MOONS'
moving in better ways

MBDV Series

Low Voltage Servo System

Hardware Manual

SHANGHAI AMP&MOONS' AUTOMATION CO.,LTD.

Rev. 2.0
07/27/2023

Contents

Disclaimer

The information in this manual was accurate and reliable at the time of its publication. Shanghai Anpu Mingzhi Automation Equipment Co., Ltd. reserves the right to change the product specifications described in this manual at any time without prior notice.

Trademark Rights

All proper names mentioned in this manual are the trademarks of their respective owners.

Customer service

Shanghai Anpu Mingzhi Automation Equipment Co., Ltd. is committed to providing quality customer service and support for all of our products. Our goal is to provide our clients with the information and resources they need in a timely and reliable manner. For quick service, we recommend that you contact your local sales representative for order status and logistics information, product information and documentation, as well as on-site technical support and applications. If you have special reasons and cannot contact your sales representative, please use the following relevant contact methods:

If you need technical support, please contact: ama-support@moons.com.cn

1 Introduction

1.1 About this manual

This manual is the hardware manual of MBDV series low voltage servo driver. It provides installation, configuration and basic operation of MBDV servo unit. This document is intended for qualified personnel who transport, assemble, and maintain this equipment.

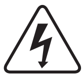
1.2 MBDV Series Low Voltage Servo Documentation

This manual is part of a series of documents, the entire series consists of the following:

- MBDV series low voltage servo hardware manual. Details hardware installation, configuration and operation.
- CANopen communication manual. Describes the CANopen communication function of the drive-in detail.
- Modbus communication manual. Detailed introduction to drive Modbus RTU communication function.
- Luna software user manual. Introduce how to use the Luna software.

1.3 Safety

To prevent hazards to people and damage to property, installation should only be performed by qualified personnel.


MBDV series low voltage servo products use dangerous voltage. The drive must be properly grounded.

Before you install MBDV series low voltage servo products, please read the product manual carefully. Failure to follow safe operating instructions may result in personal injury or equipment damage.

1.4 Safety sign

Safety signs indicate potential personal hazards or equipment damage, such as failure to follow recommended precautions and actual safe practices. The following are cautionary safety symbols used in this manual and on the drive:

 Caution  Dangerous Voltage  Earth  Caution,Hot Surface

1.5 Safety Precautions

1.5.1 Storage

Please note the following when storing:

- ◆ Please put this drive in the packing box and store it in a dry, dust-free place away from direct sunlight
- ◆ Storage ambient temperature between -20 ℃ to +65 ℃
- ◆ Storage environment humidity is in the range of 10% to 85% without condensation
- ◆ Avoid storage in corrosive atmospheres

1.5.2 Installation Precautions

	◆ It is forbidden to use this product in the environment with moisture, corrosive gas, flammable and explosive
	◆ Do not use this product in places with strong vibration and shock
	◆ Do not use cables immersed in water or oil
	◆ Do not squeeze or stress the cable to avoid dangerous situations such as electric leakage caused by damage to the cable.
	◆ Do not block the heat dissipation holes of the driver, and avoid metal chips and other conductive objects entering the driver during installation
	◆ Do not directly touch the rotating motor shaft with your hands
	◆ Do not knock the motor during installation, so as not to damage the motor shaft or the internal optical encoder
	◆ In the first test run, first separate the coupling or belt of the mechanical equipment, so that the motor is in a no-load state
	◆ Incorrect parameters will cause abnormal operation under load
	◆ The temperature of the drive radiator, motor, and external regeneration resistor will rise during operation, please avoid touching
	◆ Do not lift the motor lead wire during transportation and installation

1.5.3 Wiring Precautions

	◆ Do not connect the power grid to the UVW motor terminal on the drive side, it will damage the drive or cause a fire
	◆ Please connect the output UVW of the driver and the UVW of the servo motor directly, and do not pass the electromagnetic contactor in the middle.
	◆ Please tighten the fixing screws of the power supply and motor output terminals, otherwise it may cause fire
	◆ Do not switch the main power supply of the driver frequently. If you really need to switch the power supply repeatedly, please control it to less than 1 time per minute.
	◆ Avoid bundling the main circuit cable with the input and output signal cables.
	◆ Please use twisted pair shielded wire for input signal wire and encoder signal wire
	◆ Please use the specified power supply voltage
	◆ One wire insertion port of the terminal block, please insert only one wire
	◆ When inserting the wire, do not short the core wire with the adjacent wire
	◆ Be sure to ensure that the driver power supply and motor are well grounded
	◆ Before powering on, make sure all wiring is correct

1.5.4 Precautions during trial operation

⚠	◆ Do not directly touch the rotating motor shaft with your hands
	◆ In the first test run, first separate the coupling or belt of the mechanical equipment, so that the motor is in a no-load state
	◆ Incorrect parameters will cause abnormal operation under load
	◆ The temperature of the drive radiator, motor, and external regeneration resistor will rise during operation, please avoid touching
	◆ Before the machine starts running, please confirm whether the emergency stop device can be activated at any time
	◆ Use servo motors with brakes on vertical loads to avoid equipment falling during alarm, failure, power failure

1.6 Certified Specifications

MBDV series low voltage servo products are designed to meet the following standards.

		Drive	Motor
Europe	EMC Directive	EN 61800-3	EN 55011
			EN 55014-1
			EN 55014-2
			EN 6100-3-2
			EN 6100-3-3
	LVD	EN 61800-5-1	EN 60034-1
			EN 60034-5
	Functional Safety(STO)	UL61800-5-2(SIL2)	
		IEC61508	
		ISO13849-1(PL d)	
UL Standard		UL 61800-5-1	UL 1004-1
			UL 1004-6
CSA Standard		C22.2 No.274-13	CSA C22.2 No.100

1.7 Maintenance and Inspection

1.7.1 Check items and cycles

The normal use conditions of the servo are: Annual average ambient temperature: 30 ℃ Average load rate: below 80% Daily operating time: 20 hours or less. The items of daily inspection are as follows:

Type	Inspection cycle	Check item
Daily inspection	Daily	◆ Check the ambient temperature, humidity, dust, foreign matter, and condensation
		◆ Is there any abnormal vibration or noise
		◆ Voltage
		◆ Peculiar smell
		◆ Are there any foreign objects in the vents?
		◆ Whether the connector is loose
		◆ Whether there is foreign matter between the cable and the connector, and whether the cable conductor is exposed
		◆ Is the fastening part loose?

1.7.2 Replacement of parts

The components inside the servo products will wear and age over time, and the replacement time of the components varies according to the environmental conditions and usage methods. When replacement is required, please contact our company or our agent.

Please do not disassemble and repair by yourself.

Part	Part	Standard replacement cycle	Remark
Driver	Filter capacitor	About 6 years	The standard replacement cycle is for reference only. Even if the standard replacement cycle is not completed, it needs to be replaced in the event of an abnormality.
	Aluminum electrolytic capacitors on circuit boards	About 6 years	
	Power-up buffer relay	About 100,000 times (depending on usage conditions)	
	Power-on snubber resistor	About 20,000 times (depending on usage conditions)	
Motor	Oil seal	5000 hours	

2 Basic Information

2.1 Product confirmation

Please refer to the following chapters to confirm the model of the driver and the model of the servo motor. A complete operational servo should include the following components:

- Power-matched servo drives and servo motors
- Mini for USB to PC _ USB communication cable (optional)
- Wireless communication module for Wireless port (optional)
- Connector for I/O port (standard item)
- Encoder signal frequency division output connector for Encoder output port (for Dual axis driver, standard product)
- STO connector for STO port (standard item)
- Connectors for COM1 and COM2 ports, for CAN Open or RS485 communication (standard)

2.2 Drive model introduction

2.2.1 Drive model description

MBDV - 2X - 5 20A C - ***

① ② ③ ④ ⑤

① MBDV Series	④ Current
② # of Axes	20A: Continuous Curent 20A (RMS)
Empty: Single axis	Peak Cureent 60A (RMS)
2X: Dual axis	⑤ Communication Protocol
③ Input Voltage	C: CANopen、RS485
5: 24 ~ 60VDC	⑥ Custom Code

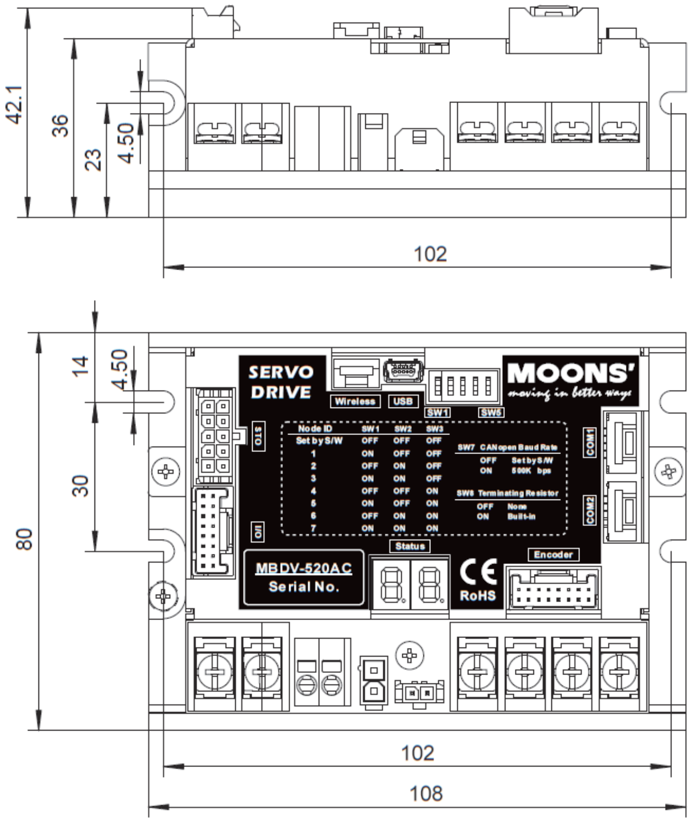
2.2.2 Drive Specifications

Input power	Main circuit power supply		24V ~ 60VDC ± 10%
	Control loop power		24VDC ± 10%
Insulation withstand voltage			One time to ground: withstand voltage 500 VAC, 1 min, (leak: 10 mA)
Use environment	Temperature		◆ Use temperature: 0 ~ 50 ℃ (if the ambient temperature exceeds 45 ℃, please place it in a well-ventilated place) ◆ Storage temperature: -20 ℃ ~ 65 ℃
	Humidity		Storage and use: 10 ~ 85%RH, no condensation
	Altitude		Altitude below 1000m
	Vibration		9.8m/s² or less, 10 ~ 60Hz (Not sustainable at resonance point)
Encoder feedback			◆ 16-bit Magnetic Incremental Encoder ◆ 2500-line optical incremental encoder
I/O *1	Digital signal	Input	4 -way optocoupler isolation general-purpose input, can be configured by parameters, 5 ~ 24VDC, 20mA
		Output	◆ 2 -way optocoupler isolated general-purpose output, function can be configured through parameters, maximum 30VDC, 100mA ◆ 1 channel optocoupler isolation motor brake control output
	Pulse signal *2	Output	3 -way Line Driver output: encoder feedback frequency division output A ±, B ±, Z ±
Comm Port	USB Mini		Used to connect PC for software debugging
	Wireless		It is used to connect the wireless module, and connect the PC through the wireless module for software debugging
	CANopen		CANopen protocol communication
	RS-485 *3		Modbus/RTU protocol communication
LED display			2 -digit 7 -segment LED display
Regenerative resistor			External regenerative resistor
Control mode			◆ CANopen communication control mode: Complies with CiA402 standard, supports PP, PV, PVT, TQ and HM modes ◆ Modbus/RTU communication control mode: Command position mode, command speed mode, command torque mode
Available input signals			Alarm clear, forward/reverse rotation inhibit limit, gain switching, zero speed clamp, emergency stop, forward/reverse running torque limit, speed limit, general-purpose input
Available output signals			Fault (Error), Warning (Alarm), Servo-Ready Status, Motor Brake Control, Speed Reached, Torque Reached, Position Reached, Servo-ON Status, Dynamic Error Follow, Positioning Complete, Zero Speed Signal, Speed Consistency, Torque Consistent, in speed limit, in torque limit, homing completed, software limit (forward, reverse), general-purpose output
Protective function			Overcurrent, overvoltage, under voltage, overheating, abnormal encoder feedback, overload, excessive speed, excessive position error, emergency stop, forward/ reverse rotation limit, communication error
Protective function			Built-in
STO			Built-in
Certification			RoHS、CE
Drive weight	MBDV-520AC		0.4kg
	MBDV-2X-520AC		0.9kg

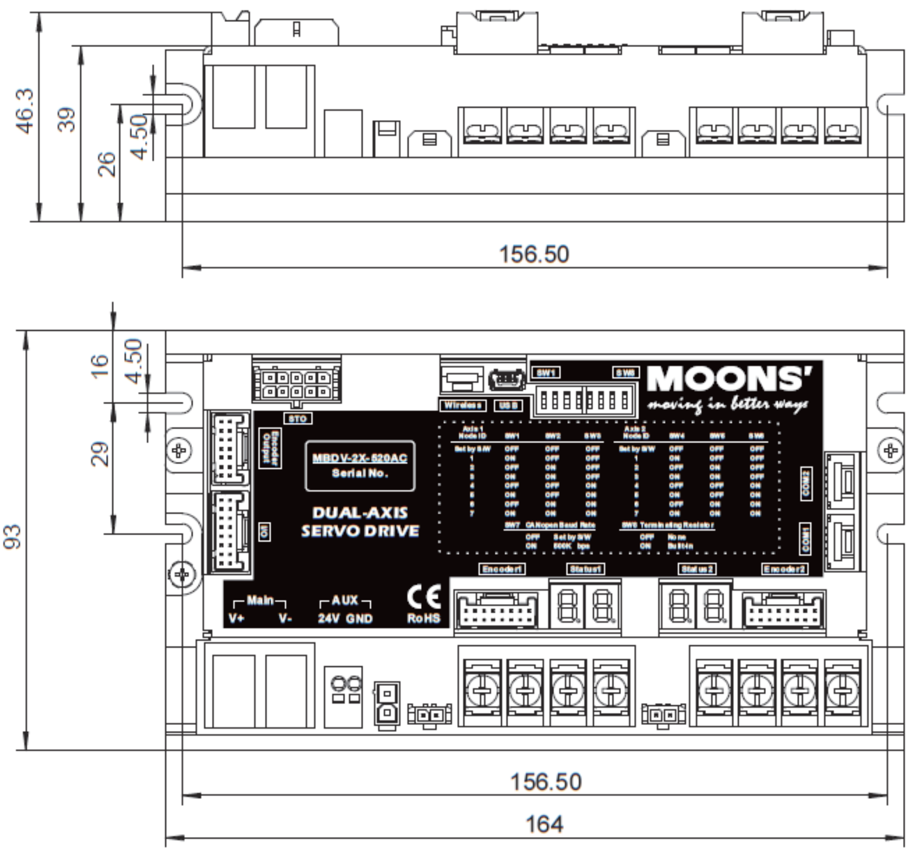
* 1 The multi-axis drive is described for a single axis
* 2 Single axis drive does not support this function, can be customized if necessary
* 3 RS485 and CANopen share communication interface

2.2.3 Dimensions of the driver (Unit: mm)

2.2.3.1 MBDV-520AC

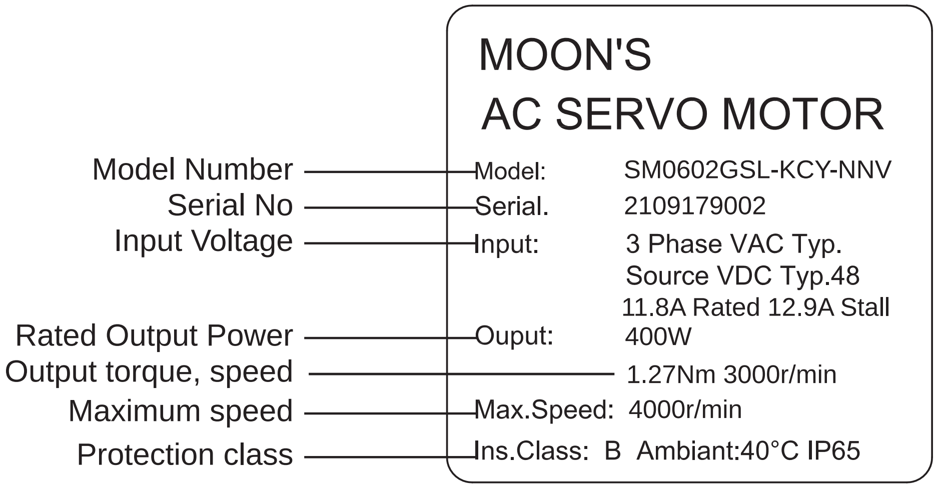


2.2.3.2 MBDV-2X-520AC



2.3 Motor model introduction

2.3.1 Motor nameplate description



2.3.2 Motor model description

SM0602GSL-KCY-NNV**

SM Series

Frame Size
04-□40mm
06-□60mm
08-□80mm

Motor Length			
	□ 40	□ 60	□ 80
01		200W	
02	100W	400W	
03			750W

Winding(DC)	
G	48V
J	24V

Brake
N: No brake
B: With brake(24VDC)

Custom code

Shaft and lead type
KCY: Standard keway, molor cable with Y type terminal

Encoder Type
SL: 16-bit incrementel Magnetic Encoder, Communication type
EL: 16-bit incremental Magnetic Master EncoderCommunication type 1000line incremental Optical Auliary Encoder

2.3.3 Motor Specifications and Dimensions

2.3.3.1 □ 40mm specifications and dimensions

☐ Specification

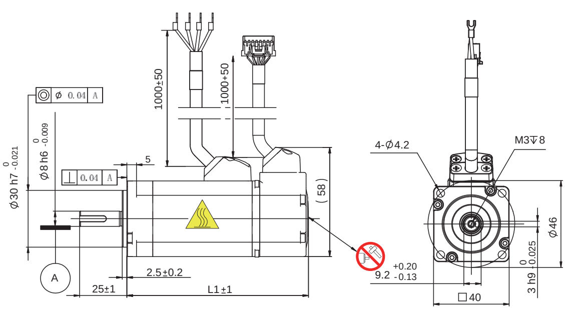
Type		SM0402JSL-KCY-☐ NV	SM0402GSL-KCY-☐ NV
Recommended drive input voltage at rated speed(DC-Bus)		24	48
Rated Output Power Rated Speed Max.Speed	watts rpm rpm	100 3000 4500	100 3000 4200
Rated Torque Peak Torque	Nm Nm	0.32 0.96	0.32 0.96
Rated Current Peak Current	A (rms) A (rms)	8.1 24.5	2.9 8.15
Voltage Constant ±5% Torque Factor ±5% Winding Resistance(Line-Line) Winding Inductance(Line-Line)	V (rms) / K rpm Nm / A (rms) Ohm @25°C mH (typ.)	2.53 0.042 0.23 0.25	7.02 0.116 1.7 1.9
Rotor Inertia Rotor Inertia - With Brake Shaft Load - Axial Shaft Load - Radial (End of Shaft) Weight Weight - With Brake	Kg·m² Kg·m² N (max.) N (max.) kg kg	0.0428×10^{-4} 0.0494×10^{-4} 50 60 0.55 0.8	0.0428×10^{-4} 0.0494×10^{-4} 50 60 0.55 0.8

Note: The torque and maximum speed depend on the DC bus voltage, please choose the proper supply voltage.

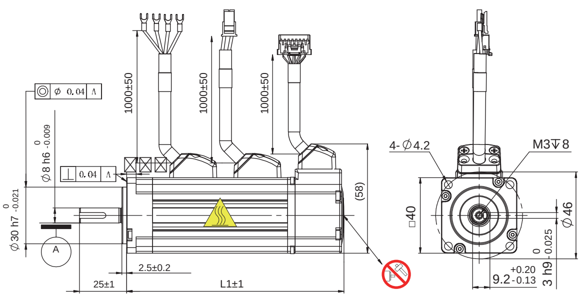
☐ Brake Options

☐ Dimensions (unit: mm)

1) Without Brake



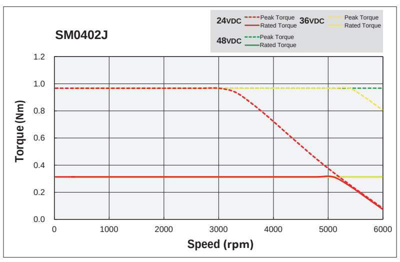
1) With Brake

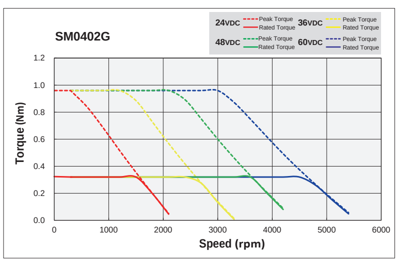


Without Brake	L1
SM0402JSL-KCY-NNV	96
SM0402GSL-KCY-NNV	96

With Brake	L1
SM0402JSL-KCY-BNV	133
SM0402GSL-KCY-BNV	133

☐ Torque Curves





2.3.3.2 □ 60mm specification and size

☐ Specification

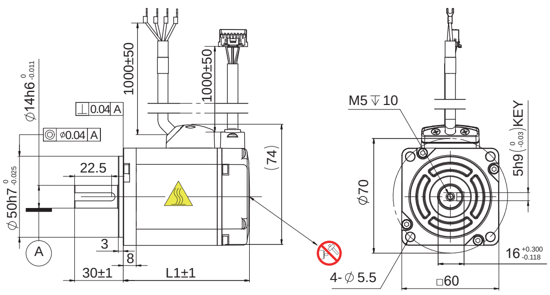
Type		SM0601JSL-KCY-☐NV	SM0601GSL-KCY-☐NV	SM0602GSL-KCY-☐NV
Recommended drive input voltage at rated speed(DC-Bus)		24	48	48
Rated Output Power	watts	200	200	400
Rated Speed	rpm	3000	3000	3000
Max.Speed	rpm	4200	3900	4000
Rated Torque	Nm	0.64	0.64	1.27
Peak Torque	Nm	1.92	1.92	3.81
Rated Current	A (rms)	16.3	6.5	11.8
Peak Current	A (rms)	49	19.3	36.2
Voltage Constant ±5%	V (rms) / K rpm	2.61	6.52	7.41
Torque Factor ±5%	Nm / A (rms)	0.043	0.108	0.122
Winding Resistance(Line-Line)	Ohm @25°C	0.1	0.52	0.22
Winding Inductance(Line-Line)	mH (typ.)	0.216	1.348	0.625
Rotor Inertia	Kg·m²	0.165×10^{-4}	0.165×10^{-4}	0.31×10^{-4}
Rotor Inertia - With Brake	Kg·m²	0.22×10^{-4}	0.22×10^{-4}	0.36×10^{-4}
Shaft Load - Axial	N (max.)	70	70	70
Shaft Load - Radial (End of Shaft)	N (max.)	200	200	240
Weight	kg	1.1	1.1	1.6
Weight - With Brake	kg	1.6	1.6	2.0

Note: The torque and maximum speed depend on the DC bus voltage, please choose the proper supply voltage.

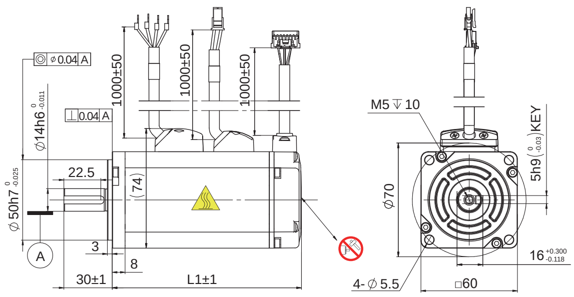
☐ Brake Options

☐ Dimensions (unit: mm)

1) Without Brake



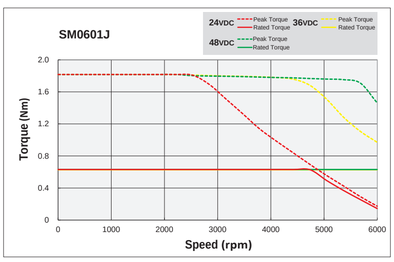
1) With Brake

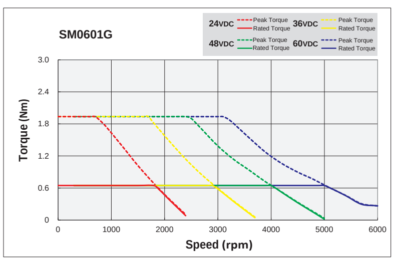


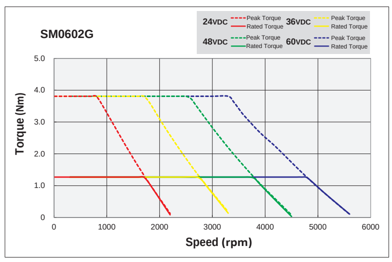
Without Brake	L1
SM0601JSL-KCY-NNV	78
SM0601GSL-KCY-NNV	78
SM0602GSL-KCY-NNV	107

With Brake	L1
SM0601JSL-KCY-BNV	117.5
SM0601GSL-KCY-BNV	117.5
SM0602GSL-KCY-BNV	146.5

☐ Torque curve







2.3.3.3 □ 80mm specification and size

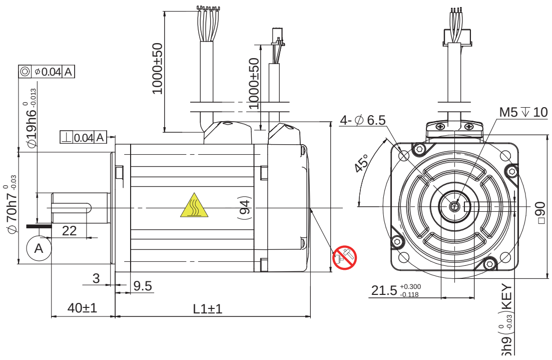
☐ Specification

Type		SM0803GSL-KCY-NNV	SM0803GSL-KCY-BNV
Recommended drive input voltage at rated speed(DC-Bus)		48	48
Rated Output Power Rated Speed Max.Speed	watts rpm rpm	750 3000 3600	750 3000 3600
Rated Torque Peak Torque	Nm Nm	2.4 7.2	2.4 7.2
Rated Current Peak Current	A (rms) A (rms)	18.8 56.7	18.8 56.7
Voltage Constant ±5% Torque Factor ±5% Winding Resistance(Line-Line) Winding Inductance(Line-Line)	V (rms) / K rpm Nm / A (rms) Ohm @25°C mH (typ.)	8.36 0.138 0.094 0.366	8.36 0.138 0.094 0.366
Rotor Inertia Shaft Load - Axial Shaft Load - Radial (End of Shaft) Weight	$Kg{\cdot}m^2$ N (max.) N (max.) kg	0.89×10^{-4} 90 270 2.6	0.97×10^{-4} 90 270 3.4

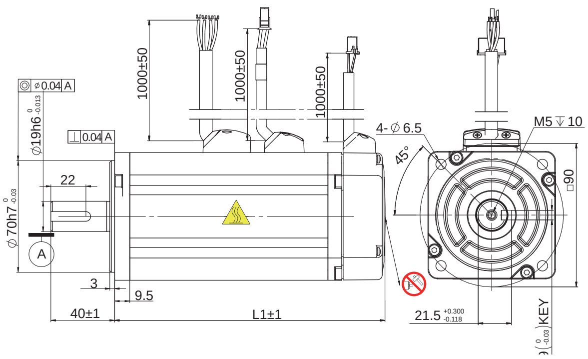
Note: The torque and maximum speed depend on the DC bus voltage, please choose the proper supply voltage.

☐ Dimensions (unit: mm)

1) Without Brake



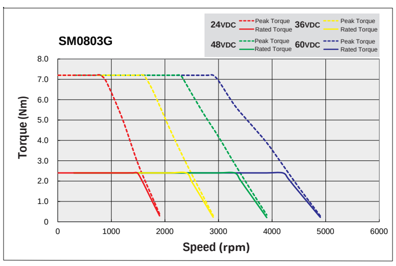
1) With Brake



Without Brake	L1
SM0803GSL-KCY-NNV	110

With Brake	L1
SM0803GSL-KCY-BNV	156.8

☐ Torque curve



2.3.3.4 □ 60mm specification and size

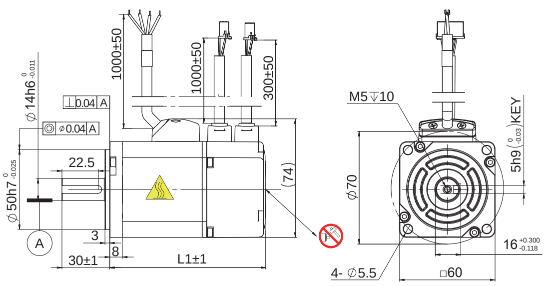
☐ Specification

Type		SM0601JEL-KCY-☐NV	SM0601GEL-KCY-☐NV	SM0602GEL-KCY-☐NV
Recommended drive input voltage at rated speed(DC-Bus)		24	48	48
Rated Output Power Rated Speed Max.Speed	watts rpm rpm	200 3000 4200	200 3000 3900	400 3000 4000
Rated Torque Peak Torque	Nm Nm	0.64 1.92	0.64 1.92	1.27 3.81
Rated Current Peak Current	A (rms) A (rms)	16.3 49	6.5 19.3	11.8 36.2
Voltage Constant ±5% Torque Factor ±5% Winding Resistance(Line-Line) Winding Inductance(Line-Line)	V (rms) / K rpm Nm / A (rms) Ohm @25°C mH (typ.)	2.61 0.043 0.1 0.216	6.52 0.108 0.52 1.348	7.41 0.122 0.2 0.625
Rotor Inertia Rotor Inertia- With Brake Shaft Load - Axial Shaft Load - Radial (End of Shaft) Weight Weight - With Brake	$Kg{\cdot}m^2$ $Kg{\cdot}m^2$ N (max.) N (max.) kg kg	0.165×10^{-4} 0.22×10^{-4} 70 200 1.1 1.6	0.165×10^{-4} 0.22×10^{-4} 70 200 1.1 1.6	0.31×10^{-4} 0.36×10^{-4} 70 240 1.6 2.0

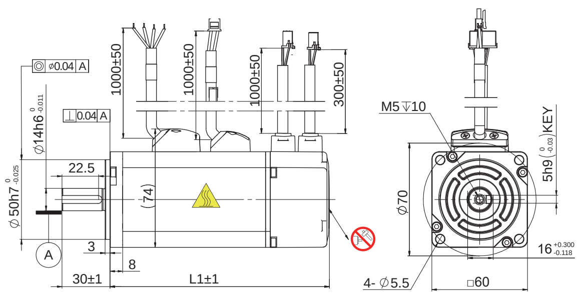
Note: The torque and maximum speed depend on the DC bus voltage, please choose the proper supply voltage.
☐ Brake Options

☐ Dimensions (unit: mm)

1) Without Brake



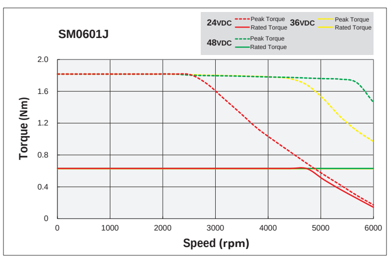
1) With Brake

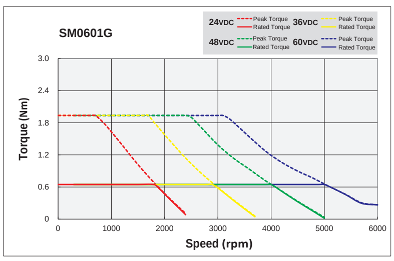


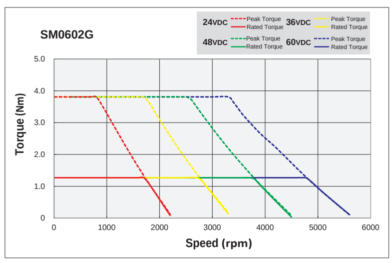
Without Brake	L1
SM0601JEL-KCY-NNV	98
SM0601GEL-KCY-NNV	98
SM0602GEL-KCY-NNV	127

With Brake	L1
SM0601JEL-KCY-BNV	137.5
SM0601GEL-KCY-BNV	137.5
SM0602GEL-KCY-BNV	166.5

☐ Torque curve







2.3.3.5 □ 80mm specifications and dimensions (unit: mm)

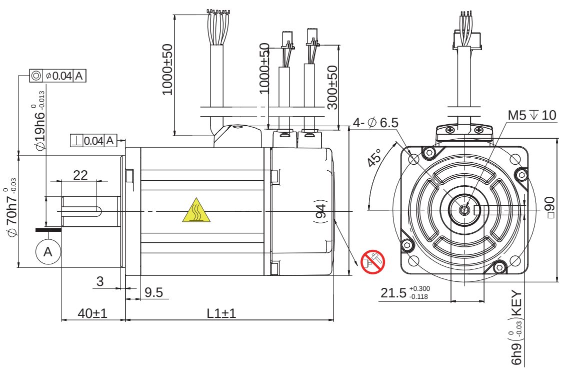
☐ Specification

Type		SM0803GEL-KCY-NNV	SM0803GEL-KCY-BNV
Recommended drive input voltage at rated speed(DC-Bus)		48	48
Rated Output Power Rated Speed Max.Speed	watts rpm rpm	750 3000 3600	750 3000 3600
Rated Torque Peak Torque	Nm Nm	2.4 7.2	2.4 7.2
Rated Current Peak Current	A (rms) A (rms)	18.8 56.7	18.8 56.7
Voltage Constant ±5% Torque Factor ±5% Winding Resistance(Line-Line) Winding Inductance(Line-Line)	V (rms) / K rpm Nm / A (rms) Ohm @25°C mH (typ.)	8.36 0.138 0.094 0.366	8.36 0.138 0.094 0.366
Rotor Inertia Shaft Load - Axial Shaft Load - Radial (End of Shaft) Weight	$Kg \cdot m^2$ N (max.) N (max.) kg	0.89×10^{-4} 90 270 2.6	0.097×10^{-4} 90 270 3.4

Note: The torque and maximum speed depend on the DC bus voltage, please choose the proper supply voltage.

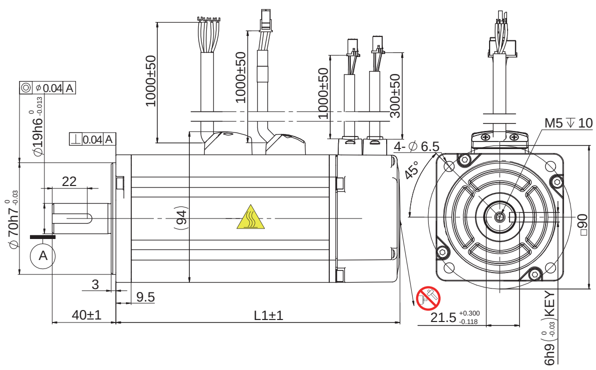
☐ Dimensions (unit: mm)

1) Without Brake



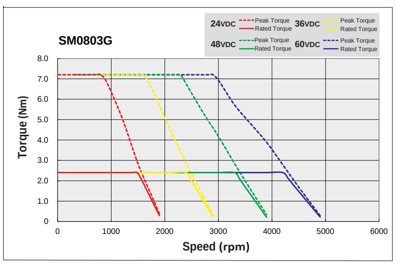
Without Brake	L1
SM0803GEL-KCY-NNV	130.8

1) With Brake



With Brake	L1
SM0803GEL-KCY-BNV	178.8

☐ Torque curve



2.4 General Motor Specifications

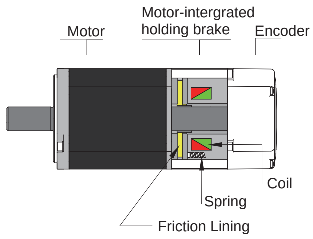
Insulation class	Class B (130 ℃)
Protection class	IP65 (except shaft penetration)
Installation conditions	Indoor installation, avoid direct sunlight, corrosive and flammable gases
Ambient temperature	Operating temperature: 0 ℃ - 40 ℃; storage temperature: -20 ℃ - 60 ℃
Wet Spend	Storage and use: 20 - 85%RH (No condensation)
Ocean pull	Altitude below 1000m
Vibrate verb: move	49m/s 2 or less, 10 - 60Hz (Not sustainable at resonance point)

2.5 Brake Specifications

The motor brake is used to prevent the motor from turning when the brake is de-energized. The most common way of using it is when the motor is used to control a vertical load, when the motor is not enabled or powered off, in order to prevent the mechanical mechanism driven by the motor from shifting due to gravity and other reasons, it is necessary to use a servo motor with a brake.

When the brake is energized, the armature is adsorbed, the brake piece is released, and the motor can run normally; when the brake is powered off, the armature will be released, the brake piece is locked, and the motor cannot rotate normally.

Frame Size	40mm	60mm	80mm
Static friction torque (Nm)	0.32	1.5	3.2
Rated Voltage (VDC)	24		
Power (W)(20℃)	6.9	7.2	10
Rated Current (A)	0.26	0.3	0.42
Brake Time	< 70ms (Standard air gap, at 20℃)		
Release Time	<25ms		
Release Voltage	18.5VDC max.(at 20℃)		



During normal operation, do not use the motor's brake to decelerate the motor, it will cause damage to the brake.

3 Installation

3.1 Storage conditions

Please note the following when storing:

- Please put this drive in the packing box and store it in a dry, dust-free place away from direct sunlight
- Storage ambient temperature between -20 ℃ to +65 ℃
- Storage environment humidity is in the range of 10% to 85% without condensation
- Avoid storage in corrosive atmospheres

3.2 Installation conditions

The environmental conditions for the driver of this product are:

1. Temperature is 0 ℃ ~ 50 ° C. If the ambient temperature exceeds 45 ℃, please place it in a well-ventilated place. It is recommended to operate at 45 ℃ for a long time
2. Below ambient temperature to ensure reliable performance of the product.
3. If this product is installed in a distribution box, the distribution box must be sized and ventilated so that there is no danger of overheating of all electronic devices used inside.
4. Ambient humidity is 10%~85% RH, no condensation
5. Vibration below 9.8m/s 2
6. Do not use the driver near corrosive gas, flammable gas or combustible material
7. Please install the driver in an indoor electrical control box without water and direct sunlight
8. Please avoid using these drive-in dusty places

3.3 Drive installation space

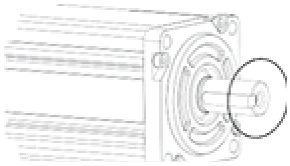
- When installing the drive, please reserve enough space up, down, left and right for the drive to ensure good air circulation.
- Do not block the cooling vents of the drive.
- To ensure the temperature in the electrical control box, it is recommended to install a cooling fan in the electrical control box.
- Please ground the drive well when installing.

3.4 Motor Installation Precautions

3.4.1 Protection of encoders and bearings

- To prevent damage to the encoder and bearing, do not knock the motor body and shaft during installation.

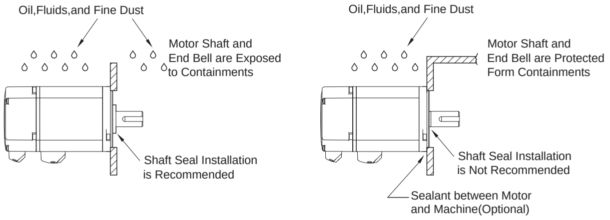
- It is recommended to use a disruptive coupling specially designed for servo motors, which can provide some buffering during eccentricity or deflection.
- When installing the coupling, please wipe clean the anti-rust oil on the shaft end of the motor.
- When using the keyway, please use the standard key in the motor box.
- When installing a pulley on a servo motor with a keyway, use the threaded hole of the motor shaft to squeeze the pulley into the motor shaft with a screw.



- When removing the pulley, please use professional tools such as pulley remover to prevent bearing injury.
- When connecting the shafts, make sure to achieve the desired concentricity. If concentricity is poor, the resulting vibration can damage bearings and encoders.
- The axial or radial load applied to the motor should not exceed the range specified in the specifications, please refer to the specification table of each servo motor.
- The material of the output shaft of the servo motor has no rust protection. Although grease has been used for anti-rust protection before leaving the factory, if the storage time exceeds six months, in order to ensure that the motor shaft is not rusted, please check the condition of the motor shaft regularly every three months. And timely supplement the appropriate anti-rust grease.

3.4.2 Precautions for motor in oil and water environment

- Do not allow oil and water to enter the inside of the motor
- Do not place cables in water or oil
- Since the through part of the motor shaft and the motor lead wires are not IP65 protected, please ensure that no water or oil enters the motor from such parts
- The motor industrial grade skeleton oil seal can block pollutants (oil, impurities) to prolong the life of the motor. When leaving the factory, the oil seal will be attached to the box, but will not be installed on the motor output shaft. After the oil seal is installed, the oil seal will cause a certain resistance and torque loss to the rotation of the motor shaft. It is recommended that the motor be dated.
- In the application with liquid, please install the motor wiring port downward



● When installing the oil seal, make sure that the lip of the oil seal faces outwards

3.4.3 Wiring

- If using a cable chain, use a super flexible cable. And ensure that there is a bending diameter of more than 100mm.
- Do not twist the cable.
- When moving the motor, do not pull on the cable.
- Do not use the same sleeve for the main circuit cable and the input/output signal cable / encoder cable, and do not bundle them together. Wiring in this case, the main circuit cable and the input/output signal cable / encoder cable should be separated by at least 30cm.

3.4.4 Motor temperature rise

Servo motors are rated for continuous operation when mounted on a standard heat sink and in an ambient temperature of 40 °C. When the servo motor is installed in a small device, the temperature may rise significantly due to the reduced heat dissipation area of the servo motor.

The dimensions of the standard cooling plate of the servo motor are as follows:

Base series	Power	Heat sink size
40mm	100W	200*200*6 aluminum
60mm	200W, 400W	250*250*6 aluminum
80mm	750W	250*250*6 aluminum

If the installation environment makes it difficult to use a large heat sink, or if the ambient temperature exceeds the specification requirements, the following requirements need to be followed:

- Do not work at rated power, choose a motor that is 1~2 times larger than the actual motor power required.
- Reduce the acceleration and deceleration of the duty cycle to reduce the motor load.
- Reduced duty cycle for work.
- External forced air cooling of the servo motor using a cooling fan or other means.
- When using a motor with an oil seal, the oil seal will cause a certain resistance and torque loss to the rotation of the motor shaft, and heat is generated due to the friction between the two. The required load torque needs to be 70% of the rated torque of the motor.

Note: Do not put any thermal insulation material between the servo motor and the metal heat sink, so as to avoid the failure of the motor to dissipate heat and cause the motor temperature to rise, which may cause the motor to malfunction.

4 System Configuration and Wiring

4.1 Electromagnetic Compatibility (EMC)

⚠	MBDV servo driver uses high-speed switching elements inside, which will generate high frequency or low frequency during normal operation interference, and interfere with peripheral equipment through conduction or radiation.
	There is also a low-voltage unit inside the servo drive, which is likely to be disturbed by the noise of the peripheral equipment of the drive. A disturbed signal may cause the device to behave unexpectedly.

Follow the electromagnetic compatibility regulations described in this manual during installation and wiring. This product can comply with the following regulations: EN 61800-3

To prevent mutual electromagnetic interference between the servo drive and its peripheral devices, the following countermeasures can be taken.

- Make sure that the driver and motor are well grounded, and the grounding wire should preferably be a cable of AWG10 or above.
- Do not use the same sleeve for the main circuit cable and the input / output signal cable / encoder cable, and do not bundle them together. When wiring, the main circuit cable and the input / output signal cable / encoder cable should be separated by more than 30cm.
- For input/output signal cables and encoder cables, use twisted-pair wires or multi-core twisted-pair shielded wires.
- The length of the input and output signal cables is less than 3m, and the encoder cable is less than 5m.
- Do not use the same power source as an electric welding machine, electric discharge machine, etc. Even if it is not the same power supply, when there is a high-frequency generator nearby, connect a noise filter to the input side of the main circuit power supply cable and the control power supply cable.

4.1.1 Ground

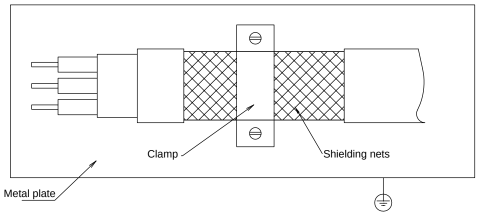
Good grounding treatment can give full play to the effect of EMI filter and greatly reduce interference.

- Must be grounded at a single point in parallel.
- Power extension cable between driver and motor, use cable with shielded mesh.
- The shielding net of the motor power line must be grounded and connected to the ground terminal of the drive.

4.1.2 Shielding of motor cables

The selection of motor cables with shielding nets and properly installed shielding nets can achieve better EMC effects and interference suppression effects. Please note the following:

- Use shielded cable (Better if there is a double-layer isolation layer)
- The shielding nets at both ends of the motor cable must be grounded with the shortest distance and maximum contact area. Use clamps to fix the shielding nets at both ends of the motor cable to the metal plane as shown in the figure below. Please refer to the connection method in the figure below.
- The protective paint should be removed from the fixing place between the clamp and the metal plane to ensure good contact, see the figure below.



4.1.3 Ferrite Ring

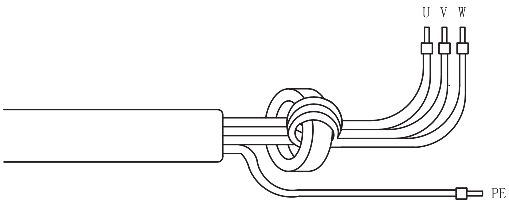
Ferrite magnetic ring, also referred to as the magnetic ring, can effectively absorb the radiation interference of the wire beam.

The magnetic ring has different impedance characteristics at different frequencies. Generally, the impedance is very small at low frequencies. When the signal frequency increases, the impedance of the magnetic ring increases sharply, making it easy for normal and useful signals to pass through, and can effectively suppress high frequencies. The path of interference signals solves the problem of high-frequency interference suppression of power lines, signal lines and connectors.

When the magnetic ring suppresses common mode interference, the eddy current loss of the magnetic ring to the high-frequency signal converts the high-frequency component into heat loss, so that a low-pass filter can be formed, so that the high-frequency noise can be greatly attenuated, and the impedance of useful signals at low frequencies can be ignored and does not affect the normal operation of the circuit.

The wire passing through the magnetic ring can be repeatedly wound on the magnetic ring to increase the inductance, thereby enhancing the use effect of the magnetic ring. But too many turns will make the loss too large and the temperature of the magnetic ring will rise too high. The recommended winding method and number of turns are as follows:

Digital signal Cables	Wrap the signal wire around the magnetic ring 2-3 times.
Motor Power Cables	Wind the U/V/W phase of the motor 2-3 times around the magnetic ring. The ground wire and the shielding net cannot be wound into the magnetic ring.
Encoder Cables	Wrap the encoder wire around the magnetic ring 2-3 times.



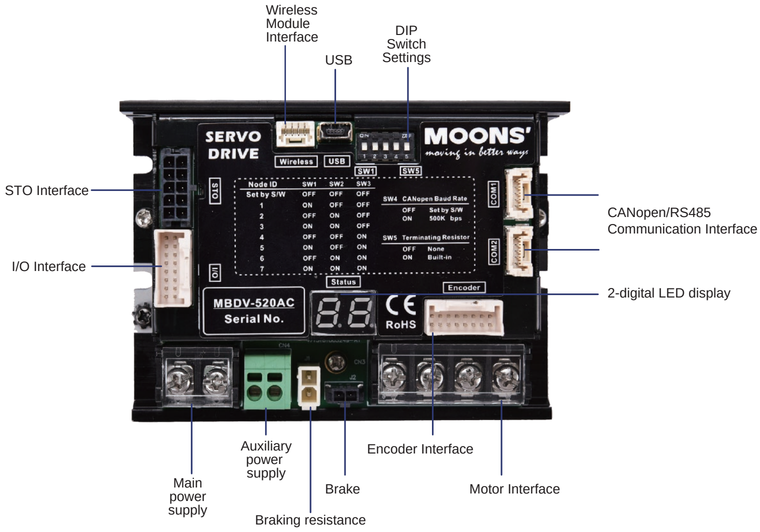
Magnetic ring recommended model:

MOONS' optional models	Manufacturer's model	Manufacturer
M2-OP3035	ZCAT3035-1330	TDK

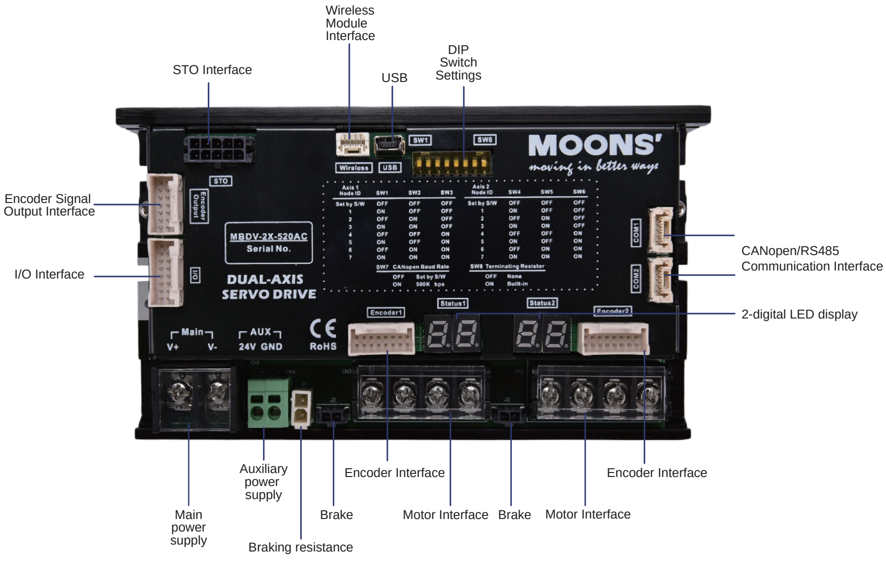
4.2 External circuit wiring

4.2.1 Interface introduction

4.2.1.1 MBDV-520AC



4.2.1.2 MBDV-2X-520AC



4.2.2 DIP switch function description

The MBDV driver has a key DIP switch, which is used to set the node address, baud rate and optional terminal matching resistance of CAN open communication. The specific definitions are as follows.

- **MBDV-520AC**

Node address:

SW1	SW2	SW3	Function Description
0	0	0	The node address is set by Luna software, the default is 1
1	0	0	Node address is 1
0	1	0	Node address is 2
1	1	0	Node address is 3
0	0	1	Node address is 4
1	0	1	Node address is 5
0	1	1	Node address is 6
1	1	1	Node address is 7

Baud rate:

SW4	Function Description
0	The baud rate is set by Luna software, the default is 1Mbps
1	500kpbs

Select the terminal matching resistor:

SW5	Function Description
0	120 Ω resistor connected between CAN_H and CAN_L
1	Connect a 120 Ω resistor between CAN_H and CAN_L

- **MBDV-2X-520AC**

1# Node address:

SW1	SW2	SW3	Function Description
0	0	0	The node address is set by Luna software, the default is 1
1	0	0	Node address is 1
0	1	0	Node address is 2
1	1	0	Node address is 3
0	0	1	Node address is 4
1	0	1	Node address is 5
0	1	1	Node address is 6
1	1	1	Node address is 7

2# Node address:

SW4	SW5	SW6	Function Description
0	0	0	The node address is set by Luna software, the default is 1
1	0	0	Node address is 1
0	1	0	Node address is 2
1	1	0	Node address is 3
0	0	1	Node address is 4
1	0	1	Node address is 5
0	1	1	Node address is 6
1	1	1	Node address is 7

Baud rate:

SW7	Function Description
0	The baud rate is set by Luna software, the default is 1Mbps
1	500kpbs

Select the terminal matching resistor:

SW8	Function Description
0	No resistor connector between CAN_H and CAN_L
1	Connect a 120 Ω resistor between CAN_H and CAN_L

4.2.3 Driver terminal description

Type	Name	Description		
Main	V+、V-	V+	positive terminal of Main power supply	
		V-	negative terminal of Main power supply	
AUX	24V、GND	24V	Positive terminal of logic power supply	Can be disconnected
		GND	negative terminal of logic power supply	
REG	REG	Regenerative resistor connector		
Motor	U、V、W	U	Red	Three-phase power supply for the motor
		V	Yellow	
		W	Blue	
	Brake	Motor brake connector		
Encoder	Encoder signal input interface	Motor encoder connector		
I/O	I/O connection	Input and output signal connector		
Encoder Output	Encoder signal output interface	Encoder signal output connector		
STO	STO interface	Safe torque off function connector		
Wireless	Wireless debugging module interface	Wireless debugging module connection port		
USB	USB debugging interface	Connect to PC		
COM1 / COM2	CAN open / RS-485 interface	CAN open / RS-485 communication interface		

4.2.4 Considerations when Wiring

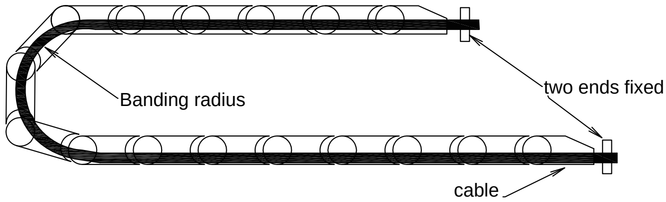
- Please make sure that the driver and motor are well grounded, and the best grounding wire is AWG10 above cables.
- The ground must be a single point ground.
- Check whether the V+ and V- connections are correct and the correct voltage is connected.
- If using an auxiliary power supply, connect the positive connector of the 24V power supply to 24V and the negative connector of the power supply to GND.
- Make sure the order of U, V, W is red, yellow, blue, wrong order will cause the motor to not rotate or rotate randomly.
- An emergency stop circuit must be provided to ensure that the power can be cut off immediately in the event of a fault.
- There is a large-capacity capacitor in the servo drive, even after the power is off, the high voltage will still be maintained. 5 Do not touch the exposed parts of the drive and motor terminals for a few minutes.
- Do not use the same sleeve for the main power cable and the input/output signal / encoder cable, and do not bundle them together. When wiring, the main power cable and the input/ output signal cable / encoder cable should be separated by at least 30cm. Getting too close will result in malfunction.
- Use twisted-pair or multi-core twisted-pair shielded cables for input/output signal cables and encoder cables.
- The maximum wiring length of the input/output signal cable is 3m, and the maximum wiring length of the encoder cable is 5m.

4.2.5 Precautions for the use of drag chain cables

When the motor cable needs to be moved or the cable is installed in a drag chain, please use a special flexible and bend-resistant cable. Ordinary cables are easily damaged during repeated bending, causing the servo motor to fail to work properly.

When using drag chain cables, make sure that:

- Correctly select the cable that meets the required bending times
- Bending radius of the cable R generally be more than 10 times the diameter of the cable
- Avoid pulling the cable. When wiring inside the drag chain, do not fix or bundle it, so as to avoid pulling the cable due to insufficient bending radius when bending.
- Please bundle the cables at the two ends of the towline and where the mechanical parts are fixed



- The wiring in the drag chain should not be too dense, and ensure that the cables occupy less than 60% of the internal space of the drag chain
- Mixed wiring of cables with large differences in outer diameter should be avoided. If mixed wiring is indeed required, please set up baffles

4.2.6 Recommended Wires

- It is recommended to use an insulated wire with a withstand voltage of 600V and a temperature above 75 ℃ for the main circuit
- Be sure to choose a wire that uses the corresponding current to prevent the wire from overheating

4.2.6.1 Recommended Wires

The recommended cables for each part of the driver are as follows:

<table>
<tr><th rowspan="3" colspan="2">Drive and matching servo motor</th><th rowspan="3">Rated power (W)</th><th colspan="7">Wire Diameter (AWG)</th></tr>
<tr><th>Connector Main</th><th>Connector AUX</th><th>Connector REG</th><th colspan="2">Connector Motor</th><th>Connect or Encoder</th><th>---</th></tr>
<tr><th>---</th><th>24V/GND</th><th>REG</th><th>U/V/W</th><th>Brake</th><th>Encoder</th><th>Power ground</th></tr>
<tr><td rowspan="4">MBDV-520AC</td><td>SM0402GSL-KCY-□NV</td><td>100</td><td>1.0 ~ 1.5mm^2 AWG16 ~ 18</td><td rowspan="9">1.0 ~ 1.5mm^2 AWG16 ~ 18</td><td rowspan="9">1.0 ~ 1.5mm^2 AWG16 ~ 18</td><td>1.0 ~ 1.5mm^2 AWG16 ~ 18</td><td rowspan="9">0.5mm^2 AWG20</td><td rowspan="9">0.1mm^2 AWG26</td><td rowspan="9">2.0 ~ 5.3mm^2 AWG10 ~ 14</td></tr>
<tr><td>SM0601GSL-KCY-□NV</td><td>200</td><td rowspan="2">2.0 ~ 3.5mm^2 AWG12 ~ 14</td><td rowspan="2">2.0 ~ 3.5mm^2 AWG12 ~ 14</td></tr>
<tr><td>SM0602GSL-KCY-□NV</td><td>400</td></tr>
<tr><td>SM0803GSL-KCY-□NV</td><td>750</td><td>3.5 ~ 5.3mm^2 AWG10 ~ 12</td><td>4.0 ~ 6.0mm^2 AWG10 ~ 12</td></tr>
<tr><td rowspan="5">MBDV-2X-520AC</td><td>SM0401GSL-KCY-□NV</td><td>50</td><td rowspan="2">2.0 ~ 3.5mm^2 AWG12 ~ 14</td><td rowspan="2">1.0 ~ 1.5mm^2 AWG16 ~ 18</td></tr>
<tr><td>SM0402GSL-KCY-□NV</td><td>100</td></tr>
<tr><td>SM0601GSL-KCY-□NV</td><td>200</td><td rowspan="2">4.0 ~ 6.0mm^2 AWG10 ~ 12</td><td rowspan="2">2.0 ~ 3.5mm^2 AWG12 ~ 14</td></tr>
<tr><td>SM0602GSL-KCY-□NV</td><td>400</td></tr>
<tr><td>SM0803GSL-KCY-□NV</td><td>750</td><td>8.0mm^2 AWG8</td><td>4.0 ~ 6.0mm^2 AWG10 ~ 12</td></tr>
</table>

◇Represents the encoder type □Represents whether there is a brake

4.2.7 Crimp terminal

Use insulated pin terminals for the power connector AUX.

◆ Pin type	◆ Sleeve type	◆ Parallel terminal: suitable for when two wires are combined into one terminal
		

- Please select the appropriate size pin terminal according to the recommended wire material. Wire Types for Connectors: AWG16 ~ Applicable wire outer diameter for AWG18 connector: ø1.0 ~ 1.5mm

4.2.8 Ground terminal

- For better EMC effect, please use 5.3mm 2 /AWG10 special copper conductor cable
- Ground terminal tightening torque

<table>
<tr><th rowspan="2">Drive model</th><th colspan="2">Ground screw</th></tr>
<tr><th>Specification</th><th>Tightening torque</th></tr>
<tr><td>MBDV-520AC -H01</td><td>M4</td><td>1.4 N.m</td></tr>
</table>

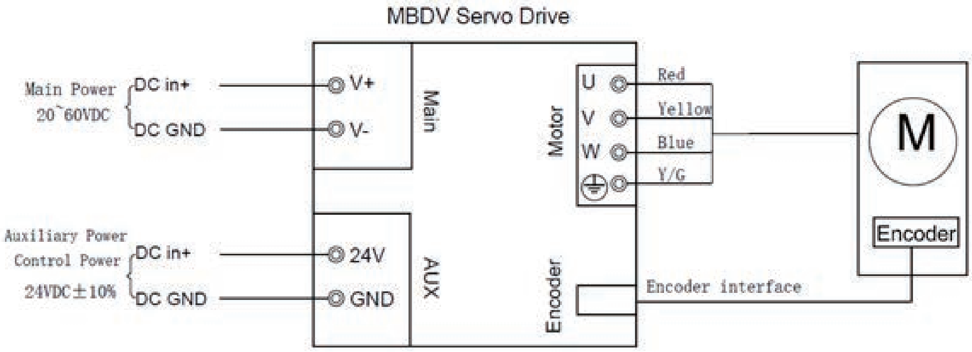
Note:

- Exceeding the maximum tightening torque can cause damage to the screw holes
- Do not install the ground screw with power on, it may cause electrical sparks
- Please check regularly whether the ground screw is loose

4.3 Main & AUX - Driver power wiring method

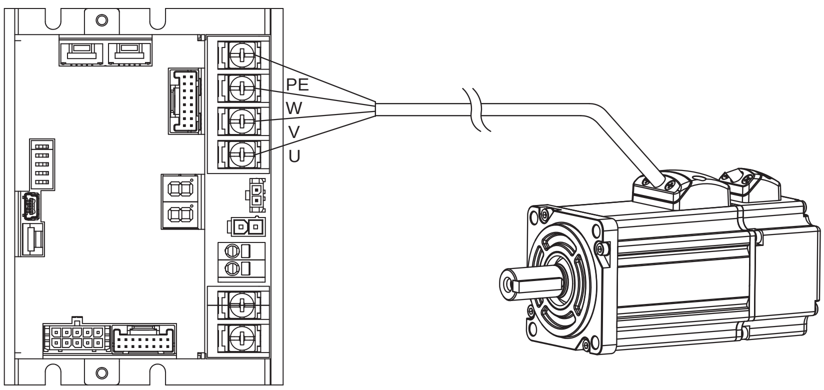
MBDV series DC servo has two power supplies.

	Pin	Function	Input specification
Main power	V+, V-	Drive main power input	24 ~ 60VDC
Auxiliary Power / Control Power	24V, GND	In the event of a mains power failure, the following two applications require auxiliary power to be turned on: a) When the DSP part of the driver is required to work normally b) Use the dedicated brake output port on the driver to directly drive the brake of the motor When the main circuit resumes power supply, the upper computer controller can quickly restore the position control.	24VDC±10%



4.4 Motor connection method

4.4.1 Block diagram of the connection between the driver and the motor power line

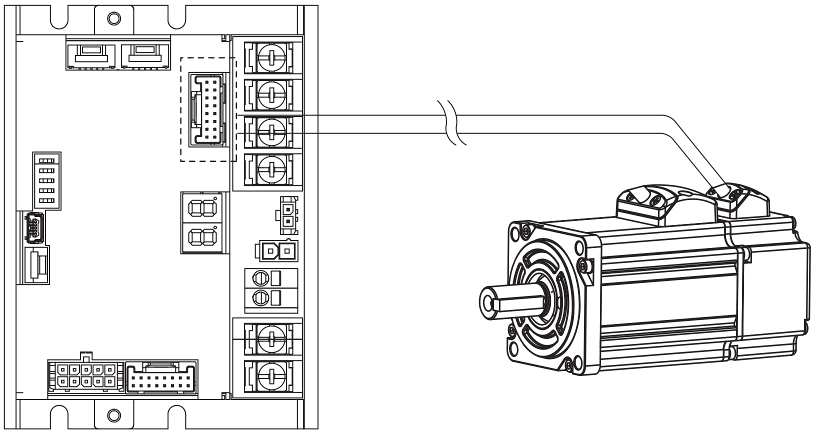


4.4.2 Definition of motor power line wiring

Signal	U	V	W	PE
Name	U phase	V phase	W phase	Motor ground wire
Color	Red	Yellow	Blue	Yellow /Blue

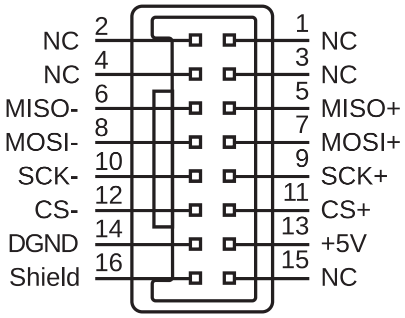
4.5 Encoder -the connection method between the driver and the motor encoder line

4.5.1 The block diagram of the connection between the driver and the motor encoder line

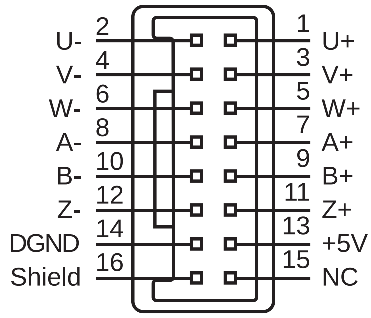


4.5.2 Encoder Pinout

SPI type encoder

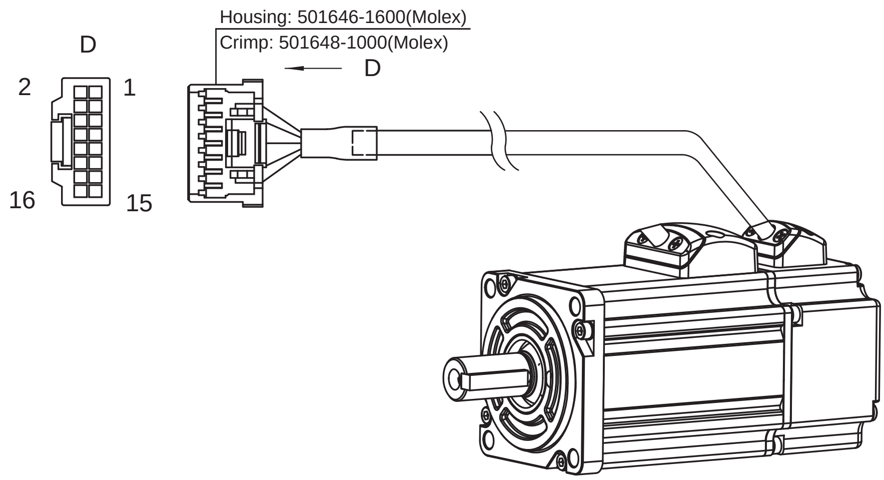


A/B/Z + Hall



PIN	Bus type encoder	A/B/Z + Hall
	Signal	Signal
1	NC	U+
2	NC	U-
3	NC	V+
4	NC	V-
5	MISO+	W+
6	MISO-	W-
7	MOSI+	A+
8	MOSI-	A-
9	SCK+	B+
10	SCK-	B-
11	CS+	Z+
12	CS-	Z-
13	5V	5V
14	DGND	DGND
15	NC	NC
16	Shield	Shield

4.5.3 Encoder line interface definition



Applicable motor encoder type	Pin	Signal	Color
Communication encoder	1	NC	——
	2	NC	——
	3	NC	——
	4	NC	——
	5	MISO+	Blue
	6	MISO-	Blue / Black
	7	MOSI+	Green
	8	MOSI-	Green / Black
	9	SCK+	Yellow
	10	SCK-	Yellow / Black
	11	CS+	Brown
	12	CS-	Brown / Black
	13	+5V	Red
	14	DGND	Black
	15	NC	——
	16	Shield	——

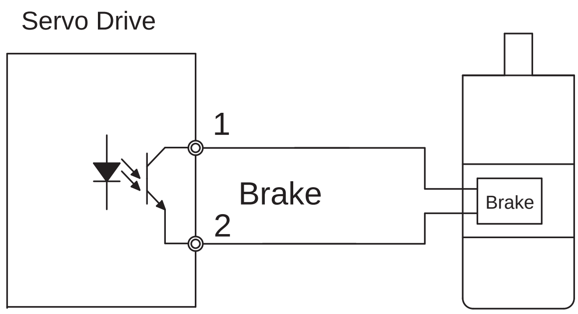
Note: Do not make any connections for undefined pins.

4.6 Using an electromagnetic brake

Servo motors are used in loads such as vertical axes. When the motor is not enabled or powered off, in order to prevent the mechanical mechanism driven by the motor from falling due to gravity and other reasons, it is necessary to use a servo motor with an electromagnetic brake.

Note: The brake of the servo motor can only be used to maintain the position of the motor when the motor is not enabled or powered off. Do not use it as a brake during deceleration, otherwise the motor will be damaged.

4.6.1 Connection diagram



4.6.2 Precautions for the use of brake motors

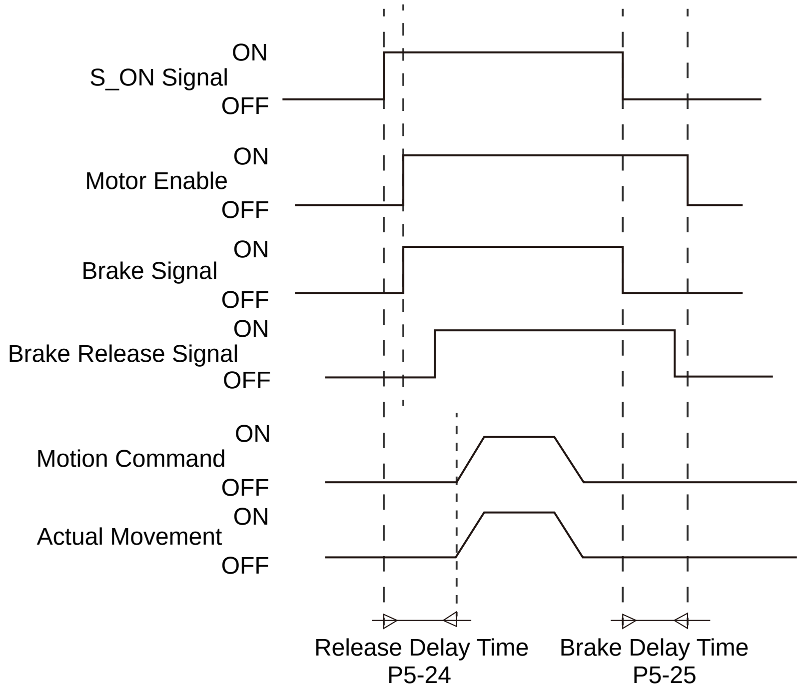
- The special output interface of the driver to control the brake can directly drive the brake of the motor, and the auxiliary power supply must be connected to provide 24VDC.
- The electromagnetic brake is a normally closed type, and the motor shaft cannot rotate without power supply to the brake.
- The brake will make a clicking sound during the braking / release action, which will not affect the use.
- It is recommended to use a cable of 0.5mm 2 (AWG20) or more to prevent the cable from being too thin and causing voltage drop.

◆ Brake specifications are as follows

Motor model	Motor Power	Holding torque (Nm)	Continuous current when released (A)	Continuous power consumption when released (W@20℃)	Rated voltage (VDC)	Release time (ms)	Release voltage (VDC)	Braking time (ms)
SM0402JSL-KCY-BNV SM0402GSL-KCY-BNV	100W	0.32	0.26	6.3	24	< 25	18.5	< 70
SM0601J*L-KCY-BNV SM0601G*L-KCY-BNV	200W	1.5	0.3	7.2		< 25	18.5	< 70
SM0602G*L-KCY-BNV	400W	1.5	0.3	7.2		< 25	18.5	< 70
SM0803G*L-KCY-BNV	750W	3.2	0.4	9.6		< 25	18.5	< 70

4.6.3 Brake action sequence

Since the brake has an action delay when releasing and braking, in order to avoid damage to the brake, it is necessary to pay attention to the action sequence during use.



Release delay and braking delay time can be set using Luna software.

4.7 REG- Regenerative energy absorption resistor wiring method

When the torque output of the motor is in the opposite direction of motion, the motor is being back driven. When the motor is in this state, the motor behaves as a generator and the mechanical energy of the motor is converted into voltage which is fed back to the driver and power supply. This results in increased bus voltage for the servo drive and is known as regenerative energy. This phenomenon is common during the deceleration of high speed applications.

This excessive bus voltage can damage the servo drive as well as the power supply unit of the system. For this reason, it is common to use a regenerative energy absorption resistor that will consume any excessive voltage and prevent overvoltage situations.

The MBDV servo family does not have built-in regenerative energy absorption resistors, known as regen resistors, but allows for external ones to be used. The following shows the recommended resistor specifications for the MBDV family of drives:

Driver	Minimum resistance value of external absorption resistor (Ohm)
MBDV-520AC	10
MBDV-2X-520AC	10

4.7.1 Calculation method of regenerative energy

A. Reciprocating motion

When the motor decelerates, the kinetic energy during deceleration will be converted into electric energy and fed back to the bus capacitor. The energy during deceleration is divided into two parts:

A) Energy generated when the motor decelerates

B) Energy generated during deceleration of external load

The following provides a simple method to quickly calculate the required regenerative energy absorption resistor.

1) Calculate the energy E M when the motor decelerates

The following table shows the energy generated by the MBDV series servo motor decelerating from 3000rpm to 0rpm without external load.

Motor series	Motor Power (W)	Servo motor model	Rotor inertia J_M(10^{-4}Kgm)	The energy generated by decelerating from 3000rpm to 0rpm E_M(J)	Maximum energy absorbed by the driver capacitor E_C (J)
M2	100	SM0402JSL**** SM0402GSL****	0.043	0.21	8.7
	200	SM0601J*L**** SM0601G*L****	0.152	0.75	8.7
	400	SM0602G*L****	0.243	1.20	13
	750	SM0803G*L****	0.856	4.22	27

2) Calculate the energy EL produced by the dragged load during deceleration

N times the inertia of the motor, the energy generated when the dragged load decelerates from 3000rpm to 0rpm is:

$$E_L = N x E_M$$

if E M + E L < E C, that is, during the deceleration process, the energy generated by the motor and the dragged load is less than the energy absorbed by the drive capacitor, so there is no need to worry about the problem of regenerative energy absorption.

3) Calculate the required average power P_{AV} of the regenerative energy absorption resistor

$$P_{AV} = \frac{E_M + E_L - E_C}{t_{dec}}$$

Note: t_{dec} is the deceleration time + the interval time between two decelerations

4) Analyze

When $P_{AV} < 0$, that is, the total power generated during the deceleration process is less than the power absorbed by the bus capacitor in the driver, so no external absorption resistor is required.

When $P_{AV} > 0$, that is, the total power generated during the deceleration process is greater than the power absorbed by the bus capacitor in the driver, and an external absorption resistor is required to reasonably control the temperature rise of the external absorption resistor. The minimum value of the resistance power is P_{AV} / 0.5.

◆ Calculation example: 400W SM0602G*L**** is selected, the load inertia is 15 times the motor inertia, assuming t_{dec} (deceleration time + interval time between two decelerations) is 0.5s, and each movement is decelerated from 3000rpm to 0rpm, then the required power of the absorption resistor is calculated as:

$$E_M = 1.2J, E_C = 13.04J$$

$$E_L = N \times E_M = 15 \times 1.2 = 18J$$

$$P_{AV}=(1.2+18-13.04) / 0.5 = 12.32\text{Watt}$$

Since the power absorbed by the bus capacitor in the driver is less than the total power generated during the deceleration process, an external absorption resistor is required.

B. The external load torque drives the motor, and the motor continuously outputs negative power.

Most motors are doing positive work, that is, the torque output direction of the motor is consistent with the rotation direction. In some special applications, the torque output direction of the motor is opposite to the rotation speed direction, and the external energy will be fed back to the drive. such as during the downward, vertical movement of a large load. in order to meet the position requirements and speed requirements of the servo system, the motor will output the opposite force to overcome the gravity of the external load. When running in this manner for a long time, the bus capacitor will become saturated and will fail to continue absorbing regenerative energy. At this time, the regenerative resistor needs to absorb the energy. The power calculation formula is as follows:

$$P_T = 2\pi T_M N_M$$

T_M: Motor output torque. Unit: Nm

N_M Motor speed. Unit: rps

◆ Calculation example:

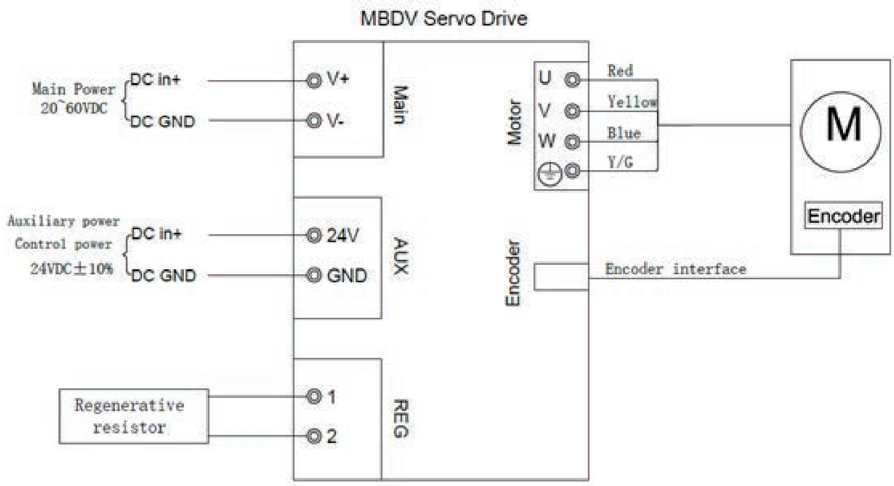
The torque output direction of the motor is opposite to the rotation speed direction. When the motor output torque is 0.6Nm and the speed is 2400rpm, the power is:

$$P_T=2 \times 3.14 \times 0.6 \times 2400 / 60= 150.72\text{Watt}$$

At this time, an external absorption resistor is required, and the minimum power is 150.72 watts. In order to reasonably control the temperature rise of the external absorption resistor, the recommended minimum power of this resistor is 300 watts.

4.7.2 Wiring method

The following is the block diagram depicting how a regen resistor is wired to an MBDV servo drive.



4.7.3 Device setting parameters

Related parameters

Parameter	Instruction	Name	Value range	Defaults	Unit	Description
P1-19	ZR	Regenerative resistor resistance	10 ~ 32000	10	Ohm	Set the resistance value of the regenerative energy absorption resistor
P1-20	ZC	Regenerative resistor power rating	1 ~ 32000	40	Watt	Set the power of the regenerative energy absorption resistor
P1-21	ZT	Regenerative resistor time constant	0 ~ 8000	1000	ms	Sets the sustainable absorption time of the regenerative energy absorption resistor

Note:

Please set the resistance value, power and absorption time of the absorption resistor correctly, otherwise it will affect the use of this function and cause the drive to generate alarms such as overvoltage and regenerative energy absorption failure.

When connecting an external absorbing resistor, please make sure that the total resistance value cannot be less than the minimum allowable resistance value of the driver. If multiple resistors are used in series or in parallel, please calculate the total resistance and total power correctly.

External: 100, 200W resistor	Parameter setting: P1-19 = 100 P1-20 = 200
External: Two 50, 200W resistors in series	Parameter setting: P1-19 = 100 P1-20 = 400
External: Two 100, 200W resistors in parallel	Parameter setting: P1-19 = 50 P1-20 = 400

4.8 Communication Interface

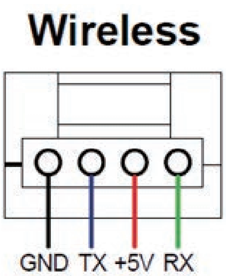
4.8.1 USB- Host computer debugging interface

The USB port is used for establashing communication between the MBDV servo drive and the PC based Luna software. Luna software allows users to set control modes, modify parameters, tune the PID loop and perform other configuration tasks.

Pin	Logo	Function
1	+5V	USB power
2	D-	Data-
3	D+	Data +
4	—	Reserve
5	GND	Power ground

4.8.2 Wireless - Host computer wireless debugging interface

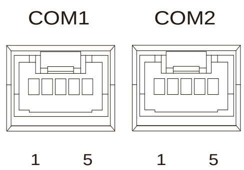
Wireless The port is used for the drive to connect the wireless debugging module to communicate with the PC. Using Luna software, you can set the control mode, modify parameters, online automatic tuning and other operations.



Pin	Logo	Function
1	GND	Power ground
2	TX	Data sending
3	+5V	Power
4	RX	Data reception

4.8.3 COM1/2 – CANOpen / RS485 Communication interface

COM1 and COM 2 are used to connect the MBDV drive to an external controller communicating over CANopen or Modbus RTU.

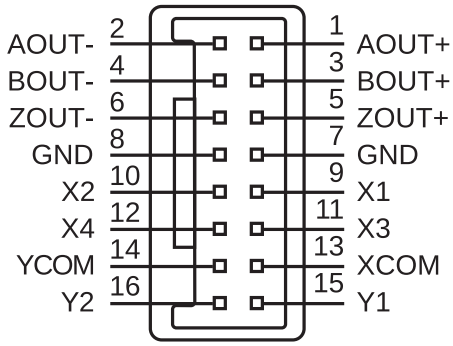


COM1/2 Pin	CANopen	RS485
1	NC	RS485+
2	NC	RS485-
3	CAN_H	NC
4	CAN_L	NC
5	GND	GND

4.9 I/O Input and output signal wiring (MBDV-520AC)

4.9.1 I/O Input and output signal specifications

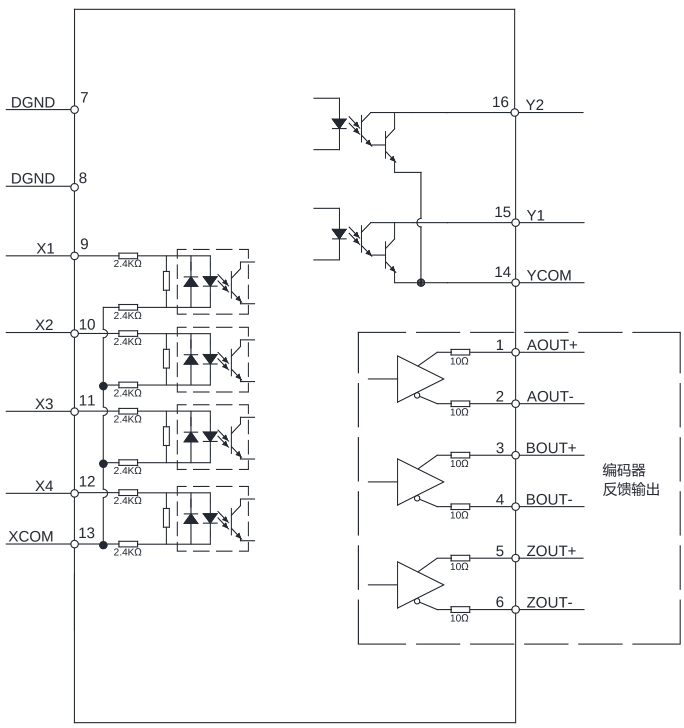
I/O port of MBDV-520AC low-voltage servo driver is used to connect input and output signals. The pin definitions are as follows:



The input and output signal specifications are as follows:

	Classification	Description
Digital Signals	Inputs	4 optically isolated inputs, can be configured by parameters, 24VDC, maximum current 20mA
	Outputs	2 optically isolated outputs, can be configured by parameters, maximum 30 VDC, maximum output current 30 mA
Pulse Signals	Outputs	3 line driver outputs: Encoder A/B/Z signals

4.9.2 I/O Signal Pin Block Diagram



4.9.3 Input and Output Pinout

Pin NO.	Signal	Description
1	AOUT+	Encoder output A+
2	AOUT-	Encoder output A-
3	BOUT+	Encoder output B+
4	BOUT-	Encoder output B-
5	ZOUT+	Encoder output Z+
6	ZOUT-	Encoder output Z-
7	DGND	Digital ground
8	DGND	Digital ground
9	X1	Digital input 1
10	X2	Digital input 2
11	X3	Digital input 3
12	X4	Digital input 4
13	XCOM	Digital input common terminal
14	YCOM	Digital output common terminal
15	Y1	Digital output 1
16	Y2	Digital output 2

Note: MBDV-520AC does not support encoder frequency division output function, if you need this function, please select MBDV-520AC-H01.

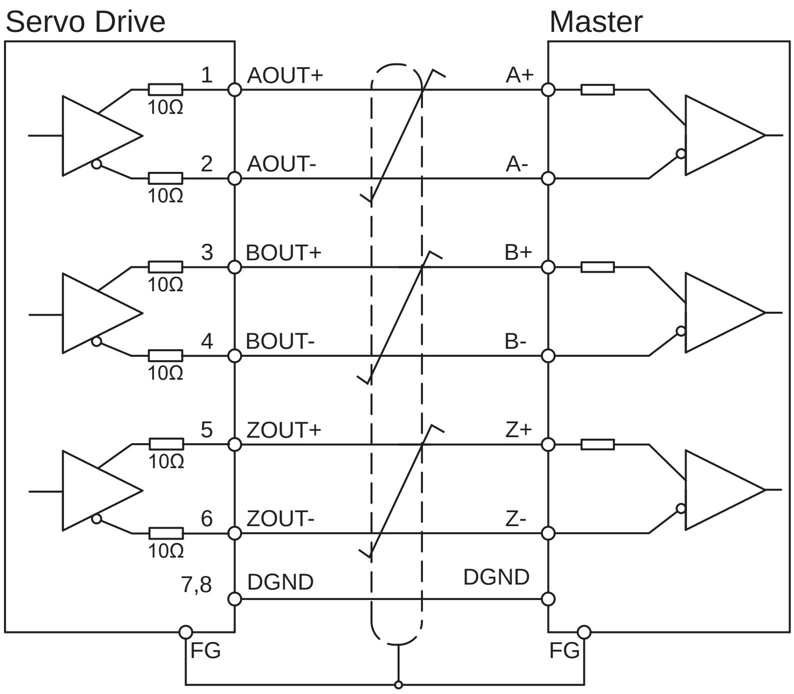
4.9.3.1 Encoder Feedback Output

The MBDV-520AC can output A/B/Z phase signals via line driver, differential outputs with a maximum of 5 V.

The host computer must use a differential line receiver to be able to accept the signals from the drive. We recommend that a twisted pair, shielded wire be used for the transmission of encoder feedback signals.

<table>
<tr><th>I/O - pin NO.</th><th colspan="2">Signal name</th><th>Description</th></tr>
<tr><td>1</td><td>AOUT+</td><td rowspan="7">Encoder Feedback Outputs</td><td rowspan="7">The encoder feedback is output in the form of A/B/Z differential signals. A/B/Z output signals and the frequency division ratio that affects the output frequency of the encoder feedback can be configured via parameters.</td></tr>
<tr><td>2</td><td>AOUT-</td></tr>
<tr><td>3</td><td>BOUT+</td></tr>
<tr><td>4</td><td>BOUT-</td></tr>
<tr><td>5</td><td>ZOUT+</td></tr>
<tr><td>6</td><td>ZOUT-</td></tr>
<tr><td>7,8</td><td>DGND</td></tr>
</table>

◆ A/B/Z differential signal connection example



Note: Make sure to connect the host computer to the digital ground of the drive.

4.9.3.2 Digital Inputs

The MBDV-520AC low voltage servo driver has 4 digital input signals. Each digital input signal can be configured to have a special fixed function. If a fixed function is assigned to an input, you may also configure the logic of the input.

◆ Predefined Functions

For example, alarm clear, limit sensor input, origin sensor input, emergency stop, etc.

◆ General Purpose Function

As a general-purpose input signal, there is no specific function，and the input may be used for application specific purposes.

Signal					Factory default		
I/O pin NO.	Signal name	Signal description	Corresponding parameters	Instruction	Signal name	Input logic*1	Defaults
9	X1	Digital input 1	P5-00	MU1	CCW-LMT	Closed	7
10	X2	Digital input 2	P5-01	MU2	CW-LMT	Closed	5
11	X3	Digital input 3	P5-02	MU3	HOM-SW	Closed	39
12	X4	Digital input 4	P5-03	MU4	E-STOP	Closed	13
13	XCOM	Digital input COM	-	-	X1, X2, X3, X4 input common terminal		

Note:

***1.** The definition of logic states for inputs and outputs is as follows:

Closed: The driver digital input circuit forms a loop, and current flows in or out of the input pins.

Open: The driver digital input circuit does not form a loop and no current flows into or out of the input pins.

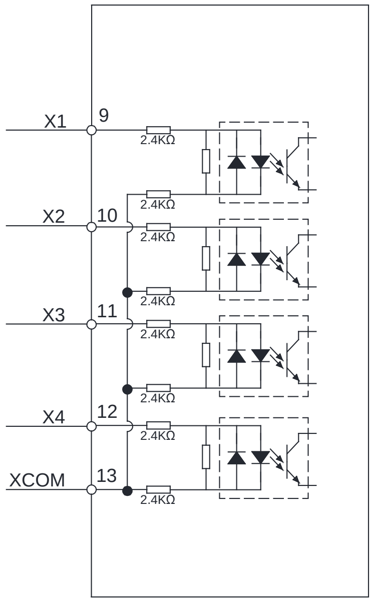
2. For details, please see: 7.1.1 Input signal setting

◆ Digital Input and Output Wiring Instructions (MBDV-520AC)

The MBDV-520AC has 4 optically isolated, single-ended inputs with a common voltage (COM) point These inputs require that they be powered separately. If using a PLC, you may use the 24 V output from the PLC. If connected to a relay or mechanical switch, a 24 VDC power supply will be required. The maximum withstand current for each input is 20 mA.What is COM?

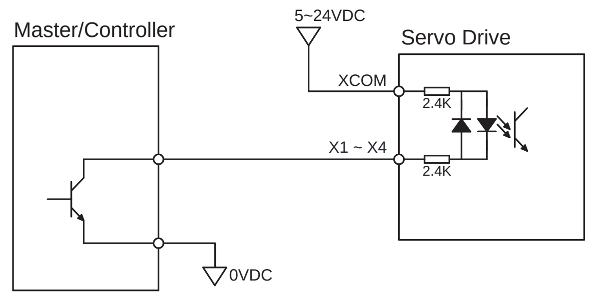
Common (COM) represents an a common voltage level for inputs (XCOM) or outputs (YCOM). If using sourcing signals (PNP), COM should be connected to ground (power source negative). If using sinking signals (NPN), COM should be connected to positive voltage (positive probe from power source).

◆ The internal circuit block diagram of X1 ~ X4 is shown in the figure below.

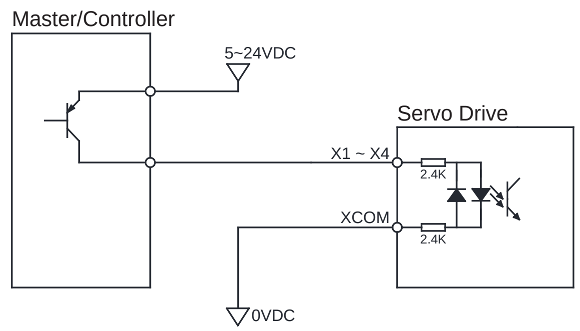


◆ Digital input X1 ~X4 Wiring example

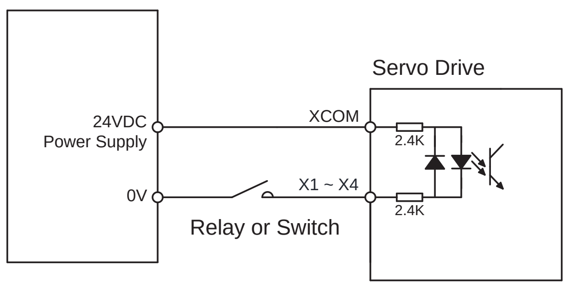
A. Controller---SINK mode



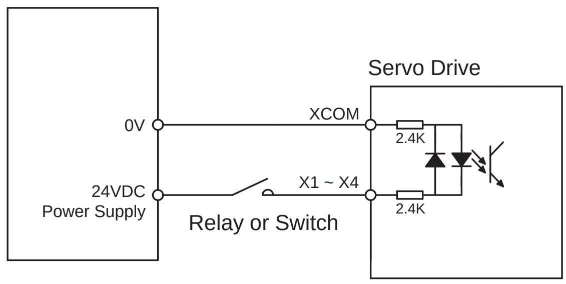
B. Controller---Sourcing mode



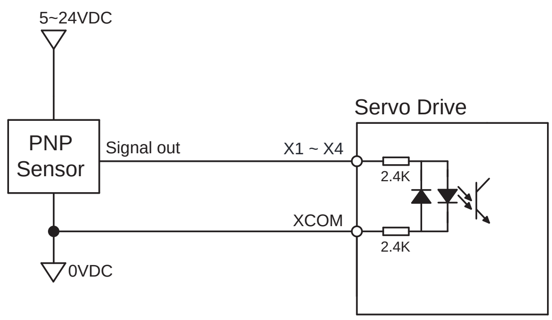
C. Connect to Relay or Switch(XCOM connect to +24V)



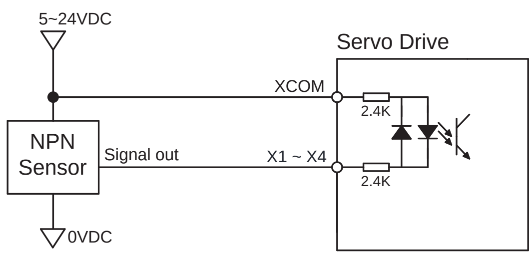
D. Connect to Relay or Switch(XCOM connect to 0V)



E. Connect a PNP sensor



F. Connect a NPN sensor



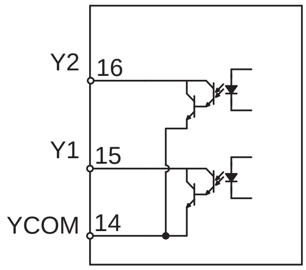
4.9.3.3 Digital Outputs

The MBDV-520AC low voltage servo driver has 2 digital output signals with a common voltage (COM) point. Each digital output signal can be configured to have a special fixed function. If a fixed function is assigned to an output, you may also configure the logic of the output.

The maximum input voltage for the outputs is 30 VDC, and the maximum withstand current is 100 mA per output.

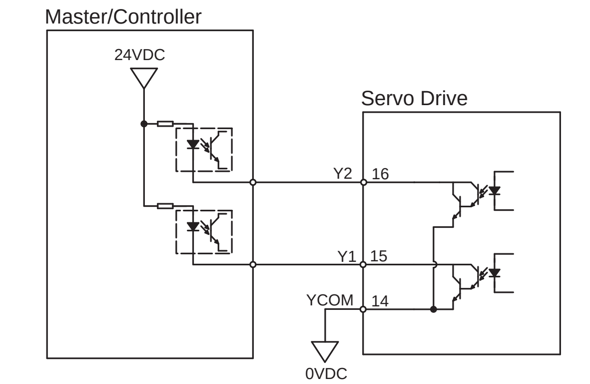
Signal					Factory default		
CN2-pin number	Signal name	Signal description	Corresponding parameters	Instruction	Signal name	Output logic *1	Defaults
15	Y1	Digital output 1	P5-12	MO1	ALM	Open	2
16	Y2	Digital output 2	P5-13	MO2	SON-ST	Closed	7
14	YCOM	Digital output COM	-		Y1, Y2 Output common		

◆ The internal circuit block diagram of Y1 ~ Y2 are as shown below.

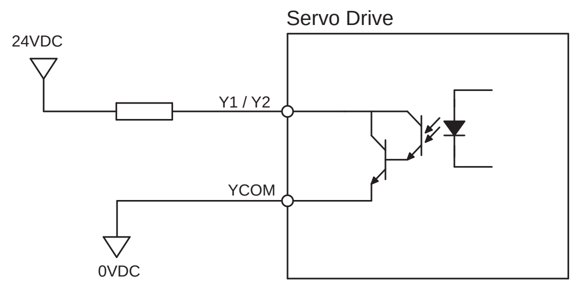


◆ Y1 ~ Y2 connection examples

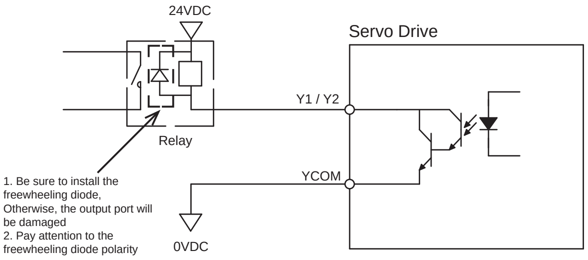
A. Connected to the control's optocoupler



B. Connected to resistor load



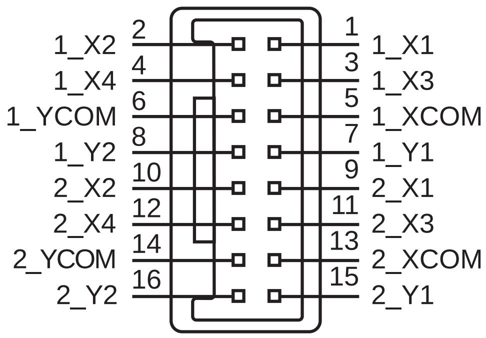
C.Connected to inductive load(Relay.etc.)



4.10 Input and Output Signals (MBDV-2X-520AC)

4.10.1 Input and Output Specifications

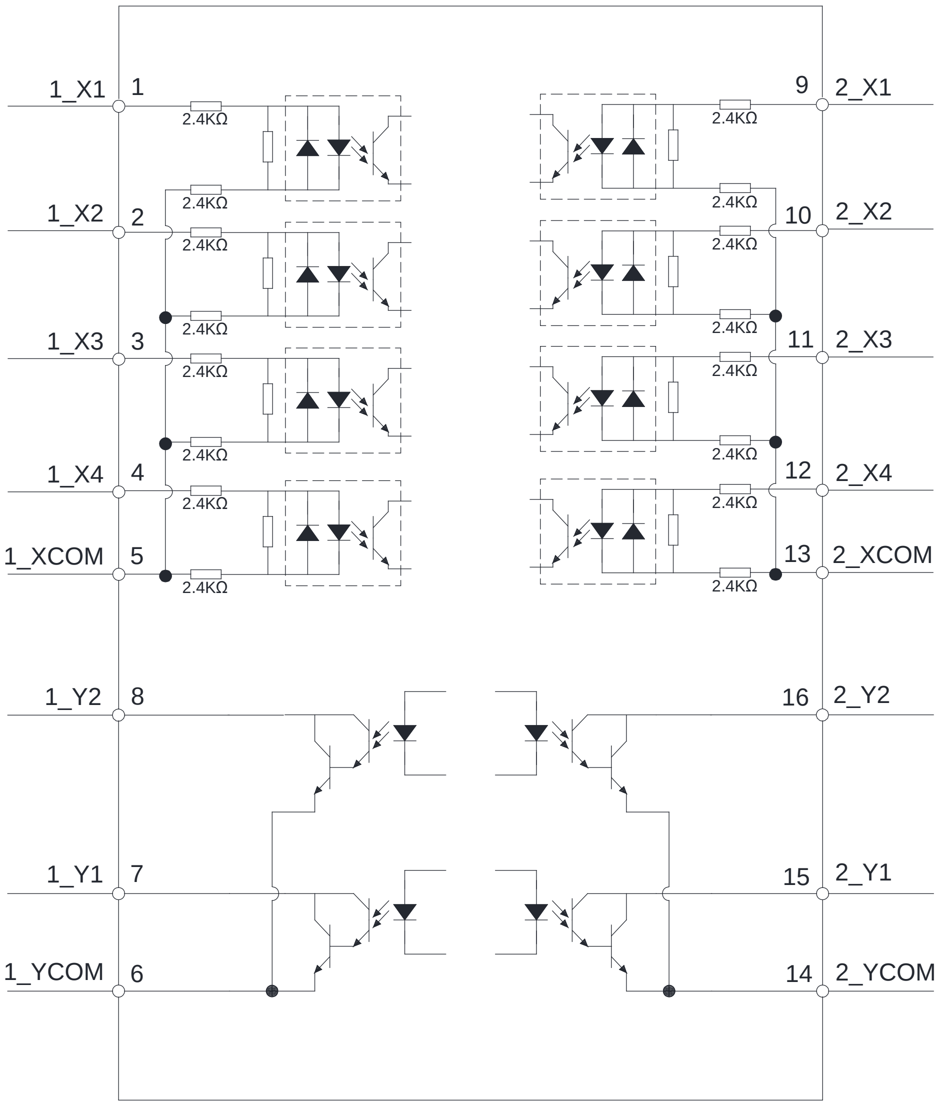
I/O port of MBDV-2X-520AC low-voltage servo driver is used to connect input and output signals. The pin definitions are as follows:



The input and output signal specifications are as follows:

Axis	Classification		Describe
1	Digital signals	Inputs	4 optically isolated inputs, configurable via parameters, max 24 VDC, max withstand current of 20 mA
		Outputs	2 optically isolate outputs, configurable via parameters, max 30 VDC, max withstand current of 100 mA
2	Digital signals	Inputs	4 optically isolated inputs, configurable via parameters, max 24 VDC, max withstand current of 20 mA
		Outputs	2 optically isolate outputs, configurable via parameters, max 30 VDC, max withstand current of 100 mA

4.10.2 I/O Signal Pin Block Diagram



4.10.3 Input and Output Pinout

Pin NO.	Signal	Description
1	1_X1	Axis1_input 1
2	1_X2	Axis1_input 2
3	1_X3	Axis1_input 3
4	1_X4	Axis1_input 4
5	1_XCOM	Axis1_input COM
6	1_YCOM	Axis1_output COM
7	1_Y1	Axis1_output 1
8	1_Y2	Axis1_output 2
9	2_X1	Axis2_input 1
10	2_X2	Axis2_input 2
11	2_X3	Axis2_input 3
12	2_X4	Axis2_input 4
13	2_XCOM	Axis2_input COM
14	2_YCOM	Axis2_output COM
15	2_Y1	Axis2_output 1
16	2_Y2	Axis2_output 2

4.10.3.1 Digital Inputs

The MBDV-2X-520AC low voltage servo driver has 4 digital input signals for each axis. Each digital input signal can be configured to have a special fixed function. If a fixed function is assigned to an input, you may also configure the logic of the input.

Signal					Factory default		
I/O-pin number	Signal name	Signal description	Corresponding parameters	Instruction	Signal name	Input logic *1	Defaults
1	1_X1	Axis1_input 1	P5-00	MU1	GPIN	Closed	0
2	1_X2	Axis1_input 2	P5-01	MU2	GPIN	Closed	0
3	1_X3	Axis1_input 3	P5-02	MU3	GPIN	Closed	0
4	1_X4	Axis1_input 4	P5-03	MU4	E-STOP	Closed	13
5	1_XCOM	Axis1_input COM	——	——	X1, X2, X3, X4 input common terminal		
9	2_X1	Axis2_input 1	P5-00	MU1	GPIN	Closed	0
10	2_X2	Axis2_input 2	P5-01	MU2	GPIN	Closed	0
11	2_X3	Axis2_input 3	P5-02	MU3	GPIN	Closed	0
12	2_X4	Axis2_input 4	P5-03	MU4	E-STOP	Closed	13
13	2_XCOM	Axis2_input COM	——	——	X1, X2, X3, X4 input common terminal		

Note:

***1.** The level logic of the pin input is as follows:

Closed: The driver digital input circuit forms a loop, and current flows in or out of the input pins.

Open: The driver digital input circuit does not form a loop, and no current flows into or out of the input pins.

2. For details, please see: 7.1.1 Input signal setting

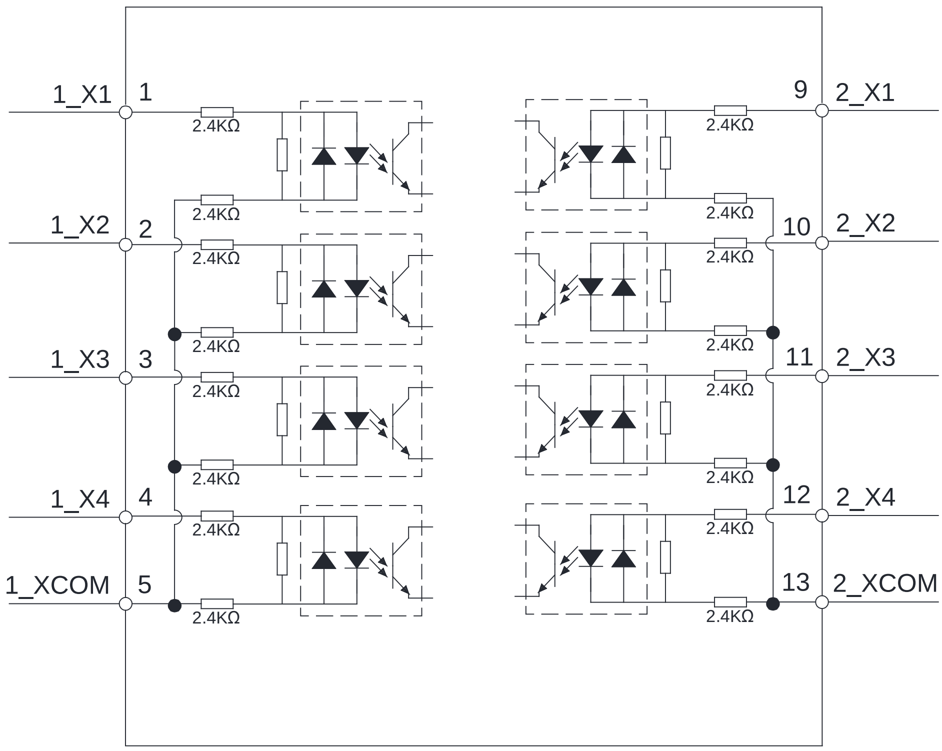
◆ Digital Input and Output Wiring Instructions

The MBDV-2X-520AC has 4 optically isolated, single-ended inputs with a common voltage (COM) point for each axis. These inputs require that they be powered separately. If using a PLC, you may use the 24 V output from the PLC. If connected to a relay or mechanical switch, a 24 VDC power supply will be required. The maximum withstand current for each input is 20 mA.

What is COM?

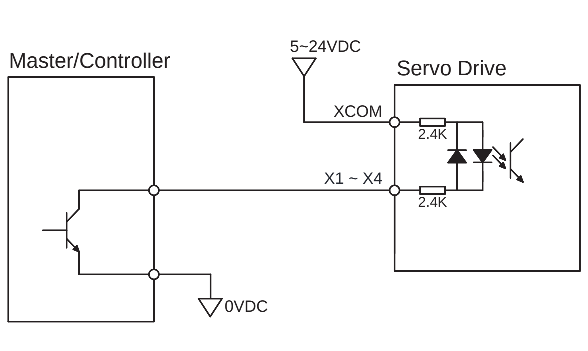
Common (COM) represents an a common voltage level for inputs (XCOM) or outputs (YCOM). If using sourcing signals (PNP), COM should be connected to ground (power source negative). If using sinking signals (NPN), COM should be connected to positive voltage (positive probe from power source).

◆ The internal block diagram of X1-X4, for each axis, is shown in the figure below.

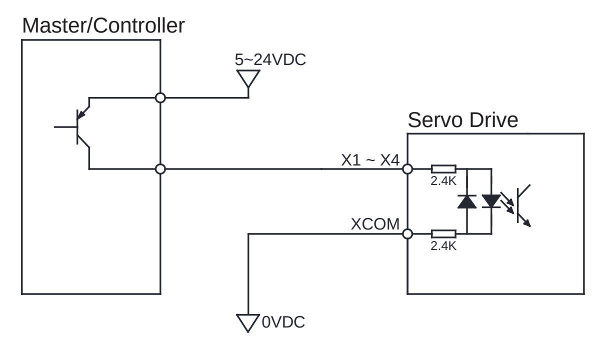


◆ Digital input X1 ~X4 Wiring example

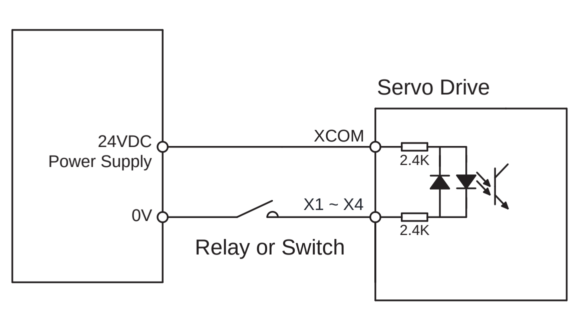
A. Controller---SINK mode



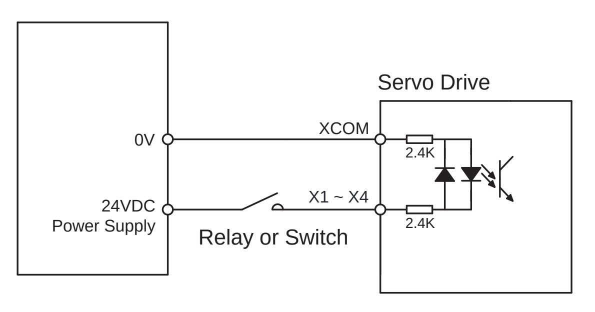
B. Controller---Sourcing mode



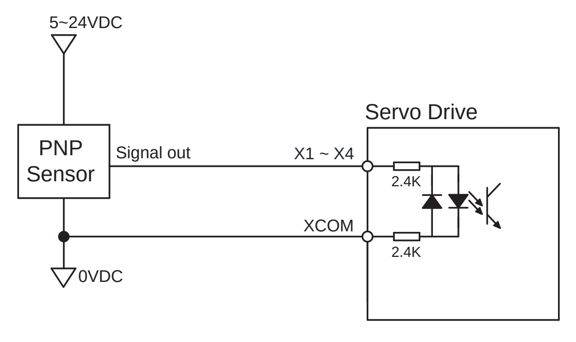
C. Connect to Relay or Switch(XCOM connect to +24V)



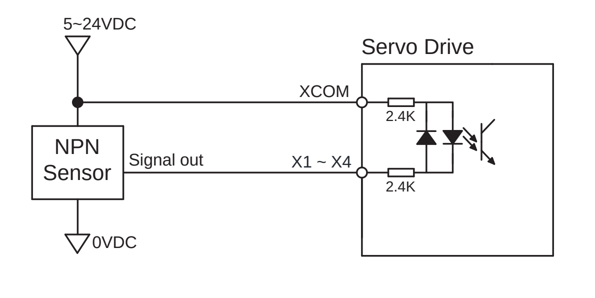
D. Connect to Relay or Switch(XCOM connect to 0V)



E. Connect a PNP sensor



F. Connect a NPN sensor



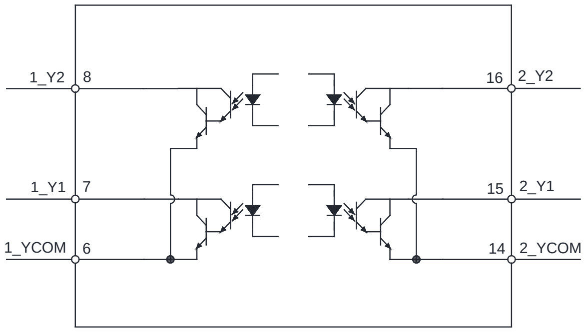
4.10.3.2 Digital output Y1 ~ Y2

The MBDV-520AC low voltage servo driver has 2 digital output signals with a common voltage (COM) point per axis. Each digital output signal can be configured to have a special fixed function. If a fixed function is assigned to an output, you may also configure the logic of the output.

Maximum withstand voltage is 30VDC, and the current is 100mA.

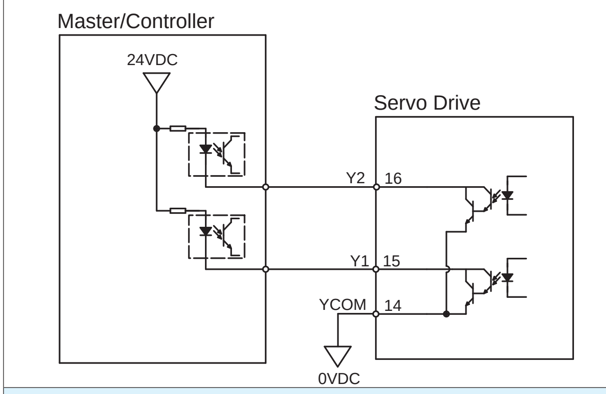
Signal					Factory default		
I/O-pin number	Signal name	Signal description	Corresponding parameters	Instruction	Signal name	Output logic	Defaults
7	Y1	Axis1_output 1	P5-12	MO1	ALM	Open	2
8	Y2	Axis1_output 2	P5-13	MO2	SON-ST	Closed	7
6	YCOM	Axis1_output COM	-		Y1, Y2 output common		
15	Y1	Axis2_output 1	P5-12	MO1	ALM	Open	2
16	Y2	Axis2_output 2	P5-13	MO2	SON-ST	Closed	7
14	YCOM	Axis2_output COM	-		Y1, Y2 output common		

◆ The internal circuit block diagrams of Y1-Y2 for each axis are shown below

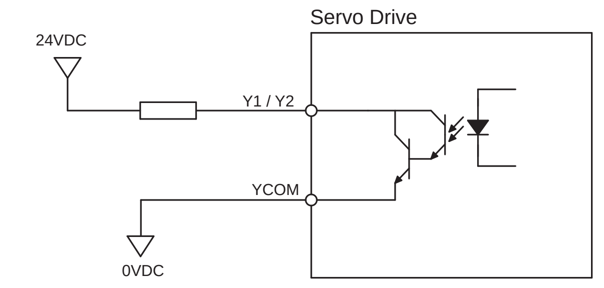


◆ Connection examples

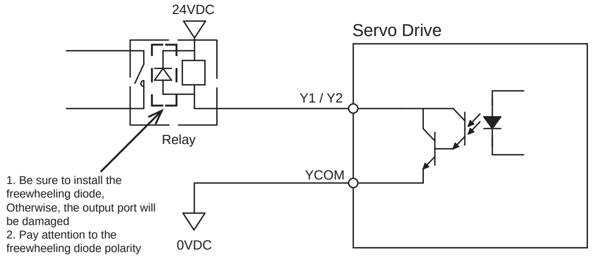
A. Connected to the control's optocoupler



B. Connected to resistor load



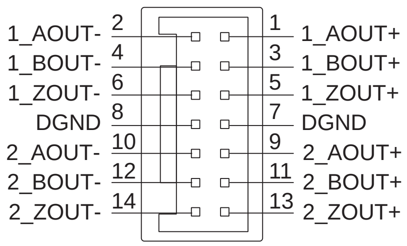
C.Connected to inductive load(Relay.etc.)



4.10.4 Encoder Feedback Output

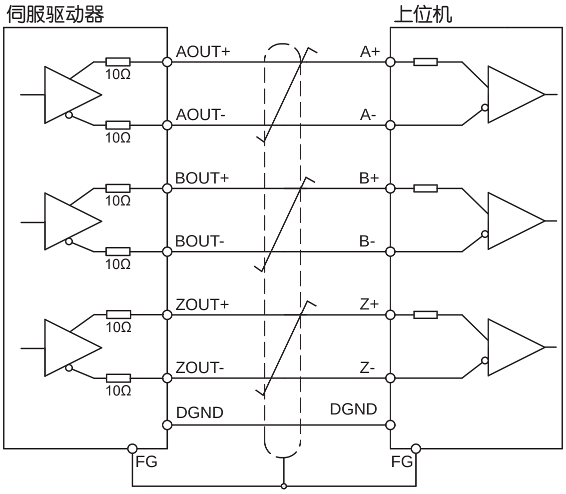
The MBDV-2X-520AC can output A/B/Z phase signals via line driver, differential outputs with a maximum of 5 V. The driver is able to output encoder feedback for each axis.

The host computer must use a differential line receiver to be able to accept the signals from the drive. We recommend that a twisted pair, shielded wire be used for the transmission of encoder feedback signals.



Encoder - Pin NO.	Signal name		Description
1	1_AOUT+	Axis 1 Encoder Feedback Outputs	The encoder feedback is output in the form of A/B/Z differential signals. The number of pulses per revolution can be configured via the Pulse Output Gear Ratio.
2	1_AOUT-		
3	1_BOUT+		
4	1_BOUT-		
5	1_ZOUT+		
6	1_ZOUT-		
7,8	DGND	Digitally	
9	2_AOUT+	Axis 2 Encoder Feedback Outputs	The encoder feedback is output in the form of A/B/Z differential signals. The number of pulses per revolution can be configured via the Pulse Output Gear Ratio.
10	2_AOUT-		
11	2_BOUT+		
12	2_BOUT-		
13	2_ZOUT+		
14	2_ZOUT-		

◆ A/B/Z phase connection example



Note: Make sure to connect the host computer to the digital ground of the drive.

4.11 STO - Safe torque off function

The MBDV series servo drives support Safe Torque Off functionality. Each drive comes with an STO port for users to connect their STO trigger mechanism to.

Safe Torque Off is a hardware level safety function. While the STO function is enabled, the physical connection between motor and drive is disabled, thereby preventing the motor from being energized. This function is meant to protect personnel as well as equipment in emergency situations.

When the STO function is enabled, the servo motor becomes disabled, the drive enters an alarm state and the LED display on the driver panel display the alarm code " 20 ".

4.11.1 Safe Torque Off Precautions

1) If STO is not required in the application, the premade STO connector provided with the drive should be connected in the STO port on the drive.

2) Before using the STO function, users should ensure that they are familiar with how STO works and the scenarios in which it is appropriate to use it.

3) When the STO function is working, due to the existence of external force (such as vertical shaft load), the motor will rotate due to the external force. Therefore, please make sure to use the servo motor with brake in this case, and connect the brake control circuit correctly.

4) When the STO function is triggered, the motor's shaft rotates freely. If the motor is in motion or under the influence of an external load, its stopping distance will be affected by the inertia of the system.

5) While the STO function is enabled, the output power from drive to motor is cut off. However, the power supply powering the servo drive remains on. If users need to troubleshoot the servo drive and motor, they must ensure that the power supply powering the entire system (motor and drive) is powered off.

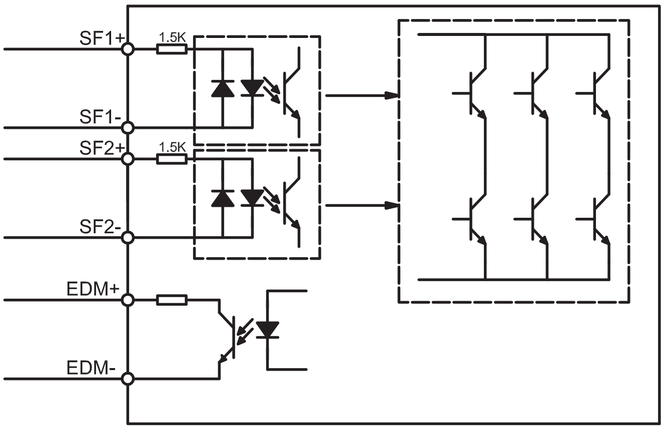
6) While the STO function is enabled, the drive will be in an alarm state and the motor will be disabled.

7) When the STO function is disabled (no longer in use), the STO alarm status of the drive is automatically cleared. The drive will also output a Servo Ready signal but the motor will be disabled.

4.11.2 STO Function Connector

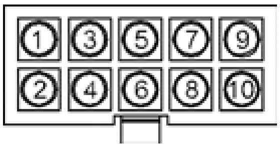
4.11.2.1 STO Internal Circuit Diagram

The pinout of the STO connector is as follows:



4.11.2.2 STO Signal Definitions

The pin definition of driver CN5 is as follows:



Connector and terminal models are as follows:

	Model	manufacturer
Connector	43025-1000	MOLEX
PIN	43030-0005	MOLEX

4.11.2.3 STO Signal Definitions

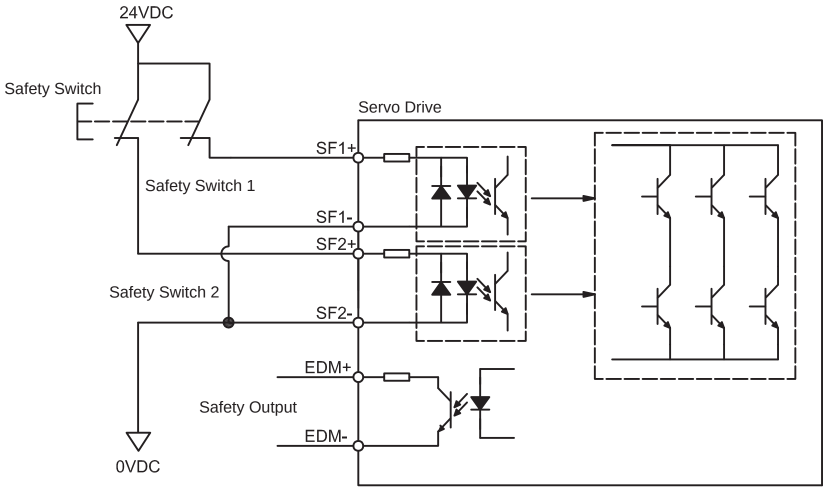
STO function input and output signals are as follows

Signal name	Logo	Pin	Description	Applicable mode
Safety signal input 1	SF1+	1	When the SF1 signal is removed, that is, SF1 is off, the STO function is activated (enabled).	All control modes
	SF1-	5		
Safety signal input 2	SF2+	3	When the SF2 signal is removed, that is, SF2 is off, the STO function is activated (enabled).	
	SF2-	2		
Safety signal output	EDM+	6	When the STO function works, this signal is output	
	EDM-	4		
Digital Ground	DGND	7,8	+5VDC power ground	
+5V	+5V	9,10	+5VDC power source	

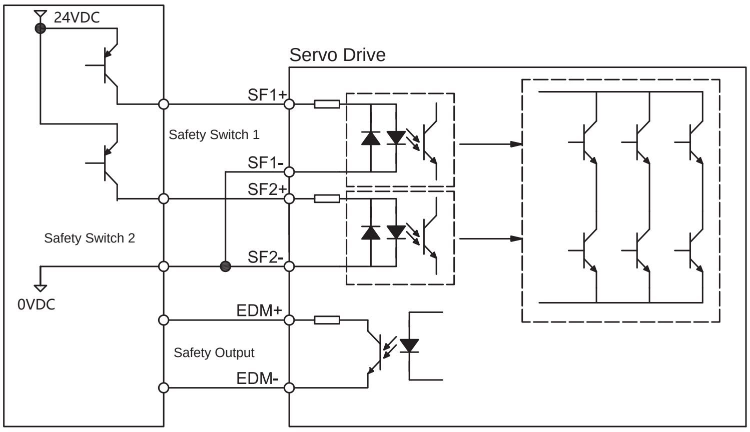
Note: When any safety input SF1 and SF2 are OFF, the STO function will start to work.

4.11.2.4 STO connection example

◆ Connection with safety switch



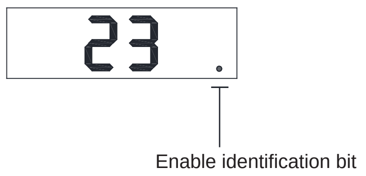
◆ Connection with safety light curtains



5 LED Display

5.1 Display content

5.1.1 Decimal point meaning

Display content	Description
	◆ Motor Enabled Flag: The decimal point in the lower right corner of the LED panel is the identification bit alerting users to the servo motor's status Solid: Motor enabled Blank: Motor is disabled

5.2 Alarm Codes and Definitions

When the MBDV drive experiences abnormal operation, it will enter an alarm state and display one of the following codes. Their definitions are included below for reference.

Alarm Code	Description	Alarm Type	Drive status after alarm
01	Drive over temperature	Fault	Servo off
02	Internal voltage	Fault	Servo off
03	Drive overvoltage	Fault	Servo off
04	Overcurrent	Fault	Servo off
05		Fault	Servo off
06		Fault	Servo off
09	Encoder feedback error	Fault	Servo off
10	Position following error	Fault	Servo off
11	Low voltage	Fault	Servo off
12	Over speed	Fault	Servo off
13	Limit switch triggered	Warning	Does not change the current state
14	Positive limit switch triggered	Warning	Does not change the current state, the motor cannot rotate negatively.
15	Positive limit switch triggered	Warning	Does not change the current state, the motor cannot rotate positively.
16	Current limit	Warning	Does not change the current state
17	Communication error	Warning	Does not change the current state
18	Parameter save failed	Warning	Does not change the current state

Alarm Code	Description	Alarm Type	Drive status after alarm
20	STO Active	Warning	Servo off
21	Regeneration failed	Fault	Servo off
22	Undervoltage warning	Warning	Does not change the current state
23	Empty Q Program	Warning	Does not change the current state
24	Motion command received while motor disabled	Warning	Does not change the current state
25	Internal voltage error	Fault	Servo off
26		Fault	Servo off
27	Emergency stopped	Warning	Motor decelerates to stop
30	Memory error	Fault	Servo off
34	Motor over temperature	Fault	Servo off
35	Drive Processor over temperature	Fault	Servo off
37	Motor stalled	Fault	Servo off
39	Homing parameters configuration error	Warning	Does not change the current state
40	Motor collision alarm	Fault	Servo off
41	Encoder communication error	Fault	Servo off
42	IO signal used is not general purpose	Warning	Does not change the current state
43	Bus watchdog trigger	Warning	Does not change the current state

6 Commissioning

During trial operation, it is recommended that the motor be operated without a load coupled to its shaft.

6.1 Inspection before commissioning

To protect the servo drive and servo motor, it is recommended that users inspect the following before commissioning these two components.

1) Wiring

Check that Main power, AUX power (if used), motor phases and motor encoder are securely and properly wired to the drive. Check that no short circuits exist between connections. Verify that motor and drive are properly grounded . Ensure that the USB connection is secure to ensure proper communication with the host PC.

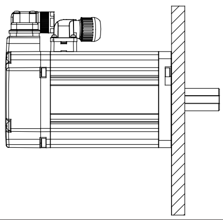
2) Power supply voltage

Verify that the voltage applied to Main power is within the specification of the drive. Verify that the voltage applied to AUX power is 24 VDC.

3) Make sure the motor and drive are securely mounted

4) Make sure the motor shaft is not loaded

6.2 Commissioning Steps

Step	Content	Description
1	Securely mount the motor 	1) Servo motor can be mounted on the machine 2) Please do not connect the load to the servo motor
2	Ensure proper and secure connection between motor and drive	1) MBDV Servo motor phases are labeled U, V, W for the red, yellow and blue cables respectively. If using a third party motor, this wiring could be different and its performance is not guaranteed with the MBDV. 2) Ensure that the motor encoder cable is properly connected to the encoder port on the MBDV drive.
3	Make sure the power circuit wiring is correct	Refer to chapter 4.3 Wiring of External Main Circuit to confirm whether the power input circuit is correct
4	Power on	Input 24 ~60VDC power supply
5	During normal operation, the drive displays its Node ID 1 If an alarm occurs, it will display the alarm code in blinking fashion 09	1) Normally, the drive has no alarm display and is disabled 2) If r09 alarm occurs, it indicates that there is a problem with the cable connection of the encoder. Please check whether the wiring is correct after power off. 3) For other alarms, please refer to Chapter 9 Troubleshooting
6	If a motor brake is used, the brake control circuit should be set up before use.	Refer to 4.6 Connection of Motor with Electromagnetic Brake
7	JOG mode operation	If there is no abnormality in the above steps, you can start a trial operation in JOG mode

Note: The drive must be configured for the proper motor model. Please refer to the following steps before initiating motion with the motor.

6.3 Drive Configuration

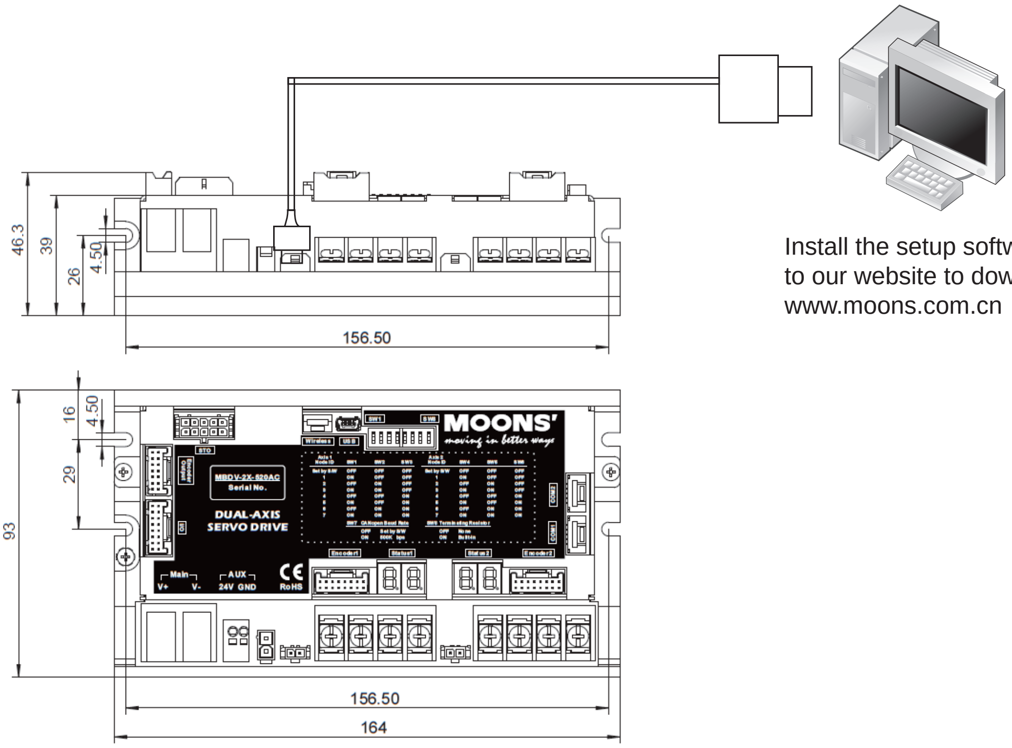
In order to integrate the MBDV drive and motor into a system, it is necessary for users to configure the drive so that its inputs, outputs, feedback and motor interact with the system in the desired way. The following are examples of things users can configure:

1. Control Mode

2. Assign functions to inputs and outputs

3. Tune PID loop parameters for improved motor control (if necessary)

Connection method



Install the setup software. Please go to our website to download: www.moons.com.cn

For detailed instructions of Luna, contact Applied Motion support..

7 Control Modes and Functions

7.1 I/O signal setting

Input and output signals can be assigned pre-defined functions (e.g. CW/CCW limits, Fault Output, In Position etc.), can be configured as general purpose and can have their logic state configured according to application requirements. Parameters provided in this section's tables are referencing the "Parameter Table" in the Luna configuration software.

7.1.1 Input Signal Configuration

7.1.1.1 Assignable input functions

The functions and logic that can be assigned to the input signal are listed below.

Signal Functions	Symbol	Setup value and corresponding input logic state	
		Valid when closed	Valid when open
General Purpose Input	GPIN	0	-
Servo On	S-ON	1	2
Alarm Reset	A-CLR	3	4
CW Limit	CW-LMT	5	6
CCW Limit	CCW-LMT	7	8
Gain Select	GAIN-SEL	11	12
Emergency stop	E-STOP	13	14
Start Homing	S-HOM	15	16
Torque Limit	TQ-LMT	19	20
Zero Speed Clamp	ZCLAMP	21	22
Speed limit select	V-LMT	37	38
Home Switch	HOM-SW	39	40
Start Q program	START-Q	45	46

The definitions of logic states for inputs are as follows:

Closed: The input's internal circuit is completed, and current flows in or out of the input pin.

Open: The input's internal circuit is not completed, and current does NOT flow in or out of the input pin.

7.1.1.2 Default input functions

The default functions of inputs signals are listed below. The parameters to configure each respective input are also listed.

Signal				Factory default		
Input NO.	Signal description	Parameters	Command	Signal name	Input Logic	Defaults
X1	Digital input 1	P5-00	MU1	CCW-LMT	Closed	7
X2	Digital input 2	P5-01	MU2	CW-LMT	Closed	5
X3	Digital input 3	P5-02	MU3	HOM-SW	Closed	39
X4	Digital input 4	P5-03	MU4	E-STOP	Closed	13
XCOM	Digital input COM terminal	-	-	X input common		

7.1.2 Output signal configuration

7.1.2.1 Assignable output functions

The functions and logic assignable to outputs are list below:

Signal name	Signal Symbol	Logic and set value when output signal is valid	
		Output when the signal is valid Closed	Output when the signal is valid Open
General Purpose Output	Output when the signal is valid	0	-
Fault Output	ALM	1	2
Warning Output	WARN	3	4
Brake Release Output	BRK	5	NONE
Servo-on Status Output	SON-ST	7	8
In-position Output	IN-POS	9	10
Dynamic Position Output	DYM-LMT	11	12
Torque Reach Output	TQ-REACH	13	14
Torque Limit Output	T-LMT	15	16
Speed Coincidence Output	V-COIN	17	18
Speed Reaches Output	AT-SPD	19	20
Velocity Limit Output	V-LMT	21	22
Servo Ready Output	S-RDY	23	24
Homing Finished Output	HOMED	25	26
Near Target Position Output	P-COIN	31	32
Zero Speed Detected	Z-SPD	33	34
Torque Coincidence output	I-COIN	35	36

The definitions of logic states for outputs are as follows:

Closed: The output's internal circuit is completed, and current flows in or out of the output pin.

Open: The output's internal circuit is not completed, and current does NOT flow in or out of the output pin.

7.1.2.2 Default output functions

The default functions for outputs are listed below. The parameters for configuring each respective output are also listed.

Signal				Factory default		
Signal name	Description	Parameters	Command	Signal name	Output logic	Defaults
Y1	Digital output 2	P5-12	MO1	ALM	Open	2
Y2	Digital output 3	P5-13	MO2	SON-ST	Closed	7
YCOM	Digital output	-		Y1, Y2 Output common		

7.1.3 Servo Enable

Enable/disable signal for energizing the motor windings. If the motor is enabled, the user may execute motion at the motor. If the motor is disabled, the user cannot execute motion at the motor.

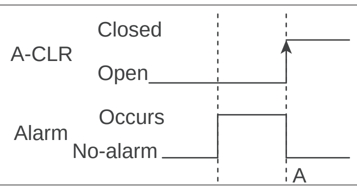
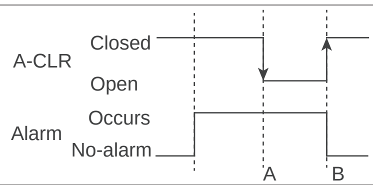
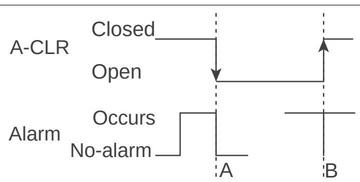
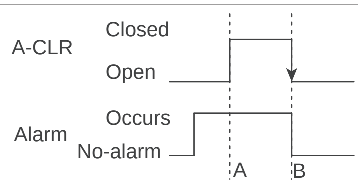
◆ Signal logic

Type	Signal name	Setup value	Signal logic	Function
Input	S-ON	1	Closed	When the input state is Closed, the driver is enabled
		2	Open	When the input state is Open state, the driver is enabled

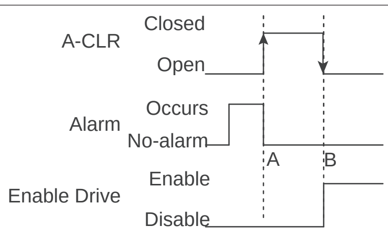
7.1.4 Alarm Reset

Used to clear warnings or alarms.

◆ Signal logic

<table>
<tr><th>Set Value</th><th>Input Logic</th><th colspan="2">Instructions</th></tr>
<tr><td rowspan="3">3</td><td rowspan="3">Closed</td><td colspan="2">In normal state, the input must remain in OPEN(High level) state. This is an edge trigger signal,that means the alarm will be cleared only when the input changes from OPEN(High level) to CLOSED(Low level).</td></tr>
<tr><td>
</td><td>
</td></tr>
<tr><td>When alarm occurs:
1) A-CLR input logic is OPEN, alarm is not reset.
2) At point A, A-CLR changes from OPEN to CLOSED, the alarm is cleared.</td><td>When alarm occurs:
1) A-CLR input logic is CLOSED, alrm is not reset.
2) At point A, A-CLR changes from CLOSED to OPEN, the alarm is NOT reset.
3) At point B, A-CLR changes from Open to Closed, the alarm is cleared.</td></tr>
<tr><td rowspan="3">4</td><td rowspan="3">Open</td><td colspan="2">In normal state, the input must remain in CLOSED(Low level) state. This is an edge trigger signal,that means the alarm will be cleared only when the input changes from CLOSED(Low level) to OPEN(High level).</td></tr>
<tr><td>
</td><td>
</td></tr>
<tr><td>When alarm occurs:
1) A-CLR input logic is CLOSED, alrm is NOT reset.
2) At point A, A-CLR changes from CLOSED to OPEN, the alarm is reset.
3) At point B, A-CLR changes from OPEN to CLOSED, the alarm is NOT cleared.</td><td>When alarm occurs:
1) A-CLR input logic is OPEN, alrm is NOT reset.
2) At point A, A-CLR changes from OPEN to CLOSED, the alarm is NOT cleared.
3) At point B, A-CLR changes from CLOSED to OPEN, the alarm is reset.</td></tr>
</table>

Note: When none of the input pins of the drive are not configured with the "servo enable" function, "alarm reset" can be used to enable the drive, as shown below:

<table>
<tr><td>
</td><td>1) At point A, the rising edge of A-CLR input clears the alarm.
2) At point B, the alarm has been cleard. The falling edge of A-CLR enables the drive.</td></tr>
</table>

7.1.5 CW, CCW Limit

In order to prevent the movable parts of the machine from exceeding the movable range and avoid accidents, it is necessary to set CW and CCW limit switches.

◆ Signal logic

Type	Signal name	Setting	Signal logic	Function
Input	CCW-LMT	7	Closed	When the input state is CLOSED, the drive shows a Negative Limit alarm, motor cannot continue rotating in negative direction.
		8	Open	When the input state is OPEN, the drive shows a Negative Limit alarm, motor cannot continue rotating in negative direction.
	CW-LMT	5	Closed	When the input state is CLOSED, the drive shows a Positive Limit alarm, motor cannot continue rotating in positive direction.
		6	Open	When the input state is OPEN, the drive shows a Positive Limit alarm, motor cannot continue rotating in positive direction.

◆ Default settings for MBDV series drives

Signal name	Input	PIN NO.	Parameter	Command	Setup value	Function	Support mode			
CCW-LMT	X1	9	P5-00	MU1	7	Motor CW limit signal input	P	V	T	
	XCOM	13								
CW-LMT	X2	10	P5-01	MU2	5	Motor CCW limit signal input				
	XCOM	13								

7.1.6 Gain Select

Use the Gain Select function to meet performance requirements of varying loads. There are different methods of using the Gain Select function. One of these is through an digital input. Another is called automatic gain switching. These are explained in this section.

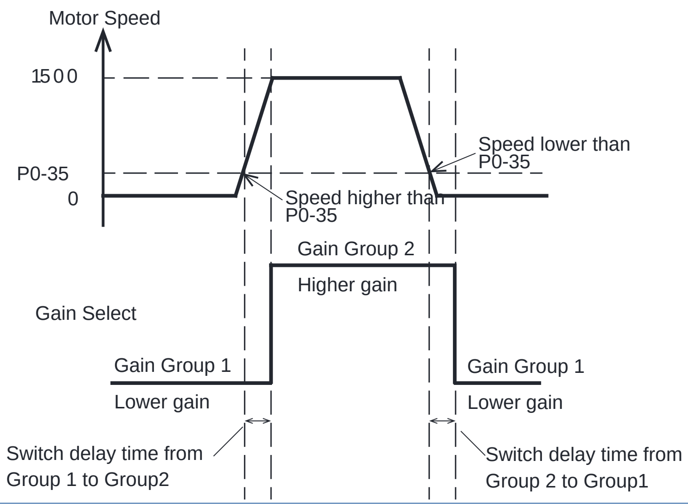
1) Increasing the gain can decrease and suppress vibration when doing position control.

2) Reducing the gain can decrease the settling time when the motor comes to a stop.

3) When the motor is running, increasing the gain can improve command following performance.

Example:

When the motor is running at low speed or stopped, a lower gain can be used to reduce noise, but when the motor is running at high speed or positioning, switch to a higher gain to improve command following performance.



1) Tuning Parameters

Parameter	Command	Description	Class	Defaults	Unit
P0-05	KP	1st position loop gain	1st Gain Group	52	0.1Hz
P0-07	KD	1st position loop derivative time constant		0	ms
P0-08	KE	1st position loop derivative filter		20000	0.1Hz
P0-11	KF	1st velocity command gain		10000	0.01%
P0-12	VP	1st velocity loop gain		183	0.1Hz
P0-13	VI	1st speed loop integral time constant		189	ms
P0-16	KC	1st command torque filter frequency		1099	0.1Hz
P0-17	UP	2nd position loop gain	2nd Gain Group	52	0.1Hz
P0-19	UD	2nd position loop derivative time constant		0	ms
P0-20	UE	2nd position loop derivative time constant		20000	0.1Hz
P0-21	UF	2nd velocity command gain		10000	0.01%
P0-22	UV	2nd velocity loop gain		183	0.1Hz
P0-23	UG	2nd velocity loop integral time constant		189	ms
P0-24	UC	2nd command torque filter frequency		1099	0.1Hz
P0-33	SD	Automatic gain switching method	-	0	
P0-34	PN	Gain switching condition - position error	-	0	counts
P0-35	VN	Gain switching condition - actual velocity	-	0	0.025rps
P0-36	TN	Gain switching condition - actual torque	-	10	0.1%
P0-37	SE1	Delay time - 2nd Group Gains to 1st Group Gains	-	10	ms
P0-38	SE2	Delay time - 1st Group Gains to 2nd Group Gains	-	10	ms

2) Digital Input Signal

Servo drive will switch the first gain to the second gain, when the the digital input signal GAIN-SEL input is valid.

Type	Signal Symbol	Setting	Signal logic	Description
Input	GAIN-SEL	11	Closed	When GAIN-SEL input is CLOSED, 2nd Gain Group takes effect. When GAIN-SEL input is OPEN, 1nd Gain Group takes effect.
		12	Open	When GAIN-SEL input is OPEN, 2nd Gain Group takes effect. When GAIN-SEL input is CLOSED, 1nd Gain Group takes effect.

Note:

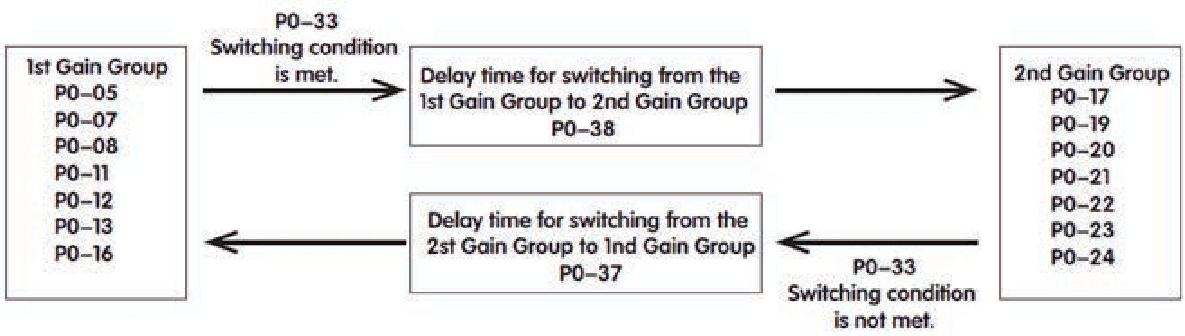
◆ Automatic gain switching is invalid when the gain switching method is set to external input switching, via the GAIN-SEL signal. That means no matter how P0-33 is set, the gain switching determined by the external input signal.

3) Automatic Gain Switch

Parameter P0-33 is used to set the method of automatic gain switching

Parameter	Setting	Condition	Switching Delay Time
P0-33	0 (Default)	Fix at 1st Gain Group	-
	1	Condition for switching to 2nd Gain Group: Absolute Position following error ≥ P0-34	P0-38
		Condition for switching to 1st Gain Group: Absolute Position following error < P0-34	P0-37
	2	Condition for switching to 2nd Gain Group: Absolute value of motor speed ≥ P0-35	P0-38
		Condition for switching to 1st Gain Group: Absolute value of motor speed < P0-35	P0-37
	3	Condition for switching to 2nd Gain Group: Absolute value of motor torque ≥ P0-36	P0-38
		Condition for switching to 1st Gain Group: Absolute value of motor torque < P0-36	P0-37
	4	Condition for switching to 2nd Gain Group: the positioning is not completed.	P0-38
		Return to 1st Gain Group: the positioning is kept in completed.	P0-37

Auto switch mode

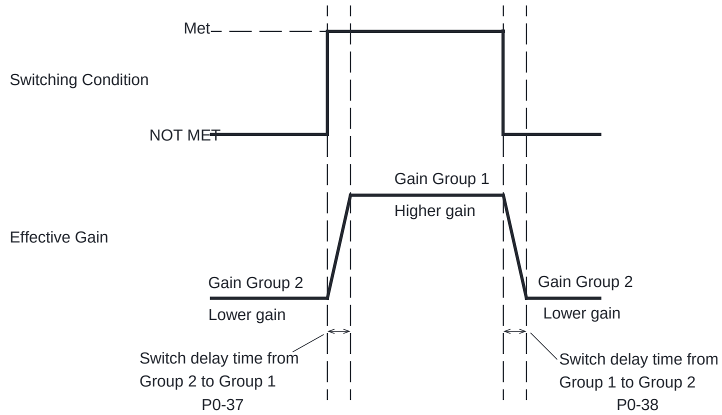


4) Gain Switch Delay Time

To avoid jitter caused by immediate gain switch, when the switch condition is met, the 1st gain group will gradually switch to the 2nd gain group with the gain switch delay time P0-38.

In the same way, when the inverse switch condition is met, the 2st gain group will gradually switch to the 1nd gain group with the gain switch delay time P0-37.

As shown below.



7.1.7 Emergency stop

Emergency stop is a function to forcibly stop the servo motor rotating through an external digital input.

The E-stop signal needs to be assigned to a digital input when using emergency stop function.

When emergency stop input signal is triggered, the motor will stop to zero with a quick stop deceleration(P2-01), then and become disabled. Meanwhile an "Emergency Stop" fault is reported.

Type	Signal name	Setting	Signal logic	Function
Input	E-STOP	13	Closed	When E-STOP input is CLOSED, the motor is emergency stopped. When E-STOP input is OPEN, the motor runs normally.
		14	Open	When E-STOP input is CLOSED, the motor runs normally. When E-STOP input is OPEN, the motor is emergency stopped.

◆ Default settings for MBDV series drives

Signal Symbol	Input NO.	PIN NO.	Parameter	Command	Setting	Signal logic	Description	Support mode			
E-STOP	X4	12	P5-04	MU5	39	Closed	Motor emergency stop.	P	V	T	
	XCOM	13				Open	Motor runs normally.				

7.1.8 Fault output

When the drive fails, the drive will have a fault alarm output and the servo system will change from the enabled state to the disable state.

To use this function, a digital output of the servo drive is configured as ALM function.

Parameters P5-12 ~ P5-13 set the function of the digital output Y1 ~ Y2 of the drive. Should either of these inputs be assigned as the fault output.

Type	Signal Symbol	Setup Value	Signal logic	Function
Output	ALM	1	Closed	When the output is CLOSED, it means that the drive has a fault
			Open	When the output is OPEN, it means the drive is in normal state and no fault is occurred.
		2	Open	When the output is OPEN, it means that the drive has a fault.
			Closed	When the output is CLOSED, it means the drive is in normal state and no fault are occurred.

LED Display	Description	Alarm Type	Drive status after the alarm occurs	LED Display	Description	Alarm Type	Drive status after the alarm occurs
01	Drive over temperature	Fault	Servo off	21	Regeneration failed	Fault	Servo off
02	Internal voltage error	Fault	Servo off	25	Internal voltage error	Fault	Servo off
03	Over-voltage	Fault	Servo off	26		Fault	Servo off
04	Over current	Fault	Servo off	28	Full-closed loop position following error	Fault	Servo off
05		Fault	Servo off	29	External encoder error	Fault	Servo off
06		Fault	Servo off	30	Memory error	Fault	Servo off
09	Encoder feedback error	Fault	Servo off	34	Motor over temperature	Fault	Servo off
10	Position following error	Fault	Servo off	35	Drive MCU over temperature	Fault	Servo off
11	Low voltage	Fault	Servo off	36	Absolute encoder multi-turn error	Fault	Servo off
12	Over speed	Fault	Servo off	37	Motor stalled	Fault	Servo off
19	Phase loss of main circuit	Fault	Servo off	40	Motor collision alarm	Fault	Servo off
20	Safe torque off	Fault	Servo off	41	Encoer Communications error	Fault	Servo off

◆ Default settings for MBDV series drives

Signal name	Output NO.	PIN NO.	Parameter	Command	Setting	Signal logic	Description	Support mode			
ALM	Y1	15	P5-12	MO1	2	Closed	The drive has a fault.	P	V	T	
	YCOM	14				Open	The drive is in normal state and no fault is occurred.				

7.1.9 Warning output

When a warning occurs, the drive will have a warning output and the servo system maintains current working status.

To use this function, a digital output of the servo drive is configured as WARN function.

Parameters P5-12 ~ P5-17 set the function of the digital output Y1 ~ Y2 of the drive.

Type	Signal name	Setting	Signal logic	Function
output	WARN	3	Closed	The drive generates an abnormal warning, and the output is in the Closed state
			Open	The drive is normal, there is no abnormal warning, and the output is in the Open state
		4	Open	The drive generates an abnormal warning, and the output is in the Open state
			Closed	The drive is normal, there is no abnormal warning, and the output is in the Closed state

LED Display	Description	Alarm Type	Drive status after the alarm occurs
13	Limit switch trigger alarm	Warning	Does not change the current state.
14	Negative limit alarm	Warning	Does not change the current state, the motor cannot rotate in the negative direction.
15	Positive limit alarm	Warning	Does not change the current state, the motor cannot rotate in the positive direction.
16	Current limit	Warning	Does not change the current state.
17	Communication Error	Warning	Does not change the current state.
18	Parameter save failed	Warning	Does not change the current state.
22	Under-voltage warning	Warning	Does not change the current state.
23	No Q program warning	Warning	Does not change the current state.
24	Motion command received while motor disabled.	Warning	Does not change the current state.
27	Emergency stopped	Warning	Motor decelerates to stop.
31	Absolute encoder battery undervoltage	Warning	Does not change the current state.
32	Absolute position lost	Warning	Does not change the current state.
33	Absolute position overflow	Warning	Does not change the current state.
39	Homing parameters configuration error	Warning	Does not change the current state.
42	IO signal used is not general purpose	Warning	Does not change the current state.
43	Bus watchdog trigger	Warning	Does not change the current state.

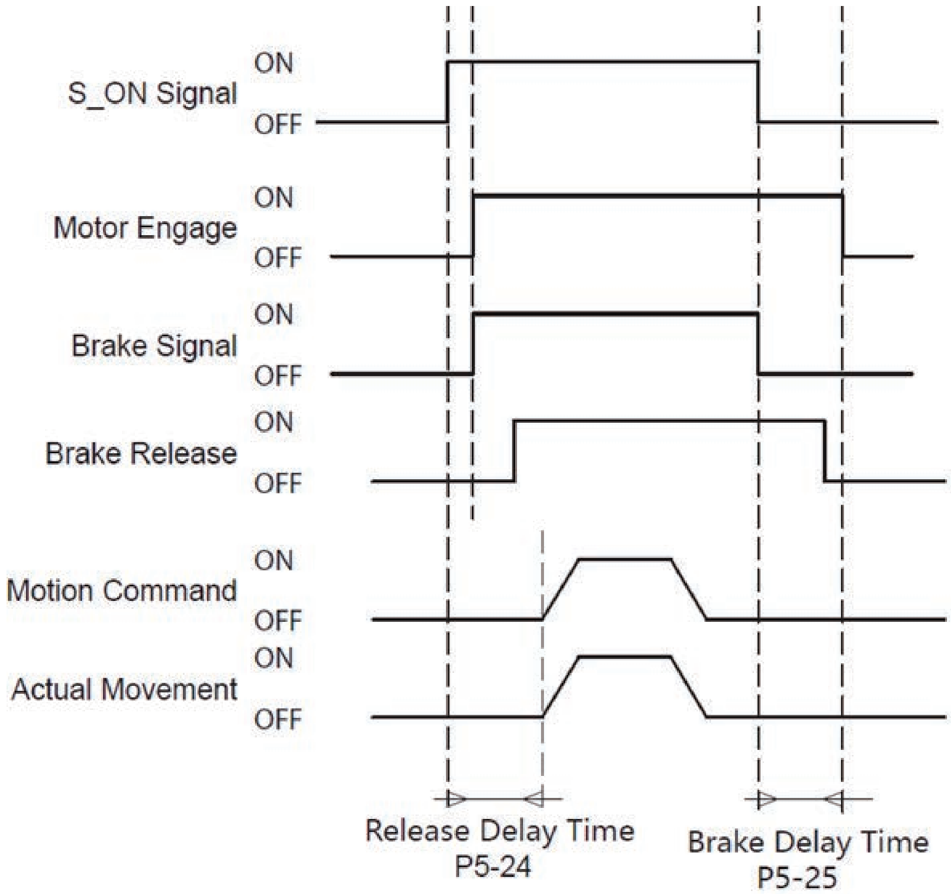
7.1.10 Motor brake control

In order to maintain a fixed position when the drive power is OFF or the motor is disabled, a servo motor with a brake needs to be used to ensure that the mechanical mechanism driven by the motor will not move due to its own weight or external force.

When using a servo motor with a brake, one of the digital outputs of the servo drive must be configured for the BRK function.

Type	Signal Symbol	Setup Value	Signal Logic	Function
Output	BRK	5	Closed	When the servo is enabled, the BRK signal is output, and the output state is CLOSED
			Open	When the servo is disabled, the BRK signal is not output, and the output status is OPEN.

Since the brake has an action delay when it works (brake or release), the timing sequence should be calculated to avoid damage to brake.



Signal Symbol	Output NO.	PIN NO.	Parameter	Command	Setup Value	Signal Logic	Description	Support mode			
BRK	BRK	BRK	P5-14	MO3	5	Closed	When the servo is enabled, the BRK signal is output	P	V	T	

Note: For wiring instructions and precautions when using electromagnetic brake, please refer to 4.6 Using an electromagnetic brake

7.1.11 Servo Ready Output

When the servo drive is power on and there is no alarm, the drive will output a Servo Ready signal, which means that the servo is ready for operation. Servo Ready refers to the situation that all of the following conditions are met.

1) The drive has no alarms.

2) Main power input is ready.

3) STO is not triggered.

4) Emergency stop(E-STOP) is not triggered.

When the servo system is not ready, even if the drive receives servo-on input signal, the drive will not be enabled or start to work.

Type	Signal Symbol	Settings	Signal logic	Function
Output	S-RDY	23	Closed	When the servo is ready for operation, the S-RDY signal is output, and the output state is CLOSED.
			Open	When the servo is NOT ready for operation, the S-RDY signal will NOT output, and the output state is OPEN.
		24	Open	When the servo is ready for operation, the S-RDY signal is output, and the output state is OPEN.
			Closed	When the servo is NOT ready for operation, the S-RDY signal will NOT output, and the output state is CLOSED.

7.1.12 Servo-on Status Output

The Servo-on Status output signal reflects whether the servo motor is in enabled status.

To use this function, a digital output of the servo drive is configured as SON-ST function.

Parameters P5-12 ~ P5-13 set the function of the digital output Y1 ~ Y2 of the drive.

Type	Signal Symbol	Settings	Signal Logic	Function
Output	SON-ST	7	Closed	When the servo is enabled, the SON-ST signal is output, and the output state is CLOSED
			Open	When the servo is not enabled, the SON-ST signal will not output, and the output state is OPEN.
		8	Open	When the servo is enabled, and the output state is OPEN.
			Closed	When the servo is NOT enabled, and the output state is CLOSED.

◆ Default settings for MBDV series drives

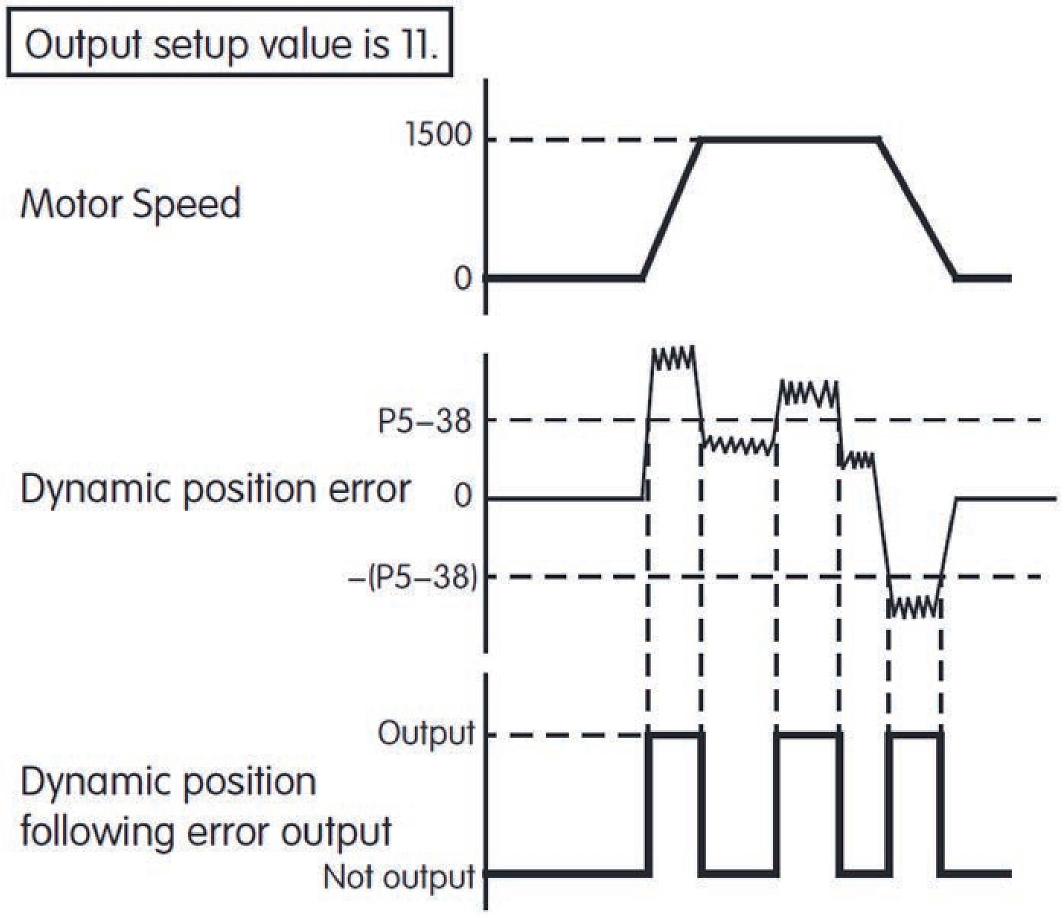
Signal Symbol	Output NO.	PIN NO.	Parameter	Command	Setup Value	Signal Logic	Description	Support mode			
SON-ST	Y2	16	P5-13	MO2	7	Closed	Drive is enabled	P	V	T	
	YCOM	14				Open	Drive is not enabled				

7.1.13 Dynamic position error output

The dynamic position error following output refers to the output of this signal when the difference between the actual position of the motor and the command position is greater than P5-38 (Dynamic position error threshold) during the operation of the motor.

Type	Signal name	Setup Value	Signal Logic	Function
Output	DYM-LMT	11	Closed	When the dynamic following error exceeds the setting of P5-38, the DYM-LMT signal is output, and the output state is CLOSED.
			Open	When the dynamic following error does not exceed the setting of P5-38, the DYM-LMT signal will not output, and the output state is OPEN.
		12	Open	When the dynamic following error exceeds the setting of P5-38, the DYM-LMT signal will NOT output, and the output state is OPEN.
			Closed	When the dynamic following error does not exceed the setting of P5-38, the DYM-LMT signal is output, and the output state is CLOSED.

The following figure is a timing diagram of the setting value of 11, that is, the error exceeds the setting of P5-38, dynamic position error threshold, and the output state is Closed.



7.1.14 Software limit output

Software limit output refers to the output of this signal when the motor encounters or triggers the limit switch oin the current direction of motion, and the motor cannot continue to run in the current direction. This output has two conditions:

1) Output SLCW when positive direction limit encountered.

2) Output SLCCW when negative direction limit encountered.

Type	Signal name	Setup value	Signal Logic	Function
Output	SLCW	27	Closed	The positive limit is triggered, the signal is output, and the output state is Closed.
			Open	The positive limit is not triggered, the signal is not output, and the output state is Open.
		28	Open	The positive limit is triggered, the signal is not output, and the output state is Open.
			Closed	The positive limit is not triggered, the signal is output, and the output state is Closed.
Output	SLCCW	29	Closed	The negative limit is triggered, the signal is output, and the output state is Closed.
			Open	The negative limit is not triggered, the signal is not output, and the output state is Open.
		30	Open	The negative limit is triggered, the signal is not output, and the output state is Open.
			Closed	The negative limit is not triggered, the signal is output, and the output state is Closed.

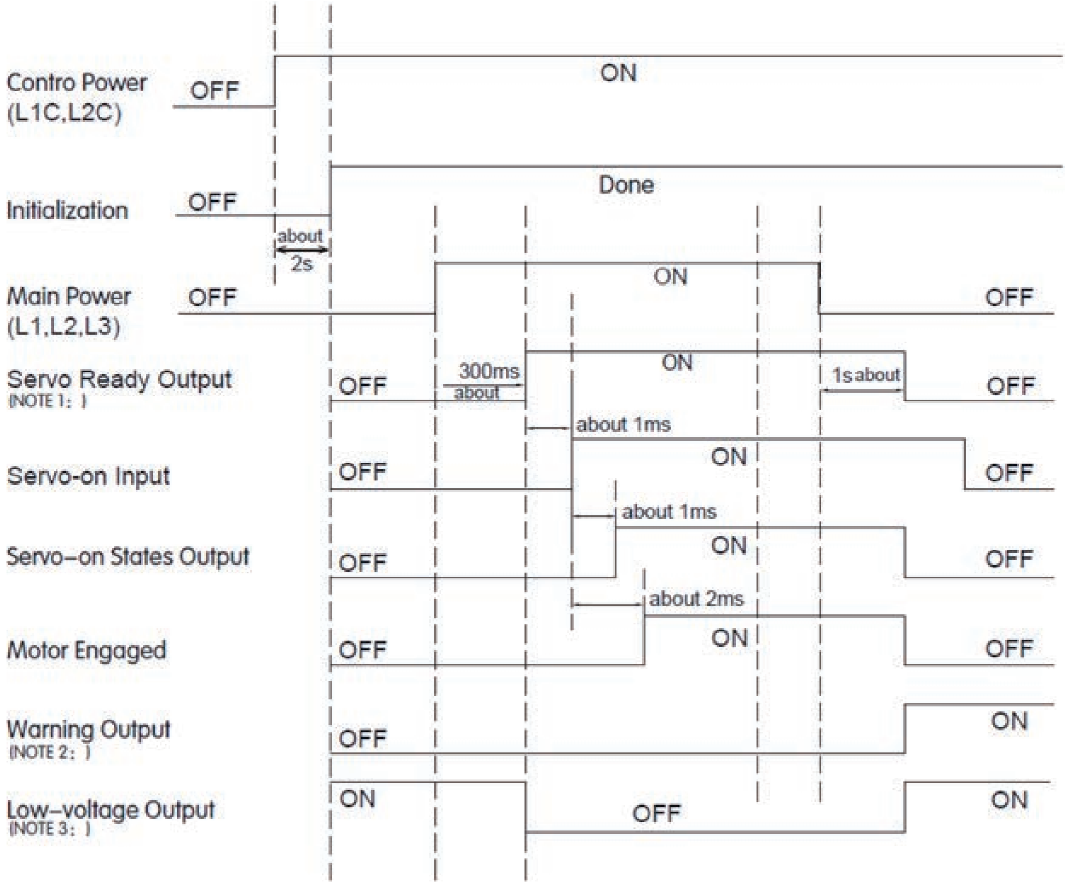
In the absolute value system, the types of limit switches are as follows. When any of the following conditions are satisfied, the corresponding rotation limit signal will be output.

1) Limit switches trigger digital inputs

2) Conditions meeting parameters P5-47 or P5-48 are met

7.1.15 Timing diagram

7.1.15.1 Timing chart for turning on the power

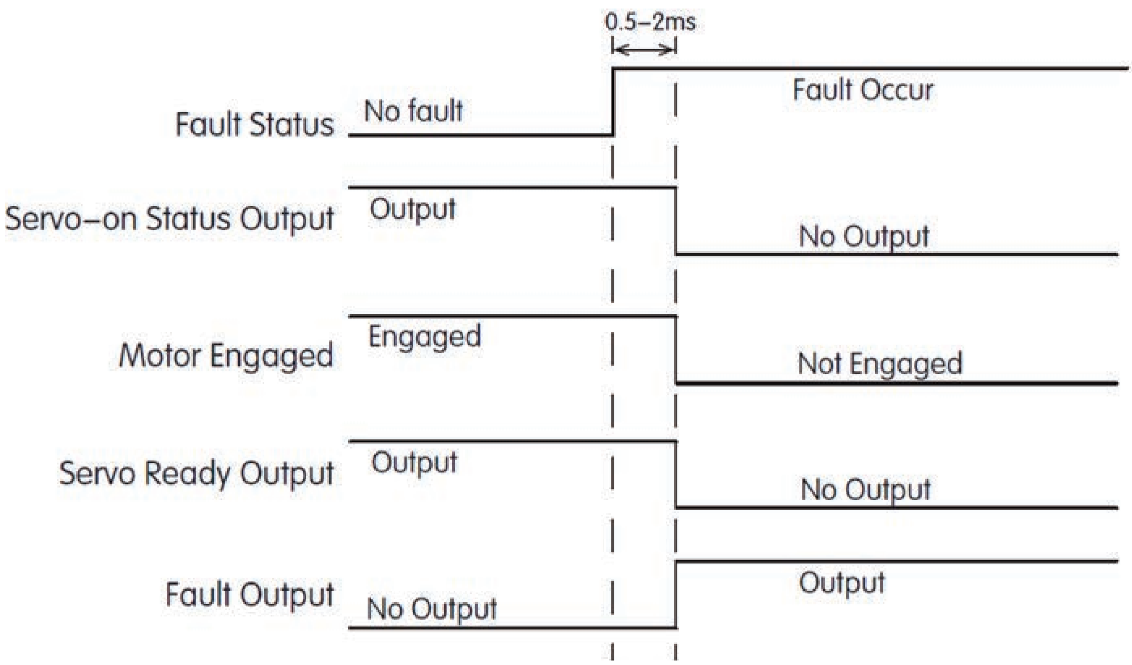


Note 1：When main power is cut off, it may take 1s or longer to stop outputting the Servo Ready signal due to the capacitor in the drive.

Note 2：If cut off main power input when the drive is enabled, possible alarms may occur as following, under-voltage alarm (Warning), low-voltage alarm (Fault), position following error.

Note 3：When main power is not applied, the Servo Ready will not output. There will be a low-voltage alarm if trying to enable the servo.

7.1.15.2 Timing chart when fault alarm occurs

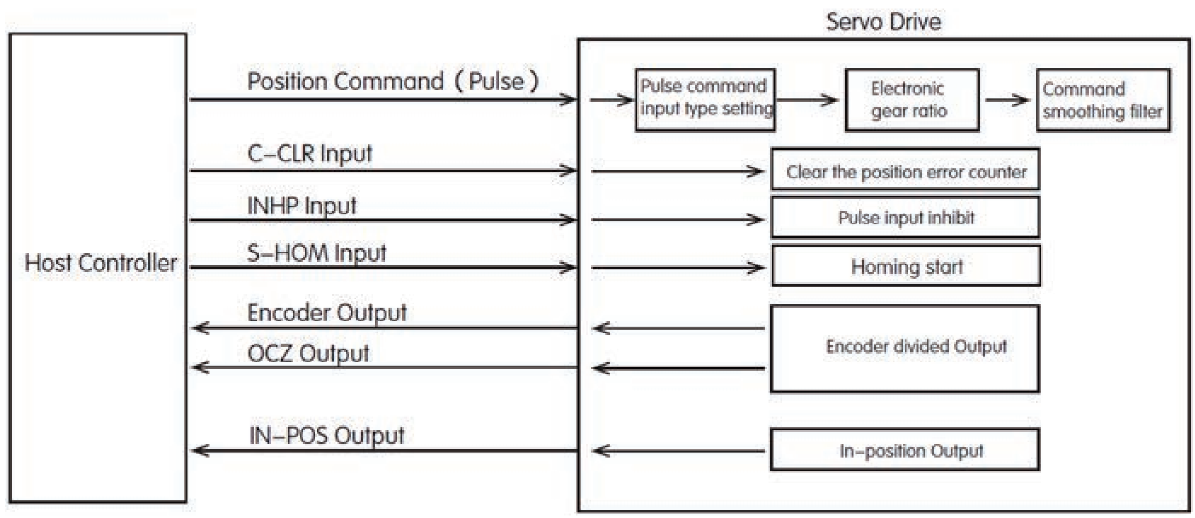


7.2 Position control mode

7.2.1 Position control mode configuration

In the position control mode, position control is performed by the position command input from the host controller. The following describes the basic settings for position control.

◆ Block diagram



◆Position Control Mode

Position mode is widely used in equipment that requires precise positioning. MBDV series supports command position mode. Set the following values to parameter P1-00 through the Luna software, and the servo drive will work in position control mode.

Parameter	Command	Setting	Mode	Command	Description
P1-00	CM	21	Position control mode	◆ Q Program ◆ Modbus/RTU	Use Q programming or Modbus/RTU communication commands for position control

◆ Command smoothing filter

Smooths the transition in position or speed caused by motion commands. This can reduce jitter and vibrations in the mechanical system.

Related parameters

Parameter	Command	Description	Range	Defaults	Unit	Instructions
P2-05	JT	Jerk time	0 ~ 50	10	ms	Smoothing filter for internal motion command.
P2-28	KJ	Jerk Filter	0 ~ 1000	10	ms	Set the time constant of the low-pass filter of the position command or speed command.

For detailed parameter setting, please refer to chapter 7.2.5 Command smoothing filter setting

◆ Positioning complete signal

In position mode, the positioning complete signal is used to indicate the current positioning state of the servo motor. When the absolute value of the difference between the commanded position and the actual position of the servo motor, that is, the position error is smaller than the set value of the parameter, the positioning completion signal will be output.

Related Parameters

Type	Signal Symbol	Setup Value	Signal logic	Function
Output	IN-POS	9	Closed	Positioning completed, IN-POS condition satisfied and signal is output. Output state is Closed.
			Open	Positioning not completed, IN-POS condition not satisfied and signal is not output. Output state is Open.
		10	Open	Positioning completed, IN-POS condition satisfied and signal is output. Output state is Open.
			Closed	Positioning not completed, IN-POS condition not satisfied and signal is not output. Output state is Closed.

For detailed parameter setting, please refer to chapter 7.2.8 Positioning complete signal

◆ Encoder feedback output

The encoder feedback output function of the servo driver is a function of outputting the position information fed back by the motor encoder via differential A/B/Z signals. A/B signals have a 90° difference. .

Related parameters

Parameter	Command	Description	Range	Defaults	Unit	Instructions
P3-12	PO	Encoder feedback output mode	0 ~ 256	1	-	Pulse frequency division output mode setting
P3-13	ON	Pulse Output Gear Ratio-Numerator	0 ~ 65535	10000	-	Set the numerator of the pulse output distribution ratio
P3-14	OD	Pulse Output Gear Ratio-Denominator	0 ~ 65535	65535	-	Set the denominator of the pulse output distribution ratio

For detailed parameter setting, please refer to chapter 7.6 Encoder frequency division output

7.2.2 Command smoothing filter setting

When the position command or speed command of the servo system changes significantly, it is easy to cause the whole system to vibrate, and the system noise will also increase. Command filter smooths the transition in position or speed caused by motion commands. This can reduce jitter and vibrations in the mechanical system.

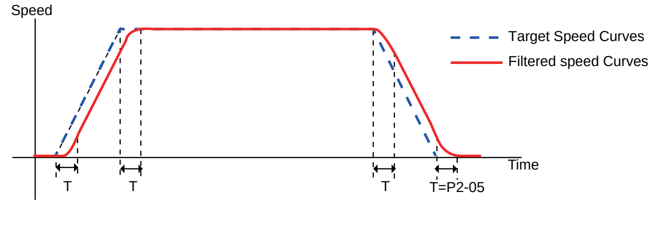
Related parameters

Parameter	Instruction	Name	Value range	Defaults	Unit	Description
P2-05	JT	jerk time	0 ~ 125	10	ms	Time constant for smoothing filtering in internal trajectory mode
P2-28	KJ	low pass smoothing filter	0 ~ 10000	10	ms	Set the time constant of the low-pass filter of the position command or speed command

Note: When set to 0, the filtering function is invalid

7.2.2.1 Jerk time

Parameter P2-05 can be used in various drive control modes (position, speed, torque) and when streaming commands to the drive from an external controller. The effect of jerk smoothing on the input command is shown in the figure below.

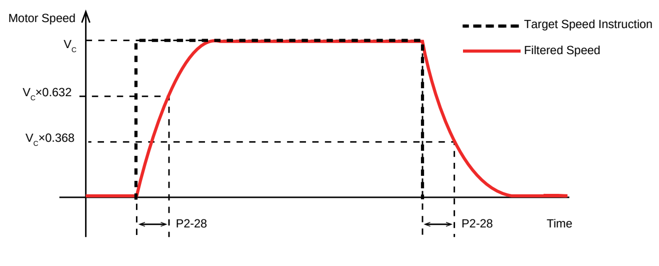


◆ Jerk time filter will produce a certain delay T for the command, but it will not affect the final positioning accuracy.

◆ The larger the P2-05 time constant, the more obvious the smoothing effect will be, and the delay of instruction response will increase, so users should set an appropriate filter time constant according to the application.

7.2.2.2 Low pass smoothing filter

Parameter P2-28 can be used in various drive control modes (position, speed, torque) and when streaming commands to the drive from an external controller. The smoothing effect of the low-pass filter on the input command is shown in the figure below.



◆ Low-pass smoothing filter will produce a certain delay T for the motion command, but it will not affect the final positioning ac curacy.

◆ The larger the time constant of P2-28, the more obvious the smoothing effect will be, and the delay of instruction response will be increased. Users should set an appropriate filter time constant according to the application.

7.2.3 Positioning complete signal

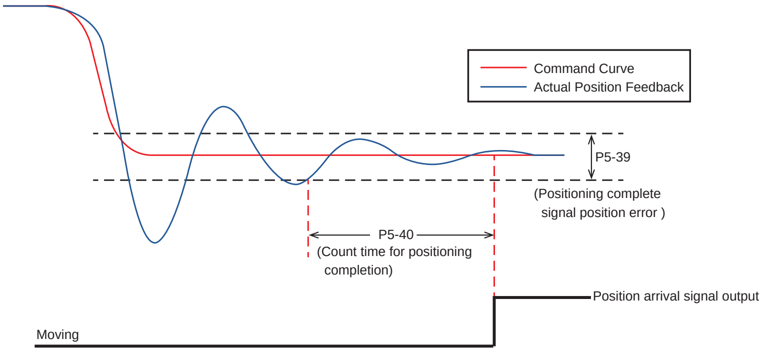
In the position control mode, use the positioning completion signal output to indicate the current positioning status of the servo motor. When the absolute value of the difference between the commanded position and the actual position of the servo motor, that is, the position error is smaller than the set value of the parameter, the positioning completion signal will be output.

Type	Signal name	Set value	Signal logic	Function
Output	IN-POS	9	Closed	Positioning completed, IN-POS condition satisfied and signal is output. Output state is Closed.
			Open	Positioning not completed, IN-POS condition not satisfied and signal is not output. Output state is Open.
		10	Open	Positioning completed, IN-POS condition satisfied and signal is output. Output state is Open.
			Closed	Positioning not completed, IN-POS condition not satisfied and signal is not output. Output state is Closed.

Related parameters

Parameter	Instruction	Name	Value range	Defaults	Unit	Description
P5-39	PD	Positioning complete error margin	0 ~ 32000	40	pulses	When motion is completed, the position error must be within this set range. If this is satisfied, the positioning complete signal is output.
P5-40	PE	Motion condition timer	0 ~ 32000	10	ms	If the motion complete condition is satisfied for this length of time, positioning will be considered complete and IN-POS will be output.

As shown below



7.2.4 position reached output

Position arrival output P-COIN signal indicates that the actual position of the motor is equal to the position set by parameter P5-46.

◆ Position arrival output **P-COIN** setting

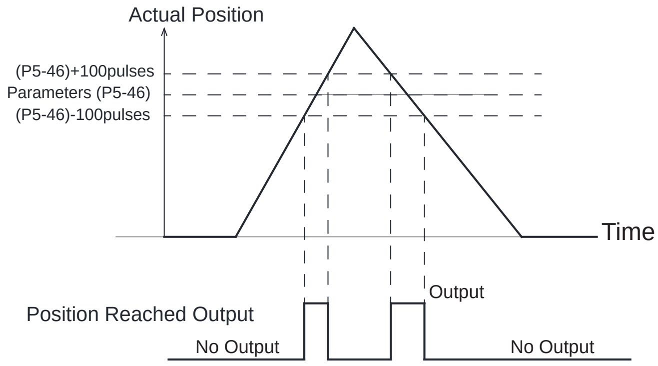
Type	Signal name	Set value	Signal logic	Function
output	P-COIN	31	Closed	the position reaches the P-COIN judgment condition, the output signal is output, and the output state is closed.
			Open	the position reaches the P-COIN judgment condition is not established, no signal is output, and the output state is open
		32	Open	the position reaches the P-COIN judgment condition is established, the output signal is output, and the output state is open
			Closed	the position reaches P-COIN, the judgment condition is not established, no signal is output, and the output state is closed.

Related parameter settings

Parameter	Instruction	Name	Value range	Defaults	Unit	Description
P5-46	DG	Absolute arrival position	-2147483647 ~ +2147483647	10000	pulses	Determine the target position of the output position coincidence signal

◆ Position arrival P-COIN judgment condition

When the actual position is equal to the setting of parameter P5-46, the output position reaches the P-COIN signal. The fluctuation range is ± 100pulses.



7.2.5 Gain parameter in position mode

In position mode, application appropriate gain parameters can make the servo system run more smoothly and accurately, and have excellent positioning performance. The following gain parameters in position mode can be automatically adjusted using Luna.

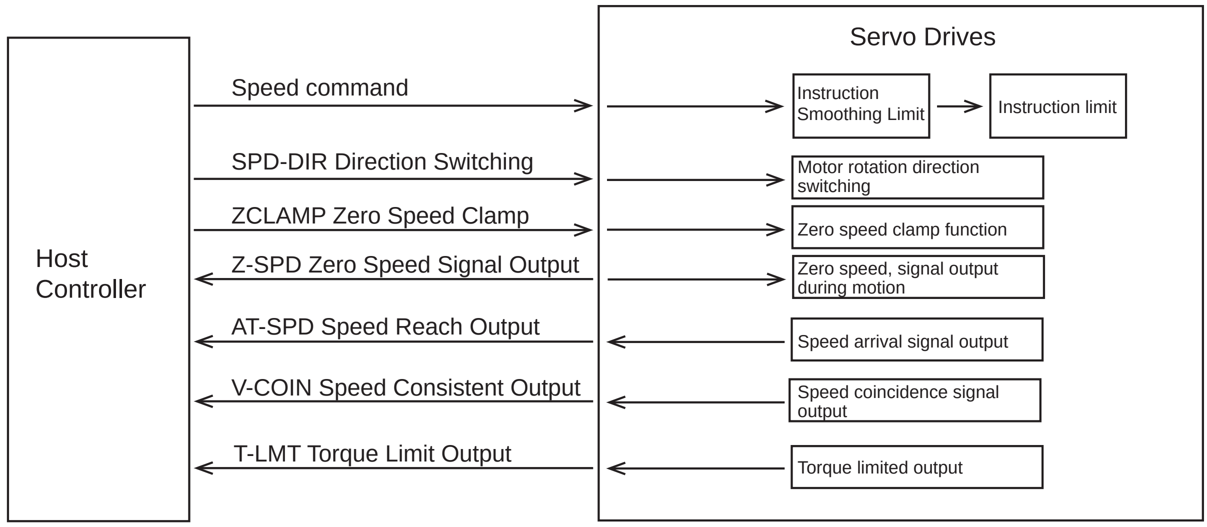
Parameter	Command	Parameter name	Type	Defaults	Unit
P0-05	KP	1st position loop gain	First set of gains	52	0.1Hz
P0-07	KD	1st position loop derivative time constant		0	ms
P0-08	KE	1st position loop derivative filter		20000	0.1Hz
P0-11	KF	1st velocity command gain		10000	0.01%
P0-12	VP	1st velocity loop gain		183	0.1Hz
P0-13	VI	1st speed loop integral time constant		189	ms
P0-16	KC	1st command torque filter frequency		1099	0.1Hz
P0-17	UP	2nd position loop gain	Second set of gains	52	0.1Hz
P0-19	UD	2nd position loop derivative time constant		0	ms
P0-20	UE	2nd position loop derivative time constant		20000	0.1Hz
P0-21	UF	2nd velocity command gain		10000	0.01%
P0-22	UV	2nd velocity loop gain		183	0.1Hz
P0-23	UG	2nd velocity loop integral time constant		189	ms
P0-24	UC	2nd command torque filter frequency		1099	0.1Hz
P0-33	SD	Automatic gain switching method	-	0	
P0-34	PN	Gain switching condition - position error	-	0	pulses
P0-35	VN	Gain switching condition - actual velocity	-	0	rps
P0-36	TN	Gain switching condition - actual torque	-	10	0.1%
P0-37	SE1	Delay time - 2nd Group Gains to 1st Group Gains	-	10	ms
P0-38	SE2	Delay time - 1st Group Gains to 2nd Group Gains	-	0	ms

7.3 Velocity control mode

7.3.1 Velocity control mode configuration

Velocity control mode is used for precise speed control.

◆ Block diagram



◆ Come back to this subsection

MBDV series servo drive command speed mode.

Command speed mode: Use MOONS' unique Q programming to control the motor, or use Modbus commands to control the motor speed.

Model	Control signal	Parameter P1-00 setting	Description
Velocity control mode	Internal speed command, communication command or Q programming	15	◆ Internal speed mode ◆ Control using the Q programming function ◆ Use Modbus command to control When using Modbus command to directly control the motor operation, P1-00 must be set to 21

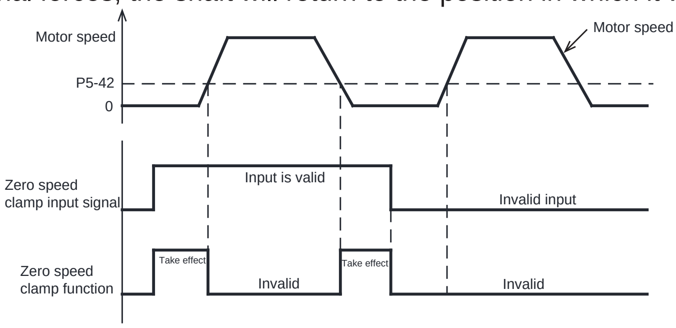
7.3.2 Zero speed clamp function

In velocity control mode, the zero speed clamp function can be configured in two ways:

◆ **P5-51 (zero speed clamp function) set to 0**

Activation of the zero speed clamp function becomes dependent on the ZCLAMP input signal. If the ZCLAMP input is valid and the commanded velocity falls below the zero speed threshold (P5-42), the servo motor enters a position lock state. This state maintains the motor shaft in position and should the shaft be caused to move by external forces, the shaft will return to the position in which it was initially locked.

Activation of the zero speed clamp function becomes dependent on the ZCLAMP input signal. If the ZCLAMP input is valid and the commanded velocity falls below the zero speed threshold (P5-42), the servo motor enters a position lock state. This state maintains the motor shaft in position and should the shaft be caused to move by external forces, the shaft will return to the position in which it was initially locked.



If the servo motor vibrates when it is in a locked stated due to the zero speed clamp function, the position loop gain needs to be adjusted. It is necessary to set an appropriate zero speed threshold. If the value is too high, it will cause significant vibrations in the system due to rapid deceleration.

ZCLAMP input signal configuration

To use the zero speed clamp function as mentioned above (setting of 0), users will need to assign the ZCLAMP function to an input. See below for configuration methods of the ZCLAMP input:

Type	Signal name	Set value	Signal logic	Function
Input	ZCLAMP	21	Closed	The input signal is valid and the speed command is less than P5-42, the ZCLAMP function is valid
			Open	Input signal is invalid, even if the speed command is less than P5-42, the ZCLAMP function will not be valid
		22	Open	The input signal is valid and the speed command is less than P5-42, the ZCLAMP function is valid
			Closed	Input signal is invalid, even if the speed command is less than P5-42, the ZCLAMP function will not be valid

◆ **P5-51 (zero speed clamp function) set to 1**

The zero-speed clamp state is independent of the zero-speed clamp input signal ZCLAMP.

Activation of the zero speed clamp function becomes independent of the ZCLAMP input signal. If the commanded velocity is 0 and the actual velocity falls below the zero speed threshold (P5-42) for a duration of time equivalent to P5-40, the servo motor enters a position lock state. This state maintains the motor shaft in position and should the shaft be caused to move by external forces, the shaft will return to the position in which it was initially locked.

If the commanded velocity is not zero, the servo motor exits the position lock state and accelerates to the current commanded velocity with an acceleration equivalent to P2-03.

Related parameters

Parameter	Instruction	Name	Value range	Defaults	Unit	Description
P5-40	PE	Motion condition timer	0 ~ 30000	10	ms	MS=0
P5-42	ZV	Zero speed threshold	0.1 ~ 2	0.5	rps	When the command speed is less than or equal to the zero-speed judgment threshold, the drive considers that it is in the zero-speed state at this time
P5-51	MS	Zero speed clamp function	0 ~ 1	0	-	

7.3.3 Rotation direction switch

In velocity control, direction of rotation can be selected via a digital input. When a digital input has been configured with the SPD-DIR function, the servo drive will use the magnitude of the commanded velocity and determine direction of motion based on the logic state of the SPD-DIR input.

SPD-DIR input signal configuration

The SPD-DIR signal can be configured as follows when assigned to a digital input:

Type	Signal name	Set value	Signal logic	Function
Input	SPD-DIR	35	Closed	When the input signal is valid, the direction of the speed command is reversed
			Open	The input signal is invalid, the rotation direction of the motor is determined by the direction of the speed command
		36	Open	When the input signal is valid, the direction of the speed command is reversed
			Closed	The input signal is invalid, the rotation direction of the motor is determined by the direction of the speed command
	GP	0	-	When all input pins of the driver are not configured with this function, the rotation direction of the motor is determined by the positive and negative of the command speed

Determined by parameter P1-11 motor rotation direction, speed command (communication command), and speed command direction switching SPD-DIR. The detailed relationship is shown in the table below.

◆ When all input pins of the driver are not configured with this function

Parameter P1-11 Motor	Speed command (Communication）	Speed command direction switching SPD-DIR input	Actual motor rotation direction
0	just	This input function is not set	CW Clockwise
0	just	This input function is not set	
0	burden	This input function is not set	CCW counterclockwise
0	burden	This input function is not set	
1	just	This input function is not set	CCW counterclockwise
1	just	This input function is not set	
1	burden	This input function is not set	CW Clockwise
1	burden	This input function is not set	

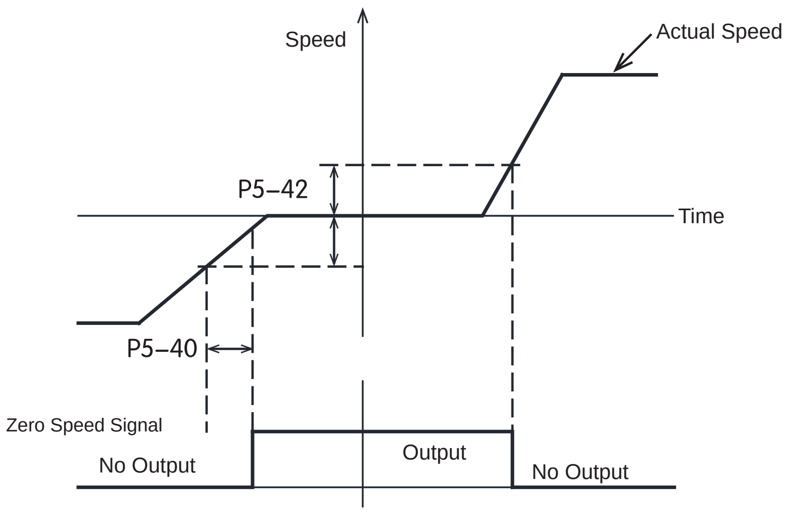
◆ When the drive input pin is configured as speed command direction switch **SPD-DIR**

Parameter P1-11 Motor rotation direction set value	Speed command (Communication command)	Speed command direction switching SPD-DIR input	Actual motor rotation direction
0	just	invalid	CW Clockwise
0	burden	invalid	
0	just	efficient	CCW counterclockwise
0	burden	efficient	
1	just	invalid	CCW counterclockwise
1	burden	invalid	
1	just	efficient	CW Clockwise
1	burden	efficient	

7.3.4 Zero speed output

When the absolute value of the actual speed of the motor is less than P5-42 (zero speed judgment threshold), and the duration reaches the set time of P5-40 , the servo drive outputs the zero-speed signal Z-SPD. If the absolute value of the actual speed of the motor is greater than P5-42, the zero-speed signal Z-SPD will not be output.

The zero speed output is not dependent on the control mode or the state of the servo motor. This allows users to use this output signal as notifier of ongoing motion at the motor.



◆ **Z-SPD output signal configuration**

When using Z-SPD, a digital output pin needs to be assigned this function.

Type	Signal name	Set value	Signal logic	Function
Output	Z-SPD	33	Closed	The Z-SPD judgment condition is satisfied, the Z-SPD signal is output, and the output state is closed
			Open	The Z-SPD judgment condition is not satisfied, the Z=SPD signal is not output, and the output state is open
		34	Open	The Z-SPD judgment condition is satisfied, the Z-SPD signal is output, and the output state is open
			Closed	The Z-SPD judgment condition is not satisfied, the Z-SPD signal is not output, and the output state is closed

Related parameters

Parameter	Instruction	Name	Value range	Defaults	Unit	Description
P5-40	PE	Motion condition timer	0 ~ 30000	10	ms	When the speed is less than or equal to the set value of P5-42, and the duration reaches the set time of P5-40, the drive considers that it is in the zero-speed state at this time
P5-42	ZV	Zero speed threshold range	0.1 ~ 2	0.5	rps	

7.3.5 Velocity reached output

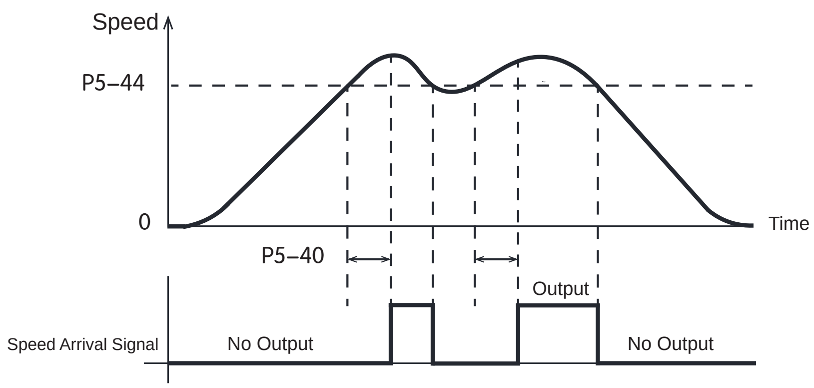
In velocity control mode mode, when the absolute value of the actual motor speed exceeds P5-44 (Velocity Reached - Minimum threshold threshold), for the duration of time specified in P5-40 P5-40, the velocity reached signal AT-SPD will be output.

If the actual speed of the motor after filtering does not exceed P5-44, the velocity reached signal AT-SPD will not be output.

◆ AT-SPD output signal configuration

When using the velocity reached output AT-SPD, a digital output pin needs to be assigned this function.

Type	Signal name	Set value	Signal logic	Function
Output	AT-SPD	19	Closed	The AT-SPD judgment condition is satisfied, the output signal is output, and the output state is closed
			Open	The AT-SPD judgment condition is not established, no signal is output, and the output state is open
		20	Open	The AT-SPD judgment condition is satisfied, the output signal is output, and the output state is open
			Closed	The AT-SPD judgment condition is not established, no signal is output, and the output state is closed



Related parameters

Parameter	Instruction	Name	Value range	Defaults	Unit	Description
P5-40	PE	Motion condition timer	0 ~ 30000	10	ms	When the absolute value of the actual speed of the motor exceeds P5-44 and the time reaches P5-40, it will output the speed reaching signal AT-SPD
P5-44	VV	Velocity Reached - Minimum threshold	0 ~ 100	10	rps	

7.3.6 Velocity consistent output

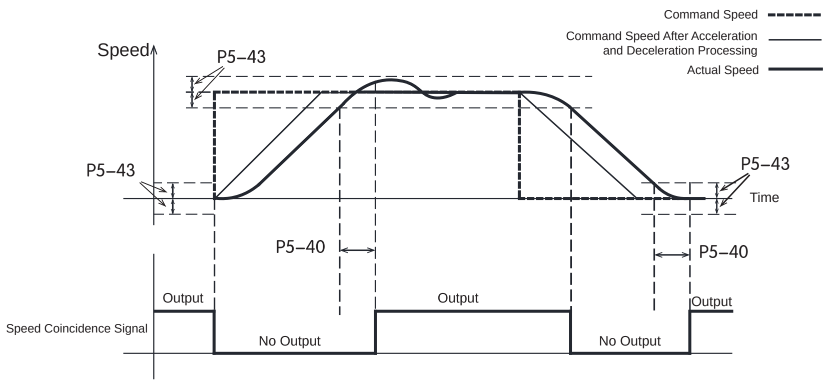
In velocity control mode, when the fluctuation of the actual velocity from the commanded velocity is within the margins set by P5-43, for the duration of time specified by P5-40, then it is determined that the actual speed of the motor is consistent with the commanded velocity and the velocity consistent signal, V-COIN, is output.

If the actual velocity falls outside of P5-43, the speed consistent signal V-COIN will not be output.

◆ **V-COIN output signal configuration**

When using the speed consistent output V-COIN, the digital output pin needs to be assigned this function.

Type	Signal name	Set value	Signal logic	Function
Output	V-COIN	17	Closed	V-COIN judgment condition is established, output signal, output state is closed
			Open	The V-COIN judgment condition is not established, no signal is output, and the output state is open
		18	Open	V-COIN judgment condition is established, output signal, output state is open
			Closed	If the judgment condition is not established, no signal is output, and the output state is closed



Related parameters

Parameter	Instruction	Name	Value range	Defaults	Unit	Description
P5-40	PE	Motion condition timer	0 ~ 32000	10	ms	If the speed error is within the setting of P5-43, and the duration reaches P5-40, it is determined that the actual speed of the motor is consistent with the command speed, and the speed consistent signal V-COIN will be output.
P5-43	VR	Velocity Reached - Permissible fluctuation range	0.1 ~ 100	0.2	rps	

7.3.7 Velocity control Mode methods

In velocity control mode, there are two control types:

1. Position over time

2. Speed control only (default setting)

Related parameters

Parameter	Instruction	Name	Value range	Defaults	Unit	Describe
P1-03	JM	Velocity control method	1，2	2	-	Set the control type in speed mode 1. Position over time 2. Speed control only (default setting)
P0-12	VP	Speed loop proportional	0 ~ 30000	183	0.1Hz	In the set speed mode, when P-15(JM) is 2, the speed loop proportional coefficient
P0-13	VI	Speed loop integral tim	0 ~ 30000	189	ms	In the set speed mode, when P-15(JM) is 2, the speed loop integral coefficient

A) P1-03 = 1, the position error is detected in real time.

Under this control type, the position error will be detected in real time. When the absolute value of the difference between the actual position fed back by the encoder and the command position, that is, the position error exceeds P3-04 (position error alarm limit), The drive will generate a fault alarm that the position error exceeds the limit.

B) P1-03 = 2, speed control only

Under this control type, no position error is detected, and no alarm will be generated even if the motor is locked. In this control mode, the speed loop gain parameter is set by P0-12 speed loop proportional gain and P0-13 speed loop integral time.

7.4 Torque control mode

7.4.1 Commanded torque control

Torque control mode is used for precise torque control. MBDV servo drives support command torque mode. Command torque mode uses communication commands to control the motor.

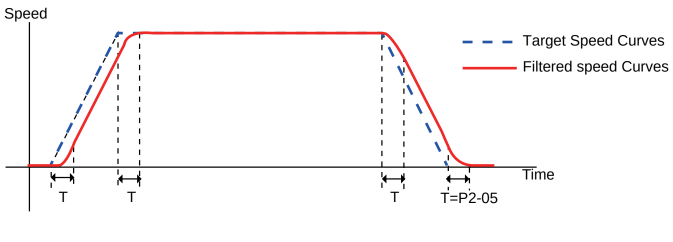
Model	Control signal	P1-00(CM) definition	Description
Command torque mode	communication command	1	Using Modbus command

7.4.2 Torque command filter

Filtering is performed on torque commands to ensure changes in torque output are gradual and thereby reduce mechanical vibrations in the system.

◆ Jerk time

Parameter P2-05 jerk time takes effect in internal trajectory modes (position, speed, torque) and communication based control mode. The effect of jerk smoothing on the input command is shown in the figure below.



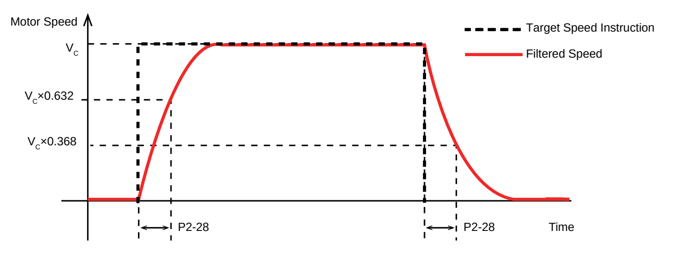
◆ Jerk time filter will produce a certain delay T for the instruction, but it will not affect the final positioning accuracy.

◆ The larger the P2-05 time constant, the more obvious the smoothing effect will be, and the delay of instruction response will increase, so users should set the appropriate filter time constant according to the application.

◆ Low pass filter

Parameter P2-28 low-pass filter can take effect in internal trajectory modes. (position, speed, torque), and communication based control mode.

The smoothing effect of the low-pass smoothing filter on the input command is shown in the figure below.



◆ Low-pass filtering will produce a certain delay T for the instruction pulse, but it will not affect the final positioning accuracy.

◆ The larger the time constant of P2-28, the more obvious the smoothing effect will be, and the delay of instruction response will be increased. Users should set the appropriate filter time constant according to the application.

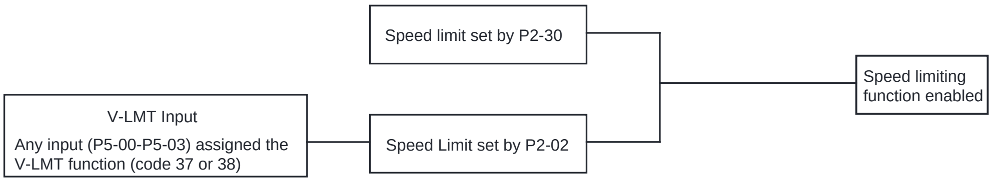
7.4.3 Speed limit in torque mode

It is recommended that users set the maximum speed of the motor prior to configuring the drive for torque control mode. The motor will run at this maximum set speed when it is used in torque control mode which, depending on the application, could cause damage to the load if left at a high value.

◆ In torque control mode, the set jog speed (P2-02) can be used as the speed limit for the motor. After the speed limiting function is enabled, the motor will accelerate and be limited to the set value.

The maximum speed setting should be based on application requirements. This limit can be configured in two ways. See the following:

Speed limit source	Describe
Internal Limits	1. Directly limited by parameter P2-30(VT) 2. Limited by parameter P2-02 (JS). To select this speed limit, a digital input must be assigned the velocity limit function (V-LMT). Once the desired input logic is satisfied, this speed limit will take effect.

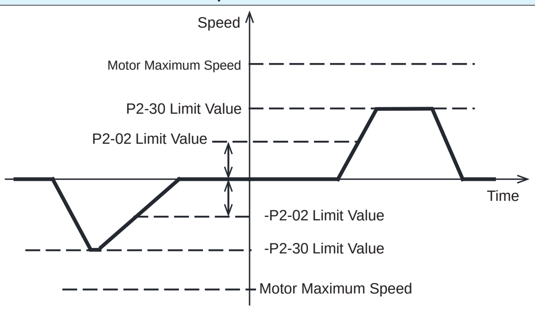
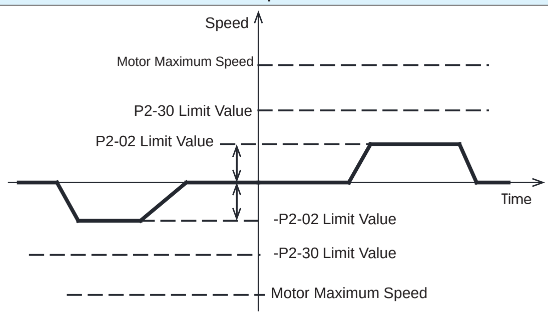


Related parameters

Parameter	Instruction	Name	Value range	Defaults	Unit	Describe
P2-02	JS	Jog Speed	-100 ~ 100	10	rps	In torque control, the jog speed can be used the speed limit of the motor. A digital input must be assigned the V-LMT function. Once the desired input logic is satisfied, V-LMT is enabled and the Jog Speed value behaves as the speed limit.
P2-03	JA	Jog Acceleration	0.167~ 5000	100	rps/s	Acceleration in torque mode
P2-04	JL	Jog Deceleration	0.167~ 5000	100	rps/s	Deceleration in torque mode
P2-30	VT	Speed limit in torque mode	0 ~ 100	80	rps	In torque control mode, this parameter can be used as the direct speed limit. No input is required to enable this speed limit. It will be enabled as soon as torque control mode is enabled at the drive.
P5-00- P5-03	MU1~MU4	Digital Input (X1-X4) function assignment	37 ~ 38	——	——	Assigning a value of 37 or 38 to an input (P5-00 - P5-03) will assign the V-LMT function to that input.
P5-12- P5-13	MO1~MO2	Digital Output (Y1-Y2) function assignment	21 ~ 22	——	——	Assigning a value of 21or 21 to an output (P5-12 - P5-13) will assign the "Velocity Limit Reached" function to that output.

◆ V-LMT function

When a digital input is assigned the V-LMT function, the drive will in essence have two speed limits when operating in Torque Control. The primary one is set by P2-30. However, once the desired V-LMT input logic is satisfied, the speed limit set by P2-02 will be enabled and will take higher priority than the limit set by P2-30.

V-LMT input is invalid	V-LMT input is valid
	

7.4.4 Output during speed limiting

In torque control mode, when the maximum speed limit is reached, an output signal will be output notifying the user. The following are the parameters of this signal:

Type	Signal name	Set value	Signal logic	Function
Output	V-LMT	21	Closed	The output speed of the motor is limited, the output signal, the output state is closed
			Open	The output speed of the motor is not limited, no signal is output, and the output state is open
		22	Open	The output speed of the motor is limited, the output signal, the output state is open
			Closed	The output speed of the motor is not limited, no signal is output, and the output state is closed

Note: Please refer to 7.1.2 Output signal setting

7.4.5 Torque reaches output

When operating in torque control, if the absolute value of the actual torque reaches the target torque (P1-07), remains within the permissible fluctuation range (P5-45) for the amount of time specified by P5-40, the Torque Reached output signal (TQ-REACH) will be output.

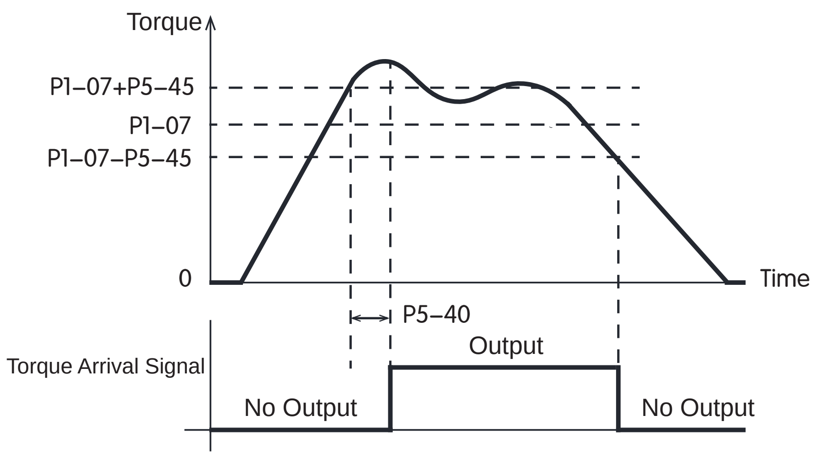
If any of the above conditions is not satisfied, the TQ-REACH signal will not be output.

TQ-REACH is applicable in all supported control modes (Torque, Velocity, Position etc.)

◆ **Setting of torque arrival signal TQ-REACH**

When using the torque arrival signal TQ-REACH, a digital output pin needs to be assigned this function.

Type	Signal name	Set value	Signal logic	Function
Output	TQ-REACH	13	Closed	TQ-REACH conditions satisfied, the signal is output and the state of the output is closed.
			Open	TQ-REACH conditions not satisfied, the signal is not output and the state of the output is open.
		14	Open	TQ-REACH conditions satisfied, the signal is output and the state of the output is open.
			Closed	TQ-REACH conditions not satisfied, the signal is not output and the state of the output is closed.



Related Parameters

Parameter	Instruction	Name	Value range	Defaults	Unit	Description
P1-07	CV	Target torque	0~3000	0	0.1%	When operating in torque control, if the absolute value of the actual torque reaches the target torque threshold (P1-07), remains within the permissible fluctuation range (P5-45) for the amount of time specified by P5-40, the Torque Reached output signal (TQ-REACH) will be output.
P5-40	PE	Motion condition timer	0 ~ 30000	10	ms	
P5-45	TV	Permissible torque fluctuation range	0~3000	10	0.1%	

7.4.6 Torque consistent output

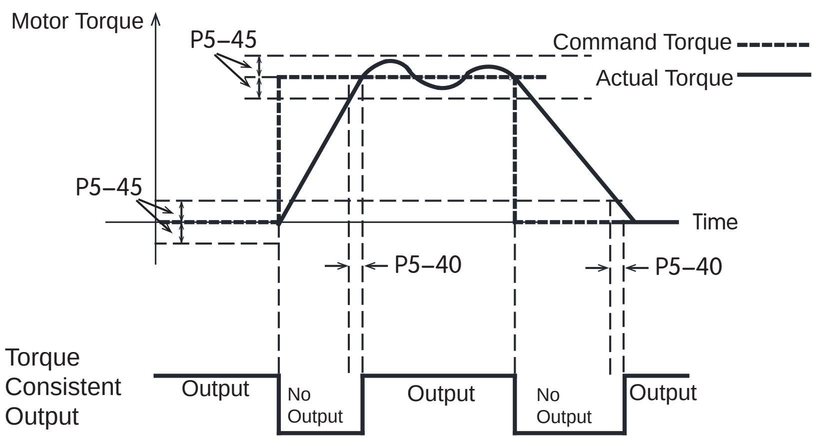
When fluctuations of the actual torque from the target torque are within P5-45 for the duration specified by P5-40, the actual torque is considered consistent with the target torque. The I-COIN signal is output to notify users of this.

If the torque fluctuation exceeds P5-45, the torque consistent signal I-COIN will not be output.

◆ Setting of torque coincidence signal **I-COIN**

When using the torque consistent output, I-COIN, the digital output pin needs to be assigned this function.

Type	Signal name	Set value	Signal logic	Function
output	I-COIN	35	Closed	I-COIN conditions satisfied, signal is output, output state is closed
			Open	I-COIN conditions not satisfied, signal is not output, output state is open
		36	Open	I-COIN conditions satisfied, signal is output, output state is open
			Closed	I-COIN conditions not satisfied, signal is not output, output state is closed



Related parameters

Parameter	Instruction	Name	Value range	Defaults	Unit	Description
P5-40	PE	Motion condition timer	0 ~ 30000	10	ms	When fluctuations of the actual torque from the target torque are within P5-45 for the duration specified by P5-40, the actual torque is considered consistent with the target torque. The I-COIN signal is output to notify users of this.
P5-45	TV	Permissible torque fluctuation range	0 ~ 3000	10	0.1%	

7.5 Torque limit

Torque limit is to limit the output torque of the servo motor. This function is applicable in all control modes, such as position, speed, torque, etc.

◆ method of torque limitation

Parameter P1-10 defines 5 kinds of torque limit methods, each limit method is as follows.

P1-10 Torque limit method setting	Positive torque limit source	Reverse torque limit source
0	Register Y	Register Z
1	Parameter P1-06	
2	Parameter P1-06	Parameter P1-25
3	TQ-LMT input is valid: P1-06	
	TQ-LMT input is invalid: P1-25	
5	TQ-LMT input is valid: P1-06	TQ-LMT input is valid: P1-25
	TQ-LMT input is invalid: P1-26	TQ-LMT input is invalid: P1-27

Related parameters

Parameter	Instruction	Name	Value range	Defaults	Unit	Description
P1-10	LD	Torque Limit Method	0 ~ 3，5	1	-	Torque limit method setting, please refer to the above description for details
P1-06	CC	first torque limit	0~3000	3000	0.1%	First torque limit of the motor
P1-25	CX	Second torque limit	0~3000	3000	0.1%	Second torque limit for motor
P1-26	CY	Third torque limit	0~3000	3000	0.1%	Third torque limit for motor
P1-27	CZ	Fourth torque limit	0~3000	3000	0.1%	Fourth torque limit for motor

7.5.1 Torque Limiting Methods

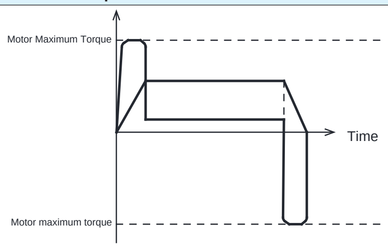
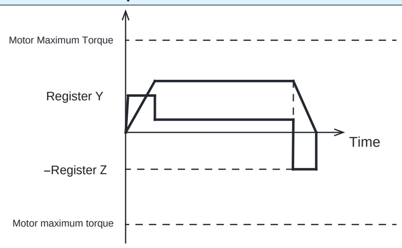
7.5.1.1 Register based torque limits --- effective immediately

When P1-10 = 0, the forward torque limit is determined by Register Y, and the reverse torque limit is determined by parameter Register Z.

Related parameters

Parameter	Modbus address	Value range	Defaults	Unit	Description
Register Y	40065	0~3000	0	0.1%	Forward torque limit for the motor, effective immediately
Register Z	40066	0~3000	0	0.1%	Reverse torque limit for the motor, effective immediately

Note: If torque limits are set too low, there may be insufficient torque available for acceleration and deceleration.

Torque Limits Disabled	Torque Limits Enabled
	
Without torque limits, the motor can reach its maximum output torque.	When torque limits are active and P1-10 = 0, the forward and reverse torque limits of the motor are set by Register Y and Register Z.

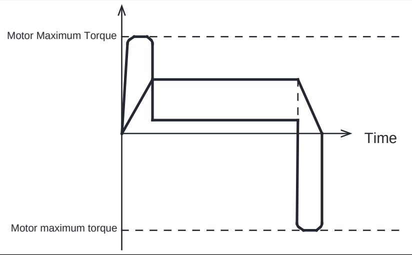
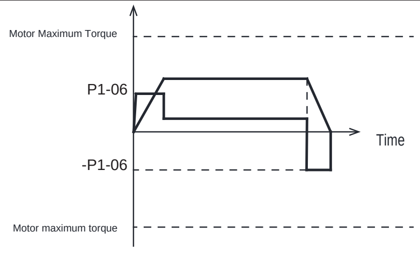
7.5.1.2 Parameter based torque limits (same limit value for forward and reverse directions)

When P1-10 = When 1, the forward and reverse torque limits are determined by parameter P1-06.

Related parameters

Parameter	Instruction	Name	Value range	Defaults	Unit	Description
P1-06	CC	First torque limit	0~3000	3000	0.1%	First torque limit of the motor

Note: If torque limits are set too low, there may be insufficient torque available for acceleration and deceleration.

<table>
<tr><th>Torque limits disabled</th><th>Torque limits enabled</th></tr>
<tr><td>
</td><td>
</td></tr>
<tr><td>Without torque limits, the motor can reach its maximum output torque.</td><td>When P1-10 = 1, both the forward and reverse torque limits are set by P1-06..</td></tr>
</table>

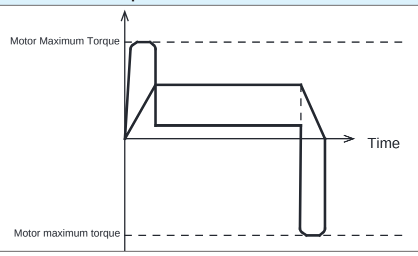
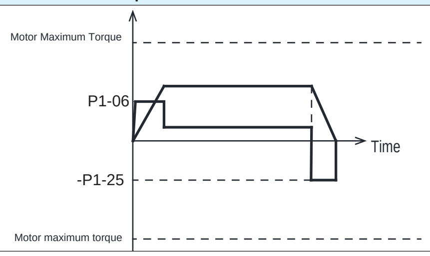
7.5.1.3 Forward and reverse torques are limited by different parameters

When P1-10 = 2, the forward torque limit is determined by parameter P1-06, and the reverse torque limit is determined by parameter P1-25.

Related parameters

Parameter	Instruction	Name	Value range	Defaults	Unit	Description
P1-06	CC	First torque limit	0~3000	3000	0.1%	First torque limit of the motor
P1-25	CX	Second torque limit	0~3000	3000	0.1%	Second torque limit for motor

Note: If torque limits are set too low, there may be insufficient torque available for acceleration and deceleration.

<table>
<tr><th>Torque limits disabled</th><th>Torque limits enabled</th></tr>
<tr><td>
</td><td>
</td></tr>
<tr><td>Without torque limits, the motor can reach its maximum output torque.</td><td>When P1-10 = 2. the forward torque limit is set by P1-06 and the reverse torque limit is set by P1-25.</td></tr>
</table>

7.5.1.4 Torque limiting via TQ-LMT input (same limit value for forward and reverse directions)

When P1-10 =3, the forward and reverse torque limit is determined by the logic state of the torque limit input TQ-LMT.

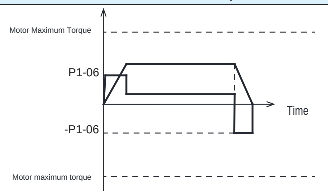
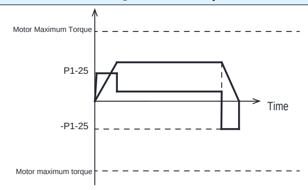
◆ Users will need to configure the logic of the TQ-LMIT input according to their application (normally open/ closed). However, when the primary TQ-LMT logic state is established (valid), forward and reverse torque limits are defined by P1-06. If the primary TQ-LMT logic state is not established (invalid), forward and reverse torque limits are defined by P1-25.

◆ Users will need to configure the logic of the TQ-LMIT input according to their application (normally open/ closed). However, when the primary TQ-LMT logic state is established (valid), forward and reverse torque limits are defined by P1-06. If the primary TQ-LMT logic state is not established (invalid), forward and reverse torque limits are defined by P1-25.

Related parameters

Parameter	Instruction	Name	Value range	Defaults	Unit	Description
P1-06	CC	First torque limit	0~3000	3000	0.1%	First torque limit of the motor
P1-25	CY	Second torque limit	0~3000	3000	0.1%	Second torque limit for motor

Note: If torque limits are set too low, there may be insufficient torque available for acceleration and deceleration.

TQ-LMT input valid	TQ-LMT input invalid
	
When P1-10 = 3 and the TQ-LMT input is valid, the forward and reverse torque limits are defined by P1-06.	When P1-10 = 3 and the TQ-LMT input is invalid, the forward and reverse torque limits are defined by P1-25.

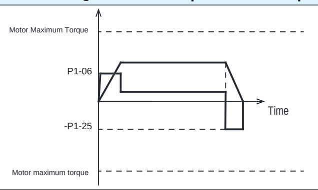
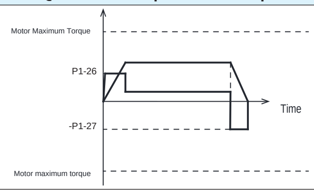
7.5.1.5 Torque limiting via TQ-LMT input (forward and reverse limits assigned differing values)

When P1-10=5, the forward and reverse torque limits are determined by the logic state of the TQ-LMT input. Users will need to configure the primary logic of the TQ-LMT beforehand (normally open/closed). Regardless of which logic they choose, when the TQ-LMT input is valid or invalid, based on the selected logic, the forward and reverse limits can be assigned different values from one another in each state of the TQ-LMT input. This means users will have 2 possible limits in the forward direction and 2 possible limits in the reverse direction.

Related parameters

Parameter	Instruction	Name	Value range	Defaults	Unit	Description
P1-06	CC	First torque limit	0~3000	3000	0.1%	First torque limit of the motor
P1-25	CX	Second torque limit	0~3000	3000	0.1%	Second torque limit for motor
P1-26	CY	Third torque limit	0~3000	3000	0.1%	Third torque limit for motor
P1-27	CZ	Fourth torque limit	0~3000	3000	0.1%	Fourth torque limit for motor

Note: If torque limits are set too low, there may be insufficient torque available for acceleration and deceleration.

TQ-LMT torque limit input valid	TQ-LMT torque limit input is invalid
	
When P1-10 = 5. The TQ-LMT torque limit input is invalid, the motor output forward torque is limited to the set value of P1-06, and the reverse torque is limited to the set value of P1-25.	When P1-10 = 5. The TQ-LMT torque limit input is valid, the motor output forward torque is limited to the set value of P1-26, and the reverse torque is limited to the set value of P1-27

7.5.2 Torque limit reached output

Related parameters

Type	Signal name	Set value	Signal logic	Function
Output	T-LMT	15	Closed	The torque limit is reached, the signal is output, the state of the output is closed.
			Open	The torque limit is not reached, the signal is not output, the state of the output is open.
		16	Open	The torque limit is reached, the signal is output, the state of the output is open.
			Closed	The torque limit is not reached, the signal is not output, the state of the output is closed.

Note: Please refer to 7.1.2 Output signal configuration

7.6 Encoder feedback output function

The encoder feedback is output in the form of A/B/Z differential signals. A/B/Z output signals and the frequency division ratio that affects the output frequency of the encoder feedback can be configured via parameters.

Related parameters

Parameter	Instruction	Name	Value range	Defaults	Description
P3-12	PO	Encoder feedback output mode	0 ~ 256	1	Pulse frequency division output setting
P3-13	ON	Pulse output gear ratio - numerator	0 ~ 65535	10000	Set the numerator of the pulse frequency division output ratio
P3-14	OD	Pulse output gear ratio - denominator	0 ~ 65535	65535	Set the denominator of the pulse frequency division output ratio

7.6.1 Pulse frequency division output signal pin

Encoder Output-pin number	Signal name	Description	Wiring
1	AOUT+	The encoder feedback is output in the form of A/B/Z differential signals. The number of pulses per revolution and the frequency division ratio that affects the output frequency of the encoder feedback can be set via parameters.	Refer to chapter 4.10.4 Encoder feedback output
2	AOUT-		
3	BOUT+		
4	BOUT-		
5	ZOUT+		
6	ZOUT-		

Note:

1. The output circuit is line driver type and the signals are 5V differential. To accept these differential signals, users will need to use a differential receiver. If this is not possible, then users will need to use a differential-to single-ended signal converter. Do not connect the OUT+ or OUT- to a power supply.

2. For reliable noise immunity, the cable harness used to transmit the encoder signals should be shielded, twisted pair wires. The shield cable should be connected to the PE port and the digital digital ground (DGND) connected to the digital ground of the computer.

3. Output signals are 5V differential. The maximum allowable current for each output pin is 20 mA.

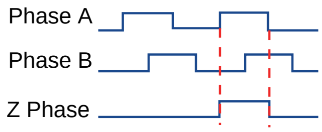
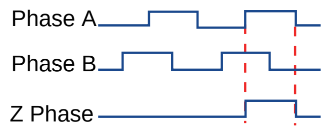
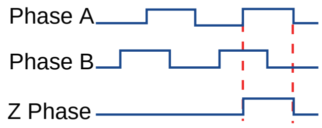
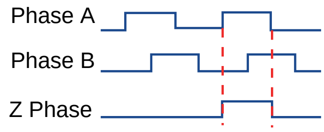
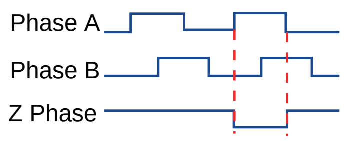
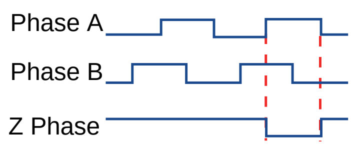
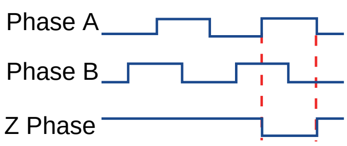
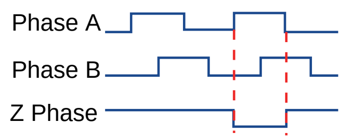
7.6.2 Pulse frequency division output mode setting

When using the encoder feedback output function, its important that users configure the sequence of output phases (A-leads-B or B-leads-A), the polarity of the Z index output and the frequency division ratio (both numerator and denominator set individually). The frequency division ratio impacts the pulses per revolution output by the drive.

Use parameter P3-12 to set the output pulse source, output pulse phase, and Z pulse output polarity type. The functions corresponding to each bit are as follows.

Parameter P3-12 Pulse frequency division output mode							
bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
0	0	0	0	Z pulse output polarity	A and B phase relationship during forward rotation	output pulse source	
				0: positive polarity	0: A leads B 90 °	bit1=0, bit0=1: Motor encoder	
				1: Negative polarity	1: B leads A 90 °		

7.6.2.1 Encoder feedback output settings

Z Pulse Polarity	A/B phase relationship	Source of feedback	Direction of Motion (Forward)	Direction of motion (reverse)	P3-12 set value
bit3	bit2	bit1=0，bit0=1			
0	0	Motor encoder			1
0	1	Motor encoder			5
1	0	Motor encoder			9
1	1	Motor encoder			13

7.6.3 Pulse output gear ratio

The number of pulses output from the MBDV drive per motor revolution can be configured by parameters P3-13 and P3-14.

$$\text{Number of output pulses per revolution} = \frac{\text{P3-13 Pulse output gear ratio - numerator}}{\text{P3-14 Pulse output gear ratio - denominator}} \times 65535$$

Note: The number of output pulses per revolution refers to the frequency multiplied by **4 of the A/B** phase

Related parameters

Parameter	Instruction	Name	Value range	Defaults	Description
P3-13	ON	Pulse output gear ratio - numerator	0 ~ 65535	10000	Sets the numerator of the pulse output gear ratio
P3-14	OD	Pulse output gear ratio - denominator	0 ~ 65535	65535	Sets the denominator of the pulse output gear ratio

Note:

1). The numerator P3-13 must be less than the denominator P3-14

2). When P3-13 > P3-14, the number of pulses output per motor revolution (post quadrature) = P3-13

Example:

The following are different ways to attain a output pulse resolution of 1000 pulses per revolution of the motor. Pulses per revolution are taken post quadrature.

1). If A/B is counted at the same time, and the frequency is multiplied by 4:

P3-13 = 1000

P3-14 = 65535 or P3-14 = 1

2). If A/B are counted at the same time, and only the rising edge or falling edge is counted when counting

Then: P3-13 = 2000

P3-14 = 65535 or P3-14 = 1

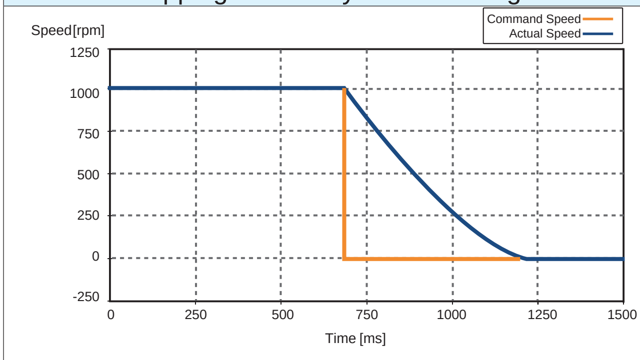
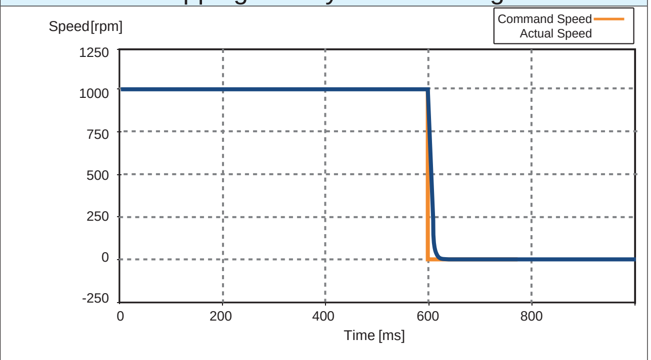
3). If only the A -phase output is counted, and only the rising edge or falling edge is counted when counting

Then: P3-13 = 4000

P3-14 = 65535 or P3-14 = 1

7.7 Dynamic braking

Dynamic braking can be used when a fault occurs at the motor or at the drive.. Dynamic braking is implemented by short circuiting the U/V/W phases of the motor. This brings the motor to a stop at the highest deceleration rate and is meant to protect personnel and equipment.

Stopping without dynamic braking	Stopping with dynamic braking
	
In this scenario, the driver exhibits a fault and is disabled. This results in the motor coming to an uncontrolled deceleration that is influenced purely by external factors such as the speed of the motor before fault, inertia of the system and the friction present in the system.	In this scenario, the driver exhibits a fault and the driver is disabled. The phases (U/V/W) of the servo motor are shorted and the current generated by the back EMF of the motor windings is used to stop the motor. This greatly reduces deceleration time and protects personnel as well as equipment.

Note:

1. Dynamic Braking with Quick Stop
    - Do not start and stop the motor through the servo enable /off function.
2. Dynamic braking is only suitable for short-term use, and it is only used in the case of abnormal servo OFF, drive error, etc.
    - After the dynamic brake is used to stop at high speed, it can be used again after an interval of 10 minutes.
3. Dynamic Braking function disabled in case of drive power loss

Related parameters

Parameter	Instruction	Name	Value range	Defaults	Unit	Description
P1-29	YV	The action of the dynamic brake when it is disabled	0 ~ 5	0	-	Dynamic braking sequence when drive receives Servo Off signal
P1-30	YR	The action of the dynamic brake when an error is reported	0 ~ 3	0	-	Dynamic braking sequence when fault occurs at the drive.
P1-31	YM	The maximum action time of the dynamic brake during the deceleration process of the deactivation	0 ~ 30000	500	ms	Maximum time of dynamic braking when drive receives Servo Off signal.
P1-32	YN	The longest action time of the dynamic brake during the deceleration process of the error	0 ~ 30000	0	ms	Maximum time of dynamic braking when a fault occurs at the drive.
P1-37	DV	Dynamic braking action speed	0 ~100	50	rps	Maximum motor velocity at which dynamic braking will be activated.
P5-42	ZV	Zero speed judgment threshold	0.1 ~ 2	0.5	rps	When the speed is less than or equal to this set value, the drive considers that it is in the zero-speed state at this time

7.7.1 Dynamic braking when Servo Off signal triggered

Servo is OFF, the dynamic braking action is set by parameter P1-29, and the longest action time during deceleration is set by parameter P1-31, please refer to the table below. The deceleration process means that the actual speed of the motor decelerates from the speed of parameter P1-37 to within the zero-speed threshold of parameter P5-42, or the deceleration time reaches the set time of P1-31 when the dynamic braking takes effect.

Value	Description	
	Deceleration process	After stop
0	According to the setting of parameter P2-01	Remain in free spin
1	According to the setting of parameter P2-01	Dynamic braking
2	Free spin	Remain in free spin
3	Free spin	Dynamic braking
4	Dynamic braking	Remain in free spin
5	Dynamic braking	Dynamic braking

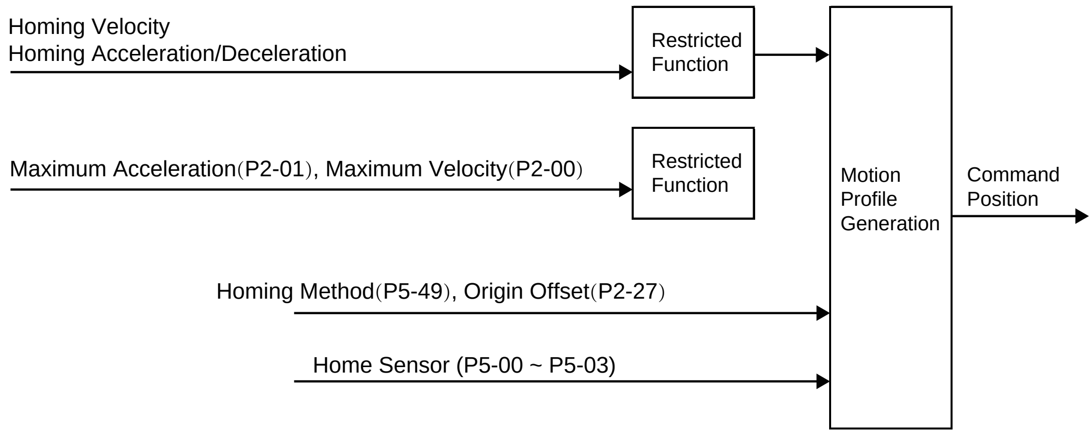
7.7.2 Dynamic braking when driver fault present

Servo reports an error, the dynamic braking action is set by parameter P1-30, and the longest action time in the deceleration process is set by P1-32, please refer to the table below. The deceleration process means that when the dynamic braking takes effect, the actual speed of the motor decelerates from the speed of parameter P1-37 to within the zero-speed threshold of parameter P5-42, or the deceleration time reaches the set time of P1-31.

Value	Description	
	Deceleration process	Stop
0	Free spin	Remain in free spin
1	Freespin	Dynamic braking
2	Dynamic braking	Remain in free spin
3	Dynamic braking	Dynamic braking

7.8 Home function

When the home function is executed, the drive generates a motion profile based on parameters such as homing acceleration, deceleration, velocity, the home position, and the home offset position. The MBDV supports up to 39 different homing modes.



There are three ways to enable homing:

◆ Digital input start (S-HOM)

Type	Signal name	Set value	Signal logic	Function
Input	S-HOM	15	Closed	The S-HOM function is enabled on the rising edge of the signal and starts to return to the origin
			Open	S-HOM function is not enabled
		16	Open	The S-HOM function is enabled on the falling edge of the signal and starts to return to the origin
			Closed	S-HOM function is not enabled

◆ Using the Q program command

◆ Using streamed commands (CANOpen or SCL)

Related Parameters

Parameter	Instruction	Name	Value range	Defaults	Unit	Description
P5-49	HE	Homing mode	-4 ~ 35	1	-	Choose a return to origin mode
P2-18	HA1	1st Homing acceleration/ deceleration	0.167 ~ 5000	100	rps/s	Set acceleration/deceleration during return to origin
P2-24	HV1	Homing Velocity 1	0.0042 ~ 100	10	rps	Set the first speed of the return to the origin.
P2-25	HV2	Homing Velocity 2	0.0042 ~ 100	1	rps	Set the first speed of the return to the origin.
P2-27	HO	Home offset	-2147483647 ~ +2147483647	0	pulses	Sets the offset position after the origin is found when returning to the origin
P2-00	VM	Maximum speed	0 ~ 100	80	rps	Maximum speed limit, limiting motor speed in all control modes
P2-01	AM	Maximum Acceleration/ Deceleration	0.167 ~ 5000	3000	rps/s	maximum deceleration during emergency stop
P5-00 ~ P5-03	MU1 ~ MU4	Digital input port function	39 ~ 40	-	-	Set one of the numeric inputs X1~X4 as the origin sensor

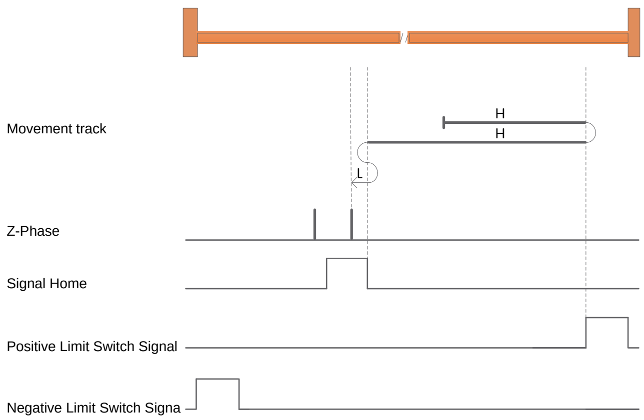
7.8.1 Back to the origin basic concept

Back-to-origin is used to find the mechanical origin and locate the positional relationship between the mechanical origin and the mechanical zero. Mechanical origin: a fixed position on the machine, which can be a certain sensor or the Z - phase signal of the motor. Mechanical zero point: the absolute 0 position on the machine.

After returning to the origin, the position where the motor stops are the machine origin. By setting the origin offset P2-27, the relationship between the machine origin and the machine zero can be set:

Mechanical origin = mechanical zero + P2-27

When P2-27=0, the mechanical origin coincides with the mechanical zero.



H: The first speed of returning to the origin P2-24

L: The first speed of returning to the origin P2-25

Origin switch signal: set digital input X1 ~ One of the inputs in X4 is the origin switch, HOM-SW=0 means the origin signal is invalid, HOM-SW=1 means the origin signal is valid.

Positive limit switch signal: set digital input X1 ~ One of the inputs in X4 is the positive limit switch, POT=0 means the positive limit signal is invalid, POT=1 means the positive limit signal is valid.

Negative limit switch signal: set digital input X1 ~ One of the inputs in X4 is the negative limit switch, NOT=0 means the negative limit signal is invalid, and NOT=1 means the negative limit signal is valid.

7.8.2 Introduction to the way of returning to the origin

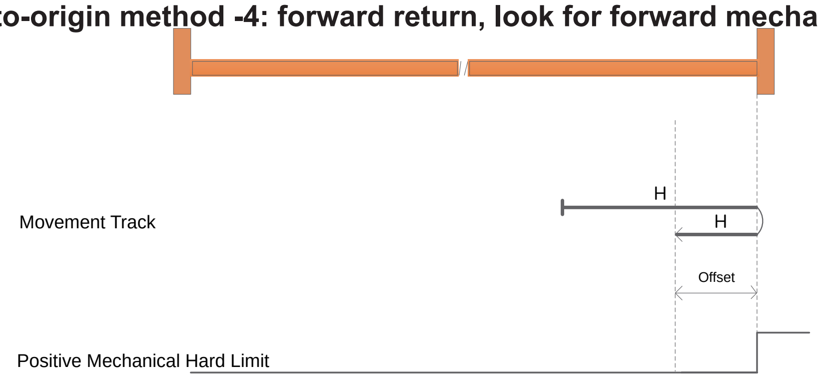
◆ **The back-to-origin mode** -4~-1 is the manufacturer-defined back-to-origin mode. The driver does not need an external switch signal as an auxiliary signal for back-to-origin, but limits the torque of the motor during the process of back-to-origin. When the mechanical hard limit is connected to the motor-driven When the load is contacted and blocked, the thrust generated by the motor-driven load is equal to the blocking force, and when the motor is stationary, the position is considered as the mechanical origin. The torque limit of the motor during the back-to-origin process is set through P0-08 (torque limit of the hard limit back-to-origin mode), 100% corresponds to 1 time the rated torque of the motor; set the value of this object according to the actual application, too small setting value may result in inaccurate return-to-origin position, and too large setting value may damage mechanical equipment.

Note: When using the back-to-origin method -4~-1, it is necessary to set a suitable back-to-origin offset P2-27, so that after finding the mechanical origin during the process of back-to-origin, the distance of the origin offset P2-27 is reversed, and the load is away from the mechanical hardware. Limit, the actual position after the motor stops is 0.

◆ The homing mode 1~35 is the homing mode defined according to the CiA402 motion control protocol.

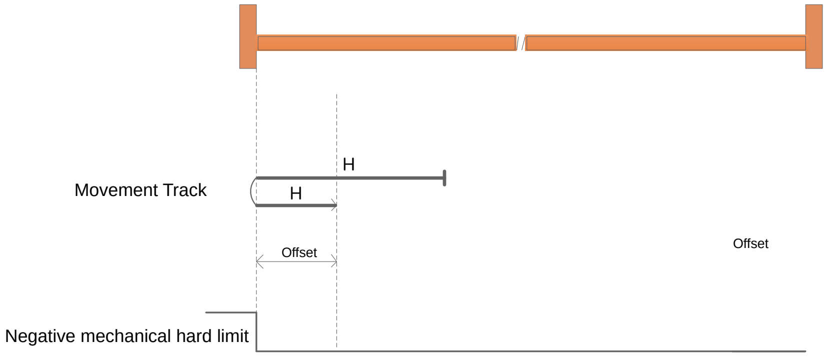
Note: When using the back-to-origin method 1~35, after the motor back-to-origin is completed, the actual position of the motor is the value of the origin offset P2-27.

7.8.2.1 Return-to-origin method -4: forward return, look for forward mechanical hard limit



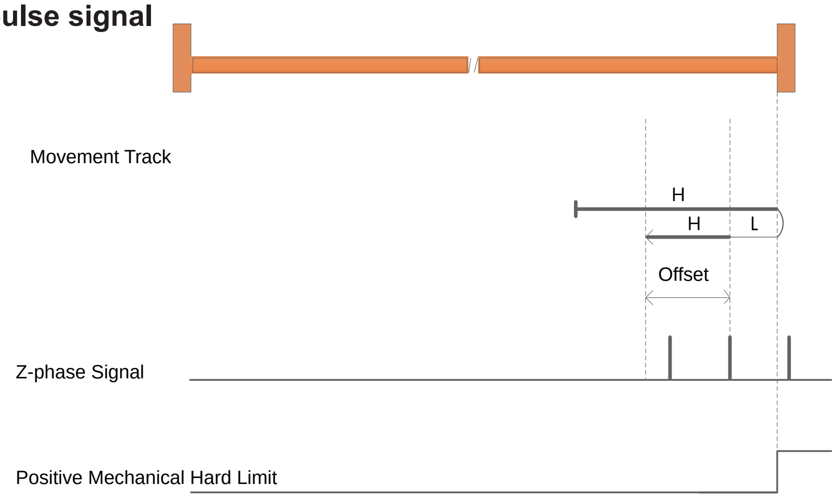
a) Start the return at positive high speed, decelerate to stop when the mechanical hard limit meets the torque equal to the blocking force and the motor limit, run at the negative high speed by the distance of the origin offset P2-27, and the position of the motor is 0 after stop.

7.8.2.2 Return-to-origin method -3: Negative return, looking for negative mechanical hard limit



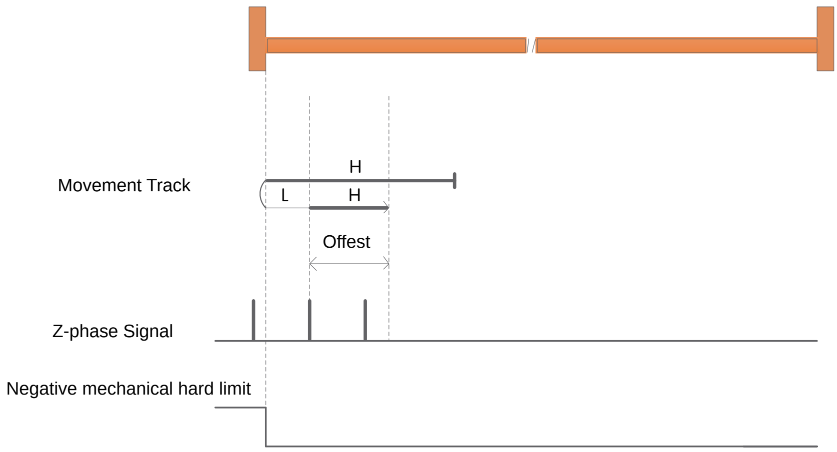
a) Start the return at a negative high speed, decelerate and stop when the mechanical hard limit meets the torque equal to the blocking force and the motor limit, run at a positive high speed by the distance of the origin offset P2-27, and the position of the motor is 0 after stopping.

7.8.2.3 Return-to-origin method -2: forward return, look for forward mechanical hard limit and Z -phase pulse signal



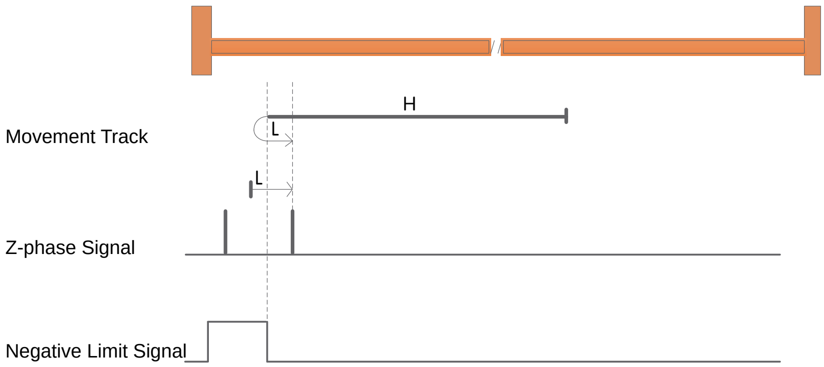
a) Start the return at a positive high speed, decelerate and stop when the mechanical hard limit meets the torque equal to the blocking force and the motor limit, run at a negative low speed, stop when encountering the first Z pulse, and run at a negative high-speed origin offset the distance of P2-27, the position of the motor after stop is 0.

7.8.2.4 Back-to-origin mode -1: Negative return, looking for negative mechanical hard limit and Z -phase pulse signal



a) Start the return at a negative high speed, decelerate and stop when the mechanical hard limit meets the torque limit of the blocking force and the motor limit, run at a positive low speed, stop at the first Z pulse, and run at a positive high-speed origin offset the distance of P2-27, the position of the motor after stop is 0.

7.8.2.5 Return to origin mode 1: Negative return, looking for negative limit and Z pulse signal

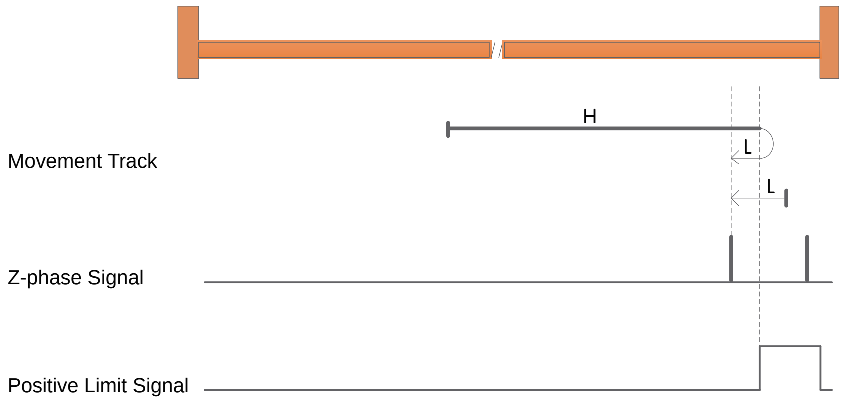


a) When starting the return, NOT=0, start the return at a high speed in the negative direction, after encountering the rising edge of NOT, decelerate, reverse, and run at a low speed in the forward direction.

The first Z pulse after the falling edge of NOT stops.

b) When starting the return, NOT=1, start the return at a forward low speed, and stop at the first Z pulse after encountering the falling edge of NOT.

7.8.2.6 Back-to-origin method 2: forward return, look for positive limit and Z pulse signal

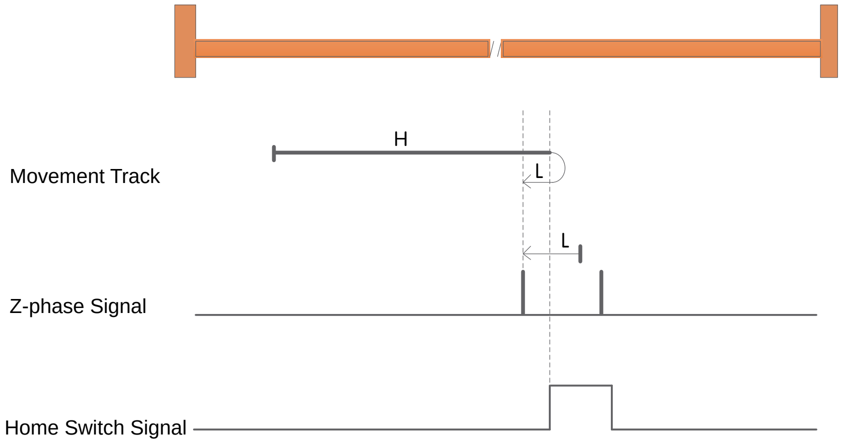


a) POT=0 when starting to return, start returning at high speed in positive direction, after encountering the rising edge of POT, decelerate, reverse, and run at low speed in negative direction.

The first Z pulse after the falling edge of POT stops.

b) When starting to return, POT=1, start to return at a negative low speed, and stop at the first Z pulse after encountering the falling edge of POT.

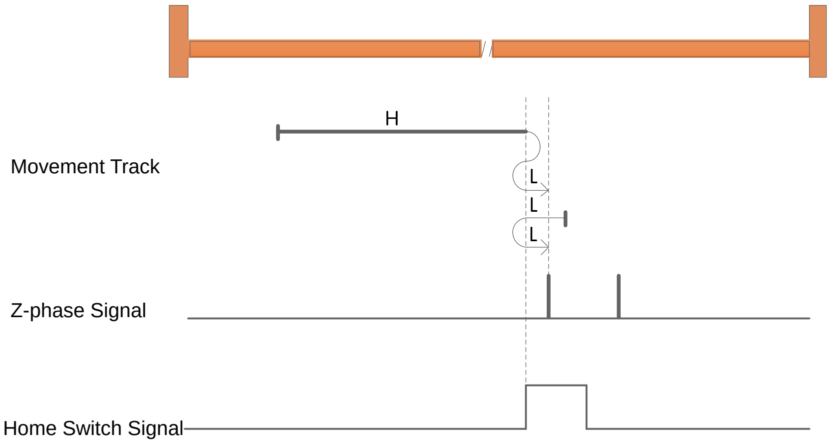
7.8.2.7 Back-to-origin method 3: forward return, look for the origin sensor falling edge and Z pulse signal



a) When starting to return, HOM-SW=0, start the return at high speed in the positive direction, after encountering the rising edge of HOM-SW, decelerate, reverse, and run at low speed in the negative direction, and stop at the first Z pulse after encountering the falling edge of HOM-SW.

b) When starting to return, HOM-SW=1, start the return at a negative low speed, and stop at the first Z pulse after encountering the falling edge of HOM-SW.

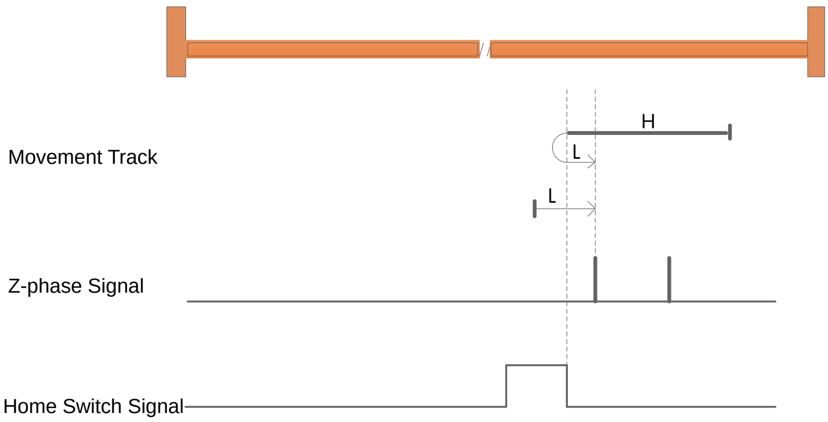
7.8.2.8 Return to origin mode 4: forward return, look for the rising edge of the origin sensor and the Z pulse signal



a) When starting to return, HOM-SW=0, start the return at high speed in positive direction, after encountering the rising edge of HOM-SW, decelerate, reverse, and run at low speed in negative direction to the position where HOM-SW is invalid, then decelerate to stop, and then move forward again Run at low speed and stop at the first Z pulse after encountering the rising edge of HW.

b) When starting to return, HOM-SW=1, start the return at low speed in negative direction, after encountering the falling edge of HOM-SW, decelerate, reverse, and run at low speed in the forward direction, and stop at the first Z pulse after encountering the rising edge of HOM-SW.

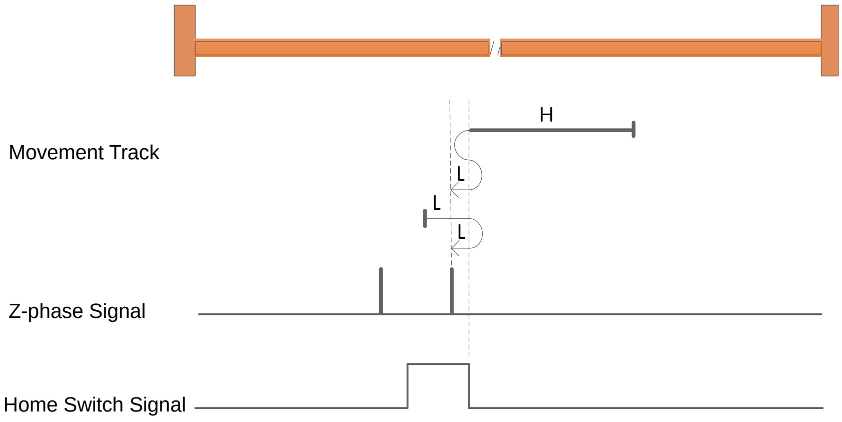
7.8.2.9 Return to origin mode 5: Negative return, look for the falling edge of the origin sensor and the Z pulse signal



a) When starting to return, HOM-SW=0, start returning at high speed in negative direction, after encountering the rising edge of HOM-SW, decelerate, reverse, and run at low speed in the forward direction, and stop at the first Z pulse after encountering the falling edge of HOM-SW.

b) When starting to return, HOM-SW=1, start the return at a forward low speed, and stop at the first Z pulse after encountering the falling edge of HOM-SW.

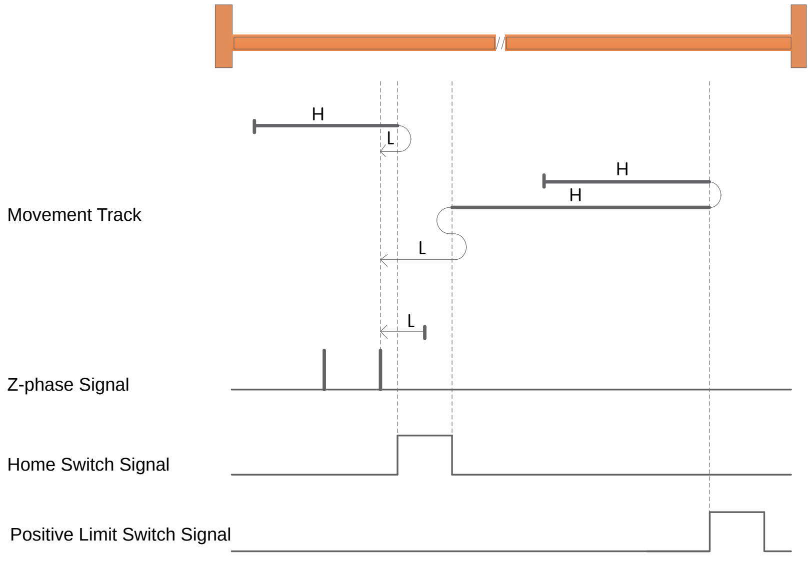
7.8.2.10 Return to origin mode 6: Negative return, look for the rising edge of the origin sensor and the Z pulse signal



a) When starting to return, HOM-SW=0, start the return at high speed in negative direction, after encountering the rising edge of HOM-SW, decelerate, reverse, and run at low speed in the forward direction to the position where HOM-SW is invalid, then decelerate and stop, and then go negative again Run at low speed and stop at the first Z pulse after encountering the rising edge of HW.

b) When starting to return, HOM-SW=1, start returning at low speed in positive direction, after encountering the falling edge of HOM-SW, decelerate, reverse, and run at low speed in negative direction, and stop at the first Z pulse after encountering the rising edge of HOM-SW.

7.8.2.11 Return to origin mode 7: forward return, look for the falling edge of the origin sensor and Z pulse signal, and automatically reverse when encountering the positive limit

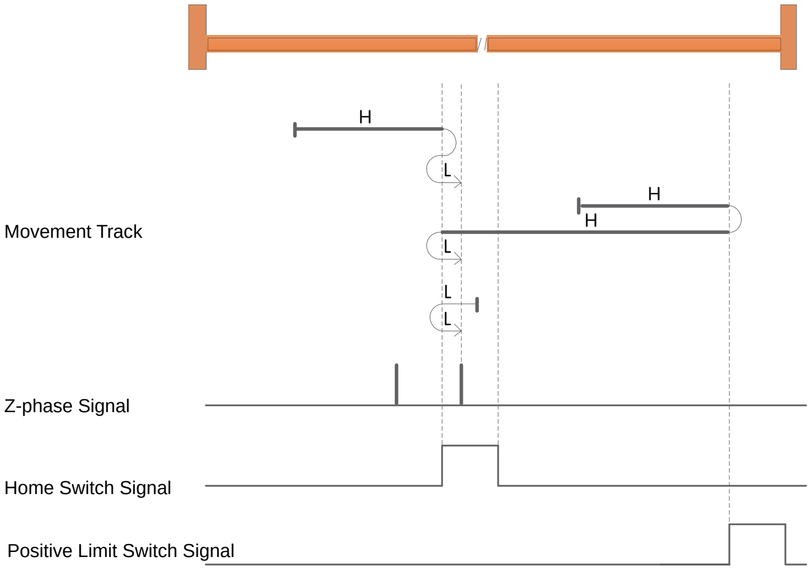


a) When starting to return, HOM - SW=0 and it is located on the negative side of the origin sensor position, and starts to return at a positive high speed. The first Z pulse after the falling edge of SW stops.

b) When starting to return, HOM -SW=0 and it is located on the positive side of the origin sensor, and starts to return at high speed in the positive direction. After encountering the rising edge of POT, decelerate, reverse, and run at high speed in the negative direction; After the rising edge, decelerate, reverse, forward and run at low speed to HOM-SW After the invalid position, it will decelerate and stop, and then run at a low speed in the negative direction, and stop at the first Z pulse after encountering the falling edge of HOM-SW.

c) When starting to return, HOM-SW=1, start the return at a negative low speed, and stop at the first Z pulse after encountering the falling edge of HOM-SW.

7.8.2.12 Return to origin mode 8: forward return, look for the rising edge of the origin sensor and Z pulse signal, and automatically reverse when encountering the positive limit



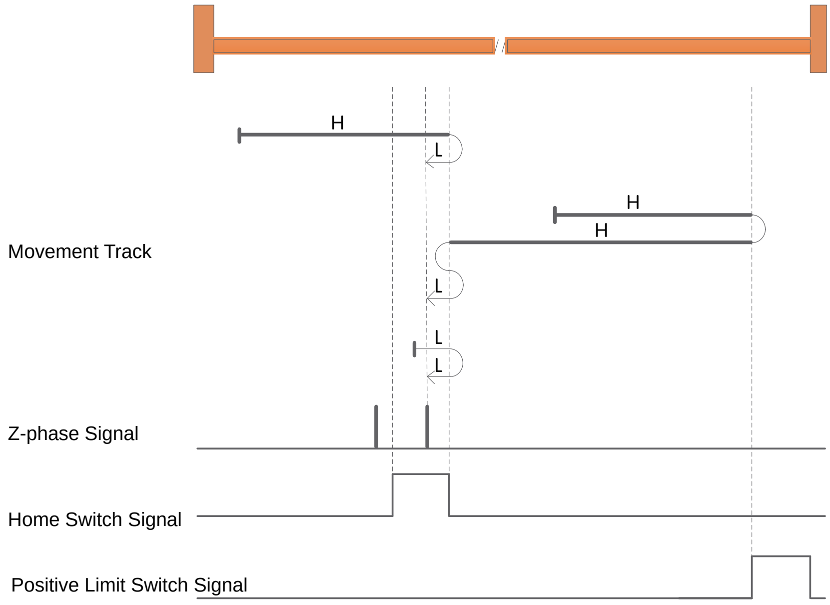
a) When starting to return, HOM-SW=0 and it is located on the negative side of the origin sensor position, and starts to return at high speed in the positive direction. After encountering the rising edge of HOM-SW, decelerate, reverse, and run at low speed in the negative direction until the HOM-SW is invalid. After the position, it decelerates to stop, and then runs forward at a low speed, and stops at the first Z pulse after the rising edge of HOM-SW.

b) When starting to return, HOM -SW=0 and it is located on the positive side of the origin sensor, and starts to return at high speed in the positive direction. After encountering the rising edge of POT, decelerate, reverse, and run at high speed in the negative direction; Decelerate after falling edge, reverse and forward at low speed, encounter HOM-

The first Z pulse after SW rises stops.

c) When starting to return, HOM-SW=1, start the return at low speed in negative direction, after encountering the falling edge of HOM-SW, decelerate, reverse, and run at low speed in the forward direction, and stop at the first Z pulse after encountering the rising edge of HOM-SW.

7.8.2.13 Return-to-origin method 9: forward return, look for the rising edge of the origin sensor and Z pulse signal, and automatically reverse when encountering the positive limit

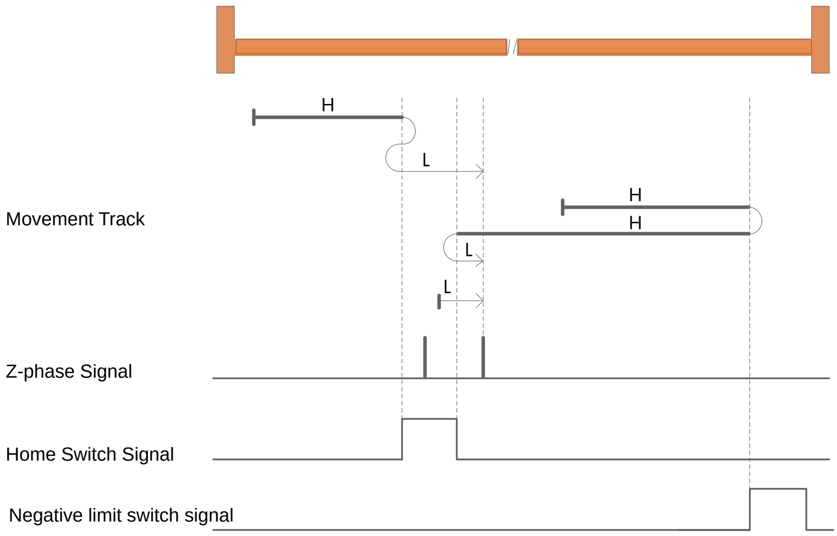


a) When starting to return, HOM-SW=0 and it is located on the negative side of the position of the origin sensor, start the return at a positive high speed, and encounter a drop in HOM-SW Decelerate after the edge, reverse, and run at low speed in the negative direction, and stop at the first Z pulse after the rising edge of HOM-SW.

b) When starting to return, HOM-SW=0 and it is located on the positive side of the position of the origin sensor, start the return at a positive high speed, and encounter the rising edge of POT Then, decelerate, reverse, and run at high speed in negative direction; after encountering the rising edge of HOM-SW, decelerate, reverse, and run at low speed in forward direction until HOM-SW is invalid. After the position, it decelerates to stop, and then runs at a low speed in the negative direction, and stops at the first Z pulse after encountering the rising edge of HOM-SW.

c) HOM-SW=1 when starting to return, start returning at low speed in positive direction, after encountering the falling edge of HOM-SW, decelerate, reverse, and run at low speed in negative direction, The first Z pulse after encountering the rising edge of HOM-SW stops.

7.8.2.14 Return to origin mode 10: Forward return, look for the falling edge of the origin sensor and Z pulse signal, and automatically reverse when encountering the positive limit



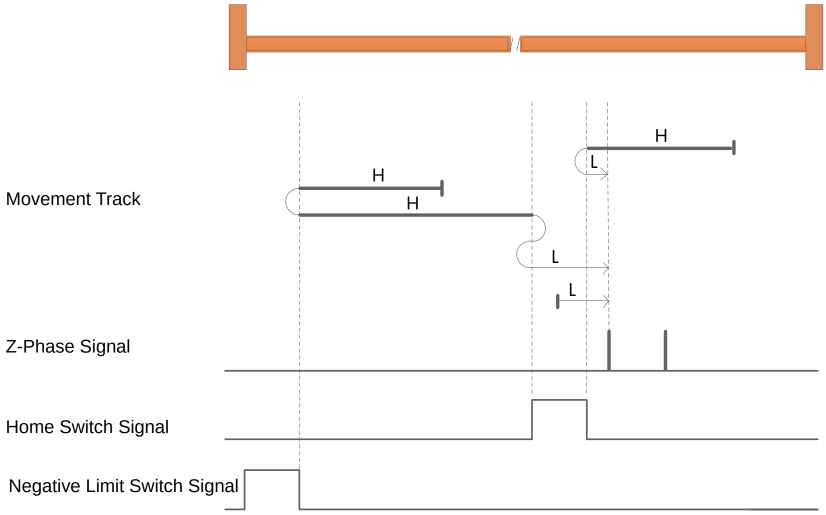
a) When starting to return, HOM-SW=0 and it is located on the negative side of the origin sensor position, start the return at a positive high speed, and encounter HOM-SW rising After the edge, decelerate, reverse, and run at a low speed in the negative direction to the position where HOM-SW is invalid, then decelerate to stop, and then run at a low speed in the positive direction.

The first Z pulse after the falling edge of SW stops.

b) When starting to return, HOM-SW=0 and it is located on the positive side of the position of the origin sensor, start the return at a positive high speed, and encounter the rising edge of POT Then, decelerate, reverse, and run at high speed in the negative direction; after encountering the rising edge of HOM-SW, decelerate, reverse, and run at low speed in the forward direction, and encounter the lower speed of HOM-SW. The first Z pulse after the falling edge stops.

c) When starting to return, HOM-SW=1, start the return at a forward low speed, and stop at the first Z pulse after encountering the falling edge of HOM-SW.

7.8.2.15 Return-to-origin method 11: Negative return, look for the falling edge of the origin sensor and Z pulse signal, and automatically reverse in case of negative limit

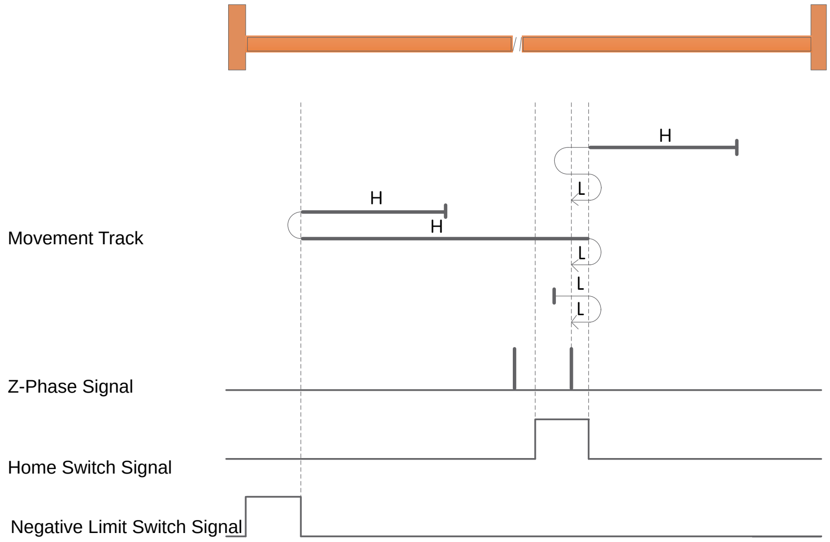


a) When starting to return, HOM-SW=0 and it is located on the positive side of the position of the origin sensor, and starts to return at a high speed in the negative direction. After encountering the rising edge of HOM-SW, Decelerate, reverse, and run at low speed in the forward direction, and stop at the first Z pulse after the falling edge of HOM-SW is encountered.

b) HOM-SW=0 when starting to return and it is on the negative side of the position of the origin sensor , start the return at a high speed in the negative direction , after encountering the rising edge of NOT , reduce Speed , reverse , and forward high-speed operation ; after encountering the rising edge of HOM-SW , decelerate , reverse , and negatively run at low speed to the position where HOM-SW is invalid, then reduce Stop at high speed , then run forward at low speed , and stop at the first Z pulse after encountering the falling edge of HOM-SW .

c) When starting to return, HOM-SW=1, start the return at a forward low speed, and stop at the first Z pulse after encountering the falling edge of HOM-SW.

7.8.2.16 Return-to-origin mode 12: Negative return, look for the rising edge of the origin sensor and Z pulse signal, and automatically reverse the direction of the negative limit



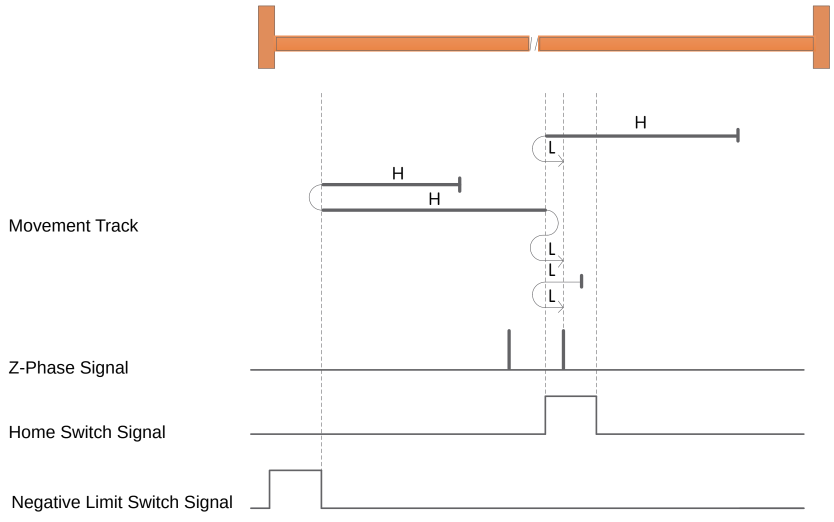
a) When starting to return, HOM-SW=0 and it is located on the positive side of the position of the origin sensor, and starts to return at a high speed in the negative direction. After encountering the rising edge of HOM-SW, Decelerate, reverse, and run at low speed in the forward direction to the position where HOM-SW is invalid, then decelerate to stop, and then run at low speed in the negative direction. After encountering the rising edge of HOM-SW the first Z pulse stops.

b) HOM-SW=0 when starting to return and it is on the negative side of the position of the origin sensor, start the return at a high speed in the negative direction, after encountering the rising edge of NOT, reduce Speed, reverse, forward high-speed operation; after encountering the falling edge of HOM-SW, decelerate, reverse, and run at low speed in negative direction, the first after encountering the rising edge of HOM-SW Z pulses stop.

c) When starting to return, HOM-SW=1, start the return at low speed in the positive direction, after encountering the falling edge of HOM-SW, decelerate, reverse, and run at low speed in the negative direction.

The first Z pulse after the rising edge of HOM-SW stops.

7.8.2.17 Return to origin mode 13: Negative return, look for the rising edge of the origin sensor and the Z pulse signal, and automatically reverse when the negative limit is encountered

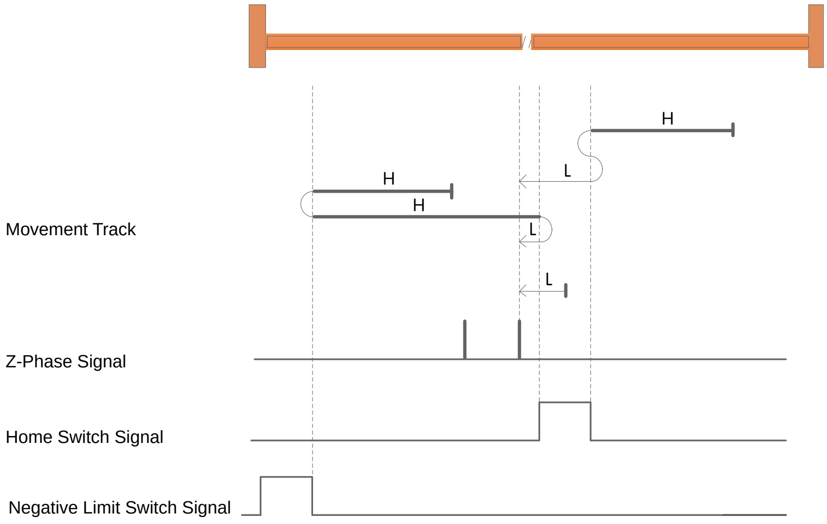


a) When starting to return, HOM-SW=0 and it is located on the positive side of the position of the origin sensor, and it starts to return at a high speed in the negative direction. When it encounters the lower part of HOM-SW After the falling edge, decelerate, reverse, and run at low speed in the forward direction, and stop at the first Z pulse after the rising edge of HOM-SW.

b) HOM-SW=0 when starting to return, and it is located on the negative side of the origin sensor position, and starts to return at a high speed in negative direction, and encounters the rising edge of NOT. Then, decelerate, reverse, and run at high speed in forward direction; after encountering the rising edge of HOM-SW, decelerate, reverse, and run at low speed in negative direction until HOM-SW is invalid. After the position, it decelerates and stops, and then runs forward at a low speed, and stops at the first Z pulse after the rising edge of HOM-SW.

c) HOM-SW=1 when starting to return, start returning at low speed in negative direction, after encountering the falling edge of HOM-SW, decelerate, reverse, and run at low speed in forward direction, The first Z pulse after encountering the rising edge of HOM-SW stops.

7.8.2.18 Return to origin mode 14: Negative return, look for the falling edge of the origin sensor and Z pulse signal, and automatically reverse when encountering the negative limit



a) When starting to return, HOM-SW=0 and it is located on the positive side of the position of the origin sensor. It starts to return at a high speed in the negative direction, and when the HOM-SW rises After the edge, decelerate, reverse, and run at low speed in the forward direction to the position where HOM -SW is invalid, then decelerate to stop, and then run at low speed in the negative direction.

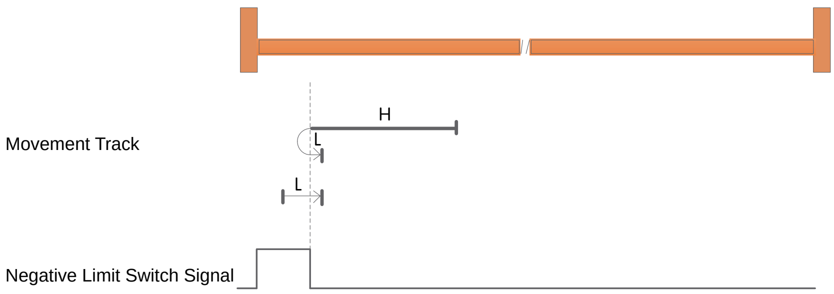
The first Z pulse after the falling edge of SW stops.

b) HOM-SW=0 when starting to return, and it is located on the negative side of the origin sensor position, and starts to return at a high speed in negative direction, and encounters the rising edge of NOT. Then, decelerate, reverse, and run at high speed in the forward direction; after encountering the rising edge of HOM-SW, decelerate, reverse, and run at low speed in the negative direction, and encounter the lower speed of HOM-SW. The first Z pulse after the falling edge stops.

c) When starting to return, HOM-SW=1, start the return at a negative low speed, and stop at the first Z pulse after encountering the falling edge of HOM-SW.

7.8.2.19 Return to origin mode 15, 16 reserved

7.8.2.20 Return to origin mode 17: Negative return, looking for negative limit signal

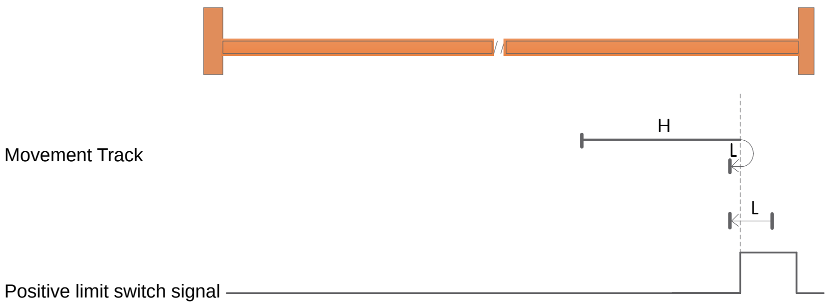


a) When starting the return, NOT=0, start the return at a high speed in the negative direction, after encountering the rising edge of NOT, decelerate, reverse, and run at a low speed in the forward direction.

Stop after falling edge of NOT.

b) When starting the return, NOT=1, start the return at a forward low speed, and stop after encountering the falling edge of NOT.

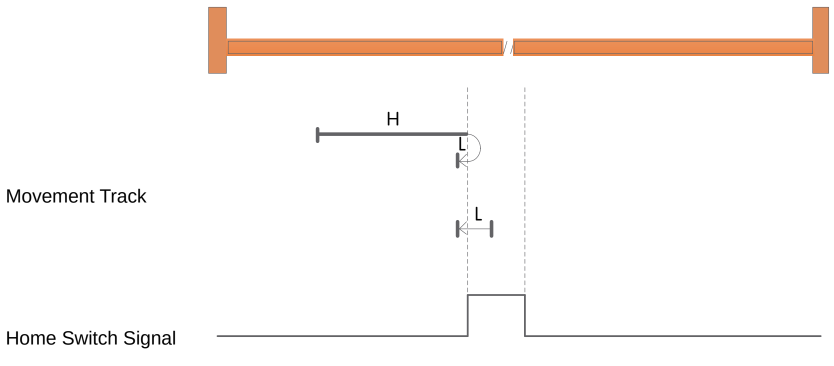
7.8.2.21 Return to origin mode 18: forward return, look for positive limit signal



a) POT=0 when starting to return, start returning at high speed in positive direction, after encountering the rising edge of POT, decelerate, reverse, and run at low speed in negative direction, when encountering POT down Stop after falling edge.

b) When starting to return, POT=1, start the return at low speed in negative direction, and stop after encountering the falling edge of POT.

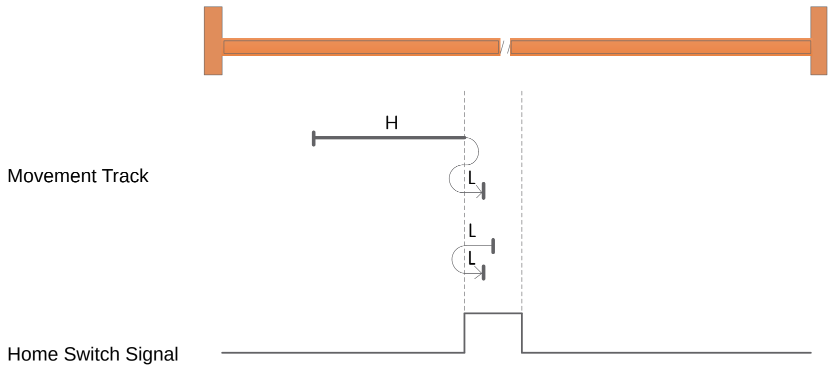
7.8.2.22 Return to origin mode 19: forward return, look for the origin sensor falling edge signal



a) When starting to return, HOM-SW=0, start returning at high speed in positive direction, after encountering the rising edge of HOM-SW, decelerate, reverse, and run at low speed in negative direction, and stop after encountering the falling edge of HOM-SW.

b) When starting to return, HOM-SW=1, start the return at low speed in negative direction, and stop after encountering the falling edge of HOM-SW.

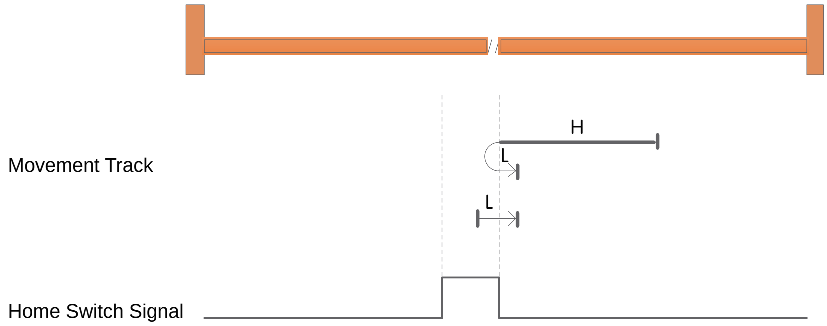
7.8.2.23 Return to origin mode 20: forward return, look for the rising edge signal of the origin sensor



a) When starting to return, HOM-SW=0, start returning at high speed in positive direction, after encountering the rising edge of HOM-SW, decelerate, reverse, and run at low speed in negative direction to the position where HOM-SW is invalid, then decelerate and stop, and then move forward again It runs at low speed and stops after encountering the rising edge of HOM-SW.

b) When starting to return, HOM-SW=1, start returning at low speed in negative direction, after encountering the falling edge of HOM-SW, decelerate, reverse, and run at low speed in the forward direction, and stop when encountering the rising edge of HOM-SW.

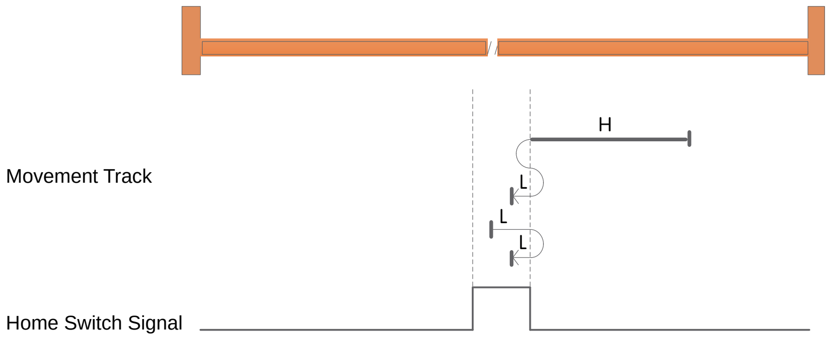
7.8.2.24 Return to origin mode 21: Negative return, look for the falling edge signal of the origin sensor



a) When starting to return, HOM-SW=0, start the return at high speed in negative direction, after encountering the rising edge of HOM-SW, decelerate, reverse, and run at low speed in the forward direction, and stop after encountering the falling edge of HOM-SW.

b) When starting to return, HOM-SW=1, start the return at a forward low speed, and stop after encountering the falling edge of HOM-SW.

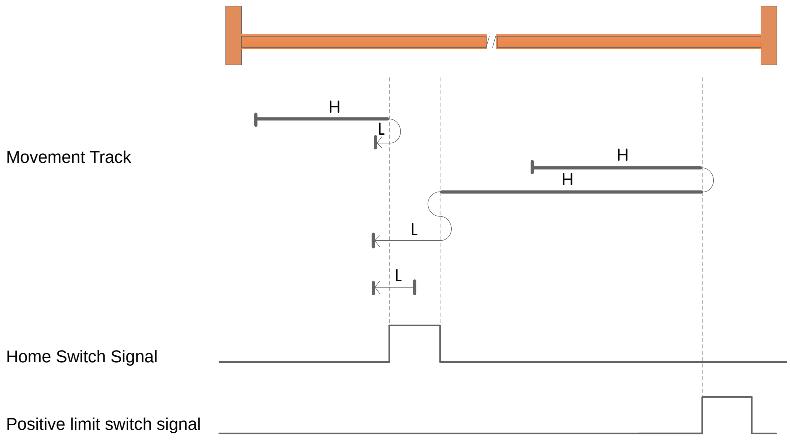
7.8.2.25 Return to origin mode 22: Negative return, look for the rising edge signal of the origin sensor



a) When starting to return, HOM-SW=0, start the return at high speed in negative direction, after encountering the rising edge of HOM-SW, decelerate, reverse, and run at low speed in the forward direction to the position where HOM-SW is invalid, then decelerate and stop, and then go negative again It runs at low speed and stops after encountering the rising edge of HOM-SW.

b) When starting to return, HOM-SW=1, start the return at low speed in the positive direction, after encountering the falling edge of HOM-SW, decelerate, reverse, and run at low speed in the negative direction, and stop after encountering the rising edge of HOM-SW.

7.8.2.26 Return to origin mode 23: Forward return, look for the falling edge signal of the origin sensor, and automatically reverse when encountering the positive limit

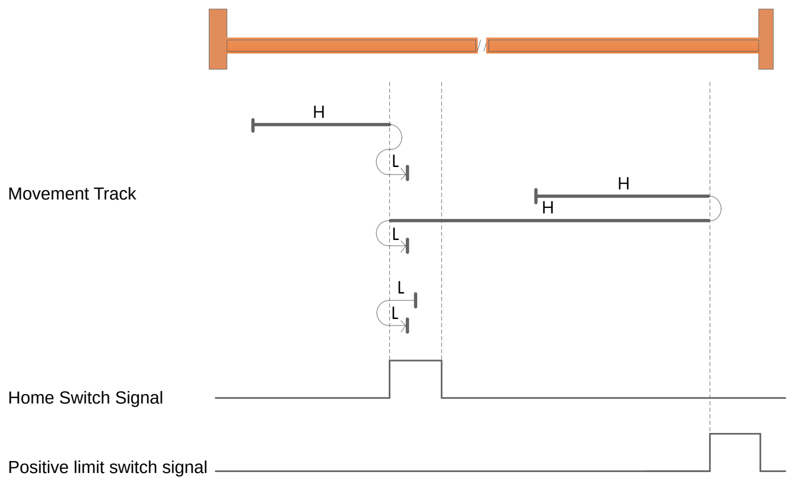


a) When starting to return, HOM-SW=0 and it is located on the negative side of the origin sensor. Start returning at high speed in positive direction. After encountering the rising edge of HOM-SW, decelerate, reverse, and run at low speed in negative direction. When encountering HOM-SW Stop after falling edge.

b) When starting to return, HOM -SW=0 and it is located on the positive side of the origin sensor, and starts to return at high speed in the positive direction. After encountering the rising edge of POT, decelerate, reverse, and run at high speed in the negative direction; After the rising edge, decelerate, reverse, forward and run at low speed to HOM-SW After the invalid position, it will decelerate and stop, and then run at a low speed in the negative direction, and stop when it encounters the falling edge of HOM-SW.

c) When starting to return, HOM-SW=1, start the return at low speed in negative direction, and stop after encountering the falling edge of HOM-SW.

7.8.2.27 Return to origin mode 24: forward return, look for the rising edge signal of the origin sensor, and automatically reverse when encountering the positive limit



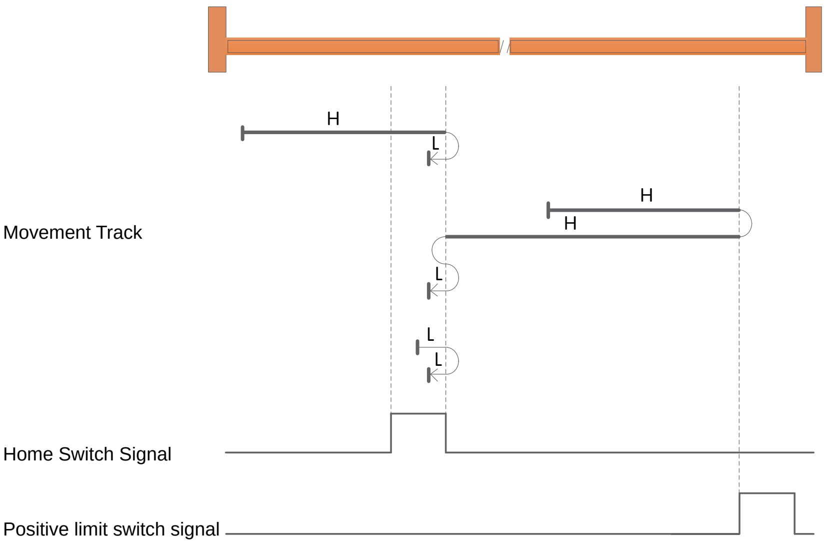
a) When starting to return, HOM-SW=0 and it is located on the negative side of the origin sensor. Start returning at high speed in positive direction. After encountering the rising edge of HOM-SW, decelerate, reverse, and run at low speed in negative direction until HOM-SW is invalid. After the position, it decelerates to stop, and then runs forward at low speed, and stops when it encounters the rising edge of HOM-SW.

b) When starting to return, HOM -SW=0 and it is located on the positive side of the origin sensor, and starts to return at high speed in the positive direction. After encountering the rising edge of POT, decelerate, reverse, and run at high speed in the negative direction; Decelerate after falling edge, reverse and forward at low speed, encounter HOM-

SW rises and stops.

c) When starting to return, HOM-SW=1, start returning at low speed in negative direction, after encountering the falling edge of HOM-SW, decelerate, reverse, and run at low speed in the forward direction, and stop when encountering the rising edge of HOM-SW.

7.8.2.28 Return to origin mode 25: forward return, look for the rising edge signal of the origin sensor, and automatically reverse when encountering the positive limit

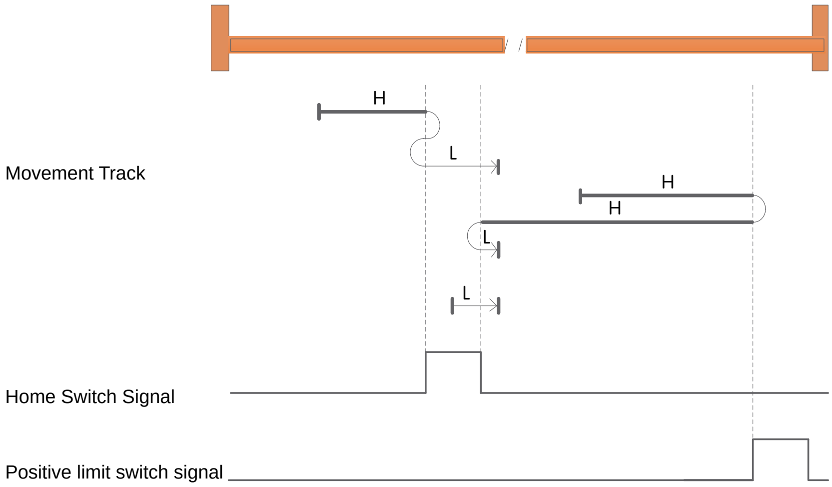


a) When starting to return, HOM-SW=0 and it is located on the negative side of the origin sensor. Start returning at high speed in the positive direction, decelerate after encountering the falling edge of HOM-SW, run in the reverse direction, and run at low speed in the negative direction, and rise when HOM-SW is encountered. stop after the edge.

b) When starting to return, HOM -SW=0 and it is located on the positive side of the origin sensor, and starts to return at high speed in the positive direction. After encountering the rising edge of POT, decelerate, reverse, and run at high speed in the negative direction; After the rising edge, decelerate, reverse, forward and run at low speed to HOM-SW After the invalid position, it will decelerate and stop, and then run at a low speed in the negative direction, and stop when it encounters the rising edge of HOM-SW.

c) When starting to return, HOM-SW=1, start the return at low speed in the positive direction, after encountering the falling edge of HOM-SW, decelerate, reverse, and run at low speed in the negative direction, and stop after encountering the rising edge of HOM-SW.

7.8.2.29 Return-to-origin mode 26: Forward return, look for the falling edge signal of the origin sensor, and automatically reverse when encountering the positive limit



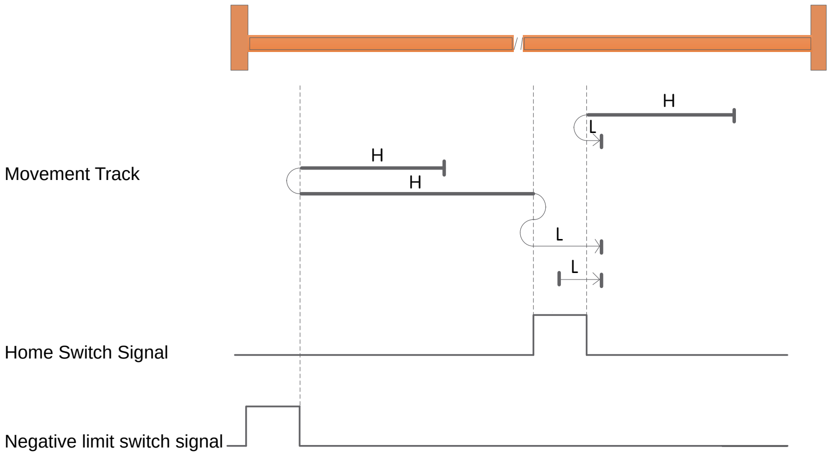
a) When starting to return, HOM-SW=0 and it is located on the negative side of the origin sensor position, start the return at a positive high speed, and encounter the rising edge of HOM-SW After that, decelerate, reverse, and run at low speed in negative direction to the position where HOM-SW is invalid, then decelerate to stop, and then run at low speed in positive direction.

Stop after falling edge of SW.

b) When starting to return, HOM-SW=0 and it is located on the positive side of the position of the origin sensor, start the return at a positive high speed, and encounter the rising edge of POT Then, decelerate, reverse, and run at high speed in the negative direction; after encountering the rising edge of HOM-SW, decelerate, reverse, and run at low speed in the forward direction, and encounter the lower speed of HOM-SW. Stop after falling edge.

c) When starting to return, HOM-SW=1, start the return at a forward low speed, and stop after encountering the falling edge of HOM-SW.

7.8.2.30 Return to origin mode 27: Negative return, look for the falling edge signal of the origin sensor, and automatically reverse when the negative limit is encountered.

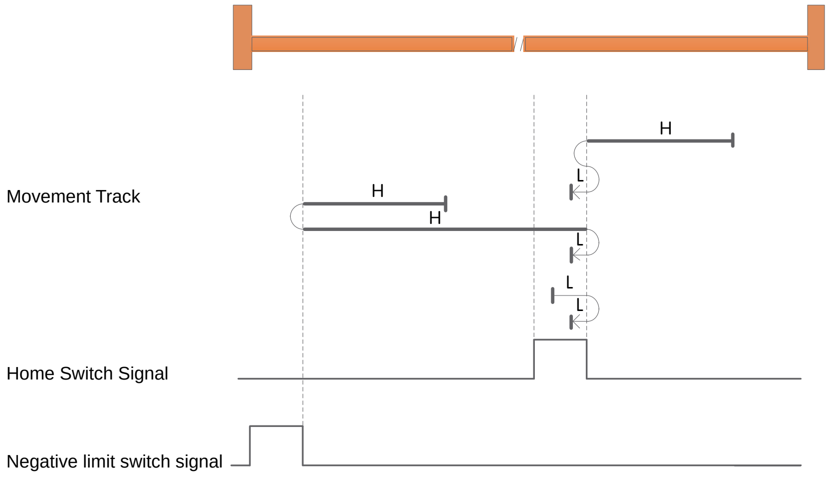


a) When starting to return, HOM-SW=0 and it is located on the positive side of the origin sensor, and starts to return at a high speed in the negative direction. After encountering the rising edge of HOM-SW, decelerate, reverse, and run at low speed in the forward direction. When encountering HOM-SW Stop after falling edge.

b) When starting to return, HOM - SW =0 and it is located on the negative side of the origin sensor, and it starts to return at a high speed in the negative direction. After the rising edge, decelerate, reverse, and run at low speed in the negative direction to HOM-SW After the invalid position, it will decelerate to stop, then run forward at low speed, and stop when it encounters the falling edge of HOM-SW.

c) When starting to return, HOM-SW=1, start the return at a forward low speed, and stop after encountering the falling edge of HOM-SW.

7.8.2.31 Return to origin mode 28: Negative return, look for the rising edge signal of the origin sensor, and automatically reverse when the negative limit is encountered



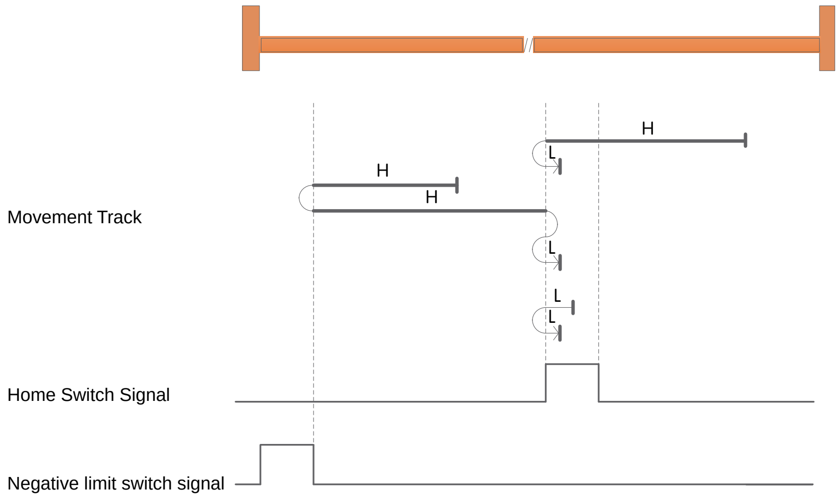
a) When starting to return, HOM-SW=0 and it is located on the positive side of the position of the origin sensor, start the return at a high speed in the negative direction, and encounter the rising edge of HOM-SW After that, decelerate, reverse, and run at low speed in the forward direction to the position where HOM -SW is invalid, then decelerate to stop, and then run at low speed in the negative direction.

Stop after the rising edge of SW.

b) HOM-SW=0 when starting to return, and it is located on the negative side of the origin sensor position, and starts to return at a high speed in negative direction, and encounters the rising edge of NOT. Then, decelerate, reverse, and run at high speed in the forward direction; after encountering the falling edge of HOM-SW, decelerate, reverse, and run at low speed in the negative direction, and encounter the falling edge of HOM-SW. Stop after rising edge.

c) HOM-SW=1 when starting to return, start returning at low speed in positive direction, after encountering the falling edge of HOM-SW, decelerate, reverse, and run at low speed in negative direction. Stop after the rising edge of HOM -SW.

7.8.2.32 Return to origin mode 29: Negative return, look for the rising edge signal of the origin sensor, and automatically reverse when encountering the negative limit

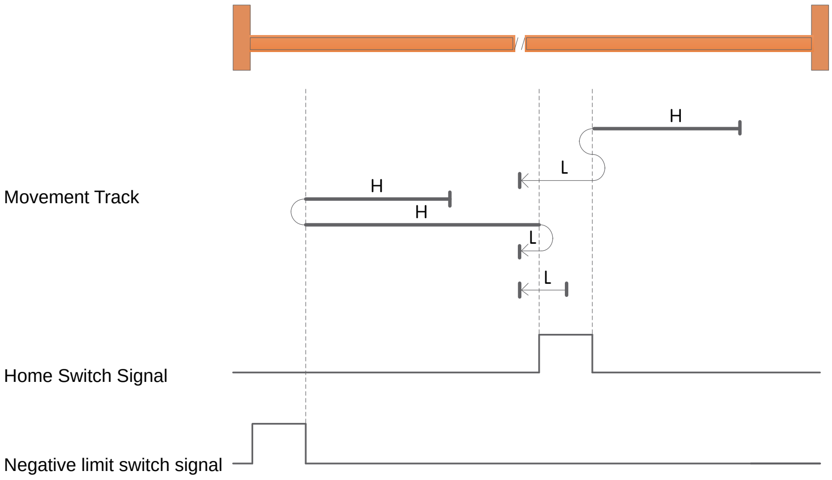


a) When starting to return, HOM - SW=0 and it is located on the positive side of the origin sensor, and starts to return at a high speed in the negative direction. Stop after the rising edge of SW.

b) When starting to return, HOM - SW =0 and it is located on the negative side of the origin sensor, and it starts to return at a high speed in the negative direction. After the rising edge, decelerate, reverse, and run at low speed in the negative direction to HOM-SW After the invalid position, it will decelerate to stop, then run forward at low speed, and stop when it encounters the rising edge of HOM-SW.

c) When starting to return, HOM-SW=1, start the return at low speed in negative direction, after encountering the falling edge of HOM-SW, decelerate, reverse, and run at low speed in the forward direction, and stop after encountering the rising edge of HOM-SW.

7.8.2.33 Return to origin mode 30: Negative return, look for the falling edge signal of the origin sensor, and automatically reverse when the negative limit is encountered.



a) When starting to return, HOM-SW=0 and it is located on the positive side of the position of the origin sensor. It starts to return at a high speed in the negative direction, and when the HOM-SW rises After the edge, decelerate, reverse, and run at low speed in the forward direction to the position where HOM -SW is invalid, then decelerate to stop, and then run at low speed in the negative direction.

Stop after falling edge of SW.

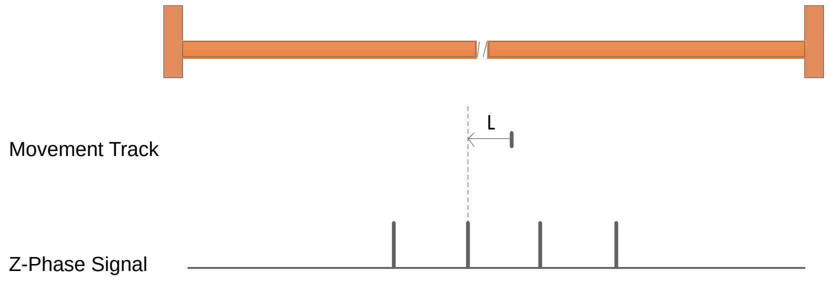
b) HOM-SW=0 when starting to return, and it is located on the negative side of the origin sensor position, and starts to return at a high speed in negative direction, and encounters the rising edge of NOT. Then, decelerate, reverse, and run at high speed in the forward direction; after encountering the rising edge of HOM-SW, decelerate, reverse, and run at low speed in the negative direction, and encounter the lower speed of HOM-SW. Stop after falling edge.

c) When starting to return, HOM-SW=1, start the return at low speed in negative direction, and stop after encountering the falling edge of HOM-SW.

Back to origin mode 31, 32, 34, 35

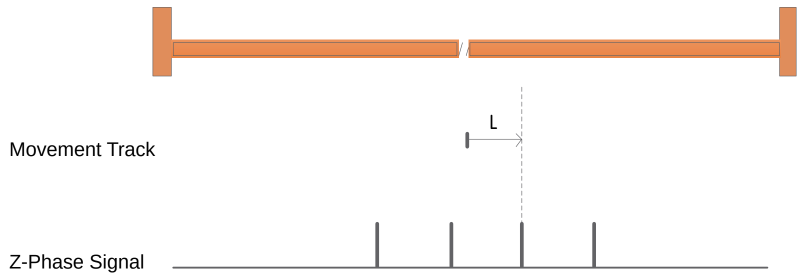
◆ Return to origin mode 31, 32 reserved

◆ Return to origin mode 33: Negative return, looking for the first Z pulse signal



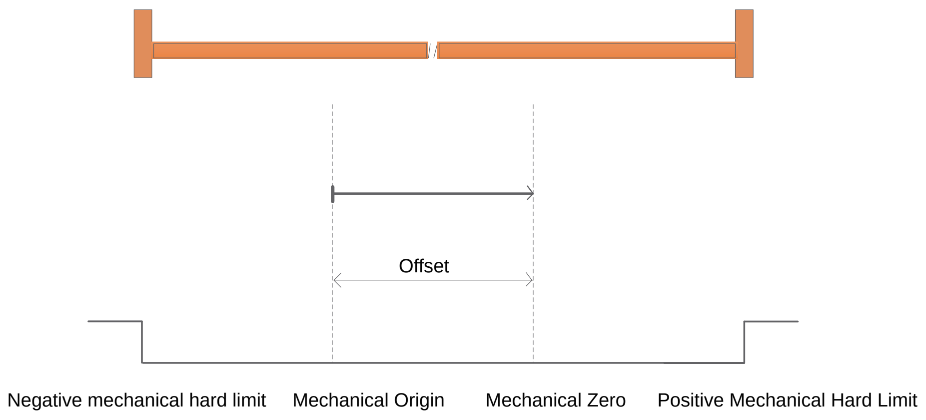
a) Start the return at a negative low speed and stop when the first Z pulse signal is encountered.

◆ Return to origin mode 34: forward return, look for the first Z pulse signal



a) Start the return at a forward low speed and stop when the first Z pulse signal is encountered.

◆ Return to origin mode 35: Take the current position as the machine origin



8 Parameter setting

8.1 Parameter classification

MBDV series low voltage servo has 5 groups of parameters.

Parameter group	Type	Function
P0-XX	PID Tuning	Set the gain parameters of the servo
P1-XX	Drive Configuration	Configure functions and set various functional parameters of the drive
P2-XX	Motion Profile Configuration	Configure motion profile parameters for each control mode.
P3-XX	Encoder Settings	Configure parameters related to the encoder and encoder output.
P5-XX	Digital I/O Signal Settings	Configure the functions and parameters of digital inputs and outputs.

8.2 List of parameters

P0-XX: PID Tuning

Serial number	Command	Function	Defaults	Range	Unit	Effective
P0-00	UM	Tuning Mode	0	0 ~ 2	——	
P0-01	LY	Load type	0	0 ~ 10	——	
P0-02	NR	Load inertia ratio	0	0 ~ 100	——	
P0-03	KG	1st mechanical stiffness level	5	0 ~ 20	——	
P0-04	KX	2nd mechanical stiffness level	5	0 ~ 20	——	
P0-05	KP	1st position loop gain	52	0 ~ 20000	0.1Hz	
P0-07	KD	1st position loop derivative time constant	2000	0 ~ 30000	ms	
P0-08	KE	1st position loop derivative filter	20000	0 ~ 40000	0.1Hz	
P0-09	KL	Velocity feedforward gain	10000	-30000 ~ 3000	0.01%	
P0-10	KR	Velocity feedforward filter frequency	20000	0 ~ 40000	0.1Hz	
P0-11	KF	1st velocity command gain	10000	-30000 ~ 3000	0.01%	
P0-12	VP	1st velocity loop gain	183	0 ~ 30000	0.1Hz	
P0-13	VI	1st speed loop integral time constant	189	0 ~ 30000	ms	
P0-14	KK	Acceleration feed forward gain	3000	0 ~ 10000	0.01%	
P0-15	KT	Acceleration feedforward filter frequency	20000	0 ~ 40000	0.1Hz	
P0-16	KC	1st command torque filter frequency	1099	0 ~ 40000	01Hz	
P0-17	UP	2nd position loop gain	52	0 ~ 20000	0.1Hz	
P0-19	UD	2nd position loop derivative time constant	2000	0 ~ 30000	ms	
P0-20	UE	2nd position loop derivative time constant	15000	0 ~ 40000	0.1Hz	
P0-21	UF	2nd velocity command gain	10000	-30000 ~ 3000	0.01%	
P0-22	UV	2nd velocity loop gain	183	0 ~ 30000	0.1Hz	
P0-23	UG	2nd velocity loop integral time constant	189	0 ~ 30000	ms	
P0-24	UC	2nd command torque filter frequency	1099	0 ~ 40000	01Hz	
P0-33	SD	Automatic gain switching method	0	0 ~ 4	——	
P0-34	PN	Gain switching condition - position error	0	0 ~ 2147483647	Pulses	
P0-35	VN	Gain switching condition - actual velocity	0	0 ~ 100	rps	
P0-36	TN	Gain switching condition - actual torque	10	0 ~ 3000	0.1%	
P0-37	SE1	Delay time - 2nd Group Gains to 1st Group Gains	10	0 ~ 10000	ms	
P0-38	SE2	Delay time - 1st Group Gains to 2nd Group Gains	0	0 ~ 10000	ms	
P0-39	LR	Velocity Feedback Filter	0	0 ~ 3	——	

Group **P1-XX: Drive Configuration**

Serial number	SCL instruction	Function	Defaults	Range	Unit	Effective
P1-00	CM	Control mode	21	1,15,21	-	Effective immediately
P1-02	PM	Control Mode on power up	10	8 ~ 10，13	-	
P1-03	JM	Jog Mode	2	1 ~ 2	-	
P1-05	GC	Current command for Torque Control	0	-3000 ~ 3000	0.1%	
P1-06	CC	First torque limit	3000	0 ~ 3000	0.1%	
P1-07	CV	Target Torque	0	0 ~ 3000	0.1%	
P1-08	HC	Hard stop home current limit	200	0 ~ 3000	0.1%	
P1-09	CL	Current foldback timer	2000	0 ~ 30000	ms	
P1-10	LD	Torque limit method	1	1 ~ 5	-	
P1-11	DR	Rotation direction	0	0，1	-	
P1-13	PR	Protocol	5	1 ~ 511	-	
P1-14	TD	Transmit delay	2	0 ~ 20	ms	
P1-15	BR	RS-485 communication baud rate	1	1 ~ 5	-	
P1-16	DA	RS-485 communication address	32	1 ~ 32	-	
P1-17	CO	CAN open cnode ID	1	1 ~ 127	-	
P1-18	CB	CAN open communication baud rate	0	0 ~ 7	-	
P1-19	ZR	Regenerative resistor resistance	200	10 ~ 32000	Ω	
P1-20	ZC	Regenerative resistor power rating	40	1 ~ 32000	W	
P1-21	ZT	Regenerative resistor time constant	1000	0 ~ 8000	ms	
P1-24	MA	Alarm mask	4294967295	0 ~ 4294967295	-	
P1-25	CX	Second torque limit	3000	0 ~ 3000	0.1%	
P1-26	CY	Third torque limit	3000	0 ~ 3000	0.1%	
P1-27	CZ	Fourth torque limit	3000	0 ~ 3000	0.1%	
P1-28	HT	Motor stall protection time	0	0 ~ 30000	ms	
P1-29	YV	Motor stall sequence when Servo Off	0	0 ~ 5		
P1-30	YR	Motor stall sequence when fault occurs	0	0 ~ 3		
P1-31	YM	The maximum action time of the dynamic brake during the deceleration process of the deactivation	500	0 ~ 30000	ms	
P1-32	YN	Maximum dynamic deceleration time when fault occurs	0	0 ~ 30000	ms	
P1-34	RT	Current ramp limit	1000	0 ~ 3000	0.1%	
P1-37	DV	Dynamic brake velocity	50	0 ~ 100	rps	
P1-38	DW	Dumping voltage trigger value	650	20 ~ 800	0.1V	
P1-39	ZS	Watchdog trigger time	500	0 ~ 10000	ms	
P1-40	ZA	Action after watchdog is triggered	1	1 ~ 16	1	

P2-XX: Motion Profile Configuration

Serial number	SCL command	Function	Defaults	Range	Unit	Effective
P2-00	VM	Maximum velocity	80	0 ~ 100	rps	
P2-01	AM	Maximum acceleration/deceleration	3000	0.167 ~ 5000	rps/s	
P2-02	JS	Jog velocity	10	-100 ~ 100	rps	
P2-03	JA	Jog acceleration	100	0.167 ~ 5000	rps/s	
P2-04	JL	Jog deceleration	100	0.167 ~ 5000	rps/s	
P2-05	JT	Jerk time	10	0 ~ 125	ms	
P2-06	VE	Target Velocity (point-to-point)	10	0.0042 ~ 100	rps	
P2-07	AC	Target acceleration (point-to-point)	100	0.167 ~ 5000	rps/s	
P2-08	DE	Target deceleration (point-to-point)	100	0.167 ~ 5000	rps/s	
P2-09	VC	Velocity change (point-to-point)	2	0 ~ 100	rps	
P2-10	JC	Multi-Speed setting (Jog mode)	2	-100 ~ 100	rps	
P2-18	HA1	1st Homing acceleration/deceleration	100	0.167 ~ 5000	rps/s	
P2-24	HV1	Homing velocity 1	10	0.0042 ~ 100	rps	
P2-25	HV2	Homing velocity 2	1	0.0042 ~ 100	rps	
P2-27	HO	Homing offset	0	-2147483647 ~ +2147483647	pulses	
P2-28	KJ	Jerk filter	0	0 ~ 1000	ms	
P2-29	FF	Interpolation filter	10	0 ~ 10	ms	
P2-30	VT	Speed limit in torque mode	80	0 ~ 100	rps	

P3-XX: Encoder Settings

Serial number	SCL command	Function	Defaults	Range	Unit	Effective
P3-04	PF	Position error limit	100000	0 ~ 2147483647	pulses	
P3-05	EG	Electronic Gearing	10000	200 ~ 131072	pulses/rev	
P3-12	PO	Encoder feedback output mode	1	0 ~ 256	-	
P3-13	ON	Pulse output gear ratio - numerator	10000	0 ~ 13107200	-	
P3-14	OD	Pulse output gear ratio - denominator	131072	0 ~ 13107200	-	
P3-15	ES	Absolute encoder setting	1	0 ~ 1	-	

P5-XX Digital I/O Signal Settings

Serial number	SCL command	Function	Defaults	Range	Unit	Effective
P5-00	MU1	Digital input 1 function		0 ~ 46	-	
P5-01	MU2	Digital input 2 function		0 ~ 46	-	
P5-02	MU3	Digital input 3 function		0 ~ 46	-	
P5-03	MU4	Digital input 4 function		0 ~ 46	-	
P5-12	MO1	Digital output 1 function		0 ~ 34	-	
P5-13	MO2	Digital output 2 function		0 ~ 34	-	
P5-14	MO3	Digital output 3 function		0 ~ 34	-	
P5-24	BD	Movement waiting time after brake release	200	0 ~ 32000	ms	
P5-25	BE	Motor disable delay time after brake applied	200	0 ~ 32000	ms	
P5-27	HX	Home sensor	5	1 ~ 10	-	
P5-28	FI1	Digital input 1 filter	1	0 ~ 8000	ms	
P5-29	FI2	Digital input 2 filter	1	0 ~ 8000	ms	
P5-30	FI3	Digital input 3 filter	1	0 ~ 8000	ms	
P5-31	FI4	Digital input 4 filter	1	0 ~ 8000	ms	
P5-38	PL	Dynamic position error threshold	10	0 ~ 2147483647	pulses	
P5-39	PD	Positioning complete error margin	40	0 ~32000	pulses	
P5-40	PE	Motion condition timer	10	0 ~ 30000	ms	
P5-42	ZV	Zero speed judgment threshold	0.5	0.1 ~ 2	rps	
P5-43	VR	Velocity Reached - Permissible fluctuation range	0.1	0 ~ 100	rps	
P5-44	VV	Velocity Reached - Minimum threshold	10	0 ~ 100	rps	
P5-45	TV	Torque Reached - Permissible fluctuation range	10	0 ~ 3000	0.1%	
P5-46	DG	Absolute arrival position	10000	-2147483647 ~ +2147483647	pulses	
P5-47	LP	Positive software limit	0	-2147483647 ~ +2147483647	pulses	
P5-48	LM	Negative software limit	0	-2147483647 ~ +2147483647	pulses	
P5-49	HE	Homing method	1	-4 ~ 40	-	
P5-50	EO	E-Stop method	1	1 ~ 8	-	
P5-51	MS	zero speed clamp function	1	0 ~ 1	-	

8.3 Parameter Description

8.3.1 Group P0-XX: PID gain setting

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns	
P0-00	UM	Tuning Mode	0	0 ~ 2	---	P	S

Set the parameter tuning method.

Set value	Parameter setting mode	Description	note
0	Tuning Free	Set the gain value of servo system by setting P0-03.	In this mode, only modification of P0-03 is valid.Manual adjustment of all other gain and tuning parameters is not allowed.
1	Auto Tuning	Parameters are automatically set (load inertia, mechanical stiffness and gains). Only the 1st Mechanical Stiffness (P0-03) and the Load Inertia Ratio (P0-02) can be manually edited.	In this mode, only P0-03 stiffness level and P0-02 load inertia ratio are valid. Manual adjustment of other gain parameters is invalid.
2	Fine Tuning	Fine tuning allows users to manually configure all gain, filter and load characteristics for tuning. A recommended method is to first use auto-tuning to get a close estimate of the required tuning parameter values and then manually adjust those estimates until a more accurate tuning profile is reached.	In this mode, all gain parameters are valid.

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P0-01	LY	Load type	0	0 ~ 10	---	P	S	T	

Set the current load type. In auto-tuning mode and advanced tuning mode, setting the load type reasonably is conducive to accurate identification and optimization of system gain parameters.

Set value	Parameter setting mode	Description
0	General load	Ex: horizontally placed screw class load.
1	Rigid load	Ex: rigid mechanism, such a horizontal installation like a turntable.
2	Flexible load	Ex: Belt driven load

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P0-02	NR	Load inertia ratio	0	0 ~ 100	---	P	S	T	

The current load inertia ratio. Set the ratio of load inertia to motor rotor inertia.

When auto-tuning is in progress, the load inertia ratio of the current system can be identified in real time, and this parameter will be automatically saved after auto-tuning is completed. When the load inertia ratio is set correctly, P0-05 can accurately represent the current system gain.

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P0-03	KG	1st Mechanical Stiffness Level	5	1 ~ 20	---	P	S	T	

The first stiffness value of the current system.

When the parameter tuning mode P0-00 is set to free tuning and automatic tuning, the higher the mechanical Stiffness level, the stronger the gain of the servo system and the faster the response, An excessively large value will cause system vibrations.

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P0-04	KX	2nd Mechanical Stiffness Level	5	1 ~ 20	---	P	S	T	

The second stiffness value of the current system. When the gain switch is turned on, the second stiffness level will be effective under the corresponding conditions. For details on gain switching, please refer to 7.1.6 Gain switching function.

When the parameter tuning mode P0-00 is set to free tuning and automatic tuning, the higher the mechanical Stiffness level, the stronger the gain of the servo system and the faster the response, An excessively large value will cause system vibrations.

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P0-05	KP	1st position loop gain	52	0 ~ 20000	0.1Hz	P	S	T	

Set the proportional gain for position control. 0 means not used, 20000 means the proportional effect is maximized. Increasing this parameter can improve the responsiveness of the system, reduce the position error, and shorten the positioning time.

When the proportional gain of the position loop is too small, the system response will be delayed and position errors will decrease slowly. If set too high, system vibrations may occur.

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P0-07	KD	1st position loop derivative time constant	0	0 ~ 30000	ms	P	S	T	

◆ Set the position loop differential time constant for position control.

◆ 0 means no derivative effect, the smaller the set value, the stronger the effect of the derivative term. When the set value of the differential time constant (KD) is too large, the system's ability to suppress vibration is insufficient, and obvious oscillation will occur during the acceleration / deceleration process, the uniform speed process and after the stop, Oscillations will decrease gradually and eventually stabilize.

◆ When the set value of the differential time constant (KD) is reasonable, the system's ability to suppress vibration is significantly enhanced, and it tends to stabilize quickly.

◆ When the differential time constant (KD) is set too small, the motion system will be too sensitive, easily vibrate and generate noise.

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P0-08	KE	1st position loop derivative filter	20000	0 ~ 40000	0.1Hz	P	S	T	

Set the position loop differential low-pass filter for position control.

0 means no filtering effect. The differential control parameters filter frequency. This filter is a simple one-pole, low-pass filter intended for attenuating high frequency oscillations. This value is a constant that must be calculated from the desired roll off frequency.

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P0-09	KL	Velocity feedforward gain	10000	-30000 ~ 3000	0.01%	P	S	T	

Higher values will reduce system noise and eliminate overshoot, but will reduce the system's dynamic following performance. Lower values will raise system stiffness, but may cause system noise.

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P0-10	KR	Velocity feedforward filter frequency	20000	0 ~ 40000	0.1Hz	P	S	T	

Sets the low-pass filtering for velocity feedforward.

0 means no filtering effect.

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P0-11	KF	1st Command Velocity Gain	10000	-30000 ~ 3000	0.01%	P	S	T	

The speed command from the position loop control process is multiplied by the ratio of this parameter to the system.

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P0-12	VP	1st velocity loop gain	183	0 ~ 30000	0.1Hz	P	S	T	

Proportional gain term used to increase stiffness of motor response in direct proportion to the velocity error

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P0-13	VI	1st speed loop integral time constant	189	0 ~ 30000	ms	P	S	T	
Set the integral time constant of the speed loop. 0 means no integral effect, the smaller the set value, the stronger the integral effect. This integral gain term is used to increase stiffness and reduce steady-state velocity errors									

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P0-14	KK	Acceleration feedforward gain	3000	0 ~ 10000	0.01%	P	S	T	
Acceleration feedforward gain in servo control. A value of 0 means that the feedforward is not used, and a value of 10000 means that the feedforward effect is maximized.									

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P0-15	KT	Acceleration feedforward filter frequency	20000	0 ~ 40000	0.1Hz	P	S	T	
Low-pass filter for acceleration feedforward gain in servo control. A value of 0 means that the filter is not used, and 40000 means that the filter effect is maximized.									

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P0-16	KC	1st command torque filter frequency	1099	0 ~ 40000	01Hz	P	S	T	
Filter the command torque. The filter is a single-output low-pass filter, which is used to low-pass filter the output of the PID controller (that is, the reference current). System operation needs to be considered when setting this value. The smaller the value, the lower the filtering frequency and the more obvious the filtering effect. The default value of 1099 works for most applications. This value can be modified in cases of motor vibrations or abnormal audible noise. An example use case is when a system is prone to mechanical resonance. The low pass filter cutoff frequency can be set below the resonance frequency of the system to prevent the motor control loop from exciting the system into its resonance frequency. In large inertia applications, increasing KP can help improve the system response but a KP value set too high can induce vibrations. To reduce those vibrations, this filter's frequency may be reduced.									

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P0-17	UP	2nd position loop gain	52	0 ~ 20000	0.1Hz	P	S	T	
Set the proportional gain for position control. 0 means not used, 20000 means the proportional effect is maximized. Increasing this parameter can improve the responsiveness of the system, reduce the position error, and shorten the positioning time. When the proportional gain of the position loop is too small, the system response will be delayed and position errors will decrease slowly. If set too high, system vibrations may occur.									

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P0-19	UD	2nd position loop differential time constant	0	0 ~ 30000	ms	P	S	T	

◆ Set the position loop differential time constant for position control.

◆ 0 means no derivative effect, the smaller the set value, the stronger the effect of the derivative term. When the set value of the differential time constant (UD) is too large, the system's ability to suppress vibration is insufficient, and obvious oscillation will occur during the acceleration / deceleration process, the uniform speed process and after the stop, Oscillations will decrease gradually and eventually stabilize.

◆ When the set value of the differential time constant (UD) is reasonable, the system's ability to suppress vibration is significantly enhanced, and it tends to stabilize quickly.

◆ When the differential time constant (UD) is set too small, the motion system will be too sensitive, easily vibrate and generate noise.

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P0-20	UE	2nd position loop derivative filter	20000	0 ~ 40000	0.1Hz	P	S	T	

Set the position loop differential low-pass filter for position control.

0 means no filtering effect. The differential control parameters filter frequency. This filter is a simple one-pole, low-pass filter intended for attenuating high frequency oscillations. This value is a constant that must be calculated from the desired roll off frequency.

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P0-21	UF	2nd velocity command gain	10000	-30000 ~ 3000	0.01%	P	S	T	

The speed command from the position loop control process is multiplied by the ratio of this parameter to the system.

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P0-22	UP	2nd velocity loop gain	183	0 ~ 30000	0.1Hz	P	S	T	

Set the proportional gain of the speed loop. In order to improve the overall response of the servo system, it is necessary to increase the speed loop gain value. Setting the value too high will cause vibration.

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P0-23	UI	1st velocity loop integral time constant	189	0 ~ 30000	ms	P	S	T	

Set the integral time constant of the speed loop.

0 means no integral effect, the smaller the set value, the stronger the integral effect.

This integral gain term is used to increase stiffness and reduce steady-state velocity errors

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P0-24	UC	1st command torque filter frequency	1099	0 ~ 40000	01Hz	P	S	T	

Filter the command torque.

The filter is a single-output low-pass filter, which is used to low-pass filter the output of the PID controller (that is, the reference current). System operation needs to be considered when setting this value.

The smaller the value, the lower the filtering frequency and the more obvious the filtering effect. The default value of 1099 works for most applications. This value can be modified in cases of motor vibrations or abnormal audible noise.

An example use case is when a system is prone to mechanical resonance. The low pass filter cutoff frequency can be set below the resonance frequency of the system to prevent the motor control loop from exciting the system into its resonance frequency. In large inertia applications, increasing KP can help improve the system response but a KP value set too high can induce vibrations. To reduce those vibrations, this filter's frequency may be reduced.

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P0-33	SD	Automatic gain switching method	0	0 ~ 4	——	P	S	T	

Set the parameter tuning method.

Set value	Switching mode	Switching condition	Switching latency
0	Fixed in Group One	Fixed in Group One	-
1	According to positional error	Switch to Group 2: Absolute position error ≥ P0-34 setting	P0-37
		Switch back to Group 1: Absolute position error < P0-34 setting	P0-38
2	According to the actual speed of the motor	Switch to group 2 conditions: absolute value of actual speed 35 P0-35 set value	P0-37
		Switch back to Group 1: Absolute value of actual speed < P0-35 set value	P0-38
3	According to the actual output torque of the motor	Switch to Group 2: Absolute value of actual torque P P0-36 set value	P0-37
		Switch back to Group 1: Absolute value of actual torque < P0-36 set value	P0-38
4	Position arrival signal	Switch to Group 2 condition: Position arrival condition is valid.	P0-37
		Switch back to Group 1 condition: Position arrival condition not valid	P0-38

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P0-34	PN	Gain switching condition - position error	0	0 ~ 2147483647	Pulses	P	S	T	

Set the judgment condition for position error-based gain switching.

When in position control, P0-33 Gain parameter switching method is set to " 1 ", this parameter is used to set the judgment condition for switching.

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P0-35	VN	Gain switching condition - actual velocity	0.000	0 ~ 100	rps	P	S	T	

Set the gain switching judgment condition based on the actual motor speed.

When in position control, velocity or torque control, P0-33 gain parameter switching method is set to " 2 ", this parameter is used to set the judgment condition for switching.

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P0-36	TN	Gain switching condition - actual torque	10	0 ~ 3000	0.1%	P	S	T	

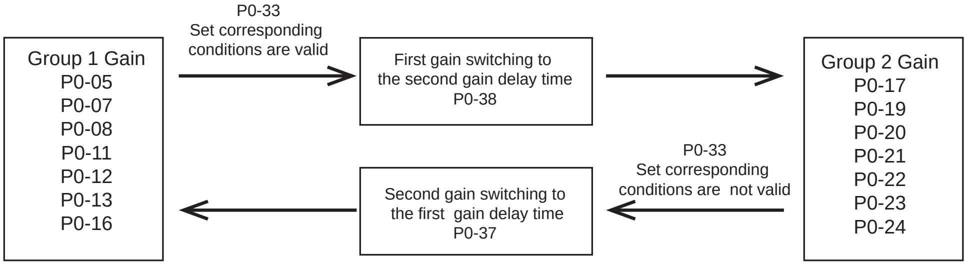
Set the gain switching judgment condition based on the actual output torque of the motor.

When in position control, velocity or torque control, P0-33 gain parameter switching method is set to " 3 ", this parameter is used to set the judgment condition for switching.

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P0-37	SE1	Delay time - 2nd Group Gains to 1st Group Gains	10	0 ~ 10000	ms	P	S	T	

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P0-38	SE2	Delay time - 1st Group Gains to 2nd Group Gains	10	0 ~ 10000	ms	P	S	T	

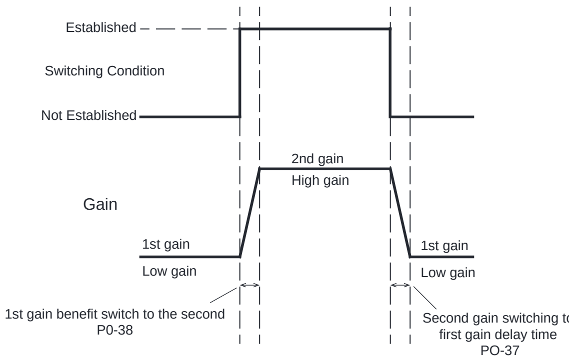
When switching gains is required in an application, users will need to configure two delay periods. P0-37 and P0-38 define the delay times for switching to and from Group 1 and Group 2 of gains.



The switching transition time is shown below

◆ When gain switching conditions are valid, Group 1 will gradually transition to Group 2 based on the time defined by P0-37.

◆ When gain switching conditions are not valid or transition to invalid, Group 2 will gradually transition back to Group 1 based on the time defined by P0-38.



Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P0-39	LR	Velocity Feedback Filter	0	0 ~ 3	——	P	S	T	

PID controller, speed loop speed feedback low-pass filter.

Set value	Filtering frequency
0	Not in use
1	8KHz
2	2KHz
3	1KHz

8.3.2 Group P1-XX: Configuration --- Configuration class parameters

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P1-00	CM	Control mode	21	1,15,21	-	P	S	T	

Parameter P1-00 can be used to set the main control mode of the drive.

Set value	Mode	Control signal	Description
1	Torque Control	Communication command	Use communication commands to control motor output torque
15	Velocity Control	Digital input signal	Internal 8 speed mode with parameters P2-10~P2-17setting speed values for each of the 1-8 speed settings, respectively.
21	Position Control	Communication command	Point-to-point position mode control using communication instructions

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P1-02	PM	Control Mode on power up	10	8 ~ 10	-	P	S	T	

Parameter P1-02 can be used to set the communication mode and working status of the drive after power-on.

Set value	Mode
8	Power-on running in Modbus/RTU mode, servo automatically enabled upon power-on
9	Running in Q mode that supports Modbus/RTU communication, the servo automatically enables and automatically executes the Q program when powered on.
10	Power-on running in Q mode that supports Modbus/RTU communication, servo is not enabled automatically after power-on, Q program is not executed automatically

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P1-03	JM	Jog Mode	2	1 ~ 2	-	P	S	T	

When jogging the motor, users can configure the drive for pure velocity control or for velocity and position control.

Set value	Mode	Mode
1	Position over time	Position and velocity tracking are monitored for errors. If the motor incurs a greater position error than defined by P3-04, the drive will fault out with a position error fault.
2	Velocity control only	Only velocity tracking is monitored for errors.

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P1-05	GC	Current command for Torque Control	0	-3000 ~ 3000	0.1%	P	S	T	

When the drive is operated in torque control (command based), this parameter defines the commanded current limit. The current draw dictates the output torque of the motor so therefore, this limit defines the maximum output torque allowable from the motor. The motor will stop motion when it reaches this current value and will try to maintain position.

Note: This current value is not maintained after power cycles.

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P1-06	CC	1st Torque Limit	3000	0 ~ 3000	0.1%	P	S	T	

Sets the maximum continuous current level for the servo motor when operating in Point-to-Point mode and Velocity Control Mode. It sets the upper limit on the continuous current range the motor may draw. However, users must be aware that the motor can still draw more than the set continuous current, therefore output higher torque, but they will be operating in what is known as the Peak Current which is only allowed for a limited amount of time.

Behaves as the first torque limit when operating in Torque Control.

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P1-07	CV	Target Torque	0	0 ~ 3000	0.1%	P	S	T	

Torque arrival signal judgment value. Please refer to chapter 7.4.9 Torque arrives

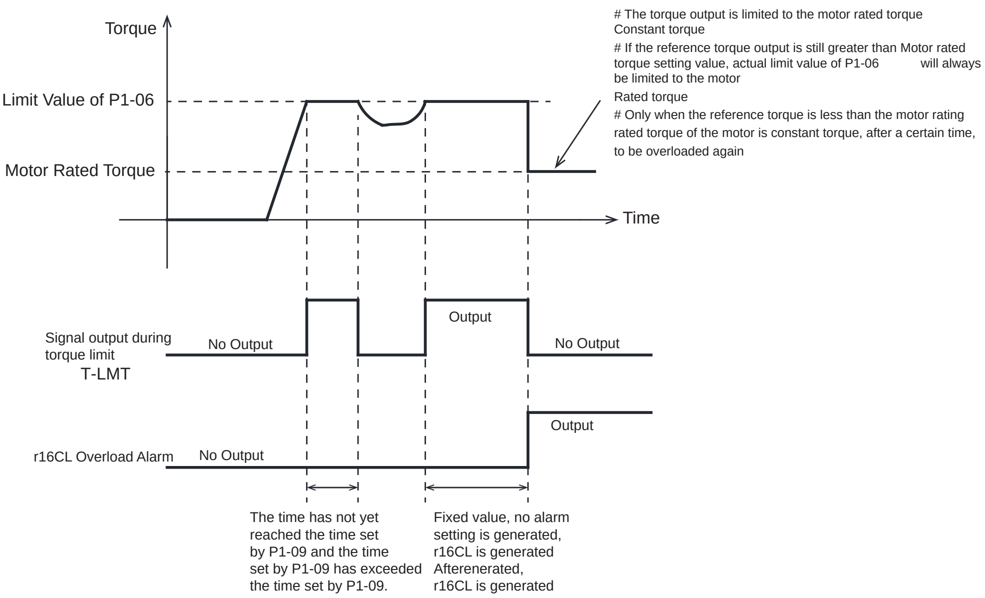
Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P1-08	HC	Hard Stop Home Current Limit	200	0 ~ 3000	0.1%	P	S	T	

Sets the hard stop homing current limit. While hard stop homing, once the motor draws this current level, the motor drive determines that the mechanical limit of the system has been reached. Hard stop homing does not require homing switches or limit switches to home. It functions entirely off of the HC value, a mechanical hard stop and the home offset value (HO). Refer to section 7. 8 for more information.

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P1-09	CL	Current Foldback Timer	0	0 ~ 30000	ms	P	S	T	

Servo motors have the ability to provide peak torque (overload torque), above that set by the continuous current value (P1-06). This parameter sets the duration of torque overload.

- When the overload time exceeds this set value, " r16CL " overload alarm will be generated.
- If the set value is too large, long-term overload will easily cause the motor to overheat and damage.
- During torque control, this function is invalid.
- When the set value is " 0 ", the " r16CL " overload alarm will not be generated, and the servo motor provides an overload output capability of 2 seconds.



Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P1-10	LD	Torque limit method	1	1 ~ 5	ms	P	S	T	

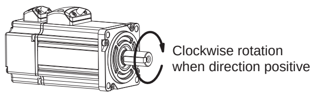
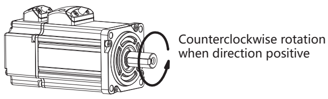
Parameter P1-10 defines 5 torque limit modes, each of which is as follows.

Set value	Forward direction	Reverse direction
0	Register Y	Register Z
1	Parameter P1-06	
2	Parameter P1-06	Parameter P1-25
3	TQ-LMT input is valid: P1-06	
	TQ-LMT input is valid: P1-25	
5	If TQ-LMT input is valid：P1-06	If TQ-LMT input is valid：P1-25
	If TQ-LMT input is invalid: P1-26	If TQ-LMT input is invalid：P1-27

Please refer to chapter 7.5 Torque limit

Parameter	Instruction	Name	Defaults	Range	Unit
P1-11	DR	Rotation Direction	0	0，1	-

Set the relationship between the direction of the command and the rotation direction of the motor:

Set value	Direction of rotation	Description
0		When the commanded direction of motion is positive, the direction of rotation of the motor shaft is clockwise when viewed from the front end of the motor.
1		When the commanded direction of motion is positive, the direction of rotation of the motor shaft is counterclockwise when viewed from the front end of the motor.

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P1-12	IF	Immediate Format	H	D,H	-	P	S	T	

This parameter sets the format of data communicated via the SCL protocol.

Set value	Mode
D	Decimal system
H	Hexadecimal system

Ex: If reading the encoder position, using EP command, and the current position value is 20000 counts but we switch P1-12 to setting "H", the return value of EP would be 4E20 (hex)

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P1-13	PR	Protocol	5	1 ~ 511	-	P	S	T	

This parameter configures serial communication using a binary setting. The following describes the effect of each bit:
Bit 0 = by default set to 1, prescribes standard SCL communication
Bit 1 = Always use address character
Bit 2 = use Ack/Nack
Bit 3 = use Checksum
Bit 4 = (set if communication is RS-485)
Bit 5 = 3-digit numeric register addressing
Bit 6 = Checksum Type
Bit 7 = Little/Big Endian Format (Modbus)
Bit 8 = 2-wire or 4-wire (RS-485)

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P1-14	TD	Transmit Delay	2	0 ~ 20	ms	P	S	T	

Sets or requests the time delay used by the drive when responding to a command that requests a response. Typically this is needed when using the 2-wire RS-485 interface (Half-duplex). Because the same wires are used for both receive and transmit a time delay is usually needed to allow transition time. The Host device’s RS-485 specification must be understood to determine the time delay needed.

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P1-15	BR	RS-485 communication baud rate	1	1 ~ 5	-	P	S	T	

The baud rate that takes effect after power-on in serial communication. This value will be saved immediately after being configured but will not take effect immediately until the next power-on, so the upper computer software can configure this value at any time.

Set value	Speed
1	9600bps
2	19200bps
3	38400bps
4	57600bps
5	115200bps

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P1-16	DA	RS-485 communication address	32	1 ~ 32	-	P	S	T	
In Modbus/RTU communication mode, set the node address of the drive									

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P1-17	CO	CAN open communication node address	1	1 ~ 127	-	P	S	T	
In CAN open communication mode, set the drive node address									

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P1-18	CB	CAN open communication baud rate	0	0 ~ 7	-	P	S	T	

When the DIP switch for setting the CANopen communication baud rate on the drive is set to OFF, this parameter can be configured via the Luna Software to set the CANopen communication baud rate. After this value is configured, it will be saved immediately but will not take effect until the next power-on which means the host computer software can configure this value at any time.

Set value	Speed
0	1 Mbps
1	800 kbps
2	500 kbps
3	250 kbps
4	125 kbps
5	50 kbps
6	20 kbps
7	12.5 kbps

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P1-19	ZR	Regenerative resistor resistance	200	10 ~ 32000	Ω	P	S	T	
Set the resistance value of the regenerative energy absorption resistor, and the driver calculates the discharge power on the regeneration resistor according to the current discharge voltage and resistance value. The default value is the resistance value of the regenerative energy absorption resistor built into the driver. When using an external regenerative energy absorption resistor value, the correct resistance value must be set.									

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P1-20	ZC	Regenerative resistor power rating	40	1 ~ 32000	W	P	S	T	
Sets or requests the regeneration resistor wattage value. MBDV drives dynamically calculate the continuous wattage induced into an external regeneration resistor and must know the continuous wattage rating of the regen resistor to do this effectively and avoid damaging the resistor.									

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P1-21	ZT	Regenerative resistor time constant	1000	0 ~ 8000	ms	P	S	T	
Sets or requests the regeneration resistor time constant. Decides the peak time that the resistor can tolerate full regeneration voltage.									

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P1-24	MA	Alarm mask	4294967295	0 ~ 4294967295	-	P	S	T	
When the driver generates some non-serious warning information, the corresponding bit of this parameter can shield the LED alarm display function of the corresponding warning information. When the shielded warning information is generated, it will no longer flash on the two 7 - segment digital tubes.									

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P1-25	CX	Second torque limit	3000	0 ~ 3000	0.1%	P	S	T	
Sets the second limit value of the motor output torque. Please refer to chapter 7.5 Torque limit									

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P1-26	CY	Third torque limit	3000	0 ~ 3000	0.1%	P	S	T	
Set the third limit value of motor output torque. Please refer to chapter 7.5 Torque limit									

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P1-27	CY	Fourth torque limit	3000	0 ~ 3000	0.1%	P	S	T	
Set the fourth limit value of motor output torque. Please refer to chapter 7.5 Torque limit									

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P1-28	HT	Motor stall protection time	0	0 ~ 30000	ms	P	S	T	
In position mode or position-based speed mode, stalling causes the drive to always output the rated torque of the motor. Stalling for a long time can cause the motor to overheat. This parameter sets the protection time of the motor stall, when the actual output current of the motor is equal to the rated current of the motor, and the time exceeds the setting of this parameter. r37ST (motor stall alarm) will be generated and the motor will be disabled.									

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P1-29	YV	The action of the dynamic brake when it is disabled	0	0 ~ 5	---	P	S	T	

Servo is OFF, the dynamic braking action is set by parameter P1-29, and the longest action time during deceleration is set by parameter P1-31, please refer to the table below. The deceleration process means that when the dynamic braking takes effect, the actual speed of the motor decelerates from the speed when it takes effect to within the zero-speed threshold of parameter P5-42, or the deceleration time reaches the set time of P1-31.

Value	Description	
	Deceleration process	After stopping
0	Slow down with parameter P2-01	Remain free-moving state
1	Slow down with parameter P2-01	Dynamic braking action
2	Free-moving state	Remain free-moving state
3	Free-moving state	Dynamic braking action
4	Dynamic braking action	Remain free-moving state
5	Dynamic braking action	Dynamic braking action

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P1-30	YR	The action of the dynamic brake when an error is reported	0	0 ~ 3		P	S	T	

When the servo reports an error, the dynamic braking action is set by parameter P1-30, and the longest action time during deceleration is set by P1-32, please refer to the table below. The deceleration process means that when the dynamic braking takes effect, the actual speed of the motor decelerates from the speed when it takes effect to within the zero-speed threshold of parameter P5-42, or the deceleration time reaches the set time of P1-31.

Value	Description	
	Deceleration process	After stopping
0	Free-moving state	Remain free-moving state
1	Free-moving state	Dynamic braking action
2	Dynamic braking action	Remain free-moving state
3	Dynamic braking action	Dynamic braking action

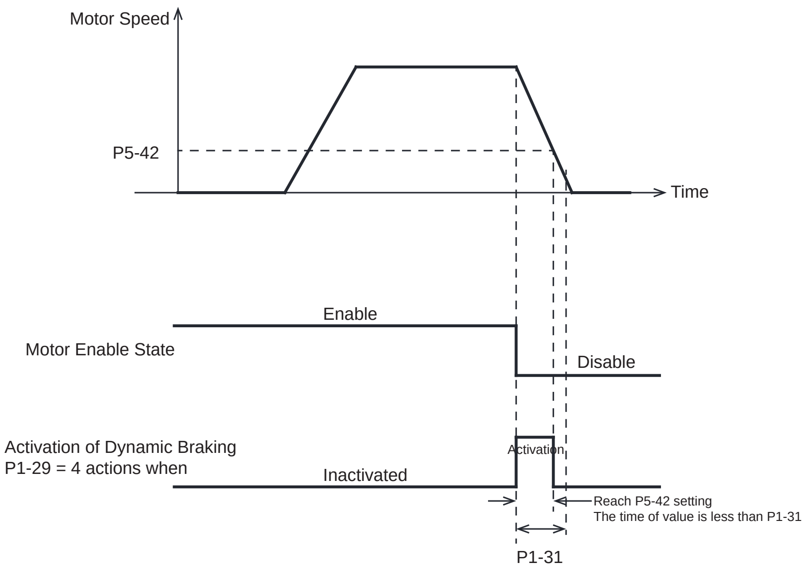
Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P1-31	YM	Dynamic brake The longest movement during a deenabled deceleration Work time	500	0 ~ 30000	ms	P	S	T	F

This parameter sets the longest action time of dynamic braking during deceleration when the servo is OFF.

The deceleration process means that when the dynamic braking takes effect, the actual speed of the motor decelerates from the speed when it takes effect to within the zero-speed threshold of parameter P5-42, or the deceleration time reaches the setting of P1-31.time.

● When the deceleration time exceeds the setting of P1-31, even if the actual speed of the motor is still greater than that of P5-42, the dynamic brake will no longer work.

The figure below is when P1-29 = 4 ms.



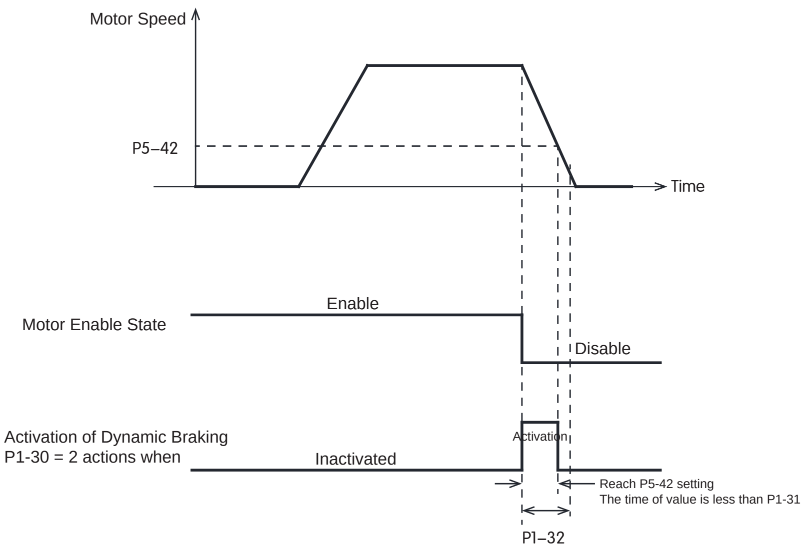
Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P1-32	YN	The longest action time of the brake during an errored deceleration	0	0 ~ 30000	ms	P	S	T	F

This parameter sets the longest action time of the dynamic brake during the deceleration process after the servo reports an error.

The deceleration process means that the actual speed of the motor decelerates from the effective speed to within the zero-speed threshold of parameter P5-42 when the dynamic brake is effective, or the deceleration time reaches the setting of P1-32.time.

● When the deceleration time exceeds with the setting of P1-32, even if the actual speed of the motor is still greater than that of P5-42, the dynamic brake will no longer work.

The figure below is when P1-30 = 2 ms.



Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P1-34	RT	Current Ramp Limit	1000	00 ~ 3000	0.1%	P	S	T	
The first speed value in multi-speed mode for multi-speed control, please refer to the chapter 7.2.13 multi-stage speed control mode									

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P1-37	DV	Dynamic brake velocity	50	0 ~50	rps	P	S	T	
The maximum speed at which the dynamic brake can be activated.									

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P1-38	DW	Dumping Voltage Setting	650	200 ~ 850	0.1V	P	S	T	
Sets or request dumping voltage level for MBDV drives. When voltage is above set level, regen resistor will be triggered									

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P1-39	ZS	Watchdog trigger time	500	0 ~ 10000	ms	P	S	T	
Sets or requests the amount of time before a communication loss is detected. The internal timer is reset when a new network application message is received and then proceeds to counts down. When the internal timer reaches zero, the action set by ZA is performed.									

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P1-40	ZA	Action after the watchdog is triggered	1	1 ~ 16	——	P	S	T	
Sets or requests the action taken when communication loss has been detected.									

8.3.3 P2-XX: Trajectory--- trajectory planning

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P2-00	VM	Maximum Velocity	80	0 ~ 100	rps	P	S	T	F
Set the maximum running speed of the motor. When the actual speed of the motor exceeds the set value of P2-00, r12OV (motor stall alarm) will be generated.									

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P2-01	AM	Maximum acceleration/deceleration	3000	0.167 ~ 5000	rps/s	P	S	T	F
Sets or requests the maximum acceleration/deceleration allowed. When the set acceleration / deceleration is greater than the set maximum value, the actual running acceleration / deceleration will be limited to the maximum value. At the same time, this value is also the maximum braking deceleration value after the emergency stop command or hitting the limit switch.									

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P2-02	JS	Jog velocity	10	-100 ~ 100	rps	P	S	T	
Sets or requests the speed for Jog moves in rev/sec.									

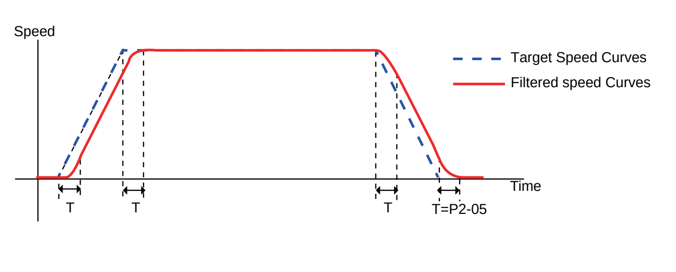
Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P2-03	JA	Jog acceleration	100	0.167 ~ 5000	rps/s	P	S	T	
Sets or requests the accel/decel rate for Jog moves in rev/sec/sec. Sending JA with no parameter causes drive to respond with present jog accel/decel rate. Setting JA overwrites the both the last JA and JL values. This means that to have different jog accel and jog decel values, you should first send JA to set the jog accel and then send JL to set the jog decel. The JA value cannot be changed while jogging.									

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P2-04	JL	Jog deceleration	100	0.167 ~ 5000	rps/s	P	S	T	
Sets or requests the decel rate for Jog moves and velocity (oscillator) modes in rev/sec/sec. The JL value cannot be changed while jogging. JA sets both the JA and JL values, so when a different JL value is required set JA first, then set JL									

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P2-05	JT	Jerk time	10	0 ~ 125	ms	P	S	T	F

Parameter P2-05 jerk time takes effect in internal trajectory mode (position, speed, torque), analog position, analog speed, analog torque, or communication command control.

The effect of jerk smoothing on the input command is shown in the figure below.



- ◆ The acceleration filter will cause a certain delay to the command T, but will not affect the final positioning accuracy
- ◆ The larger the time constant of P2-05 is, the more obvious the smoothing effect is, and the command response delay will also increase. A reasonable filter time constant should be set according to the actual application.

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P2-06	VE	Target Velocity (point-to-point)	10	0.0042 ~ 100	rps	P	S	T	F
The target speed command in point-to-point command position mode.									

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P2-07	AC	Target acceleration (point-to-point)	100	0.167 ~ 5000	rps/s	P	S	T	F
Acceleration value in point-to-point command position mode.									

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P2-08	DE	Target deceleration (point-to-point)	100	0.167 ~ 5000	rps/s	P	S	T	F
Deceleration value in point-to-point command position mode.									

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P2-09	VC	Velocity change (point-to-point)	2	0 ~ 100	rps	P	S	T	F
The internal position mode has point-to-point positioning control with variable speed. This parameter is used to set the speed value of the second stage.									

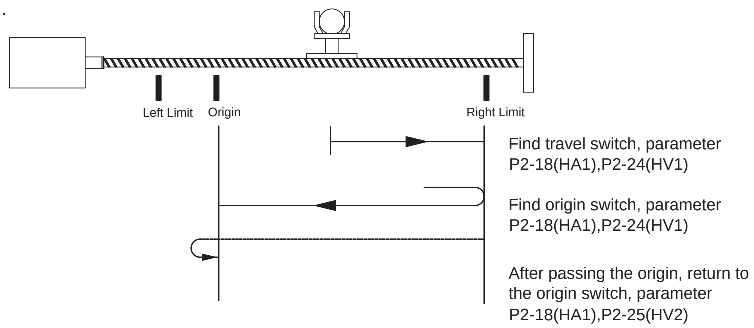
Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P2-18	HA1	1st Homing acceleration/deceleration	100	0.167 ~ 5000	rps/s	P	S	T	
Sets or requests the acceleration/deceleration rate used in the homing function.									

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P2-24	HV1	Homing velocity 1	10	0.0042 ~ 100	rps	P	S	T	
Sets the velocity used in the first state of a homing operation.									

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P2-25	HV2	Homing velocity 2	1	0.0042 ~ 100	rps	P	S	T	
Sets the velocity used in the second stage of a homing operation.									

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P2-27	HO	Homing offset	0	-2147483647 ~ +2147483647	pulses	P	S	T	

Sets the offset value during a homing operation. As an example, this value dictates the distance that the motor will back away from a hard stop during a hard stop home operation.

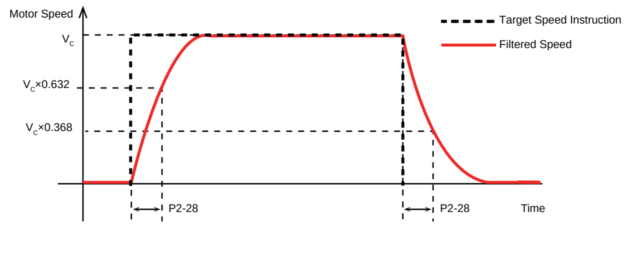


P2-18, P2-24, P2-25, P2-27 parameters are the configuration parameters of the built-in homing function of the drive. For detailed functions of homing, please refer to 7.10 _ return to origin can

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P2-28	KJ	Jerk filter	0	0 ~ 1000	ms	P	S	T	

Parameter P2-28 low-pass smoothing filter can take effect in the control mode used, such as: internal trajectory mode (position, speed, torque), analog position, analog speed, analog torque, communication command control, etc.

The smoothing effect of the low-pass filter on the input command is shown in the figure below.



◆ Low-pass smoothing filter will produce a certain delay T for the instruction, but it will not affect the final positioning accuracy.

◆ The larger the time constant of P2-28, the more obvious the smoothing effect, and the longer the instruction response delay. Therefore, we should set the reasonable filter time constant according to the practical application.

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P2-30	VT	Speed limit in torque mode	80	0 ~ 100	rps	P	S	T	

In torque control mode, this parameter can be used as the direct speed limit. No input is required to enable this speed limit. It will be enabled as soon as torque control mode is enabled at the drive.

8.3.4 P3-XX group: Encoder & Step/Dir--- Encoder and input pulse settings

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P3-04	PF	Position error limit	100000	0 ~ 2147483647	pulses	P	S	T	

The threshold for position error overrun error.

During the movement, when the deviation between the target position and the actual position fed back by the encoder exceeds the threshold, an error over-limit error will occur. The drive LED display panel will display an error code 10

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P3-05	EG	Electronic Gearing	10000	200 ~ 131072	pulses/rev	P	S	T	

Set the number of pulses per revolution of the motor.

When parameter P3-16 = 1, this parameter setting is invalid and has no effect on the resolution of the motor. The number of pulses required for each revolution of the motor will be set by the parameter P3-00 electronic gear ratio numerator and P3-01 Motor gear ratio denominator.

<table>
<tr><th>Parameter</th><th>Instruction</th><th>Name</th><th>Defaults</th><th>Range</th><th>Unit</th><th colspan="4">Related Patterns</th></tr>
<tr><td>P3-12</td><td>PO</td><td>Encoder feedback output mode</td><td>1</td><td>0 ~ 256</td><td>-</td><td>P</td><td>S</td><td>T</td><td></td></tr>
<tr><td colspan="10">Sets the output pulse source, output pulse phase, and Z pulse output polarity type. The functions corresponding to each bit are as follows.</td></tr>
</table>

<table>
<tr><th colspan="8">Parameter P3-03 input pulse setting</th></tr>
<tr><th>bit7</th><th>bit6</th><th>bit5</th><th>bit4</th><th>bit3</th><th>bit2</th><th>bit1</th><th>bit0</th></tr>
<tr><td rowspan="3">0</td><td rowspan="3">0</td><td rowspan="3">0</td><td rowspan="3">0</td><td>Z pulse output polarity</td><td>phase relationship between A and B at forward rotation</td><td colspan="2">Output pulse source</td></tr>
<tr><td>0: positive polarity</td><td>0：A leads B 90°</td><td colspan="2" rowspan="2">bit1=0, bit0=1: motor encoder</td></tr>
<tr><td>1: Negative polarity</td><td>1：B leads A 90°</td></tr>
<tr><td colspan="8">get rid of text and remove this box on the chart</td></tr>
</table>

◆ **Output source setting**

The pulse frequency division output function supports the output of the following three signal sources through the frequency division function

Set value	Description
bit1=0,bit0=1	Motor encoder

Note: When the signal source is external pulse command, parameter P3-13 and parameter P3-14 are invalid, and the command pulse does not do any processing and is directly output by-pass. P3-12 's bit2 bit

And the setting of bit3 will also be invalid.

◆ **A/B phase relationship in forward rotation**

When setting forward rotation, the external second encoder

Set value	Description
0	A leads B 90°
1	B leads A 90°

◆ **Set the polarity of the Z-phase pulse**

Set the polarity of the Z-phase pulse

Set value	Description
0	Rising edge
1	Descending edge

For detailed pulse output frequency division settings, please refer to the chapter 7.6 Encoder frequency division output function

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P3-13	ON	Pulse output gear ratio - numerator	10000	0 ~ 13107200	-	P	S	T	
Set the encoder frequency division output numerator									

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P3-14	OD	Pulse output gear ratio - denominator	131072	0 ~ 13107200	-	P	S	T	

Set the denominator of the encoder frequency division output.

When the source of the output pulse is the motor encoder or the second encoder, by setting the numerator and denominator of the frequency division output gear ratio of the encoder, you can set the number of pulses output.

$$\text{Number of output pulses per revolution} = \frac{\text{P3-13 Pulse output gear ratio - numerator}}{\text{P3-14 Pulse output gear ratio - denominator}} \times 65535$$

Note:

- The numerator of the frequency division ratio of P3-13 must be less than the denominator of the frequency division ratio of P3-14
- When P3-13 > P3-14, the number of pulses output by the motor per revolution (after the A/B phase is multiplied by 4) = P3-13

For detailed pulse output frequency division settings, please refer to the chapter 7.6 Encoder frequency division output function

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P3-15	ES	Absolute encoder setting	1	0 ~ 3	-	P	S	T	

Set the use mode of the motor absolute encoder:

Set value	liiustrate	Note
0	Incremental encoder	Used as an incremental encoder, no multi-laps of lost alarm will be generated if the battery is not plugged in.
1	Single-turn absolute encoder	Absolute position within one revolution of the feedback motor

8.3.5 Group P5-XX: IO settings

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P5-00	MU1	Digital input 1 function		0 ~ 46		P	S	T	

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P5-01	MU2	Digital input 2 function		0 ~ 46		P	S	T	

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P5-02	MU3	Digital input 3 function		0 ~ 46		P	S	T	

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P5-03	MU4	Digital input 4 function		0 ~ 46		P	S	T	

Parameters P5-00~P5-03 sequentially set the function of digital input X1~X4. The following functions and logic states can be assigned to the inputs.

Signal name	Shorthand notation	Set value and effective logic	
		Valid when closed	Valid when Open
Universal input	GPIN	0	-
Servo enable	S-ON	1	2
Alarm clear	A-CLR	3	4
Forward rotation prohibition limit	CW-LMT	5	6
Reverse prohibition limit	CCW-LMT	7	8
control mode switch	CM-SEL	9	10
Gain switching	GAIN-SEL	11	12
emergency stop	E-STOP	13	14
Return-to-origin start	S-HOM	15	16
Torque limit input	TQ-LMT	19	20
Zero speed clamp input	ZCLAMP	21	22
Multi-speed start	SP-STA	33	34
speed command direction	SPD-DIR	35	36
Speed limit input	V-LMT	37	38
Origin switch signal input	HOM-SW	39	40
Execute the Q program	START-Q	45	46

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P5-12	MO1	Digital output 1 function		0 ~ 34		P	S	T	

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P5-13	MO2	Digital output 2 function		0 ~ 34		P	S	T	

Parameters P5-12~P5-13 sequentially set the digital output port Y1~Y2 function.
The following functions and logic states can be assigned to the inputs.

Signal name	Shorthand notation	Logic and set value when output signal is valid	
		Output when the signal is valid Closed	Output when the signal is valid Open
Universal output	GPOUT	0	-
Fault output (error)	ALM	1	2
Warning output (alarm)	WARN	3	4
Brake release output	BRK	5	Not Supported
Servo-on status output	SON-ST	7	8
Positioning complete output	IN-POS	9	10
Dynamic position error overrun	DYM-LMT	11	12
Torque reaches output	TQ-REACH	13	14
Output during torque limit	T-LMT	15	16
Speed consistent output	V-COIN	17	18
Speed reaches output	AT-SPD	19	20
Output in speed limit	V-LMT	21	22
Servo Ready output	S-RDY	23	24
Return-to-origin completion signal	HOMED	25	26
Same location	P-COIN	31	32
Zero speed signal	Z-SPD	33	34
Torque consistent output	T-COIN	35	36

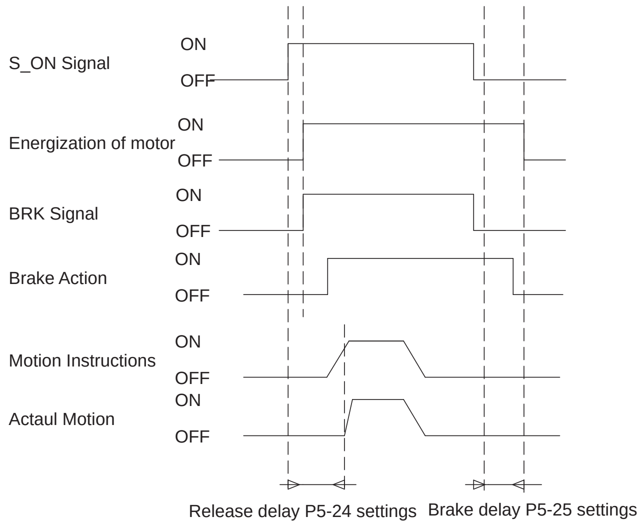
Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P5-14	MO3	Digital output 3 function		0 ,5		P	S	T	

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P5-24	BD	Movement waiting time after brake release	200	0 ~ 32000	ms	P	S	T	

Set the waiting time for the first movement after the driver is enabled, to ensure that the brake release output pin has successfully released the motor brake.

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P5-25	BE	Motor disable delay time after brake applied	200	0 ~ 32000	ms	P	S	T	

The 5-25 parameter sets the delay time between the moment the brake is applied to the motor and the moment the motor is disabled. This ensures that the brake is fully applied, before disabling the motor to make sure the load does not move unexpectedly.



Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P5-27	HX	Home sensor	4	1 ~ 4	-	P	S	T	

This parameter is simply to monitor which input pin has been assigned the "Home Sensor" function. To assign the "Homing Sensor" function to an input, this must be configured separately via the P5-00 ~ P5-03 parameters.

Display value	Digital input pin
1	X1
2	X2
...	Sequential analogy

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P5-28	FI1	Digital input 1 filtering	2	0 ~ 8000	ms	P	S	T	

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P5-29	FI2	Digital input 2 filtering	2	0 ~ 8000	ms	P	S	T	

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P5-30	FI3	Digital input 3 filtering	2	0 ~ 8000	ms	P	S	T	

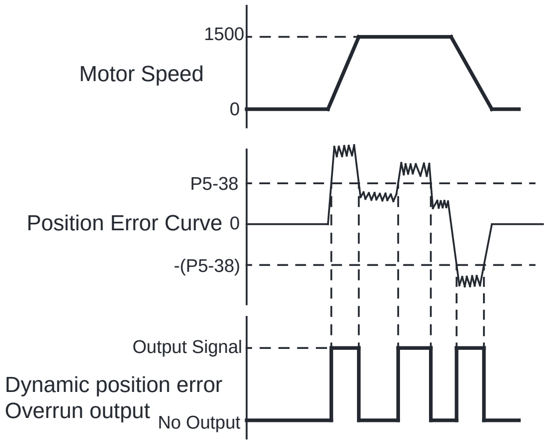
Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P5-31	FI4	Digital input 4 filtering	2	0 ~ 8000	ms	P	S	T	

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P5-38	PL	Dynamic error threshold	10	0 ~ 2147483647	pulses	P	S	T	

Position mode, parameter P5-38 sets the judgment condition for dynamic position error overrun output.

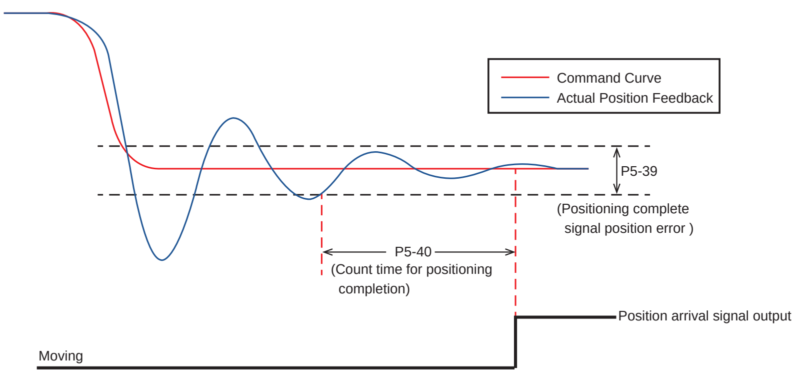
◆ Dynamic position error overrun output judgment conditions:

Dynamic position error refers to the output of this signal when the difference between the actual position of the motor and the commanded position is greater than P5-38 during the operation of the motor.



Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P5-39	PD	Positioning complete error margin	40	0 ~32000	pulses	P	S	T	

The position mode, parameter P5-39 sets the judgment condition of the positioning completion signal output.



Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P5-40	PE	Motion condition timer	10	0 ~ 30000	ms	P	S	T	

Sets the timer for various motion conditions. Depending on the control mode used, this timer will be relevant to different motion characteristics. Please see the following sections for detailed information.

7.2.3 Position Complete Signal

7.3.5 Velocity Reached Output

7.3.6 Velocity Consistent Output

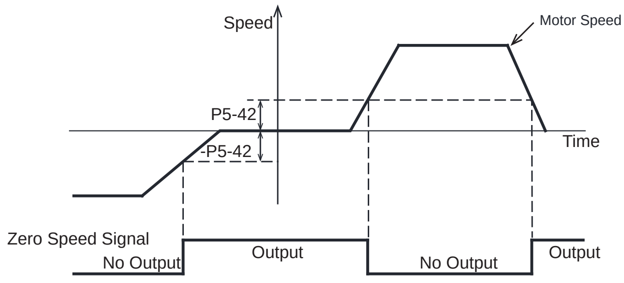
Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P5-42	ZV	Zero speed judgment threshold	0.5	0.1 ~ 2	rps	P	S	T	

P5-42 parameter is set to judge whether the motor has zero speed or not.

When the absolute value of the actual speed of the motor is less than P5-42 (zero speed judgment threshold), the servo drive outputs the zero-speed signal Z-SPD. On the contrary, if the absolute value of the actual speed of the motor

If it is larger than this value, the zero-speed signal Z-SPD will not be output.

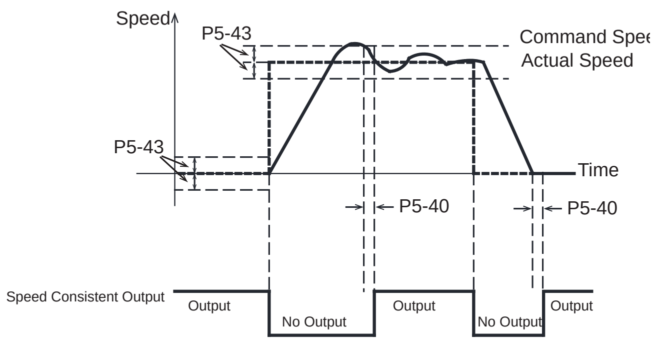
The judgment of the zero-speed signal is not affected by the control mode and servo state. Therefore, this signal can also be used as the moving signal of the motor.



Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P5-43	VR	Velocity Reached - Permissible fluctuation range	0.1	0 ~ 100	rps	P	S	T	

In velocity control mode, when the fluctuation of the actual velocity from the commanded velocity is within the margins set by P5-43, for the duration of time specified by P5-40, then it is determined that the actual speed of the motor is consistent with the commanded velocity and the velocity consistent signal, V-COIN, is output.

If the actual velocity falls outside of the margins set by P5-43, V-COIN will not be output.

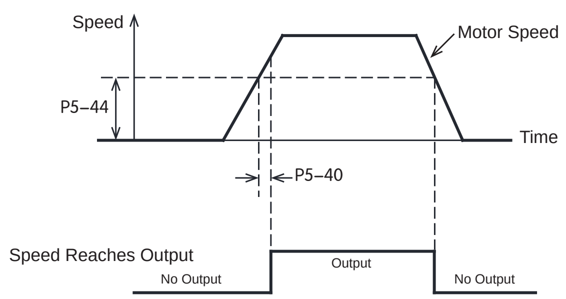


Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P5-44	VV	Velocity Reached - Minimum threshold	10	0 ~ 100	rps	P	S	T	

In velocity control mode, when the actual speed of the motor after filtering exceeds P5-44, and the time exceeds P5-40 (counting time for positioning completion), the signal for velocity reached, AT-SPD, is output.

the signal for velocity reached, AT-SPD, is output.

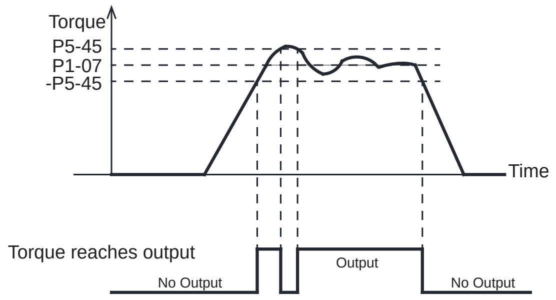
If the actual speed of the motor after filtering does not exceed P5-44 ", the signal AT-SPD will not be output"



Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P5-45	TV	Torque Reached - Permissible fluctuation range	10	0 ~ 3000	0.1%	P	S	T	

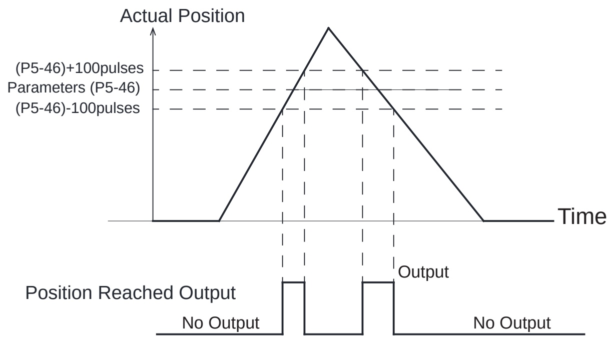
When operating in torque control, if the absolute value of the actual torque reaches the target torque (P1-07), remains within the permissible fluctuation range (P5-45) for the amount of time specified by P5-40, the Torque Reached output signal (TQ-REACH) will be output.

If any of the above conditions is not satisfied, the TQ-REACH signal will not be output.



Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P5-46	DG	Absolute position	10000	-2147483647 ~ +2147483647	pulses	P	S	T	

When the actual position of the motor is equal to the setting of parameter P5-46, it will output the same P-COIN signal. The fluctuation range is ± 100pulses. .



Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P5-47	LP	Positive software limit	0	-2147483647 ~ +2147483647	pulses	P	S	T	

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P5-48	LM	Negative software limit	0	-2147483647 ~ +2147483647	pulses	P	S	T	

Parameter P5-47 ~ P5-48 set the internal software limits of the drive.

When the motor is moving in the positive direction, and the current position is equal to or exceeds the set value of P5-47, the positive software limit reached alarm will be generated

When the motor is moving in the negative direction, and the current position is equal to or exceeds the set value of P5-48, the negative software limit reached alarm will be generated

Note:

◆ When the encoder type is incremental encoder, after the drive is powered on, parameters P5-47 and P5-48 can be set and the software limit can work normally, but cannot be saved after power off. After power on again, the parameter returns to the default value " 0 "

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P5-49	HE	Homing method	1	-4 ~ 40	-	P	S	T	
Set the method of homing. For details on how to home, please refer to the chapter 7.8 Home Function									

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P5-50	EO	E-Stop method	5	1 ~ 8	-	P	S	T	
Set the emergency stop method when emergency stop is triggered by digital input.									

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P5-51	MS	zero speed clamp function	0	0 ~ 1	-	P	S	T	
See Section 7.3.2 Zero Speed Clamp Function for detailed information on this parameter.									

9 Troubleshooting

9.1 List of drive alarms

When an alarm occurs in the driver, the LED digital display on the driver flashes to display the alarm code. The alarm code is defined as follows:

Display content	Description	Type of alert	Drive status after alarm	Resettable
01	Drive over temperature alarm	Fault	Servo off	Yes
02	Internal voltage alarm	Fault	Servo off	no
03	Drive overvoltage alarm	Fault	Servo off	Yes
04	Overcurrent	Fault	Servo off	Yes
05		Fault	Servo off	Yes
06		Fault	Servo off	Yes
09	Encoder signal error	Fault	Servo off	no
10	Position error overrun	Fault	Servo off	Yes
11	Drive low voltage alarm	Fault	Servo off	Yes
12	Stall Alarm	Fault	Servo off	Yes
13	Limit switch triggered	Warning	The motor cannot rotate without changing the current state	Yes
14	Negative limit switch triggered	Warning	Without changing the current state, the motor cannot continue to reverse	Yes
15	Positive limit switch triggered	Warning	Without changing the current state, the motor cannot continue to rotate forward	Yes
16	Current Limit	Warning	Do not change the current state	Yes
17	Communication error	Warning	Do not change the current state	Yes
18	Parameter save failed	Warning	Do not change the current state	Yes
20	Safe torque off	Warning	Servo off	Yes
21	Regeneration Failed	Fault	Servo off	Yes
22	Undervoltage warning	Warning	Do not change the current state	Yes
23	No Q program warning	Warning	Do not change the current state	Yes
24	Motion command received while motor disabled	Warning	Do not change the current state	Yes
25	Internal voltage error	Fault	Servo off	no
26		Fault	Servo off	no
27	Emergency stop	Warning	Motor decelerates to stop	Yes

Display content	Description	Type of alert	Drive status after alarm	Resettable
30	Memory error	Fault	Servo off	Yes
34	Motor overtemperature	Fault	Servo off	Yes
35	Drive processor overtemperature	Fault	Servo off	Yes
37	Motor stall	Fault	Servo off	Yes
39	Homing parameters configuration error	Warning	Do not change the current state	Yes
40	Motor Collision Alarm	Fault	Servo off	Yes
41	Encoder communication error	Fault	Servo off	no
42	IO signal used is not general purpose	Warning	Do not change the current state	no
43	Bus watchdog trigger	Warning	Do not change the current state	no

9.2 Driver Alarm Causes and Solutions

Display content	Description	Alarm Causes	Alarm Fixes	Alarm Status
01	Drive over temperature	The temperature of the driver's heat sink and power element exceeds the specified value. 1. Ambient temperature is too high 2. The operating temperature of the driver exceeds the specified value; 3. Overload, exceeding the rated load of the drive and connecting continue to use	1. Reduce drive operating temperature and improve cooling conditions; 2. Increase the capacity of the driver and motor, and extend the acceleration and deceleration time time, reduce the load. 3. Replace the fan or send in the servo drive for repair	Alarm clear
02	Internal voltage error	The internal voltage of the driver is lower than the normal value	Check the voltage of the power supply and replace the drive if there is still a problem.	Alarm clear
03	Drive overvoltage	The drive DC bus voltage is too high, higher than 80VDC 1. The power supply voltage exceeds the allowable input voltage range 2. The regenerative discharge resistor is disconnected; 3. The external regenerative discharge resistor does not match, resulting in Inability to absorb regenerative potential; 4. Drive failure (circuit failure).	1. Check the input voltage; 2. Check whether the external absorption resistance is set properly; 3. Detect the resistance value of the external absorption resistor, if it is ∞, it is off If the wire is damaged, please replace the external absorption resistor; 4. If the above does not solve the problem, replace the drive.	Alarm clear
04 05 06	Overcurrent	1. Drive has failed and is damaged. 2. Motor phases are shorted. 3. Motor is burned out. 4. Poor motor power cable contacts. 6. The load is too heavy and required torque higher than the motor's rated, continuous operation torque. 7. Improper gain values are affecting motor performance. 8. The load has encountered a hard stop. 9. The E-Brake is active. 10. Improper wiring e.g. motor power cables are connected to the wrong component on a machine.	1. Remove the motor cable, turn on the servo, if it still happens If it fails, it needs to be replaced with a new drive; 2. Check motor cable connections U, V, W Whether there is a short circuit, whether the connector wire has burrs, etc., connect the motor cable correctly; 3. Check motor cables U, V, W sequence is correct, U- red, V -yellow, W - blue; 4. Check the U, V, W of the motor cable Insulation resistance between the motor and the ground wire of the motor, if the insulation is poor, please replace the motor with a new one; 5. Increase the power of the motor. Extend the acceleration and deceleration time, reduce load; 6. Check the motor connections U, V, W Check whether the connector plug is off, if it is loose or off, it should be tightened; 7. Whether the gain parameters are properly debugged; 8. Measure the voltage of the brake terminals; 9. Correctly connect the motor cable and encoder cable to their respective on the corresponding axis.	Alarm clear
09	Encoder not connected	Motor encoder not connected	1. Make sure the encoder cable is connected to the driver correctly 2. Replace the encoder cable	Re-power on to clear
10	Position error overrun	Position error exceeds the value in parameter P3-04 (PF) "Position error limit" setting	1. Check parameter P3-04 (PF) "Position error alarm limit value" is set too small; 2. Whether the gain parameters are properly debugged; 3. Whether the motor selection matches the actual load and whether the acceleration and deceleration are too big; 4. Whether an unreasonable torque limit is used; 5. The mechanical part of the motor drive is stuck, the motor is blocked 6. Whether the motor power line is connected correctly, there are multiple motors when the power cable is connected to the correct drive.	Alarm clear

Display content	Description	Alarm Causes	Alarm Fixes	Alarm Status
11	Drive low voltage alarm	DC bus voltage is too low. Input power has fallen below 18 VDC. 1. The power supply voltage is low causing a power failure. 2. The power supply capacity is not enough to operate the MBDV and Servo motor. 3. Drive has failed (circuit failure).	Measuring input voltage 1. Increase the power supply voltage capacity and replace the power supply; 2. Connect the power supply correctly; 3. If the above does not solve the problem, replace the drive.	Alarm clear
12	Speed exceeds limit	motor speed exceeds the limit value of P2-00	Check whether the motor speed command is within a reasonable range 1. Avoid excessive speed commands; 2. When overshoot occurs due to poor gain adjustment, adjust the gain; 3. Connect the encoder cable correctly according to the wiring diagram; 4. Check motor cable U, V, W sequence is correct.	Alarm clear
13	Limit switch triggered	1. Positive rotation prohibition limit and negative rotation of digital input Turn inhibit limit is triggered 2. In the absolute value system, the actual position of the motor touches the to positive and negative software	1. The external limit switch has been triggered; 2. The limit input function is not set correctly, please refer to 7.1.5 Positive Reverse Limits chapter. 3. In the absolute value system, the software limit setting is unreasonable	Automatically clear after detachment
14	Negative limit switch triggered	1. Negative limit function trigger 2. In the absolute value system, the actual position of the motor touches		Automatically clear after detachment
15	Positive limit switch triggered	1. Positive rotation prohibit limit function trigger 2. In the absolute value system, the actual position of the motor touches the to the positive software limit		
16	Current Limit	1. The load is too heavy, and the effective torque exceeds the rated speed torque, continuous operation for a long time; 2. Poor gain adjustment leads to oscillation, vibration, The motor has vibration and abnormal sound; 3. The machine is collided and the load suddenly becomes heavier, Torsion entanglement occurs.	1. Whether the gain parameters are properly debugged; 2. Whether the motor selection matches the actual load and whether the acceleration and deceleration is too big; 3. Check motor cable U, V, W sequence is correct. U- red, V -yellow, W - blue; 4. Increase the capacity of the driver and motor, and prolong the acceleration and deceleration time, reduce the load.	less than the motor rating at constant current auto clear
17	Communication error	Check the communication error when the drive is connected to the host computer	1. The Luna software is trying to establish communication with the drive (this is a normal alarm) 2. Check the communication line and communication address, whether the baud rate is set correct	Automatically clear after normal communication
18	Parameter save failed	Failed to save parameters	Please try saving again	auto clear
20	Safe torque off	Safe Torque Off STO function is activated, please reword this correctly so that it makes sense.	Confirm safety input 1, 2 The status of the input wiring or the setting of the safety sensor is triggered.	Automatically clear after STO input is normal

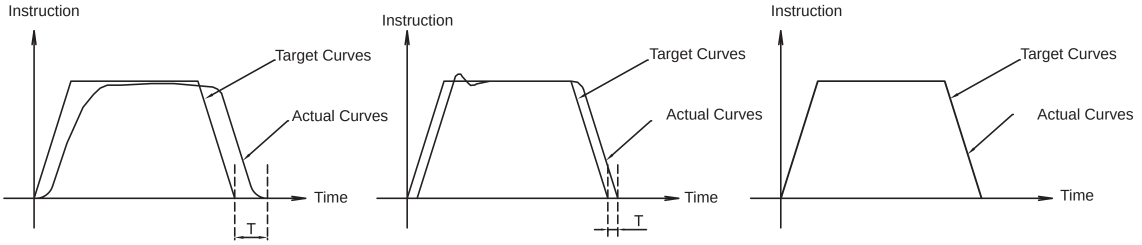
Display content	Description	Alarm Causes	Alarm Fixes	Alarm Status
21	Regeneration Failed	The regeneration energy exceeds the regeneration absorption resistance can capacity. 1. Due to the large load inertia, the generate energy, causing the bus voltage to rise, regeneration Abnormality due to insufficient energy absorption of the absorbing resistor The detected value rises; 2. The motor speed is too high to decelerate at the specified speed Regenerate energy is completely absorbed within time.	1. The external regenerative discharge resistance does not match, resulting in failure to absorb regeneration potential; 2. Reduce the running speed of the equipment and increase the acceleration and deceleration time. 3. Refer to chapter 4.7 REG- regenerative energy absorption resistor connection line	Alarm clear
22	Undervoltage warning	Driver undervoltage, below 20VDC 1. The power supply voltage is low, and an instant power failure occurs; 2. The power supply capacity is insufficient, when the main power supply is turned on the impact of the inrush current, resulting in the supply voltage under drop; 3 Drive failure (circuit failure)	Check the input voltage 1. Increase the power supply voltage capacity and replace the power supply; 2. Connect the power supply correctly, please refer to 4.3 Main -Driver Electric source wiring method; 3. Check the Main terminal of the driver and the	Alarm clear, automatically clear when the voltage is normal
23	No Q program warning	The drive is running in Q mode, but no Q program is running	1. Check if there is a Q program; 2. Check whether the working mode is correct; 3. Check whether the Q program is written incorrectly and cannot be run in a loop.	Alarm clear
24	Motion command received while motor disabled	When the motor is not enabled, the operation command is received	Please enable the motor first, and then send the running command	Alarm clear automatic clear
25 26	Internal voltage error	The internal voltage of the driver is lower than the normal value	Check the voltage of the power supply, if there is any problem, please contact the manufacturer.	Re-power on to clear
27	emergency stop	Digital input emergency stop function is triggered	1. Confirm the emergency stop input switch 2. Confirm whether the emergency stop input logic setting is reasonable	Automatically cleared when emergency stop input is released
30	memory error	Abnormal internal memory of the drive	If it cannot be cleared after powering on again, please contact the manufacturer.	Re-power on to clear
34	Motor overtemperature	The drive detects that the motor temperature exceeds the allowable value	1. Check if the ambient temperature where the motor is located is too high 2. Reduce the ambient temperature of the motor and improve the cooling conditions; 3. Increase the capacity of the driver and motor, and extend the acceleration and deceleration time time, reduce the load. 4. Whether the motor is rubbed by the load 5. When using a motor with an oil seal, please derate it. Electricity The output torque of the motor should be 70% of the rated torque of the motor 6. The temperature rise and torque of the motor is the motor installed in the standard cooling measured on the board, when the motor mounting board is small, in order to prevent The motor is overheated, please use with derating 7. The temperature of the motor is normal and cannot be cleared by re-powering on, please update change the motor	Re-power on to clear

Display content	Description	Alarm Causes	Alarm Fixes	Alarm Status
35	Drive processor over temperature	Drive processor temperature is too high	1. Detect whether the temperature of the drive installation environment is too high 2. Reduce the ambient temperature of the drive and improve the cooling conditions 3. The drive needs to be mounted on a metal backplane with good heat dissipation 4. Increase the capacity of the driver and motor, and extend the acceleration and deceleration time time, reduce the load. 5. Replace the fan or send in the servo drive for repair 6. Alarm after drive heatsink temperature is normal and power cycle still exists, please replace the drive	Alarm clear
37	Motor stall	Working in non-torque mode, when the motor is stalled time exceeds the time set by P1-28	1. Check whether the mechanical parts driven by the motor are stuck 2. Check if the electromagnetic brake is open	Alarm clear
39	Homing parameters configuration error	Origin returns parameter configuration error 1. Use the back-to-origin method with limit signal, Limit Signal not configured 2. Use the back-to-origin method with the origin signal, origin Signal not configured	Check whether the origin return parameters are fully configured	Alarm clear
40	Motor Collision Alarm	The servo system detects that the motor current is abnormal mutation 1. Motor-driven loads with other fixed negatives load collision 2. The servo gain setting is unreasonable and the gain is too large 3. Motor UVW phase sequence error, motor speeding	1. Check motor UVW phase sequence 2. Check whether the servo gain parameters are reasonable 3. Check the load	Alarm clear
41	Encoder communication error	The servo system detected an abnormality in the communication with the servo motor encoder 1. Coded wires are not wired as correctly defined 2. There is no connection code between the drive and the motor device line 3. The encoder wire is in poor contact or disconnected 4. Interference causes abnormal encoder communication 5. Encoder damaged	1. Check that the encoder wiring is according to the correct definition 2. Check the connection between the encoder cable and the driver and motor 3. Make sure the motor and driver are well grounded 4. The encoder cable uses a twisted pair with good anti-interference ability shielded wire 5. Swap the motor and encoder wiring harness respectively, and confirm that the motor is no exception	Re-power on to clear
42	IO signal used is not general purpose	1. The function of the I/O signal used in the Q program is not a general-purpose function 2. Functions of I/O Signals Used in SCL Instructions for non-generic functions	1. Configure the relevant I/O signal function as a general function 2. Use I/O signals whose functions are general-purpose functions	Alarm clear
43	Bus watchdog trigger	bus watchdog function is turned on 1. Within the set time, the drive does not receive the specified message	1. Check if the CANopen communication line is well connected 2. Check that the time set in the drive to detect a specific message is no too short 3. Check whether the time when the controller side sends a specific message too long	Alarm clear

10 Servo gain setting

Servo gain tuning is a function to optimize the response of the servo unit.

The servo drive needs to operate the motor according to the commanded requirements with as little delay as possible. In order to match more closely the commanded motion, it might be necessary for users to adjust tuning parameters. The requirement to tune is based on operation requirements and load characteristics and should not be considered a blanket requirement for all applications. The factory default tuning parameters can meet a wide range of applications, especially when there exists a mechanical reduction in the system.



The target curve is inconsistent with the actual curve

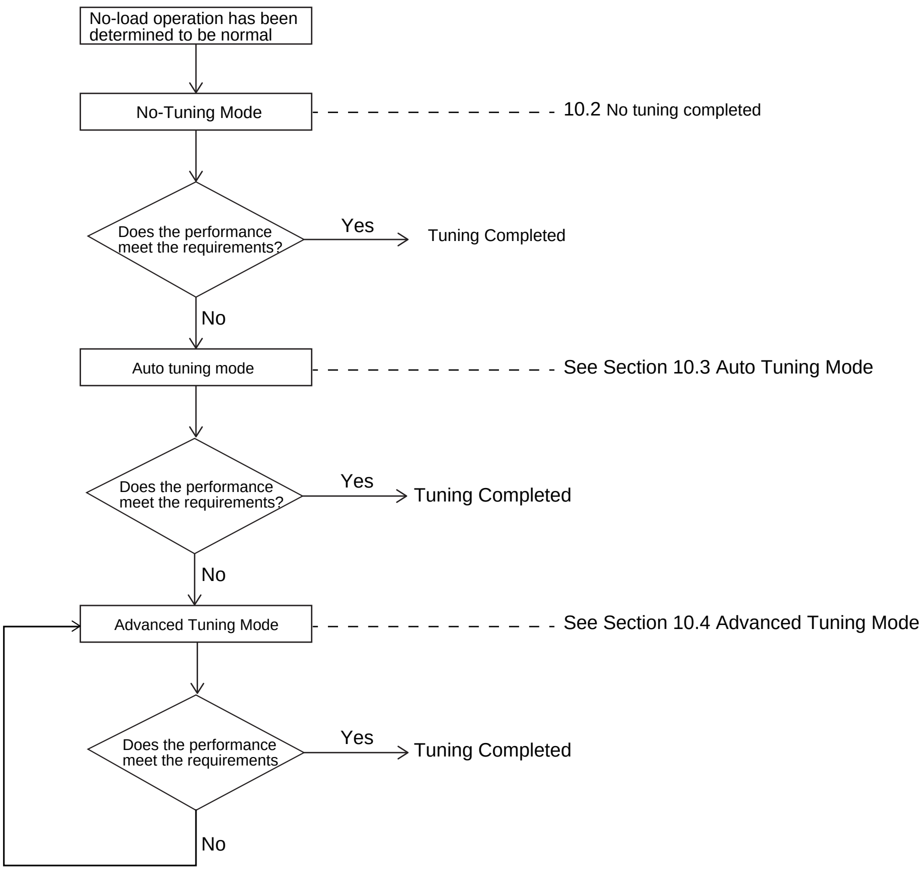
Adjust the gain parameters. The target curve is different from the actual curve. The actual curve gradually approximates

Improve the gain parameters, the target curve and the actual curve basically coincides

10.1 Servo tuning process and mode introduction

10.1.1 Servo tuning flow chart

The servo tuning flow chart is as follows. Before starting the servo tuning, make sure that the servo system can run normally according to the test run in Chapter 6.



10.1.2 Introduction to parameter tuning mode

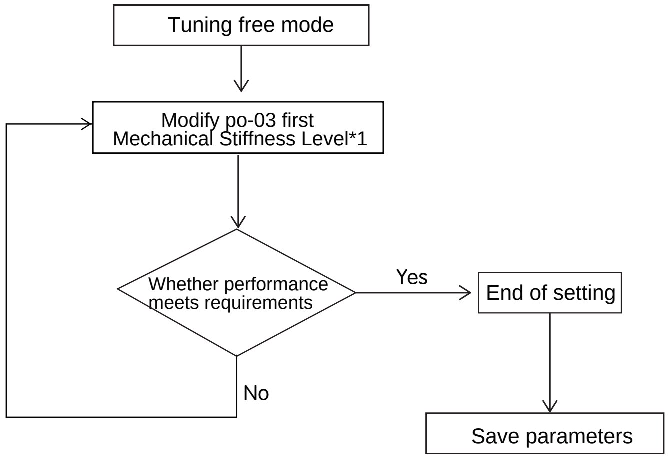
There are three Tuning Modes. The desired tuning mode is selected by parameter P0-00. See below for details.

Parameter P0-00 set value	Parameter tuning mode	Modifiable Tuning Parameters	Introduce
0	No tuning	P0-03 1st mechanical stiffness level P0-04 2nd mechanical stiffness level	When No Tuning is selected, the available parameters for performance modification are limited. Users will only have access to the mechanical stiffness parameters.
1	Auto-tuning	P0-03 1st mechanical stiffness level P0-04 2nd mechanical stiffness level P0-02 Load inertia ratio	In "auto-tuning mode", the servo system will automatically identify the external load inertia ratio, automatically select the appropriate stiffness level, and automatically adjust the following ◆ (Manual modification is invalid): ◆ Gain (position loop, velocity loop) ◆ Filter (torque filter) ◆ Vibration suppression and other parameters
2	Advanced tuning	P0-05, P0-07 P0-08, P0-11 P0-12, P0-13 P0-16 P0-17, P0-19 P0-20, P0-21 P0-22, P0-23 P0-24 P0-25, P0-27 P0-28, P0-29 P0-30, P0-31 P0-32	In advanced tuning mode, the user will have access to all servo tuning parameters and can modify them to meet their application needs.

10.2 No-Tuning Mode

" Tuning-free mode " is the default mode of the servo when it leaves the factory. The servo system is in a relatively stable state with low mechanical Stiffness. It can be powered on and run after installation, which meets most application requirements.

You can try to select the initial mechanical Stiffness that can make the servo system move normally, and gradually adjust the mechanical Stiffness level to make the servo mechanical Stiffness meet the application requirements.



Note in this mode:

- ◆ The inertia ratio P0-02 is forced to the default value of 0 and cannot be modified.
- ◆ Modification of other gain parameters is not available.
- ◆ When the gain is switched, the second group of mechanical Stiffness level PO-04 is valid

10.3 Auto tuning mode

In "auto-tuning mode", the servo system will automatically identify the external load inertia ratio, automatically select the appropriate mechanical Stiffness level, and automatically optimize and adjust the following contents:

● Gain (position loop, velocity loop)

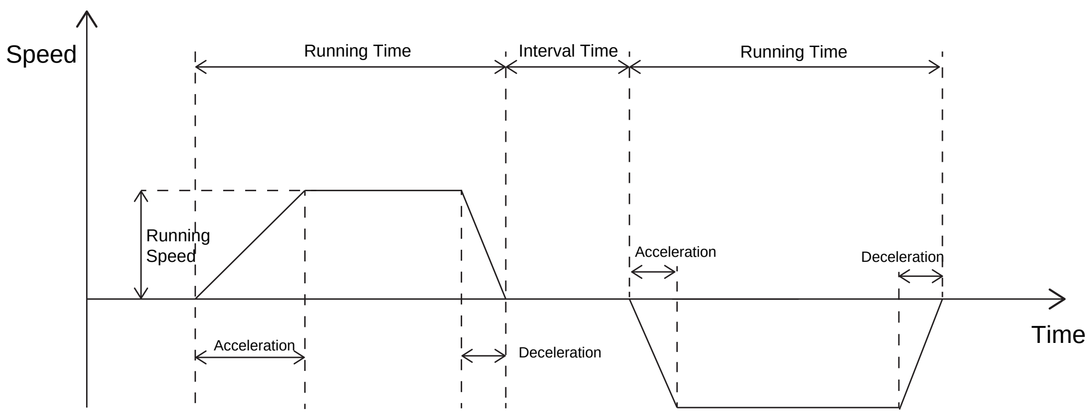
● Filter (torque filter) During auto-tuning, the parameters in the table below will be changed automatically. After the auto-tuning is completed, the parameters are automatically stored in the drive.

Parameter	Name	Whether manual modification is valid in auto-tuning mode
P0-02	Load inertia ratio	Yes
P0-03	1st mechanical stiffness level	Yes
P0-05	1st position loop gain	no
P0-07	1st position loop derivative time constant	no
P0-08	1st position loop derivative filter	no
P0-09	Velocity feedforward gain	no
P0-10	Velocity feedforward filter frequency	no
P0-11	1st velocity command gain	no
P0-12	1st velocity loop gain	no
P0-13	1st speed loop integral time constant	no
P0-14	Acceleration feed forward gain	no
P0-15	Acceleration feedforward filter frequency	no
P0-16	1st command torque filter frequency	no

10.3.1 Auto-tuned motion profile conditions

In order to accurately complete the automatic tuning of parameters, it is necessary to set a reasonable motion trajectory, including distance, running speed, running time, acceleration and deceleration, and interval time between two movements.

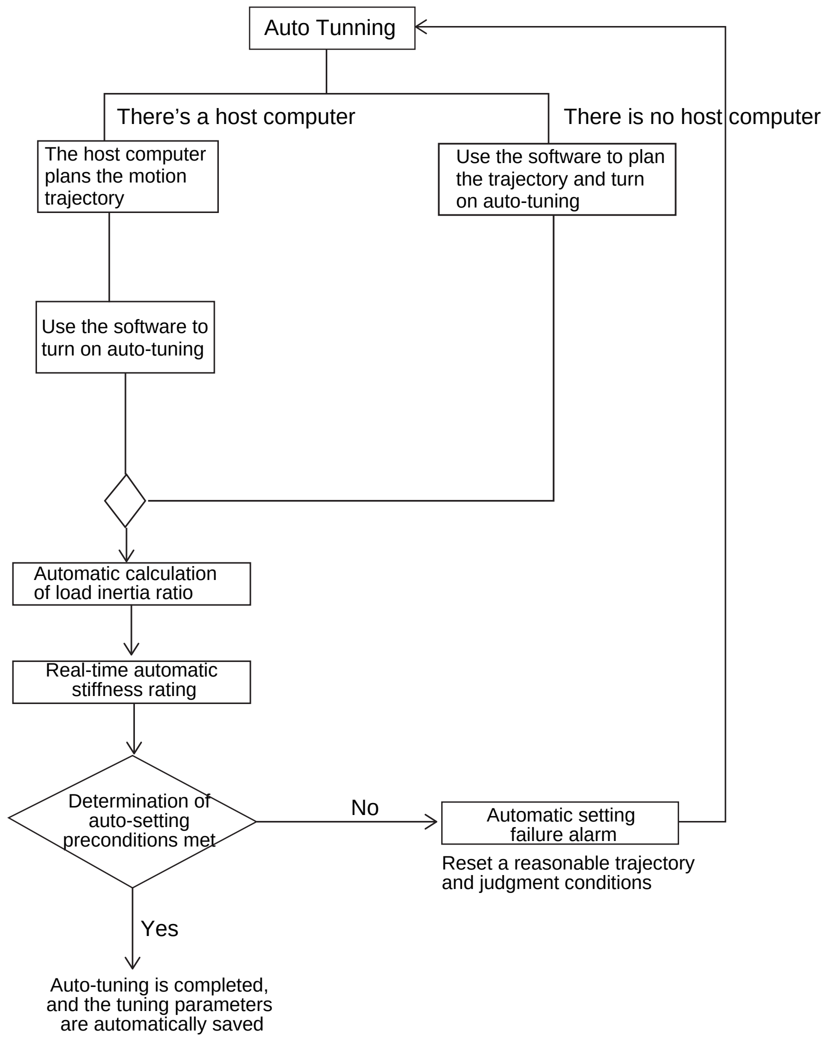
Running time: greater than 0.5 seconds
Running speed: greater than 180rpm
Acceleration and deceleration: greater than 30rps/s
Interval time: greater than 1.5 seconds



Before starting auto-tuning, it is recommended that the mechanical Stiffness level of P0-03 be 5

10.3.2 Auto-Tuning Flowchart

Users can perform automatic parameter tuning and debugging through Luna software or the operation panel on the driver. The flow chart of automatic tuning is as follows

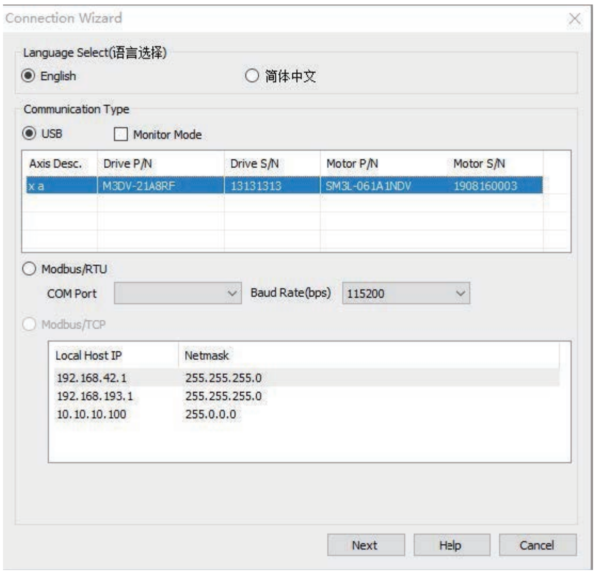


After completing the automatic tuning, you can continue to use parameters P0-03 and P0-04 to adjust the response and mechanical Stiffness of the servo system.

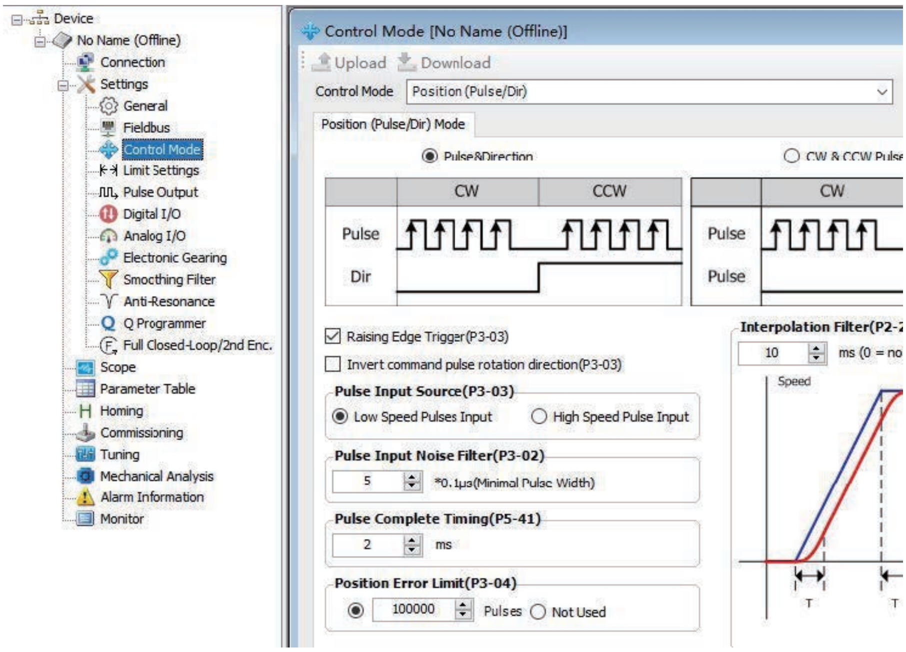
10.3.3 Start auto-tuning -- software operation on

It is recommended that Luna software be used for automatic tuning mode. The steps are as follows.

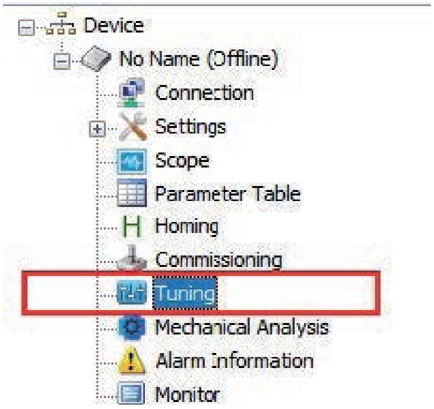
Step 1: Use the connection wizard ---- select the drive to be connected ---- click " Next " to establish communication with the drive



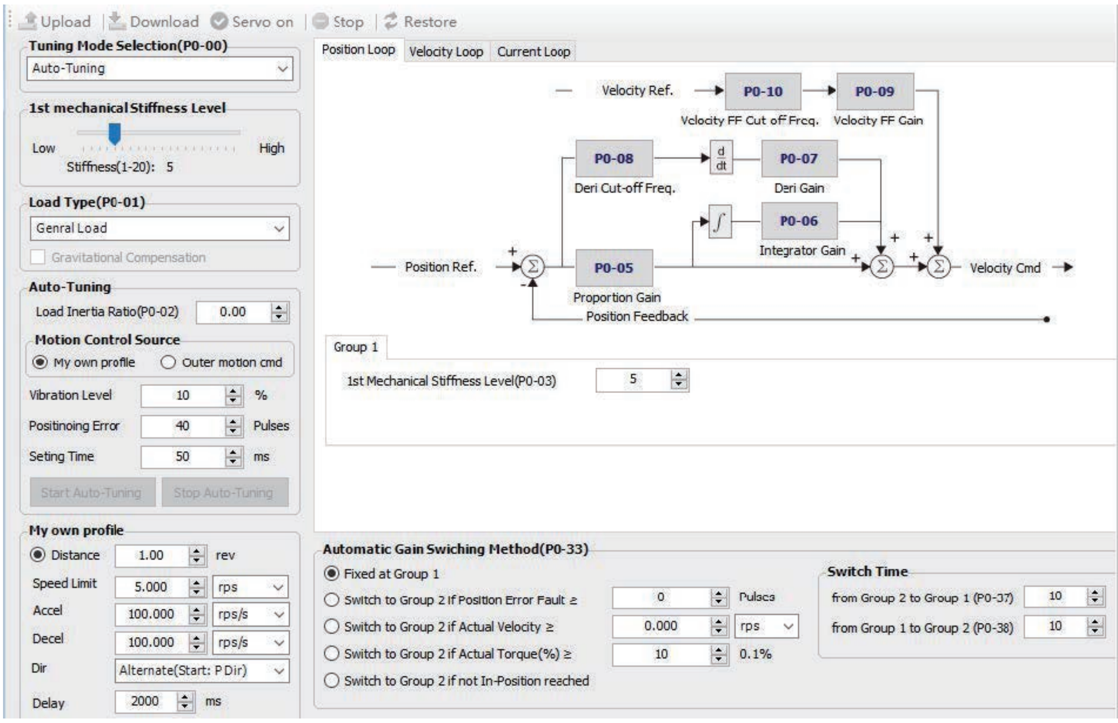
Step 2: Set the control mode to position control



Step 3: Select the " Tuning " function in the left tree interface



Step 4: In the debugging interface, set the parameter tuning mode to " Auto tuning "



- **First mechanical Stiffness grade:**

Set the appropriate first mechanical Stiffness level (P0-03), the general recommended value is “5” when running for the first time

- **Load type**

According to the current load, select the corresponding load type

Load type	Description
normal load	Suitable for most loads except belt loads
Rigid load	Horizontal turntable, ball screw, etc. with good mechanical Stiffness
Flexible load	Suitable for loads with poor mechanical Stiffness such as belts and chains

- **Load inertia ratio**

If the current load inertia ratio is known, input it into " Load inertia ratio (P0-02) “, which can improve the system mechanical Stiffness and speed up the auto-tuning speed. If you do not know the current load inertia ratio, you do not need to fill in, the system will automatically identify the load inertia ratio.

- **Motion control source custom trajectory planning**: use the software's " custom trajectory planning " to generate the trajectory

External motion command: select this item when using the host computer to send the motion track

- **Limitations of Auto Tuning**:

Vibration Level：The maximun torque vibration value that the servo system needs to be met when in auto tuning process. The larger the set value, the higher the system stiffness after auto tuning is finished.

Positioning Error：The maximum position following error that the servo system needs to be met.The smaller the set value, the higher the system stiffness after auto tuning is finished.

Setting Time：The longest positioning setting time that the servo system needs to be met. The smaller the set value, the higher the system stiffness after auto tuning is finished.

The default value of those parameters above can be used for most applications, they don't need to be set unless excellent stiffness and system response are needed. Note that too extreme conditions may cause servo system vibration easily and unstable.

Step 5: Start the Auto Tuning

After the above configurations are set, set the motion profile that meets the following conditions, and then click the "Start Auto Tuning" button to start the tuning process. The source of motion command can be choose by "My own profile" or "Outer motion profile".

Required Motion Profile：

Travel Time：> 0.5 seconds

Travel Speed：> 180 rpm

Acc./Dec.：> 30rps/s

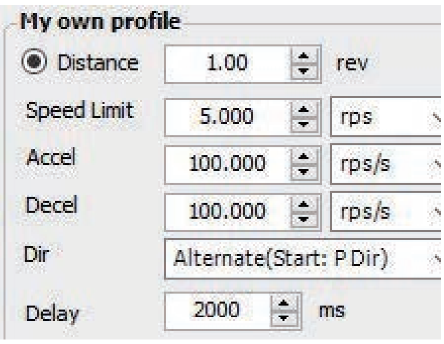
Interval Time：> 1.5 seconds

- **Use external motion command**

Click the " Start Auto-Tuning " button, and use the host computer to send motion commands directly.

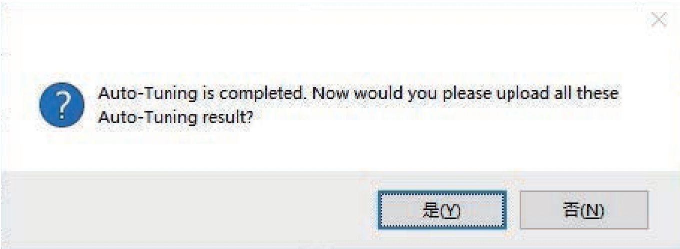
- **Custom trajectory planning**

Users can also use custom trajectory planning. Set a reasonable motion trajectory according to the above motion conditions, and click the " Start Auto-Tuning " button.



- **Complete automatic tuning**

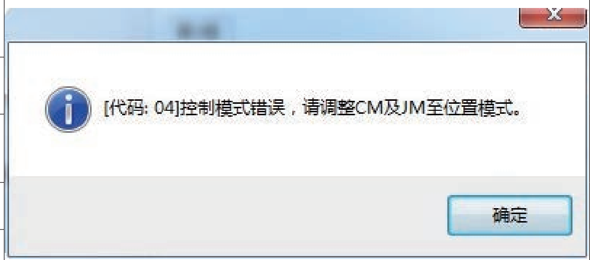
After completion, the following dialog box will prompt. After confirming the upload, you can see that the first mechanical Stiffness level and the load inertia ratio have been updated.



- **Error prompt**

If the Auto Tuning process cannot be comleted, the following error message box may be displayed, which means:

Error code	Cause	Measure
01	Positioning time out.	Increase the initial stiffness and the value of Setting Time.
02	The Interval time of two motion profile is too short.	Increase the Interval Time.
03	The stiffness is reduce to the smallest value during the tuning process.	Increase the Vibration Level.
04	Error control mode.	Set the control mode to Position Control.
05	Servo is not enabled.	Enable the servo before starting the auto tuning.
06	Error tuning mode.	Set the Tuning Mode(P0-00) to "Auto Tuning"



10.4 Advanced Tuning Mode

Advanced tuning mode is suitable for the following situations:

1) When auto-tuning cannot be completed all the time

2) After automatic tuning, by adjusting the mechanical Stiffness of P0-03 and the inertia ratio of P0-02, the response of the servo system still cannot meet the requirements

3) The characteristics of the parameters of each control loop of the servo have been fully understood, and the servo gain parameters can be determined by themselves

Using advanced tuning can fine-tune the servo system gain to meet the needs of higher servo system mechanical Stiffness, faster response time and minimum tuning time.

10.4.1 Introduction to Advanced Tuning Mode

The PID loop of the servo system can be configured via multiple parameters such as position loop gain, position loop, velocity feed forward gain, velocity loop gain and a collection of filters and other gains.

1) After the tuning mode is switched from " Auto tuning " to " Advanced tuning “, it will inherit the parameter values after the automatic tuning is completed, and it needs to be saved manually after the tuning is completed.

2) If directly switching from "No Tuning Mode" to "Fine Tuning", the servo system will inherit the factory default tuning parameters. This might require that users manually tune the servo system.

10.4.2 Parameters in Advanced Tuning Mode

Parameter	Command	Function	Type
P0-01	LY	load type	
P0-02	NR	Load inertia ratio	
P0-03	KG	1st mechanical stiffness level	First set of gains
P0-04	KX	2nd mechanical stiffness level	
P0-05	KP	1st position loop gain	
P0-07	KD	1st position loop derivative time constant	
P0-08	KE	1st position loop derivative filter	
P0-09	KL	Velocity feedforward gain	
P0-10	KR	Velocity feedforward filter frequency	
P0-11	KF	1st velocity command gain	First set of gains
P0-12	VP	1st velocity loop gain	
P0-13	VI	1st speed loop integral time constant	
P0-14	KK	Acceleration feed forward gain	
P0-15	KT	Acceleration feedforward filter frequency	
P0-16	KC	1st command torque filter frequency	First set of gains
P0-17	UP	2nd position loop gain	The second set of gains when using gain switching
P0-19	UD	2nd position loop derivative time constant	
P0-20	UE	2nd position loop derivative time constant	
P0-21	UF	2nd velocity command gain	
P0-22	UV	2nd velocity loop gain	
P0-23	UG	2nd velocity loop integral time constant	
P0-24	UC	2nd command torque filter frequency	
P0-39	LR	Velocity Feedback Filter	

Note:

1) When using gain switching, the second group of gains is valid.

10.4.3 Servo system parameter description

The servo system is composed of current loop, speed loop and position loop.

When you need to improve your response
1) Increase the mechanical Stiffness level
2) Increase the position loop gain
3) Increase the speed loop gain
4) Reduce the integral time parameter of the speed loop
when the system has overshoot and vibrations
1) Reduce the mechanical Stiffness level
2) Reduce the position loop gain
3) Reduce the speed loop gain
4) Reduce the speed loop integral time parameter
5) Reduce the torque filter frequency
6) Appropriately adjust the differential filter frequency

If one parameter is changed, other parameters also need to be re-adjusted. Please don't make major changes to just one parameter. Generally, about 5 % is used as a rough standard, and each servo gain is slightly adjusted. Regarding the procedure for changing the servo parameters, generally observe the following.

10.4.3.1 Gain parameters of the position loop:

◆ Position loop gain

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P0-05	KP	1st position loop gain	52	0 ~ 20000	0.1Hz	P	S	T	

Set the proportional gain for position control. Increasing this parameter can improve the responsiveness of the system, reduce the position error, and shorten the positioning time. 0 means not used, 20000 means the proportional effect is maximized. When the proportional gain of the position loop is too small, the response of the system will not be fast enough, and the decreasing trend of the position error will be slow. However, if the setting is too large, it may cause positioning overshoot or machine vibration. Generally speaking, the position loop gain cannot be greater than the velocity loop gain.

◆ Position loop differential gain

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P0-07	KD	1st position loop derivative time constant	0	0 ~ 30000	ms	P	S	T	

Set the position loop differential time constant for position control.

0 means no derivative effect, the smaller the set value, the stronger the effect of the derivative term.

Set value of the derivative time constant (KD) is too large, the system's ability to suppress vibration is insufficient, and obvious oscillation will occur during the acceleration / deceleration process, the uniform speed process and after stopping, and there will be a trend of decreasing oscillation. finally stabilized.

When the set value of the differential time constant (KD) is reasonable, the system's ability to suppress vibration is significantly enhanced, and it tends to stabilize quickly. When the differential time constant (KD) is set too small, the motion system will be too sensitive, easily vibrate and generate noise. When there is vibration in the system, the differential time constant can be adjusted appropriately, and the recommended initial value is 2000.

10.4.4 Gain parameter of speed loop

◆ Speed loop gain

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P0-12	VP	1st velocity loop gain	183	0 ~ 30000	0.1Hz	P	S	T	

Set the parameters of the speed loop responsiveness. The larger the set value, the faster the speed loop response of the servo system, it is necessary to increase the speed loop gain value without causing system vibration. Setting the value too high will cause vibration.

The gain of the velocity loop must be larger than the position loop by 4 ~ 6 times. However, when the gain of the position loop is larger than that of the speed loop, it will cause vibration or positioning overshoot.

◆ Speed loop integral time constant

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P0-13	VI	1st speed loop integral time constant	189	0 ~ 30000	ms	P	S	T	

Set the integral time constant of the speed loop.

0 means no integral effect, the smaller the set value, the stronger the integral effect.

Under proportional gain control, the speed error may not return to zero, or it may take a long time to return to zero. The integral time constant accumulates all errors and acts together with the proportional gain. A smaller integral time constant (VI) setting value can improve the response and responsiveness of the servo system and reduce the following error.

set value of the integral time constant (VI) is too large, the system response will be slow and the followability will be poor.

integral time constant (VI) is too small, the excessive mechanical Stiffness of the system will cause vibration and noise of the entire servo system. This vibration and noise occur during the entire movement process, and it is always in an oscillating state, which cannot be stabilized.

10.5 Resonance suppression

The machanical system has an inherent resonance frequency. If the whole system runs at this mechanical resonance frequency poit, vibration and nosie may be caused.

M3 series provide 4 methods to suppress mechanical resonance.

1） Torque Command Filter

2） Notch Filters

3） End Effector Suppress

4） Lod Disturbance Suppress

10.5.1 Torque Command Filter

Parameter	Instruction	Name	Defaults	Range	Unit	Related Patterns			
P0-16	KC	1st Torque Command Filter	1099	0 ~ 40000	01Hz	P	S	T	

Filter the command torque of Current Loop.

The filter is a single-output low-pass filter, which is used to filter the output of the PID controller (that is, the reference current). When setting this value, consider the cutoff frequency required for system operation. The default value of 1099 can be used in most applications.

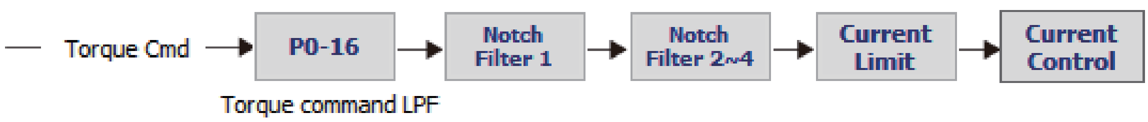
Used in some particular applications, such as:

1) Make sure the frequency of Torque Command Filter(KC) should 3 time higher than Velocity Loop Gain.

2) There are vibration with audible noise in the mechanical system. You can try reducing this value.

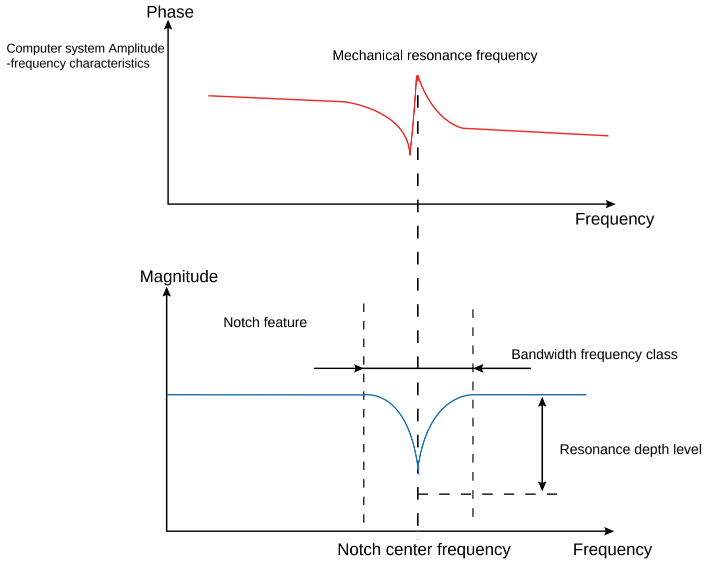
3) There is a mechanical resonance, the low-pass filter cutoff frequency can be set below the resonance frequency point so that the output of the control loop will not excite the resonance.

4) In a large inertia load system, increasing the position loop gain KP can obtain a good system response. However, excessive gain will cause jitter, and this filter could be used to be reduced to prevent jitter and vibrati



10.5.2 Notch Filters

Reducing the Torque Command Filter could solve the resonance, but it also reduce the system response bandwidth and phase margin, and thus the system becomes unstable. In some case, it may cause a counter-action that the resonance may not be suppressed.
If you know the resonance frequency, the notch filter can be used to suppress the resonance. The notch filter suppresses mechanical resonance by reducing the gain at a specific frequency for highfrequency mechanical resonance.



This resonance frequency can be detected through open-loop mechanical analysis. If the resonance frequency drifts significantly with time or due to other cause, using notch filter is not suggested.

There are 4 notch filters in M3 series and each notch filter has three parameters, which are:

- Center frequency of Notch Fitler
- Notch Bandwidth
- Notch Depth Level(Notch Filter Attenuation Level)

The first group and the second group are user-defined notch filters, and all parameters need to be set bt user. The third group and the fourth group can be set manually or be set as an adaptive notch filter which all parameters are detected by the drive in real-time and automatically set.

Note: The center point frequency of the Notch Filter must be greater than 2 times of the Torque. Command Filter(P0-16).

10.5.2.1 Adaptive Notch Filter

When the servo system resonates and needs to use the notch filter, it's recommended to use the Adaptive Notch Filter.

◆ **Scope of application and precautions:**

- Applicable to all control mode except Torque Mode

◆ **Conditions may affect nomal operation of the Adaptive Notch Filter:**

- The resonance frequency is lower than 3 times the Velocity Loop Gain
- The frequency between two resonance points is less than 100Hz

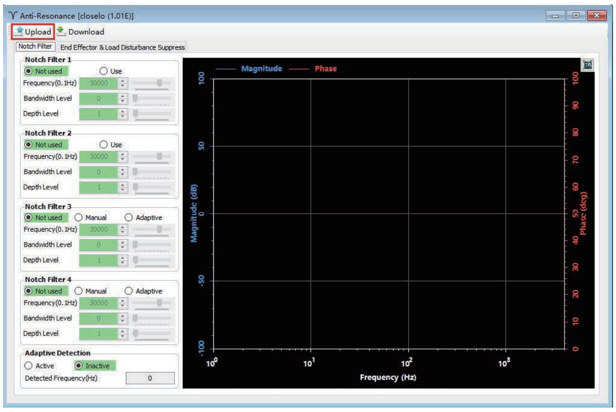
◆ **Steps for usage**

- In the "Anti-resonance" interface of Luna software, change the usage mode of "Notch Filter 3" to"Adaptive" , and then click the "Download" button to enable a self-adaptive notch filter.
- When the servo system is running, it will automatically detect resonance frequency and take effect to suppress.
- If there is a new resonance, enable the "Notch Filter 4" with same operation.
- When the system is running ,the third and fourth goups of notch filte parameters are automatically updated, but will not be displayed in the software interface.
- Although these parameters are updated automatically, they will not be saved automatically. After the servo system is powered on again, the system will automatically update these parameters when the servo is enabled and running.

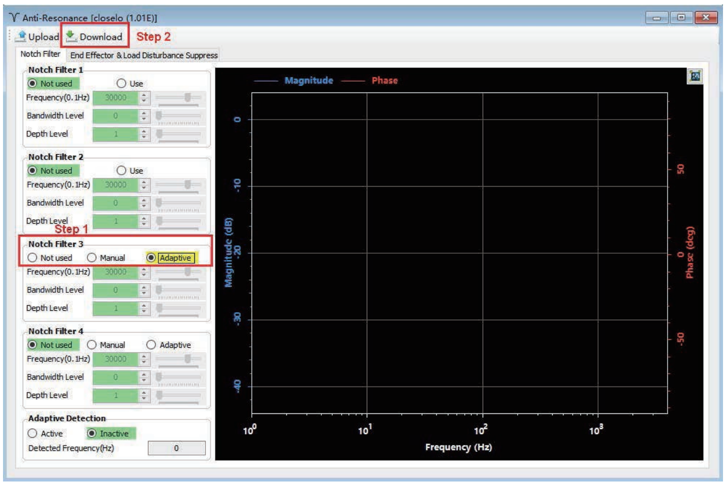
This setting can prevent abnormal movement of the servo system during operation, resulting in the notch filter parameters being updated to wrong values, which may increases vibration.

◆ **Software settings for Adaptive Notch Filter**

Step 1: In the tree list on the left, open " Anti-Resonance ", and click the " Upload " button in the Anti-Resonance interface



Step 2: Change the method of " Resonance Suppression Filter 3 " to " Adaptive ", and then click to download



Step 3: After the download is complete, the drive will automatically detect vibration and run immediately.

10.5.3 Setting the notch filter manually

Analyze resonance frequencies

To manually set the notch filter, it is necessary to measure the actual frequency when resonance occurs. You can use the " Mechanical Analysis " function in the Luna software.

Analysis types:

Analysis type	Applicable load	Method Description	Precautions
Mechnical Open-loop	Horizontal load	Analyzing the resonance of a servo system in open loop mode allows users to analyze the real time resonance frequency of the entire system. This is because open loop mode does not use the PID of the controller which might otherwise try to react to resonance and thereby provide a skewed analysis.	For mechanical open-loop analysis, the drive needs to be disabled, so it cannot be used for vertical loads
Velocity Closed-loop	Horizontal load Vertical load	Analyzing the resonance of a servo system in velocity mode can also be used. However, it is necessary to ensure that PID loop parameters are set reasonably so that the closed loop nature of the system will not skew analysis of the resonance frequency.	◆ The control mode of the drive needs to be in the command speed mode, that is, the set value of P1-00 is 10. ◆ The drive needs to be enabled when speed closed-loop analysis is performed ◆ For vertical loads, ensure that there is mechanical protection against falling.

10.5.3.1 Using Mechanical Open Loop Resonance Analysis

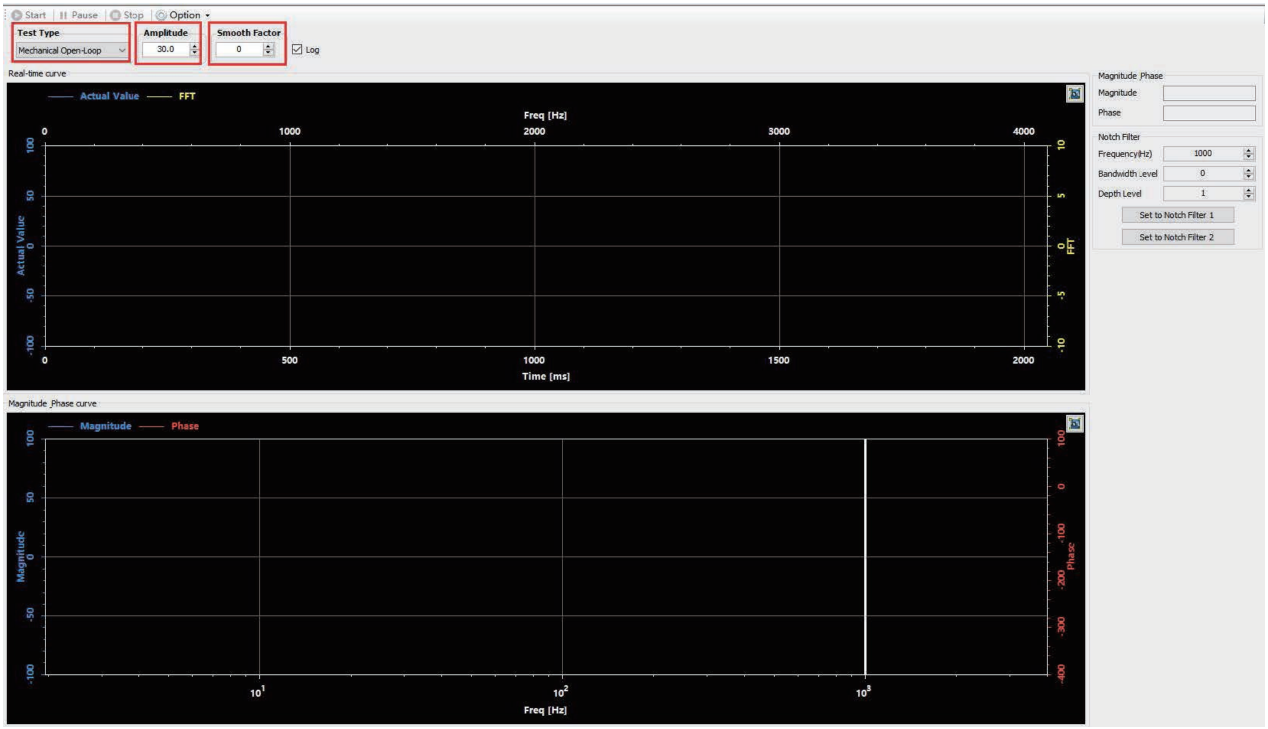
Step 1

Before performing a mechanical open-loop analysis, ensure that

- The drive has passed the trial operation described in Section 6 Trial Operation.
- Servo system has completed parameter tuning
- Make sure the drive is not enabled

Step 2

Select an appropriate amplitude to start the system, be aware that an excessively large amplitude may cause motion.may cause mechanical movement.

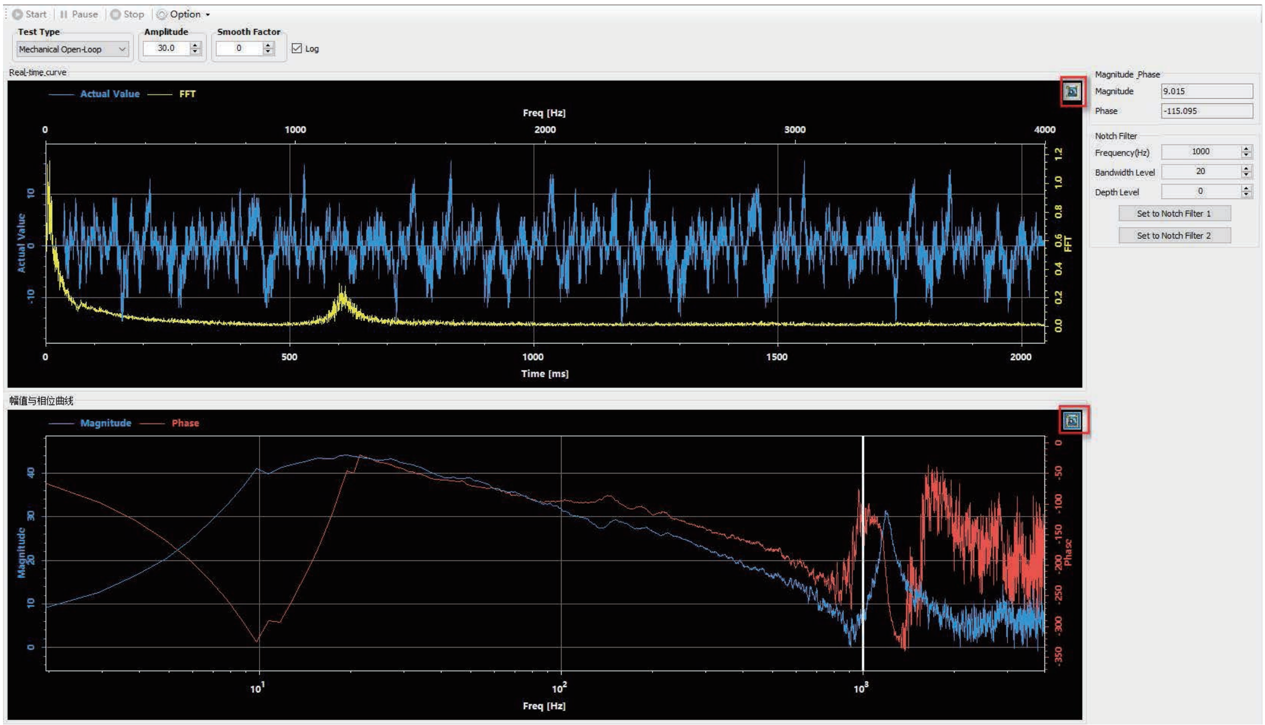


Smoothing factor:

Impacts the sampling frequency of the waveform function. The larger the value, the smoother the waveform appears. This parameter can be convenient during resonance analysis.

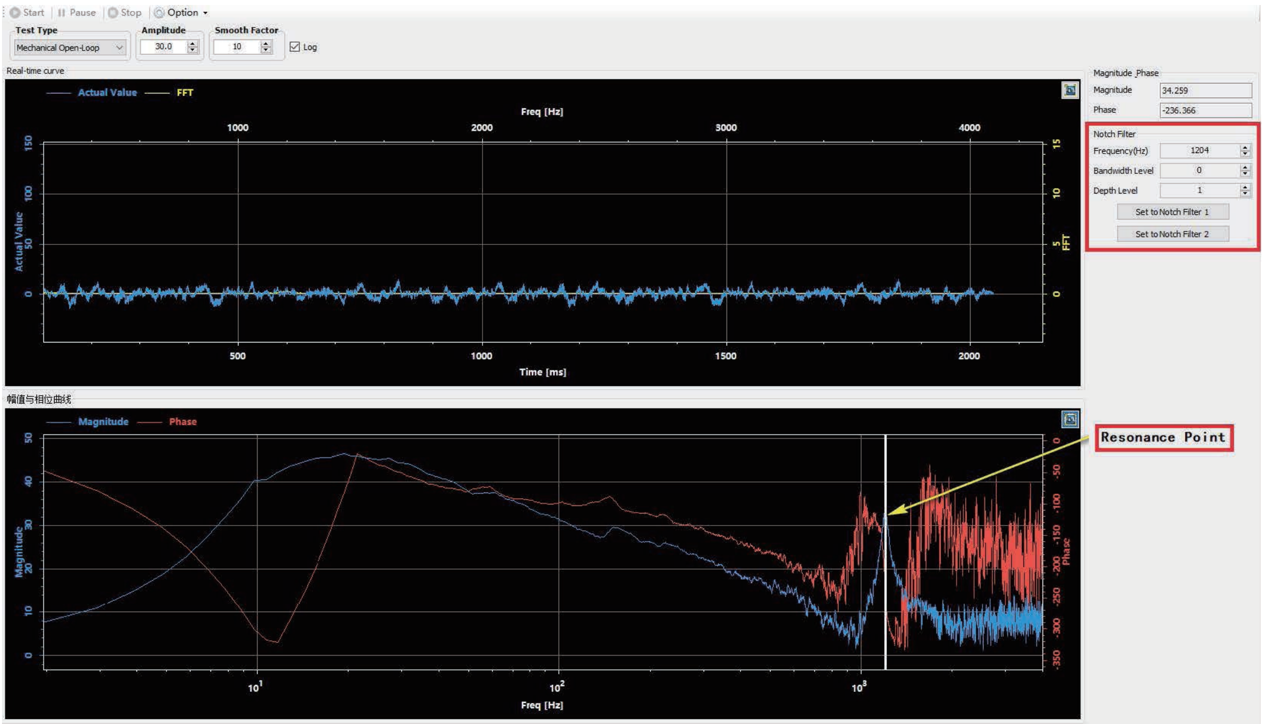
Step 3

Click the " Start Analysis " button, the servo system starts the mechanical open-loop analysis and displays the resulting curve. Click the icon in the upper right corner of the drawing area to optimize the display curve.



Step 4

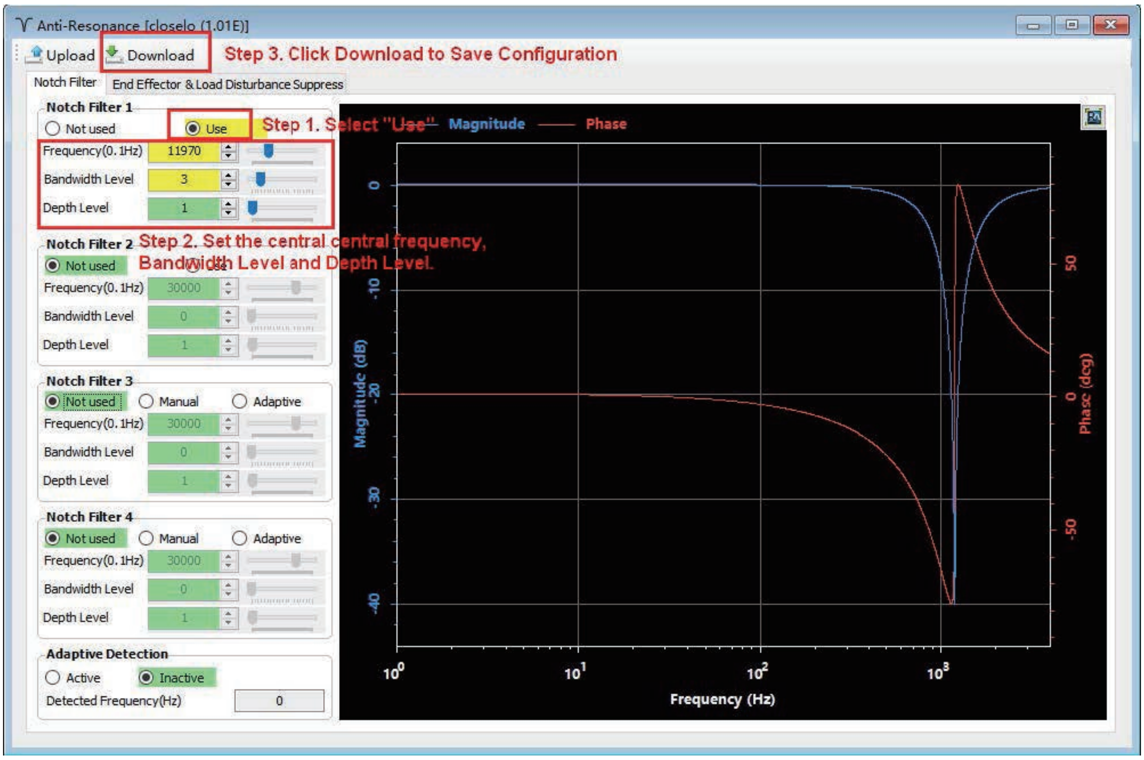
Move the reference line in the " Amplitude and Phase Curves " to the place where the amplitude curve (blue curve in the figure below) has abnormal protrusions



The resonance suppression filter in the red area will display the resonance frequency of the current reference line in real time. Click " Set as 1st Resonance Suppression Filter " or " Set as 2nd Resonance Suppression Filter " to set the resonance frequency to Resonance Suppression Filter 1 Or the resonance frequency point of the resonance suppression filter 2.

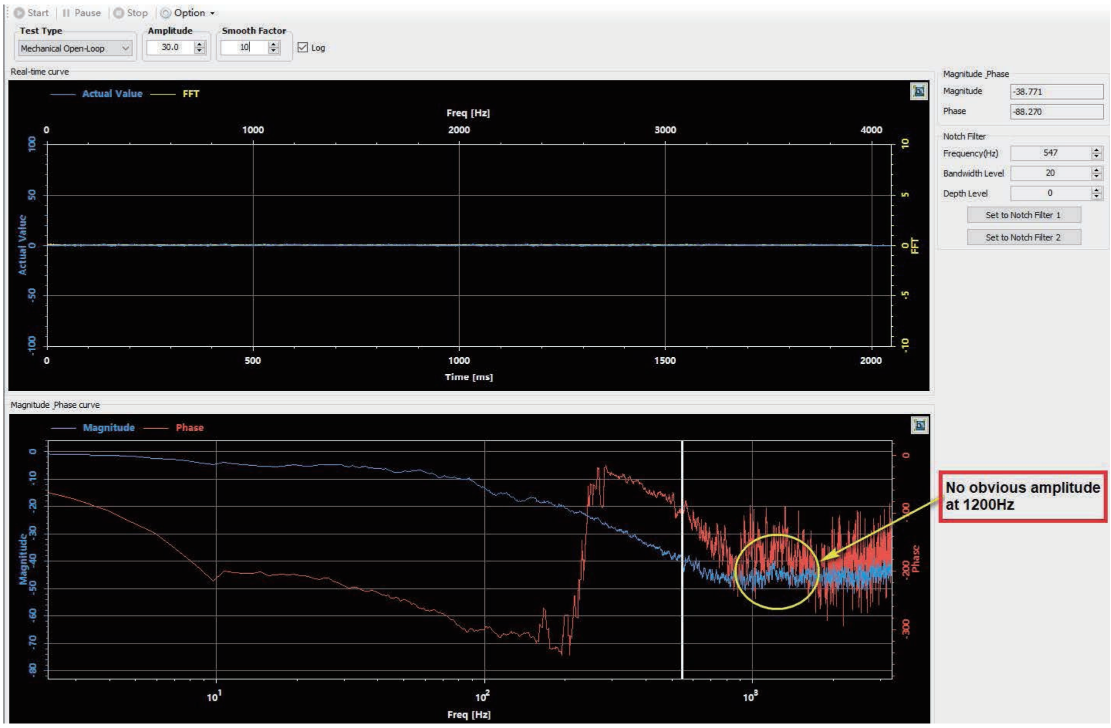
Step 5

On the resonance suppression interface, select " Use " to enable the corresponding resonance suppression filter, set the appropriate " bandwidth frequency level " and " resonance depth level ", and click " download " to set the resonance suppression notch filter. To set a resonance suppression notch filter, select the "Anti-Resonance" option in the device tree to the left of the Luna Software. On the desired filter, select "use" to enable the filter, set the appropriate bandwidth frequency level and resonance depth level. Then click download.



Note: Because mechanical open loop analysis does not include the closed loop of the servo controller, any previously downloaded Notch Filters will not be active during the analysis. If users wish to actually test the Notch Filters impact on the resonance of the system, they will need to run the motor in the "Velocity Closed Loop" mode. Otherwise, the system will run in open loop without the Notch Filter Equipped.

The image below is the result viewed using the Velocity Closed Loop analysis.



10.5.3.2 Using the Velocity Closed Loop Mode to analyze resonance frequency

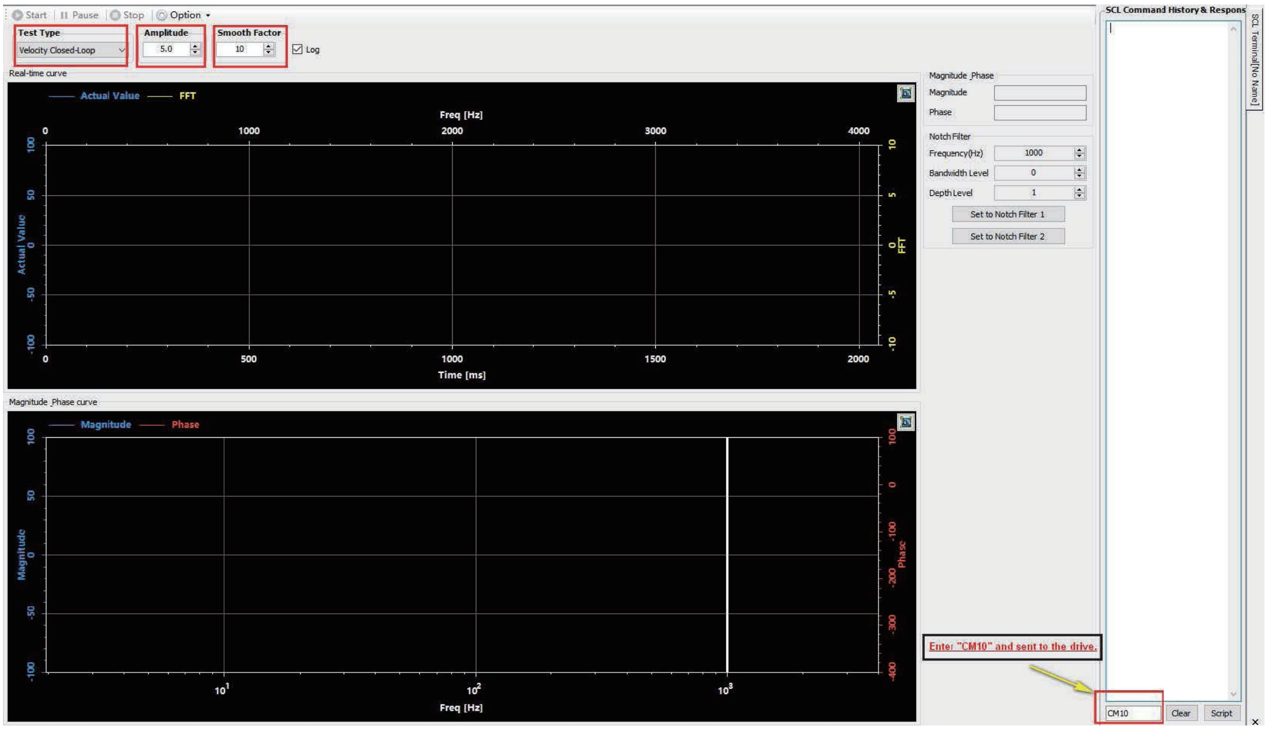
Step 1

Before performing a velocity closed-loop analysis, make sure that

- The drive has passed the trial operation described in Section 6 Trial Operation.Servo system has completed parameter tuning
- The control mode of the drive is: command speed mode
- Drive is enabled
- For vertical axis loads, it is best to use a motor with a brake to avoid accidental load drop

Step 2

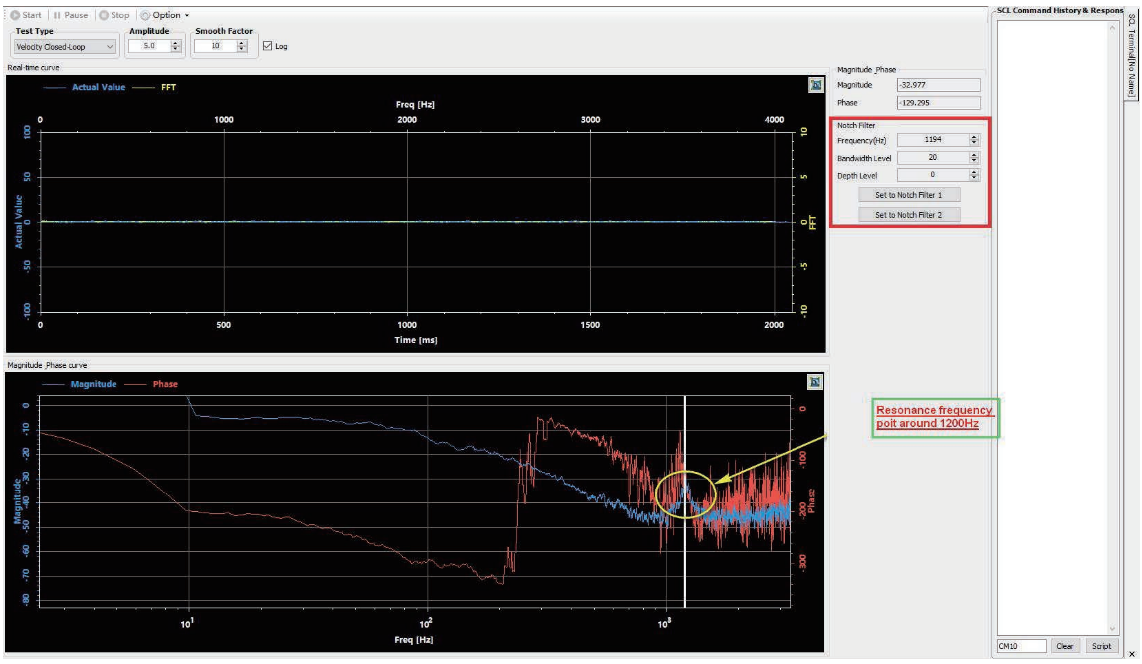
- Select an appropriate amplitude to allow the system to vibrate. Note that an excessively large amplitude may cause mechanical movement.
- Open " SCL Terminal " in the " Tools " menu
- Enter CM10 in the input box of the SCL terminal, and set the control mode of the drive to: command speed mode
- Enable the driver



Step 3

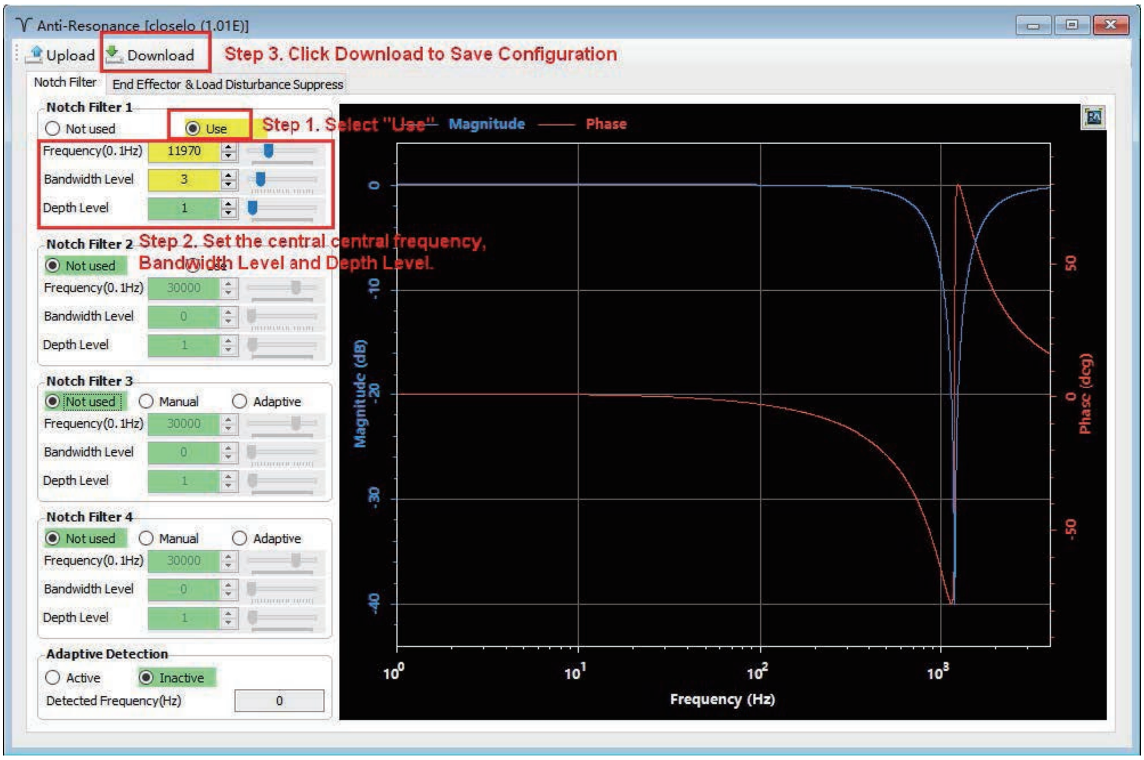
- Click the " Start Analysis " button, the servo system starts the speed closed-loop analysis, and the curve of the result is displayed.
- Click the icon in the upper right corner of the graph area to optimize the display curve.
- Move the reference line in " Amplitude and Phase Curve " to the place where the amplitude curve (blue curve in the figure below) has abnormal protrusions

The following figure shows obvious vibration at 1200Hz. Click " Set as the first group of resonance suppression filters " or " Set as the second group of resonance suppression filters " to set the resonance frequency as the resonance suppression filter 1 or the resonance suppression filter 2.



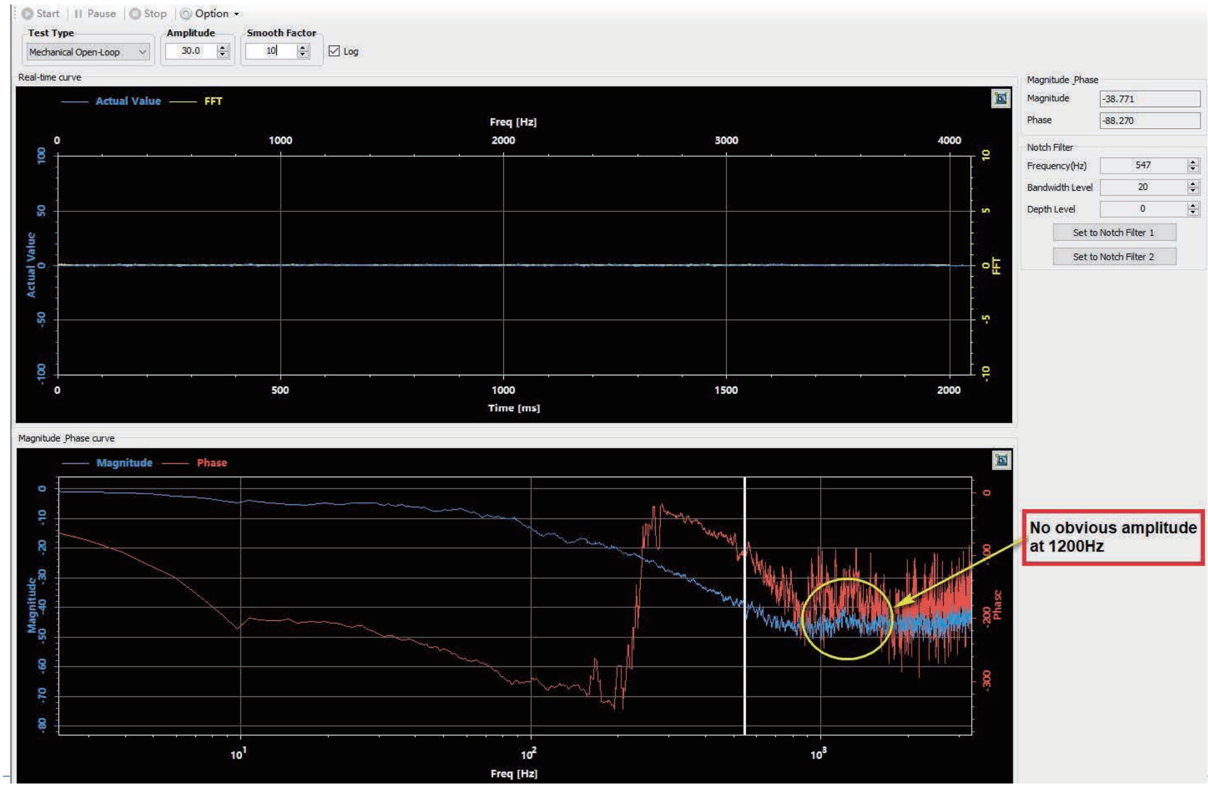
Step 4

To set a resonance suppression notch filter, select the "Anti-Resonance" option in the device tree to the left of the Luna Software. On the desired filter, select "use" to enable the filter, set the appropriate bandwidth frequency level and resonance depth level. Then click download.



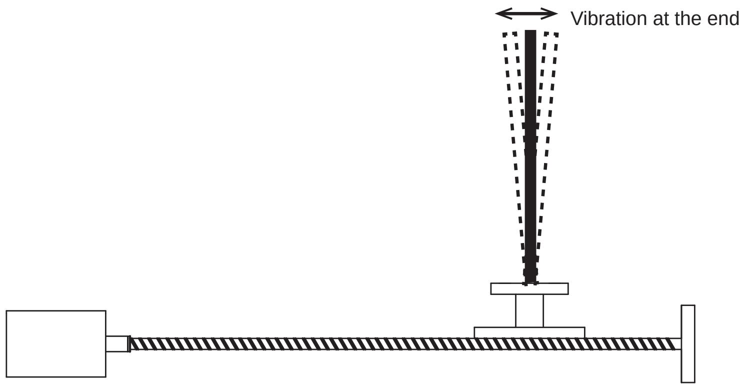
Step 5

The below waveforms showcase the results of velocity closed loop analysis



10.6 End Vibration Suppression

Figure below, due to the long length of the end of the mechanical load, it is easy to generate low-frequency vibration during operation and stop. This vibration is often low in frequency, generally within 100Hz, but it will affect the positioning accuracy and settling time of the end.

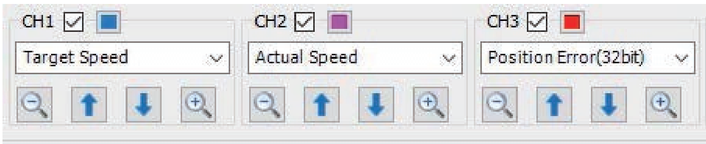


The use of end vibration suppression can better suppress such vibrations, thereby improving the positioning accuracy of the mechanical system and shortening the positioning and settling time.

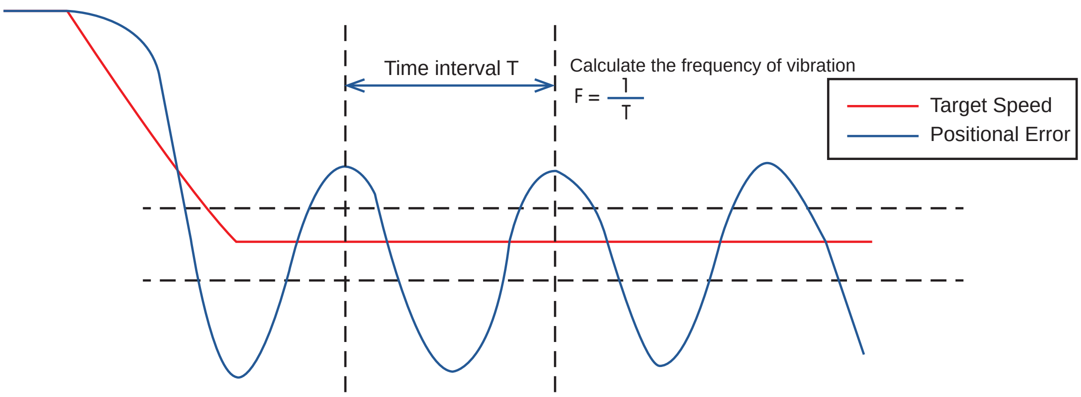
Instructions to implement end vibration suppression

Step 1: Analyze Frequency

Use the oscilloRange function of Luna software to observe the curves of " target speed " and " position error " during the motor stop phase.

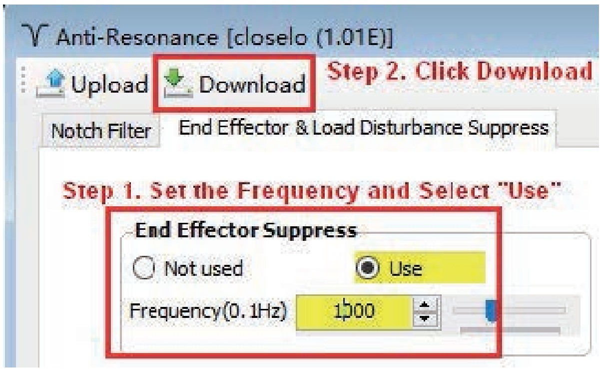


Using the figure below as an example, analyze the frequency of position error fluctuations after the target speed is zero.



Step 2: Set and enable end vibration suppression

Select the Anti-Resonance interface on Luna Software. Select the End Effector Suppression Tab, enter teh vibration frequency as measured in Step 1.



Note:

◆ Wrong vibration frequency will cause the end vibration suppression effect to become worse or even increase the vibration

◆ Only the vibration frequency within 1-300Hz can be well suppressed

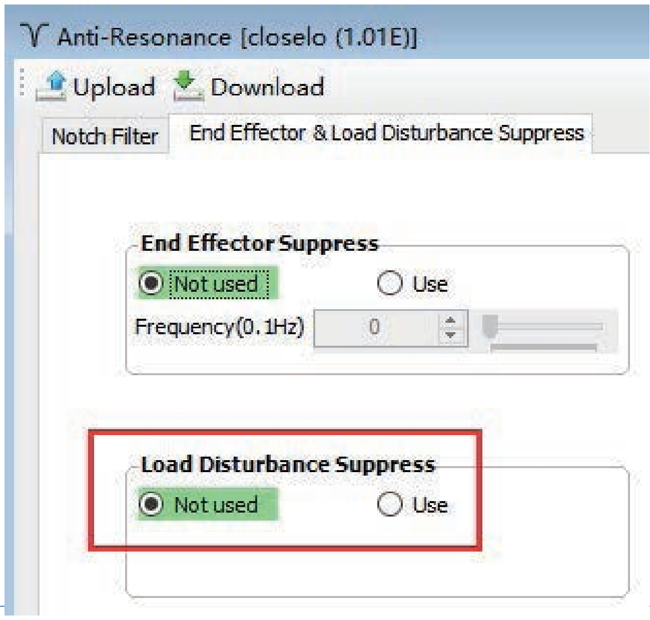
◆ This function may not work for vibrations due to reasons other than those related to reaching the mechanical end of a mechanism.

10.7 External Vibration Suppression

Servo Systems can disturbed by external factors, such as sudden changes in load or sudden changes in external forces such as friction caused by mechanical problems, resulting in system instability and abnormal vibration.

Suppression of these disturbances can significantly improve system response.

To use Select the " Anti-Resonance " function in the tree menu on the left side of the Luna software, click " End effector & Load Disturbance Suppression ", and check " Use " in the Load Disturbance Suppression. After downloading to the driver, the end disturbance suppression will take effect.



Appendix 1: LED display character comparison table

									
1	2	3	4	5	6	7	8	9	10
									
A	B	C	D	E	F	G	H	I	J
									
K	L	M	N	O	P	Q	R	S	T
									
U	V	W	X	Y	Z				

11 Connect us

Customer Service Center

+86-400-820-9661

MOONS' Headquarter

168 Mingjia Road, Minhang District, Shanghai 201107, P.R. China

MOONS' Taicang

No. 18 Yingang Rd, Fuqiao Town, Taicang City Jiangsu Province, 215434, P.R. China

Domestic Offices

Shenzhen
Room 3901, Building A, Zhongguan Times Square,No 4168 Liuxian Avenue, Nanshan District, Shenzhen, Guangdong Province, 518000, P.R. China

Beijing
Room 1206, Jing Liang Mansion, No.16 Middle Road of East,3rd Ring, Chaoyang District, Beijing 100022, P.R. China

Nanjing
Room 1101-1102, Building 2, New Town Development Center, No.126 Tianyuan Road , Moling Street, Jiangning District, Jiangsu Province, China, 211106, P.R. China

Qingdao
Rm1913,Scientific and Technological Innovation Builing,Floor19, No.171, ShanDong Road,Shibei District,QingDao, Shangdong Province, 266033, P.R. China

Wuhan
Room 3001, World Trade Tower, 686 Jiefang Avenue, Jianghan District, Wuhan, Hubei Province, 430022, P.R. China

Chengdu
Room. 3907, Maoye Plaza, No.19, Dongyu Street, Jinjiang Distrit, Chengdu Sichuan Province, 610066, P.R. China

Xi'an
Room 1006, Tower D, Wangzuo International City, 1 Tangyan Road, Xi'an, Shanxi Province, 710065, P.R. China

Ningbo
Rm 309, Tower B, Taifu Plaza, 565 Jiangjia Road,Jiangdong District, Ningbo, Zhejiang Province, 315040, P.R. China

Guangzhou
Rm 4006, Tower B, China Shine Plaza, 9 Linhe Xi Road, Tianhe District, Guangzhou, Guangdong Province, 510610, P.R. China

Chongqing
Room. 2108, South yuanzhu Buliding 20, No.18 Fuquan Rd., Jiangbei District, Chongqing, 400000, P.R. China

Hefei
Room 1521, Building B, CBC Tuoji Plaza, Jinggang Road, Shushan District, Hefei, Anhui Province, 230088, P.R. China

Suzhou
Rm 1103-1105, North Building 4, Huizu Plaza, 758 Nanhuan East Rd, Gusu District, Suzhou,Jiangsu Province, 215007, P.R. China

Dongguan
Room. 1106-1207, Building 5, Linrunzhigu, No.1 RD 5th Rd, Songshan Lake, Dongguan, Guangdong Province, 523000, P.R. China

North America Company

MOONS' Industries (AMERICA), Inc. (Chicago)
1113 North Prospect Avenue, Itasca, IL 60143，USA

MOONS' INDUSTRIES (AMERICA), INC. (Boston)
36 Cordage Park Circle, Suite 310 Plymouth, MA 02360，USA

APPLIED MOTION PRODUCTS, INC. (Morgan Hill)
18645 Madrone Parkway, Morgan Hill, CA 95037，USA

LIN ENGINEERING, INC. (Morgan Hill)
16245 Vineyard Blvd., Morgan Hill, CA 95037，USA

European Company

MOONS' INDUSTRIES (EUROPE) S.R.L.
Via Torri Bianche n.1 20871 Vimercate(MB) Italy

AMP & MOONS' AUTOMATION (GERMANY) GMBH
Kaiserhofstr. 15
60313 Frankfurt am Main Germany

Technosoft SA
Avenue des Alpes 20
CH 2000 Neuchâtel Switzerland

MOONS' INDUSTRIES (UK), LIMITED
Reading, Berkshire, UK

Singapore Company

MOONS' INDUSTRIES (SOUTH-EAST ASIA) PTE. LTD.
33 Ubi Avenue 3 #08-23 Vertex Singapore 408868

Japan Company

MOONS' INDUSTRIES JAPAN CO., LTD.
Room 602, 6F, Shin Yokohama Koushin Building, 2-12-1, Shin-Yokohama, Kohoku-ku, Yokohama, Kanagawa, 222-0033, Japan

India Company

MOONS' INTELLIGENT MOTION SYSTEM INDIA PVT. LTD.
Rm. 908, 9th Floor, Amar Business Park, Tal. Haveli, Baner, Pune-411045, Maharashtra, India

Vietnam Company

MOONS' INDUSTRIES (VIETNAM) CO., LTD.
Factory C1&D1, Lot IN3-11*A, VSIP Hai Phong Industrial Park in Dinh Vu – Cat Hai Economic Zone,Lap Le Commune, Thuy Nguyen District, Hai Phong City, Vietnam 04359

ISO 14001 TÜV SÜD ISO 9001 OHSAS 18001

https://www.moonsindustries.com/
E-mail:ama-info@moons.com.cn
MOONS' moving in better ways

- All the specifications, technical parameters of the products provided in this catalog are for reference only, subject to change without notice. For the latest details, please contact our sales department.