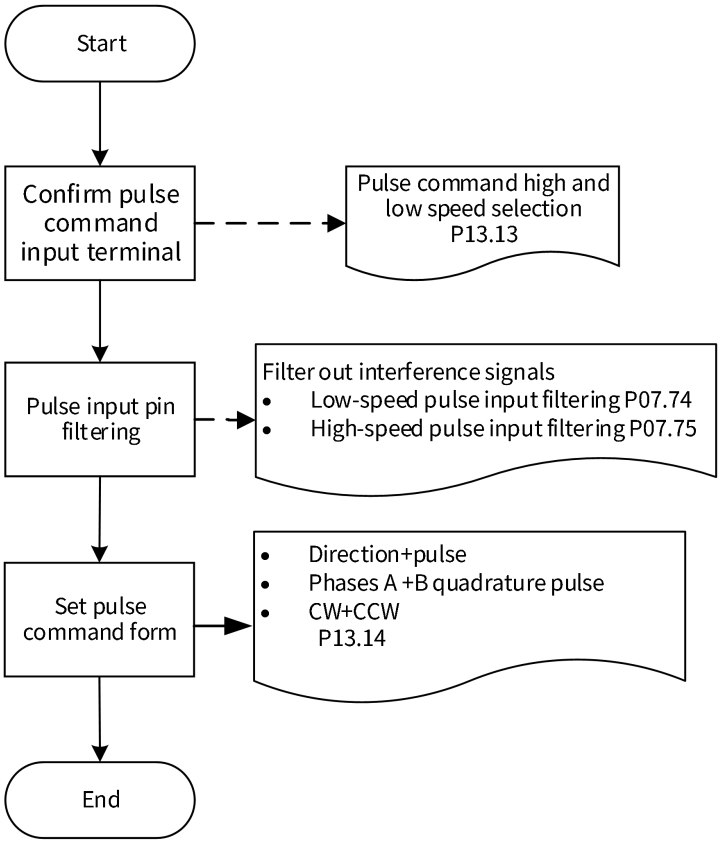
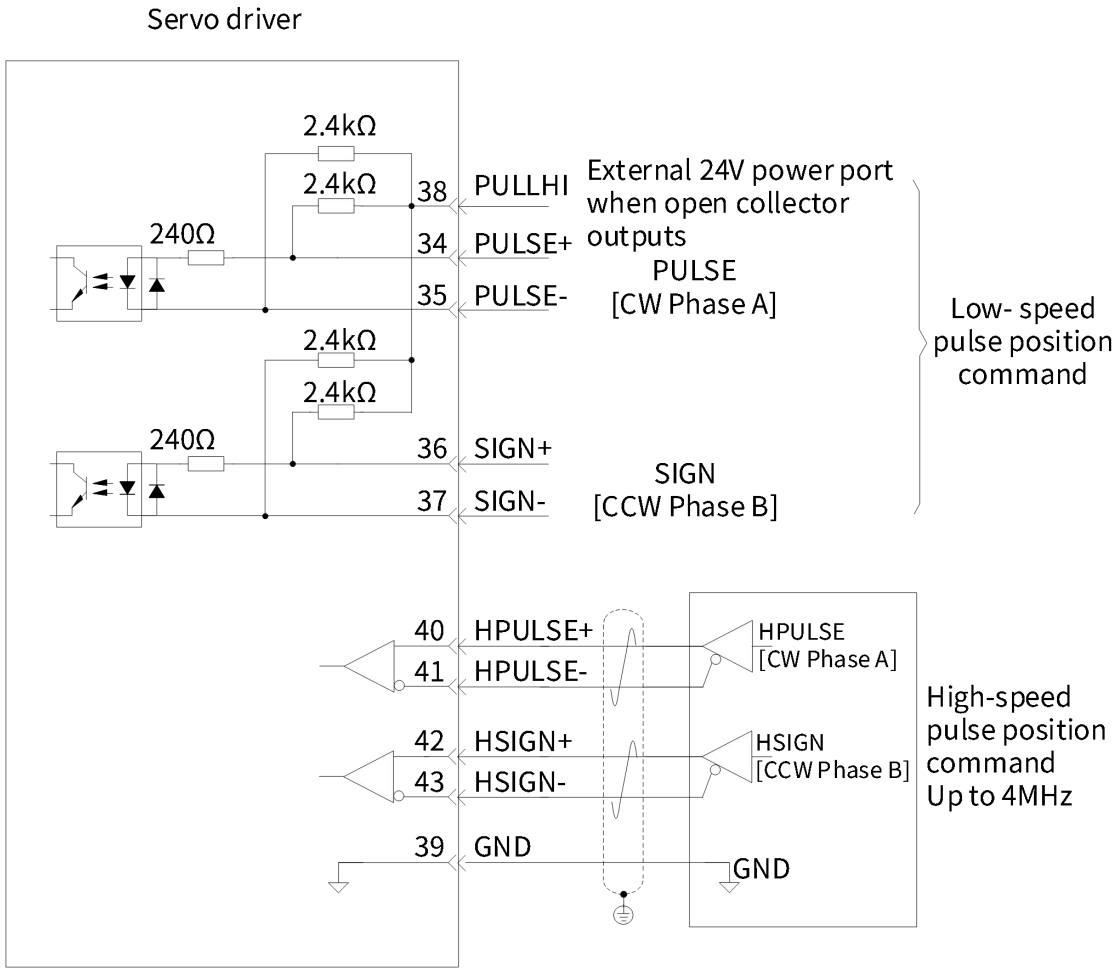


Figure 4-5 Pulse command source setting process Ⅰ **Pulse command input terminal**

The servo driver has two groups of pulse input terminals:



- Low speed pulse input terminals (corresponding to PULSE+, PULSE-, SIGN+, SIGN-) accept differential input (with the maximum frequency of input pulse of 500kpps) and open collector input (with the maximum frequency of input pulse of 200kpps).
- High speed pulse input terminals (corresponding to HPULSE+, HPULSE-, HSIGN+, HSIGN-) only accept differential input (with the maximum frequency of input pulse of 4Mpps).

Function code		Name	Range	Function	Setting mode	Effective time	Default
P13	13	Pulse command high and low speed selection	0: Low speed 1. High speed	Set the hardware input terminal of pulse command	Stop for setting	Effective immediately	0

Please refer to Section 2.7.5 for a detailed description of the port circuit.

Table 4-1 Pulse input specifications

Pulse specification	Maximum input	Voltage	Forward current

		frequency	specification	
High speed pulse	Differential signal	4M	5V	<25mA
Low speed pulse	Differential signal	500k	5V	<15mA
	Open collector signal	200k	24V	<15mA

II Pulse input pin filtering

The hardware input terminal of low speed pulse or high speed pulse needs to set a certain pin filtering time to filter the input pulse command, so as to prevent the interference signal from entering the servo driver, resulting in the motor malfunction.

Function code		Name	Range	Unit	Function	Setting mode	Effective time	Default
P07	74	Low speed pulse command filtering	0~255	25ns	Set the filtering time constant for low speed pulses	Stop for setting	Power on again	30
P07	75	High speed pulse command filtering	0~255	25ns	Set the filtering time constant for high speed pulses	Stop for setting	Power on again	3

If the filtering time constant of the pulse input pin is tF and the minimum width of the input signal is tmin, the input signal and the filtered signal shall be shown below. The filtered signal will be delayed by tF compared with the input signal.

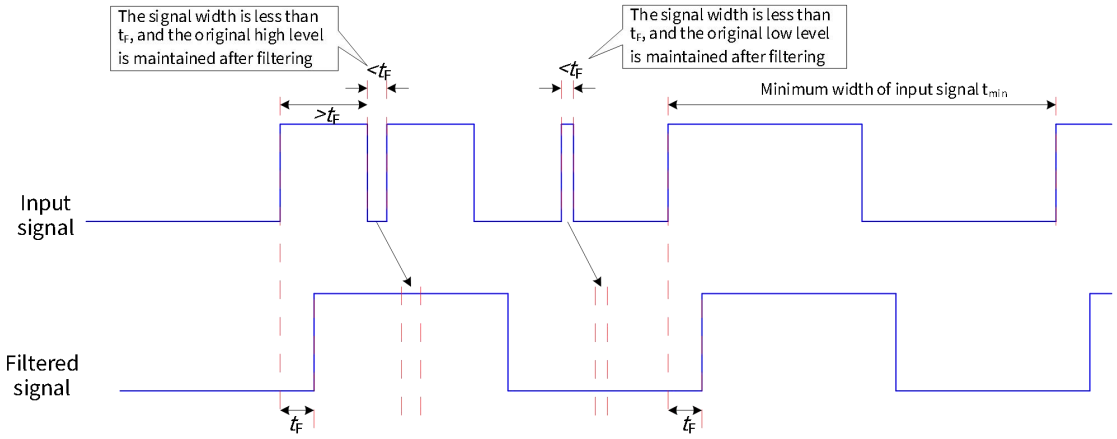


Figure 4-6 Filtered signal waveform example

The filtering time of pulse input pin t_F shall meet the following requirements: $t_F \leqslant (20\%\sim25\%)\ t_{min}$.

Given the maximum frequency (or minimum pulse width) of the input pulse, the recommended values of filtering parameters shall be shown below.

Table 4-2 List of recommended filtering parameters

Input pulse terminal	Corresponding function code	Maximum frequency of input pulse	Recommended filtering parameter (unit: 25ns)
Low speed pulse input terminal	P07.74	<167k	30
Low speed pulse input terminal	P07.74	167k~250k	20
Low speed pulse input terminal	P07.74	250k~500k	10
High speed pulse input	P07.75	500k~1M	5

Input pulse terminal	Corresponding function code	Maximum frequency of input pulse	Recommended filtering parameter (unit: 25ns)
terminal			
High speed pulse input terminal	P07.75	>1M	3

For example, if the set value is 30, the actual filtering time of the pulse input pin shall be 30*25=750ns.

III Pulse command form

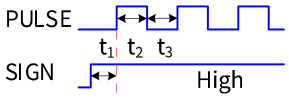
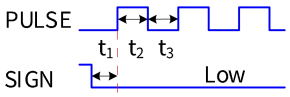
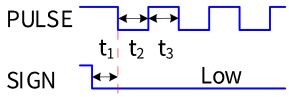
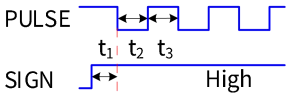
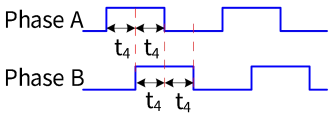
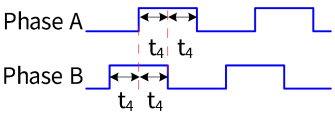
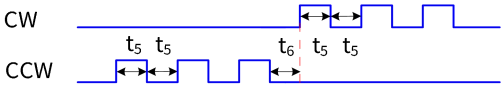
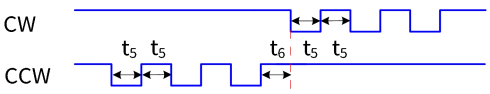
The pulse commands input from the servo driver have the following three forms:

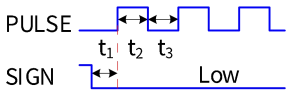
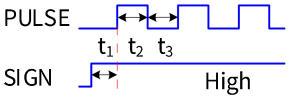
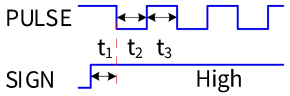
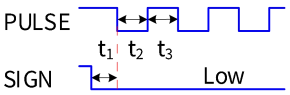
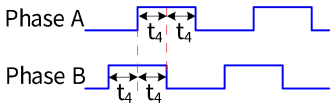
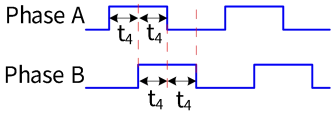
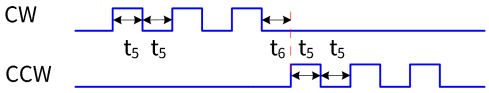
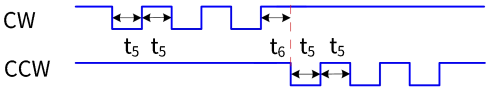
- Direction + pulse (positive logic or negative logic);
- Phases A and B orthogonal, 4x frequency;
- Positive pulse/negative pulse (CW+CCW).

Please set the pulse form based on the upper computer or other pulse output devices.

Function code		Name	Range	Function	Setting mode	Effective time	Default
P13	14	Pulse command form	0: Direction + pulse (positive logic) 1: Direction + pulse (negative logic) 2: Phase A + Phase B quadrature pulse, 4x frequency 3: CW+CCW	Select the pulse command form	Stop for setting	Power on again	0

Table 4-3 Pulse form description

P04.01 Running direction selection	P13.14 Command form setting	Pulse form	Signal	Forward pulse diagram	Reverse pulse diagram
0	0	Pulse + direction Positive logic	PULSE SIGN		
	1	Pulse + direction Negative logic	PULSE SIGN		
	2	Phases A +B orthogonal pulse 4x frequency	PULSE (Phase A) SIGN (Phase B)	 Phase A is 90° ahead of Phase B	 Phase B is 90° ahead of Phase A
	3	CW+CCW	PULSE(CW) SIGN(CCW)		
					

P04.01 Running direction selection	P13.14 Command form setting	Pulse form	Signal	Forward pulse diagram	Reverse pulse diagram
1	0	Pulse + direction Positive logic	PULSE SIGN		
	1	Pulse + direction Negative logic	PULSE SIGN		
	2	Phases A +B orthogonal pulse 4x frequency	PULSE (Phase A) SIGN (Phase B)	 Phase B is 90° ahead of Phase A	 Phase A is 90° ahead of Phase B
	3	CW+CCW	PULSE(CW) SIGN(CCW)		
					

The maximum frequency and minimum time width of position pulse commands corresponding to different input terminals are shown below:

Table 4-4 Pulse command specifications

Input terminal		Maximum frequency	Minimum time width/μs					
			t_1	t_2	t_3	t_4	t_5	t_6
High speed pulse input terminal		4Mpps	0.125	0.125	0.125	0.25	0.125	0.125
Low speed pulse input terminal	Differential input	500kpps	1	1	1	2	1	1
	Collector input	200kpps	2.5	2.5	2.5	5	2.5	2.5

The rising and falling time of position pulse command shall be less than 0.1μs.

IV Pulse command frequency

The maximum position pulse input frequency can be set with the function code P08.05. If the actual input pulse frequency is more than P08.05, the warning E.424.0 (position command overspeed fault) will occur.

Function code		Name	Range	Unit	Function	Setting mode	Effective time	Default
P08	05	Maximum position pulse input frequency	100~4000	kHz	Set the maximum frequency of external pulse command	Stop for setting	Power on again	4000

b) Position command source (preset position command, P13.00=1)

The servo driver has the preset position running function.16 segments of position commands are stored in the servo driver, and the displacement, maximum running speed and acceleration and deceleration times of each segment can be set separately, and the waiting time and connection mode between segments can also be selected depending on actual needs, with the setting process is shown below:

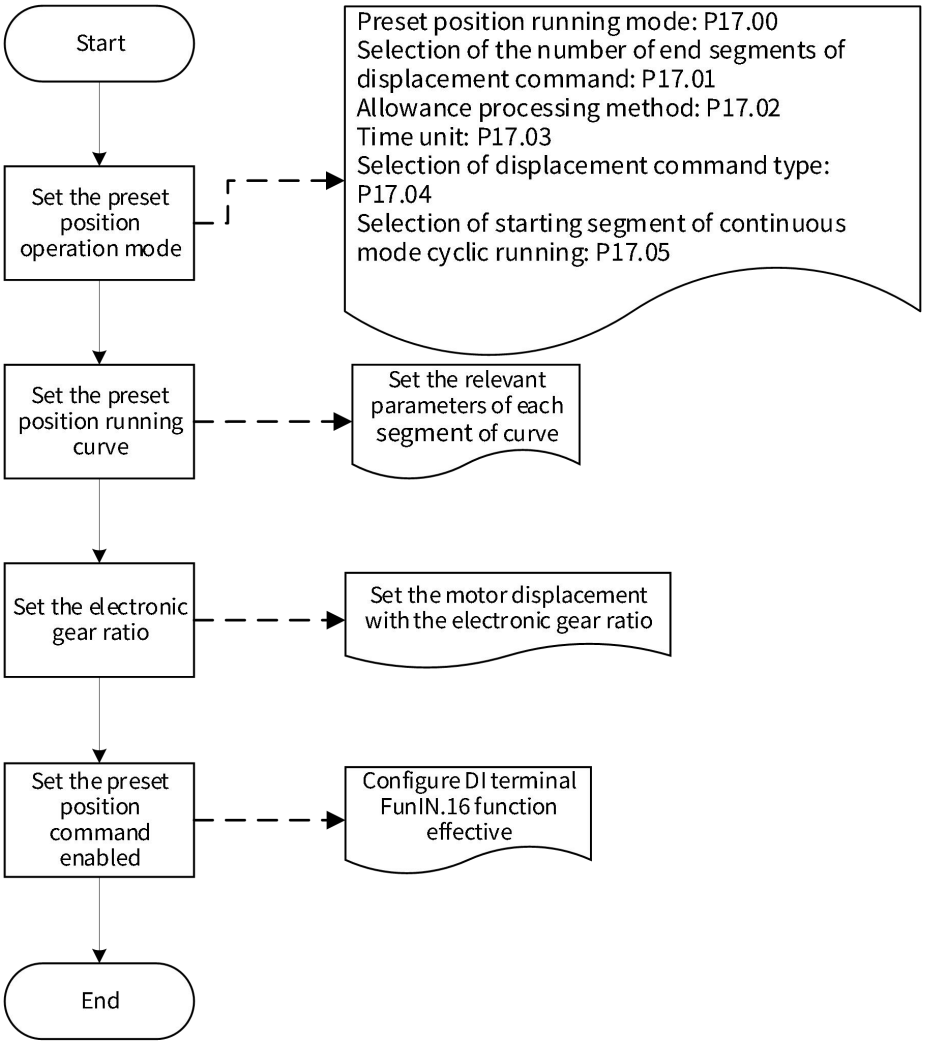


Figure 4-7 Preset position command source setting process

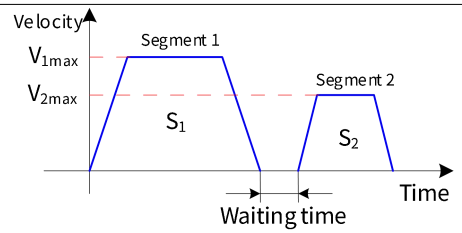
I Preset position running mode setting

Function code		Name	Range	Function	Setting mode	Effective time	Default
P17	00	Preset position task running mode	0:Single running 1:Cyclic running 2:DI switching running 3:Sequential running	Set the connection mode between segments	Stop for setting	Effective immediately	1
P17	01	Selection of the number of displacement execution segments	1~16	Set the total number of segments of the preset position command	Stop for setting	Effective immediately	1
P17	02	Allowance processing method	0: Continue to run the unfinished segments 1: Restart the running from the first segment	Set the servo enable ON, and return to the preset position from the interrupted segment number to the starting segment Note: P17.02 is only effective in case of 1P17.00≠2.	Stop for setting	Effective immediately	0
P17	03	Waiting time unit	0: ms 1: s	Set the acceleration and deceleration time and waiting time unit. Note: The waiting time is only effective in case of P17.00=0 or 1.	Stop for setting	Effective immediately	0
P17	04	Selection of position command type	0: Relative displacement command 1: Absolute displacement command	Set the position command type	Stop for setting	Effective immediately	0
P17	05	Selection of the cyclic mode starting segment	0~16	In case of P17.00=3, set the running starting segment numbers of multi-segments after the first cycle. Note: P17.05=0 or P17.05＞P17.01 indicates no cycle; P17.05＞1 indicates that the starting segment number is the set value of P17.05.	Stop for setting	Effective immediately	0

■ Stop at end of single running (P17.00=0)

Table 4-5 Single running description

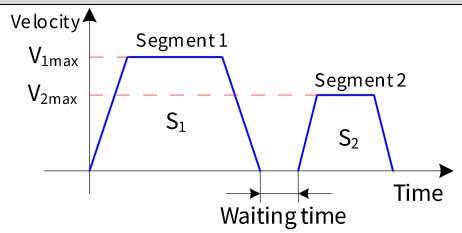
Mode description	Running curve

Running of 1 cycle; The segment numbers are automatically incremented; The waiting time can be set between segments; The preset position command enable signal is level effective.	 V_{1max} and V_{2max}: Maximum running speeds of Segments 1 and 2; S_1 and S_2: Displacements of Segments 1 and 2; After each segment of running is completed, the position coincidence signal will be effective; When the preset position command enable is OFF during the running, the servo motor will abandon the unfinished displacement of this segment and stop. After stop, the position coincidence signal will be effective; When the preset position command enable is ON again, the servo motor will run on the corresponding segment set with P17.02; When the servo enable is OFF during the running of a certain segment, the motor will stop in the servo OFF mode. After stop, the position coincidence is ineffective; During the running of a certain segment, the direction of position command is switched to DI; (FunIN.21) logic switching has no influence on the running direction of this segment.

That the driver runs completely one cycle of the total numbers of preset position command segments set with P17.00 is called completion of one running cycle.

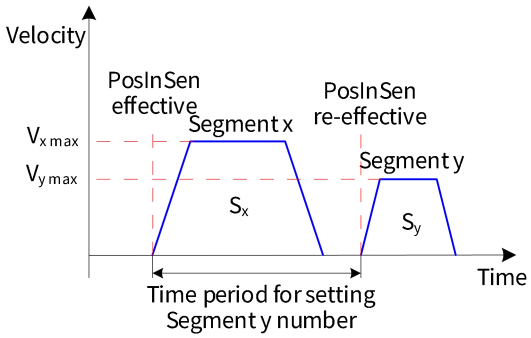
■ Cyclic running (P17.00=1)

Table 4-6 Cyclic running description

Mode description	Running curve
Cyclic running with the starting segment number of each cycle of 1; The segment numbers are automatically incremented; The waiting time can be set between segments; FunIN.16 (preset position enable) is effective in cyclic running; The preset position command enable signal is level effective.	 V_{1max} and V_{2max}: Maximum running speeds of Segments 1 and 2; S_1 and S_2: Displacements of Segments 1 and 2; After each segment of running is completed, the position coincidence signal will be effective; When the preset position command enable is OFF during the running, the servo motor will abandon the unfinished displacement of this segment and stop. After stop, the position coincidence signal will be effective; When the preset position command enable is ON again, the servo motor will run on the corresponding segment set with P17.02; When the servo enable is OFF during the running of a certain segment, the motor will stop in the servo OFF mode. After stop, the position coincidence is ineffective; During the running of a certain segment, the direction of position command is switched to DI; (FunIN.21) logic switching has no influence on the running direction of this segment.

■ DI switching running (P17.00=2)

Table 4-7 DI switching running description

Mode description	Running curve
When running the current segment number, the next segment number can be set; the motor will stop after completing the position command set with the current segment number. After the preset position command enable is ON, the segment number command will run at this time; The segment number is determined with the logic of the DI terminal; There is no waiting time between segments, and the interval time is determined with the command delay of the upper computer; The preset position command enable signal is effective for edge change.	 V_{xmax} and V_{ymax}: Maximum running speeds of Segments x and y; S_x and S_y: Displacements of Segments x and y; After each segment of running is completed, the position coincidence signal will be effective; When the preset position command enable is OFF during the running, the servo motor will continue to perform the unfinished displacement in this segment and output the position coincidence signal; The segment numbers must be switched in the following sequence: Before the positioning of the Segment x displacement is completed, the segment number switching will be ineffective; During the Segment x displacement running or after the positioning is completed, the preset position command enable will be OFF first, and then the segment number will be switched from x to y (if x=y, the servo motor will perform the Segment x displacement again); After the Segment x displacement positioning is completed, the preset position command enable will be ON, and the servo driver will perform Segment y displacement. When the servo enable is OFF during the running of a certain segment, the motor will stop in the servo OFF mode. After stop, the position coincidence is ineffective; During the running of a certain segment, the direction of position command is switched to DI; (FunIN.21) logic switching has no influence on the running direction of this segment.

When the preset position running mode is set to DI switching running, 4 DI terminals of the servo driver shall be assigned to the Functions 27~30 (FunIN.27: preset command selection 1~ FunIN.30: preset command selection 4), and the effective logic of the DI terminals shall be determined.

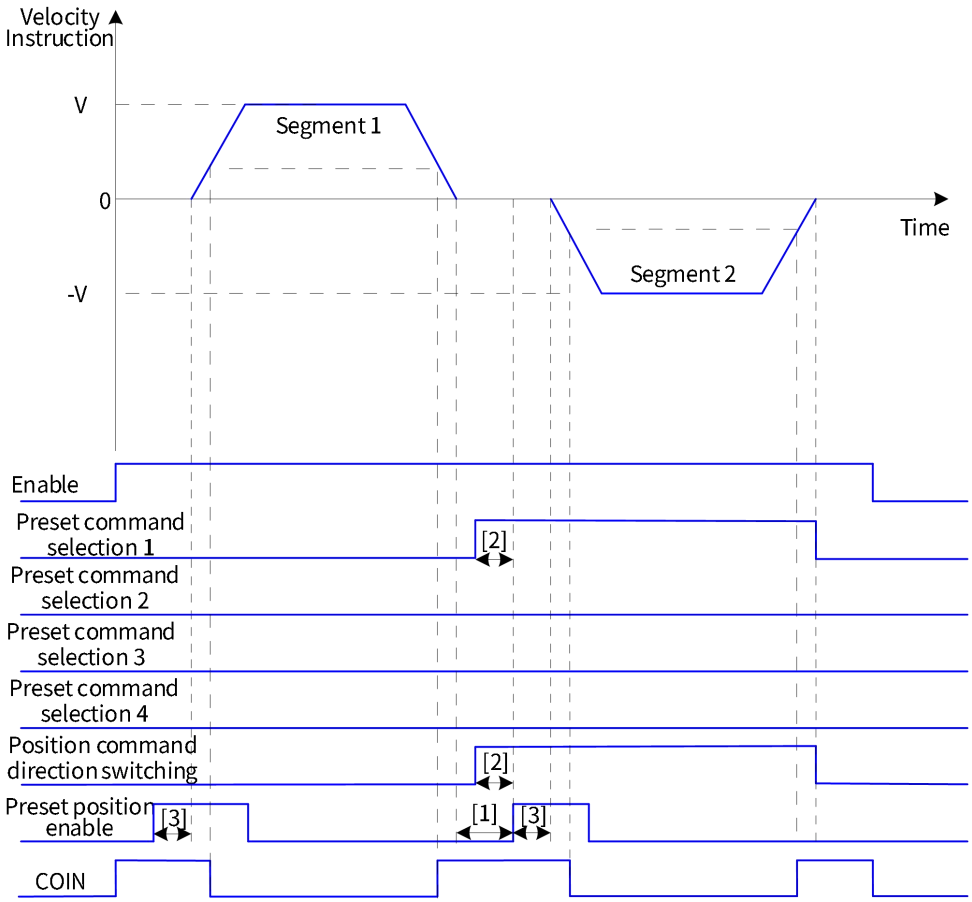


Figure 4-8 Preset position timing diagram

⚠ Notes:

*1: Area for switching segment numbers: Interval that the position command of the previous segment has been set, and the preset position enable of the next segment is effective again.

*2: When the low speed DI terminal is used, it will be effective for at least 3 ms.

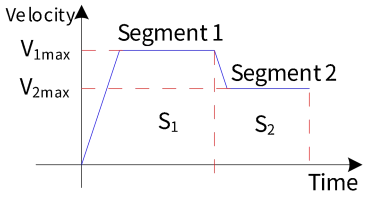
*3: When the preset position enable signal is effective for edge change and the ordinary DI terminal is used, the effective signal width shall be at least 3ms; when high speed DI terminal is used, the effective signal width shall be at least 0.25 ms.

<table>
<tr><th>Code</th><th>Function name</th><th>Function</th></tr>
<tr><td>FunIN.27</td><td>Preset command selection 1</td><td rowspan="4">The preset segment number is a 4-digit binary number, and the corresponding relationship between preset command segments 1~ 4 and the segment numbers is shown below:
<table><tr><th>Preset command selection 4</th><th>Preset command selection 3</th><th>Preset command selection 2</th><th>Preset command selection 1</th><th>Segment number</th></tr><tr><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td></tr><tr><td>0</td><td>0</td><td>0</td><td>1</td><td>2</td></tr><tr><td colspan="5">…</td></tr></table></td></tr>
<tr><td>FunIN.28</td><td>Preset command selection 2</td></tr>
<tr><td>FunIN.29</td><td>Preset command selection 3</td></tr>
<tr><td>FunIN.30</td><td>Preset command selection 4</td></tr>
</table>

		1 | 1 | 1 | 1 | 16 DI terminal logic is level effective; the preset command selection value shall be 1 when the input level is effective, otherwise it shall be 0.

■ Sequential running (P17.00=3)

Table 4-8 Sequential running description

Mode description	Running curve
Stop after running for one cycle (P17.05=0 or p17.05 > p17.01); Cyclic running, the starting segment number after the first cycle is P17.05; The segment numbers are automatically incremented; There is no waiting time between segments; The preset position enable signal is level effective.	 V_{1max} and V_{2max}: Maximum running speeds of Segments 1 and 2; S_1 and S_2: Displacements of Segments 1 and 2; After each segment of running is completed, the position coincidence signal will be effective; When the preset position command enable is OFF during the running, the servo motor will abandon the unfinished displacement of this segment and stop. After stop, the position coincidence signal will be effective; When the preset position command enable is ON again, the servo motor will run on the corresponding segment set with P17.02; When the servo enable is OFF during the running of a certain segment, the motor will stop in the servo OFF mode. After stop, the position coincidence is ineffective; During the running of a certain segment, the direction of position command is switched to DI; (FunIN.21) logic switching has no influence on the running direction of this segment.

II Preset position running curve setting

The preset position running function can set 16 different position commands, and the displacement, maximum running speed, acceleration and deceleration times of each segment and the waiting time between segments can be set separately. Take Segment 1 as an example:

Function code		Name	Range	Unit	Function	Setting mode	Effective time	Default
P17	12	Displacement of Segment 1	-1073741824 ~1073741824	Command unit	Set the sum of commands of Segment 1 position	In-running setting	Effective immediately	10000
P17	14	Running speed of Segment 1	1~6000	rpm	Set the maximum running speed of Segment 1	In-running setting	Effective immediately	200
P17	15	Acceleration and deceleration times of Segment 1	0~65535	ms(s)	Set the time for Segment 1 motor speed change from 0rpm to 1000rpm at multi-segment positions evenly	In-running setting	Effective immediately	10
P17	16	Waiting time after completion of Segment 1	0~10000	ms(s)	Set the waiting time after the positioning of Segment 1 is completed	In-running setting	Effective immediately	10

Based on the above settings, the actual running curve of the motor is shown below:

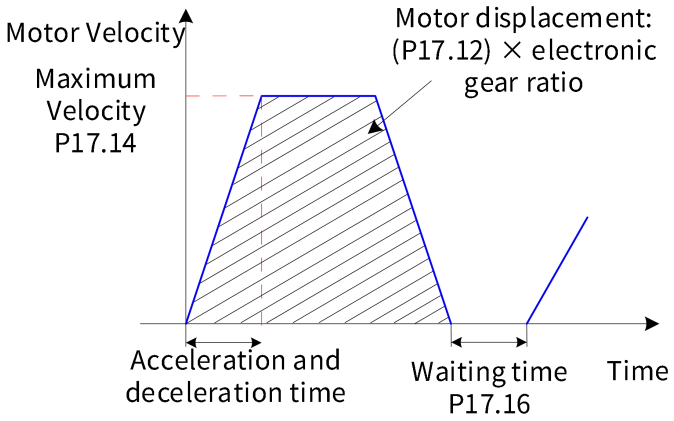


Figure 4-9 Motor running curve of Segment 1

Therefore, the actual acceleration time to P17.14 (Segment 1 displacement speed) t:

$$t = \frac{(P17.14)}{1000} \times (P17.15)$$

Please refer to Chapter 7 for the settings of the remaining 15 segments.

III Preset position command enable

When the preset position command is selected as the position command source, 1 DI terminal of the servo driver shall be assigned to the Function 16 (FunIN.16: preset position enable), and the effective logic of the DI terminal shall be determined.

Code	Function name	Function
FunIN.16	Preset position enable	Effective - The servo motor runs multi-segment position commands; Ineffective - The servo motor is locked. Notes: In case of P17.00=0, 1 and 3, the logic of the DI terminal corresponding to the preset position enable signal is level effective; In case of P17.00=2, the logic of the DI terminal corresponding to the preset position enable signal is level effective and edge effective.

(2) Position command direction setting

The position command direction can be switched with the DI terminal, so as to change the running direction of the motor. Configure 1 DI terminal of the servo driver as Function 21 (FunIN.21: position command direction switching), and determine the effective logic of the DI terminal.

Code	Function name	Function
FunIN.21	Position command direction switching	Ineffective - The actual position command direction is the same as the set position command direction; Effective - The actual position command direction is opposite to the set position command direction.

The actual motor running direction is related to the running direction selection (P04.01), the forward and negative position commands and the direction switching of position command (FunIN.21).

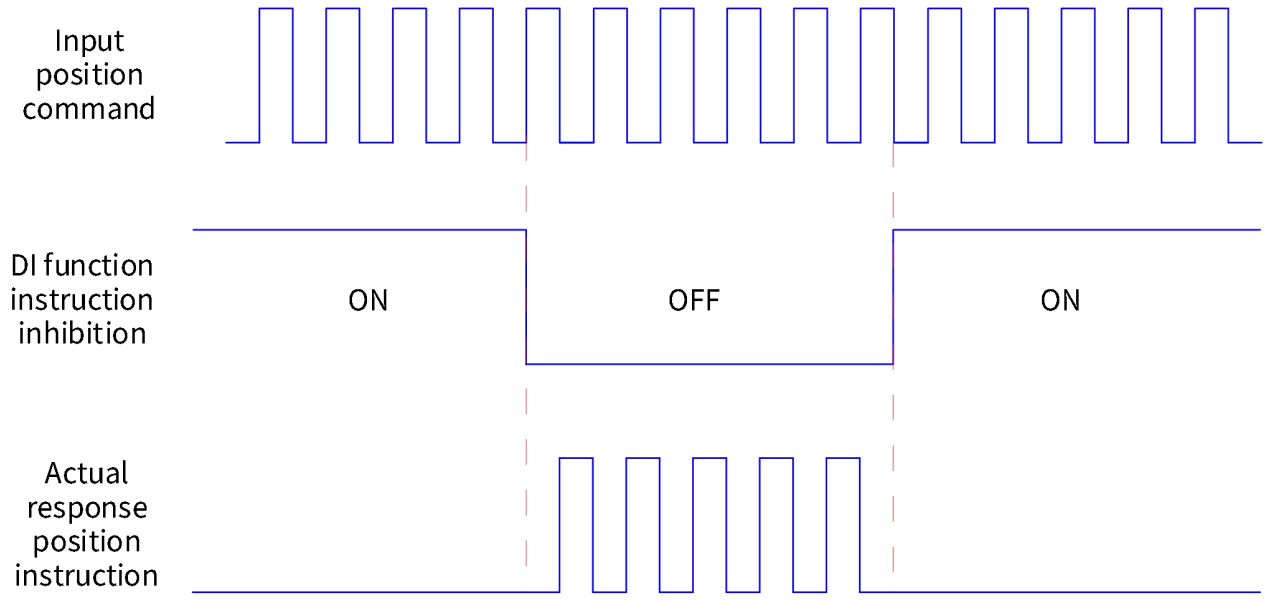
Table 4-9 Motor running direction table

P4.01	Position command (+/-)	FunIN.21	Actual motor running direction
0	+	Ineffective	Counterclockwise
0	+	Effective	Clockwise
0	-	Ineffective	Clockwise
0	-	Effective	Counterclockwise
1	+	Ineffective	Clockwise
1	+	Effective	Counterclockwise
1	-	Ineffective	Counterclockwise
1	-	Effective	Clockwise

(3)Command inhibition function

Command prohibition function: all position commands are forcibly reset to zero, and the servo driver does not respond to any internal or external position command. In the position control mode, the motor is in servo locking status. At this time, the driver can be switched to other control modes for continuous running.

When the command inhibition function is used, 1 DI terminal of the servo driver shall be assigned to the Function 3, and the effective logic of the DI terminal shall be determined.



Command prohibition function waveform example

Code	Function name	Function
FunIN.3	Command prohibition	Ineffective - The servo driver can respond to the command; Effective - The servo driver does not respond to any internal and external position command.

4.2.1.2 Position command filtering

The position command filtering is to filter the position commands (encoder unit) after frequency division or frequency multiplication by electronic gear ratio, including FIR filtering and mean filtering.

In the following cases, the position command filtering shall be considered:

- The position command output by the upper computer is not accelerated or decelerated;
- The frequency of pulse command is low;
- The electronic gear ratio is more than 10x.

Function code		Name	Range	Unit	Function	Setting mode	Effective time	Default
P07	00	FIR filtering for position command	0~6553.5	ms	Set the time constant of FIR filter for position command (encoder unit)	Stop for setting	Effective immediately	0.0
P07	01	Mean filtering of position command	0~128.0	ms	Set the time constant of the mean filter for position command (encoder unit)	Stop for setting	Effective immediately	0.0

This function has no influence on the displacement (total number of position commands).

If the set value is too large, the delay of the response will increase, and the filtering time constant shall be set based on the actual conditions.

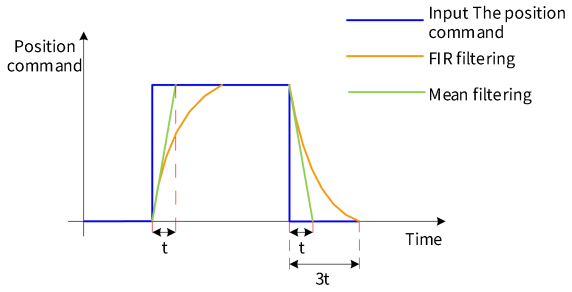


Figure 4-11 Schematic diagram of first-order filtering and mean filtering for rectangular position command

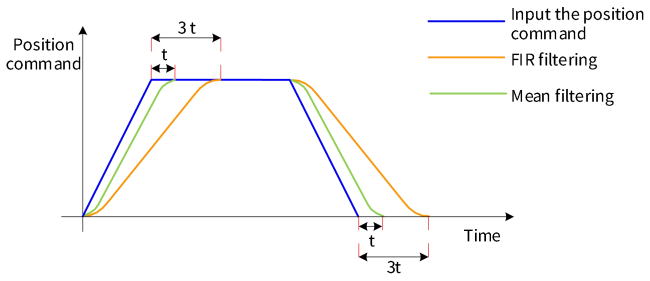


Figure 4-12 Schematic diagram of first-order filtering and mean filtering of trapezoidal position command

4.2.1.3 Position deviation clearing

Position deviation = (position command - position feedback) (encoder unit)

The position deviation clearing function means that the driver can clear the position deviation when certain conditions are met (P08.06).

Function	Name	Range	Function	Setting	Effective	Default

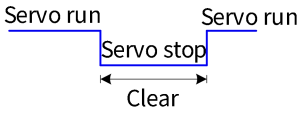
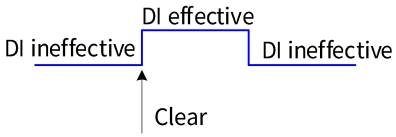
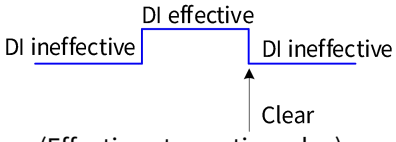
code					mode	time	
P08	08	Position deviation clearing mode	0: Clearing when the servo is not RUN 1: Clearing when the servo is OFF or DI signal is effective	Set the conditions of clearing the position deviation	Stop for setting	Effective immediately	0

In case of P08.08=1, 1 DI terminal of the servo driver shall be assigned to the Function 4 (FunIN: ClrPosPRr, position deviation clearing), and the effective logic of the DI terminal shall be determined.

Code	Function name	Function
FunIN.4	Position deviation clearing	Effective - The position deviation is cleared; Ineffective - The position deviation is not cleared.

The setting method is shown below:

Table 4-10 Position deviation clearing settings

Set value	Clearing conditions	Clearing time
P08.08=0	When the servo is not in "run" status, clear the position deviation.	
P08.08=1	When the servo is OFF or the logic of the DI terminal for clearing the position deviation will be effective, please clear the position deviation.	 (Effective at positive edge)
		 (Effective at negative edge)

4.2.1.4 Positioning coincidence signal/position near signal

The position coincidence function means that the position follow-up deviation meets the conditions set with the user (P13.08), and it can be considered that the positioning is finished in the position control mode. At this time, the servo driver can output a position coincidence (Coin) signal, and the upper computer can confirm that the positioning of the servo driver is completed after receiving this signal.

Its functional principle is shown below:

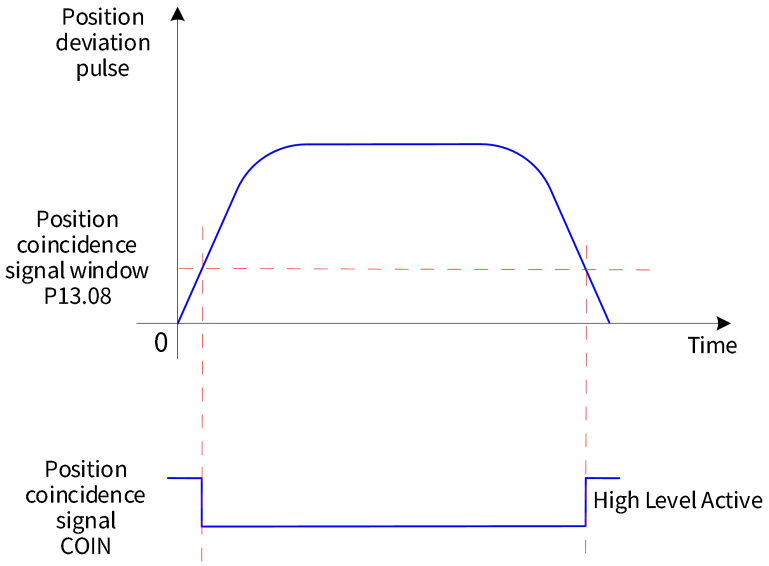


Figure 4-13 position coincidence function description

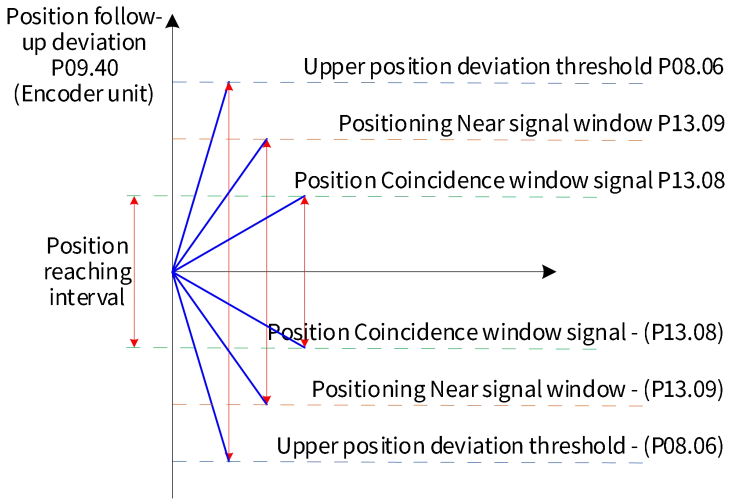
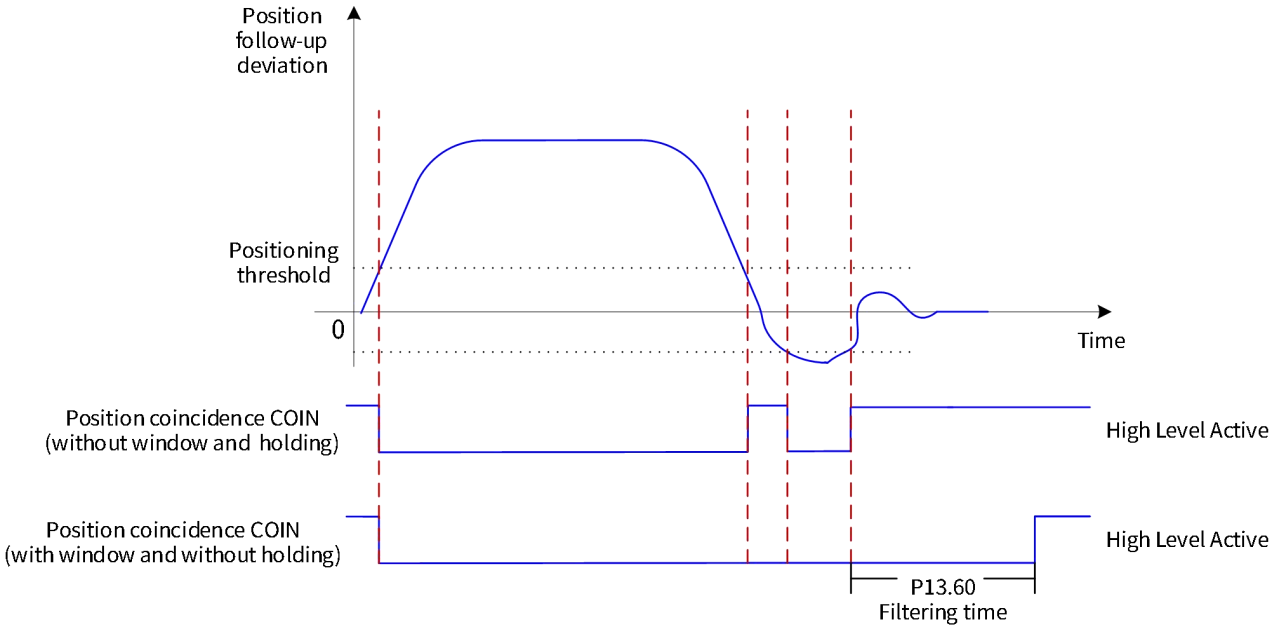
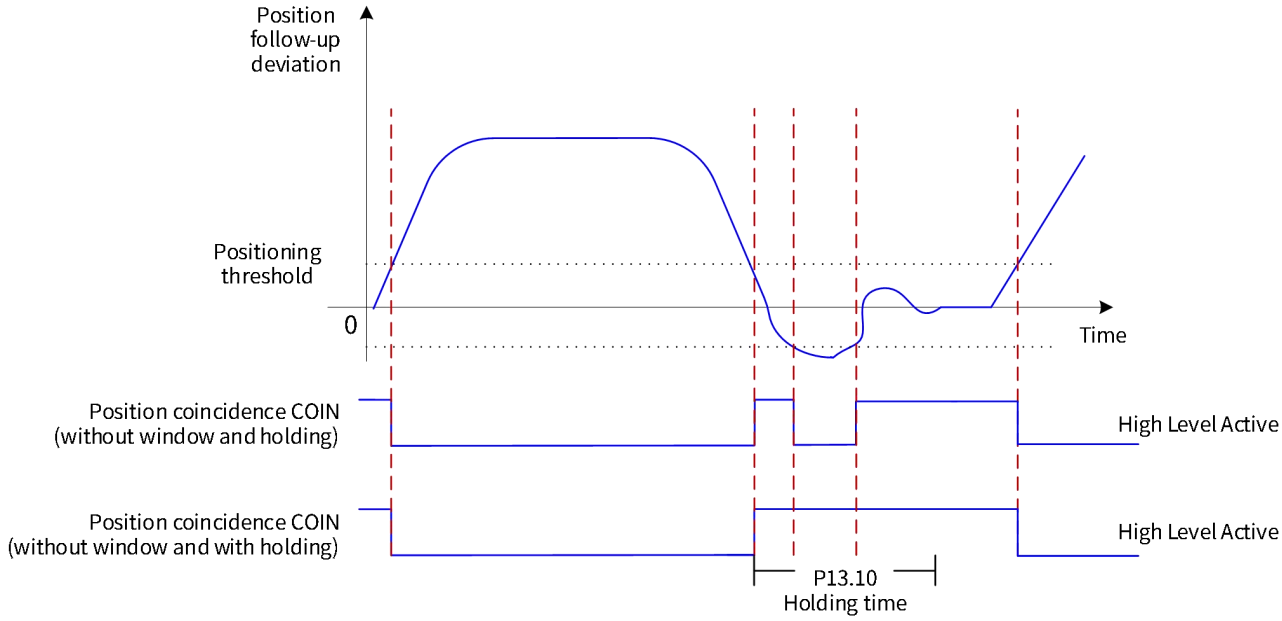


Figure 4-14 Position deviation correlation signal

When the position deviation meets the condition (P13.09), the servo driver can also output a position near signal (FunOut.10). Usually, the upper computer can receive the position near signal before confirming the position coincidence, so as to prepare for the positioning operation.

Before using the position coincidence/near function, the output conditions, threshold, window and holding time of position coincidence/position near shall be set. The principle of position coincidence window time and holding time is shown below:





When the position coincidence output section has the holding function, the set value of 0 means that the position coincidence signal will be effective until the next position command is received.

Function code		Name	Range	Unit	Function	Setting mode	Effective time	Default
P13	07	position coincidence signal output conditions	Output when the absolute value of position deviation is less than P13.08; Output when the	-	Set the conditions that the position coincidence (COIN)/positioning near (NEAR) is	In-running setting	Effective immediately	0

Function code		Name	Range	Unit	Function	Setting mode	Effective time	Default
			absolute value of position deviation is less than P13.08 and the filtered position command is 0; Output when the absolute value of position deviation is less than P13.08 and the position command before filtering is 0; Output when the absolute value of position deviation is less than P13.08, and the position command before filtering is 0, and at least the setting time of P13.10 is effective.		effective			
P13	08	Position coincidence signal window	1~65535	Encoder unit	Set the threshold of the absolute value of position deviation when position coincidence (COIN) is effective	In-running setting	Effective immediately	7
P13	09	Position near signal window	1~65535	Encoder unit	Set the threshold of the absolute value of position deviation when the position near (NEAR) is effective	In-running setting	Effective immediately	65535
P13	10	Position coincidence signal holding time	0~30000	ms	Set the minimum time that the positioning signal is effective	In-running setting	Effective immediately	0
P13	60	Position coincidence filtering time	0~30000	ms	Set the positioning signal filtering time; the effective level will output after filtering	In-running setting	Effective immediately	0

⚠ Notes:

- The position near signal window (P13.09) is generally larger than the position coincidence signal window (P13.08).

- The position coincidence signal window (P13.08) shall only reflect the threshold of absolute value of position deviation when the position coincidence is effective, and is not related to the positioning accuracy.
- When the set value of speed feedforward gain (P06.08) is too large or running at low speed, the absolute value of position deviation will be small. If the set value of P13.08 is too large, the position coincidence will always be effective. Therefore, in order to improve the effectiveness of position coincidence, please decrease the set value of P13.08.
- When the position coincidence signal window (P13.08) is small and the position deviation is small, the output conditions of the position coincidence signal can be changed by setting P13.07.
- When the servo enable is ineffective, the output of position coincidence signal (COIN) and position near signal (NEAR) shall be ineffective.
- When the position coincidence and position near functions are used, 2 DO terminals of the servo driver shall be assigned to the DO function 10 (FunOut.10: Near) and DO function 11 (FunOut.11: Coin) respectively, and the effective logic of the corresponding DO terminals shall be determined.

Code	Name	Function name	Function
FunOut.10	NEAR	Position near	Effective - In the position control mode, the absolute value of position deviation meets the set conditions of P13.09, indicating the servo position near; Ineffective - In the position control mode, the servo is in the position near process.
FunOut.11	COIN	Position coincidence	Effective - In the position control mode, the absolute value of position deviation meets the set conditions of P13.08, indicating the servo position coincidence; Ineffective - In the position control mode, the servo is in the position coincidence process.

4.2.1.5 Homing

(1) Function description

- The homing function refers to the function that the servo driver positions the mechanical origin at given the action speed based on the external signal;
- After homing ting, the actual position feedback of the motor shall be P13.51 (mechanical offset of the origin);
- The mechanical origin can correspond to the origin switch signal, and signals of positive and negative limit switches and motor Z;
- There are many homing modes mechanically. If the mechanical connection between the motor and the equipment cannot be disconnected in actual use, please see the Section "Return modes of origin" to select the appropriate homing mode, to avoid equipment damage;
- When the servo is in the homing mode and is running, it cannot be switched to other modes; when homing is completed or interrupted (failed or ineffectively enabled),it can be switched to other modes;
- Please notice the distance between the limit switch and the positive and negative limit switches, and set an appropriate acceleration, otherwise it may result in a collision!

(2) Parameter settings

a) Homing mode settings

Function code		Name	Range	Function	Setting mode	Effective time	Default
P13	44	Homing enable	0: Turn off the homing function; 1: Enable the homing function with DI; 2. Implement the homing function immediately; 3: Set the current position as the origin.	Set the homing mode and trigger the signal source	In-running setting	Effective immediately	0
P13	45	Homing mode	(-1): Negative homing. The deceleration point is the mechanical limit position, and the origin is the index pulse of the motor, and the mechanical limit position must be met before meeting the index pulse; (-2): Positive homing. The deceleration point is the mechanical limit position, and the origin is the index pulse of the motor. The mechanical limit position must be met before meeting the index pulse; 1: Negative homing. The deceleration point is the negative limit switch, and the origin is the index pulse of the motor. The negative edge of the negative limit must be met before meeting the index pulse; 2: Positive homing. The deceleration point is the positive limit switch, and the origin is the index pulse of the motor. The negative edge of the positive limit must be met before meeting the index pulse; 3: Positive homing. The deceleration point is the home switch, and the origin is the index pulse of the motor. The negative edge	Set the direction, deceleration point and origin in homing	Stop for setting	Effective immediately	1

Function code		Name	Range	Function	Setting mode	Effective time	Default
			on the same side of the home switch must be met before meeting the index pulse; 4: Positive homing. The deceleration point is the home switch, and the origin is the index pulse of the motor. The positive edge on the same side of the home switch must be met before meeting the index pulse; 5: Negative homing. The deceleration point is the home switch, and the origin is the index pulse of the motor. The negative edge on the same side of the home switch must be met before meeting the index pulse; 6: Negative homing. The deceleration point is the home switch, and the origin is the index pulse of the motor. The positive edge on the same side of the home switch must be met before meeting the index pulse; 7: Positive homing. The deceleration point is the home switch, and the origin is the index pulse of the motor. The negative edge on the same side of the home switch must be met before meeting the index pulse; 8: Positive homing. The deceleration point is the home switch, and the origin is the index pulse of the motor. The positive edge on the same side of the home switch must be met before meeting the index pulse; 9: Positive homing. The deceleration point is the home switch, and the origin is the index pulse of the motor. The positive edge on the other side of the home switch must be met before meeting the index pulse; 10: Positive homing. The deceleration point is the home switch, and the origin is the index pulse of the motor. The negative edge on the other side of the home switch must be met before meeting the index pulse; 11: Negative homing. The deceleration point is the home switch, and the origin is the index pulse of the motor. The negative edge on the same side of the home switch must be met before meeting the index pulse; 12: Negative homing. The deceleration point is the home switch, and the origin is the index pulse of the motor. The positive edge on the same side of the home switch must be met before meeting the index pulse; 13: Negative homing. The deceleration point is the home switch, and the origin is the index pulse of the motor on the other side of the home switch. The positive edge on the other side of the home switch must				

Function code		Name	Range	Function	Setting mode	Effective time	Default
			be met before meeting the index pulse; 14: Positive homing. The deceleration point is the home switch, and the origin is the index pulse of the motor on the other side of the home switch. The negative edge on the other side of the home switch must be met before meeting the index pulse. 15~16: Reserved; 17~32: They are similar to 1~14, but the deceleration point coincides with the origin. 33: Negative homing. The origin is the motor index pulse. 34: Positive homing. The origin is the index pulse of the motor. 35: The current position is the origin.				

b) Homing running curve settings

If the deceleration point signal is effective and the origin signal is effective without sufficient deceleration, the final positioning may be unstable. The displacement required for deceleration shall be fully considered before setting the deceleration point and the input position of the origin signal. The acceleration and deceleration (P13.48) will also affect the positioning stability when searching the origin, so it shall be considered.

Function code		Name	Range	Unit	Function	Setting mode	Effective time	Default
P13	46	Speed during search for switch	0~3000	rpm	Set the high speed of the deceleration point signal for homing	Stop for setting	Effective immediately	60
P13	47	Speed during search for zero	0~1000	rpm	Set the high speed of the deceleration point signal for homing. The set speed shall be low enough to prevent mechanical collision during stop.	Stop for setting	Effective immediately	10
P13	48	Homing acceleration	0~1000	rpm/s	Set the acceleration of the motor from 0 to 1000 rpm for homing	Stop for setting	Effective immediately	1000
P13	49	Homing finding time	0~655.35	s	Limit the total time for homing. If it exceeds, the warning A.425.0 (the homing fails) will occur.	Stop for setting	Effective immediately	500.00
P13	51	Mechanical offset of origin	-1073741824 ~1073741824	Command unit	Set the absolute position value of the motor after homing (P09.49)	Stop for setting	Effective immediately	0

<table>
<tr><th>Code</th><th>Function name</th><th>Function</th></tr>
<tr><td>FunIN.11</td><td>Home switch</td><td>Effective - The current position is the origin.
<table>
<tr><th>Logic of the DI terminal set with HomeSwitch</th><th>Actual effective level</th></tr>
<tr><td>0 (low level)</td><td>Low level</td></tr>
<tr><td>1 (high level)</td><td>High level</td></tr>
</table>
Based on the output of the upper computer, the logic of the DI terminal corresponding to the origin switch shall be set to be effective at high/low level.</td></tr>
<tr><td>FunIN.12</td><td>Homing enable</td><td>Effectively - Enable the homing function. During homing process, the repeated enabling is ineffective;
Ineffective - Disable the homing function.</td></tr>
<tr><td>FunOut.14</td><td>Homing completion</td><td>Effective - When the position is controlled, the homing shall be completed;
Ineffective - The homing is not completed.</td></tr>
</table>

c) Homing enable settings

i. P13.44=0

Turn off the homing function

ii. P13.44=1

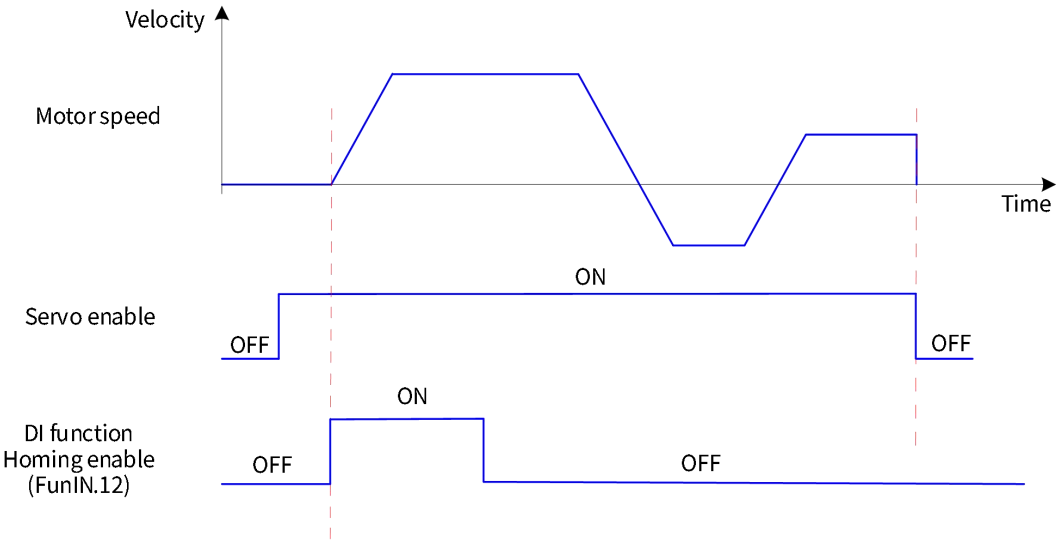


Figure 4-15 Timing example diagram

The servo enable signal must be turned on first before turning on the homing enable signal;

During homing process, the servo enable signal shall be effective, and the change of HomingStart signal shall be shielded.

During homing process, the servo enable signal shall be set to be ineffective, the servo motor shall stop, and the homing shall be restarted. Please turn on the servo enable signal first, and then the HomingStart signal;

When the homing fails (A.425.0), the servo motor shall stop, the servo enable signal shall be effective, and the HomingStart signal shall be triggered again to reset A.425.0 and the homing function shall be performed again.

The homing function can be repeatedly triggered.

iii. P13.44=2

After power-on, if the servo enable signal is set to be effective, the homing function will be implemented immediately;

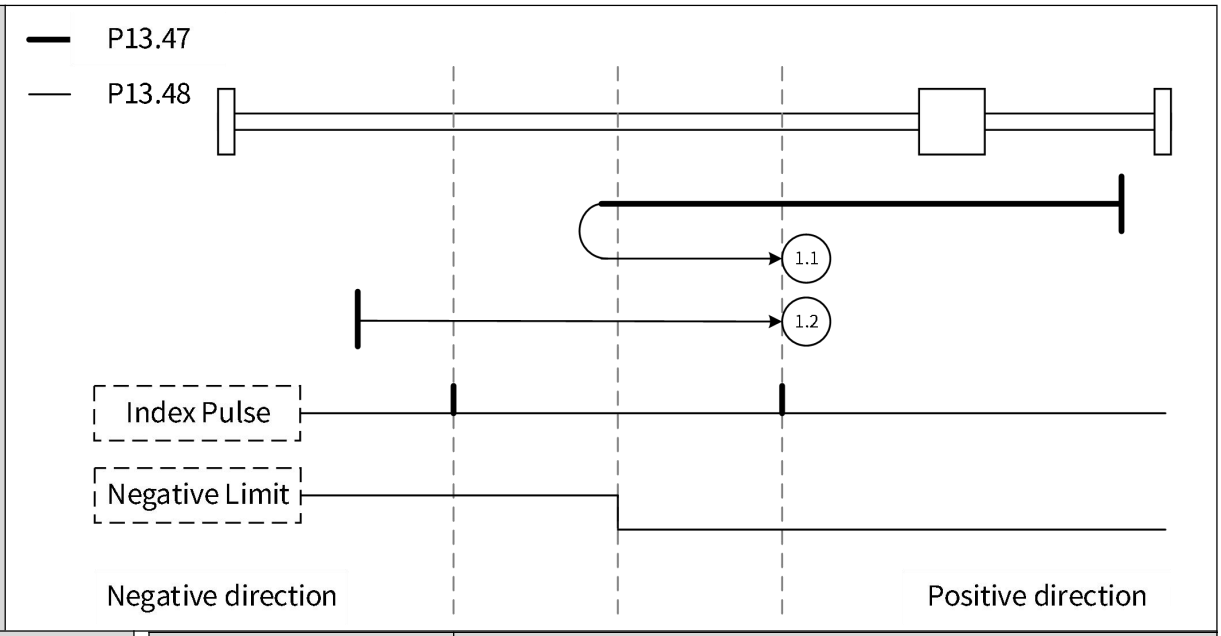
During homing process, the servo enable signal shall be set to be ineffective, the servo motor shall stop, and the homing function can be triggered again by setting the servo enable signal to be effective again;

When the homing fails (A.425.0), P13.44 will be set to 0, the servo motor will stop, and the servo enable signal will be set to ineffective to reset A.425.0; after the homing, p13.44 = 0; if the homing is implemented, must reset P13.44.

d) Introduction of homing modes

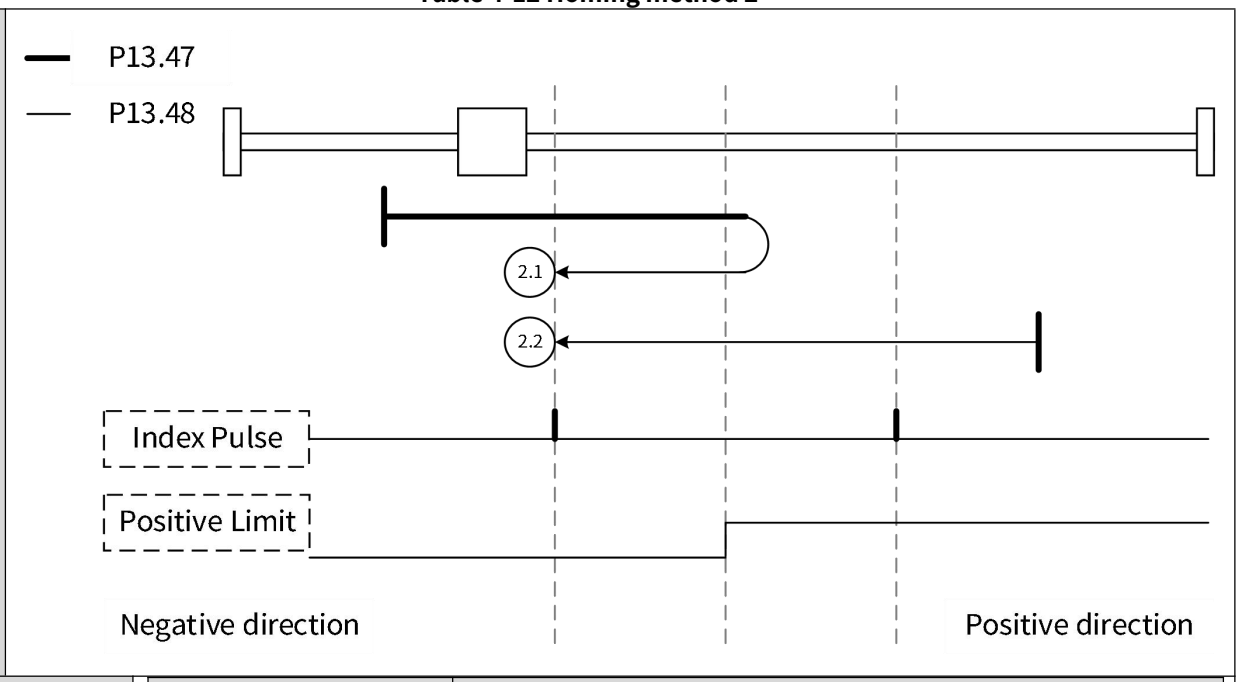
I) Method 1:

Table 4-11 Homing mode 1

<table>
<tr><td>Motion block diagram</td><td colspan="2"> 
</td></tr>
<tr><td>Positioning signal</td><td colspan="2"><table>
<tr><th>Origin</th><th>Decelerating point</th></tr>
<tr><td>Index Pulse</td><td>Negative limit</td></tr>
</table></td></tr>
<tr><td rowspan="3">Method 1</td><td colspan="2">Action description</td></tr>
<tr><td colspan="2">Note: different actions in different initial conditions</td></tr>
<tr><td colspan="2"><table>
<tr><th>Initial condition</th><th>Homing action</th></tr>
<tr><td>1.1 - Deceleration point is ineffective when homing</td><td>While start homing,it runs at high speed in the negative direction;
When encountering the positive edge of negative limit signal,it runs at low speed in the positive direction;
When encountering the first index pulse after the negative edge of negative limit signal, stop running</td></tr>
<tr><td>1.2- Deceleration point is effective when homing</td><td>While start homing, directly start positive direction homing at low speed;
When encountering the first index pulse after the negative edge of negative limit signal, stop running.</td></tr>
</table></td></tr>
</table>

II) Method 2:

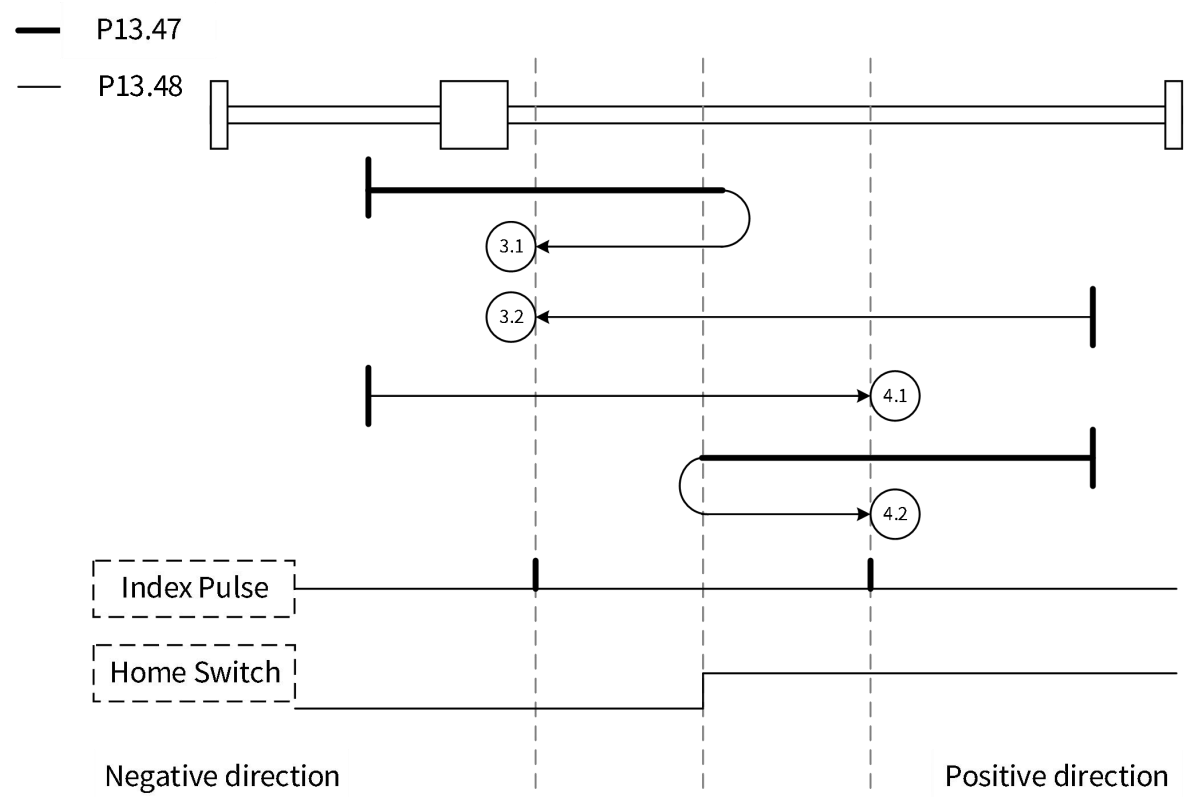
Table 4-12 Homing method 2

<table>
<tr><td>Motion block diagram</td><td colspan="2"> 
</td></tr>
<tr><td>Positioning signal</td><td colspan="2"><table>
<tr><th>Origin</th><th>Decelerating point</th></tr>
<tr><td>Index Pulse</td><td>Positive Limit</td></tr>
</table></td></tr>
<tr><td rowspan="3">Method 2</td><td colspan="2">Action description</td></tr>
<tr><td colspan="2">Note: different actions in different initial conditions</td></tr>
<tr><td colspan="2"><table>
<tr><th>Initial condition</th><th>Homing action</th></tr>
<tr><td>2.1 - Deceleration point is ineffective when homing</td><td>While start homing, it runs at high speed in the positive direction;
When encountering the positive edge of positive limit signal,it runs at low speed in the negative direction;
When encountering the first index pulse after the negative edge of positive limit signal, stop running</td></tr>
<tr><td>2.2- Deceleration point is effective when homing</td><td>While start homing, directly start negative direction homing at low speed;
When encountering the first index pulse after the negative edge of positive limit signal, stop running.</td></tr>
</table></td></tr>
</table>

III) Method 3，4:

Table 4-13 Homing method 3，4

Motion block diagram



Positioning signal	Origin	Decelerating point
	Index Pulse	Home Switch

Method 3

Action description

Note: different actions in different initial conditions

Initial condition	Homing action
3.1 - Deceleration point is ineffective when homing	While start homing, it runs at high speed in the positive direction; When encountering the positive edge of the home switch signal, it runs at low speed in the negative direction; When encountering the first index pulse after the negative edge of the home switch signal, stop running.
3.2- Deceleration point is effective when homing	While start homing, directly start negative direction homing at low speed; When encountering the first index pulse after the negative edge of home switch signal, stop running.

Method 4

Action description

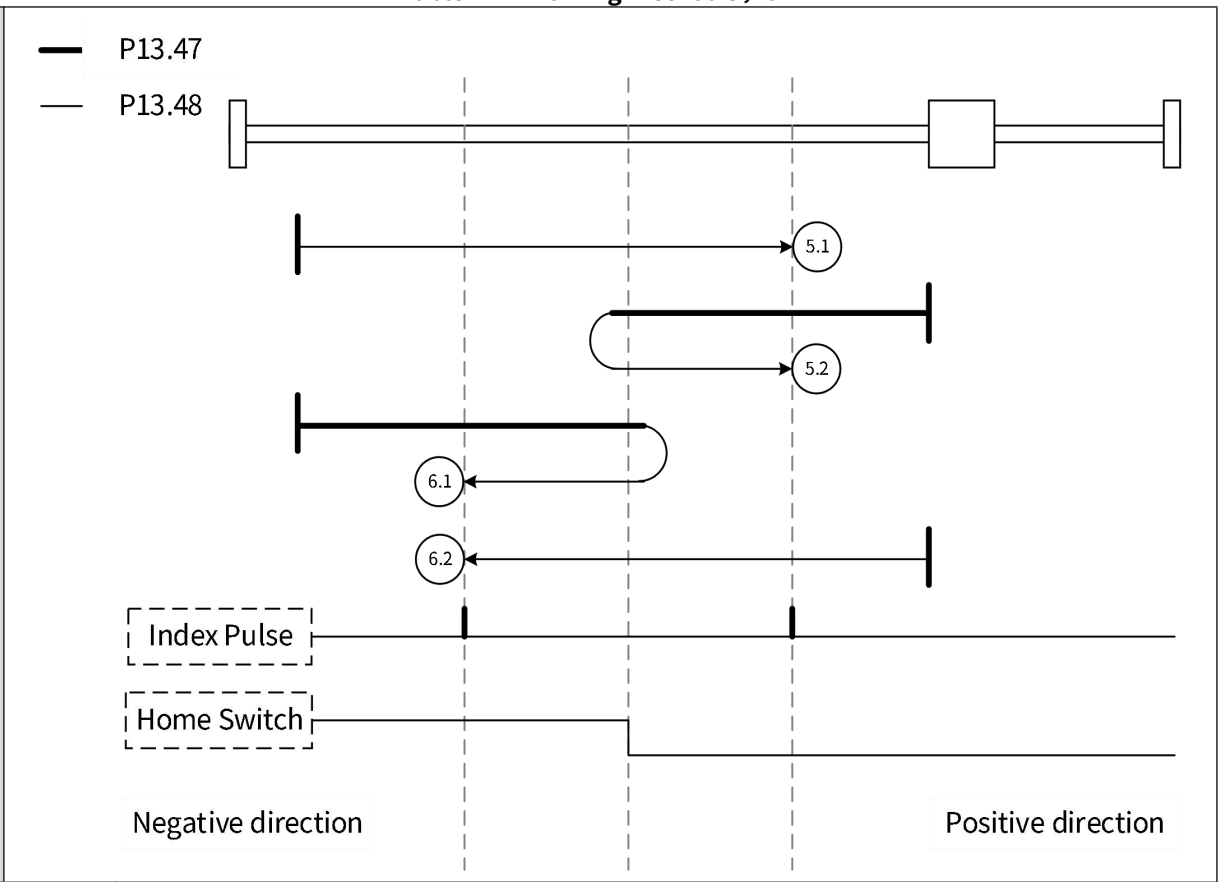
Note: different actions in different initial conditions

Initial condition	Homing action
4.1 - Deceleration point is ineffective when homing	While start homing, directly start positive direction homing at low speed; When encountering the first index pulse after the positive edge of home switch signal, stop running.
4.2- Deceleration point is effective when homing	While start homing, it runs at high speed in the negative direction; When encountering the negative edge of home switch signal, it runs at low speed in the positive direction; When encountering the first index pulse after the positive edge of home switch signal, stop running.

IV) Methods 5，6:

Table 4-14 Homing method 5，6

Motion block diagram



Positioning signal	Origin	Decelerating point
	Index Pulse	Home Switch

Method 5

Action description

Note: different actions in different initial conditions

Initial condition	Homing action
5.1 - Deceleration point is effective when homing	While start homing,directly start positive direction homing at low speed; When encountering the first index pulse after the negative edge of home switch signal, stop running.
5.2- Deceleration point is ineffective when homing	While start homing, it runs at high speed in the negative direction; When encountering the positive edge of home switch signal, it runs at low speed in the positive direction; When encountering the first index pulse after the negative edge of home switch signal, stop running.

Method 6

Action description

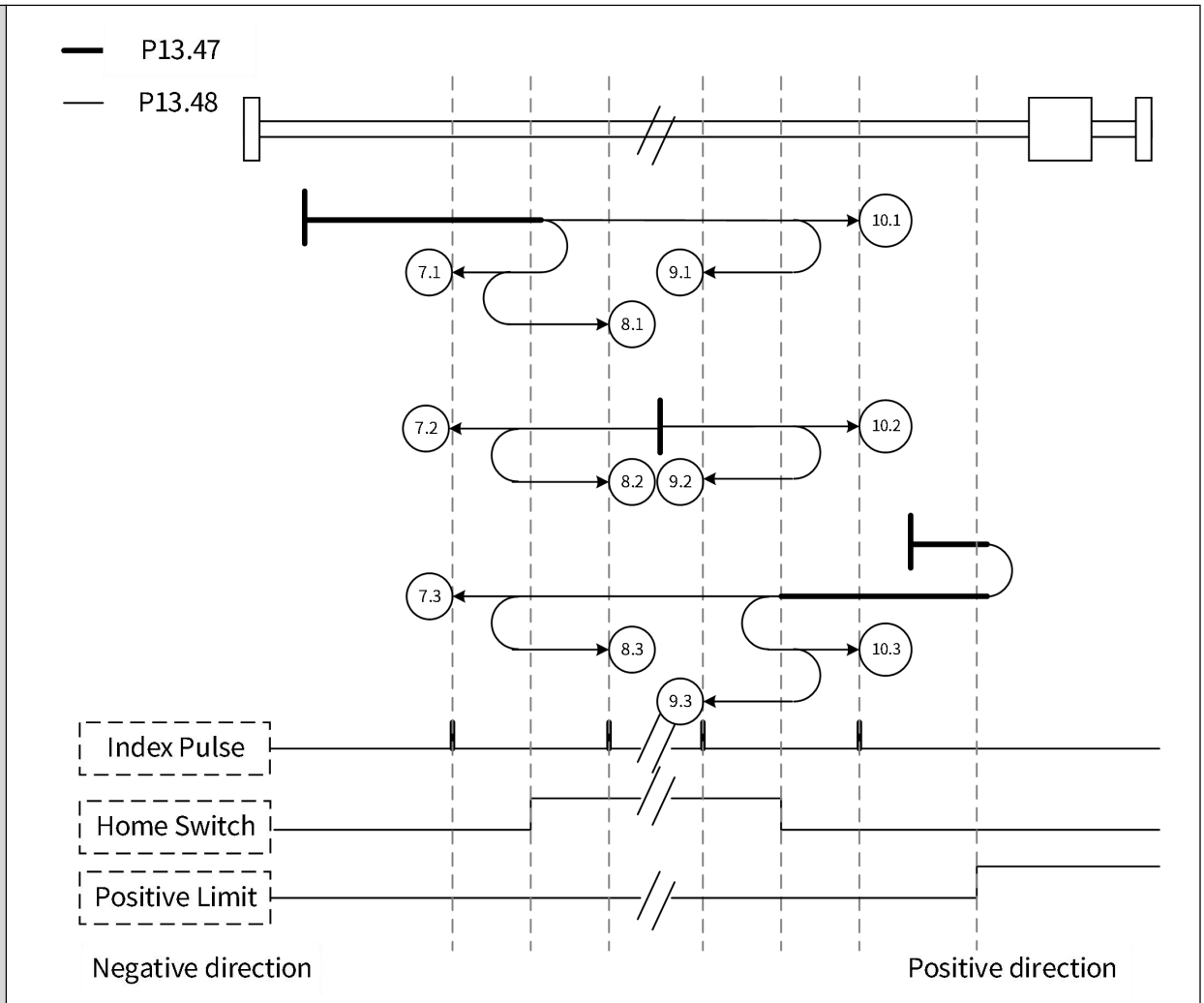
Note: different actions in different initial conditions

Initial condition	Homing action
6.1 - Deceleration point is effective when homing	While start homing, it runs at high speed in the positive direction; When encountering the negative edge of home switch signal, it runs at low speed in the negative direction; When encountering the first index pulse after the positive edge of home switch signal, stop running.
6.2- Deceleration point is ineffective when homing	While start homing,directly start negative direction homing at low speed; When encountering the first index pulse after the positive edge of home switch signal, stop running.

V) Methods 7-10:

Table 4-15 Homing method 7-10

Motion block diagram



Positioning signal	Origin	Decelerating point
	Index Pulse	Home Switch

Method 7

Action description

Note: different actions in different initial conditions

Initial condition	Homing action
7.1- The deceleration point is ineffective when homing, and no positive limit switch was encountered during the process	While start homing, it runs at high speed in the positive direction; When encountering the positive edge of home switch signal, it runs at low speed in the negative direction; When encountering the first index pulse after the negative edge of home switch signal, stop running.
7.2- The deceleration point is effective when homing	While start homing,directly start negative direction homing at low speed; When encountering the first index pulse after the negative edge of home switch signal, stop running.
7.3- The deceleration point is ineffective when homing, and encountered a positive limit switch during the	While start homing, it runs at high speed in the positive direction; When encountering positive limit signal before encountering home switch, it runs at high speed in the negative direction; When encountering the positive edge of home switch signal, it runs at low speed in the negative direction;

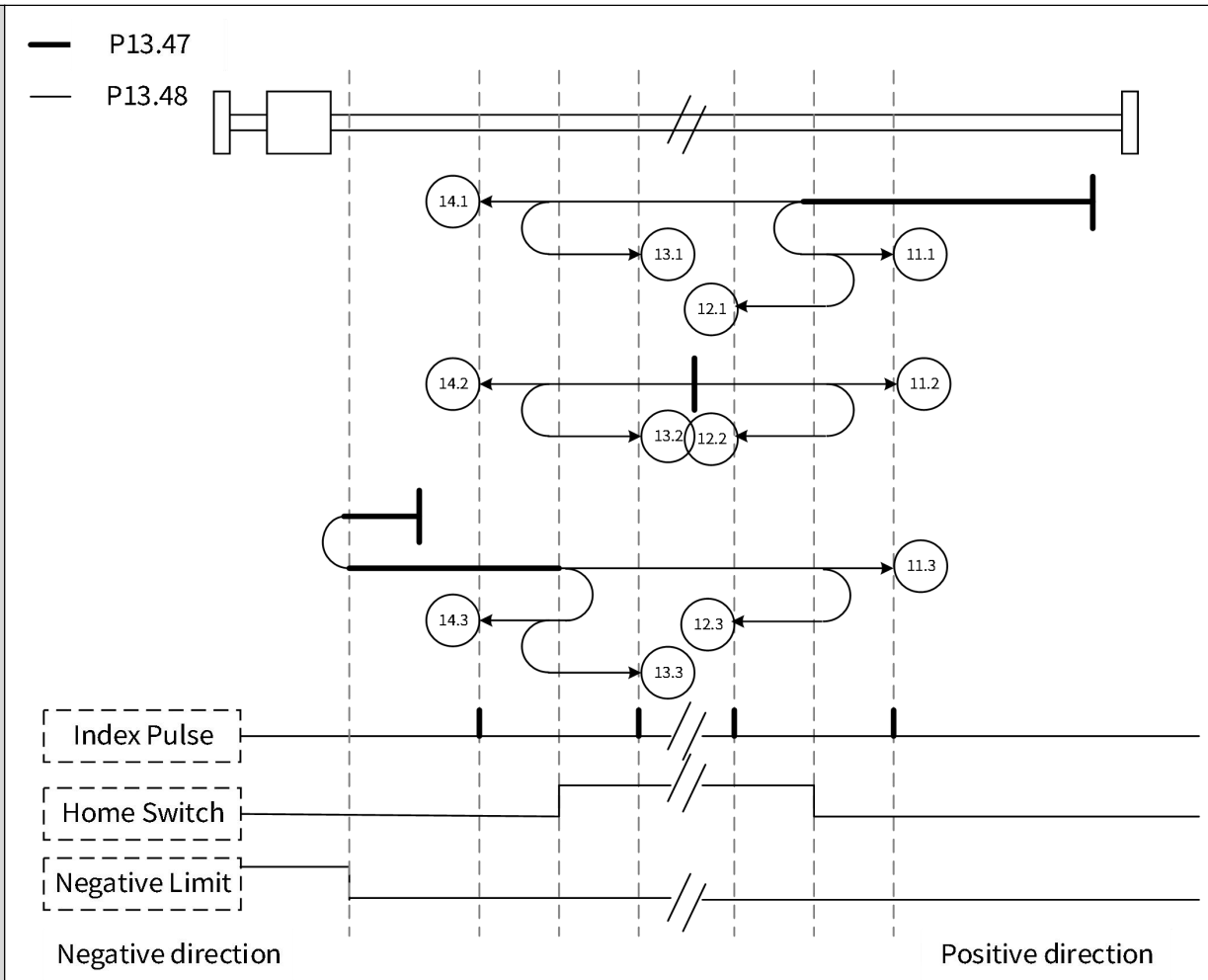
<table>
<tr><td></td><td>
<table>
<tr><td>process</td><td>When encountering the first index pulse after the negative edge of home switch signal, stop running.</td></tr>
</table>
</td></tr>
<tr><td>Method 8</td><td>
Action description
Note: different actions in different initial conditions
<table>
<tr><th>Initial condition</th><th>Homing action</th></tr>
<tr><td>8.1- The deceleration point is ineffective when homing, and no positive limit switch was encountered during the process</td><td>While start homing, it runs at high speed in the positive direction;
When encountering the positive edge of home switch signal, it runs at low speed in the negative direction;
When encountering the negative edge of home switch signal, it runs at low speed in the positive direction;
When encountering the first index pulse after the positive edge of home switch signal, stop running.</td></tr>
<tr><td>8.2- The deceleration point is effective when homing</td><td>While start homing, run at low speed in negative direction;
When encountering the negative edge of home switch signal, it runs at low speed in positive direction;
When encountering the first index pulse after the positive edge of home switch signal, stop running.</td></tr>
<tr><td>8.3- The deceleration point is ineffective when homing, and encountered a positive limit switch during the process</td><td>While start homing, it runs at high speed in the positive direction;
When encountering positive limit signal before encountering home switch, it runs at high speed in the negative direction;
When encountering the positive edge of home switch signal, it runs at low speed in the negative direction;
When encountering the negative edge of home switch signal, it runs at low speed in the positive direction;
When encountering the first index pulse after the positive edge of home switch signal, stop running.</td></tr>
</table>
</td></tr>
<tr><td>Method 9</td><td>
Action description
Note: different actions in different initial conditions
<table>
<tr><th>Initial condition</th><th>Homing action</th></tr>
<tr><td>9.1- The deceleration point is ineffective when homing, and no positive limit switch was encountered during the process</td><td>While start homing, it runs at high speed in the positive direction;
When encountering the positive edge of home switch signal, it runs at low speed in the positive direction;
When encountering the negative edge of home switch signal, it runs at low speed in the negative direction;
When encountering the first index pulse after the positive edge of home switch signal, stop running.</td></tr>
<tr><td>9.2-The deceleration point is effective when homing</td><td>While start homing, run at low speed in positive direction;
When encountering the negative edge of home switch signal, it runs at low speed in negative direction;
When encountering the first index pulse after the positive edge of home switch signal, stop running.</td></tr>
<tr><td>9.3- The deceleration point is ineffective when homing, and encountered a positive limit switch during the process</td><td>While start homing, it runs at high speed in the positive direction;
When encountering positive limit signal before encountering home switch, it runs at high speed in the negative direction;
When encountering the positive edge of home switch signal, it runs at low speed in the positive direction;
When encountering the negative edge of home switch signal, it runs at low speed in the negative direction;
When encountering the first index pulse after the positive edge of home switch signal, stop running.</td></tr>
</table>
</td></tr>
<tr><td>Method 10</td><td>
Action description
Note: different actions in different initial conditions
<table>
<tr><th>Initial condition</th><th>Homing action</th></tr>
<tr><td>10.1- The deceleration point is ineffective when homing, and no positive limit switch was</td><td>While start homing, it runs at high speed in the positive direction;
When encountering the positive edge of home switch signal, it runs at low speed in the positive direction;
When encountering the negative edge of home switch signal, it</td></tr>
</table>
</td></tr>
</table>

	encountered during the process	runs at low speed in the positive direction; When encountering the first index pulse after the negative edge of home switch signal, stop running.
	10.2- The deceleration point is effective when homing	While start homing, run at low speed in positive direction. When encountering the negative edge of home switch signal, it runs at low speed in positive direction. When encountering the first index pulse after the negative edge of home switch signal, stop running.
	10.3- The deceleration point is ineffective when homing, and encountered a positive limit switch during the process	While start homing,it runs at high speed in the positive direction. When encountering positive limit signal before encountering home switch, it runs at high speed in the negative direction; When encountering the positive edge of home switch signal, it runs at low speed in the positive direction; When encountering the negative edge of home switch signal, it runs at low speed in the positive direction; When encountering the first index pulse after the negative edge of home switch signal, stop running.

VI) Method 11-14:

Table 4-16 Homing method 11-14

Motion block diagram



Positioning signal	Origin	Decelerating point
	Index Pulse	Home Switch

Method 11

Action description

Note: different actions in different initial conditions

Initial condition	Homing action
11.1- The deceleration point is ineffective when homing, and no negative limit switch was encountered during the process	While start homing, it runs at high speed in the negative direction; When encountering the positive edge of the home switch signal, it runs at low speed in the positive direction; When encountering the first index pulse after the negative edge of home switch signal, stop running.
11.2-The deceleration point is effective when homing	While start homing,directly start positive direction homing at low speed; When encountering the first index pulse after the negative edge of home switch signal, stop running.
11.3- The deceleration point is ineffective when homing, and encountered a negative limit switch during the process	While start homing, it runs at high speed in the negative direction; When encountering negative limit signal before encountering home switch, it runs at high speed in the positive direction; When encountering the positive edge of home switch signal, it runs at low speed in the positive direction;

		When encountering the first index pulse after the negative edge of the home switch signal, stop running.

Method 12

Action description

Note: different actions in different initial conditions

Initial condition	Homing action
12.1- The deceleration point is ineffective when homing, and no negative limit switch was encountered during the process	While start homing, it runs at high speed in the negative direction; When encountering the positive edge of home switch signal, it runs at low speed in the positive direction; When encountering the negative edge of home switch signal, it runs at low speed in the negative direction; When encountering the first index pulse after the positive edge of home switch signal, stop running.
12.2-The deceleration point is effective when homing	While start homing, it runs at low speed in the positive direction; When encountering the negative edge of home switch signal, it runs at low speed in the negative direction; When encountering the first index pulse after the positive edge of home switch signal, stop running.
12.3- The deceleration point is ineffective when homing, and encountered a negative limit switch during the process	While start homing, it runs at high speed in the negative direction; When encountering negative limit signal before encountering home switch, it runs at high speed in the positive direction; When encountering the positive edge of home switch signal, it runs at low speed in the positive direction; When encountering the negative edge of home switch signal, it runs at low speed in the negative direction; When encountering the first index pulse after the positive edge of home switch signal, stop running.

Method 13

Action description

Note: different actions in different initial conditions

Initial condition	Homing action
13.1- The deceleration point is ineffective when homing, and no negative limit switch was encountered during the process	While start homing, it runs at high speed in the negative direction; When encountering the positive edge of home switch signal, it runs at low speed in the negative direction; When encountering the negative edge of home switch signal, it runs at low speed in the positive direction; When encountering the first index pulse after the positive edge of home switch signal, stop running.
13.2-The deceleration point is effective when homing	While start homing, it runs at low speed in the negative direction; When encountering the negative edge of home switch signal, it runs at low speed in the positive direction; When encountering the first index pulse after the positive edge of home switch signal, stop running.
13.3- The deceleration point is ineffective when homing, and encountered a negative limit switch during the process	While start homing, it runs at high speed in the negative direction; When encountering negative limit signal before encountering home switch, it runs at high speed in the positive direction; When encountering the positive edge of home switch signal, it runs at low speed in the negative direction; When encountering the negative edge of home switch signal, it runs at low speed in the positive direction; When encountering the first index pulse after the positive edge of home switch signal, stop running.

Method 14

Action description

Note: different actions in different initial conditions

Initial condition	Homing action

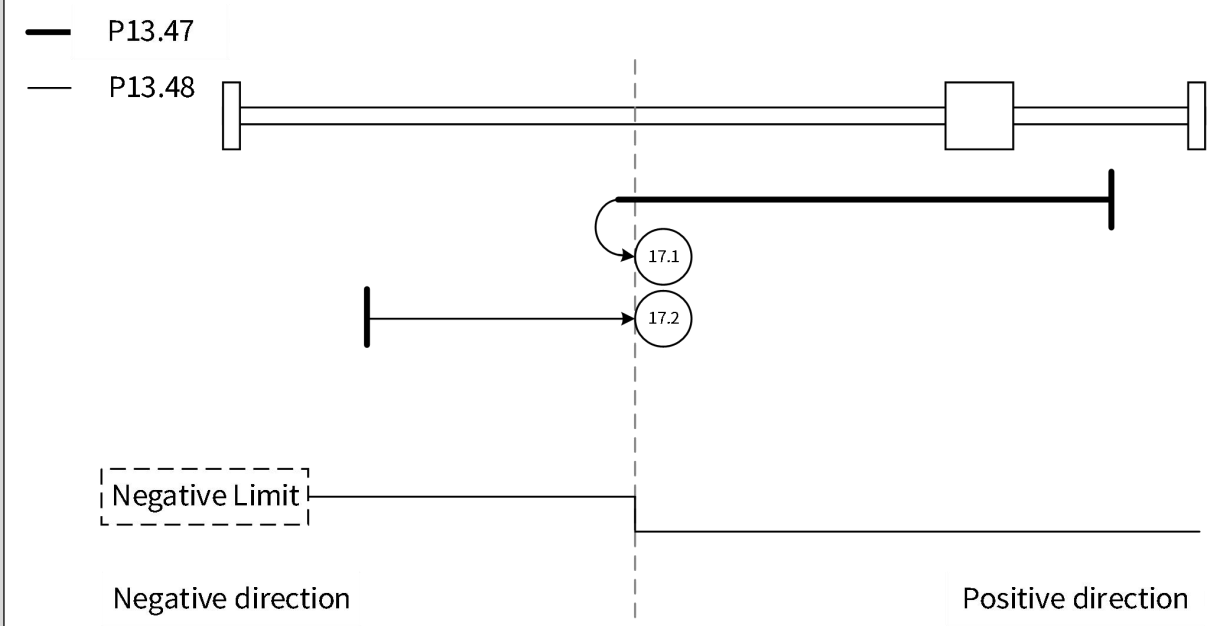
	14.1- The deceleration point is ineffective when homing, and no negative limit switch was encountered during the process	While start homing, it runs at high speed in the negative direction; When encountering the positive edge of home switch signal, it runs at low speed in the negative direction; When encountering the negative edge of home switch signal, it continue to run at low speed in the negative direction; When encountering the first index pulse after the negative edge of home switch signal, stop running.
	14.2-The deceleration point is effective when homing	While start homing, it runs at low speed in the negative direction; When encountering the negative edge of home switch signal, it continue to run at low speed in the negative direction; When encountering the first index pulse after the negative edge of home switch signal, stop running.
	14.3- The deceleration point is ineffective when homing, and encountered a negative limit switch during the process	While start homing, it runs at high speed in the negative direction; When encountering negative limit signal before encountering home switch, it runs at high speed in the positive direction; When encountering the positive edge of home switch signal, it runs at low speed in the negative direction; When encountering the negative edge of home switch signal, it continue to run at low speed in the negative direction; When encountering the first index pulse after the negative edge of home switch signal, stop running.

VII) Method 15-16: Reserved

Note that methods 17-30 are similar to methods 1-14, except that they no longer rely on the index pulse as the origin, detailed methods as follows.

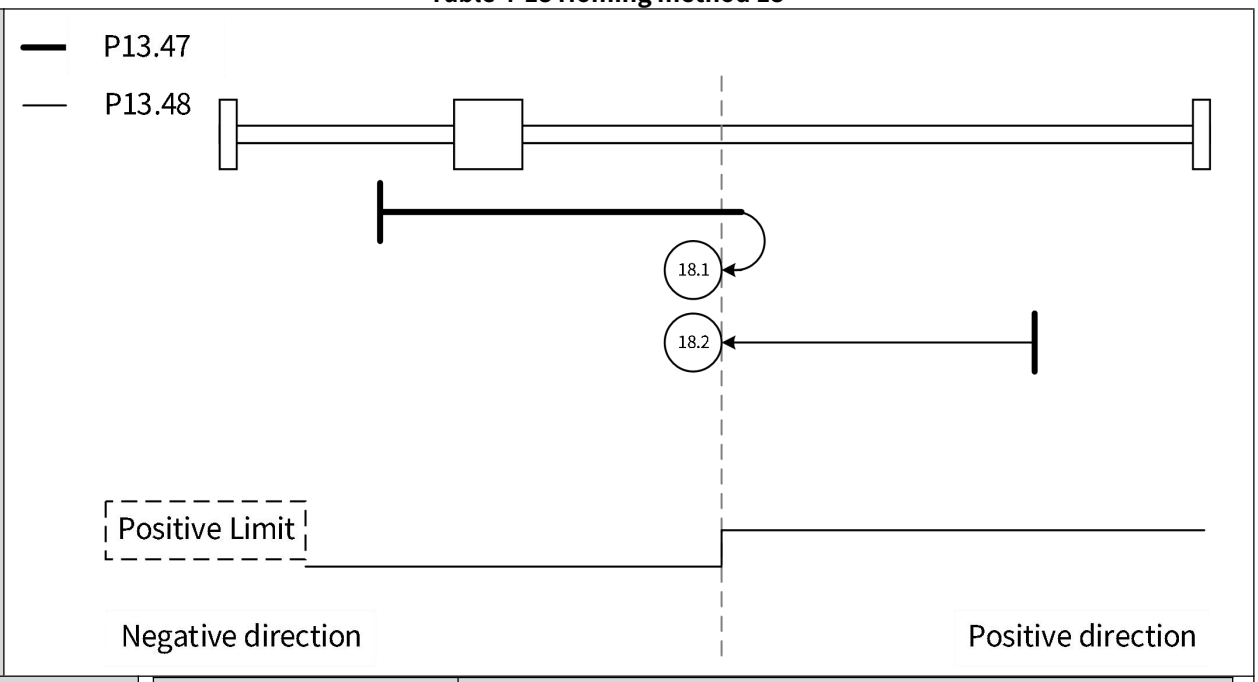
VIII) Method 17:

Table 4-17 Homing method 17

<table>
<tr><td>Motion block diagram</td><td> 
</td></tr>
<tr><td>Positioning signal</td><td>
<table>
<tr><th>Origin</th><th>Decelerating point</th></tr>
<tr><td>Negative limit</td><td>Negative limit</td></tr>
</table>
</td></tr>
<tr><td>Method 17</td><td>
Action description
Note: different actions in different initial conditions
<table>
<tr><th>Initial condition</th><th>Homing action</th></tr>
<tr><td>17.1- Deceleration point is ineffective when homing.</td><td>While start homing,it runs at high speed in the negative direction;
When encountering the positive edge of negative limit signal,it runs at low speed in the positive direction;
When encountering the negative edge of negative limit signal, stop running.</td></tr>
<tr><td>17.2- Deceleration point is effective when homing.</td><td>While start homing, directly start positive direction homing at low speed;
When encountering the negative edge of negative limit signal, stop running.</td></tr>
</table>
</td></tr>
</table>

VIII) Method 18:

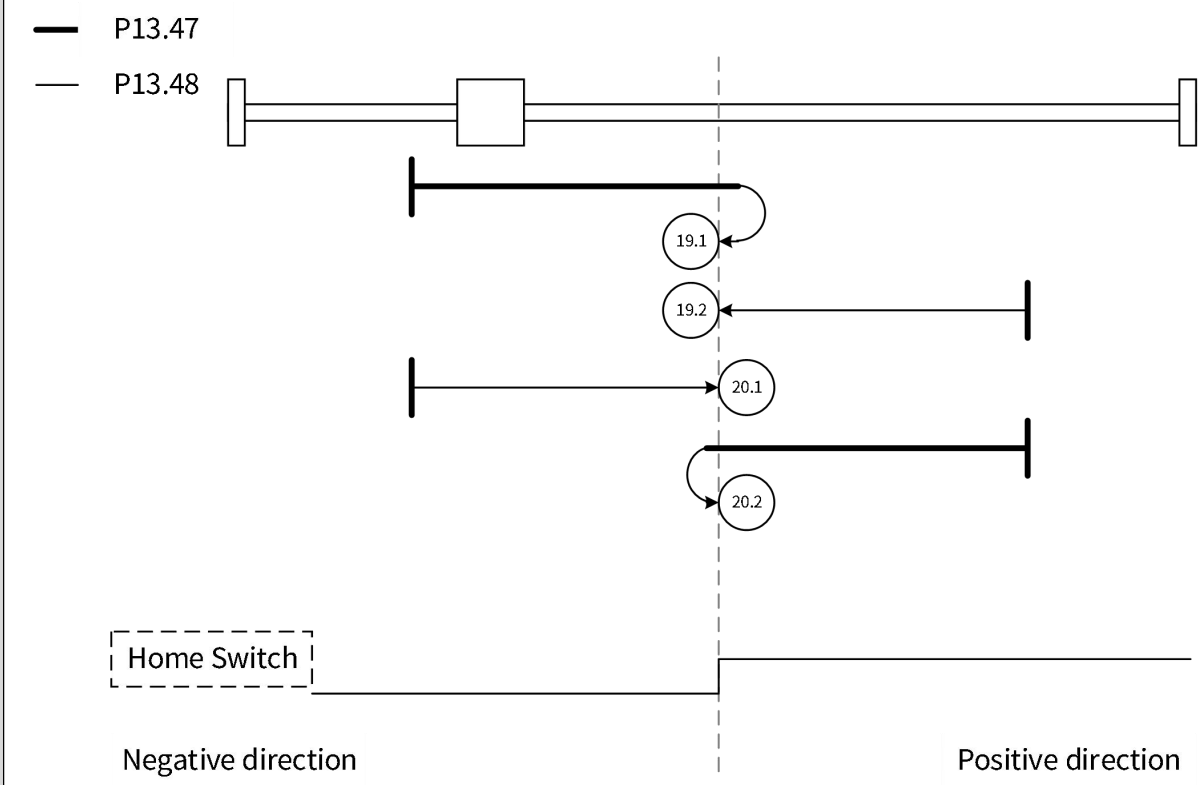
Table 4-18 Homing method 18

<table>
<tr><td>Motion block diagram</td><td colspan="2"> 
</td></tr>
<tr><td>Positioning signal</td><td colspan="2"><table>
<tr><th>Origin</th><th>Decelerating point</th></tr>
<tr><td>Positive Limit</td><td>Positive Limit</td></tr>
</table></td></tr>
<tr><td rowspan="2">Method 18</td><td colspan="2">Action description</td></tr>
<tr><td colspan="2">Note: different actions in different initial conditions
<table>
<tr><th>Initial condition</th><th>Homing action</th></tr>
<tr><td>18.1- Deceleration point is ineffective when homing</td><td>While start homing, it runs at high speed in the positive direction;
When encountering the positive edge of positive limit signal,it runs at low speed in the negative direction;
When encountering the negative edge of positive limit signal, stop running.</td></tr>
<tr><td>18.2- Deceleration point is effective when homing</td><td>While start homing, directly start negative direction homing at low speed;
When encountering the negative edge of positive limit signal, stop running.</td></tr>
</table></td></tr>
</table>

X)Method 19,20:

Table 4-19 Homing method 19,20

Motion block diagram



Positioning signal	Origin	Decelerating point
	Home Switch	Home Switch

Method 19

Action description

Note: different actions in different initial conditions

Initial condition	Homing action
19.1- Deceleration point is ineffective when homing	While start homing, it runs at high speed in the positive direction; When encountering the positive edge of home switch signal, it runs at low speed in the negative direction; When encountering the negative edge of home switch signal, stop running.
19.2- Deceleration point is effective when homing	While start homing, directly start negative direction homing at low speed; When encountering the negative edge of home switch signal, stop running.

Method 20

Action description

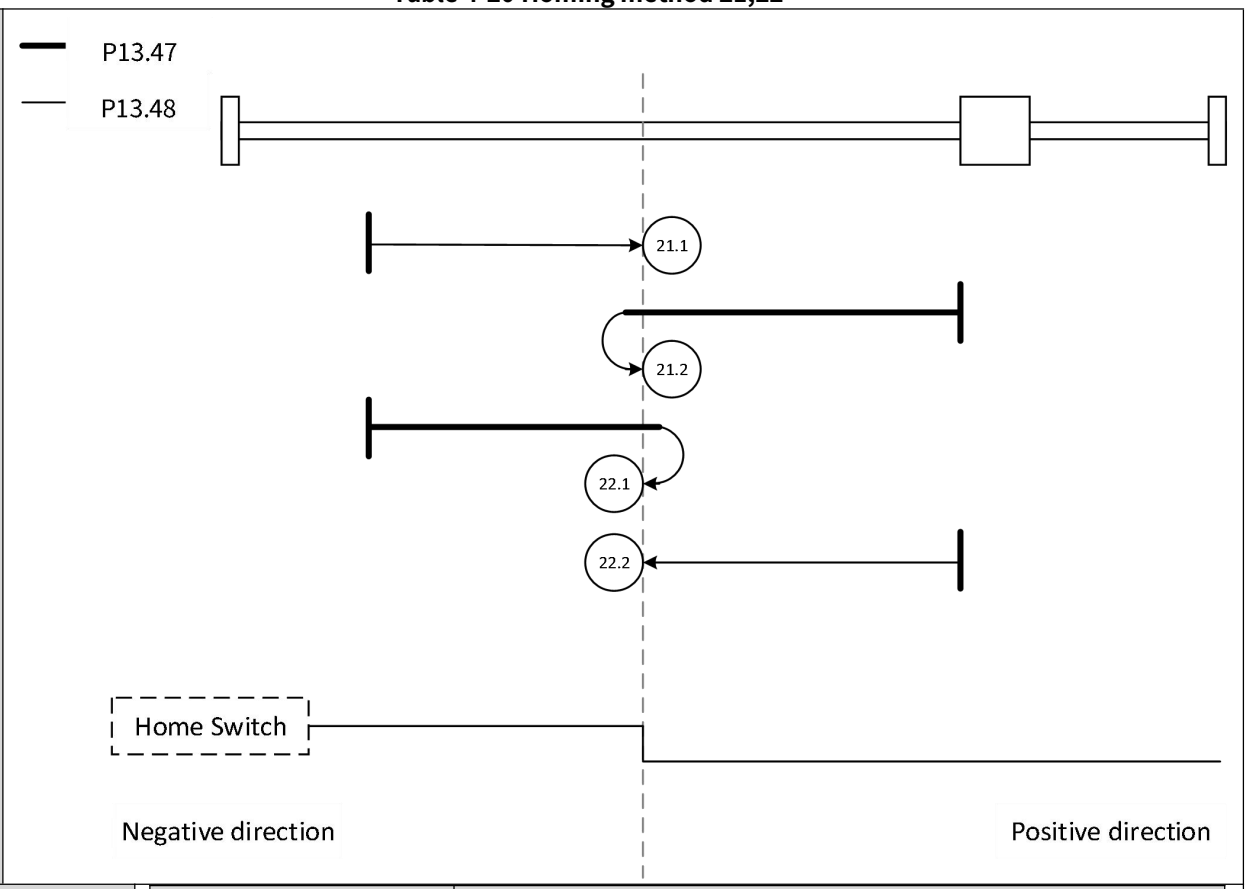
Note: different actions in different initial conditions

Initial condition	Homing action
20.1- Deceleration point is ineffective when homing	While start homing, directly start positive direction homing at low speed; When encountering the positive edge of home switch signal, stop running.
20.2- Deceleration point is effective when homing	While start homing, it runs at high speed in the negative direction; When encountering the negative edge of home switch signal, it runs at low speed in the positive direction; When encountering the positive edge of home switch signal, stop running.

X)Method 21,22:

Table 4-20 Homing method 21,22

Motion block diagram



Positioning signal	Origin	Decelerating point
	Home Switch	Home Switch

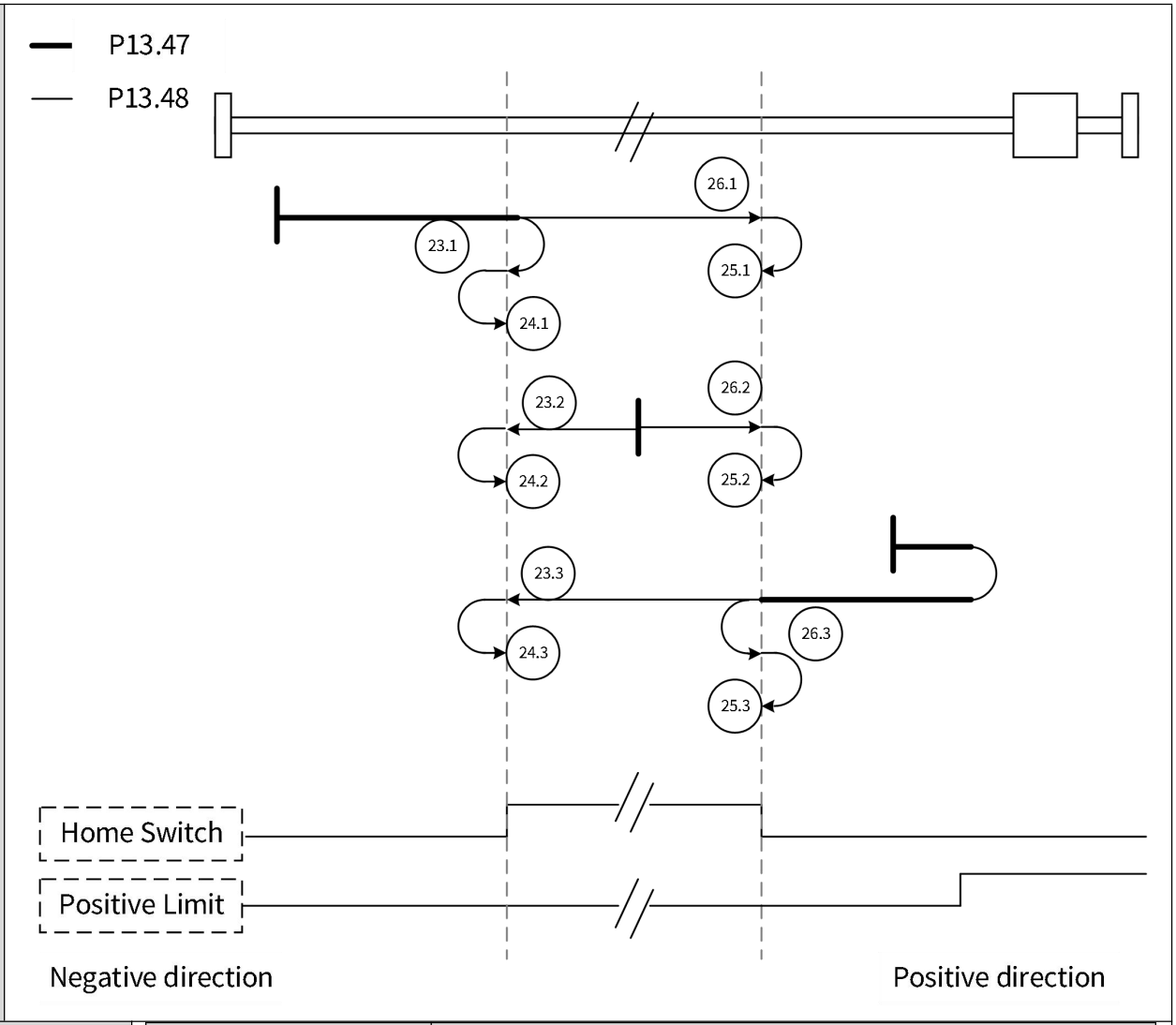
Method 21	Action description	
	Note: different actions in different initial conditions	
	Initial condition	**Homing action**
	21.1- Deceleration point is effective when homing.	While start homing,directly start positive direction homing at low speed; When encountering the negative edge of home switch signal, stop running.
	21.2- Deceleration point is ineffective when homing.	While start homing, it runs at high speed in the negative direction; When encountering the positive edge of home switch signal, it runs at low speed in the positive direction; When encountering the negative edge of home switch signal, stop running.

Method 22	Action description	
	Note: different actions in different initial conditions	
	Initial condition	**Homing action**
	22.1- Deceleration point is effective when homing.	While start homing, it runs at high speed in the positive direction; When encountering the negative edge of home switch signal, it runs at low speed in the negative direction; When encountering the positive edge of home switch signal, stop running.
	22.2- Deceleration point is ineffective when homing.	While start homing,directly start negative direction homing at low speed; When encountering the positive edge of home switch signal, stop running.

XII) Method 23-26:

Table 4-21 Homing method 23-26

Motion block diagram



Positioning signal	Origin	Decelerating point
	Home Switch	Home Switch

Method 23

Action description

Note: different actions in different initial conditions

Initial condition	Homing action
23.1- The deceleration point is ineffective when homing, and no positive limit switch was encountered during the process	While start homing, it runs at high speed in the positive direction; When encountering the positive edge of home switch signal, it runs at low speed in the negative direction; When encountering the negative edge of home switch signal, stop running.
23.2- The deceleration point is effective when homing	While start homing,directly start negative direction homing at low speed; When encountering the negative edge of home switch signal, stop running.
23.3- The deceleration point is ineffective when homing, and positive	While start homing, it runs at high speed in the positive direction; When encountering positive limit signal before encountering home switch, it runs at high speed in the negative direction;

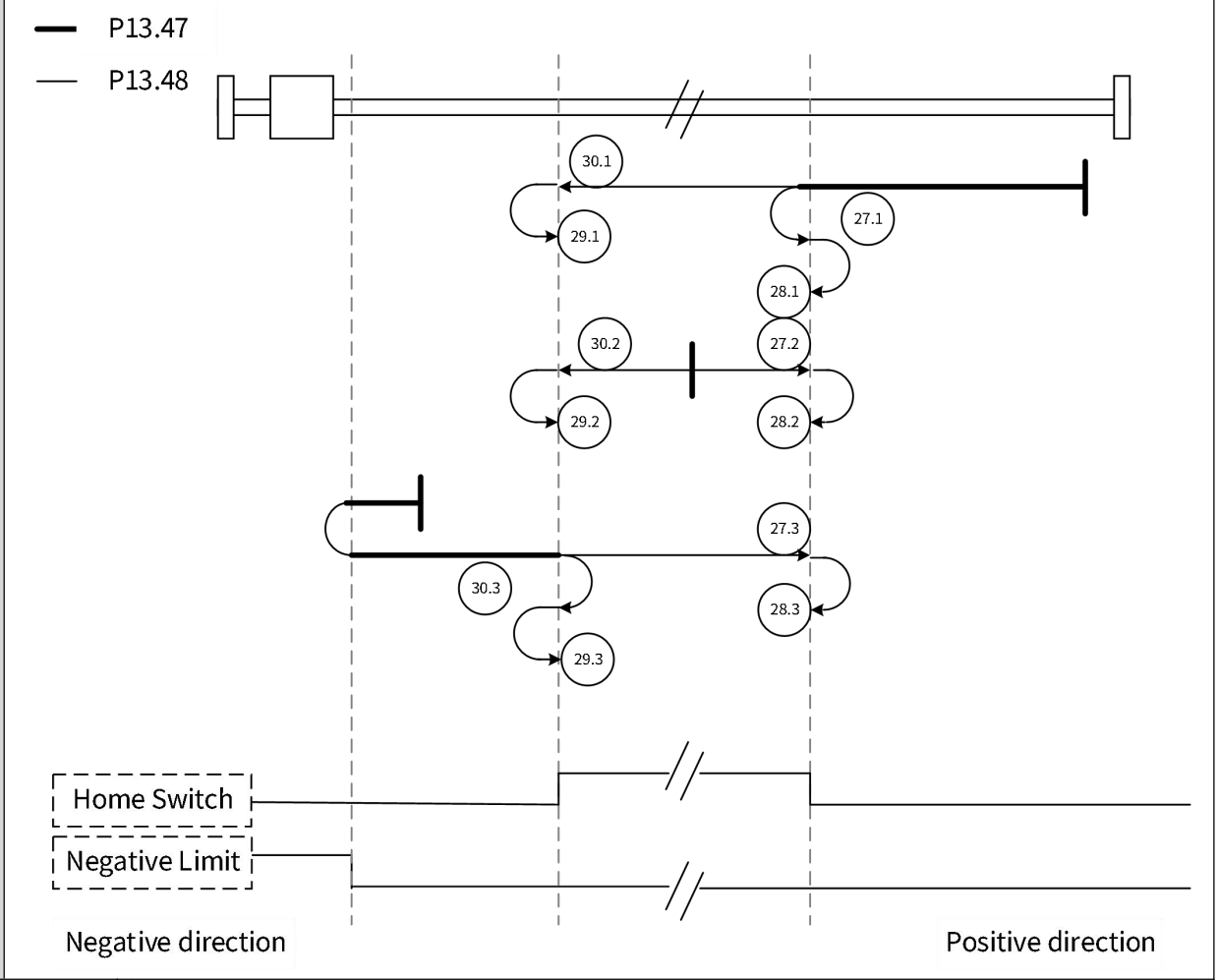
	limit switch is encountered during the process	When encountering the positive edge of home switch signal, it runs at low speed in the negative direction; When encountering the negative edge of home switch signal, stop running.
Method 24	**Action description**	
	Note: different actions in different initial conditions	
	Initial condition	**Homing action**
	24.1- The deceleration point is ineffective when homing, and no positive limit switch was encountered during the process	While start homing, it runs at high speed in the positive direction; When encountering the positive edge of home switch signal, it runs at low speed in the negative direction; When encountering the negative edge of home switch signal, it runs at low speed in the positive direction; When encountering the positive edge of home switch signal, stop running.
	24.2- Deceleration point is effective when homing	While start homing, run at low speed in negative direction; When encountering the negative edge of home switch signal, it runs at low speed in positive direction; When encountering the positive edge of home switch signal, stop running.
	24.3- The deceleration point is ineffective when homing, and positive limit switch was encountered during the process	While start homing, it runs at high speed in the positive direction; When encountering positive limit signal before encountering home switch, it runs at high speed in the negative direction; When encountering the positive edge of home switch signal, it runs at low speed in the negative direction; When encountering the negative edge of home switch signal, it runs at low speed in the positive direction; When encountering the positive edge of home switch signal, stop running.
Method 25	**Action description**	
	Note: different actions in different initial conditions	
	Initial condition	**Homing action**
	25.1- The deceleration point is ineffective when homing, and no positive limit switch was encountered during the process	While start homing, it runs at high speed in the positive direction; When encountering the positive edge of home switch signal, it runs at low speed in the positive direction; When encountering the negative edge of home switch signal, it runs at low speed in the negative direction; When encountering the positive edge of home switch signal, stop running.
	25.2- Deceleration point is effective when homing	While start homing, run at low speed in positive direction; When encountering the negative edge of home switch signal, it runs at low speed in negative direction; When encountering the positive edge of home switch signal, stop running.
	25.3- The deceleration point is ineffective when homing, and positive limit switch was encountered during the process	While start homing, it runs at high speed in the positive direction; When encountering positive limit signal before encountering home switch, it runs at high speed in the negative direction; When encountering the positive edge of home switch signal, it runs at low speed in the positive direction; When encountering the negative edge of home switch signal, it runs at low speed in the negative direction; When encountering the positive edge of home switch signal, stop running.
Method 26	**Action description**	
	Note: different actions in different initial conditions	
	Initial condition	**Homing action**
	26.1- The deceleration point is ineffective when	While start homing, it runs at high speed in the positive direction; When encountering the positive edge of home switch signal, it

	homing, and no positive limit switch was encountered during the process	runs at low speed in the positive direction; When encountering the negative edge of home switch signal, it runs at low speed in the positive direction; When encountering the negative edge of home switch signal, stop running.
	26.2- Deceleration point is effective when homing	While start homing, run at low speed in positive direction. When encountering the negative edge of home switch signal, it runs at low speed in positive direction. When encountering the negative edge of home switch signal, stop running.
	26.3- The deceleration point is ineffective when homing, and positive limit switch was encountered during the process	While start homing,it runs at high speed in the positive direction. When encountering positive limit signal before encountering home switch, it runs at high speed in the negative direction; When encountering the positive edge of home switch signal, it runs at low speed in the positive direction; When encountering the negative edge of home switch signal, it runs at low speed in the positive direction; When encountering the negative edge of home switch signal, stop running.

XIII) Method 27-30:

Table 4-22 Homing method 27-30

Motion block diagram



Positioning signal	Origin	Decelerating point
	Home Switch	Home Switch

Action description

Note: different actions in different initial conditions

Method 27	Initial condition	Homing action
	27.1: The deceleration point is ineffective when homing, and no negative limit switch was encountered during the process	While start homing, it runs at high speed in the negative direction; When encountering the positive edge of home switch signal, it runs at low speed in the positive direction; When encountering the negative edge of home switch signal, stop running.
	27.2: The deceleration point is effective when homing	While start homing,directly start positive direction homing at low speed; When encountering the negative edge of home switch signal, stop running.
	27.3: The deceleration point is ineffective when homing, and a negative limit switch is encountered during the process	While start homing, it runs at high speed in the negative direction; When encountering negative limit signal before encountering home switch, it runs at high speed in the positive direction; When encountering the positive edge of home switch signal, it runs at low speed in the positive direction; When encountering the negative edge of home switch signal,

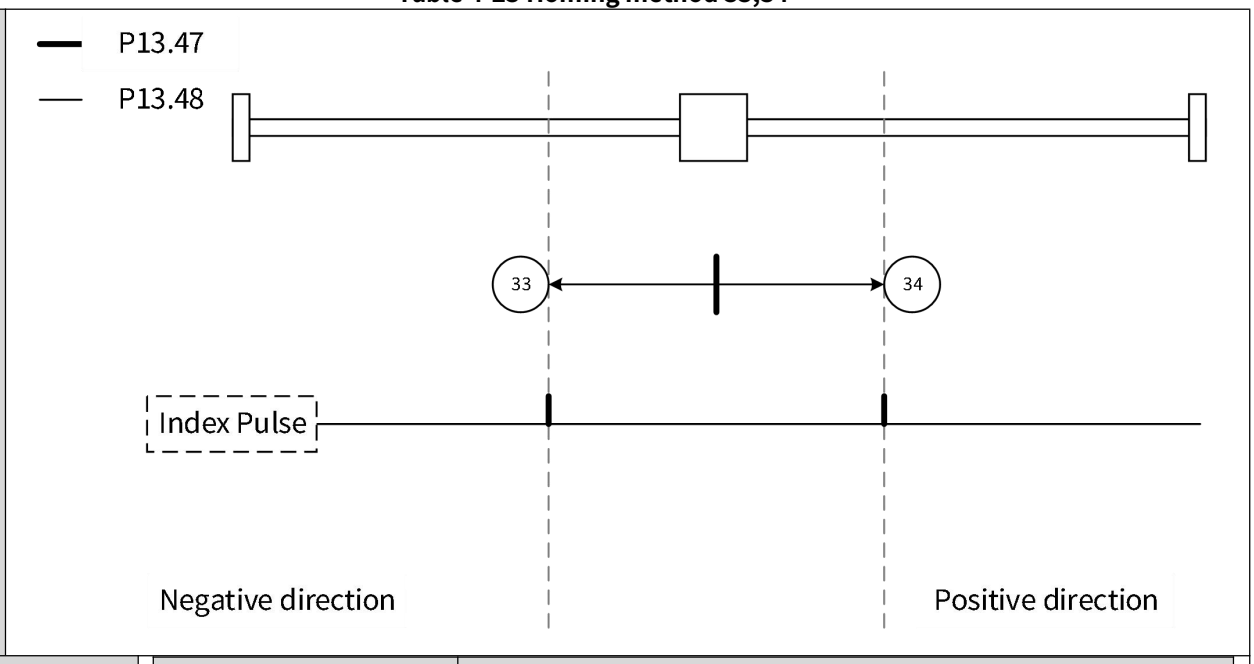
<table>
<tr><td></td><td colspan="2"><table><tr><td></td><td>stop running.</td></tr></table></td></tr>
<tr><td rowspan="3">Method 28</td><td colspan="2">Action description</td></tr>
<tr><td colspan="2">Note: different actions in different initial conditions<table><tr><th>Initial condition</th><th>Homing action</th></tr><tr><td>28.1: The deceleration point is ineffective when homing, and no negative limit switch was encountered during the process</td><td>While start homing, it runs at high speed in the negative direction;
When encountering the positive edge of home switch signal, it runs at low speed in the positive direction;
When encountering the negative edge of home switch signal, it runs at low speed in the negative direction;
When encountering the positive edge of home switch signal, stop running.</td></tr><tr><td>28.2: The deceleration point is effective when homing</td><td>While start homing, it runs at low speed in the positive direction;
When encountering the negative edge of home switch signal, it runs at low speed in the negative direction;
When encountering the positive edge of home switch signal, stop running.</td></tr><tr><td>28.3: The deceleration point is ineffective when homing, and negative limit switch is encountered during the process</td><td>While start homing, it runs at high speed in the negative direction;
When encountering negative limit signal before encountering home switch, it runs at high speed in the positive direction;
When encountering the positive edge of home switch signal, it runs at low speed in the positive direction;
When encountering the negative edge of home switch signal, it runs at low speed in the negative direction;
When encountering the positive edge of home switch signal, stop running.</td></tr></table></td></tr>
<tr><td rowspan="3">Method 29</td><td colspan="2">Action description</td></tr>
<tr><td colspan="2">Note: different actions in different initial conditions<table><tr><th>Initial condition</th><th>Homing action</th></tr><tr><td>29.1: The deceleration point is ineffective when homing, and no negative limit switch was encountered during the process</td><td>While start homing, it runs at high speed in the negative direction;
When encountering the positive edge of home switch signal, it runs at low speed in the negative direction;
When encountering the negative edge of home switch signal, it runs at low speed in the positive direction;
When encountering the positive edge of home switch signal, stop running.</td></tr><tr><td>29.2: The deceleration point is effective when homing</td><td>While start homing, it runs at low speed in the negative direction;
When encountering the negative edge of home switch signal, it runs at low speed in the positive direction;
When encountering the positive edge of home switch signal, stop running.</td></tr><tr><td>29.3: The deceleration point is ineffective when homing, and a negative limit switch is encountered during the process</td><td>While start homing, it runs at high speed in the negative direction;
When encountering negative limit signal before encountering home switch, it runs at high speed in the positive direction;
When encountering the positive edge of home switch signal, it runs at low speed in the negative direction;
When encountering the negative edge of home switch signal, it runs at low speed in the positive direction;
When encountering the positive edge of home switch signal, stop running.</td></tr></table></td></tr>
<tr><td rowspan="2">Method 30</td><td colspan="2">Action description</td></tr>
<tr><td colspan="2">Note: different actions in different initial conditions</td></tr>
</table>

Initial condition	Homing action
30.1: The deceleration point is ineffective when homing, and no negative limit switch was encountered during the process	While start homing, it runs at high speed in the negative direction; When encountering the positive edge of home switch signal, it runs at low speed in the negative direction; When encountering the negative edge of home switch signal, it continue to run at low speed in the negative direction; When encountering the negative edge of home switch signal, stop running.
30.2: The deceleration point is effective when homing	While start homing, it runs at low speed in the negative direction; When encountering the negative edge of home switch signal, it continue to run at low speed in the negative direction; When encountering the negative edge of home switch signal, stop running.
30.3: The deceleration point is ineffective when homing, and a negative limit switch is encountered during the process	While start homing, it runs at high speed in the negative direction; When encountering negative limit signal before encountering home switch, it runs at high speed in the positive direction; When encountering the positive edge of home switch signal, it runs at low speed in the negative direction; When encountering the negative edge of home switch signal, it continue to run at low speed in the negative direction; When encountering the negative edge of home switch signal, stop running.

XIV) Method 31-32: Reserved

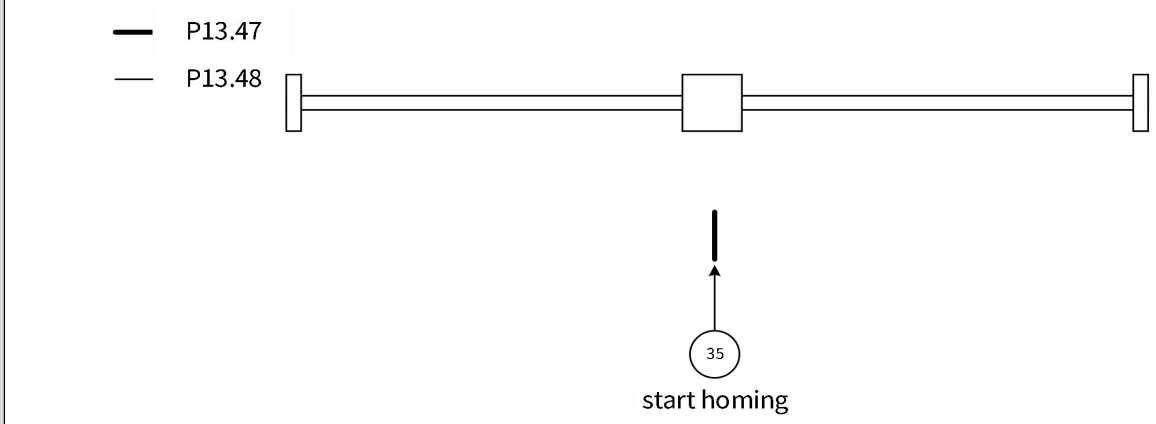
XV) Method 33,34:

Table 4-23 Homing method 33,34

<table>
<tr><td>Motion block diagram</td><td colspan="3"> 
</td></tr>
<tr><td rowspan="2">Positioning signal</td><td>Origin</td><td colspan="2">Decelerating point</td></tr>
<tr><td>Index Pulse</td><td colspan="2">No</td></tr>
<tr><td rowspan="2">Method 33</td><td colspan="3">Action description</td></tr>
<tr><td colspan="3">33: Running at low speed in the negative dirction, encountering the first index pulse, stop</td></tr>
<tr><td rowspan="2">Method 34</td><td colspan="3">Action description</td></tr>
<tr><td colspan="3">34: Running at low speed in the positive dirction, encountering the first index pulse, stop</td></tr>
</table>

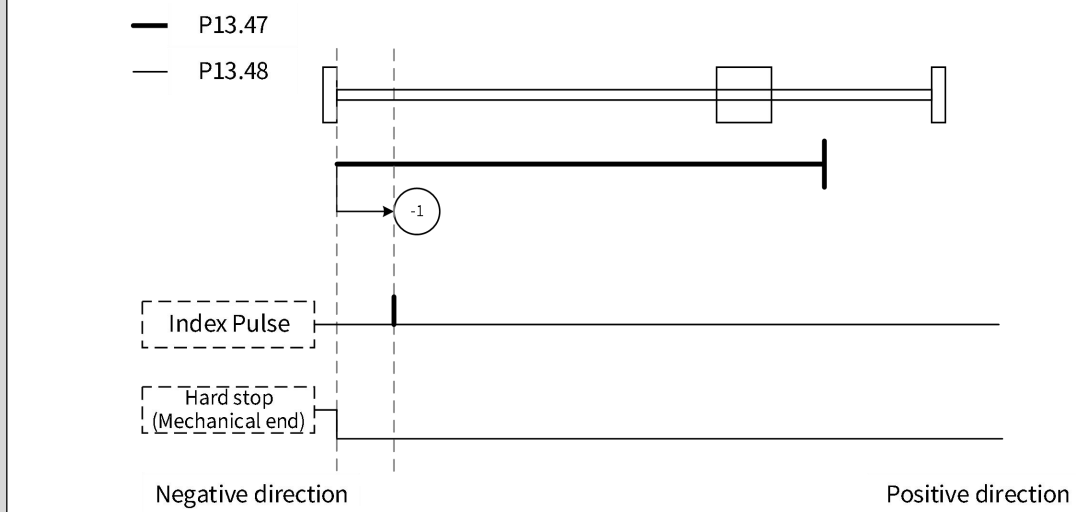
XVI) Method 35:

Table 4-24 Homing method 35

Motion block diagram		
Positioning signal	**Origin**	**Decelerating point**
	Current position	No
Method 35	**Action description**	
	35: Use the current position as the home switch	

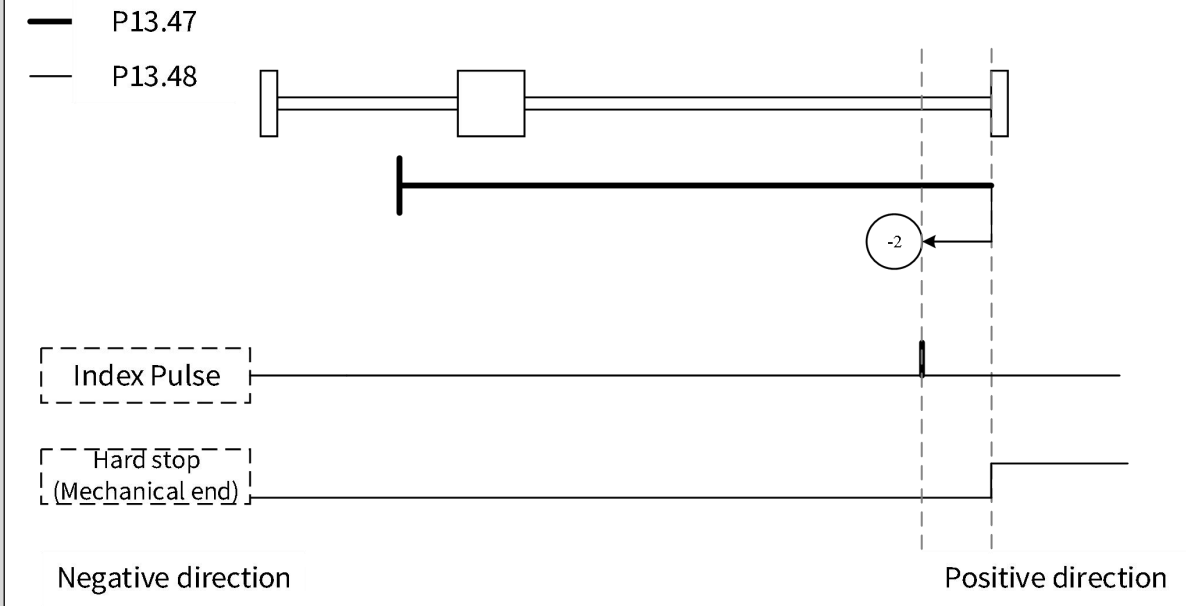
XVII) Method -1:

Table 4-25 Homing method -1

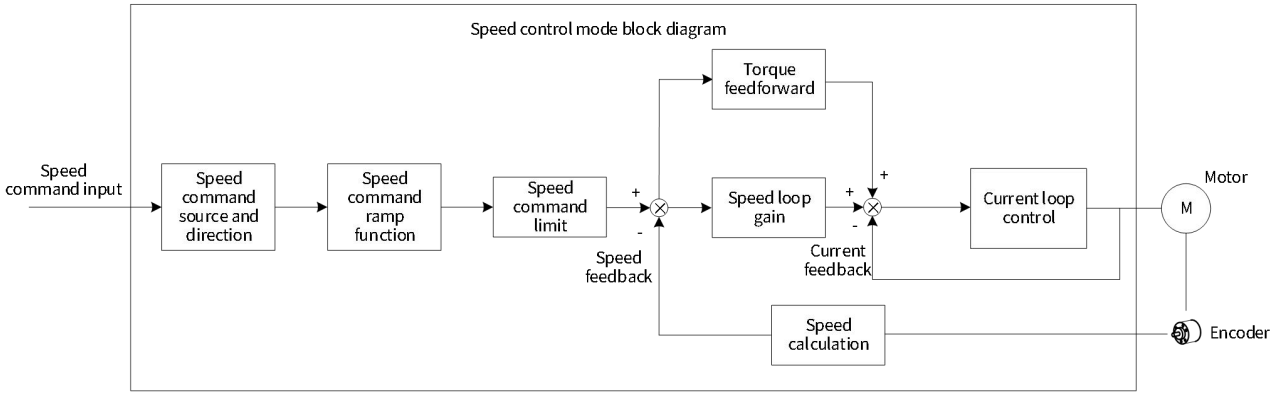
Motion block diagram		
Positioning signal	**Origin**	**Decelerating point**
	Index Pulse	Mechanical end
Method -1	**Action description**	
	Method -1: The motor first runs at high speed in the negative direction. After hitting the mechanical end, if the torque reaches the torque limit and the speed is near zero speed, besides this state maintains for a period, it proves that the shaft has reached the mechanical end position. The motor runs at low speed in the positive direction; Stop running when encountering the first index pulse.	

XVIII) Method -2

Table 4-26 Homing method -2

<table>
<tr><td>Motion block diagram</td><td colspan="2"> 
</td></tr>
<tr><td rowspan="2">Positioning signal</td><td>Origin</td><td>Decelerating point</td></tr>
<tr><td>Index Pulse</td><td>Mechanical end</td></tr>
<tr><td rowspan="2">Method -2</td><td colspan="2">Action description</td></tr>
<tr><td colspan="2">Method -2: The motor first runs at high speed in the positive direction . After hitting the mechanical end position, if the torque reaches the torque limit value and the speed is near zero speed, and this state maintains for a period, it proves to have reached the mechanical end position. The motor runs at low speed in the negative direction, stop running when encountering the first index pulse.</td></tr>
</table>

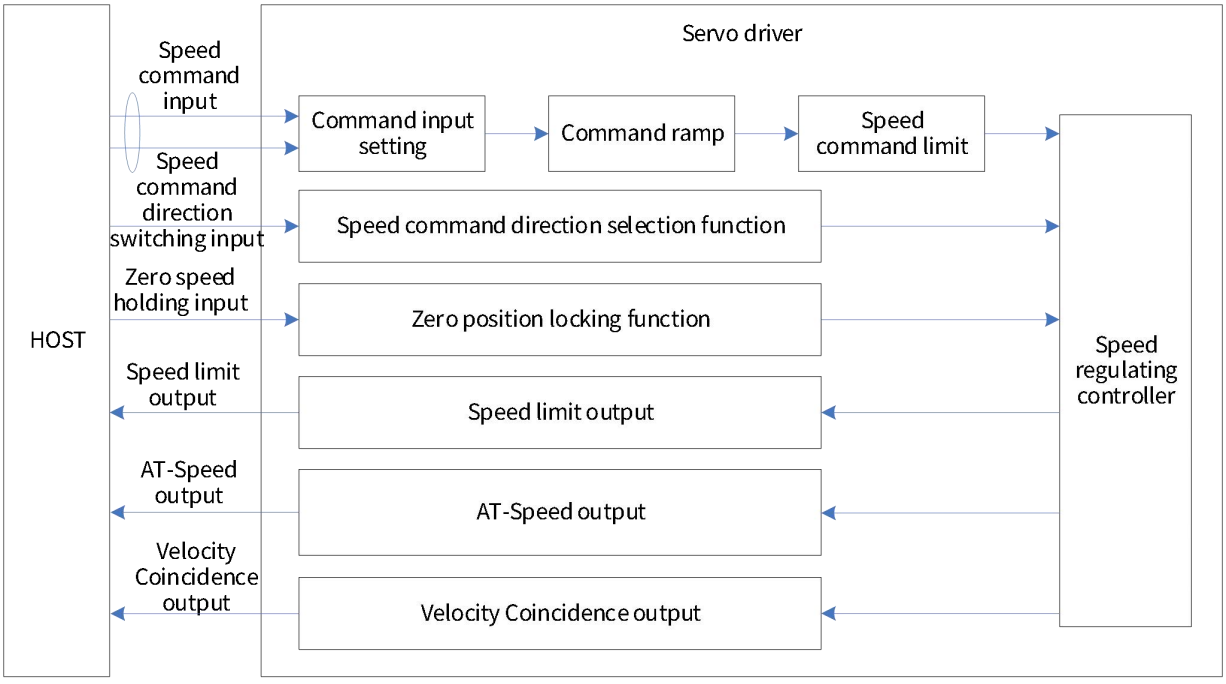
4.2.2 Speed control mode



Figuere 4-16 Speed control block diagram

If setting the value of parameter P04.00 to 0 by the servo driver panel or SV3 Designer debugging platform, the servo driver will be operated in the speed control mode.

Please set the servo driver parameters based on the mechanical structure and indicators. The basic parameter settings in the speed control mode are described below.

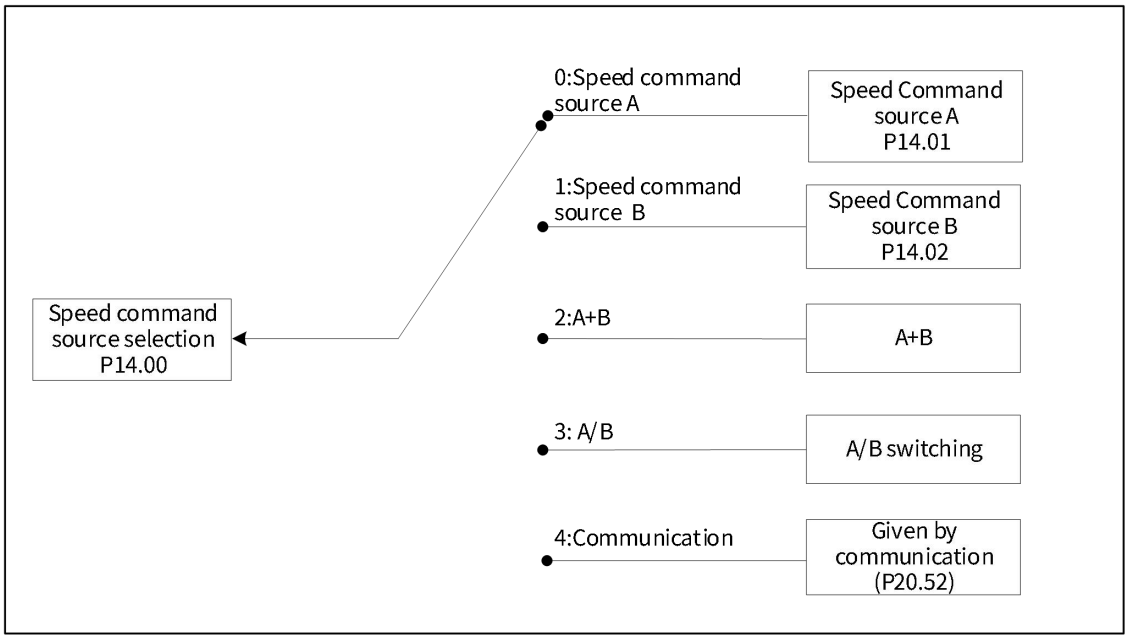


Figuere 4-17 Signal interaction diagram between servo driver and host

4.2.2.1 Speed command input setting

(1) Speed command source

In the speed control mode, there are 5 speed command acquisition modes below, which are set with the function code P14.00.

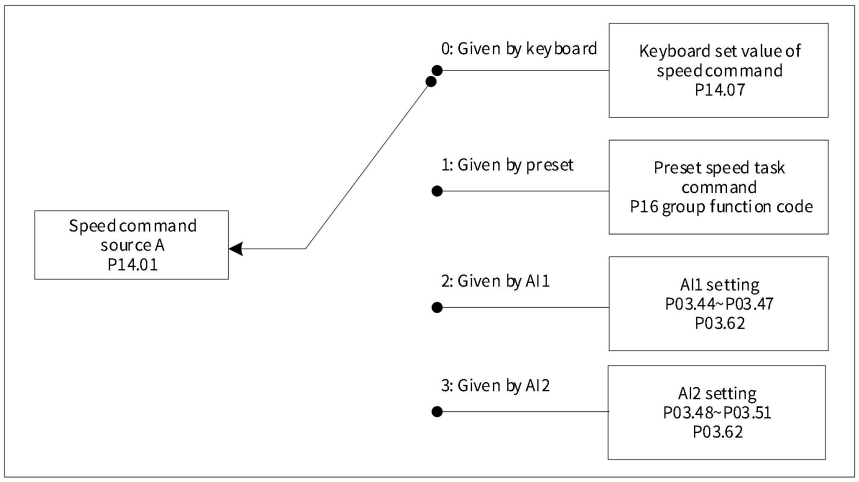


Figuere 4-18 Speed command source selection diagram

Function code		Name	Range	Unit	Function	Setting mode	Effective time	Default
P14	00	Speed command source selection	0: Source A. 1: Source B 2: Source A+B 3: Source A\B DI switching 4: Given by communication	-	Set the speed command source selection	Stop for setting	Effective immediately	0

a) Speed command source A

The speed command source A has 3 command modes: command given by keyboard, command given by analog voltage and preset speed task command. The command given by keyboard and preset speed task command are internal speed commands, and the command given by analog voltage is an external speed command.



Figuere 4-19 Speed command source A diagram

Function code		Name	Range	Unit	Function	Setting mode	Effective time	Default
P14	01	Speed command source A	0: Given by keyboard 1: Given by preset speed 2: Given by AI1 3: Given by AI2	-	Set the speed command source A	Stop for setting	Effective immediately	0

i. Given by keyboard

It refers to setting the speed value with the function code P14.07 as the speed command.

Function code		Name	Range	Unit	Function	Setting mode	Effective time	Default
P14	07	Speed command value set with keyboard	-9999~30000	rpm	Set the speed command value by keyboard	In-running setting	Effective immediately	60

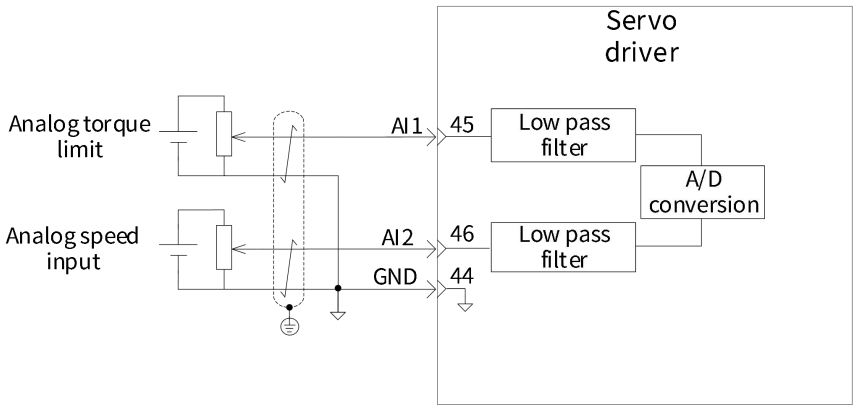
ii. Given by analog voltage

It refers to the analog voltage signal output by the upper computer or other equipment, which is processed as the speed command.

Analog voltage input terminal:

The servo driver has 2 analog input channels: AI1 and AI2. The maximum input voltage is ±10Vdc and the input resistance is about 9kΩ.

Analog input circuit:



Operation method:

Taking AI2 as an example, the method of setting speed command by analog voltage is explained below.

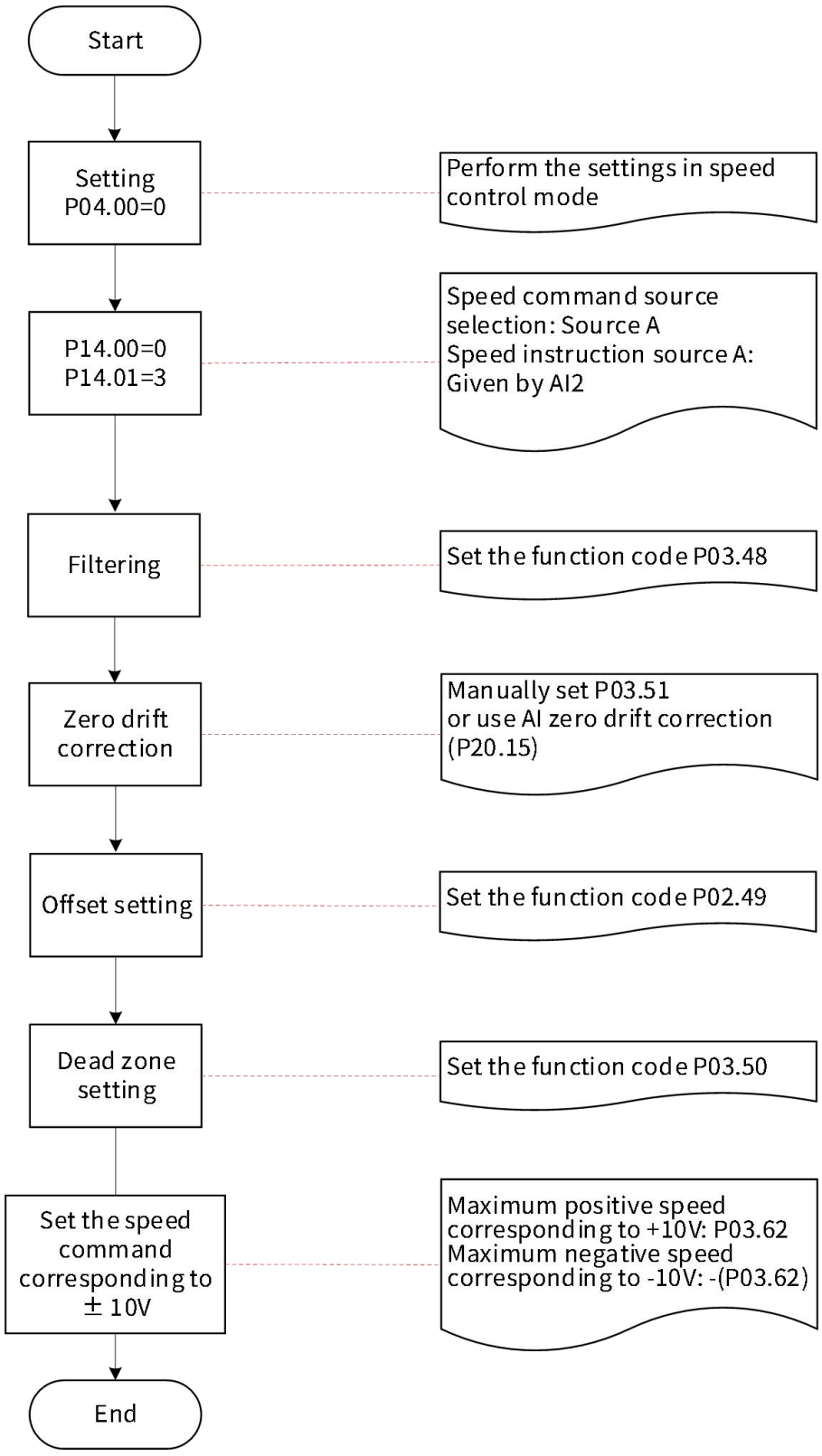


Figure 4-20 Analog voltage speed command operation flowchart

Zero drift: It refers to the value of sampling voltage of servo driver relative to GND when the input voltage of analog channel is zero.

Offset: It refers to the input voltage value of analog channel when the sampling voltage is zero after zero drift

correction.

Dead zone: It refers to the input voltage interval of the corresponding analog channel when the sampling voltage is zero.

The unprocessed output voltage of analog channel is shown as y_1 in Figure 4-21. After internal processing by the servo driver, the speed command y6 is finally obtained.

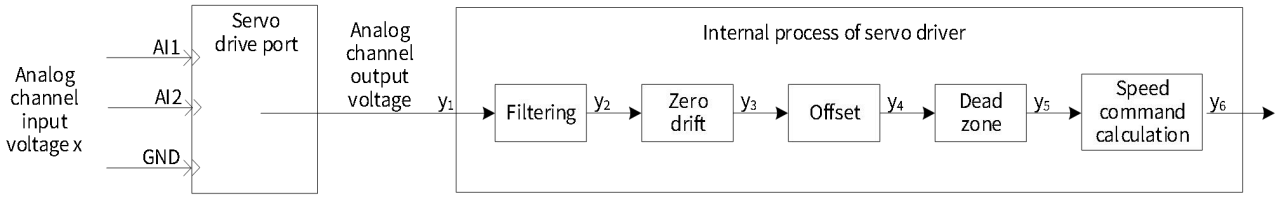


Figure 4-21 Servo driver AI process flowchart

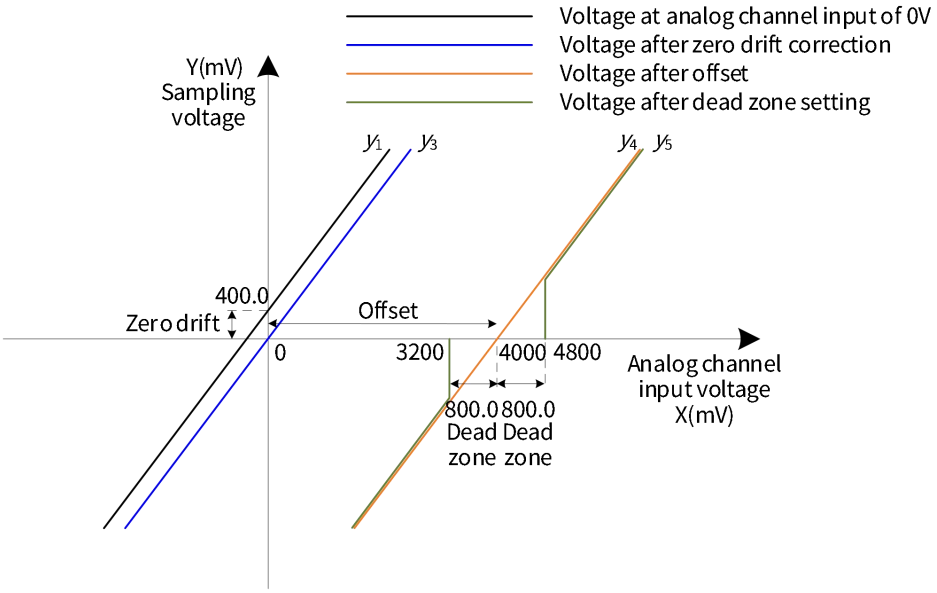


Figure 4-22 Example of sampling voltage corresponding to the servo driver AI processing

- Filtering:

The servo driver provides the analog channel filtering function. By setting the filtering time constant P03.48, the motor command fluctuation caused by the unstable analog input voltage can be prevented, and the motor misoperation caused by interference signals can also be weakened. The filtering function has no effect on eliminating or suppressing zero drift and dead zone.

- Zero drift correction:

It is used to correct the output voltage of analog channel deviated from 0V when the actual input voltage is 0V.

The output voltage of analog channel without internal processing of the driver is shown as y1. Taking the filtering time constant P03.48 = 0.00ms as an example, the filtered sampling voltage y2 is consistent with y1.

It can be seen that in case of the actual input voltage x=0, the output voltage is y1=400.0mV, which is called zero drift.

Manually set P03.48=400.0(mV). After zero drift correction, the sampling voltage is shown as y3. y3=y1-400.0

The zero drift can also be automatically corrected by the analog channel automatic adjustment function (P20.15).

- Offset setting:

  It is used to set the corresponding actual input voltage value when the sampling voltage is 0.

  As shown, when the preset sampling voltage y4=0, the corresponding actual input voltage x=4000mV, which is called bias.

  Manually set P02.49=4000(mV). After offset, the sampling voltage y4=x-4000 = y3-4000.

- Dead zone correction:

  It is used to limit the effective input voltage range when the driver sampling voltage is not 0.

  After the offset setting is completed, when the input voltage X is within 3200mV and 4800mV, the sampling voltage value will be 0; in this case, this 800.0mV is called dead zone.

  Set P03.50=800.0. After dead zone correction, the sampling voltage is as shown as y5.

$$y_5 = \begin{cases} 0 & 3200 \leqslant x \leqslant 4800 \\ y_4 & 4800 < x \leqslant 10000 \text{ or } -10000 \leqslant x < 3200 \end{cases}$$

- Calculation of speed command:

  After setting the zero drift, offset and dead zone, it is necessary to set the speed command value corresponding to 10V(10000mV) in the sampling voltage at this time with P03.62, and the actual speed command y_6 is shown below:

$$y_6 = \frac{y_5}{10000} \times (P03.62)$$

  This value is used as the given value of analog speed command in the speed control mode.

  The value without offset is shown in Figure 4-23 (left) and the value with offset is shown in Figure 4-23 (right). When the correct setting is completed, you can check the sampling voltage value of AI2 in real time with P09.23, and also check the speed command value corresponding to the input analog with P09.01.

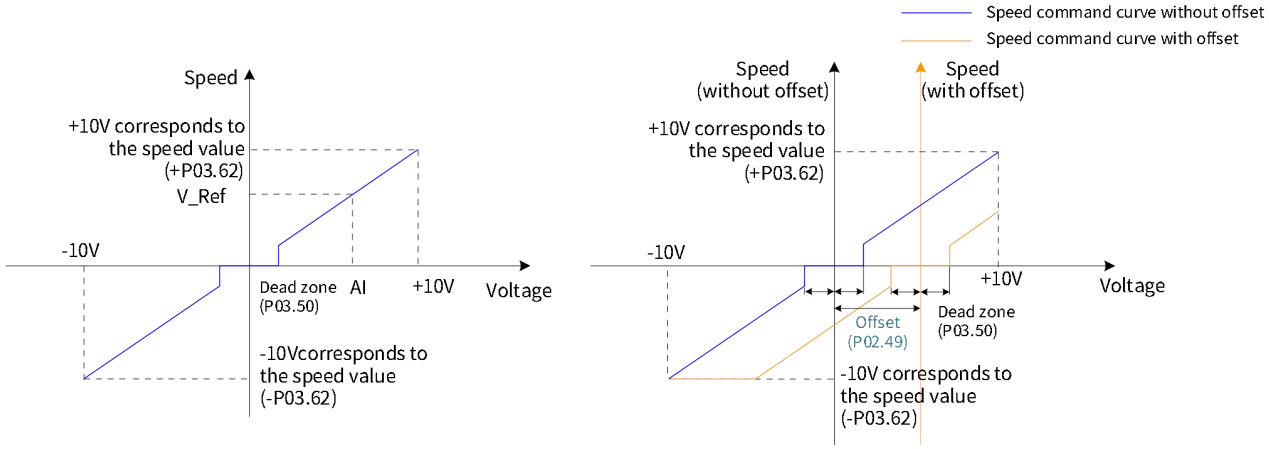


Figure 4-23 Schematic diagram of AI2 without offset (left) & AI2 with offset (right)

Relationship between the final speed command value y6 and the input voltage x:

$$y_6 = \begin{cases} 0 & B - C \leqslant x \leqslant B+C \\ x-B & B+C < x \leqslant 10000 \text{ or } -10000 \leqslant x < B - C \end{cases}$$

Where: B: Offset; C: Dead zone.

Function code		Name	Range	Unit	Function	Setting mode	Effective time	Default
P02	49	AI2 offset voltage	-10000~10000	mV	Set the analog offset value of AI2 channel	In-running setting	Effective immediately	0
P03	48	AI2 input filtering time	0~655.35	ms	Set the analog mean filtering time constant of AI2 channel	In-running setting	Effective immediately	2.00
P03	50	AI2 dead zone	0~1000.0	mV	Set the analog dead zone value of AI2 channel	In-running setting	Effective immediately	10.0
P03	51	AI2 zero drift	-500.0~500.0	mV	Set the analog zero drift value of AI2 channel	In-running setting	Effective immediately	0.0
P03	62	Speed value corresponding to the analog 10V	0~6000	rpm	Set the speed value corresponding to the analog 10V	Stop for setting	Effective immediately	3000
P20	15	AI zero drift correction	0: No operation 1: AI1 adjustment 2: AI2 Adjustment	-	Enable the automatic correction of zero drift of analog AI1 and AI2 channels	Stop for setting	Effective immediately	0

Note: When the analog AI1 input channel is selected, its setting method is similar to the above-mentioned analog AI2 setting method. For related function codes, please refer to Chapter 7.

b) Speed command source B

The speed command source B includes 3 command modes: given by keyboard, given by analog voltage and preset speed task. The command given by the keyboard and the preset speed task command are internal speed commands, and the command by the analog voltage is external speed command.

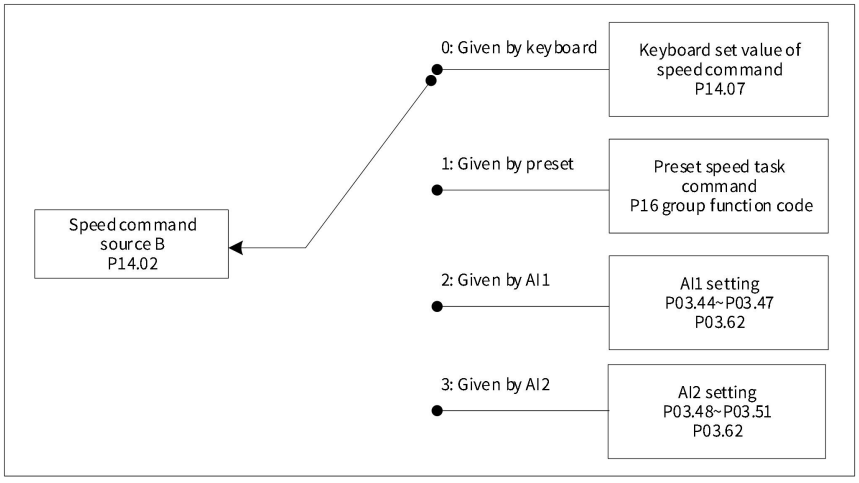


Figure 4-24 Speed command source B diagram

Function code		Name	Range	Unit	Function	Setting mode	Effective time	Default
P14	02	Speed command source B	0: Given by keyboard 1: Given by preset speed 2: Given by AI1 3: Given by AI2	-	Set the speed command source B	Stop for setting	Effective immediately	1

Among them, the method of setting digital and analog voltage is the same as the speed command source A.The preset speed task command is described below. The servo driver has the preset speed task running function. It means that there are 16 speed commands stored in the servo driver, and the maximum running speed and running time of each segment can be set separately. There are 4 groups of acceleration and deceleration time for selection. The setting process is shown below:

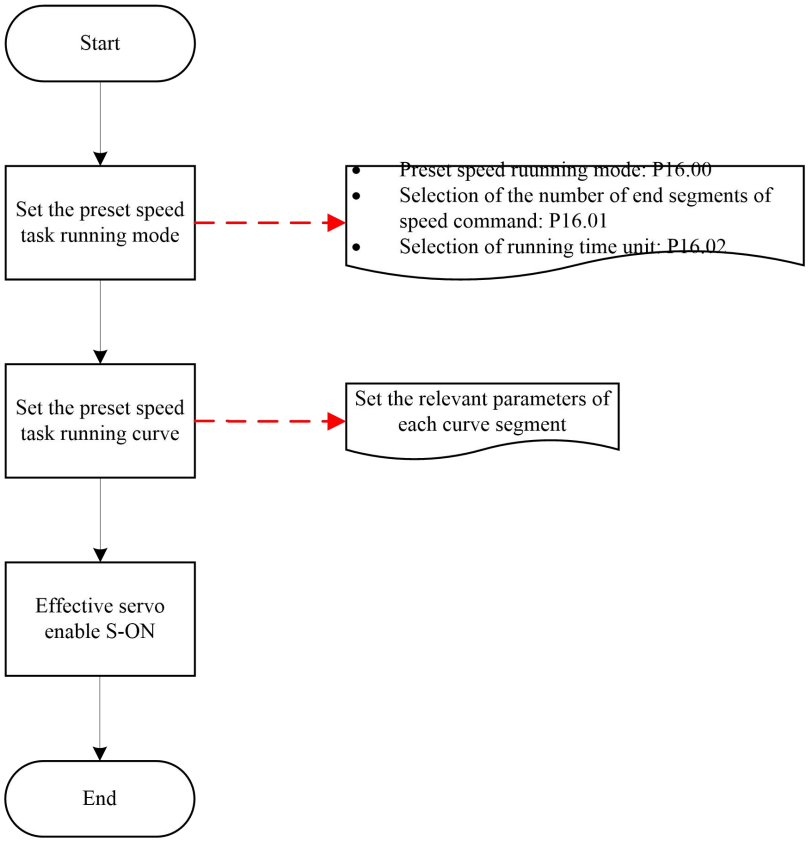


Figure 4-25 Preset speed task setting flowchart

i. Preset speed task running mode setting

Function code		Name	Range	Unit	Function	Setting mode	Effective time	Default
P16	00	Preset speed command running mode	0: Single running 1. Cyclic running 2: DI switching running	-	Set the preset speed command running mode	Stop for setting	Effective immediately	1
P16	01	Selection of speed command end segments	1~16	-	Set the number of speed command end segments	Stop for setting	Effective immediately	16
P16	02	Selection of running time unit	0：s 1：min	-	Set the running time unit	Stop for setting	Effective immediately	0

External DI terminal can be configured, and collocated as FunIN.20: Speed command direction switching, which is used to select the preset position command direction.

Function code	Name	Description
FunIN.20	Speed command direction selection	Ineffective - Forward direction; Effective - Negative direction.

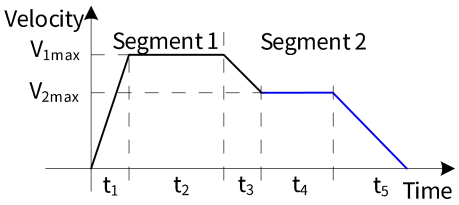
Take P16.01=2 as an example to describe each mode.

Stop after single running (P16.00=0)

Set the function code P16.00 to 0, and select the single running stop mode. After setting the function codes P16.01 and P16.02 respectively based on the total number of execution segments and the execution time unit, and setting the command value, running time, acceleration and deceleration time and other parameters of the corresponding segments according to the requirements, the driver will run from the first segment to the N^{th} segment and then stop.

Table4-27 Description of stop at the end of single running

Mode description	Running curve

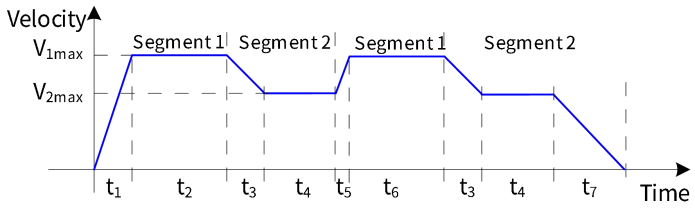
Running for 1 cycle; Automatic increment of segment numbers.	 V_{1max} and V_{2max}: Command speed of Segments 1 and 2; t_1: Actual acceleration and deceleration time of Segment 1; t_3 and t_5: Acceleration and deceleration time of Segment 2; Running time of one segment: Speed change time from the previous speed command to this speed command + Constant running time of this segment (for example, as shown, the first segment of running time is t_1+t_2, the second segment of running time is t_3+t_4,, etc.). Do not set one segment of running time to 0; otherwise, the driver will skip the speed command and execute that of next segment; When the actual motor speed reaches the maximum running speed set in this segment, the speed reaching signal will be effective; In case that servo enable OFF occurs during the running of a certain segment, the motor will stop in the servo OFF stop mode (H02-05).

Note: That the total number of preset speed task command segments set with P16.01 is completed by the driver completely is called completing one cycle of running.

Cyclic running (P16.00=1)

Set the function code P16.00 to 1, and select the cyclic running mode. After setting the function codes P16.01 and P16.02 respectively based on the total number of execution segments and the execution time unit, and setting the command value, running time and acceleration and deceleration time of the corresponding segments according to the requirements, the driver will run from the first segment to the Nth segment and then automatically jump to the first segment for cyclic running.

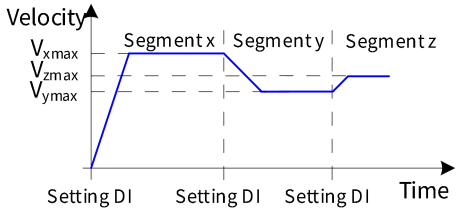
Table 4-28 Description of cyclic running

Mode description	Running curve
Cyclic running, with the starting segment number of each cycle from 1; Automatic increment of segment numbers; If the servo enable is effective, the drive will always in the cyclic running status.	 V_{1max} and V_{2max}: Maximum running speed of Segments 1 and 2; A certain segment of running time: Speed change time from the previous segment of speed command to this segment of speed command+ Constant running time of this segment (for example, the first segment of running time. is t_1+t_2, the second segment of running time is t_3+t_4, etc.). Do not set a certain segment of running time to 0; otherwise, the driver will skip the speed command and execute that of the next segment; When the actual motor speed reaches the maximum running speed set in this segment, the speed reaching signal will be effective; If the servo enable OFF occurs during a certain segment of running, the motor will stop in the servo OFF stop mode (P04.12).

DI switching running (P16.00=2)

Set the function code P16.00 to 2, and select the external DI switching mode. After setting the function codes P16.01 and P16.02 respectively based on the total number of execution segments and the execution time unit, and setting the command value, running time, acceleration and deceleration time and other parameters of the corresponding segment according to the requirements, the driver will select the speed commands for running the corresponding segment numbers based on the ON/OFF combination of the external DI.

Table 4-29 Description of DI switching running

Mode description	Running curve
If the servo is enabled effectively, it can run continuously; The segment number is determined with the logic of the DI terminal; The running time of each speed command is only determined with the switching interval of segment numbers.	 x and y: Segment number; the logical relationship between segment number and DI terminal is shown below; The running time of a certain segment is not affected by the set value of the function code. During the running of a certain segment of speed command, if the section numbers change, it will be switched to the new segment number immediately. When the actual motor speed reaches the maximum running speed set in this segment, the speed reaching signal will be effective; When the servo enable OFF occurs during a certain section of running, the motor will stop in the servo OFF stop mode (P04.12).

When the multi-segment running mode is set to DI switching running, the 4 DI terminals of the servo driver must be configured as Functions 27~30 (FunIN.27 ~ FunIN.30, multi-segment running command switching), and the effective logic of the DI terminals must be determined. At the same time, 1 DI terminal of the servo driver can be configured as Function 20 (FunIN.20: speed command direction selection) to switch the speed command direction.

<table>
<tr><th>Function code</th><th>Name</th><th>Description</th><th>Remarks</th></tr>
<tr><td>FunIN.20</td><td>Speed command direction selection</td><td>Ineffective - Positive direction;
Effective - Negative direction.</td><td>It is used to set the speed command direction only in the preset speed command DI switching mode</td></tr>
<tr><td>FunIN.27</td><td>Preset command selection 1</td><td rowspan="3">The multi-segment number is a 4-digit binary number, and the corresponding relationship between FunIN.27~FunIN.30 and segment numbers is shown below.
<table><tr><th>FunIN.30</th><th>FunIN.29</th><th>FunIN.28</th><th>FunIN.27</th><th>段号</th></tr><tr><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td></tr><tr><td>0</td><td>0</td><td>0</td><td>1</td><td>2</td></tr><tr><td colspan="5">…</td></tr><tr><td>1</td><td>1</td><td>1</td><td>1</td><td>16</td></tr></table>When the input level of the DI terminal is effective, CMD value is 1; otherwise, it is 0.</td><td></td></tr>
<tr><td>FunIN.28</td><td>Preset command selection 2</td><td></td></tr>
<tr><td>FunIN.29</td><td>Preset command selection 3</td><td></td></tr>
</table>

Function code	Name	Description	Remarks
FunIN.30	Preset command selection 4		

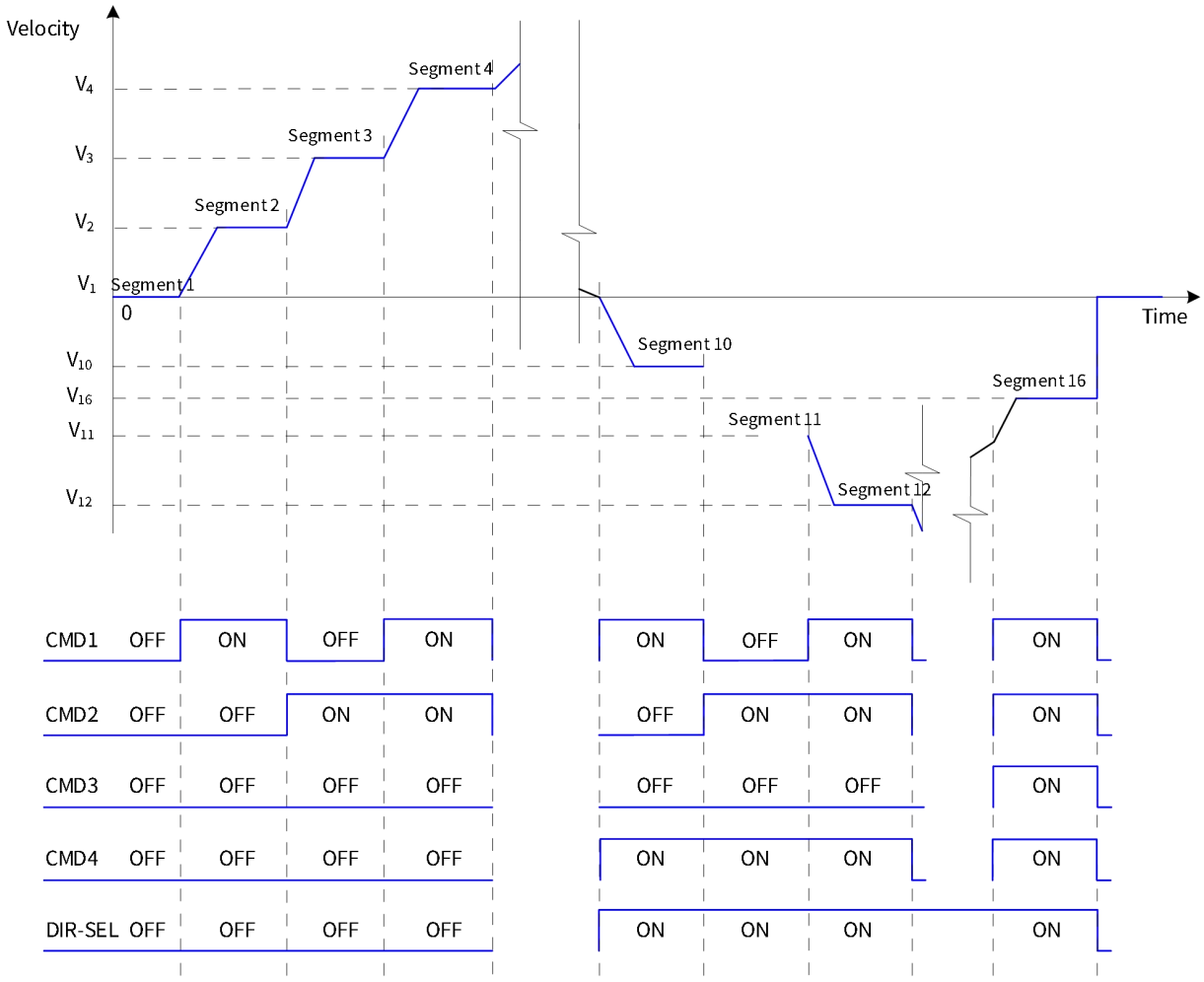


Figure 4-26 Preset speed task curve example

ii. Preset speed task running curve setting

Taking the first segment of speed command as an example, the related function codes are as below:

Function code		Name	Range	Unit	Function	Setting mode	Effective time	Default
P16	03	Acceleration time 1	0~65535	ms	Set the first group of acceleration and deceleration time	Stop for setting	Effective immediately	10
P16	04	Deceleration time 1	0~65535	ms		Stop for setting	Effective immediately	10
P16	09	Acceleration time 4	0~65535	ms	Set the fourth group of acceleration and deceleration time	Stop for setting	Effective immediately	150
P16	10	Deceleration time 4	0~65535	ms		Stop for setting	Effective immediately	150
P16	20	First segment of speed command	-6000~6000	rpm	Set the first segment of speed command value	Stop for setting	Effective immediately	0
P16	21	Running time of the first segment of command	0~6553.5	s (min)	Set the running time of the first segment of command	Stop for setting	Effective immediately	5.0
P16	22	First segment of acceleration and deceleration time	0: Acceleration and deceleration time 0 1: Acceleration and deceleration time 1 2: Acceleration and deceleration time 2 3: Acceleration and deceleration time 3 4: Acceleration and deceleration time 4	-	Select the first segment of acceleration and deceleration mode	Stop for setting	Effective immediately	0

In the preset speed task command parameters, there are 4 groups of acceleration and deceleration time for selection except 1~16 segments of command value and command running time; in the default mode, there is no acceleration and deceleration time. Taking the end of a single running of P16.01=1 in the preset speed task as an example, the actual acceleration and deceleration time and running time are explained below:

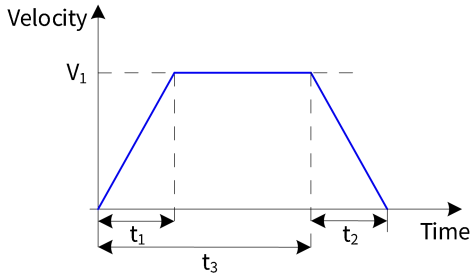


Figure 4-27 Preset speed task curve example

As shown above, the speed command of this segment is V_1, and the actual acceleration time t_1 is as below:

$$t_1=\frac{V_1}{1000}\times\text{Acceleration time in the segment}$$

Actual deceleration time t_2:

$$t_2=\frac{V_1}{1000}\times\text{Deceleration time in the segment}$$

Running time: Speed change time from the previous speed command to the current speed command +Constant running time of this segment, as shown in t_3 above.

c) A/B DI switching source

When the speed command selects “A/B switching”, that is, the function code P14.00=3, it is necessary to assign the DI function FunIN.23 to the corresponding DI terminal, and determine whether the current A command source input or B command source input is effective based on the input signal on this DI terminal.

Function code	Name	Description	Remarks
FunIN.23	Running command switching	Ineffective - The current running command is A; Effective - The current running command is B.	-

d) Given by communication

It refers to that when the function code P14.00 is set to 4, the speed command value is the set value of the function code P20.52, the function code P20.52 must be modified by communication, and the control panel is invisible.

Function code		Name	Range	Unit	Function	Setting mode	Effective time	Default
P20	52	Speed command by communication	-9000.000~9000.000	rpm	Set the speed command value given by communication, with accuracy of 0.001rpm	In-running setting	Effective immediately	0

(2) Speed command direction setting

The speed command direction switching is realized with DI, that is, the DI function FunIN.20 is assigned to the corresponding DI terminal, and the current speed command direction is determined with the input signal on this DI terminal, thus meeting the requirements of speed command direction switching.

Function code	Name	Description	Remarks
FunIN.20	Speed command direction selection	Ineffective - Positive direction; Effective - Negative direction.	-

The actual motor running direction is related to running direction selection (P04.01), speed command direction and speed command direction DI switching (FunIN.20).

Table 4-30 Actual running direction setting of motor in the speed control mode

P04.01	Speed command (+/-)	FunIN.20	Actual motor running direction
0	+	Ineffective	Counterclockwise
0	+	Effective	Clockwise
0	-	Ineffective	Clockwise
0	-	Effective	Counterclockwise
1	+	Ineffective	Clockwise
1	+	Effective	Counterclockwise
1	-	Ineffective	Counterclockwise
1	-	Effective	Clockwise

4.2.2.2 Ramp function setting

The ramp function setting refers to converting the speed command with large acceleration into one with gentle acceleration, that is, the acceleration can be controlled by setting the acceleration and deceleration time.

In the speed control mode, excessive acceleration of the speed command will cause violent motor jump or vibration. At this time, increasing the acceleration or deceleration time can realize the smooth speed change of the motor, to avoid the mechanical damage resulted.

⚠ Note:

When the speed command is given by keyboard, analog voltage and jogging speed, the acceleration and deceleration time can be set with the function codes P14.08 and P14.09;

When the speed command comes from the preset speed task, the acceleration and deceleration time can be set with P16 group parameters. See Chapter 7 for details.

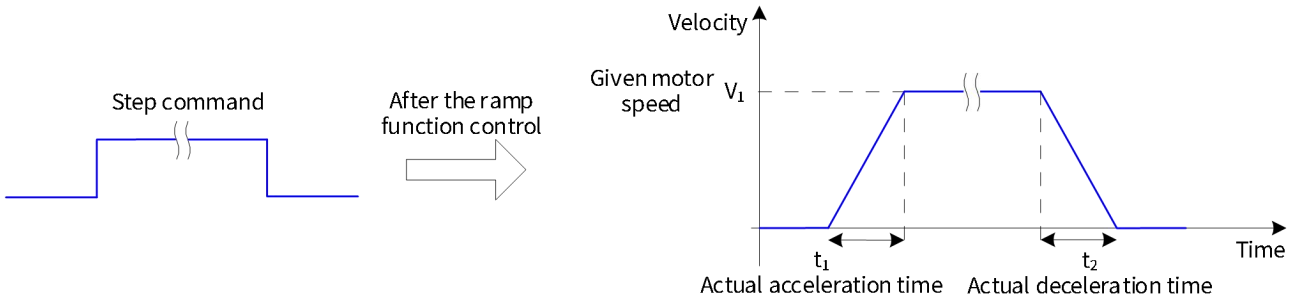


Figure 4-28 Schematic diagram of ramp function definition

P14.08: Time for the speed command to accelerate from 0 to 1000rpm.

P14.09: Time for the speed command to decelerate from 1000rpm to 0.

Therefore, the actual acceleration and deceleration time calculation formula is shown below:

$$\text{Actual acceleration time } t_1 = \frac{\text{Speed command}}{1000} \times \text{Speed command acceleration ramp time}$$

$$\text{Actual deceleration time } t_2 = \frac{\text{Speed command}}{1000} \times \text{Speed command deceleration ramp time}$$

Function code		Name	Range	Unit	Function	Setting mode	Effective time	Default
P14	08	Speed command acceleration ramp time	0~65535	ms	Set the acceleration and deceleration time value of speed command except multi-segment speed command in the speed control mode	In-running setting	Effective immediately	0
P14	09	Speed command deceleration ramp time	0~65535	ms		In-running setting	Effective immediately	0

4.2.2.3 Zero-speed locking function

Note:

The zero-speed locking function is used in the system where the position loop is not built in the upper computer in the speed control mode.

If the servo motor oscillates in the zero-speed locking status, the position loop gain can be adjusted.

The zero-speed locking function is that in the speed control mode, when the zero-speed locking DI signal FunIN.6 (zero-speed holding) is effective and the speed command amplitude is less than or equal to the set value of P14.10, the servo motor will enter the zero-speed locking status; at this time, the position loop will be built inside the servo driver, and the speed command will be ineffective; the servo motor is fixed within ±1 pulse about the effective zero-speed locking position; even if it moves under an external force, it will return to the zero position to be fixed.

If the speed command amplitude is more than P14.10, the servo motor will exit the zero-speed locking status, and the servo motor will continue to run based on the currently input speed command. If the zero-speed locking DI signal FunIN.6 (zero-speed holding) is ineffective, the zero-speed locking function will be ineffective.

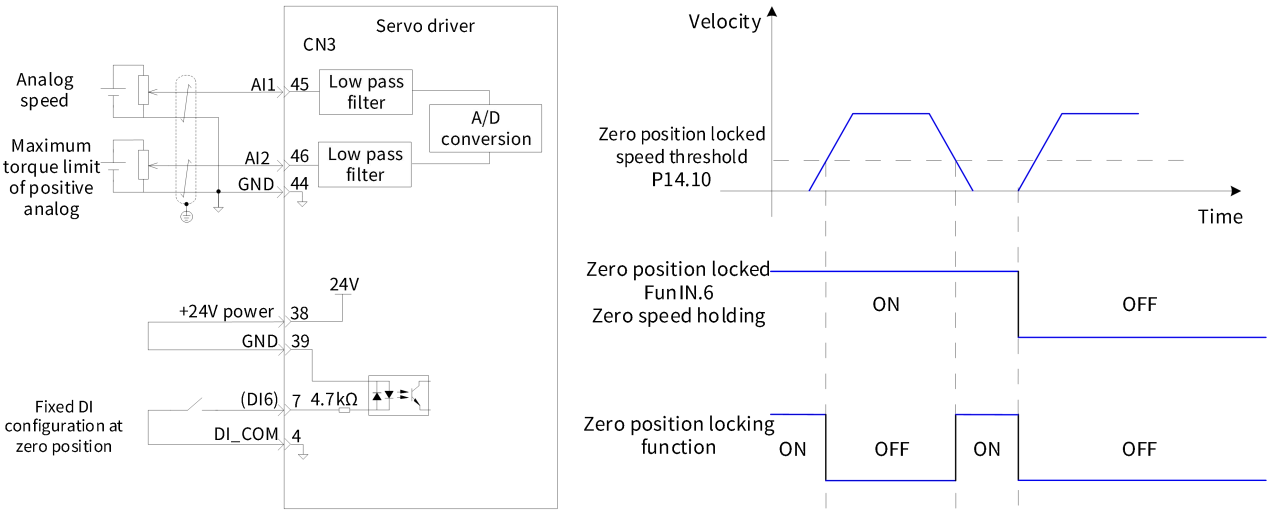


Figure 4-29 Zero-speed locking wiring and waveform diagram

Function code		Name	Range	Unit	Function	Setting mode	Effective time	Default
P14	10	Zero-speed locking speed threshold	0~6000	rpm	Set the zero-speed locking function speed threshold	In-running setting	Effective immediately	10

Function code	Name	Description	Remarks
FunIN.6	Zero-speed holding	Effective - Enable the zero-speed locking function; Ineffective - Disable the zero-speed locking function.	

4.2.2.4 Speed command limit

Note:

When the actual motor speed exceeds the overspeed fault threshold P08.03, E.416 (motor overspeed) will occur in the driver. Please refer to the detailed table of parameters in Chapter 8 for the setting of P08.03. The speed command limit must be less than P08.03.

In the speed control mode, the servo driver can limit the size of the speed command, and the speed command limitation sources include:

P14.03: Set the amplitude limit of the speed command in positive and negative directions. The speed command in positive and negative directions will be limited to this value it exceeds the set value.

P14.04: Set the speed threshold in positive direction. The speed command in positive direction will be limited to this value if it exceeds the set value.

P14.05: Set the speed threshold in negative direction. The speed command in negative direction will be limited to this value if it exceeds this set value.

Maximum motor speed (default limit point): It is determined with the actual motor model.

The actual motor speed limit interval shall met:

| Speed command amplitude in positive direction |≤ Min{Maximum motor speed, P14.03, P14.04}

| Speed command amplitude in negative direction | ≤ Min{Maximum motor speed, P14.03, P14.05}

Function code		Name	Range	Unit	Function	Setting mode	Effective time	Default
P14	03	Maximum speed limit	0~60000	rpm	Set the maximum speed limit	In-running setting	Effective immediately	3000
P14	04	Speed limit in positive direction	0~60000	rpm	Set the speed limit in positive direction	In-running setting	Effective immediately	3000
P14	05	Speed limit in positive direction	0~60000	rpm	Set the speed limit in negative direction	In-running setting	Effective immediately	3000

4.2.2.5 Speed-related DO output

After filtering, the speed feedback value can be compared with different thresholds, and the DO signal can be output for the upper computer. The corresponding filtering time parameters are set with P07.76.

(1) Motor motion signal DO output

When the absolute value of the actual motor speed after filtering reaches P14.12 (motor motion status threshold), it can be considered that the motor is moving. At this time, the servo driver can output a motor motion (FunOUT.5) signal to confirm that the motor has moved; when the absolute value of the actual motor speed after filtering is less than P14.12, it is considered that the motor is not moving.

The judgment of motor motion (FunOUT.5) signal is not affected by the operating status and control mode of the driver.

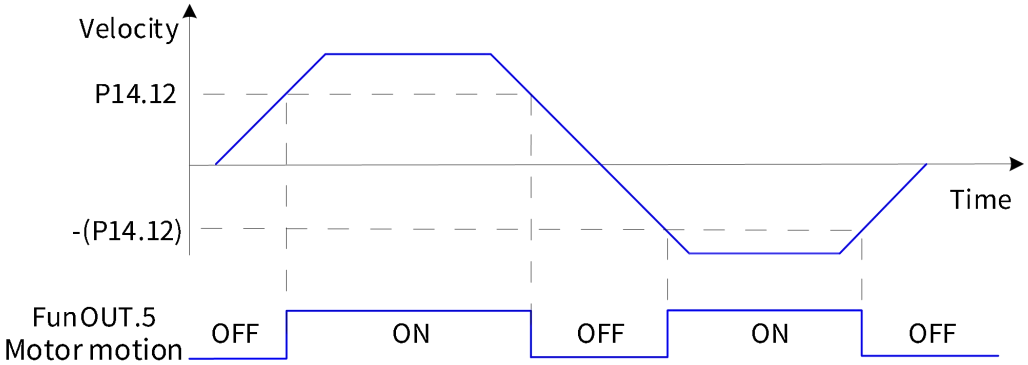


Figure 4-30 Motor motion signal waveform diagram

Note:

As shown above, ON means that the motor motion DO signal is effective, and OFF means that the motor motion DO signal is ineffective.

Function code		Name	Range	Unit	Function	Setting mode	Effective time	Default
P14	12	Motor motion status threshold	0~1000	rpm	Set the motor motion signal judgment threshold	In-running setting	Effective immediately	20

When the motor motion signal output function is used, 1 DO terminal of the servo driver shall be assigned to the DO function (FunOUT.5: motor motion), and the effective logic of the DO terminal shall be determined.

Function code	Name	Description	Remarks
FunOUT.5	Motor motion	Ineffective - The absolute value of motor speed after filtering is less than the set value of the function code P14.12; Effective - The absolute value of motor speed after filtering reaches the set value of the function code P14.12.	-

(2) Velocity coincidence signal DO output

In the speed control mode, when the absolute value of the deviation between the actual speed of the servo motor and the speed command after filtering meets a certain threshold (P14.13), it is considered that the actual motor speed reached the set value of the speed command, and at this time, the driver can output the velocity coincidence(FunOUT.7) signal. If the absolute value of the deviation between the actual speed of the servo motor and the speed command after filtering exceeds the threshold, the speed consistency signal will be ineffective.

When the driver is in non-running status or non-speed control mode, the velocity coincidence (FunOUT.7) signal will be always ineffective.

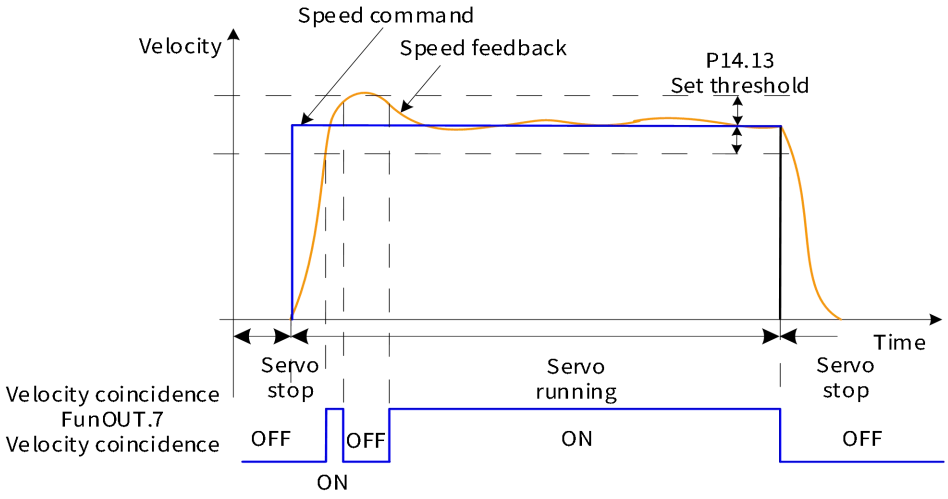


Figure 4-31 Velocity coincidence signal waveform diagram

Note:

As shown above, ON means that the velocity coincidence DO signal is effective, and OFF means that the velocity coincidence DO signal is ineffective.

Function code		Name	Range	Unit	Function	Setting mode	Effective time	Default
P14	13	Velocity coincidence signal width	0~100	rpm	Set the velocity coincidence signal width	In-running setting	Effective immediately	10

When the velocity coincidence signal output function is used, 1 DO terminal of the servo driver shall be assigned to the DO function (FunOUT.7: velocity coincidence), and the effective logic of the DO terminal shall be determined.

Function code	Name	Description	Remarks
FunOUT.7	Velocity coincidence	Ineffective - The absolute value of the deviation between the actual motor speed and the speed command after filtering is more than the function code P14.13; Effective - The absolute value of the deviation between the actual motor speed and the speed command after filtering is not more than the function code P14.13.	-

(3) At-speed signal DO output

When the absolute value of the actual speed of the servo motor after filtering exceeds a certain threshold (P14.14), it is considered that the actual speed of the servo motor reaches the expected value; at this time, the servo driver can output the at-speed (FunOUT.8: At-speed) signal. If the absolute value of the actual speed of the servo motor after filtering is not more than this value, the at-speed signal will be ineffective.

The judgment of at-speed (FunOUT.8: At-speed) signal is not affected by the running status and control mode of the driver.

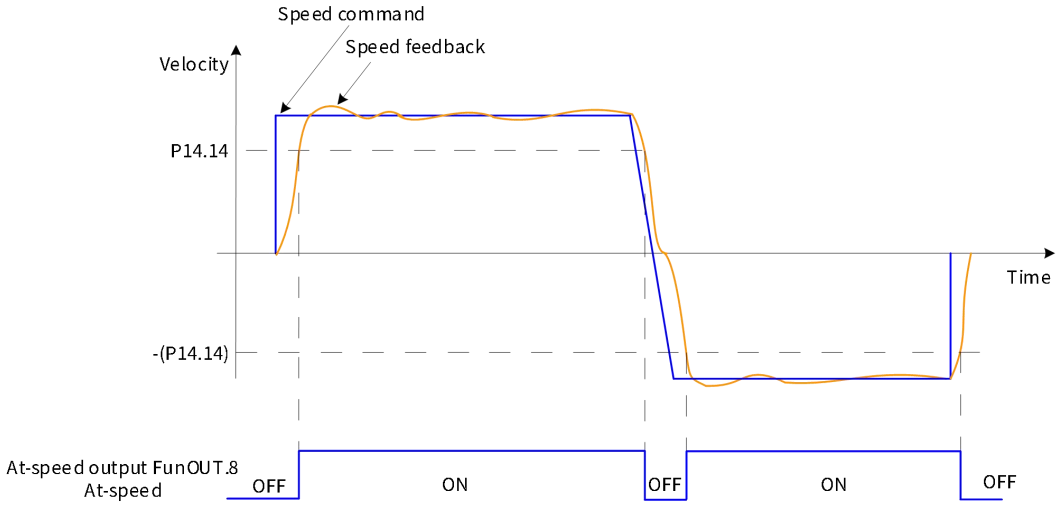


Figure 4-32 Speed reaching signal waveform diagram

Note:

As shown above, ON means that the at-speed DO signal is effective, and OFF means that the at-speed DO signal is ineffective.

Function code		Name	Range	Unit	Function	Setting mode	Effective time	Default
P14	14	At-speed signal threshold	10~6000	rpm	Set the at-speed signal judgment threshold	In-running setting	Effective immediately	1000

When the motor motion signal output function is used, 1 DO terminal of the servo driver shall be assigned to the DO function (FunOUT.8：VArr, at-speed), and the effective logic of the DO terminal shall be determined.

Function code	Name	Description	Remarks
FunOUT.8	At-speed	Ineffective - The absolute value of speed feedback of the motor after filtering is more than the function code P14.14; Effective - The absolute value of speed feedback of the motor after filtering is not more than the function code P14.14.	-

(4) Zero-speed signal DO output

When the absolute value of the actual speed of the servo motor is less than a certain threshold (P14.15), it is considered that the actual speed of the servo motor is close to stop; at this time, the servo driver can output the zero-speed (FunOUT.6, zero-speed signal) signal. If the absolute value of the actual speed of the servo motor is not more than this value, it is considered that the motor is not in a stop status and the zero-speed signal will be ineffective.

The judgment of zero-speed (FunOUT.6) signal is not affected by the operating status and control mode of the driver.

When there is interference in speed feedback, it can be filtered by speed feedback DO filter, and the corresponding filtering time parameter is set with P07.76.

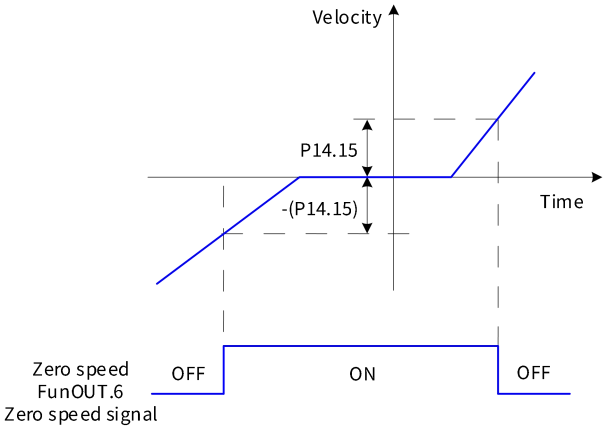


Figure 4-33 Zero-speed signal waveform diagram

Note:

As shown above, ON means that the zero-speed DO signal is effective, and OFF means that the zero-speed DO signal is ineffective.

Function code		Name	Range	Unit	Function	Setting mode	Effective time	Default
P14	15	Zero-speed output signal threshold	1~6000	rpm	Set the zero-speed output signal judgment threshold	In-running setting	Effective immediately	10

When the zero-speed signal output function of the motor is used, 1 DO terminal of the servo driver shall be assigned to the DO function 3 (FunOUT.6: zero-speed signal), and the effective logic of DO terminal shall be determined.

Function code	Name	Description	Remarks
FunOUT.6	Zero-speed signal	Ineffective - The difference of the speed feedback of the motor is more than the set value of the function code P14.15; Effective - The difference of the speed feedback of the motor is not more than the set value of function code P14.15.	Output the signal when the servo motor stops

4.2.3 Torque control mode

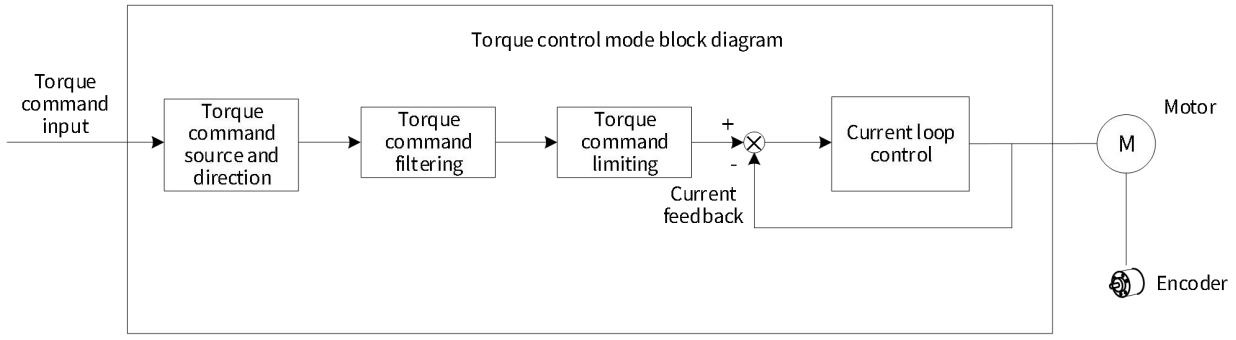


Figure 4-34 Torque control block diagram

If setting the value of parameter P04.00 to 2 on the servo driver panel or the large-scale driver debugging platform, the servo driver will be operated in the torque control mode.

Please set the servo driver parameters based on the mechanical structure and indicators. The basic parameter settings in the torque control mode are described below.

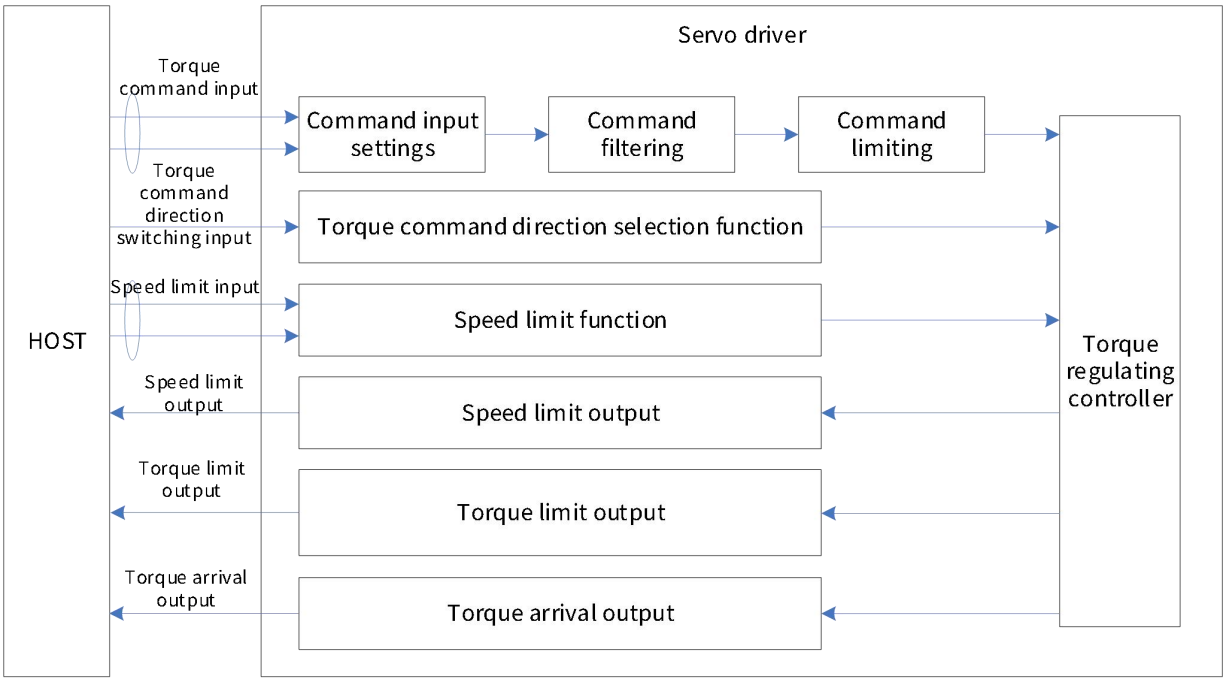


Figure 4-35 Signal interaction diagram between servo driver and upper computer

4.2.3.1 Torque command input setting

(1) Torque command source

In the torque control mode, there are 5 torque command acquisition modes, which is set with the function code P15.00.

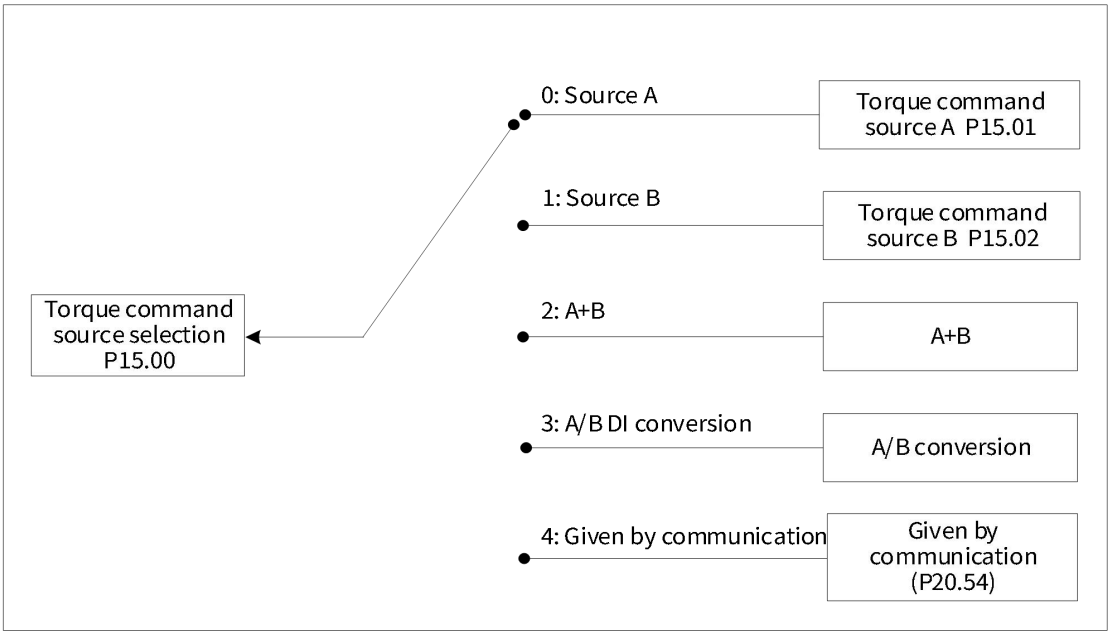


Figure 4-36 Torque command source diagram

Function code		Name	Range	Unit	Function	Setting mode	Effective time	Default
P15	00	Torque command source selection	0: Source A 1: Source B 2: Source A+B 3: Source A\B DI switching 4: Given by communication	-	Select the torque command source	Stop for setting	Effective immediately	0

a) Torque command source A

The torque command source A includes ones given by keyboard and analog voltage. The command given by keyboard is an internal torque command and the command given by analog voltage is an external torque command.

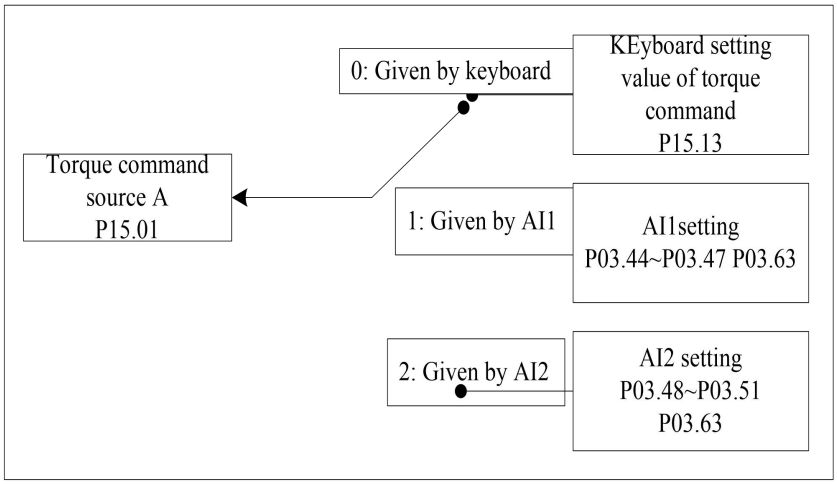


Figure 4-37 Description of torque command source A

Function code		Name	Range	Unit	Function	Setting mode	Effective time	Default
P15	01	Torque command source A	0: Given by keyboard (P15.13) 1: Given by AI1 2: Given by AI2	-	Select the torque command source A	Stop for setting	Effective immediately	0

i. Given by keyboard

It refers to the percentage of command torque relative to rated motor torque set with the function code P15.13.

Function code		Name	Range	Unit	Function	Setting mode	Effective time	Default
P15	13	Torque command given by keyboard	-300.0~300.0	%	Set the internal torque command value, with an accuracy of 0.1%	In-running setting	Effective immediately	0

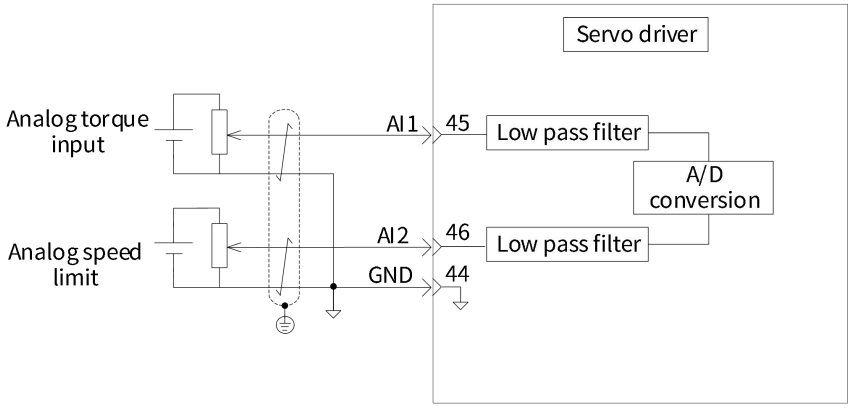
ii. Given by analog voltage

It refers to the analog voltage signal output by the upper computer or other equipment, which is processed as a torque command.

Analog voltage input terminal

The servo driver has two analog input channels: AI1 and AI2. The maximum input voltage is ±10Vdc and the input resistance is about 9kΩ.

Analog input circuit:


Servo driver
Analog torque input
AI1
45
Low pass filter
A/D conversion
Analog speed limit
AI2
46
Low pass filter
GND
44

Operation method:

Taking AI1 as an example, the method of setting the torque command by analog voltage is explained below.

Figure 4-38 Analog voltage torque command operation flowchart

Zero drift: It refers to the value of sampling voltage of servo driver relative to GND when the input voltage of analog channel is zero.

Offset: It refers to the input voltage value of analog channel when the sampling voltage is zero after zero drift correction.

Dead zone: It refers to the input voltage interval of the corresponding analog channel when the sampling voltage is zero.

The unprocessed output voltage of analog channel is shown as y1 in Figure 4-39, and the torque command y6 is finally obtained after internal processing by the servo driver.

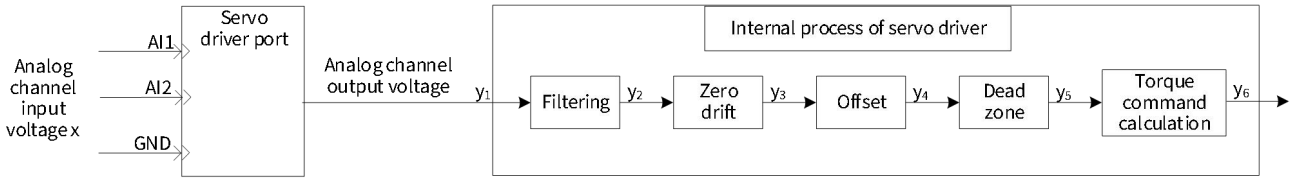


Figure 4-39 Servo driver AI processing flowchart

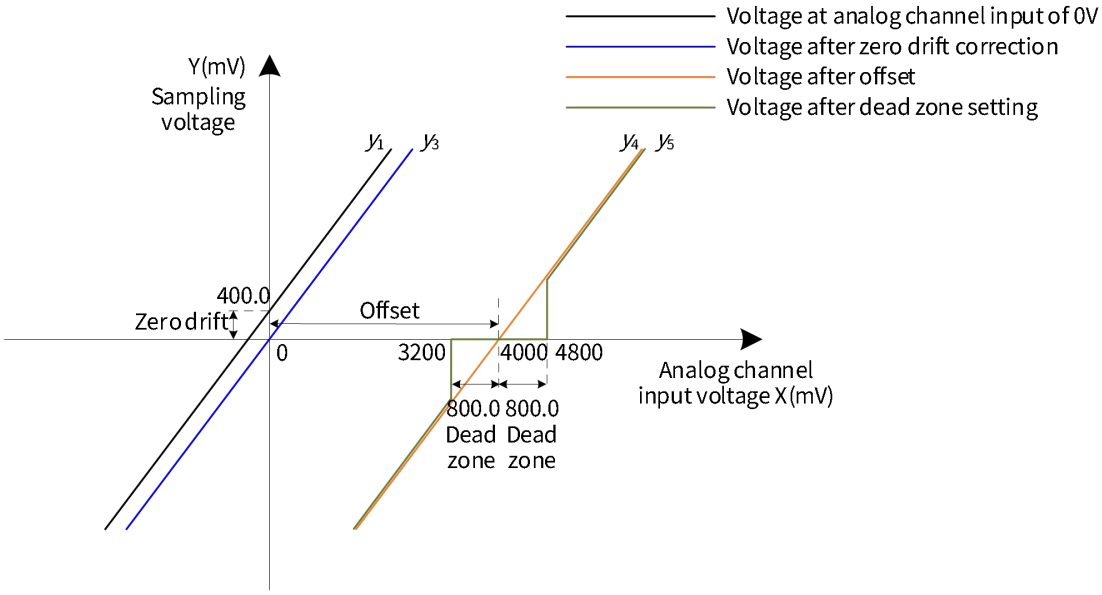


Figure 4-40 Example of sampling voltage corresponding to the servo driver AI processing

- Filtering:

The servo driver has the analog channel filtering function. By setting the filtering time constant P03.44, the motor command fluctuation caused by the unstable analog input voltage can be prevented, and the motor misoperation caused by interference signals can also be weakened. The filtering function has no effect on eliminating or suppressing zero drift and dead zone.

- Zero drift correction:

It is used to correct the output voltage of analog channel deviated from 0V when the actual input voltage is 0V.

As shown, the output voltage of the analog channel without internal processing of the driver is shown as y_1. Taking the filtering time constant P03.44 = 0.00ms as an example, the filtered sampling voltage y_2 shall be consistent with y_1.

It can be seen that when the actual input voltage x=0, the output voltage is y_1=400.0mV, which is called the

zero drift.

Manually set P03.47=400.0(mV). After zero drift correction, the sampling voltage is shown as y_3. $y_3=y_1-400.0$

The zero drift can also be automatically corrected with the automatic adjustment function of analog channel (P20.15).

- Offset setting:

It is used to set the corresponding actual input voltage value when the sampling voltage is 0.

As shown, when the preset sampling voltage is y3=0, the corresponding actual input voltage x=4000mV, which is called the offset.

Manually set P02.48=4000(mV). After offset, the sampling voltage is shown as y_4. $y_4=y_3+4000$.

- Dead zone correction:

It is used to limit the effective input voltage range when the driver sampling voltage is not 0.

After the offset setting is completed, when the input voltage x is within 3200mv and 4800mv, the sampling voltage value is 0, and this 800.0mV is called the dead zone.

Set P03.46=800. After dead zone correction, the sampling voltage is shown as y5.

$$y_5=\begin{cases}0 & 3200 \leqslant x \leqslant 4800\\ y_4 & 4800<x\leqslant 10000 \text{ or } -10000\leqslant x<3200\end{cases}$$

- Calculation of torque command:

After setting the zero drift, offset and dead zone, it is necessary to set the torque command value corresponding to 10V (10000mV) in the sampling voltage at this time with P03.63, and the actual torque command y6 is as below:

$$y_6=\frac{y_5}{10000}\times(P03.63)$$

This value will be used as the given value of analog torque command in the torque control mode.

The torque command without offset is shown in Figure 4-41 (left) and that with offset is shown in Figure 4-41 (left). After the correct setting is completed, you can check the sampling voltage value of AI1 in real time with P09.22, and also check the input analog torque command value with P09.22.

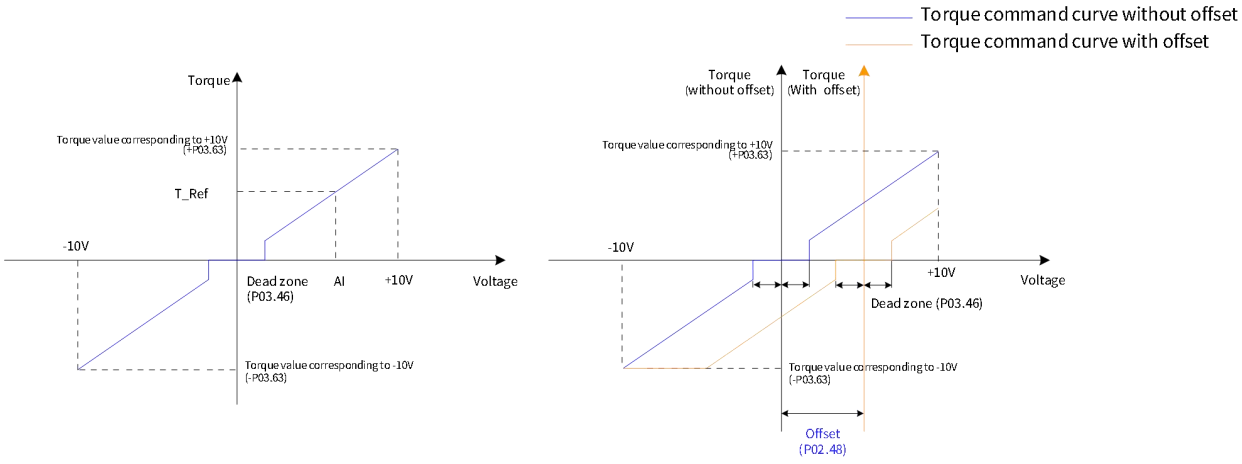


Figure 4-41 Schematic diagram of AI2 without offset (left) & AI2 with offset (right)

The relationship between final torque command value y6 and input voltage x is shown below:

$$y_6 = \begin{cases} 0 & B\text{-}C \leqslant x \leqslant B + C \\ (x\text{-}B) \times \dfrac{P03.63}{10} & B + C < x \leqslant 10000 \text{ or } -10000 \leqslant x < B - C \end{cases}$$

Among them: B: Offset; C: Dead zone.

Function code		Name	Range	Unit	Function	Setting mode	Effective time	Default
P02	48	AI1 offset voltage	-10000 ~ 10000	mV	Set the analog offset value of AI1 channel	In-running setting	Effective immediately	0
P03	44	AI1 input filtering time	0~655.35	ms	Set the mean analog filtering time of AI1 channel	In-running setting	Effective immediately	2.00
P03	46	AI1 dead zone	0~1000.0	mV	Set the analog dead zone value of AI1 channel	In-running setting	Effective immediately	10.0
P03	47	AI1 zero drift	-500.0~500.0	mV	Set the analog zero drift of AI1 channel	In-running setting	Effective immediately	0.0
P03	63	Torque corresponding to the analog 10V	1.00x ~8.00x of rated torque	x	Set the torque value corresponding to the analog 10V	Stop for setting	Effective immediately	1.00
P20	15	AI zero offset correction	0: No operation 1: AI1 adjustment 2: AI2 Adjustment	-	Enable the automatic correction of zero drift of analog AI1 and AI2 channels	Stop for setting	Effective immediately	0

Note:

When the analog AI2 input channel is selected, its setting method is similar to the above-mentioned analog AI1 setting method. For related function codes, please refer to Chapter 7.

b) Torque command source B

The usage of the torque command source B is the same as that of the main torque command source A. For details of parameters, please refer to Chapter 7.

c) A/B switching source

When "A/B switching" is used as the torque command, that is, the function code P15.00=3, it is necessary to assign the DI function FunIN.23 to the corresponding DI terminal, and determine whether the current A command source input or B command source input is effective with the input signal on this DI terminal.

Function code	Name	Description	Remarks
FunIN.23	Running command switching	OFF: The current running command is A; ON: The current running command is B.	-

d) Given by communication

It means that when the function code P15.00 is set to 4, the torque command comes from the set value of the function code P20.54, the function code P20.54 must be modified by communication, and the control panel is invisible.

Function code		Name	Range	Unit	Function	Setting mode	Effective time	Default
P20	54	Torque command given by communication	-100.000~100.000	%	Set the value of torque command given by communication, with an accuracy of 0.001%	In-running setting	Effective immediately	-

(2) Torque command direction setting

The torque command direction switching is realized with the DI terminal, that is, the DI function FunIN.19 is assigned to the corresponding DI terminal, and the current torque command direction is determined with the input signal on this DI terminal, so as to meet the requirements of torque command direction switching.

Function code	Name	Description	Remarks
FunIN.19	Torque command direction switching	Ineffective - The actual torque command direction is the same as the set direction; Effective - The actual torque command direction is reverse to the set direction.	-

The actual motor motion direction is related to motion direction selection (P04.01), torque command direction and torque command direction DI switching (FunIN.19).

Table 4-31 Setting of actual motion direction in the torque control mode

P04.01	Torque command (+/-)	FunIN.19	Actual motion direction
0	+	Ineffective	Counterclockwise
0	+	Effective	Clockwise
0	-	Ineffective	Clockwise
0	-	Effective	Counterclockwise
1	+	Ineffective	Clockwise
1	+	Effective	Counterclockwise
1	-	Ineffective	Counterclockwise
1	-	Effective	Clockwise

4.2.3.2 Torque command filtering

Note:

If the set value of filtering time constant is too large, it will reduce the response performance. Please confirm the response performance when setting it!

In position, speed, torque and mixed control modes, the servo driver can realize low-pass filtering of torque command, so as to make the command smoother and reduce vibration.

The servo driver has two torque command low-pass filters, and the filter 1 is used by default;

When the gain switching function (P06.15=1 and P06.16≠0) is used and the setting conditions of P06.16 are met, the filter 2 can be used.

Function code		Name	Range	Unit	Function	Setting mode	Effective time	Default
P07	02	Torque filtering 1	0~30.00	ms	Set the first set of torque command low-pass filtering time constant	In-running setting	Effective immediately	0.79
P07	03	Torque filtering 2	0~30.00	ms	Set the second set of torque command low-pass filtering time constant	In-running setting	Effective immediately	0.79

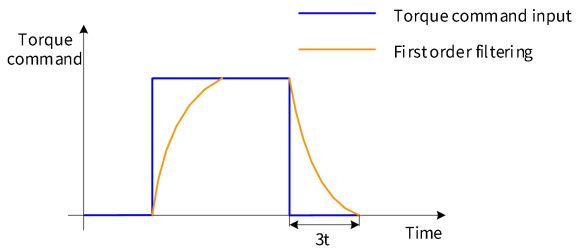


Figure 4-42 Schematic diagram of first-order filtering of rectangular torque command

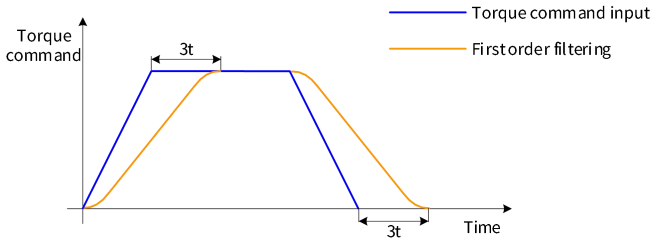


Figure 4-43 Schematic diagram of first-order filtering of ladder torque command

4.2.3.3 Torque command limit

Note:

The torque command limit is effective in position control, speed control, torque control and mixed control modes, and it must be set!

In order to protect the driver and motor, the torque command shall be limited.

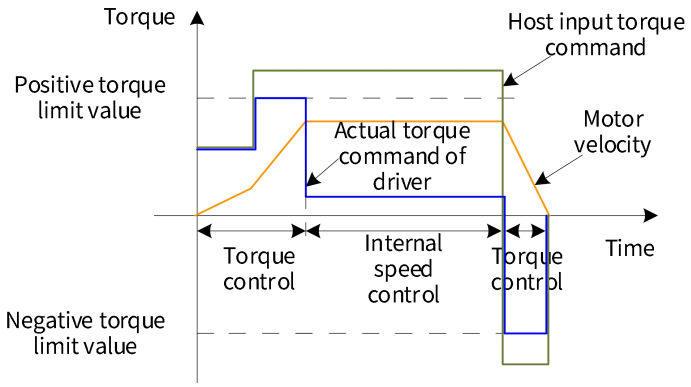


Figure 4-44 Given torque and torque limit

When the absolute value of the torque command input by the upper computer or output by the speed regulator is more than the absolute value of the torque command limit, the torque command of the actual driver will limited to the torque command limit; on the contrary, it shall be equal to the torque command value input by the upper computer or output by the speed regulator. At any time, one and only one torque limit shall be effective. The positive and negative torque limits shall be no more than the maximum torque of the driver and motor and ±300.0% of rated torque.

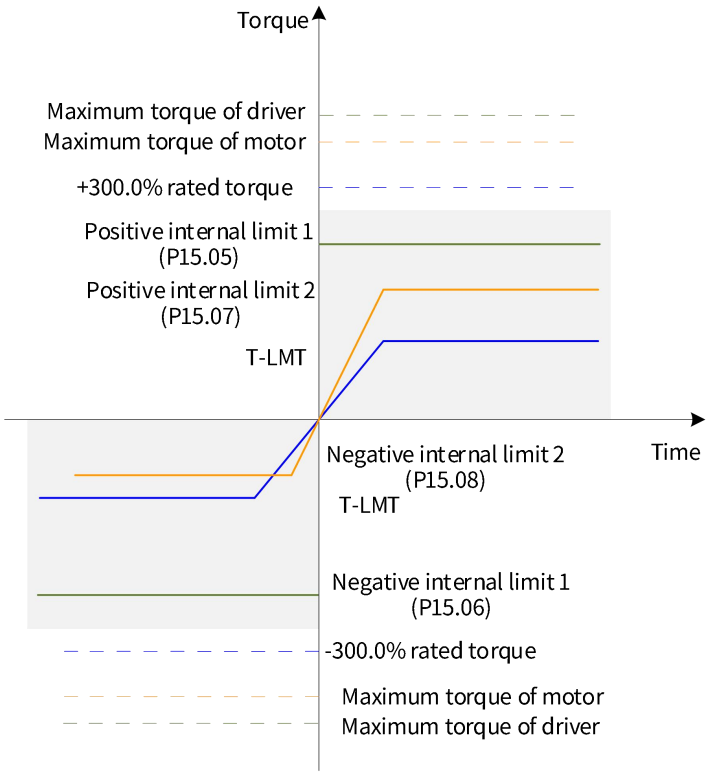


Figure 4-45 Torque limit example

(1) Torque limit source setting

The torque limit source can be set with the function code P15.03. After setting the torque limit, the torque command of the driver will be limited within the torque limit. When the torque limit is reached, the motor will run with the torque limit as the torque command. The torque limit shall be set according to the load running requirements. If the setting is too small, the acceleration and deceleration capacity of the motor may be weakened, and the actual motor speed cannot reach the required value when running with constant torque.

Function code		Name	Range	Unit	Function	Setting mode	Effective time	Default
P15	03	Torque limit source selection	0: Internal torque limit 1 1. External AI limit 2: DI switching between the internal torque limits 1 and 2 3: DI switching between the internal torque limit 1 and the external AI limit 4: Internal torque limit 1 and external AI limit minimum value	-	Select the torque limit source	Stop for setting	Effective immediately	0

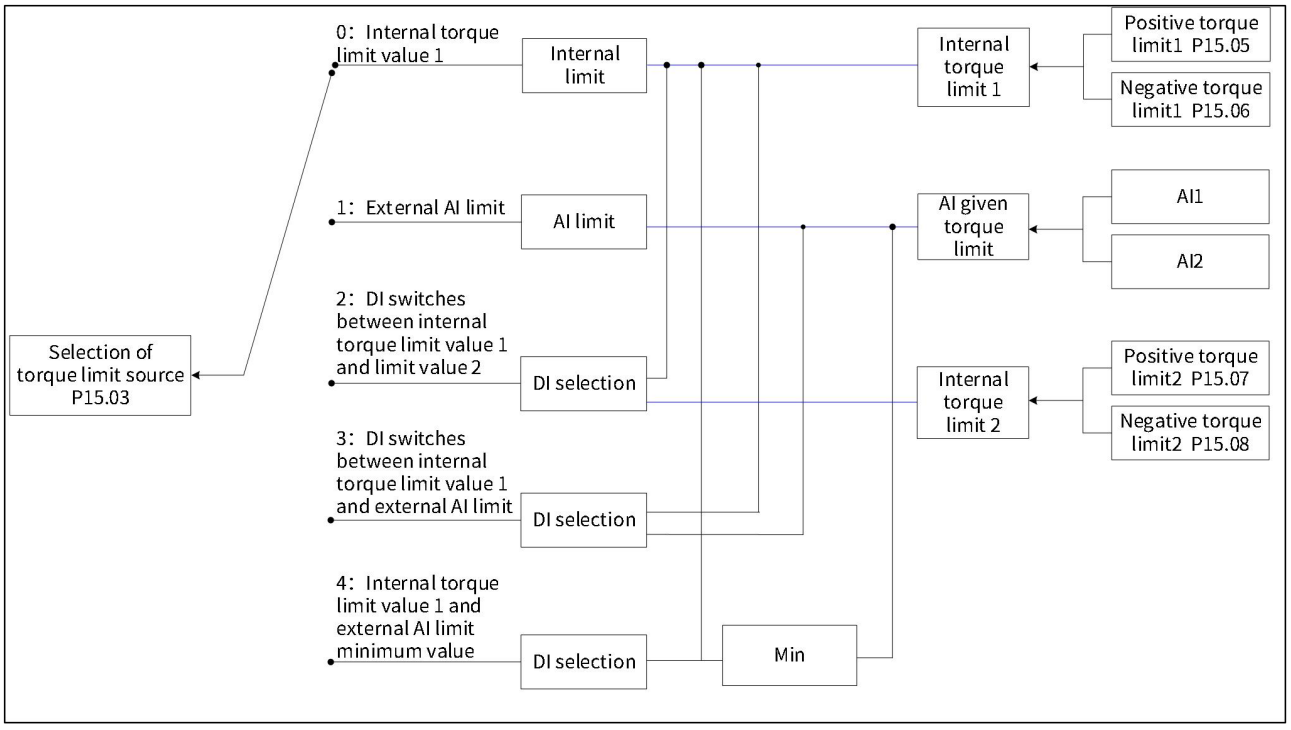


Figure 4-46 Torque limit source

As shown below, in all torque control modes, the absolute value of the torque command input by the upper computer is more than the absolute value of the torque limit.

a) P15.03 = 0: Internal torque limit

The torque command limit is only determined with the internal function codes P15.05 and P15.06.

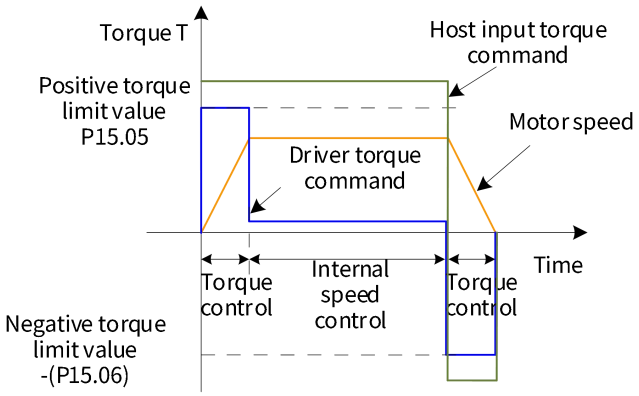


Figure 4-47 P15.03=0 Torque Limit Curve Chart

b) P15.03 = 1: External AI limit

After selecting the external analog channel with P15.04, the torque command limit is determined with the torque value corresponding to the input voltage of AI terminal.

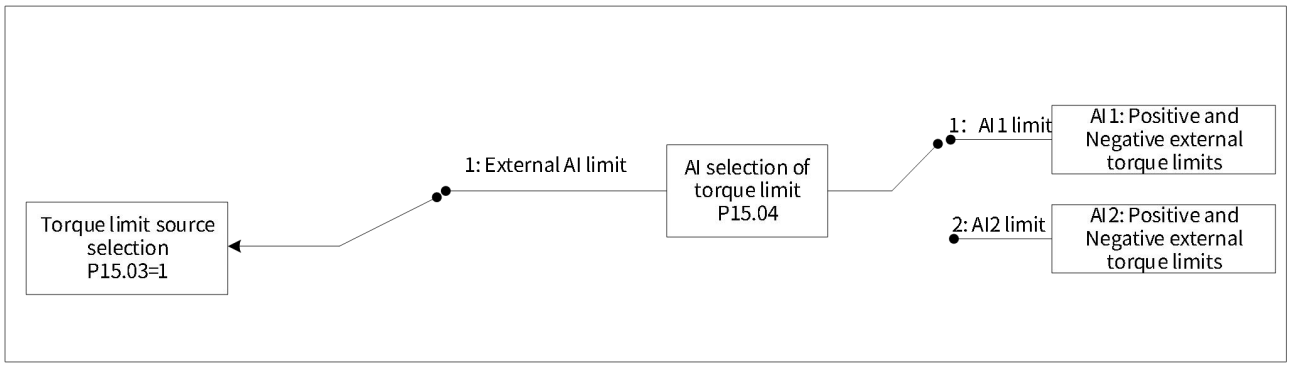


Figure 4-48 P15.03=1 Torque limit source

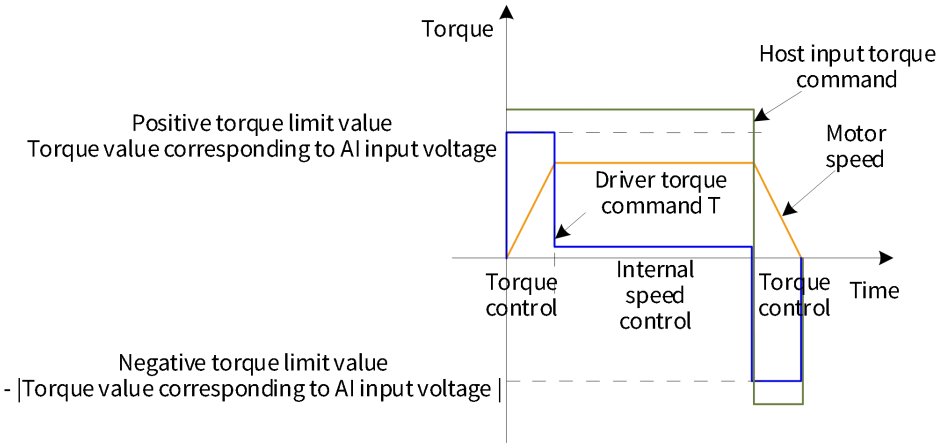


Figure 4-49 P15.03=1 Torque limit curve

For the setting of analog input terminals AI1 and AI2, please refer to Chapter 7; it is used to set the corresponding relationship between torque and analog voltage.

c) P15.03 = 2: DI switching between the internal torque limits 1 and 2

The torque command limit is selected with the logic status of the external DI signal. The positive torque limit is selected between function codes P15.05 and P15.07; the negative torque limit is selected between the function codes P15.06 and P15.08.

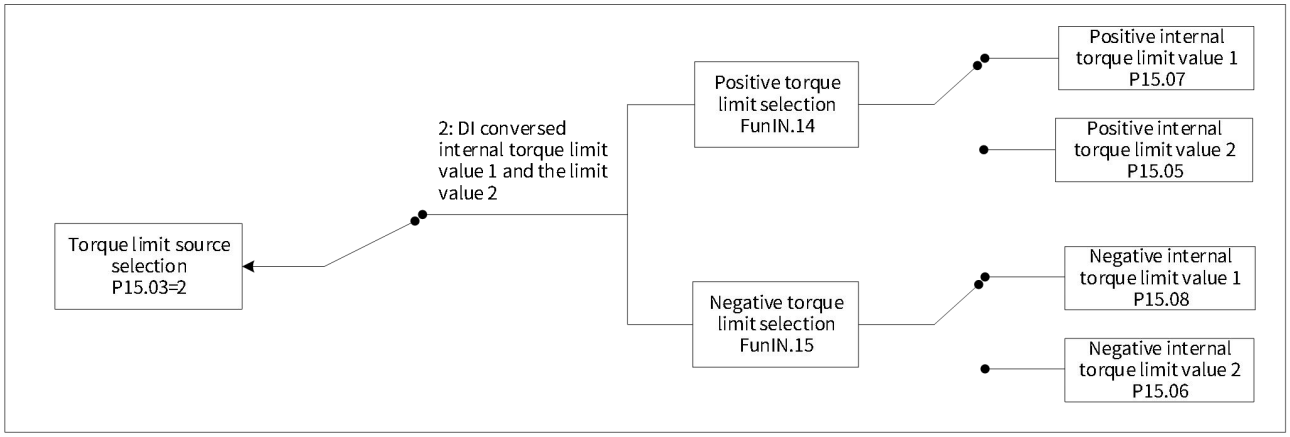


Figure 4-50 P15.03=2 Torque limit source

Table 4-32 Description of P15.03 = 2

DI function status		FunIN.14 Positive torque limit selection	
		OFF	ON
FunIN.15 Negative torque limit selection	OFF	The positive torque limit is set with P15.05; The negative torque limit is set with P15.06.	The positive torque limit is set with P15.07; The negative torque limit is set with P15.06.
	ON	The positive torque limit is set with P15.05; The negative torque limit is set with P15.08.	The positive torque limit is set with P15.07; The negative torque limit is set with P15.08.

At this time, the two DI terminals of the distribution driver shall be assigned to the DI function FunIN.14 (Positive torque limit selection) and FunIN.15 (Negative torque limit selection) respectively, and the logic of the DI terminals shall be determined.

Function code	Name	Description	Remarks
FunOUT.14	Positive torque limit selection	Based on the selection of P15.03, the torque limit source is switched. P15.03=2: Effective - The positive external torque limit is effective; Ineffective – The positive internal torque limit is effective. P15.03=3 and the AI limit is more than the positive external limit: Effective – The positive external torque limit is effective; Ineffective – The AI torque limit is effective. P15.03=4: Effective – The AI torque limit is effective; Ineffective – The positive internal torque limit is effective.	-

Function code	Name	Description	Remarks
FunIN.15	Negative torque limit selection	Based on the selection of P15.03, the torque limit source is switched. P15.03=2: Effective – The negative external torque limit is effective; Ineffective – The negative internal torque limit is effective. P15.03=3 and the AI limit is less than the inversion external limit: Effective – The negative external torque limit is effective; Ineffective – The AI torque limit is effective. P15.03=4: Effective – The AI torque limit is effective; Ineffective – The negative internal torque limit is effective.	-

d) P15.03 = 3: DI switching between the internal torque limit 1 and the external AI limit

Positive torque limit: After selecting the external analog channel with P15.04:

When the logic of the external DI signal (FunIN.14) is ineffective, the positive torque limit will be determined with the function code P15.05;

When the logic of the external DI signal (FunIN.14) is effective, the positive torque limit will be determined with the torque value corresponding to the input voltage of the AI terminal.

Negative torque limit: After selecting the external analog channel with P15.04:

When the logic of the external DI signal FunIN.15) is ineffective, the negative torque limit will be determined with the function code P15.06;

When the logic of the external DI signal (FunIN.15) is effective, the negative torque limit will be determined with the torque value corresponding to the input voltage of AI terminal.

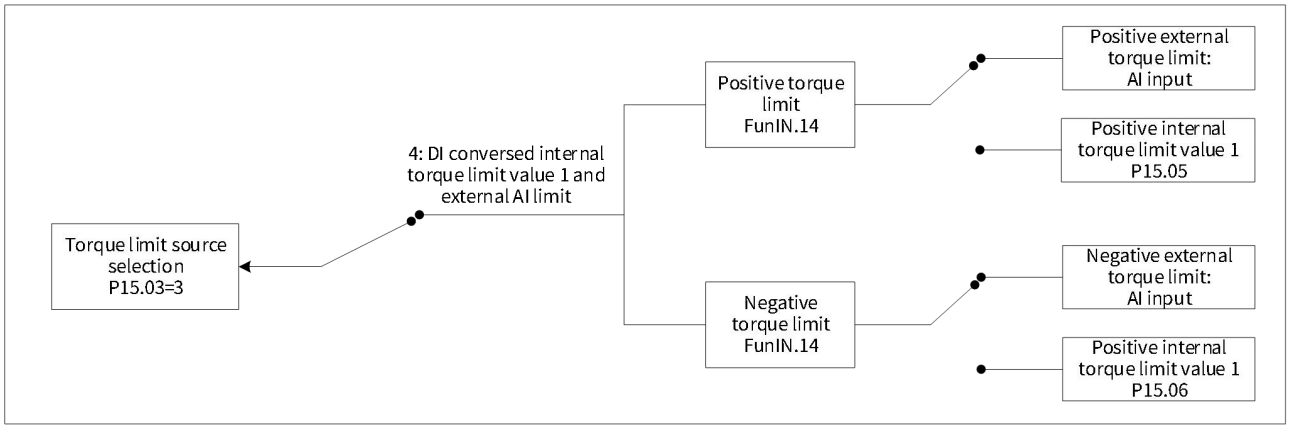


Figure 4-51 P15.03=3 Torque limit source

Table 4-33 Description of P15.03 = 3

DI function status		FunIN.14 Positive torque limit selection	
		OFF	ON
FunIN.15 Negative torque limit selection	OFF	The positive torque limit is set with P15.05; The negative torque limit is set with P15.06.	The positive torque limit is set with the torque value corresponding to the AI input; The negative torque limit is set with P15.06.
	ON	The positive torque limit is set with P15.05; The negative torque limit is set with the torque value corresponding to the AI input.	The positive torque limit is set with the torque value corresponding to the AI input; The negative torque limit is set with the torque value corresponding to the AI input.

Function code		Name	Range	Unit	Function	Setting mode	Effective time	Default
P15	04	Torque limit AI selection	1: AI1 limit 2: AI2 limit	-	Select the analog input channel of torque limit signal	Stop for setting	Effective immediately	1

Function code		Name	Range	Unit	Function	Setting mode	Effective time	Default
P15	05	Positive internal torque limit 1	0~300.0	%	Set the positive and negative internal torque limits (100% corresponds to 1 times the rated torque)	In-running setting	Effective immediately	300.0
P15	06	Negative internal torque limit 1	0~300.0	%		In-running setting	Effective immediately	300.0
P15	07	Positive internal torque limit 2	0~300.0	%	Set the positive and negative external torque limits (100% corresponds to 1 times the rated torque)	In-running setting	Effective immediately	300.0
P15	08	Negative internal torque limit 2	0~300.0	%		In-running setting	Effective immediately	300.0

e) P15.03 = 4: Internal torque limit 1 and external AI limit minimum value

Positive torque limit: After selecting the external analog channel with P15.04:

When the logic of the external DI signal (FunIN.14) is ineffective, the positive torque limit will be determined with the torque value corresponding to the input voltage of external AI terminal;

When the logic of the external DI signal (FunIN.14) is effective, the positive torque limit will be determined with the smaller of the torque values corresponding to the function code P15.07 and the input voltage of the AI terminal.

Negative torque limit: After selecting the external analog channel with P15.08:

When the logic of the external DI signal (FunIN.15) is ineffective, the negative torque limit will be determined with the torque value corresponding to the input voltage of external AI terminal;

When the logic of the external DI signal (FunIN.15) is effective, the negative torque limit will be determined with the smaller of the torque values corresponding to the function code P15.08 and the input voltage of the AI terminal.

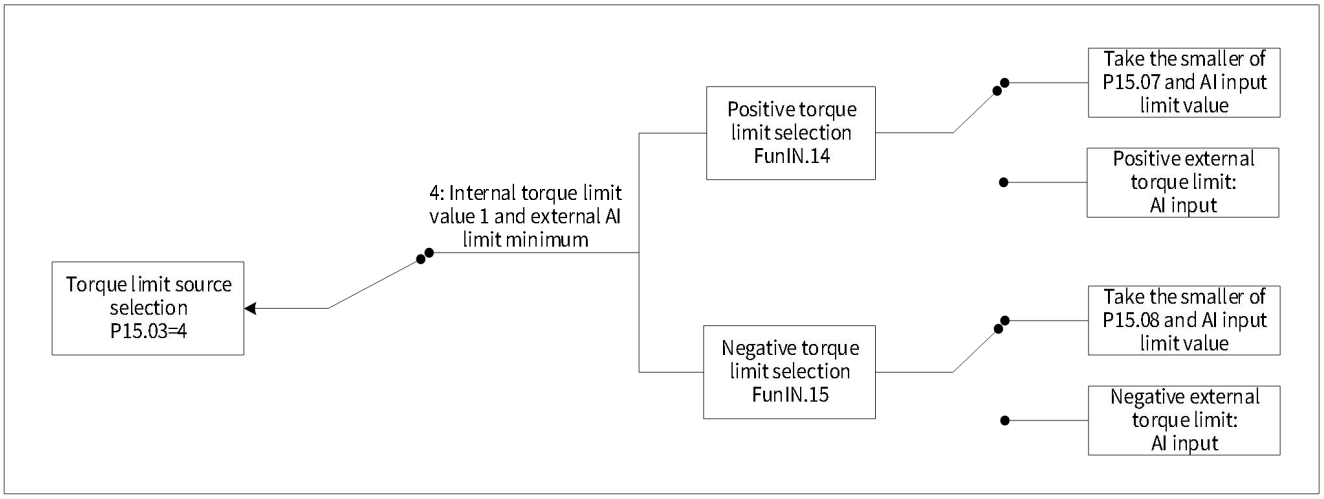


Figure 4-52 P15.03=4 Torque limit source

Table 4-34 Description of P15.03 = 4

DI function status		FunIN.14 Positive torque limit selection	
		OFF	ON
FunIN.15 Negative torque limit selection	OFF	The positive torque limit is set with the torque value corresponding to the AI input; The negative torque limit is set with the torque value corresponding to the AI input.	The positive torque limit is set with the smaller of the torque value corresponding to the AI input and P15.07; The negative torque limit is set with the torque value corresponding to the AI input.
	ON	The positive torque limit is set with the torque value corresponding to the AI input; The negative torque limit is set with the smaller of the torque value corresponding to the AI input and P15.08.	The positive torque limit is set with the smaller of the torque value corresponding to the AI input and P15.07; The negative torque limit is set with the smaller of the torque value corresponding to the AI input and P15.08.

(2) Setting of the torque limit DO output signal

When the torque command reaches the torque limit, the driver will output the torque limit signal (FunOUT.12: torque limit) for the upper computer. At this time, 1 DO terminal of the driver shall be assigned to the DO function FunOUT.12, and the logic of DO terminal shall be determined.

Function code	Name	Description	Remarks
FunOUT.12	Torque limit	Effective - The driver torque command reaches the torque limit and is limited to the limit; Ineffective - The driver torque command dose not reach the limit.	

4.2.3.4 Speed limit in the torque control mode

In the torque control mode, if the given torque command is more than the load torque on the mechanical side, the motor will be accelerated continuously, and overspeed may occur, which may damage the mechanical equipment. Therefore, in order to protect the mechanical equipment, it is necessary to limit the motor speed.

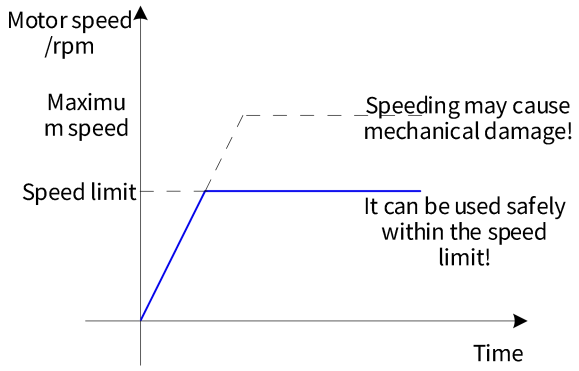


Figure 4-53 Schematic diagram of speed limit in the torque control mode

(1) Setting of the speed limit source

In the torque control mode, the speed limit source selection can be set with the function code. After setting the speed limit, the actual motor speed will be limited within the speed limit. After reaching the speed limit, the motor will run at the speed limit. The speed limit shall be set according to the load running requirements.

Function code		Name	Range	Unit	Function	Setting mode	Effective time	Default
P15	09	Speed limit source selection in the torque control mode	0: Internal speed limit 1: DI selected speed limit 2: External AI speed limit	-	Select the speed limit source in the torque control mode	Effective immediately	In-running setting	0

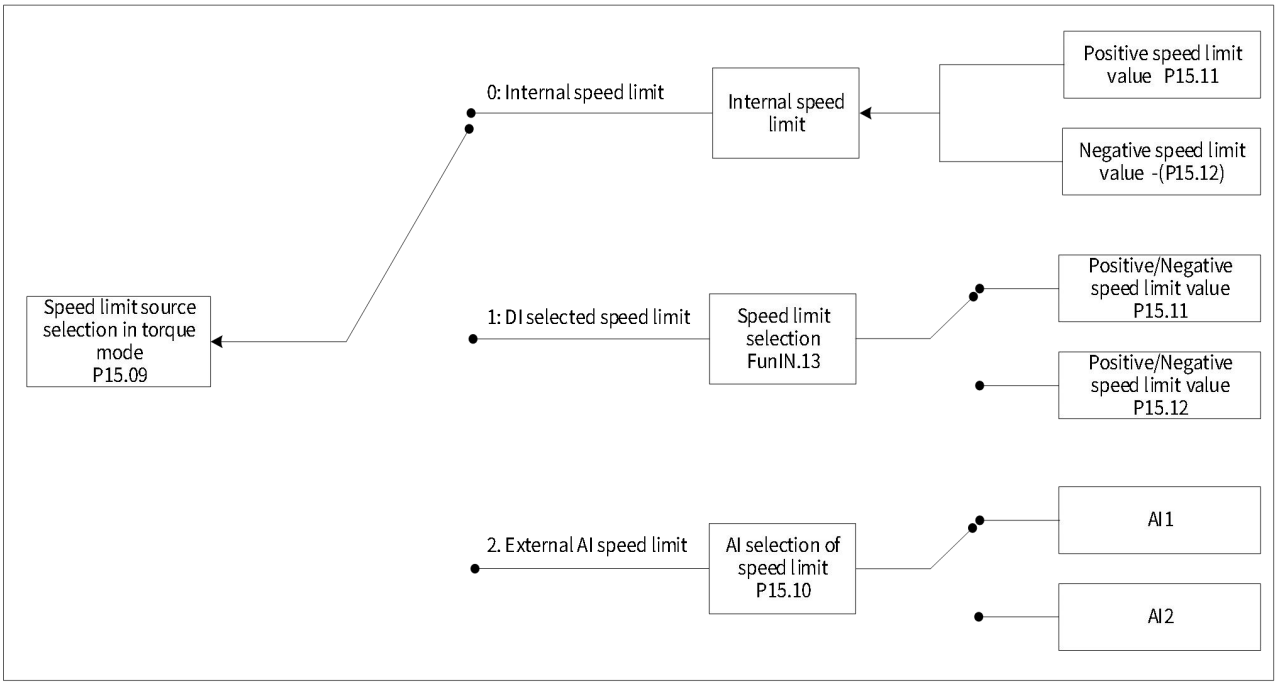


Figure 4-54 Speed limit source

a) P15.09=0: Internal speed limit

When the motor is rotated in different directions, the speed will be only determined with the internal function codes P15.11 and P15.12.

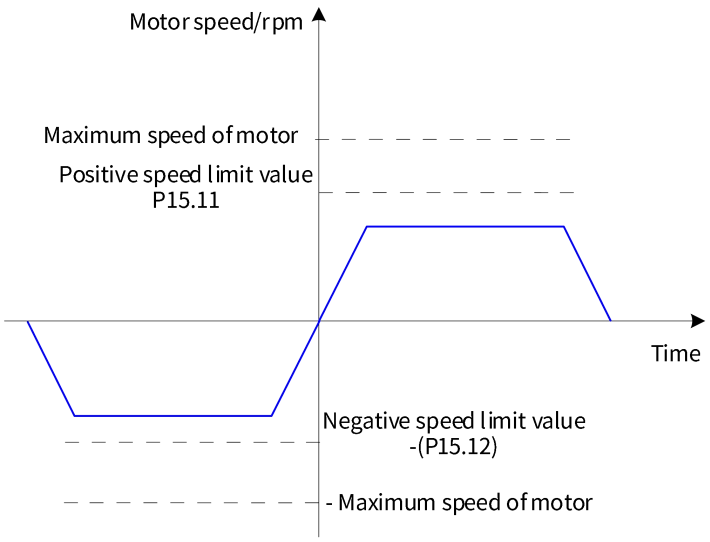


Figure 4-55 P15.09=0 Speed limit curve

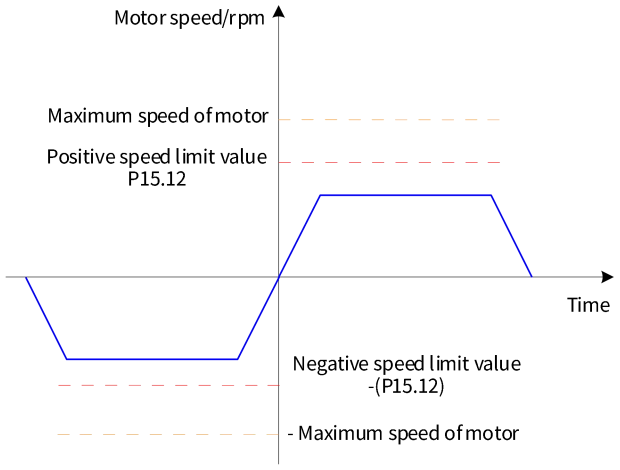
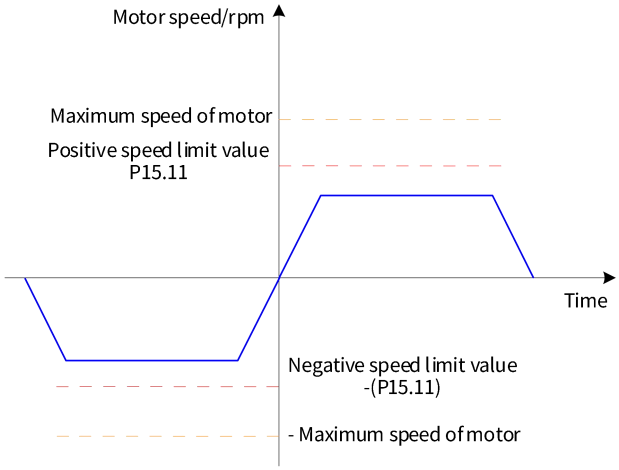
b) P15.09=1: DI selected speed limit

The servo driver selects P15.11 or P15.12 as the positive/negative speed limit based on the logic of the actual DI terminal.

At this time, a DI logic of the servo driver shall be assigned to the DI function FunIN.13 (speed limit selection) and the logic of the DI terminal logic be assigned.

Function code	Name	Description	Remarks
FunIN.13	Speed limit selection	Ineffective - P15.11 is used as the positive/negative internal speed limit; Effective - P15.12 as the positive/negative internal speed limit.	-

Table 4-35 Speed limit description

FunIN.13 Speed limit selection	
OFF	**ON**
	
When FunIN.13 is ineffective, the speed limit will be set with P15.12.	When FunIN.13 is effective, the speed limit will be set with P15.11.

Function code		Name	Range	Unit	Function	Setting mode	Effective time	Default
P15	10	Speed limit AI selection	1：AI1 2：AI2	-	Select the analog channel when AI is used as the speed limit source	Effective immediately	In-running setting	1
P15	11	Positive internal speed limit in the torque control mode	0~6000	rpm	Set the positive speed limit /speed limit 1 in torque control mode	Effective immediately	In-running setting	3000
P15	12	Negative internal speed limit in the torque control mode	0~6000	rpm	Set the negative speed limit /speed limit 2 in the torque control mode	Effective immediately	In-running setting	3000

c) P15.09=2: External AI speed limit

When the motor is rotated in different directions, the voltage corresponding to the speed limit will be input through the external analog channel specified by P15.10. When the AI input is less than the internal speed limit (P15.11/P15.12), the AI limit will be effective; when the AI input is more than the internal speed limit (P15.11/P15.12), the internal speed limit will be effective.

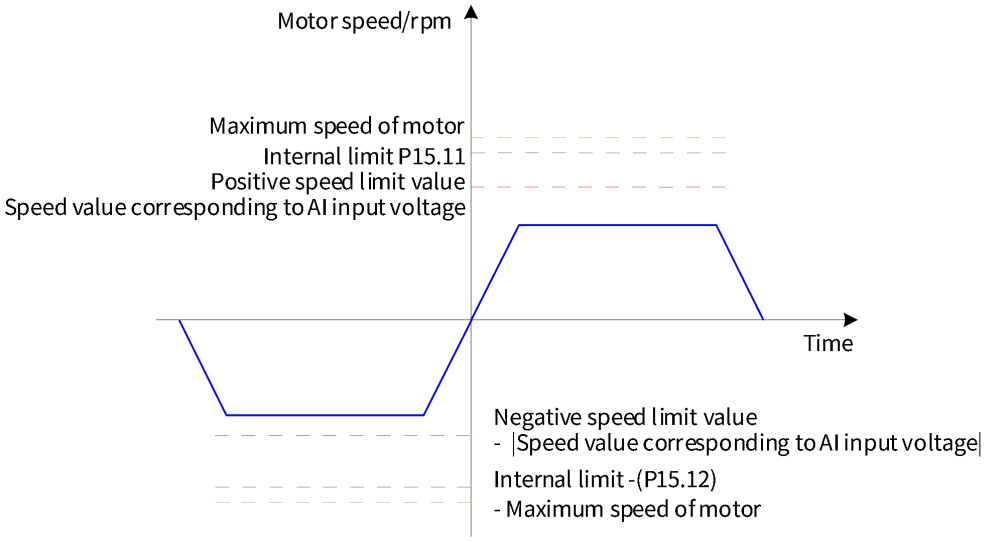


Figure 4-56 P15.09=2 Speed limit curve

(2) Setting of the speed limit DO output signal

In the torque control mode, when the absolute value of the actual speed of the servo motor exceeds the speed limit and the time reaches P15.24, it is considered that the actual speed of the servo motor is limited. At this time, the servo driver can output the speed limit (FunOUT.13: speed limit) signal for the upper computer. If any condition is not met, the speed limit signal will be ineffective.

The speed limit (FunOUT.13: speed limit) signal shall be judged only in the torque control mode and implemented in servo running status.

1 DO terminal of the servo driver shall be assigned to the DO function FunOUT.13, and the logic of the DO terminal shall be set.

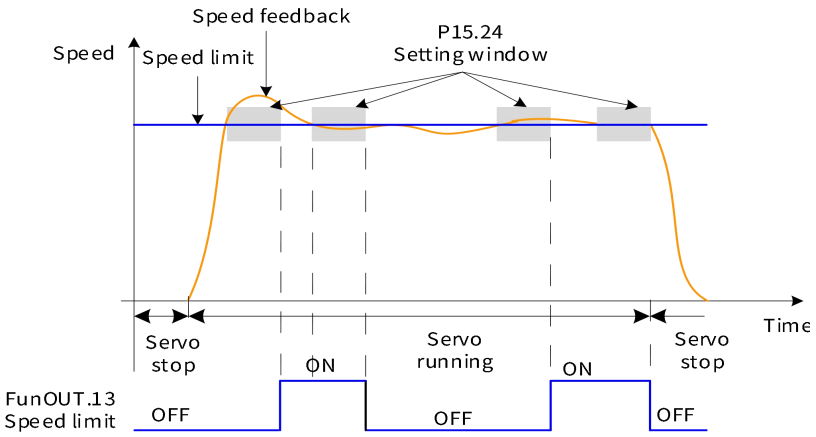


Figure 4-57 Speed limit DO output waveform example

Function code	Name	Description	Remarks
FunOUT.13	Speed limit selection	Effective – The motor speed is limited; Ineffective – The motor speed is not limited.	

4.2.3.5 Torque reaching output

The torque reaching function is used to judge whether the actual torque command reaches the set interval. When the actual torque command reaches the torque command threshold, the driver can output the corresponding DO signal (FunOUT.9: torque reaching) for the upper computer.

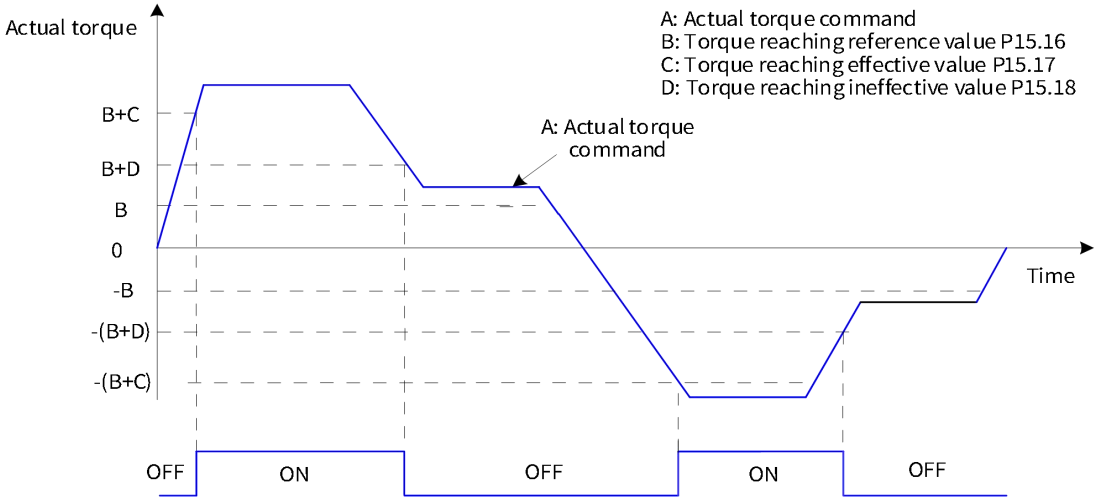


Figure 4-58 Torque reaching output waveform example

Actual torque command (viewed through P09.02): A;

Torque reaching reference value P15.16: B;

Torque reaching effective value P15.17: C;

Torque reaching ineffective value P15.18: D;

Where, c and d are offsets based on B.

Therefore, when the torque reaching DO signal changes from ineffective to effective, the actual torque command must meet the following requirements:

$|A| \geqslant B + C$

Otherwise, the torque reaching DO signal shall be ineffective.

When the torque reaching DO signal changes from effective to ineffective, the actual torque command must meet the following requirements:

$|A| < B + D$

Otherwise, the torque reaching DO signal shall be effective.

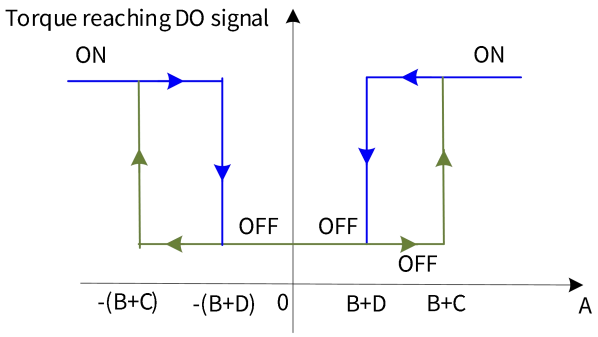


Figure 4-59 Effective torque reaching output description

Function code		Name	Range	Unit	Function	Setting mode	Effective time	Default
P15	16	Torque reaching reference value	0~300.0	%	Set the torque reaching command reference value. (100% corresponds to 1 times the rated torque)	In-running setting	Effective immediately	0
P15	17	Torque reaching effective value	0~300.0	%	Set the torque reaching effective offset threshold (100% corresponds to 1 times the rated torque)	In-running setting	Effective immediately	20.0
P15	18	Torque reaching ineffective value	0~300.0	%	Set the torque reaching ineffective offset threshold (100% corresponds to 1 times the rated torque)	In-running setting	Effective immediately	10.0

When the torque reaching DO signal is used, 1 DO terminal of the servo driver shall be assigned to DO function 9 (FunOUT.9: torque reaching), and the logic of the DO terminal shall be determined.

Function code	Name	Description	Remarks
FunOUT.9	Speed limit selection	Effective - The absolute value of torque command reaches the set value; Ineffective – The absolute value of torque command is less than the set value.	-

4.3 Application function

4.3.1 Soft limit

Traditional hardware limit function: In the traditional way, the limit position can only be given by external signals, and the external sensor signals are connected to the CN3 port of the servo driver.

Soft limit function: It refers to comparing the internal position feedback of the driver with the set limit, and immediately giving an alarm and performing stop when the limit is exceeded. This function can be used in both absolute position mode and incremental position mode. In the incremental position mode, P05.43=2 shall be set. After the drive is powered on, the origin will be reset to find the machine origin, and then the soft limit function will be enabled.

4.3.1.1 Comparison of advantages and disadvantages of traditional hardware limit and soft limit functions

<table>
<tr><th colspan="2">Traditional hardware limit function</th><th colspan="2">Soft limit function</th></tr>
<tr><td>1</td><td>It can only be limited to linear motion and single-turn rotation motion</td><td>1</td><td>It can be used not only in linear motion but also in rotation mode</td></tr>
<tr><td>2</td><td>The mechanical limit switch needs to be installed externally</td><td>2</td><td>No hardware wiring is needed to prevent misoperation caused by poor wire contact</td></tr>
<tr><td>3</td><td>It is impossible to judge the abnormal mechanical slip</td><td rowspan="2">3</td><td rowspan="2">The internal positions can be compared to prevent the abnormal action caused by mechanical slip</td></tr>
<tr><td>4</td><td>When the power is cut off, if the machine moves out of the limit, it is impossible to judge and give an alarm</td></tr>
</table>

4.3.1.2 Soft limit related function codes

Function code	Name	Range	Unit	Function	Setting mode	Effective time	Default
P05.43	Soft limit setting	0: Unlimited. 1. Limited 2. Limited after homing	1	Select the soft limit function	Stop for setting	Effective immediately	0
P13.63	Software limit of forward position	-2147483648~ 2147483647	Command unit	Set the forward position limit of software	Stop for setting	Effective immediately	2147483647
P13.65	Software limit of reverse position	-2147483648~ 2147483647	Command unit	Set the reverse position limit of software	Stop for setting	Effective immediately	-2147483648

In case of P05.43=0, the soft limit function is not enabled;

In case of P05.43=1, the soft limit function is enabled immediately after the driver is powered on. When the position feedback counter (P09.34) is more than P13.63, A.220 warning will be given, and the forward overstroke stop will be executed; when the position feedback counter (P09.34) is less than P13.65, A.221 warning will be given, and the reverse overstroke stop will be executed;

In case of P05.43=2, the soft limit is not enabled before homing after the driver is powered on. When the position feedback counter (P09.34) is more than P13.63 after homing, A.220 warning will be given, and the forward overstroke stop will be executed; when the position feedback counter (P09.34) is less than P13.65 after homing, A.221 warning will occur and the reverse overstroke stop will be executed.

In case of P13.63< P13.65, the two values will be exchanged.

4.3.2 Frequency division output

Note:

The frequency division output function cannot be used in the full closed-loop control mode. At this time, the frequency division output terminal is used as the input terminal of the external grating scale signal.

It is recommended to use the effective change edge of the index pulse output in high-precision index pulse frequency division output cases:

①P05.22=0 - The effective changing edge is the negative edge;

②P05.22=1 - The effective changing edge is the positive edge.

The frequency division output function of servo driver refers to the output of position command pulse or position pulse fed back by encoder in the A/B phase orthogonal pulse form.

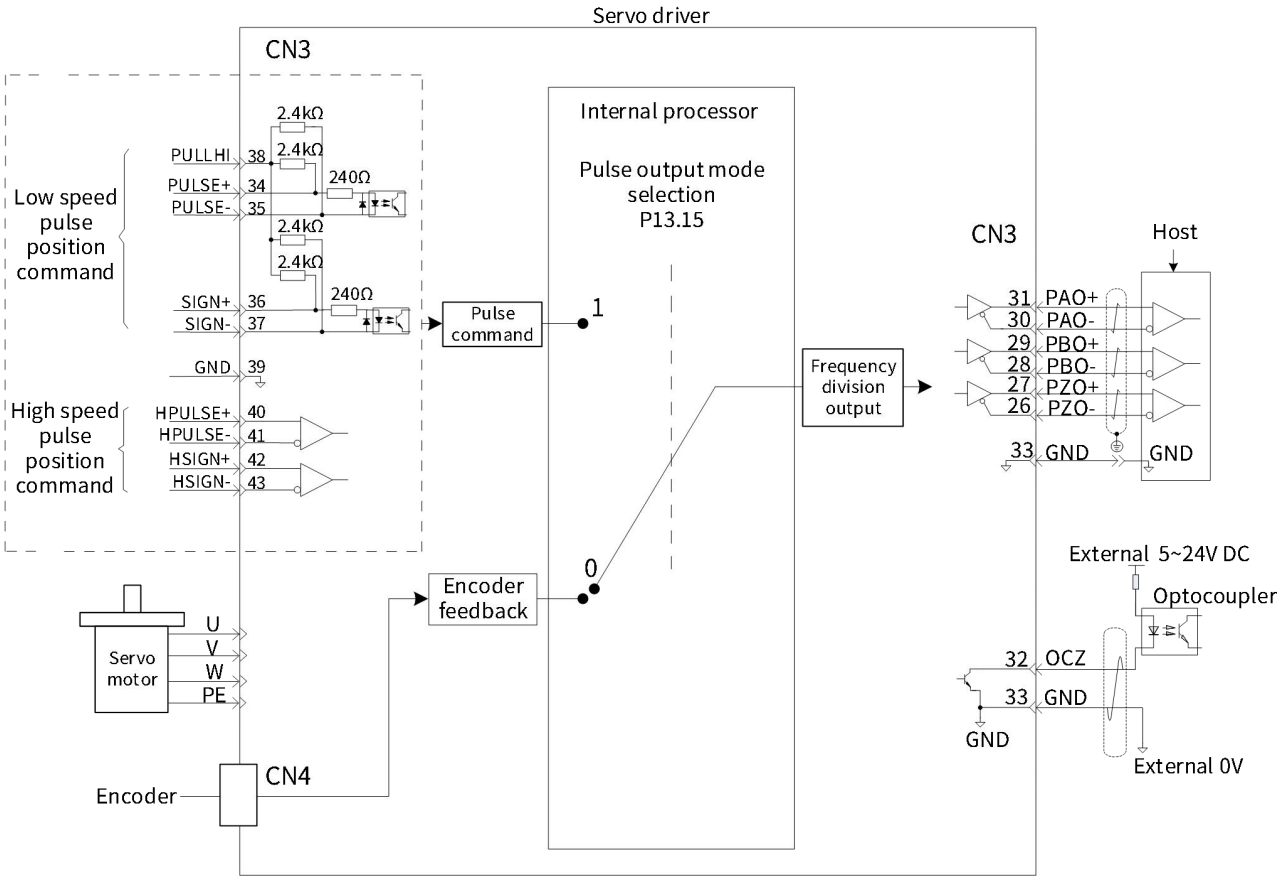


Figure 4-60 Schematic diagram of frequency division output principle

When multi-axis servo pulses are tracked synchronously, it is suggested to use the synchronous output mode of pulse commands, that is, P13.15 = 1; when the upper computer is used as closed-loop feedback, it is suggested to use the encoder frequency division output mode, that is, P13.15 = 0;

The servo driver has 1 set of frequency division output terminals:

Phase A pulse: PAO+, PAO-, differential output, with the maximum output pulse frequency of 4Mpps;

Phase B pulse: PBO+, PBO-, differential output, with the maximum output pulse frequency of 4Mpps.

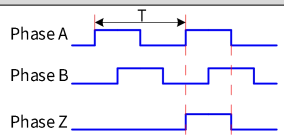
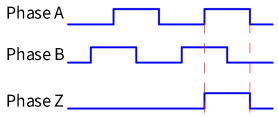
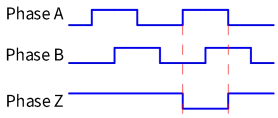
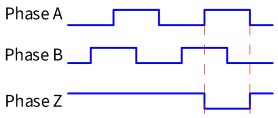
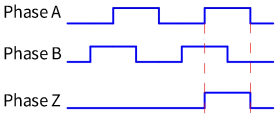
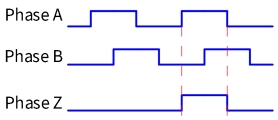
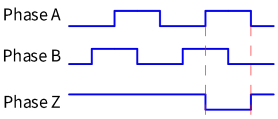
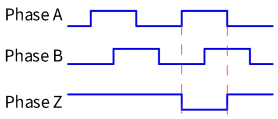
Phase Z pulse: PZO+, PZO-, differential output, with the maximum output pulse frequency of 4Mpps.

When the frequency division output function is used, the pulse output mode (P13.15), frequency division

output phase (P05.23), encoder frequency division pulse number (P13.16) and index pulse output polarity (P05.22) shall be set respectively as required.

When the output source is frequency division output of encoder (P13.15=0), the motor will be rotated for one turn, and the number of A/B phase output pulses is determined with P13.16; The pulse width of Phases A/B is determined with the motor speed, Phase Z is synchronized with Phase A, and the width is t. The index pulse will be output once every rotation of the motor.

Table 4-36 Schematic diagram of encoder frequency division output (P13.15=0) pulses

P05.23 (Frequency division output phase)	P05.22 (Pulse Z output polarity)	Pulse output schematic diagram of forward rotation	Pulse output schematic diagram of reverse rotation
0	0	 Phase A is 90° ahead of Phase B	 Phase B is 90° ahead of Phase A
	1	 Phase A is 90° ahead of Phase B	 Phase B is 90° ahead of Phase A
1	0	 Phase B is 90° ahead of Phase A	 Phase A is 90° ahead of Phase B
	1	 Phase B is 90° ahead of Phase A	 Phase A is 90° ahead of Phase B

Function code		Name	Range	Unit	Function	Setting mode	Effective time	Default
P05	23	Frequency division output phase	0: Phase A is ahead of Phase B. 1: Phase B is ahead of Phase A	-	Set the phase relationship between the Phase A pulse and the Phase B pulse of the pulse output	Stop for setting	Power on again	0
P13	15	Servo pulse output mode selection	0: Encoder frequency division output. 1. Synchronous output of pulse commands 2: Frequency division or synchronous output prohibited	-	Select the servo pulse output mode	Stop for setting	Power on again	0

P13	16	Number of frequency division pulses of the encoder	35~1073741824	p/r	Set the resolution of the output pulses, which is equal to the number of output pulses of PAO/PBO (before 4x multiplication) per rotation of the motor	Stop for setting	Power on again	2500
P05	22	Index pulse output polarity	0: Output the high level if it is effective 1: Output the low level if it is effective	-	Set the output level when Phase Z pulse is effective	Stop for setting	Power on again	1

Chapter 5 Gain Adjustment

5.1 Purpose

In order to enable the servo system to quickly and accurately track instructions from the upper computer or internal settings, fully utilize mechanical performance, improve production cycle and efficiency, it is necessary to adjust the gain of the servo control loop reasonably.

Taking common screw loads as an example, such as figure 5-1. As shown, by reasonably increasing the gain related to the speed loop and position loop, ensuring gain matching, and combining with the speed feedforward function, the trajectory tracking effect can be greatly improved.

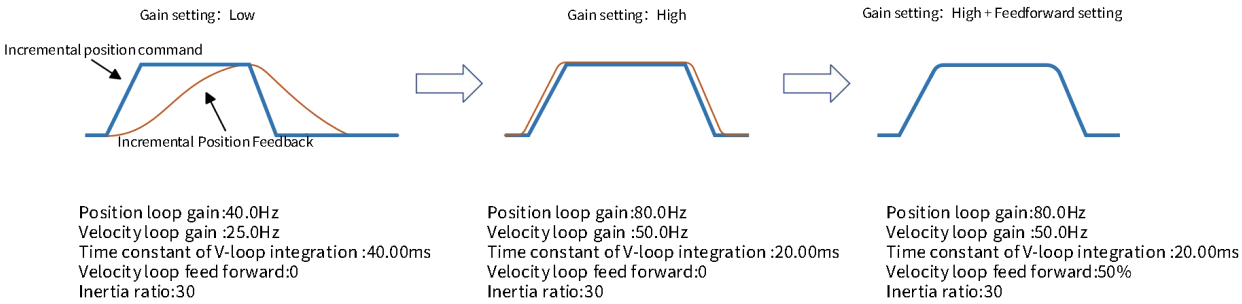


Figure 5-1 Example of gain setting

The basic gain parameters of the servo loop include the proportional coefficient K_p of the position loop, the gain coefficient K_v of the velocity loop, the integral coefficient K_i of the velocity loop, the low-pass filtering coefficient τ_m of the torque, the inertia ratio J_r of the load, etc. They affect each other, and generally need to ensure that the inner loop bandwidth is higher than the outer loop bandwidth to ensure the stability of the entire system. By setting these parameters in a reasonable combination, the servo system can achieve ideal control effects in both tracking and disturbance rejection dimensions. Therefore, in order to achieve the maximum performance of the servo, the setting of the gain must take into account the balance between the set values of various parameters, which poses high capability requirements for on-site debugging personnel. The SV3 series high-performance servo supports two modes: manual parameter tuning and automatic parameter adjustment. In general application scenarios, such as 3C, lithium battery, TP and other industries, using the automatic adjustment function can meet the needs; In trajectory application scenarios that pursue ultimate performance, such as semiconductor, machine tool, laser and other industries, detailed settings of servo system parameters are required to achieve ideal results; For P2P point application scenarios that require high speed and high precision, such as high-speed glue dispensing machines, solidification machines, and sorting machines, the SV3 series servo provides gain switching function, which can achieve ultimate tracking performance through reasonable gain settings.

Before adjusting the gain, it is necessary to perform the trial operation in Chapter 3 to confirm that the motor can operate normally without interference!

5.2 Tuning Method

The general process of gain adjustment is shown in the following figure:

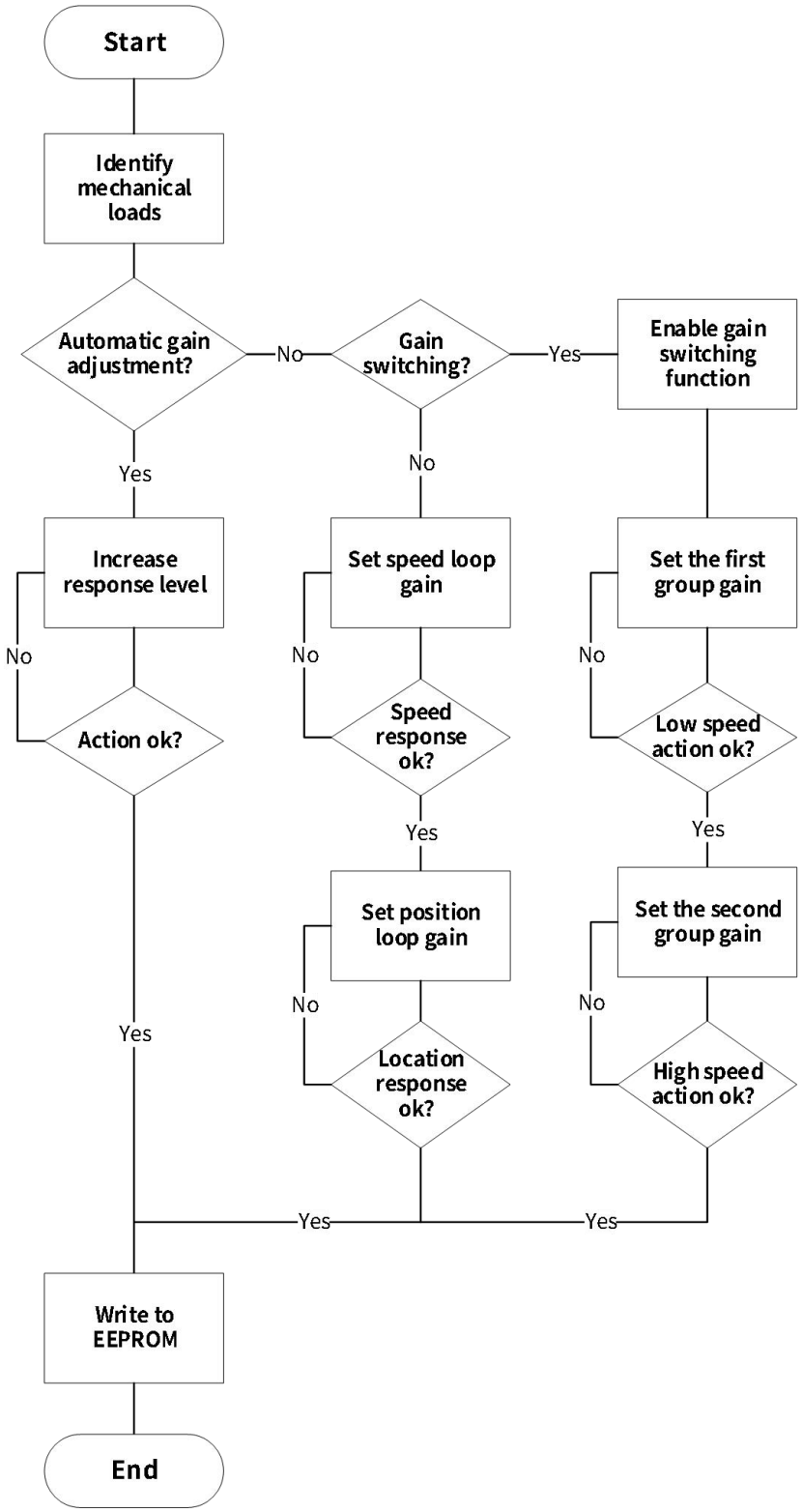


Figure 5-2 Gain Adjustment Process

The SV3 series servo provides three gain adjustment modes, namely "automatic gain adjustment", "manual gain adjustment", and "gain automatic switching". Among them,

- The "automatic gain adjustment" method only requires setting one parameter, P1A group - "response level setting", to achieve the linkage setting of multiple internal gain parameters and achieve the desired response action. The higher the response level, the faster the response; For detailed introduction, please refer to section 5.2.4 Automatic gain adjustment.
- Manual gain adjustment "requires the user to turn off the automatic gain adjustment mode P1A group -" Real time Self adjustment Setting "set to" 0-off ", and sequentially set P06 gain parameters, including speed loop and position loop gain parameters, from the inner loop to the outer loop, to achieve the desired response performance;
- Manual gain adjustment "requires the user to turn off the automatic gain adjustment mode P1A group -" Real time Self adjustment Setting "set to" 0-off ", and sequentially set P06 gain parameters, including speed loop and position loop gain parameters, from the inner loop to the outer loop, to achieve the desired response performance;

To achieve good tracking performance, the prerequisite for the above three gain adjustment methods is to execute a rigorous "mechanical load recognition" program. The SV3 series servo has a built-in mechanical load recognition algorithm, which can automatically identify the mechanical load situation through forward and reverse operation. The following will introduce the contents of mechanical load recognition, manual gain adjustment, automatic gain adjustment, and gain switching in sequence.

5.2.1 Mechanical load identification

For servo systems, mechanical loads are the controlled objects and important components of the system; Mechanical load identification includes parts such as load inertia, friction force, and load mechanical resonance point. Servo can automatically identify key mechanical characteristics, set control loop parameters and compensation parameters reasonably, and achieve dynamic response performance that meets application requirements, greatly reducing the tuning pressure of on-site debugging personnel.

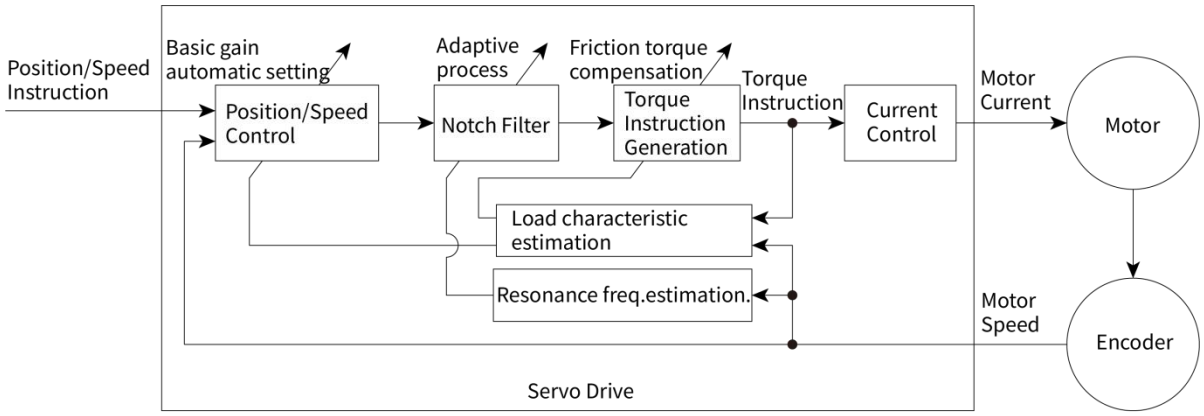


Figure 5-3 Mechanical Load Identification

Usually, we do not pay much attention to the absolute value of mechanical load inertia, but rather focus more on the relative size of load inertia and motor inertia, so it usually appears in the form of "inertia ratio" in the control loop.

Load inertia ratio' refers to:

$$\text{Load inertia ratio} = \frac{\text{Mechanical load inertia}}{\text{Motor rotor inertia}}$$

Load inertia ratio is a key parameter in the servo system, and the proper setting can help to reduce the debugging time.

The servo drive has a built-in load inertia identification function, which can automatically identify the load inertia by this algorithm.

Inertia identification automatic recognition method:

By the buttons on the servo drive panel, make the motor move, so as to realize inertia identification without the intervention of upper computer;

⚠ Note:

Under the following conditions, it migt be impossible to perform mechanical load identification normally. In this case, please adjust the gain manually.

Table 5-1 Factors of Mechanical Load Identification

	Factors of mechanical load identification
Load inertia	Inertia mismatch, load inertia ratio greater than 100 times Load inertia is unstable, time-varying or slowly changing
Mechanical properties	Extremely low mechanical rigidity, for example, in belt transmission mechanism where the belt is not tensioned. Nonlinear factors such as excessive tooth clearance in operation or excessive backlash in positive/negative rotation, e.g., misaligned gear installation in gear transmission mechanism
Movement	Movement speed less than 150rpm

conditions	When the torque for acceleration/deceleration is less than the offset load torque or less than the viscous friction torque When the acceleration is less than 3,000rpm/s

If the actual load inertia ratio is too large, that causes the motor to run slowly, then increase P1A group - "Response Level Setting" and re-identify the inertia.

If vibration occurs in the identification process, the inertia identification should be stopped immediately and P1A group - "Response Level Setting" should be reduced.

Before conducting offline inertia identification, first confirm the following:

There is a movable stroke of more than 1 turn in each direction between the mechanical limit switches:

Before identifying offline inertia, please ensure that limit switches are installed on the machinery to prevent overtravel and accidents in the inertia identification process!

If the actual load inertia ratio is large, estimated to be over 30 times greater than the motor inertia, inertia mismatch phenomenon may occur, that results in slow motor operation. In this case, the following 2 measures can be taken:

Preset load inertia ratio of a large initial value, and it's recommended to use the 5.00 times as the starting value, gradually increases until the identification is updated accordingly; The load inertia ratio can be set by "P06.10" through the panel, or of "P06 group load inertia ratio" parameter on the background software.

It can be set by appropriately increasing the driver "P1A Advanced Adjustment - Response Level Setting" on the background software, it can also be set through the function code "P1A.01".

The general process for identifying panel operation inertia is as follows:

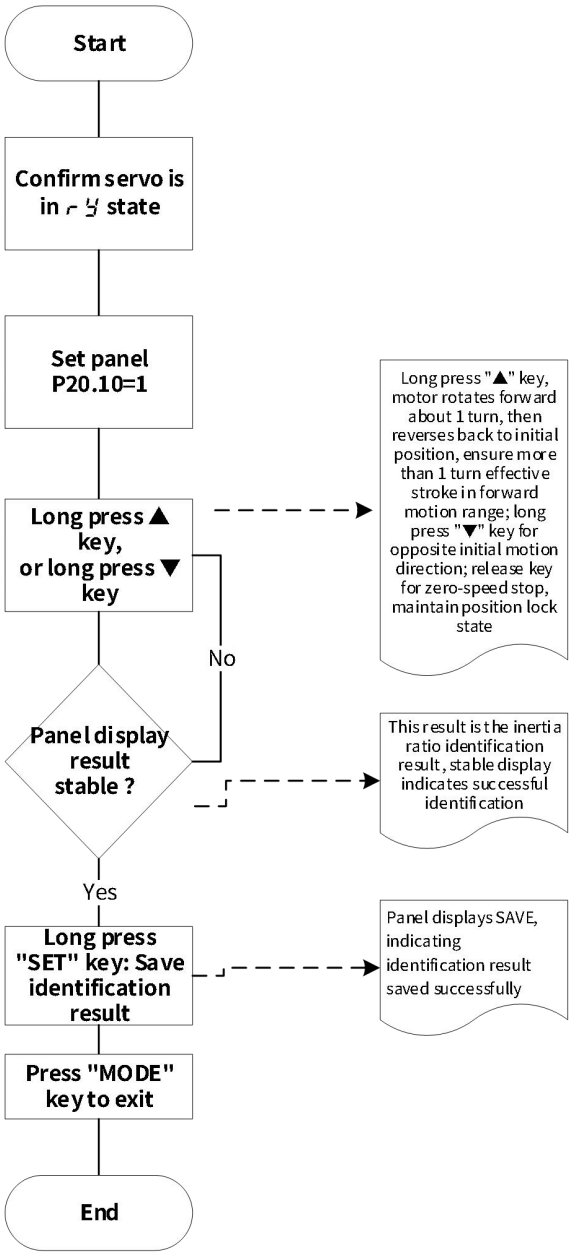


Figure 5-4 Flow Chart of Inertia Identification for Panel Operation

Inertia identification adopts the form of forward/backward triangular wave motion, and the program has already deErrored to the optimal motion parameters; Users can adjust the motion parameter settings according to actual application scenarios to realize the on-site demands. The identification program motion curve and parameter settings are as follows.

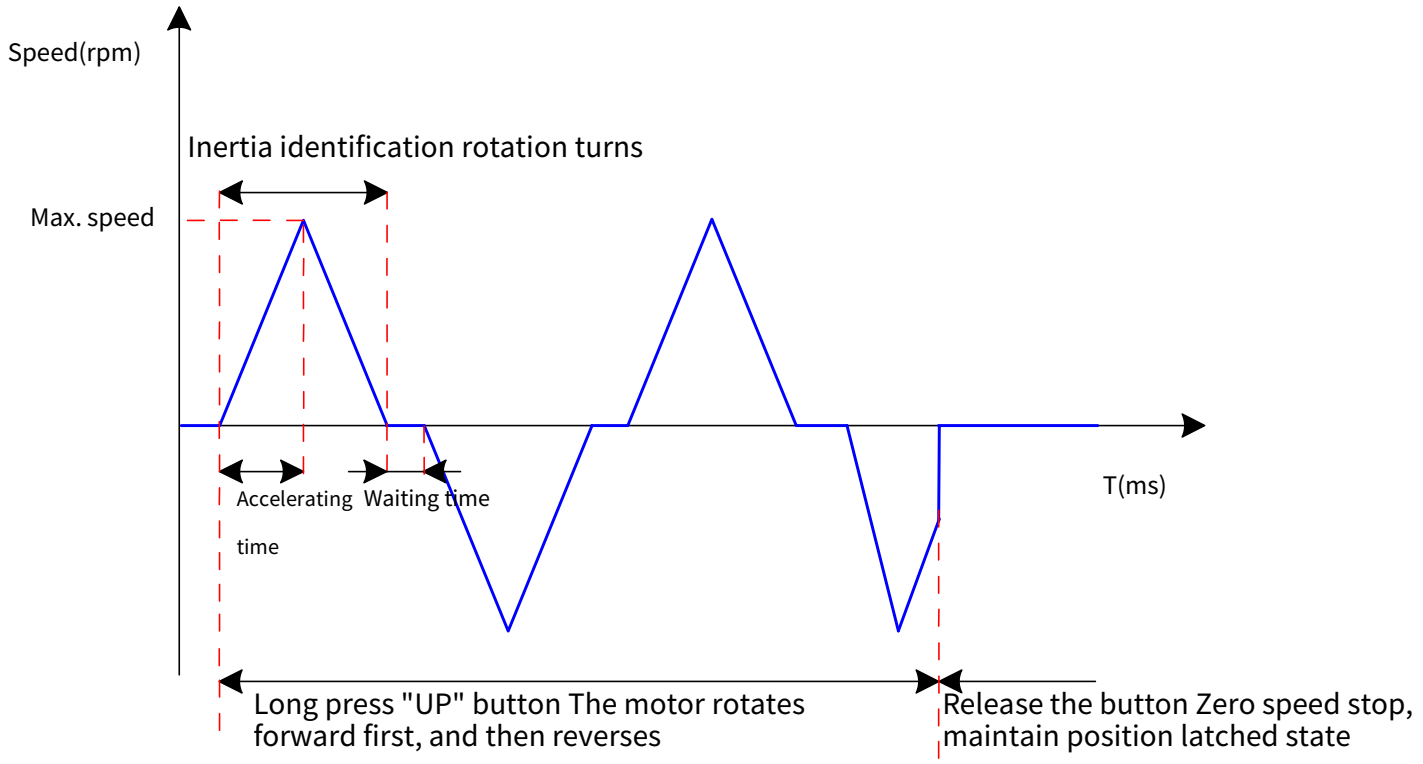


Figure 5-5 Inertia Identification Motion Curve

Table 5-2 Self-tuning Parameter Function codes

Function code	P1A.06	P1A.07	P1A.08	P1A.09
Name	Maximum speed for inertia identification	Accelerating time for inertia identification	Waiting time for inertia identification	Rotation turns for inertia identification
Accessibility	Readable/writable	Readable/writable	Readable/writable	Read-only
Unit	rpm	ms	ms	turn
Default	100	125	800	1.00
Min.	100	20	50	0
Max.	1000	800	10000	655.35
Set enable mode	Stop setting/immediate enable	Stop setting/immediate enable	Stop setting/immediate enable	--
Note	Settings of the parameters related to offline inertia identification have been the internal deError optimal values. Generally, there is no need to set them			

5.2.2 Manual gain adjustment

(1)Basic gain parameters

In scenarios with extreme performance requirements, the gain can be manually fine tuned. By making more detailed adjustments, optimize the debugging effect.

The servo system consists of 3 control loops, i.e., current loop, speed loop and position loop from the inside out. The basic control block diagram is shown in the following figure.

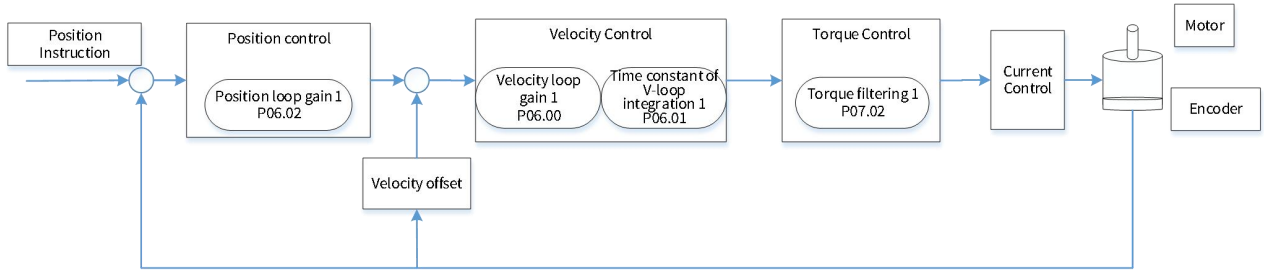


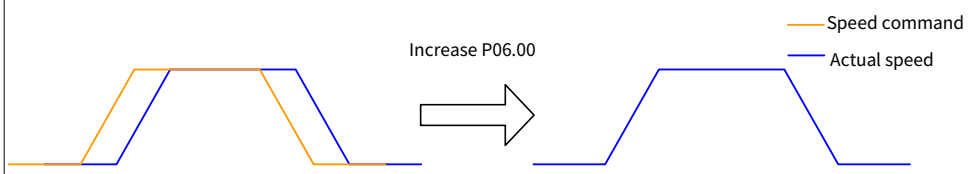
Figure 5-6 Basic Explanation Block Diagram of Manual Gain

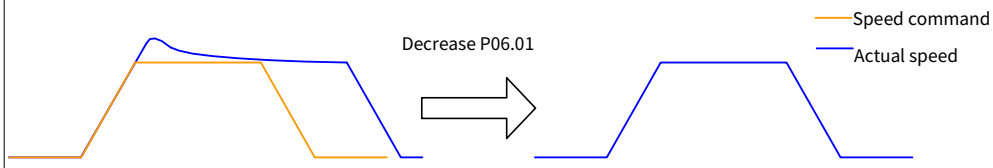
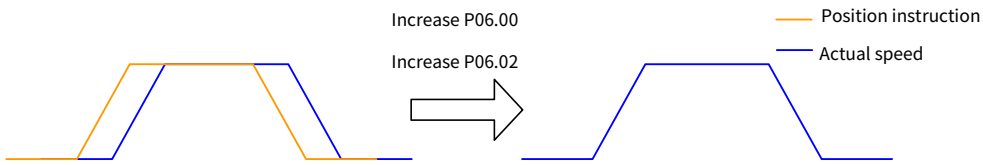
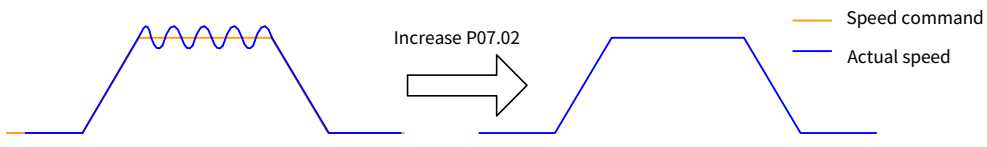
The more inner the loop, the higher the responsiveness required. Generally, the inner loop bandwidth should be set to at least 4 times the outer loop bandwidth. For example, the current loop bandwidth should be 2,000Hz, the speed loop bandwidth should be set not higher than 500Hz, and the position loop bandwidth should be set not higher than 125Hz. In the debugging process, it should adhere to this principle as much as possible, otherwise it might lead to system instability!

The deError current loop gain of servo drive ensures responsiveness and generally doesn't need any adjustment. Only the position loop gain, velocity loop gain, and other auxiliary gains need to be adjusted. Therefore, when adjusting the gain in position control mode, if users want to improve the position response performance, to ensure system stability, first increase the speed loop gain and ensure that the inner loop bandwidth between loops is 4 times higher than the outer loop bandwidth, and then increase the position loop gain and reduce position tracking error. It must ensure the order of loop gain adjustment from the inside out.

The basic gain parameter adjustment method is as follows.

Table 5-3 Adjustment Instructions of Loop Gain Parameters

Steps	Function codes	Name	Adjustment instructions
1	P06.00	Velocity loop gain 1	Parameter function: Determine Max. frequency of speed command that can follow speed-loop change. On the premise that the average of load inertia ratio (P06.10) is set properly, it can be considered that: Max. follow-up frequency of speed loop = P06.00  Adjustment method: In the case of no noise and vibration, increasing this parameter can speed up the positioning time and bring better velocity stability and followability. If noise is generated, reduce the parameter setting value;

Steps	Function codes	Name	Adjustment instructions
			When mechanical vibration occurs, the vibration can be suppressed by using the notch filter or torque low-pass filter function in Section 5.3.2 Vibration Suppression".
2	P06.01	Time constant of V-loop integration 1	 Parameter function: Eliminate velocity loop deviation. Adjustment method: Set values may follow these relations recommended: 500≤P06.00×P06.01≤1000 For example, if the velocity loop gain P06.00=40.0Hz, the time constant of the velocity loop integral shall satisfy: 12.50ms≤P06.01≤25.00ms. Reducing the settings can strengthen the integration function and speed up the positioning time, but too small the settings are prone to mechanical vibration. If the settings are too high, the velocity loop deviation can't be returned to zero. When P06.01=512.00ms, the integral is Ineffective.
3	P06.02	Position loop gain 1	Parameter function: Determines the highest frequency of changes in the position instruction that the position ring can follow. The highest following angular frequency of the position ring =2006-03h  Adjustment method: To ensure system stability, the maximum following frequency of the speed loop should be 3-5 times that of the position loop, so: $$3 \leq \frac{2 \times \pi \times 2006 - 01h}{P06.02} \leq 5$$ For example, when velocity loop gain P06.00 = 40.0Hz, The position loop gain should satisfy: 50.2Hz ⩽ P06.02 ⩽ 83.7Hz. Adjust according to the positioning time. Increasing this parameter can speed up the positioning time and improve the ability of the motor to resist external disturbances when it is stationary. Excessively high settings may cause system instability and oscillation.
4	P07.02	Torque filtering 1	Parameter function: Eliminate high-frequency noise and suppress mechanical resonance.  Adjustment method:

Steps	Function codes	Name	Adjustment instructions
			It should ensure that the cut-off frequency of the torque command low-pass filter is 4 times higher than the maximum following frequency of the speed loop, so: $\frac{1000}{2 \times \pi \times \text{P07.02}} \geq \text{P06.00} \times 4$ For example, when velocity loop gain P06.00 = 40.0Hz, The time constant of torque command filtering should satisfy: P07.02 ⩽ 1.00ms. When vibration results from 2006-01h increasement, it can be suppressed by adjusting from P07.02. Please refer to "5.3.2 Vibration Suppression Low Pass Filter" for specific settings. Excessively large settings may cause deduction of current ring response To suppress the vibration during stop, try increasing P06.00 and decreasing P07.02; The motor vibration in the stop state is too large. It may try reducing the setting of P07.02.

The position loop gain K_p, velocity loop gain K_v, velocity loop integral T_i, and torque low-pass filtering time T_f are the basic loop gain parameters of servo control. A certain relationship needs to be maintained between the 4 basic gain parameters to ensure the balance between stability and high performance of the entire servo system. The mathematical relationship between the 4 basic parameters is as follows:

$$K_p \leq \frac{\pi}{2} \cdot K_v$$

$$T_i \geq 4 \cdot \frac{1}{K_v}$$

$$T_f \leq \frac{1}{4} \cdot \frac{1}{K_v}$$

Below, based on experimental waveforms, we will introduce the role of basic gain parameters in position control mode.

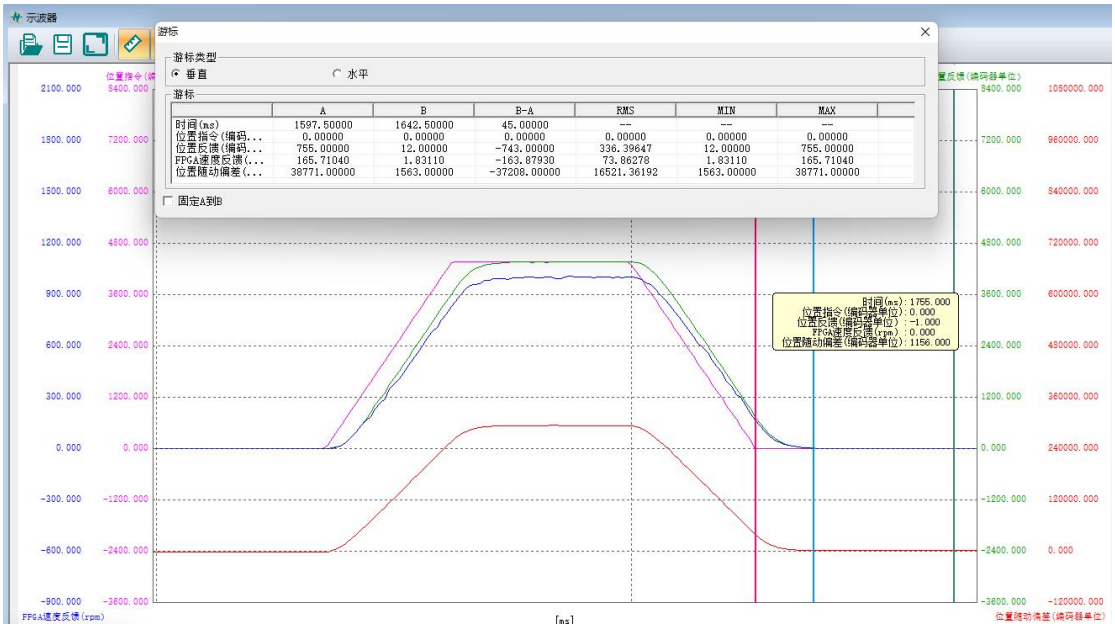


Figure 5-7 Waveform of position tracking without velocity integration

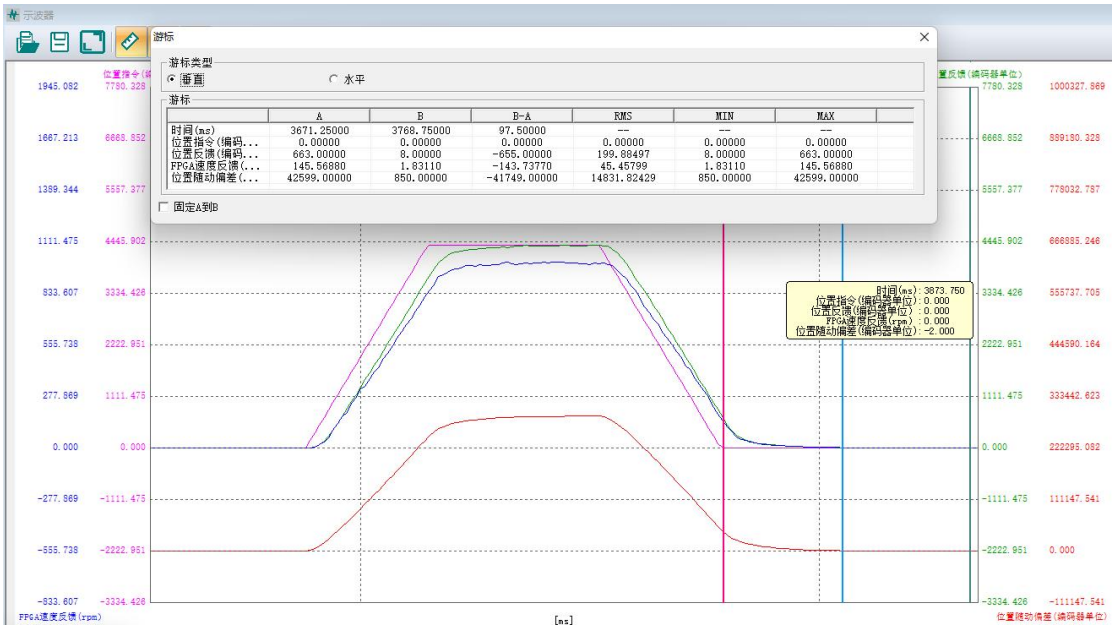


Figure 5-8 Waveform of position tracking with velocity integration

By comparing Figure 5-7 with Figure 5-8, it can be observed that when there are only position gain and velocity gain coefficients without velocity integration, fast positioning can be achieved with steady-state error. Increasing the loop gain can reduce steady-state error; When there is velocity integration, there is no steady-state error, but the tuning time becomes longer.

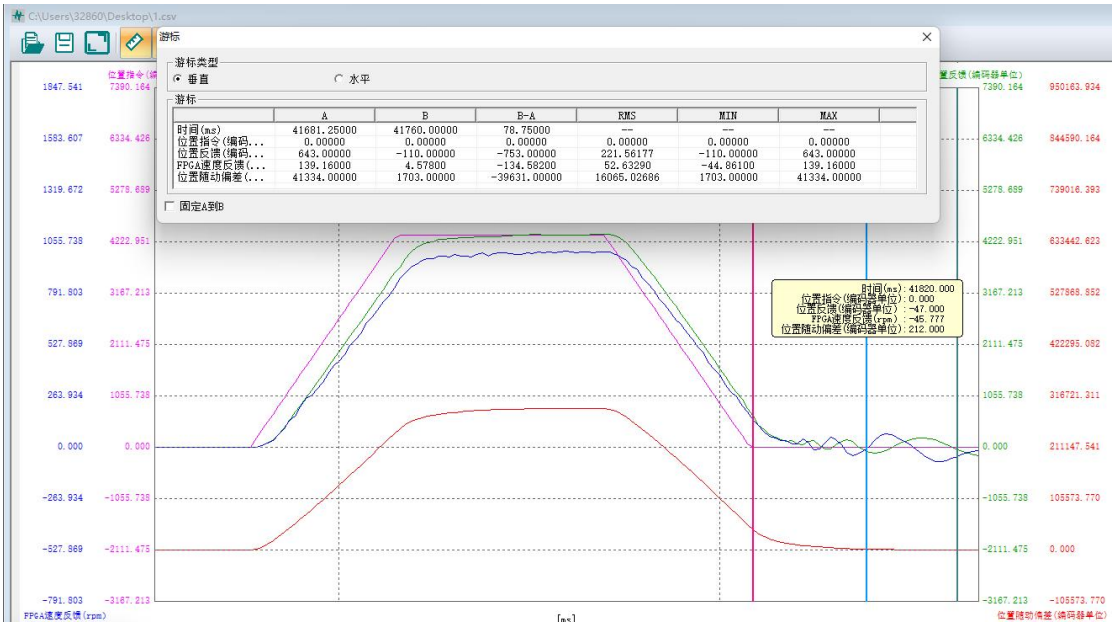


Figure 5-9 Without torque low-pass filtering

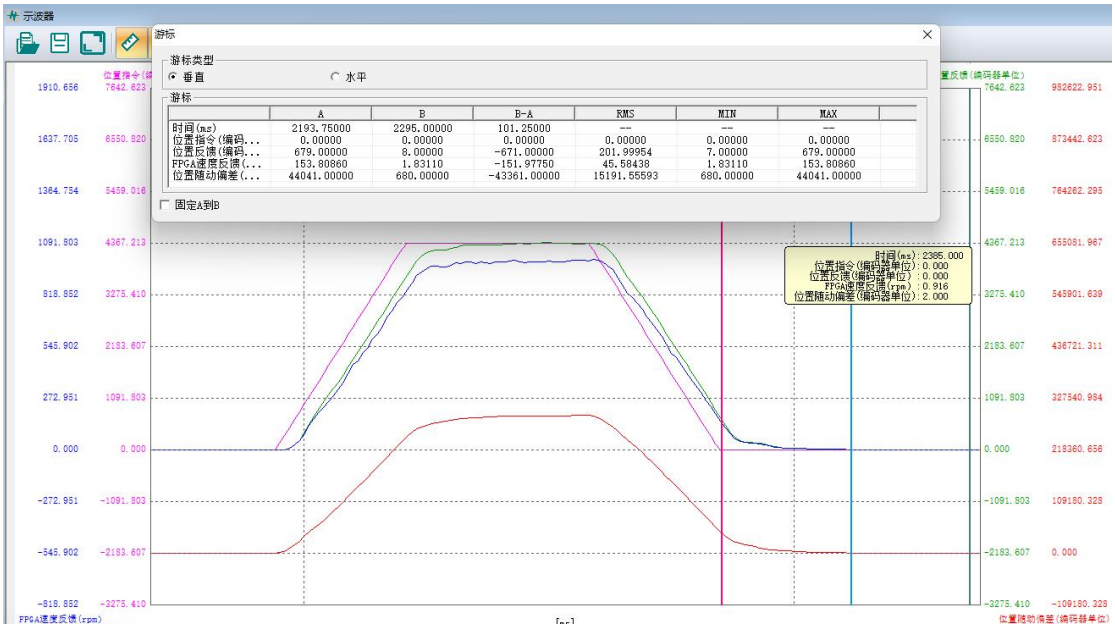


Figure 5-10: With torque low-pass filtering Tf=4ms

By comparing Figure 5-9 with Figure 5-10,it can be observed that adding torque low-pass filtering can eliminate torque oscillation, but the filtering transition frequency is low, the phase lag increases, and the gain cannot be improved, resulting in longer tuning time.

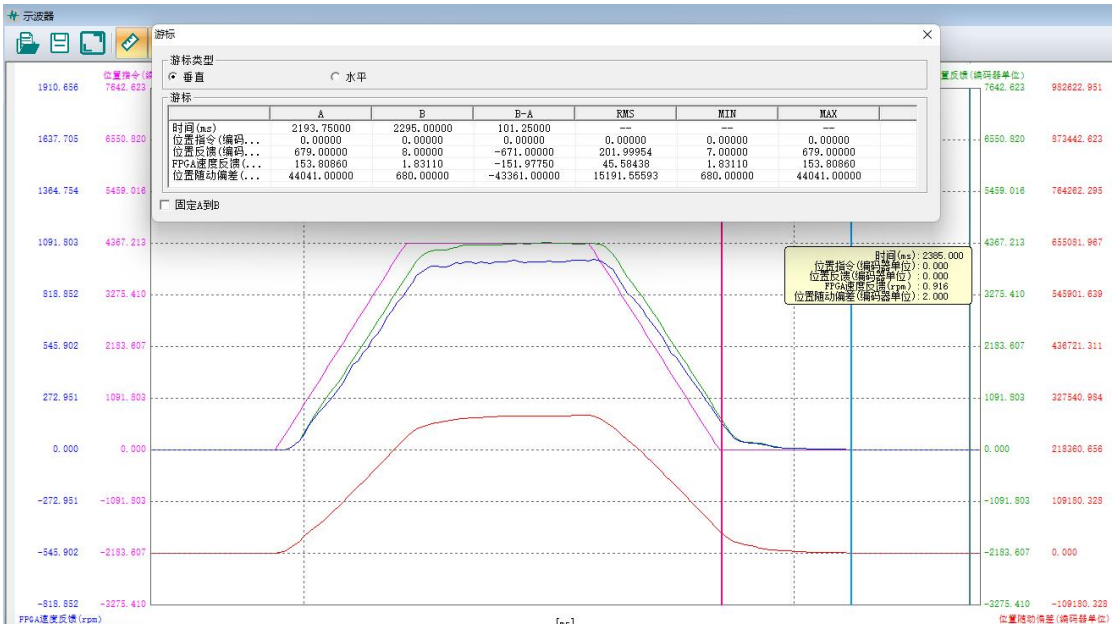


Figure 5-11 with torque low-pass filter with T_f=0.2ms

By comparing Figure 5-10 with Figure 5-11,it can be found that by setting the torque low-pass filter reasonably, torque oscillation can be eliminated while ensuring fast position adjustment, achieving a good balance between speed and stability.

The specific function codes for gain class and torque control parameters are shown in the table below:

Table 5-4 Function codes for gain class and torque control parameters

	0x2006- Gain class parameter			0x2007- Torque Control Parameter
Function	P06.00- Velocity loop gain 1	P06.01-Time constant of V-loop integration 1	P06.02-Position loop gain 1	P07.02- Torque Filter 1
Unit	Hz	ms	Hz	ms
Default	25	31.83	40	0.79
Min.	1	15	1	0
Max.	20000	51200	20000	3000
Setting and effective mode	Stop setting/immediate enable	Stop setting/immediate enable	Stop setting/immediate enable	Stop setting/immediate enable
Note	-			

(2) Feedforward control

Speed feedforward

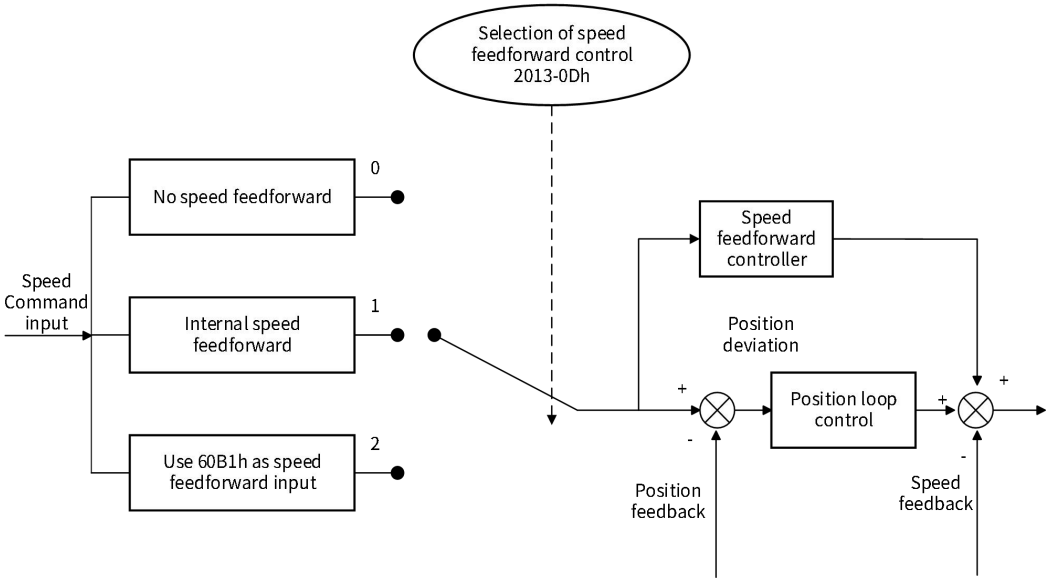


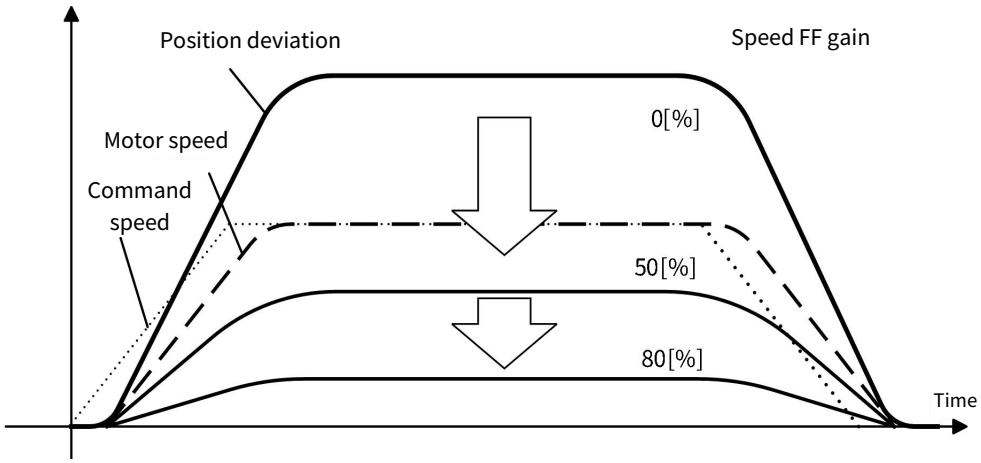
Figure 5-12 Block Diagram of Speed Feedforward Control

In position control mode, the theoretical speed command required for the action is directly calculated through internal position commands, and added to the speed command calculated by the position feedback loop. It is applied to the input of the speed regulator command, which can significantly reduce position tracking errors and improve response performance compared to simple feedback control. Therefore, using the speed feedforward function can improve the speed command response and reduce the position deviation when the speed is fixed.

In theory, the relationship between position deviation and position loop gain, as well as velocity feedforward gain, is shown below. If the speed feedforward gain is set to 100%, theoretically the position deviation will become zero, but an excessively large feedforward gain coefficient will cause excessive speed overshoot during acceleration and deceleration.

When the update cycle of the position command is less than the servo control cycle, the differential operation of speed feedforward will cause significant differential errors, which will be converted into high-frequency torque command components, thereby inducing electromagnetic noise during operation. In this case, please use a position command filter (FIR filter or sliding mean filter), or increase the speed feedforward filter value.

Position deviation [command units] = Command speed [command units/s] / Position loop



Position deviation in a certain speed range decreases as speed feedforward gain increases

Figure 5-13 Relationship between speed feedforward gain and position deviation

Operational steps for speed feedforward function:

A) Set the source of speed feedforward signal

Set P13.12(Speed Feedforward Control Selection) as a non-0 value, enable speed feedforward function, and the speed feedforward signal source can be selected internally and externally, shown as in the following table.

Table 5-5 Speed Feedforward Control and Selection of Function codes

Function codes	Name	Settings	Remarks
P13.12	Selection of speed feedforward control	0: No speed feedforward	-
		1: Internal speed feedforward	Use the velocity data corresponding to position command as the source of the velocity feedforward signal.
		2: Using AI1 as a speed feedforward input	Use AI1 as the source of the speed feedforward signal.
		3: Using AI2 as a speed feedforward input	Use AI2 as the source of the speed feedforward signal.

B) Set speed feedforward parameters

Including Velocity loop feed forward (2006-09h) and speed feedforward filtering time (2007-07h).

Table 5-6 Function codes for speed feedforward parameters

Function codes	Name	Adjustment instructions
P07.06	Velocity feedforward filtering time	Reducing filtering time can suppress speed overshoot of acceleration and deceleration; Increasing the filtering time can suppress noise in situations where the update

		cycle of the position command is longer than the control cycle of the driver, and the pulse frequency of the position command is uneven, thus suppressing the jitter of the position coincidence signal;
P06.08	Velocity loop feed forward	Refer to Figure 5-13

Torque feedforward

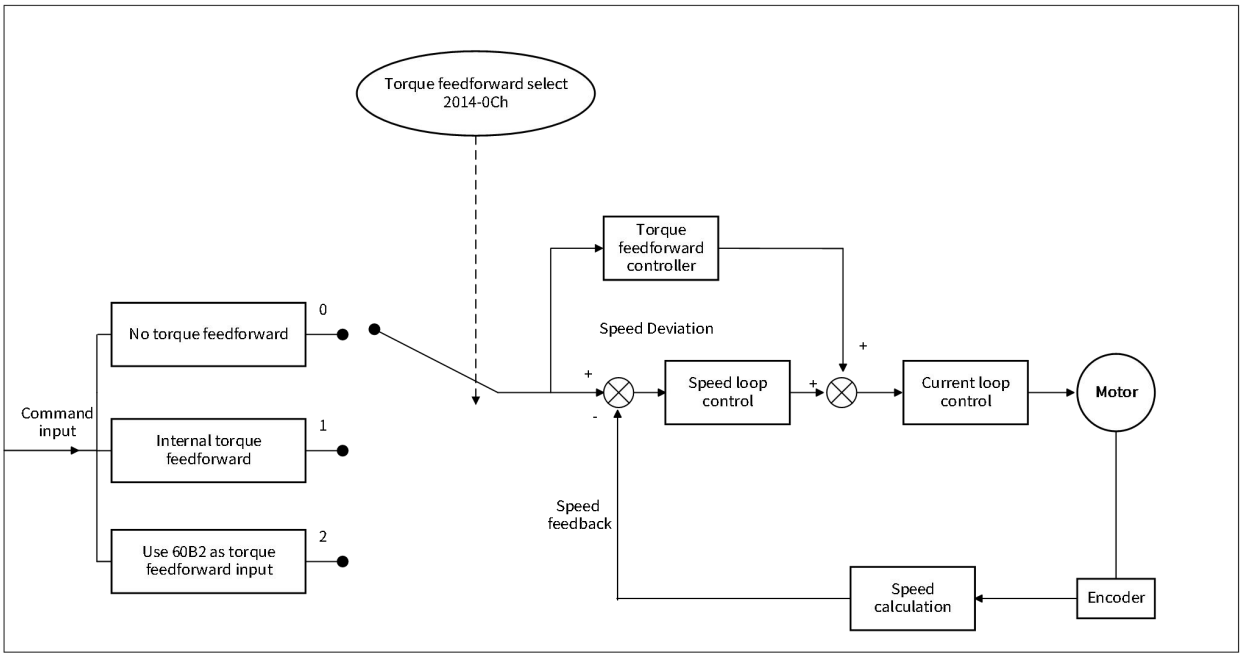


Figure 5-14 Torque Feedforward Control Operation Diagram

0Position control mode, using torque feedforward can improve dynamic velocity response and reduce position deviation during fixed acceleration/deceleration; To use torque feedforward, it is necessary to set the correct load torque inertia ratio. Please refer to the mechanical load identification results in Section 5.2.1. The torque feedforward gain is set to a non-zero value, and the torque feedforward function is enabled. By increasing the torque feedforward gain, the position deviation during constant acceleration /deceleration can be controlled to around 0, and the trapezoidal motion curve can be perfectly tracked without external torque interference.

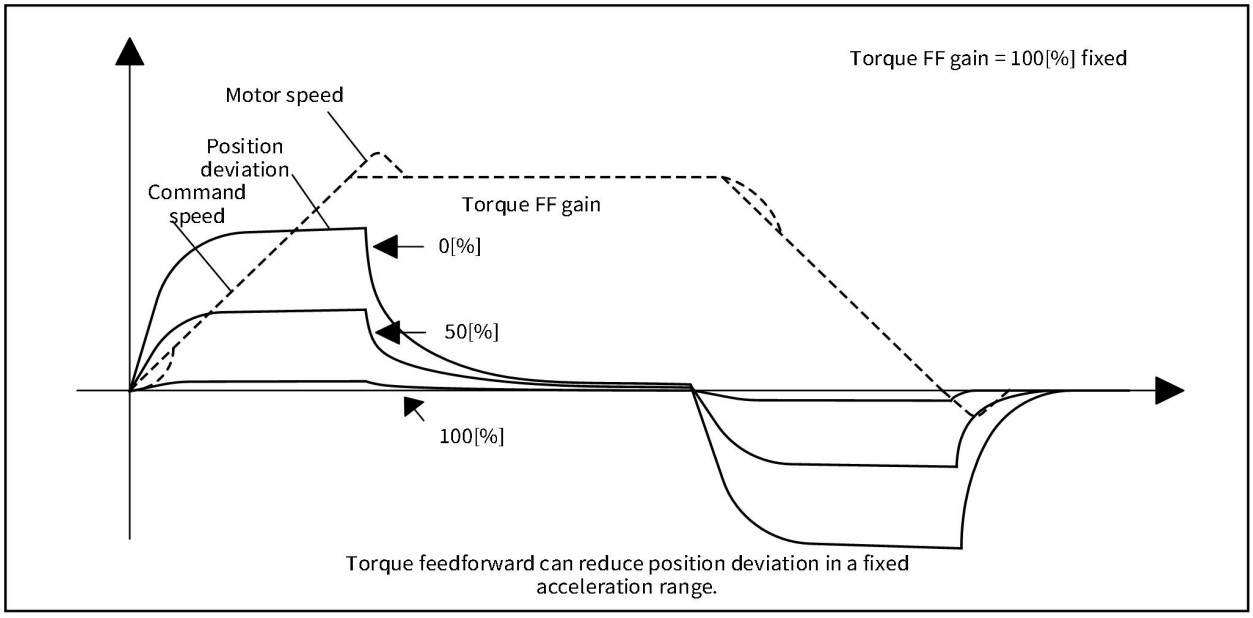


Figure 5-15 Relationship between torque feedforward gain and position deviation of acceleration and deceleration sections

Operation steps for torque feedforward function:

A) Set the source of torque feedforward signal

Set P14.11 (torque feedforward control selection) as non-zero value, enable the torque feedforward function.

The feedforward signal source can be selected from internal and external sources, as shown in the table below.

Table 5-7 Parameter Function code for Speed Feedforward Control Selection

Function codes	Name	Settings	Remarks
P14.11	Selection of torque feedforward control	0: No torque feedforward	-
		1: Internal torque feedforward	Use speed command as the source of torque feedforward signal. In position control mode, the speed command comes from the output of the position controller.

B) Set torque feedforward parameters

Including torque feedforward proportional gain (P06.09) and torque feedforward filtering time (P07.07).

Table 5-8 Function codes for speed feedforward parameters

Function codes	Name	Adjustment instructions
P06.09	Torque feedforward proportional gain	Increasing P06.09 can improve response, but overshoot may occur during acceleration/deceleration; Reducing P07.07 can suppress overshoot during acceleration and deceleration; Increasing P07.07 can suppress noise; Adjustment method: When adjusting, first, keep P07.07 at the Default; Then, gradually increase P06.09 from 0 until the torque feedforward effect is achieved at a certain setting value. When adjusting, the settings of P06.09 and P07.07 should be repeatedly adjusted to find a balanced setting
P07.07	Torque feedforward filtering time	

(3) Two-degree-of-freedom control

In non torque control mode, two-degree-of-freedom control coefficient can be used to improve the control effect, set to 100%, which is the normal PI control mode; Setting it other than 100%, i.e.,two-degree-of-freedom control, which can be used to increase resistance to external forces and improve velocity response waveforms.

The following figure shows the improvement of the two-degree-of-freedom control coefficient on slow speed increase and slow positioning completion.

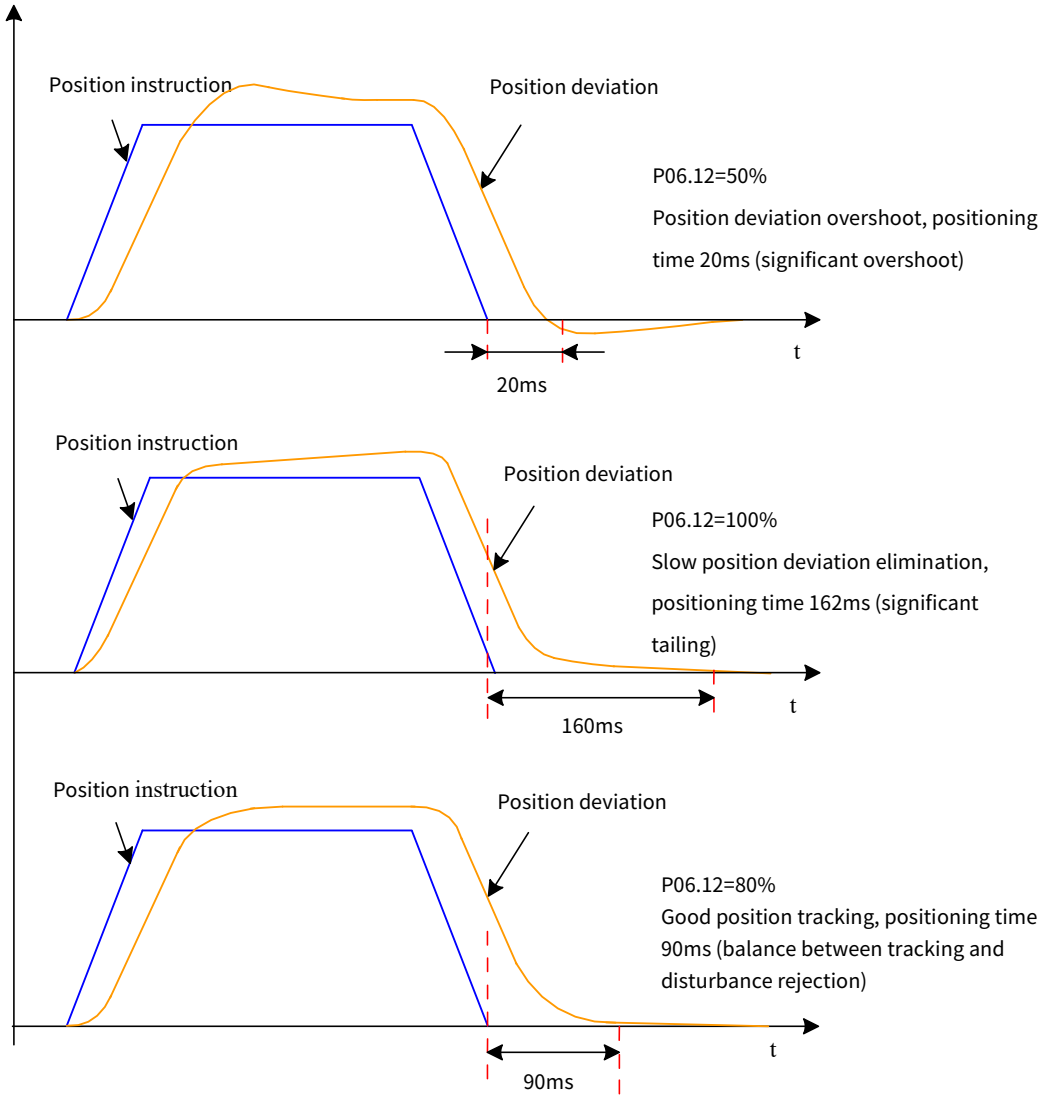


Figure 5-16 Example of two-degree-of-freedom Control

two-degree-of-freedom control enhances the anti-interference ability of the velocity loop and improves its ability to follow speed commands by adjusting the velocity loop control method.

Table 5-9 Function codes for two-degree-of-freedom feedforward coefficients

Function codes	Name	Adjustment instructions
P06.12	Two-degree-of-freedom feedforward coefficient	Parameter function: The control method for changing the speed loop in non torque control mode. Adjustment method: The setting of P06.12 is too small, resulting in slow speed loop response; When overshoot exists in velocity feedback, gradually reduce P06.12 from 100.0 until the two-degree-of-freedom control achieves effect at a certain set value. When P06.12=100.0, the velocity loop control method remains unchanged and deErrors to proportional integral control.

5.2.3 Gain Switching

The gain switching function is only effective in position and speed control mode and can be triggered by the internal state of the servo or external DI. Using gain switching can have the following effects:

When the motor is enabled to be stationary, the position latched state can be switched to a lower gain to suppress vibration and reduce static noise;

During the motor stop process, when the position is set, it can be switched to a higher gain to shorten the positioning time;

It is possible to switch to a higher gain during motor operation to achieve better command tracking performance;

Different gain settings can be switched through external signals based on the load device situation.

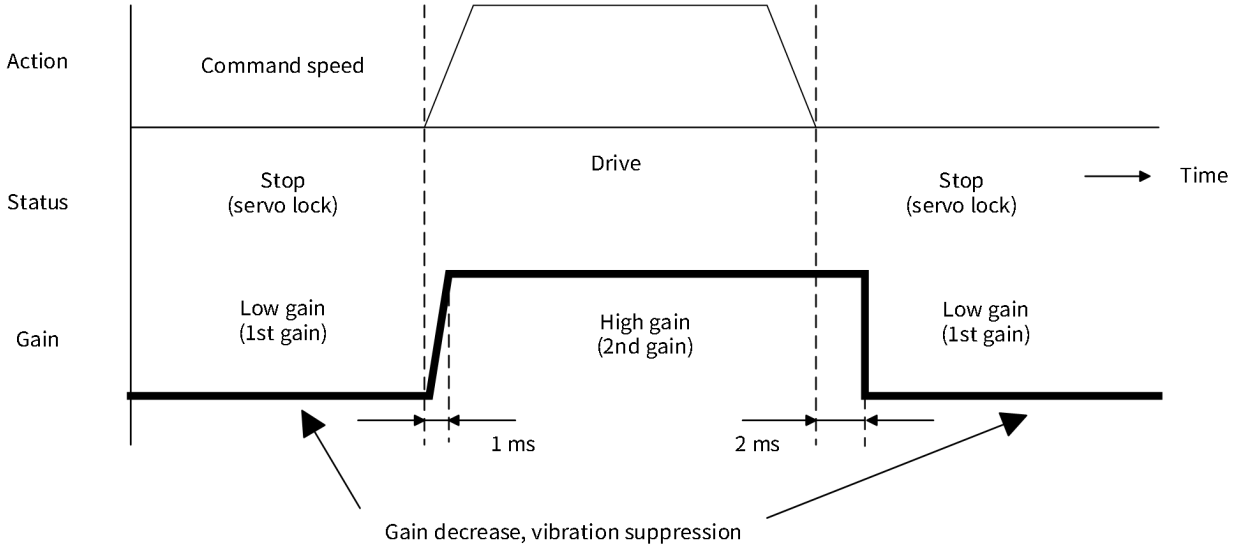


Figure 5–17 Gain Switching Diagram

For example:

In the application scenario of LED die bonder, there is a demand for high-speed, high-precision and high response servo, which is a typical application of fast positioning P2P. The gain switching function is adopted to ensure fast setting requirement and reduce the noise when the servo is enabled to be stationary.

Table 5-10 Steps for peed gain adjustment

Parameter group	Steps for gain switching adjustment	Not using gain switching, adjust the gain manually		The second gain is set the same as base gain		Enable gain switching function		In static state, adjust the first group of gain parameters, eliminate static noise
P06	Velocity proportional gain 1	35.0Hz						27.0Hz
P06	Velocity integral gain 1	16.00ms						
P06	Position proportional gain 1	63.0Hz						
P07	Torque filtering 1	0.65ms						0.84ms
P06	Velocity			35.0Hz				

	proportional gain 2							
P06	Velocity integral gain 2			16.00ms				
P06	Position proportional gain 2			63.0Hz				
P07	Torque filtering 2			0.65ms				
P06	Gain switching - Mode selection	0				1		
P06	Gain switching - Condition selection					10		
P06	Load inertia ratio	Obtained by inertia identification						

SV3 servo supports the following 10 gain switching methods, including 1 external DI switching and 9 switching methods upon internal motion status of the servo:

0: The first gain is fixed (PS)

1: Use external DI for switching (PS)

2: Torque instruction (PS)

3: Speed instruction (PS)

4: Speed instruction change rate (PS)

5: High/low speed threshold of speed instruction (PS)

6: Position deviation (P)

7: With position instruction (P)

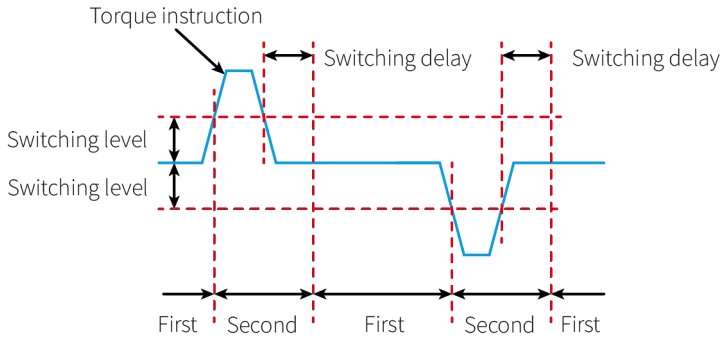
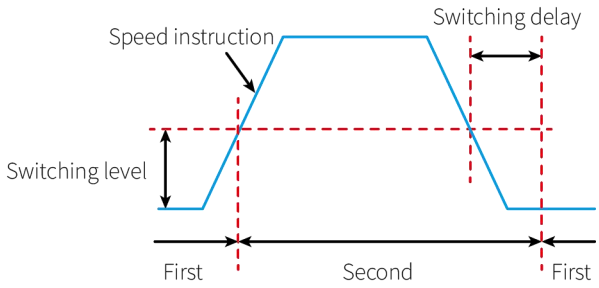
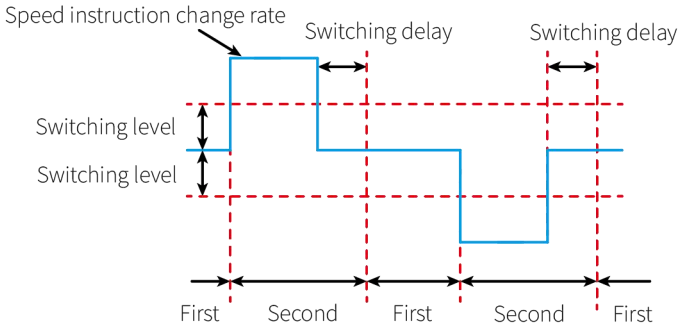
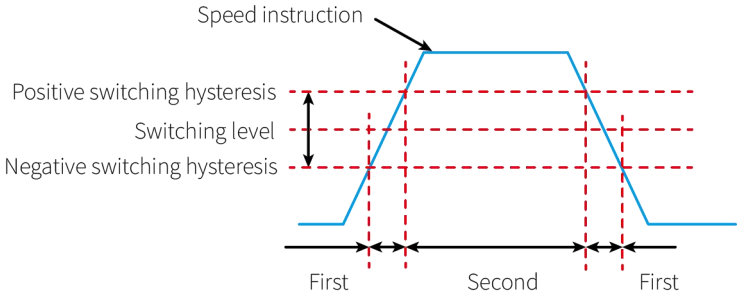
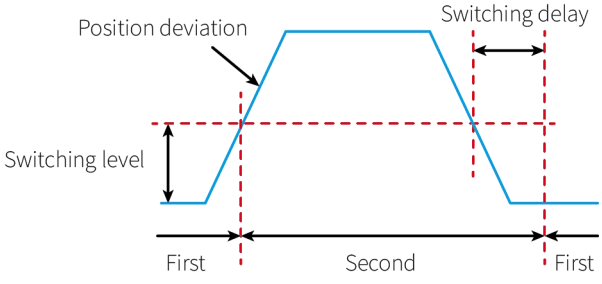
8: Positioning is incomplete (P)

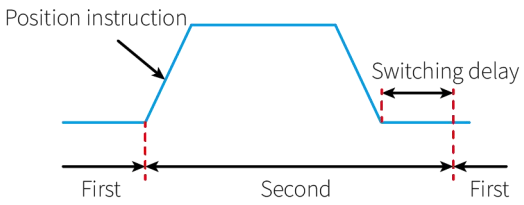
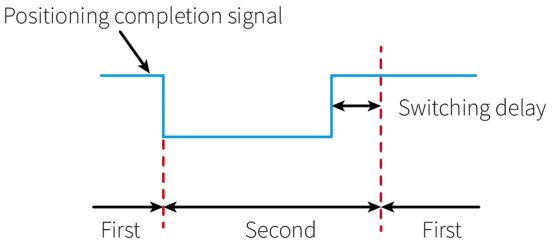
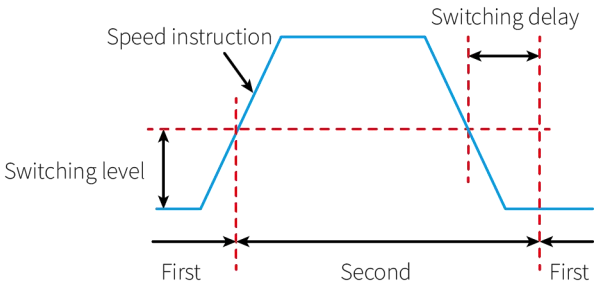
9: Actual speed (P)

10: With position instruction + actual speed (P)

Herein, (P) represents that that switching method only supports position control mode; (PS) represents that the switching method supports both position control and speed control modes. Below is the detailed instructions about the 9 internal switching methods of the servo.

Table 5-11 Change Diagram of Internal Switching Method of Servo

Gain switching method	Switching method change diagram
2: Torque instruction	
3: Speed instruction	
4: Speed instruction change rate	
5: High/low speed threshold of speed instruction	
6: Position deviation	

Gain switching method	Switching method change diagram
7: Position instruction	
8: Positioning is completed	
9: Actual speed	
10: With position instruction + actual speed	Combination of method 7 and method 9 is generally chosen to ensure fast and stable setting in place

⚠ Note:

The delay time 'P06.17' is only valid when the second gain is switched into the first gain.

Table 5-12 Function codes for gain class parameters

Function code	P06.15- Gain Switching - Mode Setting	P06.16- Gain Switching - Condition Selection	P06.17- Gain Switching - Delay	P06.18- Gain Switching - Level	P06.19- Gain Switching - Time Delay	P06.20- Gain Switching - Time
Unit	-	-	ms	-	-	ms
Default	1	0	5.0	50	30	3.0
Min.	0: The first gain fixed, use external DI for P/PI switching 1: Switching between the first gain and the second gain is valid, and the switching condition is P06.16	0: The first gain fixed (PS) 1: Switching by external DI (PS) 2: High torque instruction(PS) 3: High speed instruction(PS) 4: High change rate of speed instruction(PS) 5: Speed instruction high/low speed threshold (PS) 6: Large positional deviation (P) 7: With position instruction (P) 8: Positioning is uncompleted (P) 9: Actual speed (P) 10: With position instruction+actual speed (P)	0	0	0	0
Max.			1000	20000	20000	1000
Setting and effective mode	Run settings/Effective immediately	Run settings/Effective immediately	Stop setting/immediate enable	Stop setting/immediate enable	Stop setting/immediate enable	Stop setting/immediate enable

5.2.4 Automatic gain adjustment

Automatic gain adjustment refers that SV3 servo drive automatically generates a set of matching basic gain parameters upon parameter settings of "P1A Group - Advanced Adjustment Function - Response Level Selection" so as to meet the requirement on speed and stability.

SV3 servo provides 2 automatic gain adjustment modes: 1. Basic mode; 2. Positioning mode.

⚠ Note:

Before using the automatic gain adjustment function, it is essential to correctly obtain the load inertia ratio!

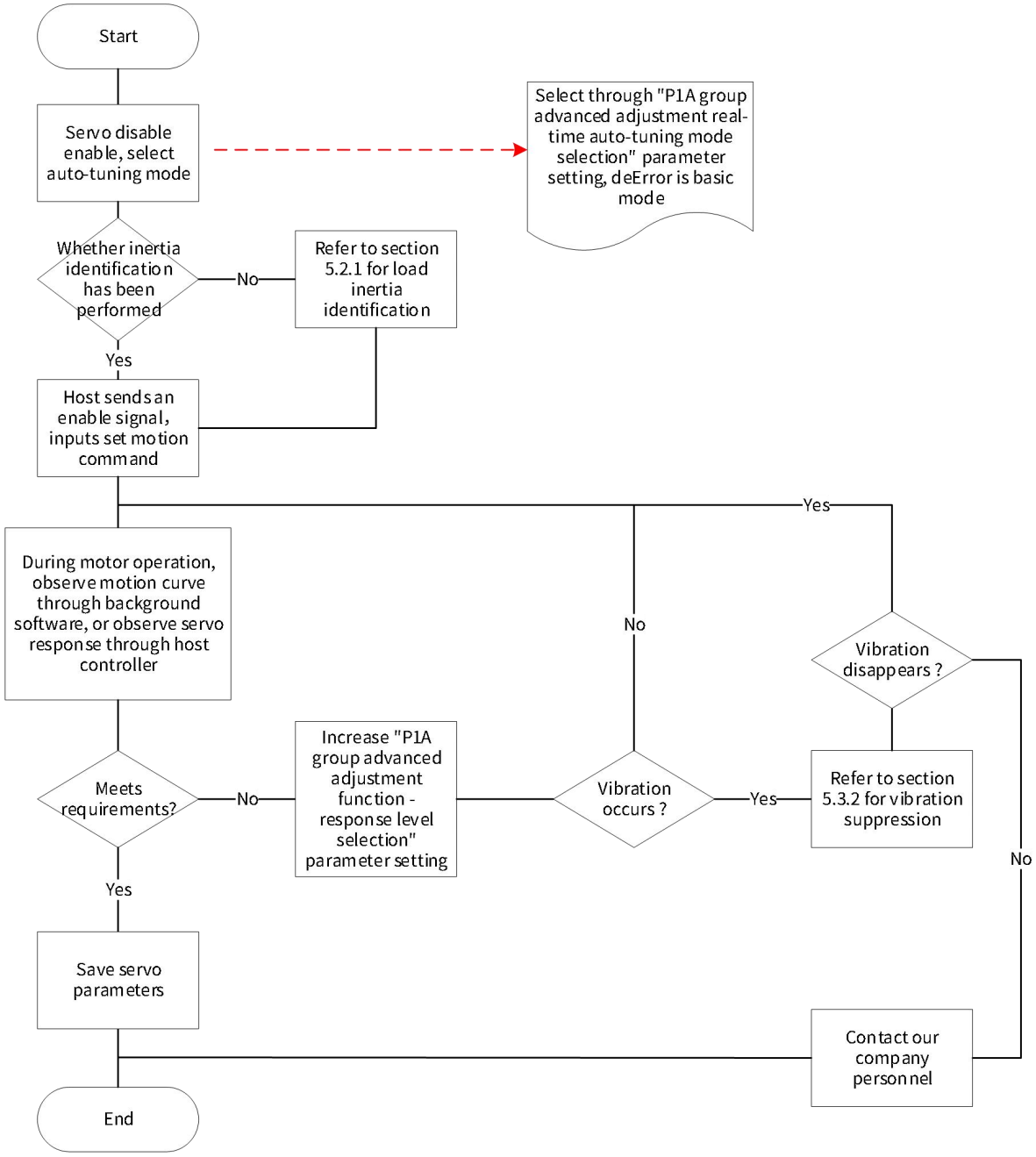


Figure 5-18 Steps for automatic gain adjustment

(1) Standard rigid table mode

Real-time automatic gain adjustment - Standard rigid table mode(P1A.00=1) is suitable for most of situations, with response levels (P1A.01) ranging from 0 to 40 levels. The higher response level means the stronger gain and the faster response. Based on different load types, the following empirical values are for reference:

Table 5-13 Response Level Reference

Recommended response level	Type of load mechanism
Level 4 to Level 8	Some large machinery
Level 8 to Level 15	Applications with low rigidity such as belt
Level 15~20	Applications with high rigidity such as ball screws and direct connections
Level 20~40	Directly connected high rigidity, small inertia load application

Real-time automatic adjustment of standard rigid table mode (P1A.00=1), basic gain (P06.00~02, P07.02) parameters, automatically updated according to the response level set in P1A.01 and stored in the corresponding Function code:

Table 5-14 Real-time automatic adjustment mode with automatic parameter update

Function codes	Name
P06.00	Velocity loop gain 1
P06.01	Time constant of V-loop integration 1
P06.02	Position loop gain 1
P07.02	Torque filtering 1

(2) Quick positioning mode

Quick positioning mode (P1A.00=2)

The parameter settings on the background software are as follows:,

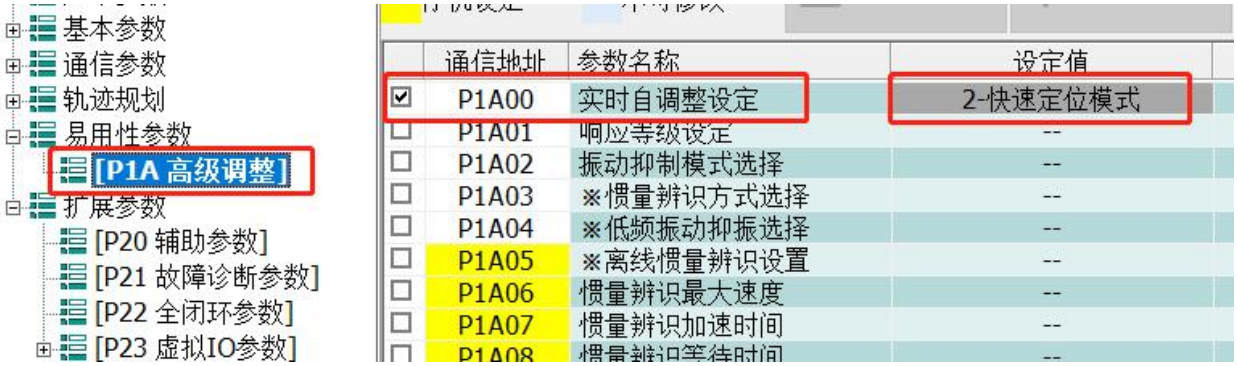


Figure 5-19 Quick positioning mode setting

The quick positioning mode inside SV3 servo automatically realizes the gain switching function in Section 5.2.3 and the feedforward control function in Section 5.2.2, organically combining the two to realize the quick positioning function. Upon "Automatic Adjustment Standard Rigid Table Mode", the second gain parameter (P06.03~05，P07.03) is also automatically updated and stored in the corresponding Function code according to the response level set in P1A.01, and the position loop gain of the second gain parameter should be 1 response level higher than the first gain parameter.

Table 5-15: Automatic Parameter Update for Quick Positioning Mode

Function codes	Name
P06.03	Velocity loop gain 1
P06.04	Time constant of V-loop integration 1
P06.05	Position loop gain 1
P07.03	Torque filtering 1

The parameters related to speed feedforward are set to fixed values:

Table 5-16 Fixed Parameters for Quick Positioning Mode

Function codes	Name	Parameters
P06.08	Speed feedforward proportional gain	30.0%
P07.06	Velocity feedforward filtering time	0.50ms

The parameters related to gain switching are set to fixed values:

In fast positioning mode, gain switching function is automatically enabled.

Table 5-17 Gain Parameters of Fast Positioning Mode

Function code	Name	Parameters	Remarks
P06.15	Gain switching - Mode selection	1	In fast positioning mode, the switching between the first gain (P06.00~02，P07.02) and the second gain (P06.03~05，P07.03) is valid; Maintain the original settings other than fast positioning mode.
P06.16	Gain switching - Condition selection	10	In fast positioning mode, the gain switching condition is P06.16=10; Maintain the original settings other than fast positioning mode.
P06.17	Gain Switching - Delay	5.0ms	In fast positioning mode, gain switching delay time is 5.0ms; Maintain the original settings other than fast positioning mode.
P06.18	Gain Switching - Level	50	In fast positioning mode, gain switching level is 50; Maintain the original settings other than fast positioning mode.
P06.19	Gain switching - time delay	30	In fast positioning mode, gain switching delay is 30; Maintain the original settings other than fast positioning mode

⚠ Note:

In automatic gain adjustment mode, parameters that are automatically updated with response level selection (201A-02h); Parameters with fixed values can't be manually modified. In order to modify it, it must set 201A-01h of 0 and exit the real-time automatic adjustment mode.

Table 5-18 Advanced Adjustment Function codes

Function code	P1A.00- Real time self-adjusting settings	P1A.01- Response Level Setting
Accessibility	Readable/writable	Readable/writable
Unit	-	-
Default	7	16
Min.	0: Ineffective 1: Standard rigid table mode 2: Quick positioning mode 5: Adaptive interpolation mode 7: Adaptive positioning mode	0
Max.		40
Setting and effective mode	Run settings/Effective immediately	Run settings/Effective immediately

5.3 Vibration suppression

5.3.1 Notch Filter

When the servo gain coefficient is relatively large, high-frequency vibration components can't be effectively attenuated, that would trigger system resonance. In order to maintain the servo response performance and drive the mechanical load smoothly without reducing the gain, it rquires to effectively suppress resonance. Generally, servo manufacturers will install notch filter in the front channel of control loop to attenuate loop gain amplitude at the resonance point by a fixed point so as to realize vibration suppression.

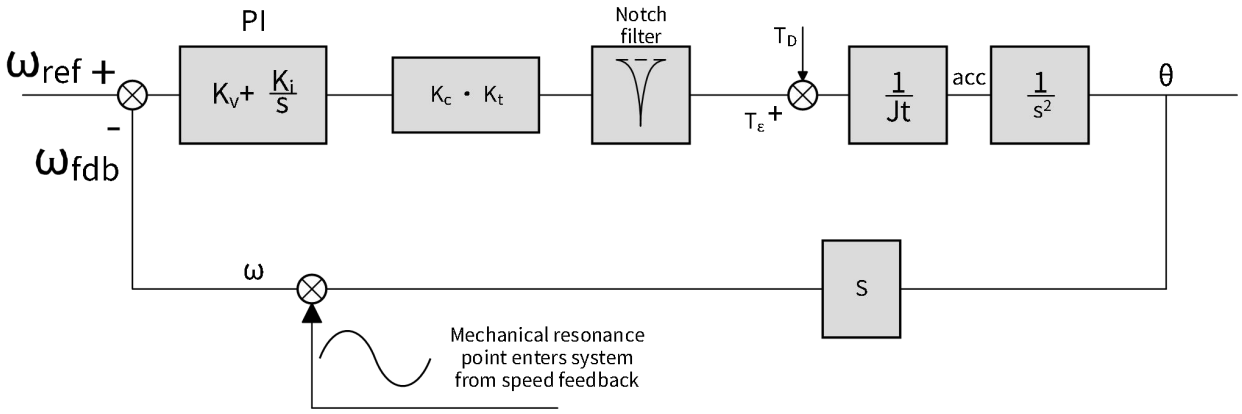


Figure 5-20 Block Diagram of Resonance Suppression Control

Transfer function of notch filter is

$$G_{notch}(s) = \frac{s^2+2\zeta_1\omega_n s+{\omega_n}^2}{s^2+2\zeta_2\omega_n s+{\omega_n}^2}$$

5.3.2 Vibration Suppression

SV3 servo has the built-in adaptive vibration suppression algorithm, which extracts vibration components from motor speed during actual operation, calculates the resonance frequency, and sets relevant parameters of adaptive notch filter automatically so as to realize vibration suppression.

(1) Automatic notch filter

To enable the adaptive notch filter function, just set "P1A Group - Advanced Adjustment - Vibration Suppression Mode Selection" of 1 or 2 in the backend software; SV3 servo supports up to 4 adaptive notch filters. When the system has 5 or more resonance points, it shall manually set the notch filters. It supports up to 4 different notch frequency settings.

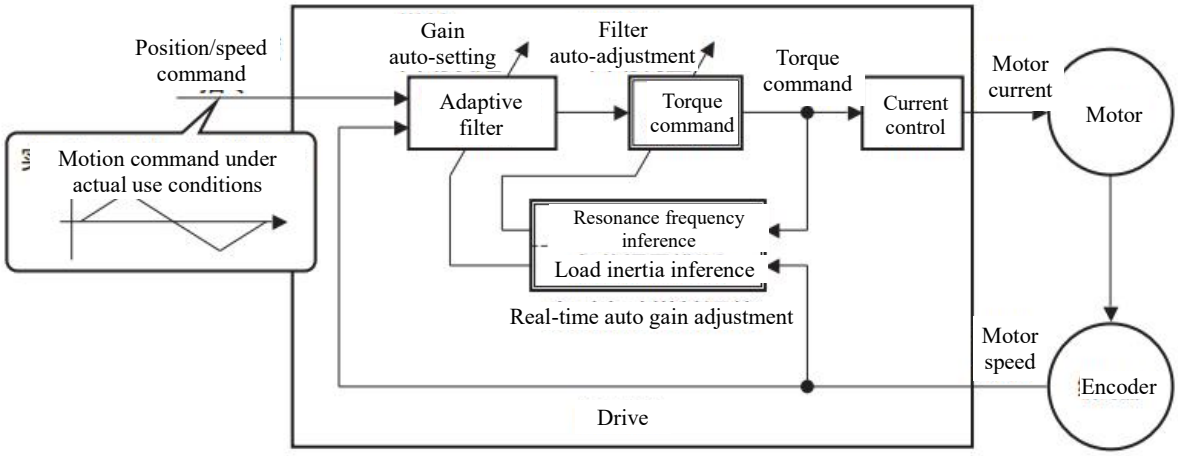


Figure 5-21 Block diagram of adaptive vibration suppression principle

⚠ Note:

Under the following conditions, it might be impossible to perform normal automatic vibration suppression. In this situation, please perform manual vibration suppression.

Table 5-19 Factors of Adaptive Vibration

	Factors of adaptive vibration suppression
Resonance characteristics	When resonance frequency is lower than the velocity response frequency When 3 or more resonance points exist When vibration amplitude is small, or control gain is low, and the impact on motor speed is nonsignificant
Mechanical properties	Nonlinear factors such as excessive tooth clearance in operation or excessive backlash in positive/negative rotation, e.g., misaligned gear installation in gear transmission mechanism Vibration components randomly appear and last for a short period
Movement conditions	Rapid acceleration/deceleration, when acceleration is greater than 30000rpm/s When the servo operates in torque mode

(2) Manual notch filter

A) Analyze resonance frequency;

Using the manual notch filter, it's necessary to set the notch filter frequency as actual resonance frequency.

The resonance frequency can be obtained by driving the oscilloscope interface of debugging platform, and there are 2 methods as follows:

Obtained by the motor current displayed on oscilloscope interface(phase current/torque command/current feedback). As shown in the figure below, the measured period is 0.625ms, and the calculated resonance frequency is:

$$f = 1/t = 1600\ Hz$$

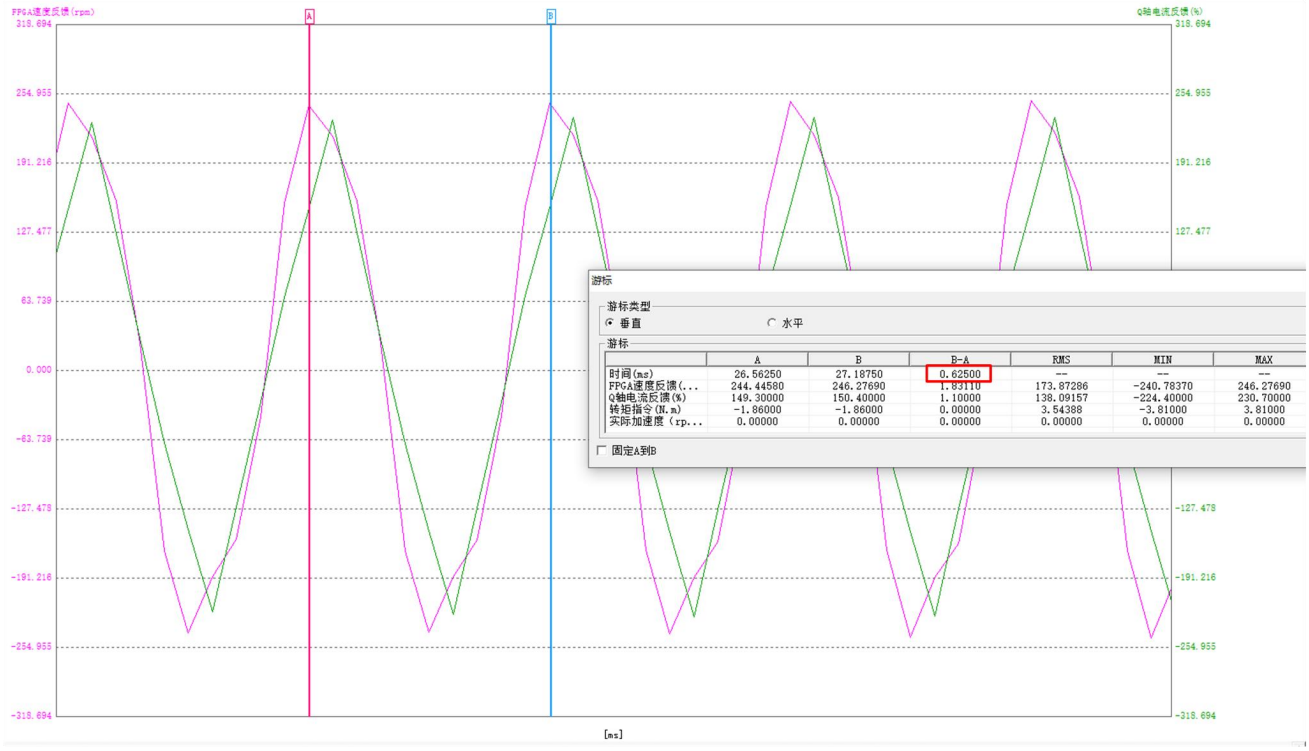


Figure 5-22 Screenshot of resonance frequency test ,on the background software

① Obtained by "resonance point identification" function on oscilloscope interface. As shown in the figure below, the measured resonance frequency is 1593.750Hz.

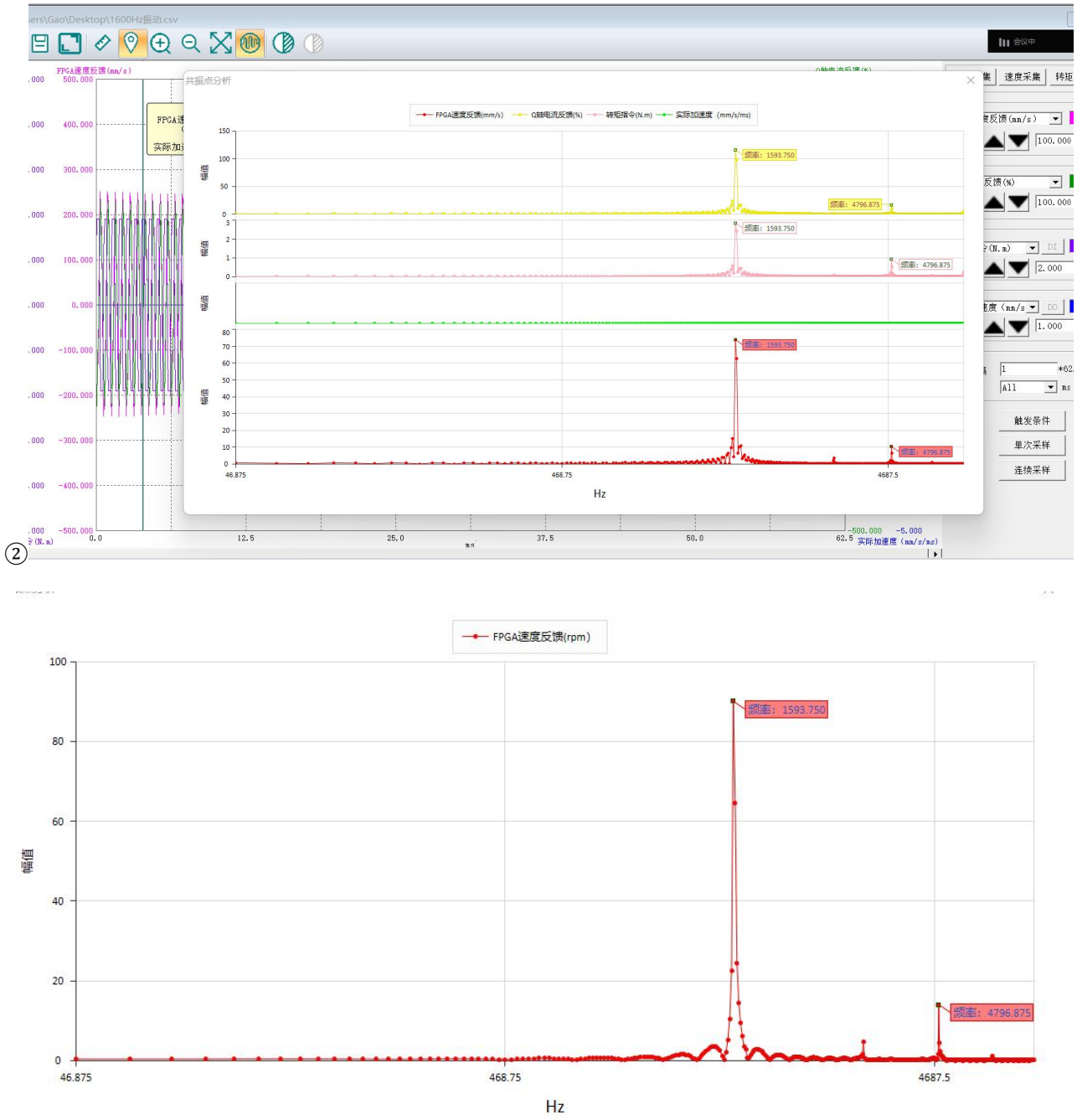


Figure 5-23 Screenshot of Resonance Point Identification Function on Backeground Software

B) Input the resonance frequency obtained in Step A) into notch frequency parameter of a notch filter, and other parameters generally don't need to be set;

通信地址	参数名称	设定值	当前值	出厂值	单位	取值范围
P0710	振动抑制频率1	--	--	5000	Hz	[50, 5000]
P0711	振动抑制带宽1	--	--	2	-	[0, 20]
P0712	振动抑制衰减1	--	--	0	-	[0, 99]
P0713	振动抑制频率2	--	--	5000	Hz	[50, 5000]
P0714	振动抑制带宽2	--	--	2	-	[0, 20]
P0715	振动抑制衰减2	--	--	0	-	[0, 99]
P0716	振动抑制频率3	--	--	5000	Hz	[50, 5000]
P0717	振动抑制带宽3	--	--	2	-	[0, 20]
P0718	振动抑制衰减3	--	--	0	-	[0, 99]
P0719	振动抑制频率4	--	--	5000	Hz	[50, 5000]
P0720	振动抑制带宽4	--	--	2	-	[0, 20]
P0721	振动抑制衰减4	--	--	0	-	[0, 99]
P0722	振动抑制频率5	--	--	5000	Hz	[50, 8000]
P0723	振动抑制带宽5	--	--	2	-	[0, 20]
P0724	振动抑制衰减5	--	--	0	-	[0, 99]
P0725	振动抑制频率6	--	--	5000	Hz	[10, 5000]
P0726	振动抑制带宽6	--	--	2	-	[0, 20]
P0727	振动抑制衰减6	--	--	0	-	[0, 99]

Figure 5-24: Parameter Settings of Notch Filter

If resonance is suppressed, it proves that the notch filter is effective and the gain can be further adjusted. If new resonance occurs after the gain increases, repeat steps A) to B);

If vibration can't be eliminated for a long time, please turn off the servo enable in time to reduce the loop gain.

(3) Low-pass filter

The torque command filtering can be set through the backend debugging software "P07 group filter parameters - torque command filtering time constant".

By setting a filtering-time constant, make the high-frequency range above the cutoff frequency in torque command be attenuated so as to suppress mechanical resonance.

The setting parameter for torque low-pass filtering is the filtering-time constant, with a unit of 0.01ms. The conversion relationship between the filtering-time constant τm and the filter cutoff frequency f_c is:

$$f_c = \frac{1}{2\pi \times \tau_m \times 0.001}$$

5.4 Common Application Scenarios

5.4.1 Load of ball screw

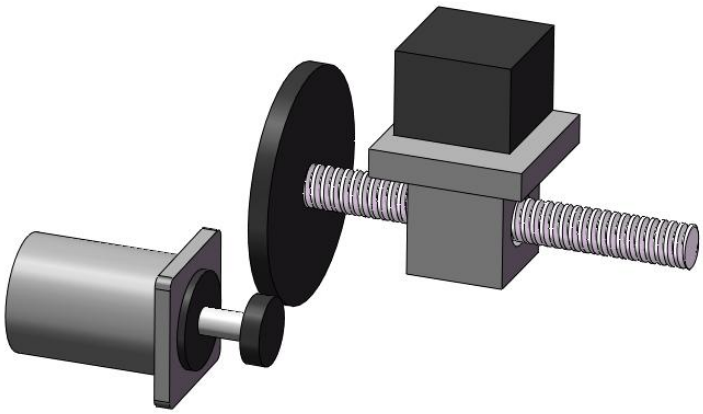


Figure 5-25 Ball screw transmission

(1) Feature of ball screw

Low friction resistance, the difference of dynamic and static friction forces is extremely small, ensure stable movement and avoid low-speed crawling. Low wear, long lifespan, and good precision retention.

After pre-tightening with double nuts, the clearance can be effectively eliminated and transmission stiffness is high.

Low friction loss, high transmission efficiency, up to 90% to 96%.

(2) Debugging precautions

The stiffness of screw load transmission is relatively high, and it is generally easy to adjust. If the inertia ratio is reasonable, only the inertia needs to be identified, and automatic gain adjustment can be performed according to Section 5.2.4 Automatic Gain Adjustment.

If high response performance is required, it is necessary to manually adjust the gain according to Section 5.2.2 Introduction on Manual Gain Adjustment, and even resonance analysis and suppression are required. Refer to Chapter 5.3 Vibration Suppression.

5.4.2 Synchronous Belt Load

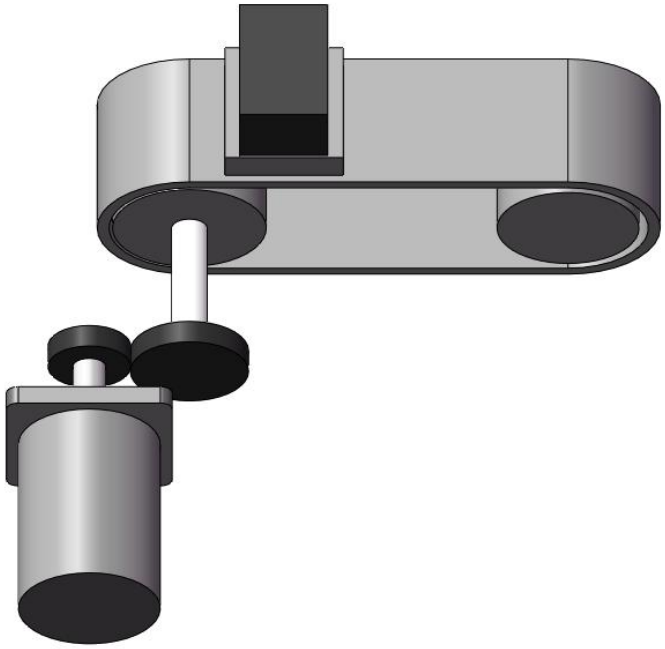


Figure 5-26 Synchronous belt transmission

(1) Feature of synchronous belt transmission

During operation, convex teeth of the synchronous belt mesh with teeth grooves of the belt to transmit motion and power.

During operation, as no sliding exists and and it has accurate transmission ratio, it's called synchronous belt.

High transmission efficiency and good energy-saving effect. It has a high transmission efficiency, generally up to 98%.

Range of transmission ratio is large, the structure is compact, and the rigidity is weak.

(2) Debugging precautions

Short synchronous belt is easy to test. In the case of reasonable inertia ratio, it's only necessary to identify the inertia ratio and perform automatic gain adjustment.

If the synchronous belt is relatively long and has a large inertia, it's prone to overshoot during operation. The requirement for position command forms is high, and position command filtering can be performed under the servo.

5.4.3 Rack and pinion load

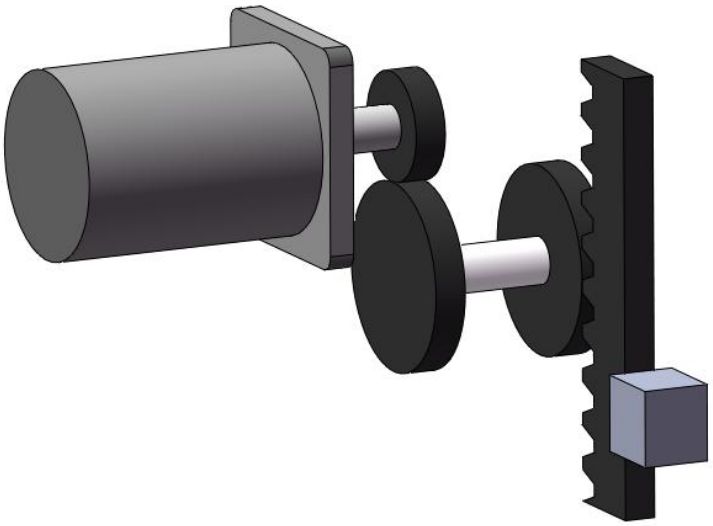


Figure 5-27 Gear and Rack Transmission

(1) Feature of Gear and Rack Transmission

Be able to configure larger reduction ratio, strong load driving capability. Increase output torque by reducing load operating speed.

Backlash of the transmission is big, that may lose partial transmission accuracy.

(2) Debugging precautions

Generally, reducer can effectively reduce the load inertia ratio, so such equipment has a relatively small inertia ratio and is easy to test. Generally, automatic gain adjustment is used.

The installation rigidity of rack at different positions may vary, and the machining accuracy of rack may differ. It's necessary to ensure that no vibration or operating noise occurs in the full-run range.

5.4.4 Inertia disk load

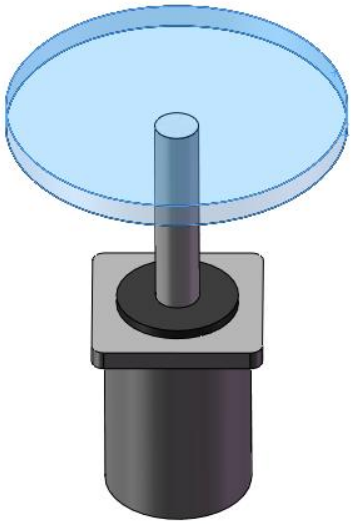


Figure 5-28 Directly connected inertia disk

(1) Load feature of directly connected inertia disk

Directly connected inertia disk load has good transmission accuracy.

Highly synchronized with motor, no backlash, high transmission rigidity.

Anti-resonance frequency is low. Max. bandwidth available of system shall be lower than anti-resonance points, besides being far away from resonance point.

(2) Debugging precautions

As this connection will inevitably bring a large inertia ratio to motor, speed gain can't be set too high.

Vertical installation condition of motor is generally used in indexing control applications, requiring fast and accurate start/stop.For adjustmnet, refer to Gain Switching in Section 5.2.3.

Horizontal installation condition of motor generally has a larger inertia and is more prone to vibration; The gain can't be set too high, that requires resonance analysis and suppression.

5.4.5 Long cantilever load

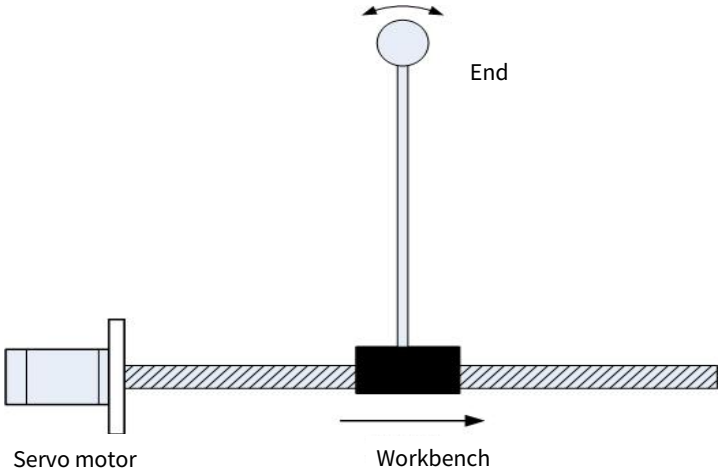
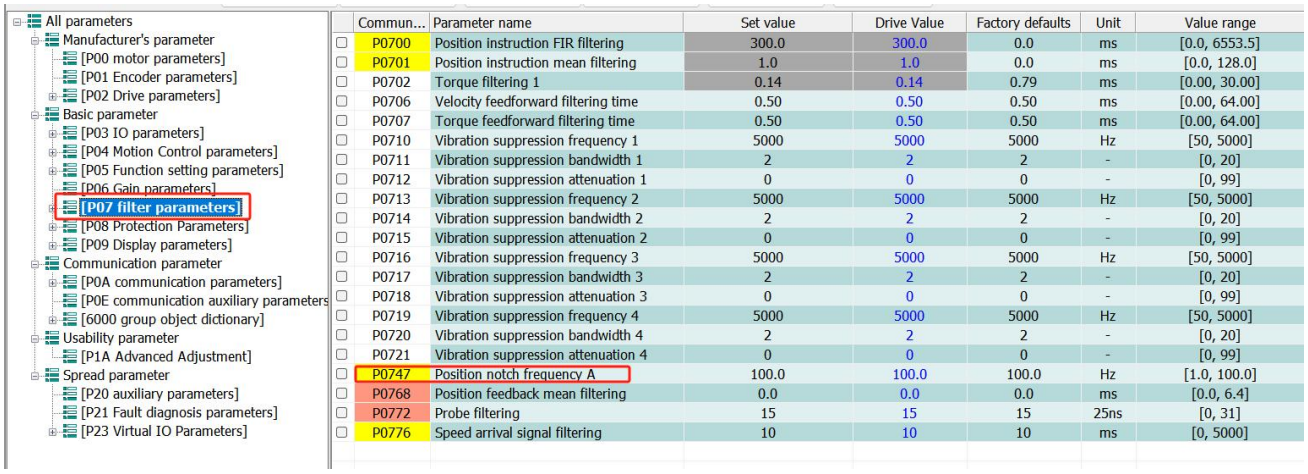


Figure 5-29 Long cantilever load

For long cantilever load, there is usually end jitter or overall equipment swing in high-speed motion. Vibration can be suppressed by eliminating frequency components from position command. SV3 servo provides a damping filter that can effectively suppress end jitter. Parameter "P07 group filtering parameters - position notch frequency A" can be set by the backend software to suppress low-frequency jitter.



Commun...	Parameter name	Set value	Drive Value	Factory defaults	Unit	Value range
P0700	Position instruction FIR filtering	300.0	300.0	0.0	ms	[0.0, 6553.5]
P0701	Position instruction mean filtering	1.0	1.0	0.0	ms	[0.0, 128.0]
P0702	Torque filtering 1	0.14	0.14	0.79	ms	[0.00, 30.00]
P0706	Velocity feedforward filtering time	0.50	0.50	0.50	ms	[0.00, 64.00]
P0707	Torque feedforward filtering time	0.50	0.50	0.50	ms	[0.00, 64.00]
P0710	Vibration suppression frequency 1	5000	5000	5000	Hz	[50, 5000]
P0711	Vibration suppression bandwidth 1	2	2	2	-	[0, 20]
P0712	Vibration suppression attenuation 1	0	0	0	-	[0, 99]
P0713	Vibration suppression frequency 2	5000	5000	5000	Hz	[50, 5000]
P0714	Vibration suppression bandwidth 2	2	2	2	-	[0, 20]
P0715	Vibration suppression attenuation 2	0	0	0	-	[0, 99]
P0716	Vibration suppression frequency 3	5000	5000	5000	Hz	[50, 5000]
P0717	Vibration suppression bandwidth 3	2	2	2	-	[0, 20]
P0718	Vibration suppression attenuation 3	0	0	0	-	[0, 99]
P0719	Vibration suppression frequency 4	5000	5000	5000	Hz	[50, 5000]
P0720	Vibration suppression bandwidth 4	2	2	2	-	[0, 20]
P0721	Vibration suppression attenuation 4	0	0	0	-	[0, 99]
P0747	Position notch frequency A	100.0	100.0	100.0	Hz	[1.0, 100.0]
P0768	Position feedback mean filtering	0.0	0.0	0.0	ms	[0.0, 6.4]
P0772	Probe filtering	15	15	15	25ns	[0, 31]
P0776	Speed arrival signal filtering	10	10	10	ms	[0, 5000]

Figure 5-30: Screenshot of the upper computer for function code "position notch frequency"

There are 2 ways to obtain jitter frequency:

Obtain the end jitter frequency of mechanical load by external sensor, as Figure 5-31 shown;

By waveform of the backend software, obtain end jitter frequency of motor,as Figure 5-32 shown.

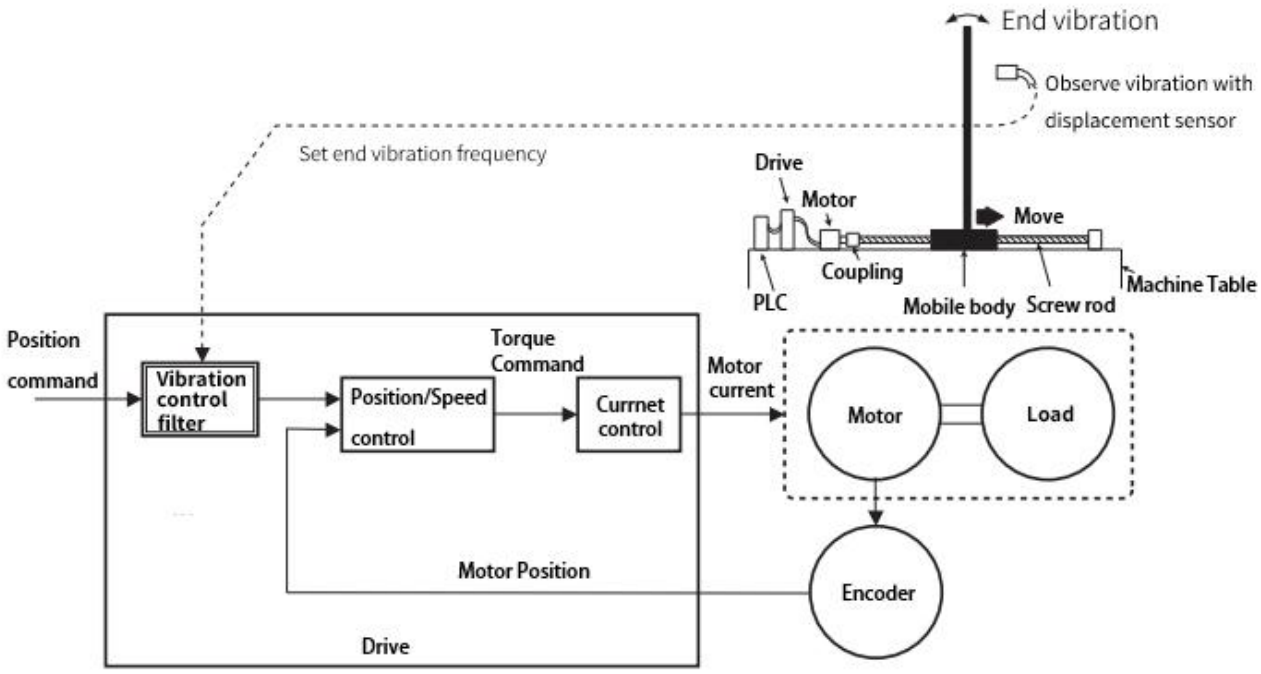


Figure 5-31 Method for acquisition and suppression of \Vibration Frequency of Long Cantilever Load

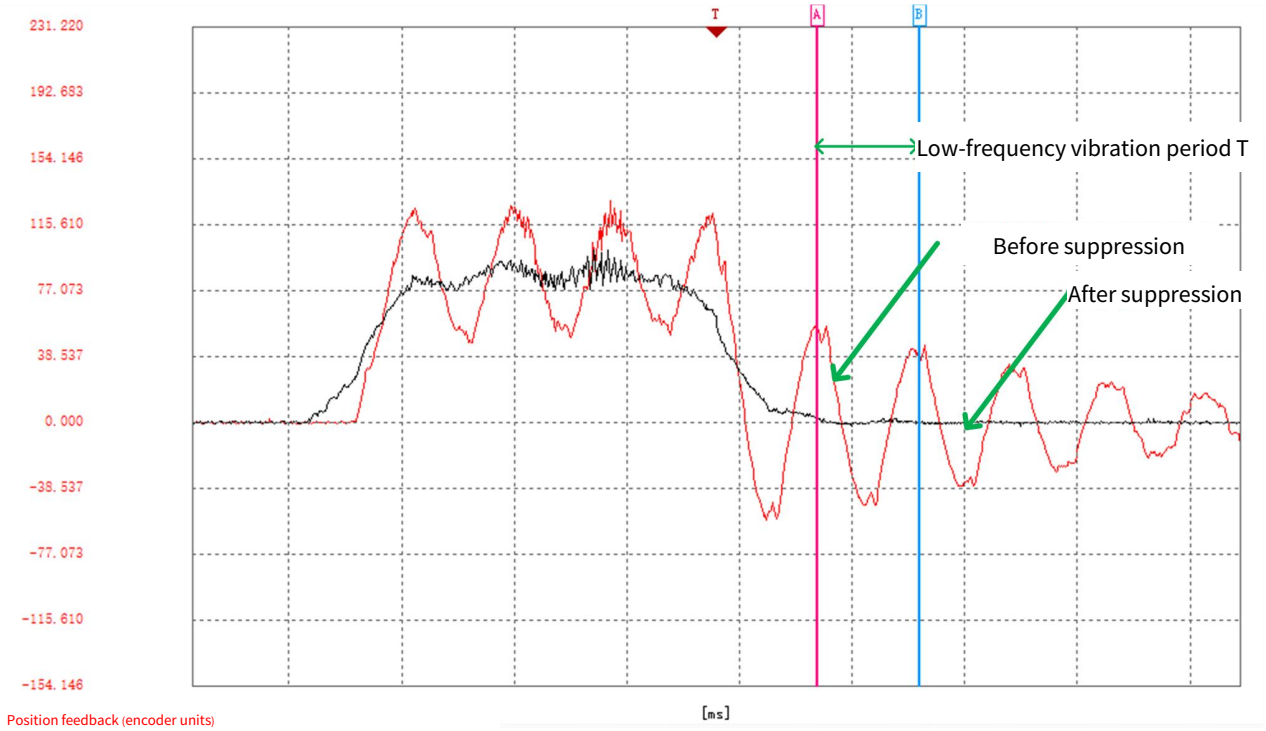


Figure 5-32 Vibration frequency acquisition and comparison of before-and-after suppression effects of long cantilever load

After measuring the low-frequency vibration period by the background, the low-frequency resonance frequency can be calculated by f=1/T, and Parameter "P07 group filtering parameters - position notch frequency A" can directly be set. Note that the unit of this parameter is 0.1Hz.

Chapter 6 Troubleshooting and Alarm

6.1 Display and Review

Alarm of SV3 servo consists of Error and Alarm. The main difference is that when a Error occurs, the servo will stop ; When a Alarm occurs, the servo can still run normally. According to the display of Error or Alarm on the panel, detailed description and solutions for corresponding Error or Alarm can be found in this manual.

After power-on, if the servo panel is off or “rdy” is not displayed at the last 3 digits, possible causes and solutions are as follows:

Table 6-1 Troubleshooting for the Error that the power-on servo is not ready

Serial No.	Error cause	Confirmation method
1	Error of control power supply voltage	After CN1, CN3, CN4, and CN5 are removed, the Error still exists. Measure AC voltage between L1C and L2C.
2	Error of main power supply voltage	Check whether 220V AC/380V AC power supply for drives is normal per specifications.
3	Servo drive Error	Contact the manufacturer for after-sales service.

After power-on, when the servo has any Error or Alarm, the panel will present the corresponding display. Herein, definitions of the display are as follows:

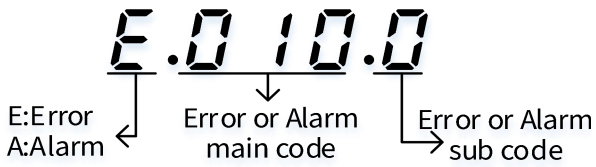


Figure 6-1 Error display sample

For example, if E.0 10.0 is displayed on panel, it presents that servo drive has Error. The Error main code is 0x010, and the Error subcode is 0x0. The panel displays A.2 18.0, i.e., Alarm has occurred on the servo drive. Main code of the Alarm is 0x218 and its sub-code is 0x0.

After above Errors are rectified, “rdy” shall be displayed in the last 3 digits of panel.

SV3 servo drive has Error logging function which can record the last 10 Errors and Alarm names, and the status parameters of servo drive when the Error or Alarm occurred. If repeated Errors or Alarms occurred in the last 5 times, the Error or Alarm code(i.e., drive status) is recorded only once.

After Error or Alarm is reset, the Error and Alarm are still saved in the Error record. By Error & Alarm management module in SV3 Designer, it can review and clear the records. For details, see the SV3 Designer instruction.

In addition, by Error & Alarm management module in SV3 Designer, it can review the detailed information of present Error and reset it.

6.2 Error Code Overview

Table 6-2 List of error codes

Error code	Error name	Reset or not
E.010	Software parameter Error	×
E.011	Error of software internal communication initialization	×
E.012	Error of software version not matching the product model	×
E.013	Error of software internal interrupt timeout	×
E.014	Error of software internal communication timeout	×
E.015	Error of current sampling timeout	×
E.016	Error of torque instruction update timeout	×
E.017	Error of parameter storage	×
E.018	Error of out-of-range parameters	×
E.019	Product matching Error	×
E.210	Error of hardware overcurrent	×
E.211	Error of output short-circuit to GND	×
E.212	Error of UVW phase sequence	×
E.213	Overrun Error	×
E.214	Error of control power supply undervoltage	×
E.216	STO Error	√
E.217	Error of input phase loss	√
E.218	Error of servo emergency stop	√
E.219	Error of drive overtemperature	√
E.227	Error of output phase loss	√
E.228	Error of abnormal precharge	√
E.228	Error of abnormal precharge	√
E.411	Error of DI allocation	√
E.412	Error of DO allocation	√
E.413	Error of current calculation overflow	√
E.414	Error of DC bus undervoltage	√
E.415	Error of DC bus overvoltage	√
E.416	Overspeed Error	√
E.417	Error of startup overspeed	√
E.418	Error of server repeatedly enabled	√
E.419	Error of drive overload	√
E.420	Error of excessively-high frequency of frequency division output	√
E.421	Error of electronic gear ratio setting	√
E.422	Error of fully closed loop parameters	√
E.423	Error of excessively large position deviation	√
E.424	Error of position instruction overspeed	√
E.430	Error of gantry compensation data overflow	√
E.710	Overspeed Error	√
E.711	Error of inertia identification	√

Error code	Error name	Reset or not
E.712	Error of magnetic pole identification	√
E.715	Error of motor parameter identification	√
E.716	Error of gain self-adjusting	√
E.910	Error of encoder parameters	×
E.911	Error of encoder communication	×
E.912	Error of encoder parameter verification error	×
E.913	Error of encoder 3-phase Hall logic error	×
E.914	Error of encoder disconnected	×
E.916	Error of encoder disconnected	√
E.917	Error of encoder battery	√
E.918	Error of rncoder multi-turn count	√
E.919	Error of encoder multi-turn counter overflow	√
E.922	Encoder overheating Alarm	√
E.B10	Error of motor overload	√
E.B11	Error of motor stall	√
E.B13	Error of motor vibration	√
E.B14	Running exception detection	√
E.B15	Error of motor PTC	√
E.D15	Error of upper/lower soft limit settings	√
E.D16	Origin bias out of soft limit range	√

⚠ Note:

“√” indicates that this Error can be reset. For details about Error reset, see 6.5 Alarm Handling. It should be noted that any Error can be successfully reset only if its source has been removed.

“×” indicates that this Error can't be reset and must be powered on and off again.

6.3 Alarm Code Overview

All Alarms can be reset automatically after the Alarm conditions have been removed. Or press any key on the control panel to reset.

Table 6-3 List of alarm codes

Alarm code	Alarm name
A.220	Positive direction overtravel Alarm
A.221	Negative direction overtravel Alarm
A.222	Alarm of input phase loss
A.224	Alarm of regenerative resistor overload
A.225	Alarm of brake resistance disconnected
A.226	Alarm of excessively small external regenerative resistance
A.227	Alarm of output phase loss
A.425	Alarm of Home failure
A.426	Alarm of power ON/OFF reset
A.427	Alarm of parameter storage exception
A.428	Alarm of frequency divider output setting error
A.920	Encoder exception Alarm
A.921	Alarm of low voltage of encoder battery
A.922	Alarm of encoder overheating
A.928	ABZ encoder feedback overclock

6.4 Troubleshooting

Table 6-4 Troubleshooting list

Error codes and their descriptions	Error cause	Handling measures
E.010.0 Factory parameter verification is abnormal	1. Software has been updated. 2. An instant power-off occurs during parameter storage. 3. Number of write times exceeds Max. value within a certain period. 4. Error of servo drive.	1. Restore factory parameters (P0501=1). 2. Power on again, after initialization of system parameters (P0501=1), re-write parameters. 3. Change the parameter writing method. 4. Replace the servo drive.
E.011.0 Software internal communication initialization is abnormal.	1. Software versions of FPGA and MCU are inconsistent. 2. FPGA Error.	1. Consult our technical support to update the matching FPGA or MCU software. 2. Contact technical support of the manufacturer.
E.012.0 Software version doesn't match the product model	1. FPGA version is too low. 2. FPGA Error.	1. Update the matching FPGA or MCU software. 2. Contact technical support of the manufacturer.
E.013.0 FPGA interruption is lost	1. FPGA Error. 2. Handshake between FPGA and MCU is abnormal. 3. Dive internal calculation timeout.	1. Replace the servo drive. 2. Contact technical support of the manufacturer.
E.014.0 Communication between MCU and FPGA timeout	1. MCU communication timeout. 2. Encoder communication timeout.	1. Use our standard motor cable and encoder cable. 2. Check whether cable connection is damaged. 3. Separate high voltage cable and weak current cable.
E.015.0 Current chip sampling timeout	1. Check if output power line is broken or in poor contact. 2. Current sampling timeout.	1. Use our standard motor cable and encoder cable. 2. Check whether cable connection is damaged. 3. Separate high voltage cable and weak current cable.
E.016.0 Torque instruction update timeout	1. Servo drive Error.	1. Replace the servo drive. 2. Contact technical support of the manufacturer.
E.017.0 Parameter storage writing is abnormal.	1. EEPROM data Error.	1. After system parameters are initialized (P0501=1), power it on again. 2. Replace the servo drive.
E.018.0 Factory parameters are out of range	1. Software is updated; Present value of function code exceeds the allowed range. 2. EEPROM Error. 3. Servo drive Error.	1. Power it on again, after initialization of system parameters (P0501=1), re-write parameters. 2. Replace the servo drive.
E.019.0 Encoder matching Error	1. Product No.(motor or drive) doesn't exist. 2. Power levels of motor and drive don't match.	1. Replace the mismatched products according to "Supporting Equipment Specification of Servo System".
E.210.0 P/N phase overflow	1. Brake resistance is too small or short circuit. 2. Motor cable is in poor contact or short-circuited. 3. Motor cable isn't properly grounded. 4. Motor burned out.	1. Select an appropriate brake resistance and set related parameters according to the specification. 2. Check if motor cable is properly connected and if there is short circuit, poor contact, or no grounding. 3. Check if encoder cable is damaged.

Error codes and their descriptions	Error cause	Handling measures
	5. Improper gain parameter settings, motor vibration. 6. Encoder cable Error.	4. Re-adjust the gain. 5. Replace the motor.
E.211.0 Output short-circuit to GND causes bus overvoltage	1. Drive power line(UVW) is short-circuited to GND. 2. Motor is short-circuited to GND. 3. Servo drive Error. 4. Bus voltage discharge(P0219) is set too low.	1. Reconnect or replace drive power cable. 2. Replace the motor. 3. Set the bus voltage release point (P0219) correctly.
E.212.0 UVW phase sequence Error	1. When the drive performs angle identification, UVW phase sequences of driver and motor doesn't match.	1. Connect UVW cables in the correct phase sequence.
E.213.0 Overrun Error	1. UVW phase sequence wiring Error. 2. Power-on interference causes the rotor initial phase error. 3. The encoder model is incorrect or wiring is wrong. 4. Under working condition of vertical axis, gravity load is excessive.	1. Connect UVW cables in the correct phase sequence. 2. Power on/off it again and re-start angle self-learning. 3. Replace the driver and motor that match mutually, and set motor model properly. 4. Check if encoder and motor cables are properly connected. 5. Reduce loads on vertical axis, or improve the rigidity, or shield this Error without affecting safety and use.
E.214.0 Undervoltage of control power supply	1. Power supply voltage is unstable or it powers off. 2. Control line in poor contact.	1. Check the wiring or replace cables. 2. Power on it again. For abnormal power-off, ensure that power supply is stable. 3. Increase the power capacity.
E.216.0 STO disconnected	1. STO disconnected causes STO valid.	1. STO wiring is correct. 2. Replace the servo drive.
E.217.0 One phase loss of 3-phase input	1. Per 3-phase specification input drive is connected to single-phase input. 2. 3-phase power input cable is in poor contact. 3. 3-phase voltage is unbalanced or the 3-phase voltage is too low.	1. Check the wiring of 3-phase power supply. 2. 3-phase drive and allow single-phase operation (below 1kW), switch off the alarm (set P0800=2).
E.218.0 Error of servo emergency stop	1.DI function 2: Emergency stop is triggered. 2. Background communication emergency stop is triggered.	1. Check the operating mode, and on the premise of safety remove the effective signal of DI brake(after the effective scram signal is removed, the Error is automatically reset).
E.219.0 Error of drive overtemperature	1. Ambient temperature is too high. 2. After overload, power off to reset the overload Error, and repeat it for several times. 3. Fan is damaged and can't work normally. 4. It's unreasonable of installation direction of servo drive and interval between the servo drive and other servo drives.	1. Improve cooling conditions of servo drive and reduce the ambient temperature. 2. Change Error reset method. Wait 30 seconds after overload, and then reset again. Increase the capacity of drive and motor, increase acceleration/deceleration time, and reduce the load. 3. Install servo drive per installation standard. 4. Replace the servo drive.
E.227.0 Phase loss of UVW output	1. U/V/W phase power line of motor is broken.	1. Check the power cable connection of the motor, reconnect the cable, and replace the

Error codes and their descriptions	Error cause	Handling measures
		cable if necessary.
E.228.0 Preloaded relay is not drawn	1. The hardware is damaged.	1. Replace the servo drive. 2. Contact technical support of the manufacturer.
E.228.0 Open circuit of precharge resistor	1. Open circuit of precharge resistor	1. Contact the factory for technical support.
E.411.0 DI function is allocated repeatedly	1. When DI function is allocated, the same function is allocated to multiple DI terminals.	1. Re-allocate DI function to avoid duplication.
E.412.0 Allocation of DO function is out of range	1. DO functio codes exceed number of DO functions.	1. Restore factory parameters and power on/off it again.
E.413.0 Error of current calculation overflow	1. DQ axis current overflows.	1. Restore factory parameters and power on/off it again. 2. Replace the servo drive.
E.414.0 Error of DC bus undervoltage	1. Power supply of main loop is unstable or power=off. 2. Instantaneous power failure occurs. 3. Power supply voltage drops during operation. 4. Per 3-phase specification input drive is connected to single-phase input.	1. Adjust or replace the power supply per the specification of input power supply. 2. Increase the power capacity. 3. Shield phase loss Error detection.
E.415.0 Error of DC bus overvoltage	1. Input voltage of main loop is excessive. 2. Power supply is unstable or affected by lightning strike. 3. Brake resistance fails. 4. External brake resistance is too large, and Max. braking energy can't be fully absorbed. 5. The sampled bus voltage has a large deviation. 6. The motor runs in high acceleration/deceleration, and Max. braking energy exceeds the absorbable value.	1. Adjust or replace the power supply per the specification of input power supply. 2. Connect the surge suppressor. 3. Select the appropriate external brake resistance per the specification of external brake resistor. 4. Increase the acceleration/deceleration time if possible.
E.416.0 Speed exceeds Max. RPM	1. Error of U/V/W phase sequence of motor cable. 2. Motor or encoder parameters are set improperly, e.g., pole-pair number, encoder resolution. 3. Motor Angle identification is not done. 4. Input command exceeds the overspeed threshold. 5. Motor speed closed-loop overshoot.	1. Perform the wiring in the proper U/V/W phase sequence. 2. Set motor parameters or encoder resolution properly. 3. Increase the power capacity. 4. Re-adjust the gain. 5. On the premise of the demand satisfied, reduce electronic gear ratio. 6. Set speed threshold within overspeed threshold.
E.417.0 Starting speed is higher than rated speed	1. When the drive is enabled, actual motor speed is higher than rated speed.	1. Reset the Error, reduce the actual speed, and re-operate the motor.
E.418.0 The servo is enabled	1. When internal function is enabled, communication servo	1. Switch off servo enable signal of upper computer.

Error codes and their descriptions	Error cause	Handling measures
repeatedly	enable is valid.	
E.419.0 Error of drive overload	1. Error of parameter settings. 2. Drive load rate is excessive, load inertia is too large or the machine is stuck. 3. Error of motor stall.	1. Set P0102 per the drive model. 2. Adjust parameters per the current feedback. 3. Replace it with a drive of larger power. 4. Adjust the machine to remove problems of the machine stuck. 5. Refer to E.B11.0 troubleshooting method.
E.420.0 Error of excessively-high frequency of frequency division output	1. Output pulse frequency exceeds upper limit of hardware frequency allowed(4MHz for a single channel).	1. Reduce the number of frequency division output pulses (P1316) of encoder. 2. Use twisted-pair shielded wire to prevent interference pulses from superimposing on real pulses, that might result in false alarm.
E.421.0 Error of local electronic gear ratio setting	1. Electronic gear ratio settings exceed the above range. 2. Parameter change sequence	1. Set gear ratio according to the range specification of electronic gear ratio. 2. Use the Error reset function or power it on again.
E.422.0 Full closed-loop can't switch internal and external loops in the multi-stage absolute position mode	1. In full closed-loop position mode, the source of position instruction is internal position instruction, but use internal/external ring switching mode.	1. When the full closed-loop function is used, and the position instruction source is internal, only the external encoder feedback mode can be used, i.e., P2200 can only be 1.
E.423.0 Internal-ring position deviation is excessive	1. Drive U/V/W output loses phase or phase sequence is connected inproperly. 2. Drive U/V/W output is disconnected or the encoder is disconnected. 3. Motor stall from mechanical factors. 4. Low servo drive gain. 5. Increment of position instruction is excessive. 6. Deviation threshold 6065h/P0806 is too small. 7. Error of servo drive/motor.	1. Re-connect the cable properly, or replace it. 2. Re-connect the cable, replace it with brand-new one, if necessary, and ensure that it's reliably connected. 3. Exclude mechanical factors. 4. Adjust the gain manually or automatically. 5. Increase acceleration/deceleration ramp of position instruction. 6. Increase the deviation threshold 6065h/P0806. 7. Replace servo drive or motor.
E.424.0 Position instruction has double overspeed for several times	1. Increment of position instruction is excessive. 2. Target position (607A target position) isn't aligned with the present position prior to mode switching or when the servo is enabled. 3. Synchronization loss which causes excessive accumulation of position instructions. 4. Motor speed limit error.	1. Reduce the increment of target position instruction. 2. Assign the value of present position to target position (607A target position) prior to mode switching or when the servo is enabled. 3. Confirm if Max. speed of motor meets the application requirement.
E.430.0 Write overflow of Gantry compensation data	Reserved	Reserved

Error codes and their descriptions	Error cause	Handling measures
E.710.0 Overflow of FPGA internal speed measured	1. Overflow of FPGA internal speed measured calculation .	1. Check and confirm that encoder cable is properly connected. 2. Power it on/off again and re-try it. 3. Replace motor or drive.
E.711.0 Error of offline inertia identification	1. Offline inertia identification is uncompleted.	1. Contact the factory for technical support.
E.712.0 Error of magnetic pole identification	1. Failure of initial magnetic pole angle identification of motor.	1. Dis-connect motor shaft and re-identify the angle.
E.715.0 Exception of parameter identification result	1. Identification result is 0	1. Contact the factory for technical support.
E.716.0 Self-adjust gain is too small	1. Self-adjust gain is too small	1. Execute self-adjustment again; 2. Contact technical support of the manufacturer.
E.910.0 Exception of encoder parameter verification during power-on	1. Models of drive and motor don't match. 2. Parameter verification error or no parameter stored in bus incremental encoder ROM.	1. Replace with a matching drive and motor. 2. Check the encoder cable, please use our company standard encoder cable. 3. Separate encoder cable from power cable.
E.911.0 (Detailed definition on pending)	1. ault of encoder wiring. 2. Encoder cable is loose. 3. Encoder Z signal is interfered (EMC issues). 4. Encoder Error.	1. Re-connect cables per the wiring diagram. 2. Re-connect cables, and ensure that encoder terminals are firmly connected. 3. Use standard encoder cables of our company. 4. Replace the servo motor.
E.912.0 Error of encoder parameter verification	1. Bus incremental encoder cable is broken or loose. 2. Exception of Read/Write parameters of bus incremental encoder.	1. Check if encoder cable is improperly connected, broken, or in poor contact. 2. Separate encoder cable from power cable. 3. Replace the servo motor.
E.913.0 Error of reading initial angle during power-on initialization	1. Models of drive and motor don't match. 2. The encoder cable is broken.	1. Replace with a matching motor and drive. 2. Replace with quality encoder cable and fix it firmly.
E.914.0 Z signal line is broken	1. Encoder Error causes Z signal loss. 2. Poor wiring connection or wrong connection causes encoder Z signal loss.	1. Replace the servo motor. 2. Check if the encoder cable is in proper contact, and re-connect or replace the cable.
E.916.0 Wire of full closed-loop grating ruler is broken	1. Frequency division output isn't disabled. 2. While using the full closed-loop function or non-standard pulse input, level difference of 2-way signals of any group A+/A-, B+/B-, Z+/Z- does not meet the requirement: Level difference is greater than or equal to 2V.	1. Set P1315 value as 2 (frequency division or synchronous output disabled). 2. Adjust the level until it meets the specification.
E.917.0 Error of encoder battery	1. Absolute encoder isn't connected any battery during power-off. 2. Voltage of encoder battery is too low.	1. Reconnect the battery or replace with a new battery. 2. Set P2005 as 1 and clear the Error.

Error codes and their descriptions	Error cause	Handling measures
E.918.0 Error of rncoder multi-turn count	1. Encoder Error.	1. Set P2005-2 to clear the Error and power on it again. 2. Replace the motor.
E.919.0 Overflow of encoder multi-turn counter	1. As for overflow of absolute value encoder multi-turn count, only if multi-turn value is 32767 or 32768, it would report Error. This Error is reported by servo drive detection, not encoder.	1. Set P2005=2 to clear multiple-turn data of encoder and power on it again.
E.922.0 Encoder overheating Alarm	1. Temperature of encoder is too high.	1. The drive stops for a period. 2. Ensure the encoder is well ventilated to reduce environmental temperature.
E.B10.0 Error of motor overload	1. Wiring of motor or encoder is wrong and bad contact. 2. Load is too heavy; Effective output torque of motor exceeds the rated torque, and runs continuously for a long time. 3. Acceleration and deceleration are too frequent or load inertia is too large. 4. Gain adjustment is unsuitable or rigidity is too strong. 5. Setting of drive or motor model is wrong. 6. Motor is stalled from mechanical factor, resulting in excessive load during operation.	1. Set parameters of drive model and motor model properly. 2. Check the wiring by our company's standard wire and according to wiring diagram. 3. Replace large-capacity drive and the matching motor, or reduce load to increase acceleration/deceleration time. 4. Increase acceleration/deceleration time in a single run. 5. Re-adjust the gain. 6. Exclude mechanical factor.
E.B11.0 Motor stall protection	1. Phase missing, broken wire, phase sequence connection error of drive U/V/W output. 2. Motor parameters are set impropery, e.g., number of pole-pairs. 3. Motor Angle identification is not done. 4. Communication command is interfered. 5. Motor is stalled from mechanical factor.	1. Re-connect the cable properly, or replace it. 2. Set motor parameters properly. 3. Check if communication line between upper computer and the servo is interfered. 4. Exclude mechanical factors, Check if motor stall occurs, occasionally stall and eccentric situation.
E.B13.0 Excessive motor vibration	1. Motor vibration is excessive	1. Adjust gain parameters 2. Start vibration suppression
E.B14.0 Position exception detection		
E.B15.0 Thermistor line is broken or thermistor is disconnected	1. Thermistor line is broken or thermistor is disconnected	1. Check thermistor and its wires
E.D15.0 Error of upper/lower soft limit settings	1. Software lower limit is equal to or greater than the upper limit.	1. Reset parameters; Ensure that 607D-01h is smaller than 607D-02h(P0B45 is smaller than P0B47).
E.D16.0 Origin bias out of soft limit range	1. The origin is offset out of soft position limit.	1. Reset the parameters of 607D-01h and 607D-02h (P0B45/P0B47) reasonably.

6.5 Alarm Handling

Table 6-5 Alarm handling list

Error codes and their descriptions	Error cause	Handling measures
A.220.0 Positive overtravel Alarm	1. Positive limit input is valid.	1. On the premise of confirming safety, give the motor a negative command to invalidate the positive limit.
A.221.0 Negative overtravel Alarm	1. Negative limit input is valid.	1. On the premise of confirming safety, give the motor a positive command to invalidate the negative limit.
A.222.0 Alarm of input phase loss	1. Phase loss of 3-phase power input.	1. Check the wiring of 3-phase power supply. 2. 3-phase drive and allow single-phase operation (below 1kW), switch off the alarm (set P0800=2).
A.224.0 Brake resistor overload	1. Wiring of external brake resistor is improperly. 2. While using built-in brake resistor, power terminals P/D are disconnected. 3. Erros of such parameters as brake resistor type, resistance and power. 4. Input voltage of main loop exceeds the specification. 5. Load moment of inertia ratio is excessive. 6. Motor has been in the deceleration for a long period. 7. Capacity of servo drive or brake resistor capacity is insufficient.	1. Check if wiring of external brake resistor is proper. 2. While using the built-in brake resistor, connect P/D terminals properly. 3. Set the parameters of brake resistor propertly. 4. Per the specification, select the appropriate brake resistance. 5. Use the appropriate power input per the specification. 6. Reduce the load, or increase acceleration/deceleration time, or increase the operation cycle.
A.225.0 Software detects that the brake resistor is disconnected	1. Brake discharge resistor is disconnected, or P/RB terminals are not short-circuited;	1. Check the connection of brake resistor.
A.226.0 External brake resistance is too small	1. While using external brake resistor, external brake resistance is less than Min.value by the specification.	1. Per the specification, select the appropriate brake resistor, and connect it properly between P/C. 2. Set the parameters of external brake resistor properly.
A.227.0 Alarm of output phase loss warning	1.The motor power line is disconnected	1. Check the wiring of the motor power cable, rewire it, and replace the cable if necessary.
A.425.0 Alarm of the origin zero timeout	1. Error of the home switch. 2. Search time for the origin is too short. 3. Switch signal speed of high-speed search for the origin is too small. 4. Switch setting is unreasonable.	1. If hardware DI is used, ensure that DI Function 11 is configured in P03h group, and then check if wiring of DI terminal is normal; Error in the origin return operation was found, and operate this function correctly. If virtual DI is used, check if VDI handling process is proper. 2. Increase the origin search time P1349. 3. Increase return-to-zero high-speed 6099-01h. 4. Set hardware switch position reasonably.

A.426.0 Alarm of power ON/OFF reset	1. After the parameters are changed, only when power ON/OFF again, can parameters be valide.	1. Power it ON/OFF again.
A.427.0 Alarm of parameter storage exception	1. Write data into EEPROM very frequently and abundantly.	1. Reduce unnecessary parameters written into EEPROM. 2. Set 2005-0Bh of 0 and do not store parameters into EEPROM.
A.428.0 Error of frequency division output setting	1. While using output function (P1315=0) of encoder frequency division, pulse number (P1316) setting of encoder frequency division doesn't meet the range requirement.	1. Reset the pulse number (P1316) of encoder frequency division so as to satisfy the specified range.
A.713.2 Sampling error Alarm	1. Contact the factory for technical support.	1. Parameter identification can be performed repeatedly. 2. Contact technical support of the manufacturer.
A.713.3 Check the error Alarm of positive edge	1. Contact the factory for technical support.	1. Parameter identification can be performed repeatedly. 2. Contact technical support of the manufacturer.
A.713.4 Check overshoot error Alarm	1. Contact the factory for technical support.	1. Parameter identification can be performed repeatedly. 2. Contact technical support of the manufacturer.
A.713.5 Alarm of Q-axis current steady state error test	1. Contact the factory for technical support.	1. Parameter identification can be performed repeatedly. 2. Contact technical support of the manufacturer.
A.713.6 Alarm of D-axis current steady state error test	1. Contact the factory for technical support.	1. Parameter identification can be performed repeatedly. 2. Contact technical support of the manufacturer.
A.920.0 Encoder internal algorithm error	1. The encoder zero search algorithm fails. 2. Error of frequency division counting algorithm of encoder.	1. Power on/off the servo drive again. 2. Replace the servo motor.
A.921.0 Encoder battery voltage is too low	1. Battery voltage of absolute encoder is lower than 3.0V.	1. Replace it with the new matching battery.
A.922.0 Alarm of encoder Overheating	1. The temperature of the encoder is too high.	1. The drive stops running for a period of time. 2. Ensure good ventilation of the encoder and reduce ambient temperature.
A.D35.0 Homing method P13.45 parameter setting error	1. The homing method is set incorrectly.	1. Correctly set P13.45 (does not support zeroing methods such as 15/16/31/32).
nr Servo not ready	1. Control loop voltage is too low; 2. Bus voltage of power loop is too low; 3. Exception of encoder feedback;	1. Confirm that AC power supply of the drive is normal per the specification. 2. Remove the motor structure being reversed, or replace the motor encoder.

6.6 Resetting Methods

There are 2 ways as follows to reset Errors and Alarms of SV3 servo:

- Set parameter P20.03 = 1 to reset.
- Reset via DI input (Function 5, Error reset);

Herein, for Error reset, the servo should be disabled first, and then the Error reset signal is sent; For Alarm reset, the Error reset signal can be directly sent. The premise for Error reset is that Error condition has been removed. After the Alarm condition is removed, the Alarm will automatically reset.

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Chapter 7 Object Dictionary

7.1 Allocation List of Function code

Parameter	Name	Property	Unit	Range	Default	Setting mode	Enable mode
00 Motor Parameter							
P0003	Motor property	RW	-	0~65535	0	Stop change	Immediate effect
P0005	Check the motor temperature sensor settingsCheck the motor temperature sensor settings	RW	-	0: No sensor 1: PTC (Thermistor) 2: NTC (Thermistor) 3: Thermostat (switch type)	0	Stop change	Power-on reset
P0010	Rated voltage of motor	RW	V	0:220V 1:380V	0	Stop change	Power-on reset
P0011	Rated current of motor	RW	0.01A	0~65535	100	Stop change	Power-on reset
P0012	Rated power of motor	RW	0.01kW	0~65535	75	Stop change	Power-on reset
P0013	Rated torque	RW	0.01Nm	0~4294967295	239	Stop change	Power-on reset
P0017	Rated speed	RW	rpm	0~65535	3000	Stop change	Power-on reset
01 Encoder Parameter							
P0100	Encoder communication protocol	RW	-	0~65535	11233	Stop change	Power-on reset
P0103	Encoder version No.	RO	-	0~65535	0	Display	Immediate effect
P0105	Encoder wire count	RW	-	0~4294967295	1048576	Stop change	Power-on reset
02 Driver Parameter							
P0200	MCU software version No.	RO	-	0~65535	0	Display	Immediate effect
P0201	FPGA software version No.	RO	-	0~65535	0	Display	Immediate effect
P0202	MCU non-standard No.	RO	-	0~4294967295	0	Display	Immediate effect
P0204	FPGA non-standard No.	RO	-	0~4294967295	0	Display	Immediate effect
P0212	Drive input voltage	RO	-	0~65535	220	Display	Immediate effect
P0213	Drive rated power	RO	0.01kW	1~65535	75	Display	Immediate effect
P0215	Drive rated current	RO	0.01A	1~65535	550	Display	Immediate effect
P0234	Regenerative resistance selection	RW	-	0: Built-in regenerative resistor 1: External regenerative resistance,	0	Stop change	Immediate effect

Parameter	Name	Property	Unit	Range	Default	Setting mode	Enable mode
				natural cooling			
				2: external regenerative resistance, forced air cooling			
				3: No regenerative resistance			
P0235	Heat radiation coefficient of regenerative resistance	RW	-	10~100	30	Stop change	Immediate effect
P0236	Built-in regenerative resistor power	RO	W	1~65535	40	Display	Immediate effect
P0237	Built-in regenerative resistance	RO	Ω	1~1000	50	Display	Immediate effect
P0238	Min. external regenerative resistance	RO	Ω	1~1000	40	Display	Immediate effect
P0239	External regenerated resistor power	RW	W	1~65535	40	Stop change	Immediate effect
P0240	External regenerative resistance	RW	Ω	1~1000	50	Stop change	Immediate effect
03 IO Parameter							
P0300	DI1 function	RW	-	0: no definition	9	Stop change	Immediate effect
				1: Servo enabled			
				2: Emergency shutdown			
				3: Command forbidden			
				4: Position deviation cleared			
				5: Reset the Error			
				6: Zero speed retention			
				7: Positive jogging			
				8: Negative jogging			
				9: Positive limit			
				10: Negative limit			
				11: Home switch			
				12: Home enabled			
				13: Speed limit selection			
				14: Positive torque limit selection			
				15: Negative torque limit selection			
				16: Preset			

Parameter	Name	Property	Unit	Range	Default	Setting mode	Enable mode
				position enabled			
				19: Torque instruction reversing			
				20: Speed instruction reversing switch			
				21: Position command reversing switch			
				22: Gain switch selection			
				23: Operation command switch			
				24: Mode switch 1			
				25: Mode switch 2			
				26: Electronic gear switch			
				27: Preset command selection 1			
				28: Preset command selection 2			
				29: Preset command selection 3			
				30: Preset command selection 4			
				31: Current DI trigger point as the origin			
				33: Probe 1			
				34: Probe 2			
P0301	DI1 Polarity	RW	-	0: Normally open 1: Normally close	0	Stop change	Immediate effect
P0302	DI2 function	RW	-	Refer to DI1 function	10	Stop change	Immediate effect
P0303	DI2 polarity	RW	-	0: Normally open 1: Normally close	0	Stop change	Immediate effect
P0304	DI3 function	RW	-	Refer to DI1 function	11	Stop change	Immediate effect
P0305	DI3 polarity	RW	-	0: Normally open 1: Normally close	0	Stop change	Immediate effect

Parameter	Name	Property	Unit	Range	Default	Setting mode	Enable mode
P0306	DI4 function	RW	-	Refer to DI1 function	0	Stop change	Immediate effect
P0307	DI4 polarity	RW	-	0: Normally open 1: Normally close	0	Stop change	Immediate effect
P0308	DI5 function	RW	-	Refer to DI1 function	0	Stop change	Immediate effect
P0309	DI5 polarity	RW	-	0: Normally open 1: Normally close	0	Stop change	Immediate effect
P0310	DI6 function	RW	-	Refer to DI1 function	0	Stop change	Immediate effect
P0311	DI6 polarity	RW	-	0: Normally open 1: Normally close	4	Stop change	Immediate effect
P0312	DI7 function	RW	-	Refer to DI1 function	0	Stop change	Immediate effect
P0313	DI7 polarity	RW	-	0: Normally open 1: Normally close	6	Stop change	Immediate effect
P0314	HDI1 function	RW	-	Refer to DI1 function	0	Stop change	Immediate effect
P0315	HDI1 polarity	RW	-	0: Normally open 1: Normally close	0	Stop change	Immediate effect
P0316	HDI2 function	RW	-	Refer to DI1 function	0	Stop change	Immediate effect
P0317	HDI2 polarity	RW	-	0: Normally open 1: Normally close	0	Stop change	Immediate effect
P0318	Initial effect DI function 1	RW	-	0: no definition 1: Servo enabled 2: Emergency shutdown 3: Command forbidden 4: Position deviation cleared 5: Reset the Error 6: Zero lock 7: Positive jogging 8: Negative jogging 9: Positive limit 10: Negative	0	Stop change	Power-on reset

Parameter	Name	Property	Unit	Range	Default	Setting mode	Enable mode
				limit			
				11: Home switch			
				12: Home enabled			
				13: Speed limit selection			
				14: Positive torque limit selection			
				15: Negative torque limit selection			
				16: Preset position enabled			
P0319	Initial effect DI function 2	RW	-	0: no definition	0	Stop change	Power-on reset
				19: Torque instruction reversing			
				20: Speed instruction reversing switch			
				21: Position command reversing switch			
				22: Gain switch selection			
				23: Speed command source switch			
				24: Mode switch 1			
				25: Mode switch 2			
				26: Electronic gear switch			
				27: Preset command selection 1			
				28: Preset command selection 2			
				29: Preset command selection 3			
				30: Preset command selection 4			
				31: Current DI trigger point as the origin			
P0320	DO1 function	RW	-	0: no definition	17	Stop change	Immediate effect
				1: Rdy			
				2: Run			
				3: Warn			

Parameter	Name	Property	Unit	Range	Default	Setting mode	Enable mode
				4: Error			
				5: TGon			
				6: Zero			
				7: VCmp			
				8: VArr			
				9: TArr			
				10: Near			
				11: Coin			
				12: Clt			
				13: Vlt			
				14: HomeOK			
				15: eHomeOK			
				17: BK			
				18: DB			
				19: AngRdy			
P0321	DO1 polarity	RW	-	0: Normally open 1: Normally close	0	Stop change	Immediate effect
P0322	DO2 function	RW	-	Refer to DO1 function	2	Stop change	Immediate effect
P0323	DO2 polarity	RW	-	0: Normally open 1: Normally close	0	Stop change	Immediate effect
P0324	DO3 function	RW	-	Refer to DO1 function	4	Stop change	Immediate effect
P0325	DO3 polarity	RW	-	0: Normally open 1: Normally close	0	Stop change	Immediate effect
P0322	DO4 function	RW	-	Refer to DO1 function	11	Stop change	Immediate effect
P0323	DO4 polarity	RW	-	0: Normally open 1: Normally close	0	Stop change	Immediate effect
P0324	DO5 function	RW	-	Refer to DO1 function	14	Stop change	Immediate effect
P0325	DO5 polarity	RW	-	0: Normally open 1: Normally close	0	Stop change	Immediate effect
P0330	DIDO enforcement	RW	-	0: no operation is performed 1: Forcibly DI enabled 2: Forcibly DO enabled 3: Forcibly DIDO enabled 4: Bus forcibly DO enabled	0	Arbitrary change	Immediate effect
P0331	DI Enforcement	RW	-	0~447	447	Arbitrar	Immediate

Parameter	Name	Property	Unit	Range	Default	Setting mode	Enable mode
						y change	effect
P0332	DO Channel selection	RW	-	0~7	0	Arbitrary change	Immediate effect
P0334	Communication forcibly DO output switch	RW	-	0~7	0	Stop change	Immediate effect
P0400	Control mode	RW	-	0: Speed mode 1: Position mode 2: Torque mode 3: Torque mode → speed mode 4: Speed mode → position mode 5: Torque mode → position mode 6: Torque mode → speed mode → position hybrid mode 10: EtherCAT bus mode	10	Stop change	Immediate effect
P0401	Direction of motor rotation	RW	-	0: CCW as positive direction 1: CW as positive direction	0	Stop change	Power-on reset
P0402	Position feedback system	RW	-	0: Incremental mode 1: Absolute linear mode 2: Absolute rotation mode	0	Stop change	Power-on reset
P0410	Type I Error stop mode	RW	-	0: Free stop, keep free state 1: DB stop, keep free state 2: DB stop, keep DB state	2	Stop change	Immediate effect
P0411	Type II Error stop mode	RW	-	0: Free stop, keep free state 1: Zero speed stop, keep free state 2: Zero speed stop, keep DB state 3: DB stop, keep free state 4: DB stop, keeps DB statte	2	Stop change	Immediate effect
P0412	Selection of disable stop	RW	-	0: Free stop	2	Stop	Immediate

Parameter	Name	Property	Unit	Range	Default	Setting mode	Enable mode
	mode			1: DB stop 2: Zero speed stop		change	effect
P0413	Selection of disable stop state	RW	-	0: Keep free state 1: Keep DB state	1	Stop change	Immediate effect
P0414	Selection of power-off stop mode	RW	-	0: Disabled mode 1: Forced zero speed mode	0	Stop change	Immediate effect
P0415	Overrun stop mode	RW	-	0: Free stop, keep free running state 1: Zero speed stop, keep position locked state 2: Zero speed stop, keep free running state	1	Stop change	Immediate effect
P0423	Torque for emergency stop	RW	0.1%	0~3000	1000	Stop change	Immediate effect
P0500	Manufacturer's password	RW	-	0~65535	0	Arbitrary change	Immediate effect
P0501	Initialization of system parameters	RW	-	0: no operation is performed 1: Parameter initialization	0	Stop change	Immediate effect
P0510	Save for communication write parameters	RW	-	0: Not save 1:2000 group save 2:6000 groups save 3:2000 group and 6000 group save	3	Arbitrary change	Immediate effect
P0511	Save for power-off parameters	RW	-	0: Not save 1: Save	0	Arbitrary change	Immediate effect
P0512	Holding brake enable switch	RW	-	0: Disable 1: Enable	1	Stop change	Immediate effect
P0513	Holding brake switch off to receive command delay	RW	ms	0~500	250	Arbitrary change	Immediate effect
P0514	Holding brake switch on zero speed time	RW	ms	1~1000	150	Arbitrary change	Immediate effect
P0515	Holding brake switch on speed threshold	RW	rpm	0~3000	30	Arbitrary change	Immediate effect
P0516	Holding brake switch on time threshold	RW	ms	1~1000	500	Arbitrary change	Immediate effect
P0519	Pre-charge test enabled	RW	-	0: Disable	1	Stop	Immediate

Parameter	Name	Property	Unit	Range	Default	Setting mode	Enable mode
				1: Enable 1:A lags B		change	effect
P0523	Frequency division output phase	RW	-	0-A leads B 1-A lags B	0	Stop change	Power-on reset
P0543	Soft limit Settings	RW	-	0: no limit 1: Limit 2: Limit after Home	0	Stop change	Immediate effect
P0600	Velocity proportional gain 1	RW	0.1Hz	1~20000	250	Arbitrary change	Immediate effect
P0601	Velocity integral gain 1	RW	0.01ms	15~51200	3183	Arbitrary change	Immediate effect
P0602	Position proportional gain 1	RW	0.1Hz	0~20000	400	Arbitrary change	Immediate effect
P0608	Speed feedforward proportional gain	RW	0.1%	0~1000	0	Arbitrary change	Immediate effect
P0609	Torque feedforward proportional gain	RW	0.1%	0~2000	0	Arbitrary change	Immediate effect
P0610	Load inertia ratio	RW	-	0~12000	200	Arbitrary change	Immediate effect
P0700	Position instruction FIR filtering	RW	0.1ms	0~65535	0	Stop change	Immediate effect
P0701	Position instruction mean filtering	RW	0.1ms	0~1280	0	Stop change	Immediate effect
P0702	Torque filtering 1	RW	0.01ms	0~3000	79	Arbitrary change	Immediate effect
P0706	Velocity feedforward filtering time	RW	0.01ms	0~6400	50	Arbitrary change	Immediate effect
P0707	Torque feedforward filtering time	RW	0.01ms	0~6400	50	Arbitrary change	Immediate effect
P0710	Vibration suppression frequency 1	RW	Hz	50~5000	5000	Arbitrary change	Immediate effect
P0711	Vibration suppression bandwidth 1	RW	-	0~20	2	Arbitrary change	Immediate effect
P0712	Vibration suppression attenuation 1	RW	-	0~99	0	Arbitrary change	Immediate effect
P0713	Vibration suppression frequency 2	RW	Hz	50~5000	5000	Arbitrary change	Immediate effect
P0714	Vibration suppression bandwidth 2	RW	-	0~20	2	Arbitrary change	Immediate effect
P0715	Vibration suppression	RW	-	0~99	0	Arbitrar	Immediate

Parameter	Name	Property	Unit	Range	Default	Setting mode	Enable mode
	attenuation 2					y change	effect
P0716	Vibration suppression frequency 3	RW	Hz	50~5000	5000	Arbitrary change	Immediate effect
P0717	Vibration suppression bandwidth 3	RW	-	0~20	2	Arbitrary change	Immediate effect
P0718	Vibration suppression attenuation 3	RW	-	0~99	0	Arbitrary change	Immediate effect
P0719	Vibration suppression frequency 4	RW	Hz	50~5000	5000	Arbitrary change	Immediate effect
P0720	Vibration suppression bandwidth 4	RW	-	0~20	2	Arbitrary change	Immediate effect
P0721	Vibration suppression attenuation 4	RW	-	0~99	0	Arbitrary change	Immediate effect
P0747	Position notch frequency A	RW	Hz	10~1000	1000	Stop change	Immediate effect
P0772	Probe filter	RW	25ns	0~31	15	Stop change	Power-on reset
P0776	Speed arrival signal filtering	RW	ms	0~5000	10	Stop change	Immediate effect
P0800	Input phase missing detection	RW	-	0: Error detection 1: Error detection and Alarm 2: No detection	0	Arbitrary change	Immediate effect
P0801	Error detection for encoder multi-turn overflow	RW	-	0: No detection 1: Detection	1	Stop change	Immediate effect
P0803	Overspeed threshold	RW	rpm	0~10000	0	Arbitrary change	Immediate effect
P0808	Position deviation removal mode	RW	-	0: Remove when the server is not running 1: Remove when servo OFF or DI signal is effective	0	Stop change	Immediate effect
P0809	Runaway protection detection	RW	-	0: No detection 1: Detection	1	Arbitrary change	Immediate effect
P0810	Runaway current judgment threshold	RW	0.1%	1000~4000	2000	Arbitrary change	Immediate effect
P0811	Runaway speed threshold	RW	rpm	1~1000	10	Arbitrary change	Immediate effect
P0812	Runaway speed feedback filtering time	RW	0.1ms	1~1000	20	Arbitrary	Power-on reset

Parameter	Name	Property	Unit	Range	Default	Setting mode	Enable mode
						change	
P0813	Runaway protection identification time	RW	ms	10~1000	30	Arbitrary change	Immediate effect
P0814	Motor overload protection gain	RW	%	50~300	100	Stop change	Immediate effect
P0816	Motor overload detection	RW	-	0: Neither detects 1: Motor overload is detected, drive overload is not detected 2: Motor overload is not detected, drive overload ia detected 3: Both detect	3	Stop change	Immediate effect
P0817	Stall detection	RW	-	0: No detection 1: Detection	1	Arbitrary change	Immediate effect
P0818	Stall protection time	RW	ms	10~65535	200	Arbitrary change	Immediate effect
P0821	Overtemperature protection point of drives	RW	°C	0~100	0	Stop change	Power-on reset
P0900	Position command speed	RO	rpm	-32767~32767	0	Display	Immediate effect
P0901	Speed command	RO	rpm	-32767~32767	0	Display	Immediate effect
P0902	Torque command	RO	0.1%	-32767~32767	0	Display	Immediate effect
P0903	Position feedback speed	RO	rpm	-32767~32767	0	Display	Immediate effect
P0904	Actual speed	RO	rpm	-32767~32767	0	Display	Immediate effect
P0906	Actual speed (accuracy 0.1rpm)	RO	rpm	-2147483648 ~2147483647	0	Display	Immediate effect
P0910	Bus voltage	RO	0.1V	0~65535	0	Display	Immediate effect
P0911	Control voltage	RO	0.1V	0~65535	0	Display	Immediate effect
P0912	Output phase current RMS(U phase) of drive	RO	0.01A	0~65535	0	Display	Immediate effect
P0913	Output line voltage RMS of drive	RO	0.1V	0~65535	0	Display	Immediate effect
P0914	Average load rate	RO	0.1%	0~8000	0	Display	Immediate effect
P0915	Drive temperature	RO	°C	0~65535	0	Display	Immediate effect
P0917	Electrical Angle	RO	0.1°	0~65535	0	Display	Immediate effect
P0918	DI input level monitoring	RO	-	0~65535	0	Display	Immediate effect

Parameter	Name	Property	Unit	Range	Default	Setting mode	Enable mode
P0920	DO output level monitoring	RO	-	0~65535	0	Display	Immediate effect
P0925	Total running time	RO	0.1s	0~4294967295	0	Display	Immediate effect
P0927	Current power-on running time	RO	-	0~4294967295	0	Display	Immediate effect
P0930	Real-time instruction counter	RO	Instruction unit	-2147483648 ~2147483647	0	Display	Immediate effect
P0932	Run instruction counter	RO	Instruction unit	-2147483648 ~2147483647	0	Display	Immediate effect
P0934	Position feedback counter	RO	Instruction unit	-2147483648 ~2147483647	0	Display	Immediate effect
P0936	Position feedback counter	RO	Encoder unit	-2147483648 ~2147483647	0	Display	Immediate effect
P0938	Position tracking deviation	RO	Instruction unit	-2147483648 ~2147483647	0	Display	Immediate effect
P0940	Position tracking deviation	RO	Encoder unit	-2147483648 ~2147483647	0	Display	Immediate effect
P0942	Number of encoder turns	RO	turn	0~65535	0	Display	Immediate effect
P0943	Encoder single turn position	RO	p	0~2147483647	0	Display	Immediate effect
P0945	Encoder absolute position (low 32 bits)	RO	Encoder unit	-2147483648 ~2147483647	0	Display	Immediate effect
P0947	Encoder absolute position (high 32 bits)	RO	Encoder unit	-2147483648 ~2147483647	0	Display	Immediate effect
P0949	Mechanical absolute position (low 32 bits)	RO	Encoder unit	-2147483648 ~2147483647	0	Display	Immediate effect
P0951	Mechanical absolute position (high 32 bits)	RO	Encoder unit	-2147483648 ~2147483647	0	Display	Immediate effect
P0953	Rotating load single-turn position (low 32 bits)	RO	Encoder unit	0~4294967295	0	Display	Immediate effect
P0955	Rotating load single-turn position (high 32 bits)	RO	Encoder unit	0~4294967295	0	Display	Immediate effect
P0957	Rotating load single-turn position	RO	Instruction unit	0~4294967295	0	Display	Immediate effect
P0A00	Slave station No.	RW	-	1~247	1	Arbitrary change	Immediate effect
P0A02	ModBus Baud rate of communication	RW	-	0:2400bps 1:4800bps 2:9600bps 3:19200bps 4:38400bps 5:57600bps 6:115200bps	6	Arbitrary change	Immediate effect
P0A03	ModBus communication protocol	RW	-	0: No check, 2 end bits (8-N-2) 1: Even parity	0	Arbitrary change	Immediate effect

Parameter	Name	Property	Unit	Range	Default	Setting mode	Enable mode
				check, 1 end bit (8-O-1) 2: Odd parity check, 1 end bit (8-E-1) 3: No check, 1 end bit (8-N-1)			
P0A10	EtherCAT version No.	RO	-	0~65535	0	Display	Immediate effect
P0A11	EtherCAT XML version No.	RO	-	0~65535	0	Display	Immediate effect
P0A12	EtherCAT Slave station name	RO	-	0~65535	0	Display	Immediate effect
P0A13	EtherCAT Slave station alias	RW	-	0~65535	0	Stop change	Immediate effect
P0A14	EtherCAT State machine	RO	-	0~65535	0	Display	Immediate effect
P0A15	EtherCAT State code	RO	-	0~65535	0	Display	Immediate effect
P0A16	EtherCAT Sync signal loss count	RO	-	0~65535	0	Display	Immediate effect
P0A17	EtherCAT port 0 frame Ineffective error count	RO	-	0~65535	0	Display	Immediate effect
P0A18	EtherCAT port 1 frame Ineffective error count	RO	-	0~65535	0	Display	Immediate effect
P0A19	EtherCAT port 0/1 frame send error count	RO	-	0~65535	0	Display	Immediate effect
P0A20	EtherCAT port 0/1 frame loss error count	RO	-	0~65535	0	Display	Immediate effect
P0A21	EtherCAT PDI interface error count	RO	-	0~65535	0	Display	Immediate effect
P0A25	CSP mode instruction cache depth	RW	-	0~1	0	Stop change	Immediate effect
P0A31	EtherCAT Sync Allowed times of signal loss	RW	-	0~65535	9	Arbitrary change	Immediate effect
P0A32	EtherCAT Sync Signal detection deviation threshold	RW	ns	0~4000	3000	Stop change	Immediate effect
P0A33	CSP position instruction increase threshold	RW	times	1~7	3	Arbitrary change	Immediate effect
P0E17	Numerator of the 2nd set of communication electronic gear ratio	RW	-	1~65535	1	Stop change	Immediate effect
P0E18	Denominator of the 2nd group of communication electronic gear ratio	RW	-	1~65535	1	Stop change	Immediate effect
P1A00	Real-time self-adjusting settings	RW	-	0: Off 1: Standard rigid table mode 2: Quick positioning mode 5: Adaptive	7	Arbitrary change	Immediate effect

Parameter	Name	Property	Unit	Range	Default	Setting mode	Enable mode
				interpolation mode 7: Adaptive positioning mode			
P1A01	Response level setting	RW	level	0~40	16	Arbitrary change	Immediate effect
P1A02	Selection of vibration suppression mode	RW	-	0: Off 1: Vibration suppression 3 effective 2: Vibration suppression 3 and 4 are effective 3: P1A.14 shows the resonance frequency 4: Restore vibration suppression 3 and 4	0	Arbitrary change	Immediate effect
P1A06	Max. speed of inertia identification	RW	rpm	100~1000	500	Stop change	Immediate effect
P1A07	Acceleration time of inertia identification	RW	ms	20~800	125	Stop change	Immediate effect
P1A08	Waiting time of inertia identification	RW	ms	50~10000	800	Stop change	Immediate effect
P1A09	Inertia identification rotation turns	RW	0.01 ring	0~65535	100	Arbitrary change	Immediate effect
P1A18	Disturbance compensation gain	RW	0.1%	-1000~1000	0	Arbitrary change	Immediate effect
P1A19	Disturbance filtering time	RW	ms	0~2500	50	Arbitrary change	Immediate effect
P1A20	Partial load compensation	RW	0.1%	-1000~1000	0	Arbitrary change	Immediate effect
P1A21	Forward friction compensation	RW	0.1%	-1000~1000	0	Arbitrary change	Immediate effect
P1A22	Reverse friction compensation	RW	0.1%	-1000~1000	0	Arbitrary change	Immediate effect
P1A23	Friction compensation speed	RW	0.1rpm	1~300	20	Arbitrary change	Immediate effect
P1A24	Selection of friction compensation speed	RW	-	0~18	0	Arbitrary change	Immediate effect
P1A25	Low frequency vibration detection enabled	RW	-	0: Off 1: Start	0	Arbitrary	Immediate effect

Parameter	Name	Property	Unit	Range	Default	Setting mode	Enable mode
						change	
P2002	Emergency shutdown	RW	-	0: no operation is performed 1: Emergency shutdown	0	Arbitrary change	Immediate effect
P2003	Error reset	RW	-	0: no operation is performed 1: Error reset	0	Stop change	Immediate effect
P2004	Software reset	RW	-	0: no operation is performed 1: Software reset	0	Stop change	Immediate effect
P2005	Encoder reset	RW	-	0: no operation is performed 1: Reset the Error 2: Reset the Error and number of rings	0	Stop change	Immediate effect
P2006	Read/write of encoder parameters	RW	-	0: no operation is performed 1: Write operation 2: Read operation	0	Stop change	Immediate effect
P2038	Call enable	RW	-	0~1	0	Arbitrary change	Immediate effect
P2040	Bus read and servo state	RO	-	0~65535	0	Display	Immediate effect
P2041	Bus read DO low 16-bit function	RO	-	0~65535	0	Display	Immediate effect
P2042	Bus read DO high 16-bit function	RO	-	0~65535	0	Display	Immediate effect
P2050	Bus setting VDI level	RW	-	0~65535	0	Arbitrary change	Immediate effect
P2051	Bus setting DO output	RW	-	0~7	0	Arbitrary change	Immediate effect
P2100	Exception parameter group ID	RO	-	0~65535	0	Display	Immediate effect
P2101	Exception parameter group bias	RO	-	0~65535	0	Display	Immediate effect
P2102	FPGA-side system status information	RO	-	0~65535	0	Display	Immediate effect
P2103	FPGA-side system Error information	RO	-	0~65535	0	Display	Immediate effect
P2104	FPGA-side timeout Error information	RO	-	0~65535	0	Display	Immediate effect
P2105	FPGA-side encoder Error information	RO	-	0~65535	0	Display	Immediate effect
P2106	Encoder status information	RW	-	0~65535	0	Arbitrary change	Immediate effect

Parameter	Name	Property	Unit	Range	Default	Setting mode	Enable mode
P2108	Current Error code	RO	-	0~65535	0	Display	Immediate effect
P2130	Error logging query	RW	-	0: current Error 1: the latest one Error 2: the latest two Errors 3: the last three Errors 4: the last four Errors 5: the last five Errors 6: the last six Errors 7: the last seven Errors 8: the last eight Errors 9: the last nine Errors	0	Arbitrary change	Immediate effect
P2131	When the Error is selected,the Error code	RO	-	0~65535	0	Display	Immediate effect
P2132	When the Error is selected,internal Error code	RO	-	0~65535	0	Display	Immediate effect
P2133	When the Error is selected,time stamp	RO	0.1s	0~4294967295	0	Display	Immediate effect
P2135	When the Error is selected,rotation speed	RO	rpm	-32767~32767	0	Display	Immediate effect
P2136	When the Error is selected,U-phase current	RO	0.01A	-32767~32767	0	Display	Immediate effect
P2137	When the Error is selected,V-phase current	RO	0.01A	-32767~32767	0	Display	Immediate effect
P2138	When the Error is selected,Bus voltage	RO	0.1V	0~65535	0	Display	Immediate effect
P2139	When the Error is selected,DI input state	RO	-	0~65535	0	Display	Immediate effect
P2140	When the Error is selected,DO output state	RO	-	0~65535	0	Display	Immediate effect
P2141	When the Error is selected,FPGA-side system state info.	RO	-	0~65535	0	Display	Immediate effect
P2142	When the Error is selected,FPGA-side system Error info.	RO	-	0~65535	0	Display	Immediate effect
P2143	When the Error is selected,FPGA-side system timeout info.	RO	-	0~65535	0	Display	Immediate effect
P2144	When the Error is selected,FPGA-side system encoder Error info.	RO	-	0~65535	0	Display	Immediate effect
P2145	When the Error is selected,encoder state info.	RO	-	0~65535	0	Display	Immediate effect
P2200	Encoder selection	RW	-	0: Internal	0	Stop	Immediate

Parameter	Name	Property	Unit	Range	Default	Setting mode	Enable mode
				encoder feedback 1: External encoder feedback 2: When DI switches the electronic gear ratio, internal/external ring encoder feedback is switched		change	effect
P2201	External encoder Enable selection	RW	-	0: Disables external encoder 1: Enable external ABZ encoder	0	Stop change	Power-on reset
P2202	External encoder Direction selection	RW	-	0: Use deError direction 1: Use negative direction	0	Stop change	Immediate effect
P2203	Number of external encoder pulses per motor rotation	RW	p	1~1073741824	10000	Stop change	Immediate effect
P2205	Numerator of the 2nd set of communication electronic gear ratio	RW	-	1~1073741824	4	Arbitrary change	Immediate effect
P2207	Denominator of the 2nd group of communication electronic gear ratio	RW	-	1~1073741824	1	Arbitrary change	Immediate effect
P2210	Fully closed loop deviation Filtering time	RW	0.1ms	0~65535	0	Stop change	Immediate effect
P2211	Hybrid control deviation threshold	RW	-	0~1073741824	1000	Arbitrary change	Immediate effect
P2213	Hybrid control deviation Clear setting	RW	-	0~100	1	Arbitrary change	Immediate effect
P2214	Fully closed loop external Position error	RO	p	-1073741824 ~1073741824	0	Display	Immediate effect
P2216	Internal encoder feedback value	RO	p	-1073741824 ~1073741824	0	Display	Immediate effect
P2218	External encoder feedback value	RO	p	-1073741824 ~1073741824	0	Display	Immediate effect
P2300	VDI enabled	RW	-	0: Disable 1: Enable	0	Stop change	Immediate effect
P2301	Initial status of VDI power-on	RW	-	0~65535	0	Arbitrary change	Power-on reset
P2302	VDO enabled	RW	-	0: Disable 1: Enable	0	Stop change	Immediate effect
P2303	Default for undefined VDO	RW	-	0x0:VDO1 Default 0x1:VDO2	0	Stop change	Immediate effect

Parameter	Name	Property	Unit	Range	Default	Setting mode	Enable mode
				Default 0x2:VDO3 Default 0x3:VDO4 Default 0x4:VDO5 Default 0x5:VDO6 Default 0x6:VDO7 Default 0x7:VDO8 Default 0x8:VDO9 Default 0x9:VDO10 Default 0xa:VDO11 Default 0xb:VDO12 Default 0xc:VDO13 Default 0xd:VDO14 Default 0xe:VDO15 Default 0xf:VDO16 Default			
P2306	VDI1 function	RW	-	0: no definition 1: Servo enabled 2: Emergency shutdown 3: Command forbidden 4: Position deviation cleared 5: Reset the Error 6: Zero speed retention 7: Forward jogging 8: Reverse jogging 9: Forwar limit 10: Reverse limit 11: Origin switch 12: Zero to return enabled 13: Speed limit selection 14: Positive	0	Arbitrary change	Immediate effect

Parameter	Name	Property	Unit	Range	Default	Setting mode	Enable mode
				torque limit selection			
				15: Negative torque limit selection			
				16: Preset position enabled			
				19: Torque instruction reversing			
				20: Speed instruction reversing switch			
				21: Position command reversing switch			
				22: Gain switch selection			
				23: Operation command switch			
				24: Mode switch 1			
				25: Mode switch 2			
				26: Electronic gear switch			
				27: Preset command selection 1			
				28: Preset command selection 2			
				29: Preset command selection 3			
				30: Preset command selection 4			
				31: Current DI trigger point as the origin			
				33: Probe 1			
				34: Probe 2			
P2307	VDI1 polarity	RW	-	0: Write 1 valid 1: Write positive edge valid (0→1)	0	Arbitrary change	Immediate effect
P2308	VDI2 function	RW	-	Refer to VDI1 function	0	Arbitrary change	Immediate effect
P2309	VDI2 polarity	RW	-	0: Write 1 valid 1: Write positive edge valid (0→1)	0	Arbitrary change	Immediate effect
P2310	VDI3 function	RW	-	Refer to VDI1	0	Arbitrar	Immediate

Parameter	Name	Property	Unit	Range	Default	Setting mode	Enable mode
				function		y change	effect
P2311	VDI3 polarity	RW	-	0: Write 1 valid 1: Write positive edge valid (0→1)	0	Arbitrary change	Immediate effect
P2312	VDI4 function	RW	-	Refer to VDI1 function	0	Arbitrary change	Immediate effect
P2313	VDI4 polarity	RW	-	0: Write 1 valid 1: Write positive edge valid (0→1)	0	Arbitrary change	Immediate effect
P2314	VDI5 function	RW	-	Refer to VDI1 function	0	Arbitrary change	Immediate effect
P2315	VDI5 polarity	RW	-	0: Write 1 valid 1: Write positive edge valid (0→1)	0	Arbitrary change	Immediate effect
P2316	VDI6 function	RW	-	Refer to VDI1 function	0	Arbitrary change	Immediate effect
P2317	VDI6 polarity	RW	-	0: Write 1 valid 1: Write positive edge valid (0→1)	0	Arbitrary change	Immediate effect
P2318	VDI7 function	RW	-	Refer to VDI1 function	0	Arbitrary change	Immediate effect
P2319	VDI7 polarity	RW	-	0: Write 1 valid 1: Write positive edge valid (0→1)	0	Arbitrary change	Immediate effect
P2320	VDI8 function	RW	-	Refer to VDI1 function	0	Arbitrary change	Immediate effect
P2321	VDI8 polarity	RW	-	0: Write 1 valid 1: Write positive edge valid (0→1)	0	Arbitrary change	Immediate effect
P2322	VDI9 function	RW	-	Refer to VDI1 function	0	Arbitrary change	Immediate effect
P2323	VDI9 polarity	RW	-	0: Write 1 valid 1: Write positive edge valid (0→1)	0	Arbitrary change	Immediate effect
P2324	VDI10 function	RW	-	Refer to VDI1 function	0	Arbitrary change	Immediate effect
P2325	VDI10 polarity	RW	-	0: Write 1 valid 1: Write positive edge valid (0→1)	0	Arbitrary change	Immediate effect
P2326	VDI11 function	RW	-	Refer to VDI1 function	0	Arbitrary change	Immediate effect
P2327	VDI11 polarity	RW	-	0: Write 1 valid 1: Write positive edge valid (0→1)	0	Arbitrary change	Immediate effect
P2328	VDI12 function	RW	-	Refer to VDI1	0	Arbitrar	Immediate

Parameter	Name	Property	Unit	Range	Default	Setting mode	Enable mode
				function		y change	effect
P2329	VDI12 polarity	RW	-	0: Write 1 valid 1: Write positive edge valid (0→1)	0	Arbitrary change	Immediate effect
P2330	VDI13 function	RW	-	Refer to VDI1 function	0	Arbitrary change	Immediate effect
P2331	VDI13 polarity	RW	-	0: Write 1 valid 1: Write positive edge valid (0→1)	0	Arbitrary change	Immediate effect
P2332	VDI14 function	RW	-	Refer to VDI1 function	0	Arbitrary change	Immediate effect
P2333	VDI14 polarity	RW	-	0: Write 1 valid 1: Write positive edge valid (0→1)	0	Arbitrary change	Immediate effect
P2334	VDI15 function	RW	-	Refer to VDI1 function	0	Arbitrary change	Immediate effect
P2335	VDI15 polarity	RW	-	0: Write 1 valid 1: Write positive edge valid (0→1)	0	Arbitrary change	Immediate effect
P2336	VDI16 function	RW	-	Refer to VDI1 function	0	Arbitrary change	Immediate effect
P2337	VDI16 polarity	RW	-	0: Write 1 valid 1: Write positive edge valid (0→1)	0	Arbitrary change	Immediate effect
P2342	VDO output level	RO	-	0~65535	0	Display	Immediate effect
P2343	VDO1 function	RW	-	0: no definition 1: Rdy 2: Run 3: Warn 4: Error 5: TGon 6: Zero 7: VCmp 8: VArr 9: TArr 10: Near 11: Coin 12: Clt 13: Vlt 14: HomeOK 15: eHomeOK 17: BK 18: DB 19: AngRdy	0	Arbitrary change	Immediate effect
P2344	VDO1 polarity	RW	-	0: Output 1 when valid 1: Output 0 when valid	0	Arbitrary change	Immediate effect

Parameter	Name	Property	Unit	Range	Default	Setting mode	Enable mode
P2345	VDO2 function	RW	-	Refer to VDO1 function	0	Arbitrary change	Immediate effect
P2346	VDO2 polarity	RW	-	0: Output 1 when valid 1: Output 0 when valid	0	Arbitrary change	Immediate effect
P2347	VDO3 function	RW	-	Refer to VDO1 function	0	Arbitrary change	Immediate effect
P2348	VDO3 polarity	RW	-	0: Output 1 when valid 1: Output 0 when valid	0	Arbitrary change	Immediate effect
P2349	VDO4 function	RW	-	Refer to VDO1 function	0	Arbitrary change	Immediate effect
P2350	VDO4 polarity	RW	-	0: Output 1 when valid 1: Output 0 when valid	0	Arbitrary change	Immediate effect
P2351	VDO5 function	RW	-	Refer to VDO1 function	0	Arbitrary change	Immediate effect
P2352	VDO5 polarity	RW	-	0: Output 1 when valid 1: Output 0 when valid	0	Arbitrary change	Immediate effect
P2353	VDO6 function	RW	-	Refer to VDO1 function	0	Arbitrary change	Immediate effect
P2354	VDO6 polarity	RW	-	0: Output 1 when valid 1: Output 0 when valid	0	Arbitrary change	Immediate effect
P2355	VDO7 function	RW	-	Refer to VDO1 function	0	Arbitrary change	Immediate effect
P2356	VDO7 polarity	RW	-	0: Output 1 when valid 1: Output 0 when valid	0	Arbitrary change	Immediate effect
P2357	VDO8 function	RW	-	Refer to VDO1 function	0	Arbitrary change	Immediate effect
P2358	VDO8 polarity	RW	-	0: Output 1 when valid 1: Output 0 when valid	0	Arbitrary change	Immediate effect
P2359	VDO9 function	RW	-	Refer to VDO1 function	0	Arbitrary change	Immediate effect
P2360	VDO9 polarity	RW	-	0: Output 1 when valid 1: Output 0	0	Arbitrary change	Immediate effect

Parameter	Name	Property	Unit	Range	Default	Setting mode	Enable mode
				when valid			
P2361	VDO10 function	RW	-	Refer to VDO1 function	0	Arbitrary change	Immediate effect
P2362	VDO10 polarity	RW	-	0: Output 1 when valid 1: Output 0 when valid	0	Arbitrary change	Immediate effect
P2363	VDO11 function	RW	-	Refer to VDO1 function	0	Arbitrary change	Immediate effect
P2364	VDO11 polarity	RW	-	0: Output 1 when valid 1: Output 0 when valid	0	Arbitrary change	Immediate effect
P2365	VDO12 function	RW	-	Refer to VDO1 function	0	Arbitrary change	Immediate effect
P2366	VDO12 polarity	RW	-	0: Output 1 when valid 1: Output 0 when valid	0	Arbitrary change	Immediate effect
P2367	VDO13 function	RW	-	Refer to VDO1 function	0	Arbitrary change	Immediate effect
P2368	VDO13 polarity	RW	-	0: Output 1 when valid 1: Output 0 when valid	0	Arbitrary change	Immediate effect
P2369	VDO14 function	RW	-	Refer to VDO1 function	0	Arbitrary change	Immediate effect
P2370	VDO14 polarity	RW	-	0: Output 1 when valid 1: Output 0 when valid	0	Arbitrary change	Immediate effect
P2371	VDO15 function	RW	-	Refer to VDO1 function	0	Arbitrary change	Immediate effect
P2372	VDO15 polarity	RW	-	0: Output 1 when valid 1: Output 0 when valid	0	Arbitrary change	Immediate effect
P2373	VDO16 function	RW	-	Refer to VDO1 function	0	Arbitrary change	Immediate effect
P2374	VDO16 polarity	RW	-	0: Output 1 when valid 1: Output 0 when valid	0	Arbitrary change	Immediate effect

7.2 DI/DO Function Definition

Function No.	Function name	Description
Description on Input signal functions		
1	Servo enable	Effective: Servo motor power-on enable Ineffective: Servo motor power-on is disabled
2	Emergency shutdown	Effective: Position locked after zero speed stop; Ineffective: Present running status is not affected.
3	Instruction disable	Effective: Disable position instruction input Ineffective: Position instruction input is allowed
4	Position deviation cleared (edge effective function)	Effective: Position deviation is zero cleared; Ineffective: Position deviation is not cleared.
5	Fault reset (Edge effective function)	Ineffective: Disable; Effective: Enable.
6	Zero speed retention	Effective: Enables the zero fixed function. Ineffective: Zero fixed function is disabled.
7	Forward Jogging	Effective: Input per the given instruction; Ineffective: Run instruction to stop input.
8	Reverse jogging	Effective: Reverse input per the given instruction; Ineffective: Run instruction to stop input.
9	Forward limit	Effective: Forward drive is disabled. Ineffective: Forward drive is allowed.
10	Reverse limit	Effective: Reverse drive is disabled; Ineffective: Reverse drive is allowed.
11	Origin switch	Ineffective: Not triggered. Effective: Triggered.
12	Return-to-zero function is enabled	Ineffective: Disabled Effective: Enabled
13	Speed limit selection	Effective: Torque instruction absolute value reaches the setting value Ineffective: Torque instruction absolute value is below the setting value
14	Forward torque limit selection	According to the selection of 2015:04h, torque limit source is switched.
15	Reverse torque limit selection	According to the selection of 2015:04h, torque limit source is switched.
16	The preset position enable	Effective: servo motor runs multi-stage position instructions; Ineffective: servo motor is locked;
19	Torque instruction	Ineffective: Positive direction;

Function No.	Function name	Description
Description on Input signal functions		
	reversing	Effective:Negative direction.
20	Speed instruction reversing selection	Ineffective: Positive direction; Effective:Negative direction.
22	Gain switching selection	When P06.15=0： Ineffective: Speed control loop is PI control; Effective: Speed control loop is P control. When P06.15=1: Execute per the settings of 2008-0Ah.
23	Runing instruction switch	Ineffective: The present running instruction is A Effective: The present running instruction is B
24	Mode switch 1	According to the selected control mode (3/4/5), switch between speed/position/torque modes
25	Mode switch 2	According to the selected control mode (6), switch between speed/position/torque modes
26	Electronic gear switch	Ineffective: Electronic gear ratio 1 Effective: Electronic gear ratio 2
27	Default instruction selection 1	16 preset instruction selection
28	Default instruction selection 2	16 preset instruction selection
29	Default instruction selection 3	16 preset instruction selection
30	Default instruction selection 4	16 preset instruction selection.
31	The present DI trigger point used as the origin	Effective: Triggered Ineffective: Not triggered

Function No.	Function name	Description	Remarks
Description on output signal functions			
1	Servo Ready (rdy)	Servo state is ready to receive S:ON effective signal: Effective: Servo ready; Inffective: Servo is not ready.	Servo is not ready: the servo has a Type I or Type II fault, or DI emergency stop is valid.
2	Servo Run (Run)	Server is in the RUN state and can receive commands: Effective: Servo can run; Inffective: Servo can't run.	-
3	Servo Warn Output (Warn)	Warning output signal is valid.(Conductive)	-
4	Servo fault output (Error)	The status is valid when fault is detected.	-
5	Motor Motion (TGon)	When motor speed is higher than the threshold 2006:11h: Effective: Motor motion signal is valid; Inffective: Motor motion signal is invalid.	-
6	Zero speed signal (Zero)	Output signal when servo motor stops Effective: Motor speed is zero; Inffective: Motor speed is not zero.	-
7	Consistent Speed (VCmp)	Under speed control, absolute value of the difference between motor speed and speed instruction is less than 606Dh; It reaches the speed threshold, and the time meets 606Eh, it's valid.	-
8	Velocity Arrival (VArr)	Effective: Speed feedback reaches the setting; Inffective: Speed feedback doesn't reach the setting.	-
9	Torque Arrival (TArr)	Effective: Absolute torque reaches the setting; Inffective: Torque absolute value is less than the setting.	-
10	Positioning Near	Under position control, it's effective when position deviation pulse reaches the setting of positioning near signal amplitude P13.09.	-
11	Position arrival(Coin)	Under position control, position deviation pulse reaches the threshold 6067h of positioning completion, and the time reaches 6068h; It is valid.	-
12	Torque Limit (Clt)	Confirmation signal of torque limit: Effective: Motor torque is limited; Inffective: Motor torque isn't limited.	-
13	Speed Limit (Vlt)	Confirmation signal of speed limitation in torque	-

Function No.	Function name	Description	Remarks
Description on output signal functions			
		control: Effective: Motor speed is limited; Inffective: Motor speed is not limited.	
14	Home completed, HomeOK	Effective: The origin zeroing is completed; Inffective: The origin zeroing is uncomplete;	-
17	holding brake control (BK)	Brake signal output Effective: Switch off, brake is cancelled; Inffective: Start the brake.	-
18	Dynamic Brake (DB)	Effective: Dynamic brake relay is OFF, dynamic brake is enabled; Inffective: Dynamic brake relay is ON, dynamic brake is disabled;	-
19	Magnetic pole identification ready (AngRdy)	Effective: Magnetic pole identification is ready; Inffective: Magnetic pole identification bit is uncomplete;	-