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M56S Sseries
AC Servo System

RS-485 Type User Manual

SHANGHAI AMP&MOONS' AUTOMATION CO.,LTD.

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Contents

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1 Introduction

1.1 About this manual

This manual is manual of M56S Series RS-485 AC Servo Driver.

It provides installation, configuration and basic operation of M56 servo unit.

This document is intended for qualified personnel who transport, assemble, and maintain this equipment.

1.2 M56 Series RS-485 Documentation

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

- M56S RS-485 Quick Start Guide. Basic setup and operation of the drive.
- M56S RS-485 User Manual. Hardware installation, configuration and operation.
- 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.

M56S series AC servo products use dangerous voltage. The drive must be properly grounded.

Before you install M56S series AC 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 Installation Precautions

◆ DO NOT subject the product to water, corrosive or flammable gases, and combustibles.
◆ DO NOT use the motor in a place subject to excessive vibration or shock.
◆ Never connect the motor directly to the AC power supply.
◆ DO NOT use cables soaked in water or oil.
◆ DO NOT extrude or pull-off the cable, nor damage the cables as electrical shocks, damages may result
◆ DO NOT block the heat dissipating holes. Please prevent any metal filings drop into the drive when mounting.
◆ DO NOT switch the power supply repeatedly.
◆ DO NOT touch the rotating shaft when the motor is running.
◆ DO NOT strike the motor when mounting as the motor shaft or encoder may be damaged.
◆ In order to prevent accidents, the initial trial run for servo motor should be conducted ◆ under no load conditions (separate the motor from its couplings and belts).
◆ Starting the operation without matching the correct parameters may result in servo drive or motor damage, or damage to the mechanical system.
◆ DO NOT Touch either the drive heat sink or the motor and regenerative resister during operation as they may become hot.
◆ DO NOT hold the motor cable during the transportation or mounting.

1.5.2 Wiring

◆ 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
◆ 即使关闭电源，驱动器内任会残留高压；在Charge灯亮时，请勿触碰电源端子
◆ Please use the specified power supply voltage
◆ 在配线时，请将端子座从伺服驱动器上拆下来
◆ 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

1.5.3 Test run

	◆ 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

M56S series low voltage servo products are designed to meet the following standards.

FUNCTIONAL SAFETY
LISTED

		Drive	Motor
Europe	EMC Directive	EN 61800-3	EN 60034-1
			EN 61000-6-2
			EN 61000-6-4
	LVD	EN 61800-5-1	EN 60034-1
			EN 60034-5
Functional Safety(STO)		UL61800-5-2(SIL 3)	
		IEC61508(SIL 3)	
		ISO13849-1(PL e)	
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.

Product	Part	Standard replacement cycle	Note
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)	
	Cooling fan	2~3 years（10,000~30,000 hours)	
Motor	Oil seal	5000 hours	
	Battery for absolute encoder	Depending on working condition	

2 Basic Information

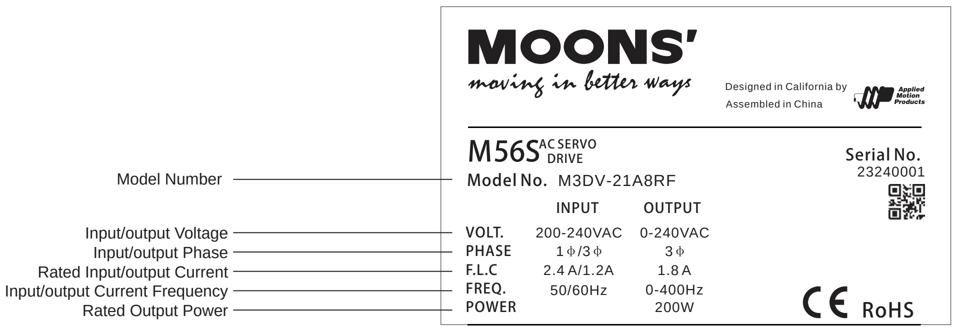
2.1 Product confirmation

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
- 用于连接驱动器及伺服电机的电机动力线(选购品)
- 用于连接驱动器及伺服电机的编码器线(选购品)
- 用于CN1口至PC机的Mini USB通讯线(选购品)
- 用于CN2口的连接器(标配品)
- 用于CN3口的编码器连接器(选购品)
- 用于CN4口的第二编码器连接器(适用于带全闭环功能型驱动器，选购品)
- 用于CN5口的STO连接器(适用于带STO功能型驱动器，选购品)
- 用于CN6及CN7口的RJ-45连接器，用于总线类产品通讯用(选购品)
- 用于P1口的驱动器电源输入连接器(标配品)
- 用于P2口的电机动力及再生电阻连接器(标配品)

2.2 Drive model introduction

2.2.1 Drive model description



2.2.2 Drive model description

M56S - 2 3A0 R F - ***

① ② ③ ④ ⑤ ⑥

① M56S Series

② Supply Voltage *1

2 : Single/Three-Phase 220VAC

3 : Three-Phase 400VAC

④ Function Type

⑤ Model Type

⑥ 版本号

③ Current

	Supply Voltage	Current	Rated Current A(rms)	Peak Current A(rms)	Rated Power
*2	2	1A8	1.8	5.4	200W
*2		3A0	3	9	400W
*2		4A5	4.5	13.5	750W
*2		6A0	6	18	1.0kW
*3		10A	10	33	1.5kW
*3		13A	13	40	2.5kW
	3	13A	13	40	3.0kW
		17A	17	42.5	5.0kW
		21	21	52.5	6.0kW
		26	26	65	7.5kW

*1 Line to Line Voltage
*2 Use Single/Three-Phase 220VAC input
*3 Available for single-phase while the motor power is under 1.5kW
*4 It will be released in the first quarter of 2024.

2.2.3 Drive Specifications

2.2.3.1 AC220V Electrical Specifications

■ Single/three-phase 220V rated AC servo drives

Drive Model	M56S-21A8R◆	M56S-23A0R◆	M56S-24A5R◆	M56S-26A0RF	M56S-210ARF
Main Circuit	Single / Three-phase, AC200 ~ 240V±10%，50/60Hz				
Control Circuit	Single-phase, AC200 ~ 240V±10%，50/60Hz				
Continuous Power Output A(rms)	1.8	3	4.5	6	10
Maximum Output A(rms)	5.4	12	15	21	30
Withstand Voltage	Primary to earth: withstand 1500 VAC, 1 min, (Leakage current: 20 mA) [220V Input]				

◆: Type of machine

■ Three-phase 220V rated AC servo drives

Drive Model	M56S-213ARF
Main Circuit	Three-phase, AC200 ~ 240V ±10%，50/60Hz
Control Circuit	Single-phase, AC200 ~ 240V ±10%，50/60Hz
Continuous Power Output A(rms)	13
Maximum Output A(rms)	45
Withstand Voltage	Primary to earth: withstand 1500 VAC, 1 min, (Leakage current: 20 mA) [220V Input]

2.2.3.2 AC220V Common Specification

Environment	Temperature		Ambient temperature: 0°C ~ 55°C (If the ambient temperature of servo drive is higher than 45°C, please install the drive in a well-ventilated location) Storage temperature: -20°C ~ 65°C
	Humidity		Both operating and storage : 10 ~ 85%RH or less
	Altitude		Derating is not required for altitudes not higher than 1000m Derating 1% for every additional 100m for altitudes between 1000m and 2000m
	Vibration		$9.8 m/s^2$ or less, 10 ~ 60Hz (Do not use continuously at resonance frequency)
Control Mode			IGBT: PWM control
Motor Encoder Feedback			● 26-bit Multi-turn Absolute Optical Encoder ● 21-bit Multi-turn Absolute Magnetic Encoder ● 17-bit Battery-less Multi-turn Absolute Encoder
Second Encoder Feedback			A/B/Z phase signal differential input
I/O	Digital Signal	Input	10 Configurable optically isolate digital general inputs, 24VDC, 20mA
		Output	6 Configurable optically isolate digital general outputs, Max. 30VDC，100mA
	Analog Signal	Input	2 Analog inputs, -10 ~ +10V, 12bit
		Output[*2]	2 Analog outputs, -10 ~ +10V, Max.10mA
	Pulse Signal	Input	2 Pulse Inputs (Optocoupler input, Line Receiver input): ● Optocoupler input: 5 ~ 24V, minimum pulse width 1μs, max. pulse frequency 500KHz ● Line Receiver input: 5V differential signal, minimum pulse width 0.125μs, max. pulse frequency 4MHz
		Output	4 Outputs(3 Line Driver outputs, 1 open collector output) ● Line Driver output: Encoder A、B、Z feedback output ● Open collector output: Encoder Z phase
Comm Port	USB		Connection with PC for configuration
	RS-485		Modbus/RTU Communication protocol
Front Panel			4 keys (MODE, UP, DOWN, SET) 5 - digital LED Display
Regeneration Resistor			● -F Type Built-in regenerative resistor ● -D Type 750W Built-in regenerative resistor ● All models can be equipped with external absorption resistors
Control Mode			1. Pulse Position Mode 2. Analog Velocity Mode 3. Analog Torque Mode 4. Internal Position Mode 5. Internal Torque Mode 6. Internal Velocity Mode 7. Command Torque Mode 8. Full Closed Loop Control Mode[*3], Each control mode can be switched by digital input
Control Input Signal			Servo-ON, Alarm Reset, CW/CCW Limit, Control Mode Select, Gain Select, Clear Position Error, Zero Speed Clamp, Command and Velocity input Direction control, Command and Torque input Direction control, Emergency Stop, Homing Switch, Torque Limit, Speed Limit, Pulse Inhibit, Multi-velocity Switch, Start Q Program, General Purpose Input
Control Output Signal			Warning Output, Fault Output, Servo Ready, Velocity Reached, Torque Reached, Position Reached, Servo-on Status, Brake Release, Dynamic Position Error Following, Positioning Complete, Zero Speed Detected, Velocity Coincidence, Torque Coincidence, Velocity limit, Torque limit, Homing Finished, Soft Limit CW/CCW, General Purpose Output
Protection			Over Current, Over Voltage,Under Voltage, Over Temperature, Bad Encoder Feedback, Over Load, Over Speed, Positon Error, STO, CW/CCW Limit, Full Closed-loop Hybrid Deviation Fault, Main Power Phase Loss
Dynamic Brake			-F Built in
STO			-F Built in
Weight			M56S-21A8R◆: 0.8Kg　M56S-26A0RF: 1.9Kg M56S-23A0R◆: 1.1Kg　M56S-210ARF: 1.9Kg M56S-24A5R◆: 1.6Kg　M56S-213ARF: 1.9Kg

Note: *1，*2，*3 -RD models don't support this function　　◆: Model Type

2.2.3.3 AC400V Electrical Specifications

■ three-phase 400V rated AC servo drives

Drive Model	M56S-313ARF	M56S-317ARF	M56S-321ARF	M56S-326ARF
Main Circuit	Three-phase, AC380 ~ 480V±10%，50/60Hz			
Control Circuit	Single-phase, AC380 ~ 480V±10%，50/60Hz			
Continuous Power Output A(rms)	13	17	21	26
Maximum Output A(rms)	40	42.5	52.5	65
Withstand Voltage	Primary to earth: withstand 1500 VAC, 1 min, (Leakage current: 20 mA) [220V Input]			

2.2.3.4 AC400V Common Specification

Environment	Temperature		● Ambient temperature: 0°C ~ 55°C (If the ambient temperature of servo drive is higher than 45°C, please install the drive in a well-ventilated location) ● Storage temperature: -20°C ~ 65°C
	Humidity		Both operating and storage : 10 ~ 85%RH or less
	Altitude		Derating is not required for altitudes not higher than 1000m Derating 1% for every additional 100m for altitudes between 1000m and 2000m
	Vibration		$9.8 m/s^2$ or less, 10 ~ 60Hz (Do not use continuously at resonance frequency)
Motor Encoder Feedback			● 23-bit Multi-turn Absolute Optical Encoder ● 21-bit Multi-turn Absolute Magnetic Encoder
Second Encoder Feedback			A/B/Z phase signal differential input
I/O	Digital Signal	Input	10 Configurable optically isolate digital general inputs, 24VDC, 20mA
		Output	6 Configurable optically isolate digital general outputs, Max. 30VDC，100mA
	Analog Signal	Input	2 Analog inputs, -10 ~ +10V, 12bit
		Output	2 Analog outputs, -10 ~ +10V, Max.10mA
	Pulse Signal	Input	2 Pulse Inputs (Optocoupler input, Line Receiver input): ● Optocoupler input: 5 ~ 24V, minimum pulse width 1μs, max. pulse frequency 500KHz ● Line Receiver input: 5V differential signal, minimum pulse width 0.125μs, max. pulse frequency 4MHz
		Output	4 Outputs(3 Line Driver outputs, 1 open collector output) ● Line Driver output: Encoder A、B、Z feedback output ● Open collector output: Encoder Z phase
Comm Port	USB		Connection with PC for configuration
	RS-485		Modbus/RTU Communication protocol
Front Panel			4 keys (MODE, UP, DOWN, SET) 5 - digital LED Display
Regeneration Resistor			Built-in regenerative resistor (All models can be equipped with external absorption resistors)
Control Mode			1. Pulse Position Mode 2. Analog Velocity Mode 3. Analog Torque Mode 4. Internal Position Mode 5. Internal Torque Mode 6. Internal Velocity Mode 7. Command Torque Mode 8. Full Closed Loop Control Mode[*3], Each control mode can be switched by digital input
Control Input Signal			Servo-ON, Alarm Reset, CW/CCW Limit, Control Mode Select, Gain Select, Clear Position Error, Zero Speed Clamp, Command and Velocity input Direction control, Command and Torque input Direction control, Emergency Stop, Homing Switch, Torque Limit, Speed Limit, Pulse Inhibit, Multi-velocity Switch, Start Q Program, General Purpose Input
Control Output Signal			Warning Output, Fault Output, Servo Ready, Velocity Reached, Torque Reached, Position Reached, Servo-on Status, Brake Release, Dynamic Position Error Following, Positioning Complete, Zero Speed Detected, Velocity Coincidence, Torque Coincidence, Velocity limit, Torque limit, Homing Finished, Soft Limit CW/CCW, General Purpose Output
Protection			Over Current, Over Voltage,Under Voltage, Over Temperature, Bad Encoder Feedback, Over Load, Over Speed, Positon Error, STO, CW/CCW Limit, Full Closed-loop Hybrid Deviation Fault, Main Power Phase Loss
Dynamic Brake			Built in
STO			Built in
Weight			M56S-313ARF: 1.9Kg　M56S-321ARF: 3.8Kg M56S-317ARF: 3.8Kg　M56S-326ARF: 3.8Kg

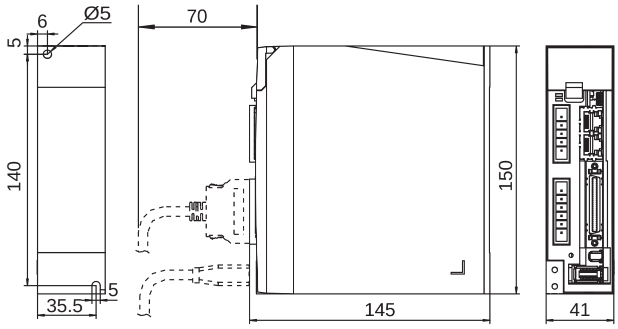
2.2.4 Regeneration resistor specification

When the output torque of the motor shaft is opposite to the direction of rotation, the energy is fed back from the motor load end to the drive bus capacitor, which makes the bus voltage increase. When it reaches the braking voltage point, the energy can only be consumed by the regeneration resistor, otherwise it will damage the servo drive. The regeneration resistor can be built-in or the user can be connected externally; the built-in and external regeneration resistors cannot be used simultaneously. The related specifications of the built-in regeneration resistor in the M3 EtherCAT series servo drive are as follows:

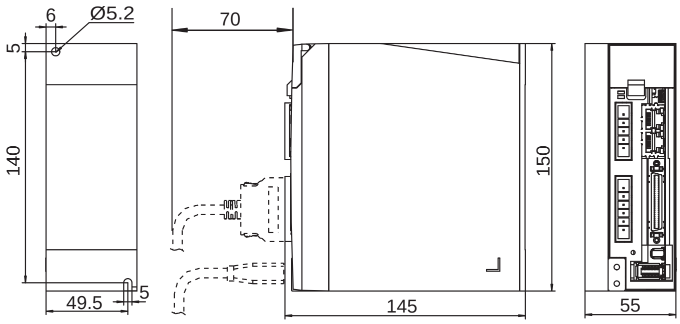
Drive P/N	Built-in resistor		External resistor
	ohm (Ω)	Power (W)	Minimal value (Ω)
M56S-21A8RD	no-built in		40
M56S-21A8RF	200	40	40
M56S-23A0RD	no-built in		40
M56S-23A0RF	200	40	40
M56S-24A5RD	100	60	40
M56S-24A5RF	100	60	40
M56S-26A0RF	25	80	15
M56S-210ARF	25	80	15
M56S-213ARF	25	80	15
M56S-313ARF	25	80	15
M56S-317ARF	35	100	35
M56S-321ARF	35	100	25
M56S-326ARF	35	100	25

2.2.5 Dimensions of the driver (Unit: mm)

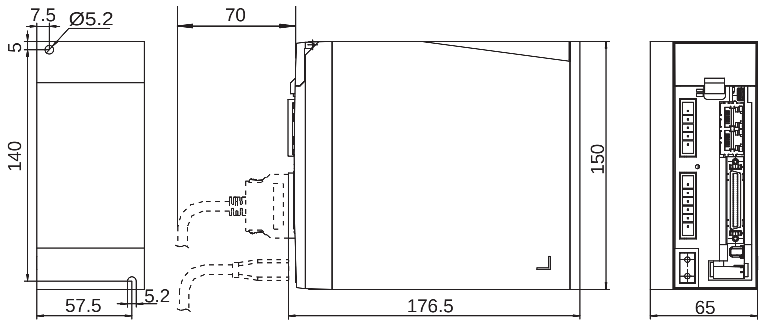
☐ M56S-21A8R◆(100/200W models)



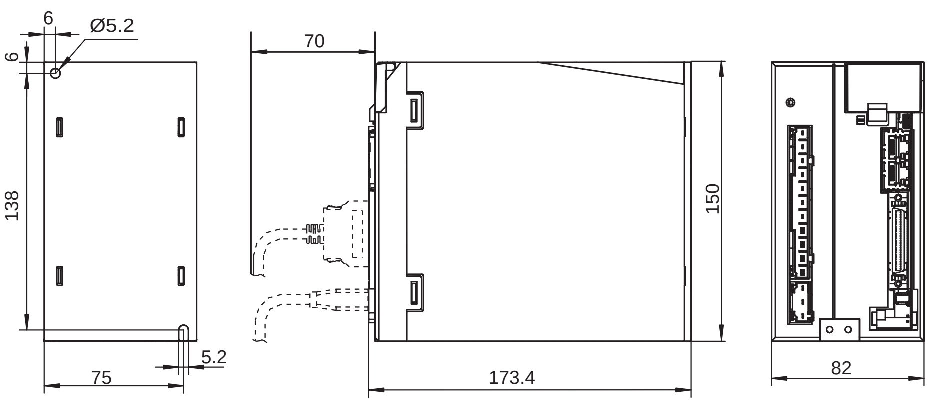
☐ M56S-23A0R◆(400W models)



☐ M56S-24A5R◆(750W models)

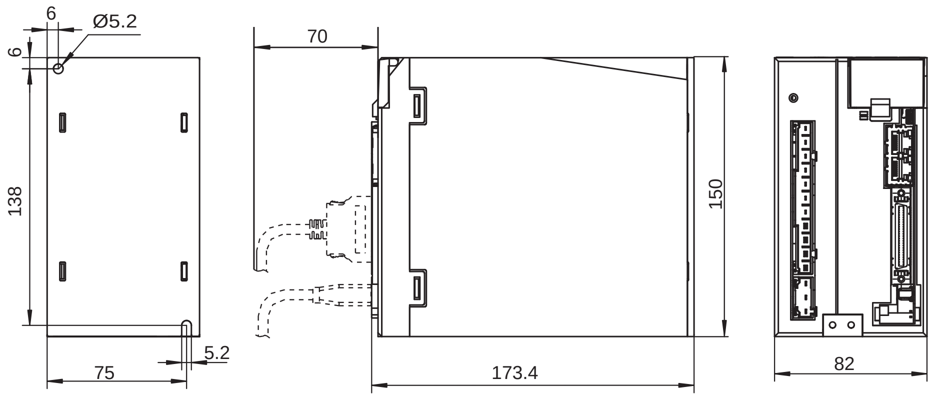


☐ M56S-26A0RF(1.0kW models)
M56S-210ARF(1.5kW models)
M56S-213ARF(2.5kW models)

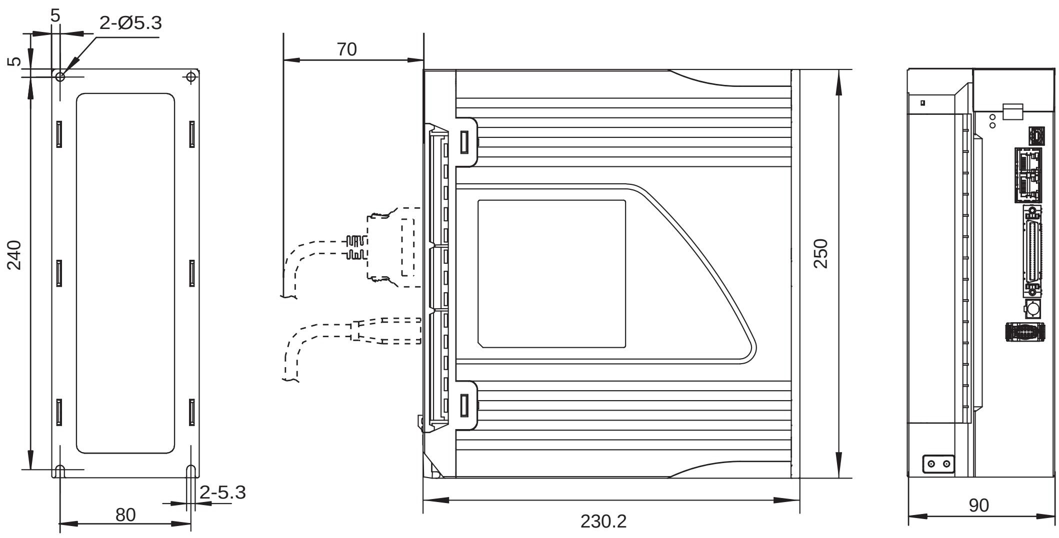


◆: 机种类别

□ M56S-313ARF(3.0kW models)



□ M56S-317ARF(5.0kW models)
M56S-321ARF(6.0kW models)
M56S-326ARF(7.5kW models)



2.3 Motor model introduction

2.3.1 Motor nameplate description

Label	Nameplate (AC SERVO MOTOR)
Model Number	Model No: SM3L-042AXNDV
Input	INPUT: 3ØAC 208-240V
	DC Source: 320V
Rated Current	RATED CURRENT: 1.2A
Output Power	RATED OUTPUT: 100W
Output Torque	RATED TORQUE: 0.32N·m
Rated Speed	RATED SPEED: 3000rpm
Max. Speed	MAX. SPEED: 6000rpm
Protection Class	Ins.Class: F IP67

2.3.2 Motor model description

SM3 L - 13 2 A X N U V - ***

Servo Moto
SM3 Series

Inertia Type	
L	Low Inertia
M	Medium Inertia
H	High Inertia

Frame Size	
04	40mm
06	60mm
08	80mm
10	100mm
13	130mm
18	180mm

Motor Length	
1	1 Stacks
2	2 Stacks
3	3 Stacks
4	4 Stacks
5	5 Stacks

Voltage	
A	220VAC
Y	400VAC

Encoder Type	
T*	26-bit Multi-turn Absolute Optical Encoder
X	21-bit Multi-turn Absolute Magnetic Encoder
B	17-bit Battery-less Multi-turn Absolute Encoder

Note: *1 For 100/130/180mm frame size motor, the encoder resolution is 23-bit.

Brake	
N	No brake
B	With brake(24VDC)

Connector & Rear Cover Type	
D	Direct-mount with sealed plastic connector, metal rear cover
P	Direct-mount with sealed plastic connector, standard rear cover
U	Direct-mount with sealed metal straight connector, standard rear cover

Shaft	
N	Circular shaft without oil seal
V	Keyway without oil seal
K	Keyway with installed oil seal

Custom Code

2.3.3 □40mm Frame Low Inertia

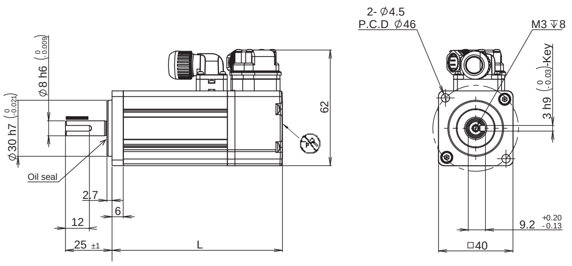
□ Specification

Type*		SM3L - 042A◇□D△
Rated Output Power Rated Speed Max.Speed	watts rpm rpm	100 3000 6000
Rated Torque Peak Torque	N·m N·m	0.32 1.28
Rated Current Peak Current	A (rms) A (rms)	1.2 5.9
Voltage Constant ±5% Torque Constant ±5%	V (rms) / K rpm N·m / A (rms)	16.8 0.267
Rotor Inertia Rotor Inertia - With Brake Shaft Load - Axial Shaft Load - Radial (End of Shaft) Weight Weight - With Brake	Kg·m^2 Kg·m^2 N (max.) N (max.) Kg Kg	0.038×10^{-4} 0.0433×10^{-4} 50 60 0.49 0.73

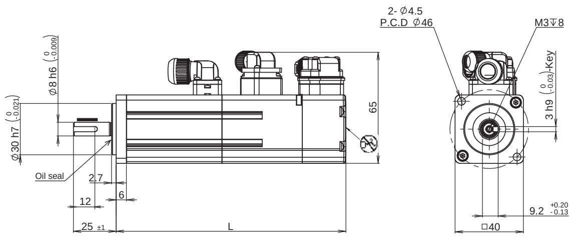
***◇Encoder Options; □Brake Options; △Oil Seal Options**

□ Dimensions (Unit: mm)

1) Without Brake



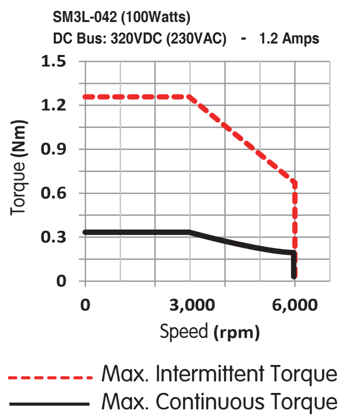
2) With Brake



Without Brake	L
SM3L-042A◇ND△	91.5
SM3L-042ABND△	100

With Brake	L
SM3L-042A◇BD△	134.5
SM3L-042ABBD△	143

□ Torque Curves



2.3.4 □40mm Frame High Inertia

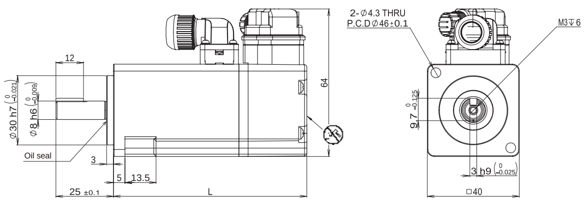
□ Specification

Type*		SM3H - 041A◇□P△	SM3H - 042A◇□P△
Rated Output Power Rated Speed Max.Speed	watts rpm rpm	50 3000 6000	100 3000 6000
Rated Torque Peak Torque	N·m N·m	0.16 0.64	0.32 1.28
Rated Current Peak Current	A (rms) A (rms)	1.4 4.8	1.4 5.7
Voltage Constant ±5% Torque Constant ±5%	V (rms) / K rpm N·m / A (rms)	9.24 0.277	14.8 0.277
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	0.0383×10^{-4} 0.0395×10^{-4} 50 60 0.31 0.55	0.0702×10^{-4} 0.0724×10^{-4} 50 60 0.42 0.66

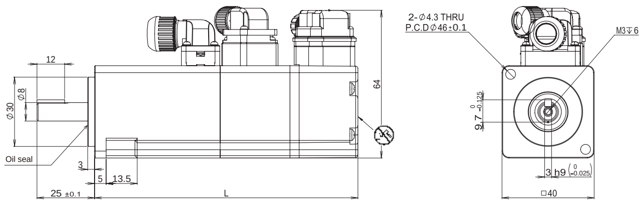
***◇Encoder Options; □Brake Options; △Oil Seal Options**

□ Dimensions (Unit: mm)

1) Without Brake



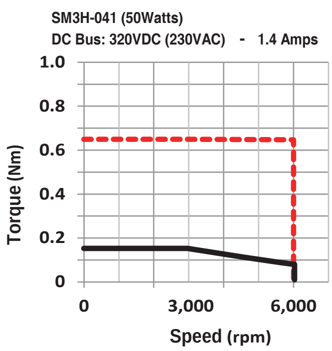
2) With Brake

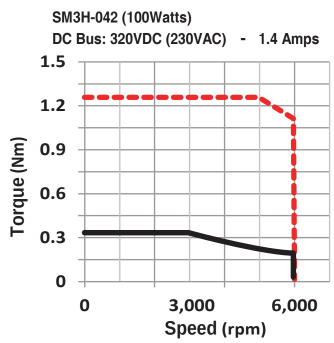


Without Brake	L
SM3H-041A◇NP△	70
SM3H-042A◇NP△	84

With Brake	L
SM3H-041A◇BP△	100.3
SM3H-042A◇BP△	114.3

□ Torque Curves





Max. Intermittent Torque
Max. Continuous Torque

2.3.5 □60mm Frame Low Inertia

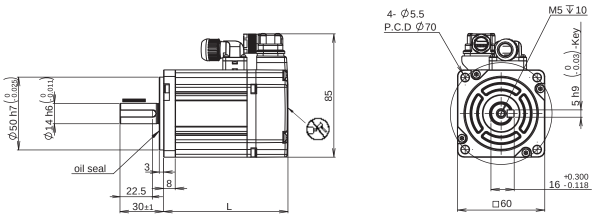
□ Specification

Type*		SM3L - 061A◇□P△	SM3L - 062A◇□P△
Rated Output Power Rated Speed Max.Speed	watts rpm rpm	200 3000 6000	400 3000 6000
Rated Torque Peak Torque	N·m N·m	0.64 1.9	1.27 3.8
Rated Current Peak Current	A (rms) A (rms)	1.5 5.4	2.8 10
Voltage Constant ±5% Torque Constant ±5%	V (rms) / K rpm N·m / A (rms)	26.5 0.427	28.3 0.454
Rotor Inertia Rotor Inertia - With Brake Shaft Load - Axial Shaft Load - Radial (End of Shaft) Weight Weight - With Brake	$Kg·m^2$ $Kg·m^2$ N (max.) N (max.) Kg Kg	0.152×10^{-4} 0.182×10^{-4} 70 200 0.85 1.3	0.237×10^{-4} 0.268×10^{-4} 70 240 1.2 1.7

***◇Encoder Options; □Brake Options; △Oil Seal Options**

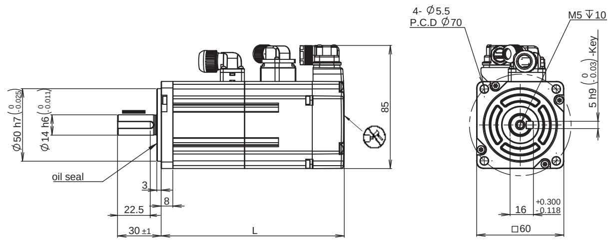
□ Dimensions (Unit: mm)

1) Without Brake



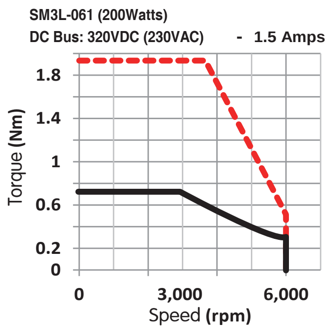
Without Brake	L
SM3L - 061A◇NP△	84.5
SM3L - 061ABND△	85.5
SM3L - 062A◇NP△	103
SM3L - 062ABND△	104

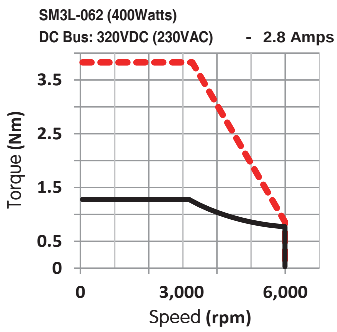
2) With Brake



With Brake	L
SM3L - 061A◇BP△	125
SM3L - 061ABBD△	126
SM3L - 062A◇BP△	143.5
SM3L - 062ABBD△	144.5

□ Torque Curves





Max. Intermittent Torque
Max. Continuous Torque

2.3.7 □60mm Frame High Inertia

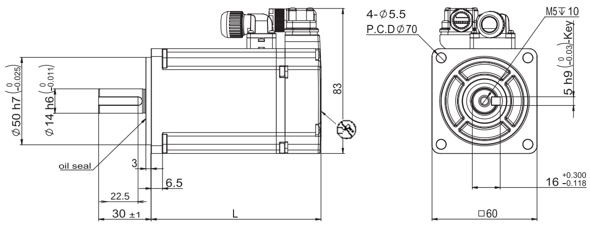
□ Specification

Type*		SM3H - 061A◇□P△	SM3H - 062A◇□P△
Rated Output Power Rated Speed Max.Speed	watts rpm rpm	200 3000 6000	400 3000 6000
Rated Torque Peak Torque	N·m N·m	0.64 2.24	1.27 4.445
Rated Current Peak Current	A (rms) A (rms)	1.7 5.9	2.8 9.8
Voltage Constant ±5% Torque Constant ±5%	V (rms) / K rpm N·m / A (rms)	24.3 0.376	28.9 0.423
Rotor Inertia Rotor Inertia - With Brake Shaft Load - Axial Shaft Load - Radial (End of Shaft) Weight Weight - With Brake	$Kg·m^2$ $Kg·m^2$ N (max.) N (max.) Kg Kg	0.31×10^{-4} 0.32×10^{-4} 70 200 0.79 1.15	0.566×10^{-4} 0.62×10^{-4} 70 240 1.2 1.5

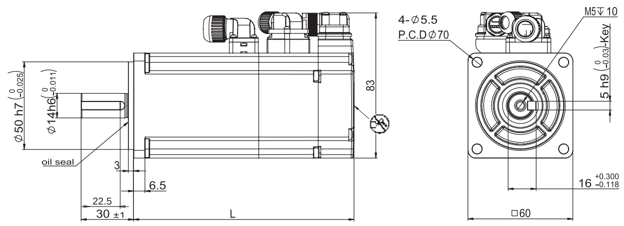
***◇Encoder Options; □Brake Options; △Oil Seal Options**

□ Dimensions (Unit: mm)

1) Without Brake



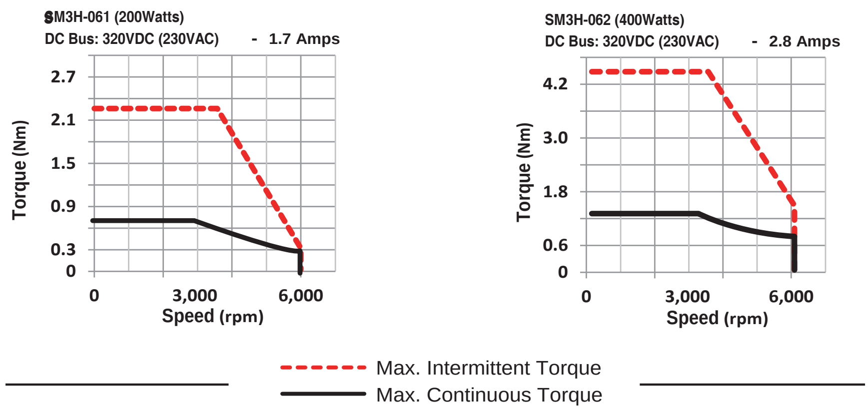
2) With Brake



Without Brake	L
SM3H-061A◇NP△	77
SM3H-062A◇NP△	97

With Brake	L
SM3H-061A◇BP△	106
SM3H-062A◇BP△	126

□ Torque Curves



2.3.8 □80mm Frame Low Inertia

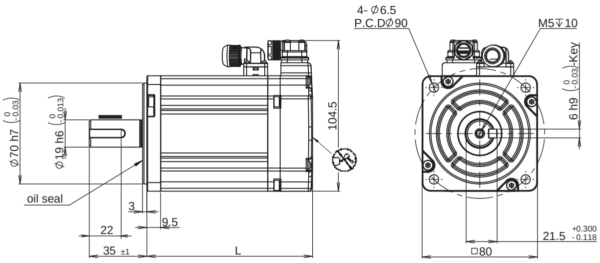
□ Specification

Type*		SM3L - 083A◇□P△	SM3L - 084A◇□P△
Rated Output Power Rated Speed Max.Speed	watts rpm rpm	750 3000 6000	1000 3000 6000
Rated Torque Peak Torque	N·m N·m	2.4 6.7	3.2 9.6
Rated Current Peak Current	A (rms) A (rms)	4.5 14	5.6 19
Voltage Constant ±5% Torque Constant ±5%	V (rms) / K rpm N·m / A (rms)	33.9 0.533	36.65 0.63
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	0.829×10^{-4} 0.961×10^{-4} 90 270 2.29 3.1	1.01×10^{-4} 1.12×10^{-4} 90 270 2.77 3.62

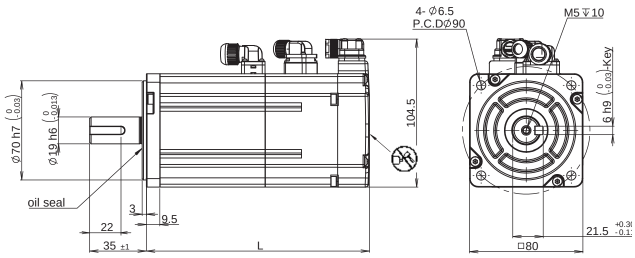
***◇Encoder Options; □Brake Options; △Oil Seal Options**

□ Dimensions (Unit: mm)

1) Without Brake



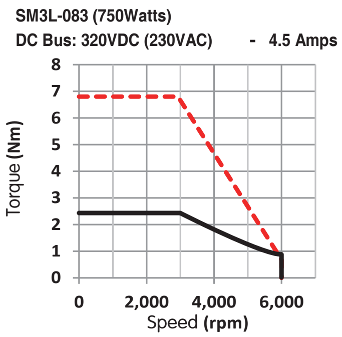
2) With Brake

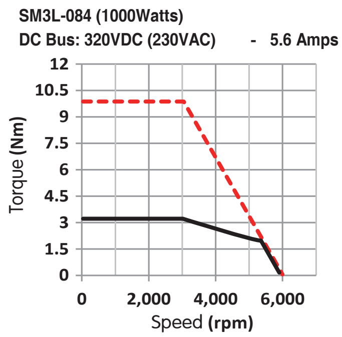


Without Brake	L
SM3L-083A◇NP△	115
SM3L-083ABND△	115
SM3L-084A◇NP△	129
SM3L-084ABND△	129

With Brake	L
SM3L-083A◇BP△	157
SM3L-083ABBP△	157.5
SM3L-084A◇BP△	171
SM3L-084ABBD△	171.5

□ Torque Curves





Max. Intermittent Torque
Max. Continuous Torque

2.3.9 □80mm Frame High Inertia

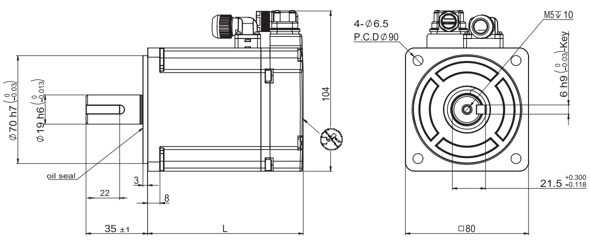
□ Specification

Type*		SM3H - 083A◇□P△
Rated Output Power Rated Speed Max.Speed	watts rpm rpm	750 3000 6000
Rated Torque Peak Torque	N·m N·m	2.4 8.4
Rated Current Peak Current	A (rms) A (rms)	4.5 16.7
Voltage Constant ±5% Torque Constant ±5%	V (rms) / K rpm N·m / A (rms)	32.3 0.53
Rotor Inertia Rotor Inertia - With Brake Shaft Load - Axial Shaft Load - Radial (End of Shaft) Weight Weight - With Brake	Kg·m^2 Kg·m^2 N (max.) N (max.) Kg Kg	1.46×10^{-4} 1.63×10^{-4} 90 270 2.1 2.85

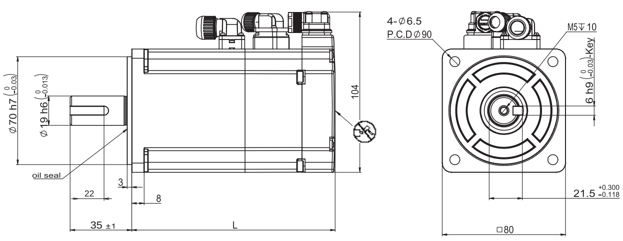
***◇Encoder Options; □Brake Options; △Oil Seal Options**

□ Dimensions (Unit: mm)

1) Without Brake



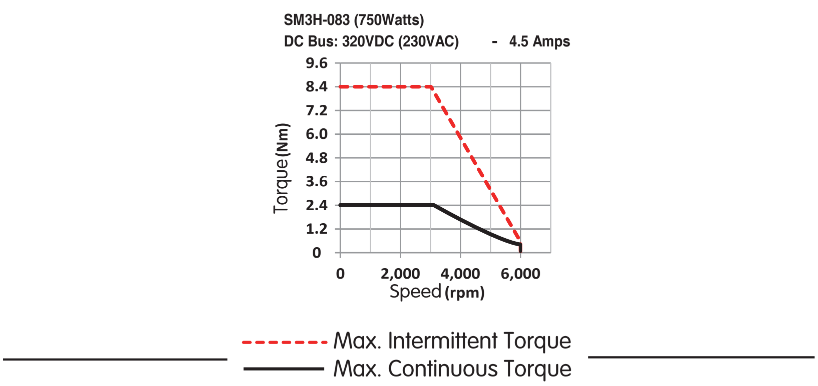
2) With Brake



Without Brake	L
SM3H-083A◇NP△	101

With Brake	L
SM3H-083A◇BP△	132

□ Torque Curves



2.3.10 □100mm Frame Low Inertia

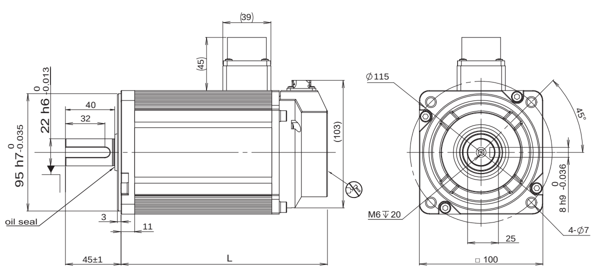
□ Specification

Type*		SM3L - 102A◇□U△	SM3L - 103A◇□U△	SM3L - 104A◇□U△	SM3L - 105A◇□U△
Rated Output Power	watts	1000	1500	2000	2500
Rated Speed	rpm	3000	3000	3000	3000
Max.Speed	rpm	6000	5700	5600	5600
Rated Torque	N·m	3.2	4.9	6.4	8
Peak Torque	N·m	9.6	14.7	19.2	24
Rated Current	A (rms)	6.0	9.6	12.7	13
Peak Current	A (rms)	21	36.5	44	45
Voltage Constant ±5%	V (rms) / K rpm	32.9	34.1	34.3	37.4
Torque Constant ±5%	N·m / A (rms)	0.543	0.563	0.565	0.61
Rotor Inertia	$Kg{\cdot}m^2$	1.79×10^{-4}	2.37×10^{-4}	2.98×10^{-4}	3.68×10^{-4}
Rotor Inertia - With Brake	$Kg{\cdot}m^2$	2.67×10^{-4}	3.25×10^{-4}	3.86×10^{-4}	4.56×10^{-4}
Shaft Load - Axial	N (max.)	90	90	90	90
Shaft Load - Radial (End of Shaft)	N (max.)	270	270	270	270
Weight	Kg	4	4.39	5.2	6.3
Weight - With Brake	Kg	5.2	5.64	6.12	7.6

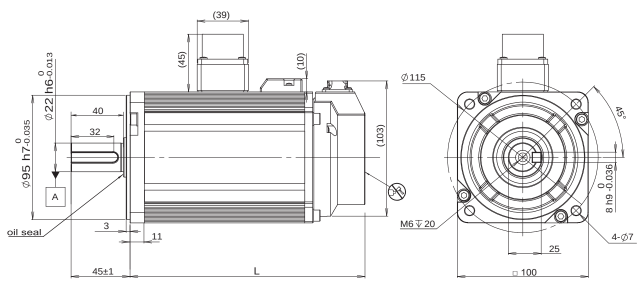
***◇Encoder Options; □Brake Options; △Oil Seal Options**

□ Dimensions (Unit: mm)

1) Without Brake



2) With Brake

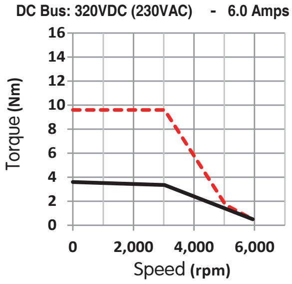


Without Brake	L
SM3L-102A◇NU△	137
SM3L-103A◇NU△	152
SM3L-104A◇NU△	168
SM3L-105A◇NU△	186

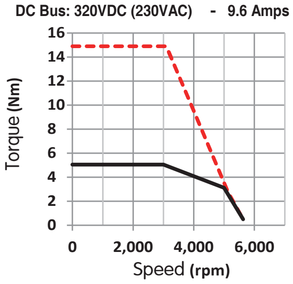
With Brake	L
SM3L-102A◇BU△	179
SM3L-103A◇BU△	194
SM3L-104A◇BU△	210
SM3L-105A◇BU△	228

□ Torque Curves

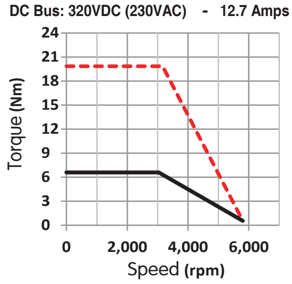
SM3L-102A (1000Watts)
DC Bus: 320VDC (230VAC) - 6.0 Amps



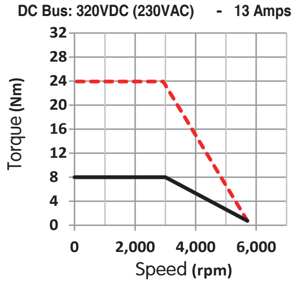
SM3L-103A (1500Watts)
DC Bus: 320VDC (230VAC) - 9.6 Amps



SM3L-104A (2000Watts)
DC Bus: 320VDC (230VAC) - 12.7 Amps



SM3L-105A (2500Watts)
DC Bus: 320VDC (230VAC) - 13 Amps



Max. Intermittent Torque
Max. Continuous Torque

2.3.11 □130mm Frame Medium Inertia

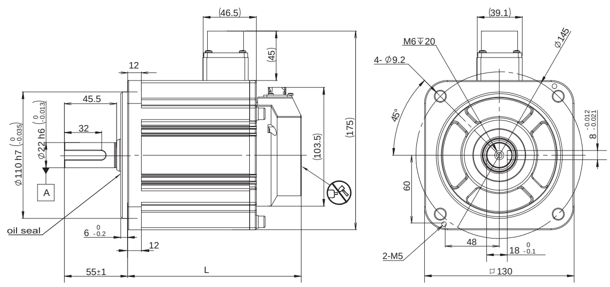
□ Specification

Type*		SM3M - 132A◇□U△	SM3M - 133A◇□U△	SM3M - 134A◇□U△
Rated Output Power Rated Speed Max.Speed	watts rpm rpm	1000 2000 3000	1500 2000 3000	2000 2000 3000
Rated Torque Peak Torque	N·m N·m	4.77 14.3	7.16 21.5	9.55 28.6
Rated Current Peak Current	A (rms) A (rms)	5.4 16.9	8.5 26	11 32.7
Voltage Constant ±5% Torque Constant ±5%	V (rms) / K rpm N·m / A (rms)	55.3 0.883	54.2 0.843	55.5 0.87
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	13×10^{-4} 15.2×10^{-4} 196 490 5.33 7.25	18.3×10^{-4} 20.5×10^{-4} 343 686 6.67 8.47	24.4×10^{-4} 26.6×10^{-4} 396 980 9.1 10.75

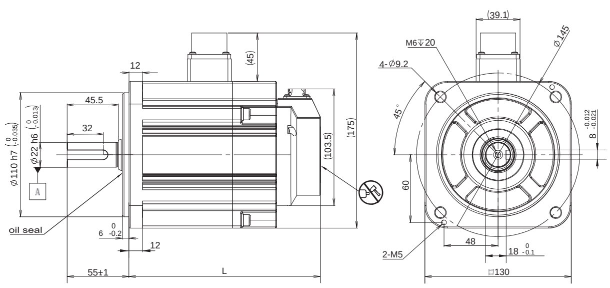
***◇Encoder Options; □Brake Options; △Oil Seal Options**

□ Dimensions (Unit: mm)

1) Without Brake



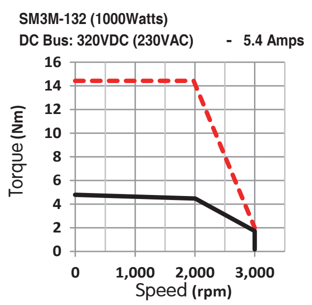
2) With Brake

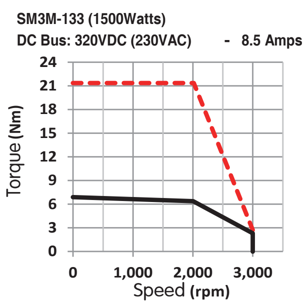


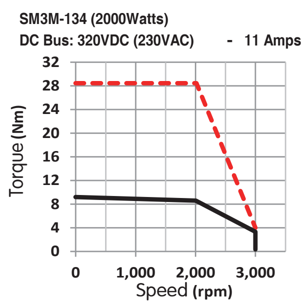
Without Brake	L
SM3M-132A◇NU△	138
SM3M-133A◇NU△	152
SM3M-134A◇NU△	169

With Brake	L
SM3M-132A◇BU△	171
SM3M-133A◇BU△	185
SM3M-134A◇BU△	202

□ Torque Curves







Max. Intermittent Torque
Max. Continuous Torque

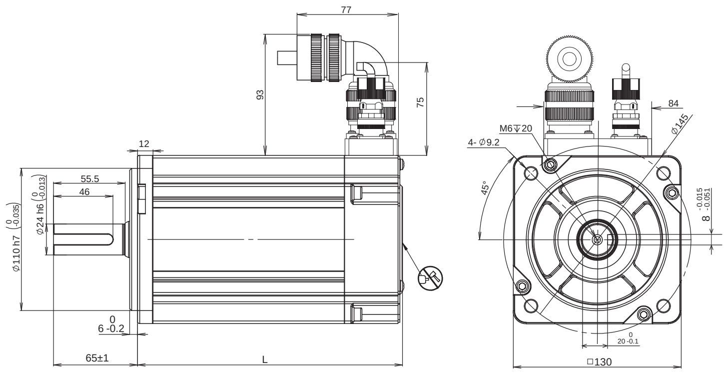
2.3.12 □130mm Frame Medium Inertia

□ Specification

Type*		SM3M - 135Y◇□M△
Rated Output Power Rated Speed Max.Speed	watts rpm rpm	3000 2000 3000
Rated Torque Peak Torque	N·m N·m	14.3 42.9
Rated Current Peak Current	A (rms) A (rms)	10.5 30
Voltage Constant ±5% Torque Constant ±5%	V (rms) / K rpm N·m / A (rms)	93.2 1.47
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	36.4×10^{-4} 38.6×10^{-4} 396 980 12.05 13.95

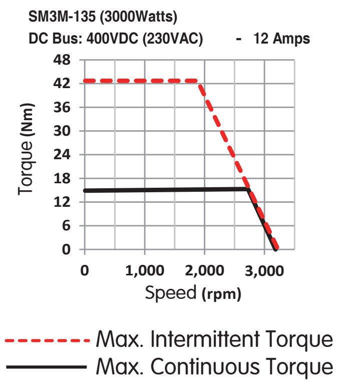
***◇Encoder Options; □Brake Options; △Oil Seal Options**

□ Dimensions (Unit: mm)



Models		L
Without Brake	SM3M-135Y◇NM△	205
With Brake	SM3M-135Y◇BM△	238

□ Torque Curves



2.3.13 □130mm Frame High Inert

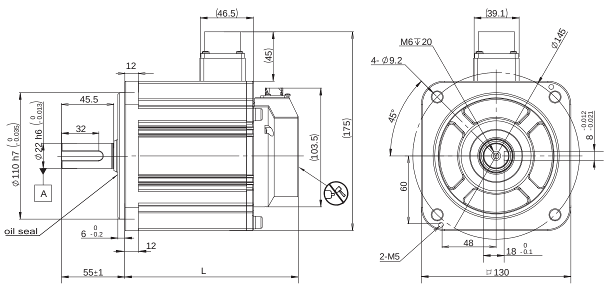
□ Specification

Type*		SM3H - 132A◇□U△	SM3H - 133A◇□U△	SM3H - 134A◇□U△
Rated Output Power	watts	850	1300	1800
Rated Speed	rpm	1500	1500	1500
Max.Speed	rpm	3000	3000	3000
Rated Torque	N·m	5.39	8.34	11.5
Peak Torque	N·m	16.2	25	34.5
Rated Current	A (rms)	6	9.6	13
Peak Current	A (rms)	19	29.6	45
Voltage Constant ±5%	V (rms) / K rpm	55.3	54.2	51
Torque Constant ±5%	N·m / A (rms)	0.891	0.869	0.88
Rotor Inertia	Kg·m²	13×10^{-4}	18.3×10^{-4}	24.4×10^{-4}
Rotor Inertia - With Brake	Kg·m²	15.2×10^{-4}	20.5×10^{-4}	26.6×10^{-4}
Shaft Load - Axial	N (max.)	196	343	396
Shaft Load - Radial (End of Shaft)	N (max.)	490	686	980
Weight	Kg	5.92	7	8.5
Weight - With Brake	Kg	7.84	8.8	10.15

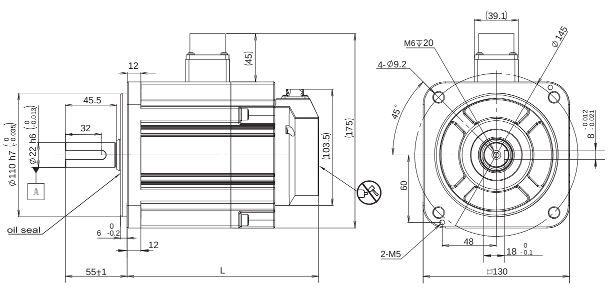
***◇Encoder Options; □Brake Options; △Oil Seal Options**

□ Dimensions (Unit: mm)

1) Without Brake



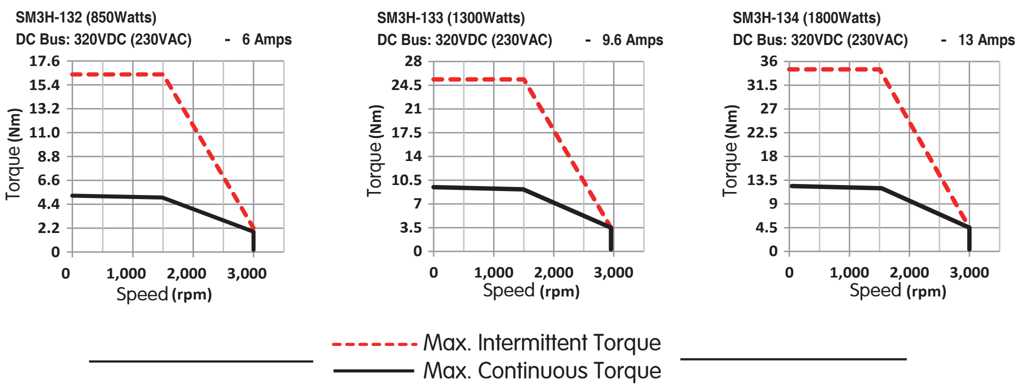
2) With Brake



Without Brake	L
SM3H-132A◇NU△	138
SM3H-133A◇NU△	152
SM3H-134A◇NU△	169

With Brake	L
SM3H-132A◇BU△	171
SM3H-133A◇BU△	185
SM3H-134A◇BU△	202

□ Torque Curves



2.3.14 □180mm Frame High Inert

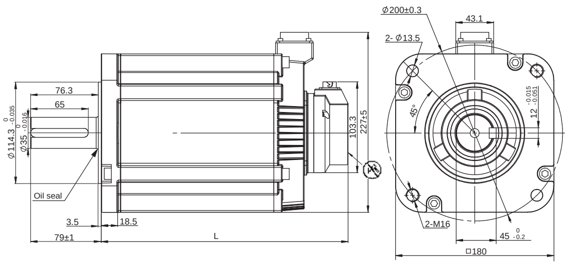
□ Specification

Type*		SM3H - 182Y◇□U△	SM3H - 183Y◇□U△
Rated Output Power Rated Speed Max.Speed	watts rpm rpm	2900 1500 3000	4400 1500 3000
Rated Torque Peak Torque	N·m N·m	18.5 55.5	28 84
Rated Current Peak Current	A (rms) A (rms)	10.5 35.5	16.7 54.7
Voltage Constant ±5% Torque Constant ±5%	V (rms) / K rpm N·m / A (rms)	115 1.76	117 1.68
Rotor Inertia Rotor Inertia - With Brake Shaft Load - Axial Shaft Load - Radial (End of Shaft) Weight Weight - With Brake	$Kg·m^2$ $Kg·m^2$ N (max.) N (max.) Kg Kg	46×10^{-4} 51×10^{-4} 490 1470 13.9 15.9	67.5×10^{-4} 72.5×10^{-4} 490 1470 17.4 19.4

***◇Encoder Options; □Brake Options; △Oil Seal Options**

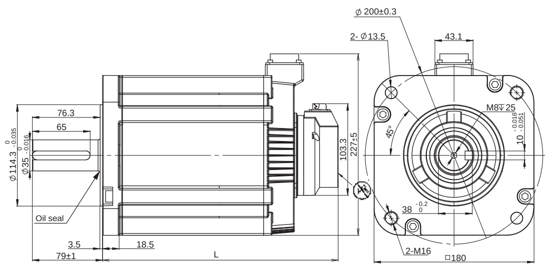
□ Dimensions (Unit: mm)

1) Without Brake



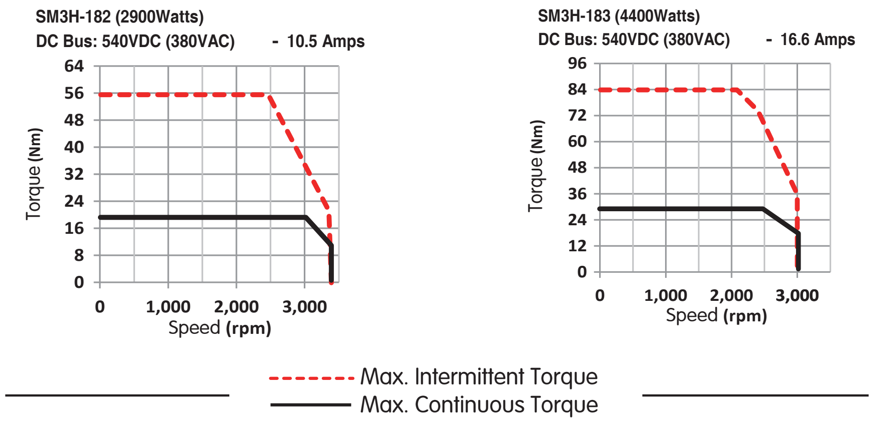
Without Brake	L
SM3H-182Y◇NU△	190
SM3H-183Y◇NU△	215

2) With Brake



With Brake	L
SM3H-182Y◇BU△	245
SM3H-183Y◇BU△	265

□ Torque Curves



2.3.15 □180mm Frame High Inert

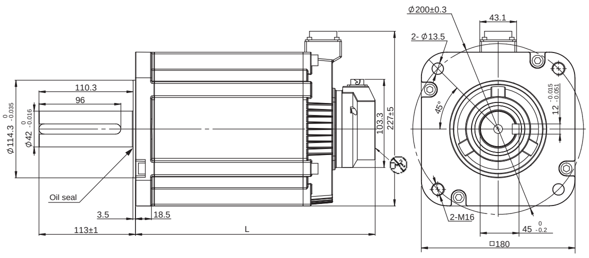
□ Specification

Type*		SM3H - 184Y◇□U△	SM3H - 185Y◇□U△
Rated Output Power Rated Speed Max.Speed	watts rpm rpm	5500 1500 3000	7500 1500 3000
Rated Torque Peak Torque	N·m N·m	35 105	48 120
Rated Current Peak Current	A (rms) A (rms)	20.9 69.9	25.2 73.4
Voltage Constant ±5% Torque Constant ±5%	V (rms) / K rpm N·m / A (rms)	114 1.67	115 1.93
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	89×10^{-4} 92×10^{-4} 588 1764 21 23	125×10^{-4} 145×10^{-4} 588 1764 26.8 28.9

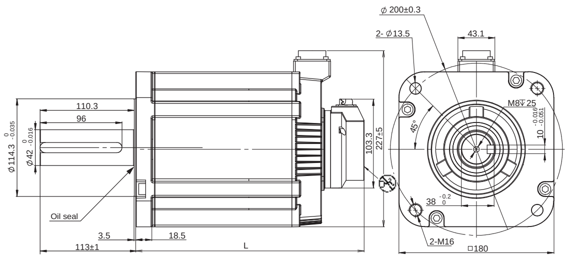
***◇Encoder Options; □Brake Options; △Oil Seal Options**

□ Dimensions (Unit: mm)

1) Without Brake



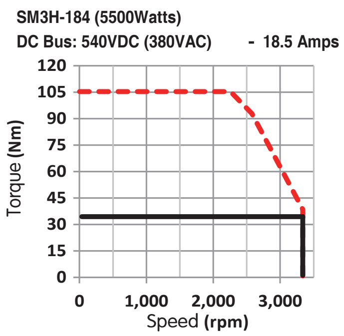
2) With Brake

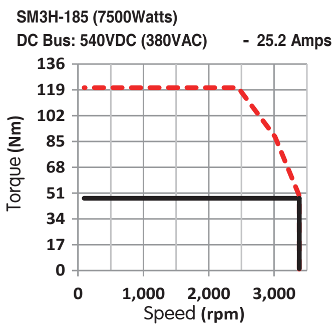


Without Brake	L
SM3H-184Y◇NU△	230
SM3H-185Y◇NU△	281

With Brake	L
SM3H-184Y◇BU△	280
SM3H-185Y◇BU△	316

□ Torque Curves





Max. Intermittent Torque
Max. Continuous Torque

2.4 Motor General Specifications

Encoder Type	26-bit, 21-bit, 17-bit Multi-turn Absolute Encoder
Insulation class	Class F (155℃)
Protection level	IP67 (Except transfixion part of shaft)
Installation conditions	indoor installation, avoiding direct sunlight, corrosive and flammable gas
Ambient temperature	Working temperature: 0℃~ 40℃ Storage temperature: -20℃ ~ 60℃
Humidity	Storage and usage: 20 ~ 85%RH (no condensation)
Altitude	Derating is not required for altitudes not higher than 1000m Derating 1% for every additional 100m for altitudes between 1000m and 2000m
Vibration	Under 49m/s^2, 10 ~ 60Hz(Do not use continuously at resonance frequency)

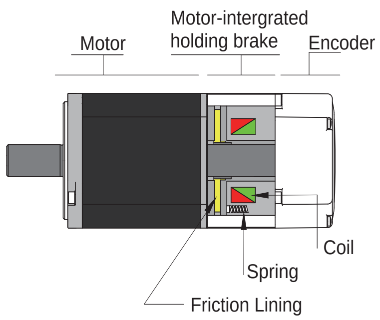
2.4.1 Motor Encoder Specifications

Item	Content		
Motor P/N	SM3*-****T***	SM3*-****X***	SM3*-****B***
Power Voltage VCC	DC 4.5V～5.5V (Typ 5V)		
External battery voltage	DC 3.3～5.5V (Typ 3.6V)		——
Power supply voltage VCC consumes current	Typ 160mA		
External battery consumption current	Typ 15μA		——
Number of pulses per revolution	67108864 (26-bit)	8388608 (23-bit)	131072 (17-bit)
Number of multi turn gyrometers	65536 (16-bit)		
Communication mode	Half-duplex acyclic serial communication		
Baud rate	4Mbps		
Operation temperature	0～105℃		

2.4.2 Brake Specifications

Motor brake is used to prevent motor from rotating by power off the servo system. The most common way of use is in vertical application, when the motor is disabled or powered off, in order to prevent the displacement of the mechanical mechanism driven by the motor due to gravity and other reasons, the servo motor with brake needs to be used.
When the brake is powered on, the armature is retracted, the brake pad is released, and the motor can operate normally. When the brake is powered off, the armature is released, the brake pad is locked, and the motor can't rotate.

Frame	40mm	60mm	80mm	100mm	130mm	180mm
Static Friction Torque (Nm)	0.32	1.5	3.2	8	18.5	60
Rated Voltage (VDC)	24					
Power Waste (W @ 20℃)	6.3	7.2	9.6	14.4	24.3	52
Current (A)	0.26	0.3	0.4	0.6	1.05	2.16
Braking 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.

2.5 Servo Drive and Motor Selection Reference Information Sheet

Servo Drives				
50pin 焊接型I/O连接器				
RS-485		M56S-21A8RD	M56S-23A0RD	M56S-24A5RD
		M56S-21A8RF	M56S-23A0RF	M56S-24A5RF
Matching Motors				
Motor Frame Size & Power				
		Frame 40, 100W	-	-
		Frame 60, 200W	Frame 60, 400W	-
		-	-	Frame 80, 750W
Low Inertia	Without Brake	SM3L-042A◇ND△ SM3L-042ABND△ SM3L-061A◇NP△	SM3L-062A◇NP△ SM3L-062ABND△	SM3L-083A◇NP△ SM3L-083ABND△
	With Brake	SM3L-042A◇BD△ SM3L-042ABBD△ SM3L-061A◇BP△	SM3L-062A◇BP△ SM3L-062ABBD△	SM3L-083A◇BP△ SM3L-083ABBD△
High Inertia	Without Brake	SM3H-042A◇ND△ SM3H-061A◇NP△	SM3H-062A◇NP△	SM3H-083A◇NP△
	With Brake	SM3H-042A◇BD△ SM3H-061A◇BP△	SM3H-062A◇BP△	SM3H-083A◇BP△

◇ **Encoder Option** △**Oil Seal Options**

Servo Drive				
50pin 焊接型I/O连接器				
RS-485		M56S-26A0RF	M56S-210ARF	M56S-213ARF
Matching Motor				
Motor Frame Size & Power				
		Frame 80, 1000W	-	Frame 100, 2000W
		Frame 100, 1000W	Frame 100, 1500W	Frame 100, 2500W
		Frame 130, 850W	Frame 130, 1300W	Frame 130, 1800W
		Frame 130, 1000W	Frame 130, 1500W	Frame 130, 2000W
Low Inertia	Without Brake	SM3L-084A◇NP△ SM3L-102A◇NU△	SM3L-103A◇NU△	SM3L-103A◇NU△ SM3L-104A◇NU△
	With Brake	SM3L-084A◇BP△ SM3L-102A◇BU△	SM3L-103A◇BU△	SM3L-103A◇BU△ SM3L-104A◇BU△
Medium Inertia	Without Brake	SM3M-132ATNU△ SM3M-132AXNU△	SM3M-133ATNU△ SM3M-133AXNU△	SM3M-134ATNU△ SM3M-134AXNU△
	With Brake	SM3M-132ATBU△ SM3M-132AXBU△	SM3M-133ATBU△ SM3M-133AXBU△	SM3M-134ATBU△ SM3M-134AXBU△
High Inertia	Without Brake	SM3H-132ATNU△ SM3H-132AXNU△	SM3H-133ATNU△ SM3H-133AXNU△	SM3H-134ATNU△ SM3H-134AXNU△
	With Brake	SM3H-132ATBU△ SM3H-132AXBU△	SM3H-133ATBU△ SM3H-133AXBU△	SM3H-134ATBU△ SM3H-134AXBU△

◇ Encoder Option △Oil Seal Options

2.6 Matching Cable and Connector Accessories

2.6.1 Servo motor matching cable

Motor Model 1*	Description	Common Type Model	Flexible Type Model 2*	Length (Unit: m)
SM3L-042A ◇☐ D△ SM3L-061A ◇☐ P△ SM3L-062A ◇☐ P△ SM3L-083A ◇☐ P△ SM3L-084A ◇☐ P△ SM3H-042A ◇☐ P△ SM3H-061A ◇☐ P△ SM3H-062A ◇☐ P△ SM3H-083A ◇☐ P△	Encoder Cables With Battery Absolute Encoder Standard	2639-0100	2639-0100-C10	1
		2639-0200	2639-0200-C10	2
		2639-0300	2639-0300-C10	3
		2639-0400	2639-0400-C10	4
		2639-0500	2639-0500-C10	5
		2639-0800	2639-0800-C10	8
		2639-1000	2639-1000-C10	10
		2639-1500	2639-1500-C10	15
		2639-2000	2639-2000-C10	20
	Encoder Cables Incremental Encoder Standard	2640-0100	2640-0100-C10	1
		2640-0200	2640-0200-C10	2
		2640-0300	2640-0300-C10	3
		2640-0400	2640-0400-C10	4
		2640-0500	2640-0500-C10	5
		2640-0800	2640-0800-C10	8
		2640-1000	2640-1000-C10	10
		2640-1500	2640-1500-C10	15
		2640-2000	2640-2000-C10	20
SM3L-042AB☐D△ SM3L-061AB☐D△ SM3L-062AB☐D△ SM3L-083AB☐D△ SM3L-084AB☐D△ SM3M-062AB☐D△ SM3M-083AB☐D△	Encoder Cables With Battery Absolute Encoder Standard	2641-0100	2641-0100-C10	1
		2641-0200	2641-0200-C10	2
		2641-0300	2641-0300-C10	3
		2641-0400	2641-0400-C10	4
		2641-0500	2641-0500-C10	5
		2641-0800	2641-0800-C10	8
		2641-1000	2641-1000-C10	10
		2641-1500	2641-1500-C10	15
		2641-2000	2641-2000-C10	20
SM3L-042A ◇☐ D△ SM3L-061A ◇☐ P△ SM3L-062A ◇☐ P△ SM3L-083A ◇☐ P△ SM3L-084A ◇☐ P△ SM3H-042A ◇☐ P△ SM3H-061A ◇☐ P△ SM3H-062A ◇☐ P△ SM3H-083A ◇☐ P△ SM3L-042AB ☐ D△ SM3L-061AB ☐ D△ SM3L-062AB ☐ D△ SM3L-083AB ☐ D△ SM3L-084AB ☐ D△ SM3M-062AB ☐ D△ SM3M-083AB ☐ D△	Motor Cables Standard	1645-0100	1645-0100-C10	1
		1645-0200	1645-0200-C10	2
		1645-0300	1645-0300-C10	3
		1645-0400	1645-0400-C10	4
		1645-0500	1645-0500-C10	5
		1645-0800	1645-0800-C10	8
		1645-1000	1645-1000-C10	10
		1645-1500	1645-1500-C10	15
		1645-2000	1645-2000-C10	20
	Motor Cables With Brake Cable	1646-0100	1646-0100-C10	1
		1646-0200	1646-0200-C10	2
		1646-0300	1646-0300-C10	3
		1646-0400	1646-0400-C10	4
		1646-0500	1646-0500-C10	5
		1646-0800	1646-0800-C10	8
		1646-1000	1646-1000-C10	10
		1646-1500	1646-1500-C10	15
		1646-2000	1646-2000-C10	20

* ◇Encoder Options △Oil Seal Options
* Flexible -C10 10 million times
Test Conditions: Bend Radius 50mm, Frequency 40 times/min, Distance 1000mm

Motor Model 1*	Description	Common Type Model	Flexible Type Model 2*	Length (Unit: m)
SM3L-102A ◇□ U△ SM3L-103A ◇□ U△ SM3L-104A ◇□ U△ SM3L-105A ◇□ U△ SM3M-132A ◇□ U△ SM3M-133A ◇□ U△ SM3M-134A ◇□ U△ SM3M-135Y ◇□ M△ SM3H-132A ◇□ U△ SM3H-133A ◇□ U△ SM3H-134A ◇□ U△ SM3H-182Y ◇□ U△ SM3H-183Y ◇□ U△ SM3H-184Y ◇□ U△ SM3H-185Y ◇□ U△	Encoder Cables With Battery Absolute Encoder Standard	2642-0100	2642-0100-C10	1
		2642-0300	2642-0300-C10	3
		2642-0500	2642-0500-C10	5
		2642-1000	2642-1000-C10	10
		2642-1500	2642-1500-C10	15
		2642-2000	2642-2000-C10	20
	Encoder Cables Incremental Encoder Standard	2643-0100	2643-0100-C10	1
		2643-0300	2643-0300-C10	3
		2643-0500	2643-0500-C10	5
		2643-1000	2643-1000-C10	10
		2643-1500	2643-1500-C10	15
		2643-2000	2643-2000-C10	20
SM3L-102A ◇ NU△ SM3M-132A ◇ NU△ SM3H-132A ◇ NU△	Motor Cables Standard	1658-0100	1658-0100-C10	1
		1658-0300	1658-0300-C10	3
		1658-0500	1658-0500-C10	5
		1658-1000	1658-1000-C10	10
		1658-1500	1658-1500-C10	15
		1658-2000	1658-2000-C10	20
SM3L-102A ◇ BU△ SM3M-132A ◇ BU△ SM3H-132A ◇ BU△	Motor Cables With Built-in Brake Cable Standard	1660-0100	1660-0100-C10	1
		1660-0300	1660-0300-C10	3
		1660-0500	1660-0500-C10	5
		1660-1000	1660-1000-C10	10
		1660-1500	1660-1500-C10	15
		1660-2000	1660-2000-C10	20
SM3L-103A ◇ NU△ SM3M-133A ◇ NU△ SM3H-133A ◇ NU△	Motor Cables Standard	1656-0100	1656-0100-C10	1
		1656-0300	1656-0300-C10	3
		1656-0500	1656-0500-C10	5
		1656-1000	1656-1000-C10	10
		1656-1500	1656-1500-C10	15
		1656-2000	1656-2000-C10	20
SM3L-103A ◇ BU△ SM3M-133A ◇ BU△ SM3H-133A ◇ BU△	Motor Cables With Built-in Brake Cable Standard	1662-0100	1662-0100-C10	1
		1662-0300	1662-0300-C10	3
		1662-0500	1662-0500-C10	5
		1662-1000	1662-1000-C10	10
		1662-1500	1662-1500-C10	15
		1662-2000	1662-2000-C10	20
SM3L-104A ◇ NU△ SM3L-105A ◇ NU△ SM3M-134A ◇ NU△ SM3M-135Y ◇ NM△ SM3H-134A ◇ NU△	Motor Cables Standard	1650-0100	1650-0100-C10	1
		1650-0300	1650-0300-C10	3
		1650-0500	1650-0500-C10	5
		1650-1000	1650-1000-C10	10
		1650-1500	1650-1500-C10	15
		1650-2000	1650-2000-C10	20
SM3L-104A ◇ BU△ SM3L-105A ◇ BU△ SM3M-134A ◇ BU△ SM3M-135Y ◇ BM△ SM3H-134A ◇ BU△	Motor Cables With Built-in Brake Cable Standard	1652-0100	1652-0100-C10	1
		1652-0300	1652-0300-C10	3
		1652-0500	1652-0500-C10	5
		1652-1000	1652-1000-C10	10
		1652-1500	1652-1500-C10	15
		1652-2000	1652-2000-C10	20

* ◇Encoder Options △Oil Seal Options
* Flexible -C10 10 million times
Test Conditions: Bend Radius 100mm, Frequency 40 times/min, Distance 1000mm

Motor Model 1*	Description	Common Type Model	Flexible Type Model 2*	Length (Unit: m)
SM3H-182Y ◇ NU△ SM3H-183Y ◇ NU△	Motor Cables Standard	1666-0100	1666-0100-C10	1
		1666-0300	1666-0300-C10	3
		1666-0500	1666-0500-C10	5
		1666-1000	1666-1000-C10	10
		1666-1500	1666-1500-C10	15
		1666-2000	1666-2000-C10	20
SM3H-182Y ◇ BU△ SM3H-183Y ◇ BU△	Motor Cables With Built-in Brake Cable Standard	1681-0100	1681-0100-C10	1
		1681-0300	1681-0300-C10	3
		1681-0500	1681-0500-C10	5
		1681-1000	1681-1000-C10	10
		1681-1500	1681-1500-C10	15
		1681-2000	1681-2000-C10	20
SM3H-184Y ◇ NU△ SM3H-185Y ◇ NU△	Motor Cables Standard	1667-0100	1667-0100-C10	1
		1667-0300	1667-0300-C10	3
		1667-0500	1667-0500-C10	5
		1667-1000	1667-1000-C10	10
		1667-1500	1667-1500-C10	15
		1667-2000	1667-2000-C10	20
SM3H-184Y ◇ BU△ SM3H-185Y ◇ BU△	Motor Cables With Built-in Brake Cable Standard	1680-0100	1680-0100-C10	1
		1680-0300	1680-0300-C10	3
		1680-0500	1680-0500-C10	5
		1680-1000	1680-1000-C10	10
		1680-1500	1680-1500-C10	15
		1680-2000	1680-2000-C10	20

* ◇Encoder Options △Oil Seal Options
* Flexible -C10 10 million times
Test Conditions: Bend Radius 100mm, Frequency 40 times/min, Distance 1000mm

2.6.2 Driver plug kit

Name	P/N	Description
I/O Connector	M2-50P	CN2, 50pin Density IO connector
Motor Encoder Connector	MSOP-CN310P	CN3, Driver side motor encoder connector
Second encoder Connector	MSOP-CN408P	CN4, Full closed loop function encoder connector
STO Function Connector	STO Connector Kit	CN5, STO Connector
Drive Connector Kit	MSOP-DRPWKITA	200/400/750W Drive P1, P2, Adjusting handle
	MSOP-DRPWKITB	1.0/1.5/2.5/3.0kW Drive P1, P2, Adjusting handle

2.6.3 Motor plug kit

Name	P/N	Description
Motor Connetor	MSOP-MTKITA	Frame 80mm and below motor connector kit (without brake connector)
	MSOP-MTKITD	Frame 80mm and below motor connector kit (with brake connector)
	MSOP-MTKITF	Frame100mm/130mm motor connector kit (Straight)
	MSOP-MTKITE	Frame 180mm motor connector kit (Straight)

2.6.4 Absolute value battery kit

Name	P/N	Description
Battery	MSOP-BA01	Used for absolute value encoder motor with battery
Battery and battery cases	MSOP-BAKIT01	

2.6.5 Communication cable

Name	P/N	Length (m)	Description
USB Config Cable	2620-150	1.5	CN1, Servo driver and PC communication configuration cable
CN6/CN7 Communiction Cable	2012-030	0.3	Twisted-pair, Unshielded type, 0.3m servo driver and controller communication cable Communication cables between servo drives
	2012-300	3	
	2013-030	0.3	Twisted-pair, Shielded type, 0.3m servo driver and controller communication cable Communication cables between servo drives
	2013-300	3	

2.6.6 Other cable

Name	P/N	Length (m)	Description
Second encoder feedback line	1643-300	3	Ordinary type, no need for bending times
	1643-500	5	
	1643-300-C05	3	Flexible type, 5 million times of bending
	1643-500-C05	5	

2.6.7 Regenerative resistor

P/N	Specification	Description
REG100W120R	100W, 120Ω	Regenerative absorbing resistor
REG200W120R	200W, 120Ω	
REG300W120R	300W,120Ω	

2.6.8 Dynamic brake resistor

P/N	Specification	Description
DBR85W3R5	85W, 3.5Ω	1.0/1.5/2.5/3.0kW type external dynamic brake resistor

2.6.9 EMI filter

P/N	Specification	Description
MSOP-EMI020	250VAC, 20A	EMI filter for AC power of drive side(Single Phase)

3 Installation

3.1 Storage Conditions

3.1.1 Drive storage environment conditions

Please note the following when storing:

- Correctly packaged and store in a clean and dry place, avoid direct sunlight
- Store within an ambient temperature range of -10℃～+65℃
- Store within a relative humidity rang of 10% to 85% and non-condensing
- DO NOT store in a place subjected to corrosive gasses

3.1.2 Motor Storage Conditions

- Correctly packaged and stored in a clean and dry place, avoid direct sunlight
- Store within an ambient temperature range of -20℃～+60℃
- Store within a relative humidity rang of 20% to 85% and non-condensing
- DO NOT store in a place subjected to corrosive gasses

3.2 Installation Conditions

3.2.1 Driving environment conditions

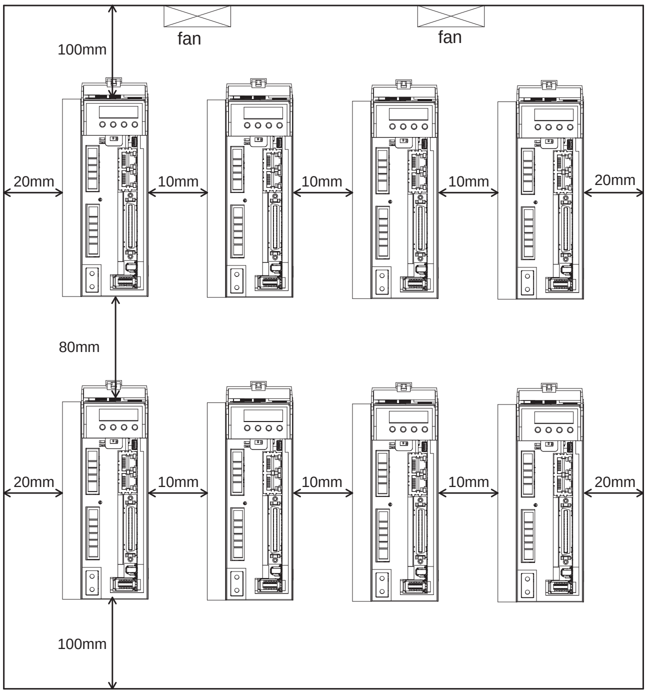
1. Temperature is 0 ℃ ~ 55 °C. If the ambient temperature exceeds 45 ℃, please place it in a well-ventilated place. It is recommended to operate at 45 ℃ for a long time
2. If this product is installed in a distribution box, the distribution box must be sized and ventilated so that there is no danger of overheating of all electronic devices used inside.
3. Ambient humidity is 10%~85% RH, no condensation
4. Vibration below $9.8m/s^2$
5. Do not use the driver near corrosive gas, flammable gas or combustible material
6. Please install the driver in an indoor electrical control box without water and direct sunlight
7. Please avoid using these drive-in dusty places

3.2.2 The motor operation ambient conditions are as follows:

- The ambient temperature is 0℃～40℃.
- Ambient humidity is 10%～85% RH, no condensation.
- Vibration below $49m/s^2$.
- Do not use the motor near corrosive gas, flammable gas, or combustible materials.
- Do not use the motor in a closed environment, the closed environment will cause the motor to high temperature and shorten the service life.

3.3 Drive installation space

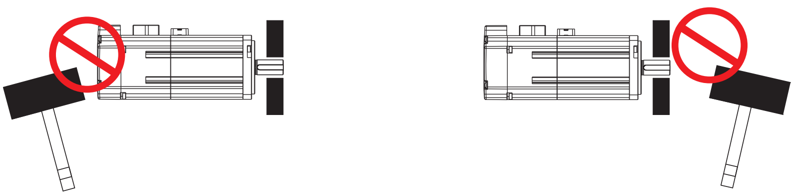
- When installing the drive, please reserve enough around space for the drive to ensure a good circulating cooling effect.
- Do not block the cooling holes of the drive.
- To ensure the temperature in the cabinet, it is recommended to install a cooling fan in the cabinet.
- Please ground the drive well during installation.



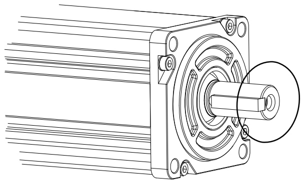
3.4 Motor Installation

3.4.1 Encoder and Bearing Protection

- DO NOT strike the motor when mounting as the motor shaft or encoder may be damaged.



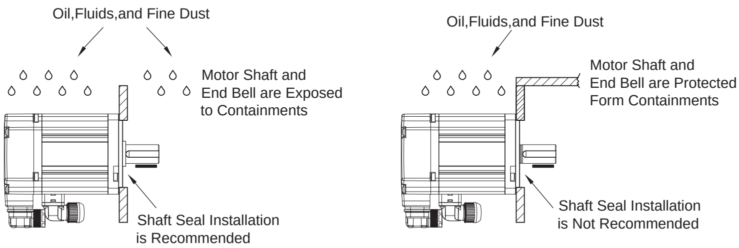
- It is recommended to use a disturbing coupling specially designed for servo motors, which can provide some cushioning during eccentricity or deflection.
- When installing the coupling, please wipe clean the anti-rust oil on the output shaft end of the motor.
- When using the keyway motor, please use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



- When disassembling the pulley, please use professional tools such as pulley remover to prevent the bearing from being injured.
- When connecting the shaft, make sure to achieve the required concentricity. If the concentricity is not good, it will produce vibration and damage the bearing and encoder.
- The load applied in the axial or radial direction of the motor should not exceed the range specified in the specifications, please refer to the specifications table of each servo motor.
- The output shaft material of the servo motor does not have the ability to prevent rust. Although grease has been used for rust protection before leaving the factory, if the storage time exceeds six months, to ensure that the motor shaft is free from rust, please check the condition of the motor shaft regularly every three months and add appropriate anti-rust grease in time.

3.4.2 Precautions for the use of the motor in the 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



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	50W、100W	200*200*6 aluminum
60mm	200W、400W	250*250*6 aluminum
80mm	750W	250*250*6 aluminum
	1kW	300*300*12 aluminum
100mm	1kW ~ 2.5kW	300*300*12 aluminum
130mm	850W ~ 3kW	400*400*20 aluminum
180mm	2.9kW ~ 7.5kW	550*550*30 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 Configutation and Wiring

4.1 Electromagnetic compatibility (EMC)

⚠	High-speed switching elements are used in the M56S series,whitch will produce high frequency interference during operation, and intefere with peripheral equipments through conduction or radiation.
	There is also a low voltage unit inside the servo drive, which is likely to be interfered by the noise of the drive's peripheral equipments. The interfered signal mat cause the device to make unexpected actions.

By following the electromagnetic compatibility specifications listed in this manual during installaition and wiring, this product can meet the following specifications.

EN 61800-3

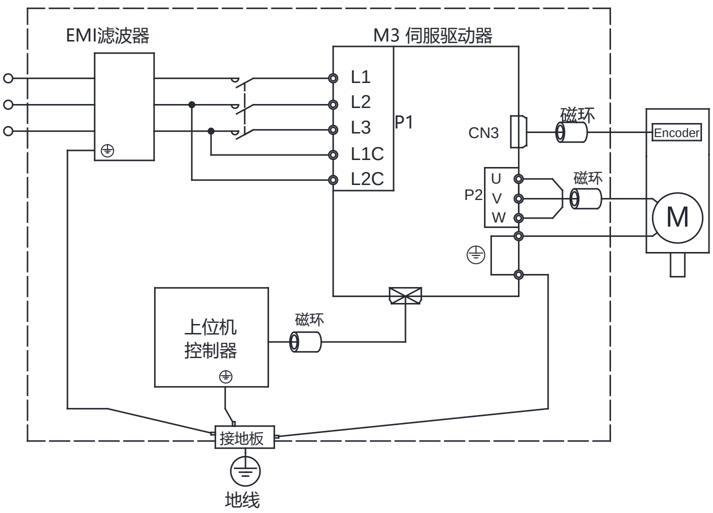
In order to prevent mutual electromagnetic interference between the servo drive and its peripheral equipments, the following countermeasurs can be taken.

- Install an appropriate EMI noise filter on the power input side.
- Make sure that the drive and motor are well grounded.AWG 10 is recommended for the grouding wire.
- Do not use the same sleeve for the main circuit cable and the input/output signal cable and encoder cable, or tie them together. When wiring, the main circuit cable and the input/output signal cable/encoder cable should be separated by more than 30cm.
- Use twisted-pair shielded wire for digital in-out signal cables and encoder signal cables.
- The length of input and output signal cables shoud be less than 3m. And the encoder cable is less than 20m.
- Do not use the same power source with eletric welders, EDM machines,etc, even if it is not the same power source,when there is a high-frenquency gnerator nearby, connect a EMI noise filter to the input side of the main circuit power and control powerr cable.

4.1.1 EMI Noise Filter

The EMI noise filter adopts correct installation method to minimize the interference.It is recommended to use EMI filter tested by MOON'S company to maximize the suppression efferct.

The recommend EMC protection wiring diagram is as follows.



More measures are as follows

1) Remove the paint layer on the contact surface when the drive is mounted on a metal plate

2) Servo drive and EMI filter are mounted on the same metal plate.

3) Position the input noise filter as close to the drive as possible

4) Route the input wires and output wires separately, do not bundle them together

5) EMI filter should be well grounded.

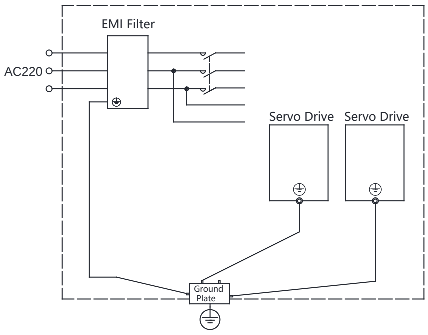
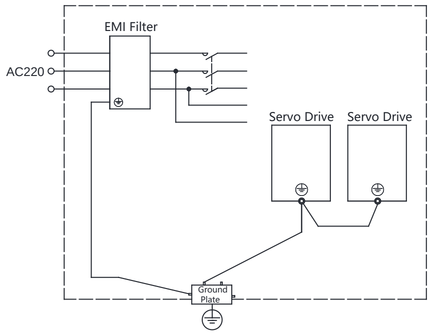
6) Use shield cables for main circuit. Shield of cable should be directly grounded to PE connector

7) Please install a ferrite magnetic ring as shown in the figure above for the input and output signal cables and power cables to get a better EMC effect.

4.1.2 Groudinng

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

- Must be parallel single-point grounding

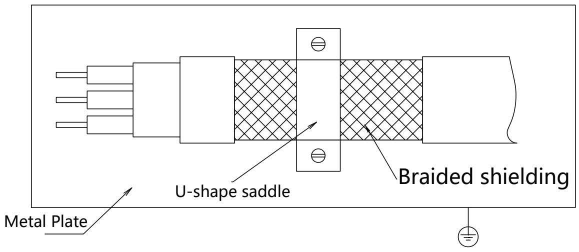
Correct Ground	Wrong Ground
	

- Use a shielded cable for the extension cable betweent the drive and motor.
- The shielding net of cable should be well grounded and connected to the ground terminal of drive.

4.1.3 Motor cable selection and installation precautions

Select the motor cable with shield and install it correctlu to get better EMC effect and interference suppression effect. Please note the following.

- Use a cable that has braided shielding (the effect of double shielding is better).
- The shield on both ends of the motor cable should be grounded with the shortest cable length and the largest contact area.
- Remove the protective paint on the U-shape saddle and metal plate in order to ensure good contact. Please see the figure below.
- A correct connection between the braided shielding of the motor cable and the metal plate is required. The braided shielding on both ends of the motor cable should be fixed by the U-shape saddle and metal plate. Please see the figure below for the correct connection.

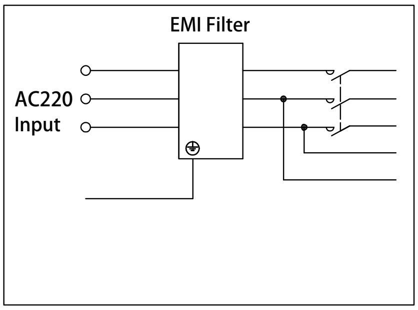
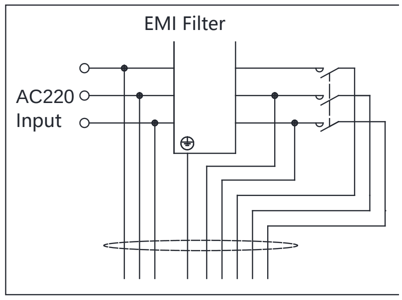


4.1.4 EMI Noise Filters

You must attach Noise Filters in appropriate places to protect the servo system from the adverse effects of noise.

NOTE:

- **Select a noise filter that matches the drive power**
- **Separate input cables from output cabls. Do not place input cables and output lines in the same duct or bundle them together**

Correct Ground	Wrong Ground
	

Recommended EMI filter

MOONS' P/N	Specification	Manufacturer	Description
MSOP-EMI020	250VAC，20A	LCR	EMI Noise Filter (Single)

More recommended EMI filters

Drive Model	Main Supply	Manufacturer	Filter P/N
M56S-21A8R◆	Single	TYCO	3ET1
M56S-23A0R◆		TYCO	6ET1
M56S-24A5R◆		TYCO	6ET1
M56S-26A0RF		TYCO	10ET1
M56S-210ARF	3-Phase	Dephir	DF300-16A-01
M56S-213ARF		Dephir	DF300-16A-01

◆ Represents the Function type

4.1.5 Ferrite Ring

The Ferrite Ring is used to absorb the radiation interference of the wire.

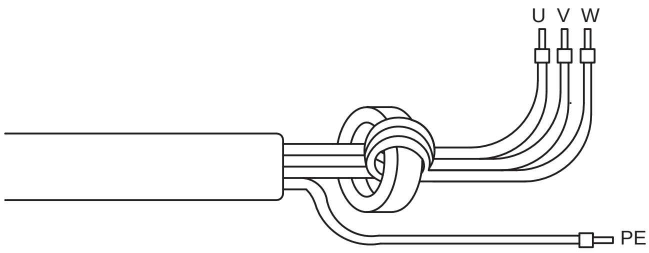
The ferrite ring has different impedance characteristics at different frequencies. Normally, the impedance is very small at low frequencies. When the signal frequency increases, the impedance of the ferrite ring rises sharply, which makes it easy for normal useful signals to pass through, and can effectively suppress high frequencies.Use the ferrite ring to optimize signal transmission and suppress high-frequency noise, and reduce high-frequency interference in the power and signal cables.

When the ferrite 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, which can cause greater attenuation of high-frequency noise, and The impedance of low-frequency useful signals can be ignored and does not affect the normal operation of the circuit.

Winding several turns of wire onto the ferrite ring can increase inductance and the ability to filter out high-frequency noise.But too many turns will cause too much loss and rise the temperature of the ferritering.

The suggested winding methods are shown below:

Digital signal Cables	Windling necessary turns.（2-3 Turns)
Motor Power Cables	Remove the jacket to the length so that wires can be wound on the ferrite ring. For effective noise reduction capability, U, V and W should be wound together. and wound 2-3 turns。 The ground wire and shield cannot be wound into the ferrite ring.
Encoder Cables	Windling necessary turns.（2-3 Turns)



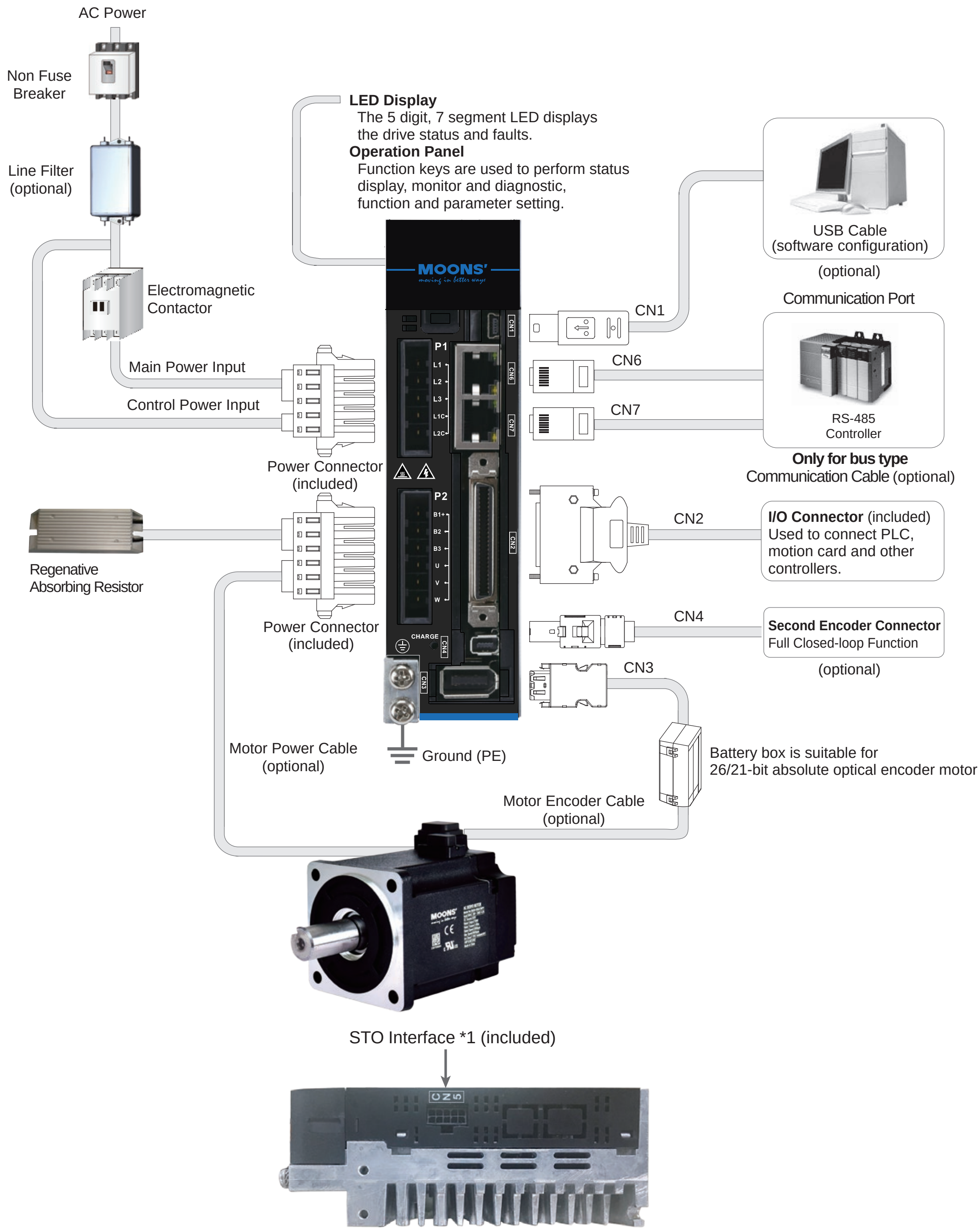
Recommend Ferrite Ring

MOONS' PN	P/N	Manufacturer
M2-OP3035	ZCAT3035-1330	TDK

4.2 External main circuit wiring

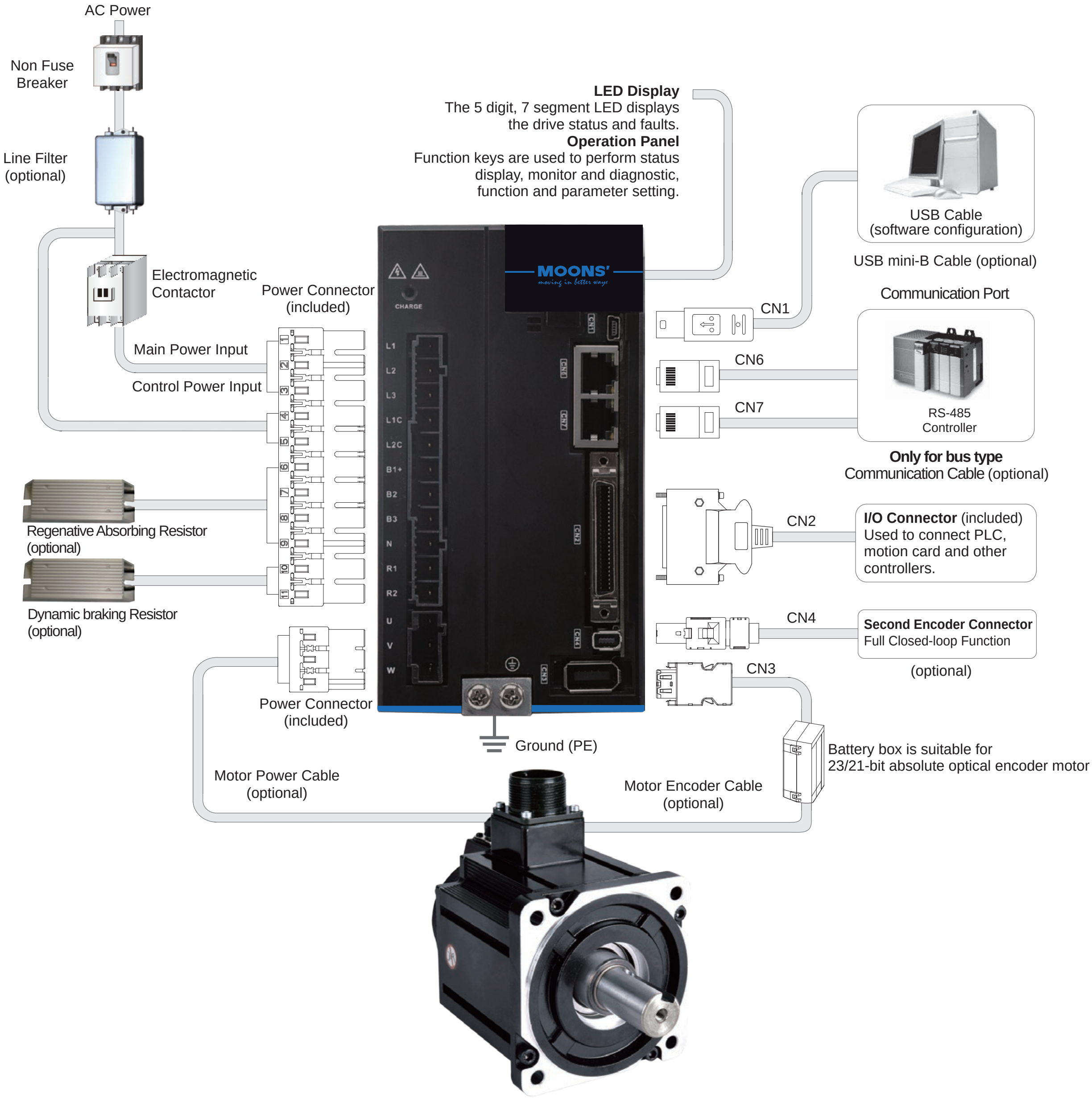
4.2.1 Main circuit wiring diagram

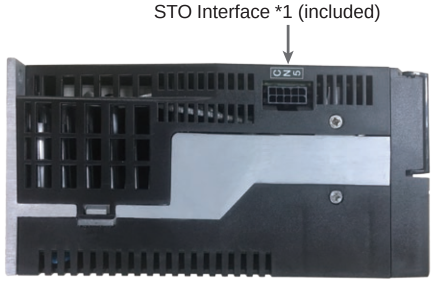
4.2.1.1 200/400/750W Type



Note: *1 Certain models don't support this function, please refer to page 16.

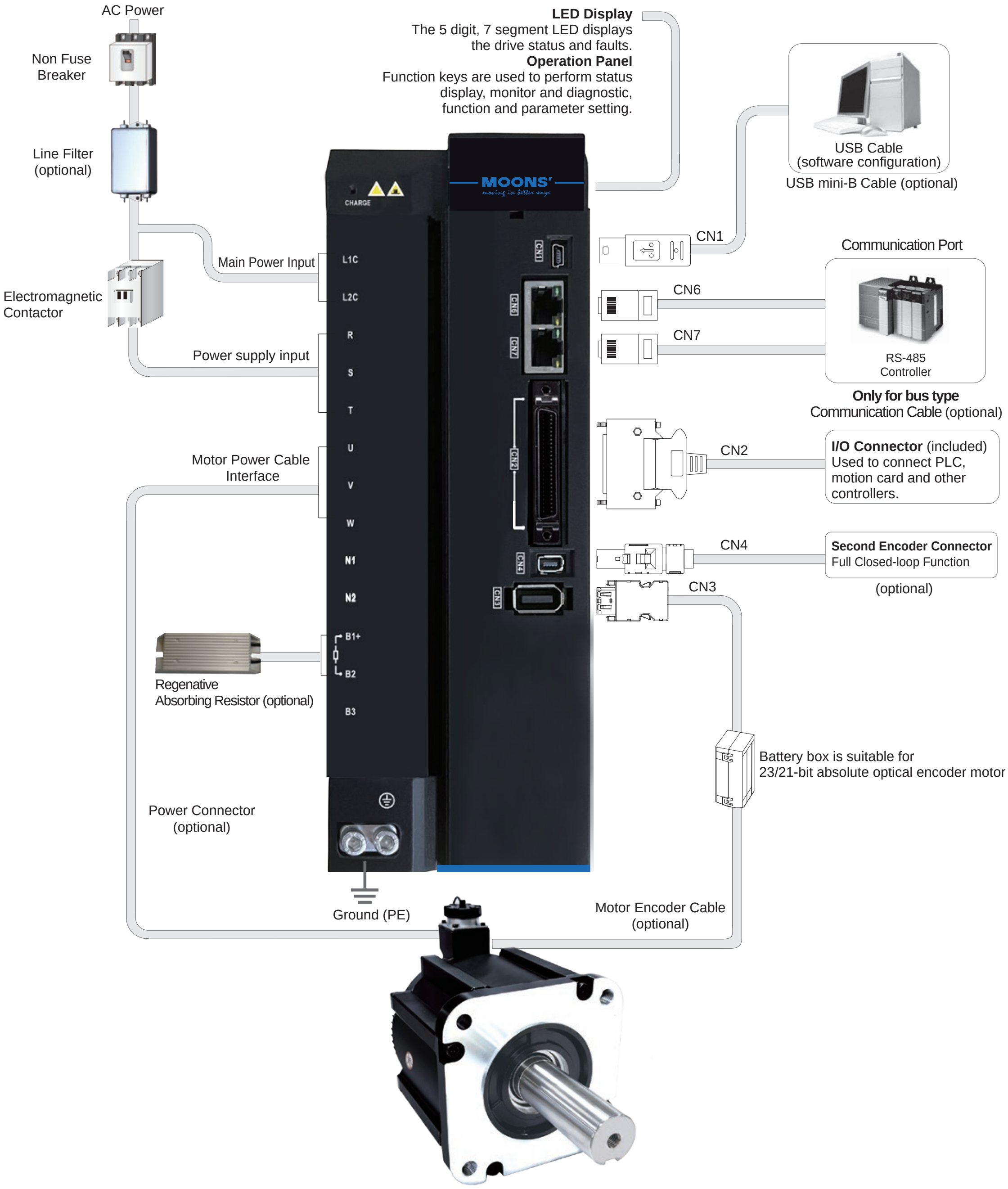
4.2.1.2 1.0/1.5/2.5/3kW Type

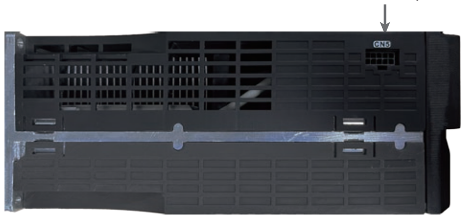




Note: *1 Certain models don't support this function, please refer to page 16.

4.2.1.3 5.0/6.0/7.5kW Type





4.2.2 Servo Drive Connectors and Terminals (750W and below models)

<table>
<tr><th>Connector Port</th><th>Symbol</th><th colspan="3">Description</th></tr>
<tr><td rowspan="2">P1</td><td>L1、L2、L3</td><td colspan="3">Main power supply, connect to single phase and 3-phase</td></tr>
<tr><td>L1C、L2C</td><td colspan="3">Control power supply, connect to single phase</td></tr>
<tr><td rowspan="7">P2</td><td rowspan="5">U、V、W</td><td colspan="3">Servo motor connector</td></tr>
<tr><td>Symbol</td><td>Color</td><td>Description</td></tr>
<tr><td>U</td><td>Red</td><td rowspan="3">Connecting to three-phase motor main circuit cable</td></tr>
<tr><td>V</td><td>Yellow</td></tr>
<tr><td>W</td><td>Blue</td></tr>
<tr><td rowspan="2">B1+、B2、B3</td><td>Internal Resistor</td><td colspan="2">Ensure the circuit is closed between B2 and B3, and the circuit is open between B1+ and B3.</td></tr>
<tr><td>External Resistor</td><td colspan="2">Ensure the circuit is open between B2 and B3, and connect the external regenerative resistor between B1+ and B2.</td></tr>
<tr><td>CN1</td><td>Mini USB Port</td><td colspan="3">Connect to PC</td></tr>
<tr><td>CN2</td><td>I/O Connetor Port</td><td colspan="3">Input and output signals</td></tr>
<tr><td>CN3</td><td>Encoder Port</td><td colspan="3">Used to connect encoder of motor</td></tr>
<tr><td>CN4</td><td>Second Encoder Port</td><td colspan="3">Connect the external encoder in full closed loop mode</td></tr>
<tr><td>CN5</td><td>STO Port</td><td colspan="3">The input for Safety Torque Off</td></tr>
<tr><td>CN6</td><td>RS-485 Port</td><td colspan="3">RS-485 Communication Port</td></tr>
<tr><td>CN7</td><td>RS-485 Port</td><td colspan="3">RS-485 Communication Port</td></tr>
</table>

4.2.3 Servo Drive Connectors and Terminals (1.0/1.5/2.5/3.0kW Type)

<table>
<tr><th>Connector Port</th><th>Symbol</th><th colspan="3">Description</th></tr>
<tr><td rowspan="5">P1</td><td>L1、L2、L3</td><td colspan="3">Main power supply, connect to single phase and 3-phase</td></tr>
<tr><td>L1C、L2C</td><td colspan="3">Control power supply, connect to single phase</td></tr>
<tr><td rowspan="2">B1+、B2、B3</td><td>Internal Resistor</td><td colspan="2">Ensure the circuit is closed between B2 and B3, and the circuit is open between B1+ and B3.</td></tr>
<tr><td>External Resistor</td><td colspan="2">Ensure the circuit is open between B2 and B3, and connect the external regenerative resistor between B1+ and B2.</td></tr>
<tr><td>N、R1、R2</td><td>External dynamic braking resistor</td><td colspan="2">When using the dynamic braking function with an external dynamic braking resistor, the resistor is connected between R1 and R2, and the resistor model is DBR85W3R5</td></tr>
<tr><td rowspan="5">P2</td><td rowspan="5">U、V、W</td><td colspan="3">Used to connect servo motor</td></tr>
<tr><td>Terminal Symbol</td><td>Wire color</td><td>Description</td></tr>
<tr><td>U</td><td>Red</td><td rowspan="3">Connecting to three-phase motor main circuit cable</td></tr>
<tr><td>V</td><td>Yellow</td></tr>
<tr><td>W</td><td>Blue</td></tr>
<tr><td>CN1</td><td>Mini USB Port</td><td colspan="3">Connect to PC</td></tr>
<tr><td>CN2</td><td>I/O Connetor Port</td><td colspan="3">Input and output signals</td></tr>
<tr><td>CN3</td><td>Encoder Port</td><td colspan="3">Used to connect encoder of motor</td></tr>
<tr><td>CN4</td><td>Second Encoder Port</td><td colspan="3">Connect the external encoder in full closed loop mode</td></tr>
<tr><td>CN5</td><td>STO Port</td><td colspan="3">The input for Safety Torque Off</td></tr>
<tr><td>CN6</td><td>RS-485 Port</td><td colspan="3">RS-485 Communication Port</td></tr>
<tr><td>CN7</td><td>RS-485 Port</td><td colspan="3">RS-485 Communication Port</td></tr>
</table>

4.2.4 Servo Drive Connectors and Terminals(5.0/6.0/7.5kW Type)

<table>
<tr><th>Connector Port</th><th>Symbol</th><th colspan="3">Description</th></tr>
<tr><td rowspan="11">Power Supply</td><td>R、S、T</td><td colspan="3">Used to connect three-phase AC main circuit power</td></tr>
<tr><td>L1C、L2C</td><td colspan="3">Used to connect single-phase AC for control circuit power</td></tr>
<tr><td rowspan="2">B1+、B2、B3</td><td>Internal Resistor</td><td colspan="2">Ensure the circuit is closed between B2 and B3, and the circuit is open between B1+ and B3.</td></tr>
<tr><td>External Resistor</td><td colspan="2">Ensure the circuit is open between B2 and B3, and connect the external regenerative resistor between B1+ and B2.</td></tr>
<tr><td>N1、N2</td><td>External reactor</td><td colspan="2">DC reactor used for suppressing high-order harmonics in power supply, connected between N1 and N2. When a reactor is not needed, short circuit between N1 and N2</td></tr>
<tr><td rowspan="5">U、V、W</td><td colspan="3">Used to connect servo motor</td></tr>
<tr><td>Terminal Symbol</td><td>Wire color</td><td>Description</td></tr>
<tr><td>U</td><td>Red</td><td rowspan="3">Connecting to three-phase motor main circuit cable</td></tr>
<tr><td>V</td><td>Yellow</td></tr>
<tr><td>W</td><td>Blue</td></tr>
<tr><td>CN1</td><td>Mini USB Port</td><td colspan="3">Connect to PC</td></tr>
<tr><td>CN2</td><td>I/O Connetor Port</td><td colspan="3">Input and output signals</td></tr>
<tr><td>CN3</td><td>Encoder Port</td><td colspan="3">Used to connect encoder of motor</td></tr>
<tr><td>CN4</td><td>Second Encoder Port</td><td colspan="3">Connect the external encoder in full closed loop mode</td></tr>
<tr><td>CN5</td><td>STO Port</td><td colspan="3">The input for Safety Torque Off</td></tr>
<tr><td>CN6</td><td>RS-485 Port</td><td colspan="3">RS-485 Communication Port</td></tr>
<tr><td>CN7</td><td>RS-485 Port</td><td colspan="3">RS-485 Communication Port</td></tr>
</table>

4.2.5 Connecting and Wiring Notes

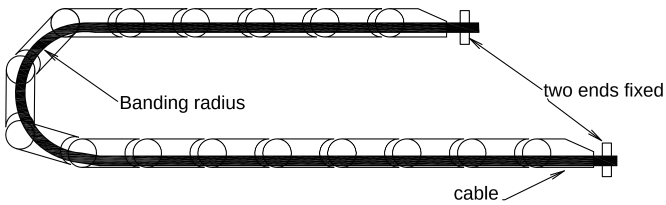
- Please ensure grounding wires are securely connected, wires with more than AWG 10(5.3mm2) on sectional area is recommended.
- 请勿在端子台螺丝松动或者电缆线松动的情况下上电，容易引发火灾
- Grounding method must be single point grounding.
- Ensure L1/L2/L3 and L1C/L2C are correctly wired, and voltage supplies are within the specification range.(3kW and below models)
- 检查R、S、T及L1C、L2C接线是否正确，且接入正确的电压(5kW及以上机型)
- When using single-phase power supply, please connect to the L1, L3 pins.(1.5kW and below models)
- Ensure U/V/W is following the order of RED/YELLOW/BLUE. Wrong connections will cause motor stop rotation, or wrong rotatory directions.
- Isolation transformer and EMI filter are recommended on drive’s power supply to ensure safety and improve its anti-interference level.
- Please setup an emergence stop circuitry to switch off the power supply when fault occurs.
- Please DO NOT touch drive or motor's connector terminals 5 minutes after drive and motor is powered off. There are electrical charge components in the circuitry. Therefore, even power is off, there might still be hazardous voltages within the circuitry, before its total discharge.
- Install the encoder cables in a separate conduit from the motor power cables to avoid signal noise. Separate the conduits by 30cm above.
- Use multi-stranded twisted-pair wires or multi-core shielded-pair wires for signal, encoder feedback cables.
- The maximum length of signal input/output cable is 3 meters, and the maximum length of encoder (PG) feedback cables is 20 meters.

4.2.6 Precautions for the use of towline cables

When you need to move the motor cable or install the cable in a drag chain, please use a dedicated flexible cable. Ordinary cables are easy to be damaged during repeated bending, causing the servo motor to fail to work normally.

When using drag chain cables, make sure that:

- Correctly choose the cable that meets the required bending resistance
- The bending radius of the cable is generally more than 10 times the outer diameter of the cable
- Avoid pulling the cable. When wiring inside the drag chain, do not fix or bundle it, so as to avoid the bending radius is not enough and the cable will be pulled
- Please bundle the cables at the two ends of the drag chain and the fixed place of the mechanical part.



- The wiring in the drag chain should not be too dense to ensure that the cable occupies less than 60% of the internal space of the drag chain.
- Avoid mixing cables with large outer diameter differences. If you really need to mix cables, please install baffles.

4.2.7 Recommended Wires

- The main circuit is recommended to use insulated wires with a withstand voltage of 600V and above 75°C.
- Be sure to choose the corresponding allowable current cable to prevent the cable from overheating.

Recommended wires for each part of the drive are as follows:

<table>
<tr><th colspan="2" rowspan="3">Driver and matching servo motor</th><th rowspan="3">Rated Power (W)</th><th colspan="7">Diameter of cable (AWG)</th></tr>
<tr><th colspan="2">Connector P1</th><th colspan="2">Connector P2</th><th>Connector CN3</th><th colspan="2">--</th></tr>
<tr><th>L1/L2/L3 R/S/T</th><th>L1C/L2C</th><th>U/V/W</th><th>B1+, B3</th><th>Encoder</th><th>Brake</th><th>GND</th></tr>
<tr><td rowspan="5">M56S-21A8R◆</td><td>SM3H-041A◇□P△</td><td>50</td><td rowspan="9">2.0mm^2 (AWG14)</td><td rowspan="25">2.0mm^2 (AWG14)</td><td rowspan="9">0.75 ~ 2.0mm^2 (AWG14 ~ 18)</td><td rowspan="9">1.25 ~ 2.0mm^2 (AWG14 ~ 16)</td><td rowspan="25">0.2mm^2 (AWG24)</td><td rowspan="25">0.5mm^2 (AWG20)</td><td rowspan="25">2.0 ~ 5.3mm^2 (AWG10 ~ 14)</td></tr>
<tr><td>SM3L-042A◇□D△</td><td rowspan="2">100</td></tr>
<tr><td>SM3H-042A◇□D△</td></tr>
<tr><td>SM3L-061A◇□P△</td><td rowspan="2">200</td></tr>
<tr><td>SM3H-061A◇□P△</td></tr>
<tr><td rowspan="2">M56S-23A0R◆</td><td>SM3L-062A◇□P△</td><td rowspan="2">400</td></tr>
<tr><td>SM3H-062A◇□P△</td></tr>
<tr><td rowspan="2">M56S-24A5R◆</td><td>SM3L-083A◇□P△</td><td rowspan="2">750</td></tr>
<tr><td>SM3H-083A◇□P△</td></tr>
<tr><td rowspan="4">M56S-26A0RF</td><td>SM3L-084A◇□P△</td><td rowspan="3">1000</td><td rowspan="4">2.0mm^2 AWG14</td><td rowspan="4">2.0 ~ 3.5mm^2 AWG12 ~ 14</td><td rowspan="16">2.0 ~ 3.5mm^2 AWG12 ~ 14</td></tr>
<tr><td>SM3L-102A◇□U△</td></tr>
<tr><td>SM3M-132A◇□U△</td></tr>
<tr><td>SM3H-132A◇□U△</td><td>850</td></tr>
<tr><td rowspan="3">M56S-210ARF</td><td>SM3L-103A◇□U△</td><td rowspan="2">1500</td><td rowspan="7">2.0 ~ 3.5mm^2 AWG12 ~ 14</td><td rowspan="7">3.5 ~ 5.3mm^2 AWG10 ~ 12</td></tr>
<tr><td>SM3M-133A◇□U△</td></tr>
<tr><td>SM3H-133A◇□U△</td><td>1300</td></tr>
<tr><td rowspan="4">M56S-213ARF</td><td>SM3L-104A◇□U△</td><td>2000</td></tr>
<tr><td>SM3L-105A◇□U△</td><td>2500</td></tr>
<tr><td>SM3M-134A◇□U△</td><td>2000</td></tr>
<tr><td>SM3H-134A◇□U△</td><td>1800</td></tr>
<tr><td rowspan="2">M56S-313ARF</td><td>SM3H-182Y◇□U△</td><td>2900</td><td rowspan="2">2mm^2 AWG14</td><td rowspan="2">2mm^2 AWG14</td></tr>
<tr><td>SM3M-135Y◇□U△</td><td>3000</td></tr>
<tr><td>M56S-317ARF</td><td>SM3H-183Y◇□U△</td><td>4400</td><td rowspan="3">5.3mm^2 AWG10</td><td rowspan="3">5.3mm^2 AWG10</td></tr>
<tr><td>M56S-321ARF</td><td>SM3H-184Y◇□U△</td><td>5500</td></tr>
<tr><td>M56S-326ARF</td><td>SM3H-185Y◇□U△</td><td>7500</td></tr>
</table>

◆ Model Type， ◇ Encoder Options，□ Brake Options，△ Oil Seal Options

- Please use insulated pin terminals for power connectors P1 and P2

◆ Crimp Type	◆ Sleeve Type	◆ Parallel Terminal
		

- Please select the pin terminal according to the recommended wire

  Connector applicable wire type: AWG14～AWG18
  The outer diameter of the wire for the connector: ø2.1～4.2mm

4.2.8 Ground wire terminal

- In order to obtain a better EMC effect, please use 5.3mm²/AWG10 dedicated copper conductor cable
- Please use O-shaped cold pressed terminals
- Tightening torque of ground wire terminals

Drive Model	Grounding screw	
	Specification	Tightening torque
M56S-21A8R◆ M56S-23A0R◆ M56S-24A5R◆ M56S-26A0RF M56S-210ARF M56S-213ARF M56S-313ARF	M3	1.2 N.m
M56S-317ARF M56S-321ARF M56S-326ARF	M4	1.4 N.m

◆ Represents the Function type

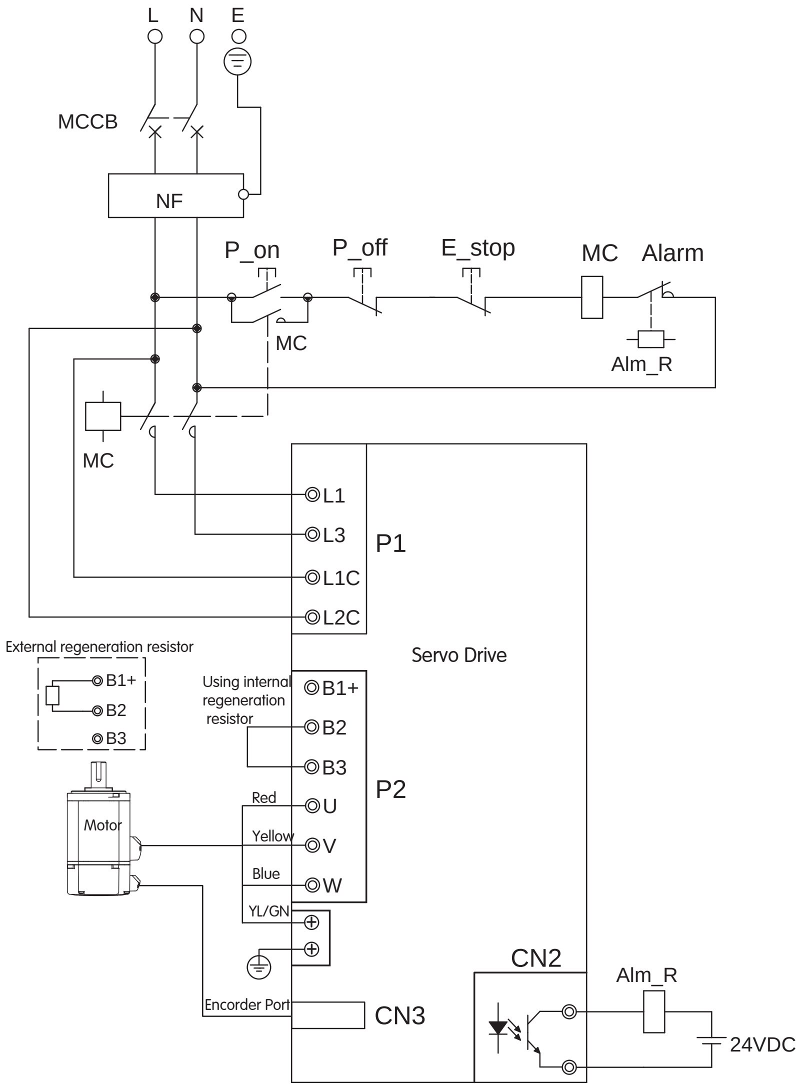
Notes:

- **Exceeding the maximum tightening torque will cause damage to the screw hole.**
- **Do not install the grounding screw when the power is on, it may cause electric sparks.**
- **Please regularly check whether the grounding screw is loose.**

4.3 Drive Power Supply Interface

220V AC servo drive supports single phase or three phase wiring method. Three phase wiring method for 1.5KW or above drives is recommended.

4.3.1 AC220V Single Phase Input (750W and below models)



Notes:

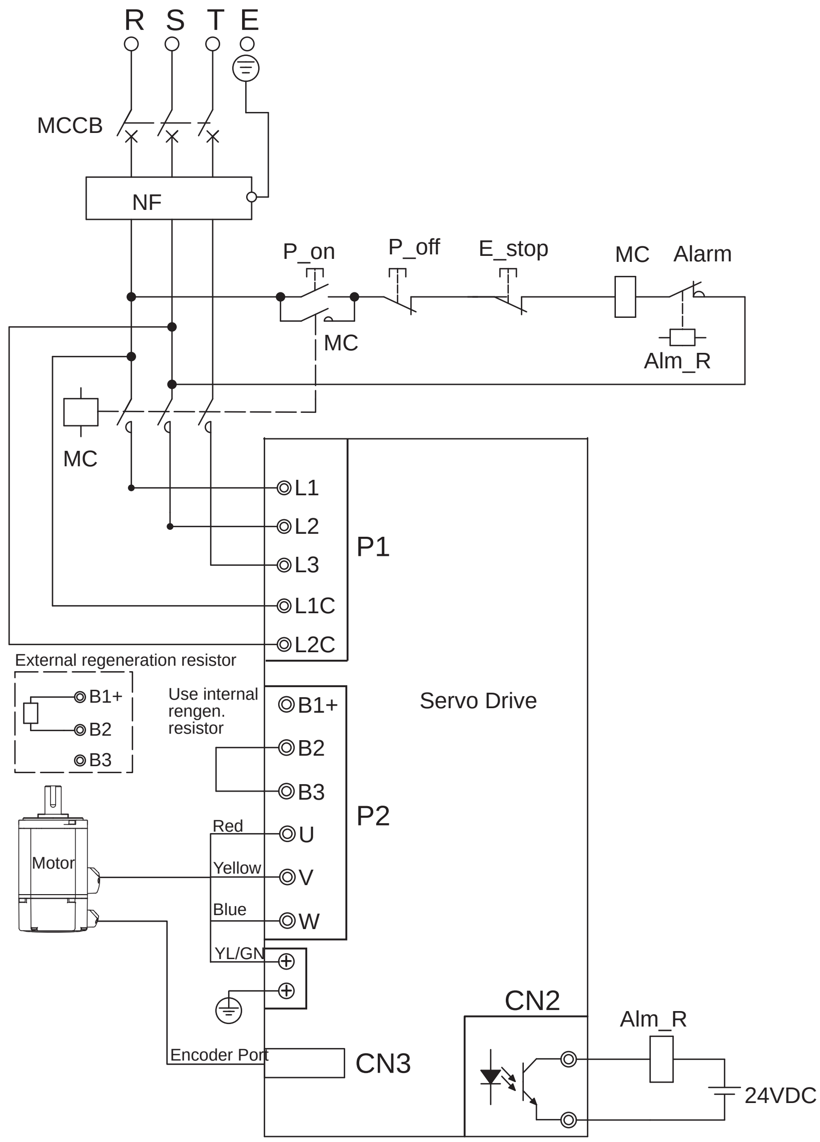
Symbol	Description		Symbol	Description
MCCB	Circuit Breaker		E_stop	Emergency Stop Switch
NF	EMI Noise Filter		MC	Magnetic Contactor
P_on	Power On Switch		Alm_R	Alarm Relay
P_off	Power Off Switch		Alarm	Alarm Relay Contactor

■ Peripheral equipment capacity for wiring

Drive	Voltage (VAC)	Motor Rated Output Power (W)	Drive Power capacity kVA (Rated Load)	Circuit Breaker Rated Current (A)	Contactor Rated Current(A)
M56S-21A8R◆	Single-Phase 220	100	0.4	6	9A (3P+1a)
		200	0.5		
M56S-23A0R◆		400	0.9	10	
M56S-24A5R◆		750	1.3	16	

◆Represents the Function type

4.3.2 AC220V Three Phase Input (750W and below models)



Note: Three-phase 220V is the line voltage

Notes:

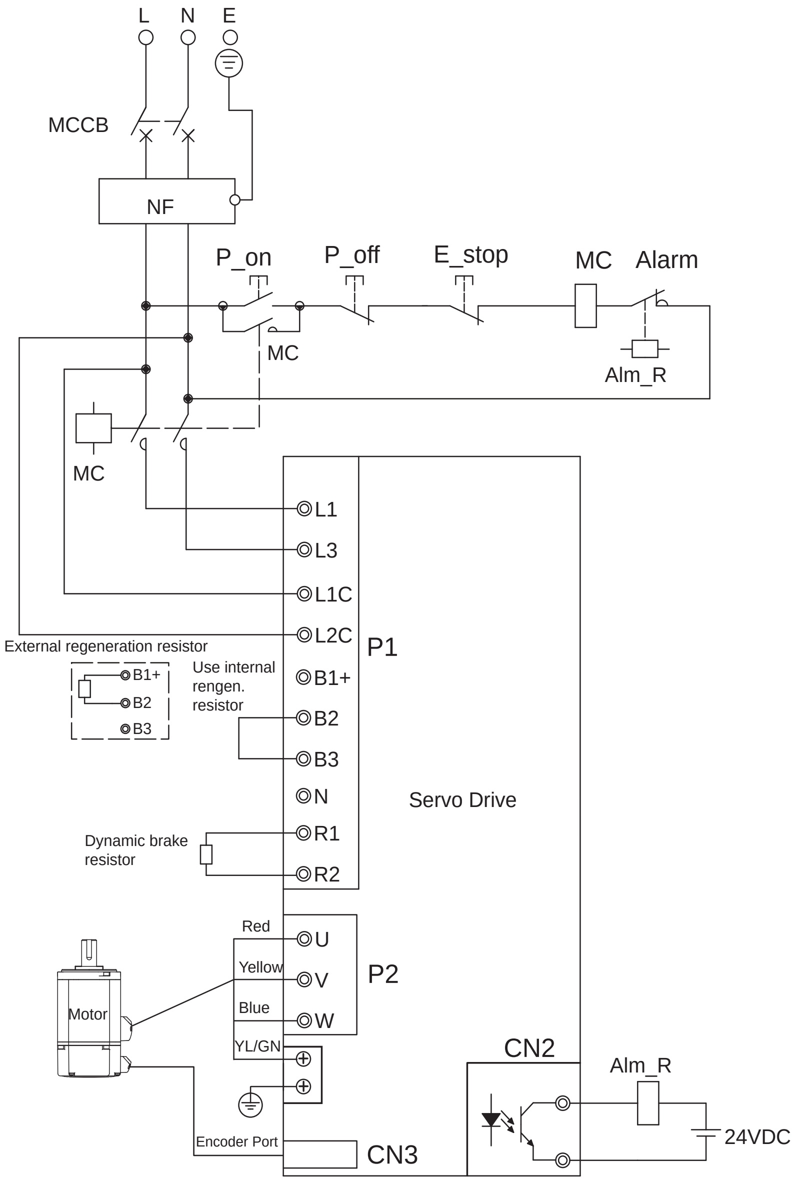
Symbol	Description	Symbol	Description
MCCB	Circuit Breaker	E_stop	Emergency Stop Switch
NF	EMI Noise Filter	MC	Magnetic Contactor
P_on	Power On Switch	Alm_R	Alarm Relay
P_off	Power Off Switch	Alarm	Alarm Relay Contactor

■ Peripheral equipment capacity for wiring

Drive	Voltage (VAC)	Motor Rated Output Power (W)	Drive Power capacity kVA (Rated Load)	Circuit Breaker Rated Current (A)	Contactor Rated Current(A)
M56S-21A8R◆	Three Phase 220	100	0.4	4	9A (3P+1a)
		200	0.5		
M56S-23A0R◆		400	0.9		
M56S-24A5R◆		750	1.3	16	

◆Represents the Function type

4.3.3 AC220V Single Phase Input (1.0/1.5kW Type)



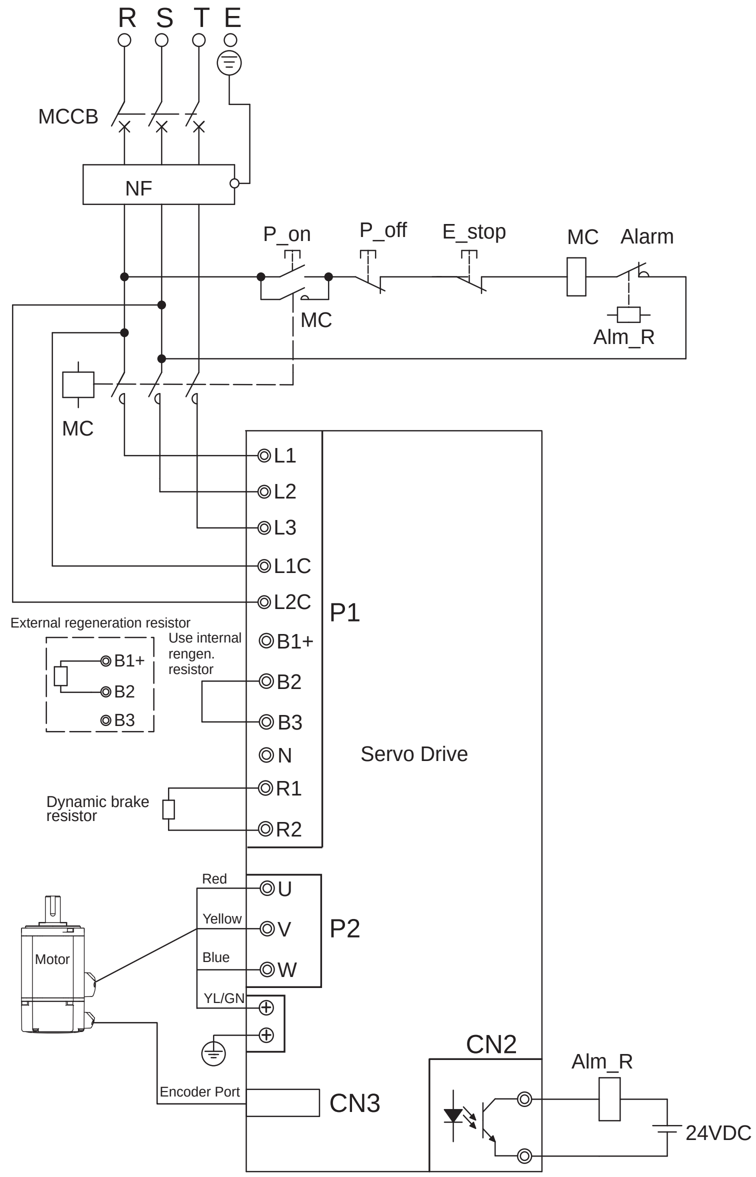
Notes:

Symbol	Description		Symbol	Description
MCCB	Circuit Breaker		E_stop	Emergency Stop Switch
NF	EMI Noise Filter		MC	Magnetic Contactor
P_on	Power On Switch		Alm_R	Alarm Relay
P_off	Power Off Switch		Alarm	Alarm Relay Contactor

■ Peripheral equipment capacity for wiring

Drive	Voltage (VAC)	Motor Rated Output Power (W)	Drive Power capacity kVA (Rated Load)	Circuit Breaker Rated Current (A)	Contactor Rated Current(A)
M56S-26A0RF	Single-Phase 220	850, 1000	1.8	16	12A (3P+1a)
M56S-210ARF		1300, 1500	2.3	20	18A (3P+1a)

4.3.4 AC220V Three Phase Input (1.0/1.5/2.5kW Type)



Note: Three-phase 220V is the line voltage

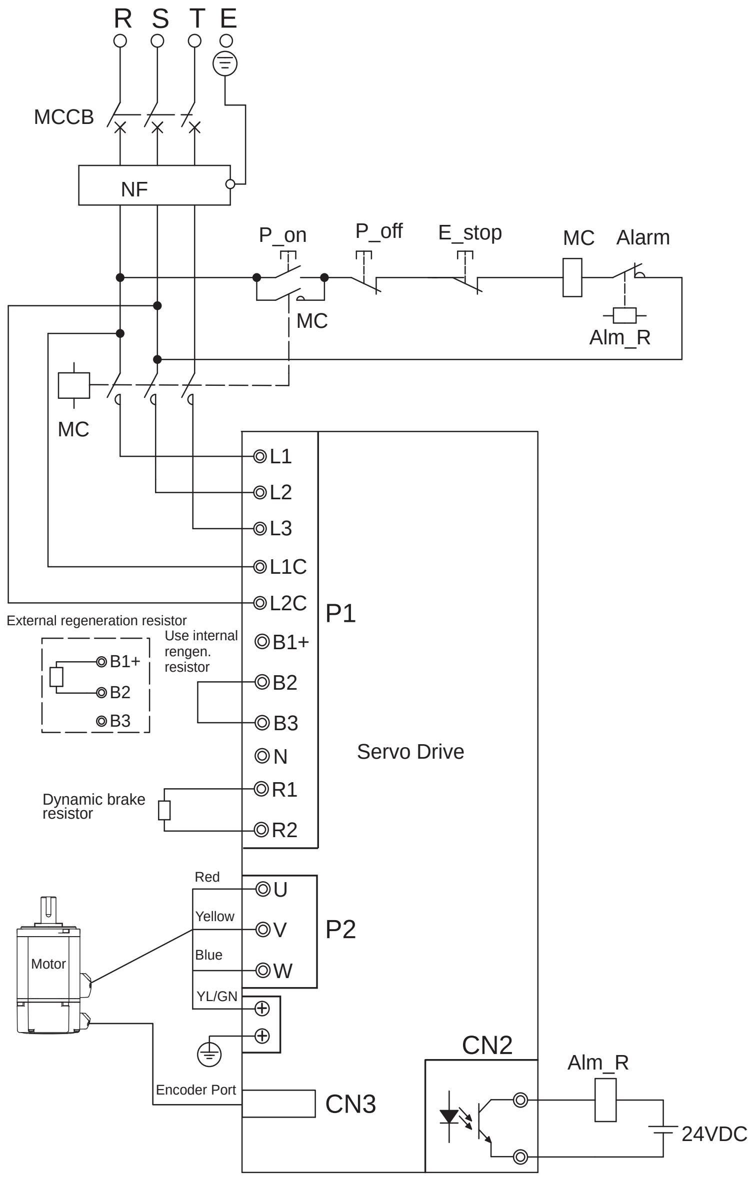
Notes:

Symbol	Description		Symbol	Description
MCCB	Circuit Breaker		E_stop	Emergency Stop Switch
NF	EMI Noise Filter		MC	Magnetic Contactor
P_on	Power On Switch		Alm_R	Alarm Relay
P_off	Power Off Switch		Alarm	Alarm Relay Contactor

■ Peripheral equipment capacity for wiring

Drive	Voltage (VAC)	Motor Rated Output Power (W)	Drive Power capacity kVA (Rated Load)	Circuit Breaker Rated Current (A)	Contactor Rated Current(A)
M56S-26A0RF	Three Phase 220	850, 1000	1.8	10	9A (3P+1a)
M56S-210ARF		1300, 1500	2.3	16	
M56S-213ARF		1800, 2000, 2500	3.3		

4.3.5 AC400V Three Phase (3kW Type)



Note: Three-phase 400V is the line voltage

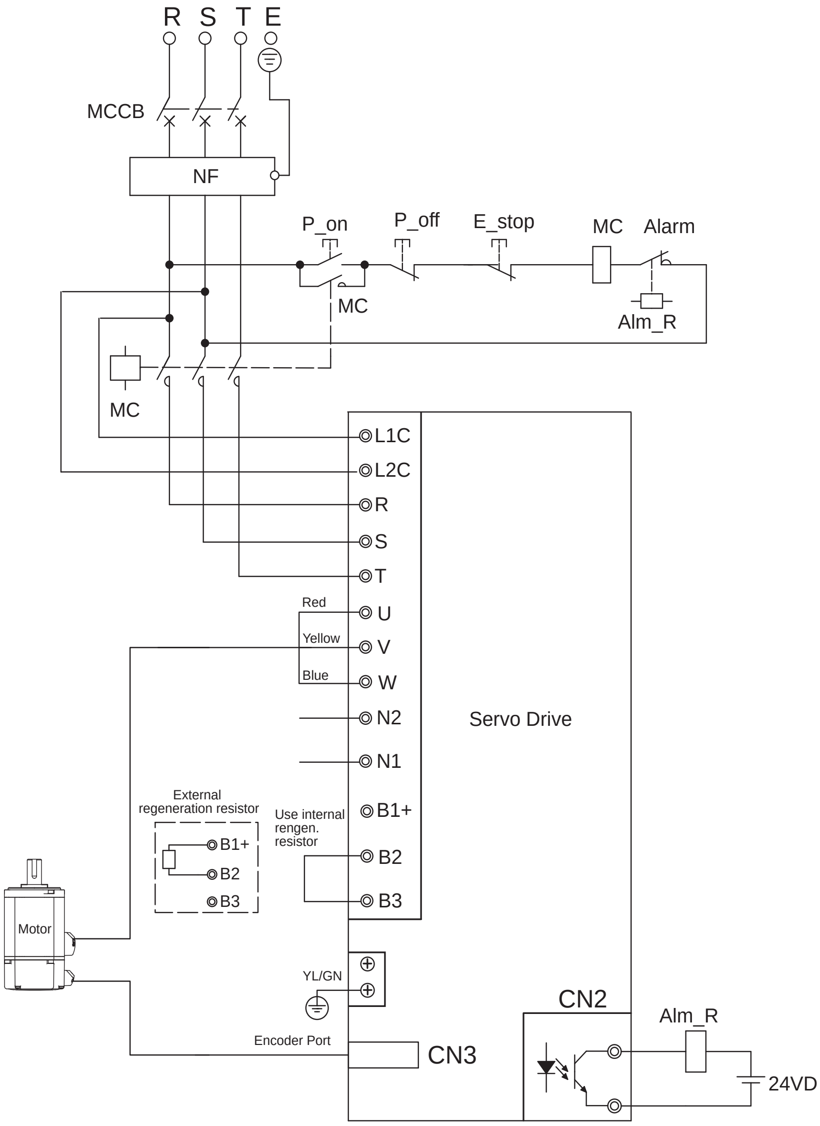
Notes:

Symbol	Description		Symbol	Description
MCCB	Circuit Breaker		E_stop	Emergency Stop Switch
NF	EMI Noise Filter		MC	Magnetic Contactor
P_on	Power On Switch		Alm_R	Alarm Relay
P_off	Power Off Switch		Alarm	Alarm Relay Contactor

■ Peripheral equipment capacity for wiring

Drive	Voltage (VAC)	Motor Rated Output Power (W)	Drive Power capacity kVA (Rated Load)	Circuit Breaker Rated Current (A)	Contactor Rated Current(A)
M56S-313ARF	Three Phase 400	2900, 3000	15.15	16	9A (3P+1a)

4.3.6 AC400V Three Phase (5.0/6.0/7.5kW Type)



Note: Three-phase 400V is the line voltage

Notes:

Symbol	Description
MCCB	Circuit Breaker
NF	EMI Noise Filter
P_on	Power On Switch
P_off	Power Off Switch

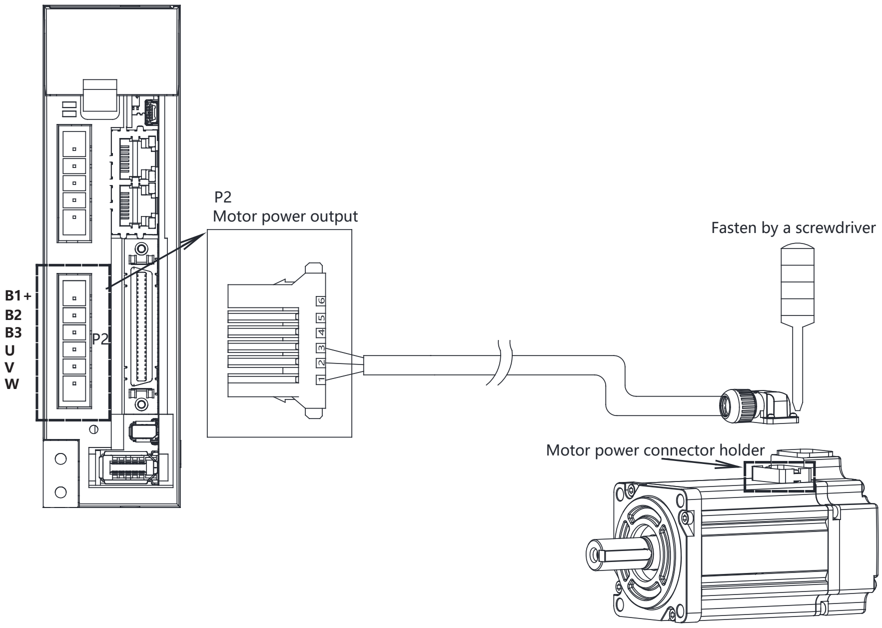
Symbol	Description
E_stop	Emergency Stop Switch
MC	Magnetic Contactor
Alm_R	Alarm Relay
Alarm	Alarm Relay Contactor

■ Peripheral equipment capacity for wiring

Drive	Voltage (VAC)	Motor Rated Output Power (W)	Drive Power capacity kVA (Rated Load)	Circuit Breaker Rated Current (A)	Contactor Rated Current(A)
M56S-317ARF	Three Phase 400	4400	22.25	20	18A (3P+1a)
M56S-321ARF		5500	25	25	
M56S-326ARF		7500	31.25	32	25A (3P+1a)

4.4 P2--Connect Motor to Drive

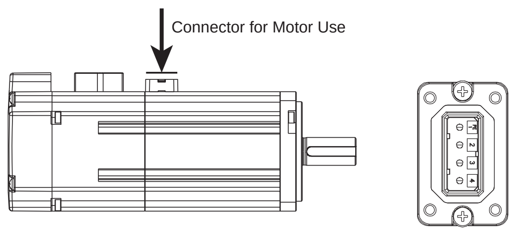
4.4.1 Motor Power Cable Configuration



4.4.2 Definition of Motor Power Connector

4.4.2.1 PIN Assigenment for Frme 80mm and below

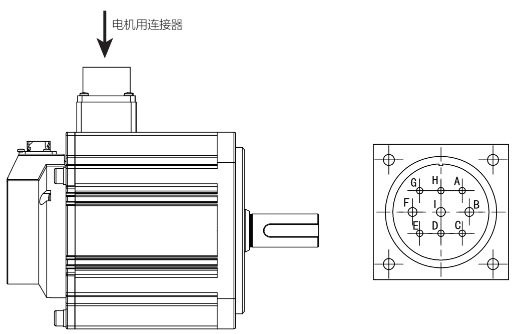
Motor Model	PIN.No	Name	Define
SM3L-042A◇□D△ SM3L-061A◇□P△ SM3L-062A◇□P△ SM3L-083A◇□P△ SM3L-084A◇□P△ SM3H-042A◇□P△ SM3H-061A◇□P△ SM3H-062A◇□P△ SM3H-083A◇□P△	1	PE	Motor ground wire
	2	U	U Phase
	3	V	V Phase
	4	W	W Phase



◇ Encoder Options，□ Brake Options，△ Oil Seal Options

4.4.2.2 PIN Assigenment for Frme100mm/130mm

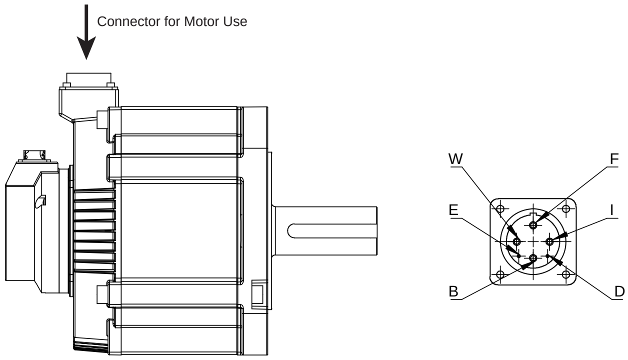
Motor Model		PIN.No	Name	Define
SM3L-102A◇□U△ SM3L-103A◇□U△ SM3L-104A◇□U△ SM3L-105A◇□U△	SM3M-132A◇□U△ SM3M-133A◇□U△ SM3M-134A◇□U△ SM3M-135Y◇□M△ SM3H-132A◇□U△ SM3H-132A◇□U△ SM3H-134A◇□U△	A	PE	Motor ground wire
		F	U	U Phase
		I	V	V Phase
		B	W	W Phase
		C	Brake 1	电机抱闸1
		D	Brake 2	电机抱闸2



◇ Encoder Options，□ Brake Options，△ Oil Seal Options

4.4.2.3 PIN Assigenment for Frme 180mm

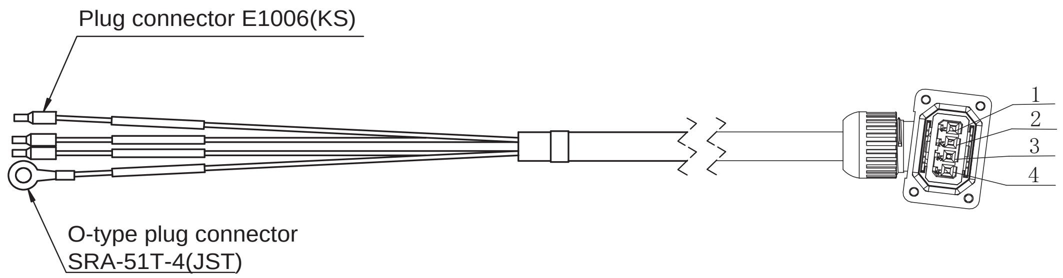
Motor Model	PIN.No	Name	Define
SM3H-182Y◇☐U△ SM3H-183Y◇☐U△ SM3H-184Y◇☐U△ SM3H-185Y◇☐U△	A	PE	Motor ground wire
	F	U	U Phase
	I	V	V Phase
	B	W	W Phase
	D	Brake 1	电机抱闸1
	E	Brake 2	电机抱闸2



◇ Encoder Options，☐ Brake Options，△ Oil Seal Options

4.4.3 Motor Power Cable Connector Specifications

4.4.3.1 Frame size 80mm and below Motor Power Cable Wiring Definition

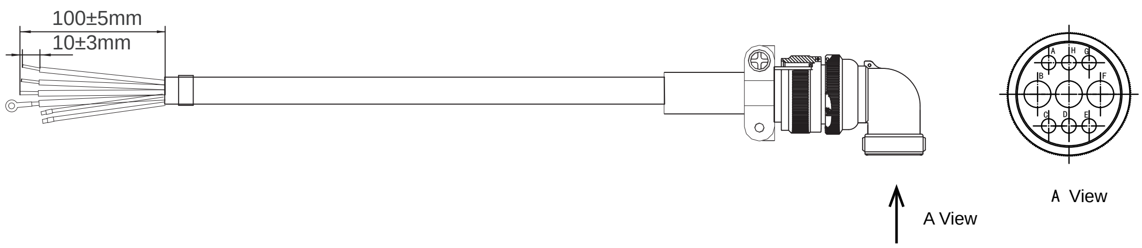


Motor Model	Drive side (JST)061JFAT-SBXGF-I	Item	Color	Motor side DGFA4S-B1-00A(H)
SM3L-042A◇☐D△ SM3L-061A◇☐P△ SM3L-062A◇☐P△ SM3L-083A◇☐P△ SM3L-084A◇☐P△ SM3H-042A◇☐P△ SM3H-061A◇☐P△ SM3H-062A◇☐P△ SM3H-083A◇☐P△	Grounding Screw	PE	Yellow/Green	1
	3	U	Red	2
	2	V	Yellow	3
	1	W	Blue	4

☐Encoder Options ◇Brake Optionst △Oil seal Options

NOTE: Ensure U/V/W is following the order of RED/YELLOW/BULE. Wrong connections will cause motor stop rotation, or wrong rotary directions.

4.4.3.2 Frame size 100mm/130mm Motor Power Cable Wiring Definition

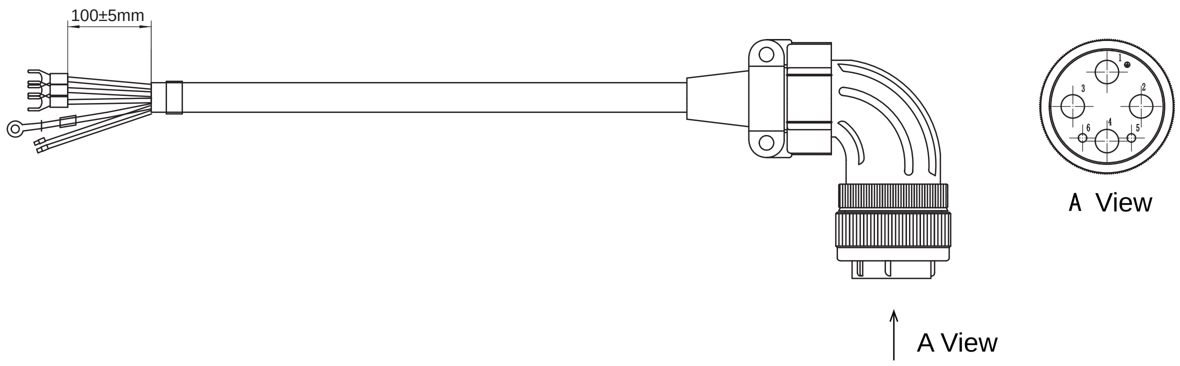


Motor Model		Drive side	Item	Color	电机侧对插连接器 XMS3108E20-18S
SM3L-102A◇☐U△ SM3L-103A◇☐U△ SM3L-104A◇☐U△ SM3L-105A◇☐U△	SM3M-132A◇☐U△ SM3M-133A◇☐U△ SM3M-134A◇☐U△ SM3M-135Y◇☐M△ SM3H-132A◇☐U△ SM3H-132A◇☐U△ SM3H-134A◇☐U△	U	U	Red	F
		V	V	Yellow	I
		W	W	Blue	B
		Grounding Screw	FG	Yellow/Green	A
		-	Brake 1	Red	C
		-	Brake 2	Black	D

☐Encoder Options ◇Brake Optionst △Oil seal Options

NOTE: Ensure U/V/W is following the order of RED/YELLOW/BULE. Wrong connections will cause motor stop rotation, or wrong rotary directions.

4.4.3.3 Frame size 180mm Motor Power Cable Wiring Definition



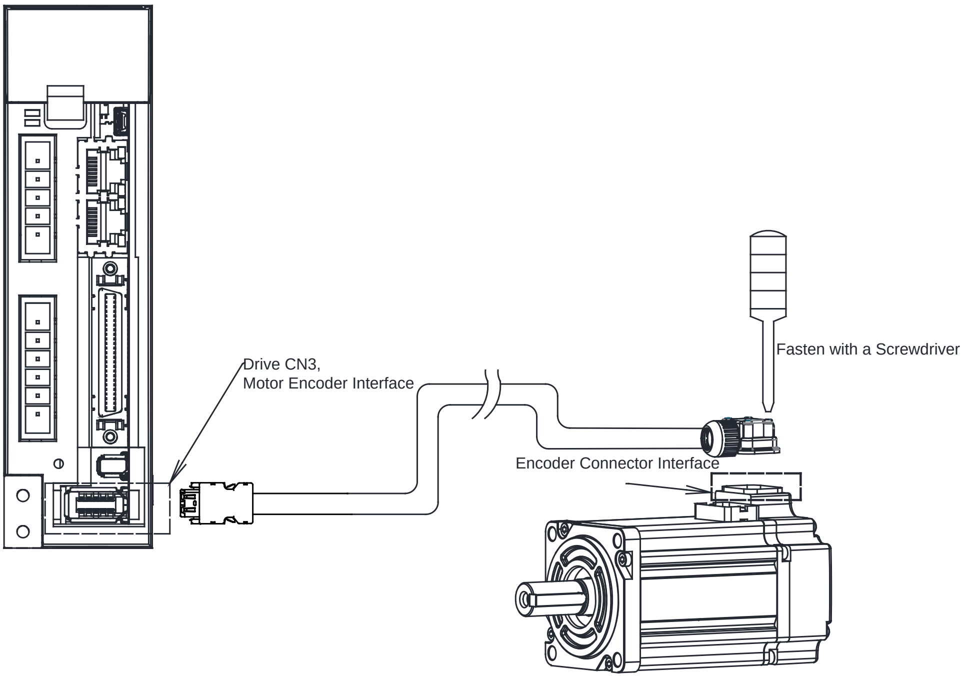
<table>
<tr><th rowspan="2">Motor Model</th><th rowspan="2">Drive side</th><th rowspan="2">Item</th><th rowspan="2">Color</th><th>电机侧对插连接器</th></tr>
<tr><th>WS32K6TS</th></tr>
<tr><td rowspan="6">SM3H-182Y◇□U△
SM3H-183Y◇□U△
SM3H-184Y◇□U△
SM3H-185Y◇□U△</td><td>U</td><td>U</td><td>Red</td><td>2</td></tr>
<tr><td>V</td><td>V</td><td>Yellow</td><td>3</td></tr>
<tr><td>W</td><td>W</td><td>Blue</td><td>4</td></tr>
<tr><td>Grounding Screw</td><td>FG</td><td>Yellow/Green</td><td>1</td></tr>
<tr><td>-</td><td>Brake 1</td><td>Red</td><td>5</td></tr>
<tr><td>-</td><td>Brake 2</td><td>Black</td><td>6</td></tr>
</table>

□Encoder Options ◇Brake Optionst △Oil seal Options

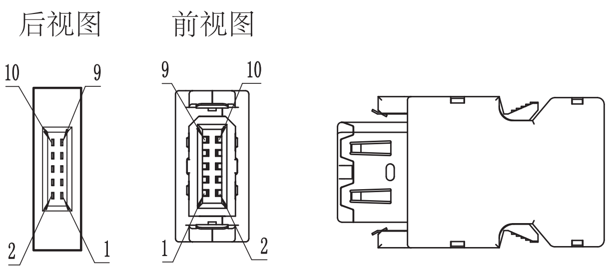
NOTE: Ensure U/V/W is following the order of RED/YELLOW/BULE. Wrong connections will cause motor stop rotation, or wrong rotary directions.

4.5 CN3--Encoder Connection

4.5.1 Encoder Connection between Motor and Drive



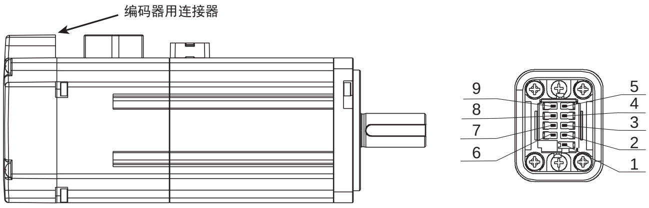
4.5.2 CN3-Encoder PIN Assignment



PIN.No	Symbol	Description
1	Encoder +5V	Encoder Power +5V
2	GND	Encoder Power GND
7	CLK-	CLK- Signal
8	CLC+	CLC+ Signal
9	SD-/DATA-	SD-Signal, or DATA- Signal
10	SD+/DATA+	SD+Signal, or DATA+ Signal
Shield	Shield	Shield

4.5.3 Motor Encoder connector specifications

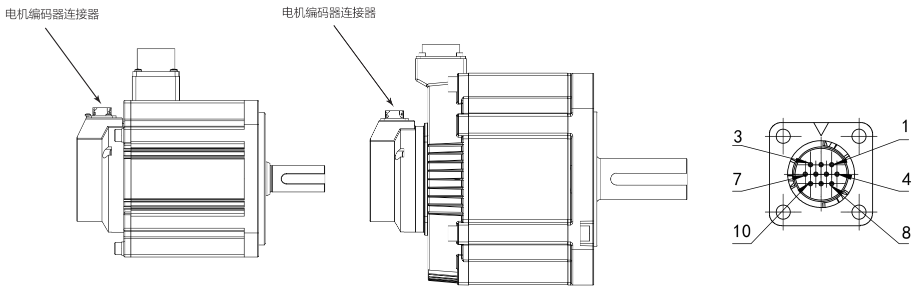
4.5.3.1 Frame size 80mm and below motor encoder connector pin definition



Motor Model		PIN.No	Symbol	Description
SM3L-042AT☐D△	SM3L-042AX☐D△	1	Shield	Shield GND
SM3L-061AT☐D△	SM3L-061AX☐D△	2	--	--
SM3L-062AT☐D△	SM3L-062AX☐D△	3	VCC	Encoder Power 5V
SM3L-083AT☐D△	SM3L-083AX☐D△	4	VBAT	Absolute value encoder battery+
SM3L-084AT☐D△	SM3L-084AX☐D△	5	SD+	Encoder communication data +
SM3H-042AT☐P△	SM3H-042AX☐P△	6	--	--
SM3H-061AT☐P△	SM3H-061AX☐P△	7	VCC_GND	Encoder Power GND
SM3H-062AT☐P△	SM3H-062AX☐P△	8	VBAT_GND	Absolute value encoder battery-
SM3H-083AT☐P△	SM3H-083AX☐P△	9	SD-	Encoder communication data -

Motor Model	PIN.No	Symbol	Description
SM3L-041AB☐D△	1	--	--
SM3L-042AB☐D△	2	CLK+	CLK+
SM3L-061AB☐D△	3	CLK-	CLK-
SM3L-062AB☐D△	4	DATA-	DATA-
SM3L-083AB☐D△	5	DATA+	DATA+
SM3L-084AB☐D△	6	5V	Encoder Power 5V
SM3M-062AB☐D△	7	--	--
SM3M-083AB☐D△	8	GND	Encoder Power GND
	9	--	--

4.5.3.2 Frame size 100mm/130mm/180mm motor encoder connector pin definition



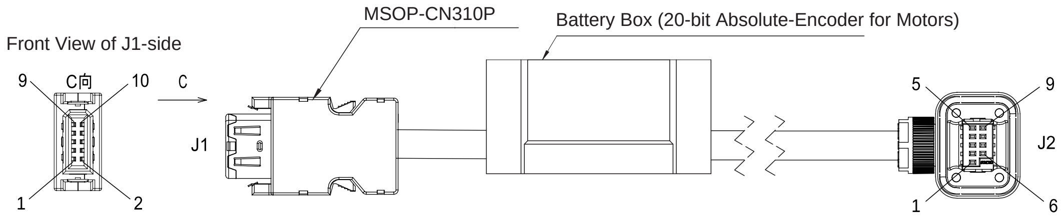
Motor Model			PIN.No	Symbol	Description
SM3L-102AT☐U△	SM3L-102AX☐U△		1	VCC	Encoder Power 5V
SM3L-102AT☐U△	SM3L-102AX☐U△		2	VCC_GND	Encoder Power GND
SM3L-102AT☐U△	SM3L-102AX☐U△		3	SD+	Encoder communication data +
SM3L-102AT☐U△	SM3L-102AX☐U△	SM3H-182YT☐U△	4	SD-	Encoder communication data -
SM3M-132AT☐U△	SM3M-132AX☐U△	SM3H-183YT☐U△	5	VBAT+	Absolute value encoder battery+
SM3M-133AT☐U△	SM3M-133AX☐U△	SM3H-184YT☐U△	6	VBAT_GND	Absolute value encoder battery-
SM3M-134AT☐U△	SM3M-134AX☐U△	SM3H-185YT☐U△	7,8,9	NC	---
SM3M-135YT☐M△	SM3M-135YX☐M△		10	Shield	Shield GND
SM3H-132AT☐U△	SM3H-132AX☐U△				
SM3H-133AT☐U△	SM3H-133AX☐U△				
SM3H-134AT☐U△	SM3H-134AX☐U△				

☐ Brake Options △ Oil seal Opions

Note: DO NOT connect the UN-defination PINs

4.5.4 Encoder Wire Connection Definition

4.5.4.1 Frame size 80mm and below encoder wire connection definition

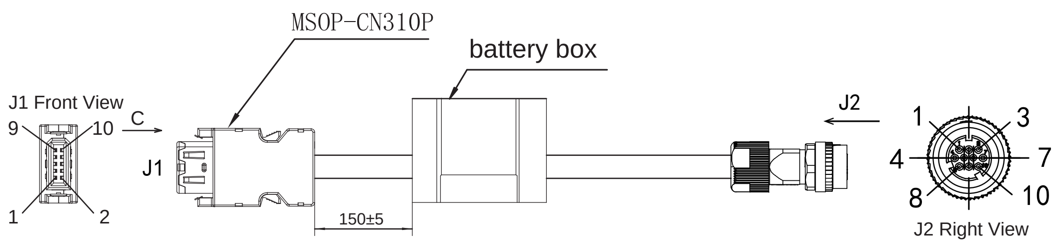


For motor encoder type	Drive side J1	Battery	Signal	Color	Motor side J2
-T Type: 26 Multi-turn Absolute -X Type: 21 Multi-turn Absolute	1	--	VCC	Red	3
	2	--	VCC_GND	Black	7
	--	Vbat+	VBAT	Green	4
	--	Vbat-	VBAT_GND	Orange	8
	9	--	SD-	Blue/Black	9
	10	--	SD+	Blue	5
	--	--	Shield		1

For motor encoder type	Drive side J1	Signal	Color	Motor side J2
-B Type: 17 Battery-less Multi-turn Absolute	1	VCC	Red	6
	2	VCC_GND	Black	8
	7	CLK-	Green	3
	8	CLK+	Orange	2
	9	DATA-	Blue/Black	4
	10	DATA+	Blue	5

Note: DO NOT connect the UN-defination PINs

4.5.4.2 Frame size 100mm/130mm/180mm encoder wire connection definition



For motor encoder type	Drive side J1	Battery	Signal	Color	Motor side J2
-T Type : 23 Multi-turn Absolute -X Type : 21 Multi-turn Absolute	1	--	VCC	Red	1
	2	--	VCC_GND	Black	2
	--	Vbat+	VBAT	Green	5
	--	Vbat-	VBAT_GND	Orange	6
	9	--	SD-	Blue/Black	3
	10	--	SD+	Blue	4
	--	--	Shield		10

Note: DO NOT connect the UN-defination PINs

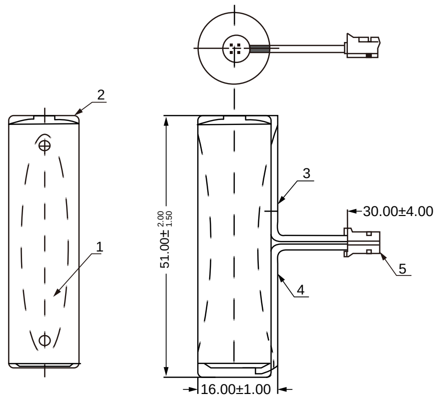
4.5.5 Battery of Absolute Encoder

When the SM3 series absolute encoder motor is used in a multi-turn absolute value system, it needs to use battery power to record multi-turn data when the drive is powered off. After power-on, the drive calculates the absolute position of the mechanical load through the absolute position of the encoder. There is no need to repeat the mechanical homing operation.

When using our company's encoder cable with a battery box, the battery box has a built-in battery MSOP-BA01, which meets the UL lithium battery standard and the IEC lithium battery international safety standard. Please refer to the figure below for the battery dimensions.

■ Battery replacement

There is a risk of electrolyte leakage after long-term use of the battery. It is recommended to replace the battery every two years. It is recommended to replace the battery when the drive is powered on, otherwise the absolute position of the encoder will be lost due to no power supply after the battery is removed.



■ Battery selection

Please refer to the information in the table below to select a battery of appropriate specifications.

Battery Spec.	Item&Unit	Rated Value			Description
		Min.	Typical	Max.	
Output Spec. 3.6V, 2.7Ah	Battery Voltage(V)	3.3	3.6	5	Standby work
	Battery low Voltage(V)	——	2.8	——	
	Battery alarm Voltage(V)	——	3.2	——	
	Current consumption(μA)	——	2	——	During normal work
		——	10	——	During standby operation, the shaft is stationary
		——	30	——	During standby operation, the shaft rotates
	Operation Ambient(℃)	0	——	40	Same as the ambient temperature of motor
	Storage Ambient(℃)	-20	——	60	

■ Precautions for battery use

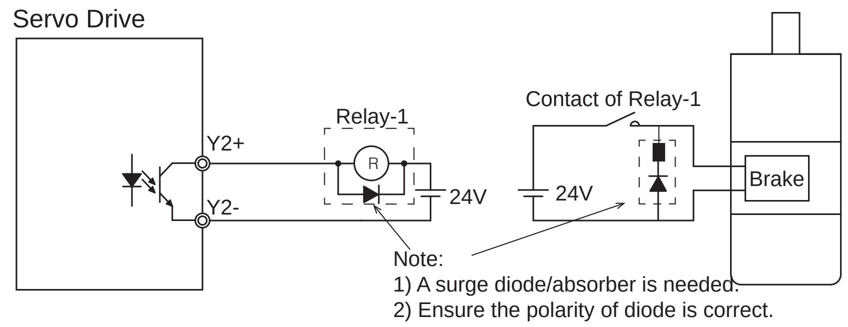
1. Connect the positive and negative electrodes correctly.
2. If a battery that has been used for a long time or an unusable battery is installed in the machine, liquid leakage may occur. It will not only corrode the surrounding parts, but also has the risk of short circuit. It is recommended to replace it regularly (reference period: it is recommended to replace it every two years).
3. It is forbidden to disassemble the battery to prevent the electrolyte from flying and affecting personal safety.
4. It is forbidden to throw the battery into the fire to avoid the danger of explosion.
5. It is strictly forbidden to short-circuit between the positive and negative electrodes of the battery
6. It is forbidden to charge the battery.
7. It is forbidden to solder directly on the surface of the battery, and the battery with solder feet or leads should be used.
8. Please discard the replaced battery according to local regulations.

4.6 Electromagnetic Brake

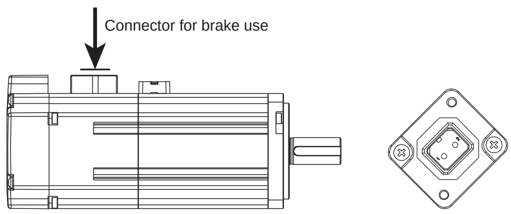
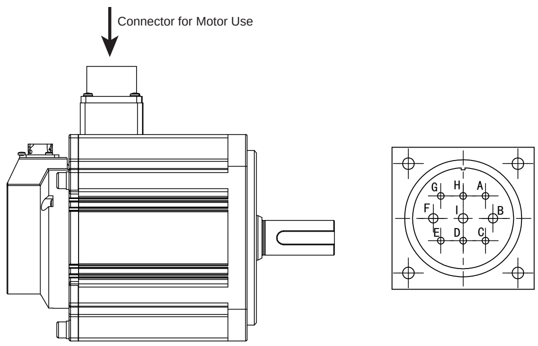
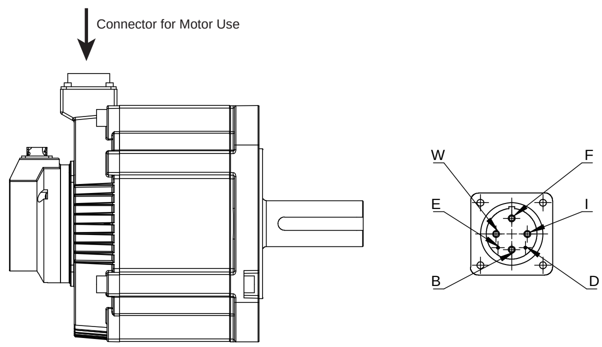
Servo motors are used in applications such as vertical axes. When the motor is disabled or powered off, to prevent the mechanical mechanism driven by the motor from falling due to gravity and other reasons, it is necessary to use a servo motor with an electromagnetic brake.

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 power-off. Do not use it for braking during deceleration, otherwise the motor will be damaged.

4.6.1 Wiring Diagram



■ PIN Definition

Motor Model	PIN.No	Item	Definition	
SM3L-041A◇BD△ SM3L-042A◇BP△ SM3L-061A◇BP△ SM3L-062A◇BP△ SM3L-083A◇BP△ SM3L-084A◇BP△ SM3H-041A◇BP△ SM3H-042A◇BP△ SM3H-061A◇BP△ SM3H-062A◇BP△ SM3H-083A◇BP△	1	24V	Brake power supply+	
	2	0V	Brake power supply-	
SM3L-102A◇BU△ SM3L-103A◇BU△ SM3L-104A◇BU△ SM3L-130A◇BU△ SM3M-132A◇BU△ SM3M-133A◇BU△ SM3M-134A◇BU△ SM3M-135Y◇BM△ SM3H-132A◇BU△ SM3H-133A◇BU△ SM3H-134A◇BU△	C	24V	Brake power supply+	
	D	0V	Brake power supply-	
SM3H-182Y◇BU△ SM3H-183Y◇BU△ SM3H-184Y◇BU△ SM3H-185Y◇BU△	5	24V	Brake power supply +	
	6	0V	Brake power supply -	

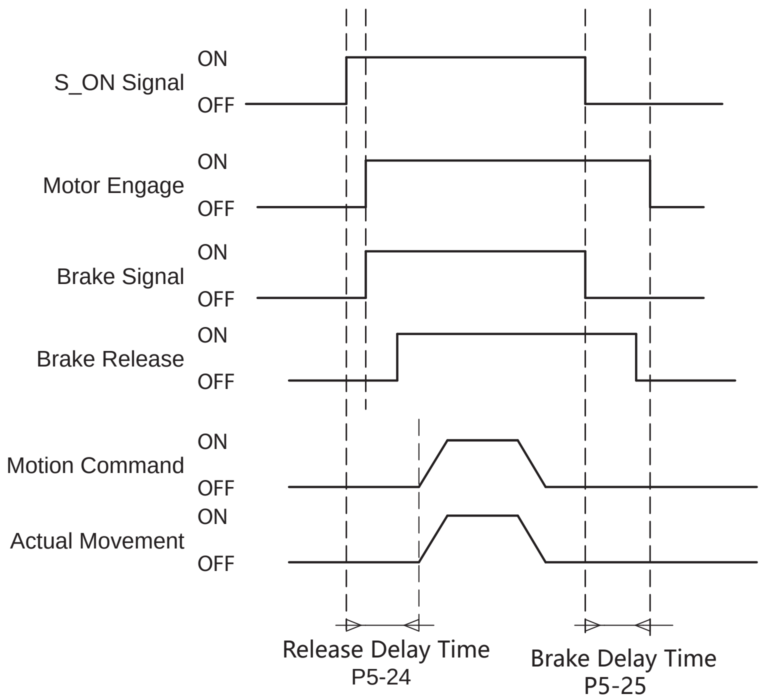
4.6.2 Precautions for the use of brake

- The signal of the drive control brake can not directly drive the motor's brake. The external 24V power supply and relay must be provided. It is best to try a separate 24V power supply to prevent other equipment from causing abnormal power supply which will eventually cause the motor brake to malfunction.
- The digital output signal of the driver is an optocoupler output, the maximum is 30VDC, 30mA. When controlling inductive loads such as relays, be sure to install a freewheeling diode, otherwise the output pin circuit of the driver will be damaged and the signal will not be output normally.
- The electromagnetic brake is a normally closed type, and the motor shaft cannot rotate when the brake is not powered
- Electromagnetic brake has no polarity requirement
- Avoid the voltage drop as the wire is too thin
- The brake specifications are as follows:

Motor	Power	Holding Torque Nm	Release Continuous Current A	Release Continuous Power W@20℃	Rated Voltage VDC	Release Time ms	Release Voltage VDC	Brake Time ms
SM3*-04******	50W、100W	0.32	0.26	6.3	24V±10%	40	15	20
SM3*-06******	200W、400W	1.5	0.3	7.2				
SM3*-08******	750W、1000W	3.2	0.4	9.6		70		25
SM3*-10******	1kW ~ 2.5kW	8.0	0.6	14.4		120	16	60
SM3*-13******	850W ~ 3kW	18.5	1.05	24.3		120		60
SM3*-18******	2.9kW ~ 7.5kW	60	2.16	52		150	19	100

4.6.3 The Timing Charts of Electromagnetic Brake

由于制动器在释放及制动时都有动作延时，为避免制动器的损坏，在使用中需要注意动作时序。



Motion waiting time and disable delay time can be set using Luna software, or by modifying parameters P5-24 and P5-25 through the panel.

4.7 Regeneration Resistor P2

当电机的转矩方向和转速方向相反时，电机处于类似发电模式，外部能量由电机端转换为电压回灌到驱动器，使得驱动器母线电压升高，这个过程中的能量称之为再生能量。比如电机在减速过程中。过高的母线电压会损伤驱动器，因此当母线电压高于一定限值时，必须使用再生能量吸收电阻来消耗这部分电压，否则驱动器会产生过压报警。

M56S系列驱动器内置的再生能量吸收电阻的规格参考下表。

Drive P/N (kW)	Built-in Resistor		External Resistor Minimum Resistor (Ω)
	Resistor (Ω)	Power P_R(W)	
M56S-21A8RD	no built-in	no built-in	50
M56S-21A8RF	200	40	50
M56S-23A0RD	no built-in	no built-in	50
M56S-23A0RF	200	40	50
M56S-24A5RD	100	60	50
M56S-24A5RF	100	60	50
M56S-26A0RF	25	80	15
M56S-210ARF	25	80	15
M56S-213ARF	25	80	15
M56S-313ARF	25	80	15
M56S-317ARF	35	100	35
M56S-321ARF	35	100	25
M56S-326ARF	35	100	25

4.7.1 Calculation method of regenerative energy

A. Reciprocating motion

When the motor decelerates, the kinetic energy during deceleration will be converted into electrical 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 when the external load decelerates

The following provides a simple method to simply calculate the required regenerative energy absorption resistance.

1) Calculate the energy E_M when the motor is decelerating

The following table shows the energy produced when the M56S series servo motor decelerates from 3000 rpm to 0 rpm without external load.

Motor Series	Frame Size (mm)	Power (W)	Servo Motor P/N	Rotor Inertia $J_M(10^{-4}Kgm)$	Energy produced by decelerating E_M(J)	Maximum energy absorbed by the driver capacitor E_C(J)
Low Inertia	40	100	SM3L-042*****	0.043	0.21	8.7
	60	200	SM3L-061*****	0.152	0.75	8.7
		400	SM3L-062*****	0.243	1.20	13
	80	750	SM3L-083*****	0.856	4.22	27
		1000	SM3L-084*****	1.07	5.27	27
	100	1000	SM3L-102*****	1.79	8.82	40.6
		1500	SM3L-103*****	2.37	11.68	40.6
		2000	SM3L-104*****	3.68	14.69	40.6
Medium Inertia	130	1000	SM3M-132*****	13.9	68.52	27
		1500	SM3M-133*****	19.4	95.64	40.6
		2000	SM3M-134*****	23.3	114.86	40.6

High Inertia	130	850	SM3H-132A****	13.9	68.52	40.6
		1300	SM3H-133A****	19.4	95.64	40.6
		1800	SM3H-134A****	23.3	114.86	40.6

2) Calculate the energy E_L generated by the dragged load during deceleration.

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

$$E_L = N \times E_M$$

If $E_M + E_L < E_C$, that means during deceleration, the energy generated by the motor and the dragged load during deceleration is less than the energy that the drive capacitor can absorb, so there is no need to worry about regenerative energy absorption.

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

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

t_{dec} is the deceleration time + the interval time between two deceleration's

4) Judgement

If $P_{AV} < P_R$， The total power generated during deceleration is less than the power of the built-in regenerative energy absorption resistance of the drive, so no external resistance is needed.

If $P_{AV} > P_R$， The total power generated during deceleration is greater than the power of the built-in regenerative resistance of the drive, and an external resistance is required. In order to reasonably control the temperature rise of the external absorption resistance, the minimum resistance power is P_{AV} / 0.5.

For example:

Use 400W motor SM3L-062A****，The load inertia is 15 times the motor inertia. Assuming tdec (deceleration time + interval between two deceleration’s) is 0.5s, and each movement is decelerated from 3000rpm to 0rpm, the required power of the regeneration resistance is calculated as::

E_M = 1.2J, E_C = 13.04J

E_L = N x E_M = 15 x 1.2 = 18J

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

Since the 400W driver has a built-in absorption resistor power of 40W, there is no need to connect an external resistor.

B. The external load torque drives the motor, and most of the continuous negative power output of the motor is doing positive work, that is, the torque output direction of the motor as same as the direction of rotation. In some special applications, the torque output direction of the motor just opposite to the speed direction, and the external energy will be fed back into the drive at this time. The servo system will output the opposite force to overcome the gravity of the external load in order to meet the requirements of position and speed. Such as the vertical downward movement of a large load, when running for a long time, the bus capacitance is full and it cannot continue to absorb the regenerative energy. At this time, the regenerative resistor is required to absorb the energy. The power calculation formula is as follows:

$$P_T = 2\pi T_M N_M$$

Where:

T_M is the output torque，Unit: Nm

N_M is the speed，Unit: rps

For example :

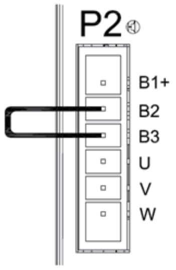
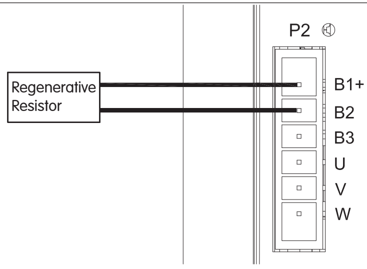
The torque output direction of the motor is opposite to the direction of rotation. When the motor output torque is 0.6Nm and the speed is 2400rpm, the power at this time is:

P_T=2 x 3.14 x 0.6 x 2400 / 60= 150.72

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

4.7.2 Wiring a Regenerative Resistor

在某些应用中，当内部吸收电阻无法吸收再生电动势时，为防止造成驱动器过压报警，需要外接功率更大的吸收电阻。

Using the build-in resistor	Using external resistor
Short-circuit the B2 and B3 of the drive's P2 connector	Disconnect B2 and B3, and connect the resistor to B1+ and B2.
	

4.7.3 Parameter Settings for Regenerative Resistor

Relevant parameters:

Para.	Command	Parameter Name	Rang	Default	Unit	Description
P1-19	ZR	Regeneration Resistor Value	10 ~ 32000	200	Ohm	The resistance of regenerative resistor.
P1-20	ZC	Regeneration Resistor Continuous Wattage	1 ~ 32000	40	Watt	The regeneration resistor power.
P1-21	ZT	Regeneration Resistor Time Constant	0 ~ 8000	1000	ms	The regeneration resistor time constant. Decides the peak time that the resistor can tolerate full regeneration voltage.

Note:

Set the resistance, power and time constant of the regenerative resistor correctly, otherwise it will affect working and cause the drive to get a over-voltage, regenerative energy absorbing failure or other alarms.

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

Connect a 100Ω，200W resistor	Parameter Settings: P1-19 = 100 P1-20 = 200
Connect two 50Ω，200W resistors in series	Parameter Settings: P1-19 = 100 P1-20 = 400
Connect two 100Ω，200W resistors in parallel	Parameter Settings: P1-19 = 50 P1-20 = 400

4.8 CN1----Connecting to a PC

The CN1 port is used for the communication between drive and PC. By using Luna software, you can set control mode, modify parameters,online tuning and more settings.

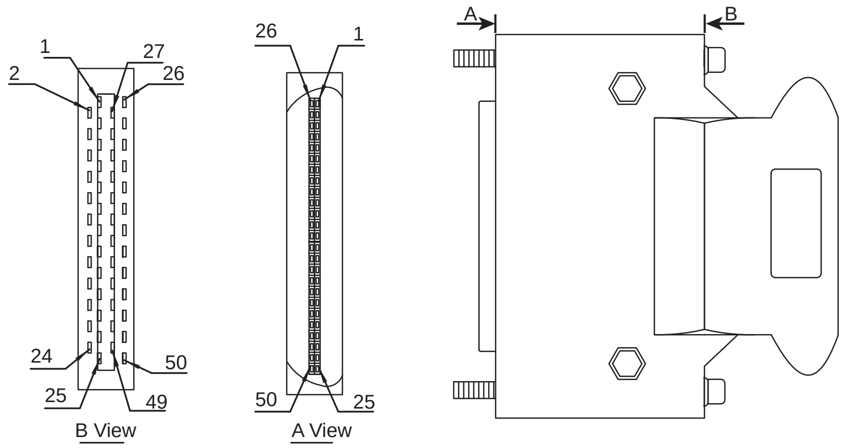
PIN NO	Symbol	Description
1	+5V	USB Power
2	D-	Data -
3	D+	Data +
4	—	Reserve
5	GND	GND

4.9 CN2 -Input/Output Signal Connection

The CN2 port of the M56S series AC servo driver is used to connect input and output signals.

4.9.1 CN2 Input and Output Specifications

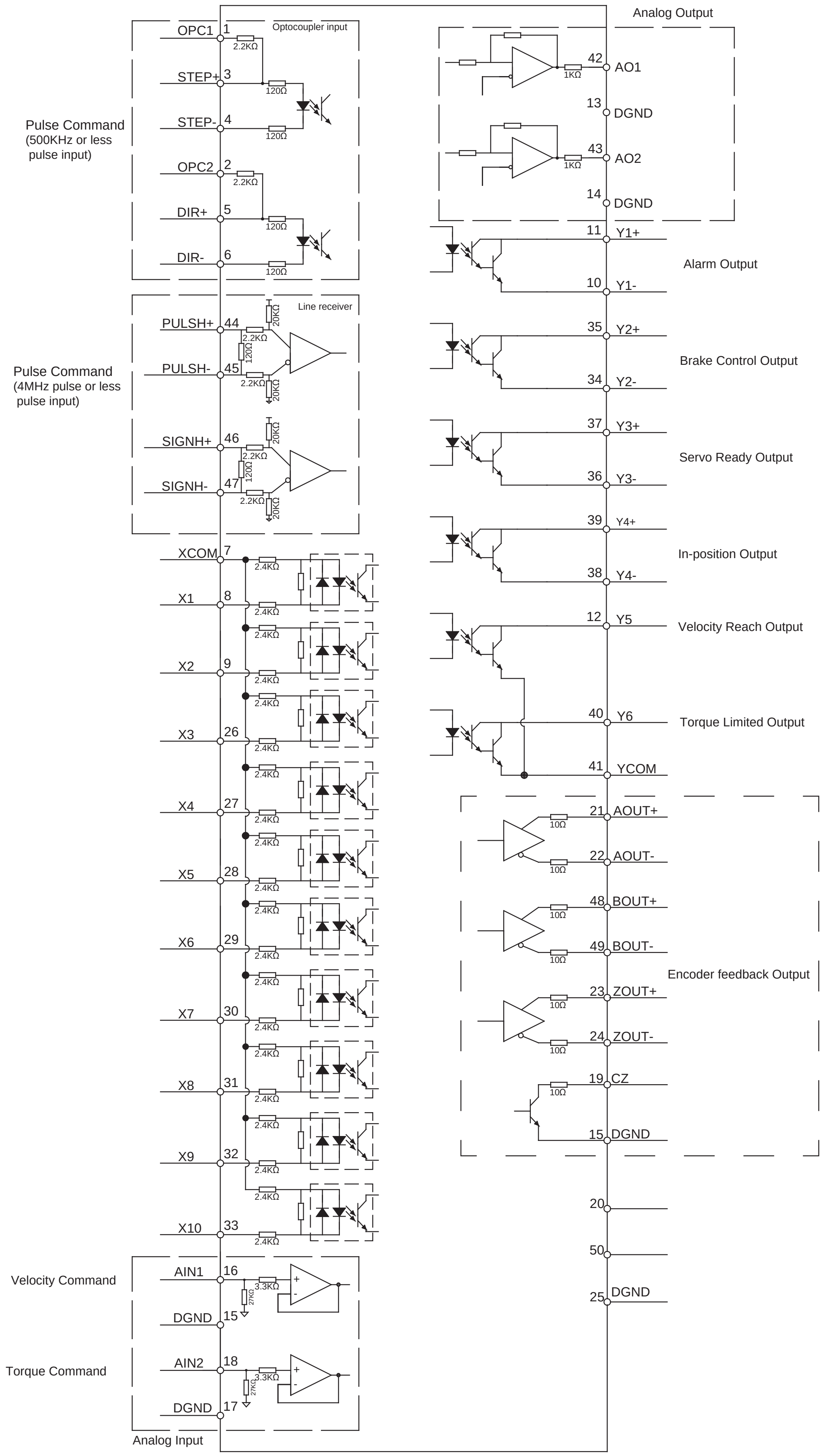
CN2 Pin assignments are as follows.



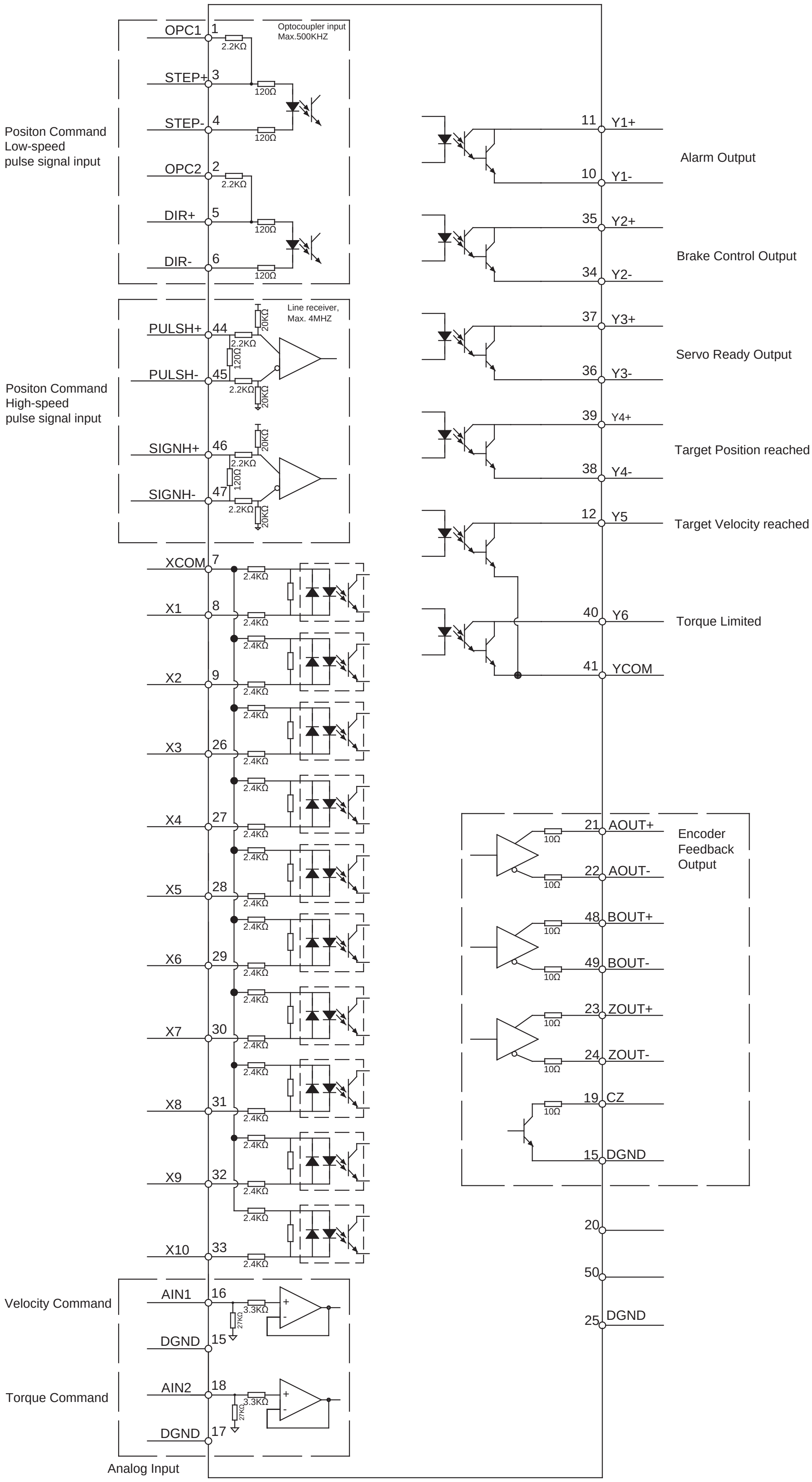
Specifications of input and output signals are as follows:

	Signals	Descriptions	RS-485 Type	
			-F Type	-R Type
Digital Signals	Input	10 configurable optical isolate digital inputs 24VDC，max input current 20mA	Support	Support
	Output	6 configurable optical isolate digital outputs,up to 30VDC,30mA	Support	Support
Analog signals	Input	12bit A/D: 2 inputs: -10~+10V	Support	Support
	Output	D/A : 2 outputs，-10~+10V	Support	Support
Pulse signals	Input	2 inputs (Photocoupler input，Line Receiver input) : ◆ Photocoupler input : 5V diffrential or 24V open-collector pulse input，minimum pulse width 1μs，maximum frequency 500KHz ◆ Line Receiver input: 5Vdiffrential pulse input，minimum pulse width 0.125μs，maximum frequency 4MHz	Support	Support
	Output	4 outputs (Line driver: 3 output, open collector: 1 output) ◆ Line Driver output : Feed out the encoder feedback pulse A、B、Z ◆ Open collector output: Feed out the encoder feedback pulse Z	Support	Support

4.9.2 CN2 Input and Output Signals Pin Diagram (-RF)



4.9.3 CN2 Input and Output Signals Pin Diagram (-RD Type)



4.9.4 CN2 Input and Output Pin Definition

50Pin高密度连接器机型所支持的功能不同，输入输出引脚也有区别，具体引脚定义见表一和表二。

◆ Table 1: -RF type pin definition

PIN NO.	Symbol	Desription	PIN NO.	Symbol	Desription	PIN NO.	Symbol	Desription
1	OPC1	Pull-up for open collector inpu-1	18	AIN2	Analog input 2	35	Y2+	Digital output 2+
2	OPC2	Pull-up for open collector inpu-2	19	OCZ	Encoder's Z signal open collector output	36	Y3-	Digital output 3-
3	STEP+	Position command pulse input+	20	N/C	N/C	37	Y3+	Digital output 3+
4	STEP-	Position command pulse input-	21	AOUT+	Encoder output A+	38	Y4-	Digital output 4-
5	DIR+	Position command direction input+	22	AOUT-	Encoder output A-	39	Y4+	Digital output 4+
6	DIR-	Position command direction input-	23	ZOUT+	Encoder output Z+	40	Y6	Digital output 6
7	XCOM	Digital inputs common point	24	ZOUT-	Encoder output Z-	41	YCOM	Digital output common point
8	X1	Digital input 1	25	DGND	Digital output	42	AO1	Analog output 1
9	X2	Digital input 2	26	X3	Digital input 3	43	AO2	Analog output 2
10	Y1-	Digital output 1-	27	X4	Digital input 4	44	PULSH+	Position command High speed pulse input+
11	Y1+	Digital output 1+	28	X5	Digital input 5	45	PULSH-	Position command High speed pulse input-
12	Y5	Digital output 5	29	X6	Digital input 6	46	SIGNH+	Position command High speed pulse sign input+
13	DGND	Digital Ground	30	X7	Digital input 7	47	SIGNH-	Position command High speed pulse sign input-
14	DGND	Digital Ground	31	X8	Digital input 8	48	BOUT+	Encoder output B+
15	DGND	Digital Ground	32	X9	Digital input 9	49	BOUT-	Encoder output B-
16	AIN1	Analog input 1	33	X10	Digital input 10	50	N/C	N/C
17	DGND	Digital Ground	34	Y2-	Digital output 2-	-		

◆ Table 2: -RD type pin definition

PIN NO.	Symbol	Desription	PIN NO.	Symbol	Desription	PIN NO.	Symbol	Desription
1	OPC1	Pull-up for open collector inpu-1	18	AIN2	Analog input 2	35	Y2+	Digital output 2+
2	OPC2	Pull-up for open collector inpu-2	19	OCZ	Encoder's Z signal open collector output	36	Y3-	Digital output 3-
3	STEP+	Position command pulse input+	20	N/C	N/C	37	Y3+	Digital output 3+
4	STEP-	Position command pulse input-	21	AOUT+	Encoder output A+	38	Y4-	Digital output 4-
5	DIR+	Position command direction input+	22	AOUT-	Encoder output A-	39	Y4+	Digital output 4+
6	DIR-	Position command direction input-	23	ZOUT+	Encoder output Z+	40	Y6	Digital output 6
7	XCOM	Digital inputs common point	24	ZOUT-	Encoder output Z-	41	YCOM	Digital output common point
8	X1	Digital input 1	25	DGND	Digital output	42	N/C	Analog output 1
9	X2	Digital input 2	26	X3	Digital input 3	43	N/C	Analog output 2
10	Y1-	Digital output 1-	27	X4	Digital input 4	44	PULSH+	Position command High speed pulse input+
11	Y1+	Digital output 1+	28	X5	Digital input 5	45	PULSH-	Position command High speed pulse input-
12	Y5	Digital output 5	29	X6	Digital input 6	46	SIGNH+	Position command High speed pulse sign input+
13	DGND	Digital Ground	30	X7	Digital input 7	47	SIGNH-	Position command High speed pulse sign input-
14	DGND	Digital Ground	31	X8	Digital input 8	48	BOUT+	Encoder output B+
15	DGND	Digital Ground	32	X9	Digital input 9	49	BOUT-	Encoder output B-
16	AIN1	Analog input 1	33	X10	Digital input 10	50	N/C	N/C
17	DGND	Digital Ground	34	Y2-	Digital output 2-	-		

4.9.4.1 Position Pulse Command

◆ Open-collector Pulse Inputs (or Low-speed pulse signal input)

CN2-Pin NO.	Signals		Description	Wiring Method
1	OPC1	Pulse command input	When bit4 of P3-03 is set to "0", this low-speed pulse input is valid. The pulse position control mode will use this input as position command reference. ◆ Opto-coupler input: 1) Open collector pulse signals, 5V or 24VDC 2) Low-speed differenct pulse signals, 5VDC ◆ Maximum pulse frequency is 500KHz. ◆ Support pulse & direction signal, CW/CCW signal and A/B quadrature signal ◆ When using 24V open collector pulse signal, you need to use OPC1 and OPC2 input for pull-up. ◆ Connecting diagram when a current regulating resistor is not used with 24 V power supply	Refer to Chapter 4.9.5 A1
3	STEP+			
4	STEP-			
2	OPC2	Pulse direction input		
5	DIR+			
6	DIR-			

◆ Line Driver pulse Inputs(or High-speed pulse signal input)

CN2-Pin NO.	Signals		Description	Wiring Method
44	PULSH+	Pulse command input	When bit4 of P3-03 is set to "1", this line driver pulse input is valid. The pulse position control mode will use this input as position command reference. ◆ For Line driver pulse input，5VDC ◆ Maximum pulse frequency is 4MHz ◆ Support pulse & direction signal, CW/CCW signal and A/B quadrature signal	Refer to Chapter 4.9.5 A2
45	PULSH-			
46	SIGNH+	Pulse direction input		
47	SIGNH-			

4.9.4.2 Analog Command Inputs

RS-485 type all have two analog signal inputs.

CN2-Pin NO.	Signals		Description	Wiring Method
16	AIN1	Analog inputs	Analog speed command -10V ~ +10V	Refer to Chapter 4.9.7 A3
18	AIN2		Analog torque command -10 ~ +10V	
13,14 15,17,25	DGND		Ground of analog signals	

NOTE: Pules control type drive does not support analog input or output.

4.9.4.3 Analog Outputs

-RF type all have two analog signal outputs.

CN2-Pin NO.	Signals		Description	Wiring Method
42	AO1	Analog output	Use the analog output signal to monitor the operating parameters of the motor: actual current, actual speed, etc. The data corresponding to the two outputs can be set by parameters	Refer to Chapter 4.9.7 A4
43	AO2			
13,14 15,17,25	DGND		Ground for analog output	

NOTE: -RD does not support analog input

4.9.4.4 Encoder Divided Outputs

编码器分频输出功能是将电机编码器的反馈信号以A,B,Z的方式差分输出，通过参数可设定每转脉冲数及脉冲输出分频比。

CN2-Pin NO.	Signals		Description	Wiring Method
21	AOUT+	Encoder signal pulse output	The serial position datas of the encoder are converted to line driver signals phase A,B,and phase Z. The number of pulses per revolution and the frequency division ratio of pulse output can be set by parameters.	Refer to Chapter 4.9.8
22	AOUT-			
48	BOUT+			
49	BOUT-			
23	ZOUT+			
24	ZOUT-			
19	OCZ		Output the Z-signal of the encoder in open collector	
13,14 15,17,25	DGND		Ground for OCZ output.	

4.9.4.5 Digital Inputs

The M56S series AC servo drive's 50Pin high-density connector type has 10 digital inputs. Each digital input can be configured to a specific function by parameters.

◆ **Specific function signal**: such as alarm reset, limit sensor input, enable input, etc.

◆ **General puepose input**

					Default Settings		
CN2-Pin NO.	Symbol	Function	Parameter No.	Command	Signal	Input Logic *1	Default value
8	X1	Digital Input 1	P5-00	MU1	CCW-LMT	Closed	7
9	X2	Digital Input 2	P5-01	MU2	CW-LMT	Closed	5
26	X3	Digital Input 3	P5-02	MU3	A-CLR	Closed	3
27	X4	Digital Input 4	P5-03	MU4	S-ON	Closed	1
28	X5	Digital Input 5	P5-04	MU5	C-CLR	Closed	17
29	X6	Digital Input 6	P5-05	MU6	CM-SEL	Closed	9
30	X7	Digital Input 7	P5-06	MU7	GPIN	Closed	0
31	X8	Digital Input 8	P5-07	MU8	GPIN	Closed	0
32	X9	Digital Input 9	P5-08	MU9	GPIN	Closed	0
33	X10	Digital Input 10	P5-09	MUA	GPIN	Closed	0
7	XCOM	COM port for digital inputs	-	-	-		

Note:

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

CLOSED: If current is flowing into or out of an input, the logic state of that input is low or closed.

OPEN: If no current is flowing, or the input is not connected, the logic state is high or open.

2. Refer to Chapter: 7.1.1 Input Signals Setting

3. Refer to the input signal wiring method: Chapter 4.9.6 CN2 - Input and Output Signals Wiring Instructions

4.9.4.6 Digital Output

The M56S series AC servo drive's 50Pin high-density connector type has 6 digital outputs. Each digital output can be configured to a specific function by parameters.

					Default Settings		
CN2-Pin NO.	Symbol	Function	Parameter No.	Command	Signal	Output Logic *1	Default value
11	Y1+	Digital output 1+	P5-12	MO1	SON-ST	Closed	7
10	Y1-	Digital output 1-					
35	Y2+	Digital output 2+	P5-13	MO2	S-RDY	Closed	23
34	Y2-	Digital output 2-					
37	Y3+	Digital output 3+	P5-14	MO3	FLT	Closed	1
36	Y3-	Digital output 3-					
39	Y4+	Digital output 4+	P5-15	MO4	IN-POS	Closed	9
38	Y4-	Digital output 4-					
12	Y5	Digital output 5	P5-16	MO5	HOMED	Closed	25
40	Y6	Digital output 6	P5-17	MO6	T-LMT	Closed	15
41	YCOM	COM port for digital outputs	-	-	-		

Note:

1. The output logic state of the pin is as follows:

CLOSED: If current is flowing into or out of an output, the logic state of that output is low or closed.

OPEN: If no current is flowing, or the output is not connected, the logic state is high or open.

2. Refer to Chapter: 7.1.2 Output Signals Setting

3. Refer to the input signal wiring method: Chapter 4.9.6 CN2 - Input and Output Signals Wiring Instructions

4.9.5 Position Pulse Signal Wiring Instructions

M56S series AC servo driver 50Pin high-density connector type has two pulse input sources:

Low Speed Pulse Signal Input : STEP/DIR

High Speed Pulse Signal Input : PULSH/SIGNH

◆ Low Speed Pulse Signal Input (Open-collector Pulse Inputs)

CN2-Pin NO.	Signals		Description	Maximum pulse frequency	Minimum pulse width	Wiring Method
1	OPC1	Pulse command input	◆ When bit4 of P3-03 is set to "0", this low-speed pulse input is valid. The pulse position control mode will use this input as position command reference. ◆ Opto-coupler input: 1) Open collector pulse signals, 5V or 24VDC 2) Low-speed differenct pulse signals, 5VDC ◆ Maximum pulse frequency is 500KHz. ◆ Support pulse & direction signal, CW/CCW signal and A/B quadrature signal ◆ When using 24V open collector pulse signal, you need to use OPC1 and OPC2 input for pull-up. ◆ Connecting diagram when a current regulating resistor is not used with 24 V power supply	500KHz	1μs	A1
3	STEP+					
4	STEP-					
2	OPC2	Pulse direction input				
5	DIR+					
6	DIR-					

◆ High Speed Pulse Signal Input (Line Driver pulse Inputs)

CN2-Pin NO.	Signals		Description	Maximum pulse frequency	Minimum pulse width	Wiring Method
44	PULSH+	Pulse command input	◆ When bit4 of P3-03 is set to "1", this line driver pulse input is valid. The pulse position control mode will use this input as position command reference. ◆ For Line driver pulse input，5VDC ◆ Maximum pulse frequency is 4MHz ◆ Support pulse & direction signal, CW/CCW signal and A/B quadrature signal	4MHz	0.125μs	A2
45	PULSH-					
46	SIGNH+	Pulse direction input				
47	SIGNH-					

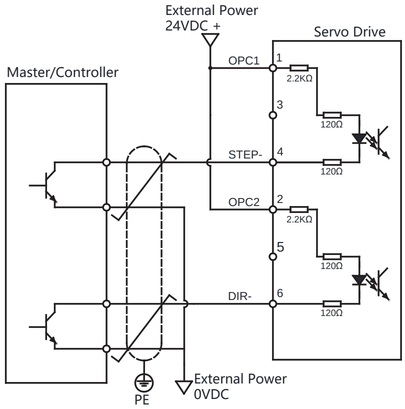
Note: STEP/DIR and PULSH/SIGNH cannot be used at the same time. Please use Bit4 of parameter P3-03 to select the position pulse signal input source.

0: Open-collector Pulse Inputs

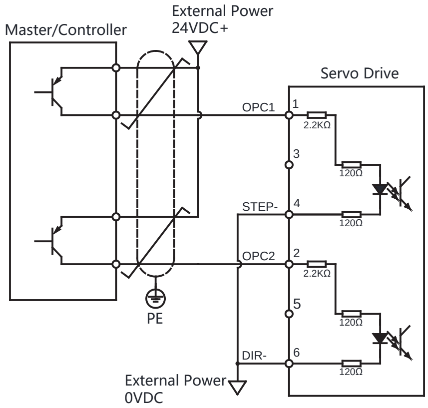
1: Line Driver pulse Inputs

A1----Low-speed pulse signal input STEP/DIR wiring method

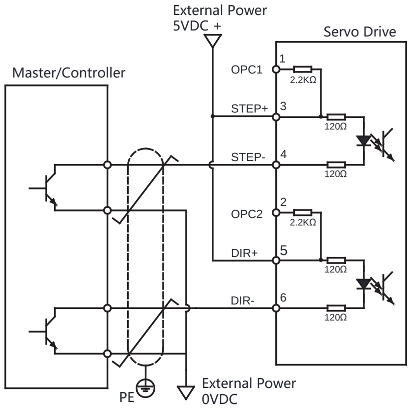
A. The source for the pulse input is open-collector NPN type equipment,which uses external 24V power supply.



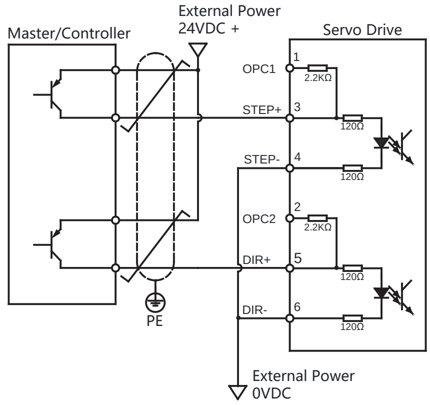
B. The source for the pulse input is open-collector PNP type equipment,which uses external 24V power supply.



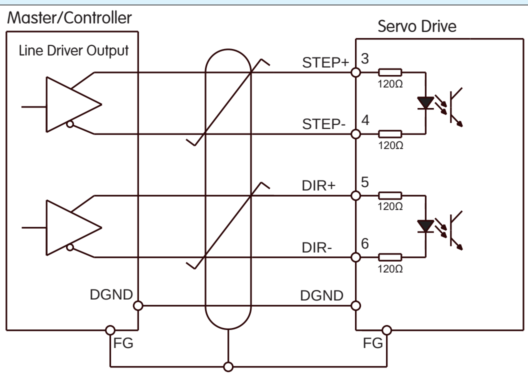
C. The source for the pulse input is open-collector NPN type equipment,which uses external 5V power supply.



D. The source for the pulse input is open-collector PNP type equipment,which uses external 5V power supply.



E. The source for the pulse input is Line driver. It can only be used with 5V power system.



◆ For 24VDC power signal

Pulse input signal is valid: higher than 16V

Pulse input signal is invalid: less than 8V

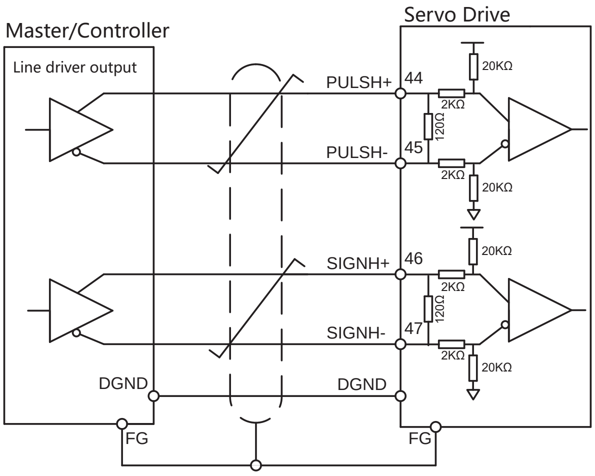
◆ For 5VDC power signal

Pulse input signal is valid: higher than 3V

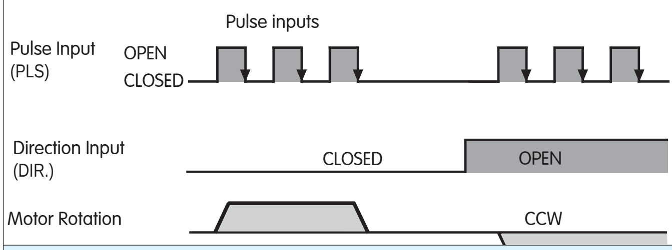
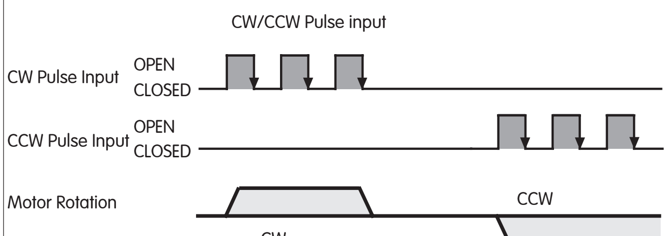
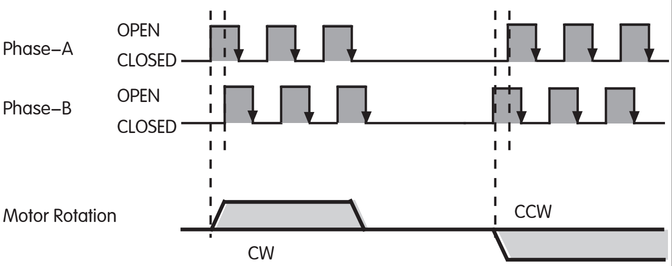
Pulse input signal is invalid: less than 2V

Ther voltage of pulse signal input should be avoided to appear in the fuzzy area of above voltage, so as to avoid uncertain pulse input.

A2----High-speed pulse signal input STEP/DIR wiring method
PULSH/SIGNH inputs can only be used with 5V line drivers signals. Do not use with 24V DC.



◆ Pulse Input Description

<table>
<tr><th>Pulse&Direction</th><th>CW/CCW Pulse Signal</th></tr>
<tr><td>--When both Pulse and Direction input signal is CLOSED, the motor will rotate in one direction
--When Pulse input signal is CLOSED, and Direction input signal is OPEN, the motor will rotate in the opposite direction.
*Direction signal can be configured via bit3 of P3-03.
The following shows motor rotates in CW when Direction input is CLOSED.</td><td>--When STEP or PULSH input signal is CLOSED,and DIR or SIGNH input signal is OPEN, the motor will rotate in one direction.
--When DIR or SIGNH input signal is CLOSED, and STEP or PULSH input signal is OPEN, the motor will rotate in one direction.
*Direction can be configured via bit3 of P3-03.</td></tr>
<tr><td>
</td><td>
</td></tr>
<tr><th>A&B Quadrature signal</th><th></th></tr>
<tr><td>In A/B Quadrature mode, motor rotary direction is based on the the leading signal between A and B.
The following shows motor rotates in CW when phase-A is 90 degrees ahead of phase-B.
*Direction signal can be configured via bit3 of P3-03.</td><td></td></tr>
<tr><td>
</td><td></td></tr>
</table>

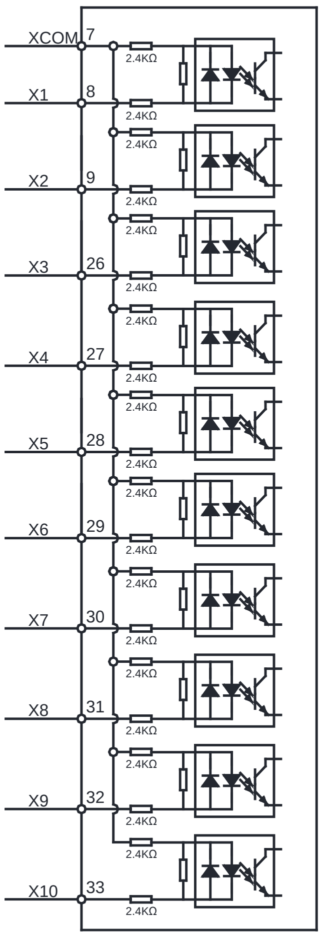
4.9.6 CN2-Input and Output Signals Wiring Instructions

4.9.6.1 Digital Inputs X1 ~ X10

The M56S series servo drives(-F&-R type) include 10 single-ended, optically isolated inputs that can be used with sourcing or sinking signals, 24 volts. This allows connection to PLCs, sensors, relays and mechanical switches. Because the input circuits are isolated, they require a source of power. If you are connecting to a PLC, you need be able to get power from the PLC power supply. If you are using relays or mechanical switches, you need a 24 V power supply. Rated current is 20mA.

What is COM?
"Common" is an electronics term for an electrical connection to a common voltage. Sometimes "common" means the same thing as "ground". If you are using sourcing (PNP) input signals, then you will want to connect COM to ground (power supply -). If you are using sinking (NPN) signals, then COM must connect to power supply +.

Note:
CLOSED: If current is flowing into or out of an input, the logic state of that input is low or closed.
OPEN: If no current is flowing, or the input is not connected, the logic state is high or open.
The internal circuit block diagram of X1 ~ X10 is as shown below.

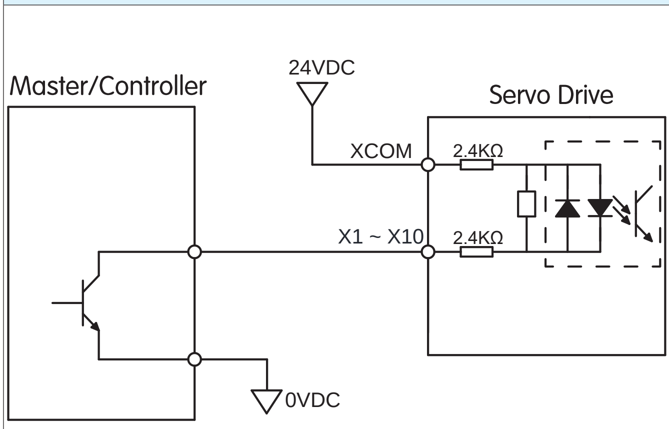
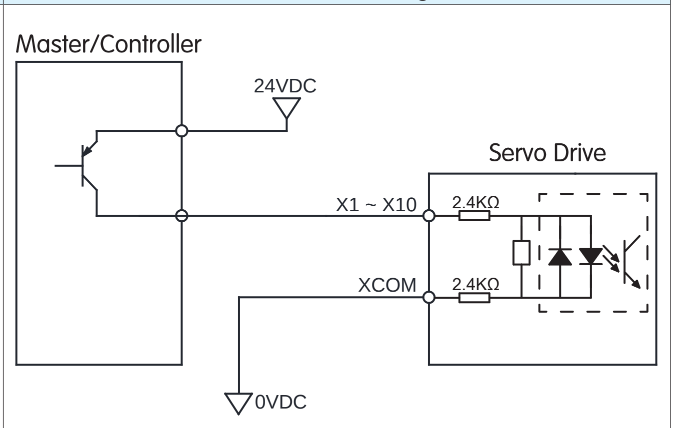
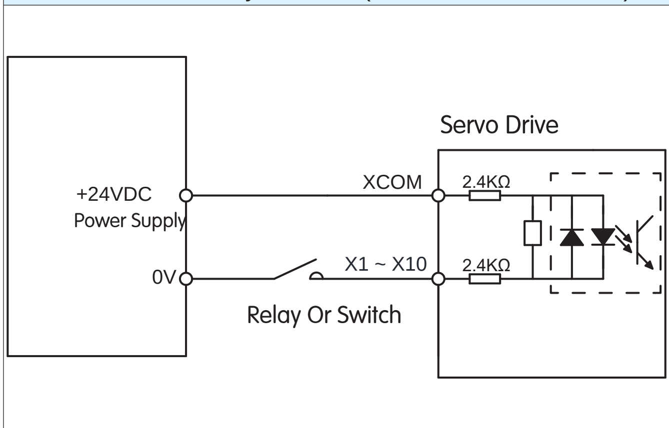
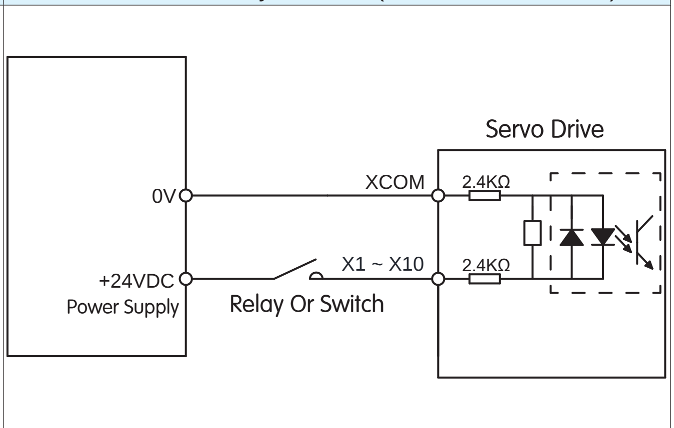
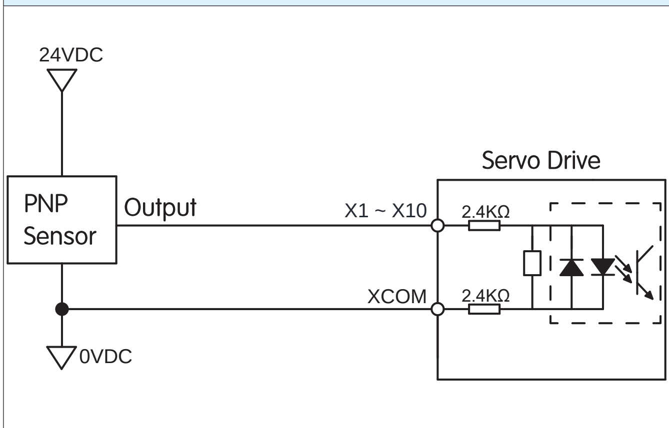
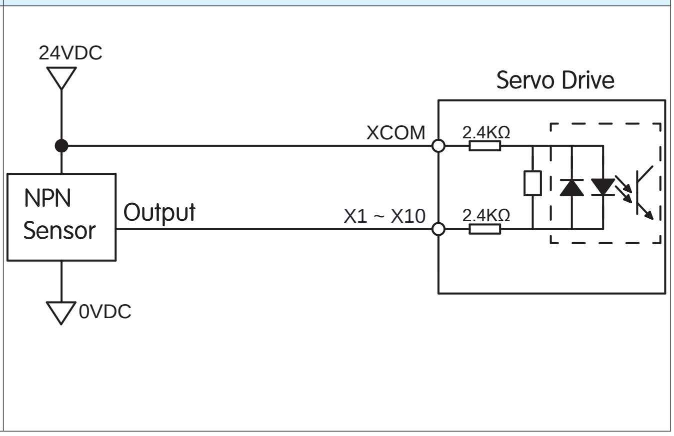


◆ For 24VDC power signal

Pulse input signal is valid: higher than 16V

Pulse input signal is invalid: less than 8V

Ther voltage of pulse signal input should be avoided to appear in the fuzzy area of above voltage, so as to avoid uncertain pulse input.
The diagrams on the following pages show how to connect X1 ~X10 to various commonly used devices.

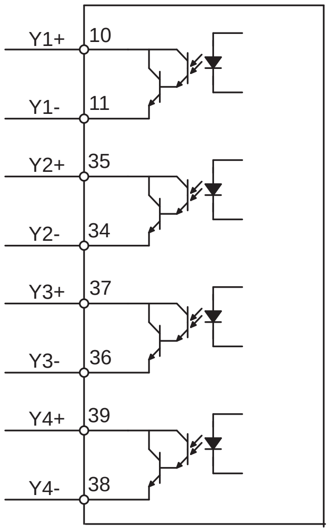
A. Controller ---SINK mode	B. Controller---Sourcing mode
	
C. Connect to Relay or Switch(XCOM connect to +24V)	**D. Connect to Relay or Switch(XCOM connect to 0V)**
	
E. Connect a PNP sensor	**F. Connect a NPN sensor**
	

4.9.6.2 Digital Output Y1 ~ Y4

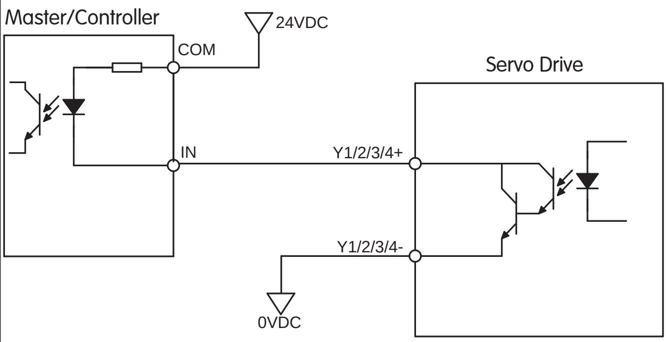
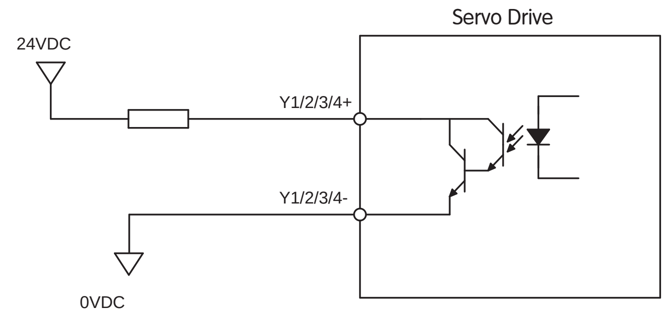
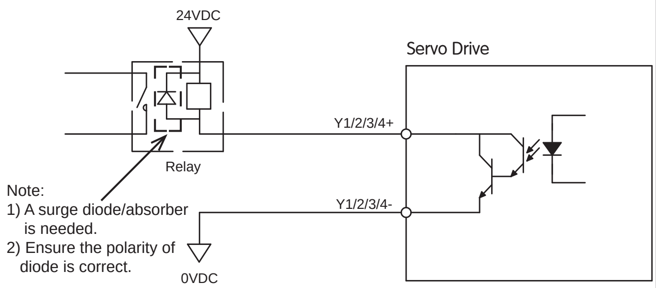
The M56S series servo drives include 6 differential, optically isolated outputs that can be used with sourcing or sinking signals.

Rated Specification :30VDC, 100mA.

The internal circuit block diagram of Y1 ~ Y4 is as shown below.



The following diagrams show how to connect Y1 ~Y4 to various commonly used devices.

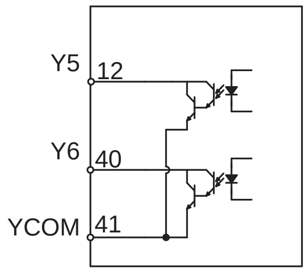
<table>
<tr><th>A. Connected to the control's optocoupler</th><th>B. Connected to resistor load</th></tr>
<tr><td>
</td><td>
</td></tr>
<tr><th>C.Connected to inductive load(Relay .etc.)</th><th></th></tr>
<tr><td>
</td><td></td></tr>
</table>

4.9.6.3 Digital Output Y5 ~ Y6

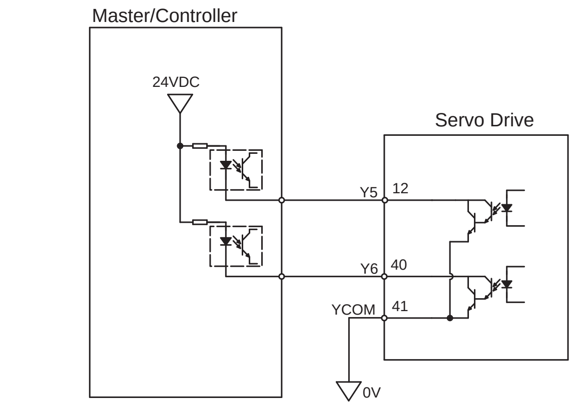
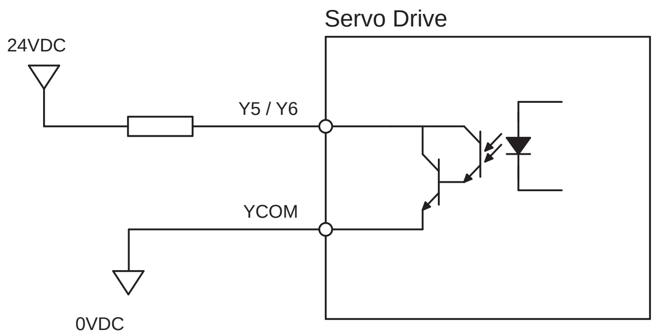
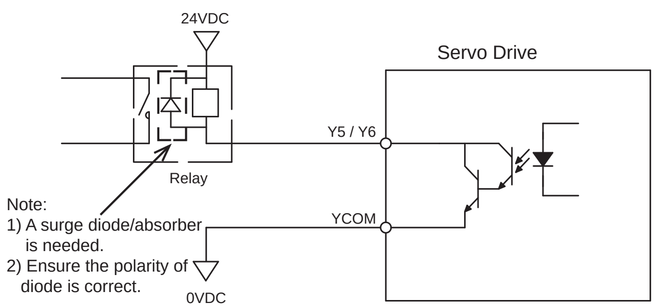
The M56S series servo drives include two single-ended, optically isolated outputs that can be used with sourcing signals.

Rated Specification :30VDC, 100mA.

The internal circuit block diagram of Y5 and Y6 is as shown below.



The following diagrams show how to connect Y5 and Y6 to various commonly used devices.

<table>
<tr><th>A. Connected to the control's optocoupler</th><th>B. Connected to resistor load</th></tr>
<tr><td>
</td><td>
</td></tr>
<tr><th>C.Connected to inductive load(Relay .etc.)</th><th></th></tr>
<tr><td>
</td><td></td></tr>
</table>

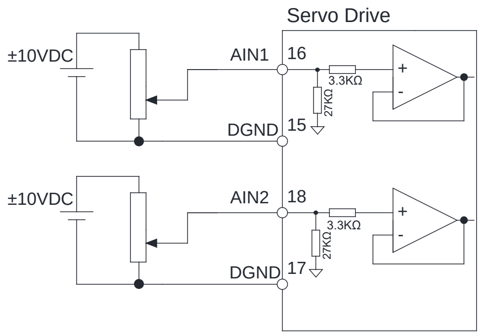
4.9.7 Analog Signal Wiring Instructions

4.9.7.1 Analog Command Inputs

The RS-485 model of M56S series servo drive includes two single-ended analog inputs, which can be used as speed command reference or torque command reference.

CN2-PIN NO.	Signals		Description
16	AIN1	Analog input	Analog speed command -10V ~ +10V
18	AIN2		Analog torque command -10 ~ +10V
13,14 15,17,25	DGND		Ground of analog signals

A3----Analog input connection diagram



4.9.7.2 Analog Outputs

The RS-485 model of M56S series servo drive includes two single-ended analog outputs,.Using the analog output signal to monitor the operating states of the motor: actual current, actual speed, etc.

The data corresponding to the two outputs can be set by parameters.

Output Specifications:

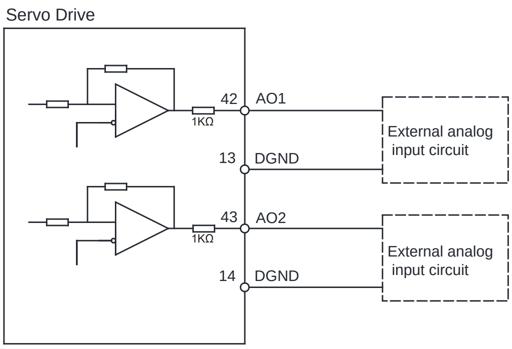
Voltage: -10 ~ +10V

Maximum output capacity: 8mA

The output impedance is 1 kOhm. Pay an attention to the input impedance of themeasuring instrument or the external circuit to be connected.

CN2-PIN NO.	Signals		Description
42	AO1	Analog output	Using the analog output signal to monitor the operating states of the motor: actual current, actual speed, etc.
43	AO2		
13,14 15,17,25	DGND		Ground for analog output

A4----Analog output connetion diagram



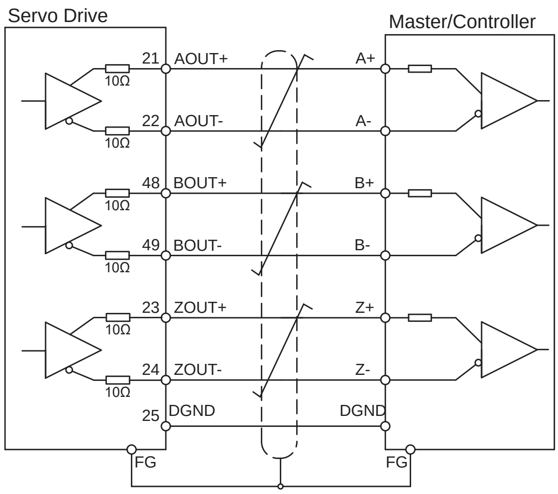
4.9.8 Encoder Divied Output

The M56S series AC servo driver(-X &-N type) can output the encoder signal A-phase, B-phase, and Z-phase through the Line Driver differential mode, and the output specification is 5V.

Line Receiver must be used to receive the signal, and the transmission line should use twisted-pair shielded wires.

CN2-PIN NO.	Signals		Description
21	AOUT+	Encoder Signal Pulse Output	The serial position datas of the encoder are converted to line driver signals phase A,B,and phase Z. The number of pulses per revolution and the frequency division ratio of pulse output can be set by parameters.
22	AOUT-		
48	BOUT+		
49	BOUT-		
23	ZOUT+		
24	ZOUT-		
19	OCZ	Z Signal Output	将编码器的Z信号以集电极开路形式输出
13,14,15,17,25	DGND		OCZ输出的地

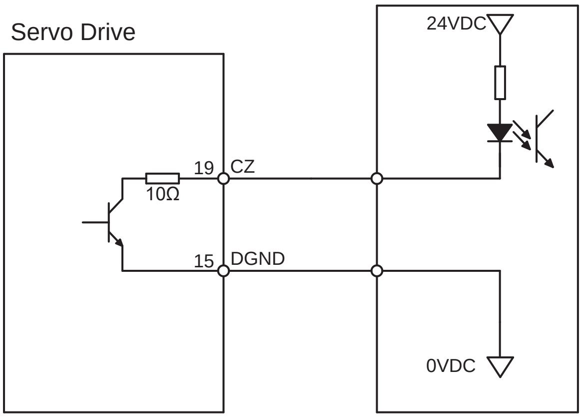
4.9.8.1 A/B/Z Example of differential signal connection



NOTE: The digital ground between controller and drive should be connected together.

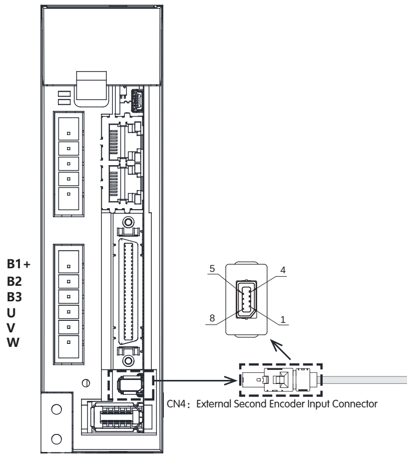
4.9.8.2 Phase-Z Open-collector Output

Output phase-Z signal of encoder feedback in open-collector. Receive this signal with high-speed photocoupler at the controller side, since the pulse width of this signal is narrow.



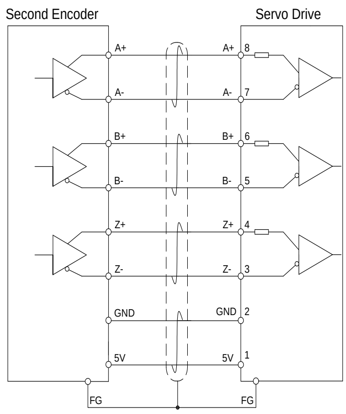
4.10 CN4-Second Encoder Input--Full-closed Loop Control

The CN4 connector is used to connect externally installed encoders or scales for full-closed loop control of the servo drive.



CN2-PIN NO.	Signals		Description
1	5V	5V Power Supply	Power supply for the second feedback signal
2	GND	5V Power Supply GND	
8	A+	Encoder Signal Input	Pulse type: differential Maximum frequency: 1Mpps Minimum pulse width: 0.5 μs
7	A-		
6	B+		
5	B-		
4	Z+		
3	Z-		

■ Signal Connection Diagram



Precautions:

- Please use a twisted-pair shielded cable for the external second encoder signal wire, with a wire diameter of 0.18mm2AWG22 or more
- The total length of the cable is recommended to be within 10 meters. When the wiring is long, to prevent 5V voltage drop and signal attenuation, please increase the wire diameter
- To prevent interference, the digital ground of the external encoder must be connected to the one of the driver, and the cable shielding layer while the driver must be well grounded.
- The maximum 5V output current of the driver is 5V±5% 200mA Max. If the current consumption of the external encoder exceeds this specification, please use an external power supply.
- When using an external power supply, do not connect the external 5V to the 5V power output of CN4. However, the 0V of the external power supply must be connected to the 0V pin of CN4 of the driver to form an equipotential.

4.11 CN5-Safrty Torque Off (STO)

The M56S series AC servo drive has a safe torque off function, namely STO, and the signal connection input port is the CN5 of the drive.

Safe Torque Off (Safe Torque Off) is a hardware-level safety protection function. When the STO function is working, the hardware circuit of the drive will be triggered to forcibly turn off the power transistor inside the drive, thereby preventing the motor from working. The drive will be disabled and is a hardware-level safety protection device that can protect the safety of people and equipment in emergency situations.

When the STO function is triggered, the Servo-ready signal of the drive will be cleared. The motor is disabled, and became an alarm statues. The LED on the drive's panel will display a alarm code r20to.

4.11.1 Precautions

1) If you don't need to use the STO function, make sure that the STO short-circuit terminal is correctly inserted into the CN5 port.

2) When using the STO function, perform an equipment risk assessment to ensure that the system conforms to the safety requirements

3) Even when the STO function is enabled, the servo motor may move due to external force (e.g. gravitational force on the vertical axis). Make sure a holding brake is used in applications where this is possible.

4) When the STO function engages and removes the torque, the motor will be "free running", requiring more distance until the motion stops. Make sure this will not be a safety issue.

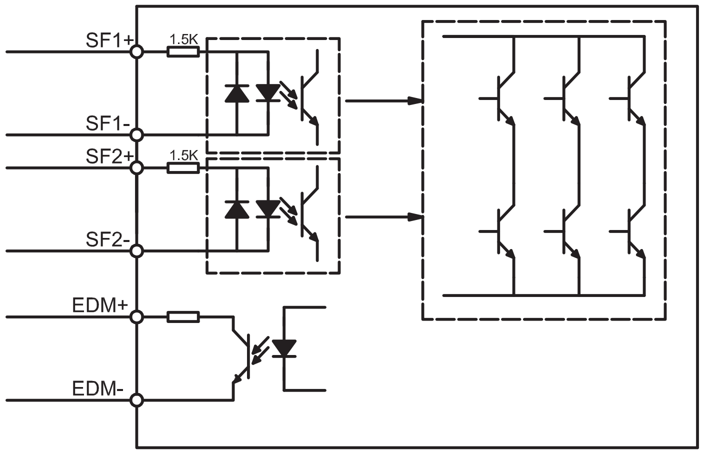
5) When the STO function is triggered, it will turn off the current to the motor, but it does not turn off the power to the servo drive. Make sure to disconnect the power to the drive before performing any maintenance on it.

6) After the STO function is triggered, the drive will have a fault alarm states(Alarm code: r20to), and the motor will be disabled.

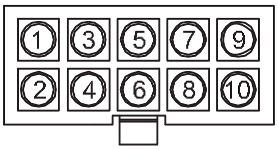
7) After the STO signal return to normal, the drive will automatically clear the STO fault alarm, but the motor will remain disabled . To restore the system to normal operation, re-enable is needed.

4.11.2 STO Input and Output Signals

■ Internal Circuit Diagram



■ Input/Output Pin No.



The model of housing and conductor is as follows:

Name	P/N	Vendor
Housing	43025-1000	MOLEX
Conductor	43030-0005	MOLEX

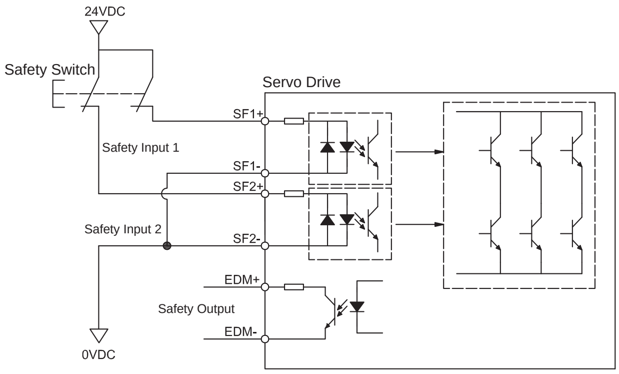
■ STO Signal Definition

Signal	Symbol	Pin	Description	Control Mode
Safety Input SF1	SF1+	1	When SF1 has no input signal, e.g. the port is disconnected, SF1 will be considered OFF. The upper half of the internal power transistor will be shut off.	Compatible with all control mode
	SF1-	5		
Safety Input SF2	SF2+	3	When SF2 has no input signal, e.g. the port is disconnected, SF2 will be considered OFF. The upper half of the internal power transistor will be shut off.	
	SF2-	2		
Safety Output	EDM+	6	Output monitor signal used to check the safety function.	
	EDM-	4		
Ground	DGND	7,8	+12VDC power ground, 750W and abelow type +24VDC power ground, 1000W and above type	
Power supply	VCC	9,10	+12VDC power ground, 750W and abelow type +24VDC power ground, 1000W and above type	

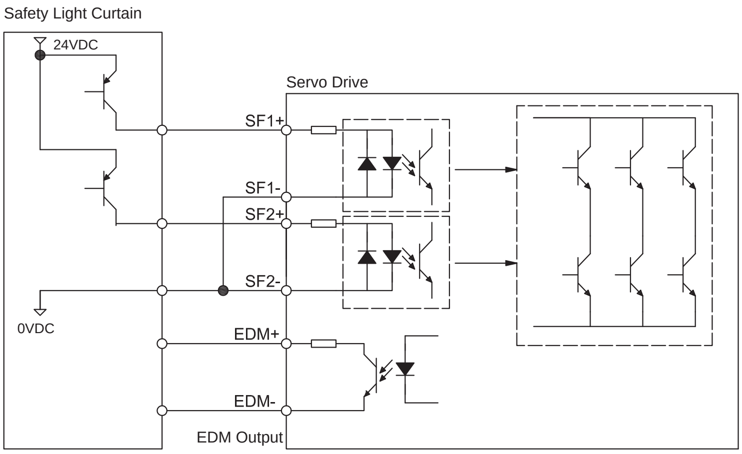
Note: When any of the safety inputs SF1 and SF2 are OFF, the STO function will start to work.

STO Connection Diagrams

● Connection to safety switch



● Safety light curtain connection

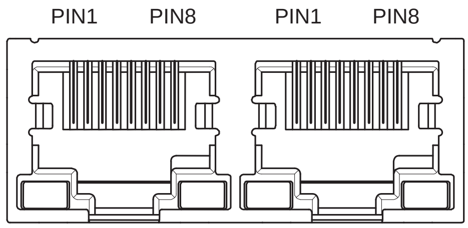


4.12 CN6,CN7--RS-485 Communication Port

RS-485 drives(-R type) use port CN6 and CN7 for standard RJ45 (8p8C) design. This can be used to build RS-485 or RS-422 daisy chain networks. Customers can use Modbus/RTU protocol to control the drive.

4.12.1 CN6 and CN7 Pin Definitions

The diagram of dual port RJ45 connectors of servo drive is as follows.



RJ45（8p8c) Pin definitions:

PIN	Definition
1	RX+
2	RX-
3	TX+
4，5	NC.
6	TX-
7，8	GND

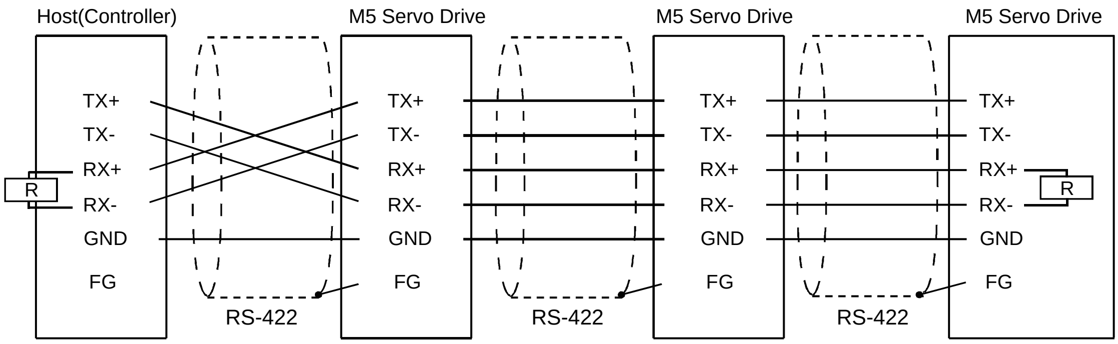
4.12.2 RS-485 and RS-422 Connection Method

RS-422/485 communication allows connection of more than one drive to a single host PC, PLC, HMI or other computer. It also allows the use of longer communication cables. The use of Category 5 cable is recommended as it is widely used for computer networks, inexpensive, easily obtained and certified for quality and data integrity.

The RS-485/RS-422 communication of M56S series AC servo supports half-duplex mode or full-duplex mode. The connection mode for host control can be point-to-point (one host to one M56S drive), or a multi-axis network (each can support up to 32 M56S drives).

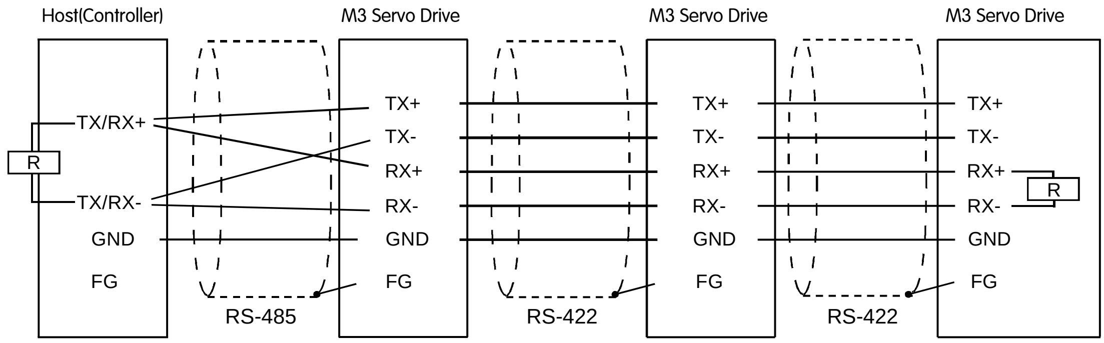
4.12.2.1 RS-422 Full-Duplex Mode

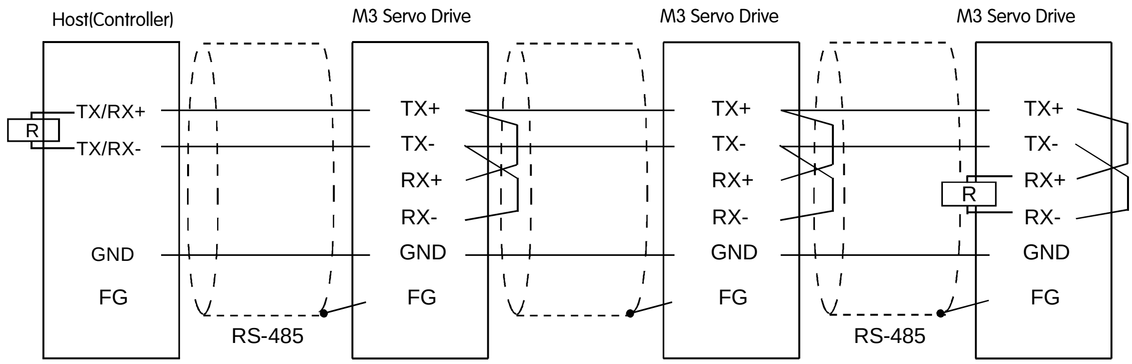
RS-422 full-duplex mode utilize separate transmit and receive wires. One pair of wires must connect the host's transmit signals to each drive's RX+ and RX- terminals. The other pair connects the drive's TX+ and TX- terminals to the host's receive signals. A logic ground terminal is provided on each drive and can be used to keep all drives at the same ground potential. This terminal connects internally to the DC power supply return (V-), so if all the drives on the RS-422/485 network are powered from the same supply it is not necessary to connect the logic grounds. One drive's GND terminal should still be connected to the host computer ground.



4.12.2.2 RS-485 Half-duplex Mode

The same cable is used for data transmission and reception in the RS-485 half-duplex mode. In this mode,he host must disable its transmitter before it can receive data. This must be done quickly before a drive begins to answer a query. The M56S drive includes a transmit delay parameter that can be adjusted to compensate for a host that is slow to disable its transmitter. This adjustment can be made over the network using the TD command, or it can be set using the Luna software. It is not necessary to set the transmit delay in a four wire system.

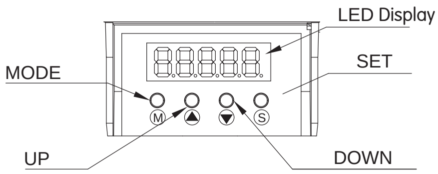




注意：由于使用 RJ45水晶头，我们强烈建议使用标准CAT5e类线。

5 Display and Touch Panel

5.1 Description of Touch Panel



KEY	Function	Description
	LED Display	The LED displays (5 digits, 7 segments) show the drive's operating condition and warning codes, parameters and settings values.
	MODE	Press and hold on mode button to switch LED display mode a). Monitoring selection mode b). Function selection mode c). Parameter setting mode When editing the parameters, press on MODE button can move the cursor to the left and then change parameters by using arrow keys.
 	UP/DOWN	UP and DOWN Key. Pressing the UP and DOWN key can scroll through and change monitor codes, parameter groups and various parameter settings.
	SET	Press to entering mode Press and hold to save parameters/settings

5.2 Switch the Display Mode

1) Pressing MODE key and SET key can change display modes such as states monitoring, function control, parameters setting and etc.

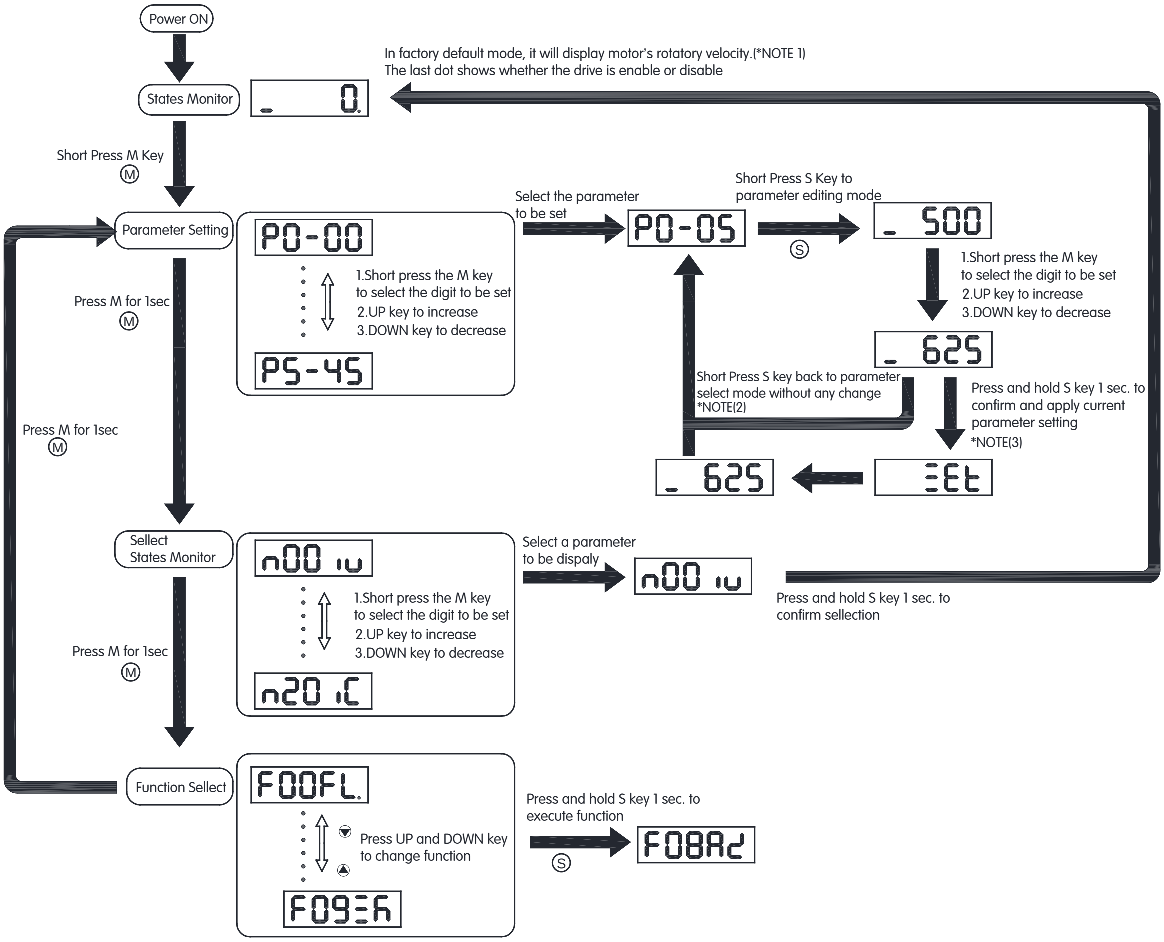
2) If no warnings or faults has occur, the drive will not go into warning and fault display mode.

3) If any alarms are detected, the LED display on the drive will switch into alarm or fault display mode immediately. Press M key and S key on the drive will switch back to previous display mode.

4) In monitoring selection mode, function selection mode and parameter setting mode, when editing the parameters, short press MODE key to switch the operation digits of addition and subtraction, and the selected digit will flash.

5) In the states monitoring mode, press and hold SET key will lock the control panel. To unlock the panel press and hold SET key again.

Refer to the figure below for switching each mode.



Note:

(1) When power is applied, drive's display will show customer defined monitoring mode. In factory default mode, it will display motor's rotary velocity.

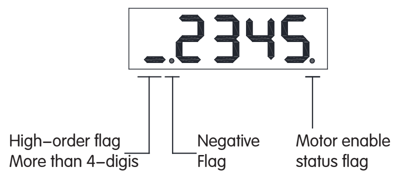
(2) In parameter setting mode, short press SET key will quit from parameter setting mode, and return back to parameter selection mode, and changes will not be saved.

(3) In parameter setting mode, press and hold SET key will confirm and apply current parameter setting. This will effect immediately. However, this change will not save to drive's Flash. If parameter is required for permanent use, please go to parameter setting mode, select the parameter which you want to save, and then press and hold SET key to save the parameter change.

(4) Do not save the parameters when the motor is running.

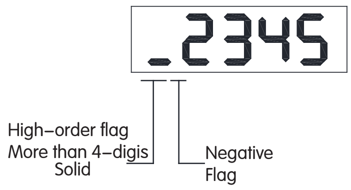
5.3 LED Display Description

5.3.1 Decimal Point Description

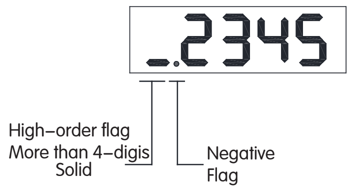
LED Display	Description
	◆ **Motor enable states flag:** The decimal point in the lower right corner of the LED panel is the identification bit of whether the driver is enabled **Solid:** Drive and motor is enabled. **No display:** Drive and motor is disabled. ◆ **Nagetive flag:** This indicates whether the displayed number is positve or negative. **Solid:** Indicates that the displayed data is negative. **No display:** Indicates that the displayed data is positive. ◆ **High-order flag:** When the displayed data is greater than 4 digits, they will be displayed in pages, and the identification flag will mark the digit of the data at this time. For details, please refer to Chapter 5.3.2 Display of More Than 4 Digits.

5.3.2 Data Display

1) 4 digits and less positive number display

LED Display	Description
	◆ The first bit from the left is the data high-order flag. **Solid:** It means that the displayed data is the lower 4 bits of data, and there are no higher bits of data. **Flashing:** It means that the displayed data is the lower 4 bits of data, and there are more than 4 digits. ◆ When the decimal point of the negative flag is off, it means that the displayed data is a positive number. **As shown in the figure, the number displayed is: 2345**

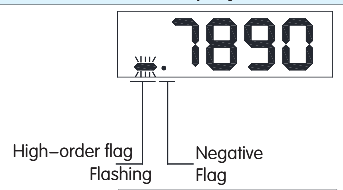
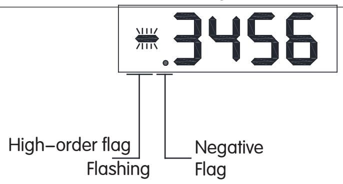
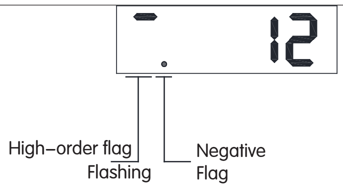
2) 4 digits and less negative number display

LED Display	Description
	◆ The data high-order flag is solid, that means the displayed data is the lower 4 bits of data, and there are no higher bits of data. ◆ The decimal point of the negative flag is solid, that means that the displayed data is a negative number. **As shown in the figure, the number displayed is: -2345**

3) Display of More Than 4 Digits

Since the M56S series AC servo LED display panel has only 5 digits, when displaying data with more than 5 digits, the following method is used.

Example: If want to show -1234567890

	LED Display	Description
Display the lower 4 digits "7890"		◆ The data high-order flag is flashing, that means the displayed data is the lowest 4 bits of data, and there are more data digits. ◆ The decimal point of the negative flag is solid, that means that the displayed data is a negative number.
Display the middle 4 digits "3456"		◆ The middle of data high-order flag is flashing, that means the displayed data is the middle 4 bits of data, and there are more data digits. ◆ The decimal point of the negative flag is solid, that means that the displayed data is a negative number.
Display the highest digits "12"		◆ The middle of data high-order flag is flashing, that means the displayed data is the middle 4 bits of data, and there are more data digits. ◆ The decimal point of the negative flag is solid, that means that the displayed data is a negative number.

Note: When the high-order is flashing, it means there are more data digits. Short press the "UP" and "DOWN" keys to switch the number of pages displayed.

5.3.3 Other Display

LED Display	Description
SEt	Means "SET". Press and hold SET key will confirm and apply current parameter setting. This will effect immediately. However, this change will not save to drive's Flash.After re-power on, the parameters will be restored to the last saved settings.
SAuEd	Means"SAVED". Select a parameter which you want to save(P3-03 for example), and then press and hold SET key to save the parameter change.This change will save the parameter to the flash of servo drive.
buSY	When motor is rotating, parameters can not be saved. It will show "busy" when you attempt to save a parameter. Stop the motor before save a parameter.

5.3.4 Point to Point Move Function Display

LED Display	Description
P--CW.	P--CW shows that the motor is rotating at CW direction in point-to-point mode.
P-CCW.	P-CCW shows that the motor is rotating at CCW direction in point-to-point mode.

5.3.5 JOG Mode Display

LED Display	Description
J--CW.	J--CW shows that the motor is rotating at CW direction in JOG mode.
J-CCW.	J-CCW shows that the motor is rotating at CCW direction in JOG mode.

5.3.6 Pamameter Lock and Unlock

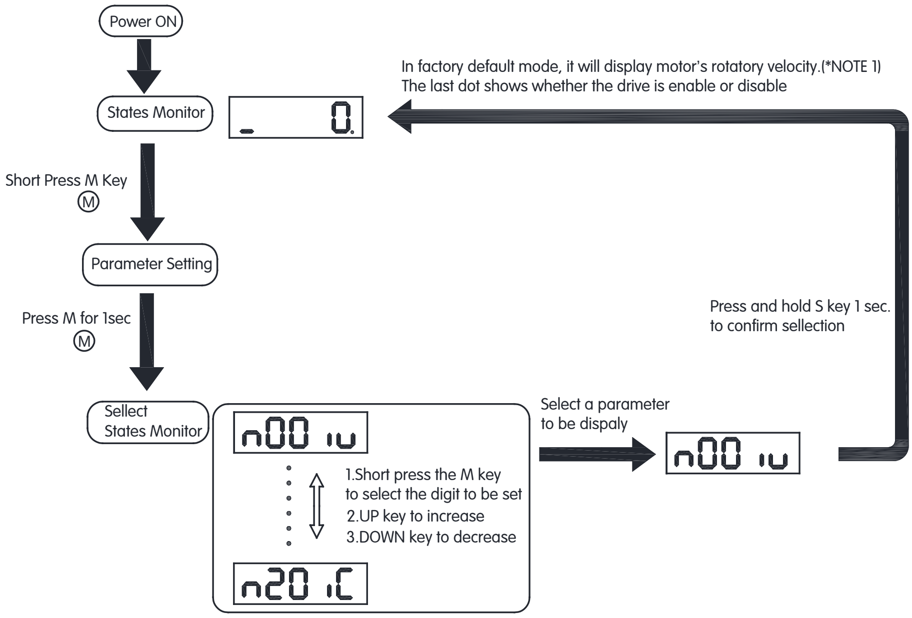
LED Display	Description
LCK	Indicates that the keys are locked. In the states display mode, long press means "SET". 1 second, you can lock the keys.
unLCK	When the keys are locked, long press means "SET" for 1 second, and the keys will be unlocked.

5.4 States Monitor Motor

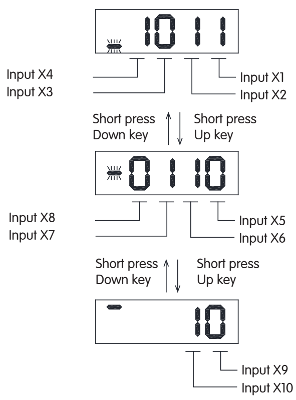
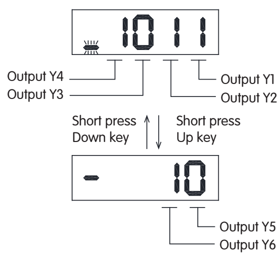
How to monitor the state of drive.

1. Press and hold M key to switch the display mode to States Monitor Selection Mode.
2. Short press the "UP" and "DOWN" keys to switch a parameter.
3. Press and hold S key 1 sec. to confirm selection.

The operation is as shown in the figure below



n-States	Display Symbol	Description	Unit	Display example
n-00		Motor Actual Speed	RPM	◆ Display "3000" rpm ◆ Display "3000" rpm
n-01		Position Error	Pulse	◆ Display -1234567890 Short press Down key / Short press Up key Short press Down key / Short press Up key
n-02		Pulses Input Counter	counts	
n-03		Encoder Feedback Counter	counts	
n-04		Position Command Counter	counts	
n-05		Drive Temperature	x 0.1℃	◆ Display "62.5" degree C
n-06		DC-Bus Voltage	x 0.1V	◆ Dispaly "315.7" VDC
n-07		Communications Address		◆ Dispaly "7 " Node-ID
n-08		Alarm History 1		◆ Display "r07" Alarm code
n-09		Alarm History 2		◆ Display "r07" Alarm code

n-States	Display Symbol	Description	Unit	Display example
n-10	n 10AH	Alarm History 3		◆ Display "r07" Alarm code - 7
n-11	n 11AH	Alarm History 4		◆ Display "r07" Alarm code - 7
n-12	n 12AH	Alarm History 5		◆ Display "r07" Alarm code - 7
n-13	n 13AH	Alarm History 6		◆ Display "r07" Alarm code - 7
n-14	n 14AH	Alarm History 7		◆ Display "r07" Alarm code - 7
n-15	n 15AH	Alarm History 8		◆ Display "r07" Alarm code - 7
n-16	n 16 iA	Analog Input 1	x 0.001V	◆ Display "8.211" V -8211
n-17	n 17 iA	Analog Input 2	x 0.001V	◆ Display "8.707" V -8707
n-18	n 18 in	Digital Inputs States		◆ Each 7-seg. digital LED indicates the innput state of a digital input: 1: The input state is CLOSED. 0: The input state is OPEN. 
n-19	n 19oU	Digital Outputs States		◆ Each 7-seg. digital LED indicates the output state of a digital input: 1: The output state is CLOSED. 0: The output state is OPEN. 
n-20	n20 iC	Torque Output percent	0.1%	◆ Torque Output is 72.5% - 725

NOTE:

CLOSED: If current is flowing into or out of an input or output, the logic state of that input is low or closed.

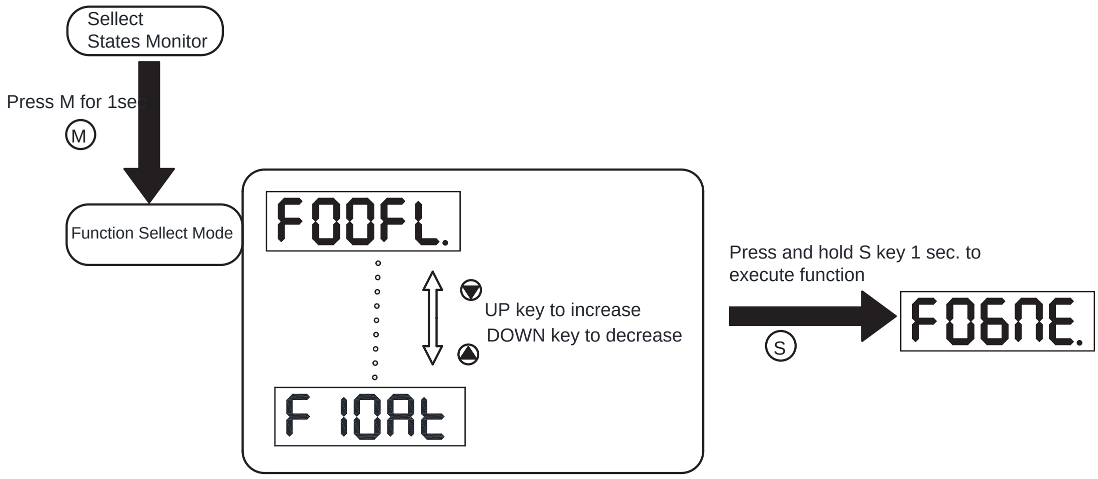
OPEN: If no current is flowing, or the input or output is not connected, the logic state is high or open.

5.5 Function Mode

In Function Mode(display F+ parameter number), you can select a funtion that needs to be execute.

1. Press and hold M key to switch the display mode to Function Mode.
2. Short press the "UP" and "DOWN" keys to select a function.
3. Press and hold S key 1 sec. to confirm or execute the selection.

The operation is as shown in the figure below

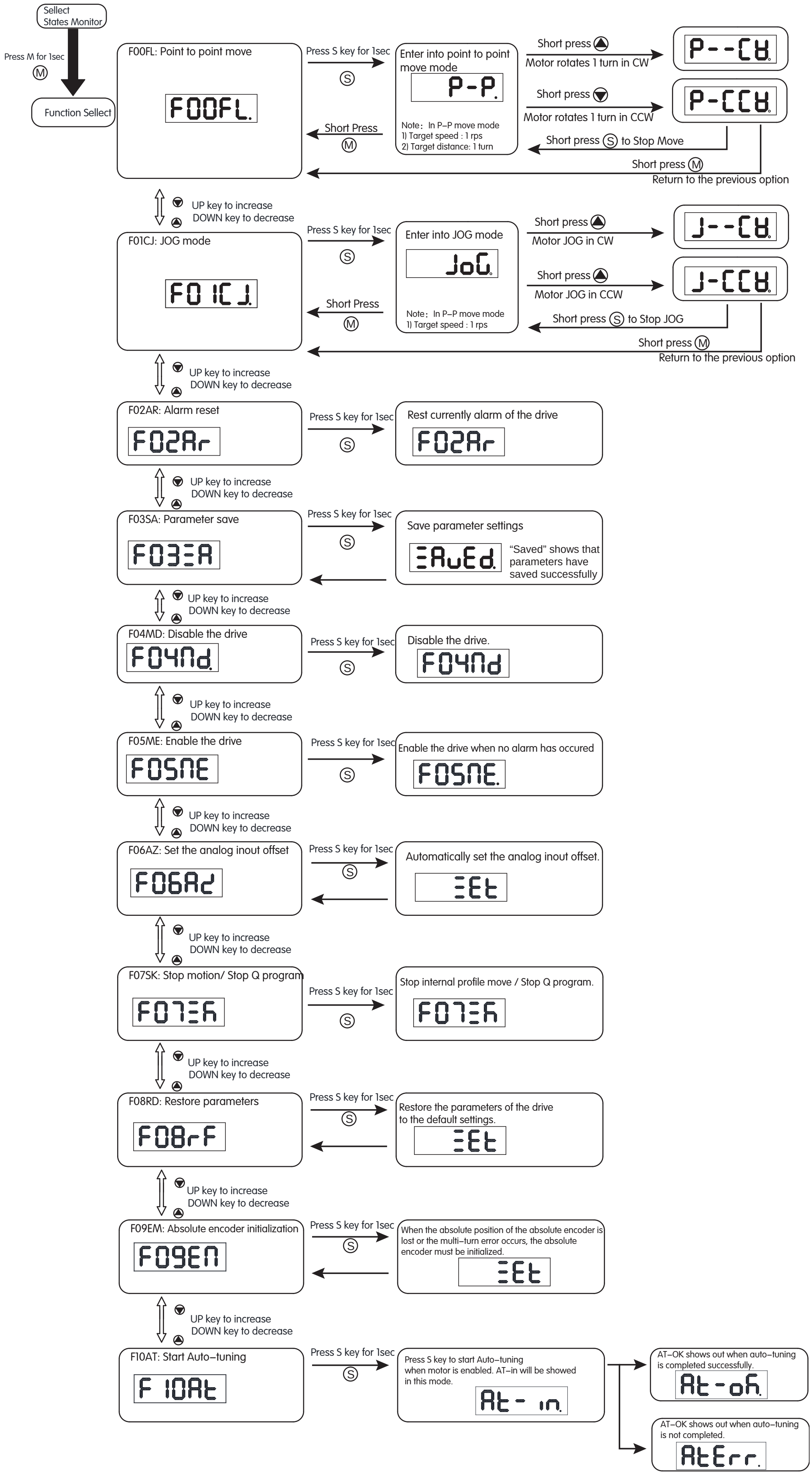


5.5.1 Functions

Executable functions are as follows

F-Functions	Display Symbol	Description
F00	F00FL	(F00FL) ---- Point to point move 1) Target speed: 1 rps 2) Target distance: 1 turn
F01	F01CJ	(F01CJ) ---- Run the motor with 1rps in JOG mode.
F02	F02Ar	(F02AR) ---- Alarm reset.
F03	F03SA	(F03SA) ---- Parameter save.
F04	F04Md	(F04MD) ---- Disable the drive.
F05	F05ME	(F05ME) ---- Enable the drive.
F06	F06Az	(F06AZ) ---- Automatically set the analog input offset
F07	F07SK	(F07SK) ---- Stop internal profile move / Stop Q program.
F08	F08rF	(F08ERF) ---- Restore the parameters of the drive to the default settings.
F09	F09EM	(F09EM) ---- Absolute encoder initialization.
F10	F10At	(F10AT) ---- Start Auto-tuning.

5.5.2 Operation Flow Chart in Function Mode



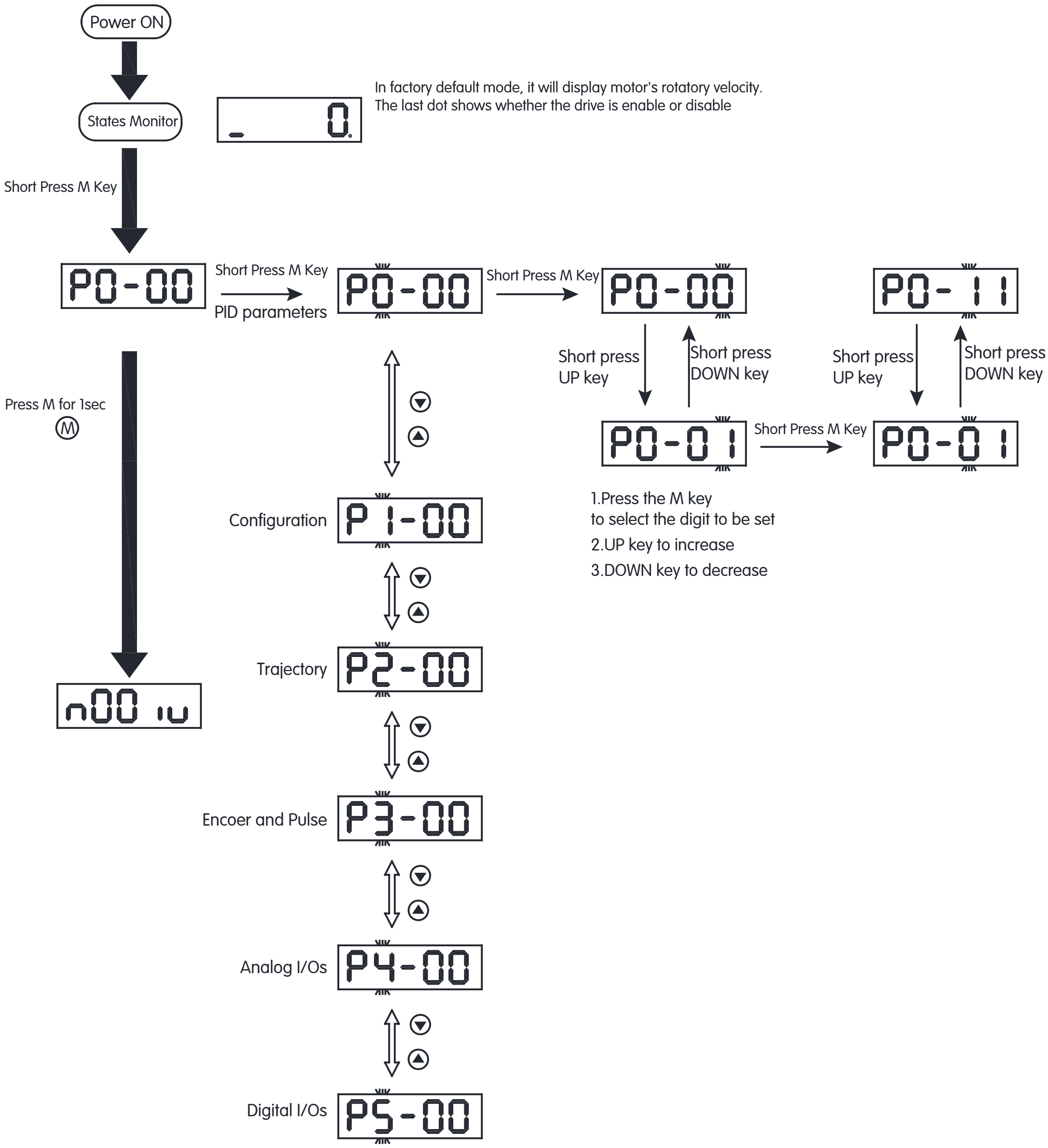
5.6 Parameter Setting Mode

5.6.1 How to Set parameters

In Parameter Setting Mode(display P+ parameter number), you can select a parameter that needs to be change.

1). Short press M key to switch the digit to be change

2). Short press the "UP" and "DOWN" keys to change the number



5.6.2 Parameter Edit and Save Example

A. Parameter Edt:

1) Short press M key to move the digit which needs to be change to high-order

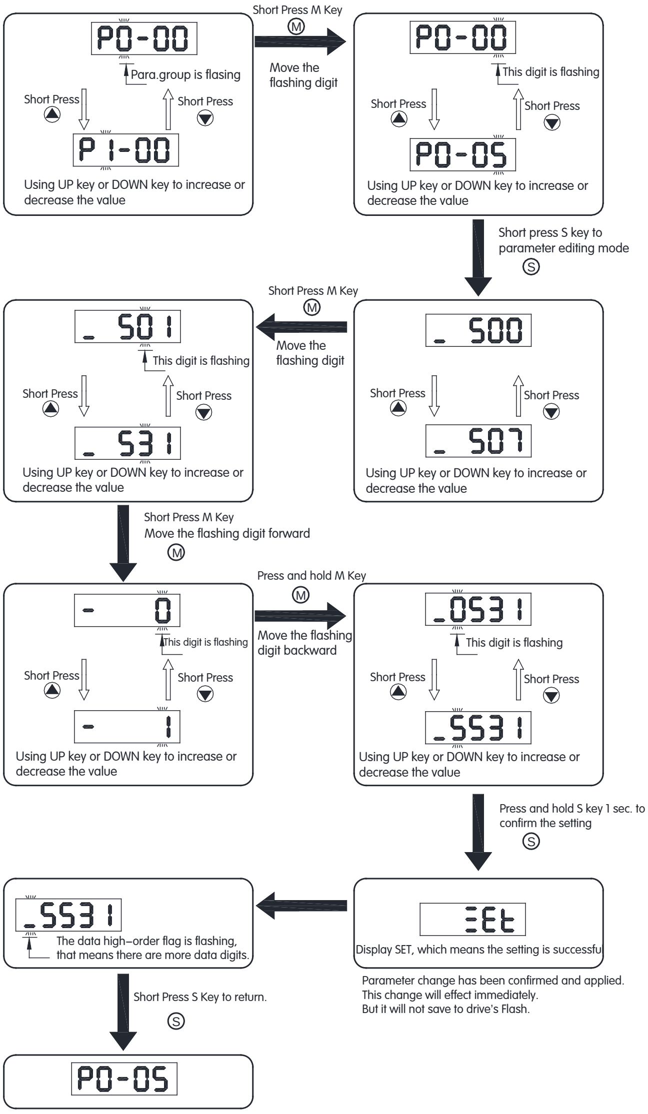
2) Press and hold M key for 1 second to move the digit which needs to be change to low-order.

3) Press UP key to increase

4) Press DOWN key to decrease

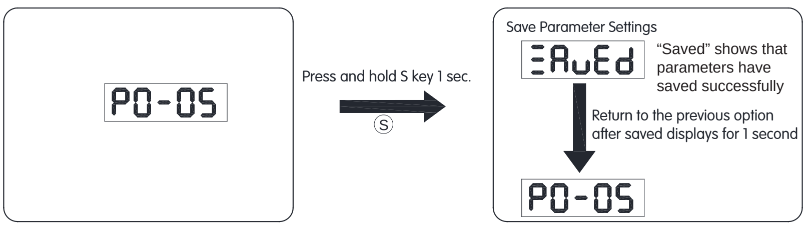
5) Press and hold M key for 1 second to save the changes.

Example: Change the value of parameter P0-05 to 15531.



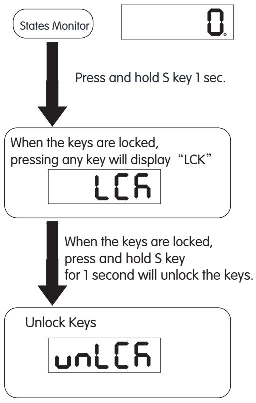
B Parameter Save

When parameter change has been confirmed and applied. This change will effect immediately. However, it will not save to drive's Flash. It means the value will be restored after next power cycle. If parameter is required for permanent use, follow the instruction bellow.



5.7 Key Lock

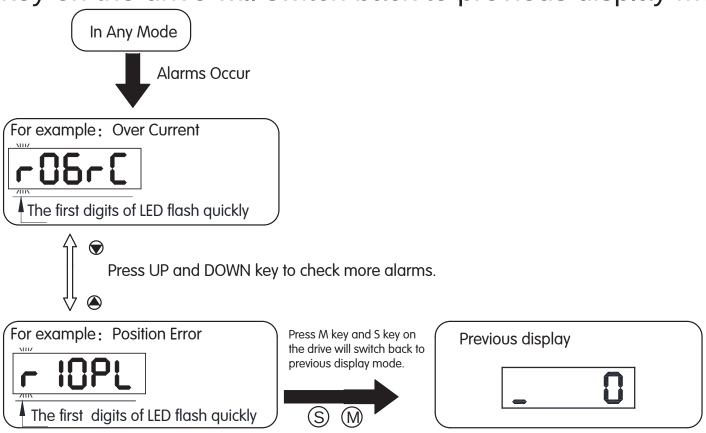
To prevent misoperation by people who are not familiar with the servo drive, a key lock function is provided. When the keys are locked, parameters can not be changed by operation panel.



5.8 Alarm Code Display

If any alarms are detected, the LED display on the drive will switch into alarm or fault display mode immediately.

- If the first digits of LED from right side flash quickly, it means there are more alarms. Press UP and DOWN key to check more.
- Press M key and S key on the drive will switch back to previous display mode.



Alarm codes

Alarm Code	Description	Alarm Type	Drive status after the alarm occurs
r01ot	Drive over temperature	Fault	Servo off
r02ur	Internal voltage error	Fault	Servo off
r03uH	Over-voltage	Fault	Servo off
r04HC	Over current	Fault	Servo off
r05LC	Over current	Fault	Servo off
r06rC	Over current	Fault	Servo off
r09Eb	Encoder feedback error	Fault	Servo off
r 10PL	Position following error	Fault	Servo off
r 11Lu	Low voltage	Fault	Servo off

Alarm Code	Description	Alarm Type	Drive status after the alarm occurs
r12ou	Over speed	Fault	Servo off
r13Lt	Limit switch trigger alarm	Warning	Does not change the current state
r14LL	Negative limit alarm	Warning	Does not change the current state, the motor cannot rotate negatively.
r15JL	Positive limit alarm	Warning	Does not change the current state, the motor cannot rotate positively.
r16CL	Current limit	Warning	Does not change the current state
r17CE	Communication error	Warning	Does not change the current state
r18≡F	Parameter save failed	Warning	Does not change the current state
r19LP	Phase loss of main circuit	Fault	Servo off
r20to	STO is triggered	Warning	Servo off
r21rF	Regeneration failed	Fault	Servo off
r22uV	Undervoltage warning	Warning	Does not change the current state
r23qE	No Q program warning	Warning	Does not change the current state
r24dd	Motion command received while motor disable	Warning	Does not change the current state
r25ur	Internal voltage error	Fault	Servo off
r26ur		Fault	Servo off
r27E≡	Emergency Stopped	Warning	Motor decelerates to stop
r28FP	Full-closed loop hybrid deviation excess error	Fault	Servo off
r29FE	External encoder error	Fault	Servo off
r30nE	Memory error	Fault	Servo off
r31bt	Absolute encoder battery undervoltage	Warning	Does not change the current state
r32AP	Absolute position lost	Warning	Does not change the current state
r33oP	Absolute position overflow	Warning	Does not change the current state
r34Mt	Motor over temperature	Fault	Servo off
r35Ct	Drive MCU over temperature	Fault	Servo off
r36Mr	Absolute encoder multi-turn error	Fault	Servo off
r37≡t	Motor stalled	Fault	Servo off
r39Hr	Homing parameters configuration error	Warning	Does not change the current state
r40Hi	Motor collision alarm	Fault	Servo off
r41Er	Encoer Communications error	Fault	Servo off
r42io	Wrong configuration of I/O function in Q mode	Warning	Does not change the current state

6 Trial Operatio

Remove the load from the servo motor, including coupling on the shaft before trail operation.

6.1 Inspection Before Trail Operation

To ensure the safety of servo drive and mechanical, it is strongly recommended to check the followings before the drive power on.

1) Wiring Inspection

Check the power input terminal P1,the motor power output P2, the encoder input C3 are correctly wired, firmed, without short-circuit and well ground.

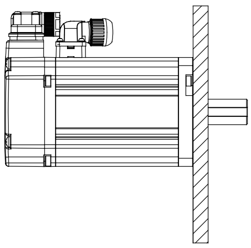
2) Power Supply Voltage Check

Check the input voltage meets the specification of the drive, both L1/L2/L3 and L1C/L2C.

3) Ensure the motor and drive are installed firmly

4) Operate the motor without load.

6.2 Steps of Trail Operation

Steps	Details	Description
1	Install the motor firmly. 	1) Servo motor can be installed on the machine. 2) Do not connect the load to the servo motor in trail operation.
2	Check the connection between the motor and the drive.	1) Motor U, V, W must correspond to the red, yellow, and blue of the lead wires. PE corresponds to yellow-green. Wrong connection will make the motor run abnormally. 2) Confirm the motor encoder is correctly connected to CN3
3	Check that the power circuit is connected correctly	Refer to Chapter 4.2 Main Power Supply Input to confirm whether the power input circuit is correct.
4	Switch on the Power	Do not input 380VAC.
5	Normally, it will display  If alarms occur,it will display 	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 Chapter 4.6 Wiring to Motor Holding Brake
7	JOG mode operation	If there is no abnormality in the above steps, you can start a trial operation in JOG mode

6.3 JOG Operation

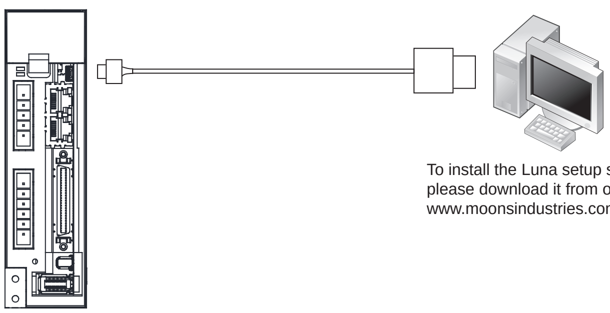
Steps	LED Display	Description
1	F00FL	Press and Hold M key to Function Mode.
2	F05ME	Use UP and DOWN key to select F05ME function. This function could enable the drive.
3	F05ME.	Press and hold S key, when the decimal point in the lower right corner of the LED panel is solid, that means the driver is enabled.
4	F01CJ.	Use UP and DOWN key to select F01CJ function.
5	JoG.	Short press S key to JOG mode.
6	J--CW.	Short press UP key, the motor rotates positive in 1 rps.
7	or J-CCW.	Short press UP key, the motor rotates positive in 1 rps.
8	JoG.	Short press S key to stop JOG move.
9	F01CJ.	Short press M key back to Function mode.
10	F04MD	Select F04MD and hold S key for 1second, the motor will be disabled.

6.4 Configuration by Personal Computer

In order to ensure servo drive and motor meet your operation requirements, we strongly recommend customers to use "Luna Software" for following configuration setups:

1. Configure encoder usage mode
2. Define drive's input/output mode
3. Apply auto tuning function on PID parameters for optimized motor performance

Connection method



To install the Luna setup software, please download it from our website www.moonsindustries.com/

Luna's detail, please refer to the software manual.

7 Operation Mode and Functions

7.1 Input and Output Signal Settings

The input and output signals have pre-assigned functions, which can also be changed to other functions, including changing the input/output logic state, Functions and logic state can be changed by parameters as follows.

7.1.1 Input Signal Settings

7.1.1.1 Assignable Functions of Input Signal

Assignable functions and input logic state list as follows. Parameters P5-00 to P5-09 define the functions of digital inputs X1 to X10. The function of digital input can be set by writing the corresponding values of the functions in the table below into the parameters.

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
Control Mode Select	CM-SEL	9	10
Gain Select	GAIN-SEL	11	12
Emergency Stop	E-STOP	13	14
Start Homing	S-HOM	15	16
Position Error Clear	C-CLR	17	18
Torque Limit	TQ-LMT	19	20
Zero Speed Clamp	ZCLAMP	21	22
Pulse Input Inhibit	INHP	25	26
Internal Speed Select 1	SPD1	27	28
Internal Speed Select 2	SPD2	29	30
Internal Speed Select 3	SPD3	31	32
Torque and Velocity Control	SP-STA	33	34
Torque and Velocity Direction Switch	SPD-DIR	35	36
Speed Limit Select	V-LMT	37	38
Home Switch	HOM-SW	39	40
Start Q Program	START-Q	45	46

The output logic state of the pin is as follows:

CLOSED: If current is flowing into or out of an output, the logic state of that output is low or closed.

OPEN: If no current is flowing, or the output is not connected, the logic state is high or open.

7.1.1.2 Input Signal Default Setting (50pin High-Density Connectors)

There are 10 digital inputs in 50pin high-density type drive. Default settings of X1 to X10 are as follows.

					Default Settings		
CN2-Pin NO.	Input NO.	Signal Description	Parameter	Command	Signal Symbol	Input Logic	Setup Value
8	X1	Digital Input 1	P5-00	MU1	CCW-LMT	Closed	7
9	X2	Digital Input 2	P5-01	MU2	CW-LMT	Closed	5
26	X3	Digital Input 3	P5-02	MU3	A-CLR	Closed	3
27	X4	Digital Input 4	P5-03	MU4	S-ON	Closed	1
28	X5	Digital Input 5	P5-04	MU5	E-STOP	Closed	13
29	X6	Digital Input 6	P5-05	MU6	CM-SEL	Closed	9
30	X7	Digital Input 7	P5-06	MU7	GPIN	Closed	0
31	X8	Digital Input 8	P5-07	MU8	GPIN	Closed	0
32	X9	Digital Input 9	P5-08	MU9	GPIN	Closed	0
33	X10	Digital Input 10	P5-09	MUA	GPIN	Closed	0
7	XCOM	COM port for digital input	-	-	X input COM port		

7.1.1.3 Input Signal Default Setting (26pin quick plug connectors)

There are 4 digital inputs in 26pin quick plug connectors drive type drive only. Default settings of X1 to X4 are as follows.

					Default Settings		
CN2-Pin NO.	Input NO.	Signal Description	Parameter	Command	Signal Symbol	Input Logic	Setup Value
22	X1	Digital Input 1	P5-00	MU1	CCW-LMT	Closed	7
21	X2	Digital Input 2	P5-01	MU2	CW-LMT	Closed	5
20	X3	Digital Input 3	P5-02	MU3	A-CLR	Closed	3
19	X4	Digital Input 4	P5-03	MU4	S-ON	Closed	1
18	XCOM	COM port for digital input			X1,X2,X3,X4 input COM port		

7.1.2 Output Signal Settings

7.1.2.1 Assignable Functions of Output Signal

Assignable functions and output logic state list as follows.Parameters P5-12 ~ P5-17 define the functions of digital outputs Y1 to Y6. The function of digital output can be set by writing the corresponding values of the functions in the table below into above parameters.

Signal Functions	Symbol	Output logic state and set value when the output signal is valid	
		Closed	Open
General Purpose Output	GPOUT	0	
Fault Output	FLT	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 Postion Output	DYM-LMT	11	12
Torque Reach Output	TQ-REACH	13	14
Torque Limit Output	T-LMT	15	16
Velocity Coincidence Output	V-COIN	17	18
Velocity Reach Output	AT-SPD	19	20
Velocity Limit Outout	V-LMT	21	22
Servo Ready Output	S-RDY	23	24
Homing Finished Output	HOMED	25	26
Soft Limit CW	SLCW	27	28
Soft Limit CCW	SLCCW	29	30
Near Target Position Output	P-COIN	31	32
Zero Speed Detected	Z-SPD	33	34
Torque Coincidence Output	T-COIN	35	36

The output logic state of the pin is as follows:

CLOSED: If current is flowing into or out of an output, the logic state of that output is low or closed.

OPEN: If no current is flowing, or the output is not connected, the logic state is high or open.

7.1.2.2 Output Signal Default Setting(50pin High-Density Type)

There are 6 digital outputs. Default settings of Y1 to Y6 are as follows.

					Default Settings		
CN2-Pin NO.	Input NO.	Signal Description	Parameter	Command	Signal Symbol	Input Logic	Setup Value
11	Y1+	Digital Output 1+	P5-12	MO1	SON-ST	Closed	7
10	Y1-	Digital Output 1-					
35	Y2+	Digital Output 2+	P5-13	MO2	S-RDY	Closed	23
34	Y2-	Digital Output 2-					
37	Y3+	Digital Output 3+	P5-14	MO3	FLT	Closed	1
36	Y3-	Digital Output 3-					
39	Y4+	Digital Output 4+	P5-15	MO4	IN-POS	Closed	9
38	Y4-	Digital Output 4-					
12	Y5	Digital Output 5	P5-16	MO5	HOMED	Closed	25
40	Y6	Digital Output 6	P5-17	MO6	T-LMT	Closed	15
41	YCOM	COM port for digital output	-		Y5,Y6 output COM port		

7.1.3 Servo On Setting

Set the digital input for controlling the motor enable or disable.In the default setting, the servo-on input signal is set by follows.

<table>
<tr><th>Signal Symbol</th><th>Input NO.</th><th>CN2-Pin NO</th><th>Parameter</th><th>Command</th><th>Setup Value</th><th>Description</th><th colspan="4">Control Mode</th></tr>
<tr><td rowspan="2">S-ON</td><td>X4</td><td>27</td><td rowspan="2">P5-03</td><td rowspan="2">MU4</td><td rowspan="2">1</td><td rowspan="2">Set the digital input for controlling the motor enable or disable.</td><td rowspan="2">P</td><td rowspan="2">V</td><td rowspan="2">T</td><td rowspan="2">F</td></tr>
<tr><td>XCOM</td><td>7</td></tr>
</table>

Signal logic state:

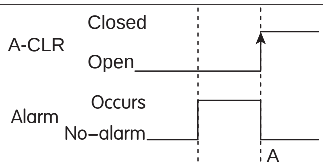
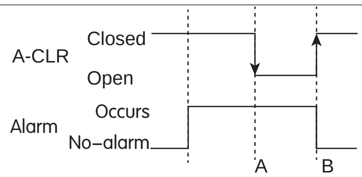
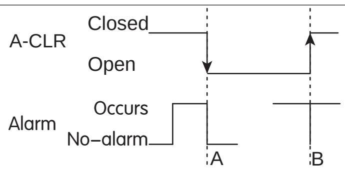
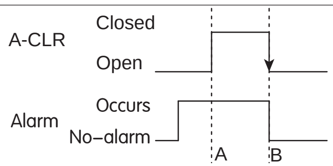
Setup Value	Signal Logic	Function
1	Closed	When the input logic state is CLOSED, the drive will be enabled.
2	Open	When the input logic state is OPEN, the drive will be enabled.

7.1.4 Alarm Reset

Set digital input to clear abnormal warning or fault of the drive and reset the drive to pre-operation. In the default setting, the alarm clear signal is set by the following table.

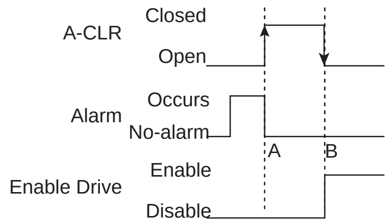
<table>
<tr><th>Signal Symbol</th><th>Input NO.</th><th>CN2-Pin NO</th><th>Parameter</th><th>Command</th><th>Setup Value</th><th>Description</th><th colspan="4">Control Mode</th></tr>
<tr><td rowspan="2">A-CLR</td><td>X3</td><td>26</td><td rowspan="2">P5-02</td><td rowspan="2">MU3</td><td rowspan="2">3</td><td rowspan="2">Clear abnormal warning or alarm of the drive and reset the drive to pre-operation</td><td rowspan="2">P</td><td rowspan="2">V</td><td rowspan="2">T</td><td rowspan="2">F</td></tr>
<tr><td>XCOM</td><td>7</td></tr>
</table>

Signal Input Logic State

<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 all digital inputs of the drive are not configured with the "Servo Enable" function, "Alarm Reset" can be used to enable the drive, as shown below:



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.

7.1.5 CW, CCW Limit

In order to prevent the movable part of the machine from exceeding the travel range and avoid accidents, it is necessary to set up limit switches or sensors.

In the default setting, the CW/CCW Limit is set by the followings.

Signal Symbol	Input NO.	CN2-Pin NO	Parameter	Command	Setup Value	Description	Control Mode			
CCW-LMT	X1	8	P5-00	MU1	7	Motor negative direction limit input	P	V	T	F
	XCOM	7								
CW-LMT	X2	9	P5-01	MU2	5	Motor positive direction limit input				
	XCOM	7								

Signal Input Logic State:

Input Type	Signal Symbol	Setup Value	Input Logic	Description
Input	CCW-LMT	7	Closed	When the input state is CLOSED, the drive shows a Negative Limit alrm, motor cannot be continoed rotate at negetive direction.
		8	Open	When the input state is OPEN, the drive shows a Negative Limit alrm, motor cannot be continoed rotate at negetive direction.
	CW-LMT	5	Closed	When the input state is CLOSED, the drive shows a Positive Limit alrm, motor cannot be continoed rotate at positve direction.
		6	Open	When the input state is OPEN, the drive shows a Positive Limit alrm, motor cannot be continoed rotate at positive direction.

7.1.6 Gain Select(Gain Switch)

Use the Gain Select function to meet different loads.

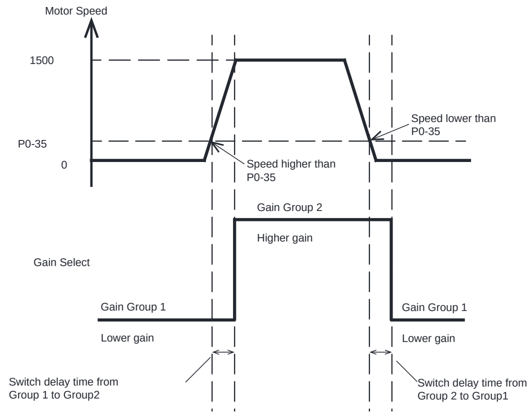
1) Increase gain can decrease and suppress vibration when doing position control.

2) Reduce the gain can decrease the setting time when motor is stopping.

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

For example:

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



1) Gain Switch Related Parameters

Parameter	Command	Description	Class	Default Value	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 Velocity Loop Integral Time Constant		189	ms
P0-16	KC	1st Torque Command Filter		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 Filter		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 Torque Command Filter		1099	0.1Hz
P0-25	XP	Full Closed-loop Position Loop Gain	Full Closed-loop Gain Group	52	0.1Hz
P0-27	XD	Full Closed-loop Position Loop Derivative Time Constant		0	ms
P0-28	XE	Full Closed-loop Position Loop Derivative Filter		20000	0.1Hz
P0-29	XF	Full Closed-loop Velocity Command Gain		10000	0.01%
P0-30	XV	Full Closed-loop-Velocity Loop Gain		183	0.1Hz
P0-31	XG	Full Closed-loop Velocity Loop Integral Time Constant		189	ms
P0-32	XC	Full Closed-loop Torque Command Filter		1099	0.1Hz
P0-33	SD	Automatic Gain Swiching Method	-	0	-
P0-34	PN	Gain Switch with Position Error Condition Change	-	0	counts
P0-35	VN	Gain Switch with Actual Speed Condition Change	-	0	0.025rps
P0-36	TN	Gain Switch with Actual Torque Condition Change	-	10	0.1%
P0-37	SE1	Gain Switching Delay Time 1	-	10	ms
P0-38	SE2	Gain Switching Delay Time 2	-	10	ms

2) Gain switching method

Gain switching can be done using:

A. External input signal B. Automatic gain switching.

3) External input signal switching

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

Signal Type	Signal Symbol	Setup Value	Input Logic	Description
Input	GAIN-SEL	11	Closed	The default is that the 1st Gain Group takes effect. 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.

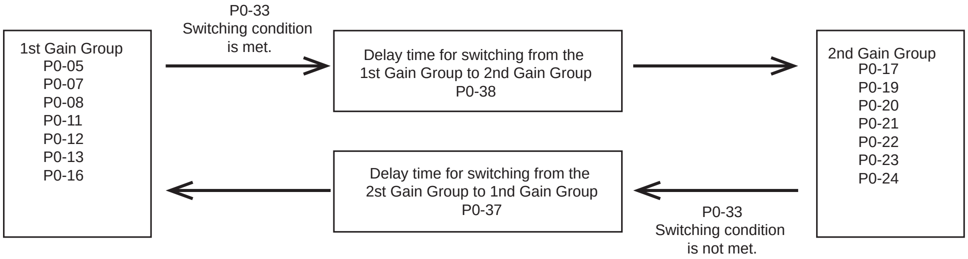
NOTE:

- When in full closed-loo control mode, the gain is switched between Full Closed-loop Gain Group(P0-25 ~ P0-32) and 2nd Gain Grpup(P0-17 ~ P0-24).
- Automactic gain switching is invalid when the gain switching method is set to external input switching, the GAIN-SEL. That means no matter how P0-33 is set, the gain switching determined by the external input signal.

4) Automatic Gain Switch

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

Parameter	Setup Value	Conditions	Swithing 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

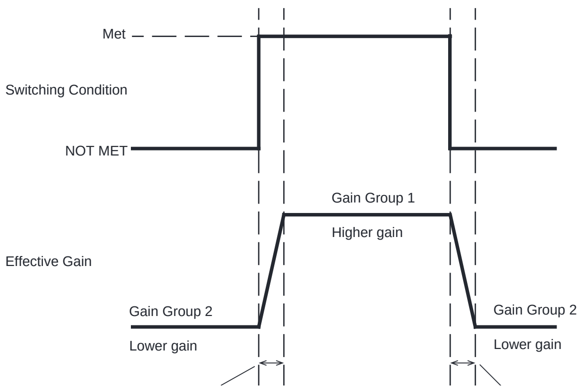


5) Gain Switch Delay Time

To avoid jitter caused by immediate gain switch, when switch condition is not 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 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 Control Mode Select

In addition to position control, velocity control, and torque control, M56S series can also combine two control modes and switch these two modes. Switch the current control mode to another one by using external input signal which is called CM-SEL.

1) Control Mode Select Related Parameters

The control mode is set by parameters P1-00 and P1-01.

Parameter	Command	Description	Default Setting
P1-00	CM	Main Control Mode	7
P1-01	CN	Second Control Mode	21

2) Control Modes

The control modes that can be switched are as follows。

Setting Value	Control Mode	Reference Command	Descriptions
1	Command torque mode	SCL Command	Use SCL command to control the output torque
2	Analog torque mode	+10~-10V analog input	Use external analog for torque control, the output torque of the motor is linear with the analog input value.
7	Digital pulse position mode	Pulse&Direction CW/CCW A/B quard.	External digital pulse signal control
11	Analog velocity mode	+10~-10V analog input	Use external analog for speed control, the output speed of the motor is linear with the analog input value.
15	Internal velocity mode	Digital Inputs	Use digital input to control the speed of the motor, the target speed of the motor has been preset.
21	Internal position mode	Communication Command	Use Modbus and Q programming for point-to-point position mode control

3) Switchable Control Modes

Control Mode	P1-00	P1-01
Pulse position < ==== > Internal velocity	7	15
Pulse position < ==== > Analog velocity	7	11
Pulse position < ==== > Analog torque	7	2
Pulse position < ==== > Command torque	7	1
Analog velocity < ==== > Analog torque	11	2
Analog velocity < ==== > Command torque	11	1
Internal velocity < ==== > Analog velocity	15	11
Internal velocity < ==== > Analog torque	15	2
Internal velocity < ==== > Command torque	15	1

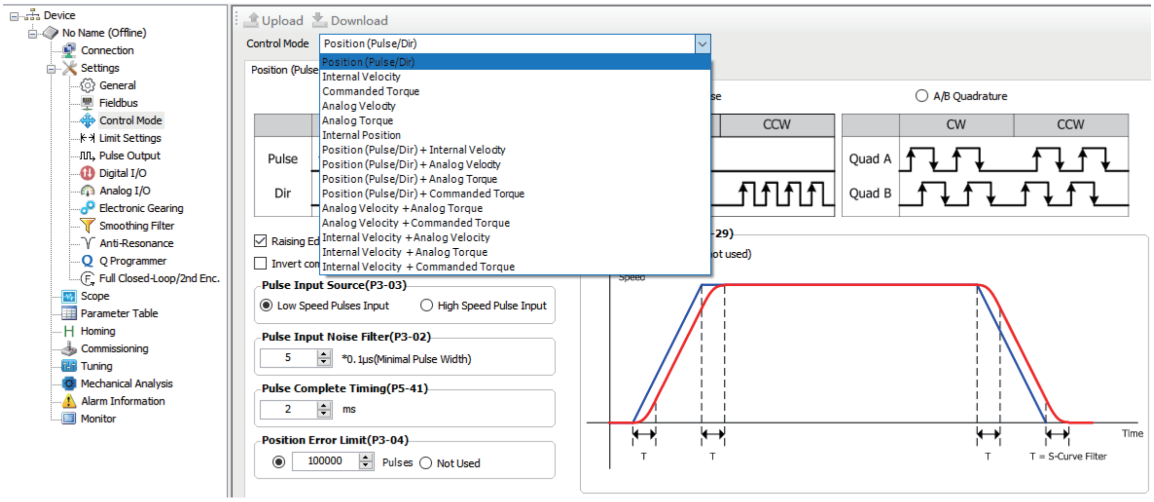
4) Control Mode Switch Input Signal Setting

When using the control mode switching function, configuration is required in all control modes, and the input logic must be consistent. If it is not configured correctly, the switching function cannot work.

Signal Symbol	Input NO.	CN2-Pin NO	Parameter	Command	Setup Value	Signal Logic	Description	Control Mode			
CM-SEL	X6	29	P5-05	MU6	9	Closed	Main control mode--->Second control mode	P	V	T	F
	XCOM	7				Open	Second control mode--->Main control mode				

◆ **How to set by using Luna software**

Directly select the desired control mode in control mode page.



7.1.8 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 the digital input when using emergency stop function.

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

Signal Type	Signal Symbol	Setup Value	Signal Logic	Instructions
Input	E-STOP	13	Closed	When E-STOP inputs is CLOSED, the motor is emergency stopped. When E-STOP inputs is OPEN, the motor runs normally.
		14	Open	When E-STOP inputs is CLOSED, the motor runs normally. When E-STOP inputs is OPEN, the motor is emergency stopped.

Under default settings, the servo emergency stop signal is set in the table below.

Signal Symbol	Input NO.	CN2-Pin NO	Parameter	Command	Setup Value	Signal Logic	Description	Control Mode			
E-STOP	X5	28	P5-04	MU5	13	Closed	Motor emergency stop.	P	V	T	F
	XCOM	7				Open	motor runs normally.				

7.1.9 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 ~ P5-17 set the function of the digital output Y1 ~ Y6 of the drive.

Signal Type	Signal Symbol	Setup Value	Signal Logic	Instructions
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 is occurred.

LED Display	Description	Alarm Type	Drive status after the alarm occurs		LED Display	Description	Alarm Type	Drive status after the alarm occurs
r01ot	Drive over temperature	Fault	Servo off		r25ur	Internal voltage error	Fault	Servo off
r02ur	Internal voltage error	Fault	Servo off		r26ur		Fault	Servo off
r03uH	Over-voltage	Fault	Servo off		r28FP	Full-closed loop position following error	Fault	Servo off
r04HC	Over current	Fault	Servo off		r29FE	External encoder error	Fault	Servo off
r05LC		Fault	Servo off		r30nE	Memory error	Fault	Servo off
r06rC		Fault	Servo off		r34nt	Motor over temperature	Fault	Servo off
r09Eb	Encoder feedback error	Fault	Servo off		r35Ct	Drive MCU over temperature	Fault	Servo off
r10PL	Position following error	Fault	Servo off		r36nr	Absolute encoder multi-turn error	Fault	Servo off
r11Lu	Low voltage	Fault	Servo off		r37Et	Motor stalled	Fault	Servo off
r12ou	Over speed	Fault	Servo off		r40H1	Motor collision alarm	Fault	Servo off
r19LP	Phase loss of main circuit	Fault	Servo off		r41Er	Encoer Communications error	Fault	Servo off
r21rF	Regeneration failed	Fault	Servo off					

Under default settings, the servo emergency stop signal is set in the table below.

Signal Symbol	Output NO.	CN2-Pin NO	Parameter	Command	Setup Value	Signal Logic	Description	Control Mode			
FLT	Y3+	37	P5-14	MO3	1	Closed	The drive has a fault.	P	V	T	F
	Y3-	36				Open	The drive is in normal state and no fault is occurred.				

7.1.10 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 ~ Y6 of the drive.

Signal Type	Signal Symbol	Setup Value	Signal Logic	Instructions
Output	WARN	3	Closed	When the output is CLOSED, it means that the drive has a warning.
			Open	When the output is OPEN, it means the drive is in normal state and no warning is occurred.
		4	Open	When the output is OPEN, it means that the drive has a warning.
			Closed	When the output is CLOSED, it means the drive is in normal state and no warning is occurred.

LED Display	Description	Alarm Type	Drive status after the alarm occurs
r 13Lt	Limit switch trigger alarm	Warning	Does not change the current state
r 14LL	Negative limit alarm	Warning	Does not change the current state, the motor cannot rotate negative.
r 15JL	Positive limit alarm	Warning	Does not change the current state, the motor cannot rotate positive.
r 16CL	Current limit	Warning	Does not change the current state
r 17CE	Communication error	Warning	Does not change the current state
r 18SF	Parameter save failed	Warning	Does not change the current state
r20to	STO is triggered	Warning	Servo off
r22uV	Under-voltage warning	Warning	Does not change the current state
r23QE	No Q program warning	Warning	Does not change the current state
r24dd	Motion command received while motor disable	Warning	Does not change the current state
r27ES	Emergency Stopped	Warning	Motor decelerates to stop
r3 1bt	Absolute encoder battery undervoltage	Warning	Does not change the current state
r32AP	Absolute position lost	Warning	Does not change the current state
r33oP	Absolute position overflow	Warning	Does not change the current state
r39Hr	Homing parameters configuration error	Warning	Does not change the current state
r42 io	Wrong configuration of I/O function in Q mode	Warning	Does not change the current state

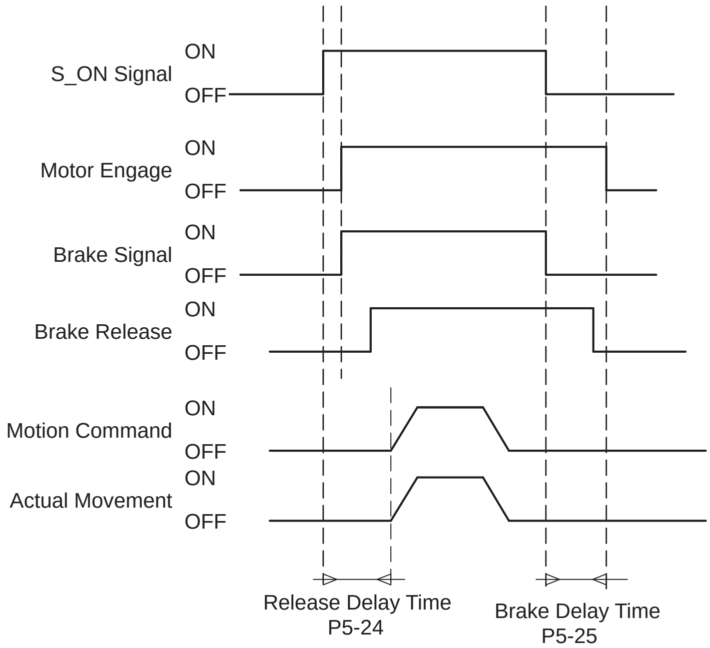
7.1.11 Motor Brake Release Control

The motor brake is used to hold the shaft not rotating when the motor is diabled or power off. When motor drives the vertical axis, brake is be used to hold and prevent the work (moving load) from falling by gravity while the power or servo is shut off.

When controlling a servo motor with brake, a digital output of the servo drive must be configured as a BRK function.

Signal 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 noticed to avoid damage to brake.



The release delay and brake delay time can be set using Luna software. Or set by parameter P5-24 and parameter P5-25.

Note: For more precautions, refer to Chapter 4.6 Wiring to the Motor Holding Brake.

7.1.12 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.

Signal Type	Signal Symbol	Setup Value	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.

By default, the Servo Ready signal is set in the table below.

Signal Symbol	Output NO.	CN2-Pin NO	Parameter	Command	Setup Value	Signal Logic	Description	Control Mode			
S-RDY	Y2+	35	P5-13	MO2	23	Closed	The servo is ready for operation	P	V	T	F
	Y2-	34				Open	The servo is not ready for operation				

7.1.13 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.

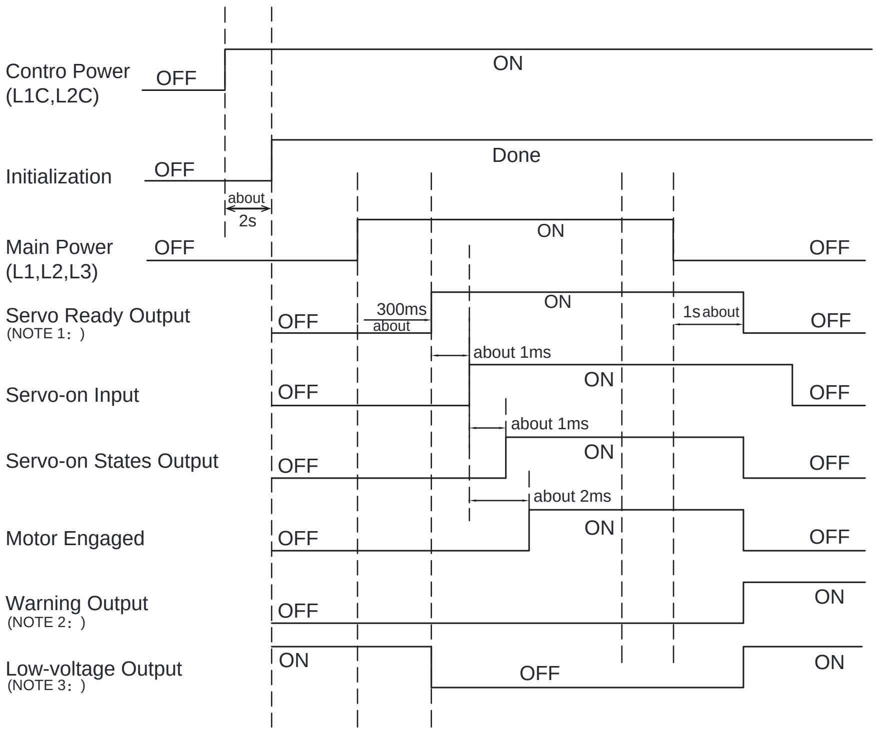
Parameters P5-12 ~ P5-17 set the function of the digital output Y1 ~ Y6 of the drive.

Signal Type	Signal Symbol	Setup Value	Signal Logic	Instructions
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.

Under default settings, the servo emergency stop signal is set in the table below.

Signal Symbol	Output NO.	CN2-Pin NO	Parameter	Command	Setup Value	Signal Logic	Description	Control Mode			
SON-ST	Y1+	11	P5-12	MO1	7	Closed	The servo is enabled.	P	V	T	F
	Y1-	10				Open	The servo is not enabled.				

The sequence diagram is as follows:

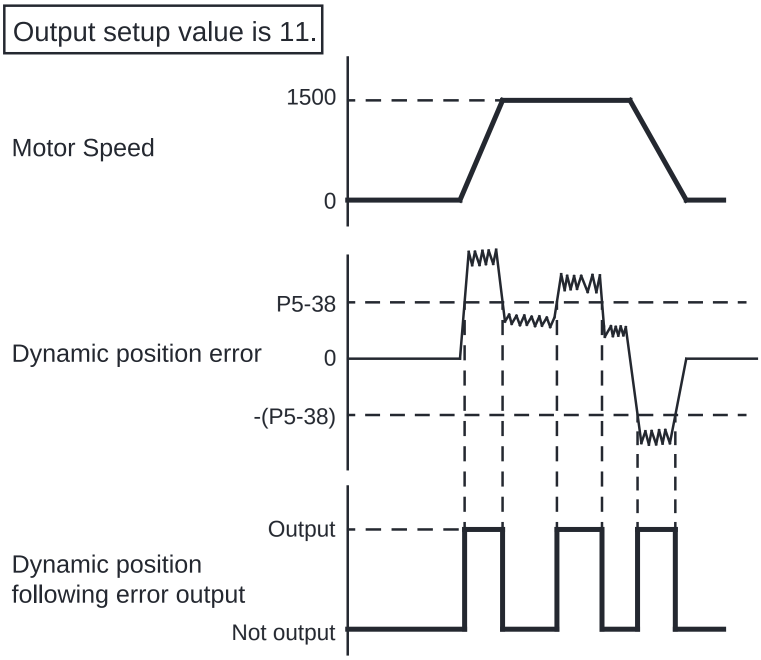


Note 1: When main power is cut off, it may take 1s or longer to stop outputting the Servo Ready signal due to the capacitor in the drive.
Note 2: If cut off main power input when the drive is enabled, possible alarms may occur as following, under-voltage alarm(Warning), low-voltage alarm(Fault), position 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.

7.1.14 Dynamic Position Output

Dynamic position following error output refers to the output of this signal when the difference between the motor actual position and the command position is greater than P5-38 Dynamic Follow Error Threshold during the motor is rotating.

The following figure shows that the dynamic following error exceeds the setting of P5-38, the DYM-LMT signal outputs.



Signal Type	Signal Symbol	Setup Value	Signal Logic	Instructions
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.

7.1.15 Rotation Limit Output

Rotation limit output refers to this output when the limit sensor of current rotation direction is touched or triggered when the motor is rotating, and the motor cannot continue to rotate in the same direction.

There are two outputs of this function.

1) Forward rotation limit SLCW

2) Negative rotation limit SLCCW

Signal Type	Signal Symbol	Setup Value	Signal Logic	Instructions
Output	SLCW	27	Closed	Motor cannot rotate forward when the forward rotation limit switch is triggered, SLCW signal is output and the output state is CLOSED.
			Open	Motor rotates forward notmally when the forward rotation limit switch is NOT triggered. SLCW signal will NOT output and the output state is OPEN.
		28	Open	Motor cannot rotate forward when the forward rotation limit switch is triggered. SLCW signal will NOT output and the output state is OPEN.
			Closed	Motor rotates forward notmally when the forward rotation limit switch is NOT triggered. SLCW signal is output and the output state is CLOSED.
Output	SLCCW	29	Closed	Motor cannot rotate forward when the forward rotation limit switch is triggered, SLCCW signal is output and the output state is CLOSED.
			Open	Motor rotates forward notmally when the forward rotation limit switch is NOT triggered. SLCCW signal will NOT output and the output state is OPEN.
		30	Open	Motor cannot rotate forward when the forward rotation limit switch is triggered. SLCCW signal will NOT output and the output state is OPEN.
			Closed	Motor rotates forward notmally when the forward rotation limit switch is NOT triggered. SLCCW signal is output and the output state is CLOSED.

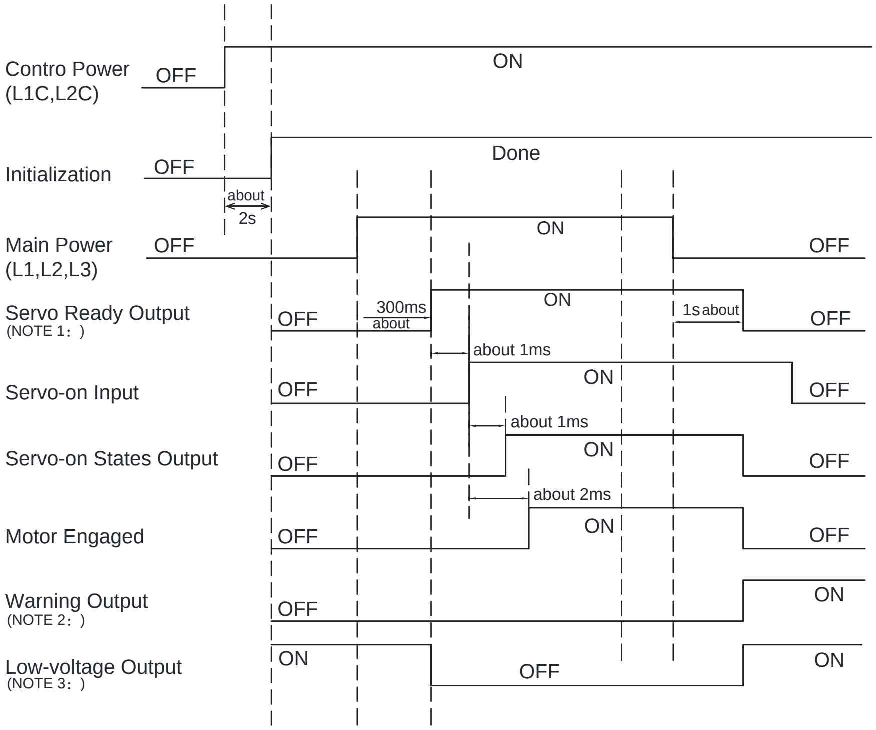
In the absolute encoder servo system, when any of the following conditions are met, the rotation limit signal will be output.

1) Limit signal of digital inputs

2) Software limit set by parameter P5-47(Software positive limit) and P5-48(Software negetive limit)

7.1.16 Sequence diagram

7.1.16.1 Sequence Diagram When Power-on

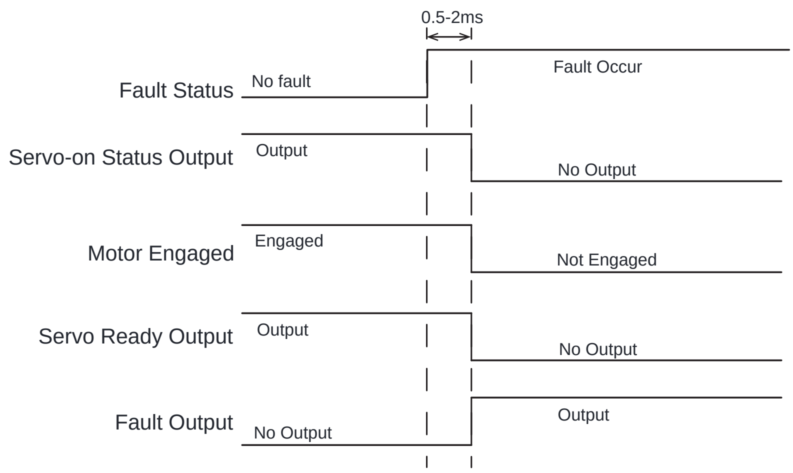


Note 1: When main power is cut off, it may take 1s or longer to stop outputting the Servo Ready signal due to the capacitor in the drive.

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.

7.1.16.2 Sequence Diagram When Faults Occur

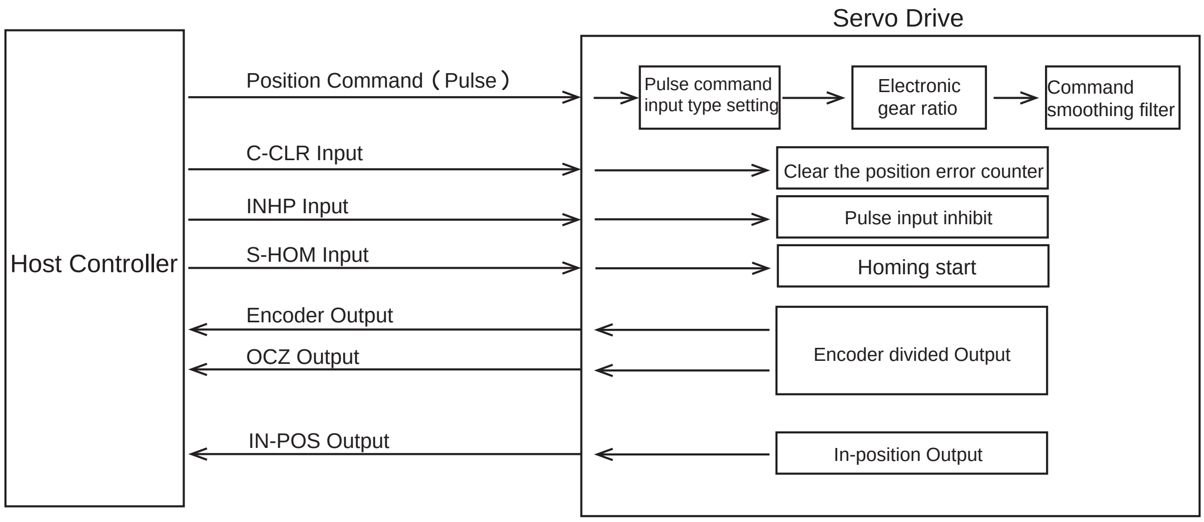


7.2 Position Mode

7.2.1 Overview of Position Mode Setting Process

Position Mode is to control the position by the position command input from the host controller. The following describes the basic setting for position control.

◆ **Function setting block diagram**



◆ **Position Control Method**

Position control is widely used in devices that require precise positioning. There are two position control methods in the M56S series servo system: Digital pulse command position mode and Internal command position mode.

Set the following values to parameter P1-00 through the drive's LED operation panel of Luna Software, and the servo drive will work in the corresponding mode.

Parameter	Command	Setup Value	Position Mode	Command	Description
P1-00	CM	7	Digital pulse command position mode	◆ Pulse & Direction ◆ CW/CCW Pulse ◆ A/B quard	500KHz Open-collector input or 4MHz Line driver pulse
		21	Internal command position mode	◆ Q Program ◆ Modbus/RTU	Use Q programming or Modbus/RTU communication commands for position control

◆ **Pulse position command input setting**

- Pulse command input source
- Pulse command type
- Rotation direction setting
- Valid pulse edge setting
- Pulse input noise filter

Related parameters

Parameter	Command	Description	Range	Default	Unit	Instructions
P3-03	PT	Pulse input setting	1 ~ 30	9	-	Set the input pulse command source, pulse type, rotation direction and pulse edge valid type: ◆ bit0 bit1: Pulse command type ◆ bit2: Rotation direction ◆ bit3: Valid pulse setting ◆ bit4: Pulse input source
P3-02	SZ	Pulse input noise filter	0~3200	2	-	Set the pulse input noise filter

For detailed parameter setting, please refer to Chapter 7.2.3 Position Command Input Settings

◆ Electronic Gear Ratio

The Electronic Gear Ratio means that multiply the pulse command input by the electronic gear ratio as the position command in position mode. By using this function, you can easily set the motor speed and movement distance corresponding to the pulse input command.

Related Parameters

Parameter	Command	Description	Range	Default	Unit	Instructions
P3-00	EN	Electronic gear ratio-Numerator	0 ~ 100000	32000	-	Set the numerator of electronic gear ratio
P3-01	EU	Electronic gear ratio-Denominator	0 ~ 100000	32000	-	Set the denominator of electronic gear ratio
P3-05	EG	Command Pulses per revolution	200 ~ 131072	10000	-	Set the number of pulses required for each turn of the motor

For detailed parameter setting, please refer to Chapter 7.2.4 Electronic Gear Ratio

◆ Command Smoothing Filter

Filter the motion command such as position command or speed command can reduce the vibration caused by sudden change of motor speed, and make the mechanical system operation more smoother.

Related Parameters

Parameter	Command	Description	Range	Default	Unit	Instructions
P2-05	JT	Jerk Time	0 ~ 125	10	ms	Smoothing filter for internal motion commmand.
P2-28	KJ	Jerk Filter	0 ~ 10000	10	ms	Set the time constant of the low-pass filter of the position command or speed command.
P2-29	FF	Interpolation Filter	0 ~ 100	10	ms	Time constant of smoothing filter under pulse position command.

For detailed parameter setting, please refer to Chapter 7.2.5 Command Smoothing Filter

◆ Clear position following error counter

In pulse position mode, use an external input to clear the position following error counter. When input C-CLR is true, this counter is set to zero and no position compensation is performed.

Related Parameters

Signal Type	Signal Symbol	Setup Value	Signal Logic	Instructions
Input	C-CLR	17	Closed	C-CLR function is enabled, position error counter is set to zero.
			Open	C-CLR function is NOT enabled, the value of Position error counter = Position command-Encoder feedback.
		18	Open	C-CLR function is enabled, position error counter is set to zero.
			Closed	C-CLR function is NOT enabled, the value of Position error counter = Position command-Encoder feedback.

For detailed parameter setting, please refer to Chapter 7.2.7 Clear the Position Following Error Counter

◆ Pulse Input Prohibition Function

The pulse command input prohibition function means that in the pulse position mode, an external digital input is used to stop the input pulse command counting. The drive will ignore the input pulses and will not rotate immediately.

Related Parameters

Signal Type	Signal Symbol	Setup Value	Signal Logic	Instructions
Input	INHP	25	Closed	INHP function is enabled, drive ignores input pulses.
			Open	INHP function is NOT enabled, motor works under the control of input pulse.
		26	Open	INHP function is enabled, drive ignores input pulses.
			Closed	INHP function is NOT enabled, motor works under the control of input pulse.

For detailed parameter setting, please refer to Chapter 7.2.6 Pulse Input Prohibition Function

◆ In Position Output

In the position mode, use the In Position Output signal to indicate the current positioning status of the servo drive. When the difference between the total number of pulse commands received by the drive and the number of pulses actually moved by the servo motor, that is, the position following error is less than the parameter setting value, the positioning completion signal will be output.

Related Parameters

Signal Type	Signal Symbol	Setup Value	Signal Logic	Instructions
Output	IN-POS	9	Closed	When positioning finished condition is met, the IN-POS signal is output, and the output state is CLOSED.
			Open	When positioning finished condition is NOT met, the IN-POS signal will NOT output, and the output state is OPEN.
		10	Open	When positioning finished condition is met, the IN-POS signal is output,and the output state is OPEN.
			Closed	When positioning finished condition is NOT met, the IN-POS signal will NOT output, and the output state is CLOSED.

For detailed parameter setting, please refer to Chapter 7.2.8 In Position Output.

◆ Encoder Divided Output

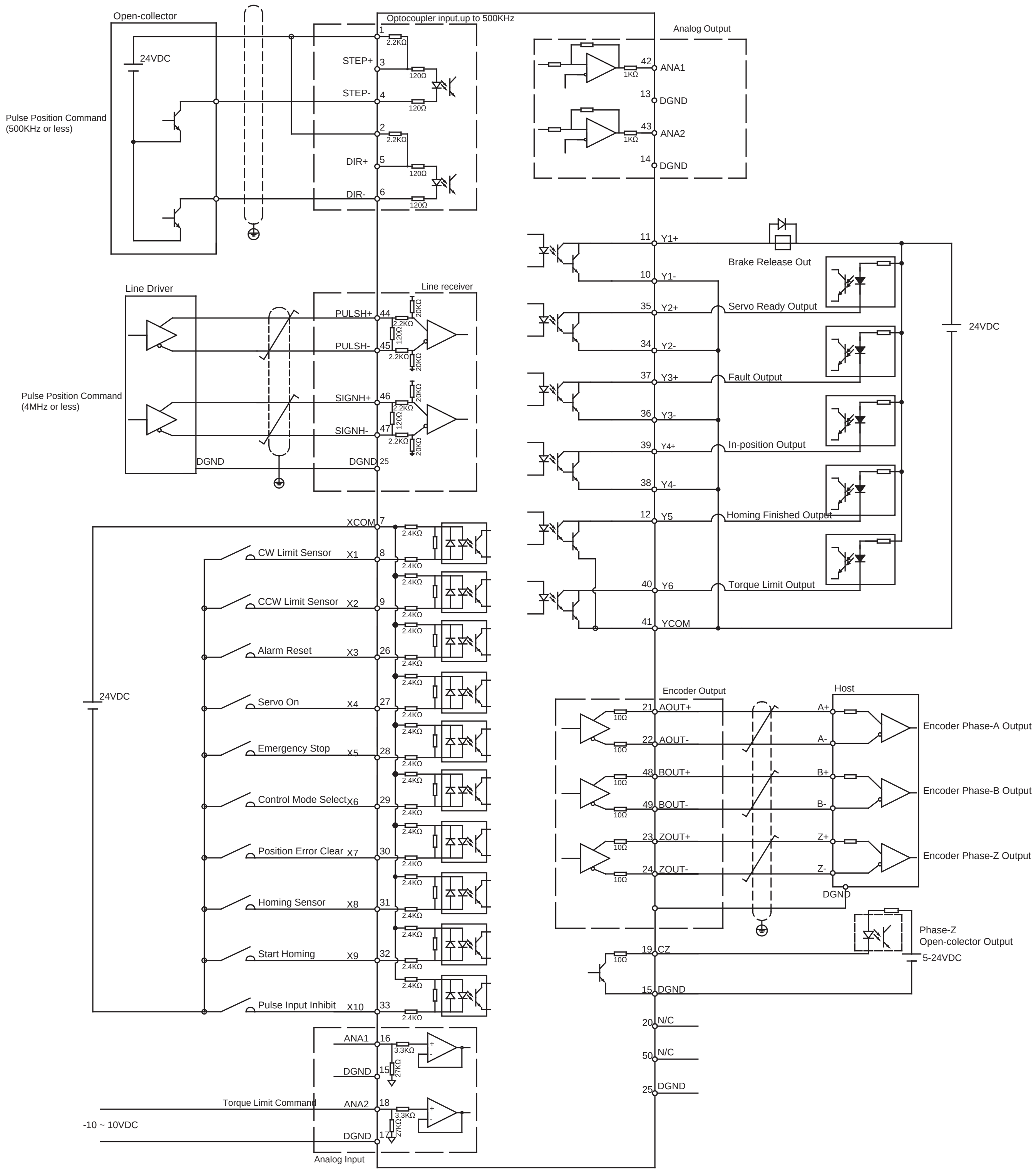
The Encoder Divided Output function is used to output the position feedback from the motor encoder or the external position pulse command in A/B quadrature pulse. Z-phase pulse output is support.

Related Parameters

Parameter	Command	Description	Range	Default	Unit	Instructions
P3-12	PO	Pulse Output Mode	0 ~ 256	1	-	Set the pulse division output mode.
P3-13	ON	Pulse Output Gear Ratio-Numerator	0 ~ 131072	10000	-	Set the numerator of the pulse output gear ratio
P3-14	OD	Pulse Output Gear Ratio-Denominator	0 ~ 131072	131072	-	Set the denominator of the pulse output gear ratio

For detailed parameter setting, please refer to Chapter 7.6 Encoder Divided Output.

7.2.2 Wiring Diagram of Digital Pulse Position Mode



7.2.3 Position Command Input Settings

When P1-00 is set to 7, which is digital pulse position mode, the followings need to be set.

- Pulse command input source
- Pulse command type
- Rotation direction setting
- Valid pulse edge setting
- Pulse input noise filter

Related Parameters

Parameter	Command	Description	Range	Default	Unit	Instructions
P3-03	PT	Pulse input setting	1 ~ 30	9	-	Set the input pulse command source, pulse type, rotation direction and pulse edge valid type: ◆ bit0 & bit1: Pulse command type ◆ bit2: Rotation direction ◆ bit3: Valid pulse setting ◆ bit4: Pulse input source
P3-02	SZ	Pulse input noise filter	0~3200	2	-	Set the pulse input noise filter

Parameters P3-03

Parameter P3-03 is used to set the input pulse command source, pulse type, rotation direction and pulse edge valid type.

P3-03 Pulse input setting							
bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
0	0	0	0: Open-colector input	0: Valid on falling edge	0: Positive Direction	bit1=0,bit0=1: Pulse & Direction	
						bit1=1,bit0=0: CW/CCW	
			1: Line receiver input	1: Valid on raising edge	1: Negative Direction	bit1=1,bit0=1: A/B Quadrature	
bit0 & bit1: Pulse command type bit2: Rotation direction bit3: Valid pulse setting bit4: Pulse input source							

7.2.3.1 Pulse Input Source

The pulse input source is set by bit4 of parameter P3-03.

P3-03 Pulse input setting							
bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
0	0	0	0: Open-collector input				
			1: Line receiver input				

◆ When bit4 = 0, Open-collector Pulse Inputs (or Low-speed pulse signal input) is selected.

CN2-Pin NO.	Signals		Description
1	OPC1	Pulse command input	When bit4 of P3-03 is set to "0", this low-speed pulse input is valid. The pulse position control mode will use this input as position command reference. ◆ Optocoupler input: 1) Open collector pulse signals, 5V or 24VDC 2) Low-speed difference pulse signals, 5VDC ◆ Maximum pulse frequency is 500KHz. ◆ Support pulse & direction signal, CW/CCW signal and A/B quadrature signal ◆ When using 24V open collector pulse signal, you need to use OPC1 and OPC2 input for pull-up.
3	STEP+		
4	STEP-		
2	OPC2	Pulse direction input	
5	DIR+		
6	DIR-		

◆ When bit4 = 1,Line Driver pulse Inputs(or High-speed pulse signal input) is selected.

CN2-Pin NO.	Signals		Description
44	PULSH+	Pulse command input	When bit4 of P3-03 is set to "1", this line driver pulse input is valid. The pulse position control mode will use this input as position command reference. ◆ For Line driver pulse input，5VDC, Maximum pulse frequency is 4MHz ◆ Support pulse & direction signal, CW/CCW signal and A/B quadrature signal
45	PULSH-		
46	SIGNH+	Pulse direction input	
47	SIGNH-		

7.2.3.2 Input Pulse Type Setting

◆ **Pulse type, Rotation direction, Valid Pulse Edge Setting**

Parameter P3-03 is used to set the input pulse type, rotation direction and pulse edge valid type.

P3-03 Pulse input setting							
bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
0	0	0	0: Open-colector input	0: Valid on falling edge	0: Positive Direction	bit1=0,bit0=1: Pulse & Direction	
						bit1=1,bit0=0: CW/CCW	
			1: Line receiver input	1: Valid on raising edge	1: Negative Direction	bit1=1,bit0=1: A/B Quadrature	

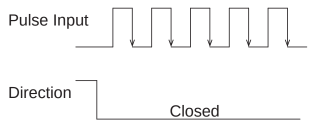
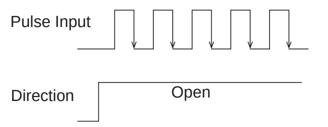
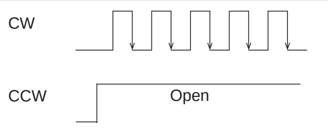
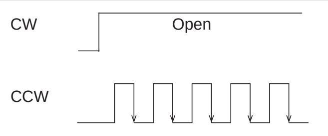
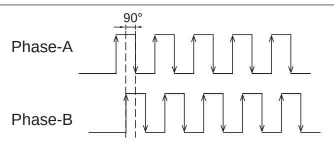
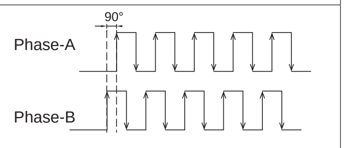
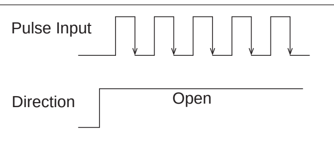
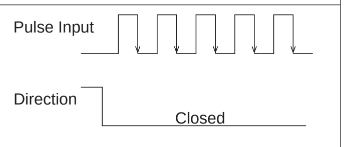
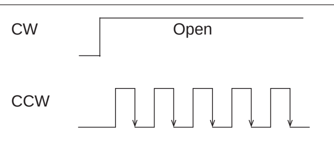
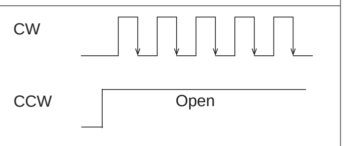
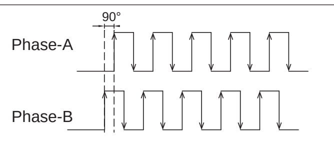
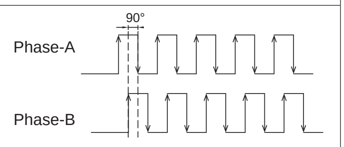
1) Input Pulse Type:

There are three types of input pulse: Pulse & Direction, CW/CCW pulse, A/B quadrature pulse that is set by bit0 and bit1 of parameter P3-03.

bit 1	bit 0	Input pulse type
0	1	Pulse & Direction(Default)
1	0	CW/CCW pulse
1	1	A/B quadrature pulse

2) Rotation Direction:

Bit 2 of parameter P3-03 determines the relationship between the input pulse and the rotation direction of the motor, as shown in the figure below.

Bit2	Input pulse type	Positive Direction		Negative Direction	
0 (Default)	Pulse & Direction	Positive rotation when the direction signal keeps CLOSED.		Negative rotation when the direction signal keeps OPEN.	
	CW/CCW pulse	When the CW pulse input, and the CCW keeps Open, it is positive rotation.		When the CCW pulse input, and the CW keeps Open, it is negative rotation	
	A/B quadrature	When phase-A leads phase-B by 90 degree, it is positive rotation		When phase-B leads phase-A by 90 degree, it is negative rotation	
1	Pulse & Direction	Positive rotation when the direction signal keeps OPEN		Negative rotation when the direction signal keeps CLOSED.	
	CW/CCW pulse	When the CCW pulse input, and the CW keeps Open, it is positive rotation.		When the CW pulse input, and the CCW keeps Open, it is negative rotation	
	A/B quadrature	When phase-B leads phase-A by 90 degree, it is positive rotation		When phase-A leads phase-B by 90 degree, it is negative rotation	

3) Valid Pulse Edge Setting:

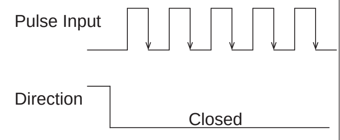
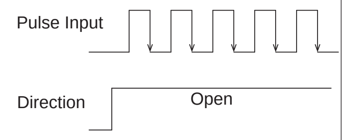
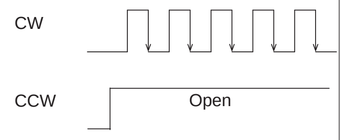
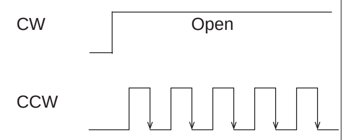
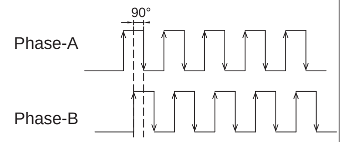
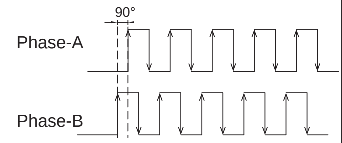
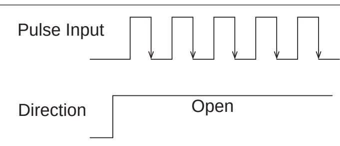
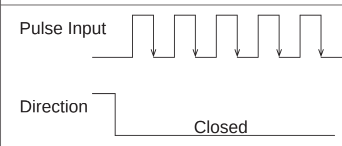
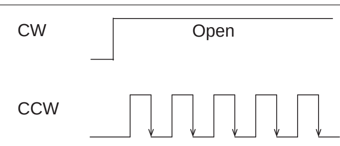
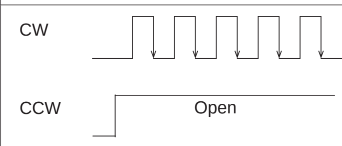
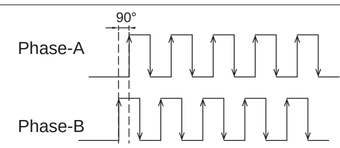
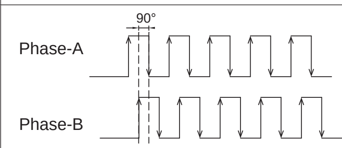
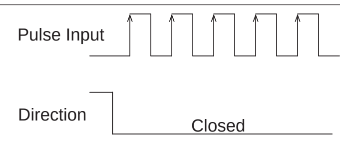
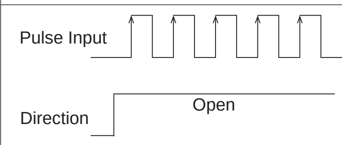
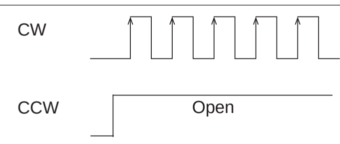
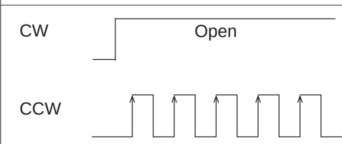
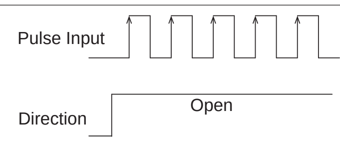
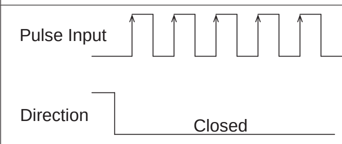
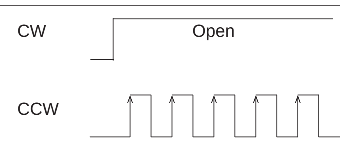
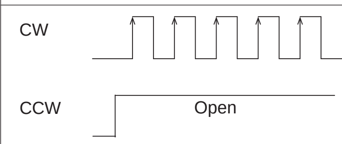
Bit3 of parameter P3-03 determines the valid edge condition of input pulse.

bit 3	Valid edge
0	Valid on falling edge(Default)
1	Valid on raising edge

7.2.3.3 Quick Setup for Input Pulse Type

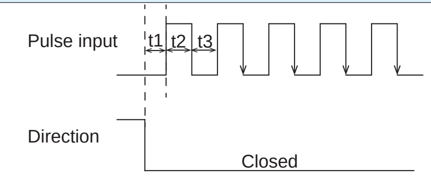
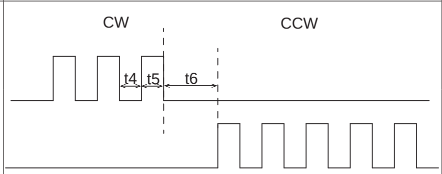
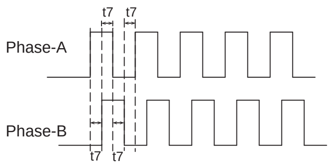
The following table lists the quick setup of parameter P3-03 based on the following conditions.

- Pulse command input source
- Pulse command type
- Rotation direction setting
- Valid pulse edge setting

Valid pulse edge	Rotation direction	Pulse command type			Positive	Negative	Parameter P3-03 Set value (Decimal)	
bit3	bit2	bit1	bit0				Open-collector	Line receiver
0	0	0	1	Pulse & Direction			1	17
0	0	1	0	CW/ CCW			2	18
0	0	1	1	A/B			3	19
0	1	0	1	Pulse & Direction			5	21
0	1	1	0	CW/ CCW			6	22
0	1	1	1	A/B			7	23
1	0	0	1	Pulse & Direction			9	25
1	0	1	0	CW/ CCW			10	26
1	1	0	1	Pulse & Direction			13	29
1	1	1	0	CW/ CCW			14	30

7.2.3.4 Specification of Pulse command

The minimum pulse width of the input pulse should meet the following conditions.

		Low speed pulse input STEP+, STEP-, DIR+, DIR-						Line receiver input PULSH+,PULSH- SIGN+,SIGN-		
		Line Driver Min. pluse width(μs)			Open Collector Min. pluse width(μs)			Line Driver Min. pluse width(μs)		
Pulse & Direction		t1	t2	t3	t1	t2	t3	t1	t2	t3
		0.25	0.25	0.25	1	1	1	0.125	0.125	0.125
CW/CCW		t4	t5	t6	t4	t5	t6	t4	t5	t6
		0.25	0.25	0.25	1	1	1	0.125	0.125	0.125
A/B		t7			t7			t7		
		0.25			1			0.125		

Pulse edge(raising edge or falling edge) swtiching time should be less than 0.1μs.

7.2.3.5 Pulse Input Noise Filter

Using paratermer P3-02 Pulse Input Noise Filter to filte the input pulse signal to prevent it from being interfered and cause inaccurate positioning and other problems. This noise filter is a low-pass filter, and the unit is 0.1μs.

Related Parameters

Parameter	Command	Description	Range	Default	Unit	Instructions
P3-02	SZ	Pulse Input Noise Filter	0~32000	2	0.1μs	Set the Pulse Input Noise Filter

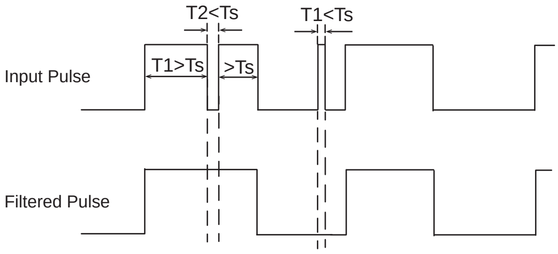
Instructions:

Ts: The set value of P3-02 pulse input noise filter

T1: The high voltage level width of input pulse

T2: The low voltage level width of input pulse

Then the relationship between the input pulse signal and the the filtered signal is as follows.



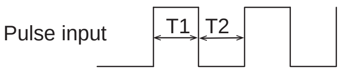
- Both T1 and T2 of a pulse are bigger than Ts, this input pulse is valid.
- One of T1 and T2 of a pulse is smaller than Ts, this input pulse will be filtered.

$$\text{Noise Filter time :Ts} \leq \frac{1}{\text{A x Pulse Input Frequency (Hz)}}$$

Generally, when the duty cycle of the input frequency is 50%, the value of A is 4 or 5.

Example:

1) When the input pulse frequency is 200KHz, and the duty cycle is 50%.

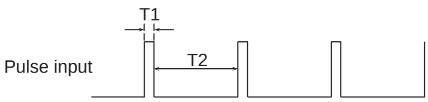


$$T1 = \frac{1}{200000} \text{ X } 0.5 = 0.0000025s \qquad T2 = \frac{1}{200000} \text{ X } 0.5 = 0.0000025s$$

$$Ts = \frac{1}{5 \text{ x } 200000} = 0.000001s \qquad Ts < T1 \text{ and } T2$$

That is, the minimum filter time is 1μs. Since the unit of parameter P3-02 is 0.1μs, the value of P3-02 is 10.

2) When the input pulse frequency is 500KHz, and the duty cycle is 10%.



$$T1 = \frac{1}{500000} \text{ X } 0.1 = 0.0000002s \qquad T2 = \frac{1}{500000} \text{ X } 0.9 = 0.0000018s$$

$$Ts = \frac{T1}{2} = 0.0000001s$$

Since the pulse widths T1 and T2 of the input pulse need to be both greater than P3-02, the pulse input is valid. In the case of 10% duty cycle, if the value is 5 according to formula, Ts is 0.4μs and greater than T1, the pulse input will be invalid at this time.

Set Ts=0.5 x T1=0.1μs. Since the unit of parameter P3-02 is 0.1μs, the value of P3-02 is 1.

7.2.4 Electronic Gear Ratio

M56S series servo drives have two electronic gearing systems, parameter P3-16 is used to switch this.

Parameter P3-16 set value	Description	Instructions
0	Based on parameter P3-05 (Command Pulses per revolution) Setting	Set the required number of command pulses per revolution of motor. Note: ◆ When this setting is zero, electronic gear ratio P03-00 and P3-01 is invalid. ◆ The read value of feedback encoder position is also determined by this parameter. That is, the read value of feedback encoder position per motor revolution = the setting of parameter P3-05
1	Electronic gear ratio is valid	◆ Electronic gear ratio P03-00 and P3-01 become valid and P3-05 is invalid ◆ The read value of feedback encoder position is: Feedbakc encoder position per revolution= $\frac{1048576}{\text{(Encoder resolution)}} \times \frac{\text{P3-01 (Electronic Gear Ratio-Numerator)}}{\text{P3-00 (Electronic Gear Ratio-Denominator)}}$

The electronic gear ratio is to multiply the pulse input command by the electronic gear ratio as the position command reference. By using this function, the motor rotation and movement amount corresponding to the input command pulse can be set.

$$\begin{array}{c}\text{External Position Pulse Command}\\ \text{(Communication Position Command)}\end{array} \times \frac{\text{P3-00 (Electronic Gear Ratio-Denominator)}}{\text{P3-01 (Electronic Gear Ratio-Numerator)}} = \text{Reference Position Command}$$

◆ When parameter P3-16 = 0, the electronic gear ratio P03-00 and P03-01 is invalid. The number of pulses per revolution of the motor is determined by parameter P3-05.

◆ When parameter P3-16 = 1, the electronic gear ratio P03-00 and P03-01 become valid. The number of pulses for one rotation of the motor is fixed to the encoder resolution. Regardless of the encoder with 17-bit or 20-bit resolution, it takes 1,048,576 pulses to rotate the motor once.

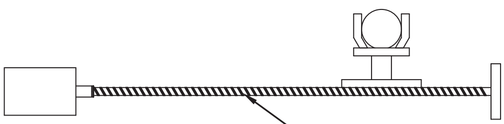
For example: the number of pulses required for one revolution of the motor is 1048576 pulses. When the electronic gear ratio is equal to 1, the controller sends 1048576 pulses and the motor rotates one turn. When the electronic gear ratio is equal to 0.5, that is, every 2 pulses sent by the controller to the motor rotation is 1 pulse. The controller needs to send 2097152 pulses, multiplied by the electronic gear ratio, the position command reference is 1048576 pulses, and the motor rotates one turn.

Setting an appropriate electronic gear ratio will simplify the calculation of pulses sent by the host controller.

Related Parameters

Parameter	Command	Description	Range	Default	Unit	Instructions
P3-00	EN	Electronic Gear Ratio-Numerator	1 ~ 2147483647	1048576	-	Set the numerator of electronic gear ratio
P3-01	EU	Electronic Gear Ratio-Denominator	1 ~ 2147483647	10000	-	Set the denominator of electronic gear ratio
P3-05	EG	Command Pulse per Revolution	200 ~ 131072	10000	pulses	Set the number of pulses required for one revolution
P3-16	PU	Electronic Gearing Switch	0 ~ 1	0	-	Enable electronic gear ratio

For example: The lead of the screw is 3mm, when you needs to move 4mm.



If the electronic gear ratio is not used, the number of pulses that need to be sent is:

Since the lead is 3mm, that is, for each turn of the motor, the mechanical moves 3mm. Moving 4mm requires a 4/3 turns.

Calculate required pulses :
If the pulses required per motor revolution is 1048576 pulses, $1048576 \times \frac{4}{3} = 1398101.33333.....$ ···pulses.

Moving 4mm requires 1398101.3333 input pulses, and cumulative error will be generated . Using an electronic gear ratio will solve this problem.

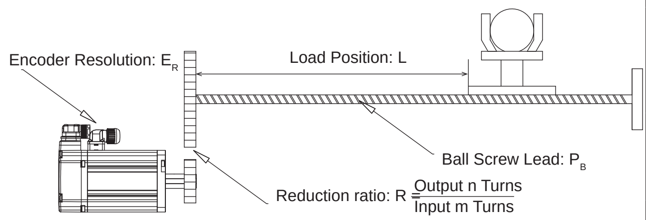
7.2.4.1 Electronic Gear Ratio Calculations:

The total mechanical transmission ratio of the motor shaft and the load side is m:n (when the motor rotates m turns, the load moves n turns), the electronic gear ratio can be quickly calculated by the following formula.

$$\text{Electronic Gear Ratio } \frac{B}{A} = \frac{P3-00}{P3-01} = \frac{\text{Encoder Resolution}}{\text{Position commands for one rotation of the load shaft}} \times \frac{m}{n}$$

7.2.4.2 Calculation Example

Taking the lead screw as an example, the related parameters are:

◆ Ball screw lead: PB，Unit: mm	
◆ Load Position: L，Unit: mm	
◆ Total mechanical transmission ratio: $R = \frac{\text{Output n Turns}}{\text{Input m Turns}}$	
◆ Encoder Resolution E_R，Unit :counts **ER=1048576 counts**	
◆ Numerator of Electronic gear ratio: B	
◆ Denominator of Electronic gear ratio: A	
◆ Required Input Pulses: P, Unit: counts	

1) Calculate the electronic gear ratio according to the external input pulse P(counts) and the corresponding load travel distance L(mm)

According to:

Motor shaft turns X Mechanical transmission ratio = Ball screw turns

When the load travel distance is L, the ball screw turns $\frac{L}{P_B}$, motor shaft turns $\frac{P \times \frac{B}{A}}{E_R}$,

That is

$$\frac{P \times \frac{B}{A}}{E_R} \times R = \frac{L}{P_B}$$

So the electronic gear ratio is:

$$\frac{B}{A} = \frac{L}{P_B} \times \frac{1}{R} \times E_R \times \frac{1}{P}$$

2) Calculate the electronic gear ratio according to the external input one pulse and the corresponding load travel distance ΔL(mm)

According to

Motor shaft turns X Mechanical transmission ratio = Ball screw turns

When the external input one pulse and the load travel distance is ΔL $\frac{\Delta L}{P_B}$, motor shaft turns $\frac{1 \times \frac{B}{A}}{E_R}$

That is

$$\frac{1 \times \frac{B}{A}}{E_R} \times R = \frac{\Delta L}{P_B}$$

So the electronic gear ratio is:

$$\frac{B}{A} = \frac{\Delta L}{P_B} \times \frac{1}{R} \times E_R$$

3) Calculate the electronic gear ratio according to the external input pulse frequency F (Hz) and the corresponding load speed V_L(mm/s)

According to:

Motor shaft speed X Mechanical transmission ratio = Load speed

Load Speed: $\frac{V_L}{P_B}$ (rps), Motor shaft speed: $\frac{F \times \frac{B}{A}}{E_G}$ 。

That is

$$F \times \frac{B}{A} \times \frac{1}{E_G} \times R = \frac{V_L}{P_B}$$

So the electronic gear ratio is:

$$\frac{B}{A} = \frac{V_L}{P_B} \times \frac{1}{R} \times E_G \times \frac{1}{F}$$

7.2.4.3 Electronic Gear Ratio Calculation Example

Ball screw lead: 3mm

Mechanical transmission ratio: 10:1

Requirements: Every time the host controller sends one puplse, the workload travels 1 μm.

$$\frac{B}{A} = \frac{1}{3000} \times 10 \times 1048576 = \frac{1048576}{300}$$

So

P3-00 Electronic gear raito - Numerator: 1048576

P3-01 Electronic gear raito - Denominator: 300

7.2.5 Command Smoothing Filter

When the position command or speed command to the servo system changes suddenly, it is easy to cause the whole system to vibrate, and the running noise will also increase. Command Smoothing Filter is used to filter and smooth the position command or speed command, which can reduce the running transient of the motor and mechanical system and make the operation smoother.

Command Smoothing Filter frequency, in Hz. The lower the frequency value the more pronounced the S-curve profile will be. Setting the value to 0 will disable the filter.

S-curve acceleration/deceleration ramps are beneficial in positioning systems where instantaneous changes in speed may cause the load to jerk excessively. One example is when the load is connected to the motion actuator via a long moment arm. If the arm is not sufficiently rigid, changes in speed at the actuator can result in undesirable oscillations and increased settling time at the load. Smoothed transitions in speed changes, can alleviate this unwanted motion and reduce settling time.

Related Parameters

Parameter	Command	Description	Range	Default	Unit	Instructions
P2-05	JT	Jerk Time	0 ~ 125	10	ms	The FIR filter time ofinternal trajectory planning.
P2-28	KJ	Low-pass Jerk Filter	0 ~ 10000	10	ms	Set the time constant of the low-pass filter of the position command or speed command.
P2-29	FF	Interpolation Filter	0 ~ 125	10	ms	Time constant of smoothing filter in pulse position control command

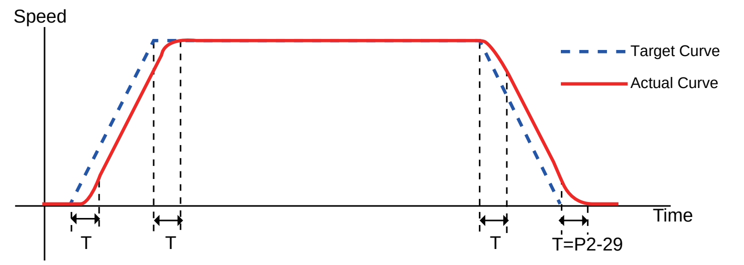
Note: The filter function will be disabled when the value is set to zero.

7.2.5.1 Interpolation Filter

Parameter P2-29 Interpolation Filter works in the pulse position control mode, applicable to the following application scenarios:

- ◆ Input pulse command does not perform acceleration or deceleation.
- ◆ The frequency of input pulse command changes suddenly.
- ◆ The frequency of input pulse command is extremely low.

The smoothing effect of the Interpolation Filter to the input command is shown in the figure below.



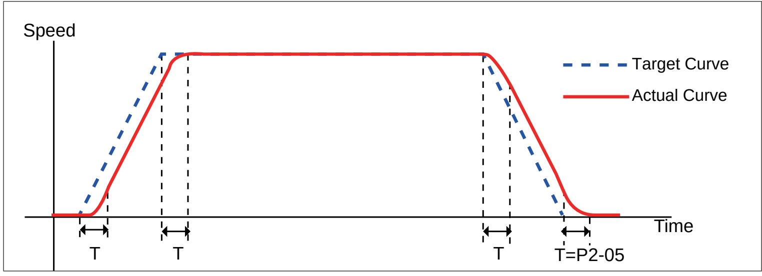
◆ Interpolation filter will cause a certain delay to the input command pulse, but it will not affect the final positioning accuracy.

◆ The larger the time constant of P2-29 is, the more smoothing effect will be, and the command delay will also increase. A reasonable filter time constant should be set according to the actual aoolication.

7.2.5.2 Jerk Time

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

The smoothing effect of the Jerk Time to the input command is shown in the figure bellow.



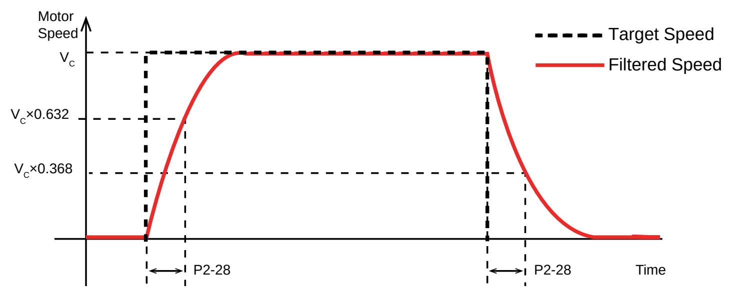
◆ The Jerk Time function will cause a certain delay to the input command pulse, but it will not affect the final positioning accuracy.

◆ The larger the time constant of P2-05 is, the more smoothing effect will be, and the command delay will also increase. A reasonable filter time constant should be set according to the actual aoolication.

7.2.5.3 Low-pass Jerk Filter

Parameter P2-28 Low-pass Jerk Filter can take effect in all control modes, such as: external pulse control position mode, internal trajectory mode (position, speed, torque), analog position, analog speed, analog torque, Communication command control(SCL or Modbus), etc.

The smoothing effect of Low-pass Jerk Filter to the input command is shown in the figure below.



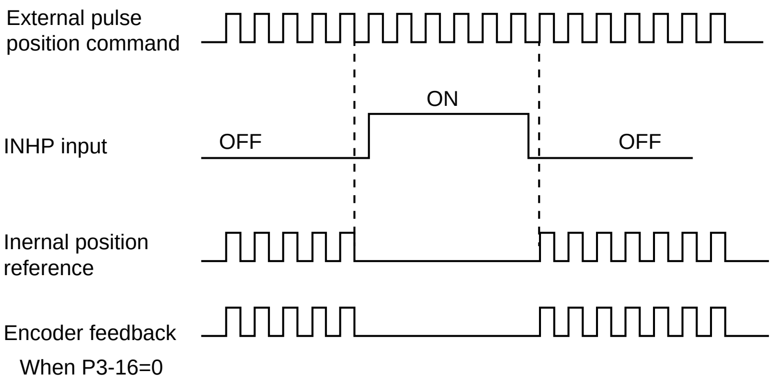
◆ The low-pass jerk filter will cause a certain delay to the input command pulse, but it will not affect the final positioning accuracy.

◆ The larger the time constant of P2-28 is, the more smoothing effect will be, and the command delay will also increase. A reasonable filter time constant should be set according to the actual aoolication.

7.2.6 Pulse Input Prohibition Function

The pulse command input prohibition function means that in the pulse position mode, an external digital input is used to stop the input pulse command counting.

The drive will ignore the input pulses and will not rotate immediately.



To use this function, one of the digital input of the servo drive is configured as INHP function.

<table>
<tr><th>Signal Type</th><th>Signal Symbol</th><th>Setup Value</th><th>Signal Logic</th><th>Instructions</th></tr>
<tr><td rowspan="4">Input</td><td rowspan="4">INHP</td><td rowspan="2">25</td><td>Closed</td><td>INHP function is enabled, drive ignores input pulses.</td></tr>
<tr><td>Open</td><td>INHP function is NOT enabled, motor works under the control of input pulse.</td></tr>
<tr><td rowspan="2">26</td><td>Open</td><td>INHP function is enabled, drive ignores input pulses.</td></tr>
<tr><td>Closed</td><td>INHP function is NOT enabled, motor works under the control of input pulse.</td></tr>
</table>

7.2.7 Clear the Position Following Error Counter Input

Position Following Error = Position Command Reference - Encoder Feedback

In pulse position mode, use an external input to clear the position following error counter. When input C-CLR is true, this counter is set to zero and no position compensation is performed.

To use this function, one of the digital input of the servo drive is configured as C-CLR function.

<table>
<tr><th>Signal Type</th><th>Signal Symbol</th><th>Setup Value</th><th>Signal Logic</th><th>Instructions</th></tr>
<tr><td rowspan="4">Input</td><td rowspan="4">C-CLR</td><td rowspan="2">17</td><td>Closed</td><td>C-CLR function is enabled, position error counter is set to zero.</td></tr>
<tr><td>Open</td><td>C-CLR function is NOT enabled, the value of Position error counter = Position command-Encoder feedback.</td></tr>
<tr><td rowspan="2">18</td><td>Open</td><td>C-CLR function is enabled, position error counter is set to zero.</td></tr>
<tr><td>Closed</td><td>C-CLR function is NOT enabled, the value of Position error counter = Position command-Encoder feedback.</td></tr>
</table>

7.2.8 In-position Output Signal

The In-position output signal is used to indicate current positioning status of the servo system in the position mode. When the position following error, which is the difference between input position command and the motor actual position feedback by motor encoder, is less than the set value of P5-39, the In-position signal will output.

To use this function, one of the digital output of the servo drive is configured as IN-POS function.

Signal Type	Signal Symbol	Setup Value	Signal Logic	Instructions
Output	IN-POS	9	Closed	When positioning finished condition is met, the IN-POS signal is output, and the output state is CLOSED.
			Open	When positioning finished condition is NOT met, the IN-POS signal will NOT output, and the output state is OPEN.
		10	Open	When positioning finished condition is met, the IN-POS signal is output,and the output state is OPEN.
			Closed	When positioning finished condition is NOT met, the IN-POS signal will NOT output, and the output state is CLOSED.

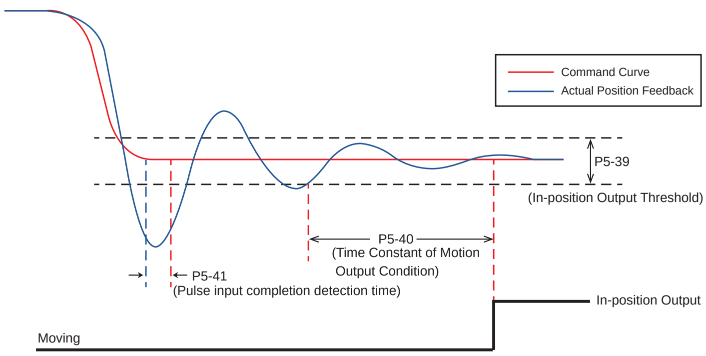
By default, the Servo Ready signal is set in the table below.

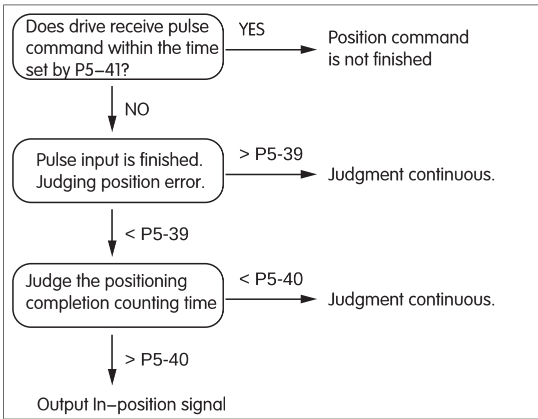
Signal Symbol	Output NO.	CN2-Pin NO	Parameter	Command	Setup Value	Signal Logic	Description	Control Mode			
IN-POS	Y4+	39	P5-15	MO4	9	Closed	When positioning finished condition is met, the IN-POS signal is output, and the output state is CLOSED.	P	V	T	F
	Y4-	38				Open	When positioning finished condition is NOT met, the IN-POS signal will NOT output, and the output state is OPEN.				

Related Parameters

Parameter	Command	Description	Range	Default	Unit	Instructions
P5-39	PD	In-position Output Threshold	0 ~ 32000	40	pulse	The position following error judgment range that determines whether the In-positionsignal is output or not.
P5-40	PE	Time Constant of Motion Output Condition	0 ~ 32000	10	ms	Counting time for positioning completion
P5-41	TT	Pulse Complete Timer	0 ~ 20000	2	ms	Pulse input completion detection time

The following figure shows the relastionship of P5-39,P5-40 and P5-41.





When the drive dose not receive a new pulse input within the pulse input completion detection time of P5-41, it is deemed that the pulse input has completed.

After that, if the position following error is less than parameter P5-39(In-position Output Threshold) and the duration exceeds parameter P5-40, the In-position signal will output.

7.2.9 Near Target Position Output

Near target position, which is also called Position Consistent, is to output a signal(P-COIN) when the actual position of motor is equal to the position set by parameter P5-46.

To use this function, one of the digital output of the servo drive is configured as P-COIN function.

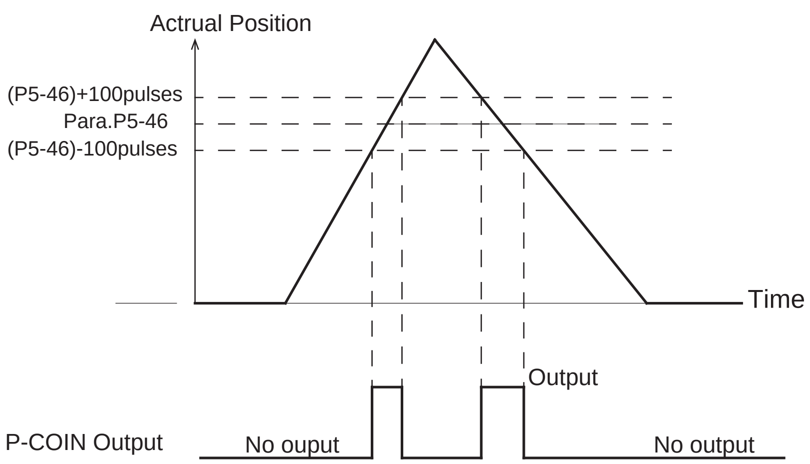
Signal Type	Signal Symbol	Setup Value	Signal Logic	Instructions
Output	P-COIN	31	Closed	When Position Consistent Output judgment condition is met, the P-COIN signal is output, and the output state is CLOSED.
			Open	When Position Consistent Output judgment condition is NOT met, the P-COIN signal will NOT output, and the output state is OPEN.
		32	Open	When Position Consistent Output judgment condition is met, the P-COIN signal is output,and the output state is OPEN.
			Closed	When Position Consistent Output judgment condition is NOT met, the P-COIN signal will NOT output, and the output state is CLOSED.

Related Parameters

Parameter	Command	Description	Range	Default	Unit	Instructions
P5-46	DG	Near Target Position	-2147483647 ~ +2147483647	10	Pulse	Target position of the jugement of whether output the P-COIN signal.

Near Target Position Output jugement condition

The P-COIN will out when the actual position of motor is equal to the position set by parameter P5-46. Detection is associated with ±100pulses hysteresis.



7.2.10 Gain Parameters in Position Mode

In position mode, reasonable gain parameters can make the servo system run more smoothly and accurately and excellent positioning performance.

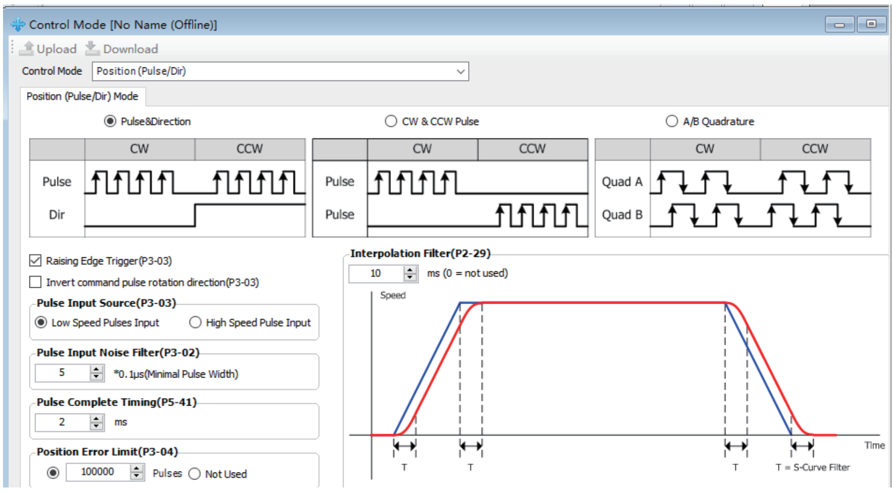
The following gain parameters take effects in position mode and can be automatically adjusted using the Luna software, and can also be modified and fine-tuned though software or LED operation panel.

Parameter	Command	Description	Type	Default	Unit
P0-05	KP	1st Position Loop Gain	First Gain Parameters 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 Velocity Loop Integral Time Constant		189	ms
P0-16	KC	1st Torque Command Filter		1099	0.1Hz
P0-17	UP	2nd Position Loop Gain	Second Gain Parameters Group	52	0.1Hz
P0-19	UD	2nd Position Loop Derivative Time Constant		0	ms
P0-20	UE	2nd Position Loop Derivative Filter		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 Torque Command Filter		1099	0.1Hz
P0-25	XP	Full Closed-loop Position Loop Gain	Full Closed-loop Gain Parameters Group	52	0.1Hz
P0-27	XD	Full Closed-loop Position Loop Derivative Time Constant		0	ms
P0-28	XE	Full Closed-loop Position Loop Derivative Filter		20000	0.1Hz
P0-29	XF	Full Closed-loop Velocity Command Gain		10000	0.01%
P0-30	XV	Full Closed-loop Velocity Loop Gain		183	0.1Hz
P0-31	XG	Full Closed-loop Velocity Loop Integral Time Constant		189	ms
P0-32	XC	Full Closed-loop Torque Command Filter		1099	0.1Hz
P0-33	SD	Automatic Gain Swiching Method	-	0	
P0-34	PN	Gain Switch with Position Error Condition Change	-	0	counts
P0-35	VN	Gain Switch with Actual Speed Condition Change	-	0	0.025rps
P0-36	TN	Gain Switch with Actual Torque Condition Change	-	10	0.1%
P0-37	SE1	Second Gain Switching to First Gain Delay Time	-	10	ms
P0-38	SE2	First Gain Switching to Second Gain Delay Time	-	0	ms

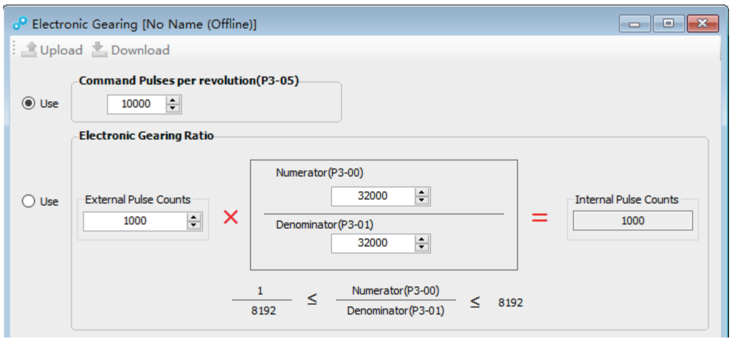
7.2.11 Using Luna Software to Configurate Position Control Mode

The position control mode can be easily configured using the Luna software.

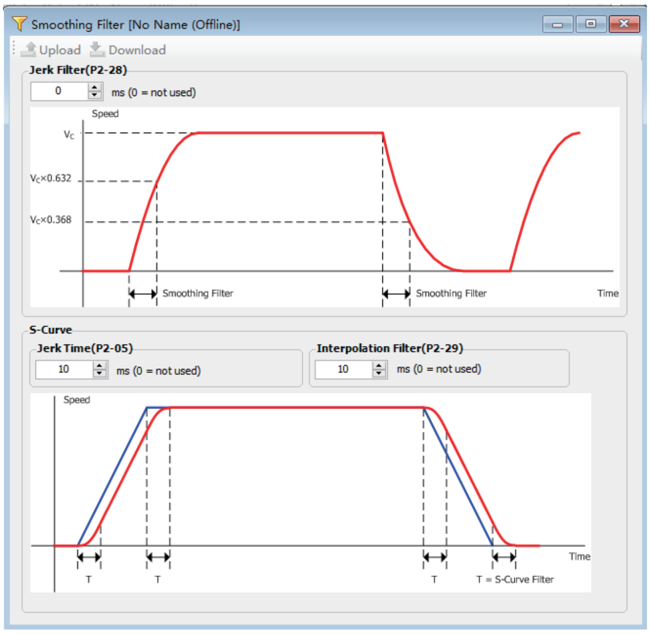
Step 1: Select Control Mode



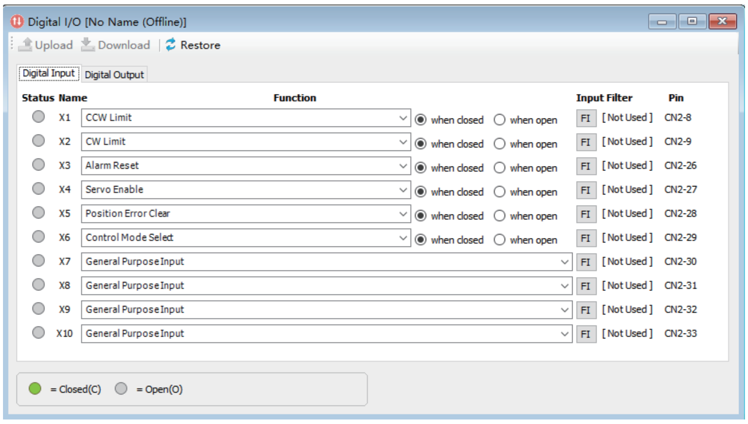
Step 2: Set Electronic Gear Ratio



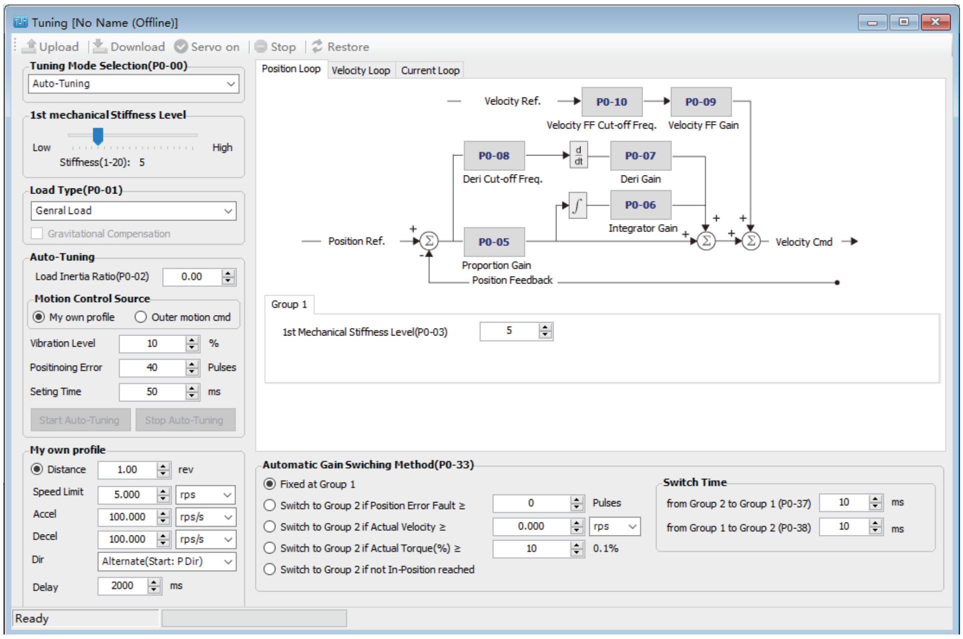
Step 3: Set Smoothing Filter



Step 4: Set Input and Output Function



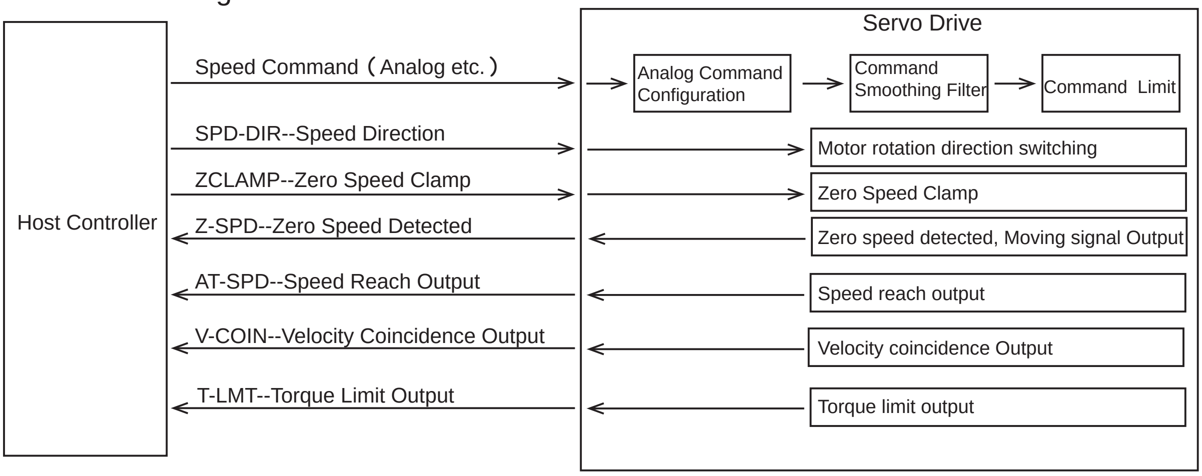
Step 5: Gain Tuning



7.3 Velocity Mode

Velocity control mode is used for precise speed control.

◆ Function Block Diagram



◆ Velocity Control Mode Select

There are three velocity control mode in M56S series, Analog Speed Mode, Command Speed Mode and Internal Multi-speed Mode.

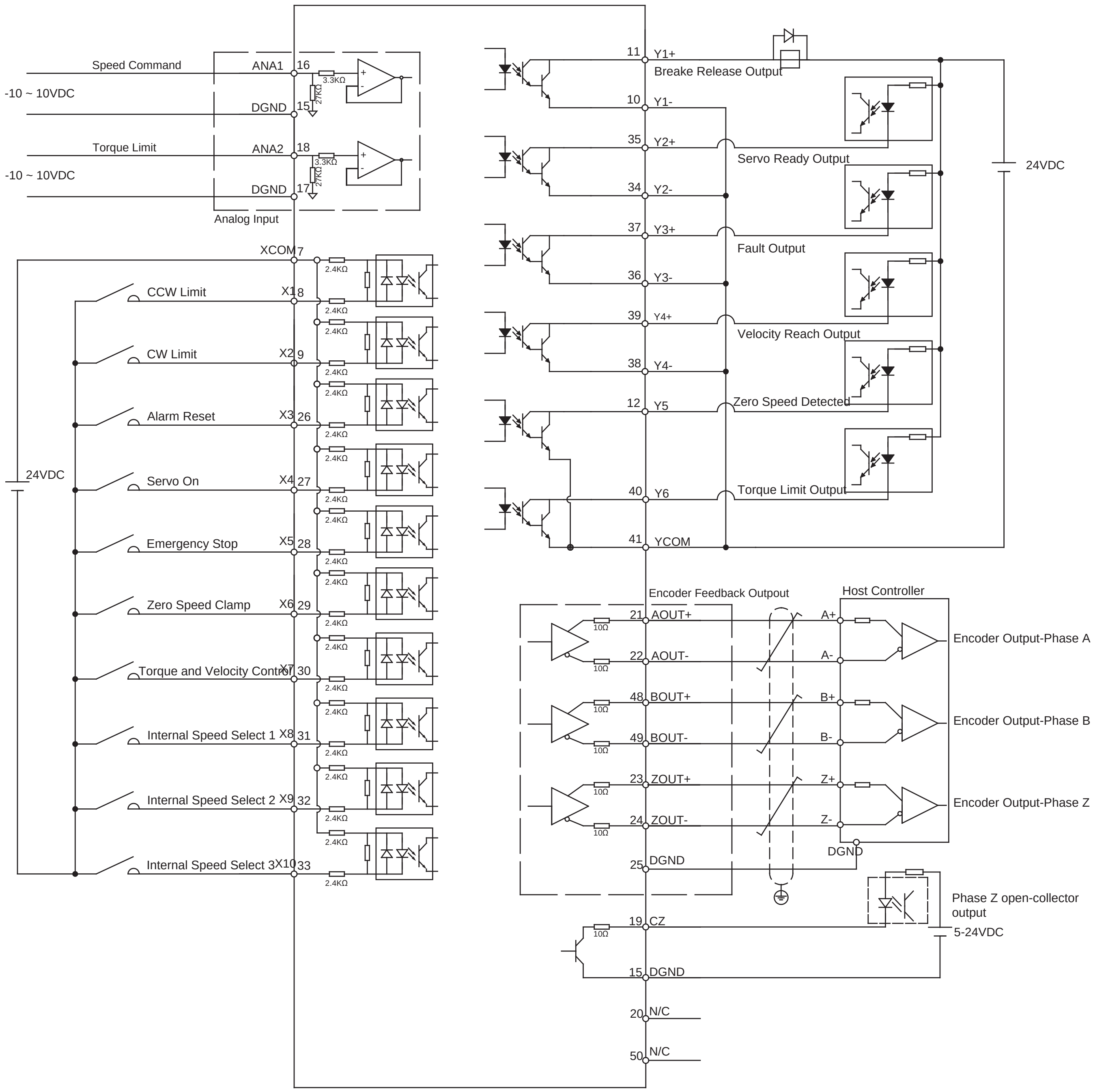
1) Analog Speed Mode: -10 ~ +10Vdc external analog voltage input to control the motor speed.

2) Command Speed Mode: Use Q program commands to control the motor speed, or use Modbus commands to control the motor speed.

3) Internal Multi-speed Mode: Use the digital input to select and control the motor speed, there up to 8 different speeds can be select.

Control Mode	Control Signal	P1-00	Instructions
Analog Speed Mode	+10~-10V Analog input	11	◆ Analog speed mode
Command Speed Mode	Q program commands or Modbus commands	21	◆ Q program commands ◆ Modbus communications control
Internal Multi-speed Mode	Digital Inputs	15	When motor is enabled, the running speed is set by P2-10 to P2-17, and selected by the digital input states of SPD1,SPD2 and SPD3.

7.3.1 Wiring Diagram of Speed Control Mode



7.3.2 Related Parameters to Analog Speed Control

There are two -10 ~ +10Vdc analog inputs with 12bit revolution,each can be set low-pass filter, Offset, Deadband,etc.

AIN1 is used as speed reference and AIN2 is used as torque reference,

Parameters	Command	Description	Range	Default	Unit	Instructions
P1-00	CM	Main Control Mode	1,2,7,11,15,21	7		The first control mode selection of the driver
P1-01	CN	Secondary Control Mode	1,2,7,11,15,21	21		The second control mode selection of the driver
P1-03	JM	Speed Control Clamp Mode	1-2	2		Select the control type for speed mode
P4-01	AG	Analog Input Velocity Scale	0 ~ 100	50	Rps	Scale factor value for motor speed and analog input. (Set corresponding motor speed when the analog input voltage is 10VDC).
P4-02	AN	Analog Input Torque Scale	0 ~ 3000	1000	0.1%	Scale factor value for motor torque and analog input. (Set corresponding motor torque when the analog input voltage is 10VDC)
P4-03	AV1	Analog Input 1 Offset	-10000 ~ 10000	0	mV	The offset of analog input 1.
P4-04	AV2	Analog Input 2 Offset	-10000 ~ 10000	0	mV	The offset of analog input 2.
P4-05	AD1	Analog Input 1 Deadband	0 ~ 255	0	mV	The deadband of analog input 1.
P4-06	AD2	Analog Input 1 Deadband	0 ~ 255	0	mV	The deadband of analog input 2.
P4-07	AF1	Analog Input 1 Filter	0 ~ 20000	1000	0.1Hz	Low-pass filter for analog input 1
P4-08	AF2	Analog Input 2 Filter	0 ~ 20000	1000	0.1Hz	Low-pass filter for analog input 2
P4-11	FA1	Velocity Limit Source Setting	0 ~ 2	0		The source of velocity limit command.
P2-03	JA	Jog Acceleration	0.167 ~ 5000	100	rps/s	The acceleration in internal speed control mode and analog speed mode.
P2-04	JL	Jog Deceleration	0.167 ~ 5000	100	rps/s	The deceleration in internal speed control mode and analog speed mode.

Note:

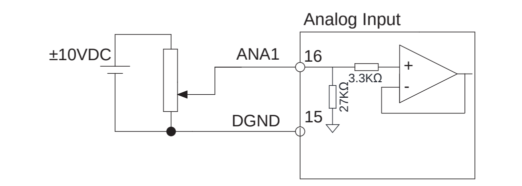
1. The parameter unit is the unit shown in software, it will be different when the parameter is shown in LED display on the drive.

2. The default values of different drive are not same.

7.3.3 Analog Speed Mode Settings

7.3.3.1 Wiring Methods of Analog Input

Signal Type	Signals	Pin No.	Description
Input	AIN1	16	Analog speed command
	DGND	15	GND of analog input



7.3.3.2 Source of Analog Speed Command

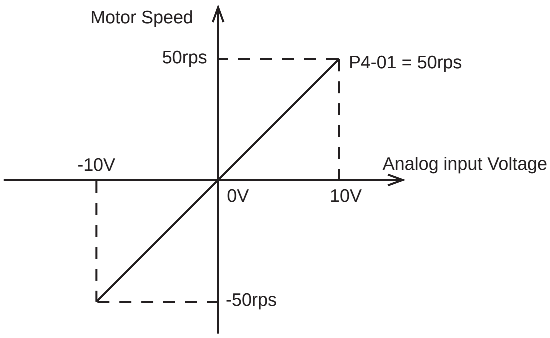
The source of anlog speed command is set by parameter P4-11.

Parameter	Command	Description	Range	Default	Unit	Instructions
P4-11	FA1	Velocity Limit Source Setting	0，1	0	-	The source of velocity limit command. 0: Internal speed command 1: Analog input 1

Note: When the control mode is set as Analog Speed Mode, P4-11 will be automatically set to 1.

7.3.3.3 Analog Speed Scale

The range of analog input is 10~+10VDC, P4-00 set the corresponding motor speed when analog input voltage is at 10VDC



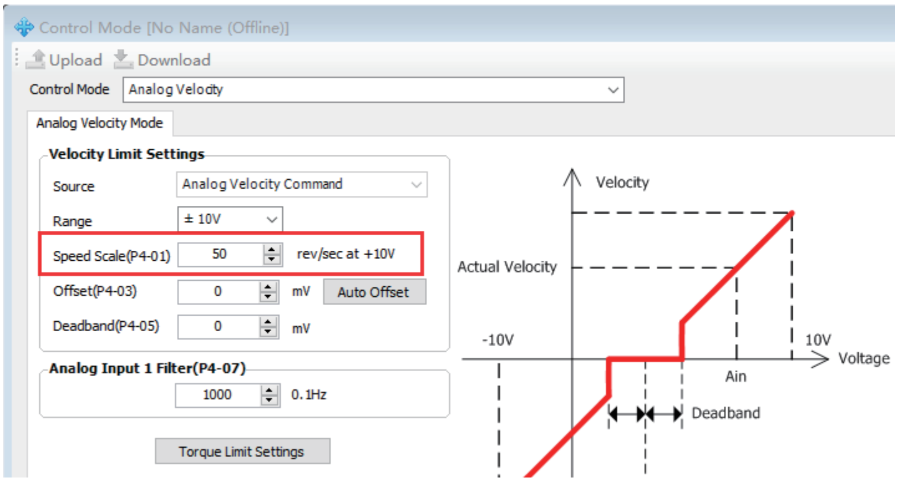
Parameter	Command	Description	Range	Default	Unit	Instructions
P4-01	AG	Analog Input Velocity Scale	0 ~ 100	50	rps	Set corresponding motor speed when the analog input voltage is 10VDC.

Note: To check or to change this value from drive operation panel, please calculate according to the following formula.

$$\textbf{LED Display value} = V \times 240$$

Where V is the speed to be set in rps(revolution per second)

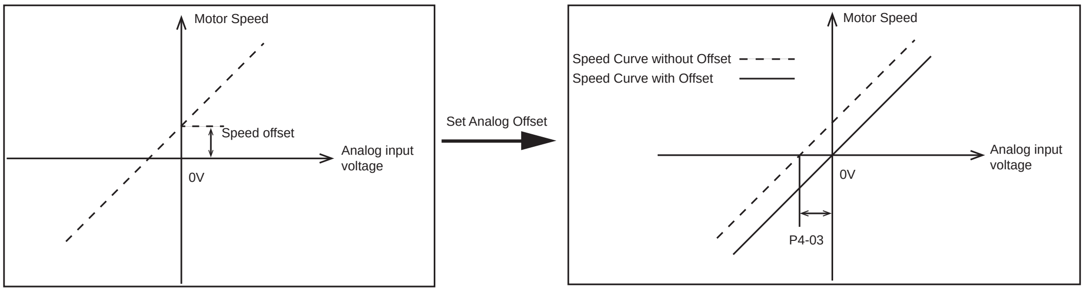
Set by Luna Software



7.3.3.4 Analog Input Offset

When using the analog speed mode, the servo motor may rotate slightly in some cases even if the input analog command is at 0 voltage. This is because there is a slight drift when analog signal is received by drive.

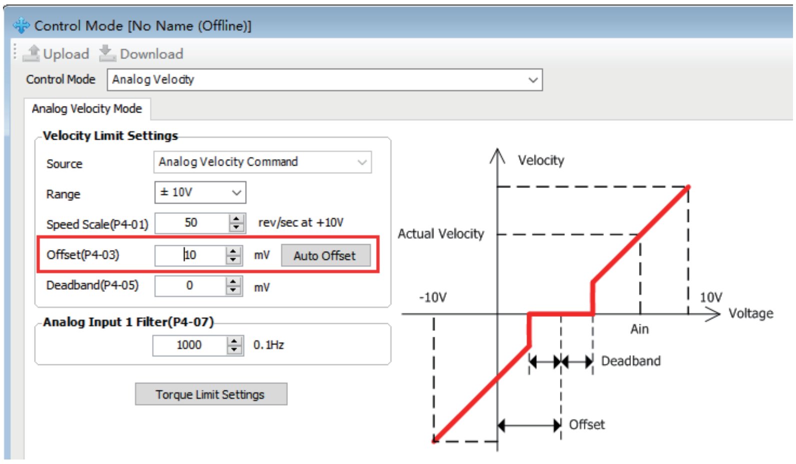
The parameter P4-03 and P4-04 are used to eliminate this situation. You can use the Luna software to automatically adjust the offset or manually modify these parameters.



Parameter	Command	Description	Unit	Range	Default	Instructions
P4-03	AV1	Analog Input 1 Offset	mV	-10000 ~ 10000	0	The offset of analo input 1.
P4-04	AV2	Analog Input 2 Offset	mV	-10000 ~ 10000	0	The offset of analo input 2.

The M56Sseries provides two methods of automatically adjust the analog offset.

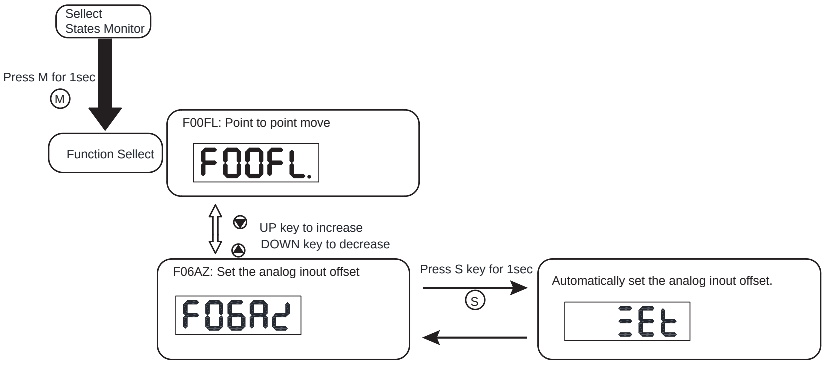
1) Automatic Adjust by Software



2) Adjust by LED Operation Panel

In the function mode, select the F06AZ function code to set the offset of analog input 1 and analog input 2 at the same time.

Related operations are as follows. For more details, refer to Chapter 5.5 Function Mode.

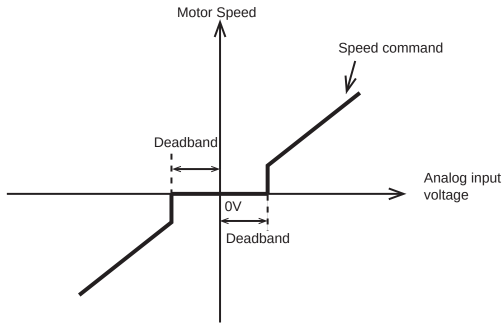


Note: When performing automatic adjustment:

- ◆ The servo system should be disabled.
- ◆ The analog command of the host controller outputs 0 voltage.

7.3.3.5 Analog Input Deadband

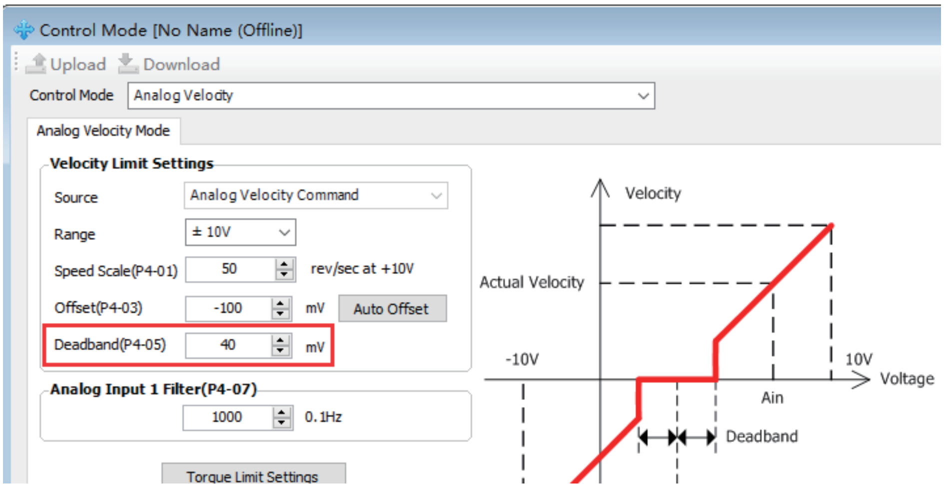
In analog control mode, due to some disturbances and other reasons, even if the command voltage is 0V, the input voltage on the drive side may be not absolutely zero, which makes the motor rotate at a very low speed. In order to eliminate this situation, setting a reasonable deadband can ensure that when the input voltage is within the deadband, it is regarded as 0V.



The analog input deadband can be set P4-05 and P4-06.

Parameter	Command	Description	Unit	Range	Default	Instructions
P4-05	AD1	Analog Input 1 Deadband	mV	0 ~ 255	0	The deadband of analog input 1.
P4-06	AD2	Analog Input 1 Deadband	mV	0 ~ 255	0	The deadband of analog input 2.

Set by Luna Software



7.3.3.6 Analog Input Filter

In analog control mode, due to external interference, the analog voltage may fluctuate, which will cause the fluctuation of the motor speed or the torque output, which will affect the control accuracy.

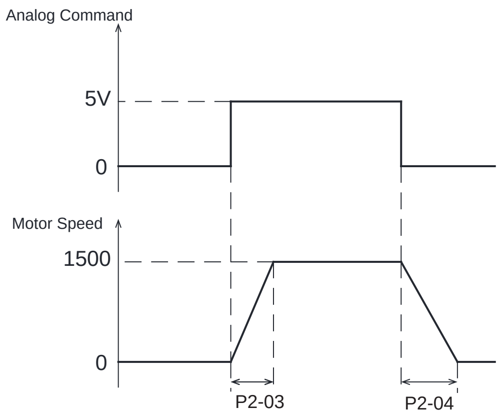
The analog input filter is a low-pass filter which is used to eliminate this fluctuation.

Parameter	Command	Description	Unit	Range	Default	Instructions
P4-07	AF1	Analog Input 1 Filter	0.1Hz	0 ~ 20000	1000	Low-pass filter for analog input 1
P4-08	AF2	Analog Input 2 Filter	0.1Hz	0 ~ 20000	1000	Low-pass filter for analog input 2

Note:
If the set value is too small, the response to the speed command will be reduced.

7.3.3.7 Acceleration Smoothing For Analog Speed Control

Analog commands are generally step signals, for example, the analog input voltage changes from 1V to 5V, which can easily cause equipment vibration when motor speed changes. Acceleration smoothing filtering is to smooth the step speed command, that is, to control the accleration and deceleration when target speed changes.



Parameters P2-03 and P2-04 set acceleration and deceleration in analog speed control mode.

Parameter	Command	Description	Unit	Range	Default	Instructions
P2-03	JA	Jog Acceleration	rps/s	0.167 ~ 5000	100	The acceleration in internal speed control mode and analog speed mode.
P2-04	JL	Jog Deceleration	rps/s	0.167 ~ 5000	100	The deceleration in internal speed control mode and analog speed mode.

Note: To check or to change this value from drive operation panel, please calculate according to the following formula.

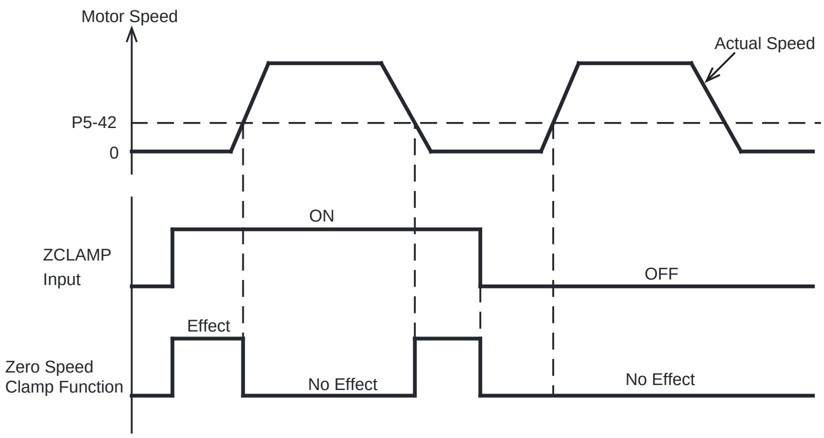
LED Display value = *V* x 6

Where *V* is the acceleration or deceleration to be set in rps/s

7.3.4 Zero Speed Clamp

In the speed control mode, when the Zero Speed Clamp input signal (ZCLAMP) is valid and the speed command is less than the set value of P5-42 (zero-speed judgment width), the servo motor will decelerate to zero and enters the zero-position lock state. Meanwhile the drive becomes position controlled, even if the shaft rotates under external force, it will return to the position when the ZCLAMP was valid.

If the speed command is higher than the set value of P5-42, servo drive exits the zero speed clamping state and accelerates to the command speed with the acceleration set by P2-03.



If the servo motor vibrates when the zero speed clamp is in effect, the position loop gains need to be tuned.

It is necessary to set a reasonable zero-speed judgment width. If the set value is too higher, it will cause vibration when motor decelerates quickly.

◆ **ZCLAMP--Zero speed clamp input signal**

To use Zero Speed Clamp function, one of digital inputs needs to be assigned this function.

Signal Type	Signal Symbol	Setup Value	Signal Logic	Instructions
Input	ZCLAMP	21	Closed	ZCLAMP will be in effect when the input is CLOSED.
			Open	ZCLAMP will be no effect when the input is OPEN.
		22	Open	ZCLAMP will be in effect when the input is OPEN.
			Closed	ZCLAMP will be no effect when the input is CLOSED.

Related Parameter

Parameter	Command	Description	Unit	Range	Default	Instructions
P5-42	ZV	Zero Speed Width	rps	0 ~ 2	0.5	When the speed is less than or equal to this set value, it is in the zero speed state.

Note: To check or to change this value from drive operation panel, please calculate according to the following formula.

$$\textbf{LED Display value} = \underline{V} \times 240$$

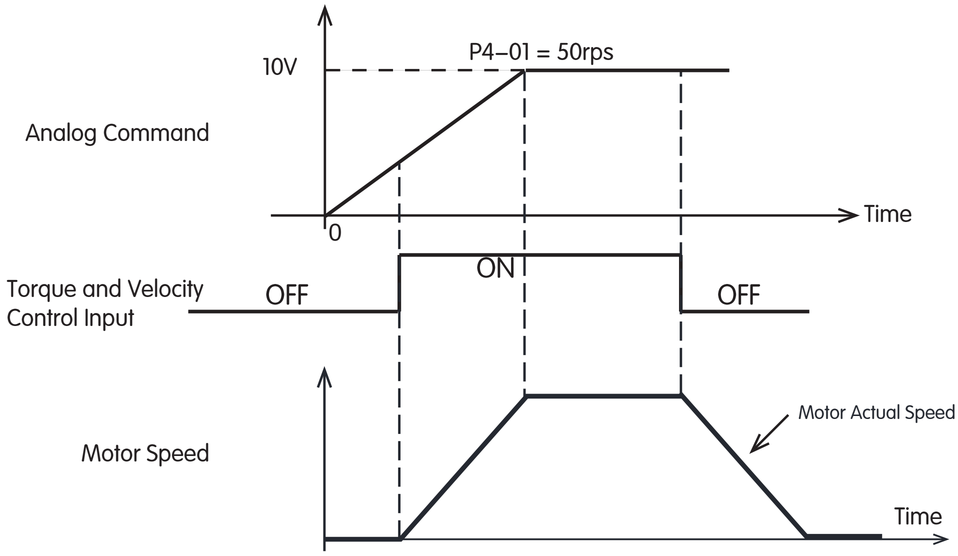
Where $\underline{V}$ is the speed to be set in rps(revolution per second)

7.3.5 Start/Stop Control and Direction Changing in Analog Speed Mode

7.3.5.1 Start and Stop Control

The motor speed is determined by the actual analog input voltage in the analog speed mode. When the speed command is "zero", the motor keeps the speed at zero.

You can also use the "Torque and Velocity Control" of input function to start and stop the motor rotating.



Note:
When the digital input is configured as the "Torque and Velocity Contro" function, if the input logic is OFF, the motor will stop even if the speed command is not zero.

7.3.5.2 Direction Control

In the speed mode, the motor rotation direction is usually determined by the sign of analong input voltage, or by the sign of speed command. If one of the digital inputs is set as Torque and Velocity Direction Switch(SPD-DIR) function, the motor rotates the absolute value of speed command, and the direction is controlled by the input logic of SPD-DIR.

For example, the analog input voltage is only 0 to 10V, the motor can only rotate positive, but the SPD-DIR input can be used to change the direction..

◆ SPD-DIR Configuration

To use torque and Velocity Direction Switch, one of digital inputs needs to be assigned this function.

Signal Type	Signal Symbol	Setup Value	Signal Logic	Instructions
Input	SPD-DIR	35	Closed	SPD-DIR input is valid, the motor rotates direction will be changed.
			Open	SPD-DIR input is invalid, the motor rotates direction will NOT be changed.
		36	Open	SPD-DIR input is valid, the motor rotates direction will be changed.
			Closed	SPD-DIR input is invalid, the motor rotates direction will NOT be changed.
	GP	0	-	None of digital inputs is configured as SPD-DIR function, the rotate direction is controlled by the sign of speed command.

The actual rotation direction is determined by the parameters P1-11 (Rotational Direction Setup), Speed Command (such as analog or communication command), and the input logic of SPD-DIR. The detailed relationship is as follows.

◆ When none of digital inputs is configured as SPD-DIR function

Value of P1-11	Speed Command	Input logic of SPD-DIR	Actual motor rotation direction
0	Positive	NONE FUNCTION	CW
0	Negative	NONE FUNCTION	CCW
1	Positive	NONE FUNCTION	CCW
1	Negative	NONE FUNCTION	CW

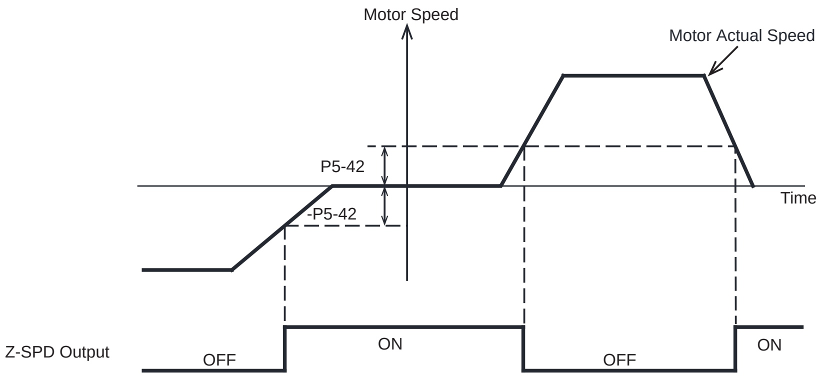
◆ One of digital inputs is configured as SPD-DIR function:

Value of P1-11	Speed Command	Input logic of SPD-DIR	Actual motor rotation direction
0	Positive	Invalid	CW
0	Negative	Invalid	
0	Positive	Valid	CCW
0	Negative	Valid	
1	Positive	Invalid	CCW
1	Negative	Invalid	
1	Positive	Valid	CW
1	Negative	Valid	

7.3.6 Zero Speed Detected Output

When the absolute value of motor actual speed is less than the set value of P5-42(zero-speed judgment width), the servo drive outputs the Zero Speed Detected(Z-SPD) signal. On the contrary, if the absolute value of motor actual speed is less than P5-42, the Z-SPD signal will not output.

Z-SPD output is not affected by control mode and servo status, therefore, this signal can also be used as the motor moving signal.



◆ Z-SPD Configuration

To use Zero Speed Detected(Z-SPD), one of digital outputs needs to be assigned this function.

Signal Type	Signal Symbol	Setup Value	Signal Logic	Instructions
Output	Z-SPD	33	Closed	When Zero Speed Detected output judgment condition is met, the Z-SPD signal will output, and the output state is CLOSED.
			Open	When Zero Speed Detected output judgment condition is NOT met, the Z-SPD signal will NOT output, and the output state is OPEN.
		34	Open	When Zero Speed Detected output judgment condition is met, the Z-SPD signal will output, and the output state is OPEN
			Closed	When Zero Speed Detected output judgment condition is NOT met, the Z-SPD signal will NOT output, and the output state is CLOSED.

Related Parameters

Parameter	Command	Description	Unit	Range	Default	Instructions
P5-42	ZV	Zero Speed Width	rps	0 ~ 2	0.5	As the speed is less than or equal to this set value, it is in the zero speed state.

Note: To check or to change this value from drive operation panel, please calculate according to the following formula.

LED Display value = *V* x 240

Where *V* is the speed to be set in rps(revolution per second)

7.3.7 Velocity Reach Output

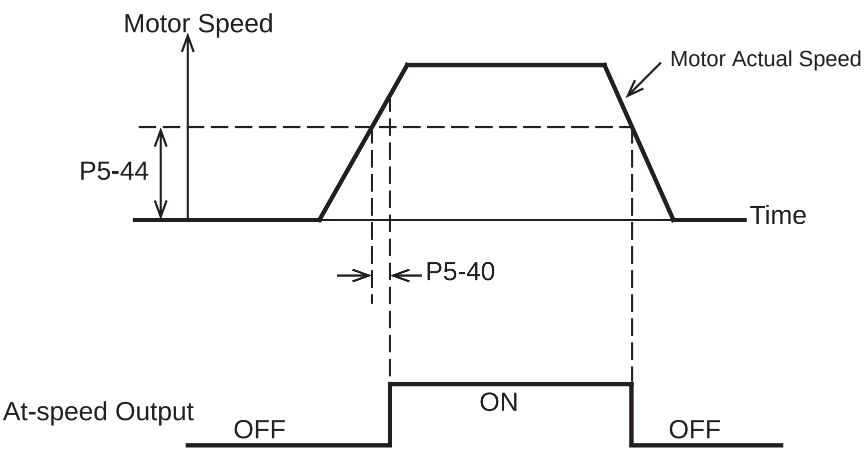
In speed control mode, the Velocity Reach Output, also know as At-speed(AT-SPD), which will be output when the filtered motor actual speed exceeds P5-44 (Target Value of AT-speed Output), and the time exceeds P5-40 (counting time for positioning completion) .

On the contrary, if the filtered motor actual speed is less than P5-44, the AT-SPD signal will not output.

◆ AT-SPD Configuration

To use Velocity Reach Output(AT-SPD), one of digital outputs needs to be assigned this function.

Signal Type	Signal Symbol	Setup Value	Signal Logic	Instructions
Output	AT-SPD	19	Closed	When Velocity Reach Output judgment condition is met, the AT-SPD signal will output, and the output state is CLOSED.
			Open	When Velocity Reach Output judgment condition is NOT met, the AT-SPD signal will NOT output, and the output state is OPEN.
		20	Open	When Velocity Reach Output judgment condition is met, the AT-SPD signal will output, and the output state is OPEN.
			Closed	When Velocity Reach Output judgment condition is NOT met, the AT-SPD signal will NOT output, and the output state is CLOSED.



Related Parameters

Parameter	Command	Description	Unit	Range	Default	Instructions
P5-44	VV	Target Value of AT-speed Output	Rps	0~100	10	AT-SPD will be out when the filtered motor actual speed exceeds P5-44 (Target Value of AT-speed Output), and the time exceeds P5-40 (counting time for positioning completion)
P5-40	PE	Time Constant of Motion Output Condition	ms	0 ~ 32000	10	

Note: To check or to change this value of P5-44 from drive operation panel, please calculate according to the following formula.

$$\textbf{LED Display value} = V \times 240$$

Where V is the speed to be set in rps(revolution per second)

7.3.8 Velocity Coincidence Output

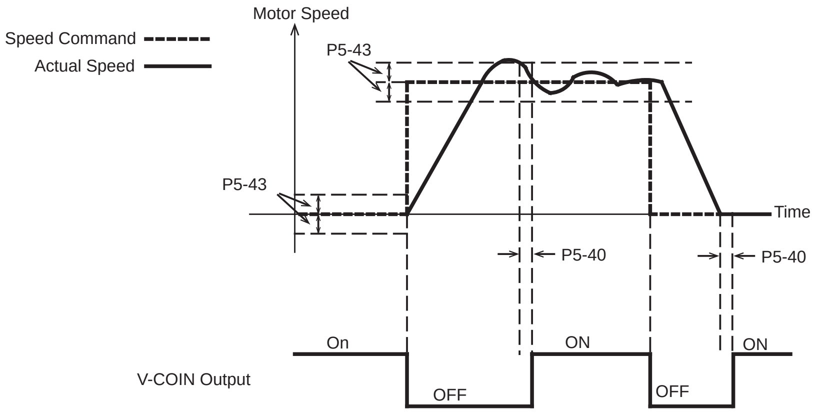
In speed mode, when the difference between the filtered motor actual speed and the speed command, that is, the speed error is within the range of P5-43 (Speed Coincidence Width), and the duration time meets the set value of P5-40 (Time Constant of Motion Output Condition), then the Velocity Coincidence signal V-COIN is output.

If the speed error exceeds the set value of P5-43, V-COIN will not output.

◆ V-COIN Configuration

To use Velocity Coincidence Output(V-COIN), one of digital outputs needs to be assigned this function.

Signal Type	Signal Symbol	Setup Value	Signal Logic	Instructions
Output	V-COIN	17	Closed	When Velocity Coincidence output judgment condition is met, the V-COIN signal will output, and the output state is CLOSED.
			Open	When Velocity Coincidence output judgment condition is NOT met, the V-COIN signal will NOT output, and the output state is OPEN.
		18	Open	When Velocity Coincidence output judgment condition is met, the V-COIN signal will output, and the output state is OPEN.
			Closed	When Velocity Coincidence output judgment condition is NOT met, the V-COIN signal will NOT output, and the output state is CLOSED.



Related Parameters

Parameter	Command	Description	Unit	Range	Default	Instructions
P5-43	VR	Speed Coincidence Width	Rps	0~100	0.1	V-COIN will output when the speed error is within the range of P5-43 (Speed Coincidence Width), and the duration time meets the set value of P5-40 (Time Constant of Motion Output Condition).
P5-40	PE	Time Constant of Motion Output Condition	ms	0 ~ 32000	10	

Note: To check or to change this value of P5-43 from drive operation panel, please calculate according to the following formula.

LED Display value = *V* x 240

Where ***V*** is the speed to be set in rps(revolution per second)

7.3.9 Gain parameters and Speed Control Type in Speed Mode

There are two speed control types in the speed mode.

1. Detect the position errors in real-time
2. Speed control only(default setting)

Related Parameters

Parameter	Command	Description	Unit	Range	Default	Instructions
P1-03	JM	Speed Control Clamp Mode	-	1，2	2	Set the control type in speed mode JM=1. Detect the position errors in real-time JM=2. Speed control only(default setting)

A) P1-03 = 1-----Detect the position errors in real-time

In this control type, the position error will be detected in real time. When the position error exceeds the setting of P3-04 (Position Error Limit), the drive will get a position follow error fault.

Related gain parameters are as follows.

Parameter	Command	Description	Type	Default	Unit
P0-05	KP	1st Position Loop Gain	First Gain Parameters 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 Velocity Loop Integral Time Constant		189	ms
P0-16	KC	1st Torque Command Filter		1099	0.1Hz
P0-17	UP	2nd Position Loop Gain	Second Gain Parameters Group	52	0.1Hz
P0-19	UD	2nd Position Loop Derivative Time Constant		0	ms
P0-20	UE	2nd Position Loop Derivative Filter		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 Torque Command Filter		1099	0.1Hz

B) P1-03 = 2-----Speed control only

In this control type, position error will not be detected, and no alarm will be occurred even if the motor stalled.

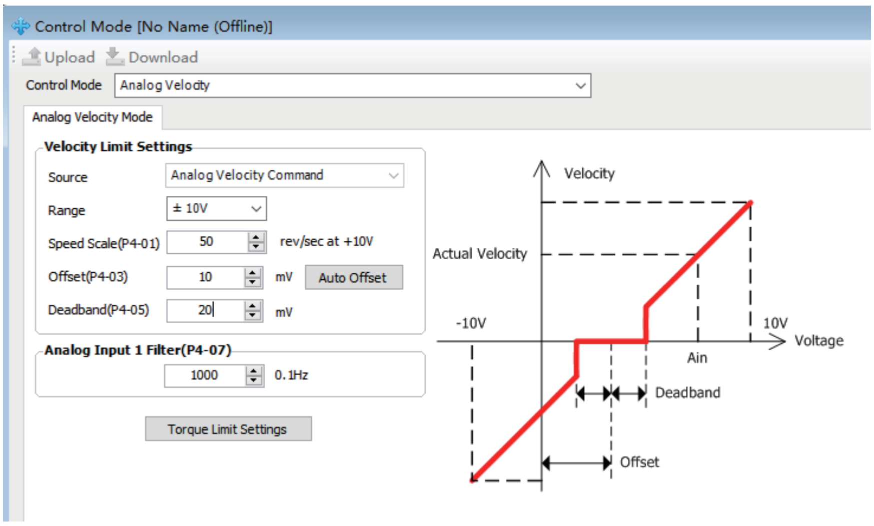
The speed loop gain parameters are set by P0-12 and P0-13.

Parameter	Command	Description	Unit	Range	Default
P0-12	VP	1st Velocity Loop Gain	0.1Hz	0~30000	515
P0-13	VI	1st Velocity Loop Integral Time Constant	ms	0~32767	79

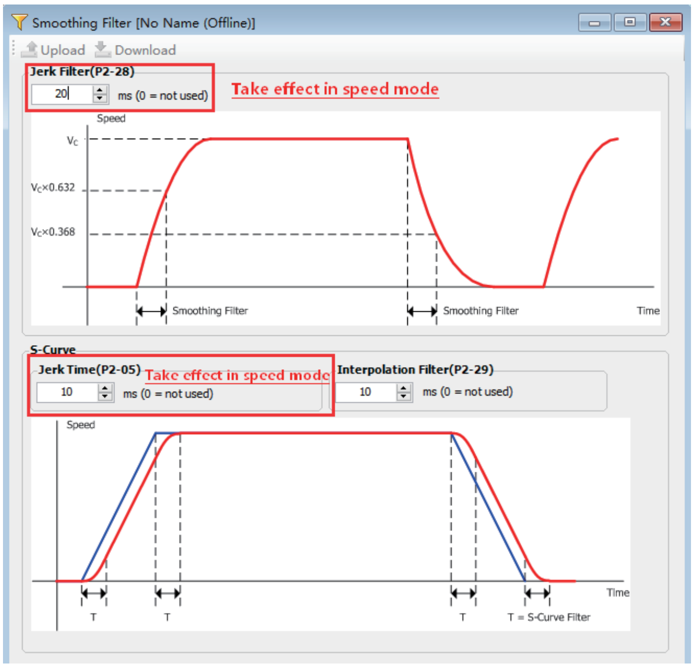
7.3.10 Using Luna Software to Configurate Speed Control Mode

The speed control mode can be easily configured using the Luna software.

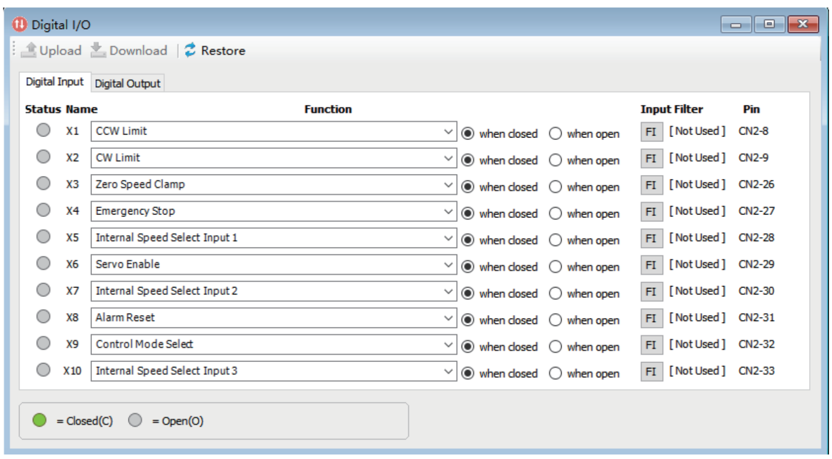
Step 1: Select Control Mode



Step 2: Set Smoothing Filter

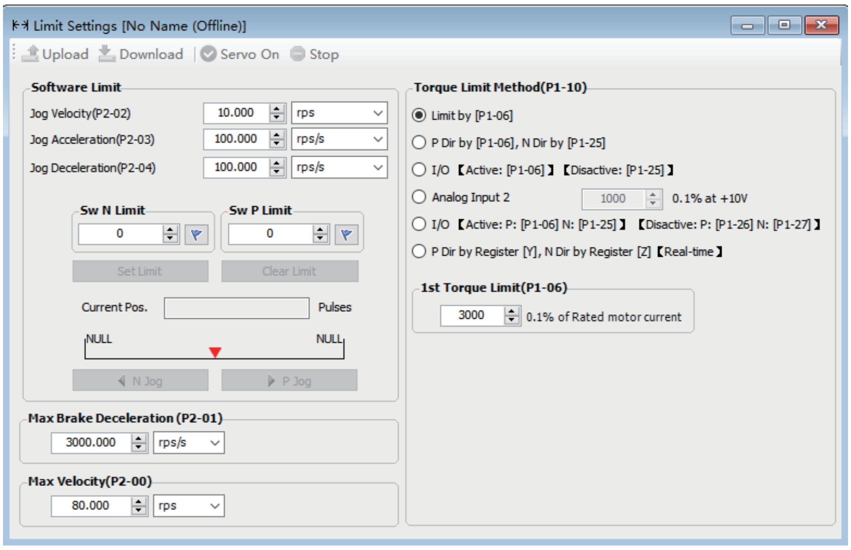


Step 3: Input and Output Configurations

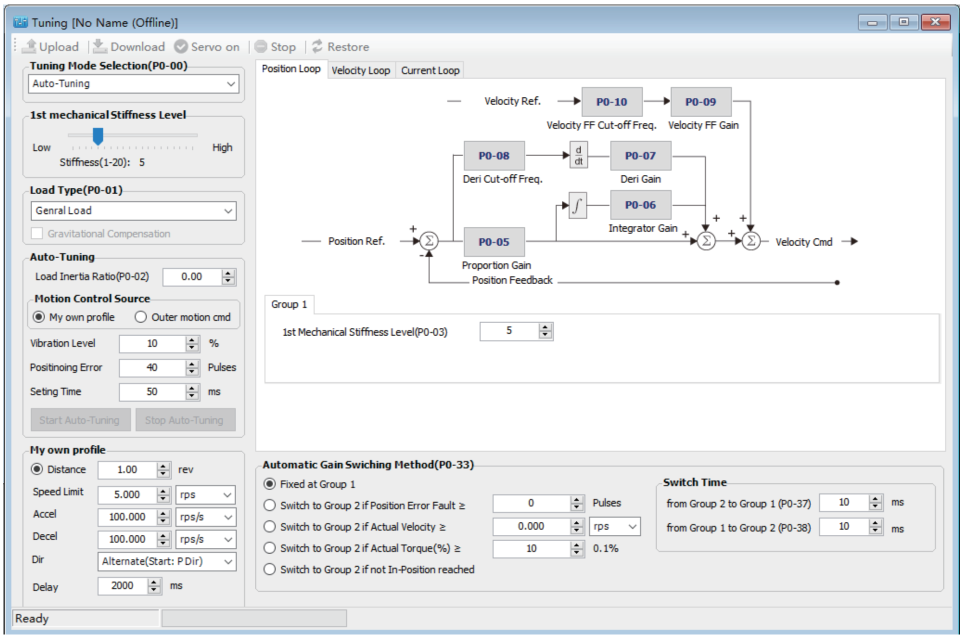


Step 4: Position Limit and Torque Limit Configuration

The torque limit function can also be used in speed mode. If an absolute encoder is used, the soft limit function can be used.



Step 5: Gain Tuning



7.4 Torque Mode

7.4.1 Torque Control Mode Instructions

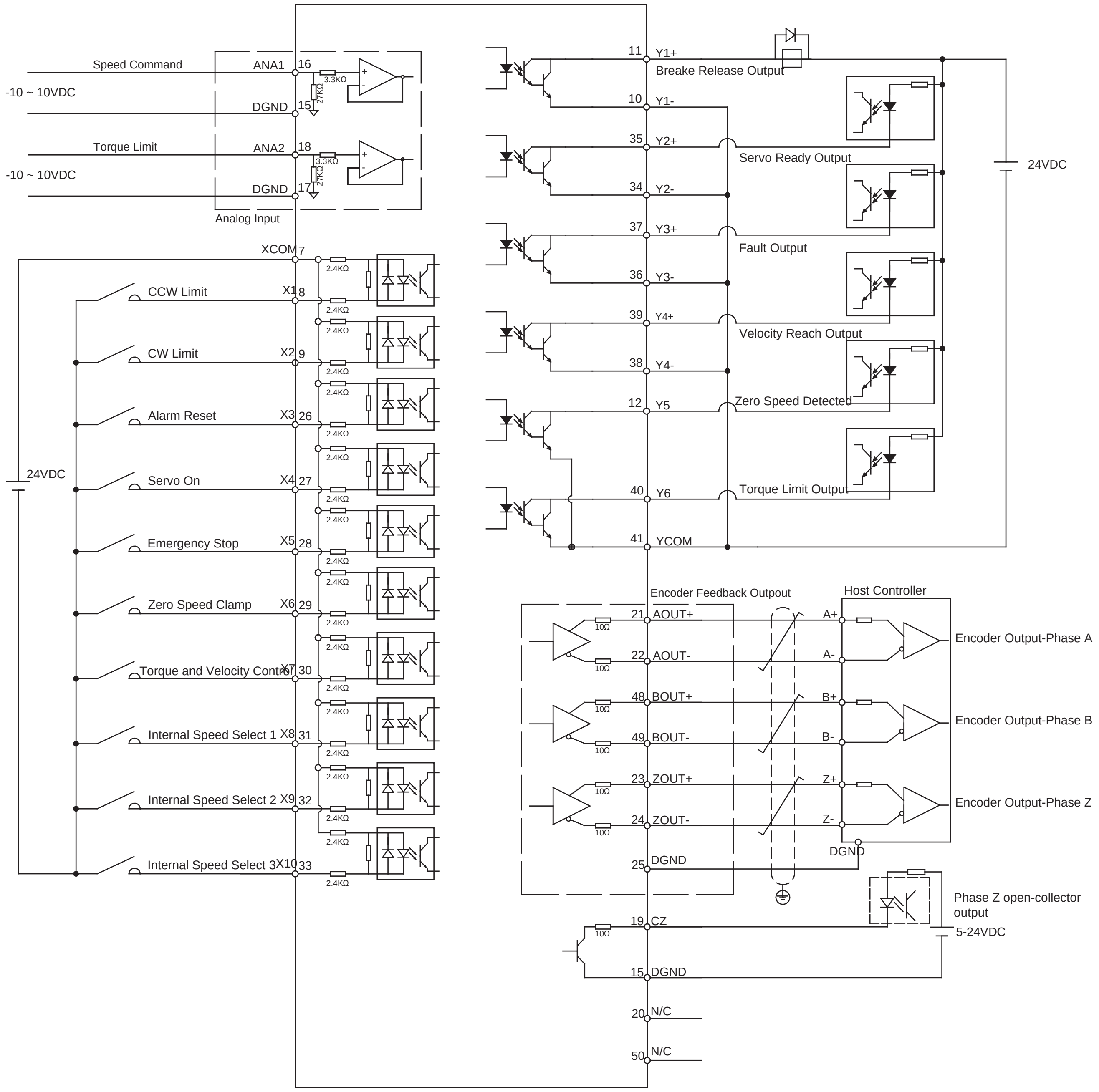
Torque control mode is used for precise torque control. There are two torque control mode in M56S series: Analog Torque Mode and Command Torque Mode.

1) Analog Torque Mode: -10 ~ +10Vdc external analog voltage input to control the motor torque.

2) Command Torque Mode: Use Q program commands to control the motor torque, or use Modbus commands to control the motor torque.

Control Mode	Control Signal	P1-00	Instructions
Analog Torque Mode	+10~-10V Analog input	2	◆ Analog speed mode
Command Torque Mode	Q program commands or Modbus commands	1	◆ Q program commands ◆ Modbus communications control

7.4.2 Wiring Diagram of Torque Control Mode



7.4.3 Related Parameters to Analog Torque Control

There are two -10 ~ +10Vdc analog inputs with 12bit revolution,each can be set low-pass filter, Offset, Deadband,etc.

AIN1 is used as speed reference and AIN2 is used as torque reference,

Parameters	Command	Description	Range	Default	Unit	Instructions
P1-00	CM	Main Control Mode	1,2,7,11,15,21	7		The first control mode selection of the driver
P1-01	CN	Secondary Control Mode	1,2,7,11,15,21	21		The second control mode selection of the driver
P1-03	JM	Speed Control Clamp Mode	1-2	2		Select the control type for speed mode
P4-01	AG	Analog Input Velocity Scale	0 ~ 100	50	Rps	Scale factor value for motor speed and analog input. (Set corresponding motor speed when the analog input voltage is 10VDC).
P4-02	AN	Analog Input Torque Scale	0 ~ 3000	1000	0.1%	Scale factor value for motor torque and analog input. (Set corresponding motor torque when the analog input voltage is 10VDC)
P4-03	AV1	Analog Input 1 Offset	-10000 ~ 10000	0	mV	The offset of analog input 1.
P4-04	AV2	Analog Input 2 Offset	-10000 ~ 10000	0	mV	The offset of analog input 2.
P4-05	AD1	Analog Input 1 Deadband	0 ~ 255	0	mV	The deadband of analog input 1.
P4-06	AD2	Analog Input 1 Deadband	0 ~ 255	0	mV	The deadband of analog input 2.
P4-07	AF1	Analog Input 1 Filter	0 ~ 20000	1000	0.1Hz	Low-pass filter for analog input 1
P4-08	AF2	Analog Input 2 Filter	0 ~ 20000	1000	0.1Hz	Low-pass filter for analog input 2
P4-11	FA1	Velocity Limit Source Setting	0 ~ 2	0		The source of velocity limit command.
P2-03	JA	Jog Acceleration	0.167 ~ 5000	100	rps/s	The acceleration in internal speed control mode and analog speed mode.
P2-04	JL	Jog Deceleration	0.167 ~ 5000	100	rps/s	The deceleration in internal speed control mode and analog speed mode.

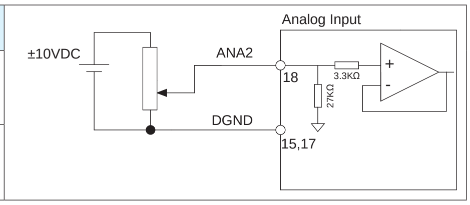
Note:
1. The parameter unit is the unit shown in software, it will be different when the parameter is shown in LED display on the drive.
2. The default values of different drive are not same.

7.4.4 Analog Torque Mode Settings

When the control mode of torque mode is selected as analog control, i.e. P1-00=2. It is necessary to make relevant settings for analog input.

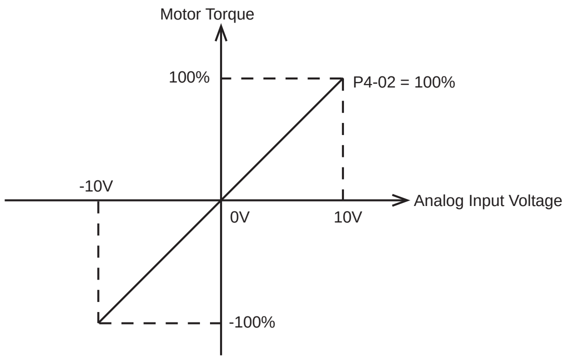
7.4.4.1 Wiring Methods of Analog Torque Command Input

Signal Type	Signals	Pin No.	Description
Input	AIN2	18	Analog torque command input
	DGND	15, 17	GND of analog input



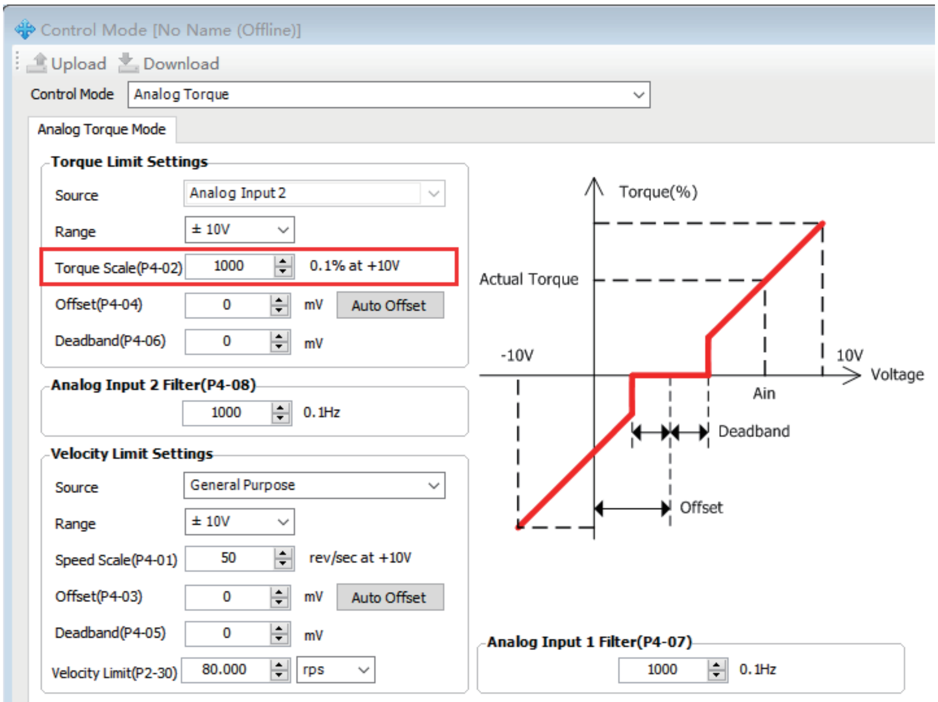
7.4.4.2 Analog Torque Scale

The range of analog input is 10~+10VDC, P4-02 set the corresponding motor output torque when analog input voltage is at 10VDC.



Parameter	Command	Description	Range	Default	Unit	Instructions
P4-02	AN	Analog Input Torque Scale	0 ~ 3000	1000	0.1%	Set corresponding motor output torque when the voltage of analog input 2 is 10VDC.

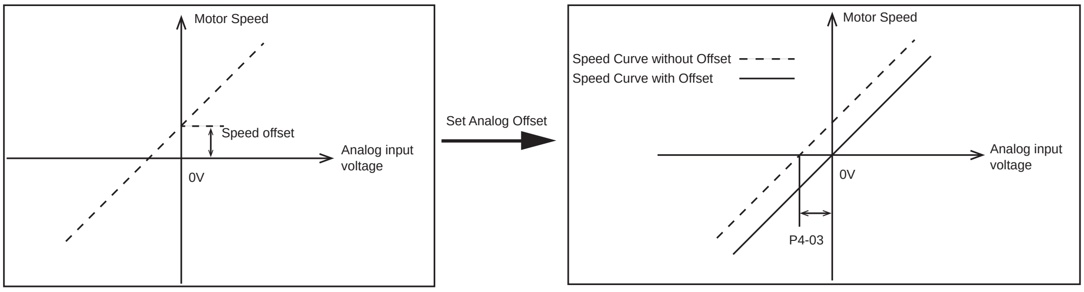
Software Settings



7.4.4.3 Analog Input Offset

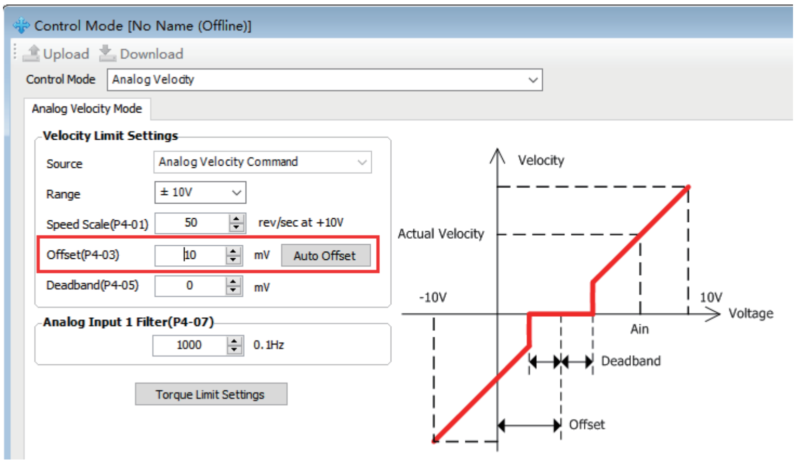
When using the analog speed mode, the servo motor may rotate slightly in some cases even if the input analog command is at 0 voltage. This is because there is a slight drift when analog signal is received by drive.

The parameter P4-03 and P4-04 are used to eliminate this situation. You can use the Luna software to automatically adjust the offset or manually modify these parameters.



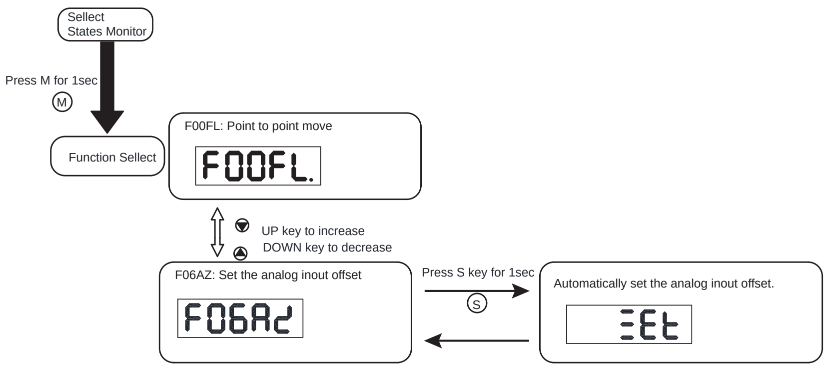
Parameter	Command	Description	Unit	Range	Default	Instructions
P4-03	AV1	Analog Input 1 Offset	mV	-10000 ~ 10000	0	The offset of analo input 1.
P4-04	AV2	Analog Input 2 Offset	mV	-10000 ~ 10000	0	The offset of analo input 2.

The M56Sseries provides two methods of automatically adjust the analog offset.
1) Automatic Adjust by Software



2) Adjust by LED Operation Panel
In the function mode, select the F06AZ function code to set the offset of analog input 1 and analog input 2 at the same time.

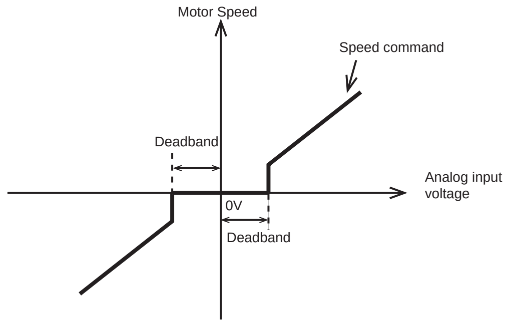
Related operations are as follows. For more details, refer to Chapter 5.5 Function Mode.



Note: When performing automatic adjustment:
- ◆ The servo system should be disabled.
- ◆ The analog command of the host controller outputs 0 voltage.

7.4.4.4 Analog Input Deadband

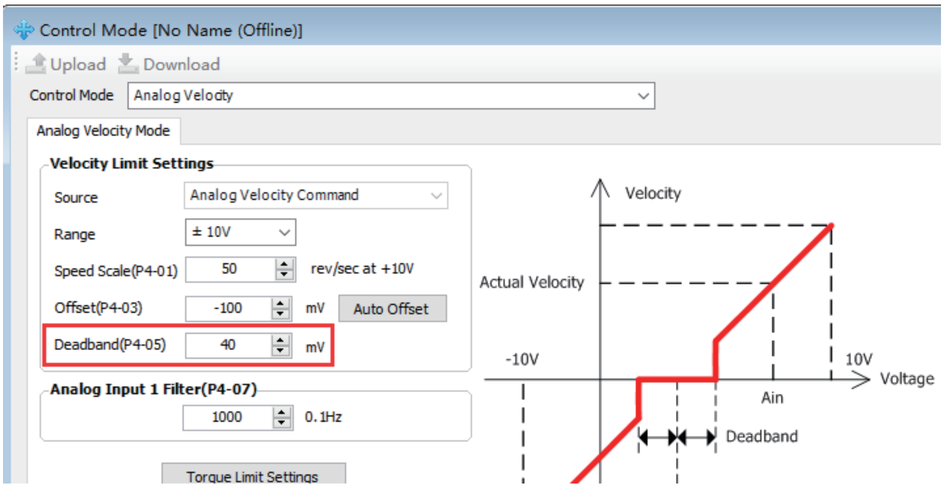
In analog control mode, due to some disturbances and other reasons, even if the command voltage is 0V, the input voltage on the drive side may be not absolutely zero, which makes the motor rotate at a very low speed. In order to eliminate this situation, setting a reasonable deadband can ensure that when the input voltage is within the deadband, it is regarded as 0V.



The analog input deadband can be set P4-05 and P4-06.

Parameter	Command	Description	Unit	Range	Default	Instructions
P4-05	AD1	Analog Input 1 Deadband	mV	0 ~ 255	0	The deadband of analog input 1.
P4-06	AD2	Analog Input 1 Deadband	mV	0 ~ 255	0	The deadband of analog input 2.

Set by Luna Software



7.4.4.5 Analog Input Filter

In analog control mode, due to external interference, the analog voltage may fluctuate, which will cause the fluctuation of the motor speed or the torque output, which will affect the control accuracy.

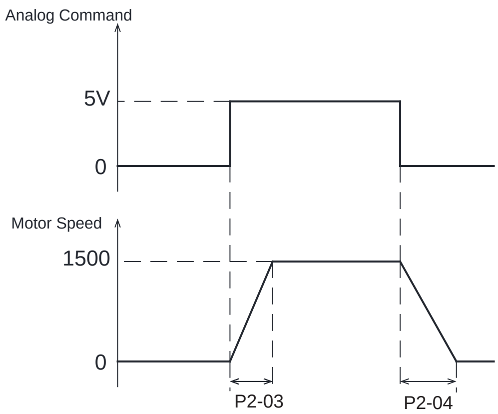
The analog input filter is a low-pass filter which is used to eliminate this fluctuation.

Parameter	Command	Description	Unit	Range	Default	Instructions
P4-07	AF1	Analog Input 1 Filter	0.1Hz	0 ~ 20000	1000	Low-pass filter for analog input 1
P4-08	AF2	Analog Input 2 Filter	0.1Hz	0 ~ 20000	1000	Low-pass filter for analog input 2

Note:
If the set value is too small, the response to the speed command will be reduced.

7.4.4.6 Acceleration Smoothing For Analog Speed Control

Analog commands are generally step signals, for example, the analog input voltage changes from 1V to 5V, which can easily cause equipment vibration when motor speed changes. Acceleration smoothing filtering is to smooth the step speed command, that is, to control the accleration and deceleration when target speed changes.



Parameters P2-03 and P2-04 set acceleration and deceleration in analog speed control mode.

Parameter	Command	Description	Unit	Range	Default	Instructions
P2-03	JA	Jog Acceleration	rps/s	0.167 ~ 5000	100	The acceleration in internal speed control mode and analog speed mode.
P2-04	JL	Jog Deceleration	rps/s	0.167 ~ 5000	100	The deceleration in internal speed control mode and analog speed mode.

Note: To check or to change this value from drive operation panel, please calculate according to the following formula.

LED Display value = *V* x 6

Where ***V*** is the acceleration or deceleration to be set in rps/s

7.4.5 Speed Limit in Torqur Control Mode

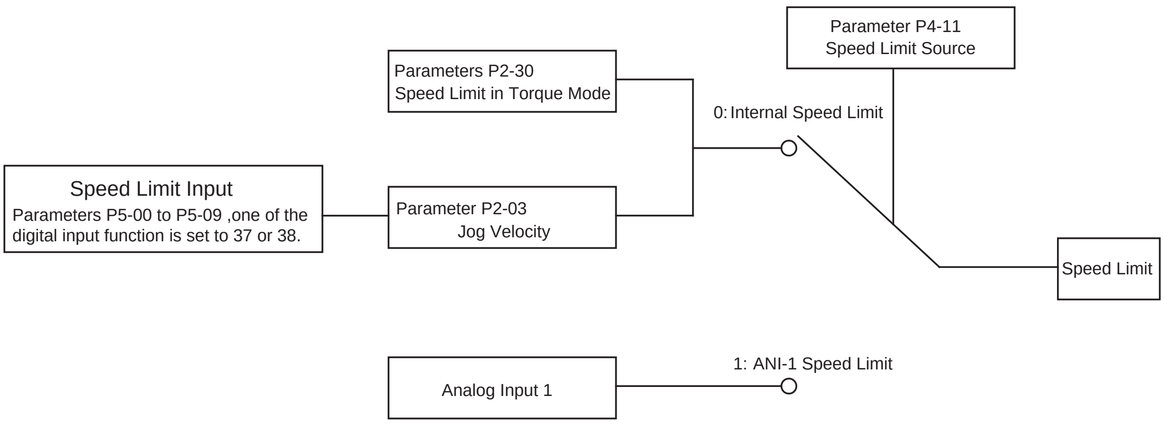
In torque mode, when the load connected to the motor is small but the torque command is too large, the motor may accelerate to a very high speed if the motor output speed is not limited, which may cause unexpected situations. Therefore it is necessary to set a maximum motor speed in torque mode. The motor actual speed will be limited within the set value.

7.4.5.1 Speed Limit Source

There are three limit sources in torque control mode.

Speed Limit Source	Description
Analog Input 1	Use analog input 1 as the speed limit source, and the corresponding limit speed at 10Vdc is set by parameter P4-01(AG)
Internal Speed Limits	There are two internal speed limits: 1. Directly limited by parameter P2-30(VT) 2. If the digital input function is set as the Speed Limit Input (V-LMT), when the input logic is ON, the speed limit function takes effect, the speed is limited at the value set by P2-02 (JS).

The mechanism of speed limit sources is shown in the figure below.



Related Parameters

Parameter	Command	Description	Range	Default	Unit	Description
P4-11	FA	Velocity Limit Setting of Torque Control	0 ~ 1	0		Speed limit source: 0: Inernal Speed command 1: Analog Input 1
P4-01	AG	Analog Input Velocity Scale	0 ~ 100	50	rps	Analog input speed scaling. In torque mode, when the analog input 1 is used as the speed limit source, this parameter corresponds to the speed limit value at 10Vdc
P2-30	VT	Velocity Limit in Torque Control	0 ~ 100	50	rps	In torque mode, when the internal speed limit is used as the speed limit source, this parameter is used as the speed limit value
P2-02	JS	Jog Velocity	-100 ~ 100	10	rps	If the digital input function is set as the Speed Limit Input (V-LMT), when the input logic is ON, the speed limit function takes effect, the speed is limited at the value set by P2-02 (JS).
P5-00 至 P5-09	MU1~MUA	Digital Input Function	37 ~ 38			Set the function of digital input X1 to X10 as "Speed Limit Input"
P5-12 至 P5-17	MO1~MO6	Digital Output Function	21 ~ 22			Set the function of digital output Y1 to Y6 as "Speed Limit Output"

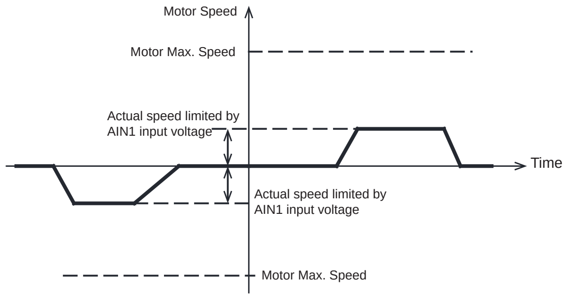
Note: To check or to change the value of P4-01\P2-30\P2-02 from drive operation panel, please calculate according to the following formula.

LED Display value = *V* x 240

Where *V* is the speed to be set in rps(revolution per second)

1) Seed Limit Source----Analog Input 1(P4-11 = 1)

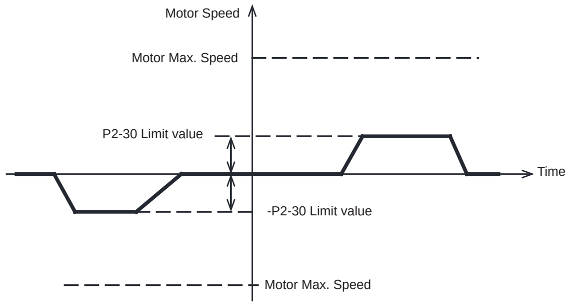
When the parameter P4-11 is set to 1, the analog input 1 is used as the speed limit source, the corresponding speed limit value at 10V is set by parameter P4-01 (AG).



2) Seed Limit Source----Internal Speed Command(P4-11 = 0)

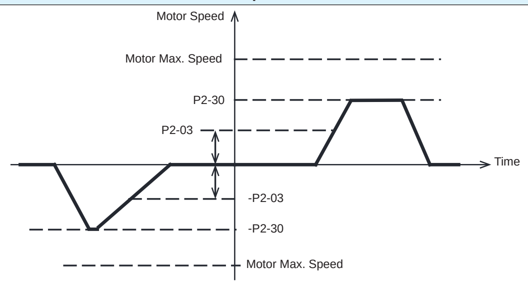
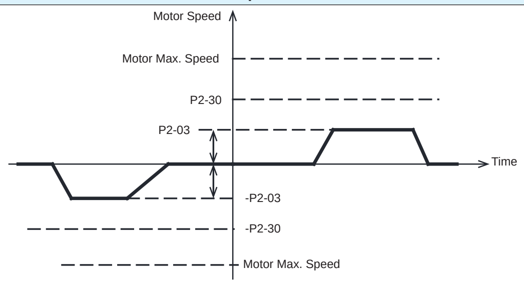
A) Directly limited by P2-30

When P4-11 is set to 0, parameter P2-30 is used as the speed limit in torque mode.



B) Speed Limit Input(V-LMT)

If the digital input function is set as the Speed Limit Input (V-LMT), when the input logic is ON, the speed limit function takes effect, the speed is limited at the value set by P2-02 (JS)

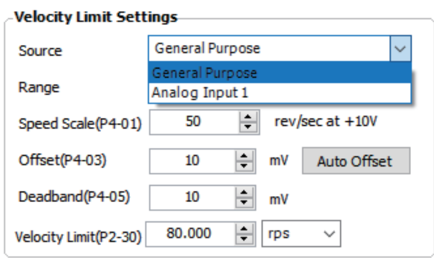
V-LMT input is invalid	V-LMT input is valid
	

◆ V-LMT configuration

To use Speed Limit Input function, one of digital inputs needs to be assigned this function.

Signal Type	Signal Symbol	Setup Value	Signal Logic	Instructions
Input	V-LMT	37	Closed	V-LMT will be in effect when the input is CLOSED.
			Open	V-LMT will be no effect when the input is OPEN.
		38	Open	V-LMT will be in effect when the input is OPEN.
			Closed	V-LMT will be no effect when the input is CLOSED.

7.4.5.2 How to Set by Luna Software



7.4.6 Speed Limited Output(V-LTD)

V-LTD, speed limited output siganl, indicates that the motor speed is limited.

Related Parameter

Signal Type	Signal Symbol	Setup Value	Signal Logic	Instructions
Output	V-LMT	21	Closed	When the motor output speed is limited, the V-LTD signal will output, and the output state is CLOSED.
			Open	When the motor output speed is NOT limited, the V-LTD signal will NOT output, and the output state is OPEN.
		22	Open	When the motor output speed is limited, the V-LTD signal will output, and the output state is OPEN.
			Closed	When the motor output speed is NOT limited, the V-LTD signal will NOT output, and the output state is CLOSED.

7.4.7 Torque Reach Output

When the absolute value of the actual motor output torque exceeds the set value of P1-07(Target Torque Value when Torque Value Reached), and the torque fluctuation is within the range of P5-45, the torque reach signal TQ-REACH will be output.

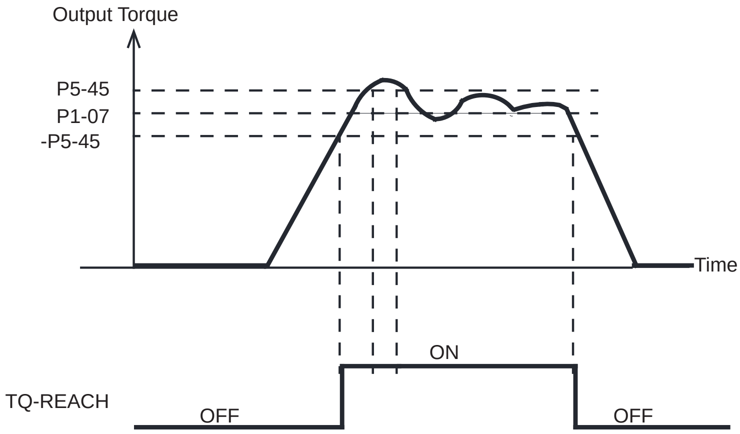
If the actual motor output torque doesn't exceed or is lower than P1-07, the TQ-REACH signal will not output.

This function is applicable in all control modes, such as position mode, speed mode, torque mode, etc.

◆ TQ-REACH signal configuration

To use Torque Reach Output(TQ-REACH), one of digital outputs needs to be assigned this function.

Signal Type	Signal Symbol	Setup Value	Signal Logic	Instructions
Output	TQ-REACH	13	Closed	When Torque Reach Output judgment condition is met, the TQ-REACH signal will output, and the output state is CLOSED.
			Open	When Torque Reach Output judgment condition is NOT met, the TQ-REACH signal will NOT output, and the output state is OPEN.
		14	Open	When Torque Reach Output judgment condition is met, the TQ-REACH signal will output, and the output state is OPEN.
			Closed	When Torque Reach Output judgment condition is NOT met, the TQ-REACH signal will NOT output, and the output state is CLOSED.



Related Parameters

Parameter	Command	Description	Range	Default	Unit	Instructions
P1-07	CV	Target Torque Value when Torque Value Reached	0~3000	0	0.1%	When the actual motor output torque exceeds the P1-07 and the torque fluctuation is within the range of P5-45, the TQ-REACH signal will be output.
P5-45	TV	Torque Reach Width	0~3000	10	0.1%	

7.4.8 Torque Coincidence Output

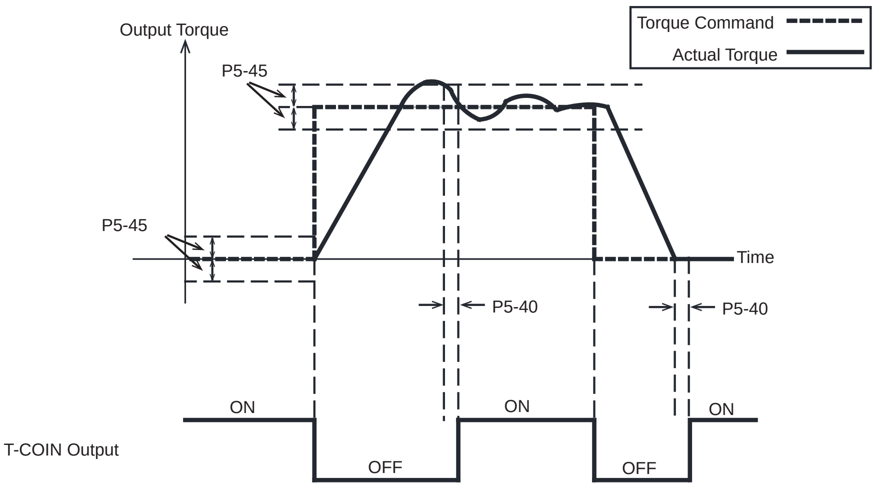
In torque mode, when the difference between the filtered motor actual output torque and the torque command, that is, the torque error is within the range of P5-45 (Torque Reach Width), and the duration time meets the set value of P5-40 (Time Constant of Motion Output Condition), then the Torque Coincidence signal T-COIN is output.

If the torque error exceeds the set value of P5-45, T-COIN will not output.

◆ T-COIN signal configuration

To use Torque Coincidence Output(T-COIN), one of digital outputs needs to be assigned this function.

Signal Type	Signal Symbol	Setup Value	Signal Logic	Instructions
Output	T-COIN	35	Closed	When Torque Coincidence output judgment condition is met, the T-COIN signal will output, and the output state is CLOSED.
			Open	When Torque Coincidence output judgment condition is NOT met, the T-COIN signal will NOT output, and the output state is OPEN.
		36	Open	When Torque Coincidence output judgment condition is met, the T-COIN signal will output, and the output state is OPEN.
			Closed	When Torque Coincidence output judgment condition is NOT met, the T-COIN signal will NOT output, and the output state is CLOSED.



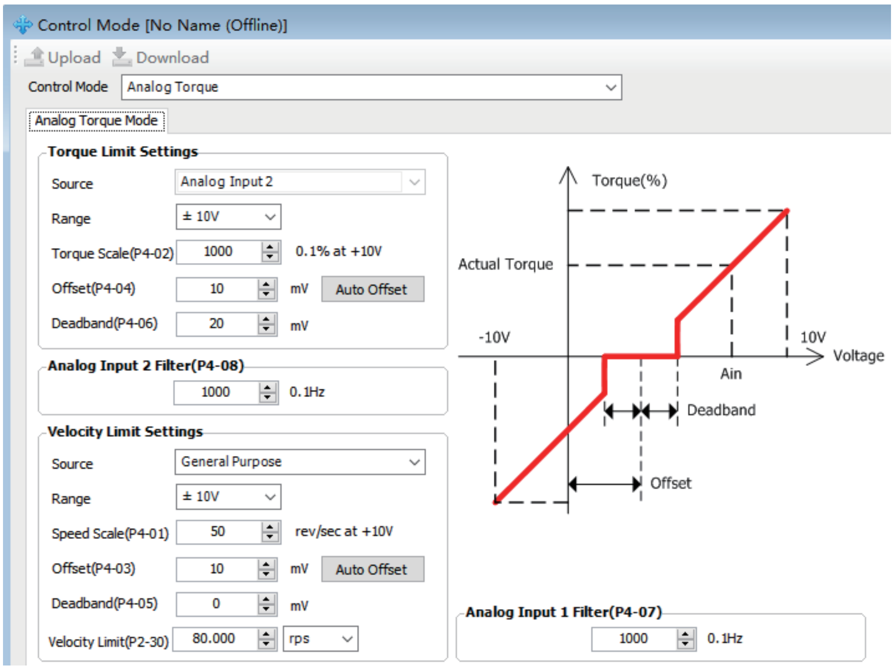
Related Parameters

Parameter	Command	Description	Unit	Range	Default	Instructions
P5-45	TV	Torque Reach Width	0.1%	0 ~ 3000	10	T-COIN will output when the torque error is within the range of P5-45 and the duration time meets the set value of P5-40.
P5-40	PE	Time Constant of Motion Output Condition	ms	0 ~ 32000	10	

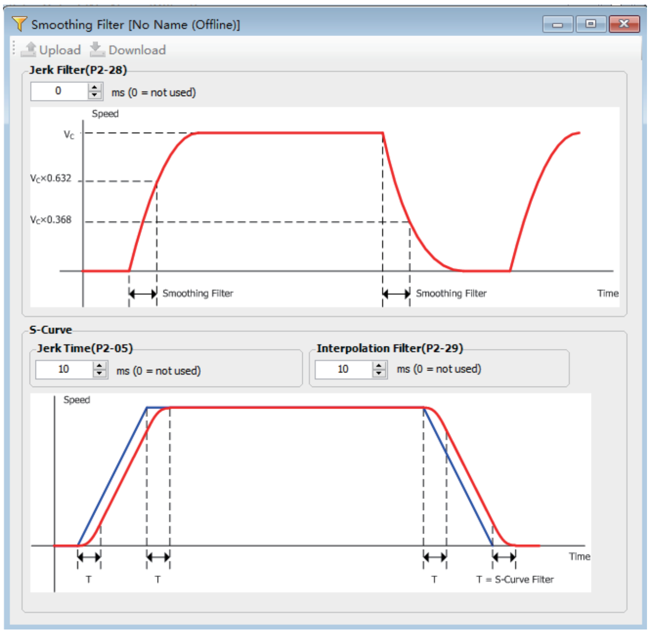
7.4.9 Using Luna Software to Configurate Torque Control Mode

The torque control mode can be easily configured using the Luna software.

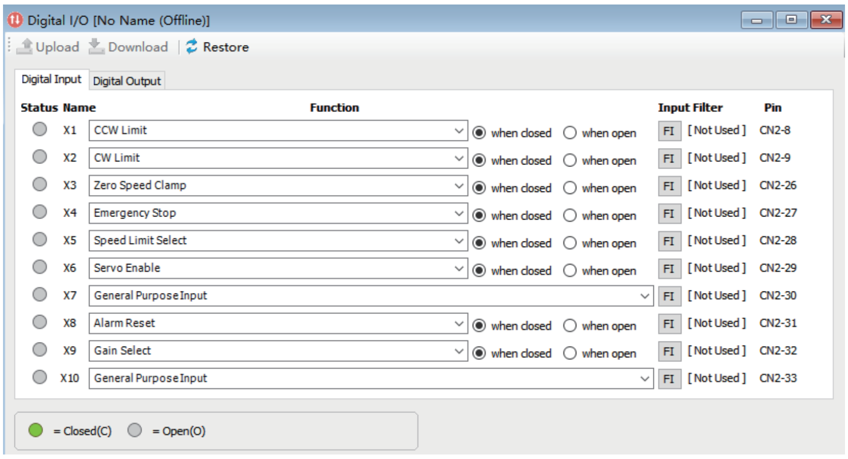
Step 1: Select Control Mode
Select control mode and set related parameters.



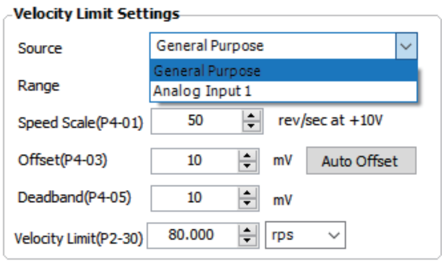
Step 2: Set Smoothing Filter



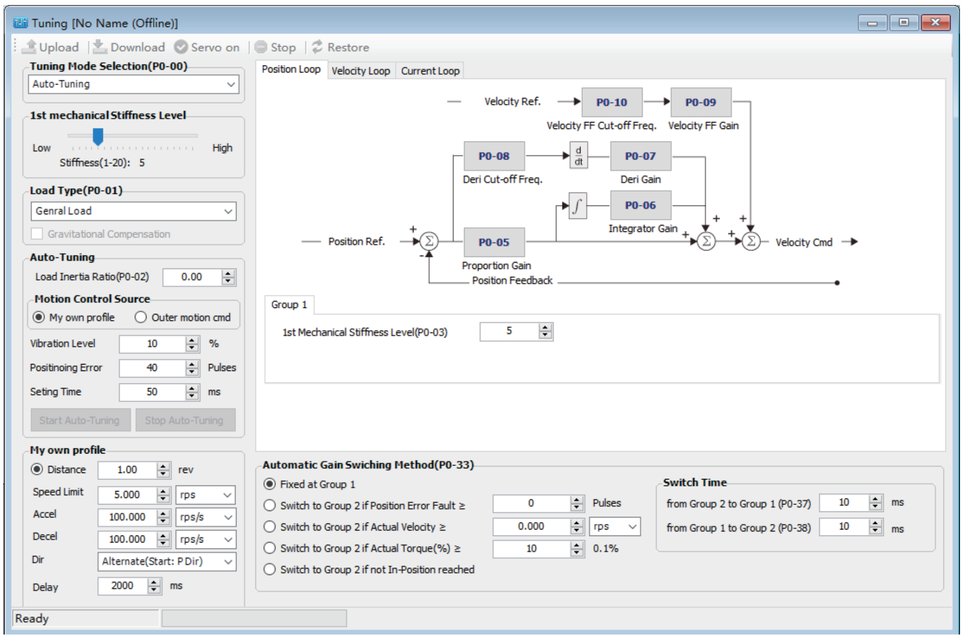
Step 3: Input and Outpu Configurations



Step 4: Speed Limit Settings



Step 5: Gain Tuning



7.5 Torque Limit

Torque Limit Function is used to limit the motor output torque. This function is applicable in all control modes, such as Position Control, Speed Control and Torque Control, etc.

7.5.1 Torque Limit Methods

Parameter P1-10 defines 6 kinds of torque limit methods which are shown as follows.

P1-10 Torque Limit Method	Positive Torque Limit Source	Negative Torque Limit Source
0	Register [Y]	Register [Z]
1 (Default)	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	
4	Analog input 2(AIN2)	
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

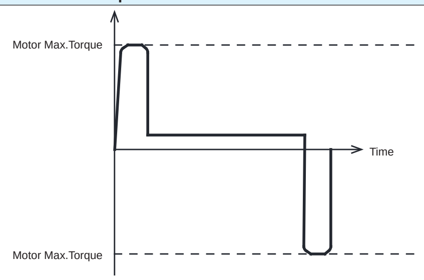
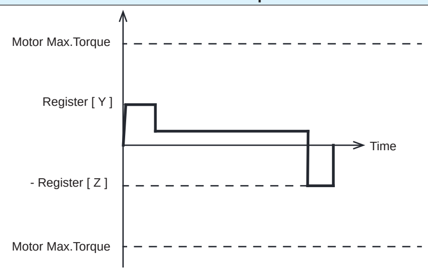
Parameter	Command	Description	Unit	Range	Default	Instructions
P1-10	LD	Torque Limit Method	0 ~ 6	0	-	Torque limit method.
P1-06	CC	1st Torque Limit	0~3000	3000	0.1%	Set up the first limit value of the motor output torque.
P1-25	CX	2nd Torque Limit	0~3000	3000	0.1%	Set up the second limit value of the motor output torque.
P1-26	CY	3rd Torque Limit	0~3000	3000	0.1%	Set up the third limit value of the motor output torque.
P1-27	CZ	4th Torque Limit	0~3000	3000	0.1%	Set up the fourth limit value of the motor output torque.
P4-02	AN	Analog Input Torque Scale	-3000 ~ 3000	1000	0.1%	Set the motor output torque when analog input voltage is at 10Vdc.

7.5.2 Torque Limit Sources

7.5.2.1 Limited by Registers

There are some registers in M56S servo system.

When P1-10 = 0, the positive direction torque limit is set by register [Y], and the negative torque limit is set by register [Z]. The values of these two registers can be set by communication and take effect in real time.

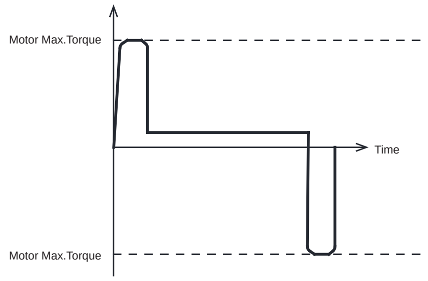
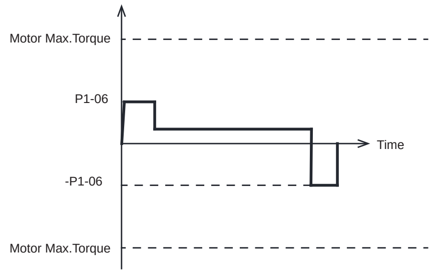
Torque limit is not enabled	Enable the torque limit
	
Torque limit function is not enabled, the motor can output upto the motor maximum torque.	When P1-10 = 0, the positive direction torque limit is set by register [Y], and the negative torque limit is set by register [Z]

7.5.2.2 Limited by Parameter P1-06 in both Direction

When P1-10 = 1, the positive direction torque and the negative torque is limited by P1-06.

Related Parameters

Parameter	Command	Description	Unit	Range	Default	Instructions
P1-06	CC	1st Torque Limit	0~3000	3000	0.1%	Set up the first limit value of the motor output torque

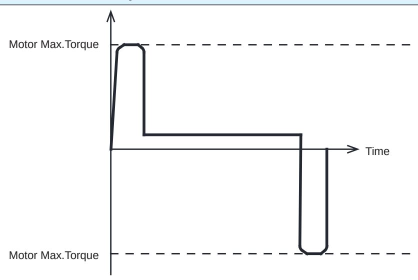
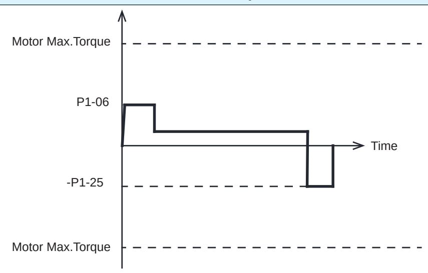
Torque limit is not enabled	Enable the torque limit
	
Torque limit function is not enabled, the motor can output upto the motor maximum torque.	When P1-10 = 1, the motor output torque is limited to the set value of P1-06.

7.5.2.3 Positive and Negetive Direction are limited by different parameters

When P1-10 = 2, the positive direction torque is limited by P1-06, and the negative torque is limited by P1-25.

Related Parameters

Parameter	Command	Description	Unit	Range	Default	Instructions
P1-06	CC	1st Torque Limit	0~3000	3000	0.1%	Set up the first limit value of the motor output torque.
P1-25	CX	2nd Torque Limit	0~3000	3000	0.1%	Set up the second limit value of the motor output torque.

Torque limit is not enabled	Enable the torque limit
	
Torque limit function is not enabled, the motor can output upto the motor maximum torque.	When P1-10 = 2, the motor positive direction torque is limited to the set value of P1-06, and the negative direction torque output is limited to the value of -(P1-25).

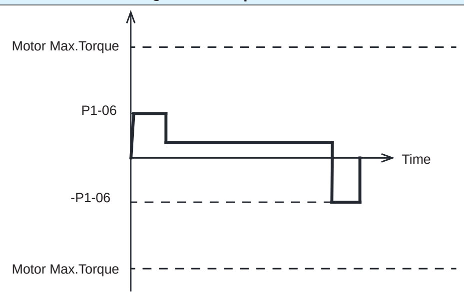
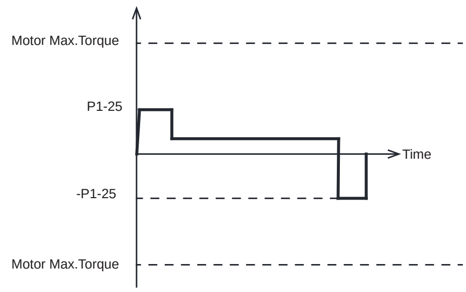
7.5.2.4 Limited by Digital Input----Method One

When P1-10 = 3, the positive and negative torque limit is determined by the input logic state of Torque Limit Input function(TQ-LMT).

- When the TQ-LMT input is VALID, the positive and negative direction torque is limited by the set value of P1-06.
- When the TQ-LMT input is INVALID, the positive and negative direction torque is limited by the set value of P1-25.

Related Parameters

Parameter	Command	Description	Unit	Range	Default	Instructions
P1-06	CC	1st Torque Limit	0~3000	3000	0.1%	Set up the first limit value of the motor output torque.
P1-25	CX	2nd Torque Limit	0~3000	3000	0.1%	Set up the second limit value of the motor output torque.

TQ-LMT input is valid.	TQ-LMT input is invalid
	
When theTQ-LMT input is VALID, the positive and negative direction torque is limited by the set value of P1-06.	When theTQ-LMT input is INVALID, the positive and negative direction torque is limited by the set value of P1-25.

7.5.2.5 Limited by Analog Input 2

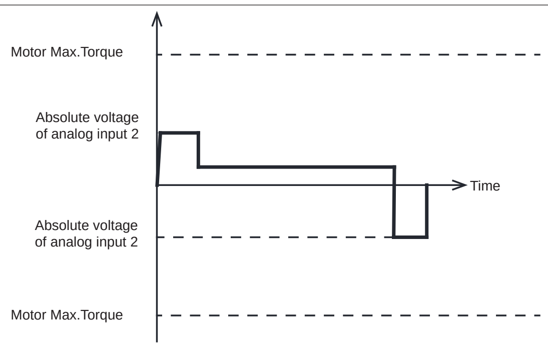
When P1-10 = 4, the positive and negative torque are limited by the voltage of analog input 2.

Related Parameters

Parameter	Command	Description	Range	Default	Unit	Instructions
P4-02	AN	Analog Input Torque Scale	0 ~ 3000	1000	0.1%	Set corresponding motor output torque when the voltage of analog input 2 is 10VDC.

Note:

- When the analog input voltage is negative, take the absolute value as the torque limit.



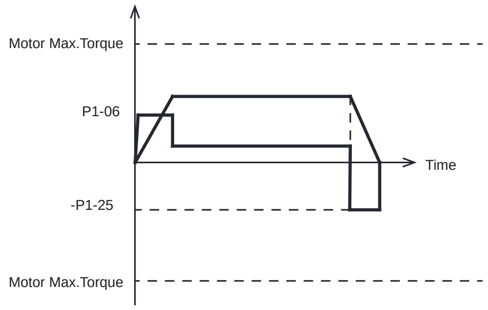
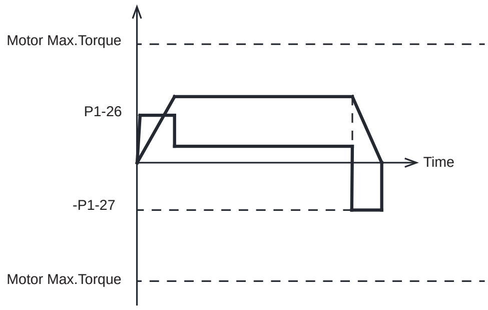
When P1-10 = 4, the positive and negative torque are limited by the absolute voltage of analog input 2.

7.5.2.6 Limited by Digital Input----Method Two

When P1-10 = 5, the positive and negative torque limit is determined by the input logic state of Torque Limit Input function(TQ-LMT).

- When the TQ-LMT input is VALID, the positive direction torque is limited by the set value of P1-06, and negative direction torque is limited by the set value of P1-25.
- When the TQ-LMT input is INVALID, the positive direction torque is limited by the set value of P1-26, and negative direction torque is limited by the set value of P1-27.

Parameter	Command	Description	Unit	Range	Default	Instructions
P1-06	CC	1st Torque Limit	0~3000	3000	0.1%	Set up the first limit value of the motor output torque.
P1-25	CX	2nd Torque Limit	0~3000	3000	0.1%	Set up the second limit value of the motor output torque.
P1-26	CY	3rd Torque Limit	0~3000	3000	0.1%	Set up the third limit value of the motor output torque.
P1-27	CZ	4th Torque Limit	0~3000	3000	0.1%	Set up the fourth limit value of the motor output torque.

<table>
<tr><th>TQ-LMT input is valid.</th><th>TQ-LMT input is invalid</th></tr>
<tr><td>
</td><td>
</td></tr>
<tr><td>When the TQ-LMT input is VALID, the positive direction torque is limited by the set value of P1-06, and negative direction torque is limited by the set value of P1-25.</td><td>When the TQ-LMT input is INVALID, the positive direction torque is limited by the set value of P1-26, and negative direction torque is limited by the set value of P1-27.</td></tr>
</table>

7.5.3 Torque Limited Output(T-LMT)

The T-LMT output signal shows that the motor output torque is being limited.

To use Torque Limited Output(T-LMT), one of digital outputs needs to be assigned this function.

Signal Type	Signal Symbol	Setup Value	Signal Logic	Instructions
Output	T-LMT	15	Closed	When the motor output torque is being limited, the T-LMT signal will output, and the output state is CLOSED.
			Open	When the motor output torque is NOT limited, the T-LMT signal will NOT output, and the output state is OPEN.
		16	Open	When the motor output torque is being limited, the T-LMT signal will output, and the output state is OPEN.
			Closed	When the motor output torque is NOT limited, the T-LMT signal will NOT output, and the output state is CLOSED.

7.6 Encoder/Pulse Divided Output

Encoder/Pulse Divided Output is a function that output the position information feedback by the encoder and the external position pulse command in a A/B quadrature line driver mode.

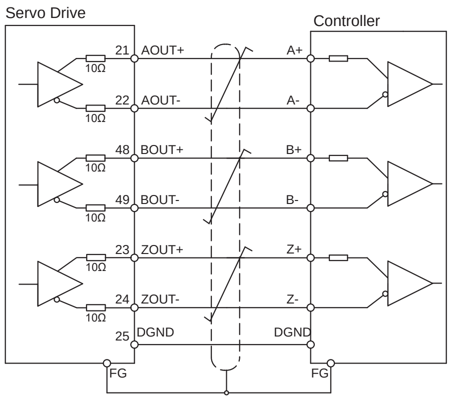
Related Parameters

Parameter	Command	Description	Range	
P3-12	PO	Pulses Output Mode	0 ~ 256	Pulse output settings
P3-13	ON	Pulses Output Gear Ratio - Numerator	0 ~ 13107200	Set the numerator of pulse output division ratio
P3-14	OD	Pulses Output Gear Ratio - Denominator	0 ~ 13107200	Set the denominator of pulse output division ratio

7.6.1 Pin Numbers of Pulse Output Function

<table>
<tr><th>CN2-Pin No.</th><th colspan="2">Signals</th><th>Description</th><th>Connecting Method</th></tr>
<tr><td>21</td><td>AOUT+</td><td rowspan="8">Encoder feedback ouput</td><td rowspan="6">The position feedback informations of the encoder are output differentially in A,B and Z signals.
The number of pulses per revolution and frequency division ratio of pulse output can be set by parameters.</td><td rowspan="8">Refer to Chaper 4.9.8</td></tr>
<tr><td>22</td><td>AOUT-</td></tr>
<tr><td>48</td><td>BOUT+</td></tr>
<tr><td>49</td><td>BOUT-</td></tr>
<tr><td>23</td><td>ZOUT+</td></tr>
<tr><td>24</td><td>ZOUT-</td></tr>
<tr><td>19</td><td>OCZ</td><td>Output phase Z of the encoder in open collector</td></tr>
<tr><td>13,14
15,17,25</td><td>DGND</td><td>Digital ground.</td></tr>
</table>

◆ Example of A/B/Z differential signal connection



Note:

1. The output circuits are line-driver output, the line-receiver circuits are recommended in the host controller. A differential to single-ended conversion board is needed is the host does not support differential signals. Do not connect directly the OUT+ to power+ or connect OUT- to ground.

2. Twisted shielded wires are recommended for well anti-interference. The shielding must be connected to PE, and the both digital ground of servo drive and host should be connected together.

3. The outputs are 5V differential signals, maximum output current is 20mA.

7.6.2 Pulse Divided Output Settings.

Parameter P3-12 is used to set the pulse output source, pulse output phase logic, Z pulse output polarity, and division ratio.

The corresponding functions to each bit are as follows.

<table>
<tr><th colspan="8">P3-12 Pulse output settings</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="4">0</td><td rowspan="4">0</td><td rowspan="4">0</td><td rowspan="4">0</td><td>Z pulse output polarity</td><td>Pulse output phase logic</td><td colspan="2">Pulse output source</td></tr>
<tr><td rowspan="2">0: Rasing edge</td><td rowspan="2">0: Phase A leads Phase B</td><td colspan="2">bit1=0,bit0=1: Main Encoder feedback</td></tr>
<tr><td colspan="2" rowspan="2">bit1=1,bit0=0: Second Encoder feedback</td></tr>
<tr><td rowspan="2">1: Falling edge</td><td rowspan="2">1: Phase B leads Phase A</td></tr>
<tr><td colspan="4"></td><td colspan="2">bit1=1,bit0=1: External pulse command</td></tr>
<tr><td colspan="8">bit0 and bit1: Pulse output source
bit2: Pulse output phase logic
bit3: Z pulse output polarity</td></tr>
</table>

Note:
When set this parameter from the LED operation panel and software, it needs to be converted into decimal.

7.6.2.1 Pulse Output Source

The pulse divided output function supports the following three signal sources. The bit0 and bit1 of parameter P3-12 are used to select signal sources.

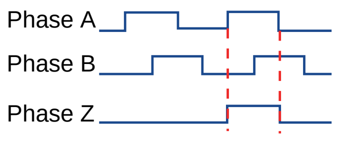
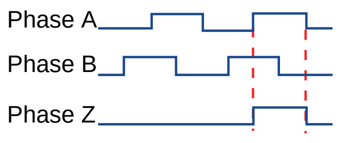
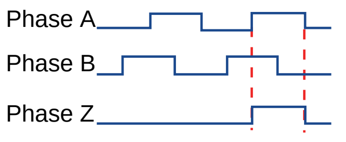
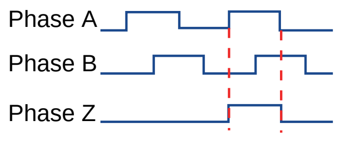
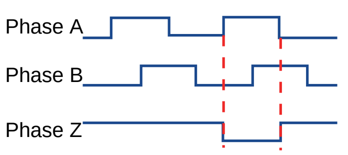
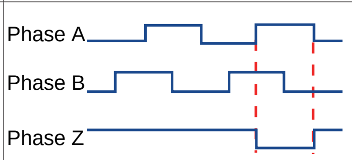
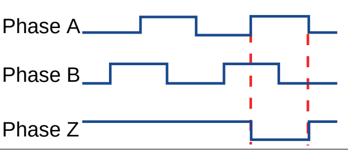
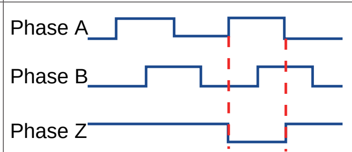
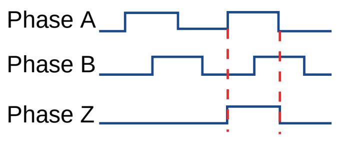
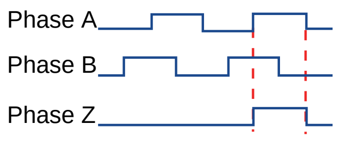
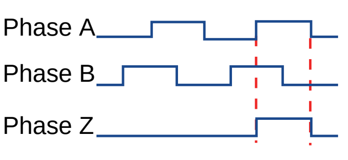
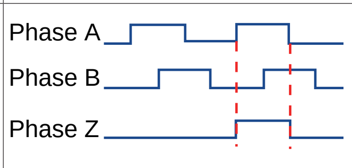
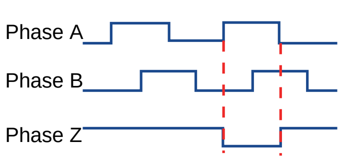
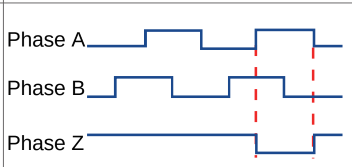
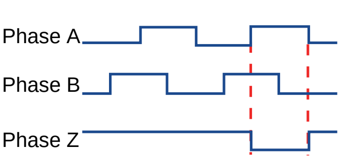
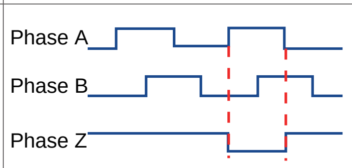
bit1=0,bit0=1: Main Encoder feedback

bit1=1,bit0=0: Second Encoder feedback, full closed-loop encoder feedback

bit1=1,bit0=1: External pulse position command(By pass)

Note:
When the signal source is external pulse command, the setting of parameter P3-13 and parameter P3-14 are invalid, and the external command pulse is directly output by-pass. The setting of bit2 and bit3 of P3-12 will also be invalid.

7.6.2.2 Pulse Output Settings

Z pulse output polarity	Pulse output phase logic	Pulse output source			Positive Direction	Negative Direction	P3-12 Set Value (Decimal)
bit3	bit2	bit1	bit0				
0	0	0	1	Main encoder			1
0	1	0	1	Main encoder			5
1	0	0	1	Main encoder			9
1	1	0	1	Main encoder			13
0	0	1	0	Second encoder			2
0	1	1	0	Second encoder			6
1	0	1	0	Second encoder			10
1	1	1	0	Second encoder			14
Any set	Any set	1	1	External pulse input	By pass	By pass	3

7.6.3 Pulse Output Gear Ratio

When the pulse output source is the motor encoder or second encoder, some applications where the number of output pulses per one motor revolution is not an integer, you can set the output gear ratio.

Output counts per motor revolution(A and B are converted into 4 times the frequency.)

$$\frac{\text{P3-13 Pulses Output Gear Ratio - Numerator}}{\text{P3-14 Pulses Output Gear Ratio - Denominator}} \times 131072$$

Related Parameters

Parameter	Command	Description	Range	Default	
P3-13	ON	Pulses Output Gear Ratio - Numerator	0 ~ 13107200	10000	Set the numerator of pulse output division ratio
P3-14	OD	Pulses Output Gear Ratio - Denominator	0 ~ 13107200	131072	Set the denominator of pulse output division ratio

Note:
1). P3-13 should be smaller than P3-14.
2). When P3-13 is larger than P3-14, output pulse counts per motor revolution is set by P3-13.

For example: If you need to output 1000 pulses per revolution.

1). If you count A/B at the same time, and the frequency is 4 times.

Then: P3-13 = 1000

P3-14 = 131072 or P3-14 = 1

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

Then: P3-13 = 2000

P3-14 = 131072 or P3-14 = 1

3). If you only count the output of phase A, and only count the rising edge or the falling edge when counting.

Then: P3-13 = 4000

P3-14 = 131072 or P3-14 = 1

7.7 Analog Output

The data to be monitored can be output as a voltage signal through the analog output function. M56S series servo drive provides two analog output channels. Maximum output capacity is 7mA and the output voltage is -10 ~ +10V.

Related Parameters

Parameter	Command	Description	Range	Default	Description
P4-16	OS1	Analog Output 1 Scale	1 ~ 32000	1000	Output scale for analog output 1. The values of speed, torque, position error, etc. corresponding to the analog output at 10V can be set.
P4-17	OS2	Analog Output 2 Scale	1 ~ 32000	1000	Output scale for analog output 2. The values of speed, torque, position error, etc. corresponding to the analog output at 10V can be set.
P4-18	XA1	Analog Output 1 Function	0 ~ 5	0	Function definition of analog output 1: 0: As a general-purpose voltage output. 1: As the motor actual output current, unit: 0.1% 2: As the motor command current, unit: 0.1% 3: As the motor actual output speed, unit: 0.25 rpm 4: As the motor command speed, unit: 0.25 rpm 5: As counts of position following error, unit: counts
P4-19	XA2	Analog Output 2 Function	0 ~ 5	0	Function definition of analog output 2: 0: As a general-purpose voltage output. 1: As the motor actual output current, unit: 0.1% 2: As the motor command current, unit: 0.1% 3: As the motor actual output speed, unit: 0.25 rpm 4: As the motor command speed, unit: 0.25 rpm 5: As counts of position following error, unit: counts

Setting Example:

Use analog output 1 to monitor the motor actual speed, the speed range is -3000rpm to 3000rpm and the output voltage is -10 to 10V。

The parameters are set as follows:

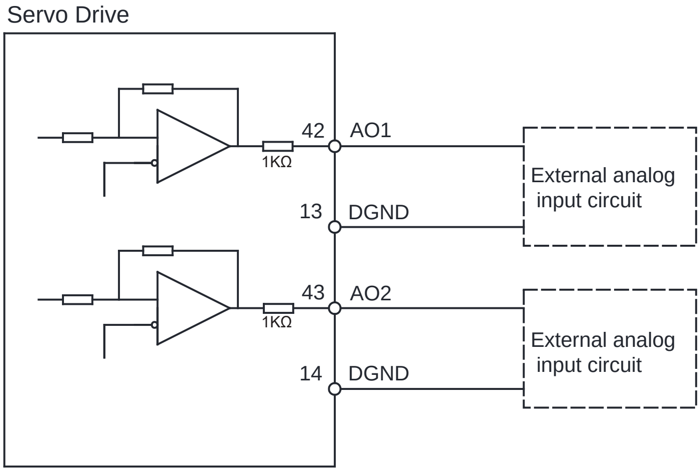
P4-16 = 12000
P4-18 = 3

7.7.1 Analog Output Wiring Method

◆ M56S Series-RF Type

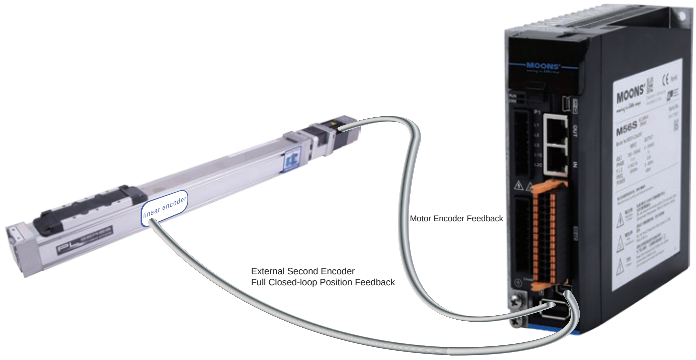
Output Specifications:
Voltage: -10 ~ +10V
Maximum output capacity: 8mA
The output impedance is 1 kOhm. Pay an attention to the input impedance of themeasuring instrument or the external circuit to be connected.

Wiring Diagram:



7.8 Full Closed-loop Control

High precision positioning is possible with a full closed-loop position control, an external installed encoder is used to detect the position of the controlled machine and the machine's position information is fed back to the servo drive.

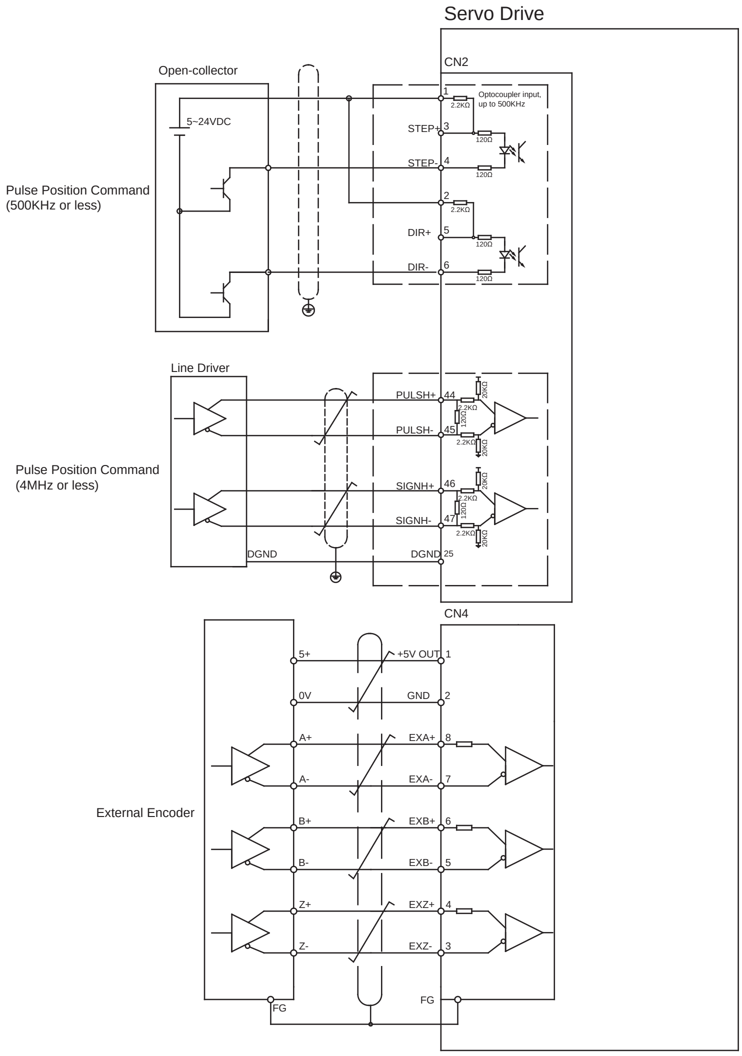


Note: Only A/B quadrature incremental encoder is supported in M56S-RT sereis.

7.8.1 Full Closed-loop Wiring Method

The CN4 connector of M56S-RF series AC servo drive is used to connect the external second encoder.

7.8.1.1 Wrinng Diagram



7.8.2 Full Closed-loop Control Gain Tuning

7.8.2.1 Tuning Step of Full Closed-loop Control

Step 1: Complete the parameter settings without turning on the full closed-loop function. For detailed tuning method, please refer to Chapter 10. Servo Gain Tuning.

Step 2: After first step, when the gain tuning is completed, proceed to Chapter 7.8.3 Full Closed-loop Control Setting Steps.

7.8.2.2 Related Gain Parameters in Full Closed-loop Control

In different gain tuning modes, the synergistic parameters to be tuned in full closed-loop control mode are different.

1) The Gain Tuning Mode P0-00 is 0.
P0-00 = 0, the gain Gain Tuning Mode is NO tuning, which means only needs to change the stiffness level of P0-03 or P0-04 in the full closed-loop mode.

Parameter	Command	Description	Range	Default	Unit	Instructions
P0-03	KG	1st Mechanical Stiffness Level	1 ~ 20	5	-	The first stiffness value of the servo system.
P0-04	KX	2nd Mechanical Stiffness Level	1 ~ 20	5	-	The second stiffness value of the servo system.

2) The Gain tuning Mode P0-00 is 1.
P0-00 = 1，the gain Gain Tuning Mode is Auto-tuning.

Step 1: Complete the load inertia ratio estimating and gain tuning without turning on the full closed-loop function.

Step 2: Enable the full closed-loop control and than only needs to change the stiffness level of P0-03 or P0-04.

Related Parameters

Parameter	Command	Description	Range	Default	Unit	Instructions
P0-03	Kg	1st Mechanical Stiffness Level	1 ~ 20	5	-	The first stiffness value of the servo system.
P0-04	KX	2nd Mechanical Stiffness Level	1 ~ 20	5	-	The second stiffness value of the servo system.

3) The Gain tuning Mode P0-00 is 2.
P0-00 = 2, the gain Gain Tuning Mode is Fine Tuning, there is a set of independent gain parameters shown as follows in full closed-loop control mode.

Parameter	Command	Description	Range	Default	Unit	Instructions
P0-25	XP	Full Closed-loop Position Loop Gain	0 ~ 20000	52	0.1Hz	Proportional gain in full closed-loop control mode. The proportional gain of the position loop in the PID control algorithm can improve the system's stiffness and reduce the system error.
P0-27	XD	Full Closed-loop Position Loop Derivative Time Constant	0 ~ 32767	0	ms	Derivative time constant in full closed-loop control mode. The derivative time constant of position loop in the PID control algorithm. Setting to zero means that derivative function is not used. The smaller setting value will increase derivative gain effect.
P0-28	XE	Full Closed-loop Position Loop Derivative Filter	0 ~ 40000	20000	0.1Hz	A low-pass filter for derivative gain. This filter is a single-output low-pass filter, which is used to filter the derivative output of the PID controller. When setting this value, the cutoff frequency needs to be considered
P0-29	XF	Full Closed-loop Velocity Command Gain	-30000 ~ 30000	10000	0.01%	The percentage of speed command gain of speed loop in full closed-loop control.

Parameter	Command	Description	Range	Default	Unit	Instructions
P0-30	XV	Full Closed-loop Velocity Loop Gain	0 ~ 30000	183	0.1Hz	Proportional gain of speed loop in full closed-loop control mode. Thie parameter determines the responsiveness of speed loop. Higher set value can increase the speed loop responds. If it's set too larger, it may cause vibrations and noise. In the position control mode, the speed loop proportional gain and the position loop proportional gain should be increased both.
P0-31	XG	Full Closed-loop Velocity Loop Integral Time Constant	0 ~ 30000	189	ms	Integral time constant of speed loop in full closed-loop control mode. The smaller setting value will increase integral gain effect.
P0-32	XC	Full Closed-loop Torque Command Filter	0 ~ 40000	1099	0.1Hz	A low-pass filter for the output of PID controller. This filter is a single-output low-pass filter used to filter the output of PID controller,that is the reference current. It's necessary to consider the cutoff frequency required for the whole system. By performing low-pass filtering on the command current, the output current can be made to decelerate and vibrate more smoothly.

7.8.3 Full Closed-loop Control Setting Steps

After all the operations of Chapter 7.8.2, if the servo system can run normally without full closed-loop control function, the following setting steps can be applied to set the necessary parameters of full closed-loop control.

Step 1: Set the resolution of external second encoder/scale

The resolution of external encoder/scale must be input correctly, otherwise it will cause the full closed-loop following error alarm.

Related Parameter**:**

Parameter	Command	Description	Range	Default	Unit	Instructions
P3-11	XR	Second Encoder Resolution	200 ~ 13107200	10000	pulses/rev pulses/user uint	The resolution of external encoder/scale.

A) For rotary encoder, enter the resolution of one revolution of the encoder;

B) For linear scale, enter the number of pulses per moving user unit.

Note 1:

The maximum speed under the full closed-loop control is 128 user unit per second, the appropriate resolution and user unit must be set.

For example, the resolution of a linear scale is 0.5 μm.

- If the user unit is in mm, when P3-11 is set to 2000, the maximum speed is 128 mm/s
- If the user unit is in cm, when P3-11 is set to 20000, the maximum speed is 128 cm/s

Note 2:

In any case, as long as the setting value of P3-11 is changed, the mechanical transmission ratios P3-00 and P3-01 must be reset

Steo 2: Set the feedback signal direction of external encoder

The positive rotation direction of the motor is defined as: viewed from the front of the motor when motor shaft rotates clockwise, the motor encoder counter is increased; when the motor shaft rotates counterclockwise, the motor encoder counter is decreased.

In full closed-loop mode, the feedback signal direction of the external second encoder needs to be the same as the direction of the motor encoder. That is, when the motor shaft rotates clockwise, the motor encoder counter is increased and the external second encoder counter must also be increased. Similarly, when the motor shaft rotates counterclockwise, the motor encoder counter is decreased and the external second encoder counter must be decreased.

If not, it needs to be modified with parameter P3-06 (Second Encoder Direction). Or directly swap the wiring of the second encoder's phase A and phase B.

Note: The direction must be set correctly, otherwise a position follwing error will be caused.

Related Parameter

Parameter	Command	Description	Range	Default	Instructions
P3-06	PV	Second Encoder Direction	0 ~ 1	0	Define the direction of the second encoder in full closed loop mode:: 0: A Leads B 1: B Leads A

Use the software or the operation panel on the driver (refer to Chapter 6.3 JOG mode) to enter the JOG mode. When the motor rotates, use the monitoring page of the Luna software to observe he change of the value of the motor encoder and the second encoder. Or when the motor is disabled, move the load and observe the change of the value through the Luna software.

Step 3: Set the pulses per user unit length (user unit)

In full closed-loop control mode, the electronic gear ratio (P3-00 and P3-01) will be invalid, P3-05(Command Pulses per revolution) will take effect.

Related Parameter

Parameter	Command	Description	Range	Default	Instructions
P3-05	EG	Command Pulses per revolution	200 ~ 131072	10000	Set the number of required command pulses to move each user unit length

Note:

- The set value of P3-05 must be less than or equal to P3-11 (Second Encoder Resolution).
- If the set value of P3-05 is higher than P3-11, the number of required command pulses to move each user unit length is set by P3-11.

In any case, as long as the setting value of P3-05 is changed, the mechanical transmission ratios P3-00 and P3-01 must be reset.

Setting Example 1:

Linear scale resolution is 1μm,if P3-11 is set to 10000.

- When P3-05 is set to 1000, the mechanical will move 1cm for every 1000 pulses sent by the host.
- When P3-05 is set to 10000, the mechanical will move 1cm for every 10000 pulses sent by the host.
- When P3-05 is set to 20000, the mechanical will move 1cm for every 10000 pulses sent by the host.

Setting Example 2:

Linear scale resolution is 0.5μm,if P3-11 is set to 20000.

- When P3-05 is set to 1000, the mechanical will move 1cm for every 1000 pulses sent by the host.
- When P3-05 is set to 10000, the mechanical will move 1cm for every 10000 pulses sent by the host.
- When P3-05 is set to 20000, the mechanical will move 1cm for every 20000 pulses sent by the host.

Step 4: Set the numerator and denominator of the mechanical transmission ratio

The electronic gear ratio (P3-00 and P3-01) of the system will become the mechanical transmission ratio in the fully closed-loop control mode. The appropriate mechanical transmission ratio must be set otherwise the system will not work normally, and a full closed-loop hybrid deviation excess error will occur.

If the mechanical transmission ratio cannot be determined, the following methods can be used.

$$\frac{\text{P3-00}}{\text{P3-01}} = \frac{\text{Numerator of transmission ratio in full closed-loop mode}}{\text{Denominatior of transmission ratio in full closed-loop mode}}$$

$$= \frac{\text{The number of motor encoder feedback pulses per motor revolution}}{\text{The number of external encoder feedback pulses per motor revolution}}$$

◆ Use Luna software to confirm the mechanical transimission ratio

Method 1:

1) Disable the full-closed-loop control function, and make the motor rotate one revolution in Commissioning interface of the software.

2) Then check and record the number of Motor Encoder Position and the number of 2nd Encoder Position after the motor rotates once in Monitor interface of the software

3) Fill these two numbers into the above formula.

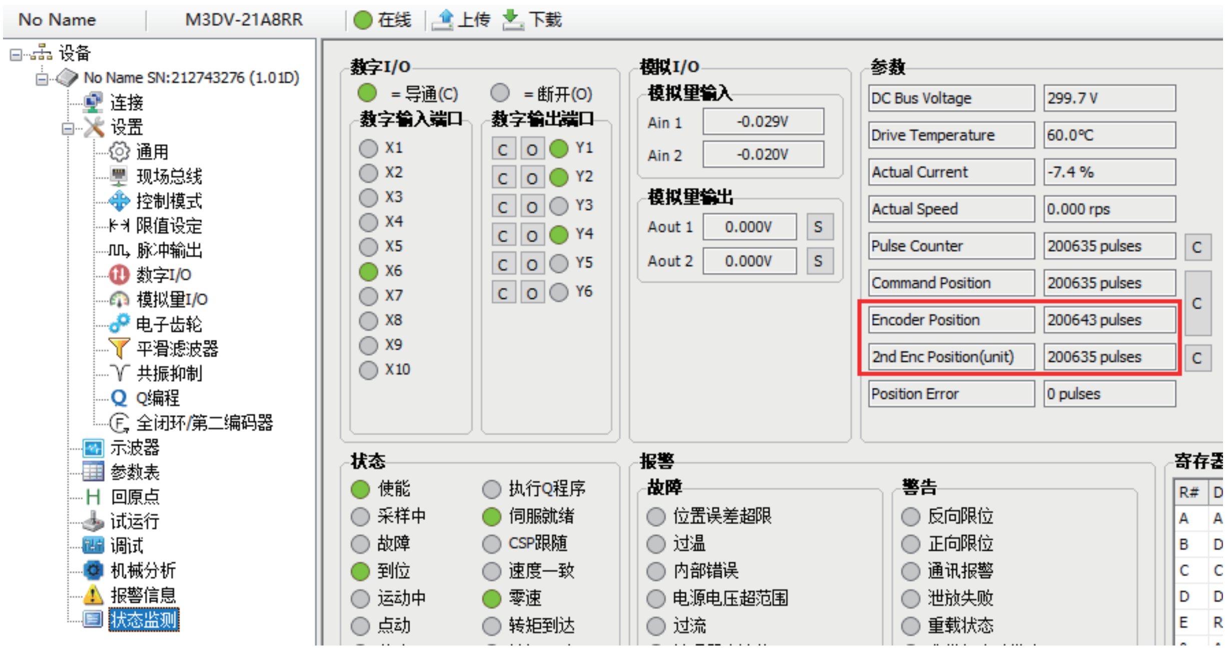
Method 2:

1) Disable the full-closed-loop control function and disable the drive

2) Make the load move a small distance

3) Then check and record the number of Motor Encoder Position and the number of 2nd Encoder Position after the motor rotates once in Monitor interface of the software

4) Fill these two numbers into the above formula.



Related Parameter**:**

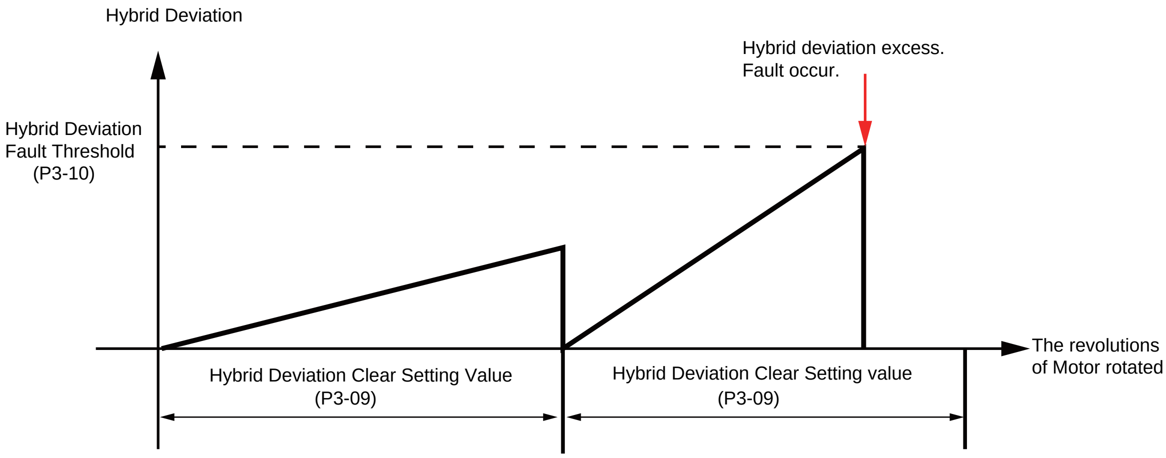
Parameter	Command	Description	Range	Default	Instructions
P3-00	EN	Electronic Gear Ratio - Numerator	1 ~ 2147483647	10000	Numerator of transmission ratio in full closed-loop mode
P3-01	EU	Electronic Gear Ratio - Denominator	1 ~ 2147483647	10000	Denominatior of transmission ratio in full closed-loop mode

Note:

- The appropriate mechanical transmission ratio must be set otherwise the system will not work normally, vibration and a full closed-loop hybrid deviation excess error will occur.
- If the numerator or denominator of mechanical transmission ratio is set to zero, the servo system will calculate the ratio as 1:1.
- The effective transmission ratio ranges from 1/8192 to 8192. If the actual transmission ratio is greater than 8192, the system automatically calculates the transmission ratio as 8192. If the actual transmission ratio is less than 1/8192, the system automatically calculates the transmission ratio as 1/8192.
- If the transmission ratio is set incorrectly, the deviation between the position value calculated from the motor encoder and the position value calculated from the second encoder will increase, and a full closed-loop hybrid deviation excess error will occur during long-distance motion.

Step 5: Full Closed-loop Hybrid Deviation Error

Set the allowable deviation between the current position of motor encoder and external second encoder, and automatically clear the hybrid deviation whenever the motor's revolutions reaches the set value.



Note:

- The servo motor rotates the number of revolutions set by P3-09, and the hybrid deviation is always less than the set value of P3-10. As the motor reaches the revolutions set by P3-09, the hybrid deviation is cleared to zero and counted again from zero.
- Once hybrid deviation is greater than the set value of P3-10, a full closed-loop hybrid deviation excess error will occur.
- As P3-10 is set to 0 which means the hybrid deviation is not detected.

A. Hybrid Deviation Fault Threshold in full closed-loop control mode

As the deviation between the current position of motor encoder and external second encoder is greater than the set value of P3-10, a full closed-loop hybrid deviation excess error will occur, r28FP will display on the drive's LED display panel.

Related Parameter

Parameter	Command	Description	Range	Default	Instructions
P3-10	XO	Hybrid Deviation Fault Threshold	0 ~ 2147483647	100000	Hybrid Deviation Fault Threshold in full closed-loop control mode

B. Hybrid Deviation Clear Setting

As the motor reaches the revolutions set by P3-09, the hybrid deviation is cleared to zero and counted again from zero.

Related Parameter

Parameter	Command	Description	Range	Default	Instructions
P3-09	XT	Hybrid Deviation Clear Setting	0 ~ 2147483647	100000	-

7.8.4 Enable Full Closed-loop Control Mode

After completing the setting of full closed-loop in Chapter 7.8.3, the full closed-loop control can be enable though parameter P1-04(Full Closed-loop Control Switch).

Related Parameter

Parameter	Command	Description	Range	Default	Instructions
P01-04	XM	Full Closed-loop Control Switch	0 ~ 1	0	Full Closed-loop Control 0 = Disable 1 = Enable

7.8.5 Common Error and Trouble-shooting in Full Closed-loop Control Mode

Common alarms in full closed loop mode are as follows.

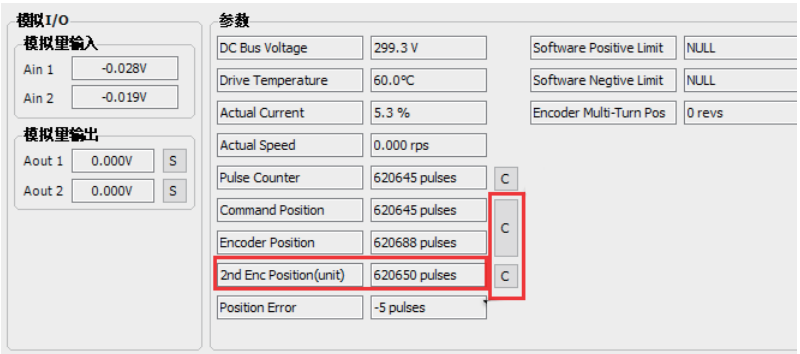
LED Display	Description	Causes	Measures
r28FP	Full closed-loop hybrid decviation excess error	Full closed-loop hybrid deviation exceeds the threshold.	1. Check whether the set value of P3-09 and P3-10 are too small. 2. Check whether the CN4 port, external encoder input is correct. Monitor the feedback value of second encoder changes even the motor stopped.
r29FE	External encoder error	External encoder input error.	Check whether the CN4 port, external encoder input is correct. Check whether the feedback cable connection is correct.
r 10PL	Position following error	The value of position following error exceeds the set value of P3-04.	1. Check whether the set value of P3-4(Position error limit) is too small. 2. Check whether the gain parameters are properly set. 3. Check whether the motor selection matches the actual load and whether the acceleration and deceleration are too large. 4. Check whether an unreasonable torque limit is used. 5. The electronic gear ratio sets incorrectly. 6. The mechanical part is stuck, the motor is stalled. 7. Check the motor power cable is connected correctly. If there are more than one motor, check whether the cable is connected to the correct servo drive..

7.8.5.1 Full Closed-loop Hybrid Deviation excess error

The error code displayed on the drive's LED is r28FP

Causes: Full closed-loop hybrid deviation exceeds the threshold which is set by P3-10.

Measures: The set value of P3-10 is to small, this alarm is likely to occur in some applications where the mechanical transmission ratio is relatively large.



Measure steps:

1) Click to reset the Encoder Position and 2nd Encoder Position to zero
2) Make the motor run the number of turns set by P3-09
3) Make sure that the set value of P3-10 is larger than the monitored data of 2nd Encoder Position

7.8.5.2 External Encoder Error

The error code displayed on the drive's LED is r29FE

Causes: External encoder input error.
Measures: Check whether the CN4 port, the external encoder input is correct. Check whether the feedback cable connection is correct.

7.8.5.3 Velocity is Limited or Position following error

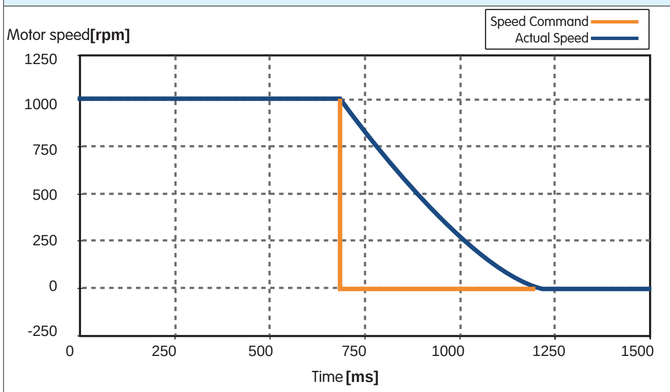
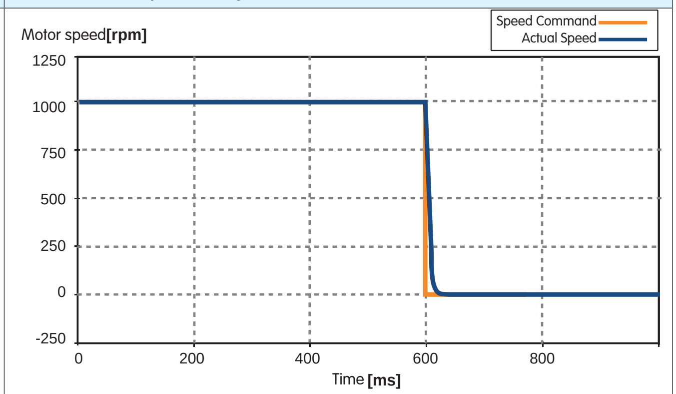
Anomaly: In full closed-loop control mode, if the pulse command frequency is incresaed, the motor fails to reach the set speed or generates a position following error alarm. The error code displayed by the drive LED is r 10PL

Causes: The value of position following error exceeds the set value of P3-04.
Measures: If the operation is normal in non-full-closed-loop mode, only in full closed-loop mode, there is this problem, please focus on confirming whether the resolution of the external second encoder P3-11 are correctly input.

7.9 Dynamic Brake

In the case of abnormal servo OFF, driver fault or sudden power off, etc., the driver can not control the motor normally, and the dynamic brake function can be used as the servo motor stop method. When the dynamic brake is working, the U/V/W three-phase of the motor is short-circuited to make the motor stop at the fastest speed, thereby protecting the safety of equipment and people.

There are build-in dynamic brake in the F type and X type of M56S series.

• Motor Stop without Dynamic Brake	• Motor Stop with Dynamic Brake
	
While a fault occur, the drive will disable, decelerate and free stop uncontrollable. The stopping time and free-run distance are depend on the system inertia and friction.	When the driver has a fault alarm, the driver will short-circuit the three phases of the motor as the driver is disabled, and use the current torque generated by the back EMF in the motor winding to stop at the fastest speed. Significantly reduce deceleration time and stopping-distance, protect the equipment and personal safety.

Note:

1. Dynamic brake is a stop function for servo abnormality. Do not use it to stop normal operation.

2. When the driver control power input is disconnected, the dynamic brake remains in action.

3. When the dynamic brake is activated, do not drive the motor to rotate by external force, otherwise it may damage the dynamic brake circuit and even cause the driver to smoke or catch fire.

4. Frequency and number of times of dynamic brake use

Frequency: more than 5 minutes/1

Time Number: stop from rated speed, 1000 times under the condition of applicable load inertia

7.9.1 Dynamic braking resistor wiring method

For models of 750W and below that support the dynamic braking function, the driver has a built-in dynamic braking resistor and does not need to be connected externally.

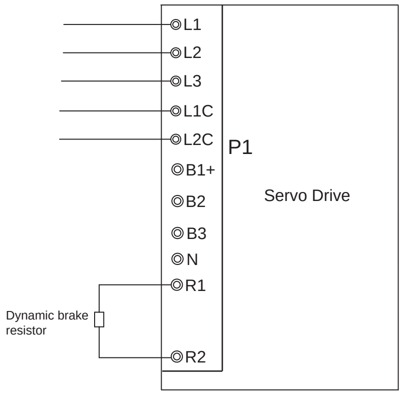
For models of 1kW and above that support the dynamic braking function, an external dynamic braking resistor is required.

7.9.1.1 The specifications of the external dynamic brake resistor are as follows:

Resistance	Minimum: 3 ohms, Maximum: 10 ohms
Power	＞30W

7.9.1.2 External dynamic brake resistor wiring method

Connect an external dynamic brake resistor to the R1 and R2 pins of the drive power connector.



Related Parameters

Parameter	Command	Description	Range	Default	Unit	Instructions
P5-42	ZV	Zero Speed Width	0.1 ~ 2	0.5	rps	As the speed is less than or equal to this set value, it is in the zero speed state.
P1-29	YV	Dynamic Brake Sequence when Servo Off	0 ~ 5	0	-	Select the action mode of the dynamic brake when the drive state changes from servo-on to servo-off
P1-30	YR	Dynamic Brake Sequence when Fault Occurs	0 ~ 3	0	-	Select the action mode of the dynamic brake when fault occurs
P1-31	YM	Dynamic Brake Action Time during Deceleration of Servo Off	0 ~30000	500	ms	Set the maximum working time of the dynamic brake when the servo is OFF.
P1-32	YN	Dynamic Brake Action Time during Deceleration when Fault Occurs	0 ~30000	500	ms	Set the maximum working time of the dynamic brake when fault occurs.

7.9.2 Dynamic Brake when Servo-off

When the servo state changes from servo-on to servo-off, the action mode of dynamic brake is set by P1-29 and the maximum braking time is set by P1-31.

The braking time refers to the total time that the motor actual speed deceleates to the threshold speed set by P5-42 when the dynamic brake takes effect.

P1-29	Description	
	Deceleration period	Stopped
0	Decelerate according to the setting of parameter P2-01	Free Run
1	Decelerate according to the setting of parameter P2-01	Dynamic Brake
2	Free Run	Free Run
3	Free Run	Dynamic Brake
4	Dynamic Brake	Free Run
5	Dynamic Brake	Dynamic Brake

7.9.3 Dynamic Brake when Drive Fault Occurs

When the servo fault occurs, the action mode of dynamic brake is set by P1-30 and the maximum braking time is set by P1-31.

P1-30	Description	
	Deceleration period	Stopped
0	Free Run	Free Run
1	Free Run	Dynamic Brake
2	Dynamic Brake	Free Run
3	Dynamic Brake	Dynamic Brake

7.10 Homing Mode

In Homing Control Mode, the servo drive generates a motion profile according to the parameters such as homing acceleration/deceleration, velocity, Home Offset etc. Homing mode and the Home sensor signal are set by the controller which also controls execution of the generated motion profile.

The M56S series of AC servo drives supports 39 homing methods.

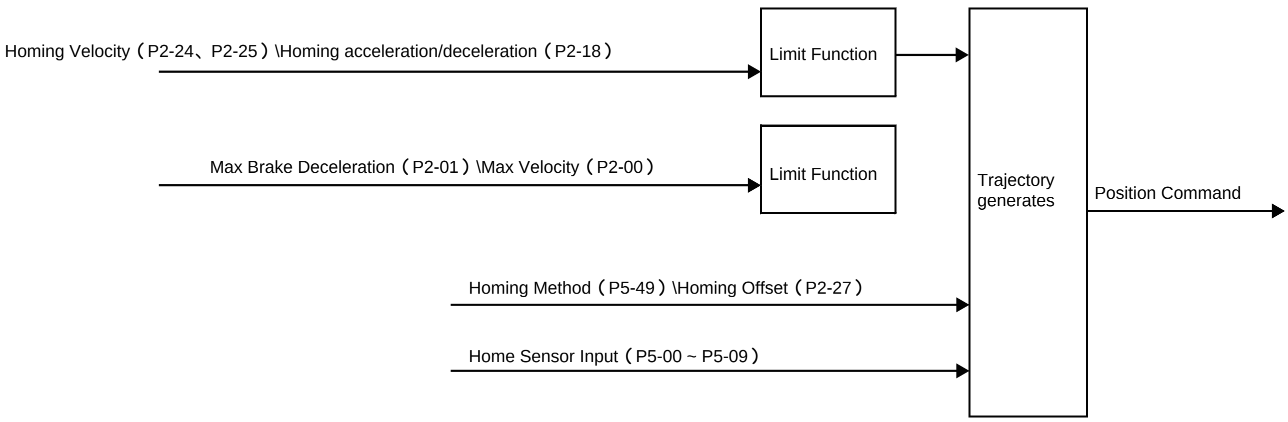
There are three ways to start homing.

◆ Start with digital input (S-HOM)

Signal Type	Signal Symbol	Setup Value	Signal Logic	Instructions
Input	S-HOM	15	Closed	When the input logic is ON(CLOSED), Homing starts.
			Open	When the input logic is OFF(OPEN), Homing dose not start.
		16	Open	When the input logic is OFF(OPEN), Homing starts.
			Closed	When the input logic is ON(CLOSED), Homing dose not start.

◆ Start with Q program

◆ Start with Modbus Command



Related Parameters

Parameter	Command	Description	Range	Default	Unit	Instructions
P5-49	HE	Homing Method	-4 ~ 35	1	-	Set homing method.
P2-18	HA1	Homing Acceleration/ Deceleration	0.167 ~ 5000	100	rps/s	Set homing acceleration and deceleration.
P2-24	HV1	Homing Velocity 1	0.0042 ~ 100	10	rps	Set the first velocity of seek home.
P2-25	HV2	Homing Velocity 2	0.0042 ~ 100	1	rps	Set the second velocity of seek home.
P2-27	HO	Homing Offset	-2147483647 ~ +2147483647	0	pulses	Set the offset position when homing is finished.
P2-00	VM	Max Velocity	0 ~ 100	80	rps	Set the maximum speed of motor.
P2-01	AM	Max. Brake Deceleration	0.167 ~ 5000	3000	rps/s	Set the maximum deceleration for emergence stop.
P5-00 ~ P5-09	MU1 ~ MUA	Digital Input Function	39 ~ 40	-	-	Set one of the digital inputs as the home sensor's input.

7.10.1 Homing Function Instructions

Homing function is used to seek the mechanical home sensor and define the position relationship between the mechanical origin and mechanical zero.

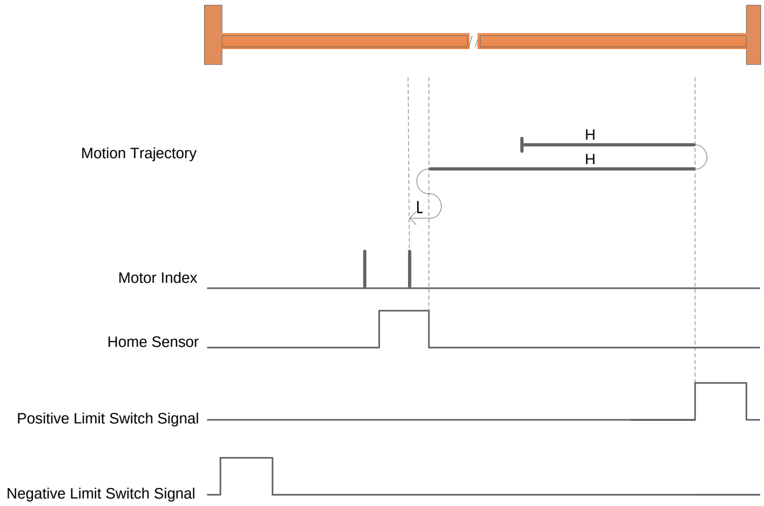
Mechanical Origin: A fixed position on the machine that can be a switch sensor or the index signal of the motor encoder.

Mechanical Zero : The absolute zero position.

When finished the homing operation, the position where the motor stop is the Mechanical Origin. The relationship between Mechanical Origin and Mechanical Zero can be set by parameter P2-27(Homing Offset).

Mechanical Origin = Mechanical Zero + P2-27

When P2-27 is set to zero, the Mechanical Origin coincides with the Mechanical Zero.



H: Seek home sensor speed 1 is set by parameter P2-24.

L: Back to home sensor speed 2 is set by parameter P2-25.

Home Sensor: You can use one of the digital inputs as the home switch sensor.

Positive Limit Switch: You can use one of the digital inputs as the positive limit switch sensor.

Negative Limit Switch: You can use one of the digital inputs as the negative limit switch sensor.

7.10.2 Homing Methods Summary

Homing Method	Motor Index Pulse	Home Sensor	Limit Switch
Methods -4 & -3			
Methods -2 & -1	√		
Methods 1 & 2	√		√
Methods 3 to 6	√	√	
Methods 7 to 14	√	√	√
Methods 15 & 16	Reserved		
Methods 17 & 18			√
Methods 19 to 22		√	
Methods 23 to 30		√	√
Methods 31 & 32	Reserved		
Methods 33 & 34	√		
Methods 35			

The homing methods 1~35 are defined in accordance with the CiA402 motion control protocol.

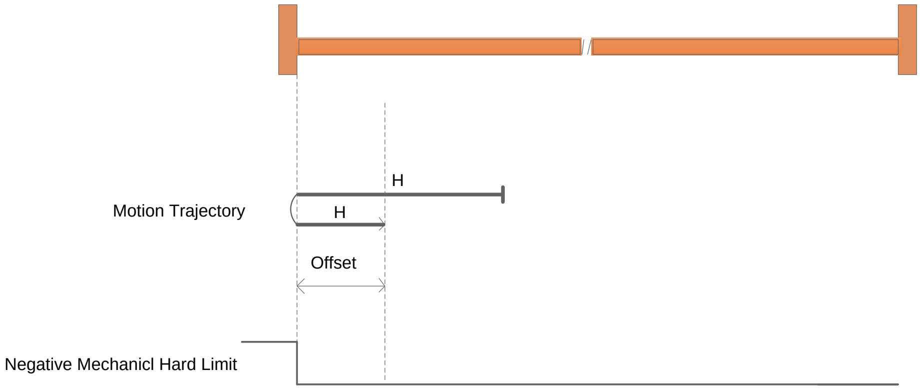
The homing methods -4 ~ -1,AKA Hard-stop Homing, are manufacturer customized methods that don't need external switch sensor. By detecting the torque of the motor during the homing process, when the position that the moving load is blocked by the mechanical hard limit, and the output torque of the motor is equal to the set current threshold, than the motor stops and set the encoder position to zero, this is the mechanical origin.

The current threshold is set by parameter P1-08(Torque Limit for Hard Stop Homing). Set the value of this object according to the actual needs. If the set value is too small, the homing process may fail. Too large value may cause damage to mechanical equipment.

Note:

- When using homing methods -4~-1, it is necessary to set a suitable homing offset, so that after reachs the mechanical origin, the load could move a small distance away from the mechanical hard limit. This new position is the mechanical zero.
- When using homing methods 1~35, the actual position after homing finished is the value set by P2-27.

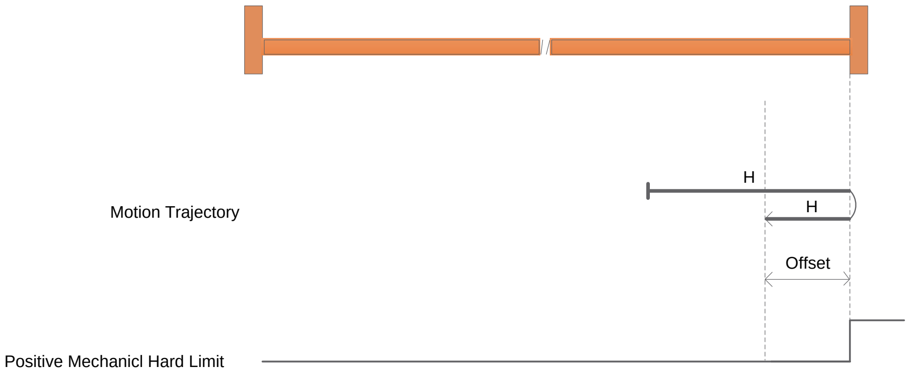
7.10.2.1 Method -4: Start in the negative direction, seek for the negative mechanical hard limit



Start homing at the speed set by P2-24 in the negative direction, when the moving load is blocked by the negative mechanical hard limit, and the output torque of the motor is equal to the set current threshold(P1-08), than the motor stops and sets the encoder position to zero,the whole homing process has finished.

If the Homing Offset(P2-27) is not zero, the motor moves a offset distance set by P2-27.

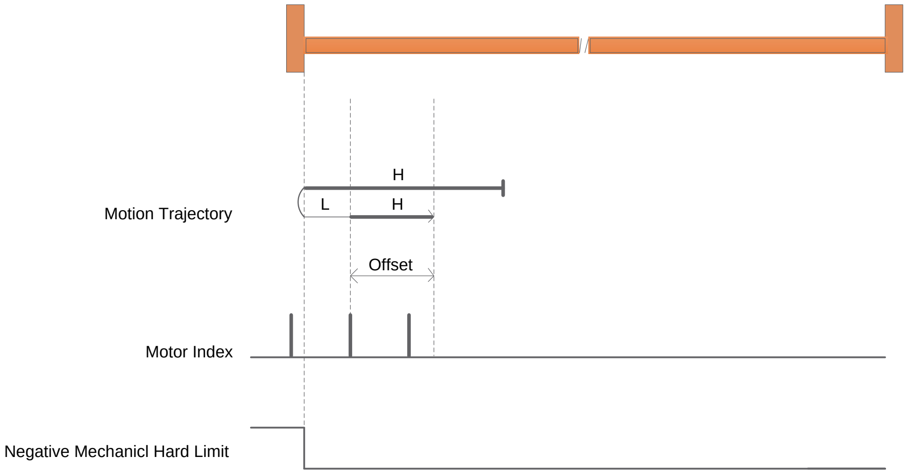
7.10.2.2 Method -3: Start in the positive direction, seek for the positive mechanical hard limit



Start homing at the speed set by P2-24 in the positive direction, when the moving load is blocked by the positive mechanical hard limit, and the output torque of the motor is equal to the set current threshold(P1-08), than the motor stops and sets the encoder position to zero,the whole homing process has finished.

If the Homing Offset(P2-27) is not zero, the motor moves a offset distance set by P2-27.

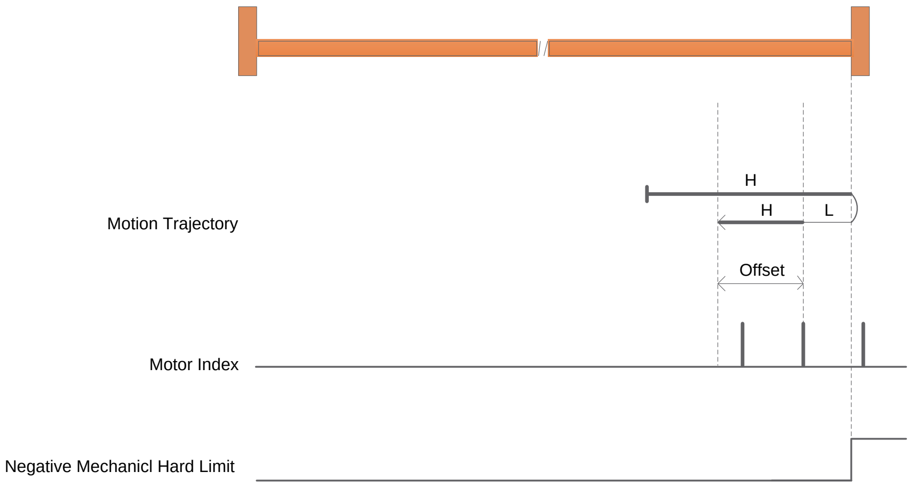
7.10.2.3 Method -2: Start in the negative direction, seek for the negative mechanical hard limit and motor index



Start homing at the speed set by P2-24 in the negative direction, when the moving load is blocked by the negative mechanical hard limit, and the output torque of the motor is equal to the set current threshold(P1-08), than the motor stops and turns back at the speed set by P2-25 for seeking encoder's index signal. The motor will stop and set encoder position to zero till the first rising edge of index signal is detected, the whole homing process has finished after that.

If the Homing Offset(P2-27) is not zero, the motor moves a offset distance set by P2-27.

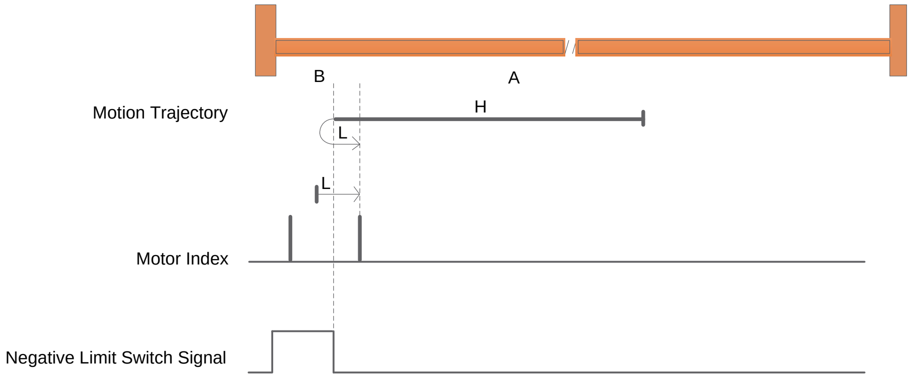
7.10.2.4 Method -1: Start in the positive direction, seek for the positive mechanical hard limit and motor index



Start homing at the speed set by P2-24 in the positive direction, when the moving load is blocked by the positive mechanical hard limit, and the output torque of the motor is equal to the set current threshold(P1-08), than the motor stops and turns back at the speed set by P2-25 for seeking encoder's index signal. The motor will stop and set encoder position to zero till the first rising edge of index signal is detected, the whole homing process has finished after that.

If the Homing Offset(P2-27) is not zero, the motor moves a offset distance set by P2-27.

7.10.2.5 Method 1: Start in the negative direction, seek for the negative limit switch and Motor Index

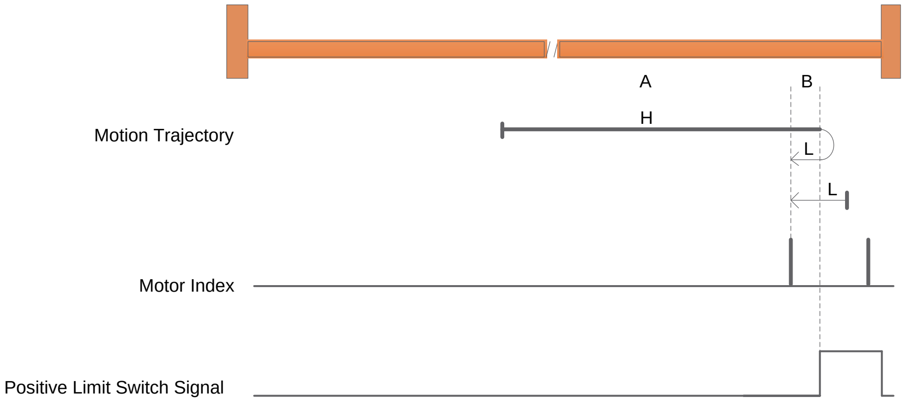


Position A: The motor moves in the negative direction with a homing speed set by P2-24 as long as the Negative Limit Switch(NLS) remains invalid. When the valid state of NLS is detected, the motor changes direction and speed, and moves in the positive direction with a homing speed set by P2-25 until the first index pulse is detected after NLS attains the invalid state.

Position B: The valid state of NLS is detected when homing starts, the motor movies in the positive direction with a homing speed set by P2-25 until the first motor index pulse is detected after NLS attains the invalid state.

When receiving this event and the motor completely stops, the drive sets Homing Finished bit of drive's status.

7.10.2.6 Method 2: Start in the positive direction, seek for the positve limit switch and Motor Index

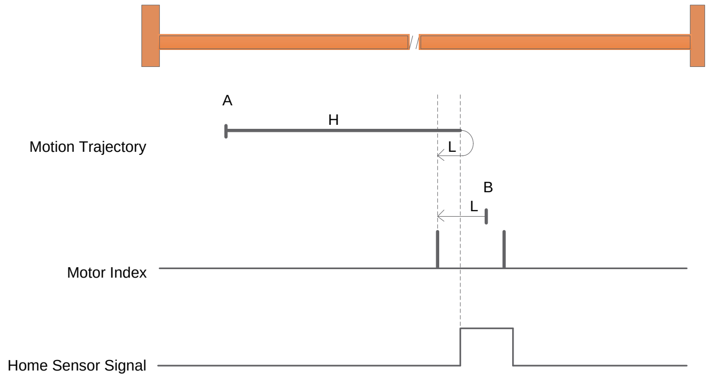


Position A: The motor moves in the positive direction with a homing speed set by P2-24 as long as the Positive Limit Switch(PLS) remains invalid. When the valid state of PLS is detected, the motor changes direction and speed, and moves in the negative direction with a homing speed set by P2-25 until the first motor index pulse is detected after PLS attains the invalid state.

Position B: The valid state of PLS is detected when homing starts, the motor movies in the negative direction with a homing speed set by P2-25 until the first motor index pulse is detected after NLS attains the invalid state.

When receiving this event and the motor completely stops, the drive sets Homing Finished bit of drive's status.

7.10.2.7 Method 3: Start Positive Homing for the Falling-edge of Home Sensor and Motor Index



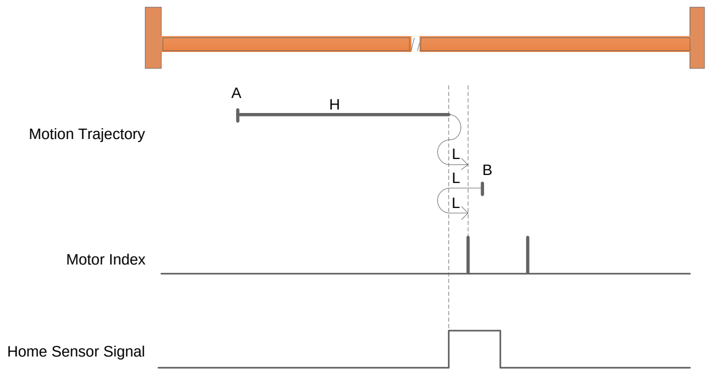
The initial direction of movement depends on the logic state of home sensor when start homing.

Position A: If homing starts and the home sensor is invalid, the motor moves in the positive direction with a homing speed set by P2-24 as long as home sensor remains invalid. When the valid state of home switch is detected, the motor stops, changes direction and speed, and moves in the negative direction with a homing speed set by P2-25 until the logic state of home sensor changes to invalid, where means the falling-edge is detected. Then if the first motor index pulse is detected, the motor stops,Homing has been finished.

Position B: If homing starts and the home sensor is valid, the motor moves in the negative direction with a speed set by P2-25 until the logic state of home sensor changes to invalid. Then if the first motor index pulse is detected, the motor stops,Homing has been finished.

When receiving this event and the motor completely stops, the drive sets Homing Finished bit of drive's status.

7.10.2.8 Method 4: Start Positive Homing for the Raising-edge of Home Sensor and Motor Index



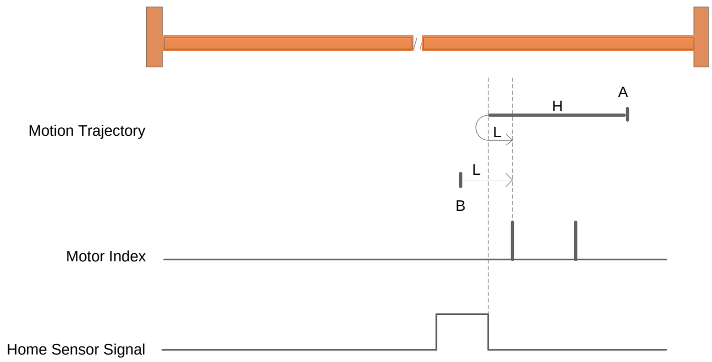
The initial direction of movement depends on the logic state of home sensor when start homing.

Position A: If homing starts and the home sensor is invalid, the motor moves in the positive direction with a homing speed set by P2-24 as long as home sensor remains invalid. When the valid state of home switch is detected, the motor stops, changes direction and speed, and moves in the negative direction with a homing speed set by P2-25 until the logic state of home sensor changes to invalid, then changes direction and speed, and moves again in the positive direction with a speed set by P2-25 as long as home sensor remains valid. Then if the first motor index pulse is detected, the motor stops,Homing has been finished.

Position B: If homing starts and the home sensor is valid, the motor moves in the negative direction with a speed set by P2-25 until the logic state of home sensor changes to invalid. then changes direction and speed, and moves again in the positive direction with a speed set by P2-25 as long as home sensor remains valid. Then if the first motor index pulse is detected, the motor stops,Homing has been finished.

When receiving this event and the motor completely stops, the drive sets Homing Finished bit of drive's status.

7.10.2.9 Method 5: Start Negative Homing for the Falling-edge of Home Sensor and Motor Index



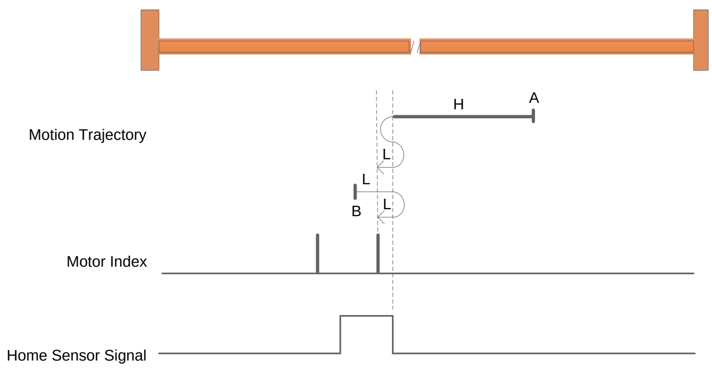
The initial direction of movement depends on the logic state of home sensor when start homing.

Position A: If homing starts and the home sensor is invalid, the motor moves in the negative direction with a homing speed set by P2-24 as long as home sensor remains invalid. When the valid state of home switch is detected, the motor stops, changes direction and speed, and moves in the positive direction with a homing speed set by P2-25 until the logic state of home sensor changes to invalid, where means the falling-edge is detected. Then if the first motor index pulse is detected, the motor stops,Homing has been finished.

Position B: If homing starts and the home sensor is valid, the motor moves in the positive direction with a speed set by P2-25 until the logic state of home sensor changes to invalid. Then if the first motor index pulse is detected, the motor stops,Homing has been finished.

When receiving this event and the motor completely stops, the drive sets Homing Finished bit of drive's status.

7.10.2.10 Start Negative Homing for the Raising-edge of Home Sensor and Motor Index



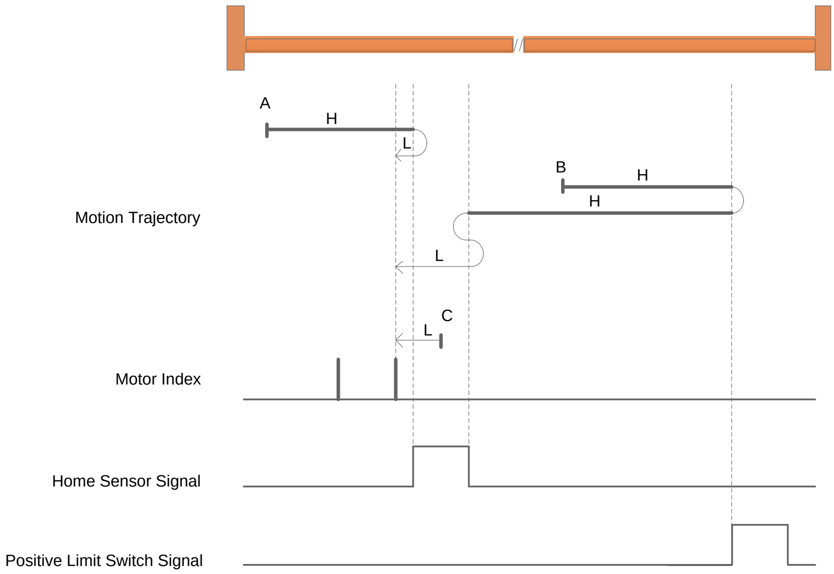
The initial direction of movement depends on the logic state of home sensor when start homing.

Position A: If homing starts and the home sensor is invalid, the motor moves in the negative direction with a homing speed set by P2-24 as long as home sensor remains invalid. When the valid state of home switch is detected, the motor stops, changes direction and speed, and moves in the positive direction with a homing speed set by P2-25 until the logic state of home sensor changes to invalid, then changes direction and speed, and moves again in the negative direction with a speed set by P2-25 as long as home sensor remains valid. Then if the first motor index pulse is detected, the motor stops,Homing has been finished.

Position B: If homing starts and the home sensor is valid, the motor moves in the positive direction with a speed set by P2-25 until the logic state of home sensor changes to invalid, then changes direction and speed, and moves again in the negative direction with a speed set by P2-25 as long as home sensor remains valid. Then if the first motor index pulse is detected, the motor stops,Homing has been finished.

When receiving this event and the motor completely stops, the drive sets Homing Finished bit of drive's status.

7.10.2.11 Method 7: Start Positive Homing, Seek for PLS, Falling-edge of Home Switch's Negative Side and Motor Index, Reverse on the PLS



When using homing method 7, the initial direction of movement depends on the logic state of home sensor when start homing.

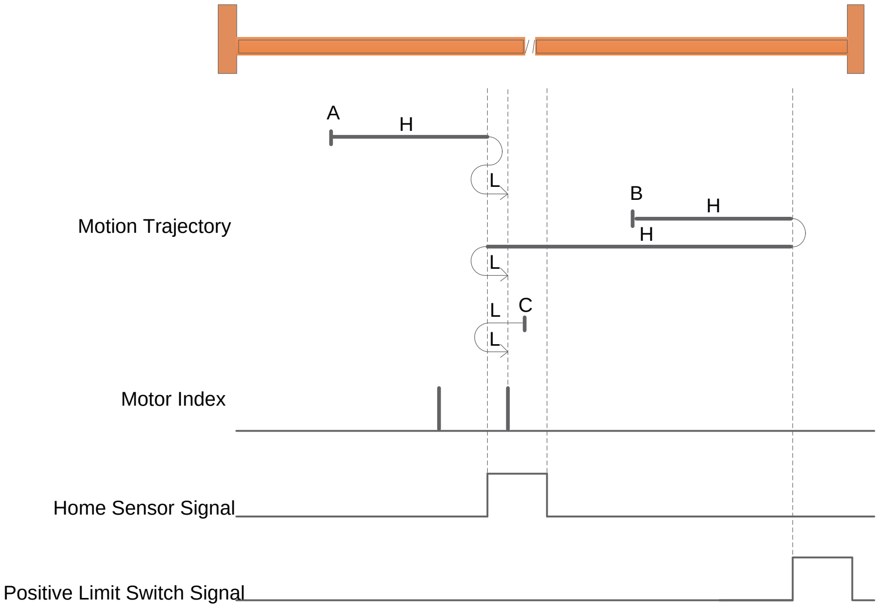
If homing starts and the home sensor is invalid, the motor moves in the positive direction with a homing speed set by P2-24 until one of two possible event occur:

- Position A: When the valid state of home sensor is detected, the motor stops, changes direction and speed, and moves in the negative direction with a homing speed set by P2-25 until the logic state of home sensor changes to invalid, where means the falling-edge is detected. Then if the first motor index pulse is detected, the motor stops,Homing has been finished.
- Position B: When the valid state of PLS is detected, the motor stops, changes direction and speed, and moves in the negative direction with a homing speed set by P2-24 until the logic state of home sensor changes to valid, then reverse to leave away the home sensor. After left the home sensor, the motor changes direction again and moves in the negative direction with a homing speed set by P2-25 until the home sensor changes logic state from invalid to valid, and then from valid to invalid, where means the falling-edge is detected. Then if the first motor index pulse is detected, the motor stops,Homing has been finished.

If homing starts and the home sensor is valid(like Position C), the motor moves in the negative direction with a speed set by P2-25 until home switch changes logic state from valid to invalid.Then if the first motor index pulse is detected, the motor stops,Homing has been finished.

When receiving this event and the motor completely stops, the drive sets Homing Finished bit of drive's status.

7.10.2.12 Method 8: Start Positive Homing, Seek for PLS, Raising-edge of Home Switch's Negative Side and Motor Index, Reverse on the PLS



When using homing method 8, the initial direction of movement depends on the logic state of home sensor when start homing.

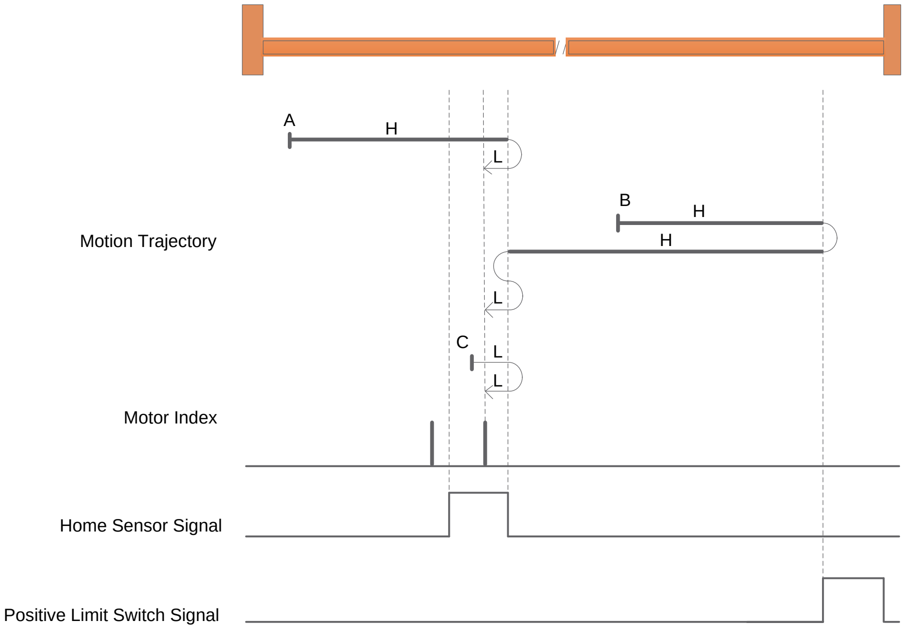
If homing starts and the home sensor is invalid, the motor moves in the positive direction with a homing speed set by P2-24 until one of two possible event occur:

- Position A: When the valid state of home sensor is detected, the motor stops, changes direction and speed, and moves in the negative direction with a homing speed set by P2-25 until the logic state of home sensor changes to invalid. After left the home sensor, the motor changes direction again and moves in the positive direction with a homing speed set by P2-25 until the home sensor changes logic state from invalid to valid, where means the raising-edge is detected. Then if the first motor index pulse is detected, the motor stops,Homing has been finished.
- Position B: When the valid state of PLS is detected, the motor stops, changes direction and speed, and moves in the negative direction with a homing speed set by P2-24 until the valid state of home sensor is detected. In this case the motor continues to move in the negative direction as long as home sensor remain valid. After left the home sensor, the home sensor invalid state is detected, the motor reverses with a homing speed set by P2-25 until the home sensor changes logic state from invalid to valid, where means the raising-edge is detected. Then if the first motor index pulse is detected, the motor stops,Homing has been finished.

If homing starts and the home sensor is valid(like Position C), the motor moves in the negative direction with a speed set by P2-25 until home switch changes logic state from valid to invalid. After left the home sensor, the motor reverses with a homing speed set by P2-25 until the home sensor changes logic state from invalid to valid, where means the raising-edge is detected. Then if the first motor index pulse is detected, the motor stops,Homing has been finished.

When receiving this event and the motor completely stops, the drive sets Homing Finished bit of drive's status.

7.10.2.13 Method 9: Start Positive Homing, Seek for PLS, Raising-edge of Home Switch's Positive Side and Motor index, Reverse on the PLS



When using homing method 9, the initial direction of movement depends on the logic state of home sensor when start homing.

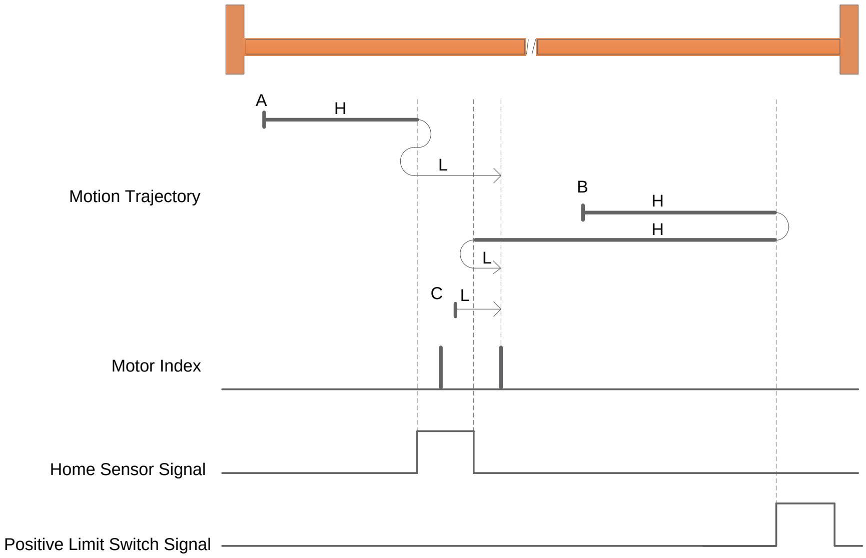
If homing starts and the home sensor is invalid, the motor moves in the positive direction with a homing speed set by P2-24 until one of two possible event occur:

- Position A: The valid state of home sensor is detected. In this case the motor continues to move in the positive direction with the same speed as long as home sensor remains valid. When the home sensor invalid state is detected, the motor stops, changes direction and speed, and moves in the negative direction with a homing speed set by P2-25 until the logic state of home sensor changes to valid, where means the raising-edge is detected. Then if the first motor index pulse is detected, the motor stops,Homing has been finished.
- Position B: When the valid state of PLS is detected, the motor stops, changes direction and speed, and moves in the negative direction with a homing speed set by P2-24 until the logic state of home sensor changes to valid, then reverse to leave away the home sensor. After left the home sensor, the motor changes direction again and moves in the negative direction with a homing speed set by P2-25 until the home sensor changes logic state from invalid to valid,where means the raising-edge is detected. Then if the first motor index pulse is detected, the motor stops,Homing has been finished.

If homing starts and the home sensor is valid(like Position C), the motor moves in the positive direction with a speed set by P2-25 as long as home switch remains valid. When the invalid state is detected, the motor changes direction again and moves in the negative direction with a homing speed set by P2-25 until the home sensor attains the valid state. Then if the first motor index pulse is detected, the motor stops,Homing has been finished.

When receiving this event and the motor completely stops, the drive sets Homing Finished bit of drive's status.

7.10.2.14 Method 10: Start Positive Homing, Seek for PLS, Falling-edge of Home Switch's Positive Side and Motor Index, Reverse on the PLS



When using homing method 10, the initial direction of movement depends on the logic state of home sensor when start homing.

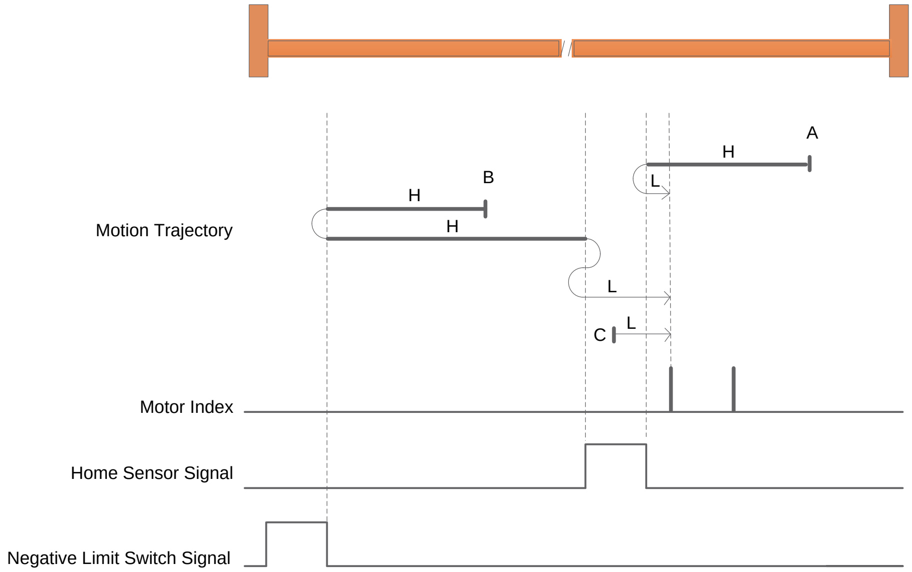
If homing starts and the home sensor is invalid, the motor moves in the positive direction with a homing speed set by P2-24 until one of two possible event occur:

- Position A: When the valid state of home sensor is detected, the motor stops, changes direction and speed, and moves in the negative direction with a homing speed set by P2-25 until the logic state of home sensor changes to invalid. After left the home sensor, the motor changes direction again and continues to moves in the positive direction with a homing speed set by P2-25 until the home sensor changes logic state from invalid to valid, and then the change from valid to invalid state is detected, where means the falling-edge is detected. Then if the first motor motor index pulse is detected, the motor stops,Homing has been finished.
- Position B: When the valid state of PLS is detected, the motor stops, changes direction and speed, and moves in the negative direction with a homing speed set by P2-24 until the valid state of home sensor is detected, then the motor reverses with a homing speed set by P2-25 until the home sensor changes logic state from valid to invalid, where means the falling-edge is detected. Then if the first motor index pulse is detected, the motor stops,Homing has been finished.

If homing starts and the home sensor is valid(like Position C), the motor moves in the positive direction with a speed set by P2-25 until home switch changes logic state from valid to invalid, where means the falling-edge is detected. Then if the first motor index pulse is detected, the motor stops,Homing has been finished.

When receiving this event and the motor completely stops, the drive sets Homing Finished bit of drive's status.

7.10.2.15 Method 11: Start Negative Homing, Seek for NLS, Falling-edge of Home Switch's Positive Side and Motor Index, Reverse on the NLS



When using homing method 11, the initial direction of movement depends on the logic state of home sensor when start homing.

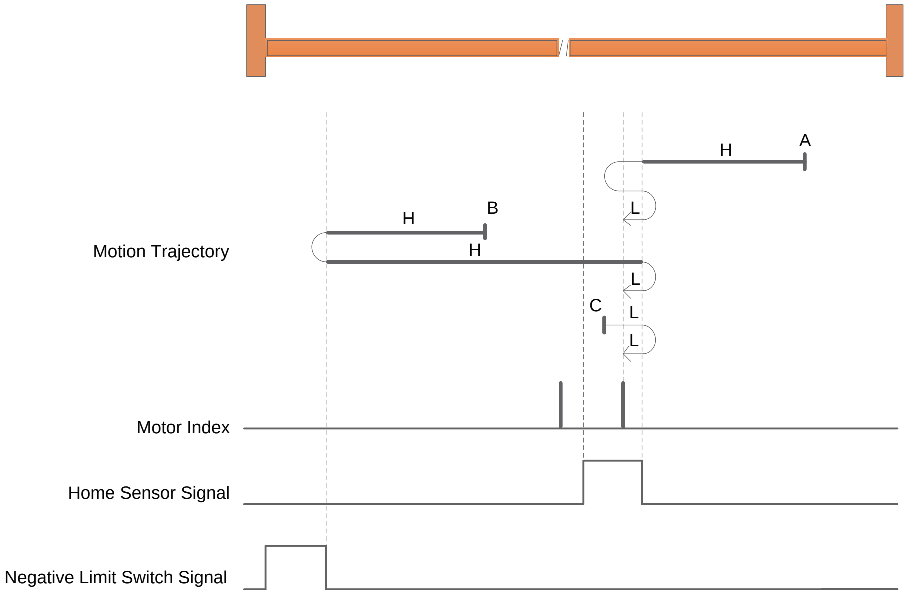
If homing starts and the home sensor is invalid, the motor moves in the negative direction with a homing speed set by P2-24 until one of two possible event occur:

- Position A: When the valid state of home sensor is detected, the motor stops, changes direction and speed, and moves in the positive direction with a homing speed set by P2-25 until the logic state of home sensor changes to invalid, where means the falling-edge is detected. Then if the first motor index pulse is detected, the motor stops,Homing has been finished.
- Position B: When the valid state of NLS(Negative Limit Switch) is detected, the motor stops, changes direction and speed, and moves in the positive direction with a homing speed set by P2-24 until the logic state of home sensor changes to valid, then reverse to leave away the home sensor. After left the home sensor, the motor changes direction again and moves in the negative direction with a homing speed set by P2-25 until the home sensor changes logic state from invalid to valid, and then the change from valid to invalid state is detected, where means the falling-edge is detected. Then if the first motor index pulse is detected, the motor stops,Homing has been finished.

If homing starts and the home sensor is valid(like Position C), the motor moves in the positive direction with a speed set by P2-25 until home switch changes logic state from valid to invalid.Then if the first motor index pulse is detected, the motor stops,Homing has been finished.

When receiving this event and the motor completely stops, the drive sets Homing Finished bit of drive's status.

7.10.2.16 Method 12: Start Negative Homing, Seek for NLS, Raising-edge of Home Switch's Positive Side and Motor Index, Reverse on the NLS



When using homing method 12, the initial direction of movement depends on the logic state of home sensor when start homing.

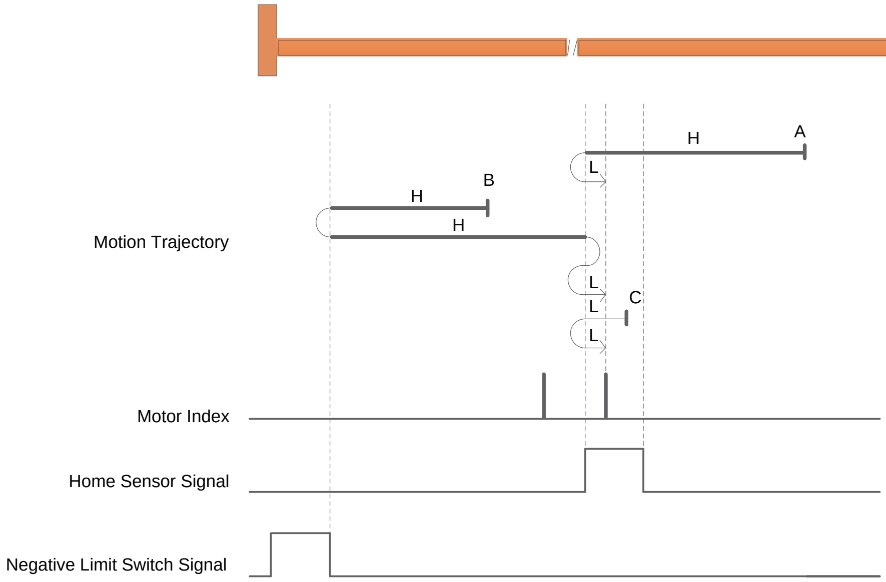
If homing starts and the home sensor is invalid, the motor moves in the negative direction with a homing speed set by P2-24 until one of two possible event occur:

- Position A: When the valid state of home sensor is detected, the motor stops, changes direction and speed, and moves in the positive direction with a homing speed set by P2-25 until the logic state of home sensor changes to invalid. After left the home sensor, the motor changes direction again and moves in the negative direction with a homing speed set by P2-25 until the home sensor changes logic state from invalid to valid, where means the raising-edge is detected. Then if the first motor index pulse is detected, the motor stops,Homing has been finished.
- Position B: When the valid state of NLS(Negative Limit Switch) is detected, the motor stops, changes direction and speed, and moves in the positive direction with a homing speed set by P2-24 until the valid state of home sensor is detected. In this case the motor continues to move in the positive direction as long as home sensor remain valid. After left the home sensor, the home sensor invalid state is detected, the motor reverses with a homing speed set by P2-25 until the home sensor changes logic state from invalid to valid, where means the raising-edge is detected. Then if the first motor index pulse is detected, the motor stops,Homing has been finished.

If homing starts and the home sensor is valid(like Position C), the motor moves in the positive direction with a speed set by P2-25 until home switch changes logic state from valid to invalid. After left the home sensor, the motor reverses with a homing speed set by P2-25 until the home sensor changes logic state from invalid to valid, where means the raising-edge is detected. Then if the motor first motor index pulse is detected, the motor stops,Homing has been finished.

When receiving this event and the motor completely stops, the drive sets Homing Finished bit of drive's status.

7.10.2.17 Method 13: Start Negative Homing, Seek for NLS, Raising-edge of Home Switch's Negative Side and Motor Index, Reverse on the NLS



When using homing method 13, the initial direction of movement depends on the logic state of home sensor when start homing.

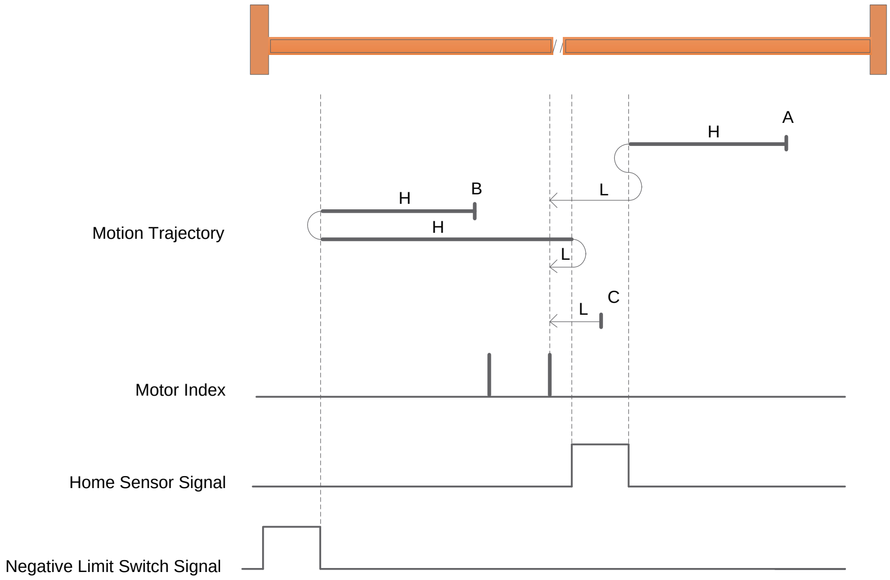
If homing starts and the home sensor is invalid, the motor moves in the negative direction with a homing speed set by P2-24 until one of two possible event occur:

- Position A: The valid state of home sensor is detected. In this case the motor continues to move in the negative direction with the same speed as long as home sensor remains valid. When the home sensor invalid state is detected, the motor stops, changes direction and speed, and moves in the positive direction with a homing speed set by P2-25 until the logic state of home sensor changes to valid, where means the raising-edge is detected. Then if the first motor index pulse is detected, the motor stops,Homing has been finished.
- Position B: When the valid state of NLS(Negative Limit Switch) is detected, the motor stops, changes direction and speed, and moves in the positive direction with a homing speed set by P2-24 until the logic state of home sensor changes to valid, then reverse to leave away from the home sensor. After left the home sensor, the motor changes direction again and moves in the positive direction with a homing speed set by P2-25 until the home sensor changes logic state from invalid to valid,where means the raising-edge is detected. Then if the first motor motor index pulse is detected, the motor stops,Homing has been finished.

If homing starts and the home sensor is valid(like Position C), the motor moves in the negative direction with a speed set by P2-25 as long as home switch remains valid. When the invalid state is detected, the motor changes direction again and moves in the positive direction with a homing speed set by P2-25 until the home sensor attains the valid state. Then if the first motor index pulse is detected, the motor stops,Homing has been finished.

When receiving this event and the motor completely stops, the drive sets Homing Finished bit of drive's status.

7.10.2.18 Method 14: Start Negative Homing, Seek for NLS, Falling-edge of Home Switch's Negative Side and Motor Index, Reverse on the NLS



When using homing method 14, the initial direction of movement depends on the logic state of home sensor when start homing.

If homing starts and the home sensor is invalid, the motor moves in the negative direction with a homing speed set by P2-24 until one of two possible event occur:

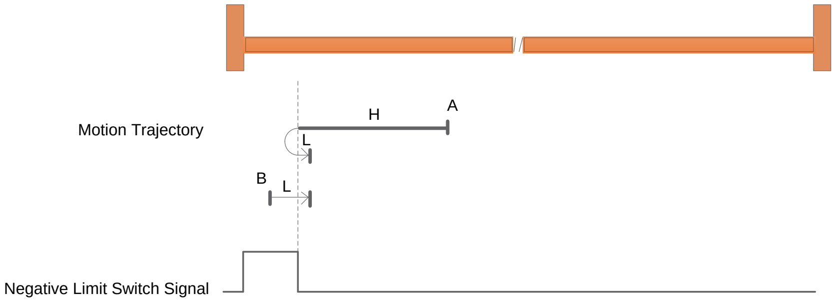
- Position A: When the valid state of home sensor is detected, the motor stops, changes direction and speed, and moves in the positive direction with a homing speed set by P2-25 until the logic state of home sensor changes to invalid. After left the home sensor, the motor changes direction again and continues to moves in the negative direction with a homing speed set by P2-25 until the home sensor changes logic state from invalid to valid, and then the change from valid to invalid state is detected, where means the falling-edge is detected. Then if the first motor motor index pulse is detected, the motor stops, Homing has been finished.
- Position B: When the valid state of NLS(Negative Limit Switch) is detected, the motor stops, changes direction and speed, and moves in the positive direction with a homing speed set by P2-24 until the valid state of home sensor is detected, then the motor reverses with a homing speed set by P2-25 until the home sensor changes logic state from valid to invalid, where means the falling-edge is detected. Then if the first motor index pulse is detected, the motor stops, Homing has been finished.

If homing starts and the home sensor is valid(like Position C), the motor moves in the negative direction with a speed set by P2-25 until home switch changes logic state from valid to invalid, where means the falling-edge is detected. Then if the first motor index pulse is detected, the motor stops, Homing has been finished.

When receiving this event and the motor completely stops, the drive sets Homing Finished bit of drive's status.

7.10.2.19 Methods 15 and 16: Reserved

7.10.2.20 Method 17: Start Negative Homing, Seek for Negative Home Switch



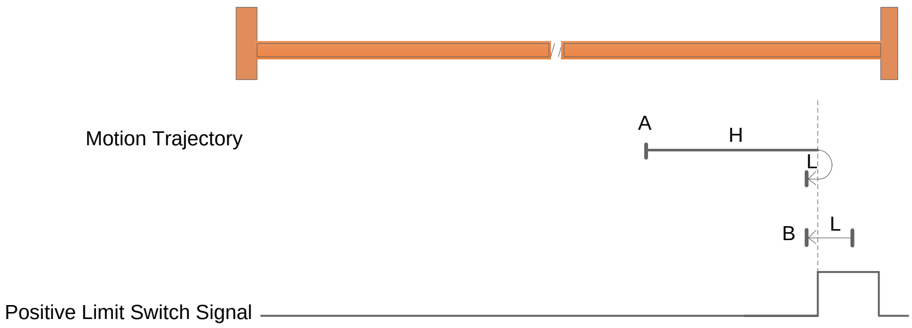
Method 17 is similar to method 1, except that the home position is not dependent on the motor index, it is dependent only on the NLS(Negative Limit Switch).

Position A:The motor moves in the negative direction with a homing speed set by P2-24 as long as the Negative Limit Signal(NLS) remains invalid. When the valid state of NLS is detected, the motor changes direction and speed, and moves in the positive direction with a homing speed set by P2-25 until NLS attains the invalid state.

Position B: The valid state of NLS is detected when homing starts, the motor movies in the positive direction with a homing speed set by P2-25 until NLS attains the invalid state.

When receiving this event and the motor completely stops, the drive sets Homing Finished bit of drive's status.

7.10.2.21 Method 18: Start Positive Homing, Seek for Positive Home Switch



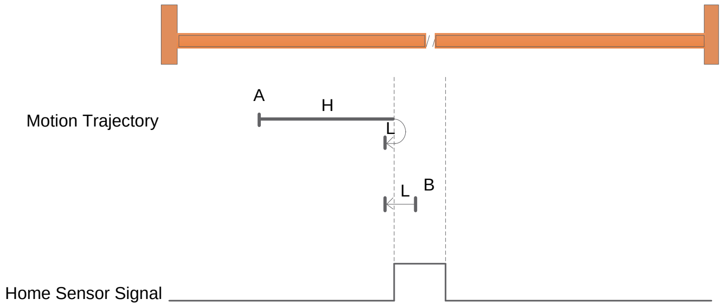
Method 18 is similar to method 2, except that the home position is not dependent on the motor index, it is dependent only on the NLS(Negative Limit Switch).

Position A: The motor moves in the positive direction with a homing speed set by P2-24 as long as the Positive Limit Signal(PLS) remains invalid. When the valid state of PLS is detected, the motor changes direction and speed, and moves in the negative direction with a homing speed set by P2-25 until PLS attains the invalid state.

Position B: The valid state of PLS is detected when homing starts, the motor movies in the negative direction with a homing speed set by P2-25 until PLS attains the invalid state.

When receiving this event and the motor completely stops, the drive sets Homing Finished bit of drive's status.

7.10.2.22 Method 19: Start Positive Homing for the Falling-edge of Home Sensor



Method 19 is similar to method 3, except that the home position is not dependent on the motor index, it is dependent only on the home sensor.

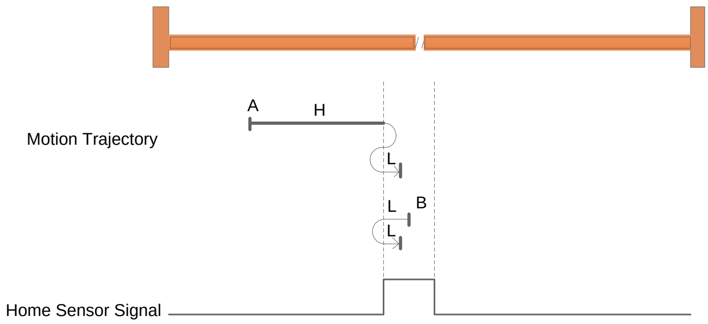
The initial direction of movement depends on the logic state of home sensor when start homing.

Position A: If homing starts and the home sensor is invalid, the motor moves in the positive direction with a homing speed set by P2-24 as long as home sensor remains invalid. When the valid state of home switch is detected, the motor stops, changes direction and speed, and moves in the negative direction with a homing speed set by P2-25 until the logic state of home sensor changes to invalid, where means the falling-edge is detected, then the motor stops, Homing has been finished.

Position B: If homing starts and the home sensor is valid, the motor moves in the negative direction with a speed set by P2-25 until the logic state of home sensor changes to invalid, then the motor stops, Homing has been finished.

When receiving this event and the motor completely stops, the drive sets Homing Finished bit of drive's status.

7.10.2.23 Method 20: Start Positive Homing for the Raising-edge of Home Sensor



Method 20 is similar to method 4, except that the home position is not dependent on the motor index, it is dependent only on the home sensor.

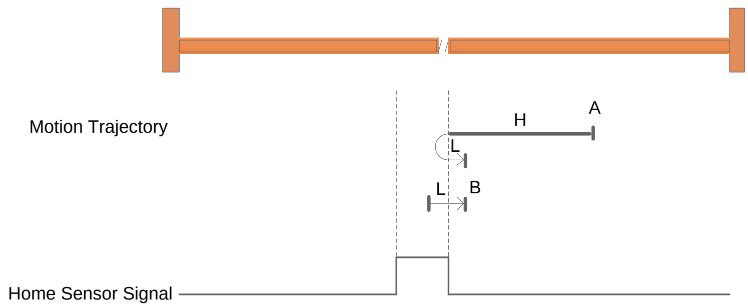
The initial direction of movement depends on the logic state of home sensor when start homing.

Position A: If homing starts and the home sensor is invalid, the motor moves in the positive direction with a homing speed set by P2-24 as long as home sensor remains invalid. When the valid state of home switch is detected, the motor stops, changes direction and speed, and moves in the negative direction with a homing speed set by P2-25 until the logic state of home sensor changes to invalid, then changes direction and speed, and moves again in the positive direction with a speed set by P2-25 as long as home sensor remains valid. Then if the first motor index pulse is detected, the motor stops,Homing has been finished.

Position B: If homing starts and the home sensor is valid, the motor moves in the negative direction with a speed set by P2-25 until the logic state of home sensor changes to invalid. then changes direction and speed, and moves again in the positive direction with a speed set by P2-25 as long as home sensor remains valid. Then if the first motor index pulse is detected, the motor stops, Homing has been finished.

When receiving this event and the motor completely stops, the drive sets Homing Finished bit of drive's status.

7.10.2.24 Method 21: Start Negative Homing for the Falling-edge of Home Sensor



Method 21 is similar to method 5, except that the home position is not dependent on the motor index, it is dependent only on the home sensor.

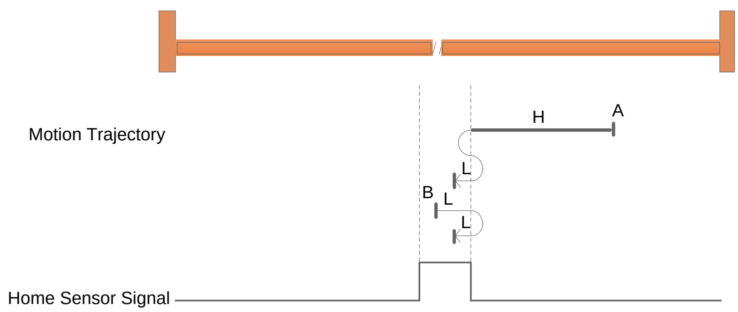
The initial direction of movement depends on the logic state of home sensor when start homing.

Position A: If homing starts and the home sensor is invalid, the motor moves in the negative direction with a homing speed set by P2-24 as long as home sensor remains invalid. When the valid state of home switch is detected, the motor stops, changes direction and speed, and moves in the positive direction with a homing speed set by P2-25 until the logic state of home sensor changes to invalid, where means the falling-edge is detected, then the motor stops, Homing has been finished.

Position B: If homing starts and the home sensor is valid, the motor moves in the positive direction with a speed set by P2-25 until the logic state of home sensor changes to invalid, then the motor stops, Homing has been finished.

When receiving this event and the motor completely stops, the drive sets Homing Finished bit of drive's status.

7.10.2.25 Method 22: Start Negative Homing for the Raising-edge of Home Sensor



Method 22 is similar to method 6, except that the home position is not dependent on the motor index, it is dependent only on the home sensor.

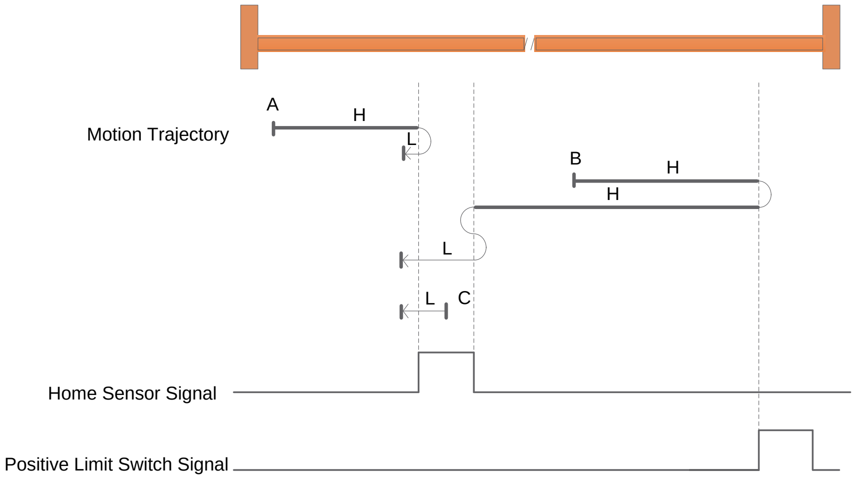
The initial direction of movement depends on the logic state of home sensor when start homing.

Position A: If homing starts and the home sensor is invalid, the motor moves in the negative direction with a homing speed set by P2-24 as long as home sensor remains invalid. When the valid state of home switch is detected, the motor stops, changes direction and speed, and moves in the positive direction with a homing speed set by P2-25 until the logic state of home sensor changes to invalid, then changes direction and speed, and moves again in the negative direction with a speed set by P2-25 until the home sensor state transition from invalid to valid is detected, then the motor stops, Homing has been finished.

Position B: If homing starts and the home sensor is valid, the motor moves in the positive direction with a speed set by P2-25 until the logic state of home sensor changes to invalid, then changes direction and speed, and moves again in the negative direction with a speed set by P2-25 until the home sensor state transition from invalid to valid is detected, then the motor stops, Homing has been finished.

When receiving this event and the motor completely stops, the drive sets Homing Finished bit of drive's status.

7.10.2.26 Method 23: Start Positive Homing, Seek for PLS, Falling-edge of Home Switch's Negative Side, Reverse on the PLS



Method 23 is similar to method 7, except that the home position is not dependent on the motor index, it is dependent only on the home sensor transitions and positive limit switch(PLS) transitions.

When using homing method 23, the initial direction of movement depends on the logic state of home sensor when start homing.

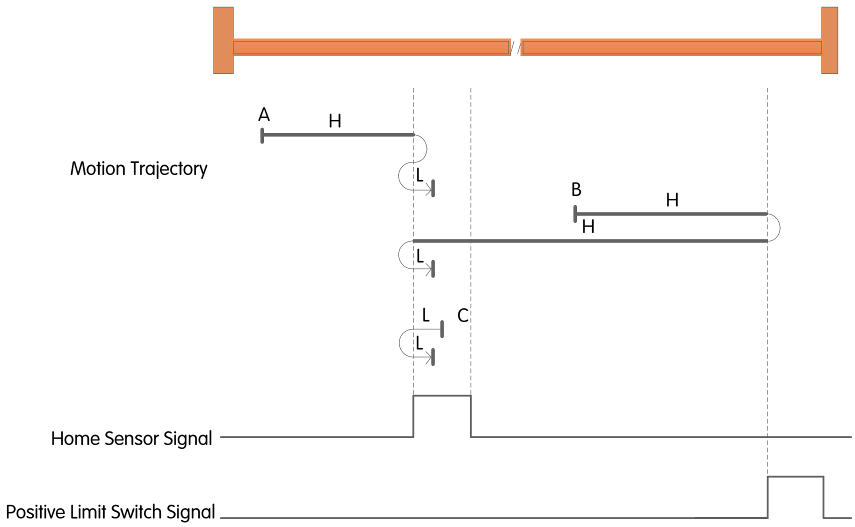
If homing starts and the home sensor is invalid, the motor moves in the positive direction with a homing speed set by P2-24 until one of two possible event occur:

- Position A: When the valid state of home sensor is detected, the motor stops, changes direction and speed, and moves in the negative direction with a homing speed set by P2-25 until the home sensor state transition from valid to invalid, where means the falling-edge is detected, then the motor stops, Homing has been finished.
- Position B: When the valid state of PLS is detected, the motor stops, changes direction and speed, and moves in the negative direction with a homing speed set by P2-24 until the logic state of home sensor changes to valid, then reverse to leave away the home sensor. After left the home sensor, the motor changes direction again and continues to moves in the negative direction with a homing speed set by P2-25 until the home sensor changes logic state from invalid to valid, and then the change from valid to invalid state is detected, where means the falling-edge is detected, then the motor stops, Homing has been finished.

If homing starts and the home sensor is valid(like Position C), the motor moves in the negative direction with a speed set by P2-25 until home switch changes logic state from valid to invalid, then the motor stops,Homing has been finished.

When receiving this event and the motor completely stops, the drive sets Homing Finished bit of drive's status.

7.10.2.27 Method 24: Start Positive Homing, Seek for PLS, Raising-edge of Home Switch's Negative Side, Reverse on the PLS



Method 24 is similar to method 8, except that the home position is not dependent on the motor index, it is dependent only on the home sensor transitions and positive limite switch(PLS) transitions.

When using homing method 24, the initial direction of movement depends on the logic state of home sensor when start homing.

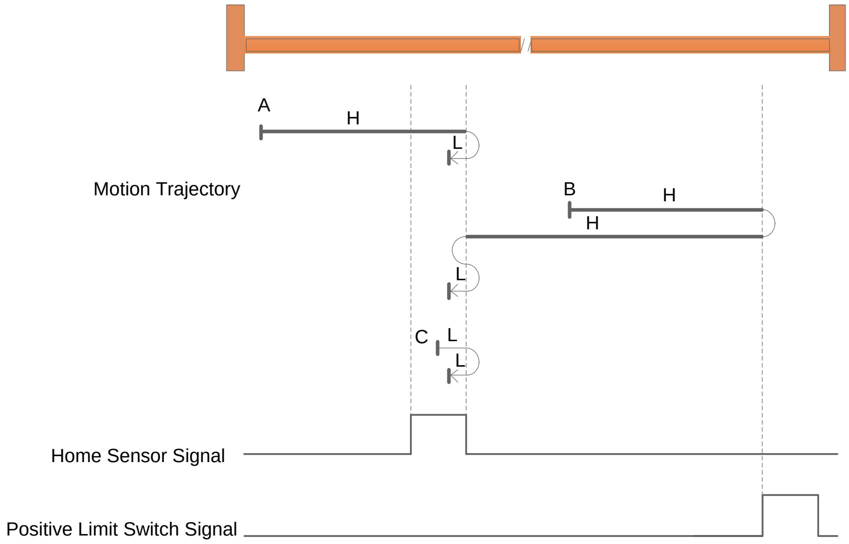
If homing starts and the home sensor is invalid, the motor moves in the positive direction with a homing speed set by P2-24 until one of two possible event occur:

- Position A: When the valid state of home sensor is detected, the motor stops, changes direction and speed, and moves in the negative direction with a homing speed set by P2-25 until the logic state of home sensor changes to invalid. After left the home sensor, the motor changes direction again and moves in the positive direction with a homing speed set by P2-25 until the home sensor changes logic state from invalid to valid, where means the raising-edge is detected, then the motor stops, Homing has been finished.
- Position B: When the valid state of PLS is detected, the motor stops, changes direction and speed, and moves in the negative direction with a homing speed set by P2-24 until the valid state of home sensor is detected. In this case the motor continues to move in the negative direction as long as home sensor remain valid. After left the home sensor, the home sensor invalid state is detected, the motor reverses with a homing speed set by P2-25 until the home sensor changes logic state from invalid to valid, where means the raising-edge is detected, then the motor stops, Homing has been finished.

If homing starts and the home sensor is valid(like Position C), the motor moves in the negative direction with a speed set by P2-25 until home switch changes logic state from valid to invalid. After left the home sensor, the motor reverses with a homing speed set by P2-25 until the home sensor changes logic state from invalid to valid, where means the raising-edge is detected, then the motor stops,Homing has been finished.

When receiving this event and the motor completely stops, the drive sets Homing Finished bit of drive's status.

7.10.2.28 Method 25: Start Positive Homing, Seek for PLS, Raising-edge of Home Switch's Positive Side, Reverse on the PLS



Method 25 is similar to method 9, except that the home position is not dependent on the motor index, it is dependent only on the home sensor transitions and positive limit switch(PLS) transitions.

When using homing method 25, the initial direction of movement depends on the logic state of home sensor when start homing.

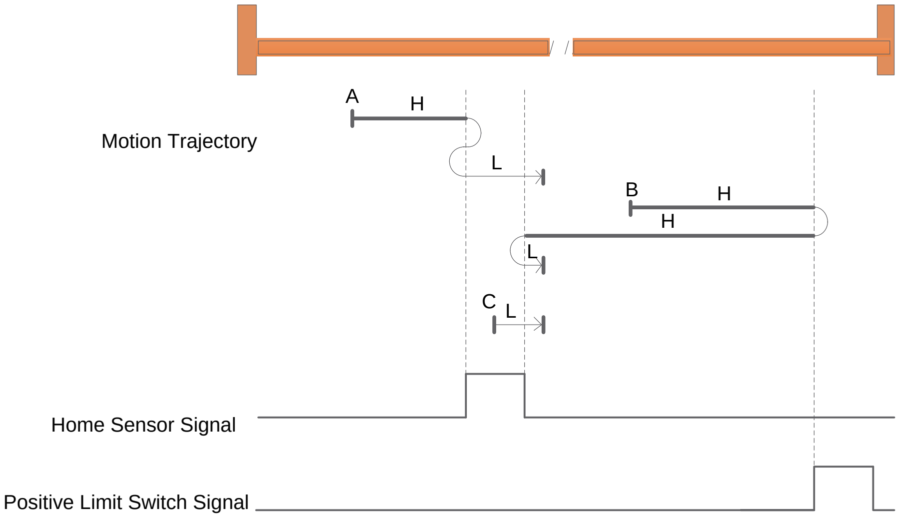
If homing starts and the home sensor is invalid, the motor moves in the positive direction with a homing speed set by P2-24 until one of two possible event occur:

- Position A: The valid state of home sensor is detected. In this case the motor continues to move in the positive direction with the same speed as long as home sensor remains valid. When the home sensor invalid state is detected, the motor stops, changes direction and speed, and moves in the negative direction with a homing speed set by P2-25 until the home sensor state transition from invalid to valid is detected, where means the raising-edge is detected, then the motor stops, Homing has been finished.
- Position B: When the valid state of PLS is detected, the motor stops, changes direction and speed, and moves in the negative direction with a homing speed set by P2-24 until the logic state of home sensor changes to valid, then reverse to leave away the home sensor. After left the home sensor, the motor changes direction again and moves in the negative direction with a homing speed set by P2-25 until the home sensor state transition from invalid to valid is detected, where means the raising-edge is detected, then the motor stops, Homing has been finished.

If homing starts and the home sensor is valid(like Position C), the motor moves in the positive direction with a speed set by P2-25 as long as home switch remains valid. When the invalid state is detected, the motor changes direction again and moves in the negative direction with a homing speed set by P2-25 until the home sensor state transition from invalid to valid is detected, where means the raising-edge is detected, then the motor stops, Homing has been finished.

When receiving this event and the motor completely stops, the drive sets Homing Finished bit of drive's status.

7.10.2.29 Method 26: Start Positive Homing, Seek for PLS, Falling-edge of Home Switch's Positive Side, Reverse on the PLS



Method 26 is similar to method 10, except that the home position is not dependent on the motor index, it is dependent only on the home sensor transitions and positive limit switch(PLS) transitions.

When using homing method 26, the initial direction of movement depends on the logic state of home sensor when start homing.

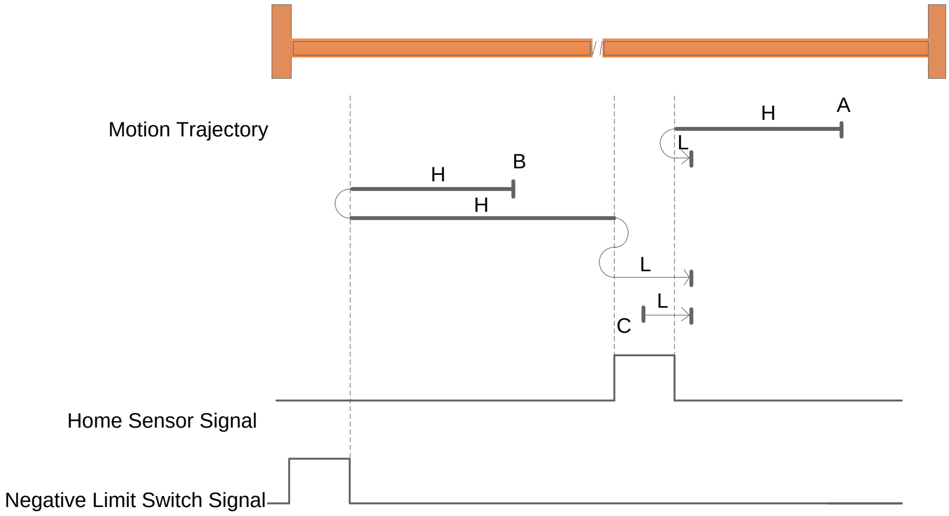
If homing starts and the home sensor is invalid, the motor moves in the positive direction with a homing speed set by P2-24 until one of two possible event occur:

- Position A: When the valid state of home sensor is detected, the motor stops, changes direction and speed, and moves in the negative direction with a homing speed set by P2-25 until the logic state of home sensor changes to invalid. After left the home sensor, the motor changes direction again and continues to moves in the positive direction with a homing speed set by P2-25 until the home sensor changes logic state from invalid to valid, and then the change from valid to invalid state is detected, where means the falling-edge is detected, then the motor stops, Homing has been finished.
- Position B: When the valid state of PLS is detected, the motor stops, changes direction and speed, and moves in the negative direction with a homing speed set by P2-24 until the valid state of home sensor is detected, then the motor reverses with a homing speed set by P2-25 until the home sensor changes logic state from valid to invalid, where means the falling-edge is detected, then the motor stops, Homing has been finished.

If homing starts and the home sensor is valid(like Position C), the motor moves in the positive direction with a speed set by P2-25 until home switch changes logic state from valid to invalid, where means the falling-edge is detected, then the motor stops, Homing has been finished.

When receiving this event and the motor completely stops, the drive sets Homing Finished bit of drive's status.

7.10.2.30 Method 27: Start Negative Homing, Seek for NLS, Falling-edge of Home Switch's Positive Side, Reverse on the NLS



Method 27 is similar to method 11, except that the home position is not dependent on the motor index, it is dependent only on the home sensor transitions and negative limit switch(NLS) transitions.

When using homing method 27, the initial direction of movement depends on the logic state of home sensor when start homing.

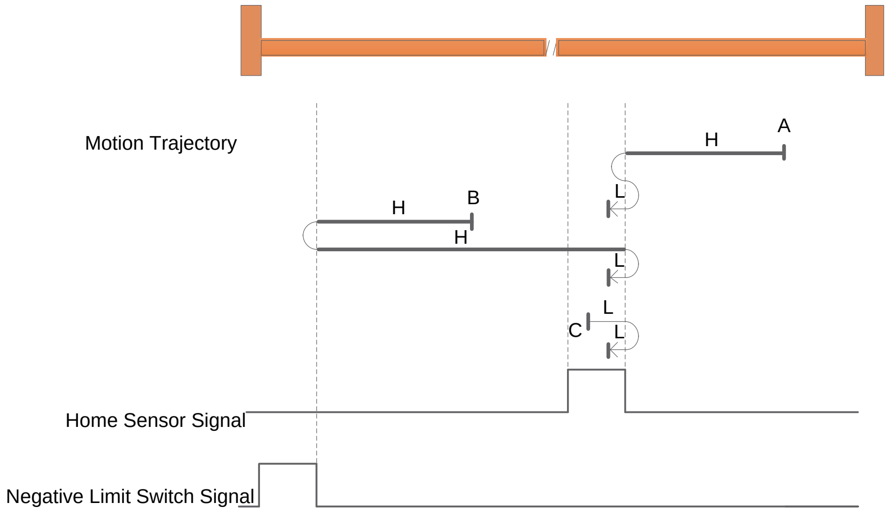
If homing starts and the home sensor is invalid, the motor moves in the negative direction with a homing speed set by P2-24 until one of two possible event occur:

- Position A: When the valid state of home sensor is detected, the motor stops, changes direction and speed, and moves in the positive direction with a homing speed set by P2-25 until the home sensor state transition from valid to invalid, where means the falling-edge is detected, then the motor stops, Homing has been finished.
- Position B: When the valid state of NLS(Negative Limit Switch) is detected, the motor stops, changes direction and speed, and moves in the positive direction with a homing speed set by P2-24 until the logic state of home sensor changes to valid, then reverse to leave away the home sensor. After left the home sensor, the motor changes direction again and moves in the negative direction with a homing speed set by P2-25 until the home sensor changes logic state from invalid to valid, and then the change from valid to invalid state is detected, where means the falling-edge is detected, then the motor stops, Homing has been finished.

If homing starts and the home sensor is valid(like Position C), the motor moves in the positive direction with a speed set by P2-25 until home switch changes logic state from valid to invalid, then the motor stops, Homing has been finished.

When receiving this event and the motor completely stops, the drive sets Homing Finished bit of drive's status.

7.10.2.31 Method 28: Start Negative Homing, Seek for NLS, Raising-edge of Home Switch's Positive Side, Reverse on the NLS



Method 28 is similar to method 12, except that the home position is not dependent on the motor index, it is dependent only on the home sensor transitions and negative limit switch(NLS) transitions.

When using homing method 28, the initial direction of movement depends on the logic state of home sensor when start homing.

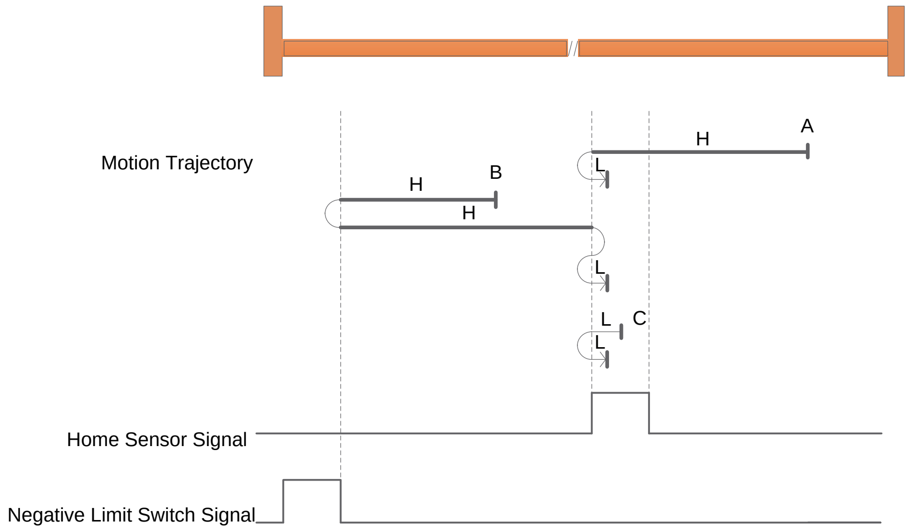
If homing starts and the home sensor is invalid, the motor moves in the negative direction with a homing speed set by P2-24 until one of two possible event occur:

- Position A: When the valid state of home sensor is detected, the motor stops, changes direction and speed, and moves in the positive direction with a homing speed set by P2-25 until the logic state of home sensor changes to invalid. After left the home sensor, the motor changes direction again and moves in the negative direction with a homing speed set by P2-25 until the home sensor changes logic state from invalid to valid, where means the raising-edge is detected, then the motor stops, Homing has been finished.
- Position B: When the valid state of NLS(Negative Limit Switch) is detected, the motor stops, changes direction and speed, and moves in the positive direction with a homing speed set by P2-24 until the valid state of home sensor is detected. In this case the motor continues to move in the positive direction as long as home sensor remain valid. After left the home sensor, the home sensor invalid state is detected, the motor reverses with a homing speed set by P2-25 until the home sensor changes logic state from invalid to valid, where means the raising-edge is detected, then the motor stops, Homing has been finished.

If homing starts and the home sensor is valid(like Position C), the motor moves in the positive direction with a speed set by P2-25 until home switch changes logic state from valid to invalid. After left the home sensor, the motor reverses with a homing speed set by P2-25 until the home sensor changes logic state from invalid to valid, where means the raising-edge is detected, then the motor stops, Homing has been finished.

When receiving this event and the motor completely stops, the drive sets Homing Finished bit of drive's status.

7.10.2.32 \Method 29: Start Negative Homing, Seek for NLS, Raising-edge of Home Switch's Negative Side, Reverse on the NLS



Method 29 is similar to method 13, except that the home position is not dependent on the motor index, it is dependent only on the home sensor transitions and negative limit switch(NLS) transitions.

When using homing method 29, the initial direction of movement depends on the logic state of home sensor when start homing.

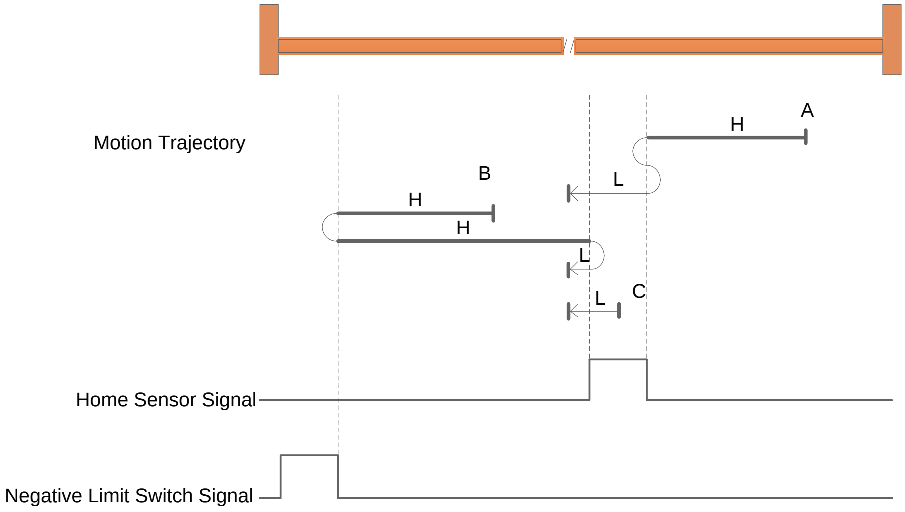
If homing starts and the home sensor is invalid, the motor moves in the negative direction with a homing speed set by P2-24 until one of two possible event occur:

- Position A: The valid state of home sensor is detected. In this case the motor continues to move in the negative direction with the same speed as long as home sensor remains valid. When the home sensor invalid state is detected, the motor stops, changes direction and speed, and moves in the positive direction with a homing speed set by P2-25 until the home sensor state transition from invalid to valid is detected, where means the raising-edge is detected, then the motor stops, Homing has been finished.
- Position B: When the valid state of NLS(Negative Limit Switch) is detected, the motor stops, changes direction and speed, and moves in the positive direction with a homing speed set by P2-24 until the valid state of home sensor is detected, then reverse to leave away from the home sensor. After left the home sensor, the motor changes direction again and moves in the positive direction with a homing speed set by P2-25 until the home sensor changes logic state from invalid to valid,where means the raising-edge is detected, then the motor stops, Homing has been finished.

If homing starts and the home sensor is valid(like Position C), the motor moves in the negative direction with a speed set by P2-25 as long as home switch remains valid. When the invalid state is detected, the motor changes direction again and moves in the positive direction with a homing speed set by P2-25 until the home sensor state transition from invalid to valid is detected, where means the raising-edge is detected, then the motor stops, Homing has been finished.

When receiving this event and the motor completely stops, the drive sets Homing Finished bit of drive's status.

7.10.2.33 Method 30: Start Negative Homing, Seek for NLS, Falling-edge of Home Switch's Negative Side, Reverse on the NLS



Method 30 is similar to method 14, except that the home position is not dependent on the motor index, it is dependent only on the home sensor transitions and negative limit switch(NLS) transitions.

When using homing method 30, the initial direction of movement depends on the logic state of home sensor when start homing.

If homing starts and the home sensor is invalid, the motor moves in the negative direction with a homing speed set by P2-24 until one of two possible event occur:

- Position A: When the valid state of home sensor is detected, the motor stops, changes direction and speed, and moves in the positive direction with a homing speed set by P2-25 until the logic state of home sensor changes to invalid. After left the home sensor, the motor changes direction again and continues to moves in the negative direction with a homing speed set by P2-25 until the home sensor changes logic state from invalid to valid, and then the change from valid to invalid state is detected, where means the falling-edge is detected, then the motor stops, Homing has been finished.
- Position B: When the valid state of NLS(Negative Limit Switch) is detected, the motor stops, changes direction and speed, and moves in the positive direction with a homing speed set by P2-24 until the valid state of home sensor is detected, then the motor reverses with a homing speed set by P2-25 until the home sensor changes logic state from valid to invalid, where means the falling-edge is detected, then the motor stops, Homing has been finished.

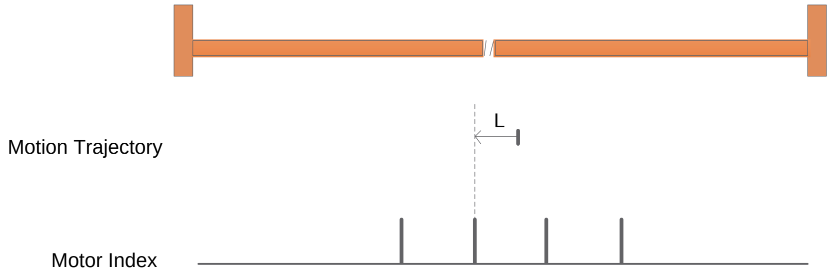
If homing starts and the home sensor is valid(like Position C), the motor moves in the negative direction with a speed set by P2-25 until home switch changes logic state from valid to invalid, where means the falling-edge is detected, then the motor stops, Homing has been finished.

When receiving this event and the motor completely stops, the drive sets Homing Finished bit of drive's status.

7.10.2.34 Methods 31 and 32: Reserved.

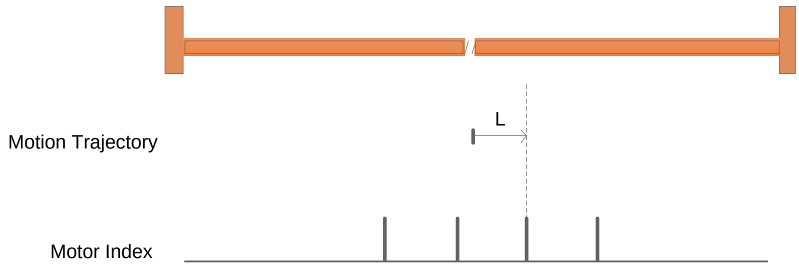
These two homing methods are reserved for future expansion of the homing mode.

7.10.2.35 Method 33: Start Negative Homing, Seek for First Motor Index



The motor moves in the negative direction with a homing speed set by P2-25 until the first motor index pulse is detected, the motor stops, Homing has been finished.

7.10.2.36 Method 34: Start Positive Homing, Seek for First Motor Index

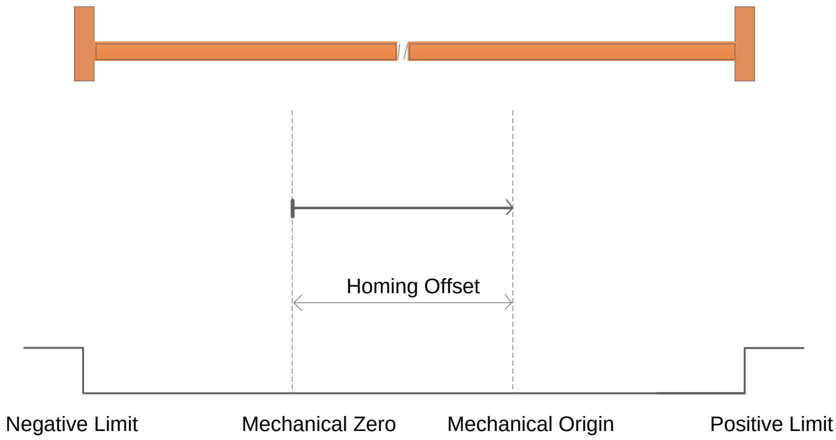


The motor moves in the positive direction with a homing speed set by P2-25 until the first motor index pulse is detected, the motor stops, Homing has been finished.

7.10.2.37 Method 35: Homing on the Current Position

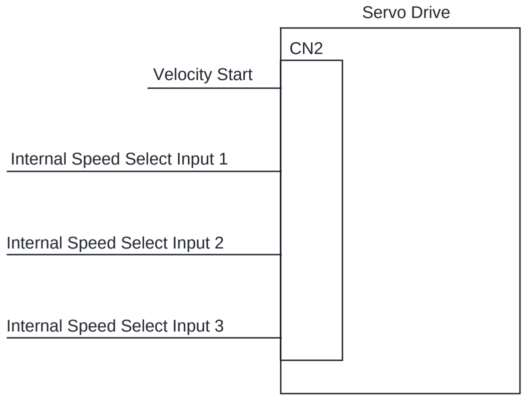
In this Method, the current position is taken to be the home position.

If Home Offset(parameter P2-27) is set, Mechanical Origin = Mechanical Zero + Home Offset



7.11 Internal Velocity Control

M56S series servo drive supports setting 8 groups of internal speeds, and selects the corresponding speed group through the external digital inputs. Since the parameters are stored in the driver, the speed mode can be controlled without analog input.



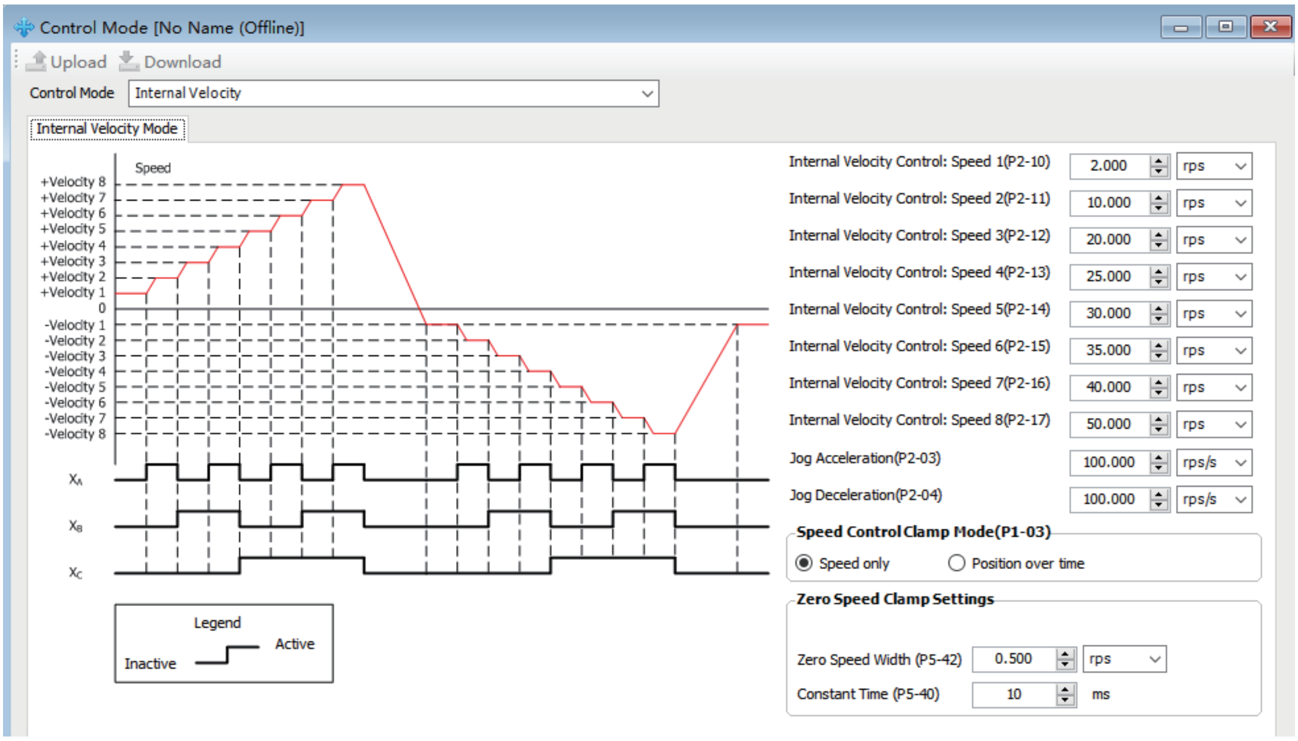
7.11.1 Set the Control Mode to Internal Velocity

Parameter P1-00 is used to set the main control mode.

Set Value	Description
15	Internal Velocity

Software Setting Method

The control mode can also be set through the "Control Mode" interface of the Luna software.



7.11.2 Digital Inputs Settings

When using the internal velocity mode, it is necessary to set the corresponding function for the digital inputs. Parameters P5-00 ~ P5-09 are used to set the functions of digital inputs X1 ~ X10.

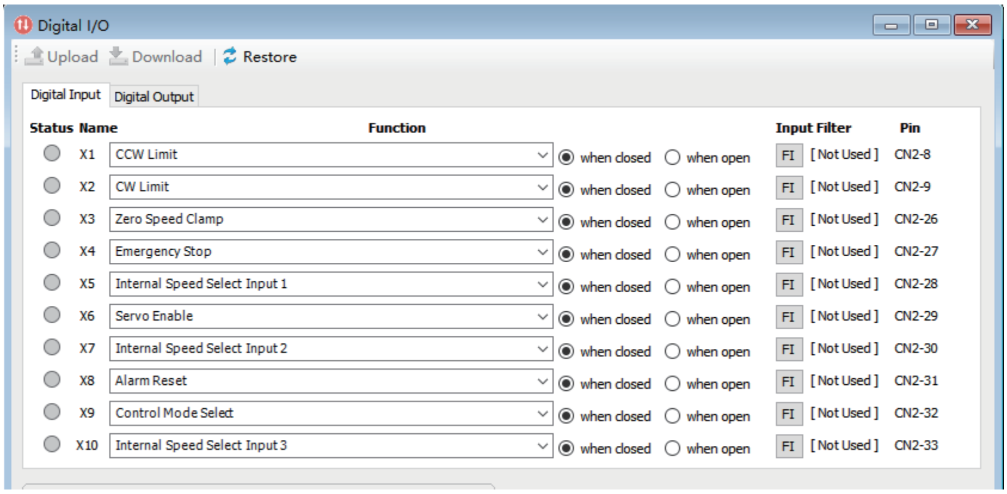
Signals	Symbol	Setup value and corresponding input logic state of P5-00 ~ P5-09.		Description
		Valid when Closed	Valid when Open	
Internal speed select input 1	SPD1	27	28	Internal speed select input 1
Internal speed select input 2	SPD2	29	30	Internal speed select input 2
Internal speed select input 3	SPD3	31	32	Internal speed select input 3
Velocity Start	SP-STA	33	34	Start velocity control
Velocity Direction Switch	SPD-DIR	35	36	Switch the rotation direction

Note:

The valid logic of internal speed select input must be set to all CLOSED or all OPEN, which cannot be mixed set.

Software Setting Method

The control mode can also be set through the "Digital I/O" interface of the Luna software.



7.11.3 Internal Velocity Settings

Target Speed Setting

Parameters P2-10 to P-17 are used to set 8 different speeds of the internal velocity mode.

Parameters	SCL Com.	Description	Default	Range	Unit
P2-10	JC1	Internal Velocity Control: Speed 1	0	-100 ~ 100	rps
P2-11	JC2	Internal Velocity Control: Speed 2	10	-100 ~ 100	rps
P2-12	JC3	Internal Velocity Control: Speed 3	20	-100 ~ 100	rps
P2-13	JC4	Internal Velocity Control: Speed 4	25	-100 ~ 100	rps
P2-14	JC5	Internal Velocity Control: Speed 5	30	-100 ~ 100	rps
P2-15	JC6	Internal Velocity Control: Speed 6	35	-100 ~ 100	rps
P2-16	JC7	Internal Velocity Control: Speed 7	40	-100 ~ 100	rps
P2-17	JC8	Internal Velocity Control: Speed 8	50	-100 ~ 100	rps

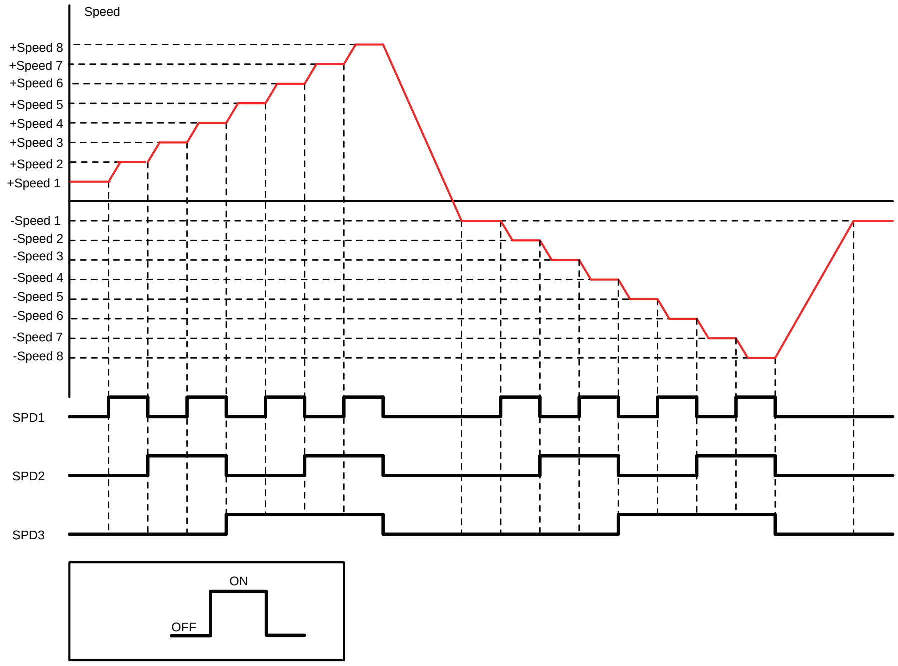
Acceleration and Deceleration Settings

The acceleration is set by parameter P2-03 and the deceleration is set by P2-04.

Parameters	SCL Com.	Description	Default	Range	Unit
P2-03	JA	Jog Acceleration	100	0.167 ~ 5000	rps/s
P2-04	JL	Jog Deceleration	100	0.167 ~ 5000	rps/s

7.11.4 Input Signal and 8-segment Internal Speed Selection

The correspondences between the logic state of the speed selection input signal and the internal speed segments are as shown in the figure below.



7.11.5 Rotation Direction Switching in Internal Velocity Mode

The rotation direction is usually determined by the positve and nagetive of speed command set by parameters P2-10 to P2-17 in internal velocity control mode.

Since one of the digital inputs set as the SPD-DIR(Velocity Direction Swith) function, the speed reference takes the absolute value of speed command and the rotation direction are controlled by the logic state of the SPD-DIR input.

SPD-DIR Configuration

To use torque and Velocity Direction Switch, one of digital inputs needs to be assigned this function.

Signal Type	Signal Symbol	Setup Value	Signal Logic	Instructions
Input	SPD-DIR	35	Closed	SPD-DIR input is valid, the motor rotates direction will be changed.
			Open	SPD-DIR input is invalid, the motor rotates direction will NOT be changed.
		36	Open	SPD-DIR input is valid, the motor rotates direction will be changed.
			Closed	SPD-DIR input is invalid, the motor rotates direction will NOT be changed.
	GP	0	-	None of digital inputs is configured as SPD-DIR function, the rotate direction is controlled by the sign of speed command.

The actual rotation direction is determined by the parameters P1-11 (Rotational Direction Setup), Speed Command, and the input logic of SPD-DIR. The detailed relationship is as follows.

◆ None of digital inputs is configured as SPD-DIR function

Value of P1-11	P2-10 to P2-17 Speed Command	Input logic of SPD-DIR	Actual motor rotation direction
0	Positive	NONE FUNCTION	CW
0	Positive	NONE FUNCTION	CCW
0	Negative	NONE FUNCTION	CCW
0	Negative	NONE FUNCTION	CW
1	Positive	NONE FUNCTION	CCW
1	Positive	NONE FUNCTION	CW
1	Negative	NONE FUNCTION	CW
1	Negative	NONE FUNCTION	CCW

◆ One of digital inputs is configured as SPD-DIR function:

Value of P1-11	P2-10 to P2-17 Speed Command	Input logic of SPD-DIR	Actual motor rotation direction
0	Positive	Invalid	CW
0	Negative	Invalid	
0	Positive	Valid	CCW
0	Negative	Valid	
1	Positive	Invalid	CCW
1	Negative	Invalid	
1	Positive	Valid	CW
1	Negative	Valid	

8 Parameter Settings

8.1 Parameter Definitions

The servo drive parameters are divided into six groups.

Group	Type	Instruction
Group 0: P0-XX	PID parameters	Set the gain parameters of the servo and related parameters
Group 1: P1-XX	Configuration	Set or configure various drive functions
Group 2: P2-XX	Trajectory	Set the parameters related to the internal motion trajectory
Group 3: P3-XX	Encoder & Step/Dir	Set parameters related to encoder and input/output pulses
Group 4: P4-XX	Analog	Set parameters related to analog input and output
Group 5: P5-XX	I/O	Set the parameters of digital input and output related functions

8.2 Parameter List

Group 0: P0-XX: PID Parameters

Parameter	Command	Description	Default	Range	Unit	Type
P0-00	UM	Parameter tuning mode	0	0 ~ 2	——	
P0-01	LY	Load type	0	0 ~ 10	——	
P0-02	NR	Load inertia ratio	0	0 ~ 10000	0.01倍	
P0-03	Kg	First rigidity level	5	0 ~ 20	——	
P0-04	KX	Second rigidity level	5	0 ~ 20	——	
P0-05	KP	First position loop gain	52	0 ~ 20000	0.1Hz	
P0-07	KD	First position loop differential time constant	2000	0 ~ 30000	ms	
P0-08	KE	First position loop differential filter frequency	20000	0 ~ 40000	0.1Hz	
P0-09	KL	Speed feedforward gain	10000	-30000 ~ 3000	0.01%	
P0-10	KR	Speed feedforward filter frequency	20000	0 ~ 40000	0.1Hz	
P0-11	KF	First command speed gain	10000	-30000 ~ 3000	0.01%	
P0-12	VP	First speed loop gain	183	0 ~ 30000	0.1Hz	
P0-13	VI	First speed loop integral time constant	189	0 ~ 30000	ms	
P0-14	KK	Acceleration feedforward gain	3000	0 ~ 10000	0.01%	
P0-15	KT	Acceleration feedforward filter frequency	20000	0 ~ 40000	0.1Hz	
P0-16	KC	First command torque filter frequency	1099	0 ~ 40000	01Hz	
P0-17	UP	Second position loop gain	52	0 ~ 20000	0.1Hz	
P0-19	UD	Second position loop differential time constant	2000	0 ~ 30000	ms	
P0-20	UE	Second position loop differential filter frequency	15000	0 ~ 40000	0.1Hz	
P0-21	UF	Second command speed gain	10000	-30000 ~ 3000	0.01%	
P0-22	UV	Second speed loop gain	183	0 ~ 30000	0.1Hz	
P0-23	UG	Second speed loop integral time constant	189	0 ~ 30000	ms	
P0-24	UC	Second command torque filter frequency	1099	0 ~ 40000	01Hz	
P0-25	XP	Full closed loop - position loop gain	52	0 ~ 20000	0.1Hz	
P0-27	XD	Full closed loop - position loop differential time constant	2000	0 ~ 30000	ms	
P0-28	XE	Full closed loop - position loop differential filter frequency	15000	0 ~ 40000	0.1Hz	
P0-29	XF	Full closed loop - command speed gain	10000	-30000 ~ 3000	0.01%	
P0-30	XV	Full closed loop - speed loop gain	183	0 ~ 30000	0.1Hz	
P0-31	XG	Full closed loop - speed loop integral time constant	189	0 ~ 30000	ms	
P0-32	XC	Full closed loop - command torque filter frequency	1099	0 ~ 40000	0.1Hz	
P0-33	SD	Gain switching condition selection	0	0 ~ 4	——	
P0-34	PN	Gain switching condition - position	0	0 ~ 2147483647	Pulses	
P0-35	VN	gain switching condition - speed	0.000	0 ~ 100	rps	
P0-36	TN	gain switching condition - torque	10	0 ~ 3000	0.1%	
P0-37	SE1	Second gain switches to first gain Delay time	10	0 ~ 10000	ms	
P0-38	SE2	First gain switches to second gain Delay time	0	0 ~ 10000	ms	
P0-39	LR	Speed feedback filter	0	0 ~ 3	——	

Group 1: P1-XX: Configurations

Parameter	Command	Description	Default	Range	Unit	Type
P1-00	CM	Main Control Mode	21	1,2,7,11,15,21	-	Effective immediately
P1-01	CN	Secondary Control Mode	21	1,2,7,11,15,21	-	Effective immediately
P1-02	PM	Operation Mode When Power-up	10	8 ~ 10	-	
P1-03	JM	Speed Control Clamp Mode	2	1 ~ 2	-	
P1-04	XM	Full Closed-loop Control Switch	0	0, 1	-	
P1-05	GC	Torque Command for Internal Torque Mode	0	-3000 ~ 3000	0.1%	
P1-06	CC	1st Torque Limit	3000	0 ~ 3000	0.1%	
P1-07	CV	Target Torque Value when Torque Value Reached	0	0 ~ 3000	0.1%	
P1-08	HC	Torque Limit for Hard Stop Homing	200	0 ~ 3000	0.1%	
P1-09	CL	Current Foldback Continuous Time	2000	0 ~ 30000	ms	
P1-10	LD	Torque Limit Method	1	1 ~ 5	-	
P1-11	RN	Rotational Direction Setup	0	0，1	-	
P1-12	-	Reserved	-	-	-	
P1-13	PR	Communication Protocol	5	1 ~ 511	-	
P1-14	TD	Transmit Delay	2	0 ~ 20	ms	
P1-15	BR	RS-485 Baud Rate	1	1 ~ 5	-	
P1-16	DA	RS-485 Address	32	1 ~ 32	-	
P1-19	ZR	Regeneration Resistor Value	200	10 ~ 32000	Ω	
P1-20	ZC	Regeneration Resistor Continuous Wattage	40	1 ~ 32000	W	
P1-21	ZT	Regeneration Resistor Time Constant	1000	0 ~ 8000	ms	
P1-22	PK	Key Setting Lock	0	0，1	-	
P1-23	DD	Default Display	0	0 ~ 20	-	
P1-24	MA	Alarm Mask	4294967295	0 ~ 4294967295	-	
P1-25	CX	2nd Torque Limit	3000	0 ~ 3000	0.1%	
P1-26	CY	3rd Torque Limit	3000	0 ~ 3000	0.1%	
P1-27	CZ	4th Torque Limit	3000	0 ~ 3000	0.1%	
P1-28	HT	Motor Stall protection time	0	0 ~ 30000	ms	
P1-29	YV	Dynamic Brake Sequence when Servo Off	0	0 ~ 5		
P1-30	YR	Dynamic Brake Sequence when Fault Occurs	0	0 ~ 3		
P1-31	YM	Dynamic Brake Action Time during Deceleration of Servo Off	500	0 ~ 30000	ms	
P1-32	YN	Dynamic Brake Action Time during Deceleration when Fault Occurs	0	0 ~ 30000	ms	
P1-33	OT	Missing phase detection switch	0	0 ~ 1		
P1-34	RT	Instantaneous change value of current	1000	0 ~ 3000	0.1%	

Group 2: P2-XX: Trajectory

Parameter	Command	Description	Default	Range	Unit	Type
P2-00	VM	Max Velocity	80	0 ~ 100	rps	
P2-01	AM	Max Brake 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	Point-to-Point Velocity	10	0.0042 ~ 100	rps	
P2-07	AC	Point-to-Point Acceleration	100	0.167 ~ 5000	rps/s	
P2-08	DE	Point-to-Point Deceleration	100	0.167 ~ 5000	rps/s	
P2-09	VC	Point-to-Point Change Velocity	2	0 ~ 100	rps	
P2-10	JC1	Internal Velocity Control: Speed 1	2	-100 ~ 100	rps	
P2-11	JC2	Internal Velocity Control: Speed 2	10	-100 ~ 100	rps	
P2-12	JC3	Internal Velocity Control: Speed 3	20	-100 ~ 100	rps	
P2-13	JC4	Internal Velocity Control: Speed 4	25	-100 ~ 100	rps	
P2-14	JC5	Internal Velocity Control: Speed 5	30	-100 ~ 100	rps	
P2-15	JC6	Internal Velocity Control: Speed 6	35	-100 ~ 100	rps	
P2-16	JC7	Internal Velocity Control: Speed 7	40	-100 ~ 100	rps	
P2-17	JC8	Internal Velocity Control: Speed 8	50	-100 ~ 100	rps	
P2-18	HA1	Homing Acceleration/Deceleration	100	0.167 ~ 5000	rps/s	
P2-21	-	Reserved-	-	-	-	
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 ~ 125	ms	
P2-30	VT	Velocity Limit of Torque Control	80	0 ~ 100	rps	

Group 3: P3-XX: Encoder & Step/Dir

Parameter	Command	Description	Default	Range	Unit	Type
P3-00	EN	Electronic Gear Ratio - Numerator	32000	1 ~ 2147483647	-	
P3-01	EU	Electronic Gear Ratio - Denominator	32000	1 ~ 2147483647	-	
P3-02	SZ	Pulse Input Noise Filter	2	0 ~ 32000	0.1μs	
P3-03	PT	Pules Input Setting	9	0 ~ 31		
P3-04	PF	Position Error Limit	100000	0 ~ 2147483647	pulses	
P3-05	EG	Command Pulses per revolution	10000	200 ~ 131072	pulses/rev	
P3-06	PV	Second Encoder Direction	0	0 ~ 1	-	
P3-07	--	Reserved	-	-	-	
P3-08	--	Reserved	-	-	-	
P3-09	XT	Hybrid Deviation Clear Setting	10	1 ~ 100	rev	
P3-10	XO	Hybrid Deviation Fault Threshold	100000	0 ~ 2147483647	pulses	
P3-11	XR	Second Encoder Resolution	10000	200 ~ 100000	pulses/rev	
P3-12	PO	Pulses Output Mode	1	0 ~ 256	-	
P3-13	ON	Pulses Output Gear Ratio - Numerator	10000	0 ~ 13107200	-	
P3-14	OD	Pulses Output Gear Ratio - Denominator	131072	0 ~ 13107200	-	
P3-15	ES	Absolute Encoder Usage	1	0 ~ 3	-	
P3-16	PU	Electronic Gearing Switch	0	0 ~ 1	-	

Group 4: P4-XX: Analog

Parameter	Command	Description	Default	Range	Unit	Type
P4-01	AG	Analog Input Velocity Gain	50	0 ~ 100	rps/10V	
P4-02	AN	Analog Input Torque Gain	1000	0 ~ 3000	0.1%	
P4-03	AV1	Analog Input 1 Offset	0	-10000 ~ 10000	mV	
P4-04	AV2	Analog Input 2 Offset	0	-10000 ~ 10000	mV	
P4-05	AD1	Analog Input 1 Dead-band	0	0 ~ 255	mV	
P4-06	AD2	Analog Input 2 Dead-band	0	0 ~ 255	mV	
P4-07	AF1	Analog Input 1 Filter	1000	0 ~ 2000	0.1Hz	
P4-08	AF2	Analog Input 2 Filter	1000	0 ~ 2000	0.1Hz	
P4-09	AT1	Analog Input 2 Threshold	5000	-10000 ~ 10000	mV	
P4-10	AT2	Analog Input 2 Threshold	5000	-10000 ~ 10000	mV	
P4-11	FA1	Velocity Limit Setting of Torque Control	1	0 ~ 1		
P4-16	OS1	Analog Output 1 Scale	1000	1 ~ 32000		
P4-17	OS2	Analog Output 2 Scale	1000	1 ~ 32000		
P4-18	XA1	Analog Output 1 Function	0	0 ~ 5		
P4-19	XA2	Analog Output 2 Function	0	0 ~ 5		

Group 5: P5-XX: I/O Configuration

Parameter	Command	Description	Default	Range	Unit	Type
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	-	
P5-04	MU5	Digital Input 5 Function		0 ~ 46	-	
P5-05	MU6	Digital Input 6 Function		0 ~ 46	-	
P5-06	MU7	Digital Input 7 Function		0 ~ 46	-	
P5-07	MU8	Digital Input 8 Function		0 ~ 46	-	
P5-08	MU9	Digital Input 9 Function		0 ~ 46	-	
P5-09	MUA	Digital Input 10 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	-	
P5-15	MO4	Digital Output 4 Function		0 ~ 34	-	
P5-16	MO5	Digital Output 5 Function		0 ~ 34	-	
P5-17	MO6	Digital Output 6 Function		0 ~ 34	-	
P5-24	BD	Move Command Delay Time after Brake Release	200	0 ~ 32000	ms	
P5-25	BE	Servo-off Delay Time after Brake Engagement	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	
P5-32	FI5	Digital Input 5 Filter	1	0 ~ 8000	ms	
P5-33	FI6	Digital Input 6 Filter	1	0 ~ 8000	ms	
P5-34	FI7	Digital Input 7 Filter	1	0 ~ 8000	ms	
P5-35	FI8	Digital Input 8 Filter	1	0 ~ 8000	ms	
P5-36	FI9	Digital Input 9 Filter	1	0 ~ 8000	ms	
P5-37	FIA	Digital Input 10 Filter	1	0 ~ 8000	ms	
P5-38	PL	Dynamic Follow Error Threshold	10	0 ~ 2147483647	pulses	
P5-39	PD	In-position Output Threshold	40	0 ~32000	pulses	
P5-40	PE	Time Constant of Motion Output Condition	10	0 ~ 30000	ms	
P5-41	TT	Pulse Complete Timing	2	0 ~ 20000	ms	
P5-42	ZV	Zero Speed Width	0.5	0.1 ~ 2	rps	
P5-43	VR	Speed Coincidence Width	0.1	0 ~ 100	rps	
P5-44	VV	Target Value of AT-speed Output	10	0 ~ 100	rps	
P5-45	TV	Torque Reach Width	10	0 ~ 3000	0.1%	
P5-46	DG	Near Target 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	-	

8.3 Parameter Description

8.3.1 Group P0-XX: PID Parameters

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P0-00	UM	Tuning Mode Selection	0	0 ~ 2	---	P	V	T	F

The servo drive provides three gain tuning modes for gain parameters tuning.

Set value	Tuning Mode	Description	Note
0	No Tuning	Increase or decrease the mechanical stiffness level by setting P0-03.	The mechanical stiffness level is only set by P0-03. Modification other gain parameters is invalid.
1	Auto Tuning	Performing Auto-tuning, the servo system will estimate the load inertia ratio and set the best mechanical stiffness level automatically.	After Auto-tuning is finished, parameters P0-03 and P0-02 could be modified to optimize the system's performance. Modification other gain parameters is invalid.
2	Fine Tuning	Set the tuning mode to "Fine Tuning", all gain parameters can be modified to optimize the response of the system.	

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P0-01	LY	Load Type	0	0 ~ 10	---	P	V	T	F

Set the current load type.
Setting the load type is conducive to accurate identification and optimization of system gain parameters.

Set value	Load Type	Description
0	General Type	Horizontally placed ball-screw, Turntable, etc..
1	Stiffness Type	Ball-screw load mounted horizontally on a marble base. Horizontally placed turntable, etc.
2	Flexible Type	Belt load, etc..

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P0-02	NR	Load Inertia Ratio	0	0 ~ 10000	0.01倍	P	V	T	F

Set the ratio of load inertia to motor rotator inertia。

The load inertial ratio can be indentified in real time when auto-tuning is in progress, and it will be automatically saved after auto-tuning is completed.

If the load inertial ratio is set correcttly, P0-05 can represent the system response accurately.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P0-03	Kg	1st mechanical Stiffness Level	5	1 ~ 20	---	P	V	T	F

The first stiffness level. You can set this while the tuning mode is set to Auto-tuning.

Increase this value can enhance the velocity response and servo stiffness. If set the value too high, it may cause vibration and noise.

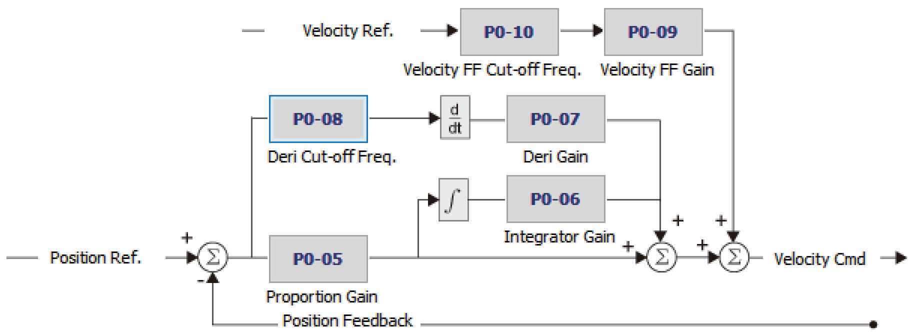
Parameter	Command	Description	Default	Range	Unit	Contol mode			
P0-04	KX	2nd mechanical Stiffness Level	5	1 ~ 20	---	P	V	T	F

The second stiffness level.Increase this value can enhance the velocity response and servo stiffness. If set the value too high, it may cause vibration and noise.

When gain switch function is actived, the second stiffness level will take effect due to conditions. Refer to Chapter 7.1.6 Gain Select for details.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P0-05	KP	1st Position Loop Gain	52	0 ~ 20000	0.1Hz	P	V	T	

Set the rigidity gain of position control.
0 means not used, and 20000 means the proportional action is maximized.
Increasing this parameter can improve the responsiveness of the system, reduce the position error, and shorten the positioning time.
When the position loop proportional gain is too small, the system will not respond fast enough and the position error will decrease slowly. However, if it is set too large, it may cause vibration.
The algorithm control block diagram of the position loop is as follows:



Parameter	Command	Description	Default	Range	Unit	Contol mode			
P0-07	KD	1st Position Loop Derivative Time Constant	0	0 ~ 30000	ms	P	V	T	

The derivative time constant of Position Loop in the PID control algorithm.
Setting to zero means that derivative function is not used. The smaller the set value, the stronger the effect of derivative term.
Running a motor with a pure PI controller the motor would overreact to small errors, creating ever large errors,ultimately becoming unstable. If know what the motor is going to do before it do it, you could prevent this.
A motor drive can control a motor better if it examines the rate of change of the position error and includes that in its torque calculation. For example, if the motor has error, but the error is decreasing, back off on the torque.
When the system's ability to suppress vibration is insufficient, there will be obvious vibrations during the acceleration/deceleration, cruising and stopped. This vibrations has a decreasing trend and eventually stabilizes.
◆ When the set value of the derivative time constant (KD) is reasonable, the system's ability to suppress vibration is significantly enhanced, and it tends to stabilize quickly.
◆ When the derivative time constant (KD) is set too small, the motion system will be too sensitive, easily vibrate and generate noise.

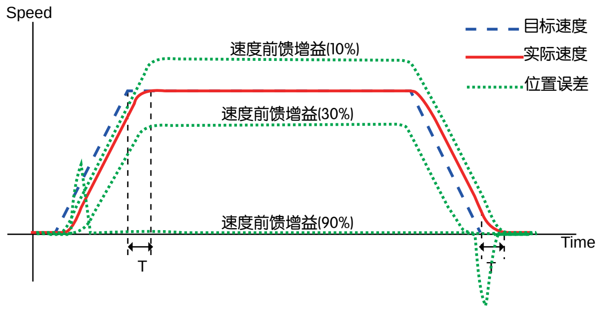
Parameter	Command	Description	Default	Range	Unit	Contol mode			
P0-08	KE	1st Position Loop Derivative Filter	20000	0 ~ 40000	0.1Hz	P	V	T	

Set the low-pass filter for the first derivative time constant of position loop .
Set to zero means the low-pass filter does not take effect.
This filter is a single-output low-pass filter,which is used to filter the derivative output of the PID controller. When setting this value, the cutoff frequency needs to be considered. The default value of 20000 can be used in most applications.
For a load with a large inertia ratio, it's necessary to increase the position loop gain(P0-05) and reduce the derivative time constant to obtain a good performance. However, excessive gain value may cause jitter, and it's necessary to reduce the derivative low-pass filter P0-08 to prevent jitter and suppress the noise caused by derivative gain.

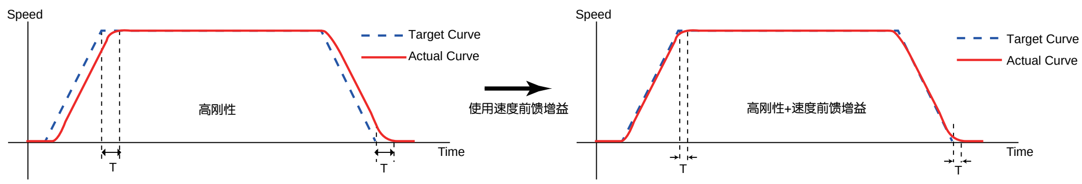
Parameter	Command	Description	Default	Range	Unit	Contol mode			
P0-09	KL	Velocity Feedforward Gain	10000	-30000 ~ 3000	0.01%	P	V	T	F

The value of the reference speed generated by the position loop calculation in the internal trajectory planning and the ratio of this parameter is added to the speed command generated by the position loop, which can reduce the position error and speed error and improve the response speed of the system.

As can be seen from the figure below, when the command speed and position loop gain remain unchanged, increasing the speed feedforward gain will reduce the following position deviation during the movement.



In the servo algorithm, speed feedforward is used in combination with speed feedback to increase the suppression capability. The feedforward value is generated by "trajectory calculation". If the speed feedforward gain is increased, if the servo motor runs well, the calculated speed value of the motor will match the actual speed value, and a shorter positioning time and smaller position following error can be obtained.

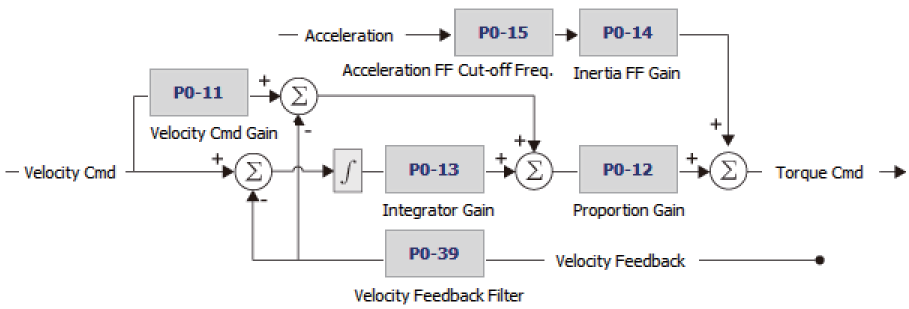


Parameter	Command	Description	Default	Range	Unit	Contol mode			
P0-10	KR	Velocity Feedforward Filter	20000	0 ~ 40000	0.1Hz	P	V	T	F

Sets the low pass filter for velocity feedforward.
0 means no filtering effect.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P0-11	KF	1st Velocity Command Gain	10000	-30000 ~ 3000	0.01%	P	V	T	

As motor power per size has gone up so has the size of the loads. As more performance is asked of the servo motor we may need to add more damping. Velocity feedback has been added to the M56S servo drive to provide greater damping for the larger loads.
This term adds in the motor actual Velocity as negative feedback and usually works in conjunction with the Velocity Feedforward term (See above). If the velocity of the motor matches what is expected no feedback value is generated. If however the velocity's do not match the negative feedback helps to "damp" the differences in velocity. Typically both terms are set to the same value。



Parameter	Command	Description	Default	Range	Unit	Contol mode			
P0-12	VP	1st Velocity Loop Gain	183	0 ~ 30000	0.1Hz	P	V	T	

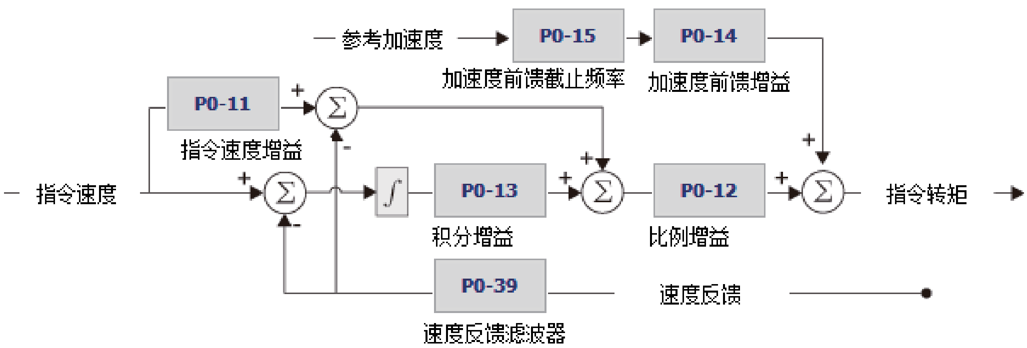
The stiffness gain of the Velocity Loop in the PID control algorithm.
The simplest part of the Velocity Loop is the proportional gain, or VP, term. The drive applies current to the motor in direct proportion to the error. For example, if a motor is not moving, and the shaft is turned by hand or some other force, the drive will increase the motor current until the motor returns to "0" speed. The faster the motor is moved from "0" speed, the more the opposing torque will increase. The VP term (also called VP gain) governs how much torque will be applied for a given amount of velocity error (Vn). In general, more load inertia or load friction, requires more torque and therefore a higher VP gain.
To improve the overall response of the servo system and to reduce position following error, it is necessary to increase the speed loop gain value. Setting the value too high will cause vibration.The response frequency of the speed loop must be 4–6 times higher than the response frequency of the position loop; otherwise, the machinery might vibrate or it might cause overshoot when positioning
When P0-02 (auto estimation or manually set value) is equal to the real inertia ratio (JL/ JM), the real speed loop frequency response is the value set by P0-12.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P0-13	VI	1st Velocity Loop Integral Time Constant	189	0 ~ 30000	ms	P	V	T	

Set the Integral Time Constant of the Velocity Loop. The Integral gain will not take effect when the value is set to zero.
If only proportional gain is working without integral gain, the error is hard to decrease to zero quickly, or it may take long time to get zero. The integral time constant accumulates all errors and takes effect together with the proportional gain. A smaller integral time constant (VI) setting can improve the response and responsiveness of the servo system and reduce the following error.
The smaller the set value, the stronger the integral gain. If the set value of the integral time constant (VI) is too small, the excessive rigidity of the system will cause vibration and noise of the entire servo system. This vibration and noise occurs during the entire movement process, and it is always in an oscillating state, which cannot be stabilized.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P0-14	KK	Acceleration Feedforward Gain	3000	0 ~ 10000	0.01%	P	V	T	F

Acceleration feedforward gain in servo control. The Acceleration Feedforward does not work when set the value to zero. Set to 10000 means that the feedforward effect is maximized.
A larger load usually comes larger load inertia ratio, and a larger inertia can be controlled more easily by estimating the torque required by the system. The acceleration feedforward gain obtains an acceleration value according to the required torque to perform feedforward control and eliminate the following error. The gain coefficient can significantly improve the dynamic response during acceleration and deceleration by giving the open-loop control current of a certain load under a certain acceleration.



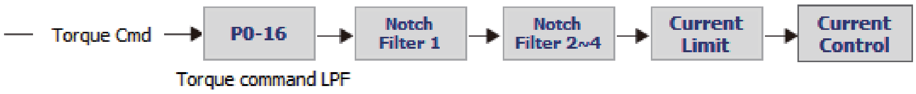
The acceleration feedforward gain coefficient can significantly improve the dynamic response during acceleration and deceleration by giving an open-loop control current for a certain load under a certain acceleration.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P0-15	KT	Acceleration Feedforward Filter	20000	0 ~ 40000	0.1Hz	P	V	T	F

The low-pass filter of Acceleration Feedforward Gain(P0-14). The filter does not work when set the value to zero.
The filter is a single-output low-pass filter used to filter the output of the acceleration feedforward gain. The smaller the value, the lower the filtering frequency and the more obvious the filtering effect. The default value of 20000 can be used in most situations.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P0-16	KC	1st Torque Command Filter	1099	0 ~ 40000	0.1Hz	P	V	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) There are vibration with audible noise in the mechanical system. You can try reducing this value.
2) 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.
3) 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 vibration.



Parameter	Command	Description	Default	Range	Unit	Contol mode			
P0-17	UP	2nd Position Loop Gain	52	0 ~ 20000	0.1Hz	P	V	T	F

The second group of Proportional Gain for the Position Loop in the PID control algorithm. Refer to parameter P0-05.
For the first group/second group gain switching function, please refer to Chapter 7.1.6 Gain Switching.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P0-19	UD	2nd Position Loop Derivative Time Constant	2000	0 ~ 30000	ms	P	V	T	F

The second group of Derivative time constant of Position Loop in the PID control algorithm. Refer to parameter P0-07.
For the first group/second group gain switching function, please refer to Chapter 7.1.6 Gain Switching.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P0-20	UE	2nd Position Loop Derivative Filter	15000	0 ~ 40000	0.1Hz	P	V	T	F

Set the low-pass filter for the second group of derivative time constant. Refer to parameter P0-08.
For the first group/second group gain switching function, please refer to Chapter 7.1.6 Gain Switching.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P0-21	UF	2nd Velocity Command Gain	10000	-30000 ~ 3000	0.01%	P	V	T	F

Set the second group of Velocity Command Gain. Refer to parameter P0-11.
For the first group/second group gain switching function, please refer to Chapter 7.1.6 Gain Switching.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P0-22	UV	2nd Velocity Loop Gain	183	0 ~ 30000	0.1Hz	P	V	T	F

Set the second group of the Proportional Gain for the Velocity Loop in the PID control algorithm. Refer to parameter P0-12.
For the first group/second group gain switching function, please refer to Chapter 7.1.6 Gain Switching.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P0-23	UG	2nd Velocity Loop Integral Time Constant	189	0 ~ 30000	ms	P	V	T	F

Set the second group of the Integral Time Constant of the Velocity Loop. Refer to parameter P0-13.
For the first group/second group gain switching function, please refer to Chapter 7.1.6 Gain Switching.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P0-24	UC	2nd Torque Command Filter	1099	0 ~ 40000	01Hz	P	V	T	F

Set the second group of low-pass filter for the torque command of Current Loop. Refer to parameter P0-16.
For the first group/second group gain switching function, please refer to Chapter 7.1.6 Gain Switching.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P0-25	XP	Full Closed-loop Position Loop Gain	52	0 ~ 20000	0.1Hz	P	V	T	F

Set the Position Loop Proportional Gain in Full Closed-loop control mode. Refer to parameter P0-05.
For the first group/second group gain switching function, please refer to Chapter 7.1.6 Gain Switching.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P0-27	XD	Full Closed-loop Position Loop Derivative Time Constant	2000	0 ~ 30000	ms	P	V	T	F

Set the Derivative Time Constant of Position Loop in Full Closed-loop control mode. Refer to parameter P0-07.
For the first group/second group gain switching function, please refer to Chapter 7.1.6 Gain Switching.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P0-28	XE	Full Closed-loop Position Loop Derivative Filter	15000	0 ~ 40000	0.1Hz	P	V	T	F

Set the low-pass filter of Derivative Time Constant in Full Closed-loop control mode. Refer to parameter P0-08.
For the first group/second group gain switching function, please refer to Chapter 7.1.6 Gain Switching.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P0-29	XF	Full Closed-loop Velocity Command Gain	10000	-30000 ~ 3000	0.01%	P	V	T	F

Set the Velocity Command Gain in Full Closed-loop control mode. Refer to parameter P0-11.
For the first group/second group gain switching function, please refer to Chapter 7.1.6 Gain Switching.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P0-30	XV	Full Closed-loop Velocity Loop Gain	183	0 ~ 30000	0.1Hz	P	V	T	F

Set the Proportional Gain of the Velocity Loop in Full Closed-loop control mode. Refer to parameter P0-12.
For the first group/second group gain switching function, please refer to Chapter 7.1.6 Gain Switching.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P0-31	XG	Full Closed-loop Velocity Loop Integral Time Constant	189	0 ~ 30000	ms	P	V	T	F

Set the Integral Time Constant of the Velocity Loop in Full Closed-loop control mode. Refer to parameter P0-13.
For the first group/second group gain switching function, please refer to Chapter 7.1.6 Gain Switching.

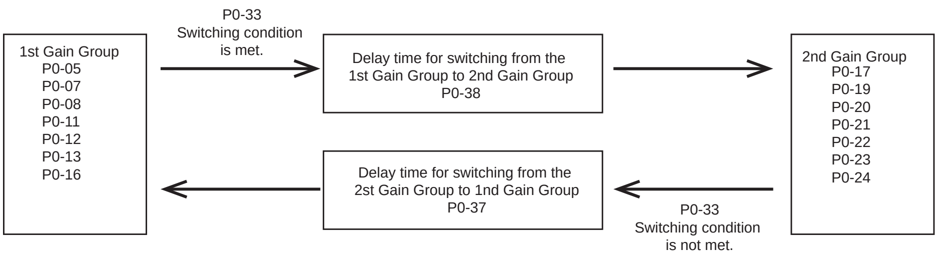
Parameter	Command	Description	Default	Range	Unit	Contol mode			
P0-32	XC	Full Closed-loop Torque Command Filter	1099	0 ~ 40000	0.1Hz	P	V	T	F

Set the low-pass filter for the torque command of Current Loop in Full Closed-loop control mode. Refer to parameter P0-16.
For the first group/second group gain switching function, please refer to Chapter 7.1.6 Gain Switching.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P0-33	SD	Automatic Gain Swiching Method	0	0 ~ 4	——	P	V	T	F

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

Setup Value	Conditions	Swithing Delay Time
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



Parameter	Command	Description	Default	Range	Unit	Contol mode			
P0-34	PN	Gain Switch with Position Error Condition Change	0	0 ~ 2147483647	Pulses	P	V	T	F

Gain switch condition: Absolute Position Following Error.
When P0-33(Gain Swiching Method) is set to "1", this parameter is used to set the jugement condition for gain switch.
If the absolute position following error is greater than the set value of P0-34, switch to 2nd Gain Group.
If the absolute position following error is smaller than the set value of P0-34, switch to 1st Gain Group.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P0-35	VN	Gain Switch with Actual Speed Condition Change	0.000	0 ~ 100	rps	P	V	T	F

Gain switch condition: Absolute value of motor speed.
When P0-33(Gain Swiching Method) is set to "2", this parameter is used to set the jugement condition for gain switch.
If the absolute motor speed is greater than the set value of P0-35, switch to 2nd Gain Group.
If the absolute motor speed is smaller than the set value of P0-35, switch to 1st Gain Group.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P0-36	TN	Gain Switch with Actual Torque Condition Change	10	0 ~ 3000	0.1%	P	V	T	F

Gain switch condition: Absolute value of motor output torque.
When P0-33(Gain Swiching Method) is set to "3", this parameter is used to set the jugement condition for gain switch.
If the absolute motor torque is greater than the set value of P0-36, switch to 2nd Gain Group.
If the absolute motor torque is smaller than the set value of P0-36, switch to 1st Gain Group.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P0-37	SE1	Gain Switching Delay Time 1	10	0 ~ 10000	ms	P	V	T	F

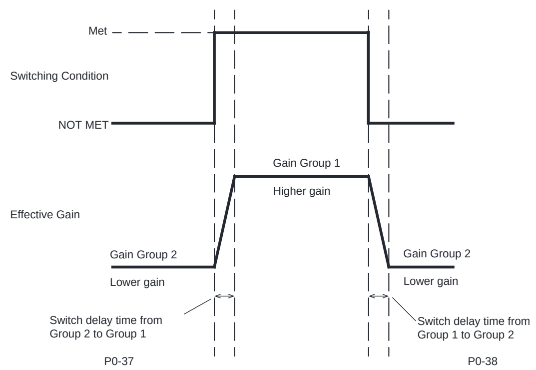
Parameter	Command	Description	Default	Range	Unit	Contol mode			
P0-38	SE2	Gain Switching Delay Time 2	10	0 ~ 10000	ms	P	V	T	F

To avoid jitter caused by immediate gain switch, parameters P0-37 and P0-38 define the switch delay in the process of gain switching between the first gain group and the second gain group.

◆ When the switching conditions are not met, the first gain group will gradually switch to the second gain group after the rise time of P0-38 gain switching.

◆ When the switching conditions are met, the second gain group will gradually switch to the first gain group after the rise time of P0-37 gain switching.

As shown below.



Parameter	Command	Description	Default	Range	Unit	Contol mode			
P0-39	LR	Velocity Feadback Filter	0	0 ~ 3	——	P	V	T	F

The low-pass filter for Speed Feedback in Velocity Loop.

Setup Value	Low-pass Frequency
0	Not used
1	8KHz
2	2KHz
3	1KHz

8.3.2 Group P1-XX: Configurations

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P1-00	CM	Main Control Mode	21	1,2,7,11,15,21	-	P	V	T	F

Parameter P1-00 is used to set the Main Control Mode of the drive.

Setup Value	Control Mode	Control Signal	Instruction
1	Command Torque Mode	Q program commands or Modbus commands	Use communication commands to control the motor output torque
2	Analog Torque Mode	+10~-10V Analog input	Use external analog input for torque control
7	Digital pulse position mode	Pulse & Direction CW/CCW Pulse A/B quard	Use digital pulse for position control
11	Analog Speed Mode	+10~-10V Analog input	Use external analog input for velocity control
15	Internal Multi-speed Mode	Digital Inputs	Internal 8-segment speed mode
21	Internal command position mode	Q program commands or Modbus commands	Use communication commands to control point-to-point position control.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P1-01	CN	Secondary Control Mode	21	1,2,7,11,15,21	-	P	V	T	F

Parameter P1-01 is used to set the Secondary Control Mode of the drive.

Setup Value	Control Mode	Control Signal	Instruction
1	Command Torque Mode	Q program commands or Modbus commands	Use communication commands to control the motor output torque
2	Analog Torque Mode	+10~-10V Analog input	Use external analog input for torque control
7	Digital pulse position mode	Pulse & Direction CW/CCW Pulse A/B quard	Use digital pulse for position control
11	Analog Speed Mode	+10~-10V Analog input	Use external analog input for velocity control
15	Internal Multi-speed Mode	Digital Inputs	Internal 8-segment speed mode
21	Internal command position mode	Q program commands or Modbus commands	Use communication commands to control point-to-point position control.

For control mode switching, please refer to Chapter: 7.1.7 Control Mode Select

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P1-02	PM	Operation Mode When Power-up	10	8 ~ 10	-	P	V	T	F

Parameter P1-02 is used to set the communication mode and servo operation mode after power-up.

Setup Value	Power-up Mode
8	Automatically enable the servo drive after power-up, and support Modbus communication, the Q program is not executed.
9	Automatically enable the servo drive and execute Q program after power-up. Modbus communication is supported.
10	After power-on, the servo is disabled and the Q program is not executed. Modbus communication is supported.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P1-03	JM	Speed Control Clamp Mode	2	1 ~ 2	-	P	V	T	F

You can chose to use the position loop in speed control mode or torque control mode.

Setup Value	Mode	Description
1	Use the Position-loop	The position-loop takes effect and the position error is detected in real time in speed control mode or torque control mode. When the position error exceeds the set value of parameter P3-04, a Position Following Error will occur.
2	Speed-loop Only	Only Speed-loop takes effect.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P1-04	XM	Full Closed-loop Control Switch	0	0, 1	-	P	V	T	F

Switch of full closed-loop control mode.

Setup Value	Description
0	Full closed-loop control is disabled.
1	Full closed-loop control is enabled.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P1-05	GC	Torque Command for Internal Torque Mode	0	-3000 ~ 3000	0.1%	P	V	T	F

This parameter is used to set the target output torque of motor when using internal torque mode or Modbus communication control mode.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P1-06	CC	1st Torque Limit	3000	0 ~ 3000	0.1%	P	V	T	F

Set up the first limit value of the motor output torque.
Refer to Chapter 7.5 Torque Limit for more details.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P1-07	CV	Target Torque when Torque Reached	0	0 ~ 3000	0.1%	P	V	T	F

Set the detecting value to output Torque Reach signal.
When the actual motor output torque exceeds the P1-07 and the torque fluctuation is within the range of P5-45, the TQ-REACH signal will be output.
Refer to Chapter 7.4.7 Torque Reach Output.

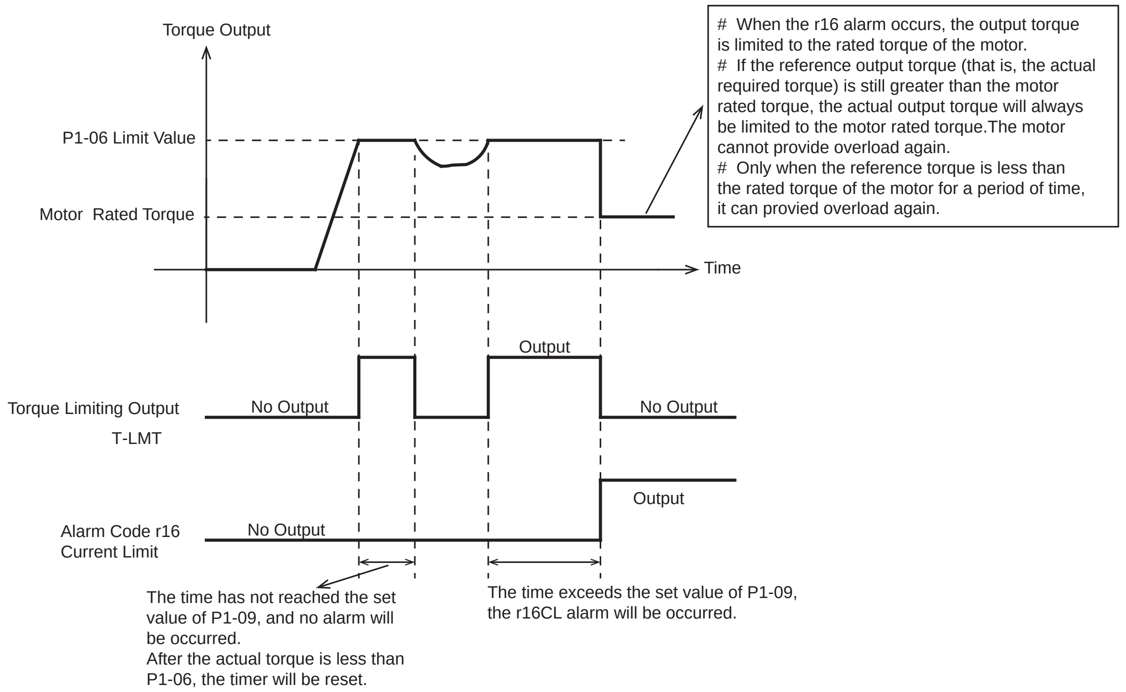
Parameter	Command	Description	Default	Range	Unit	Contol mode			
P1-08	HC	Torque Limit for Hard Stop Homing	200	0 ~ 3000	0.1%	P	V	T	F

The homing methods -4 ~ -1,AKA Hard-stop Homing, are manufacturer customized methods that don't need external switch sensor. By detecting the torque of the motor during the homing process, when the position that the moving load is blocked by the mechanical hard limit, and the output torque of the motor is equal to the set current threshold, than the motor stops and set the encoder position to zero, this is the mechanical origin.
The current threshold is set by parameter P1-08(Torque Limit for Hard Stop Homing).
Refer to Chapter 7.10 Homing Mode for more details.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P1-09	CL	Current Foldback Continuous Time	0	0 ~ 30000	ms	P	V	T	F

The servo can provide overlaod torque for a short time, the maximum overload output torque is set by parameter P1-06, and the duration of overload torque output is by the parameter P1-09.

- When the duration of overload is greater than P1-09, alarm code r16CL (Current Limit) will occur.
- Too large set value and long-time overload will easily cause the the motor overheat and damage.
- This function doesn't take effect in Torque Contol Mode.
- Even if the value is set to "0", alarm code r16CL will not be generated, the servo motor still provides overload torque output for 2 seconds.



Parameter	Command	Description	Default	Range	Unit	Contol mode			
P1-10	LD	Torque Limit Method	1	1 ~ 5	ms	P	V	T	F

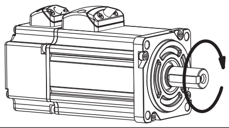
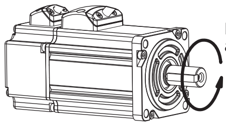
Parameter P1-10 defines 6 kinds of torque limit methods which are shown as follows.

P1-10 Torque Limit Method	Positive Torque Limit Source	Negative Torque Limit Source
0	Register [Y]	Register [Z]
1 (Default)	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	
4	Analog input 2(AIN2)	
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

Refer to Chapter 7.5 Torque Limit for more details.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P1-11	RN	Rotational Direction Setup	0	0，1	-	P	V	T	F

Setup the relationship between the direction of command and direction of motor rotation

Setup Value	Rotation Direction	Description
0		Motor rotates CW in response to positive direction command (CW when viewed from load side shaft end)
1		Motor turns CCW in response to positive direction command (CCW when viewed from load side shaft end)

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P1-12	IF	Immediate Format	H	D,H	-	P	V	T	F

Data format when using SCL command.

Setup Value	Data Format
D	Decimal
H	Hexadecimal

For example the "IE" command is used to get the current position of the encoder. Suppose the current position value in decimal is "20000", if this parameter is set to "H", the return value of IP is 4E20 in hexadecimal.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P1-13	PR	Communication Protocol	5	1 ~ 511	-	P	V	T	F

The serial communication protocol settings. There are a number of settings that can be turned on or off in the PR command. Each setting is assigned a bit in a 8-bit binary word. The parameter of the PR command is the decimal equivalent of this word. If you send the PR command without a parameter the drive will respond with the decimal equivalent of the word as well. The different protocol settings and their bit assignments are shown below.

Bit 0 = Default ("Standard SCL")
bit 1 = Always use Address Character
bit 2 = Ack/Nack
bit 3 = Checksum (RESERVED)
bit 4 = RS-485 Adaptor
bit 5 = 3-digit numeric register addressing
bit 6 = Checksum Type
bit 7 = Little endian or big endian used in MODBUS type drive
bit 8 = Full Duplex in RS-485

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P1-14	TD	Transmit Delay	2	0 ~ 20	ms	P	V	T	F

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.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P1-15	BR	RS-485 Baud Rate	1	1 ~ 5	-	P	V	T	F

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 host can configure this value at any time.

Setup Valuse	Baud Rate
1	9600bps
2	19200bps
3	38400bps
4	57600bps
5	115200bps

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P1-16	DA	RS485 Address	32	1 ~ 32	-	P	V	T	F

The drive unique address character for multi-axis RS-485 or Modbus/RTU communications.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P1-19	ZR	Regeneration Resistor Value	200	10 ~ 32000	Ω	P	V	T	F

This parameter sets the resistance of the regenerative energy absorption resistor, the drive calculates the discharge power of the resistor according to the current voltage and this resistance.
The default setup value is the resistance of build-in absorption resistor. When an external resistor is used, a correct value must be set.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P1-20	ZC	Regeneration Resistor Continuous Wattage	40	1 ~ 32000	W	P	V	T	F

Set the heat dissipation power of the regenerative energy absoption resistor.
The drive calculatesthe power continuously according to the current absorption power and its dissipated power so as to aviod damage to the absorption resistor.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P1-21	ZT	Regeneration Resistor Time Constant	1000	0 ~ 8000	ms	P	V	T	F

The time of the regenerative resistor can continuously absorb the regenerative energy.
For more details about the regeneation energy, refer to Chapter 4.7 Regenerative Resistor Settings.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P1-22	PK	Key Setting Lock	0	0，1	-	P	V	T	F

The buttons below the drive LED display panel can be used to modify or set parameters. To prevent misoperation by people who are not familiar with the servo drive, a key lock function is provided. When the keys are locked, parameters can not be changed by operation panel.

Setpup Value	Description
0	Parameters can be changed by Keys
1	Parameters can not be changed by Keys

Note:
When the Keys are blocked, all the parameters except P1-22 CANNOT be changed. This parameter must be set to "0" before changing other parameters.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P1-23	DD	LED Default Display	0	0 ~ 20	-	P	V	T	F

Set the content displayed on the LED panel after the drive is power-on.

Status	Description	Unit
n00	Motor Actual Speed	RPM
n01	Position Error	Pulse
n02	Pulses Input Counter	counts
n03	Encoder Feedback Counter	counts
n04	Position Command Counter	counts
n05	Drive Temperature	x 0.1℃
n06	DC-Bus Voltage	x 0.1V
n07	Communications Address	
n08	Alarm History 1	
n09	Alarm History 2	
n10	Alarm History 3	
n11	Alarm History 4	
n12	Alarm History 5	
n13	Alarm History 6	
n14	Alarm History 7	
n15	Alarm History 8	
n16	Analog Input 1	x 0.001V
n17	Analog Input 2	x 0.001V
n18	Digital Inputs States	
n19	Digital Outputs States	
n20	Torque Output percent	0.1%

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P1-24	MA	Alarm Mask	4294967295	0 ~ 4294967295	-	P	V	T	F

When there are some non-serous warning, the corresponding bits of this parameter can shield these warnings displayed on drive's LED. When the shield warning is occurred, it will no longer be displayed on the LED.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P1-25	CX	2nd Torque Limit	3000	0 ~ 3000	0.1%	P	V	T	F

Set up the second limit value of the motor output torque.
Refer to Chapter 7.5 Torque Limit for more details.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P1-26	CY	3rd Torque Limit	3000	0 ~ 3000	0.1%	P	V	T	F

Set up the third limit value of the motor output torque.
Refer to Chapter 7.5 Torque Limit for more details.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P1-27	CZ	4th Torque Limit	3000	0 ~ 3000	0.1%	P	V	T	F

Set up the fourth limit value of the motor output torque.
Refer to Chapter 7.5 Torque Limit for more details.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P1-28	HT	Motor Stall protection time	0	0 ~ 30000	ms	P	V	T	F

In position control mode or in speed control mode with position loop(for example P1-03 = 1), the drive will keep outputing rated torque if the motor is stalled, which may cause the motor overheat.
This parameter is used to set the protection time in such situation. When the actual output current is equal to the rated current of the motor and the time exceeds the setting value of P1-28, an alarm which is Motor Stalled(alarm code r37) will be generated and the drive will be disabled.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P1-29	YV	Dynamic Brake Sequence when Servo Off	0	0 ~ 5	---	P	V	T	F

If the servo state changes from servo-on to servo-off, the action mode of dynamic brake is set by P1-29 and the maximum braking time is set by P1-31.
The braking time refers to the total time for the motor actual speed to decelerate to the threshold speed set by P5-42 when the dynamic brake takes effect.
The deceleration period means that the actual speed of the motor decelerates from the speed when the dynamic brake takes effect to within the set value of parameter P5-42, or the deceleration time reaches the set time of P1-31.

P1-29	Description	
	Deceleration period	Stopped
0	Decelerate according to the setting of parameter P2-01	Free Run
1	Decelerate according to the setting of parameter P2-01	Dynamic Brake
2	Free Run	Free Run
3	Free Run	Dynamic Brake
4	Dynamic Brake	Free Run
5	Dynamic Brake	Dynamic Brake

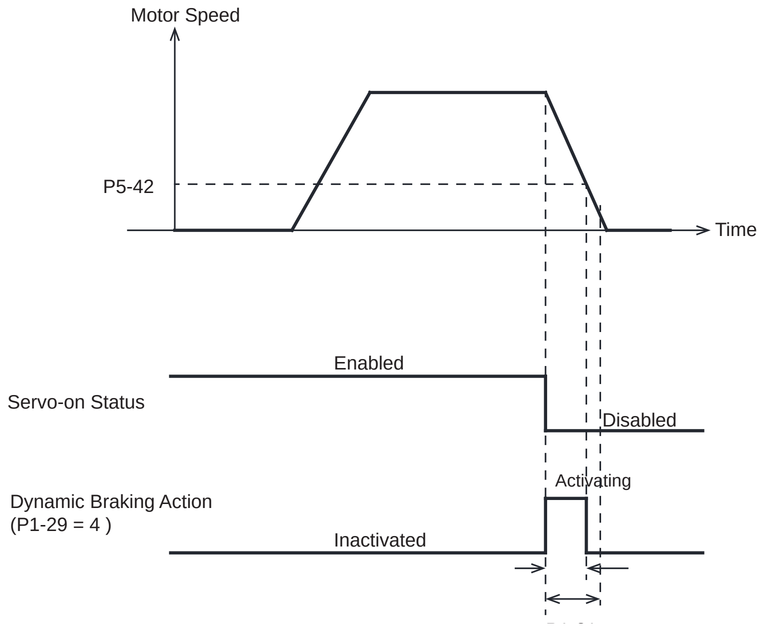
Parameter	Command	Description	Default	Range	Unit	Contol mode			
P1-30	YR	Dynamic Brake Sequence when Fault Occurs	0	0 ~ 3		P	V	T	F

When the servo fault occurs, the action mode of dynamic brake is set by P1-30 and the maximum braking time is set by P1-31.

P1-30	Description	
	Deceleration period	Stopped
0	Free Run	Free Run
1	Free Run	Dynamic Brake
2	Dynamic Brake	Free Run
3	Dynamic Brake	Dynamic Brake

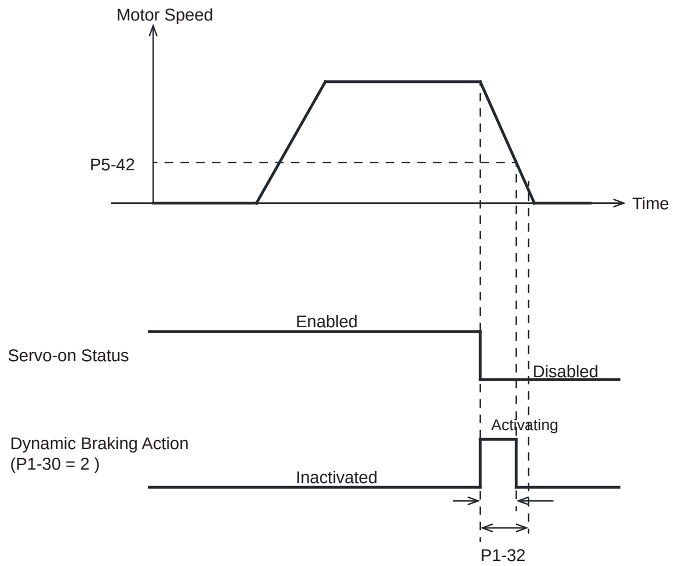
Parameter	Command	Description	Default	Range	Unit	Contol mode			
P1-31	YM	Dynamic Brake Action Time during Deceleration of Servo Off	500	0 ~ 30000	ms	P	V	T	F

This parameter sets the maximum braking time of dynamic brake during deceleration period after the sevro-off.
When the deceleration time exceeds the setting of P1-31, even if the actual speed is still greater than the setting value of P5-42, the dynamic brake will stop working to protect the internal braking resistor.
The following figure shows dynamic braking process when P1-29 = 4.



Parameter	Command	Description	Default	Range	Unit	Contol mode			
P1-32	YN	Dynamic Brake Action Time during Deceleration when Fault Occurs	0	0 ~ 30000	ms	P	V	T	F

This parameter sets the maximum braking time of dynamic brake during deceleration period after the drive gets a fault.
When the deceleration time exceeds the setting of P1-32, even if the actual speed is still greater than the setting value of P5-42, the dynamic brake will stop working to protect the internal braking resistor.
The following figure shows dynamic braking process when P1-30 = 2.



Parameter	Command	Description	Default	Range	Unit	Contol mode			
P1-33	OT	Phase Lost Detect Switch	0	0 ~ 1		P	V	T	F

Drive's power supply phase loss detection switch.
If this function is turned on, when it is detected that there is a phase loss in the power supply of the drive, an alarm of "Phase loss of main circuit"(Alarm code r19) will occur.

Setup Value	Description
0	Disable
1	Enable

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P1-34	RT	Current Ramp Limit	1000	0 ~ 3000	0.1%	P	V	T	F

This parameter sets the current ramp up limit value when the current change instantaneously.
When the servo system detects that the current ramp up exceeds this limit value, a "Motor Collision Alarm" (Alarm code r41)will occur.

8.3.3 Group P2-XX: Trajectory

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P2-00	VM	Max Velocity	80	0 ~ 100	rps	P	V	T	F

The maximum motor velocity in rev/sec. Used in all control mode to limit the maximumspeed of the drive.
If the actual speed exceeds the set value of P2-00 for 400ms, an alarm of "Motor Over Speed" (Alarm code r12)will occur.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P2-01	AM	Max Brake Deceleration	3000	0.167 ~ 5000	rps/s	P	V	T	F

The maximum acceleration/deceleration allowed. When the targeted acceleration/deceleration excels the maximum value, the actual acceleration/deceleration will limit to the maximum value.
Also sets the deceleration rate used when an end-of-travel limit is activated during a move or an emergency stop command is executed.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P2-02	JS	Jog Velocity	10	-100 ~ 100	rps	P	V	T	

The speed for Jog moves in internal speed control mode.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P2-03	JA	Jog Acceleration	100	0.167 ~ 5000	rps/s	P	V	T	

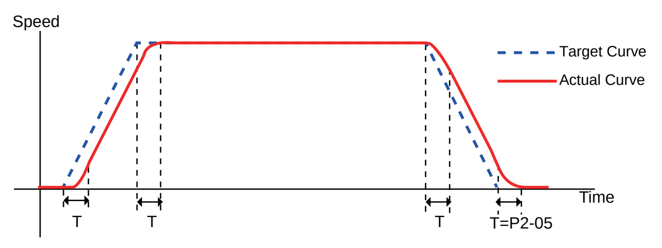
The acceleration rate for Jog moves and internal velocity control mode.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P2-04	JL	Jog Deceleration	100	0.167 ~ 5000	rps/s	P	V	T	

The deceleration rate for Jog moves and internal velocity control mode.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P2-05	JT	Jerk Time	10	0 ~ 125	ms	P	V	T	F

The FIR filter time of internal trajectory planning control command, for example: internal position/velocity/torque control mode, analog velocity control mode, analog torque control mode and communication command control mode.
The smoothing effect of Jerk Filter to the input command is shown in the figure below.



◆ The Jerk Time function will cause a certain delay to the input command pulse, but it will not affect the final positioning accuracy.

◆ The larger the time constant of P2-05 is, the more smoothing effect will be, and the command delay will also increase. A reasonable filter time constant should be set according to the actual aoolication.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P2-06	VE	Point-to-Point Velocity	10	0.0042 ~ 100	rps	P	V	T	F

The target motor speed for point-to-point move.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P2-07	AC	Point-to-Point Acceleration	100	0.167 ~ 5000	rps/s	P	V	T	F

The acceleration rate used in point-to-point move commands in rev/sec/sec.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P2-08	DE	Point-to-Point Deceleration	100	0.167 ~ 5000	rps/s	P	V	T	F

The deceleration rate used in point-to-point move commands in rev/sec/sec.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P2-09	VC	Point-to-Point Change Velocity	2	0 ~ 100	rps	P	V	T	F
If the internal position control command which suppots point-to-point move with variable speed control, this parameter is used to set the speed of second stage.									

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P2-10	JC1	Internal Velocity Control: Speed 1	2	-100 ~ 100	rps	P	V	T	
The first speed setting value for Internal Velocity Control. For more details about multi-speed control, refer to Chapter 7.11 Internal Velocity Control									

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P2-11	JC2	Internal Velocity Control: Speed 2	10	-100 ~ 100	rps	P	V	T	
The second speed setting value for Internal Velocity Control.									

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P2-12	JC3	Internal Velocity Control: Speed 3	20	-100 ~ 100	rps	P	V	T	
The third speed setting value for Internal Velocity Control.									

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P2-13	JC4	Internal Velocity Control: Speed 4	25	-100 ~ 100	rps	P	V	T	
The fourth speed setting value for Internal Velocity Control.									

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P2-14	JC5	Internal Velocity Control: Speed 5	30	-100 ~ 100	rps	P	V	T	
The fifth speed setting value for Internal Velocity Control.									

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P2-15	JC6	Internal Velocity Control: Speed 6	35	-100 ~ 100	rps	P	V	T	
The sixth speed setting value for Internal Velocity Control.									

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P2-16	JC7	Internal Velocity Control: Speed 7	40	-100 ~ 100	rps	P	V	T	
The seventh speed setting value for Internal Velocity Control.									

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P2-17	JC8	Internal Velocity Control: Speed 8	50	-100 ~ 100	rps	P	V	T	
The eighth speed setting value for Internal Velocity Control.									

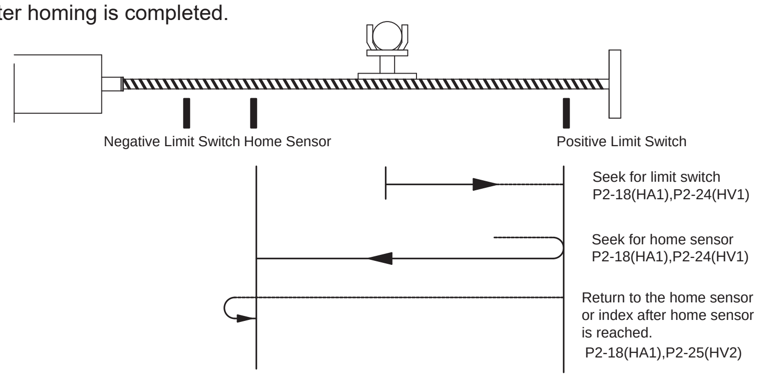
Parameter	Command	Description	Default	Range	Unit	Contol mode			
P2-18	HA1	Homing Acceleration/Deceleration	100	0.167 ~ 5000	rps/s	P	V	T	
The acceleration and deceleration rate used in first stage of homing mode.									

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P2-24	HV1	Homing Velocity 1	10	0.0042 ~ 100	rps	P	V	T	
This parameter set the velocity used in first stage of homing mode.									

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P2-25	HV2	Homing Velocity 2	1	0.0042 ~ 100	rps	P	V	T	
This parameter set the velocity used in second stage of homing mode.									

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P2-27	HO	Homing Offset	0	-2147483647 ~ +2147483647	pulses	P	V	T	

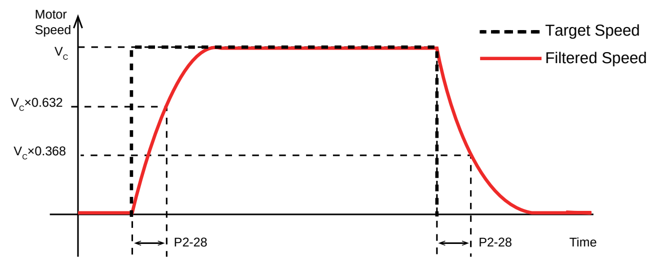
The offset distance after homing is completed.



P2-18，P2-24，P2-25 and P2-27 are the configuration parameters of the build-in homing function, refer to Chapter 7.10 Homing for more detailed.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P2-28	KJ	Jerk Filter	0	0 ~ 1000	ms	P	V	T	F

Parameter P2-28 Low-pass Jerk Filter can take effect in all control modes, such as: external pulse control position mode, internal trajectory mode (position, speed, torque), analog position, analog speed, analog torque, Communication command control(SCL or Modbus), etc.
The smoothing effect of Low-pass Jerk Filter to the input command is shown in the figure below.



◆ The low-pass jerk filter will cause a certain delay to the input command pulse, but it will not affect the final positioning accuracy.

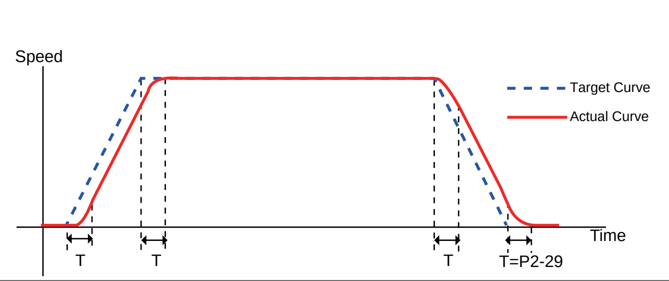
◆ The larger the time constant of P2-28 is, the more smoothing effect will be, and the command delay will also increase. A reasonable filter time constant should be set according to the actual aoolication.

Refer to Chapter 7.2.5 Command Smoothing Filter for more detailed.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P2-29	FF	Interpolation Filter	10	0 ~ 125	ms	P	V	T	F

Parameter P2-29 Interpolation Filter works in the pulse position control mode, applicable to the following application scenarios:
- ◆ Input pulse command does not perform acceleration or deceleation.
- ◆ The frequency of input pulse command changes suddenly.
- ◆ The frequency of input pulse command is extremely low.

The smoothing effect of the Interpolation Filter to the input command is shown in the figure below.



◆ Interpolation filter will cause a certain delay to the input command pulse, but it will not affect the final positioning accuracy.

◆ The larger the time constant of P2-29 is, the more smoothing effect will be, and the command delay will also increase. A reasonable filter time constant should be set according to the actual aoolication.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P2-30	VT	Velocity Limit of Torque Control	80	0 ~ 100	rps	P	V	T	

In torque mode, when the internal speed limit is used as the speed limit source, this parameter is used as the speed limit value.
Refer to Chapter 7.4.5 Speed Limit in Torque Control Mode.

8.3.4 Group P3-XX: Encoder & Step/Dir Configuration

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P3-00	EN	Electronic Gear Ratio - Numerator	32000	0 ~ 131072	-	P	V	T	F

This parameter defines the numerator of Electronic Gear Ratio.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P3-01	EU	Electronic Gear Ratio - Denominator	32000	0 ~ 131072	-	P	V	T	F

This parameter defines the denominator of Electronic Gear Ratio.
The electronic gear ratio is to multiply the pulse input command by the electronic gear ratio as the position command reference. By using this function, the motor rotation and movement amount corresponding to the input command pulse can be set.

$$\begin{matrix}\text{External Position Pulse Command} \\ \text{(Communication Position Command)}\end{matrix} \times \frac{\text{P3-00 (Electronic Gear Ratio-Denominator)}}{\text{P3-01 (Electronic Gear Ratio-Numerator)}} = \text{Reference Position Command}$$

Refer to Chapter 7.2.4 Electronic Gear Ratio for more detailed settings.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P3-02	SZ	Pulse Input Noise Filter	2	0 ~ 32000	0.1μs	P	V	T	F

Using paratermer P3-02 Pulse Input Noise Filter to filte the input pulse signal to prevent it from being interfered and cause inaccurate positioning and other problems. This noise filter is a low-pass filter, and the unit is 0.1μs.

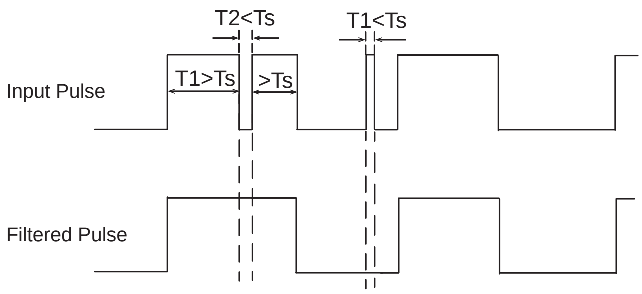
Instructions:

Ts: The set value of P3-02 pulse input noise filter

T1: The high voltage level width of input pulse

T2: The low voltage level width of input pulse

Then the relationship between the input pulse signal and the the filtered signal is as follows.



- ◆ Both T1 and T2 of a pulse are bigger than Ts, this input pulse is valid.
- ◆ One of T1 and T2 of a pulse is smaller than Ts, this input pulse will be filtered.

$$\text{Noise Filter time :Ts} \leq \frac{1}{\text{A x Pulse Input Frequency (Hz)}}$$

Generally, when the duty cycle of the input frequency is 50%, the value of A is 4 or 5.

Refer to Chapter 7.2.3.5 Pulse Input Noise Filter for more detailed settings.

Parameter	Command	Description	Default	Range	Unit	Contol mode
P3-03	PT	Pules Input Setting	9	0 ~ 31		P V T F

Parameter P3-03 is used to set the input pulse command source, pulse type, rotation direction and pulse edge valid type.

<table>
<tr><td colspan="9">P3-03 Pulse input setting</td></tr>
<tr><td>bit7</td><td>bit6</td><td>bit5</td><td>bit4</td><td>bit3</td><td>bit2</td><td>bit1</td><td>bit0</td></tr>
<tr><td rowspan="3">0</td><td rowspan="3">0</td><td rowspan="3">0</td><td>0: Open-colector input</td><td>0: Valid on falling edge</td><td>0: Positive Direction</td><td colspan="2">bit1=0,bit0=1: Pulse & Direction</td></tr>
<tr><td rowspan="2">1: Line receiver input</td><td rowspan="2">1: Valid on raising edge</td><td rowspan="2">1: Negative Direction</td><td colspan="2">bit1=1,bit0=0: CW/CCW</td></tr>
<tr><td colspan="2">bit1=1,bit0=1: A/B Quadrature</td></tr>
<tr><td colspan="8">bit0 & bit1: Pulse command type
bit2: Rotation direction
bit3: Valid pulse setting
bit4: Pulse input source</td></tr>
</table>

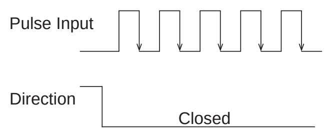
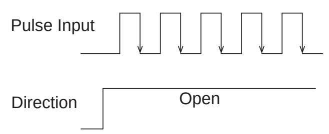
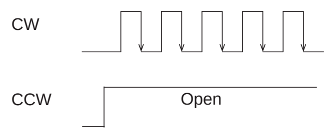
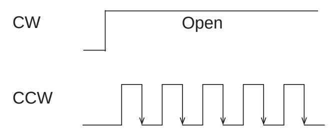
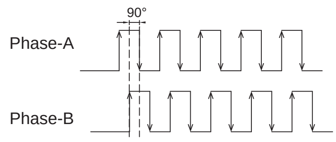
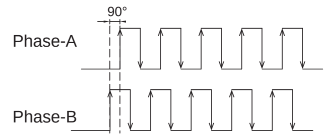
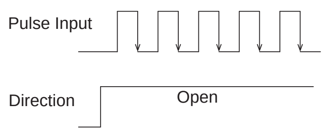
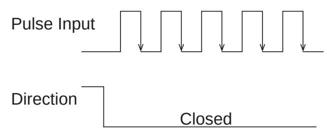
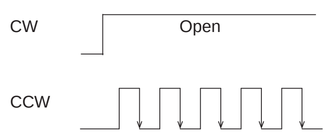
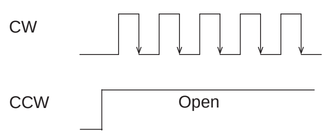
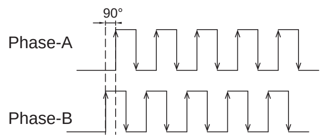
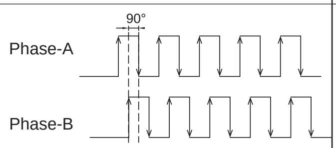
◆ **Input Pulse Type:**

There are three types of input pulse: Pulse & Direction, CW/CCW pulse, A/B quadrature pulse that is set by bit 0 and bit 1 of parameter P3-03.

bit 1	bit 0	Input pulse type
0	1	Pulse & Direction(Default)
1	0	CW/CCW pulse
1	1	A/B quadrature pulse

◆ **Rotation Direction:**

Bit 2 of parameter P3-03 determines the relationship between the input pulse and the rotation direction of the motor, as shown in the figure below.

<table>
<tr><td>Bit2</td><td>Input pulse type</td><td colspan="2">Positive Direction</td><td colspan="2">Negative Direction</td></tr>
<tr><td rowspan="3">0
(Default)</td><td>Pulse & Direction</td><td>Positive rotation when the direction signal keeps CLOSED.</td><td>
</td><td>Negative rotation when the direction signal keeps OPEN.</td><td>
</td></tr>
<tr><td>CW/CCW pulse</td><td>When the CW pulse input, and the CCW keeps Open, it is positive rotation.</td><td>
</td><td>When the CCW pulse input, and the CW keeps Open, it is negative rotation</td><td>
</td></tr>
<tr><td>A/B quadrature</td><td>When phase-A leads phase-B by 90 degree, it is positive rotation</td><td>
</td><td>When phase-B leads phase-A by 90 degree, it is negative rotation</td><td>
</td></tr>
<tr><td rowspan="3">1</td><td>Pulse & Direction</td><td>Positive rotation when the direction signal keeps OPEN</td><td>
</td><td>Negative rotation when the direction signal keeps CLOSED.</td><td>
</td></tr>
<tr><td>CW/CCW pulse</td><td>When the CCW pulse input, and the CW keeps Open, it is positive rotation.</td><td>
</td><td>When the CW pulse input, and the CCW keeps Open, it is negative rotation</td><td>
</td></tr>
<tr><td>A/B quadrature</td><td>When phase-B leads phase-A by 90 degree, it is positive rotation</td><td>
</td><td>When phase-A leads phase-B by 90 degree, it is negative rotation</td><td>
</td></tr>
</table>

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P3-03	PT	Pules Input Setting	9	0 ~ 31		P	V	T	F

◆ **Valid Pulse Edge Setting:**

Bit 3 of parameter P3-03 determines the valid edge condition of input pulse.

bit 3	Valid edge
0	Valid on falling edge(Default)
1	Valid on raising edge

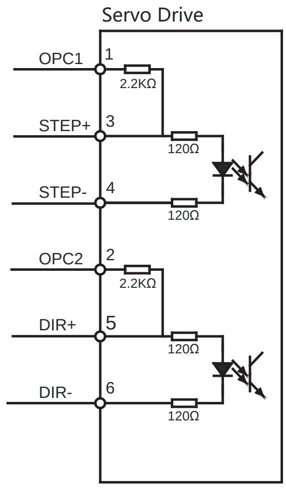
◆ **Pulse input source**

Bit 4 of parameter P3-03 sets the input port for the position pulse command. There are variety input ports in M56S series, it is necessary to select the appropriate pulse input port according to the pulse type of the controller and the drive model.

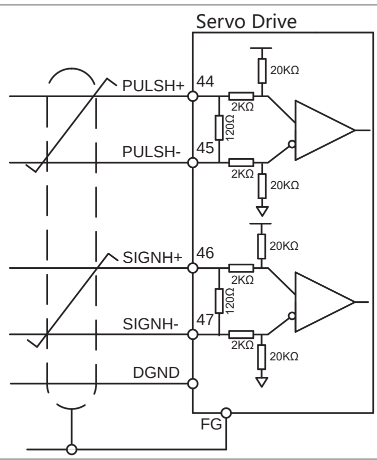
0: Open-colector input
1: Line receiver input

1) There are two pulse input sources in -F & -R Type (50-Pin CN2 Connector) of M56S series.

◆ **When bit4 = 0, Open-collector Pulse Inputs (or Low-speed pulse signal input) is selected.**

bit4	CN2-Pin NO.	Signals		Wiring Diagram
0	1	OPC1	Pulse command input	
	3	STEP+		
	4	STEP-		
	2	OPC2	Pulse direction input	
	5	DIR+		
	6	DIR-		

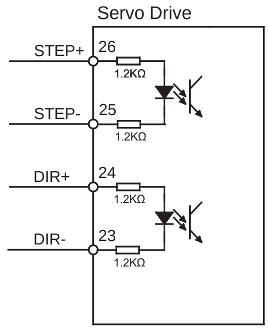
◆ **When bit4 = 1,Line Driver pulse Inputs(or High-speed pulse signal input) is selected.**

bit4	CN2-Pin NO.	Signals		Wiring Diagram
1	44	PULSH+	Pulse command input	
	45	PULSH-		
	46	SIGNH+	Pulse direction input	
	47	SIGNH-		

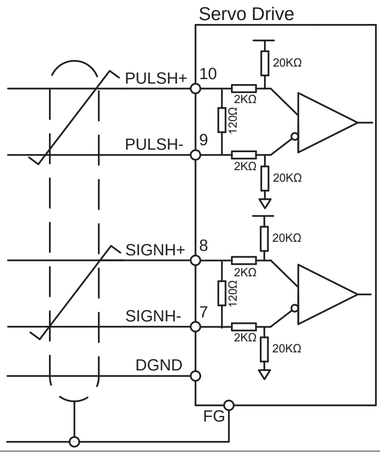
Parameter	Command	Description	Default	Range	Unit	Contol mode
P3-03	PT	Pules Input Setting	9	0 ~ 31		P V T F

2) -X & -N Type (26-Pin CN2 Connector) of M56S series

◆ **When bit4 = 0, Open-collector Pulse Inputs (or Low-speed pulse signal input) is selected.**

<table>
<tr><th>bit4</th><th>CN2-Pin NO.</th><th colspan="2">Signals</th><th>Wiring Diagram</th></tr>
<tr><td rowspan="4">0</td><td>26</td><td>STEP+</td><td rowspan="2">Pulse command input</td><td rowspan="4">
</td></tr>
<tr><td>25</td><td>STEP-</td></tr>
<tr><td>24</td><td>DIR+</td><td rowspan="2">Pulse direction input</td></tr>
<tr><td>23</td><td>DIR-</td></tr>
</table>

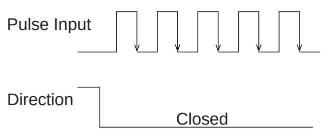
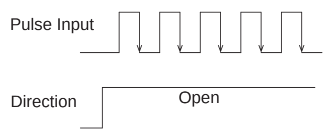
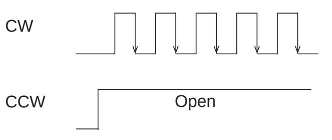
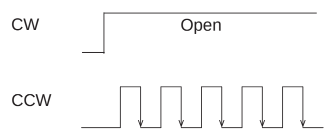
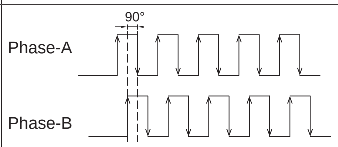
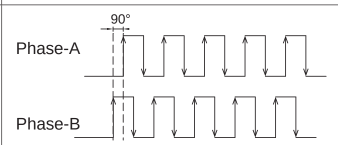
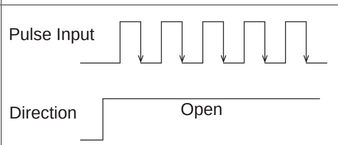
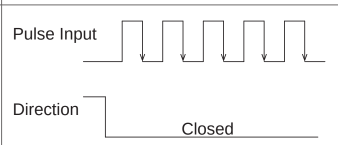
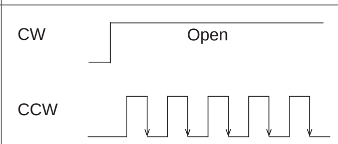
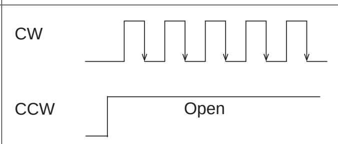
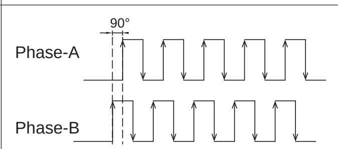
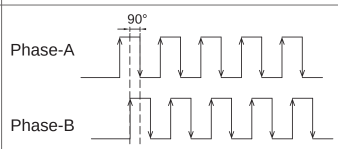
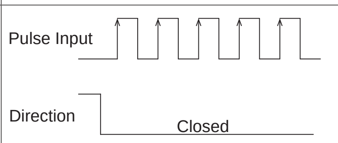
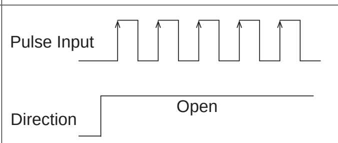
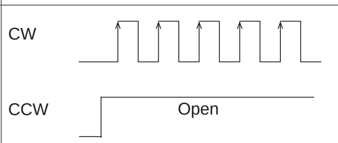
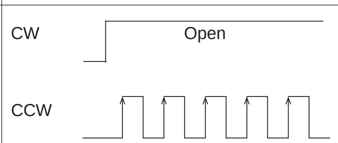
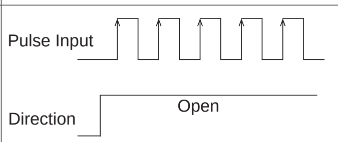
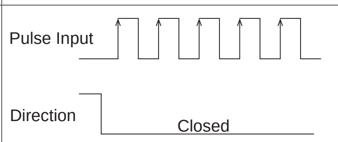
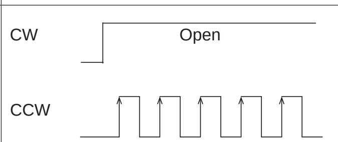
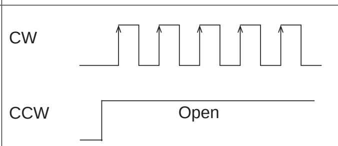
◆ **When bit4 = 1,Line Driver pulse Inputs(or High-speed pulse signal input) is selected.**

<table>
<tr><th>bit4</th><th>CN2-Pin NO.</th><th colspan="2">Signals</th><th>Wiring Diagram</th></tr>
<tr><td rowspan="4">1</td><td>10</td><td>PULSH+</td><td rowspan="2">Pulse command input</td><td rowspan="4">
</td></tr>
<tr><td>9</td><td>PULSH-</td></tr>
<tr><td>8</td><td>SIGNH+</td><td rowspan="2">Pulse direction input</td></tr>
<tr><td>7</td><td>SIGNH-</td></tr>
</table>

Note:
The RS-485 type driver does not support the high-speed pulse input of the Line Driver, only supports the pulse signal of the open-collector. When using this type drive, please set bit4 of parameter P3-03 to "0".

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P3-03	PT	Pules Input Setting	9	0 ~ 31		P	V	T	F

Quick setup for P3-03

Valid pulse edge	Rotation direction	Pulse command type			Positive	Negative	Parameter P3-03 Set value (Decimal)	
bit3	bit2	bit1	bit0				Open-collector	Line receiver
0	0	0	1	Pulse & Dirction			1	17
0	0	1	0	CW/ CCW			2	18
0	0	1	1	A/B			3	19
0	1	0	1	Pulse & Dirction			5	21
0	1	1	0	CW/ CCW			6	22
0	1	1	1	A/B			7	23
1	0	0	1	Pulse & Dirction			9	25
1	0	1	0	CW/ CCW			10	26
1	1	0	1	Pulse & Dirction			13	29
1	1	1	0	CW/ CCW			14	30

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P3-04	PF	Position Error Limit	100000	0 ~ 2147483647	pulses	P	V	T	F

During the movement, when the deviation between the target position and the actual position fed back by the encoder exceeds the set value of P3-04, an error "Position Following Error" will occur, and the LED display panel of the driver will display an error code r 10PL.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P3-05	EG	Command Pulses per revolution	10000	200 ~ 131072	pulses/rev	P	V	T	F

Set the required number of pulses to make the motor rotates one revolution.
When parameter P3-16 is set to zero, this parameter setting is invalid. The required number of pulse per revolution is set by electronic gear ratio, that is, by the parameter P3-00(Electronic Gear Ratio - Numerator) and P3-01(Electronic Gear Ratio - Denominator).

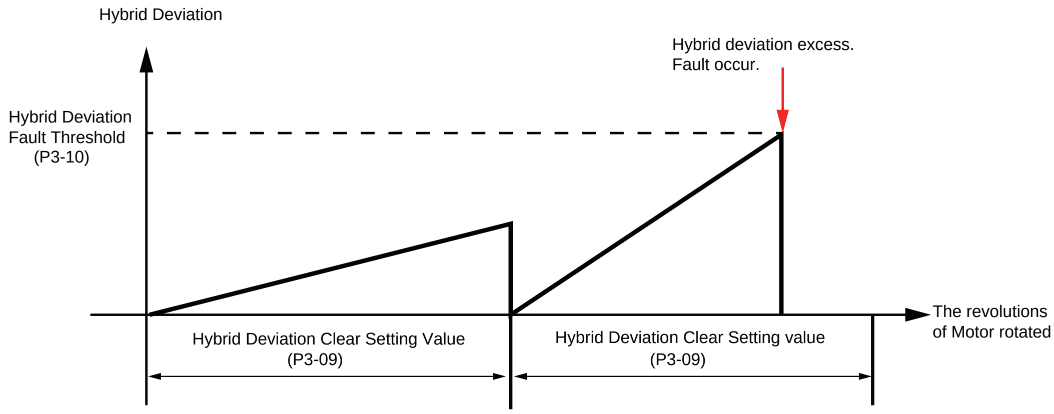
Parameter	Command	Description	Default	Range	Unit	Contol mode			
P3-06	PV	Second Encoder Direction	0	0 ~ 1	-	P	V	T	F

Define the direction of the second encoder in full closed-loop control mode.

Setup Value	Description
0	In positive direction, the second encoder's Phase-A leads Phase-B 90 degrees.
1	In positive direction, the second encoder's Phase-B leads Phase-A 90 degrees.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P3-09	XT	Hybrid Deviation Clear Setting	10	1 ~ 100	rev	P	V	T	F

Set the allowable deviation between the current position of motor encoder and external second encoder, and automatically clear the hybrid deviation whenever the motor's revolutions reaches the set value.



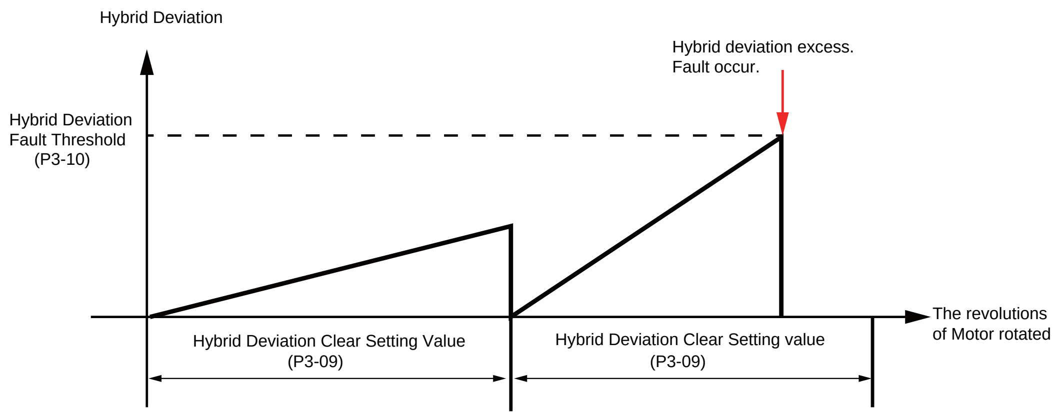
Note:

◆ The servo motor rotates the number of revolutions set by P3-09, and the hybrid deviation is always less than the set value of P3-10. As the motor reaches the revolutions set by P3-09, the hybrid deviation is cleared to zero and counted again from zero.
◆ Once hybrid deviation is greater than the set value of P3-10, a full closed-loop hybrid deviation excess error will occur.
◆ As P3-10 is set to 0 which means the hybrid deviation is not detected.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P3-10	XO	Hybrid Deviation Fault Threshold	100000	0 ~ 2147483647	pulses	P	V	T	F

Set the position following error alarm threshold in full closed-loop control mode.
As the deviation between the current position of motor encoder and external second encoder is greater than the set value of P3-10, a full closed-loop hybrid deviation excess error will occur, r28FP will display on the drive's LED display panel.

- Once hybrid deviation is greater than the set value of P3-10, a full closed-loop hybrid deviation excess error will occur.
- As P3-10 is set to 0 which means the hybrid deviation is not detected.



Parameter	Command	Description	Default	Range	Unit	Contol mode			
P3-11	XR	Second Encoder Resolution	10000	200 ~ 100000	pulses/ user-unit	P	S	T	F

The resolution of external second encoder or scale.
A) For rotary encoder, enter the resolution of one revolution of the encoder;
B) For linear scale, enter the number of pulses per moving user unit.

Note 1:
The maximum speed under the full closed-loop control is 128 user unit per second, the appropriate resolution and user unit must be set.
For example, the resolution of a linear scale is 0.5 μm.
◆ If the user unit is in mm, when P3-11 is set to 2000, the maximum speed is 128 mm/s
◆ If the user unit is in cm, when P3-11 is set to 20000, the maximum speed is 128 cm/s

Note 2:
In any case, as long as the setting value of P3-11 is changed, the mechanical transmission ratios P3-00 and P3-01 must be reset

Note 3:
The resolution of the external second encoder must be input correctly, otherwise, it will cause the full-closed loop position following error alarm when running.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P3-12	PO	Pulses Output Mode	1	0 ~ 256	-	P	S	T	F

Parameter P3-12 is used to set the pulse output source, pulse output phase logic, Z pulse output polarity, and division ratio.
The corresponding functions to each bit are as follows.

P3-12 Pulse output settings							
bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
0	0	0	0	Z pulse output polarity	Pulse output phase logic	Pulse output source	
				0: Rasing edge	0: Phase A leads Phase B	bit1=0,bit0=1: Main Encoder feedback	
						bit1=1,bit0=0: Second Encoder feedback	
				1: Falling edge	1: Phase B leads Phase A	bit1=1,bit0=1: External pulse command	

bit0 and bit1: Pulse output source
bit2: Pulse output phase logic
bit3: Z pulse output polarity

Note:
When set this parameter from the LED operation panel and software, it needs to be converted into decimal.

◆ **Pulse Output Source**

The pulse divided output function supports the following three signal sources. The bit0 and bit1 of parameter P3-12 are used to select signal sources.

Setup Value	Description
bit1=0,bit0=1	Main Encoder feedback
bit1=1,bit0=0	Second Encoder feedback, full closed-loop encoder feedback
bit1=1,bit0=1	External pulse position command(By pass)

Note:
When the signal source is external pulse command, the setting of parameter P3-13 and parameter P3-14 are invalid, and the external command pulse is directly output by-pass. The setting of bit2 and bit3 of P3-12 will also be invalid.

◆ **Pulse output phase logic**

Set the relationship between Phase-A and Phase-B of pulse output when motor rotates at positive direction.

Setup Value	Description
0	Phase-A leads Phase-B 90 degrees
1	Phase-B leads Phase-A 90 degrees.

◆ **Z pulse output polarity**

Set the output polarity of Z pulse.

Setup Value	Description
0	Rasing edge
1	Rasing edge

Refer to Chapter 7.6 Encoder/Pulse Divided Output for more detaled.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P3-13	ON	Pulses Output Gear Ratio - Numerator	10000	0 ~ 13107200	-	P	V	T	F
Set the numerator of pulse output division ratio									

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P3-14	OD	Pulses Output Gear Ratio - Denominator	131072	0 ~ 13107200	-	P	V	T	F

Set the denominator of pulse output division ratio
When the pulse output source is the motor encoder or second encoder, some applications where the number of output pulses per one motor revolution is not an integer, you can set the output gear ratio.
Output counts per motor revolution(A and B are converted into 4 times the frequency.)

$$\frac{\text{P3-13 Pulses Output Gear Ratio - Numerator}}{\text{P3-14 Pulses Output Gear Ratio - Denominator}} \times 131072$$

Note:
1). P3-13 should be smaller than P3-14.
2). When P3-13 is larger than P3-14, output pulse counts per motor revolution is set by P3-13.
3). The output pulse unit is CPR, which means counts per revolution, and refers to the number of quadrature decoded states that exist between the two outputs A and B. With both outputs A and B switching between high and low, there exists 2 bits of information represented as 4 distinct states. The term quadrature decoding describes the method of using both outputs A and B together to count each state change. This results in 4 times the amount of counts that exist for each pulse or period.Therefore, the CPR of an encoder is the encoder’s PPR multiplied by 4.
Refer to Chapter 7.6 Encoder/Pulse Divided Output for more detaled.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P3-15	ES	Absolute Encoder Usage	1	0 ~ 3	-	P	V	T	F

Define the usage of Absolute Encoder:

Setup Value	Description	Instructions
0	Incremental Encoder	It is used as an incremental encoder, the encoder fedback position will be reset to zero when power-on.Even if no external battery is connected, the alarm of multi-turn loss will not be generated.
1	Single Turn Absolute Encoder	Same as an incremental encoder, but the absolute position information of the motor within one revolution can be get.
2	Multi-Turn Absolute Encoder	Use as a multi-turn absolute encoder, records the absolute position of the motor.
3	Multi-Turn Absolute Encoder without Overflow	Use as a multi-turn absolute encoder. Even if the multi-turn value exceeds the range, the multi-turn overflow alarm will not be generated

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P3-16	PU	Electronic Gearing Switch	1	0 ~ 1	-	P	V	T	F

M56S series servo drives have two electronic gearing systems, parameter P3-16 is used to switch this.

Parameter P3-16 set value	Description	Instructions
0	Based on parameter P3-05 (Command Pulses per revolution) Setting	Set the required number of command pulses per revolution of motor. Note: ◆ When this setting is zero, electronic gear ratio P03-00 and P3-01 is invalid. ◆ The read value of feedback encoder position is also determined by this parameter. That is, the read value of feedback encoder position per motor revolution = the setting of parameter P3-05
1	Electronic gear ratio is valid	◆ Electronic gear ratio P03-00 and P3-01 become valid and P3-05 is invalid ◆ The read value of feedback encoder position is: Feedbakc encoder position per revolution= $\frac{1048576}{\text{(Encoder resolution)}} \times \frac{\text{P3-01 (Electronic Gear Ratio-Numerator)}}{\text{P3-00 (Electronic Gear Ratio-Denominator)}}$

The electronic gear ratio is to multiply the pulse input command by the electronic gear ratio as the position command reference. By using this function, the motor rotation and movement amount corresponding to the input command pulse can be set.

$$\begin{matrix}\text{External Position Pulse Command} \\ \text{(Communication Position Command)}\end{matrix} \times \frac{\text{P3-00 (Electronic Gear Ratio-Denominator)}}{\text{P3-01 (Electronic Gear Ratio-Numerator)}} = \text{Reference Position Command}$$

◆ When parameter P3-16 = 0, the electronic gear ratio P03-00 and P03-01 is invalid. The number of pulses per revolution of the motor is determined by parameter P3-05.
◆ When parameter P3-16 = 1, the electronic gear ratio P03-00 and P03-01 become valid. The number of pulses for one rotation of the motor is fixed to the encoder resolution. Regardless of the encoder with 17-bit or 20-bit resolution, it takes 1,048,576 pulses to rotate the motor once.

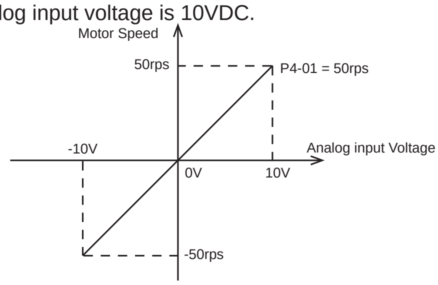
Parameter	Command	Description	Default	Range	Unit	Contol mode			
P3-18	FV	Absolute Encoder Multi-turn Counter Overflow Value	1	0 ~ 2147483647/[P3-05]	-	P	V	T	F

Define the absolute encoder Multi-turn counter overflow value

8.3.5 Group P4-XX: Analog

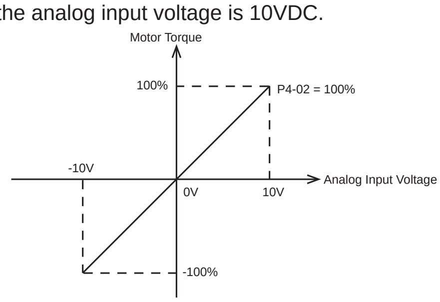
Parameter	Command	Description	Default	Range	Unit	Contol mode			
P4-01	AG	Analog Input Velocity Gain	50	0 ~ 100	rps/10V	P	V	T	F

Scale factor value for motor speed and analog input.
Set corresponding motor speed when the analog input voltage is 10VDC.



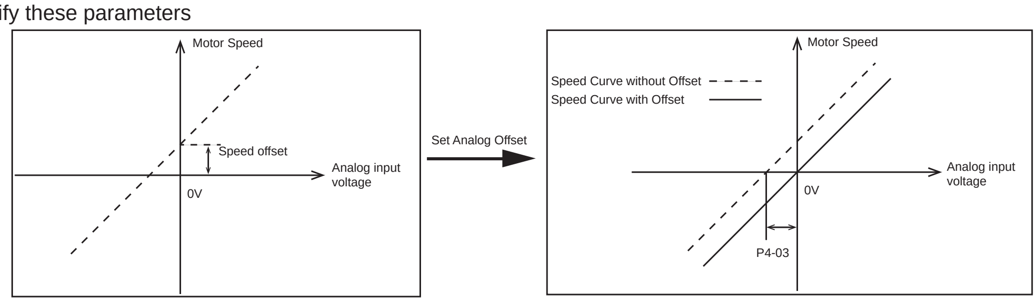
Parameter	Command	Description	Default	Range	Unit	Contol mode			
P4-02	AN	Analog Input Torque Gain	1000	0 ~ 3000	0.1%/10V	P	V	T	F

Scale factor value for motor output torque and analog input.
Set corresponding motor output torque when the analog input voltage is 10VDC.



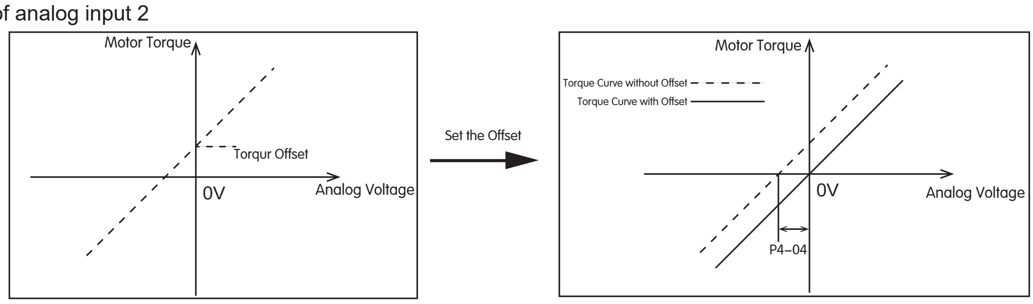
Parameter	Command	Description	Default	Range	Unit	Contol mode			
P4-03	AV1	Analog Input 1 Offset	0	-10000 ~ 10000	mV	P	V	T	F

When using the analog mode, the servo motor may rotate slightly in some cases even if the input analog command is at 0 voltage. This is because there is a slight drift when analog signal is received by drive.
The parameter P4-03 and P4-04 are used to eliminate this situation. You can use the Luna software to automatically adjust the offset or manually modify these parameters



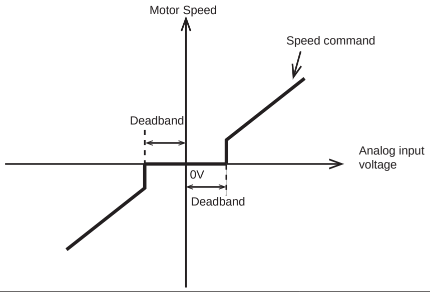
Parameter	Command	Description	Default	Range	Unit	Contol mode			
P4-04	AV2	Analog Input 2 Offset	0	-10000 ~ 10000	mV	P	V	T	F

Set the offset of analog input 2



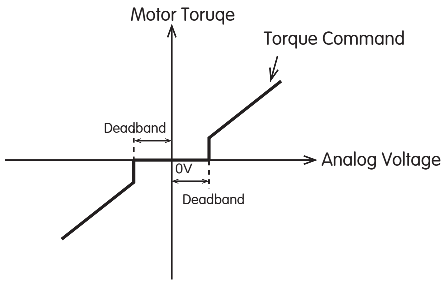
Parameter	Command	Description	Default	Range	Unit	Contol mode			
P4-05	AD1	Analog Input 1 Dead-band	0	0 ~ 255	mV	P	S	T	F

The analog input deadband value of the analog input 1.
The deadband value is the zone around the "zeroed"value of the analog input. This deadband defines the area of the analog input range that the drive should interpret as "zero". The deadband is an absolute value that in usage is applied to either side of the zero point.



Parameter	Command	Description	Default	Range	Unit	Contol mode			
P4-06	AD2	Analog Input 1 Dead-band	0	0 ~ 255	mV	P	S	T	F

The analog input deadband value of the analog input 2.



Parameter	Command	Description	Default	Range	Unit	Contol mode			
P4-07	AF1	Analog Input 1 Filter	1000	0 ~ 2000	0.1Hz	P	S	T	F

This parameter sets the low-pass filter for analog input 1.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P4-08	AF2	Analog Input 2 Filter	1000	0 ~ 2000	0.1Hz	P	S	T	F

This parameter sets the low-pass filter for analog input 2.
In analog control mode, due to external interference, the analog voltage may fluctuate, which will cause the fluctuation of the motor speed or the torque output, which will affect the control accuracy.
The analog input filter is a low-pass filter which is used to eliminate this fluctuation.
Note:
If the set value is too small, the response to the speed command will be reduced.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P4-09	AT1	Analog Input 1 Threshold	5000	-10000 ~ 10000	mV	P	S	T	F

Sets the trigger threshold for analog input 1.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P4-10	AT2	Analog Input 1 Threshold	5000	-10000 ~ 10000	mV	P	S	T	F

Sets the trigger threshold for analog input 2.
The analog input can be set as the motor speed and torque commands, and can also be used as a general analog input to feedback the actual voltage of analog input.
In Q program or SCL communication command, the AT1 and AT2 command can be used to set the voltage trigger threshold of analog input. Hense the analog voltage is used as a trigger switch. When the input voltage is equla to or greater than the parameter setting value, the input is actived.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P4-11	AF1	Velocity Limit Setting of Torque Control	1	0 ~ 1	---	P	V	T	F

In torque mode, when the load connected to the motor is small but the torque command is too large, the motor may accelerate to a very high speed if the motor output speed is not limited, which may cause unexpected situations. Therefore it is necessary to set a maximum motor speed in torque mode. The motor actual speed will be limited within the set value.
This parameter sets the source of the motor speed limit command.

Setup Value	Description
0	Internal Speed Limit
1	Analog Input 1

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P4-16	OS1	Analog Output 1 Scale	1000	1 ~ 32000	/10V	P	V	T	F

Output scale for analog output 1. The values of speed, torque, position error, etc. corresponding to the analog output at 10V can be set.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P4-17	OS2	Analog Output 2 Scale	1000	1 ~ 32000	/10V	P	V	T	F

Output scale for analog output 2. The values of speed, torque, position error, etc. corresponding to the analog output at 10V can be set.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P4-18	XA1	Analog Output 1 Function	0	0 ~ 5		P	V	T	F

Function definition of analog output 1.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P4-19	XA2	Analog Output 2 Function	0	0 ~ 5		P	V	T	F

Function definition of analog output 2.

Setup Value	Description
0	As a general-purpose voltage output.
1	As the motor actual output current, unit: 0.1%
2	As the motor command current, unit: 0.1%
3	As the motor actual output speed, unit: 0.25 rpm
4	As the motor command speed, unit: 0.25 rpm
5	As counts of position following error, unit: counts

8.3.6 Group P5-XX: IO Configuration

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P5-00	MU1	Digital Input 1 Function		0 ~ 46		P	S	T	F

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P5-01	MU2	Digital Input 2 Function		0 ~ 46		P	S	T	F

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P5-02	MU3	Digital Input 3 Function		0 ~ 46		P	S	T	F

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P5-03	MU4	Digital Input 4 Function		0 ~ 46		P	S	T	F

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P5-04	MU5	Digital Input 5 Function		0 ~ 46		P	S	T	F

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P5-05	MU6	Digital Input 6 Function		0 ~ 46		P	S	T	F

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P5-06	MU7	Digital Input 7 Function		0 ~ 46		P	S	T	F

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P5-07	MU8	Digital Input 8 Function		0 ~ 46		P	S	T	F

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P5-08	MU9	Digital Input 9 Function		0 ~ 46		P	S	T	F

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P5-09	MUA	Digital Input 10 Function		0 ~ 46		P	S	T	F

Assignable functions and input logic state list as follows. Parameters P5-00 to P5-09 define the functions of digital inputs X1 to X10. The function of digital input can be set by writing the corresponding Function Code in the table below into the parameters.

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
Control Mode Select	CM-SEL	9	10
Gain Select	GAIN-SEL	11	12
Emergency Stop	E-STOP	13	14
Start Homing	S-HOM	15	16
Position Error Clear	C-CLR	17	18
Torque Limit	TQ-LMT	19	20
Zero Speed Clamp	ZCLAMP	21	22
Pulse Input Inhibit	INHP	25	26
Internal Speed Select 1	SPD1	27	28
Internal Speed Select 2	SPD2	29	30
Internal Speed Select 3	SPD3	31	32
Torque and Velocity Control	SP-STA	33	34
Torque and Velocity Direction Switch	SPD-DIR	35	36
Speed Limit Select	V-LMT	37	38
Home Switch	HOM-SW	39	40
Start Q Program	START-Q	45	46

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P5-12	MO1	Digital Output 1 Function		0 ~ 34		P	V	T	F

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P5-13	MO2	Digital Output 2 Function		0 ~ 34		P	V	T	F

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P5-14	MO3	Digital Output 3 Function		0 ~ 34		P	V	T	F

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P5-15	MO4	Digital Output 4 Function		0 ~ 34		P	V	T	F

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P5-16	MO5	Digital Output 5 Function		0 ~ 34		P	V	T	F

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P5-17	MO6	Digital Output 6 Function		0 ~ 34		P	V	T	F

Assignable functions and output logic state list is as follows. Parameters P5-12 ~ P5-17 define the functions of digital outputs Y1 to Y6. The function of digital output can be set by writing the corresponding Function Code in the table below into above parameters.

Signal Functions	Symbol	Output logic state and set value when the output signal is valid	
		Closed	Open
General Purpose Output	GPOUT	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 Postion Output	DYM-LMT	11	12
Torque Reach Output	TQ-REACH	13	14
Torque Limit Output	T-LMT	15	16
Velocity Coincidence Output	V-COIN	17	18
Velocity Reach Output	AT-SPD	19	20
Velocity Limit Outout	V-LTD	21	22
Servo Ready Output	S-RDY	23	24
Homing Finished Output	HOMED	25	26
Soft Limit CW	SLCW	27	28
Soft Limit CCW	SLCCW	29	30
Near Target Position Output	P-COIN	31	32
Zero Speed Detected	Z-SPD	33	34
Torque Coincidence Output	T-COIN	35	36

The output logic state of the pin is as follows:
CLOSED: If current is flowing into or out of an output, the logic state of that output is low or closed.
OPEN: If no current is flowing, or the output is not connected, the logic state is high or open.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P5-24	BD	Move Command Delay Time after Brake Release	200	0 ~ 32000	ms	P	V	T	F

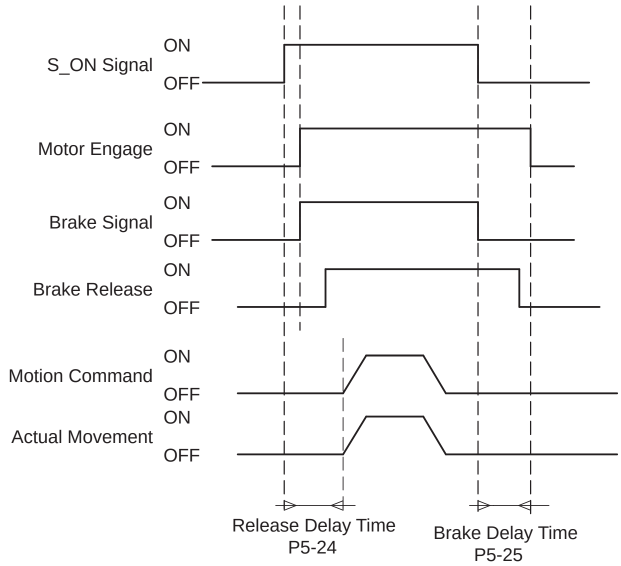
The parameter P5-24 sets the delay time for the first movement after the drive is enabled. The brake must be released before a movements starts, since there is action time when the brake is released or braked, this parameter is set to ensure that the brake has been released successfully.

Note:

As mentioned above, it will cause a delay to the actual movement even if the motion command has been received. If the application is sensitvie to this delay and doesn't need to uese the motor brake, you can set P5-24 to zero, or don't configure the "Brake Release Output" function for the digital outputs.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P5-25	BE	Servo-off Delay Time after Brake Engagement	200	0 ~ 32000	ms	P	V	T	F

The parameter P5-25 sets the delay time to actually disable the drive after the drive receives the disable command, to ensure that the brake has been braked successfully.



Parameter	Command	Description	Default	Range	Unit	Contol mode			
P5-27	HX	Home Sensor	5	1 ~ 10	-	P	V	T	F

This parameter P5-27 shows which digital input is configured as the Home Switch input. The function of digital input needs to be configured as "Home Switch Input" through parameters P5-00 to P5-09.

Display Value	Digital Inputs
1	X1
2	X2
◦ ◦ ◦	◦ ◦ ◦
10	X10

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P5-28	FI1	Digital Input 1 Filter	2	0 ~ 8000	ms	P	V	T	F

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P5-29	FI2	Digital Input 2 Filter	2	0 ~ 8000	ms	P	V	T	F

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P5-30	FI3	Digital Input 3 Filter	2	0 ~ 8000	ms	P	V	T	F

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P5-31	FI4	Digital Input 4 Filter	2	0 ~ 8000	ms	P	V	T	F

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P5-32	FI5	Digital Input 5 Filter	2	0 ~ 8000	ms	P	V	T	F

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P5-33	FI6	Digital Input 6 Filter	2	0 ~ 8000	ms	P	V	T	F

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P5-34	FI7	Digital Input 7 Filter	2	0 ~ 8000	ms	P	V	T	F

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P5-35	FI8	Digital Input 8 Filter	2	0 ~ 8000	ms	P	V	T	F

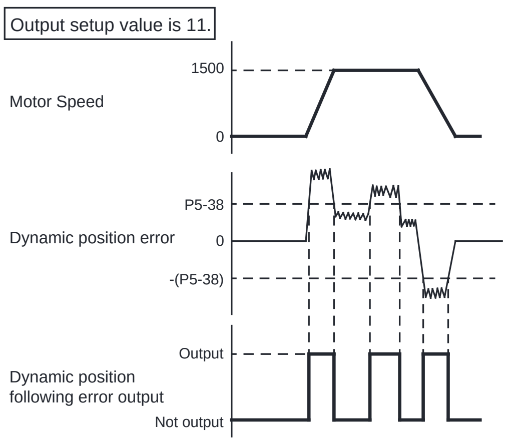
Parameter	Command	Description	Default	Range	Unit	Contol mode			
P5-36	FI9	Digital Input 9 Filter	2	0 ~ 8000	ms	P	V	T	F

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P5-37	FIA	Digital Input 10 Filter	2	0 ~ 8000	ms	P	V	T	F

Parameters P5-28 to P5-37 set the input filter of digital input X1 to X10.
When the width of input signal is greater than the set filter time, the input signal is valid.
If there are lot of electromagnetic interferences, setting a reasonable input filter can improve the reliability of digital inputs, but too large filtering time will affect the input response.

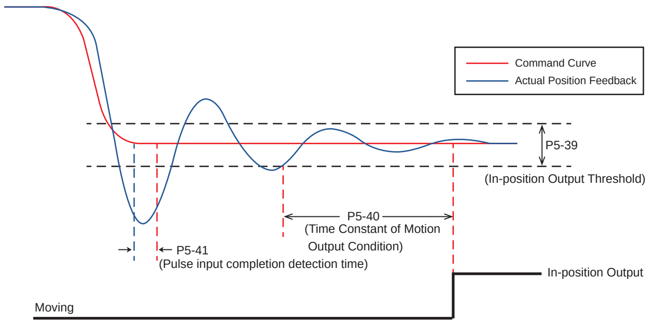
Parameter	Command	Description	Default	Range	Unit	Contol mode			
P5-38	PL	Dynamic Follow Error Threshold	10	0 ~ 2147483647	pulses	P	S	T	F

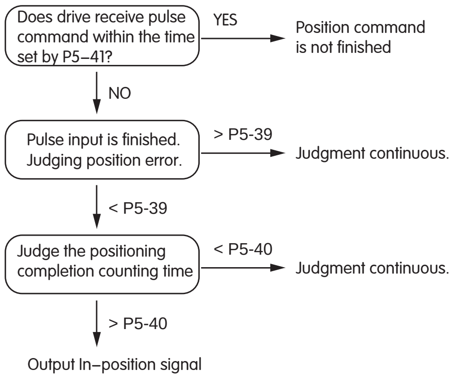
This parameter P5-38 sets the jugement condition of outputing Dynamic Position Following Error over limit.
Dynamic Position Following Error output refers to the output of this signal when the difference between the motor actual position and the command position is greater than P5-38 Dynamic Follow Error Threshold during the motor is rotating.
The following figure shows that the dynamic following error exceeds the setting of P5-38, the DYM-LMT signal outputs.



Parameter	Command	Description	Default	Range	Unit	Contol mode			
P5-39	PD	In-position Output Threshold	40	0 ~32000	pulses	P	V	T	F

This parameter P5-39 sets the jugement condition of the In-position signal output.
The In-position output signal is used to indicate current positioning status of the servo system in the position mode. When the position following error, which is the difference between input position command and the motor actual position feedback by motor encoder, is less than the set value of P5-39, the In-position signal will output.





◆ When the drive dose not receive a new pulse input within the pulse input completion detection time of P5-41, it is deemed that the pulse input has completed.

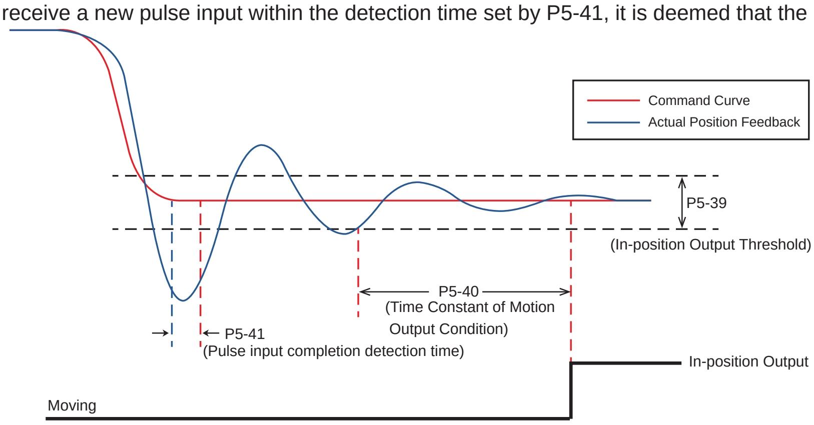
◆ After that, if the position following error is less than parameter P5-39(In-position Output Threshold) and the duration exceeds parameter P5-40, the In-position signal will output.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P5-40	PE	Time Constant of Motion Output Condition	10	0 ~ 30000	ms	P	V	T	F

One of the conditions for judging whether to output the following signals: Time Constant.
For more detailed,please refer to following chapters:
Chapter 7.2.8 In-postion output Signal
Chapter 7.3.7 Velocity Reach Output
Chapter 7.3.8 Velocity Coincidence Output

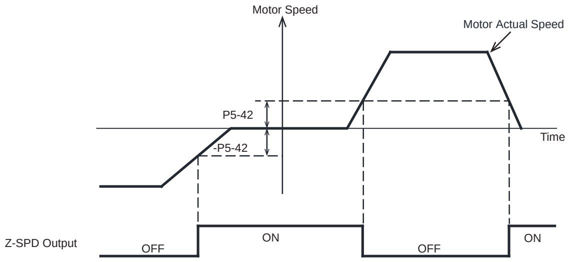
Parameter	Command	Description	Default	Range	Unit	Contol mode			
P5-41	TT	Pulse Complete Timing	2	0 ~ 20000	ms	P	V	T	F

The parameter P5-41 sets the detection time width for judging whether the input position pulses ends.
When the drive dose not receive a new pulse input within the detection time set by P5-41, it is deemed that the pulse input has completed.



Parameter	Command	Description	Default	Range	Unit	Contol mode			
P5-42	ZV	Zero Speed Width	0.5	0.1 ~ 2	rps	P	V	T	

The paramter P5-42 sets the judgment condition whether the actual motor speed is zero.
When the absolute value of motor actual speed is less than the set value of P5-42(zero-speed judgment width), the servo drive outputs the Zero Speed Detected(Z-SPD) signal. On the contrary, if the absolute value of motor actual speed is less than P5-42, the Z-SPD signal will not output.
The detection of Zero Speed is not affected by control mode and servo status, therefore, this signal can also be used as the motor moving signal.



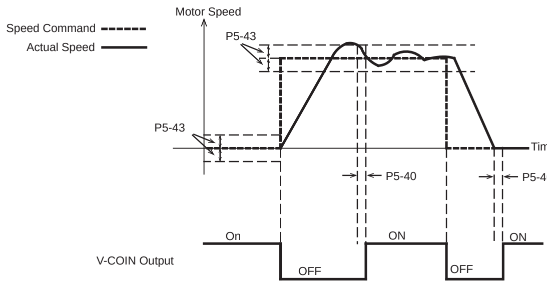
Note: To check or to change this value from drive operation panel, please calculate according to the following formula.

LED Display value = *V* x 240

Where *V* is the speed to be set in rps(revolution per second)

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P5-43	VR	Speed Coincidence Width	0.1	0 ~ 100	rps	P	V	T	

In speed mode, when the difference between the filtered motor actual speed and the speed command, that is, the speed error is within the range of P5-43 (Speed Coincidence Width), and the duration time meets the set value of P5-40 (Time Constant of Motion Output Condition), then the Velocity Coincidence signal V-COIN is output.
If the filtered speed error exceeds the set value of P5-43, V-COIN will not output.



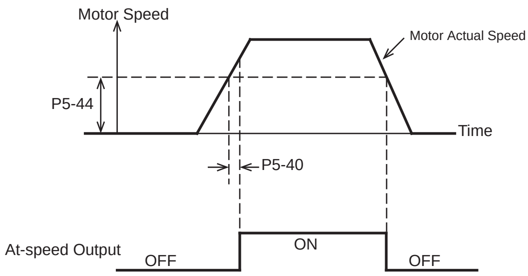
Note: To check or to change this value from drive operation panel, please calculate according to the following formula.

LED Display value = *V* x 240

Where *V* is the speed to be set in rps(revolution per second)

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P5-44	VV	Target Value of AT-speed Output	10	0 ~ 100	rps	P	V	T	

In speed control mode, the Velocity Reach Output, also know as At-speed(AT-SPD), which will be output when the filtered motor actual speed exceeds P5-44 (Target Value of AT-speed Output), and the time exceeds P5-40 (counting time for positioning completion) .
On the contrary, if the filtered motor actual speed is less than P5-44, the AT-SPD signal will not output.



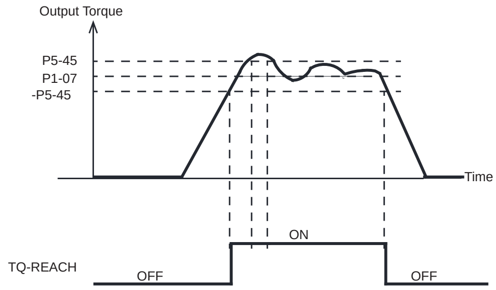
Note: To check or to change this value from drive operation panel, please calculate according to the following formula.

LED Display value = *V* x 240

Where *V* is the speed to be set in rps(revolution per second)

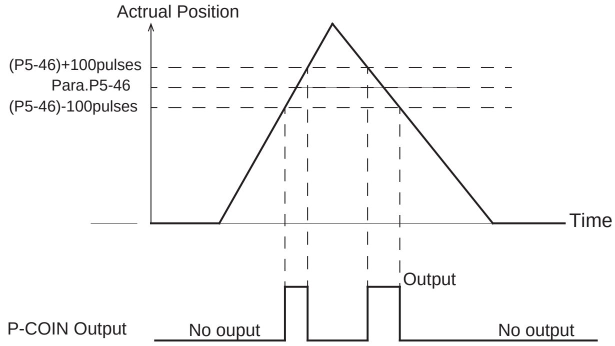
Parameter	Command	Description	Default	Range	Unit	Contol mode			
P5-45	TV	Torque Arrival Width	10	0 ~ 3000	0.1%	P	V	T	

When the absolute value of the actual motor output torque exceeds the set value of P1-07(Target Torque Value when Torque Value Reached), and the torque fluctuation is within the range of P5-45, the torque reach signal TQ-REACH will be output.
If the actual motor output torque doesn't exceed or is lower than P1-07, the TQ-REACH signal will not output.
This function is applicable in all control modes, such as position mode, speed mode, torque mode, etc.
To use Torque Reach Output(TQ-REACH), one of digital outputs needs to be assigned this function.



Parameter	Command	Description	Default	Range	Unit	Contol mode			
P5-46	DG	Near Target Position	10000	-2147483647 ~ +2147483647	pulses	P	V	T	

Near target position, which is also called Position Consistent, is to output a signal(P-COIN) when the actual position of motor is equal to the position set by parameter P5-46. The fluctuation range is ±100 pulses.



Parameter	Command	Description	Default	Range	Unit	Contol mode			
P5-47	LP	Positive Software Limit	0	-2147483647 ~ +2147483647	pulses	P	V	T	F

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P5-48	LM	Negative Software Limit	0	-2147483647 ~ +2147483647	pulses	P	V	T	F

ParametersP5-47 and P5-48 set the software position limit for the drive.
◆ If the actual motor position is equal to or exceeds the set value of P5-47 while motor is rotating at positive direction, a Positive Limit Alarm (Alarm Code r 15JL)will occure, hence the motor can not continue to rotate in positive direction.

◆ If the actual motor position is equal to or exceeds the set value of P5-48 while motor is rotating in nagetive direction, a Nagetive Limit Alarm (Alarm Code r 14LL)will occure, hence the motor can not continue to rotate at nagetive direction.

Note:
◆ When the motor 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".
◆ If using the motor with absolute encoder, parameters P5-47 and P5-48 can be saved.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P5-49	HE	Homing Method	1	-4 ~ 40	-	P	V	T	F

The paramter P5-49 sets the homing method in Homing Mode.
Refer to Chapter 7.10 Homing Mode for more detailed.

9 Troubleshooting

9.1 Alarm List

Alarm Code	Description	Error Type		Drive status after the alarm occurs	Resettable
		Fault	Warning		
r01ot	Drive over temperature	Fault		Servo off	YES
r02ur	Internal voltage error	Fault		Servo off	NO
r03uH	Over-voltage	Fault		Servo off	YES
r04HC	Over current	Fault		Servo off	YES
r05LC		Fault		Servo off	YES
r06rC		Fault		Servo off	YES
r09Eb	Encoder feedback error	Fault		Servo off	否
r10PL	Position following error	Fault		Servo off	YES
r11Lu	Low voltage	Fault		Servo off	YES
r12ou	Over speed	Fault		Servo off	YES
r13Lt	Limit switch trigger alarm		Warning	Current state does not change.	YES
r14LL	Negative limit alarm		Warning	Current state does not change. Motor cannot rotate in negative direction.	YES
r15JL	Positive limit alarm		Warning	Current state does not change. Motor cannot rotate in positive direction	YES
r16CL	Current limit		Warning	Current state does not change.	YES
r17CE	Communication error		Warning	Current state does not change.	YES
r18≡F	Parameter save failed		Warning	Current state does not change.	YES
r19LP	Phase loss of main circuit	Fault		Servo off	YES
r20to	STO is triggered		Warning	Servo off	YES
r21rF	Regeneration failed	Fault		Servo off	YES
r22uW	Under-voltage warning		Warning	Current state does not change.	YES
r23qE	No Q program warning		Warning	Current state does not change.	YES
r24dd	Motion command received while motor disable		Warning	Current state does not change.	YES
r25ur	Internal voltage error	Fault		Servo off	NO
r26ur				Servo off	NO
r27E≡	Emergency Stopped		Warning	Motor decelerates and stops.	YES
r28FP	Full-closed loop hybrid deviation excess error	Fault		Servo off	YES

r29FE	External encoder error	Fault		Servo off	NO
r30nE	Memory error	Fault		Servo off	YES
r31bt	Absolute encoder battery undervoltage		Warning	Current state does not change.	YES
r32AP	Absolute position lost		Warning	Current state does not change.	NO
r33oP	Absolute position overflow		Warning	Current state does not change.	NO
r34Mt	Motor over temperature	Fault		Servo off	YES
r35Ct	Drive MCU over temperature	Fault		Servo off	NO
r36Mr	Absolute encoder multi-turn error	Fault		Servo off	NO
r37≡t	Motor stalled	Fault		Servo off	YES
r38CE	Homing parameters configuration error	Fault		Servo off	YES
r39Hr	Motor collision alarm		Warning	Current state does not change.	YES
r40Hi	Motor Collision Alarm	Fault		Servo off	YES
r41Er	Encoder Communication error	Fault		Servo off	NO
r42io	Wrong configuration of I/O function in Q mode		Warning	Current state does not change.	YES

9.2 Driver Alarm Causes and Measures

Alarm Code	Description	Causes	Measures	Reset Method
r01ot	Drive over temperature	Temperature of the heat sink and power component of the drive exceeds the specified value. 1. Ambient temperature is too high; 2. Drive operating temperature exceeds the specified value; 3. Overload, continue to use while the drive has exceed the rated load; 4. Drive cooling fan failure.	1. Reduce the drive operating temperature and improve the cooling conditions; 2. Increase the capacity of the drive and motor, set up longer acceleration/deceleration time, and lower the load; 3. Replace the fan or return the servo drive for repairing.	Alarm reset
r02ur	Internal voltage error	The internal voltage is lower than the normal value.	Check the voltage of the power supply and replace the drive if still problems.	Re-power up
r03uH	Drive over voltage	Drive DC bus voltage is too high (220 series: higher than 420VDC, MBDV drive series: higher than 80VDC) 1. Power supply voltage exceeds the allowable input voltage range; 2. Disconnection of the regenerative absorbing resistor; 3. The built-in regenerative absorption resistor is too small to absorb the regenerative energy; 4. The external regenerative absorbing resistor does not match, resulting in the inability to absorb the regenerative energy; 5. Drive failure (circuit failure).	1. Check and input correct voltage; 2. Measure the resistance of the internal regeneration resistor; 3. Detect the resistance of the external resistor. Replace the external resistor if the value is ∞; 4. If the problem is not resolved as described above, contact MOONS or replace the drive with a new one.	Alarm reset
r04HC r05LC r06rC	Over-current	1. Failure of drive; 2. Short of the motor wire U, V, W; 3. Burned out of the motor; 4. Poor contact of the motor wire; 5. Input pulse frequency is too high; 6. Motor is over load, command output torque is larger than maximum torque, for a long operating time; 7. Poor gain adjustment cause motor vibration, and abnormal noise; 8. Machine has stalled or the load has gotten heavy suddenly. Machine has been distorted; 9. The motor electromagnetic brake is not released; 10. In the multiple mechanical wiring, the motor wire is mistakenly connected to other axes, and the wiring is incorrect.	1. Turn to Servo-ON, while disconnecting the motor. If error occurs immediately, replace with a new driver; 2. Check that the motor wire (U, V and W) is not shorted, and check the branched out wire out of the connector. Make a correct wiring connection; 3. Check if the motor wires U, V, W are in the correct order. U-red, V-yellow, W-blue; 4. Measure the insulation resistance between motor wires, U, V and W and PE. In case of poor insulation, replace the motor; 5. Increase the power of the drive and motor. Extend the acceleration and deceleration time and reduce the load; 6. Check if the connector plug of the motor connection part U, V, W is off. If loose or falling off, fix them securely; 7. Adjust gain value settings; 8. Measure the voltage at the brake terminals; 9. Check drive and motor encoder and power wires correctly.	Alarm reset
r09Eb	Encoder feedback error	Motor encoder error	1. Verify encoder lines properly connected to the motor; 2. Verify encoder lines connected with the drive correctly; 3. Replace the encoder wires; 4. Re-power on, if still problems, replace the motor.	Re-power up
r10PL	Position following error	Position following error value exceeds the position error range set by parameter P3-04(PF).	1. Check if the position error range set by parameter P3-04 is too small 2. Check drive's gain parameters have been set properly; 3. Check if the selected motor model matches with the actual load, or if the acceleration/ deceleration is too large; 4. Check if any unreasonable torque limits; 5. Inappropriate electronic gear ratio setting; 6. Mechanical part of the motor drive is stuck and the motor is blocked; 7. Check if the motor power wire is connected correctly, when more than one motor, check if the power wire is connected to the correct drive.	Alarm reset

Alarm Code	Description	Causes	Measures	Reset Method
r 11Lu	Low voltage	DC bus voltage is too low (220V series: below 90VDC) 1. Power supply voltage is low. Instantaneous power failure has occurred; 2. Lack of power capacity. Power supply voltage has fallen down due to inrush current at the main power-on; 3. Failure of servo drive (failure of the circuit).	Measure input voltage 1. Increase the power capacity. Change the power supply; 2. Check power input connections. Please refer to Chapter 4.3 3. If the problem is not resolved as described above, contact MOONS or replace the drive with a new one	Alarm reset
r 12ou	Over speed	Motor rotary velocity exceeds parameter P2-00(VM) setting value.	Check if the motor speed command is within a reasonable range 1. Avoid high velocity command; 2. Check the command pulse input frequency and division/multiplication ratio; 3. Make a gain adjustment when an overshoot has occurred due to a poor gain adjustment; 4. Connect the encoder cable correctly according to the wiring diagram. 5. Check if the motor wires U, V, W are in the correct order. U-red, V-yellow, W-blue;	Alarm reset
r 13Lt	Limit switch trigger alarm	1. CW or CCW limit switch is triggered; 2. In the absolute value system, the actual position of the motor is equal the soft limit.	1. External limit switch is triggered; 2. The limit input function is not set correctly, please refer to Chapter 7.1.5 CW and CCW Limit; 3. In the absolute value system, the software limit setting is unreasonable.	Auto-clear after detachment
r 14LL	Negative limit alarm	1. CCW limit is triggered; 2. In the absolute value system, the actual position of the motor is equal to the nagetive soft limit.		
r 15JL	Positive limit alarm	1. CW limit is triggered; 2. In the absolute value system, the actual position of the motor is equal to the positive soft limit		
r 16CL	Current limit	Driver's output current exceeds setting value P1-06(CC),and the duration exceeds the set value of P1-09 1. Acceleration is too large; 2. Load was heavy and actual torque has exceeded the rated torque and kept running for a long time; 3. Poor gain adjustment causes oscillation, vibration, and abnormal sound; 4. Mechanical movement is restricted, a collision occurs, or the load suddenly becomes heavier.	1. Make a gain re-adjustment; 2. Check if the selected motor model matches with the actual load, or if the acceleration/deceleration is too large; 3. Check motor wirings for U/V/W as red/yellow/blue; 4. Increase the power capacity of the driver and motor. Set up longer acceleration/deceleration time. Lower the load requirement.	Auto-clear when less than the rated current
r 17CE	Communication error	Detected communication error when the host controller communicate with the drive.	1. Luna software is trying to establish communication with the drive (this is a normal alarm); 2. Check wiring connection, and drive's communication address and baud rate setting.	Auto-clear when communication is normal
r 18≡F	Parameter save failed	Saving parameter failure.	1. Please try to save again; 2. If problems is not solved, please contact MOONS.	Auto-clear
r 19LP	Main power input phase lost	When the power is 3-phase, the drive detected one of the power inputs is lost	1. Check power input connections. Please refer to Chapter 4.3 P1 drive power connection; 2. Check the Power Lost Detect function is set correctly.	Auto-clear
r20to	STO is triggered	Safety torque off function is activated. Either or both safety input 1 or 2 is activated.	1. Check the safety input 1 and 2 wiring configuration; 2. Check Safety sensor setting.	Auto-clear after STO input is normal

Alarm Code	Description	Causes	Measures	Reset Method
r21rF	Regeneration failed	Regenerative energy has exceeded the capacity of regenerative resistor, 1. Due to the large load inertia, the regenerative energy during deceleration is generated, causing the bus voltage to rise and the regenerative resistor is insufficient to this energy; 2. Regenerative energy has not been absorbed in the specified time due to a high motor rotational speed.	1. Internal resistor value is smaller than required, cannot absorb the regeneration energy; 2. Check external regeneration resistor connections; 3. Reduce rotary velocity and decrease acceleration and deceleration value; 4. Refer to Chapter 4.7	Alarm reset
r22uv	Under-voltage warning	Drive voltage lower than 200VDC 1. Power supply voltage is low. Instantaneous power failure has occurred; 2. Lack of power capacity. Power supply voltage has fallen down due to inrush current at the main power-on; 3. Failure of servo driver (failure of the circuit); 4. Drive main power is not powered.	Check input voltage 1. Increase the power capacity. Change the power supply; 2. Please check power connections, please refer to Chapter 4.3; 3. Check drive L1/L2/L3 terminals and voltage input; 4. Replace a new drive if still problems.	Alarm reset Auto-clear when the voltage is normal
r23qE	No Q program warning	Drive in Q mode, but Q program is empty.	1. Check Q program; 2. Check operation mode correction; 3. Check Q program coding, make sure no faults to stop the program running.	Alarm reset
r24dd	Motion-command received while motor disable	Motion command is received while motor is disabled.	Please enable the motor, and send the command again.	Alarm reset
r25ur r26ur	Internal voltage error	The internal voltage is lower than the normal value.	Check the voltage of the power supply and replace the drive if still problems.	Re-power up
r27ES	Emergency stop	Digital input emergency stop function is triggered.	1. Check emergency stop input switch; 2. Confirm if the emergency stop input logic setting is reasonable.	Alarm reset
r28FP	Full-closed loop hybrid deviation excess error	Full closed loop control position deviation exceeds the set value.	1. Check if the CN4 external encoder input is correct. 1. Check whether the set value of parameterss P3-10 and P3-11	Alarm reset
r29FE	External encoder error	CN4-Second encoder input is not conntected correctly.	Check if the CN4 external encoder input is correct.	Alarm reset
r30nE	Memory error	Drive internal memory unit is in exceptional situation.	Repower on, if still problems, contact MOONS.	Re-power up
r31bt	Absolute encoder battery under-voltage	The battery voltage of the absolute encoder is lower than the specified value of 3.2V.	Replace the battery. To prevent loss of absolute position, replace the battery while the drive is powered on.	Alarm reset
r32AP	Absolute position lost	The absolute encoder loses its multi-turn absolute positions due to low battery voltage or power interruption. 1. The encoder is configured as absolute type, but no battery is installed; 2. The absolute encoder is used for the first time without any configuration. 3. The battery voltage is too low and the it's not replaced in time. 4. Replacing the battery when the drive is not power-on. 5. The battery circuit is in poor contact or disconnected. 6. The current position exceeds -2147483647 ~ +2147483648	1. Check whether the battery voltage is lower than 2.8V, replace the battery in time; 2. Replace the battery when the drive is power-on; 3. Check and repair the wiring so that the battery can power the encoder normally. 1) Check the encoder wiring; 2) Check the wiring between the inside of the battery box, the outside and the driver.	After replacing the battery, it is necessary to perform the multi-turn zero clearing operation of the absolute encoder.
r33oP	Absolute position overflow	Absolute encoder multi-turn number exceeds the maximum range: -32768 ~ +32767	1. Check whether motor actual position exceeds the maximum range; 2. Out of range, please perform absolute encoder multi-turn clear; 3. For unidirectional operation, set parameter P3-15 to 2 (multi-turn encoder does not count overflow)	Perform the multi-turn zero clearing operation of the absolute encoder.

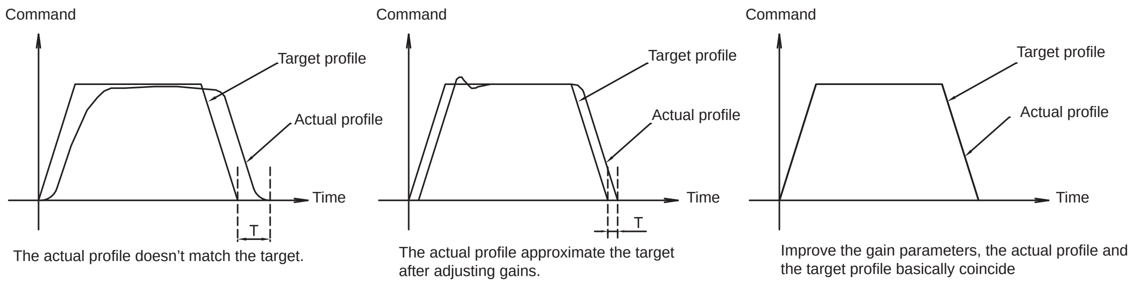
Alarm Code	Description	Causes	Measures	Reset Method
r34nt	Motor over temperature	The drive detects that the motor temperature exceeds the allowable value	1. Check if the ambient temperature where the motor is installed is too high; 2. Reduce the ambient temperature of the motor and improve the cooling conditions; 3. Increase the capacity of the driver and motor, prolong the acceleration and deceleration time, and reduce the load; 4. Whether the motor is rubbed by the load; 5. When using a motor with an oil seal, please derate it. The output torque of the motor should be 70% of the rated torque of the motor; 6. The temperature rise and the motor torque are measured when the motor is mounted on a standard heat sink. When the motor mounting plate is small, in order to prevent the motor from overheating, please use it with derating; 7. The temperature of the motor is normal and cannot be cleared by powering on again, please replace the motor	Re-power up
r35Ct	Drive MCU over temperature	Drive processor temperature is too high	1. Check if the ambient temperature of the drive installation is too high 2. Reduce the ambient temperature of the drive and improve the cooling conditions 3. The drive needs to be installed on a metal backplane with good heat dissipation 4. Increase the capacity of the driver and motor, prolong the acceleration and deceleration time, and reduce the load. 5. Replace the fan or send the servo drive for repair 6. The temperature of the drive heatsink is normal and the alarm still exists after powering on again, please replace the drive	Alarm reset
r36nr	Absolute encoder multi-turn error	The absolute encoder loses its multi-turn absolute positions 1. The encoder is configured as absolute type, but no battery is installed; 2. The absolute encoder is used for the first time without any configuration.	Need to perform absolute encoder multi-turn clear operation.	Perform the multi-turn zero clearing operation of the absolute encoder.
r37≡t	Motor stalled	Working in non-torque mode, the duration time that motor has beed stalled exceeds the value set by P1-28.	1. Check whether the mechanical part driven by the motor is stuck 2. Check if the electromagnetic brake is open	Alarm reset
r38CE	EtherCAT communication error	EtherCAT communication error 1. EtherCAT communication parameter configuration error 2. EtherCAT communication interruption	1. Check the configuration parameters of EtherCAT communication 2. Check whether the communication line is connected well.	Auto-clear when communication is normal
r39Hr	Homing parameters configuration error	Check if the Homing Parameter is configurated entirely. 1. Use the homing method with limit signal, the limit switch is not configured 2. Using the homing method with home switch, the home switch is not configured	Check if the Homing Parameter is configurated entirely.	Alarm reset
r40Hi	Motor Collision Alarm	1. The instantaneous change of current exceeded the value of P1-34. 2. The motor-driven load collides with other fixed loads; 3. The servo gain setting is unreasonable and the stiffness gain is too large; 3. The motor is losing control caused by wrong UUW phase sequence.	1. Check the motor UVW phase sequence 2. Check whether the servo gain parameters are reasonable 3. Check the load condition	Alarm reset

Alarm Code	Description	Causes	Measures	Reset Method
r41Er	Encoder Communication error	The servo drive detected abnormality in the communication with the encoder. 1. Encoder cable is not wired according to the correct definition 2. Encoder cable is not connected well. 3. Interference causes abnormal encoder communications 4. The encoder is damaged.	1. Check whether the encoder wiring is in accordance with 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. Use twisted pair shielded wire with good anti-interference ability for encoder wire 5. Swap the motor and encoder wiring harness respectively to confirm whether the motor is abnormal	Re-power up
r42io	Wrong configuration of I/O function in Q mode	1. The function of I/O signal in Q program is not General Purpose. 2. The function of I/O signal in SCL command is not General Purpose.	Configurate the function of I/O as General Purpose.	Alarm reset

10 Servo Gain Tuning

Servo Gain Tuning is used to optimize the response of the servo system.

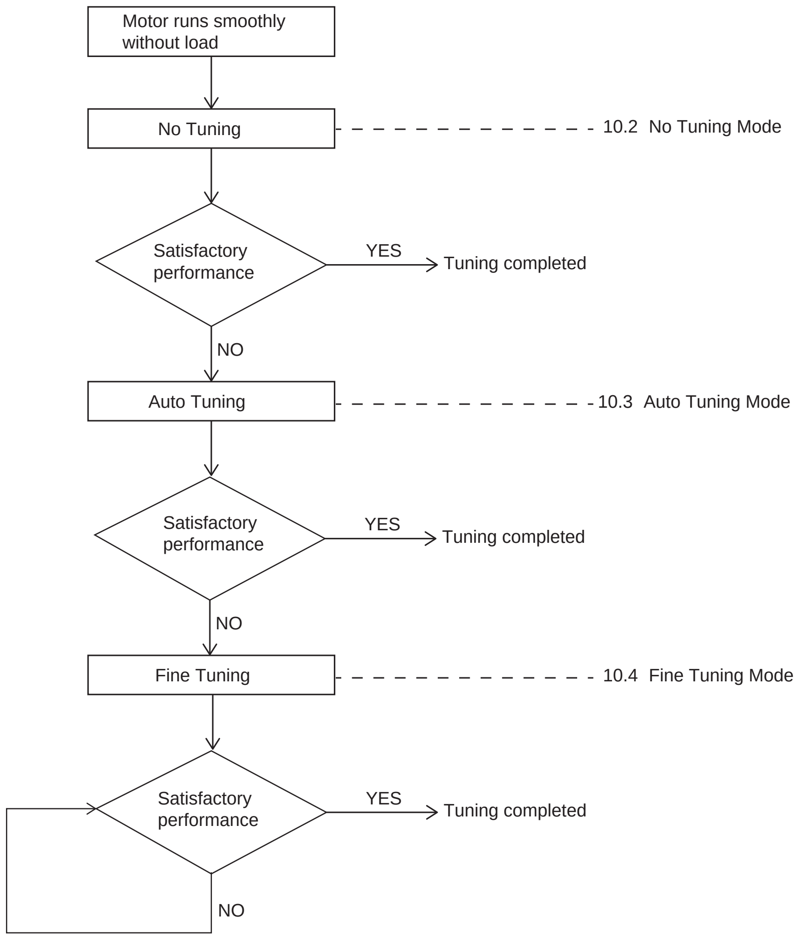
It is required for the servo drive to control the motor in least time delay and as accurately as possible to follow the command of controller. In order to make the motor action closer to the command and maximize the mechanical performance, it is necessary to adjust the gain.



10.1 Instructions for Gain Tuning Mode and Procedures

10.1.1 Servo Tuning Procedures

The servo tuning flowchart is as follows. Make sure that the servo system can run normally before starting the servo tuning. Reter to Chapter 6 for trial operation.



10.1.2 What is the Gain Tuning Mode

The servo drive provides three gain tuning modes for gain parameters tuning, which are set by parameter P0-00.。

Setup Value	Tuning Mode	Valid parameters	Instructions
0	No tuning	P0-03 1st mechanical Stiffness Level P0-04 2nd mechanical Stiffness Level	The mechanical stiffness level are only set by P0-03 or P0-04. Modification other gain parameters is invalid.
1	Auto Tuning	P0-03 1st mechanical Stiffness Level P0-04 2nd mechanical Stiffness Level P0-02 Load Inertia Ratio	The mechanical stiffness level is only set by P0-03. Modification other gain parameters is invalid.
2	Fine 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 the "Fine Tuning" mode, you can manually set all gain parameters of each control loop of the servo control to get well stiffness, quick response and performance."

10.2 Auto Tuning Mode

In the "Auto Tuning" mode, the servo system can automatically indentify the external load inertia ratio, select an appropriate mechanical stiffness level and optimize the following gains:

- Gains(Position loop and Velocity loop)
- Filters（Torque filter of current loop)

The parameters in the table below will be changed automatically when the auto-tuning in progress and be stored after the tuning is completed.

Parameter	Description	Valid to manually modify parameters 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	NO
P0-11	1st Velocity Command Gain	NO
P0-12	1st Velocity Loop Gain	NO
P0-13	1st Velocity Loop Integral Time Constant	NO
P0-14	Acceleration Feedforward Gain	NO
P0-15	Acceleration Feedforward Filter	NO
P0-16	1st Torque Command Filter	NO

10.2.1 Required Motion Profile in Auto Tuning Mode

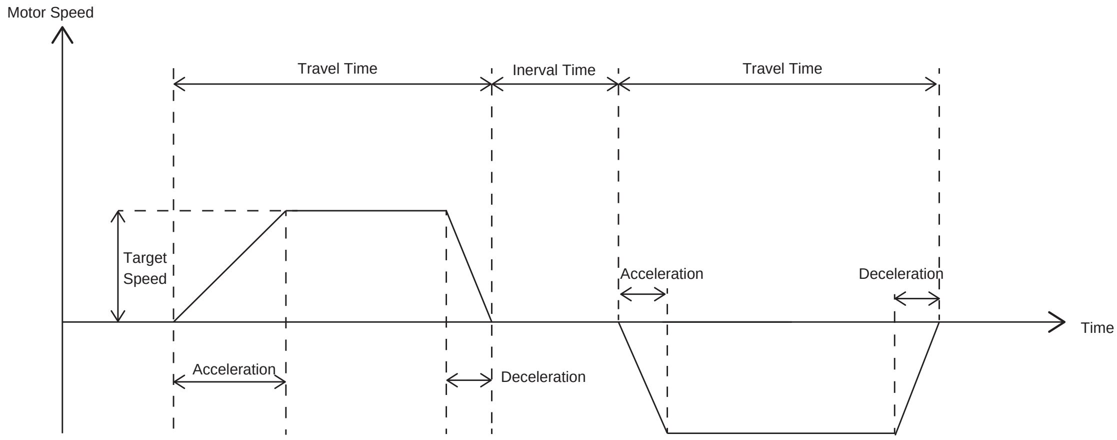
In order to accurately complete the auto tuning, it's necessary to set reasonable motion trajectory including moving distance, travel speed, travel time, acceleration and deceleration and Interval time between two movements.

Travel Time: > 0.5 seconds

Travel Speed: > 180 rpm

Acc./Dec.: > 30rps/s

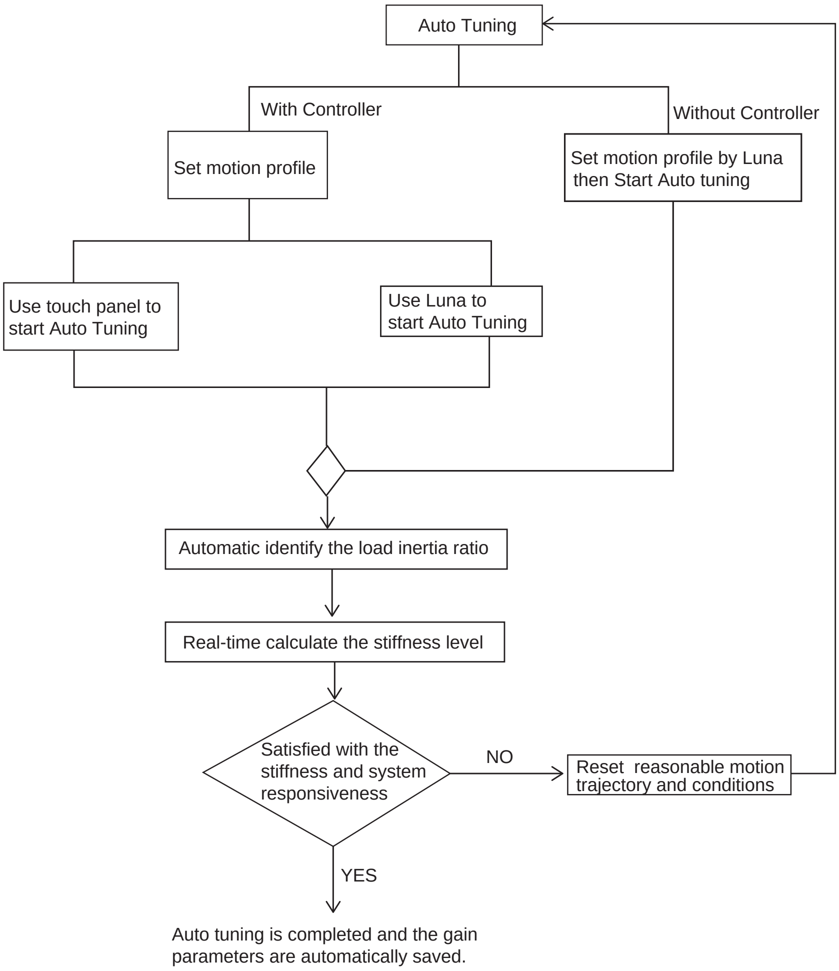
Interval Time: > 1.5 seconds



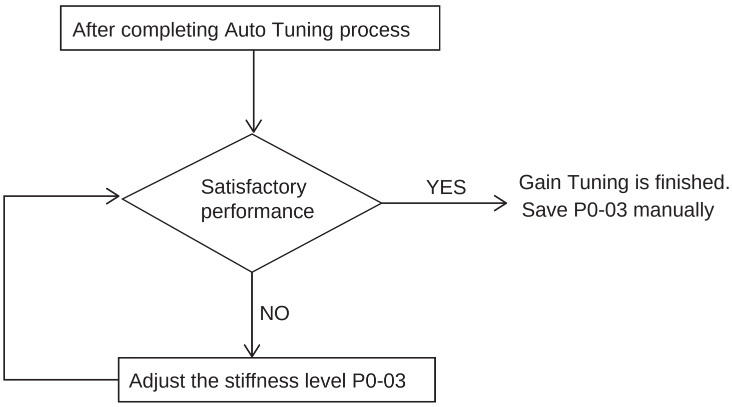
Before staring auto tuning, it is recommended to set P0-03(mechanical stiffness level) to "5".

10.2.2 Auto Tuning Flowchart

You can perform the Auto Tuning through Luna software or operation panel of the drive.



After completing the auto tuning, you can continue to modify the paramters P0-03 and P0-04 to optimize the response and stiffness of the servo system.



10.2.3 Start Auto Tuning-- By Operation Panel

Use the operation panel to start Auto Tuning:

（1) Long press "MODE" key to switch to "Function Select Mode", which will display "F00FL".

（2) Short press "UP" or "DOWN" key to select "F10AT"

（3) Long press "SET" key to start auto tuning, the LED will display "At-in".

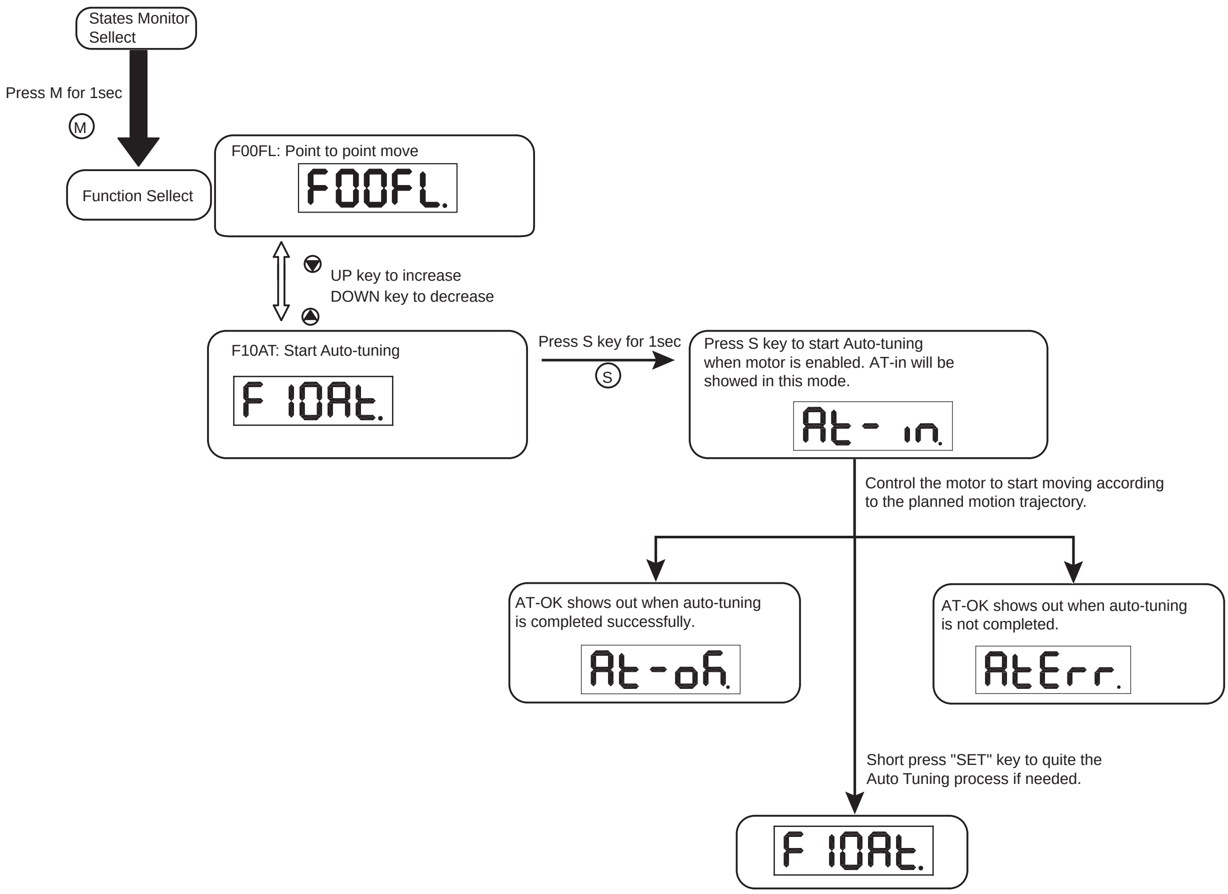
（4) Control the motor to start moving according to the planned motion trajectory.

（5) If error occurs when the auto-tuning in progress, alarm code "AtErr" will be displayed and the tuning process will be stopped and quited. Short press "SET" to exit the error.

（6) After Auto Tuning is finished, "At-ok" is displayed.

（7) Short press "SET" key to quite the Auto Tuning process.

Note:
Before starting Auto Tuning, the servo drive must be enabled, otherwise alarm code "AtErr" will be displayed.

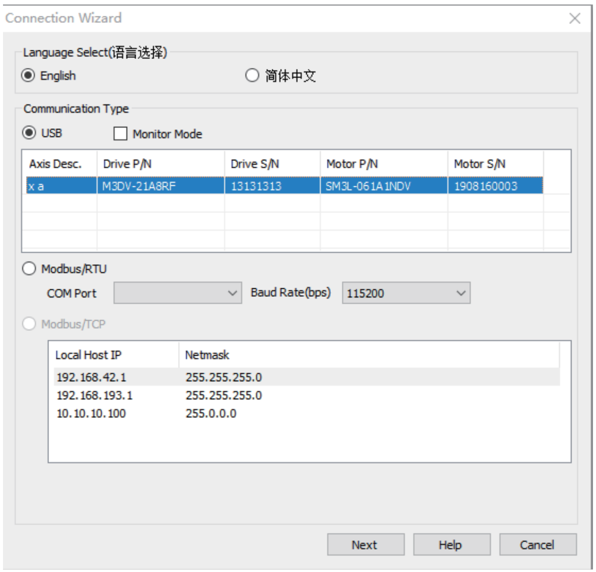


10.2.4 Start Auto Tuning-- By Luna software

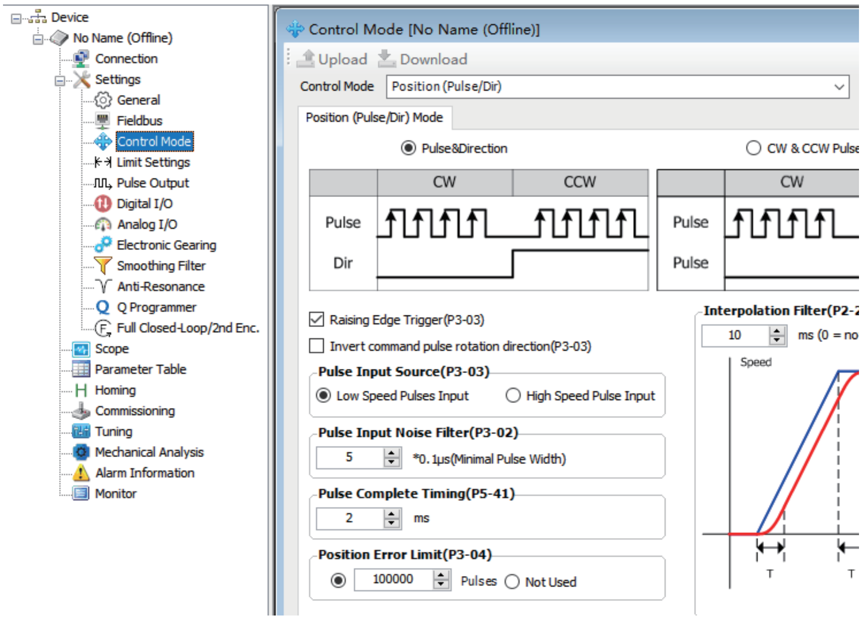
It's recommended to use Luna software to start Auto tuning. The operation steps are as follows.

Step 1: Connection Wizard

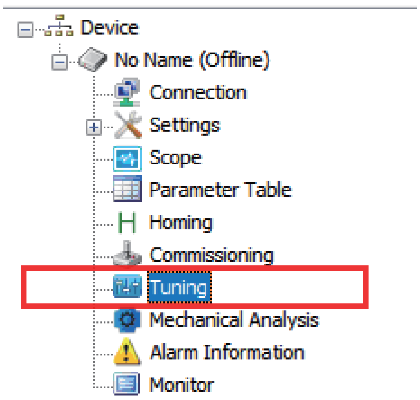
Select the drive that needs to be connented----Click "Next" button to establish communication with the drive.



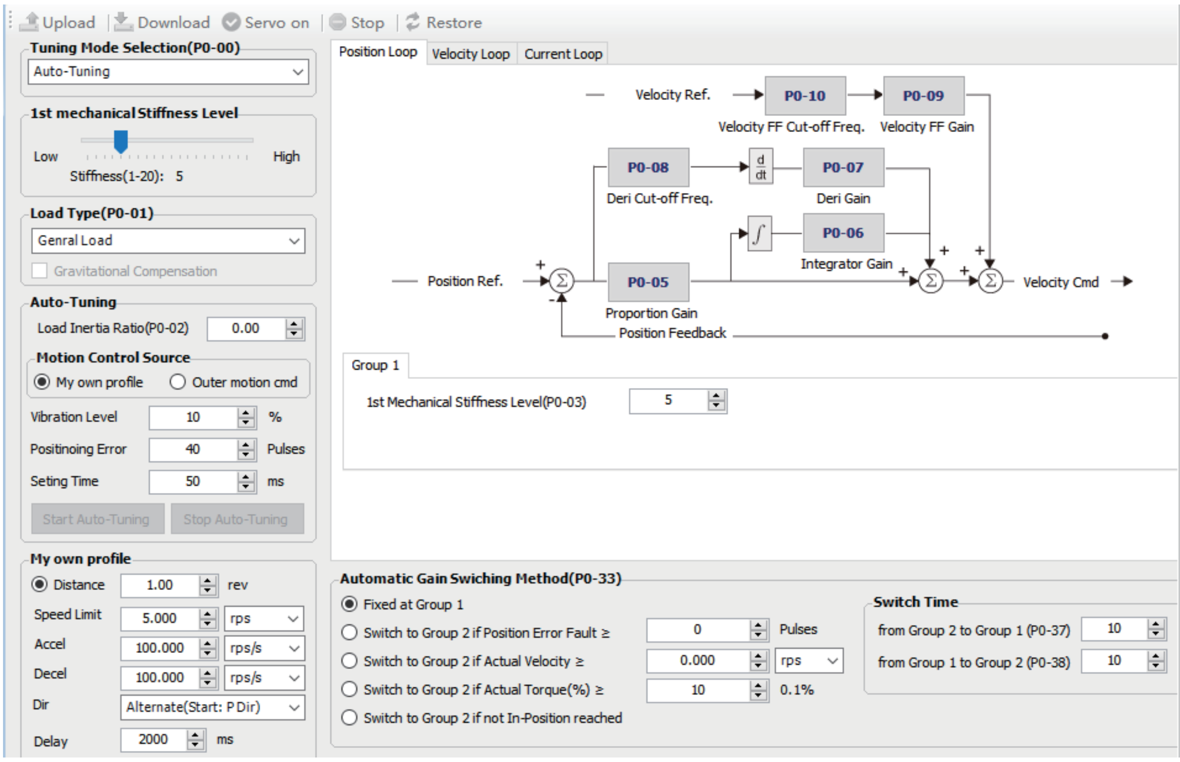
Step 2: Set the Conrol mode to Position Control



Step 3: Select "Tuning" funtion



Step 4: Select the tuning mode to "Auto Tuning"



1) 1st Mechanical Stiffness Level:
Set the appropriate stiffness level. It's recommended to set to "5" when running for the first time.

2) Lode Type
Select the load type accoeding to the current mechanical structure.

Load Type	Description
General Type	Horizontally placed ball-screw, Turntable, etc..
Stiffness Type	Ball-screw load mounted horizontally on a marble base. Horizontally placed turntable, etc.
Flexible Type	Belt load, etc..

3) Load Inertia Ratio

If already know the current load inertai ratio, input it into "Load Inertai Ratio(P0-02)", which can improve the servo system stiffness and speed up the auto tuning process. It doesn't need to be set if don't know the inertia ratio, the system will indentify the load inertia ratio automatically.

4) Motion Control Source

自定义轨迹规划: 使用软件的“自定义轨迹规划”生成轨迹

外部运动指令: 当使用上位机发送运动轨迹时选择此项

5) Judgment Conditions for 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

1) 使用外部运动指令

点击“开始自动整定”按钮，使用上位机直接发送运动指令。

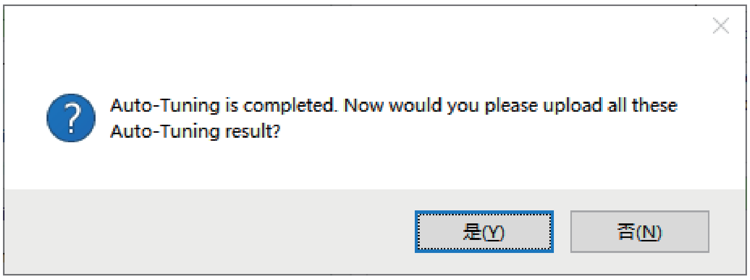
2) 自定义轨迹规划

用户也可以使用自定义轨迹规划。

按上述运动条件设定合理的运动轨迹，点击“开始自动整定”按钮。

3) **The Auto Tuning is completed.**

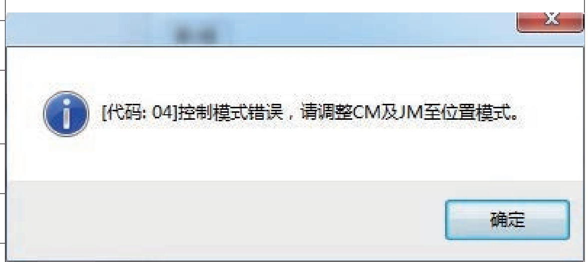
Since the Auto Tuning is completed successfully, the gain parameters will also be saved in the drive automatically, and the following message box will be showed to notice that whether upload parameters from the drive to the software or not. After comfirming the upload, you can see that the first mechanical stiffness level and load inertia ratio have been updated.



4) **Error Message**

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"



10.3 Fine Tuning Mode

Fine Tuning mode is suiteable for the following situations:

1) Errors alway occur in the auto tuning and cannot finish the tuning.

2) After auto tuning, even if optimize the stiffness level(P0-03) and the load inertia ratio(P0-02), the servo system response still cannot meet the requirements.

Using the Fine Tuning can optimize the system gains to meet the requirements of high servo stiffness, quick response time and minimum setting time.

10.3.1 Introducton of Fine Tuning Mode

Servo system gains are set by several parameters, such as: Load Inertia Ratio, Stiffness Level, Position Loop Gain, Position Loop Derivative Time Constant, Derivative Filter, Velocity Feedforward Gain, Velocity Feedforward Filter, Velocity Command Gain, Velocity Loop Gain, Velocity Loop Integral Time constant, Acceleration Feedforward Gain, Acceleration Filter and Torque Command Filter.

The PID tuning optimizes all the parameters above to meet the performance requirements of the motion system. In generally, for machines with high stiffness mechanical, the servo system response can be improved by increasing the servo gain parameters. However, for the machine with low stiffness mechanical, such as Bell Load, when increase the servo gain parameters, vibration may occur and servo system response cannot be improved.

After fine tuning, gain parameters need to be saved manually.

10.3.2 Parameters in Fine Tuning Mode

Parameter	Command	Description	Type
P0-01	LY	Load Type	
P0-02	NR	Load Inertia Ratio	
P0-03	KG	1st mechanical Stiffness Level	Gain Group 1
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	
P0-11	KF	1st Velocity Command Gain	Gain Group 1
P0-12	VP	1st Velocity Loop Gain	
P0-13	VI	1st Velocity Loop Integral Time Constant	
P0-14	KK	Acceleration Feedforward Gain	
P0-15	KT	Acceleration Feedforward Filter	
P0-16	KC	1st Torque Command Filter	Gain Group 1
P0-17	UP	2nd Position Loop Gain	Gain Group 2 when using Gain Switch function
P0-19	UD	2nd Position Loop Derivative Time Constant	
P0-20	UE	2nd Position Loop Derivative Filter	
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 Torque Command Filter	
P0-25	XP	Full Closed-loop Position Loop Gain	When using Gain Switch, the first gain group in full closed-loop control
P0-27	XD	Full Closed-loop Position Loop Derivative Time Constant	
P0-28	XE	Full Closed-loop Position Loop Derivative Filter	
P0-29	XF	Full Closed-loop Velocity Command Gain	
P0-30	XV	Full Closed-loop Velocity Loop Gain	
P0-31	XG	Full Closed-loop Velocity Loop Integral Time Constant	
P0-32	XC	Full Closed-loop Torque Command Filter	
P0-39	LR	Velocity Feadback Filter	

Note:
1) When using gain switch function, the gain group 1 and group 2 are used.
2) Parameters P0-25 to P0-32 are the first gain group in full closed-loop control mode.

10.3.3 Description for Gain Parameters

The servo system consists of current loop, velocity loop and position loop. The more the inner control loop, the more it needs to improve its responsiveness. Failure to observe this principle can result in poor response or vibration.

If need to improve the response

1) Increase Mechanical Stiffness Level
2) Increase Position Loop Gain
3) Increase Velocity Loop Gain
4) Decease the Velocity Loop Integral Time Constant.

If overshot and vibration occur

1) Decease mechanical stiffness level
2) Decease Position Loop Gain
3) Decease Velocity Loop Gain
4) Incease the Velocity Loop Integral Time Constant
5) Decease the Torque Command Filter
6) Appropriately adjust the Derivative Time Constant

If one parameter is changed, other parameters also need to be modified. Do not make huge changes to just one parameter, 5% changes each time is recommended.

10.3.3.1 Gain Parameters for Position Loop:

◆ **Position Loop Gain**

Parameter	Comand	Description	Default	Range	Unit	Control mode			
P0-05	KP	1st Position Loop Gain	52	0 ~ 20000	0.1Hz	P	V	T	

The stiffness gain of the Position Loop in the PID control algorithm. It determines the response of position loop. Increase this value can improve the system's stiffness and get higher response frequency of position loop, and reduce the system position error. If set the value too high, it may cause vibration and overshot.

Too small of this gain may cause the response of the system not fast enough, and decreasing trend of position following error will be slow.

Set to 0 means not used, value 20000 means the proportional effect is maximized.

The position loop gain must be smaller than the velocity loop gain.

◆ **Position Loop Derivative Time Constant**

Parameter	Comand	Description	Default	Range	Unit	Control mode			
P0-07	KD	1st Position Loop Derivative Time Constant	0	0 ~ 30000	ms	P	V	T	

The derivative time constant of Position Loop in the PID control algorithm.

Setting to zero means that derivative function is not used. The smaller the set value, the stronger the effect of derivative term.

Running a motor with a pure PI controller the motor would overreact to small errors, creating ever large errors, ultimately becoming unstable. If know what the motor is going to do before it do it, you could prevent this.

A motor drive can control a motor better if it examines the rate of change of the position error and includes that in its torque calculation. For example, if the motor has error, but the error is decreasing, back off on the torque.

When the system's ability to suppress vibration is insufficient, there will be obvious vibrations during the acceleration/deceleration, cruising and stopped. This vibrations has a decreasing trend and eventually stabilizes. If the system vibrates, the differential time constant can be adjusted appropriately, and the recommended starting value is 2000.

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

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

10.3.4 Gain Parameters for Velocity Loop

◆ **Velocity Loop Gain**

Parameter	Comand	Description	Default	Range	Unit	Control mode			
P0-12	VP	1st Velocity Loop Gain	183	0 ~ 30000	0.1Hz	P	V	T	

The stiffness gain of the Velocity Loop in the PID control algorithm.

The simplest part of the Velocity Loop is the proportional gain, or VP, term. The drive applies current to the motor in direct proportion to the error. For example, if a motor is not moving, and the shaft is turned by hand or some other force, the drive will increase the motor current until the motor returns to "0" speed. The faster the motor is moved from "0" speed, the more the opposing torque will increase. The VP term (also called VP gain) governs how much torque will be applied for a given amount of velocity error (Vn). In general, more load inertia or load friction, requires more torque and therefore a higher VP gain.

In generally, applications or machines that require high speed and high precision, higher frequency response bandwidth is required. To improve the overall response of the servo system and to reduce position following error, it is necessary to increase the speed loop gain value. Setting the value too high will cause vibration. The response frequency of the speed loop must be 4–6 times higher than the response frequency of the position loop; otherwise, the machinery might vibrate or it might cause overshoot when positioning

When P0-02 (auto estimation or manually set value) is equal to the real inertia ratio (JL/ JM), the real speed loop frequency response is the value set by P0-12.

◆ **Velocity Loop Integral Time Constant**

Parameter	Comand	Description	Default	Range	Unit	Control mode			
P0-13	VI	1st Velocity Loop Integral Time Constant	189	0 ~ 30000	ms	P	V	T	

Set the Integral Time Constant of the Velocity Loop. The Integral gain will not take effect when the value is set to zero.

If only proportional gain is working without integral gain, the error is hard to decrease to zero quickly, or it may take long time to get zero. The integral time constant accumulates all errors and takes effect together with the proportional gain. A smaller integral time constant (VI) setting can improve the response and responsiveness of the servo system and reduce the following error.

The smaller the set value, the stronger the integral gain. If the set value of the integral time constant (VI) is too small, the excessive rigidity of the system will cause vibration and noise of the entire servo system. This vibration and noise occurs during the entire movement process, and it is always in an oscillating state, which cannot be stabilized.

10.4 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.

M56S series provide 4 methods to suppress mechanical resonance.

1) Torque Command Filter
2) Notch Filters
3) End Effector Suppress
4) Lod Disturbance Suppress

10.4.1 Torque Command Filter

Parameter	Comand	Description	Default	Range	Unit	Control mode			
P0-16	KC	1st Torque Command Filter	1099	0 ~ 40000	0.1Hz	P	V	T	

对指令转矩进行滤波。数值越小，代表滤波频率越低，滤波效果越明显。

默认值1099可应用于大部分场合。转矩滤波频率(P0-16)必须是速度环增益(P0-12)的3倍以上.

该滤波器是一个单输出的低通滤波器，用来对PID控制器的输出(也就是参考电流)进行低通滤波。设定该值时需要考虑系统运行所需要的截止频率。

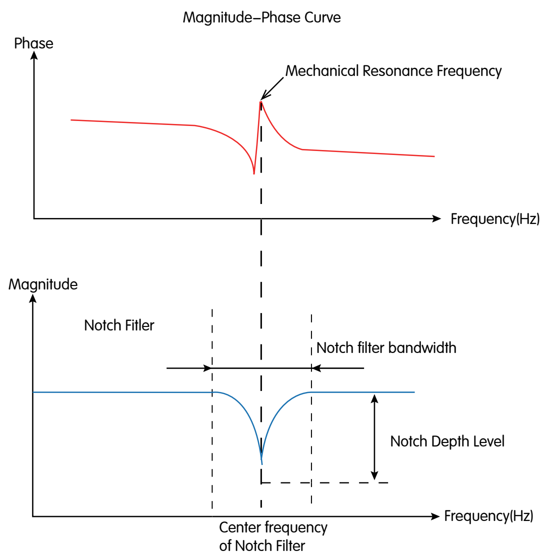
在一些特定场合使用，比如电机出现振动或是明显可听见的噪声。可以尝试减小此值，该滤波器对控制环路的输出进行低通滤波。

当一个系统容易出现机构共振，该低通滤波器截止频率可设置到共振频率点以下，这样控制环路的输出就不会激励共振。

10.4.2 Notch Filter

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 high-frequency 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 M56S 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).

10.4.2.1 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

1).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.

2).When the servo system is running, it will automatically detect resonance frequency and take effect to suppress.

3).If there is a new resonance, enable the "Notch Filter 4" with same operation.

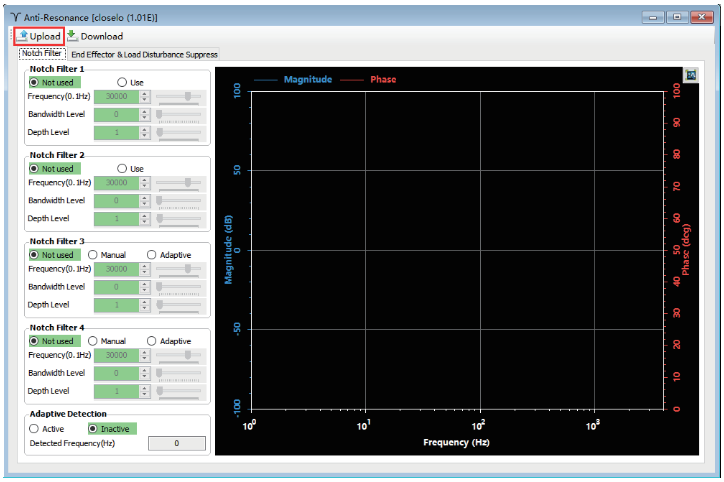
4).When the system is running, the third and fourth goups of notch filte parameters are automatically updated, but will not be displayed in the software interface.

5) 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.

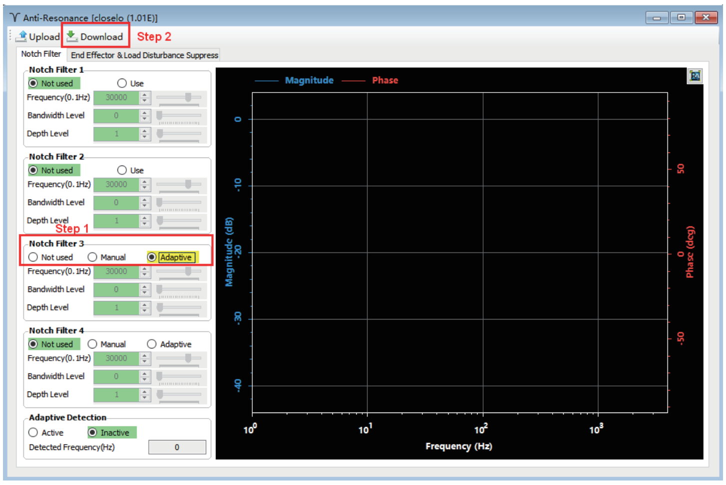
This setting can prevent abnormal movement of the servo system during operation, resulting in the notch filter parameters being updated to wrong values, which may increases vibration.

◆ Software settings for Adaptive Notch Filter

Step 1: Open the "Anti-resonance" window, and than click "Upload" button.



Step 2: Change the usage mode of "Notch Filter 3" to "Adaptive", and then click the "Download" button.



Step 3: When the servo system is running, it will automatically detect resonance frequency and take effect to suppress.

10.4.3 Mechanical Analysis and Manual Setting of Notch Filtes

Analyze Resonance Frequency

To manually set the notch filter, it is necessary to detect the actual frequency when resonance occurs. You can use the "Mechanical Analysis" function in the Luna software.

Test Type for Mechanical Analysis

Test Type:	Applicable load	Principle	Note
Mechnical Open-loop	Horizontal Load	Analyze the resonance of a servo system in torque mode. Because it does not include the loop of the servo controller, it can be used to analyze the real resonance frequency of the whole system, and even detect vibration caused by unreasonable parameter settings.	For mechanical open-loop analysis, the drive needs to be disabled, so it cannot be used for vertical loads
Velocity Closed-loop	Horizontal Vertical Load	Analyze the resonance of a mechanical system in Command Velocity Mode. At this point the servo control loop is engaged. When using, it is necessary to ensure that the control parameters of the servo are set reasonably.	◆ The control mode of the drive needs to be in the Command Velocity Mode, that is, the set value of P1-00 is 10. ◆ The drive needs to be enabled when starting the Velocity Closed-loop Analysis. ◆ For vertical loads, ensure that there are mechanical protection measures against falling.

10.4.3.1 How to Analyze Resonance Frequency using Mechanical Open-loop

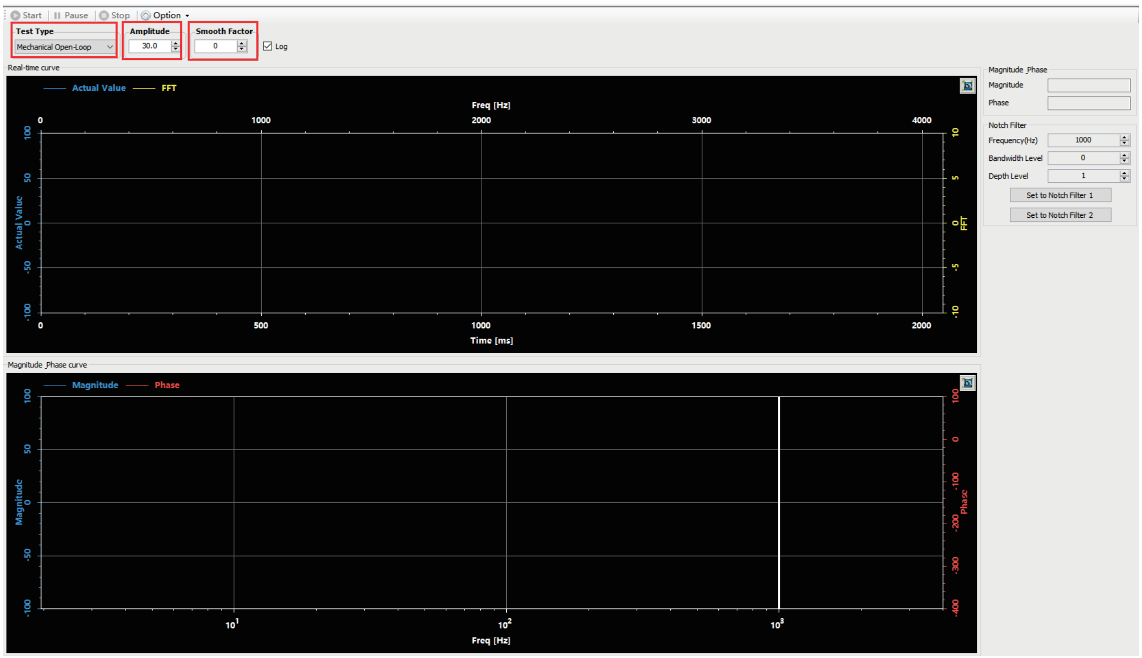
Step 1

Before starting the Mechanical Open-loop analysis, ensure that:

- Servo system works well.
- The gain parameters tuninng is completed.
- Make sure the drive is disabled.

Step 2

Set an appropriate amplitude to start, be aware that an excessively large value may cause mechanical movement.



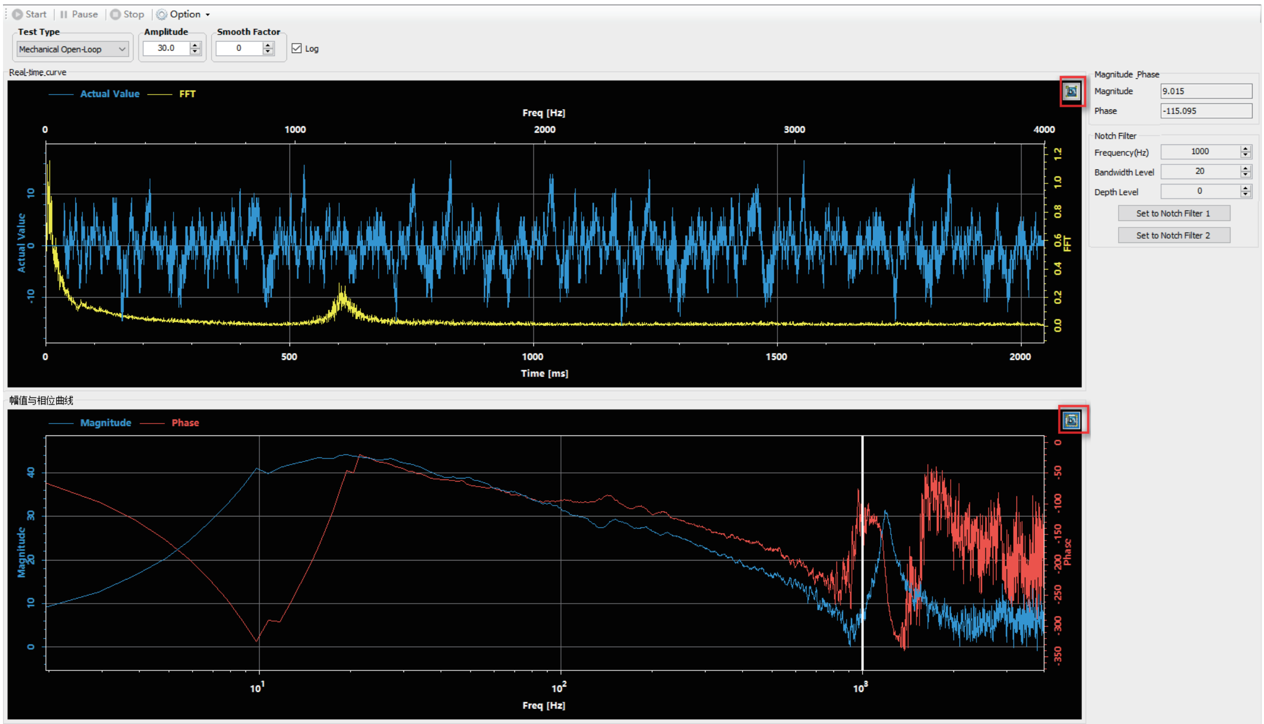
Smooth Factor:

The curve will be displayed smoothly, which is helpful for analyzing the frequency points of resonance. The larger the value, the smooth the curve.

Step 3

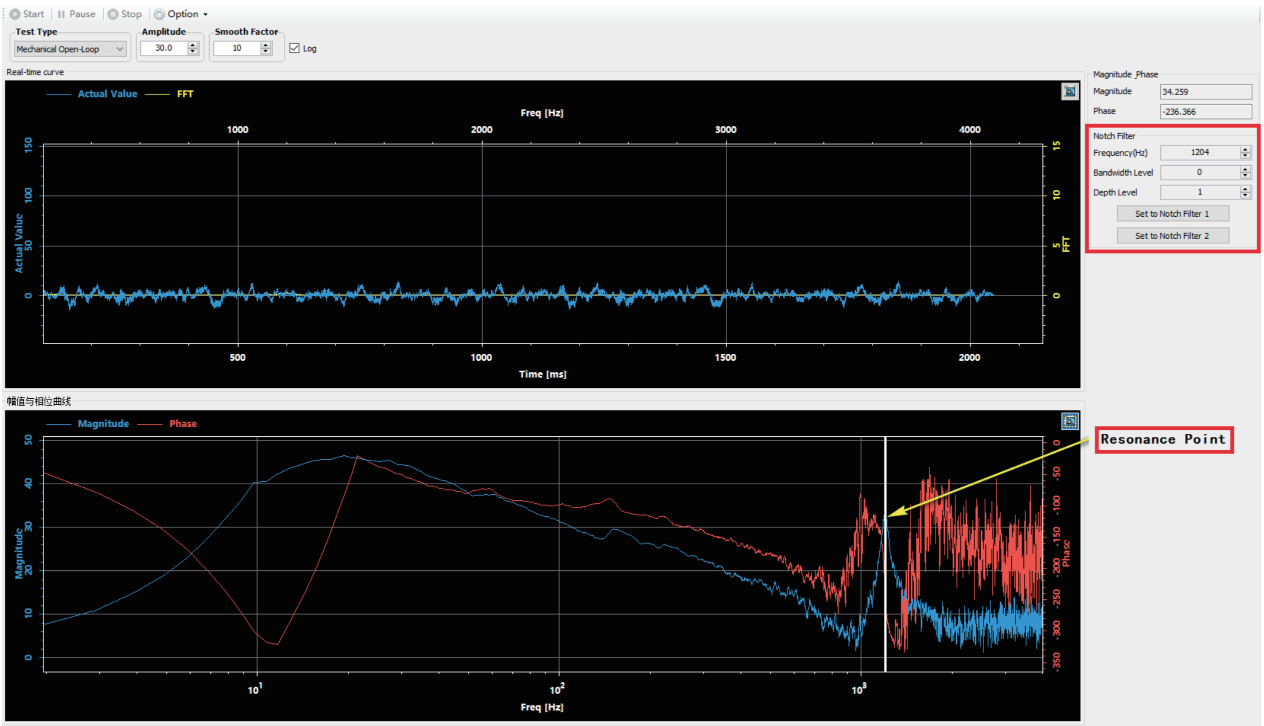
Click the "Start" button, the servo system starts the Mechanical Open-loop analysis and displays the result curve.

Click the icon in the upper right corner of the drawing area to optimize the displayed curve.



Step 4

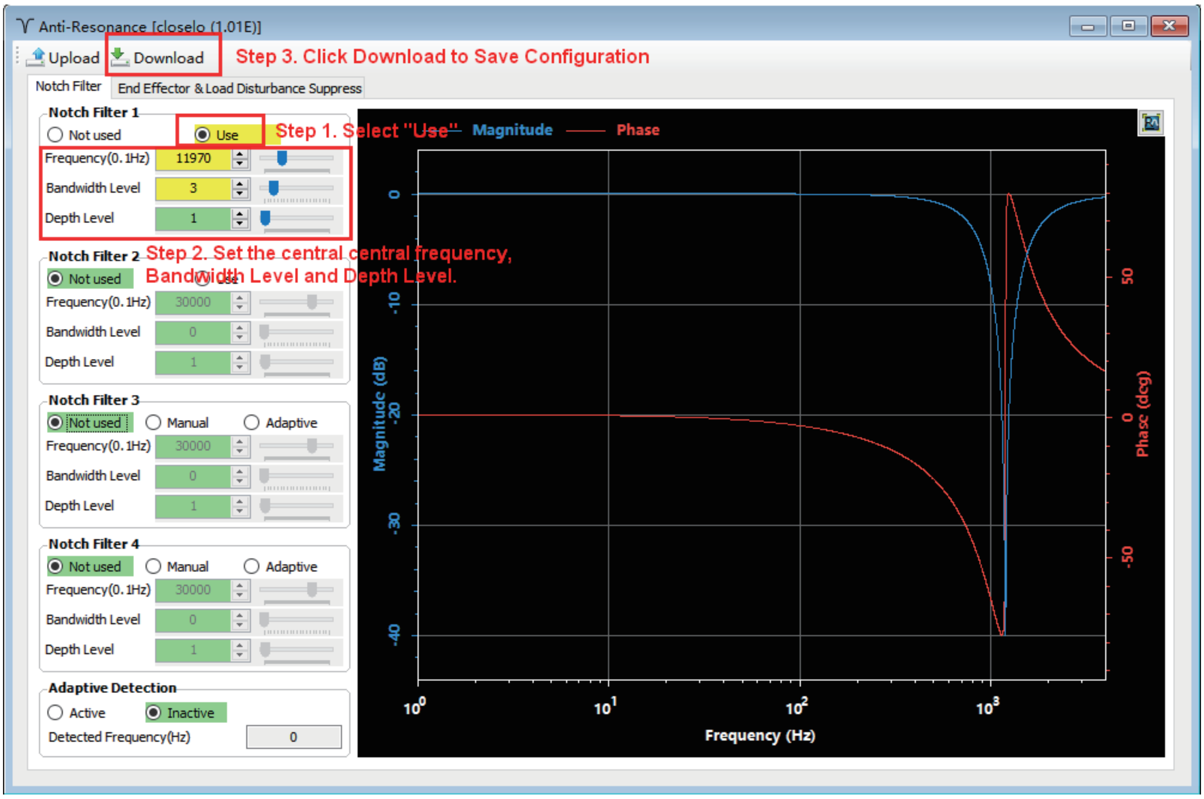
Move the reference line in the "Magnitude_Phase Curve" to the place where the Magnitude curve (Blue curve in the figure below) has abnormal protrusion.



The Notch Filter in red area will display the resonance frequency of the current reference line(The picture above is around 1200Hz). Click "Set to Notch Filter 1" or "Set to Notch Filter 2" button will set this frequency as the resonance suppression frequency.

Step 5

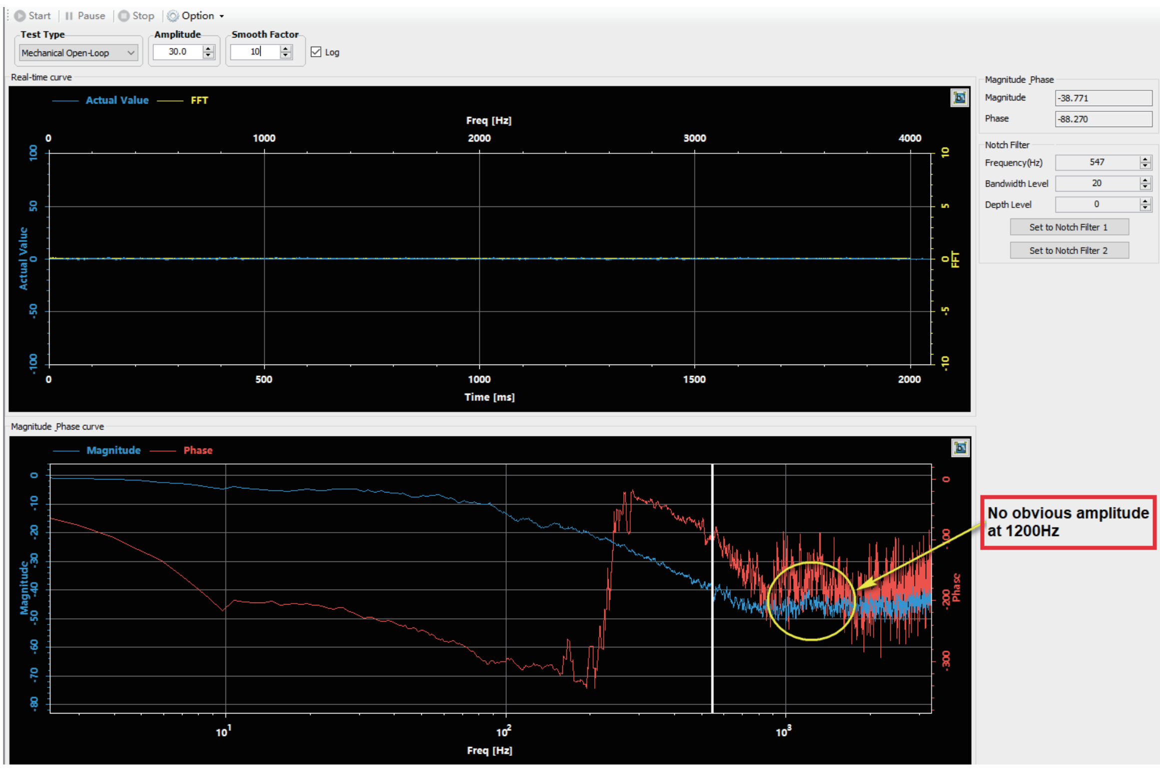
Open the "Anti-Resonance" window, select "Use" and set approprate Bandwidth Level and Depth Level, and than click "Download" button to enable the notch filter.



Note:

1) The mechanical open-loop analysis not include the servo control loop, even if the Notch Filter is set, the resonance frequency still can be detected when the open-loop analysis is performed again. You can use the Velocity Closed-loop Analysis to check the suppression result after the Notch Filter is set.

2) The center point frequency of the Notch Filter must be greater than 2 times of the Torque



10.4.3.2 How to Analyze Resonance Frequency using Velocity Closed-loop

Step 1

Before performing the Velocity Closed-loop Analysis, make sure that:

- Servo system works well.
- The gain parameters tuninng is completed.
- The Control Mode is set to Command Velocity Mode
- Make sure the drive is enabled.
- It's recommended to use a motor with brake for vertical load to avoid accidental load drop.

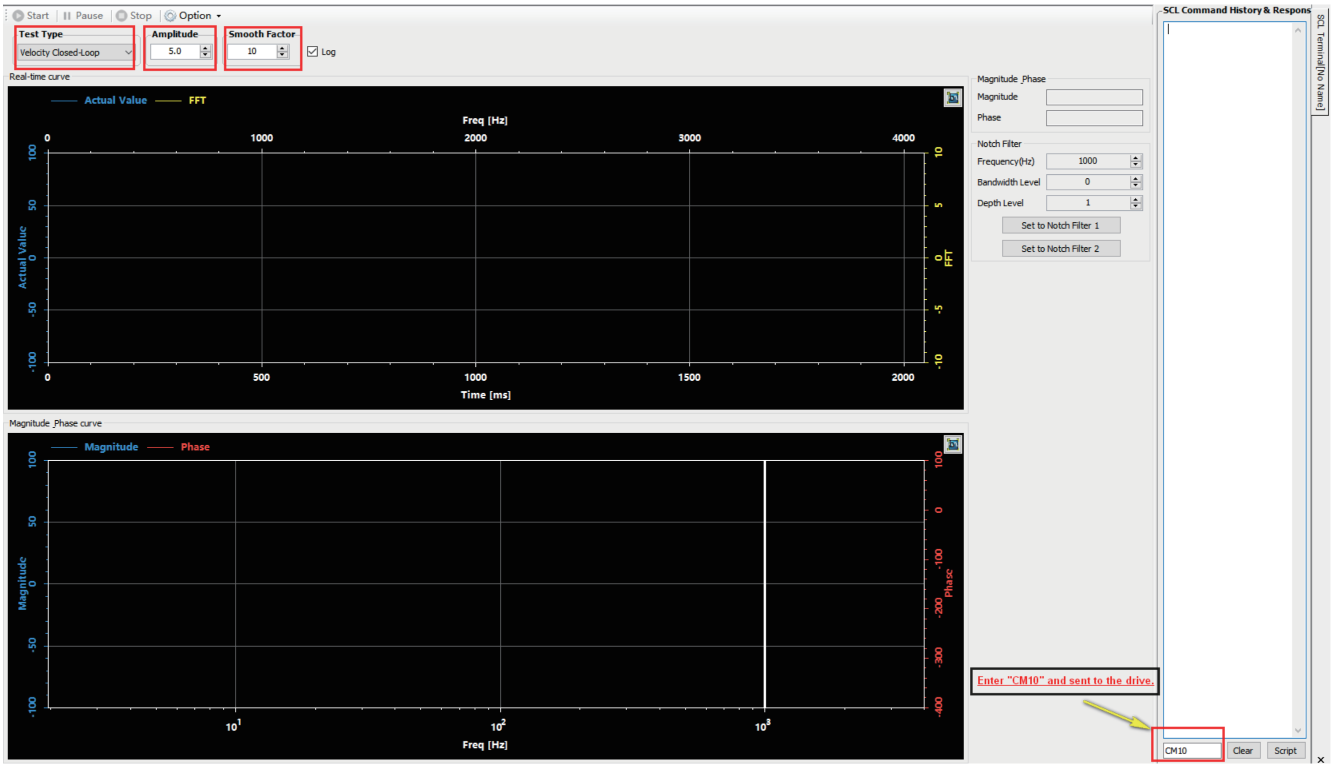
Step 2

1) Set an appropriate amplitude to start, be aware that an excessively large value may cause mechanical movement.

2) Open "SCL Terminal" from the "Tools" menu.

3) Enter "CM10" in the SCL terminal to set the control mode to Command Velocity Mode.

4) Enable the drive



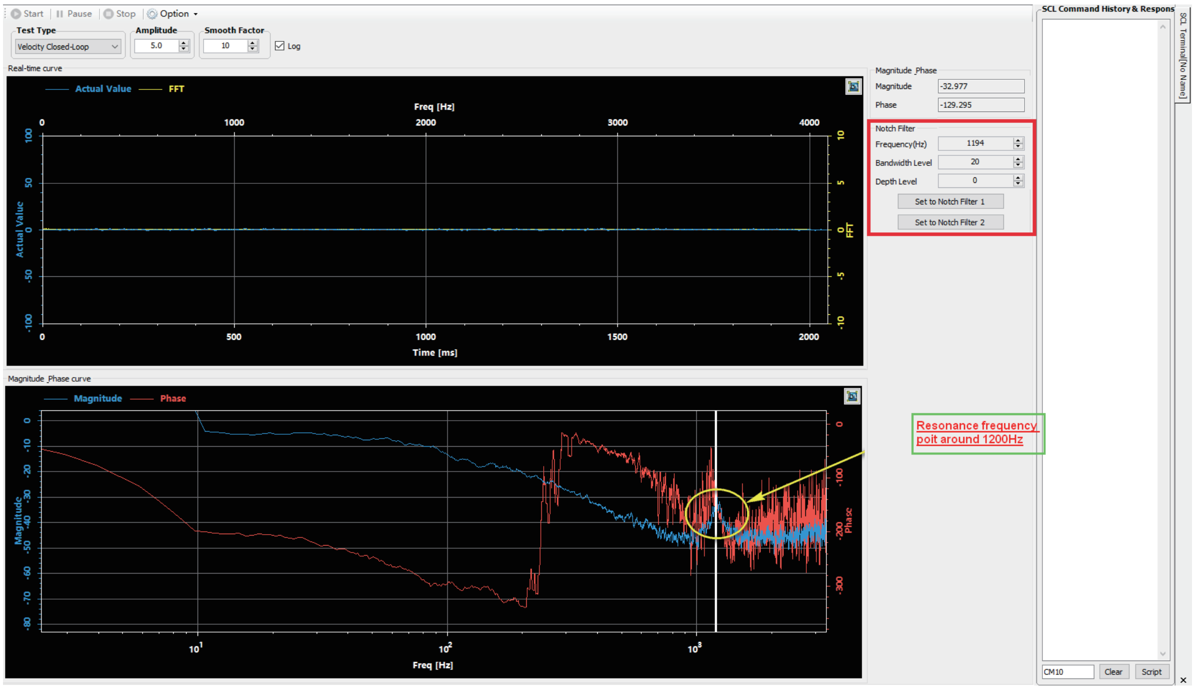
Step 3

1) Click the "Start" button, the servo system starts the Velocity Closed-loop analysis and displays the result curve.

2) Click the icon in the upper right corner of the drawing area to optimize the displayed curve.

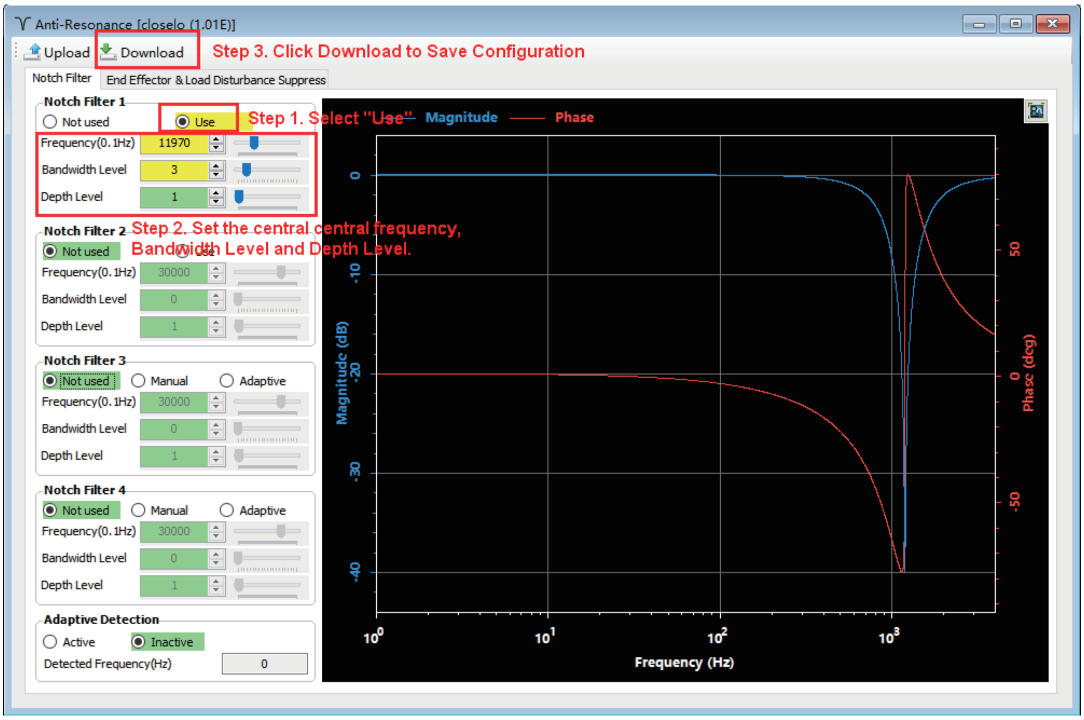
3) Move the reference line in the "Magnitude_Phase Curve" to the place where the Magnitude curve (Blue curve in the figure below) has abnormal protrusion.

The Notch Filter in red area will display the resonance frequency of the current reference line(The picture below shows there is an obvious vibration around 1200Hz,). Click "Set to Notch Filter 1" or "Set to Notch Filter 2" button will set this frequency as the resonance suppression frequency.



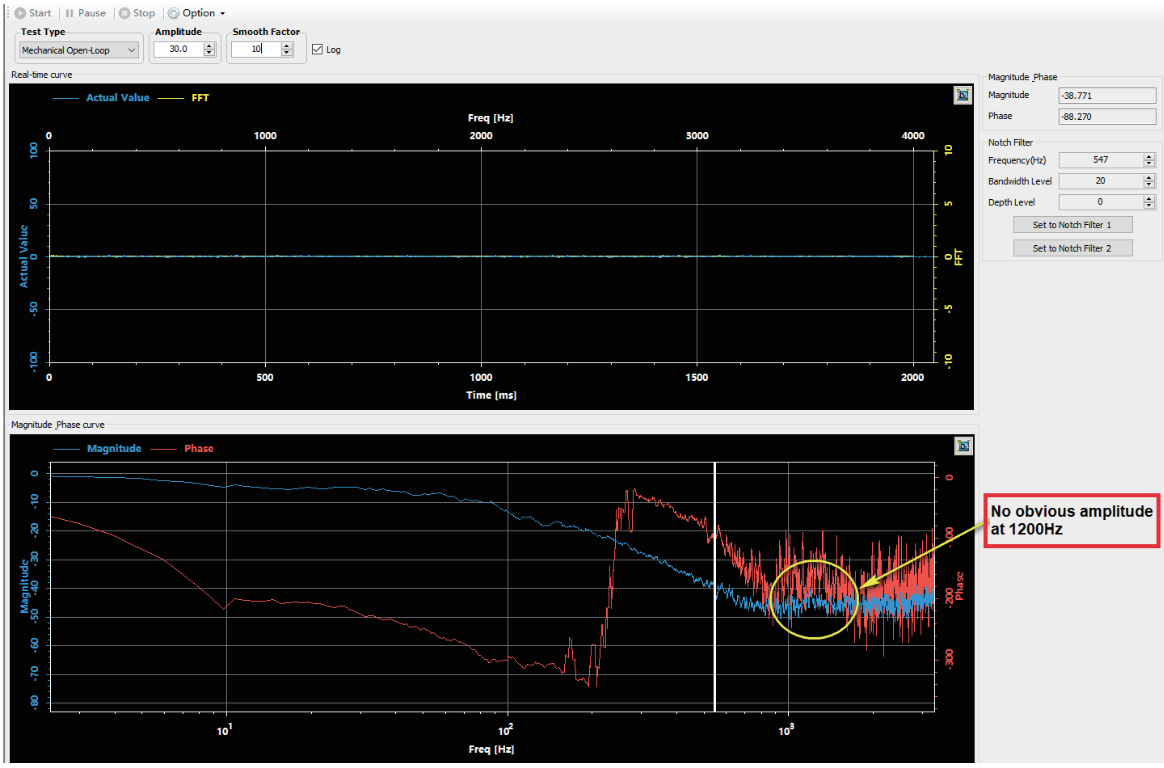
Step 4

Open the "Anti-Resonance" window, select "Use" and set approprate Bandwidth Level and Depth Level, and than click "Download" button to enable the notch filter.



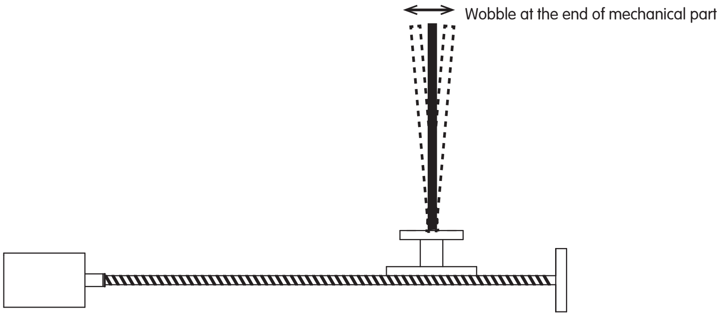
Step 5

Perform Velocity Closed-loop analysis again to check the suppressed result.



10.5 End Effector Suppress

As shown in the figure below, the mechanical transmission part has a certain elasticity. For example, due to the long length of the end of the mechanical load and the hysteresis of the position control loop, it is easy to generate low-frequency vibration during running and stopping. This vibration tends to have a low frequency, generally within 30Hz, but it will affect the positioning accuracy and settling time.

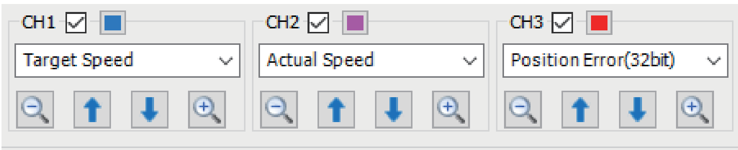


After the position command has finishied, the end of the machenical part is still wobble even if the motor has stopped moving. This kind of of vibration can be suppressed well by using the End Effector Suppress function, so as to improve the position accuracy and shorten the positioning and settling time.

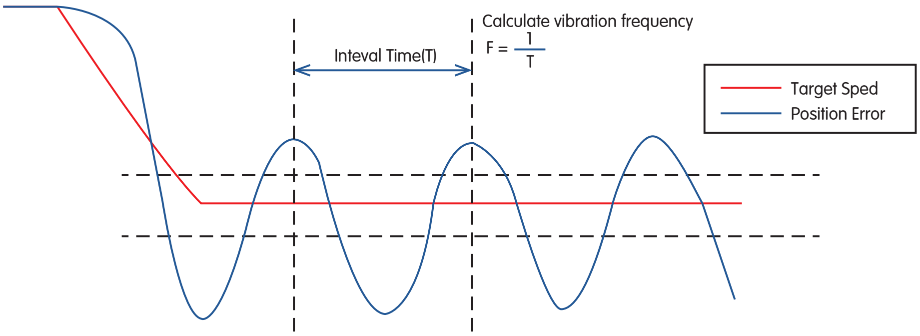
How to Use:

Step 1: Detect the wobble frequency

Use the oscilloscope function of Luna software to observe the curves of "Target Speed" and "Actual Speed" and "Position Error" when motor stops.

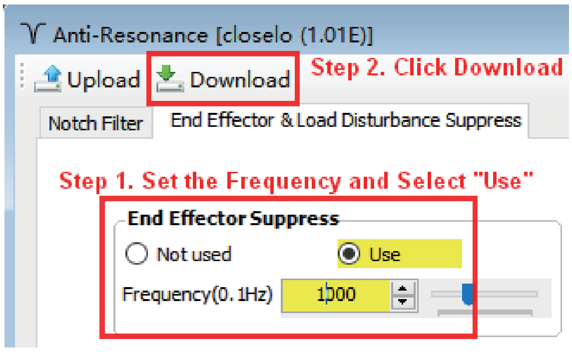


As shown in the figure below, when the Target Speed is zero, the Position Error still has a relatively fluctuation, but the amplitude decrease gradually under the damping effect of servo system. The fluctuation frequency of Position Error can be measured.



Step 2: Set the Frequency and Enable the End Effector Suppress function

Open the "Anti-resonance" window and click the tape of "End Effector & Load Disturbance Suppress",and than enter the fluctuation frequency measured in the first step and check "Use", and than click "Download" button. After downloading to the driver, the end vibration suppression will take effect.



Note:

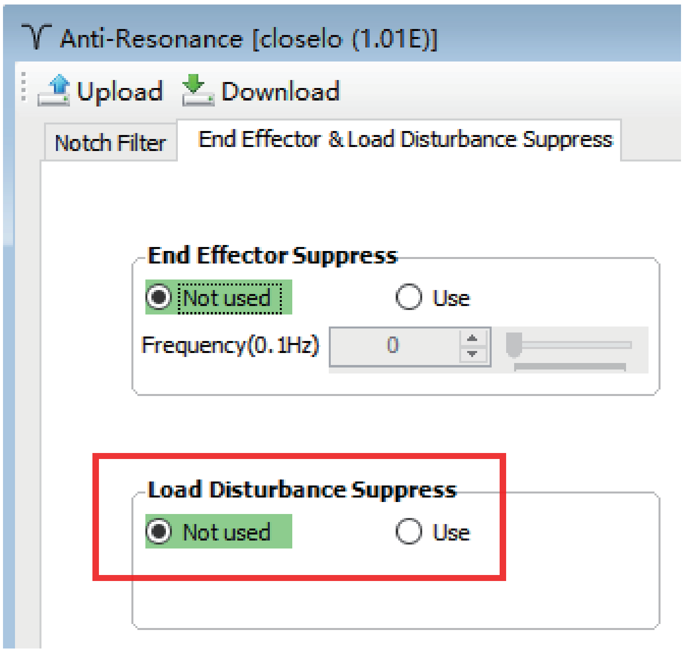
- Wrong Fluctuation Frequency will cause the end vibration suppression effect to become worse or even increase the vibration.
- Only the Fluctuation Frequency within 1-30Hz can be well suppressed.
- This function is not suitable for vibration caused by non-mechanical end causes.

10.6 Load Disturbance Suppress

The servo system is disturbed by external factors, such as sudden changes in load or sudden changes in external forces or friction, which may cause servo system vibration easily and become unstable.

The Load Disturbance Suppress function can eliminate such disturbances and improves system response.

How to Use:
Open the "Anti-resonance" window and click the tape of "End Effector & Load Disturbance Suppress",and than check "Use" of "Load Disturbance Suppress", and than click "Download" button. After downloading to the driver, the Load Disturbance Suppress function will take effect.



11 Modbus/RTU Commucation

There are two types of communication methods for ModBUS, ASCII(American Standard Code for information interchange) mode and RTU(Remote Terminal Unit)mode, this is defined based on different bus modulation and demodulation methods. For M56S series AC servo drives, only ModBUS RTU is supported.

11.1 Modbus/RTU Configurations

11.1.1 Data Encode

The drive uses "Big-Endian" or "Little-Endian" for 32-bit data storage. In M5, each register is a word in 16-bit, so when storing a 32-bit data, it needs to occupy 2 registers.

Big-Endian: The Most Significant Byte (MSB) value is stored at the memory location with the lowest address; the next byte value in significance is stored at the following memory location and so on. This is akin to Left-to-Right reading in hexadecimal order.

For example: To store a 32bit data 0x12345678 into register address 40011 and 40012. 0x1234 will be defined as MSB, and 0x5678 as LSB. With big-endian system:

Register 40031 = 0x1234
Register 40032 = 0x5678

When transfer 0x12345678, the first word will be 0x1234, and the second word will be 0x5678

Little-Endian: The Least Significant Byte (LSB) value is stored at the memory location with the lowest address, and the MSB value is stored at the following memory location and so on.

For example: To store a 32bit data 0x12345678 into register address 40031 and 40032. 0x5678 will be defined as LSB, and 0x1234 as MSB. With little-endian system:

Register 40031 = 0x5678
Register 40032 = 0x1234

When transfer 0x12345678, the first word will be 0x5678, and the second word will be 0x1234. M56S drive parameter P1-13 (PR) defines data transfer type:

P1-13(PR) = 5 represents Big-Endian.
P1-13(PR) = 133 represents Little-Endian.

11.1.2 Communication Address

In the network system, each drive requires a unique drive address. Only the drive with the matching address will responded to the host command. In ModBUS network, address "0" is the broadcast address.

It cannot be used for individual drive’s address. ModBUS RTU/ASCII can set drive address from 1 to 31. Parameter P1-16(DA) is used to set the communication address(Node ID) in RS-485 network.

11.1.3 Communication Protocol and Baud Rate

The supported data protocol in M56S series is :

- 8, N, 1. That is: 8 data bits, 1 stop bit, no parity bit.

The communication baud rate is set by parameter P1-15(BR).

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 host software can configure this value at any time.

1 = 9600bps
2 = 19200bps
3 = 38400bps
4 = 57600bps
5 = 115200bps

11.1.4 Power-on Mode

Configure the operating mode of the drive after power on. Parameter P1-02(PM) is used to set it. The corresponding relationship between PM command parameter value and working mode in Modbus RTU communication mode is as follows:

8: After power on, the driver is in enable working mode.
9: After power on, the drive is in the working mode that conduct the Q programming automatically.
10:After power on, the drive is in non-enable working mode.

11.2 Modbus/RTU Message Frame

Modbus RTU protocol establishes the query message by putting the slave device address (or broadcast), the function code defining the requested operation, the data to be sent as well as CRC verification into the host query. The response message in slave device also uses Modbus RTU message structure, including the slave device address, the function code requesting operation, the data to be sent as well as CRC check. If there is fault when receiving the information or the slave device cannot operate the requested action, the slave device will send an abnormal information as a response. Modbus RTU data frame structure is as follows:

Address Domain	Function Code	Data Domain	CRC Check
1 BYTE	1 BYTE	n BYTES	2 BYTES

11.3 Supported Function Codes for Modbus

The Modbus function codes supported by the MOONS' driver are as follows:

- 0x03: Read hold register
- 0x06: Write a single register
- 0x10: Write multiple registers

11.3.1 Function Code :0x03: Read Hold Register

Read single or multiple holding registers, up to 50 registers are allowed to be read, broadcast are not supported.

E.g. Read the drive status with slave address 1 and the register address is 40002, assuming the register value is 0x0009

Host sends: Command Message(Master)				Slave response: Response Message(Slave)		
Function	Data	Number of Bytes		Function	Data	Number of Bytes
Slave Address	01H	1		Slave Address	01H	1
Function Code	03H	1		Function Code	03H	1
Starting Data Address (Register 40002)	00H(High) 01H(Low)	2		Number of Data (In Byte)	04H	1
Number of Data (In word)	00(High) 01(Low)	2		Content of Starting Data Address 40002	00H(High) 09H(Low)	2
CRC Check Low	D5H	1		CRC Check Low	78H	1
CRC Check High	CAH	1		CRC Check High	42H	1

Host Sends: 01 03 00 01 00 01 D5 CA
Slave Responses: 01 03 02 00 09 78 42

If communication error occurs, the data format returned by the exception is:
01 83 XX CRC_L CRC_H
Where XX is,

- XX = 01H means does not support to read the function code 03H;
- XX = 02H means illegal register;
- XX = 03H means illegal data area;
- XX = 11H means register does not support read or write

The Modbus RTU/TCP message sent by the host is as follows:

Modbus Protocol Type	MBAP Message Header	Address Code	Function Code	Register Address	Register Amount	CRC Check
Modbus RTU	None	01	03	00 01	00 01	D5 CA
Modbus TCP	00 00 00 00 00 06 01	None	03	00 01	00 01	None

The Modbus RTU/TCP message returned by the slave station equipment is as follows:

Modbus Protocol Type	MBAP Message Header	Address Code	Function Code	Register Address	Register Amount	CRC Check
Modbus RTU	None	01	03	02	00 09	78 42
Modbus TCP	00 00 00 00 00 05 01	None	03	02	00 09	None

11.3.2 Function Code 0x06: Write a Single Register

Writes to a single holding register. When using a broadcast instruction, all slave devices on the bus perform the write operation to the same register.

For example, write the motor running speed to the drive whose slave device address is 11. The register address is 40030. Assuming that the motor speed is set to 12.5 rps, write the data bit 12.5*240 =3000, which is converted to hexadecimal 12CH.

Host sends: Command Message(Master)				Slave response: Response Message(Slave)		
Function	Data	Number of Bytes		Function	Data	Number of Bytes
Slave Address	0BH	1		Slave Address	0BH	1
Function Code	06H	1		Function Code	06H	1
Starting Data Address (Register 40030)	00H(High) 1DH(Low)	2		Starting Data Address (Register 40030)	00H(High) 1DH(Low)	2
Content of Data	01(High) 2C(Low)	2		Content of Data	01(High) 2C(Low)	2
CRC Check Low	19H	1		CRC Check Low	19H	1
CRC Check High	2BH	1		CRC Check High	2BH	1

Host Sends: 0B 06 00 1D 01 2C 19 2B
Slave Responses: 0B 06 00 1D 01 2C 19 2B
If communication error occurs, the data format returned by the exception is:
0B 86 XX CRC_L CRC_H
Where XX is

- XX = 01H, does not support to write in function code 06H
- XX = 02H, illegal register
- XX = 03H, illegal data area
- XX = 12H, register does not support read or write
- XX = 13H, set value exceeds the scope

The Modbus RTU/TCP message sent by the host is as follows:

Modbus Protocol Type	MBAP Message Header	Address Code	Function Code	Register Address	Register Amount	CRC Check
Modbus RTU	None	0B	06	00 1D	01 2C	19 2B
Modbus TCP	00 00 00 00 00 06 0B	None	06	00 1D	01 2C	None

The Modbus RTU/TCP message returned by the slave station equipment is as follows:

Modbus协议类型	MBAP Message Header	Address Code	Function Code	Register Address	Register Amount	CRC Check
Modbus RTU	None	0B	06	00 1D	01 2C	19 2B
Modbus TCP	00 00 00 00 00 06 0B	None	06	00 1D	01 2C	None

11.3.3 Function Code 0x10: Write Multiple Register

Write single or multiple holding registers, with a maximum of 50 registers allowed. When a broadcast command is used, the same registers of all slave devices on the bus perform to write operations.

E.g. Write the target distance to the drive which the slave address is 10. The register addresses are 40031 and 40032. Assuming that the target distance is 30000, it is converted into hexadecimal 7530H and transmits in Big Endian encoding.

Host sends: Command Message(Master)				Slave response: Response Message(slave)		
Function	Data	Number of Bytes		Function	Data	Number of Bytes
Slave Address	0AH	1		Slave Address	0AH	1
Function Code	10H	1		Function Code	10H	1
Starting Data Address (Register 40031)	00H(High) 1EH(Low)	2		Starting Data Address (Register 40031)	00H(High) 1EH(Low)	2
Number of Data (In word)	00H(High) 02H(Low)	2		Number of Data (In word)	00(High) 02(Low)	2
Number of Data (In byte)	04H	1		CRC Check Low	20H	1
Content of First Data Address	00H(High) 00H(Low)	2		CRC Check High	B5H	1
Content of Second Data Address	75H(High) 30H(Low)	2				
CRC Check Low	70H	1				
CRC Check High	8FH	1				

Host Sends: 0A 10 00 1E 00 02 04 00 00 75 30 70 8F
Slave Responses: 0A 10 00 1E 00 02 20 B5
If communication error occurs, the data format returned by the exception is:
0A 90 XX CRC_L CRC_H

Where XX is:
- ◆ XX = 01H: Function code 10H is not supported
- ◆ XX = 02H: Illegal register
- ◆ XX = 03H: Illegal data area
- ◆ XX = 12H: Register does not support writing in
- ◆ XX = 13H: Set value is out of range

The Modbus RTU/TCP message sent by the host is as follows:

Modbus Protocol Type	MBAP Message Header	Address Code	Function Code	Register Address	Register Amount	Number of Bytes	Data Content	CRC Check
Modbus RTU	None	0A	10	00 1E	00 02	04	00 00 75 30	70 8F
Modbus TCP	00 00 00 00 00 0B 0A	None	10	00 1E	00 02	04	00 00 75 30	None

The Modbus RTU/TCP message returned by the slave station equipment is as follows:

Modbus Protocol Type	MBAP Message Header	Address Code	Function Code	Register Address	Register Amount	CRC Check
Modbus RTU	None	0A	10	00 1E	00 02	20 B5
Modbus TCP	00 00 00 00 00 06 0A	None	10	00 1E	00 02	None

11.4 SCL Command Code

11.4.1 Command Code

Register 40125 is defined as the operation code register. If write corresponding operation code to register 40125, then it operates the corresponding function of operation code. The operation code that supports is listed as below.

SCL Command Encoding Table

Function	SCL	Opcode	Parameter 1	Parameter 2	Parameter 3	Parameter 4	Parameter 5
Alarm Reset	AX	0xBA	×	×	×	×	×
Start Jogging	CJ	0x96	×	×	×	×	×
Stop Jogging	SJ	0xD8	×	×	×	×	×
Encoder Position	EP	0x98	Position	Position	×	×	×
Feed to Length with Speed Change	FC	0x6D	I/O Point	Condition	×	×	×
Feed to Length	FL	0x66	×	×	×	×	×
Feed to Sensor with Mask Distance	FM	0x6A	I/O Point	Condition	×	×	×
Feed and Set Output	FO	0x68	I/O Point	Condition	×	×	×
Feed to Position	FP	0x67	×	×	×	×	×
Feed to Sensor	FS	0x6B	I/O Point	Condition	×	×	×
Feed to Sensor with Safety Distance	FY	0x6C	I/O Point	Condition	×	×	×
Motor Disable	MD	0x9E	×	×	×	×	×
Motor Enable	ME	0x9F	×	×	×	×	×
Seek Home	SH	0x6E	I/O Point	Condition	×	×	×
Set Position	SP	0xA5	Position	Position	×	×	×
Full Closed-loop Control Switch	XM	0x54	0..1	×	×	×	×
Set Output	SO	0x8B	I/O Point	Condition	×	×	×
Wait for Input	WI	0x70	×	×	×	×	×
Queue Load & Execute	QX	0x78	1..12	×	×	×	×
Wait Time	WT	0x6F	0.01 sec	×	×	×	×
Find Home	FH	0xDB	-4..35	×	×	×	×
Stop Move & Kill Buffer, Max Decel	SK	0xE1	×	×	×	×	×
Stop Move & Kill Buffer, Normal Decel	SKD	0xE2	×	×	×	×	×

Notes: "x" in the table means do not use

E.g. SCL command "FL" means executing relative position control. In Modbus, writing "0x66" into register 40125 (that is FL`s Opcode in register table) can execute relative position control.

For detailed operation code function, please refer to HOST COMMAND REFERENCE brochure.

For detailed usage routines of the motor brake, please refer to the Modbus user manual.

11.4.2 I/O Code

The coding of digital input/output port and status is shown in the table below.

Character	Hex	Description
‘0’	0x30	Z-phase signal for encoder
‘1’	0x31	Digital Input/Output 1
‘2’	0x32	Digital Input/Output 2
‘3’	0x33	Digital Input/Output 3
‘4’	0x34	Digital Input/Output 4
‘5’	0x35	Digital Input/Output 5
‘6’	0x36	Digital Input/Output 6
‘7’	0x37	Digital Input/Output 7
‘8’	0x38	Digital Input/Output 8
‘9’	0x39	Digital Input/Output 9
‘:’	0x3A	Digital Input/Output 10
‘;’	0x3B	Digital Input/Output 11
‘<’	0x3C	Digital Input/Output 12
‘L’	0x4C	Low-level (Optocoupler on)
‘H’	0x48	High-level (Optocoupler off)
‘R’	0x52	Rising edge of the signal
‘F’	0x46	Falling edge of the signal

E.g. SCL command "FS1F". In Modbus control, when write "0x6B" in register 40125, "0x31" in register 40126 and "0x46" in register 40127, they execute the same control.

11.5 Modbus Register Tabble of M56S Series

11.5.1 M56S Series General Purpose Registers

11.5.1 M56S Series General Purpose Registers					
Register	Access	Data Type	Units	Description	SCL Register
40001..002	Read Only	LONG	——	Alarm Code (AL)	f
40003..004	Read Only	LONG	——	Status Code (SC)	s
40005	Read Only	SHORT	——	Digital Output Status (IO)	y
40006	Read Only	SHORT	——	Digital Input Status (IS)	i
40007..008	Read Only	LONG	pulses	Immediate Absolute Position (IP)	l
40009..010	Read Only	LONG	pulses	Secondary Encoder Position (EQ)	
40011..012	Read Only	LONG	pulses	Encoder Position (EP)	e
40013..014	Read Only	LONG	pulses	Internal Use	
40015	R/W	SHORT		Reserved	
40016	Read Only	SHORT	rev	Encoder Multi-turn Data	
40017	Read Only	SHORT	1/240rps	Immediate Actual Velocity (IV)	v
40018	Read Only	SHORT	1/240rps	Immediate Target Velocity (IV1)	w
40019	Read Only	SHORT	0.1℃	Immediate Drive Temperature (IT)	t
40020	Read Only	SHORT	0.1℃	Immediate DSP Temperature (IT1)	
40021	Read Only	SHORT	0.1℃	Immediate Encoder Temperature (IT2)	
40022	Read Only	SHORT	0.1V	Immediate DC_Bus Voltage (IU)	u
40023..024	Read Only	LONG	pulses	Immediate Position Error (IX)	x
40025	R/W	SHORT		Reserved	
40026	Read Only	SHORT	mv	Analog Input 1 (IA1)	j
40027	Read Only	SHORT	mv	Analog Input 2 (IA2)	k
40028	R/W	SHORT	mv	Analog Output 1 (OA1)	T
40029	R/W	SHORT	mv	Analog Output 2 (OA2)	W (Capital)

11.5.1 M56S Series General Purpose Registers					
Register	Access	Data Type	Units	Description	SCL Register
40030	Read Only	SHORT	——	Q Program Line Number	b
40031	Read Only	SHORT	0.1%	Immediate Current Command (IC)	c
40032	Read Only	SHORT	0.1%	Q Current (IQ)	q
40033..034	Read Only	LONG	pulses	Relative Distance (ID)	d
40035..036	Read Only	LONG	pulses	Sensor Position	g
40037	Read Only	SHORT	——	Condition Code	h
40038	Read Only	SHORT	——	Control Mode	m
40039	Read Only	SHORT	——	Velocity Move State	n
40040	Read Only	SHORT	——	Point-to-Point Move State	o
40041	Read Only	SHORT	——	Q Segment Number	p
40042	Read Only	SHORT	——	Model Number	
40043	Read Only	SHORT	——	Sub Model	
40044	Read Only	SHORT	——	DSP Firmware Version	
40045	Read Only	SHORT	——	FPGA Firmware Version NO	
40046	Read Only	SHORT	——	FPGA Firmware Version LA	
40047..048	R/W	LONG	pulses	Input Counter	I (Capital)
40049..050	R/W	LONG	pulses	Pulse Counter	S (Capital)
40051	R/W	SHORT	——	Internal Use	
40052..053	Read Only	LONG	s	Power Up Seconds	
40054..055	Read Only	LONG	times	Power On Times	
40056	Read Only	SHORT	——	Encoder Firmware Version	
40057	R/W	SHORT	——	Internal Use	
40058	Read Only	SHORT	——	Internal Use	
40059	Read	SHORT	——	Internal Use	

11.5.1 M56S Series General Purpose Registers					
Register	Access	Data Type	Units	Description	SCL Register
40060	R/W	SHORT	1%	Internal Use	
40061	R/W	SHORT	pulses	Internal Use	
40062	R/W	SHORT	ms	Internal Use	
40063	R/W	SHORT	——	Internal Use	
40064	R/W	SHORT	——	Internal Use	
40065	R/W	SHORT	0 ~ 3000	Torque Limit Dynamic CW	Y
40066	R/W	SHORT	0 ~ 3000	Torque Limit Dynamic CCW	Z (Capital)
40067..68	Read Only	LONG	——	Alarm Code	r
40069	Read Only	SHORT	——	Alarm Buffer 0 驱动器报错代码记录8	
40070	Read Only	SHORT	——	Alarm Buffer 1 驱动器报错代码记录1	
40071	Read Only	SHORT	——	Alarm Buffer 2 驱动器报错代码记录2	
40072	Read Only	SHORT	——	Alarm Buffer 3 驱动器报错代码记录3	
40073	Read Only	SHORT	——	Alarm Buffer 4 驱动器报错代码记录4	
40074	Read Only	SHORT	——	Alarm Buffer 5 驱动器报错代码记录5	
40075	Read Only	SHORT	——	Alarm Buffer 6 驱动器报错代码记录6	
40076	Read Only	SHORT	——	Alarm Buffer 7 驱动器报错代码记录7	
40077..78	Read Only	LONG	s	Alarm Buffer 8 驱动器报错代码记录8产生时间	
40079..80	Read Only	LONG	s	Alarm Buffer 9 驱动器报错代码记录1产生时间	
40081..82	Read Only	LONG	s	Alarm Buffer 10 驱动器报错代码记录2产生时间	
40083..84	Read Only	LONG	s	Alarm Buffer 11 驱动器报错代码记录3产生时间	
40085..86	Read Only	LONG	s	Alarm Buffer 12 驱动器报错代码记录4产生时间	
40087..88	Read Only	LONG	s	Alarm Buffer 13 驱动器报错代码记录5产生时间	
40089..90	Read Only	LONG	s	Alarm Buffer 14 驱动器报错代码记录6产生时间	
40091..92	Read Only	LONG	s	Alarm Buffer 15 驱动器报错代码记录7产生时间	

11.5.1 M56S Series General Purpose Registers					
Register	Access	Data Type	Units	Description	SCL Register
40093..94	Read Only	LONG	——	Alarm Buffer 16	
40095..96	Read Only	LONG	——	Alarm Buffer 17	
40097..98	Read Only	LONG	——	Alarm Buffer 18	
40099..100	Read	LONG	——	Alarm Buffer 19	
40101..102	Read Only	LONG	——	Alarm Buffer 20	
40103..104	Read Only	LONG	——	Alarm Buffer 21	
40105..106	Read Only	LONG	——	Alarm Buffer 22	
40107..108	Read Only	LONG	——	Alarm Buffer 23	
40109..110	Read Only	LONG	——	Alarm Buffer 24 驱动器报错代码记录8产生时刻错误值	
40111..112	Read Only	LONG	——	Alarm Buffer 25 驱动器报错代码记录1产生时刻错误值	
40113..114	Read Only	LONG	——	Alarm Buffer 26 驱动器报错代码记录2产生时刻错误值	
40115..116	Read Only	LONG	——	Alarm Buffer 27 驱动器报错代码记录3产生时刻错误值	
40117..118	Read Only	LONG	——	Alarm Buffer 28 驱动器报错代码记录4产生时刻错误值	
40119..120	Read Only	LONG	——	Alarm Buffer 29 驱动器报错代码记录5产生时刻错误值	
40121..122	Read Only	LONG	——	Alarm Buffer 30 驱动器报错代码记录6产生时刻错误值	
40123..124	Read Only	LONG	——	Alarm Buffer 31 驱动器报错代码记录7产生时刻错误值	
40125	R/W	SHORT	——	Command Opcode	
40126	R/W	SHORT	——	Parameter 1	
40127	R/W	SHORT	——	Parameter 2	
40128	R/W	SHORT	——	Parameter 3	
40129	R/W	SHORT	——	Parameter 4	
40130	R/W	SHORT	——	Parameter 5	
40131..132	Read Only	LONG	——	Accumulator	0
40133..134	R/W	LONG	——	User Register 1	1
40135..136	R/W	LONG	——	User Register 2	2
40137..138	R/W	LONG	——	User Register 3	3

11.5.1 M56S Series General Purpose Registers

Register	Access	Data Type	Units	Description	SCL Register
40139..140	R/W	LONG	——	User Register 4	4
40141..142	R/W	LONG	——	User Register 5	5
40143..144	R/W	LONG	——	User Register 6	6
40145..146	R/W	LONG	——	User Register 7	7
40147..148	R/W	LONG	——	User Register 8	8
40149..150	R/W	LONG	——	User Register 9	9
40151..152	R/W	LONG	——	User Register 10	:
40153..154	R/W	LONG	——	User Register 11	;
40155..156	R/W	LONG	——	User Register 12	<
40157..158	R/W	LONG	——	User Register 13	=
40159..160	R/W	LONG	——	User Register 14	>
40161..162	R/W	LONG	——	User Register 15	?
40163..164	R/W	LONG	——	User Register 16	@
40165..166	R/W	LONG	——	User Register 17	[
40167..168	R/W	LONG	——	User Register 18	\
40169..170	R/W	LONG	——	User Register 19	]
40171..172	R/W	LONG	——	User Register 20	^
40173..174	R/W	LONG	——	User Register 21	_
40175..176	R/W	LONG	——	User Register 22	`

11.5.2 M56S Series—P0 Group (PID)

11.5.2 M56S Series—P0 Group (PID)						
Register	Access	Data Type	Units	Range	Description	SCL Register
40177..178	R/W	LONG	——	0 ~ 2	Tuning Mode Selection (UM)	
40179..180	R/W	LONG	——	0 ~ 10	Load Type (LY)	
40181..182	R/W	LONG	——	0 ~ 100	Inertia Ratio (NR)	
40183..184	R/W	LONG	——	1 ~ 20	1st Mechanical Stiffness Level (Kg)	
40185..186	R/W	LONG	——	1 ~ 20	2nd Mechanical Stiffness Level (KX)	
40187..188	R/W	LONG	0.1Hz	0 ~ 20000	1st Position Loop Gain (KP)	
40189..190	R/W	LONG	ms	0 ~ 30000	1st Position Loop Integral Time Constant (KI)	
40191..192	R/W	LONG	ms	0 ~ 30000	1st Position Loop Derivative Time Constant (KD)	
40193..194	R/W	LONG	0.1Hz	0 ~ 40000	1st Position Loop Derivative Filter (KE)	
40195..196	R/W	LONG	0.01%	-30000 ~ 30000	Velocity Feedforward Gain (KL)	
40197..198	R/W	LONG	0.1Hz	0 ~ 40000	Velocity Feedforward Filter (KR)	
40199..200	R/W	LONG	0.01%	-30000 ~ 30000	1st Velocity Command Gain (KF)	
40201..202	R/W	LONG	0.1Hz	0 ~ 30000	1st Velocity Loop Gain (VP)	
40203..204	R/W	LONG	ms	0 ~ 30000	1st Velocity Loop Integral Time Constant (VI)	
40205..206	R/W	LONG	0.01%	0 ~ 20000	Acceleration Feedforward Gain (KK)	
40207..208	R/W	LONG	0.1Hz	0 ~ 40000	Acceleration Feedforward Filter (KT)	
40209..210	R/W	LONG	0.1Hz	0 ~ 40000	1st Torque Command Filter (KC)	
40211..212	R/W	LONG	0.1Hz	0 ~ 20000	2nd Position Loop Gain (UP)	
40213..214	R/W	LONG	ms	0 ~ 30000	2nd Position Loop Integral Time Constant (UI)	

11.5.2 M56S Series—P0 Group (PID)						
Register	Access	Data Type	Units	Range	Description	SCL Register
40215..216	R/W	LONG	ms	0 ～ 30000	2nd Position Loop Derivative Time Constant (UD)	
40217..218	R/W	LONG	0.1Hz	0 ～ 40000	2nd Position Loop Derivative Filter (UE)	
40219..220	R/W	LONG	0.01%	-30000 ～ 30000	2nd Velocity Command Gain (UF)	
40221..222	R/W	LONG	0.1Hz	0 ～ 30000	2nd Velocity Loop Gain (UV)	
40223..224	R/W	LONG	ms	0 ～ 30000	2nd Velocity Loop Integral Time Constant (UG)	
40225..226	R/W	LONG	0.1Hz	0 ～ 40000	2nd Torque Command Filter (UC)	
40227..228	R/W	LONG	0.1Hz	0 ～ 20000	Full Closed-loop Position Loop Gain (XP)	
40229..230	R/W	LONG	ms	0 ～ 30000	Full Closed-loop Position Loop Integral Time Constant (XI)	
40231..232	R/W	LONG	ms	0 ～ 32767	Full Closed-loop Position Loop Derivative Time Constant (XD)	
40233..234	R/W	LONG	0.1Hz	0 ～ 40000	Full Closed-loop Position Loop Derivative Filter (XE)	
40235..236	R/W	LONG	0.01%	-30000 ～ 30000	Full Closed-loop Velocity Command Gain (XF)	
40237..238	R/W	LONG	0.1Hz	0 ～ 30000	Full Closed-loop Velocity Loop Gain (XV)	
40239..240	R/W	LONG	ms	0 ～ 30000	Full Closed-loop Velocity Loop Integral Time Constant (XG)	
40241..242	R/W	LONG	0.1Hz	0 ～ 40000	Full Closed-loop Torque Command Filter (XC)	
40243..244	R/W	LONG	——	0 ～ 4	Automatic Gain Switching Method (SD)	O (Capital)
40245..246	R/W	LONG	pulses	0 ～ 2147483647	Use Position Error as the Condition (PN)	

11.5.2 M56S Series—P0 Group (PID)						
Register	Access	Data Type	Units	Range	Description	SCL Register
40247..248	R/W	LONG	1/240rps	0 ～ 24000	Use Actual Speed as the Condition (VN)	
40249..250	R/W	LONG	0.1%	0 ～ 3000	Use Actual Torque as the Condition (TN)	
40251..252	R/W	LONG	ms	0 ～ 10000	Gain Switching Waiting Time 1 (SE1)	
40253..254	R/W	LONG	ms	0 ～ 10000	Gain Switching Waiting Time 2 (SE2)	
40255..256	R/W	LONG	——	0 ～ 3	Velocity Feedback Filter (LR)	
40257..258	R/W	LONG	——	0 ～ 1	Self-adapting Filter Switch (AE)	
40259..260	R/W	LONG			Reserved	

11.5.3 M56S Series—P1 Group (Configuration)

11.5.3 M56S Series—P1 Group (Configuration)						
Register	Access	Data Type	Units	Range	Description	SCL Register
40261..262	R/W	LONG			Reserved	
40263..264	R/W	LONG	——	1,2,7,11,15,21	Main Control Mode (CM)	
40265..266	R/W	LONG	——	1,2,7,11,15,21	Secondary Control Mode (CN)	
40267..268	R/W	LONG	——	8 ~ 10	Operation Mode When Power-up (PM)	
40269..270	R/W	LONG	——	1 ~ 2	Speed Control Clamp Mode (JM)	
40271..272	R/W	LONG	——	0 ~ 1	Full Closed-loop Control Switch (XM)	
40273..274	R/W	LONG	0.1%	-3000 ~ 3000	Torque Command of Internal Torque Mode (GC)	G
40275..276	R/W	LONG	0.1%	0 ~ 3000	1st Torque Limit (CC)	
40277..278	R/W	LONG	0.1%	0 ~ 3000	Target Value of Torque Arrival (CV)	
40279..280	R/W	LONG	0.1%	0 ~ 3000	Torque Limit of Hardstop Homing (HC)	
40281..282	R/W	LONG	ms	0 ~ 30000	Current Foldback Continuous Time (CL)	
40283..284	R/W	LONG	——	0 ~ 5	Torque Limit Method (LD)	
40285..286	R/W	LONG	——	0 ~ 1	Rotational Direction Setup (RN)	
40287..288	R/W	LONG			Reserved	
40289..290	R/W	LONG	——	1 ~ 511	Communication Protocol (PR)	
40291..292	R/W	LONG	ms	0 ~ 20	Transmit Delay (TD)	
40293..294	R/W	LONG	——	1 ~ 5	RS-485 Baud Rate (BR)	
40295..296	R/W	LONG	——	0 ~ 32	RS-485 Address (DA)	
40297..298	R/W	LONG	——	1 ~ 127	Node ID (CO)	
40299..300	R/W	LONG	——	0 ~ 7	CANopen Baud Rate	
40301..302	R/W	LONG	Ω	10 ~ 32000	Regeneration Resistor Value (ZR)	

11.5.3 M56S Series—P1 Group (Configuration)						
Register	Access	Data Type	Units	Range	Description	SCL Register
40303..304	R/W	LONG	W	1 ～ 32000	Regeneration Resistor Wattage (ZW)	
40305..306	R/W	LONG	ms	0 ～ 8000	Regeneration Resistor Time Constant (ZT)	
40307..308	R/W	LONG	——	0 ～ 1	Keypad Setting Lock (PK)	
40309..310	R/W	LONG	——	0 ～ 20	LED Default Display (DD)	
40311..312	R/W	LONG	——	0 ～ 4294967295	Alarm Mask (MA)	
40313..314	R/W	LONG	0.1%	0 ～ 3000	2nd Torque Limit (CX)	
40315..316	R/W	LONG	0.1%	0 ～ 3000	3rd Torque Limit (CY)	
40317..318	R/W	LONG	0.1%	0 ～ 3000	4th Torque Limit (CZ)	
40319..320	R/W	LONG	ms	0 ～ 30000	Motor Stall Protection Time (HT)	
40321..322	R/W	LONG	——	0 ～ 5	Dynamic Brake Sequence when Servo Off (YV)	
40323..324	R/W	LONG	——	0 ～ 3	Dynamic Brake Sequence when Fault Occurs (YR)	
40325..326	R/W	LONG	ms	0 ～ 30000	Dynamic Brake Action Time during Deceleration of Servo Off (YM)	
40327..328	R/W	LONG	ms	0 ～ 30000	Dynamic Brake Action Time during Deceleration when Fault Occurs (YN)	
40329..330	R/W	LONG	——	0 ～ 1	Main Power Phase Lost Detecting (OT)	
40331..332	R/W	LONG	0.1%	0 ～ 3000	Current Ramp Limit (RT)	
40333	R/W	SHORT			Reserved	
40334	R/W	SHORT			Reserved	

11.5.4 M56S Series—P2 Group (Trajectory)

11.5.4 M56S Series—P2 Group (Trajectory)						
Register	Access	Data Type	Units	Range	Description	SCL Register
40335..336	R/W	LONG	1/6(rps/s)	1 ~ 30000	Max Brake Deceleration (AM)	
40337..338	R/W	LONG	1/240rps	0 ~ 24000	Max Velocity (VM)	M
40339..340	R/W	LONG	1/6(rps/s)	1 ~ 30000	Jog Accel (JA)	K (Capital)
40341..342	R/W	LONG	1/6(rps/s)	1 ~ 30000	Jog Decel (JL)	L
40343..344	R/W	LONG	1/240rps	-24000 ~ 24000	Jog Velocity (JS)	J
40345..346	R/W	LONG	1/6(rps/s)	1 ~ 30000	Point-to-Point Accel (AC)	A
40347..348	R/W	LONG	1/6(rps/s)	1 ~ 30000	Point-to-Point Decel (DE)	B
40349..350	R/W	LONG	1/240rps	0 ~ 24000	Point-to-Point Velocity (VE)	V (Capital)
40351..352	R/W	LONG	pulses	-2147483647 ~ 2147483647	Point-to-Point Distance (DI)	D
40353..354	R/W	LONG	pulses	-2147483647 ~ 2147483647	Point-to-Point Change Distance (DC)	C (Capital)
40355..356	R/W	LONG	1/240rps	0 ~ 24000	Point-to-Point Change Velocity (VC)	U (Capital)
40357..358	R/W	LONG	1/6(rps/s)	1 ~ 30000	Homing Accel /Decel (HA1)	
40359..360	R/W	LONG			Reserved	
40361..362	R/W	LONG	1/240rps	0 ~ 24000	Homing Velocity 1 (HV1)	
40363..364	R/W	LONG	1/240rps	0 ~ 24000	Homing Velocity 2 (HV2)	
40365..366	R/W	LONG	pulses	-2147483647 ~ 2147483647	Homing Offset (HO)	
40367..368	R/W	LONG	1/240rps	-24000 ~ 24000	Internal Velocity Control: Speed 1 (JC1)	
40369..370	R/W	LONG	1/240rps	-24000 ~ 24000	Internal Velocity Control: Speed 2 (JC2)	
40371..372	R/W	LONG	1/240rps	-24000 ~ 24000	Internal Velocity Control: Speed 3 (JC3)	

11.5.4 M56S Series—P2 Group (Trajectory)						
Register	Access	Data Type	Units	Range	Description	SCL Register
40373..374	R/W	LONG	1/240rps	-24000 ~ 24000	Internal Velocity Control: Speed 4 (JC4)	
40375..376	R/W	LONG	1/240rps	-24000 ~ 24000	Internal Velocity Control: Speed 5 (JC5)	
40377..378	R/W	LONG	1/240rps	-24000 ~ 24000	Internal Velocity Control: Speed 6 (JC6)	
40379..380	R/W	LONG	1/240rps	-24000 ~ 24000	Internal Velocity Control: Speed 7 (JC7)	
40381..382	R/W	LONG	1/240rps	-24000 ~ 24000	Internal Velocity Control: Speed 8 (JC8)	
40383..384	R/W	LONG	ms	0 ~ 125	Jerk Time (JT)	
40385..386	R/W	LONG	ms	0 ~ 1000	Jerk Filter (KJ)	
40387..388	R/W	LONG	ms	0 ~ 125	Interpolation Filter (FF)	
40389..390	R/W	LONG	1/240rps	0 ~ 24000	Velocity Limit of Torque Mode (VT)	
40391	R/W	SHORT			Reserved	
40392	R/W	SHORT			Reserved	
40393	R/W	SHORT			Reserved	
40394	R/W	SHORT			Reserved	
40395	R/W	SHORT			Reserved	
40396	R/W	SHORT			Reserved	
40397	R/W	SHORT			Reserved	
40398	R/W	SHORT			Reserved	

11.5.5 M56S Series—P3 Group(Encoder & Step/Dir)

11.5.5 M56S Series—P3 Group(Encoder & Step/Dir)						
Register	Access	Data Type	Units	Range	Description	SCL Register
40399..400	R/W	LONG	——	1 ~ 2147483647	Electronic Gear Ratio – Numerator (EN)	
40401..402	R/W	LONG	——	1 ~ 2147483647	Electronic Gear Ratio - Denominator (EU)	
40403..404	R/W	LONG	0.1 μs	0 ~ 32000	Pulse Input Noise Filter (SZ)	
40405..406	R/W	LONG	——	0 ~ 31	Pulse Input Setting (PT)	
40407..408	R/W	LONG	pulses	0 ~ 2147483647	Position Error Limit (PF)	
40409..410	R/W	LONG	pulses/rev	200 ~ 131072	Command Pulses per Revolution (EG)	R
40411..412	R/W	LONG	——	0 ~ 1	Second Encoder Direction (PV)	
40413..414	R/W	LONG			Reserved	
40415..416	R/W	LONG			Reserved	
40417..418	R/W	LONG	rev	1 ~ 100	Hybrid Deviation Clear Setting (XT)	
40419..420	R/W	LONG	pulses	0 ~ 2147483647	Hybrid Deviation Fault Threshold (XO)	
40421..422	R/W	LONG	pulses/rev	200 ~ 100000	Second Encoder Resolution (XR)	
40423..424	R/W	LONG	——	0 ~ 256	Pulses Output Mode (PO)	
40425..426	R/W	LONG	——	0 ~ 13107200	Pulse Output Gear Ratio - Numerator (ON)	
40427..428	R/W	LONG	——	0 ~ 13107200	Pulse Output Gear Ratio - Denominator (OD)	
40429..430	R/W	LONG	——	0 ~ 3	Absolute Encoder Usage (ES)	
40431..432	R/W	LONG	——	0 ~ 1	Electronic Gearing Switch (PU)	
40433	R/W	SHORT			Reserved	
40434	R/W	SHORT			Reserved	
40435	R/W	SHORT			Reserved	
40436	R/W	SHORT			Reserved	
40437	R/W	SHORT			Reserved	
40438	R/W	SHORT			Reserved	
40439	R/W	SHORT			Reserved	
40440	R/W	SHORT			Reserved	

11.5.6 M56S Series—P4 Group(Analog)

11.5.6 M56S Series—P4 Group(Analog)						
Register	Access	Data Type	Units	Range	Description	SCL Register
40441..442	R/W	LONG			Reserved	
40443..444	R/W	LONG	1/240rps	0 ～ 24000	Analog Input Velocity Gain (AG)	
40445..446	R/W	LONG	0.1%	0 ～ 3000	Analog Input Torque Gain (AN)	
40447..448	R/W	LONG	mv	-10000 ～ 10000	Analog Input 1 Offset (AV1)	
40449..450	R/W	LONG	mv	-10000 ～ 10000	Analog Input 2 Offset (AV2)	
40451..452	R/W	LONG	mv	0 ～ 255	Analog Input 1 Deadband (AD1)	
40453..454	R/W	LONG	mv	0 ～ 255	Analog Input 2 Deadband (AD2)	
40455..456	R/W	LONG	0.1Hz	1 ～ 20000	Analog Input 1 Filter (AF1)	
40457..458	R/W	LONG	0.1Hz	1 ～ 20000	Analog Input 2 Filter (AF2)	
40459..460	R/W	LONG	mv	-10000 ～ 10000	Analog Input 1 Threshold (AT1)	
40461..462	R/W	LONG	mv	-10000 ～ 10000	Analog Input 2 Threshold (AT2)	
40463..464	R/W	LONG	——	0 ～ 1	Velocity Limit Setting of Torque Control (FA1)	
40465..466	R/W	LONG			Reserved	
40467..468	R/W	LONG			Reserved	
40469..470	R/W	LONG			Reserved	
40471..472	R/W	LONG			Reserved	
40473..474	R/W	LONG	——	1 ～ 32000	Analog Output 1 Scale (OS1)	
40475..476	R/W	LONG	——	1 ～ 32000	Analog Output 2 Scale (OS2)	
40477..478	R/W	LONG	——	0 ～ 5	Analog Output 1 Function (XA1)	
40479..480	R/W	LONG	——	0 ～ 5	Analog Output 2 Function (XA2)	
40481	R/W	SHORT			Reserved	
40482	R/W	SHORT			Reserved	
40483	R/W	SHORT			Reserved	
40484	R/W	SHORT			Reserved	
40485	R/W	SHORT			Reserved	

11.5.6 M56S Series—P4 Group(Analog)						
Register	Access	Data Type	Units	Range	Description	SCL Register
40486	R/W	SHORT			Reserved	
40487	R/W	SHORT			Reserved	
40488	R/W	SHORT			Reserved	
40489	R/W	SHORT			Reserved	
40490	R/W	SHORT			Reserved	

11.5.7 M56S Series—P5 Group(I/O)

11.5.7 M56S Series—P5 Group(I/O)						
Register	Access	Data Type	Units	Range	Description	SCL Register
40491..492	R/W	LONG	——	0 ~ 46	Digital Input 1 Function (MU1)	
40493..494	R/W	LONG	——	0 ~ 46	Digital Input 2 Function (MU2)	
40495..496	R/W	LONG	——	0 ~ 46	Digital Input 3 Function (MU3)	
40497..498	R/W	LONG	——	0 ~ 46	Digital Input 4 Function (MU4)	
40499..500	R/W	LONG	——	0 ~ 46	Digital Input 5 Function (MU5)	
40501..502	R/W	LONG	——	0 ~ 46	Digital Input 6 Function (MU6)	
40503..504	R/W	LONG	——	0 ~ 46	Digital Input 7 Function (MU7)	
40505..506	R/W	LONG	——	0 ~ 46	Digital Input 8 Function (MU8)	
40507..508	R/W	LONG	——	0 ~ 46	Digital Input 9 Function (MU9)	
40509..510	R/W	LONG	——	0 ~ 46	Digital Input 10 Function (MUA)	
40511	R/W	SHORT			Reserved	
40512	R/W	SHORT			Reserved	
40513	R/W	SHORT			Reserved	
40514	R/W	SHORT			Reserved	
40515	R/W	SHORT			Reserved	
40516	R/W	SHORT			Reserved	
40517	R/W	SHORT			Reserved	

11.5.7 M56S Series—P5 Group(I/O)						
Register	Access	Data Type	Units	Range	Description	SCL Register
40518	R/W	SHORT			Reserved	
40519..520	R/W	LONG	——	0 ~ 36	Digital Output 1 Function (MO1)	
40521..522	R/W	LONG	——	0 ~ 36	Digital Output 2 Function (MO2)	
40523..524	R/W	LONG	——	0 ~ 36	Digital Output 3 Function (MO3)	
40525..526	R/W	LONG	——	0 ~ 36	Digital Output 4 Function (MO4)	
40527..528	R/W	LONG	——	0 ~ 36	Digital Output 5 Function (MO5)	
40529..530	R/W	LONG	——	0 ~ 36	Digital Output 6 Function (MO6)	
40531	R/W	SHORT			Reserved	
40532	R/W	SHORT			Reserved	
40533	R/W	SHORT			Reserved	
40534	R/W	SHORT			Reserved	
40535	R/W	SHORT			Reserved	
40536	R/W	SHORT			Reserved	
40537	R/W	SHORT			Reserved	
40538	R/W	SHORT			Reserved	
40539..540	R/W	LONG	ms	0 ~ 32000	Move Command Waiting Time When Brake Release (BD)	
40541..542	R/W	LONG	ms	0 ~ 32000	Servo-off Brake Engage Waiting Time (BE)	
40543..544	R/W	LONG			Reserved	
40545..546	R/W	LONG	——	0 ~ 10	Home Sensor (HX)	
40547..548	R/W	LONG	ms	0 ~ 8000	Digital Input 1 Filter (FI1)	
40549..550	R/W	LONG	ms	0 ~ 8000	Digital Input 2 Filter (FI2)	
40551..552	R/W	LONG	ms	0 ~ 8000	Digital Input 3 Filter (FI3)	
40553..554	R/W	LONG	ms	0 ~ 8000	Digital Input 4 Filter (FI4)	
40555..556	R/W	LONG	ms	0 ~ 8000	Digital Input 5 Filter (FI5)	
40557..558	R/W	LONG	ms	0 ~ 8000	Digital Input 6 Filter(FI6)	

11.5.7 M56S Series—P5 Group(I/O)						
Register	Access	Data Type	Units	Range	Description	SCL Register
40559..560	R/W	LONG	ms	0 ～ 8000	Digital Input 7 Filter (FI7)	
40561..562	R/W	LONG	ms	0 ～ 8000	Digital Input 8 Filter (FI8)	
40563..564	R/W	LONG	ms	0 ～ 8000	Digital Input 9 Filter (FI9)	
40565..566	R/W	LONG	ms	0 ～ 8000	Digital Input 10 Filter (FIA)	
40567..568	R/W	LONG	pulses	0 ～ 2147483647	Dynamic Follow Error Threshold (PL)	
40569..570	R/W	LONG	pulses	0 ～ 32000	In-position Output Threshold (PD)	
40571..572	R/W	LONG	ms	0 ～ 32000	Time Constant of Motion Output Condition (PE)	
40573..574	R/W	LONG	ms	0 ～ 20000	Pulse Complete Timing (TT)	
40575..576	R/W	LONG	1/240rps	24 ～ 480	Zero Speed Width (ZV)	
40577..578	R/W	LONG	1/240rps	24 ～ 24000	Speed Coincidence Width (VR)	
40579..580	R/W	LONG	1/240rps	0 ～ 24000	Target Value of AT-speed (VV)	
40581..582	R/W	LONG	0.1%	0 ～ 3000	Torque Arrival Width (TV)	
40583..584	R/W	LONG	pulses	-2147483647 ～ 2147483647	Near Target Position (DG)	
40585..586	R/W	LONG	pulses	-2147483647 ～ 2147483647	Positive Software Limit (LP)	
40587..588	R/W	LONG	pulses	-2147483647 ～ 2147483647	Negative Software Limit (LM)	
40589..590	R/W	LONG	——	-4 ～ 35	Homing Method (HE)	

11.6 Alarm Code and Status Code of M56S:

11.6.1 Servo M56S Drive Alarming Code (Main Code) Table

Register	Bit	Explanation		Bit	Explanation
40001 40002	0	***Position Error out of Limit***		16	Drive main Circuit Power Input Phase Loss
	1	CCW Direction Limit Prohibited		17	***STO Prohibited***
	2	CW Direction Limit Prohibited		18	Reserve
	3	***Overtemperature***		19	***Motor Velocity exceeds Limit***
	4	***Internal Error***		20	Drive under Voltage
	5	***Power Voltage over Range***		21	***Emergency Stop***
	6	Reserve		22	***Second Encoder not connected***
	7	***Drive over Current***		23	***Full closed-loop Hybrid Deviation Over Limit***
	8	Reserve		24	Absolute Encoder Battery under Voltage
	9	***Motor Encoder not connected***		25	Absolute Position Loss
	10	Abnormal Communication		26	Absolute Position Overflow
	11	Reserve		27	Reserve
	12	Release Failure		28	***Absolute Encoder Multi-turn Error***
	13	Motor heavy Load Protection		29	***Abnormal Motor Action Protection***
	14	Reserve		30	***EtherCAT Communication Error***
	15	Abnormal Start Alarm		31	Homing Parameter Configuration Error

11.6.2 M56S Drive Alarming Code (auxiliary code) Table

Register (40001..02) Bit	Explanation	Register (40067..68) Bit	Explanation
3	***Overtemperature***	*5*	***Drive Processor over Temperature***
		6	***Drive Power Module over Temperature***
		7	***Motor over Temperature***
4	***Internal Error***	*8*	***Parameter read Failure***
		9	***Inside Voltage Error***
		10	***Reserve function and keep "0"***
		11	***Reserve function and keep "0"***
		12	***FPGA Error***
		13	***Parameter Save Failure***
		14	***Motor Encode Communication Error***
5	***Power Voltage over Scope***	*15*	***Drive over Voltage***
		16	***Drive Low Voltage***
7	***Over-current***	*2*	***Low-end over Current***
		3	***High-end over Current***
		4	***Reading over Current***
15	Abnormal Start Warning	17	The motor commands its operation when it is not enabled.
		18	The motor commands its operation when it is not enabled.
		19	I/O Signal Function Multiplex
29	***Motor Movement Abnormal Protection***	*24*	***Motor Locked-rotor Protection***
		25	***Motor Anti-collision Protection***

12 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				

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