MDX+RC Series

CANopen/RS485/Pulse

DC Servo System

Hardware Manual

Applied Motion Products
A MOONS' COMPANY

920-0167 RevC
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Contents

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1 Introduction

1.1 About this Manual

This manual describes the MDX+ Servo motor.

It provides the information required for installation, configuration and basic operation of the MDX+ series motor.

This document is intended for persons who are qualified to transport, assemble, commission, and maintain the equipment described herein.

1.2 Documentation Set for MDX+ R/C Series Servo Motor

This manual is part of a documentation set. The entire set consists of the following:

- MDX+ R/C Series Hardware Manual. This includes hardware installation, configuration and operation.
- MDX+ CANopen User manual. This introduces the drive CANopen protocol functions.
- MDX+ Modbus Communication User Manual. This introduces the drive Modbus protocol functions.
- Luna Software user manual.

1.3 Safety

Only qualified persons may perform the installation procedures. The following explanations are for things that must be observed in order to prevent harm to people and damage to property.

MDX+ utilizes hazardous voltages. Be sure the drive is properly grounded.

Before you install the MDX+, review the safety instructions in this manual.

Failure to follow the safety instructions may result in personal injury or equipment damage.

1.4 Safety Symbols

Safety symbols indicate a potential for personal injury or equipment damage if the recommended precautions and safe operating practices are not followed.

The following safety-alert symbols are used on the drive and in the documentation:

Caution   Dangerous Voltage   Earth   Caution, Hot Surface

1.5 Safety Precautions

1.5.1 Storage

Note the following when storing:

- ◆ Put this motor in the packaging box and store it in a dry, dust-free place away from direct sunlight.
- ◆ Storage environment temperature is between -20 ºC to +65 ºC
- ◆ The storage environment humidity is within the range of 10% to 85%, and there is no condensation.
- ◆ Avoid storage in corrosive gas environment

1.5.2 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.
◆ DO NOT use cables soaked in water or oil.
◆ DO NOT stress the cables to avoid potential hazards, including electric leakage resulting ◆ from cable damage.
◆ Avoid metal chips and other conductive objects from entering the drive connectors during installation.
◆ DO NOT impact motor during installation, as to not damage the motor shaft or the internal [optical] ◆ encoder.

1.5.3 Wiring

◆ Use the specified power supply voltage
◆ Insert only one wire into one wire insertion hole of the terminal block.
◆ Tighten the fixing screws of the power supply terminals, to prevent wire coming loose and causing electrilcal damage.
◆ DO NOT frequently switch the MDX main power supply. If repeated power supply switching is necessary, ensure it occurs less than 1 time per minute.
◆ Use multi-stranded twisted-pair wires or multi-core shielded-pair wires for signal cable.
◆ Avoid bundling main power cables and I/O signal cables together.
◆ When inserting the wire, do not short-circuit adjacent wire.
◆ Ensure the motor and power supply are well gounded.
◆ Ensure all wires are securely connected before powering up.

1.5.4 Pilot Run

◆ DO NOT touch the rotating shaft when the motor is running.
◆ In the first test run disconnect the coupling or belt of the mechanical equipment to ensure the motor operates without any load.
◆ Incorrect parameters will cause abnormal operation under load.
◆ The temperature of the drive heat sink, motor, and external regenerative resistor will rise during operation, avoid touching.
◆ Before the machine starts to run, confirm whether the emergency stop device can be activated at any time
◆ Use servo motors with brakes on vertical loads to prevent equipment from falling when alarms, failures, or power failures occur.

1.6 Certified Specifications

MDX+Series servo products are designed to meet the following standards.

	Drive	Motor
EMC Directive	EN 61800-3	EN 55011
		EN 55014-1
		EN 55014-2
		EN 6100-3-2
		EN 6100-3-3
LVD	EN 61800-5-1	EN 60034-1
		EN 60034-5
Functional Safety (STO)	UL61800-5-2(SIL 3)	
	IEC61508	
	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 Cycle

The normal use conditions of the servo are as follows: Annual average ambient temperature: 30 °C, Average load rate: below 80% , Daily running time: less than 20 hours

The items for daily inspection are as follows:

Inspection cycle	Check item
Daily	◆ Check the ambient temperature, humidity, dust, foreign matter, and condensation
	◆ Any abnormal vibration or noise
	◆ Voltage
	◆ Peculiar smell
	◆ Are there any foreign objects in the openings?
	◆ Loose connectors
	◆ Whether there is foreign matter between the cable and the connector, and whether the cable conductor is exposed
	◆ Loose fasteners

2 Product Introduction

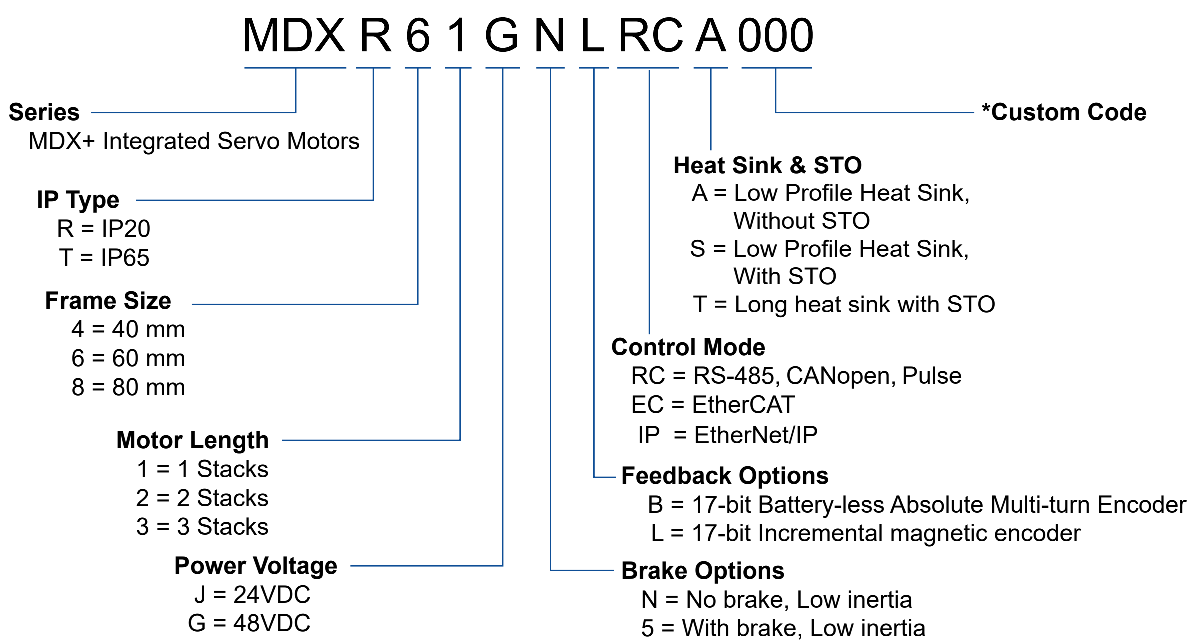
2.1 Unpacking Check

Refer to the following chapters to confirm the motor model.

A complete and operable servo system should include the following parts:

- Power cable for motor power supply (sold separately for IP65 models)
- Connector for I/O port (standard for IP20 models, sold separately for IP65 models)
- 3m communication cable for COM1 and COM2 ports, used for CANopen or RS485 communication (standard for IP20 models, sold separately for IP65 models.)

2.2 Part Numbering System



2.3 MDX+ Drive Specifications

2.3.1 40mm Specification

<table>
<tr><th colspan="3">Model</th><th>MDXR42J□◇RC★000</th><th>MDXT42J□◇RC★000</th></tr>
<tr><td colspan="3">IP Level</td><td>IP20</td><td>IP65</td></tr>
<tr><td colspan="3">Rated Output Power (3000rpm)</td><td>100W</td><td>100W</td></tr>
<tr><td rowspan="2">Main Power</td><td colspan="2">Input voltage range</td><td colspan="2">24V ~ 60VDC</td></tr>
<tr><td colspan="2">Recommended input voltage</td><td colspan="2">24VDC</td></tr>
<tr><td>Auxiliary Power</td><td colspan="2">Input voltage range</td><td colspan="2">24VDC±10%</td></tr>
<tr><td colspan="3">Insulation withstand voltage</td><td colspan="2">Primary to earth: withstand 500 VDC, 1 min</td></tr>
<tr><td rowspan="4">Environment</td><td colspan="2">Temperature</td><td colspan="2">◆ Ambient temperature: 0°C ~ 50°C (If the ambient temperature of motor is higher than 45°C, install the drive in a well-ventilated location)
◆ Storage temperature: -20°C ~ 65°C</td></tr>
<tr><td colspan="2">Humidity</td><td colspan="2">Both operating and storage : 10 ~ 85%RH or less</td></tr>
<tr><td colspan="2">Altitude</td><td colspan="2">Lower than 1000m</td></tr>
<tr><td colspan="2">Vibration</td><td colspan="2">$49 m/s^2$ or less, 10 ~ 60Hz (Do not use continuously at resonance frequency)</td></tr>
<tr><td colspan="3">Encoder Feedback</td><td colspan="2">◆ 17-bit Battery-less absolute encoder
◆ 17-bit Incremental magnetic encoder</td></tr>
<tr><td rowspan="5">I/O</td><td rowspan="2">Digital Signal</td><td>Input</td><td>◆ 4 Configurable optically isolate digital inputs, 24VDC, 20mA</td><td>◆ 2 Configurable optically isolate digital inputs, 24VDC, 20mA</td></tr>
<tr><td>Output</td><td>◆ 3 Configurable optically isolate digital outputs, Max.30VDC, 30mA</td><td>◆ 2 Configurable optically isolate digital outputs, Max.30VDC, 30mA</td></tr>
<tr><td>Analog Signal</td><td>Input</td><td colspan="2">1 Analog input, (-10 ~ +10V, 12-bit)</td></tr>
<tr><td rowspan="2">Pulse Signal</td><td>Input</td><td>◆ 2 Channels 5V pulse inputs, min. pulse width 250ns, max. pulse frequency 500KHz
or
◆ 2 Channels 24V pulse inputs, minimum pulse width 1μs, max. Pulse frequency 500KHz</td><td>◆ 24V pulse inputs, minimum pulse width 1μs, max. Pulse frequency 500KHz</td></tr>
<tr><td>Output</td><td>◆ 3 Line Driver outputs, encoder A±, B±, Z± feedback frequency division output</td><td>N/A</td></tr>
<tr><td rowspan="3">Communication</td><td colspan="2">USB Mini</td><td colspan="2">Connection with PC for configuration</td></tr>
<tr><td colspan="2">CANopen</td><td colspan="2">CANopen</td></tr>
<tr><td colspan="2">RS-485</td><td colspan="2">Modbus/RTU</td></tr>
<tr><td colspan="3">Status LED</td><td colspan="2">Red and green status LED</td></tr>
<tr><td colspan="3">Control Mode</td><td colspan="2">◆ CANopen:
CiA 402, PP, PV, PVT, TQ and HM
◆ Modbus/RTU:
Command position mode, command speed mode, command torque mode</td></tr>
<tr><td colspan="3">Control Input Signal</td><td colspan="2">Alarm clear input, CW/CCW Limit, Homing switch, gain switch, zero speed clamp, emergency stop, CW/CCW torque limit, speed limit, general input</td></tr>
<tr><td colspan="3">Control Output Signal</td><td colspan="2">Fault output (error), warning output (alarm), Servo-Ready, speed reached, torque reached, position reached, Servo-ON status output, dynamic following error output, zero speed signal, speed consistent, torque consistent, speed limit, torque limit, software limit (forward rotation, reverse rotation), general output</td></tr>
<tr><td colspan="3">Protection</td><td colspan="2">Over current, over voltage, under voltage, over temperature, encoder feedback error, current foldback, excessive speed, position error, emergency stop, forward/reverse limit, communication error</td></tr>
<tr><td colspan="3">Dynamic Brake</td><td colspan="2">Built in</td></tr>
<tr><td colspan="3">STO*1</td><td colspan="2">Built in, SIL3</td></tr>
<tr><td colspan="3">Certification</td><td colspan="2">RoHS, CE, UL pending</td></tr>
</table>

□: Indicates whether there is a brake, refer to the MDX+ Part Numbering System
◇: Indicates encoder types, refer to the MDX+ Part Numbering System
★: Indicates whether there is a STO, refer to the MDX+ Part Numbering System

*1: This means that some models do not support STO function. Refer to the MDX+ Part Numbering System.

2.3.2 60mm Specification

Model			MDXR61G□◇RC★000	MDXR62G□◇RC★000	MDXT61G□◇RC★000	MDXT62G□◇RC★000
IP Level			IP20		IP65	
Rated Output Power (3000rpm)			200W	400W	200W	400W
Main Power	Input voltage range		24V ~ 60VDC			
	Recommended input voltage		48VDC			
Auxiliary Power	Input voltage range		24VDC±10%			
Insulation withstand voltage			Primary to earth: withstand 500 VDC, 1 min			
Environment	Temperature		◆ Ambient temperature: 0°C ~ 50°C (If the ambient temperature of motor is higher than 45°C, 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		Lower than 1000m			
	Vibration		49m/s² or less, 10 ~ 60Hz (Do not use continuously at resonance frequency)			
Encoder Feedback			◆ 17-bit Battery-less absolute encoder ◆ 17-bit Incremental magnetic encoder			
I/O	Digital Signal	Input	◆ 4 Configurable optically isolate digital inputs, 24VDC, 20mA		◆ 2 Configurable optically isolate digital inputs, 24VDC, 20mA	
		Output	◆ 3 Configurable optically isolate digital outputs, Max.30VDC, 30mA		◆ 2 Configurable optically isolate digital outputs, Max.30VDC, 30mA	
	Analog Signal	Input	1 Analog input, (-10 ~ +10V, 12-bit)			
	Pulse Signal	Input	◆ 2 Channels 5V pulse inputs, min. pulse width 250ns, max. pulse frequency 500KHz or ◆ 2 Channels 24V pulse inputs, minimum pulse width 1μs, max. Pulse frequency 500KHz		◆ 24V pulse inputs, minimum pulse width 1μs, max. Pulse frequency 500KHz	
		Output	◆ 3 Line Driver outputs, encoder A±, B±, Z± feedback frequency division output		N/A	
Communication	USB Mini		Connection with PC for configuration			
	CANopen		CANopen			
	RS-485		Modbus/RTU			
Status LED			Red and green status LED			
Control Mode			◆ CANopen: CiA 402, PP, PV, PVT, TQ and HM ◆ Modbus/RTU: Command position mode, command velocity mode, command torque mode			
Control Input Signal			Alarm clear input, CW/CCW Limit, Homing switch, gain switch, zero speed clamp, emergency stop, CW/CCW torque limit, speed limit, general input			
Control Output Signal			Fault output (error), warning output (alarm), Servo-Ready, speed reached, torque reached, position reached, Servo-ON status output, dynamic following error output, zero speed signal, speed consistent, torque consistent, speed limit, torque limit, software limit (forward rotation, reverse rotation), general output			
Protection			Over current, over voltage, under voltage, over temperature, encoder feedback error, current foldback, excessive speed, position error, emergency stop, forward/reverse limit, communication error			
Dynamic Brake			Built in			
STO*1			Built in			
Certification			RoHS, CE			

□: Indicates whether there is a brake, refer to the MDX+ Part Numbering System
◇: Indicates encoder types, refer to the MDX+ Part Numbering System
★: Indicates whether there is a STO, refer to the MDX+ Part Numbering System

*1: This means that some models do not support STO function. Refer to the MDX+ Part Numbering System.

2.3.3 80mm Specification

<table>
<tr><th colspan="3">Model</th><th>MDXR82G□◇RC★000</th><th>MDXT82G□◇RC★000</th></tr>
<tr><td colspan="3">IP Level</td><td>IP20</td><td>IP65</td></tr>
<tr><td colspan="3">Rated Output Power (3000rpm)</td><td>550W</td><td>550W</td></tr>
<tr><td rowspan="2">Main Power</td><td colspan="2">Input voltage range</td><td colspan="2">24V ~ 60VDC</td></tr>
<tr><td colspan="2">Recommended input voltage</td><td colspan="2">48VDC</td></tr>
<tr><td>Auxiliary Power</td><td colspan="2">Input voltage range</td><td colspan="2">24VDC±10%</td></tr>
<tr><td colspan="3">Insulation withstand voltage</td><td colspan="2">Primary to earth: withstand 500 VDC, 1 min</td></tr>
<tr><td rowspan="4">Environment</td><td colspan="2">Temperature</td><td colspan="2">◆ Ambient temperature: 0°C ~ 50°C (If the ambient temperature of motor is higher than 45°C, install the drive in a well-ventilated location)
◆ Storage temperature: -20°C ~ 65°C</td></tr>
<tr><td colspan="2">Humidity</td><td colspan="2">Both operating and storage : 10 ~ 85%RH or less</td></tr>
<tr><td colspan="2">Altitude</td><td colspan="2">Lower than 1000m</td></tr>
<tr><td colspan="2">Vibration</td><td colspan="2">$49 m/s^2$ or less, 10 ~ 60Hz (Do not use continuously at resonance frequency)</td></tr>
<tr><td colspan="3">Encoder Feedback</td><td colspan="2">◆ 17-bit Battery-less absolute encoder
◆ 17-bit Incremental magnetic encoder</td></tr>
<tr><td rowspan="5">I/O</td><td rowspan="2">Digital Signal</td><td>Input</td><td>◆ 4 Configurable optically isolated digital inputs, 24VDC, 20mA</td><td>◆ 2 Configurable optically isolate digital inputs, 24VDC, 20mA</td></tr>
<tr><td>Output</td><td>◆ 3 Configurable optically isolate digital outputs, Max.30VDC, 30mA</td><td>◆ 2 Configurable optically isolate digital outputs, Max.30VDC, 30mA</td></tr>
<tr><td>Analog Signal</td><td>Input</td><td colspan="2">1 Analog input, (-10 ~ +10V, 12-bit)</td></tr>
<tr><td rowspan="2">Pulse Signal</td><td>Input</td><td>◆ 2 Channels 5V pulse inputs, min. pulse width 250ns, max. pulse frequency 500KHz
or
◆ 2 Channels 24V pulse inputs, minimum pulse width 1μs, max. Pulse frequency 500KHz</td><td>◆ 24V pulse inputs, minimum pulse width 1μs, max. Pulse frequency 500KHz</td></tr>
<tr><td>Output</td><td>◆ 3 Line Driver outputs, encoder A±, B±, Z± feedback frequency division output</td><td>N/A</td></tr>
<tr><td rowspan="3">Communication</td><td colspan="2">USB Mini</td><td colspan="2">Connection with PC for configuration</td></tr>
<tr><td colspan="2">CANopen</td><td colspan="2">CANopen</td></tr>
<tr><td colspan="2">RS-485</td><td colspan="2">Modbus/RTU</td></tr>
<tr><td colspan="3">Status LED</td><td colspan="2">Red and green status LED</td></tr>
<tr><td colspan="3">Control Mode</td><td colspan="2">CANopen:
CiA 402, PP, PV, PVT, TQ and HM
◆ Modbus/RTU:
Command position mode, command velocity mode, command torque mode</td></tr>
<tr><td colspan="3">Control Input Signal</td><td colspan="2">Alarm clear input, CW/CCW Limit, Homing switch, gain switch, zero speed clamp, emergency stop, CW/CCW torque limit, speed limit, general input</td></tr>
<tr><td colspan="3">Control Output Signal</td><td colspan="2">Fault output (error), warning output (alarm), Servo-Ready, speed reached, torque reached, position reached, Servo-ON status output, dynamic following error output, zero speed signal, speed consistent, torque consistent, speed limit, torque limit, software limit (forward rotation, reverse rotation), general output</td></tr>
<tr><td colspan="3">Protection</td><td colspan="2">Over current, over voltage, under voltage, over temperature, encoder feedback error, current foldback, excessive speed, position error, emergency stop, forward/reverse limit, communication error</td></tr>
<tr><td colspan="3">Dynamic Brake</td><td colspan="2">Built in</td></tr>
<tr><td colspan="3">STO*1</td><td colspan="2">SIL3</td></tr>
<tr><td colspan="3">Certification</td><td colspan="2">RoHS, CE, UL Pending</td></tr>
</table>

□: Indicates whether there is a brake, refer to the MDX+ Part Numbering System
◇: Indicates encoder types, refer to the MDX+ Part Numbering System
★: Indicates whether there is a STO, refer to the MDX+ Part Numbering System

*1: This means that some models do not support STO function. Refer to the MDX+ Part Numbering System.

2.4 40mm Motor Specification

2.4.1 IP20 Type

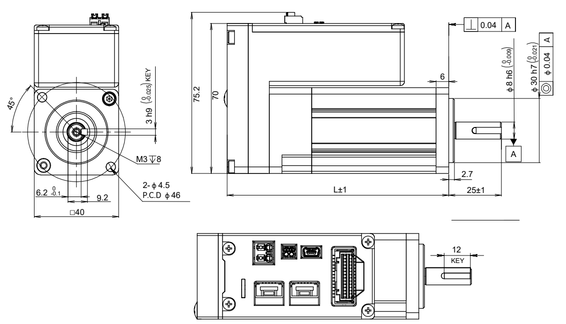
- **Frame Size:** 40mm
- **Power Rating:** 100W
- **6 Digital Inputs**
- **3 Digital Outputs**
- **1 Analog Inputs**

Model		MDXR42J□★RC: 000
Recommended Input Voltage	VDC	24
Rated Output Power (@ 3,000 RPM)	W	100
Rated Speed	rpm	3000
Max. Speed	rpm	4000
Rated Torque	N·m	0.32
Peak Torque	N·m	0.96
Rated Current	A (rms)	8.1
Peak Current	A (rms)	24.5
Voltage Constant±10%	V(rms) K rpm	2.53
Torque Constant±10%	Nm/A (rms)	0.042
Rotor Inertia	$kg.m^2$	0.0428×10^{-4}
Rotor Inertia-with Brake	$kg.m^2$	0.0457×10^{-4}
Shaft Load - Axial	N(max.)	50
Shaft Load - Radial (End of Shaft)	N(max.)	60
Mass	kg	MDXR42JNL◇RC★000: 0.7
		MDXR42J5LRC★000: 0.9
		MDXR42JNBRC★000: 0.8
		MDXR42J5BRC★000: 0.9

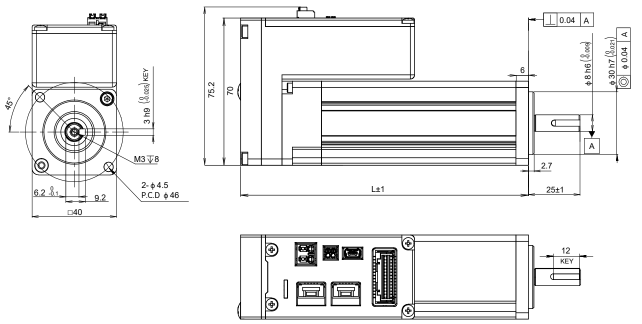
□: **Brake Options**; ◇: **Encoder Options**; ★: **STO Options**

Dimensions (Unit: mm)

1) Without Brake



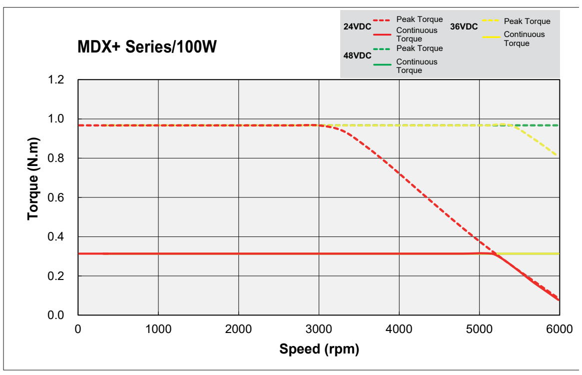
2) With Brake



Without Brake		L
MDXR42JNLRCA000	MDXR42JNLRCS000	105
MDXR42JNBRCA000	MDXR42JNBRCS000	115

With Brake		L
MDXR42J5LRCA000	MDXR42J5LRCS000	140
MDXR42J5BRCA000	MDXR42J5BRCS000	150

Torque Curves



2.4.2 IP65 Type

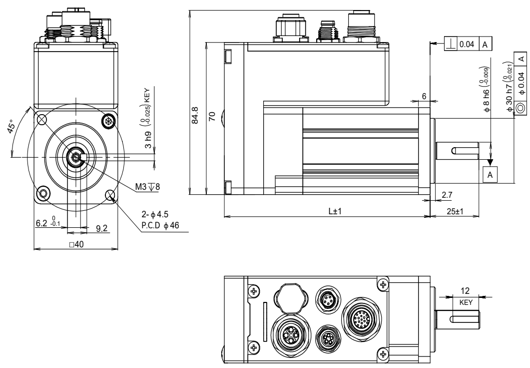
- **Frame Size:** 40mm
- **Power Rating:** 100W
- **4 Digital Inputs**
- **2 Digital Outputs**
- **1 Analog Inputs**

Model		MDXT42J□★RC:000
Recommended Input Voltage	VDC	24
Rated Output Power (@ 3,000 RPM)	W	100
Rated Speed	rpm	3000
Max. Speed	rpm	4000
Rated Torque	N·m	0.32
Peak Torque	N·m	0.96
Rotor Inertia	kg.m^2	0.0428 x 10^{-4}
Rated Current	A (rms)	8.1
Peak Current	A (rms)	24.5
Voltage Constant±10%	V(rms) K rpm	2.53
Torque Constant±10%	Nm/A (rms)	0.042
Rotor Inertia-with Brake	kg.m^2	0.0457 x 10^{-4}
Shaft Load - Axial	N(max.)	50
Shaft Load - Radial (End of Shaft)	N(max.)	60
Mass	kg	MDXT42JN◇RC★000: 0.7
		MDXT42JLBRC★000: 1.1
		MDXT42J5BRC★000: 1.3

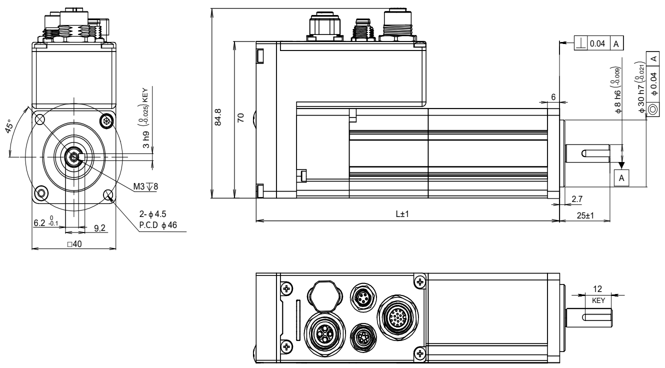
□: Brake Options; ◇: Encoder Options; ★: STO Options

Dimensions (Unit: mm)

1) Without Brake



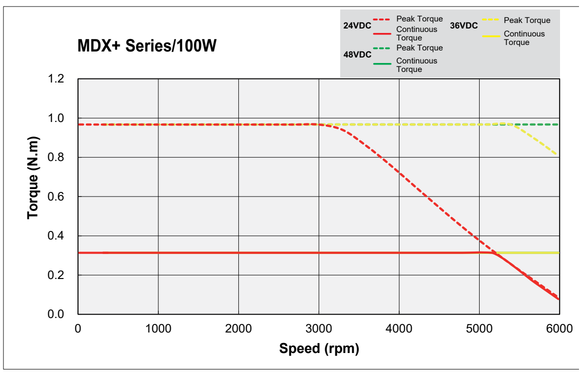
2) With Brake



Without Brake		L
MDXT42JNLRCA000	MDXT42JNLRCS000	105
MDXT42JNBRCA000	MDXT42JNBRCS000	115

With Brake		L
MDXT42J5LRCA000	MDXT42J5LRCS000	140
MDXT42J5BRCA000	MDXT42J5BRCS000	150

Torque Curves



2.5 60mm Motor Specification

2.5.1 IP20 Type

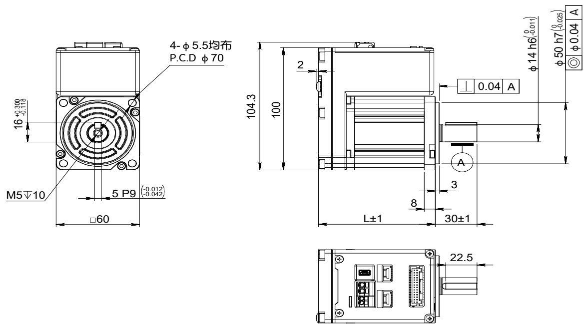
- **Frame Size:** 60mm
- **Power Rating:** 200W, 400W
- **6 Digital Inputs**
- **3 Digital Outputs**
- **1 Analog Inputs**

Model		MDXR61G□◇RC★000	MDXR62G□◇RC★000
Recommended Input Voltage	VDC	48	48
Rated Output Power (@ 3,000 RPM)	W	200	400
Rated Speed	rpm	3000	3000
Max. Speed	rpm	6000	4000
Rated Torque	N·m	0.64	1.27
Peak Torque	N·m	1.9	3.8
Rated Current	A (rms)	10	10
Peak Current	A (rms)	30	30
Voltage Constant±10%	V(rms) K rpm	4.1	8.3
Torque Constant±10%	Nm/A (rms)	0.065	0.127
Rotor Inertia	$kg.m^2$	0.156×10^{-4}	0.272×10^{-4}
Rotor Inertia-with Brake	$kg.m^2$	0.162×10^{-4}	0.327×10^{-4}
Shaft Load - Axial	N(max.)	70	70
Shaft Load - Radial (End of Shaft)	N(max.)	200	240
Mass	kg	MDXR61GNLRC★000: 1.2	MDXR62GNLRC★000: 1.6
		MDXR61GNBRC★000: 1.4	MDXR62GNBRC★000: 1.9
		MDXR61G5◇RC★000: 1.8	MDXR62G5◇RC★000: 2.3

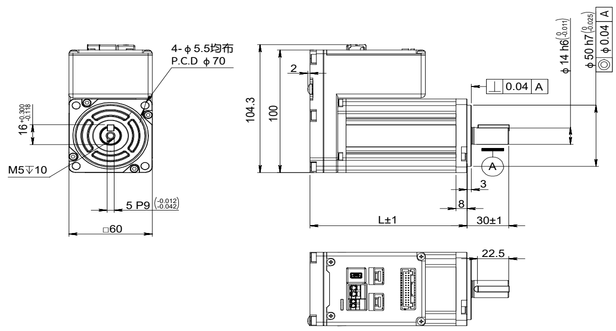
□: **Brake Options**; ◇: **Encoder Options**; ★: **STO Options**

Dimensions (Unit: mm)

1) Without Brake



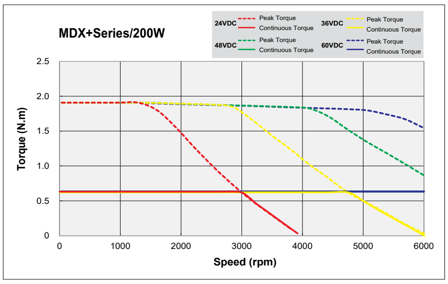
2) With Brake

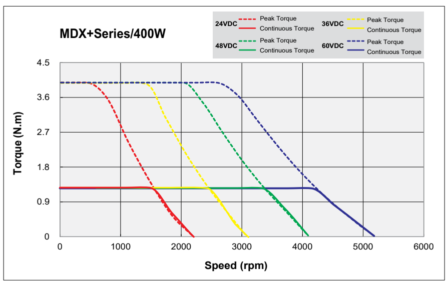


Without Brake		L
MDXR61GNLRCA000	MDXR61GNLRCS000	84
MDXR61GNBRCA000	MDXR61GNBRCS000	108.5
MDXR62GNLRCA000	MDXR62GNLRCS000	113
MDXR62GNBRCA000	MDXR62GNBRCS000	137.5

With Brake		L
MDXR61G5LRCA000	MDXR61G5LRCS000	148
MDXR61G5BRCA000	MDXR61G5BRCS000	148
MDXR62G5LRCA000	MDXR62G5LRCS000	177
MDXR62G5BRCA000	MDXR62G5BRCS000	177

Torque Curves





2.5.2 IP65 Type

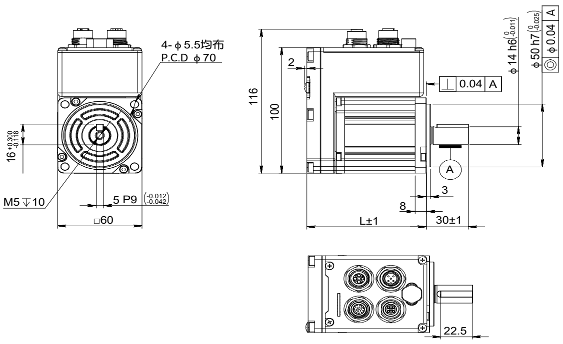
- **Frame Size:** 60mm
- **Power Rating:** 200W, 400W
- **4 Digital Inputs**
- **2 Digital Outputs**
- **1 Analog Inputs**

Model		MDXT61G□◇RC★000	MDXT62G□◇RC★000
Recommended Input Voltage	VDC	48	48
Rated Output Power (@ 3,000 RPM)	W	200	400
Rated Speed	rpm	3000	3000
Max. Speed	rpm	6000	4000
Rated Torque	N·m	0.64	1.27
Peak Torque	N·m	1.9	3.8
Rated Current	A (rms)	10	10
Peak Current	A (rms)	30	30
Voltage Constant±10%	V(rms) K rpm	4.1	8.3
Torque Constant±10%	Nm/A (rms)	0.065	0.127
Rotor Inertia	$kg.m^2$	0.156×10^{-4}	0.272×10^{-4}
Rotor Inertia-with Brake	$kg.m^2$	0.162×10^{-4}	0.327×10^{-4}
Shaft Load - Axial	N(max.)	70	70
Shaft Load - Radial (End of Shaft)	N(max.)	200	240
Mass	kg	MDXT61GNLRC★000: 1.3	MDXT62GNLRC★000: 1.8
		MDXT61G5LRC★000: 1.9	MDXT62G5LRC★000: 2.4
		MDXT61GNBRC★000: 1.4	MDXT62GNBRC★000: 2.0
		MDXT61G5BRC★000: 1.9	MDXT62G5BRC★000: 2.4

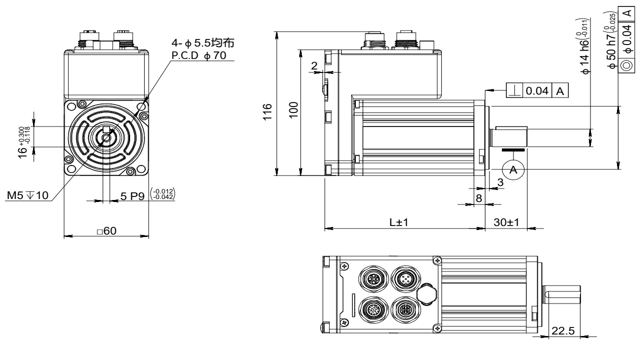
□: **Brake Options**; ◇: **Encoder Options**; ★: **STO Options**

Dimensions (Unit: mm)

1) Without Brake



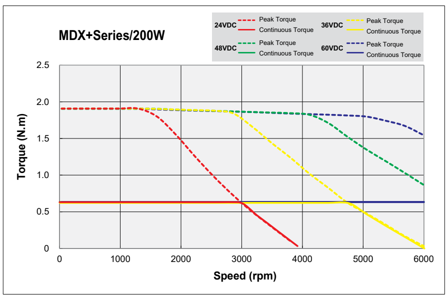
2) With Brake

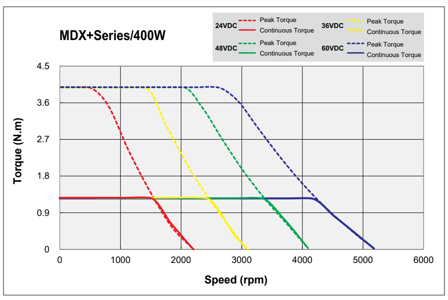


Without Brake		L
MDXT61GNLRCA000	MDXT61GNLRCS000	85
MDXT61GNBRCA000	MDXT61GNBRCS000	110.5
MDXT62GNLRCA000	MDXT62GNLRCS000	114
MDXT62GNBRCA000	MDXT62GNBRCS000	139.5

With Brake		L
MDXT61G5LRCA000	MDXT61G5LRCS000	150
MDXT61G5BRCA000	MDXT61G5BRCS000	150
MDXT62G5LRCA000	MDXT62G5LRCS000	179
MDXT62G5BRCA000	MDXT62G5BRCS000	179

Torque Curves





2.6 80mm Motor Specification

2.6.1 IP20 Type 550W

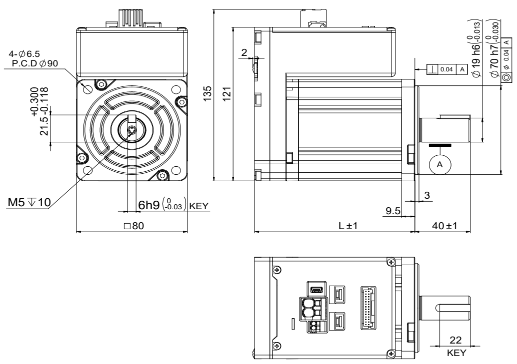
- **Frame Size:** 80mm
- **Power Rating:** 550W
- **6 Digital Inputs**
- **3 Digital Outputs**
- **1 Analog Inputs**

Model		MDXR82G□◇RC★000
Recommended Input Voltage	VDC	48
Rated Output Power (@ 3,000 RPM)	W	550
Rated Speed	rpm	3000
Max. Speed	rpm	3900
Rated Torque	N·m	1.8
Peak Torque	N·m	7.2
Rated Current	A (rms)	13.5
Peak Current	A (rms)	56
Voltage Constant±10%	V(rms) K rpm	8.8
Torque Constant±10%	Nm/A (rms)	0.138
Rotor Inertia	$kg.m^2$	0.85×10^{-4}
Rotor Inertia-with Brake	$kg.m^2$	0.927×10^{-4}
Shaft Load - Axial	N(max.)	90
Shaft Load - Radial (End of Shaft)	N(max.)	270
Mass	kg	MDXR82GNLRC★000: 2.6
		MDXR82GNBRC★000: 2.8
		MDXR82G5◇RC★000: 3.2

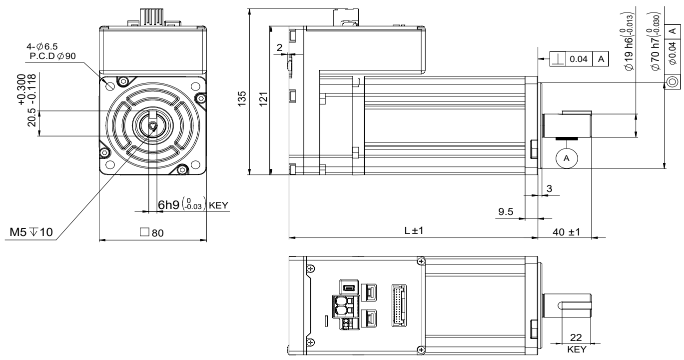
□: **Brake Options**; ◇: **Encoder Options**; ★: **STO Options**

Dimensions (Unit: mm)

1) Without Brake



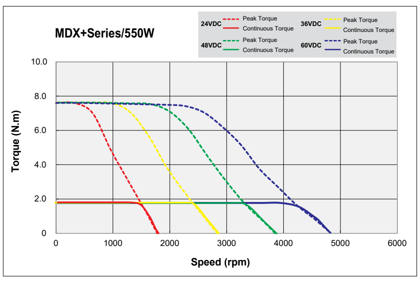
2) With Brake



Without Brake		L1
MDXR82GNLRCA000	MDXR82GNLRCS000	115.5
MDXR82GNBRCA000	MDXR82GNBRCS000	140

With Brake		L1
MDXR82G5LRCA000	MDXR82G5LRCS000	185.5
MDXR82G5BRCA000	MDXR82G5BRCS000	185.5

Torque Curves



2.6.2 IP65 Type 550W

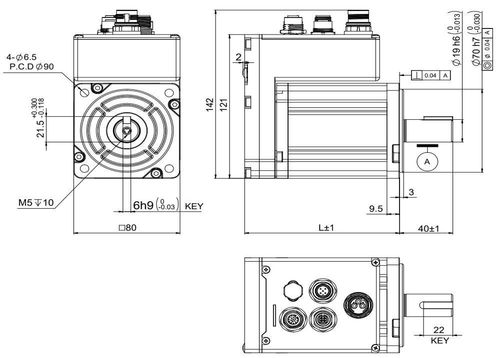
- **Frame Size:** 80mm
- **Power Rating:** 550W
- **4 Digital Inputs**
- **2 Digital Outputs**
- **1 Analog Inputs**

Model		MDXT82G□◇RC★000
Recommended Input Voltage	VDC	48
Rated Output Power (@ 3,000 RPM)	W	550
Rated Speed	rpm	3000
Max. Speed	rpm	3900
Rated Torque	N·m	1.8
Peak Torque	N·m	7.2
Rated Current	A (rms)	13.5
Peak Current	A (rms)	56
Voltage Constant±10%	V(rms) K rpm	8.8
Torque Constant±10%	Nm/A (rms)	0.138
Rotor Inertia	$kg.m^2$	0.85×10^{-4}
Rotor Inertia-with Brake	$kg.m^2$	0.927×10^{-4}
Shaft Load - Axial	N(max.)	90
Shaft Load - Radial (End of Shaft)	N(max.)	270
Mass	kg	MDXT82GNLRC★000: 2.6
		MDXT82GNBRC★000: 2.8
		MDXT82G5◇RC★000: 3.2

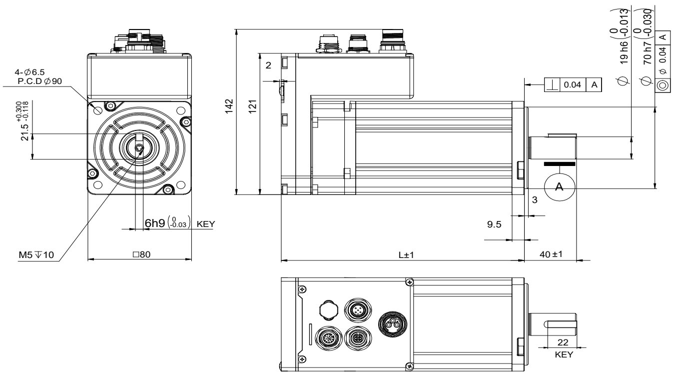
□: **Brake Options**; ◇: **Encoder Options**; ★: **STO Options**

Dimensions (Unit: mm)

1) Without Brake



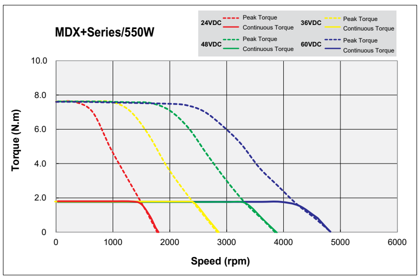
2) With Brake



Without Brake		L
MDXT82GNLRCA000	MDXT82GNLRCS000	116.5
MDXT82GNBRCA000	MDXT82GNBRCS000	141

With Brake		L
MDXT82G5LRCA000	MDXT82G5LRCS000	186.5
MDXT82G5BRCA000	MDXT82G5BRCS000	186.5

Torque Curves



2.6.3 IP20 Type 750W

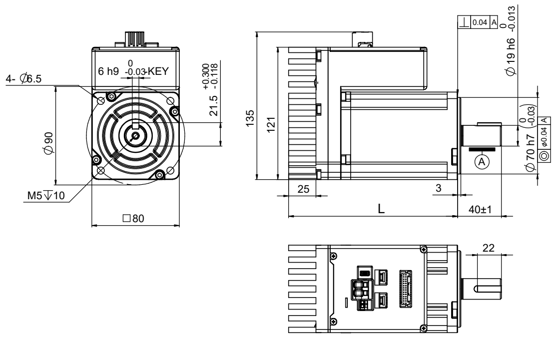
- **Frame Size: 80mm**
- **Power Rating: 750W**
- **6 Digital Inputs**
- **3 Digital Outputs**
- **1 Analog Inputs**

Model		MDXR83G□◇RC★000
Recommended Input Voltage	VDC	48
Rated Output Power (@ 3,000 RPM)	W	750
Rated Speed	rpm	3000
Max. Speed	rpm	3600
Rated Torque	N·m	2.4
Peak Torque	N·m	7.2
Rated Current	A (rms)	18.5
Peak Current	A (rms)	55
Voltage Constant±10%	V(rms) K rpm	8.8
Torque Constant±10%	Nm/A (rms)	0.138
Rotor Inertia	kg.m^2	1.06 x 10^{-4}
Rotor Inertia-with Brake	kg.m^2	1.14 x 10^{-4}
Shaft Load - Axial	N(max.)	90
Shaft Load - Radial (End of Shaft)	N(max.)	270
Mass	kg	MDXR83GNXRC★000: 3.0
		MDXR83G5XRC★000: 4.0
		MDXR83GNBRC★000: 3.2
		MDXR83G5BRC★000: 4.0

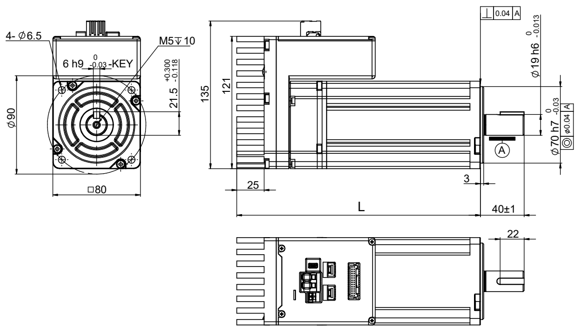
□: **Brake Options**◇: **Encoder Options** ★: **Heatsink and STO Options**

Dimensions (Unit: mm)

1) Without Brake



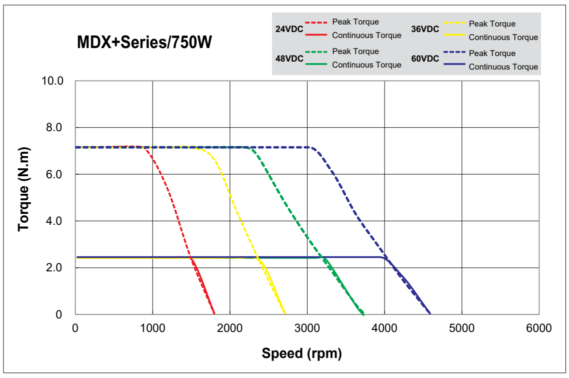
2) With Brake



Without Brake		L
MDXR83GNXRCB000	MDXR83GNXRCT000	154.5
MDXR83GNBRCB000	MDXR83GNBRCT000	180

With Brake		L
MDXR83G5XRCB000	MDXR83G5XRCT000	222.5
MDXR83G5BRCB000	MDXR83G5BRCT000	222.5

Torque Curves



2.6.4 IP65 Type 750W

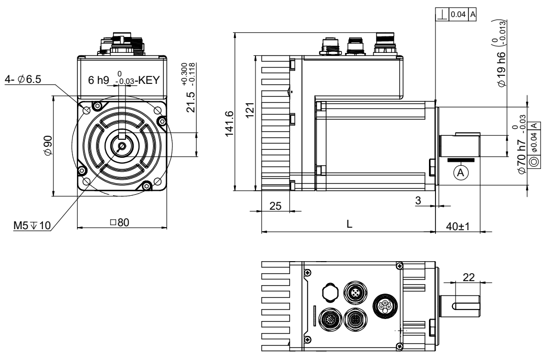
- **Frame Size: 80mm**
- **Power Rating: 750W**
- **4 Digital Inputs**
- **2 Digital Outputs**
- **1 Analog Inputs**

Model		MDXT83G□◇RC★000
Recommended Input Voltage	VDC	48
Rated Output Power (@ 3,000 RPM)	W	750
Rated Speed	rpm	3000
Max. Speed	rpm	3600
Rated Torque	N·m	2.4
Peak Torque	N·m	7.2
Rated Current	A (rms)	18.3
Peak Current	A (rms)	55
Voltage Constant±10%	V(rms) K rpm	8.8
Torque Constant±10%	Nm/A (rms)	0.138
Rotor Inertia	$kg.m^2$	1.06×10^{-4}
Rotor Inertia-with Brake	$kg.m^2$	1.14×10^{-4}
Shaft Load - Axial	N(max.)	90
Shaft Load - Radial (End of Shaft)	N(max.)	270
Mass	kg	MDXR83GNXRC★000: 3.0
		MDXR83G5XRC★000: 4.0
		MDXR83GNBRC★000: 3.2
		MDXR83G5BRC★000: 4.0

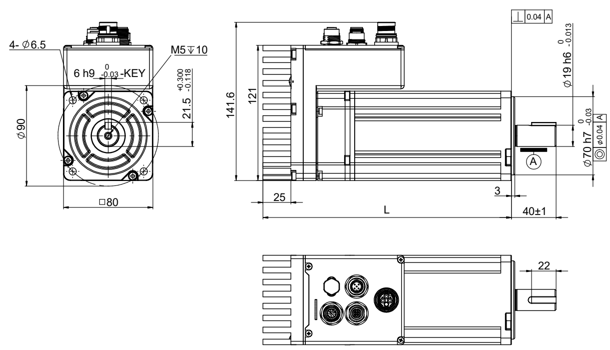
□: **Brake Options**◇: **Encoder Options** ★: **Heatsink and STO Options**

Dimensions (Unit: mm)

1) Without Brake



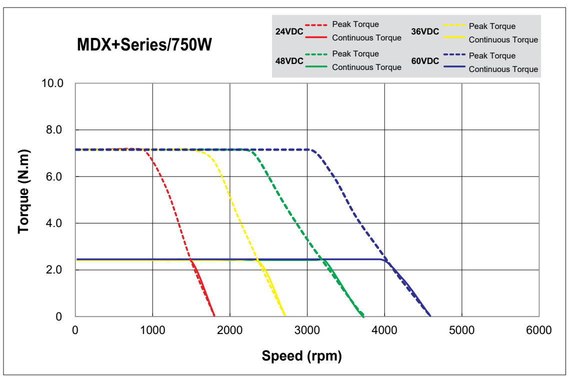
2) With Brake



Without Brake		L
MDXT83GNXRCB000	MDXT83GNXRCT000	155.5
MDXT83GNBRCB000	MDXT83GNBRCT000	180

With Brake		L
MDXT83G5XRCB000	MDXT83G5XRCT000	223.5
MDXT83G5BRCB000	MDXT83G5BRCT000	223.5

Torque Curves

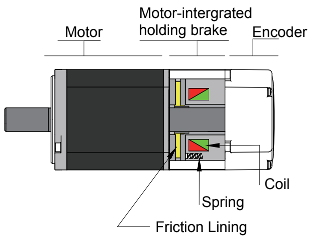


2.7 Brake Specifications

The motor brake is used to prevent the motor from rotating when the brake is power off. A common application of a motor brake is a veritcal application. Because the mechanism driven by the motor can be moved by gravity, it is necessary to have a holding brake that will activate should the motor fail. The holding brake will prevent the load from falling, avoiding damage to personnel or equipment.

When the brake is energized, the armature is retracted and the brake plate is released, and the motor can operate normally. When the brake is powered off, the armature will be re-applied. The brake plate becomes locked and the motor shaft can no longer rotate.

Frame Size	40mm	60mm	80mm
Static friction torque (Nm)	0.32	1.5	3.2
Rated Voltage (VDC)	24		
Power (W)(20 ºC)	6.3	7.2	9.6
Rated Current (A)	0.26	0.3	0.4
Brake Time	< 70ms (Standard air gap, at 20 ºC)		
Release Time	<25ms		
Release Voltage	18.5VDC max.(at 20 ºC)		



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

3 Installation

3.1 Storage Conditions

Note the following when storing:

- Correctly packaged and stored in a clean and dry place, avoid direct sunlight
- Store within an ambient temperature range of -20ºC~+70ºC
- Store within a relative humidity rang of 10% to 85% and non-condensing
- DO NOT store in a place subjected to corrosive gasses

3.2 Installation Conditions

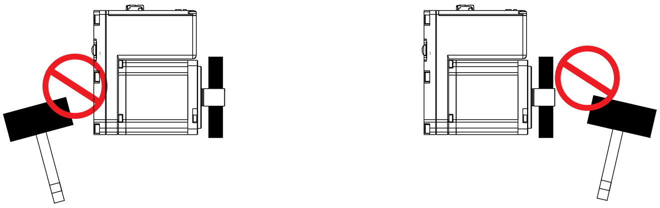
The motor operation ambient conditions are as follows:

- The permissible ambient temperature is 0ºC~50ºC. If the ambient temperature exceeds 45°C, place the motor in a well-ventilated place.
- Ambient humidity is 10%~85% RH, no condensation.
- Vibration below 9.8m/s^2, 10~60Hz (can not be used continuously at the resonance point).
- Do not use the motor near corrosive gas, flammable gas, or combustible materials.
- Do not install motors on equipment exposed to water or direct sunlight.
- Do not use the motor in a closed environment, the closed environment will cause the motor to reach high temperatures and shorten the service life.

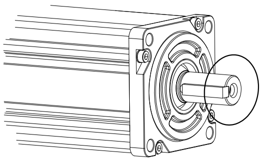
3.3 Motor Installation

3.3.1 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 load isolating coupler specially designed for servo motors, which can provide some cushioning during eccentricity or deflection.
- When installing the coupler, wipe clean the anti-rust oil on the output shaft end of the motor.
- When using the keyed shaft, use the standard key provided in the motor box.
- When installing a pulley on a servo motor with a keyway, use the threaded hole of the motor shaft to push the pulley into the motor shaft with a screw.



- When disassembling the pulley, use professional tools such as pulley remover to prevent the bearing from being damaged.
- 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, 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, check the condition of the motor shaft regularly every three months and add appropriate anti-rust grease in time.

3.3.2 Precautions for Using Motors in Oil and Water Environments

- Do not allow oil or water to enter the motor
- Do not put the cable in water or oil
- Since the the mounting face of the motor is not designed with IP65 protection, make sure that no water or oil intrudes from such parts
- An industrial oil seal for motors can block contaminants like oil and impurities to extend the motor's life. However, it is recommended to derate the motor by 30% as the seal may create some resistance to shaft rotation
- When installing the oil seal, make sure that the lip of the oil seal faces outwards

3.3.3 Wiring

- If you use cable drag chain, use bending resistant cable, and ensure that there is a bending diameter of 100mm or more.
- Do not twist the cable.
- When moving the motor, do not pull the cable.
- Do not use the same sleeve for the main circuit cable and the input/output signal cable/encoder cable, and do not tie them together; when wiring, the main circuit cable and the input/output signal cable/encoder cable should be separated by more than 30cm.

3.3.4 Motor Temperature Rise

The rated value of the servo motor power is the continuous allowable rating when it is installed on an Aluminum plate or heat sink and the operating environment temperature is 40°C. When the servo motor is installed on a small device, the heat dissipation area of the servo motor is reduced, so the temperature may rise significantly.

The size of the recommended heat sink when continously operating at rated performance is the following:

Frame Size	Power	Heatsink Dimension
40mm	100W	200*200*6 Aluminum
60mm	200W, 400W	250*250*6 Aluminum
80mm	550W, 750W	250*250*6 Aluminum

If the installation environment is difficult to use a large heatsink, or work in ambient temperature exceeding the specification requirements, you need to follow the following requirements:

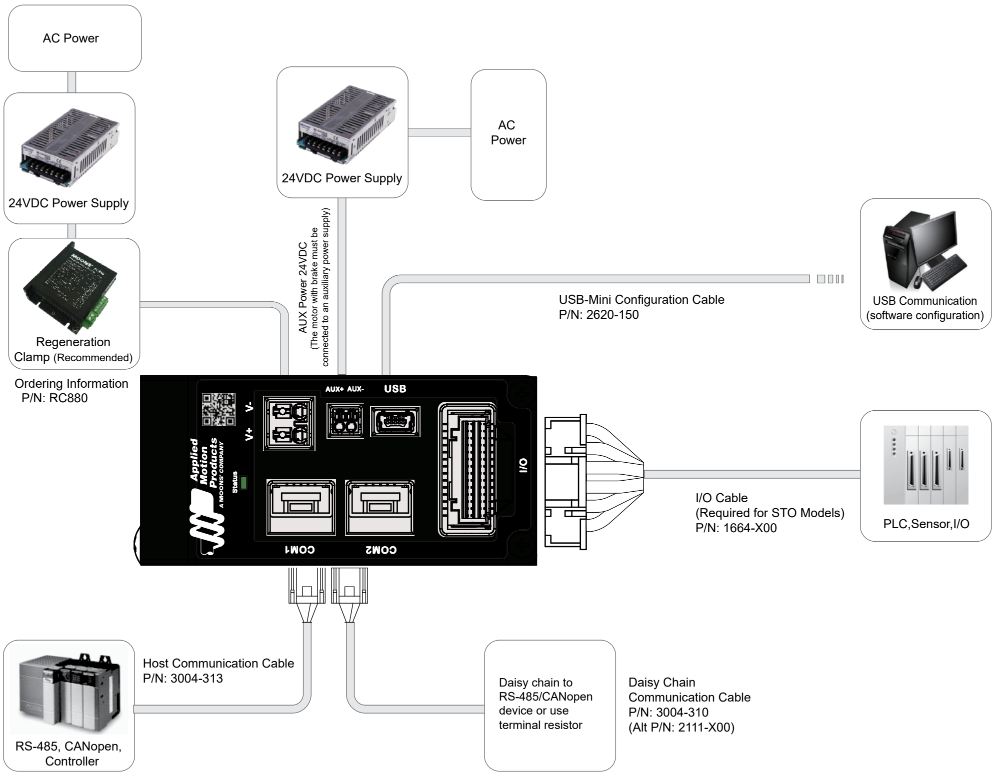
- Do not work at rated power, choose a motor that is 1 to 2 times larger than the actual motor power required
- Reduce the acceleration and deceleration of the working cycle to reduce the motor load
- Reduce the duty cycle of work
- Use a cooling fan or other methods to perform external forced air cooling of the servo motor
- When using a motor with an oil seal, the required load torque must be 70% of the rated torque of the motor

Note: Do not place any heat-insulating material between the servo motor and the metal heatsink, otherwise the motor cannot dissipate heat and cause the motor temperature to rise, which may cause the motor failure.

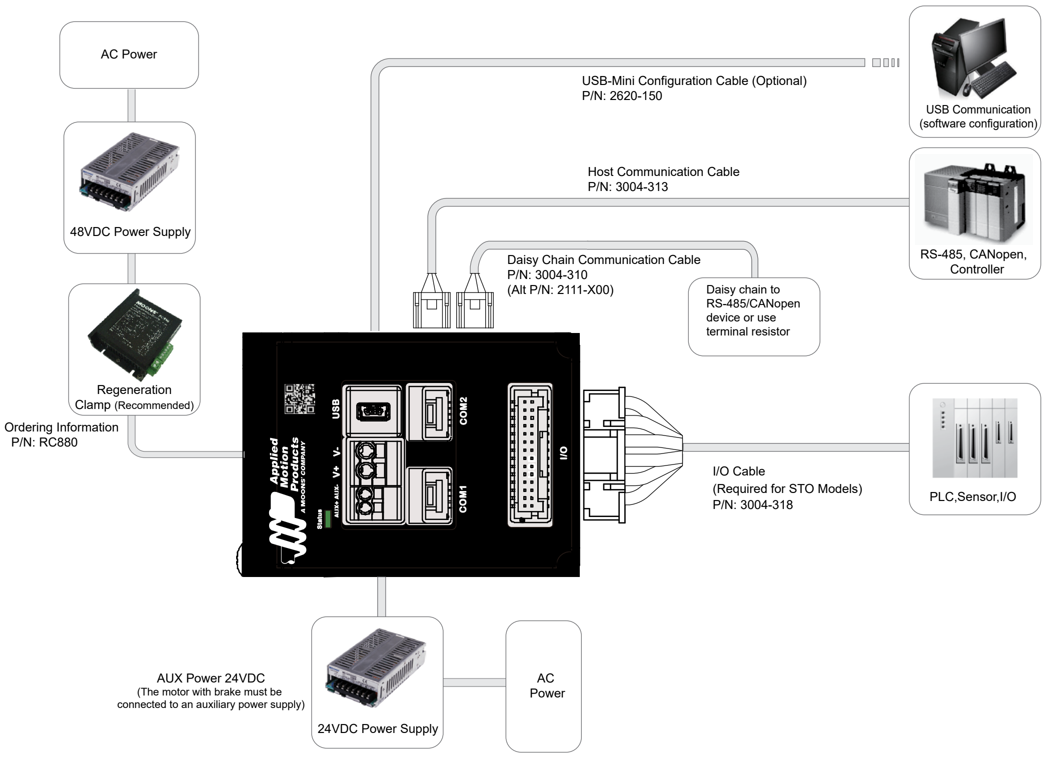
4 Wiring

4.1 IP20 Type System Configuration

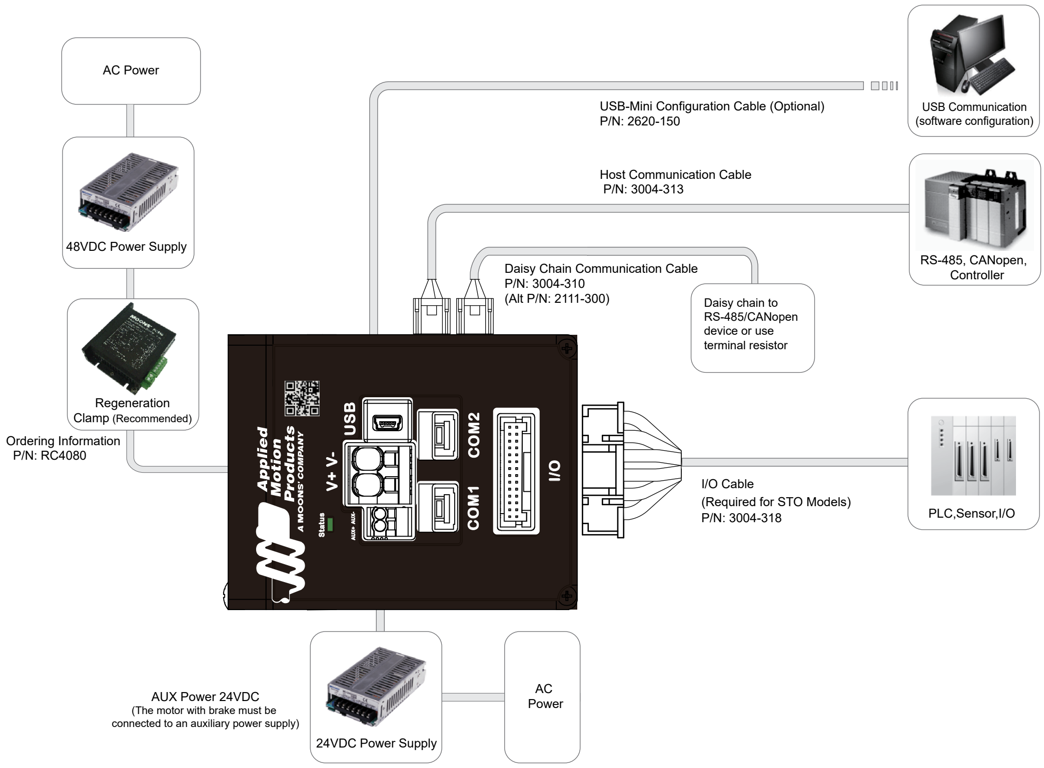
4.1.1 40mm Motor



4.1.2 60mm Motor

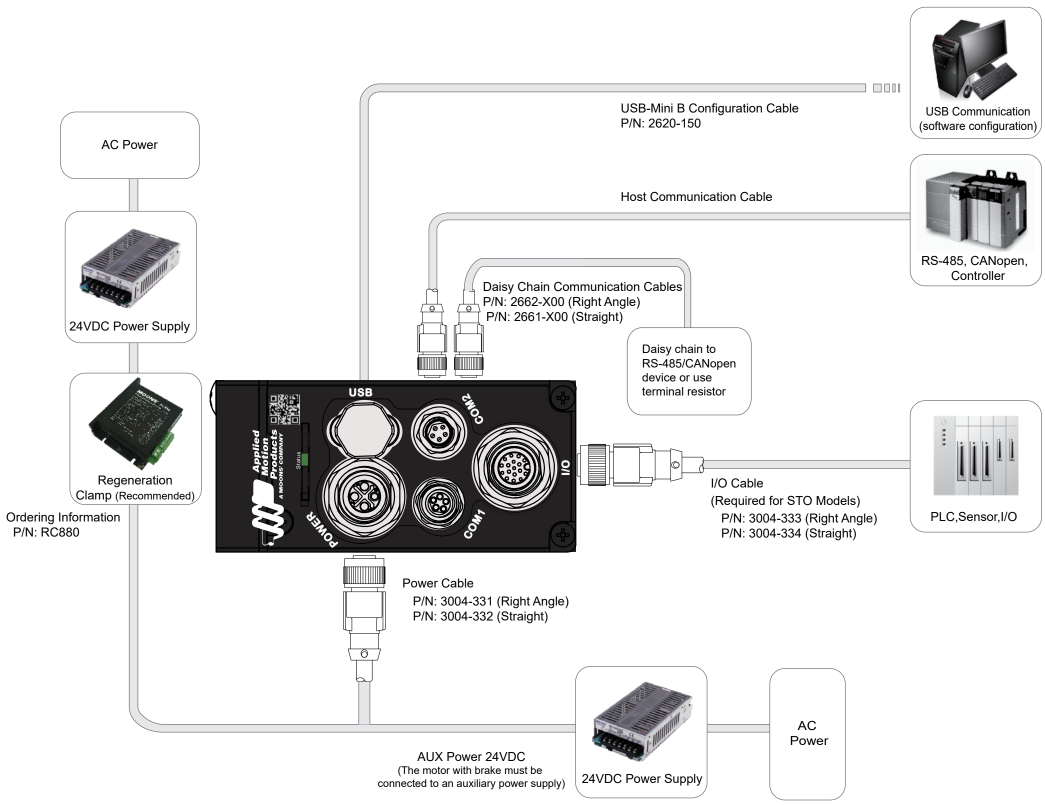


4.1.3 80mm Motor

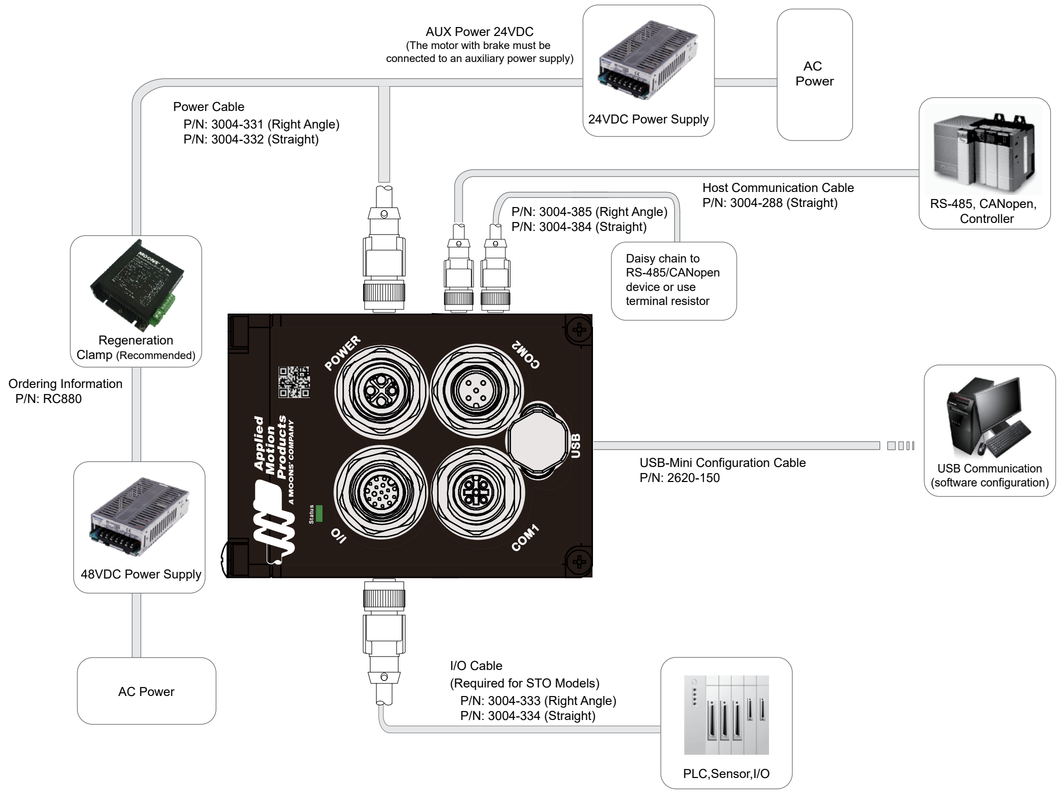


4.2 IP65 Type System Configuration

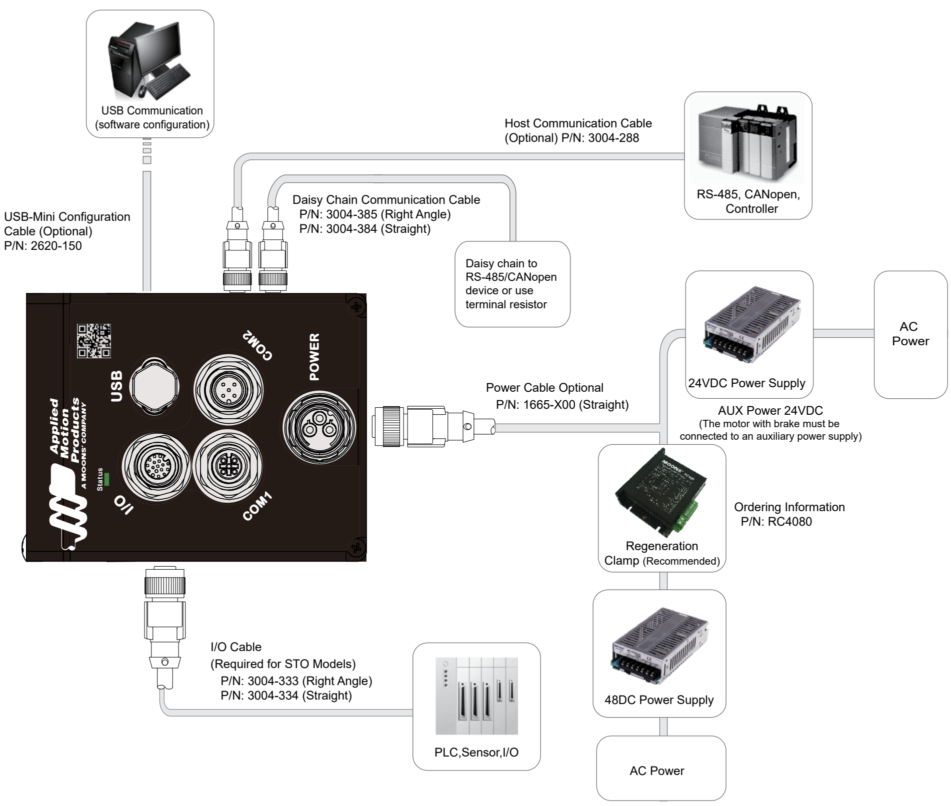
4.2.1 40mm Motor



4.2.2 60mm Motor



4.2.3 80mm Motor



4.3 EMC Control

⚠	MDX+ motor uses high-speed switching elements inside, which will produce high frequency or low-frequency interference during normal operation, and interfere with peripheral equipment through conduction or radiation.
	There is also a low-voltage unit inside the motor, which is likely to be interfered by the noise of the motor's peripheral equipment. The interfered signal may cause the device to make unexpected actions.

When installing and wiring, follow the electromagnetic compatibility specifications described in this user manual. This product complies with EN 61800-3 specifications.

In order to prevent the mutual electromagnetic interference between the motor and its peripheral equipment, the following countermeasures can be taken:

- Make sure that the motor is well grounded, and the grounding wire is preferably AWG10 or higher.
- Do not use the same sleeve for the power circuit cable and the input/output signal cable/encoder cable, and do not 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 wire or multi-core twisted-pair shielded wire for input and output signal cables and encoder cables.
- The length of the input and output signal cables is less than 5m.
- Do not use the same power source with electric welders, EDM machines, etc.; even if they are not the same power source, when there is a high-frequency generator nearby, connect a noise filter to the input side of the main circuit power cable and control power cable.

4.3.1 Grounding

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

4.3.2 Ferrite Ring

The ferrite magnetic ring can effectively absorb the radiation interference of the wire harness.

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

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

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

Signal cable	Wind cables the 2-3 turns to form the signal noise filter.
Power cable	Wind cables the 2-3 turns to form the signal noise filter.

Recommended Ferrite ring:

Model	Manufacturer
ZCAT3035-1330	TDK

4.4 External Circuit Wiring

4.4.1 Motor Connectors and Terminals

Terminal Identification	Description		
POWER	V+	Main power input positive	
	V-	Main power input negative	
	AUX+	Auxiliary power +24V	Required for models with brake
	AUX-	Auxiliary power GND	
I/O	Used to connect external controllers		
USB	Connect to PC		
COM1 / COM2	CANopen or Modbus communication port		

4.4.2 Connections and Wiring Notes

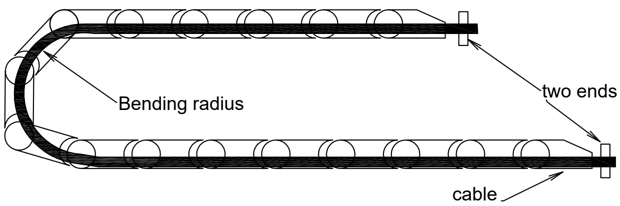
- Ensure grounding wires are securely connected, wires with more than AWG 10 (5.3mm^2) of sectional area is recommended.
- Grounding method must be single point grounding.
- Ensure V+ and V- are correctly wired, and voltage supplies are within the specification range.
- If you use an auxiliary power supply, connect the positive terminal of the 24V power supply to AUX+ and the negative terminal of the power supply to AUX-; connect the negative terminals of the main power supply and the auxiliary power supply together.
- Setup an emergency stop circuitry to switch off the power supply when fault occurs.
- DO NOT touch the motor or its terminals for 5 minutes after powering off. Hazardous voltages may remain even after shutdown, as the circuitry takes time to fully discharge.
- Install the encoder cables in a separate conduit from the motor power cables to avoid signal noise. Separate the conduits by 30cm or more.
- 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 5 meters.

4.4.3 Precautions for the Use of Cable Rails

When you need to move the motor cable or install the cable in a drag chain, use a flex rated 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
- 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, install baffles.

4.4.4 Recommended Wires

- Insulated wires with withstand voltage of 600V above 75°C are recommended for the main power circuit.
- Be sure to choose the corresponding cable sizes to prevent the cable from overheating.

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

Model	Rated Power (W)	Diameter of cables(AWG)		
		Connector Main	Connector AUX	Grounding
		V+/V-	AUX+/AUX-	PE
MDXR/T42J□□□□□000	100	1.0 ~ 1.5mm^2 AWG16 ~ 18	1.0 ~ 1.5mm^2 AWG16 ~ 18	2.0 ~ 5.3mm^2 AWG10 ~ 14
MDXR/T61G□□□□□000	200	2.0 ~ 3.5mm^2 AWG12 ~ 14		
MDXR/T62G□□□□□000	400			
MDXR/T82G□□□□□000	550	3.5 ~ 5.3mm^2 AWG10 ~ 12		
MDXR/T83G□□□□□000	750			

4.4.5 Terminal Crimp

Use insulated pin terminals for power connectors

◆ Crimp Type	◆ Sleeve Type	◆ Parallel Terminal
		

4.4.6 Grounded PIN

- In order to obtain a better EMC effect, use 5.3mm^2/AWG10 dedicated copper conductor cable
- Use M4 grounding screws, the recommended tightening torque is 1.4N.m

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.**
- **Regularly check whether the grounding screw is loose.**

4.5 Choosing a Power Supply

The main considerations when choosing a power supply are the voltage and current requirements for the application.

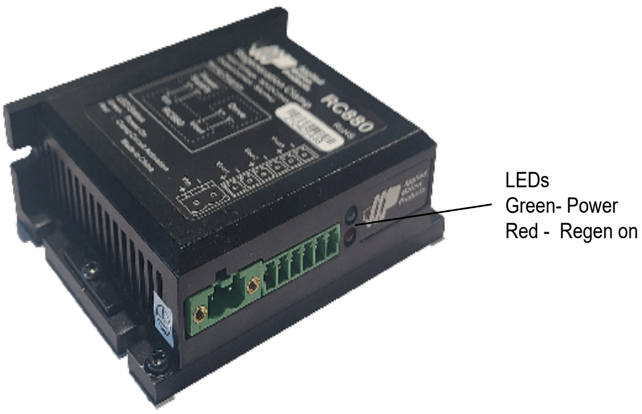
4.5.1 Voltage

The MDX+ motor is designed to give optimum performance between 24 and 48 Volts DC. Choosing the voltage depends on the performance needed and motor heating that is acceptable and/or does not cause a motor over-temperature. Higher voltages will give higher speed performance but will cause the motor to produce higher temperatures. Using power supplies with voltage outputs that are near the motor maximum may significantly reduce the operational duty cycle.

The allowed operating voltage range of the MDX+ integrated motor is 18~60VDC voltage. When the MDX+ is powered below 24VDC, the motor's high-speed performance will be affected. In addition, it is recommended to connect a larger voltage stabilizing capacitor in parallel to the power input end to prevent the motor from causing low-voltage alarm due to unstable power supply voltage. In addition, the voltage stabilizing capacitor can also absorb current spikes on the power line to protect the MDX+. When the supply voltage is below 20V, MDX+ operation may be unreliable. Do not operate the MDX+ with a DC voltage lower than 18V, otherwise the motor will issue a low-voltage alarm, and this alarm will cause the MDX+ to stop working.

4.5.2 Regeneration Clamp RC880 and RC4080

If you choose a regulated power supply, you may encounter the problem of back EMF. Because the motor is a conversion unit of electromagnetic energy and mechanical energy, when the motor drives the load and suddenly decelerates from a higher speed, part of the kinetic energy of the load will be converted into electrical energy of the motor. This electrical energy will be superimposed on the motor in the form of a voltage. When this happens, the power supply voltage is raised instantly which can easily cause the output of the regulated power supply to overvoltage and cause a protective shut down of the power supply. Using Applied Motion Products's back EMF clamp absorption module RC880 and RC4080 (as shown in the figures below) can effectively solve this problem. You can also use regen clamp to detect whether back EMF is in fact a problem for your application. Connect the regen clamp in series between the MDX+ and the power supply. If the "Regen" LED indicator on the regen clamp never flashes, it means you don't have too much back EMF in your circuit, and an a regen circuit is not necessary for operation. Find RC880 and RC4080 product information at https://www.applied-motion.com/s/



RC880

RC4080

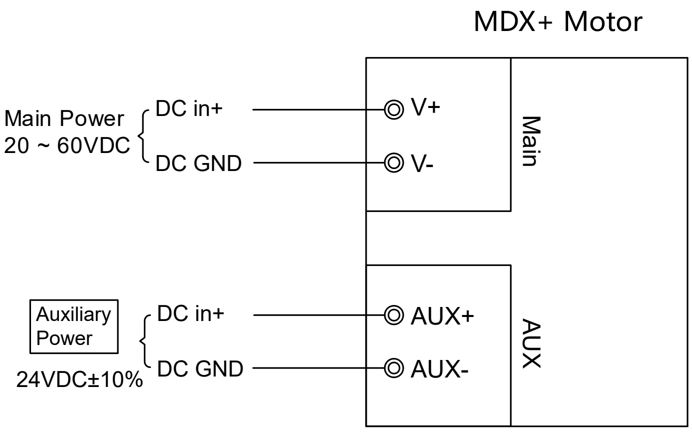
4.6 Main & AUX -- Wiring for Power Supply

The MDX+ series DC servo includes two power circuits: main power circuit and auxiliary power circuit (logic power), which can be connected according to application needs.

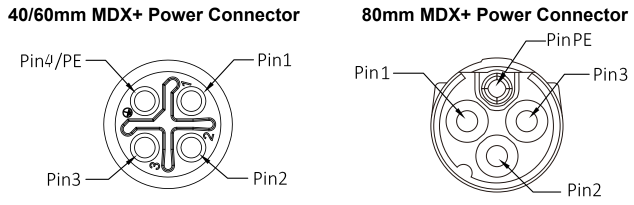
Name	Symbol	Description	Range
Main Power	V+, V-	Main power supply input	20 ~ 60VDC
Auxiliary Power	AUX+, AUX-	When the main power supply is cut off, the following two applications require the auxiliary power supply to be connected: a) When the logic/communication of the motor needs to work normally b) When selecting a motor with electromagnetic brake	24VDC±10%

Note: When using the auxiliary power supply, the negative terminals of the main power supply and the auxiliary power supply need to be connected together.

4.6.1 IP20 type Power Connector PIN Definition



4.6.2 IP65 type Power Connector PIN Definition

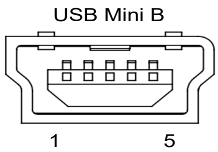


PIN No.	Symbol	Function
1	V+	Main Power Positive
2	V(AUX)-	Main Power and Auxiliary Power Negative
3	AUX+	Auxiliary Power Positive
4	PE	Grounding
Connect to cover	Shield	Shielded connect to cover

4.7 Communication Port

4.7.1 USB -- PC Configuration Port

The USB port is used for communication between the motor and PC. Using Luna software, you can modify parameters, perform online auto tuning and other operations.

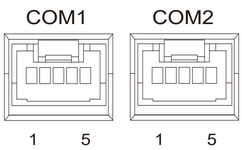


PIN No.	Symbol	Function
1	+5V	USB POWER
2	D-	DATA-
3	D+	DATA+
4	—	N/A
5	GND	GND

4.7.2 COM1/COM2-- Bus Communication

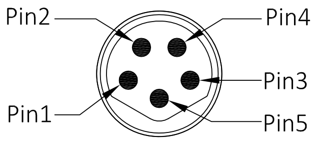
COM1/COM2 port are used to connect the motor to the controller for CANopen/RS485 bus communication.

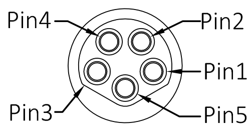
◆ IP20 Type (MDXR4, MDXR6, MDXR8)



PIN	RS-485	CANopen
1	RS485+	N/C
2	RS485-	N/C
3	N/C	CAN_H
4	N/C	CAN_L
5	GND	GND

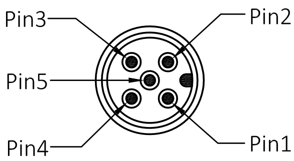
◆ IP65 Type (MDXT4)

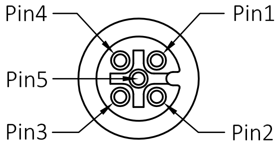




PIN	RS-485	CANopen
1	RS485+	N/C
2	RS485-	N/C
3	GND	GND
4	N/C	CAN_H
5	N/C	CAN_L

◆ IP65 Type (MDXT6, MDXT8)



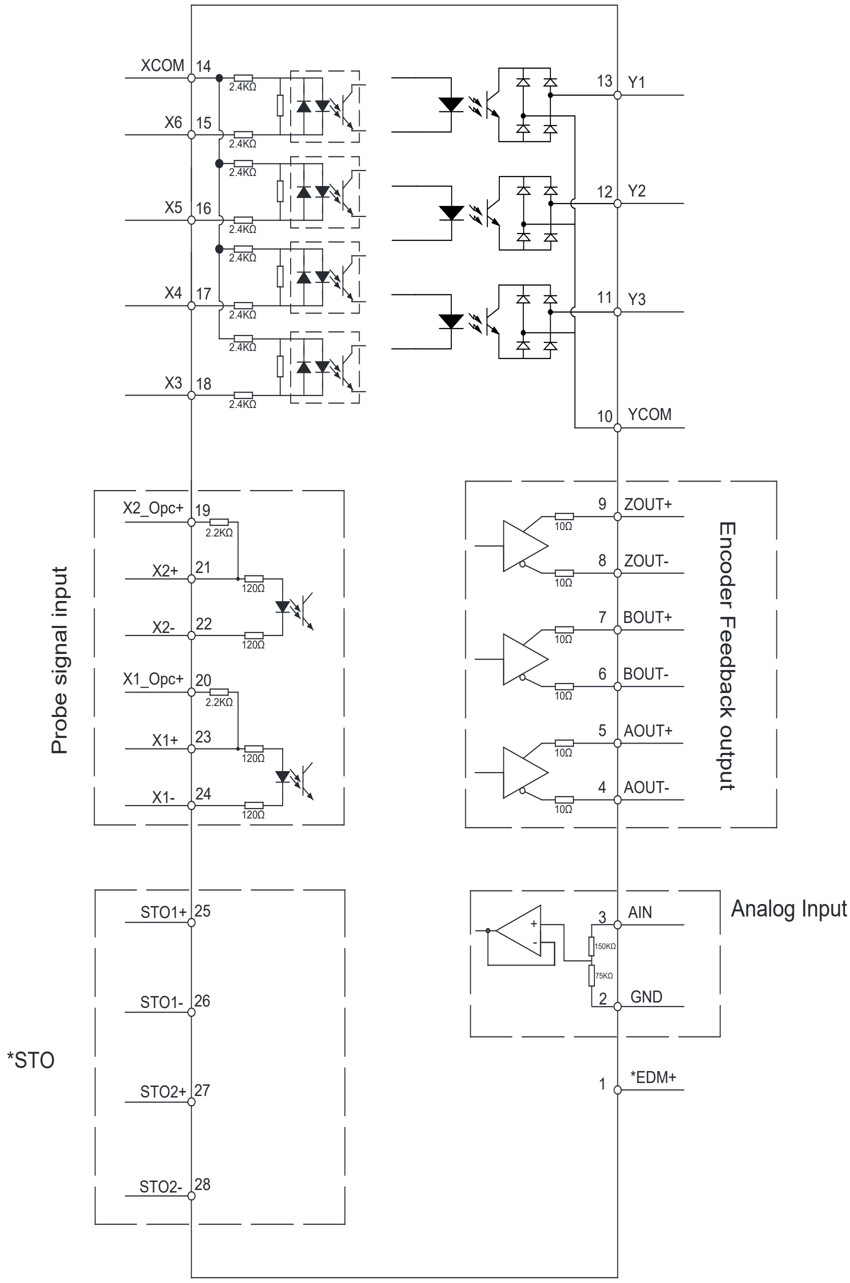


PIN	RS-485	CANopen
1	RS485+	N/C
2	RS485-	N/C
3	GND	GND
4	N/C	CAN_H
5	N/C	CAN_L

4.8 IP20 Type -- Inputs and Outputs

4.8.1 Inputs and Outputs Definition

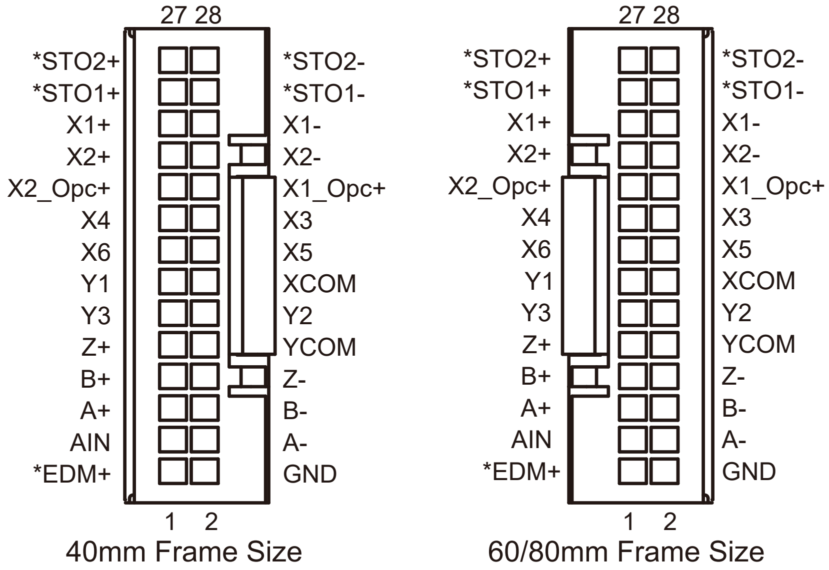
◆ I/O Diagram



***Applicable only to models with STO functionality. Do not connect on models without STO.**

4.8.2 I/O PIN Definition

The I/O port of the motor is used to connect input and output signals. The pin definition is as follows:



***Applicable only to models with STO functionality. Do not connect on models without STO.**

IP20 (MDXR4, MDXR6, MDXR8)					
Pin	Signal	Function	Pin	Signal	Function
1	*EDM+	Safety Signal Output	2	GND	Digital Ground
3	AIN	Analog Input	4	AOUT-	Encoder Output A-
5	AOUT+	Encoder Output A+	6	BOUT-	Encoder Output B-
7	BOUT+	Encoder Output B+	8	ZOUT-	Encoder Output Z-
9	ZOUT*	Encoder Output Z+	10	YCOM	Digital Output COM Port (Includes EDM- for STO Models)
11	Y3	Digital Output Y3	12	Y2	Digital Output Y2
13	Y1	Digital Output Y1	14	XCOM	Digital Input COM Port
15	X6	Digital Input X6	16	X5	Digital Input X5
17	X4	Digital Input X4	18	X3	Digital Input X3
19	X2_OPC+	Pull-up for Open Collector X2	20	X1_OPC+	Pull-up for Open Collector X1
21	X2+	Digital Input X2+	22	X2-	Digital Input X2-
23	X1+	Digital Input X1+	24	X1-	Digital Input X1-
25	*STO1+	STO1+	26	*STO1-	STO1-
27	*STO2+	STO2+	28	*STO2-	STO2-

Note:
***Applicable only to models with STO functionality. Do not conect on models without STO.**
Refer to the 2D cable drawing for detailed information on pin color assignments

4.8.3 Digital Signal Input

MDX+ IP20 type has 6 digital input signals, and each input signal can be configured with a specific function through parameters as well as the logic of the input level (normally open/closed).

◆ **Specific function signals,** such as alarm reset, limit switch, Homing switch input, Emergency stop, etc. See section 7.1 I/O Signal Setting for input functions and descriptions.

◆ **General input signal,** no specific function assigned, can be used as customer needs.

Signal					Default		
I/O-PIN No.	Symbol	Description	Parameter	Command	Function	Input Logic*1	Default Value
20	X1	Digital Input 1	P5-00	MU1	GP	Closed	0
19	X2	Digital Input 2	P5-01	MU2	GP	Closed	0
18	X3	Digital Input 3	P5-02	MU3	A-CLR	Closed	3
17	X4	Digital Input 4	P5-03	MU4	S-ON	Closed	1
16	X5	Digital Input 5	P5-04	MU5	CCW-LMT	Closed	7
15	X6	Digital Input 6	P5-05	MU6	CW-LMT	Closed	5
14	XCOM	X3,X4,X5,X6 Input common	-	-	-		

Note:

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

Closed: The digital input circuitry is closed with current flowing in or out of the input pins.

Open: The digital input circuit is open and no current flows into or out of the input pins.

4.8.4 Input Signal Wiring Description

Pulse Signal Input Wiring

MDX+ IP20 type motor has two high-speed pulse signal inputs.

◆ 24V Pulse signal

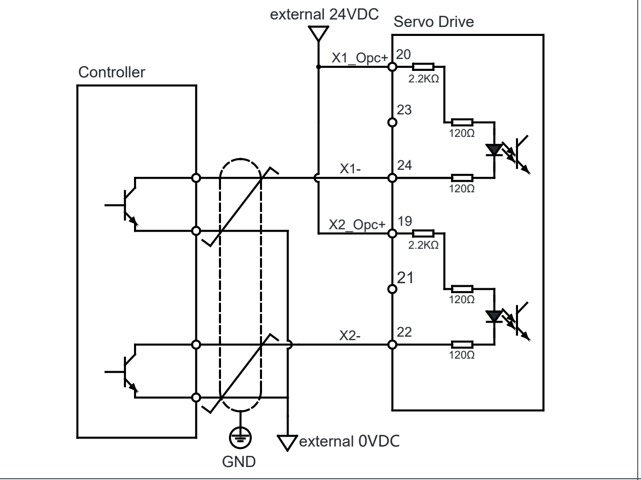
PIN No.	Signal		Description	Max. Pulse frequency	Min. Pulse width
20	X1_Opc+	Pulse Signal Input	◆ Optocoupler input, supports: open collector pulse signal, 24VDC ◆ Support pulse & direction signals, CW/CCW signals, A/B quadrature signals	500KHz	1μs
24	X1-				
19	X2_Opc+	Pulse Direction Signal Input			
22	X2-				

◆ 5V Pulse signal

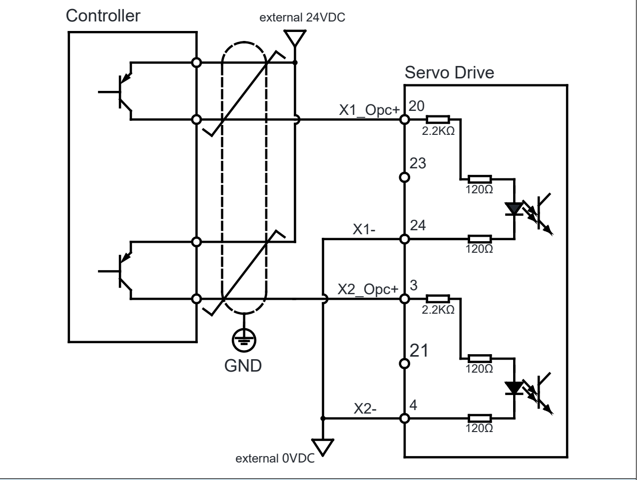
PIN No.	Signal		Description	Max. Pulse frequency	Min. Pulse width
23	X1+	Pulse Signal Input	◆ Optocoupler input, supports: 1) Open collector pulse signal, supports 5VDC 2) Low-speed differential pulse input, supports 5VDC ◆ Support pulse & direction signals, CW/CCW signals, A/B quadrature signals	2MHz	250ns
24	X1-				
21	X2+	Pulse Direction Signal Input			
22	X2-				

◆ Input Wiring

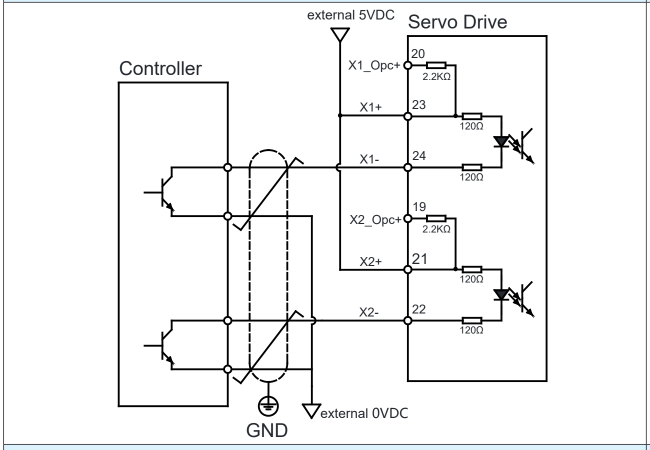
A. The signal source is open collector NPN input (external 24V power supply)



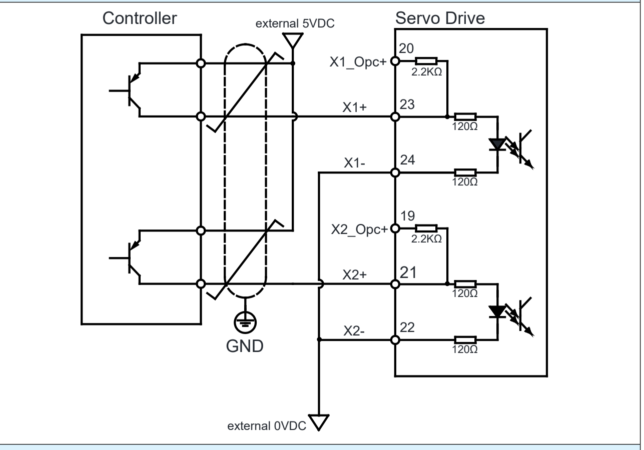
B. The signal source is open collector PNP input (external 24V power supply)



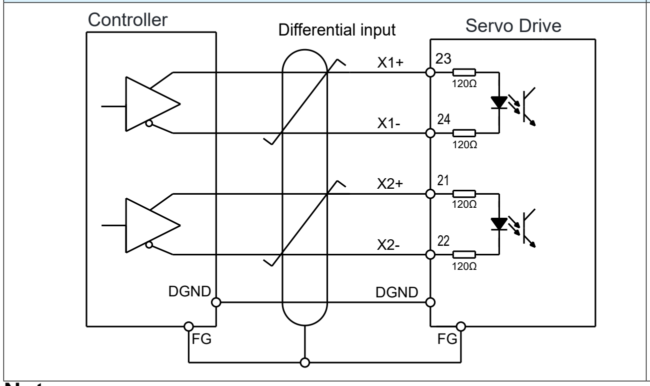
C. The signal source is open collector NPN input (external 5V power supply)



D. The signal source is open collector PNP input (external 5V power supply)



E. The signal source is differential signal input



Note:

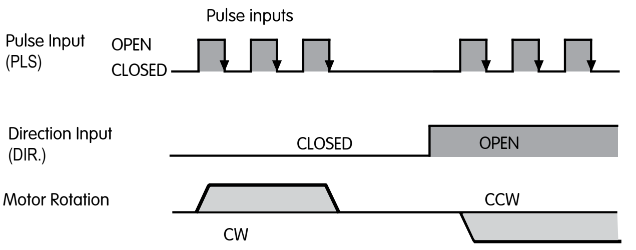
1. Do not use both X+ and X_Opc+ simultaneously.

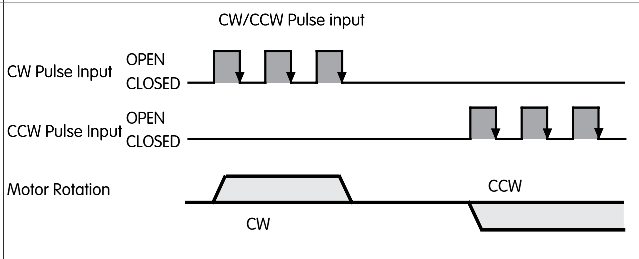
2. The voltage levels of the pulse train need to be clean signals to avoid false High and Low states..

	24V Signal	5V Signal
Minimum threshold for HIGH Signal	>16V	>3V
Maximum threshold for LOW Signal	<8V	<2V

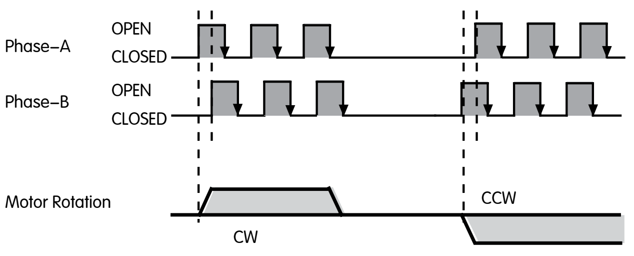
◆ Pulse Input Mode

Pulse/Direction Mode	CW/CCW Mode
When there is pulse input and the direction input is Closed, the motor rotates in one direction. When there is pulse input and the direction input is Open, the motor rotates in the other direction. *The direction signal definition can be configured through bit2 of parameter P3-03. The figure below shows that the motor is configured so that when the direction input is ON, the motor rotates in the CW direction.	When there is a pulse signal Clockwise (CW) input, the motor rotates in one direction. When there is a pulse signal CounterClockwise (CCW) input, the motor rotates in the other direction. *Direction definition can be configured through bit2 of parameter P3-03.





A&B Quadrature signal	
Receive A&B quadrature pulses and control the motor rotation. *The direction can be configured through bit2 of parameter P3-03. Direction is determined by which channel is ahead of the other. The figure below shows that when phase A leads phase B by 90 degrees, the motor rotation direction is CW. When direction B leads phase A by 90 degrees, the motor rotation direction is CCW.	



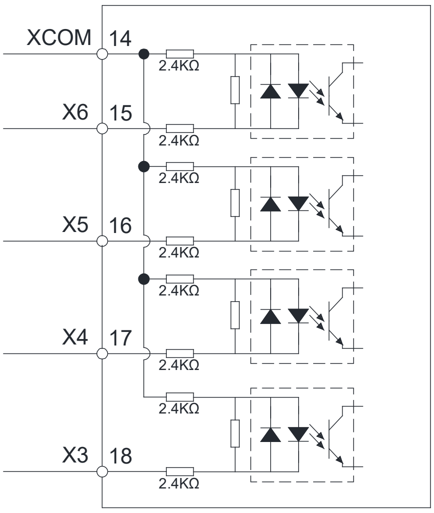
Digital Signal Input Wiring

MDX+ IP20 type motor has 4 optically isolated single-ended inputs with a common COM point. Because these input circuits are optically isolated, they require a power supply. If it is connected to a PLC, you can use the power supply of the PLC; if it is connected to a relay or a mechanical switch, a 24VDC power supply is required.

What's COM?

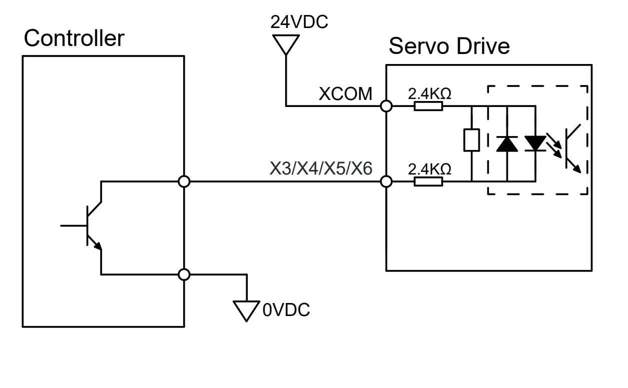
"Common" represents a common terminal of equal potential. If you are using a source current (PNP) signal, you should connect COM to the ground (negative of the power supply); if you are using a current sink (NPN) signal, then COM should be connected to the positive of the power supply.

◆ X3 ~ X6 Circuits are as follows:

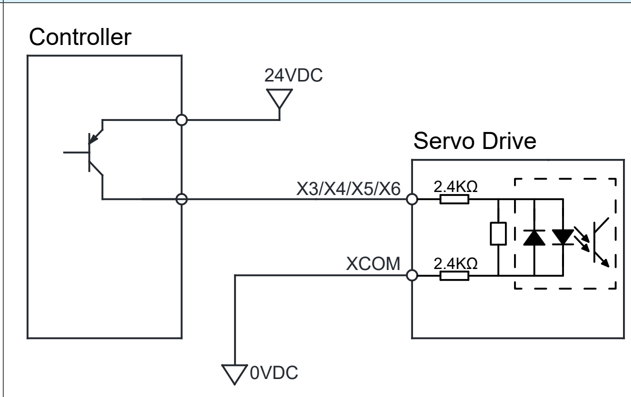


◆ X3 ~ X6 Input connection Diagram

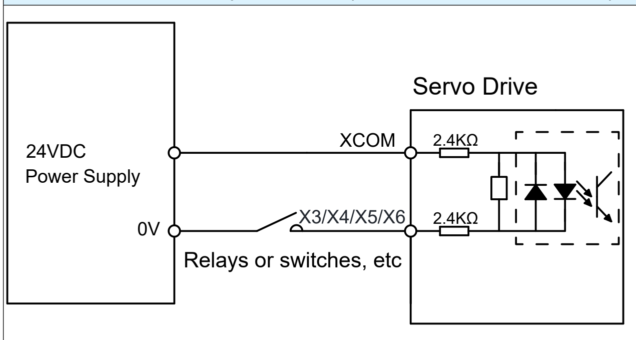
A. Host Sink Mode



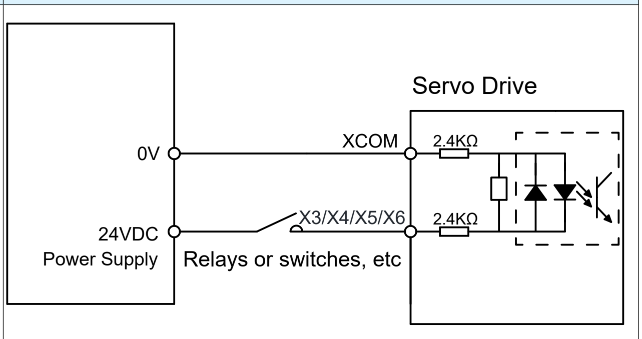
B. Host Sourcing Mode



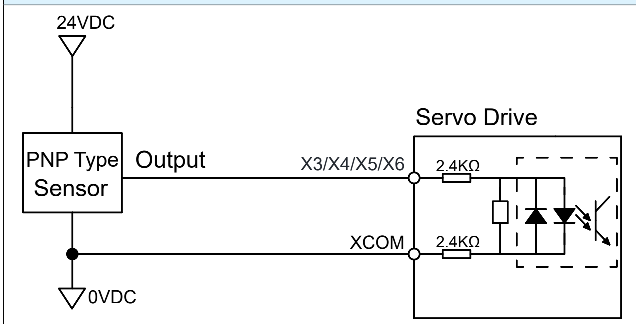
C. Connect to Relay or Switch(XCOM connect to +24V)



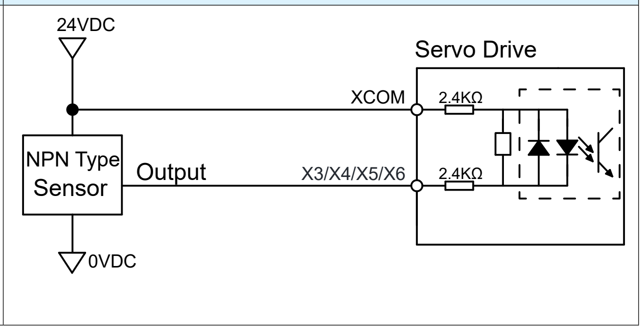
D. Connect to Relay or Switch(XCOM connect to 0V)



E. Connect a PNP sensor



F. Connect a NPN sensor



4.8.5 Digital Signal Output

The MDX+ IP20 motorr has 3 optically isolated output signals with a common COM point. Each output signal can be configured for a specific function and output logic through parameters; the maximum withstand voltage is 30VDC and the current is 30mA. See section 7.1 I/O Signal Setting for output functions and descriptions.

Signal					Default		
I/O-PIN No.	Symbol	Description	Parameter	Command	Function	Output Logic *1	Default Value
13	Y1	Digital Output 1	P5-12	MO1	SON-ST	Closed	7
12	Y2	Digital Output 2	P5-13	MO2	FAULT	Open	2
11	Y3	Digital Output 3	P5-14	MO3	IN-POS	Closed	9
14	YCOM	Digital Output Common	-	-	-		

Note:

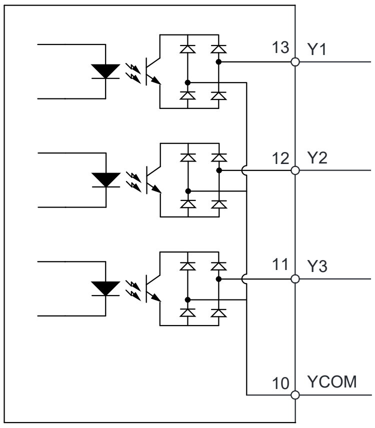
***1. The level logic of the pin output is as follows:**

Closed: The digital output circuitry is closed with current flowing in or out of the output pins.

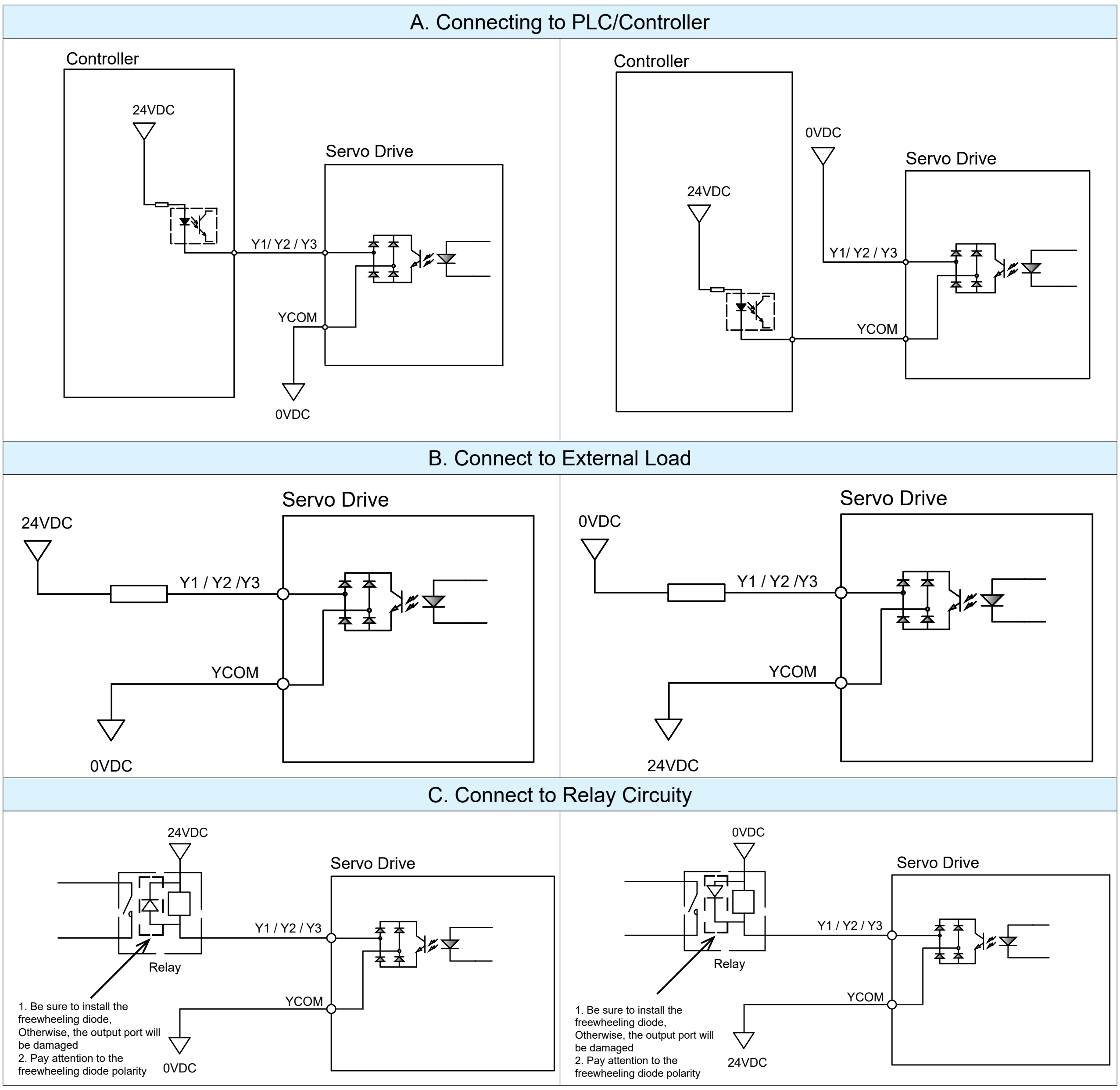
Open: The digital output circuit is open and no current flows into or out of the output pins.

4.8.6 Output Signal Wiring

◆ Y1 ~ Y3 Signal Diagram



◆ Y1 ~ Y3 Connection Diagram

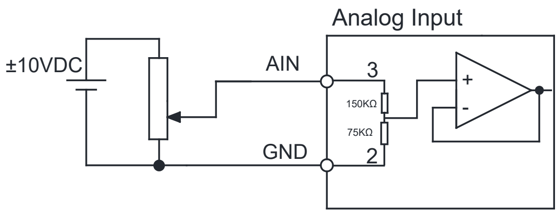


4.8.7 Analog Signal Input

The MDX+ IP20 has 1 single-ended analog input with a voltage range of -10V~+10V that can be used for analog velocity and torque control. The motor speed range and torque range, when using analog control, can be set through parameters.

I/O-Pin	Signal		Description
3	AIN	Analog Input Signal	◆ Analog Velocity Command -10V ~ +10V, -3000 ~ +3000rpm Range can be set through parameters.
2	GND		Analog GND

◆ Analog Input Connection Diagram



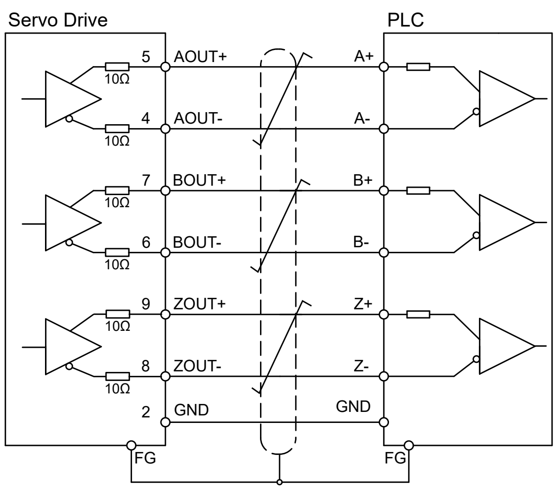
4.8.8 Encoder Frequency Division Output Signal

The MDX+ can output the encoder signals A-phase, B-phase, and Z-phase through Line Driver differential mode, and the output voltage is 5 V.

The controller must use a Line Receiver to receive signals, and the transmission line must use twisted pair shielded wires.

I/O-Pin No	Signal		Description
5	AOUT+	Encoder Signal Output	The feedback signal of the encoder is output in the form of A, B, Z differential, and the number of output pulses per rotation of the motor can be set through configuration.
4	AOUT-		
7	BOUT+		
6	BOUT-		
9	ZOUT+		
8	ZOUT-		
2	GND		

◆ **A/B/Z Connection Diagram**

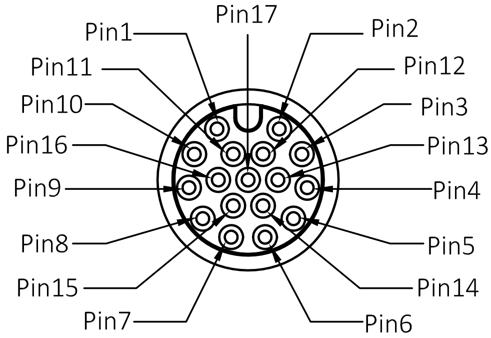


Note: Make sure the host controller and the motor are connected to a common ground.

4.9 IP65 Type -- Input and Output Interface

4.9.1 Input and Output Interface Specification and Diagram

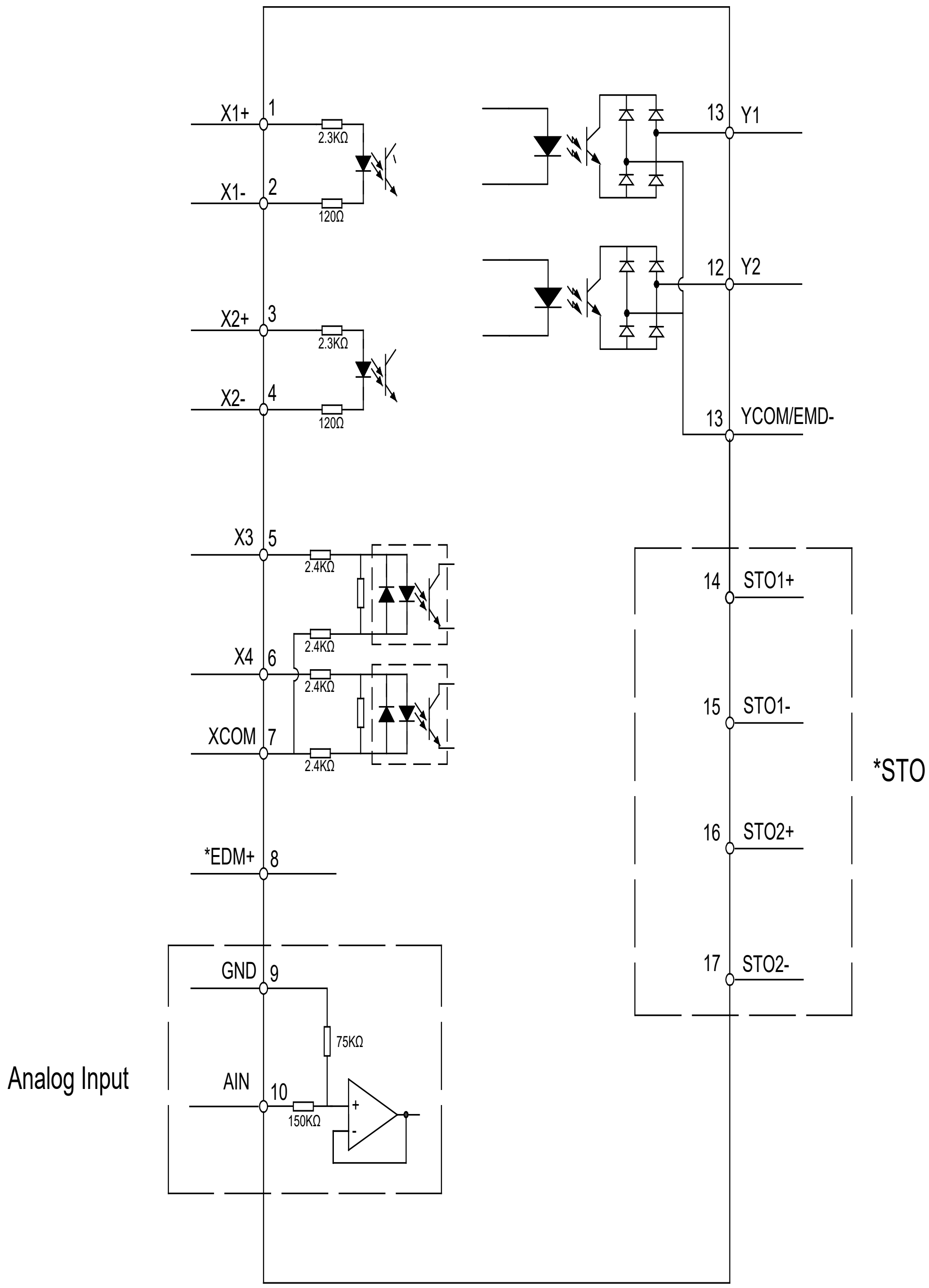
Connector Definition:



Input and Output specification:

I/O	Type	Description
Digital Signal	Input	2 Configurable Optically isolated Inputs, 24VDC, 20mA
	Output	2 Configurable Optically isolated Outputs, max 30VDC, 20mA .
Pulse Signal	Input	2 24V pulse input, Min. Pulse width 1us, Max. Pulse frequency 500KHz
	Output	3 Line Driver Output: Encoder A±, B±, Z± frequency division output
Analog Signal	Input	1 analog inputs, -10V~+10V, resolution 12bit

◆ I/O Diagram



***Applicable only to model with STO functionality. Do not connect on models without STO.**

4.9.2 Input and Output Pin Definition

IP65 Type (MDXT4, MDXT6, MDXT8)					
Pin	Signal	Function	Pin	Signal	Function
1	X1+	Digital Input X1+	2	X1-	Digital Input X1-
3	X2+	Digital Input X2+	4	X2-	Digital Input X2-
5	X3	Digital Input X3	6	X4	Digital Input X4
7	XCOM	Digital Input COM Port	8	*EDM+	Safety Signal Output
9	GND	Digital Ground	10	AIN	Analog Input
11	Y1	Digital Output Y1	12	Y2	Digital Output Y2
13	YCOM	Digital Output COM Port (Includes EDM- for STO Models)	14	*STO1+	STO1+
15	*STO1-	STO1-	16	*STO2+	ST02+
17	*STO2-	STO2-	8		

Note

***Applicable only to models with STO functionality. Do not connect on models without STO.**

Refer to the 2D cable drawing for detailed information on pin color assignments

4.9.3 Digital Input Signal

MDX+ IP65 has 4 digital input signals, and each input signal can be configured to a specific function through parameters as well as the logic of the input level.

◆ Specific function signals, such as alarm reset, limitation switch, homing sensor, etc. See section 7.1 I/O Signal Setting for input functions and descriptions.

◆ General input signal, as a general input signal, no specific function

Signal					Default		
I/O- PIN No.	Symbol	Description	Parameter	Signal	Symbol	Input Logic*1	Default
1, 2	X1	Digital Input 1	P5-00	MU1	GP	Closed	0
3, 4	X2	Digital Input 2	P5-01	MU2	GP	Closed	0
5	X3	Digital Input 3	P5-02	MU3	A-CLR	Closed	3
6	X4	Digital Input 4	P5-03	MU4	S-ON	Closed	1
7	XCOM	X3,X4 Digital Input COM	-	-	-		

Note:

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

Closed: The digital input circuitry is closed with current flowing in or out of the input pins.

Open: The digital input circuit is open and no current flows into or out of the input pins.

4.9.4 Input Signal Wiring

Pulse Input Signal Wiring

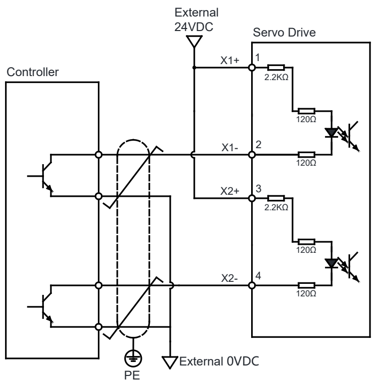
MDX+ IP65 has 2 high-speed input ports.

◆ 24V pulse input signal

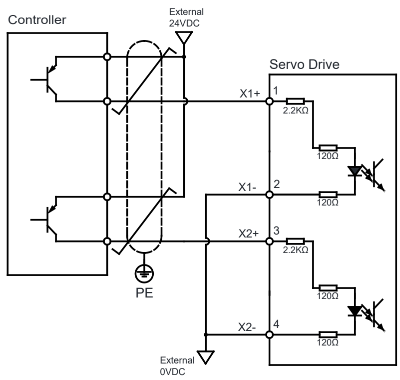
PIN	Signal		Description	Max. frequency	Min. Pulse width
1	X1+	Pulse Input	◆ Optocoupler input, supports: 1) High-speed differential pulse input, supports 24VDC ◆ Support pulse & direction signals, CW/CCW signals, A/B quadrature signals	500KHz	1μs
2	X1-				
3	X2+	Pulse Direction Input			
4	X2-				

◆ Input connection diagram

A. SINK mode



B. SOURCING mode



Note:

The voltage levels of the pulse train need to be clean signals to avoid false High and Low states

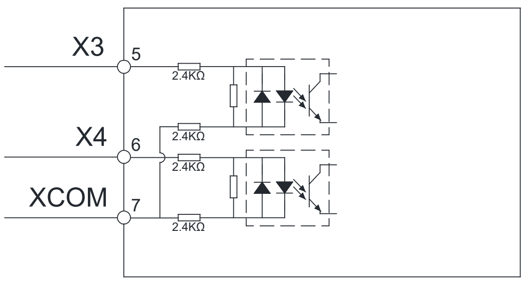
	24V signal
Minimum threshold for HIGH Signal	>16V
Maximum threshold for LOW Signal	<8V

Input Signal Connection Diagram

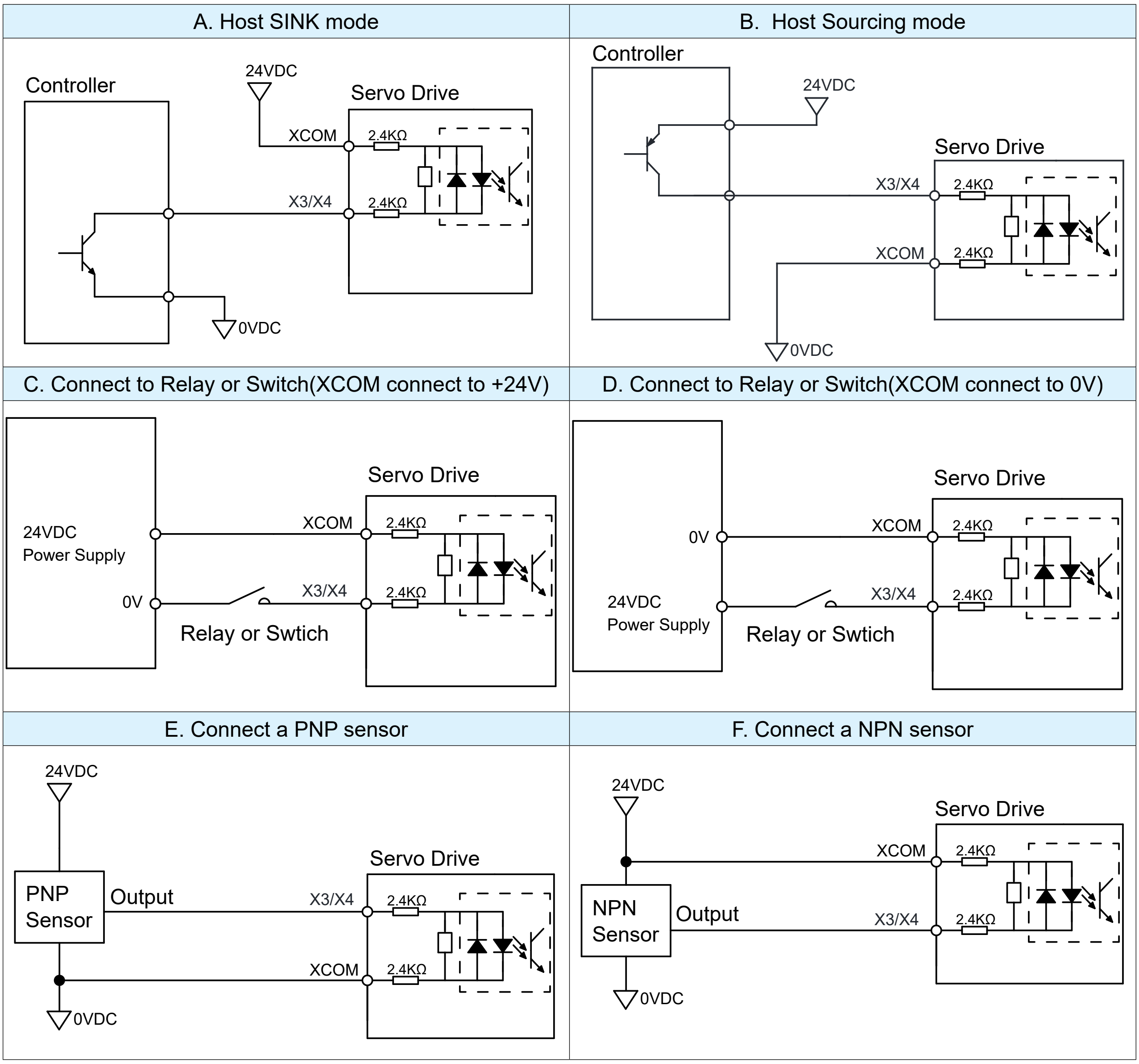
The MDX+ motor also has 4 optically isolated single-ended input ports with a common COM point. Because these input circuits are optically isolated, they require a power supply. If it is connected to a PLC, you can use the power supply of the PLC. If it is connected to a relay or a mechanical switch, a 24VDC power supply is required.

What's COM?
"Common" represents a common terminal of equal potential. If you are using a source current (PNP) signal, you should connect COM to the ground (negative of the power supply); if you are using a current sink (NPN) signal, then COM should be connected to the positive of the power supply

◆ X3 ~ X4 circuits are as follows:



◆ X3 ~ X4 Input connection Diagram



4.9.5 Digital Output Signal

MDX+ IP65 has 2 optically isolated outputs with COM. The functions can be configured through software while both sink and source connections are supported. See section 7.1 I/O Signal Setting for output functions and descriptions.

Signal					Default		
I/O-PIN No.	Symbol	Description	Parameter	Signal	Signal	Output Logic *1	Default
13	Y1	Digital Output 1	P5-12	MO1	FAULT	Open	2
12	Y2	Digital Output 2	P5-13	MO2	IN-POS	Closed	9
14	YCOM	Digital Output Common	-	-	-		

Note:

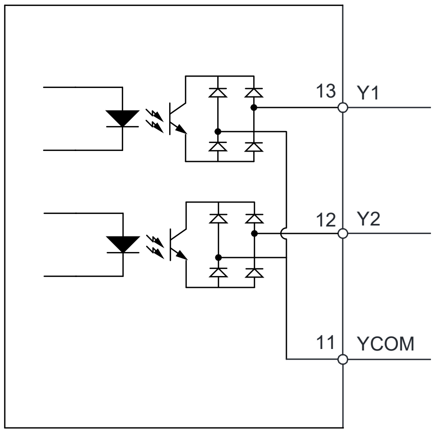
***1. The level logic of the pin input is as follows:**

Closed: The digital output circuitry forms a loop with current flowing in or out of the output pins

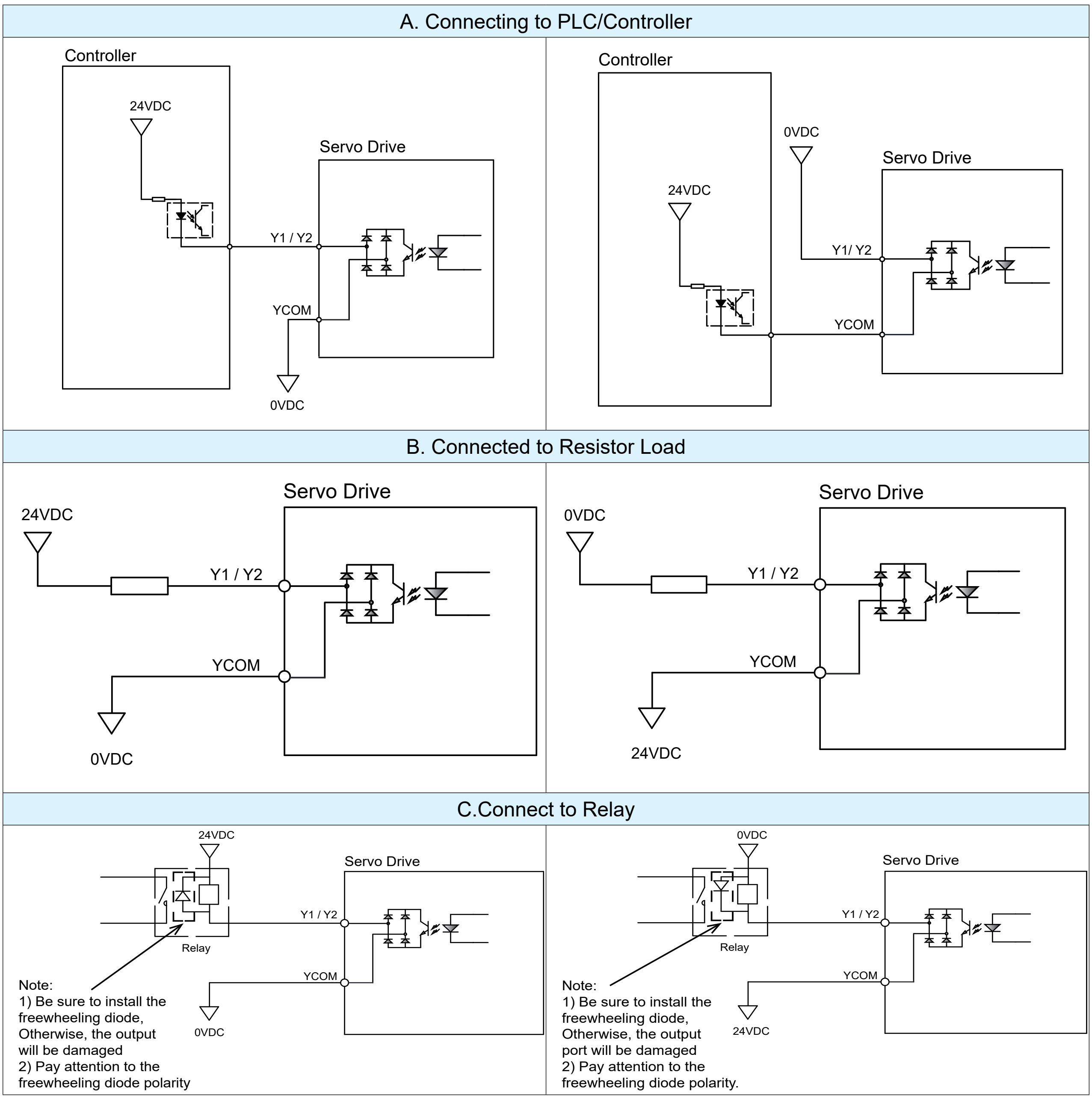
Open: The digital output circuit is open and no current flows into or out of the output pins.

4.9.6 Output Signal Wiring

◆ Y1 ~ Y2 Output Signal Diagram



◆ Y1 ~ Y2 Output Connection Diagram

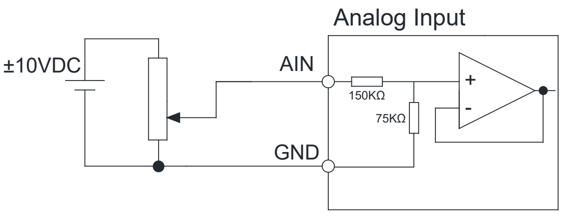


4.9.7 Analog Signal Input

MDX+ IP65 motor has 1 single-ended analog inputs. The voltage range is -10V~+10V. The speed and torque range when operating in analog voltage control modes can be configured via parameters

I/O-PIN No	Signal		Description
10	AIN	Analog Input Signal	◆ Analog Velocity Command -10V ~ +10V, -3000 ~ +3000rpm can be configured to change the setting range.
9	GND		Analog GND

◆ Analog Input connection Diagram



4.10 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.

4.10.1 Brake Use Instructions

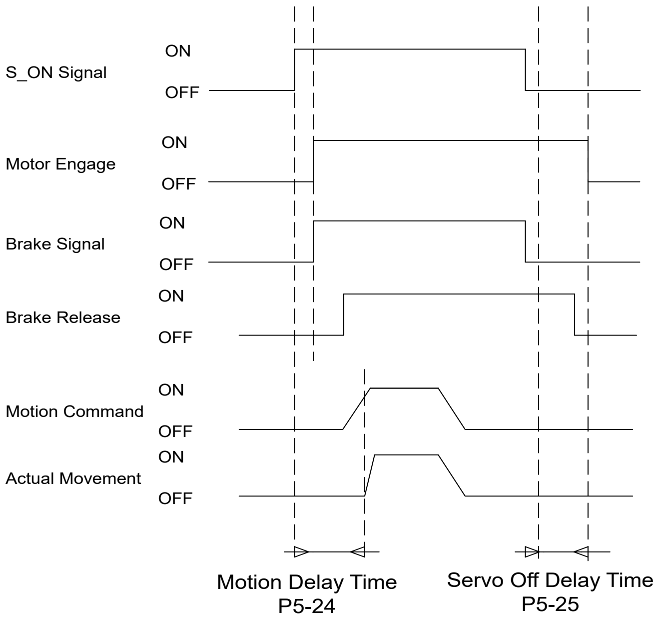
- MDX+ motors with brakes need to be connected to 24VDC auxiliary power supply.
- The digital input can be configured as a forced brake output function. When this signal is valid, the brake can be forced to open.
- The electromagnetic brake is normally closed. When the brake is not powered, the motor shaft cannot rotate.
- The brake will make a clicking sound when braking/releasing, which will not affect use.

◆ The brake specifications are as follows:

Motor P/N	Motor Power W	Holding Torque Nm	Working Current A	Power W@20ºC	Rated Voltage VDC	Release Time ms	Release Voltage VDC	Engage Time ms
MDXR/T4	100	0.32	0.26	6.3	24	< 25	18.5	< 70
MDXR/T6	200/400	1.5	0.3	7.2		< 25	18.5	< 70
MDXR/T8	550	3.2	0.4	9.6		< 25	18.5	< 70

4.10.2 Timing Charts of Electromagnetic Brake

Since the brake has an action delay when releasing and braking, in order to avoid damage to the brake, you need to pay attention to the timing sequence during use.



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

4.11 Safety Torque Off (STO)

Several MDX+ models include a Safe Torque Off (STO) function.

Safe Torque Off (Safe Torque Off) is a hardware-level safety protection function. When the STO function is working, the hardware circuit of the motor will be triggered to forcibly turn off the power stage, thereby preventing the motor from running. The motor will be disabled while the drive will remain powered on.

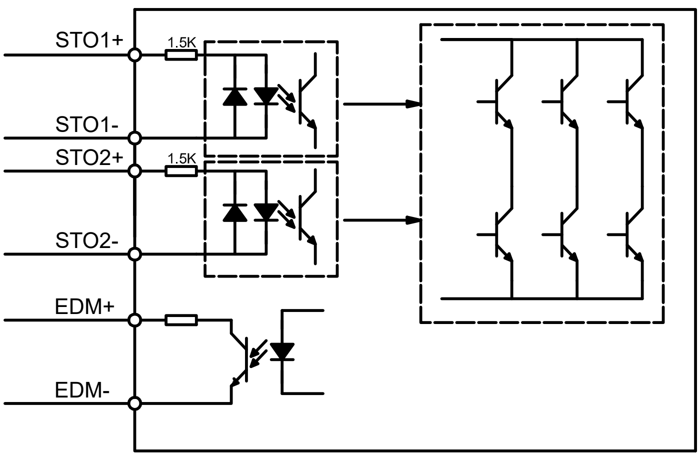
When the STO function is triggered, the servo-ready signal is no longer active. the motor is disabled and the drive will output an alarm status relevant to the STO function.

4.11.1 STO Precautions

1. If STO is not required in the application, select a model without STO funtionality.
2. Before using the STO function, users should ensure that they are familiar with how STO works and the scenarios in which it is appropriate to use it.
3. When the STO function is enabled, the motor shaft and load are under the influence of external forces such as gravity in vertical applications. If this can occur in you application, ensure that other safety mechanisms such as holding brakes are used to prevent motion that could damage equipment or hurt personnel.
4. When the STO function is triggered, the motor's shaft rotates freely. If the motor is in motion or under the influence of an external load, its stopping distance is directly related to the momentum of the system.
5. While the STO function is enabled, the output power from drive to motor is cut off. However, the power supply powering the servo drive remains on. If users need to perfom maintenance on the system, they should be aware of this and decide whether this provides adequate safety for their own personnel.
6. While the STO function is enabled, the drive will be in an alarm state and the motor will be disabled.
7. When the STO function is disabled (no longer in use), the STO alarm status of the drive is automatically cleared. The drive will also output a Servo Ready signal but the motor will disabled. Users will need to re-enable the motor before operation can resume again.

4.11.2 STO Input and Output Signals

■ Internal Circuit Diagram



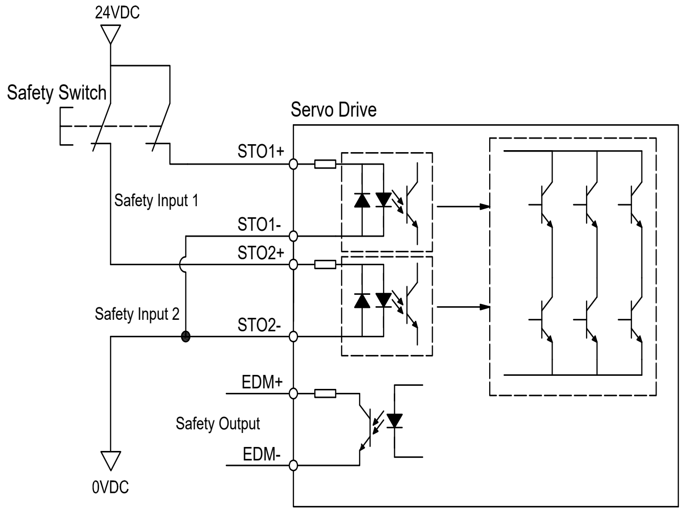
■ STO Signal Definition

Signal	Symbol	Description	Control Mode
Safety Input STO1	STO1+	When STO1 has no input signal, e.g. the port is disconnected, STO1 will be considered OFF. The STO function will be enabled, disabling the motor.	Compatible with all control modes
	STO1-		
Safety Input STO2	STO2+	When STO2 has no input signal, e.g. the port is disconnected, STO2 will be considered OFF. The STO function will be enabled, disabling the motor.	
	STO2-		
Safety Output	EDM+	Output monitor signal used to check the safety function.	
	EDM-		

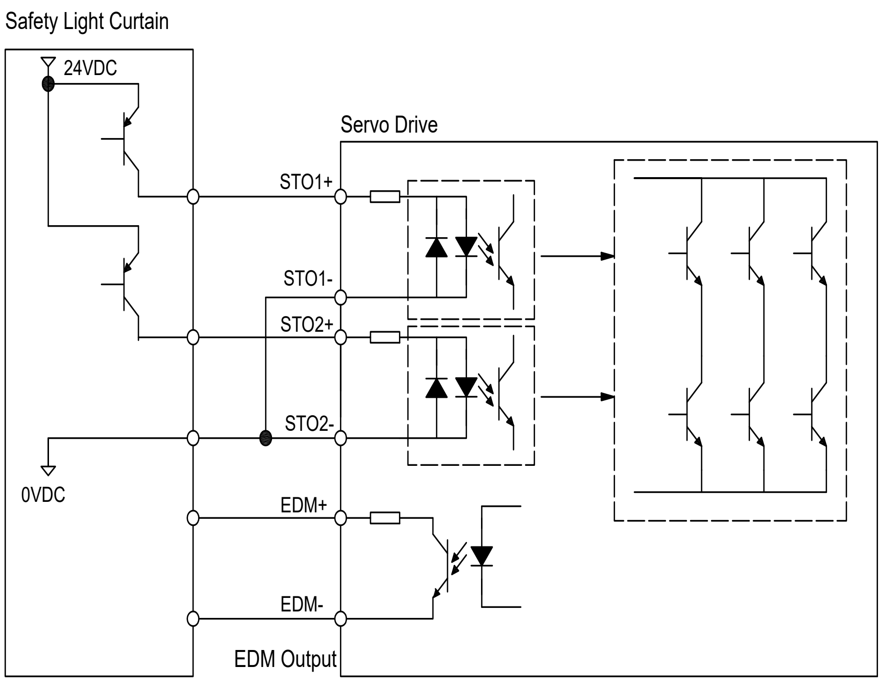
Note: When any of the safety inputs STO1 and STO2 are OFF, the STO function will start to work.

■ STO Connection Diagrams

- Connection to safety switch



- Safety light curtain connection



5 Troubleshooting

The red and green indicator lights are used to display the operating status and alarm codes.

Status

5.1 Status LED Error Codes

Errors are indicated by combinations of red and green flashes as shown below. This feature can be disabled for certain warnings but not for faults. Refer to the software manual for details on masking warnings.

Status	Description	Alarm type	Motor status after alarm	Alarm Resettable	Error code (0x603F)	DSP status code(0x200F)
Solid Green	Motor disabled				0x0000	0x00000000
Flashing Green	Motor enabled				0x0000	0x00000000
1R1G	Position Fault Limit	Fault	Servo off	Yes	0xFF06	0x00000001
1R2G	Move while disabled	Warning	Keep current status	Yes	0xFF35	0x00008000
2R1G	CCW limit	Warning	Keep current status: The motor cannot continue in CCW direction	Yes	0xFF32	0x00000002
2R2G	CW limit	Warning	Keep current status: The motor cannot continue in CW direction	Yes	0xFF31	0x00000004
3R1G	Over temperature	Fault	Servo off	Yes	0xFF03	0x00000008
3R2G	Internal voltage out of range	Fault	Servo off	Yes	0xFF05	0x00000010
3R3G	Blank Q segment	Warning	Keep current status	Yes	0xFF37	0x00004000
4R1G	Power supply over voltage	Fault	Servo off	Yes	0xFF02	0x00000020
4R2G	Power supply low voltage	Fault	Servo off	Yes	0xFF36	0x00000020
4R3G	memory error	Fault	Servo off	Yes	0xFF0E	0x00000010
4R4G	Power supply under voltage	Warning	Keep current status	Yes	0xFF44	0x00100000
4R5G	STO	Fault	Servo off	Yes	0xFF0B	0x00020000
5R1G	Over current	Fault	Servo off	Yes	0xFF01	0x00000080
5R2G	Current foldback	Warning	Keep current status	Yes	0xFF34	0x00002000
5R3G	Motor speed exceeds limit	Fault	Servo off	Yes	0xFF38	0x00080000
5R4G	CANopen/RS485 communication error	Fault	Servo off	Yes	0xFF43	0x08000000
6R2G	Motor encoder error	Fault	Servo off	No	0xFF07	0x00000200
6R3G	Emergency stop	Fault	Configurable by P5-50 or 0x605A	No	0xFF3A	0x00200000
6R4G	Homing parameter configuration error	Warning	Keep current status	Yes	0xFF45	0x80000000
7R1G	USB Communication abnormality	Warning	Keep current status	Yes	0xFF40	0x00000400
7R2G	Parameter saving failed	Fault	Servo off	Yes	0xFF41	0x00000010
7R3G	Motor stall protection	Fault	Servo off	Yes	0xFF10	0x20000000
7R4G	Motor collision protection	Fault	Servo off	Yes	0xFF46	0x20000000
7R5G	I/O signal used is not general purpose	Warning	Keep current status	Yes	0xFF42	0x00008000
7R6G	End of Travel Limit	Warning	Keep the current status, the motor cannot continue to rotate forward/reverse	Yes	0xFF33	0x00000006
8R1G	Absolute position overflow	Warning	Keep current status	Yes	0xFF3D	0x04000000
8R2G	Absolute encoder multiturn error	Fault	Servo off	No	0xFF0F	0x10000000
8R3G	Absolute position lost	Warning	Keep current status	Yes	0xFF3C	0x02000000

.

5.2 Causes and Solutions of Drive Alarms

Status	Description	Reason for alarm	Solutions	Alarm Reset Method
1R1G	Position Fault Limit	The position error exceeds the "position fault limit" setting in parameter P3-04 (PF)	1. Check whether the setting of parameter P3-04 (PF) "Position Fault Limit" is too small; 2. Whether the gain parameters are appropriate, 3. Check if the motor selected is capable of driving the load and whether the acceleration and deceleration are too large; 4. Whether unreasonable torque limit is used; 5. The mechanical part driven by the motor is stuck and the motor is blocked.	Clear alarm
1R2G	Move while disabled	When the motor is not enabled, a running command is received	Enable the motor first and then send the operation command	Clear alarm
2R1G	CCW limit	1. Reverse limit function trigger 2. In the absolute value system, the actual position of the motor	1. The external limit switch has been triggered; 2. The limit input function setting is incorrect. 3. In the absolute value system, the software limit has been set appropriately	Automatically clear after detachment
2R2G	CW limit	1. Forward rotation prohibition limit function is triggered 2. In the absolute value system, the actual position of the motor encounters the positive soft limit		Automatically clear after detachment
3R1G	Over temperature	The temperature of the motor's radiator and power components exceeds the specified value. 1. The ambient temperature is too high 2. The operating temperature of the motor exceeds the specified value;	1. Reduce the operating temperature of the motor and improve cooling conditions; 2. Increase the capacity of the motor, extend the acceleration and deceleration time, and reduce the load.	Clear alarm
3R2G	Internal voltage out of range	The internal voltage of the motor is lower than the normal value	Check the voltage of the power supply. If there is still a problem, replace the motor.	Clear alarm
3R3G	Blank Q segment	The motor is running in Q mode, but no Q program is running	1. Check whether there is a Q program; 2. Check whether the Q program is written incorrectly and cannot run in a loop.	Clear alarm
4R1G	Power supply over voltage	The motor DC bus voltage is too high, higher than 80VDC. The power supply voltage exceeds the allowable input voltage range;	1. Check the input voltage; 2. Extend the acceleration and deceleration time; 3. If the above problem is not solved, replace the motor.	Clear alarm
4R2G	Power supply low voltage	DC bus voltage is too low, lower than 18VDC 1. The power supply voltage is low and a momentary power outage occurs; 2. The power supply capacity is insufficient and is affected by the inrush current when the main power supply is turned on, causing the power supply voltage to drop;	Measure input voltage 1. Increase the power supply voltage capacity and replace the power supply; 2. Connect the power supply correctly; 3. If the above problem is not solved, replace the motor.	Clear alarm
4R3G	Memory error	Motor internal memory abnormality	If it cannot be cleared after powering on again, contact the manufacturer.	Power cycle to clear
4R4G	Power supply under voltage	The motor is under voltage, lower than 20VDC; 1. The power supply voltage is low and a momentary power outage occurs; 2. The power supply capacity is insufficient and is affected by the inrush current when the main power supply is turned on, causing the power supply voltage to drop; 3. Motor failure (circuit failure).	Check input voltage 1. Increase the power supply voltage capacity and replace the power supply; 2. Connect the power supply correctly, refer to 4.6 Main & AUX -- Wiring for Power Supply 3. Check the motor Main terminal and voltage input; 4. If the above problem is not solved, replace the motor.	Automatically clear when voltage is normal
4R5G	STO	The Safe Torque Off STO function is activated, and the input photocoupler of at least one of Safety Input 1 or Safety Input 2 is Open.	Check the input wiring status of safety inputs 1 and 2 or whether the safety sensor and other settings are triggered.	Automatically cleared after STO input is normal

Status	Description	Reason for alarm	Approach	Clear method
5R1G	Over current	1. Motor failure; 2. The motor is burned out; 3. The load is too heavy, the effective torque exceeds the rated torque, and the machine continues to operate for a long time; 4. Poor gain adjustment leads to oscillation and vibration.	1. Increase the power of the motor, extend the acceleration and deceleration time, and reduce the load; 2. Whether the gain parameters are debugged reasonably; 3. If the above problem is not solved, replace the motor.	Clear alarm
5R2G	Current foldback	The motor output current reaches the rated torque of the motor. The setting of P1-06, and the duration exceeds the setting value of P1-09 1. The load is too heavy, the effective torque exceeds the rated torque, and the machine continues to operate for a long time; 2. Poor gain adjustment causes oscillation and vibration, and the motor vibrates and makes abnormal sounds; 3. The machine is subject to collision and the load suddenly becomes heavier, causing torsion and entanglement.	1. Whether the gain parameters are set reasonably; 2. Whether the motor selection matches the actual load and whether the acceleration and deceleration are too large; 3. Increase the capacity of the motor and motor, extend the acceleration and deceleration time, and reduce the load.	Automatically cleared when the current is less than the rated current of the motor
5R3G	Motor speed exceeds limit	The motor speed exceeds the limit value of P2-00	Check whether the motor speed command is within a reasonable range 1. Avoid excessive speed commands; 2. If overshoot occurs due to poor gain adjustment, adjust the gain.	Clear alarm
5R4G	CANopen/ RS485 communication error	CANopen/RS485 communication error 1. Communication parameters are configured incorrectly; 2. Communication is interrupted.	1. Check the configuration parameters of CANopen/RS485 communication; 2. Check whether the communication cable is normal.	The abnormal alarm is cleared after the communication is normal.
6R2G	Motor encoder error	The servo system detects an abnormality in the communication with the servo motor encoder. 1. Interference causes encoder communication abnormalities; 2. The encoder is damaged.	1. Make sure the motor is well grounded; 2. If the above problem is not solved, replace the motor.	Power cycle to clear
6R3G	Emergency stop	Digital input emergency stop function is triggered	1. Confirm whether the emergency stop input switch malfunctions; 2. Confirm whether the emergency stop input logic setting is appropriate.	Automatically cleared when emergency
6R4G	Homing parameter configuration error	Homing parameter configuration error 1. Use the homing method with limit signal, and the limit signal is not configured; 2. Use the homing method with home signal, and the home signal is not configured.	Check whether the homing parameters are completely configured	Clear alarm
7R1G	USB Communication abnormality	1. Luna software is trying to establish communication with the motor (this is a normal alarm); 2. Check whether the communication cable is normal.	Automatically cleared after normal communication	Automatically cleared after
7R2G	Parameter saving failed	Parameter out of range	Try saving again	Automatically clear
7R3G	Motor stall protection	When working in non-torque mode, the motor stall time exceeds the time set by P1-28.	1. Check whether the load is stuck 2. Check whether the electromagnetic brake is on.	Clear alarm
7R4G	Motor collision protection	The instantaneous change value of current exceeds the setting value of P1-34	1. Check whether the motor is colliding with a hard stop; 2. The servo gain setting is unreasonable and the gain is too large; 3. Check whether the setting value of P1-34 is too small.	Clear alarm

Status	Description	Reason for alarm	Approach	Clear method
7R5G	I/O signal used is not general purpose	1. The functions of the I/O signals used in the Q program are non-universal functions; 2. The functions of the I/O signals used in the SCL instruction are non-general functions.	1. Configure the relevant I/O signal functions as general functions; 2. Use I/O signals whose functions are general functions.	Clear alarm
7R6G	End of Travel Limit	1. Both forward rotation limit and reverse rotation limit digital inputs are triggered; 2. The actual position of the motor encounters both forward and reverse software limits.	1. Ensure limit input function logic setting is correct. 2. Check limit switches/sensors are not being triggered by other objects. 3. Ensure software limits are correctly set in the corresponding direction.	Automatically clear when only one or no limits are triggered
8R1G	Absolute position overflow	1. The number of multi-turns of the absolute encoder exceeds the maximum range: -32768 ~ +32767; 2. The absolute position exceeds the maximum range of parameter -2^31 ~ 2^31 -1.	1. Check whether the actual position of the motor exceeds the maximum range; 2. If it exceeds the range, perform multi-turn clearing of the absolute encoder; 3. If you need to run in one direction, set P3-15 to 2 (multi-turn encoders do not count overflow).	Clear automatically after clearing the absolute encoder for multiple turns.
8R3G	Absolute position lost	When powered on, the absolute encoder works in multi-turn mode, and the absolute encoder is used for the first time after leaving the factory.	Perform multi-turn clearing of absolute encoder	Clear automatically after clearing the absolute encoder for multiple turns.

6 Trial Run

6.1 Inspection Before Trial Run

In order to ensure the safety of the motor and mechanical structure, it is strongly recommended to check the following items before powering on the motor.

1) Wiring inspection

Check whether the power input terminal Main, AUX, I/O, and communication terminal USB are correctly wired, whether the wiring is secure, whether there is a short circuit, and confirm the correct grounding.

2) Power supply voltage check

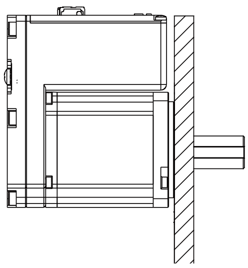
Check whether the voltage between V+ and V- meets the input specifications of the motor, and check whether the voltage between AUX+ and AUX- is within the correct range.

3) Make sure the motor is installed securely

4) Make sure the motor shaft is not loaded

6.2 Trial Run Procedure

Note: Be sure to set the motor parameters according to the following steps before moving with the motor.

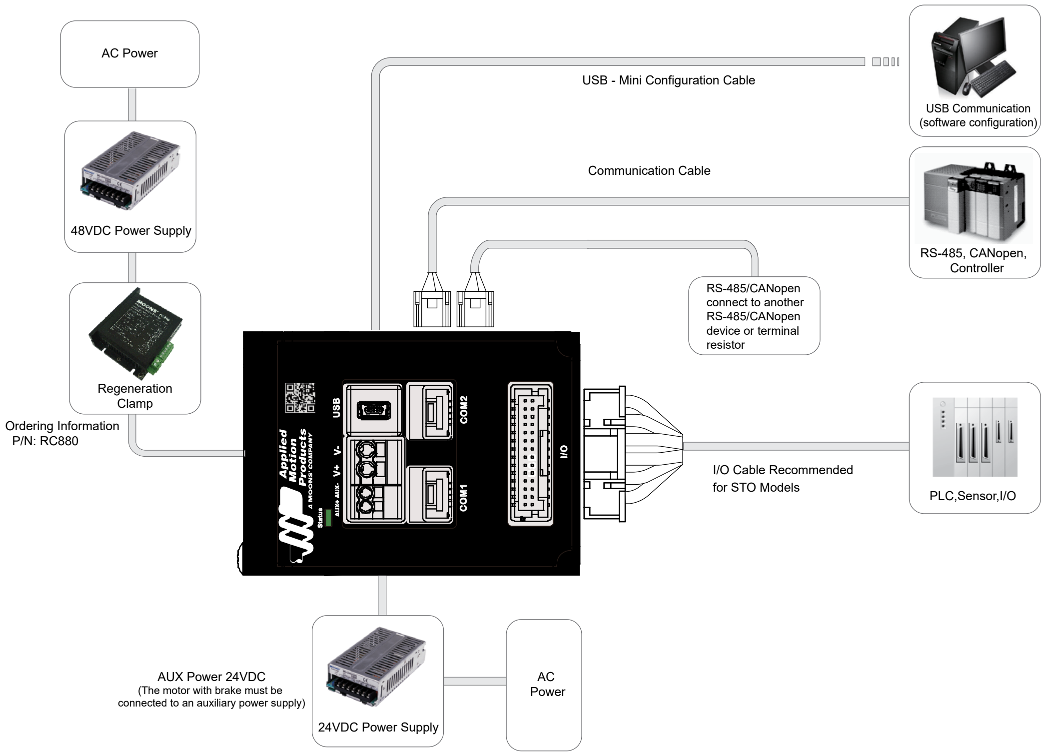
Steps	Details	Description
1	Install the motor securely 	1) The motor can be installed on the machine. 2) Ensure no load is installed on the servo motor.
2	Make sure the wiring between the motor is correct	Refer to Chapter 4.6 Main & AUX -- Wiring for Power Supply to confirm whether the power input circuit is correct.
3	Supply Power	1) Main power input 20 ~ 60VDC 2) Control/auxiliary power input 24VDC±10%
4	Under normal circumstances, the green indicator light is always on. When an alarm occurs, the red indicator light lights up	1) Under normal circumstances, the motor has no alarm display, the green indicator light is always on, and is in a non-enabled state; if the indicator light does not light up, check the power supply voltage input to the motor. 2) If the red indicator light is on, it means that the motor has an alarm;
6	If using a motor with electromagnetic brake, please check the appropriate manual section for instructions	Refer to Chapter 4.10 Electromagnetic Brake
7	JOG mode operation	If there is no abnormality in the above steps, you can start the JOG mode test run.

6.3 Configuration by PC

In order to ensure motor meets your operation requirements, we strongly recommend using "Luna Software" for following configuration setups:

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

Connect to Personal Computer



Refer to the Luna software for detail.

7 Control Modes and Functions

7.1 I/O Signal Setting

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

7.1.1 Input Signal Configuration

Assignable input functions

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

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

The definitions of logic states for inputs are as follows:
Closed: The input's internal circuit is completed, and current flows in through the input.
Open: The input's internal circuit is not completed, and current does NOT flow through the input

Default input functions

The parameters, functions and default parameter values corresponding to the IP20 model input signals X1~X6 in each mode are as follows.

Signal				Default Value		
Symbol	Description	Parameter	Command	Abbreviation	Input Logic	Default
X1	Digital Input 1	P5-00	MU1	GP	Closed	0
X2	Digital Input 2	P5-01	MU2	GP	Closed	0
X3	Digital Input 3	P5-02	MU3	A-CLR	Closed	3
X4	Digital Input 4	P5-03	MU4	S-ON	Closed	1
X5	Digital Input 5	P5-04	MU5	CCW-LMT	Closed	7
X6	Digital Input 6	P5-05	MU6	CW-LMT	Closed	5
XCOM	X3/X4/X5/X6 Digital Input Common	-	-	-		

The parameters, functions and default parameter values corresponding to the IP65 model input signals X1~X4 in each mode are as follows.

Signal				Default Value		
Symbol	Description	Parameter	Command	Abbreviation	Input Logic	Default
X1	Digital Input 1	P5-00	MU1	GP	Closed	0
X2	Digital Input 2	P5-01	MU2	GP	Closed	0
X3	Digital Input 3	P5-02	MU3	A-CLR	Closed	3
X4	Digital Input 4	P5-03	MU4	S-ON	Closed	1

7.1.2 Output Signal Configuration

Assignable output functions

The functions and logic assignable to outputs are listed below:

Signal name	Signal Symbol	Logic and set value when output signal is valid	
		Output when the signal is valid Closed	Output when the signal is valid Open
General Purpose Output	GPOUT	0	-
Fault Output	FAULT	1	2
Warning Output (Alarm)	WARN	3	4
Brake Release Output	BRK	5	Not Supported
Servo-on Status Output	SON-ST	7	8
In-Position Output	IN-POS	9	10
Dynamic Position Error 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 Output	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 definitions of logic states for outputs are as follows:
Closed: The output's internal circuit is completed, and current flows through the output.
Open: The output's internal circuit is not completed, and current does NOT flow through the output.

Default output functions

The parameters, functions and default parameter values corresponding to the IP20 model output signals Y1~Y3 in each mode are as follows.

Signal				Default Value		
Symbol	Description	Parameter	Command	Abbreviation	Output Logic	Default
Y1	Digital Output 1	P5-12	MO1	SON-ST	Closed	7
Y2	Digital Output 2	P5-13	MO2	FAULT	Closed	2
Y3	Digital Output 3	P5-14	MO3	IN-POS	Closed	9
YCOM	Common Terminal	-	-	-		

The parameters, functions and default parameter values corresponding to the IP65 model output signals Y1~Y2 in each mode are as follows.

Signal				Default Value		
Symbol	Description	Parameter	Command	Abbreviation	Output Logic	Default
Y1	Digital Output 1	P5-12	MO1	FAULT	Closed	2
Y2	Digital Output 2	P5-13	MO2	IN-POS	Closed	9
YCOM	Common Terminal	-	-	-		

7.1.3 Servo Enable

Servo Enable Input function (S-ON) is the enable/disable signal for energizing the motor windings. If the motor is enabled, the user may execute motion at the motor. If the motor is disabled, the user cannot execute motion at the motor.

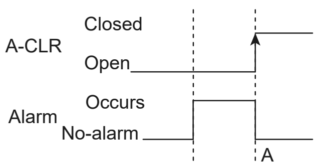
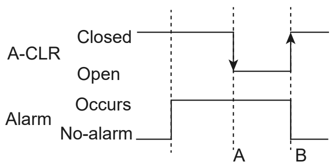
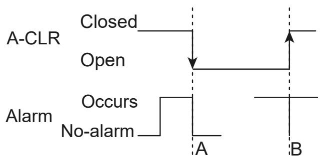
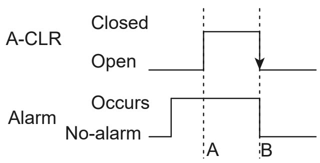
Signal logic

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

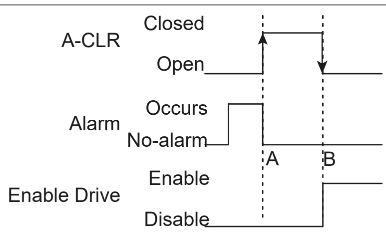
7.1.4 Alarm Reset

Alarm Reset Inout function (A-CLR) is used or faults

Signal logic

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

Note: When none of the input pins of the motor are configured with the "servo enable" function, "alarm reset" can be used to enable the motor, as shown below:

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

7.1.5 CW, CCW Limit

The CW Limit Input (CW-LMT) and CCW Limit Input (CCW-LMT) functions work with limit sensors or switches to prevent the machine's movable parts from exceeding their allowed range, thereby avoiding accidents.

Signal logic

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

IP20 type default settings for MDX+ Series

Signal name	Input	PIN NO.	Parameter	Command	Setup value	Function	Support mode		
CCW-LMT	X5	16	P5-00	MU5	7	Motor CW limit signal input	P	V	T
	XCOM	14							
CW-LMT	X6	15	P5-01	MU6	5	Motor CCW limit signal input			
	XCOM	14							

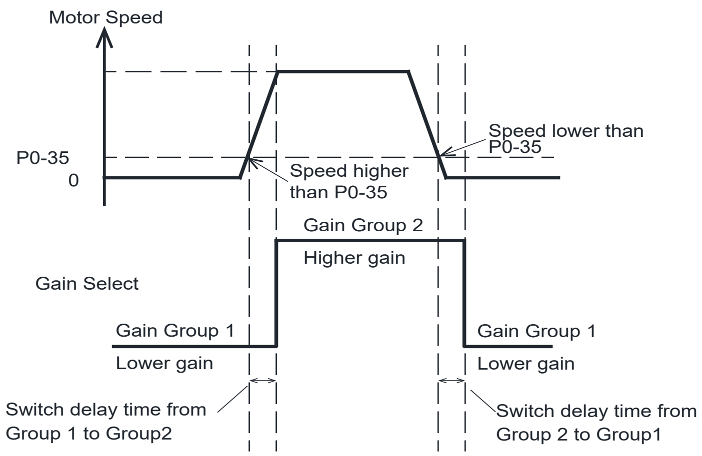
7.1.6 Gain Select

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

1. Increasing the gain can decrease and suppress vibration when doing position control.
2. Reducing the gain can decrease the settling time when the motor comes to a stop.
3. When the motor is running, increasing the gain can improve command following performance.

Example:

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



Tuning Parameters

Parameter	Command	Description	Class	Defaults	Unit
P0-05	KP	1st Position Loop Gain	1st Gain Group	52	0.1Hz
P0-07	KD	1st Position Loop Derivative Time Constant		0	ms
P0-08	KE	1st Position Loop Derivative Filter		20000	0.1Hz
P0-11	KF	1st Velocity Command Gain		10000	0.01%
P0-12	VP	1st Velocity Loop Gain		183	0.1Hz
P0-13	VI	1st Speed Loop Integral Time Constant		189	ms
P0-16	KC	1st Command Torque Filter Frequency		1099	0.1Hz
P0-17	UP	2nd Position Loop Gain	2nd Gain Group	52	0.1Hz
P0-19	UD	2nd Position Loop Derivative Time Constant		0	ms
P0-20	UE	2nd Position Loop Derivative Time Constant		20000	0.1Hz
P0-21	UF	2nd Velocity Command Gain		10000	0.01%
P0-22	UV	2nd Velocity Loop Gain		183	0.1Hz
P0-23	UG	2nd Velocity Loop Integral Time Constant		189	ms
P0-24	UC	2nd Command Torque Filter Frequency		1099	0.1Hz
P0-33	SD	Automatic Gain Switching Method	-	0	
P0-34	PN	Gain Switching Condition - Position Error	-	0	counts
P0-35	VN	Gain Switching Condition - Actual Velocity	-	0	0.025rps
P0-36	TN	Gain Switching Condition - Actual Torque	-	10	0.1%
P0-37	SE1	Delay Time - 2nd Group Gains to 1st Group Gains	-	10	ms
P0-38	SE2	Delay Time - 1st Group Gains to 2nd Group Gains	-	10	ms

1. Gain Select via digital input signal

Motor will switch the 1st Gain Group to the 2nd Gain Group, when the the digital input signal GAIN-SEL input is valid.

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

Note:

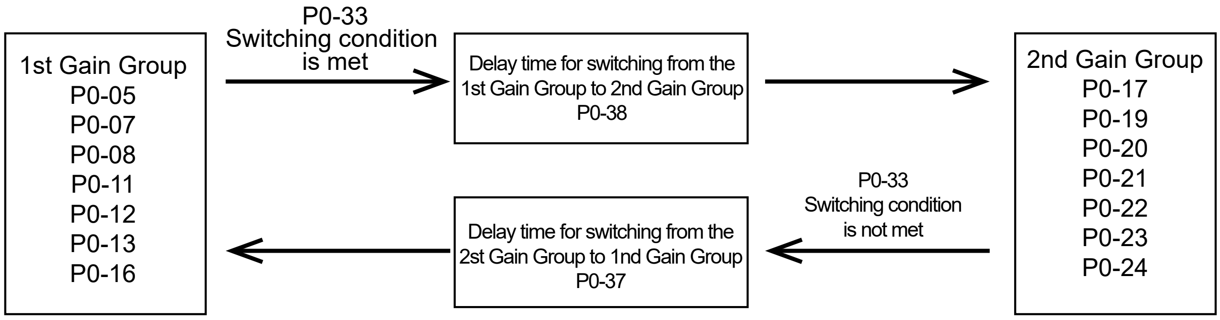
Automatic gain switching is High when the gain switching method is set to external input switching, via the GAIN-SEL signal. That means no matter how P0-33 is set, the gain switching determined by the external input signal.

2. Automatic Gain Select

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

Parameter	Setting	Condition	Switching Delay Time
P0-33	0 (Default)	Fix at 1st Gain Group	-
	1	Condition for switching to 2nd Gain Group: Position following error ≥ P0-34	P0-38
		Condition for switching to 1st Gain Group: Position following error < P0-34	P0-37
	2	Condition for switching to 2nd Gain Group: Actual Velocity ≥ P0-35	P0-38
		Condition for switching to 1st Gain Group: Actual Velocity < P0-35	P0-37
	3	Condition for switching to 2nd Gain Group: Actual Torque ≥ P0-36	P0-38
		Condition for switching to 1st Gain Group: Actual torque < P0-36	P0-37
	4	Condition for switching to 2nd Gain Group: Positioning Complete (IN-POS) Invalid	P0-38
		Return to 1st Gain Group: Positioning Complete (IN-POS)	P0-37

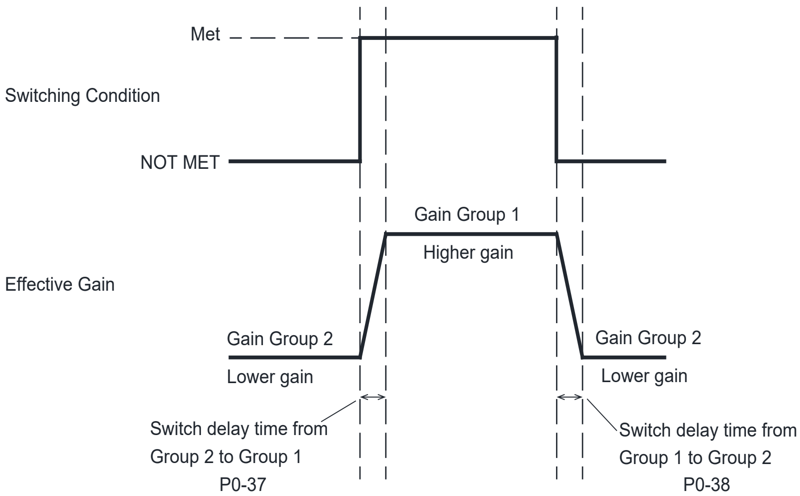
Auto switch mode



Gain Switch Delay Time

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

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



7.1.7 Emergency Stop

Emergency stop is a function that forcibly stops the operation of the servo motor through an external digital input signal.

When using emergency stop, the signal E-STOP needs to be assigned to the digital input port.

When the emergency stop input signal is valid, the motor controls the motor operation in the emergency stop mode set by P5-50.

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

◆ Emergency stop option

The MDX+ motor supports the following emergency stop methods, and users can choose the appropriate method according to application needs.

Emergency stop trigger		Emergency stop reset	
Motor stop deceleration	Servo status	Servo status	Alarm
AM command(P2-01)	Disabled	Disabled	Continue to show
AM command (P2-01)	Enabled	Enabled	Continue to show
AM command (P2-01)	Disabled	Disabled	Automatically clear
AM command (P2-01)	Enabled	Enabled	Automatically clear
AM command (P2-01)	Disabled	Enabled	Automatically clear
AM command (P2-01)	Enabled	Disabled	Automatically clear
Coast to Stop	Disabled	Disabled	Continue to show
Coast to stop	Disabled	Disabled	Automatically clear

Note: When the motor works in CANopen mode, after emergency stop reset, the servo status depends on the value of the control word (0x6040).

7.1.8 Fault Error Output

When a fault occurs, the motor will generate a fault error output, and the servo system will change from the enabled state to disabled state. Parameters P5-12 ~ P5-14 set the functions of the motor's digital output Y1 ~ Y3. To use this function, configure one of the motor's digital output as the FAULT function.

Type	Abbreviation	Value	Logic	Function
Output	FAULT	1	Closed	If the motor has a fault, an error message is generated, and the output is in the Closed state.
			Open	The motor is normal, no errors are reported, and the output is Open.
		2	Open	An error message is generated when the motor is faulty, and the output is in the Open state.
			Closed	The motor is normal, no errors are reported, and the output is in Closed status.

LED status	Description	Alarm type	Motor status after alarm		LED status	Description	Alarm type	Motor status after alarm
1R1G	Position error exceeds limit	Fault	Servo off		7R3G	Motor stall protection	Fault	Servo off
3R1G	Motor overtemperature	Fault	Servo off		7R4G	Motor collision protection	Fault	Servo off
3R2G	Internal voltage error	Fault	Servo off					
4R1G	Motor overvoltage	Fault	Servo off					
4R2G	Motor low voltage	Fault	Servo off					
4R3G	Memory error	Fault	Servo off					
4R5G	STO	Fault	Servo off					
5R1G	Motorr overcurrent	Fault	Servo off					
5R3G	Motor speed exceeds limit	Fault	Servo off					
6R2G	Encoder communication abnormality	Fault	Servo off					
6R3G	Emergency stop	Fault	Servo off					
7R2G	Parameter saving failed	Fault	Servo off					

◆ IP20 Model motor default settings

Abbreviation	Signal	PIN No(I/O)	Parameter	Command	Value	Logic	Function	Support Mode		
FAULT	Y2	12	P5-13	MO2	2	Closed	Motor emergency stop	P	V	T
	YCOM	10				Open	Emergency stop does not take effect			

◆ IP65 Model motor default settings

Abbreviation	Signal	PIN No(I/O)	Parameter	Command	Value	Logic	Function	Support Mode		
FAULT	Y2	12	P5-13	MO2	2	Closed	Motor emergency stop	P	V	T
	YCOM	13				Open	Emergency stop does not take effect			

7.1.9 Warning Output

When the motor generates the following types of abnormal warnings, a warning signal will be output. Parameters P5-12 ~ P5-14 set the functions of the motor's digital output Y1 ~ Y3.

To use this function, configure one of the motor's digital output as WARN function.

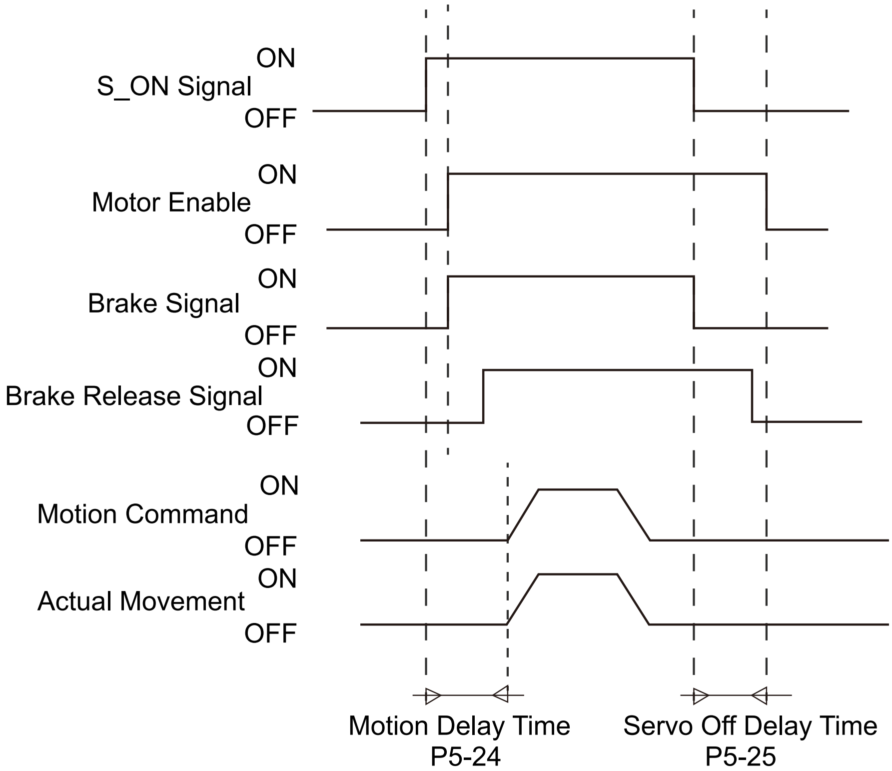
Type	Abbreviation	Value	Logic	Function
Output	WARN	3	Closed	The motor generates an abnormal warning and the output is Closed status.
			Open	The motor is normal, there are no abnormal warnings, and the output is Open.
		4	Open	The motor has an abnormal warning and the output is Open.
			Closed	The motor is normal, there are no abnormal warnings, and the output is Closed status

LED status	Description	Alarm Type	Motor status after alarm
7R6G	CW LIMIT and CCW LIMIT	Warning	The motor cannot rotate. Keep current status.
2R1G	CCW LIMIT	Warning	The motor cannot continue in CCW direction. Keep current status.
2R2G	CW LIMIT	Warning	The motor cannot continue in CW direction. Keep current status.
5R2G	Current foldback	Warning	Keep current status
7R1G	RS485 or USB communication error	Warning	Keep current status
4R4G	Motor undervoltage	Warning	Keep current status
3R3G	Blank Q segment	Warning	Keep current status
1R2G	Move while disabled	Warning	Keep current status
8R3G	Absolute position lost	Warning	Keep current status
8R1G	Absolute value position overflow	Warning	Keep current status
6R4G	Homing parameter configuration error	Warning	Keep current status
7R5G	I/O signal function multiplexing	Warning	Keep current status
5R4G	Bus watchdog trigger	Warning	Keep current status

7.1.10 Motor Brake Control

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

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



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

7.1.11 Servo Ready Output

When the motor is powered on and there is no alarm, the motor 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 motor 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 motor receives servo-on input signal, the motor will not be enabled or start to work.

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

7.1.12 Servo-on Status Output

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

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

Parameters P5-12 ~ P5-14 configure the functions of digital outputs Y1 ~ Y3 on the motor.

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

IP20 default settings

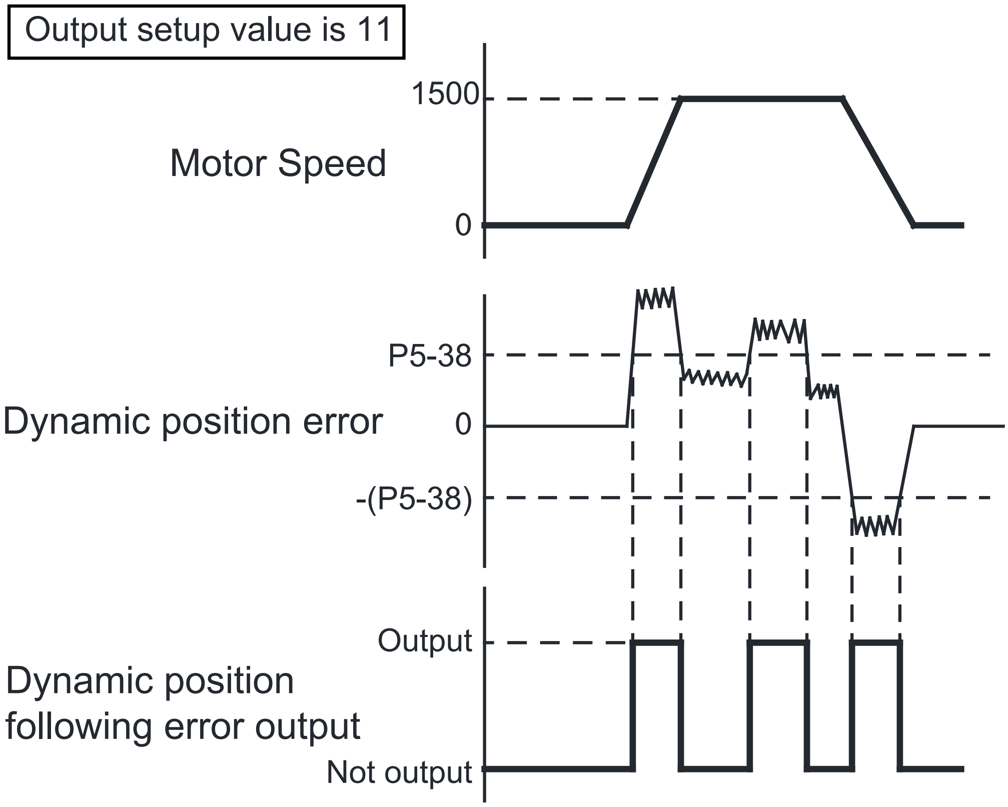
Signal Symbol	Output NO.	PIN NO.	Parameter	Command	Setup Value	Signal Logic	Description	Support mode			
SON-ST	Y1	13	P5-12	MO1	7	Closed	Motor is enabled	P	V	T	
	YCOM	10				Open	Motor is not enabled				

7.1.13 Dynamic Position Error Output

The dynamic position error output activates when the difference between the motor's actual position and the commanded position exceeds the threshold set in P5-38 (Position Error Signal Threshold) during motor operation.

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

The following figure is a timing diagram when configuring an outuput to a value of 11, that is, the error exceeds the setting of P5-38, Position Error Signal Threshold, and the output state is Closed.



7.1.14 Software Limit Output

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

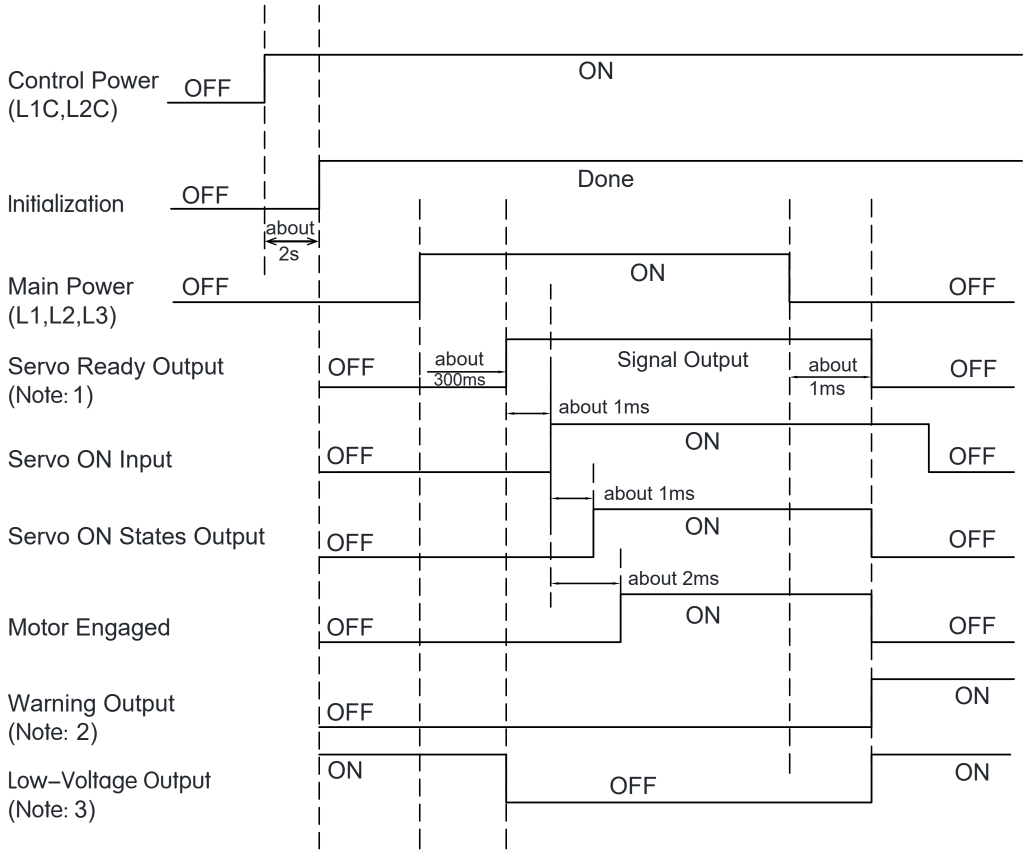
1. Output SLCW when positive direction limit encountered.
2. Output SLCCW when negative direction limit encountered.

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

Hardware limit switches can also be used with the MDX+ Series. Digital input signals must first be configured as limit signals via the Luna Software.

7.1.15 Timing Diagram

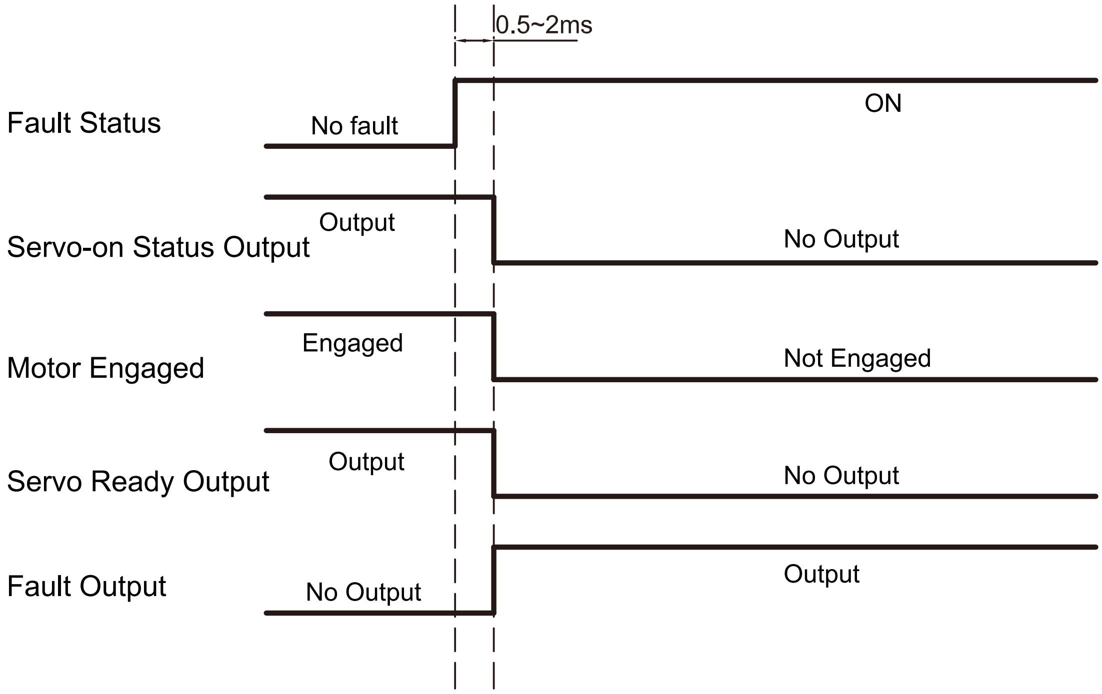
Timing chart for turning on the power



Note:

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

Timing chart when fault alarm occurs

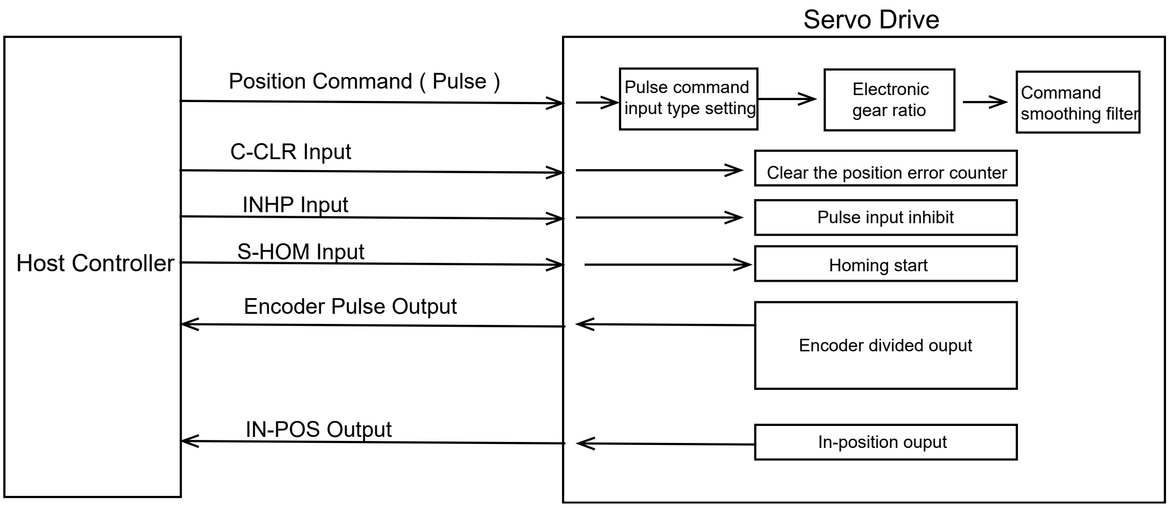


7.2 Position Control Mode

7.2.1 Position Control Mode Configuration

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

Block diagram



Position Control Mode

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

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

7.2.2 Command Smoothing Filter Setting

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

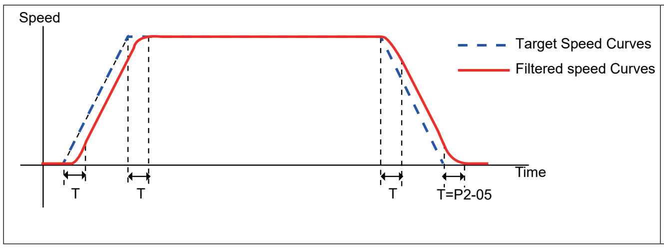
Related parameters

Parameter	Instruction	Name	Value range	Defaults	Unit	Description
P2-05	JT	Jerk Time	0 ~ 250	10	ms	Time constant for smoothing filtering in internal trajectory mode
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

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

Jerk time

Parameter P2-05 can be used in various motor control modes (position, velocity, torque). The effect of jerk smoothing on the input command is shown in the figure below.

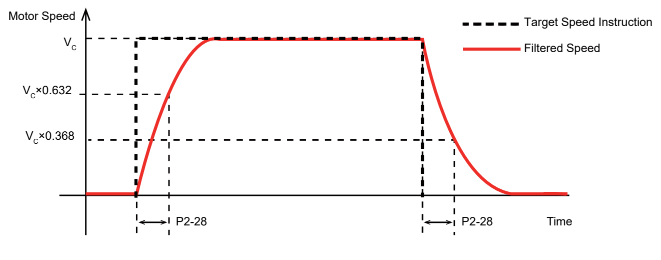


◆ Jerk time filter will produce a certain delay T for the command, but it will not affect the final positioning accuracy.

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

Low pass smoothing filter

Parameter P2-28 can be used in various motor control modes (position, speed, torque). The smoothing effect of the low-pass filter on the input command is shown in the figure below.



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

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

7.2.3 In-Position Signal Output

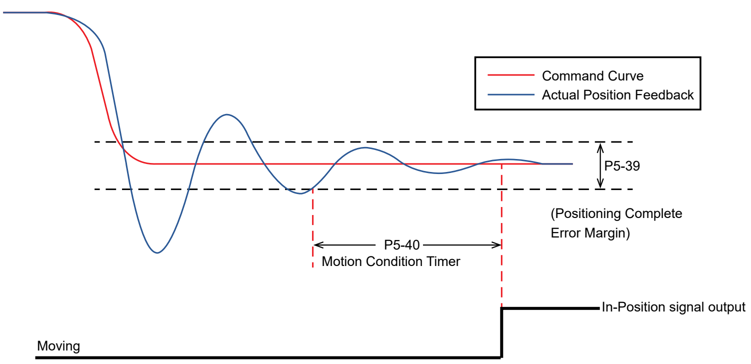
In position control mode, use the In-Position Output signal (IN-POS) to indicate the completion of the servo motor's positioning. The IN-POS signal is activated when the absolute value of the position error—the difference between the position setpoint and actual positions—falls below the threshold defined by parameter P5-39 for the duration specified by the timer in parameter P5-40.

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

Related parameters

Parameter	Instruction	Name	Value range	Defaults	Unit	Description
P5-39	PD	Positioning Complete Error Margin	0 ~ 32000	40	pulses	Specifies the acceptable position error range upon motion completion. If the error falls within this range, the positioning complete signal is activated.
P5-40	PE	Motion Condition Timer	0 ~ 32000	10	ms	Defines the duration for which the motion complete condition must be satisfied for the positioning to be considered complete, resulting in the output of the IN-POS signal.

As shown below



7.2.4 Near Target Position Output

The Near Target Position (P-COIN) signal indicates when the motor's actual position matches a specified absolute position. This position is defined by parameter P5-46, which determines the target position for the signal.

Near Target Position Output P-COIN setting

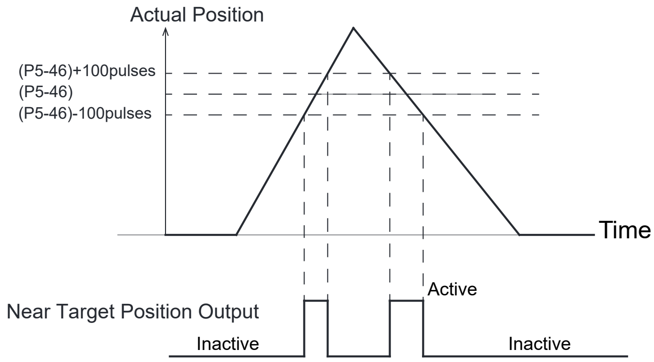
Type	Signal Name	Set Value	Signal Logic	Function
Output	P-COIN	31	Closed	When position is within 100 pulse of Near Target Position, P-COIN is active, and output is closed.
			Open	When position is not within 100 pulse of Near Target Position, P-COIN is inactive, and output is open.
		32	Open	When position is within 100 pulse of Near Target Position, P-COIN is active, and output is open.
			Closed	When position is not within 100 pulse of Near Target Position, P-COIN is inactive, and output is closed.

Related parameter settings

Parameter	Instruction	Name	Value range	Defaults	Unit	Description
P5-46	DG	Near Target Position	-2147483647 ~ +2147483647	10000	pulses	Sets the target position for which the Near Target Position signal (P-COIN) becomes active.

Near Target Position (P-COIN) Trigger Condition

The P-COIN trigger condition is met when the actual position aligns with the target set by parameter P5-46 within a tolerance of ±100 pulses. When this condition is satisfied, the P-COIN signal activates.



7.2.5 Gain Parameter in Position Mode

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

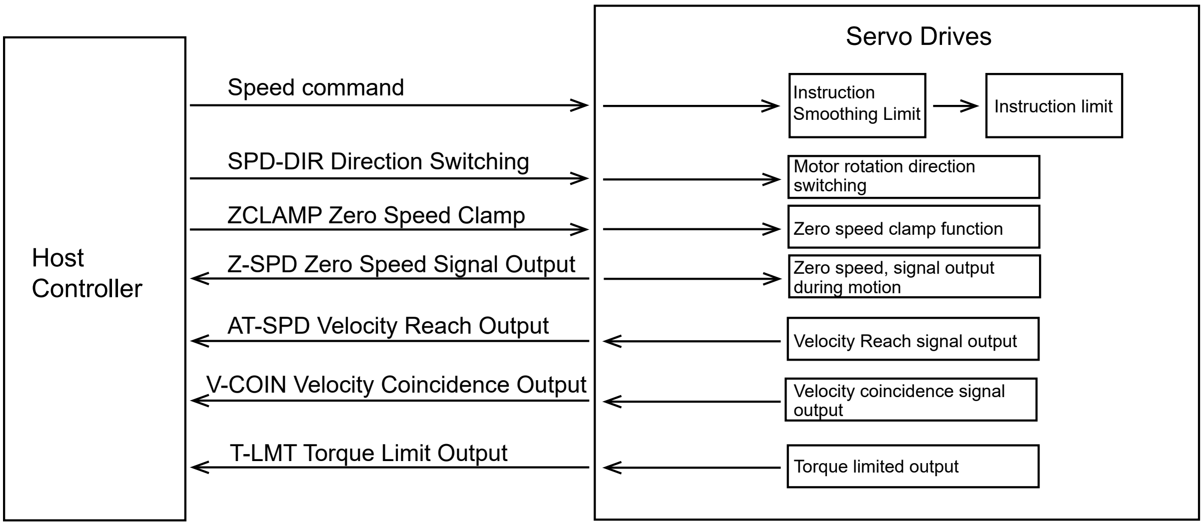
Parameter	Command	Parameter name	Type	Defaults	Unit
P0-05	KP	1st Position Loop Gain	1st set of gains	52	0.1Hz
P0-07	KD	1st Position Loop Derivative Time Constant		0	ms
P0-08	KE	1st Position Loop Derivative Filter		20000	0.1Hz
P0-11	KF	1st Velocity Command Gain		10000	0.01%
P0-12	VP	1st Velocity Loop Gain		183	0.1Hz
P0-13	VI	1st Speed Loop Integral Time Constant		189	ms
P0-16	KC	1st Command Torque Filter Frequency		1099	0.1Hz
P0-17	UP	2nd Position Loop Gain	2nd set of gains	52	0.1Hz
P0-19	UD	2nd Position Loop Derivative Time Constant		0	ms
P0-20	UE	2nd Position Loop Derivative Time Constant		20000	0.1Hz
P0-21	UF	2nd Velocity Command Gain		10000	0.01%
P0-22	UV	2nd Velocity Loop Gain		183	0.1Hz
P0-23	UG	2nd Velocity Loop Integral Time Constant		189	ms
P0-24	UC	2nd Command Torque Filter Frequency		1099	0.1Hz
P0-33	SD	Automatic Gain Switching Method	-	0	
P0-34	PN	Gain Switching Condition - Position Error	-	0	pulses
P0-35	VN	Gain Switching Condition - Actual Velocity	-	0	rps
P0-36	TN	Gain Switching Condition - Actual Torque	-	10	0.1%
P0-37	SE1	Delay Time - 2nd Group Gains to 1st Group Gains	-	10	ms
P0-38	SE2	Delay Time - 1st Group Gains to 2nd Group Gains	-	0	ms

7.3 Velocity Control Mode

7.3.1 Velocity Control Mode Configuration

Velocity control mode is used for precise speed control.

◆ Block diagram



◆ Velocity control mode selection

MDX+ series motor command speed mode.

Command velocity mode: Use the motor's internal command speed, AMP unique Q programming, or use Modbus commands to control the motor speed.

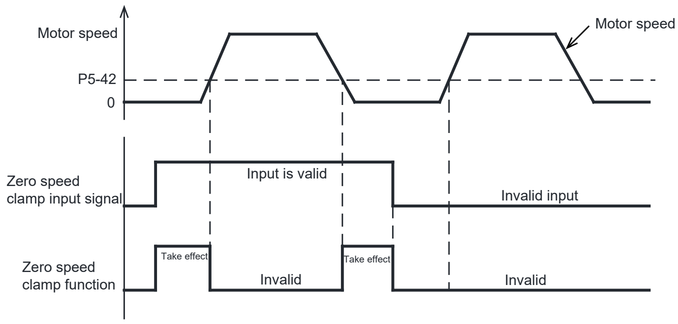
Parameter	Command	Value	Control Mode	Control method	Description
P1-00	CM	15	Command Velocity Mode	Internal speed command, communication command or Q programming	◆ Internal Multi-speed mode ◆ Use Q programming function control ◆ Use Modbus command control When using Modbus command to directly control the motor operation, P1-00 must be set to 21

7.3.2 Zero Speed Clamp Function

In velocity control mode, the Zero Speed Clamp function is used to maintain the shaft position when zero speed is desired. This is achieved by enabling the Position Control Loop in the servo system. The Zero Speed Clamp function can be triggered using two methods.

1. Zero Speed Clamp function (P5-51) set to 0

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



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

ZCLAMP input signal configuration

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

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

2. Zero Speed Clamp function (P5-51) set to 1

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

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

Related parameters

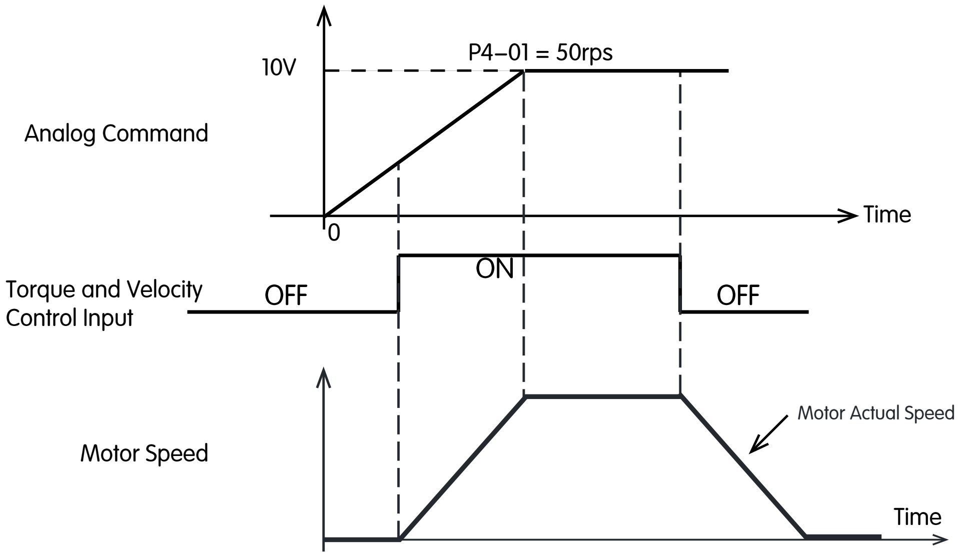
Parameter	Instruction	Name	Value range	Defaults	Unit	Description
P5-40	PE	Motion Condition Timer	0 ~ 30000	10	ms	MS=0 When the command speed is less than or equal to the zero-speed judgment threshold, the motor considers that it is in the zero-speed state at this time
P5-42	ZV	Zero Speed Width	0.1 ~ 2	0.5	rps	
P5-51	MS	Zero Speed Clamp Function	0 ~ 4	0	-	

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

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 Control" function, if the input logic is OFF, the motor will stop even if the speed command is not zero.

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 speed command sign is ignored, and the direction is determined by the logic of the digital input configured to 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.

<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="5">Input</td><td rowspan="4">SPD-DIR</td><td rowspan="2">35</td><td>Closed</td><td>SPD-DIR input is valid, the motor rotates direction will be changed.</td></tr>
<tr><td>Open</td><td>SPD-DIR input is invalid, the motor rotates direction will NOT be changed.</td></tr>
<tr><td rowspan="2">36</td><td>Open</td><td>SPD-DIR input is valid, the motor rotates direction will be changed.</td></tr>
<tr><td>Closed</td><td>SPD-DIR input is invalid, the motor rotates direction will NOT be changed.</td></tr>
<tr><td>GP</td><td>0</td><td>-</td><td>None of digital inputs is configured as SPD-DIR function, the rotate direction is controlled by the sign of speed command.</td></tr>
</table>

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 are configured as SPD-DIR function

<table>
<tr><th>Parameter P1-11 motor rotation direction</th><th>command torque (communication command)</th><th>Input logic of SPD-DIR</th><th>Actual motor rotation direction</th></tr>
<tr><td>0</td><td>Positive</td><td rowspan="4">Input signal not used</td><td>CW</td></tr>
<tr><td>0</td><td>Negative</td><td>CCW</td></tr>
<tr><td>1</td><td>Positive</td><td>CCW</td></tr>
<tr><td>1</td><td>Negative</td><td>CW</td></tr>
</table>

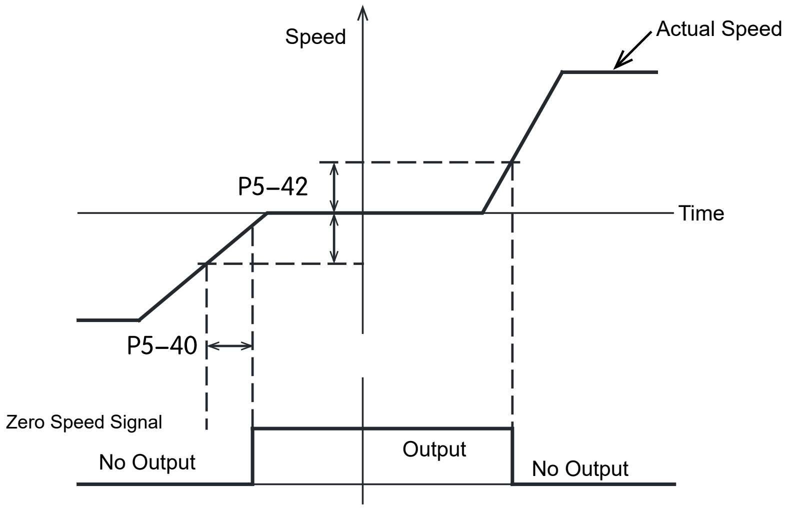
◆ One of digital inputs is configured as SPD-DIR function:

<table>
<tr><th>Parameter P1-11 motor rotation direction</th><th>command torque (communication command)</th><th>Input logic of SPD-DIR</th><th>Actual motor rotation direction</th></tr>
<tr><td>0</td><td>Positive</td><td>High</td><td rowspan="2">CW</td></tr>
<tr><td>0</td><td>Negative</td><td>High</td></tr>
<tr><td>0</td><td>Positive</td><td>Low</td><td rowspan="2">CCW</td></tr>
<tr><td>0</td><td>Negative</td><td>Low</td></tr>
<tr><td>1</td><td>Positive</td><td>High</td><td rowspan="2">CCW</td></tr>
<tr><td>1</td><td>Negative</td><td>High</td></tr>
<tr><td>1</td><td>Positive</td><td>Low</td><td rowspan="2">CW</td></tr>
<tr><td>1</td><td>Negative</td><td>Low</td></tr>
</table>

7.3.4 Zero Speed Output

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

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



Z-SPD output signal configuration

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

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

Related parameters

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

7.3.5 Velocity Reached Output

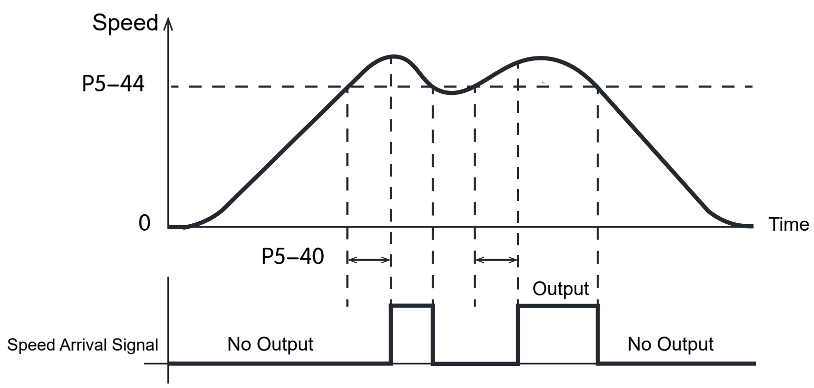
In velocity control mode mode, when the absolute value of the actual motor speed exceeds P5-44 (Velocity Reached Threshold), for the duration of time specified in P5-40, the velocity reached signal AT-SPD will be output.

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

AT-SPD output signal configuration

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

Type	Signal name	Set value	Signal logic	Function
Output	AT-SPD	19	Closed	The AT-SPD judgment condition is satisfied, the output signal is active, and the output state is closed
			Open	The AT-SPD judgment condition is not established, the signal is not active, and the output state is open
		20	Open	The AT-SPD judgment condition is satisfied, the output signal is active, and the output state is open
			Closed	The AT-SPD judgment condition is not established, the signal is not active, and the output state is closed



Related parameters

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

7.3.6 Velocity Coincidence (V-COIN)

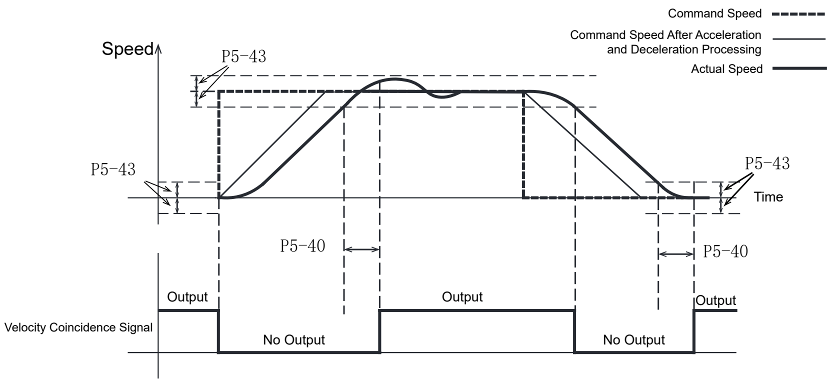
In velocity control mode, when the fluctuation of the actual velocity from the commanded velocity is within the margins set by P5-43, for the duration of time specified by P5-40, then it is determined that the actual speed of the motor is consistent with the commanded velocity and the velocity consistent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

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

V-COIN output signal configuration

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

Type	Signal name	Set value	Signal logic	Function
Output	V-COIN	17	Closed	V-COIN judgment condition is established, the signal is active, output state is closed
			Open	The V-COIN judgment condition is not established, the signal is not active, and the output state is open
		18	Open	V-COIN judgment condition is established, the signal is active, output state is open
			Closed	If the judgment condition is not established, the signal is not active, and the output state is closed



Related parameters

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

7.3.7 Velocity Control Mode Methods

In velocity control mode, there are two control types:

1. Position over time
2. Speed control only (default setting)

Related parameters

Parameter	Instruction	Name	Value range	Defaults	Unit	Describe
P1-03	JM	Jog Mode	1, 2	2	-	Set the control type in speed mode 1. Position over time 2. Velocity control only (default setting)
P0-12	VP	Velocity Loop Gain	0 ~ 30000	183	0.1Hz	Adjust the Velocity Loop [Proportional] Gain to regulate the system's response to velocity error.
P0-13	VI	Velocity Loop Integral Time Constant	0 ~ 30000	189	ms	Adjust the Velocity Loop Integral Time Constant to control the influence of accumulated velocity error on the system's response.

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

  In this control type, the system detects position errors in real time. If the absolute difference between the actual position (as reported by the encoder) and the command position exceeds the threshold set in parameter P3-04 (position fault limit), the motor will trigger a fault alarm indicating that the position error has surpassed the allowed limit.

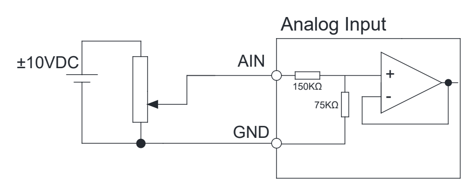
- **P1-03 = 2**, velocity control only

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

7.3.8 Analog Speed Mode Settings

Wiring Methods of Analog Input

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



Source of Analog Speed Command

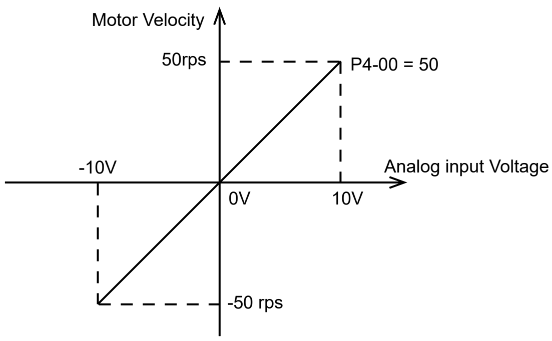
The source of anlog speed command is set by parameter P4-11.

Parameter	Command	Description	Range	Default	Unit	Instructions
P4-11	FA1	Velocity Limit Setting in Torque Control	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.

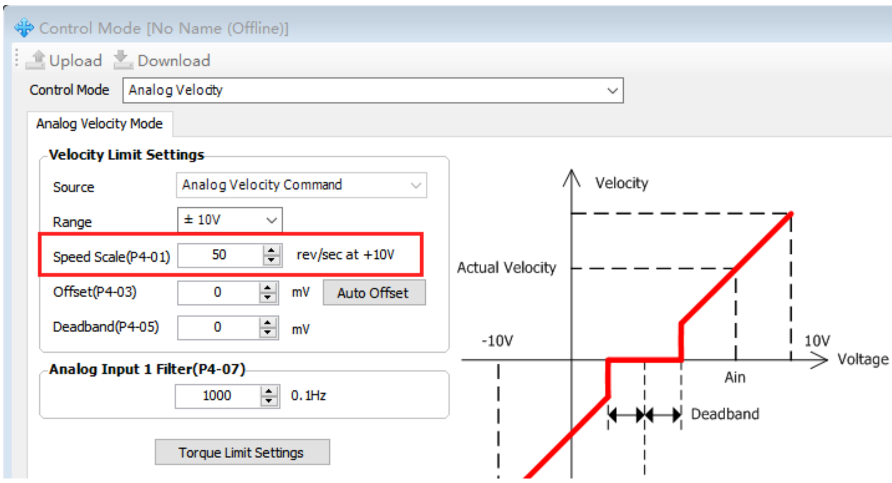
Analog Speed Scale

The range of analog input is 10~+10VDC, P4-01 set the corresponding motor speed when analog input voltage is at 10VDC



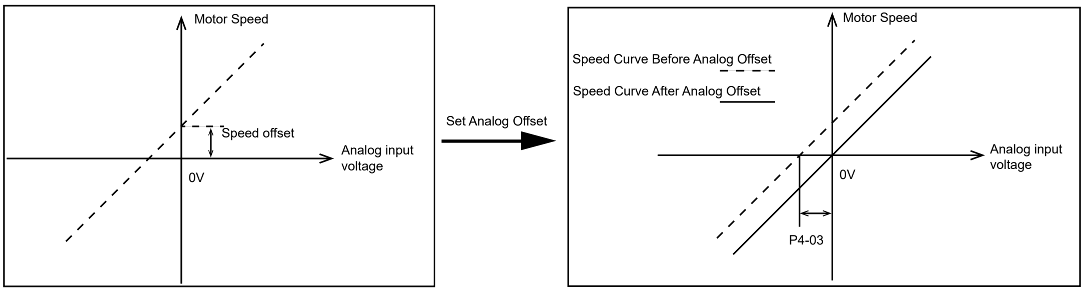
Parameter	Command	Description	Range	Default	Unit	Instructions
P4-01	AG	Analog Input Velocity	0 ~ 100	50	0.1rps/V	Set corresponding motor speed when the analog input voltage is 10VDC.

Set by Luna Software



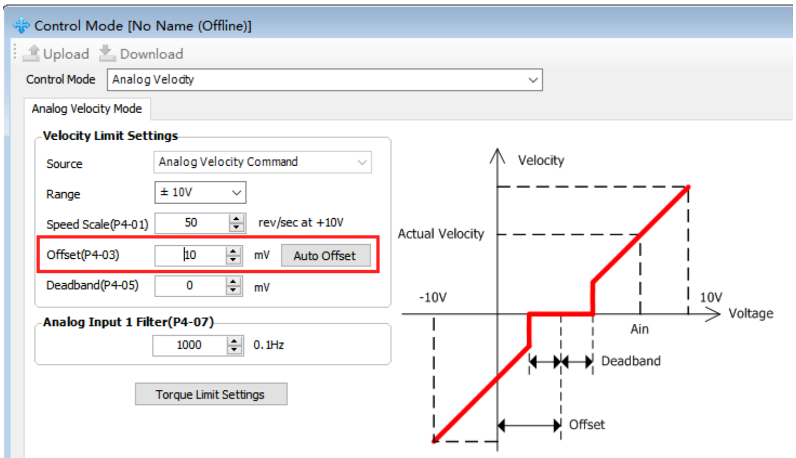
Analog Input Offset

When using the analog velocity 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 motor. The parameter P4-03 is used to eliminate this situation. You can use the Luna software to automatically adjust the offset or manually modify these parameters.



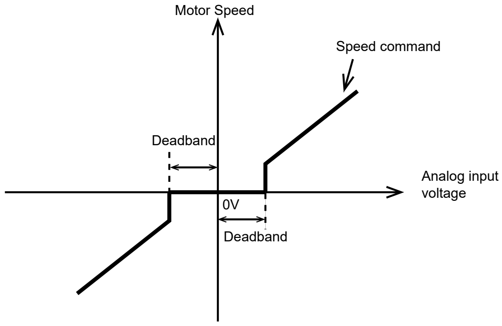
Parameter	Command	Description	Unit	Range	Default	Instructions
P4-03	AV1	Analog Input 1 Offset	mV	-10000 ~ 10000	0	The offset of analog input 1.

1) Automatic Adjust by Software



Analog Input Deadband

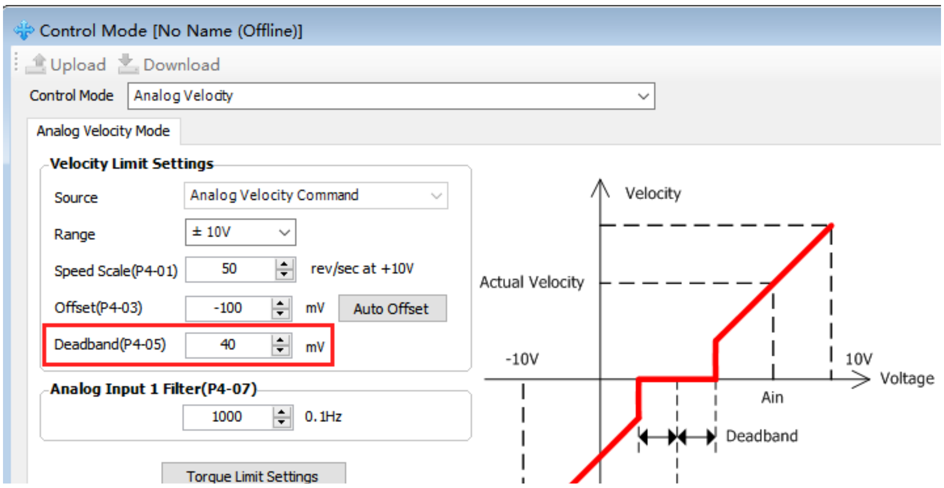
In analog control mode, due to some disturbances and other reasons, even if the command voltage is 0V, the input voltage on the motor side may be not absolutely zero, which makes the motor rotate at a very low speed. In order to eliminate this situation, setting a reasonable deadband can ensure that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



The analog input deadband can be set P4-05.

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

Set by Luna Software



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.

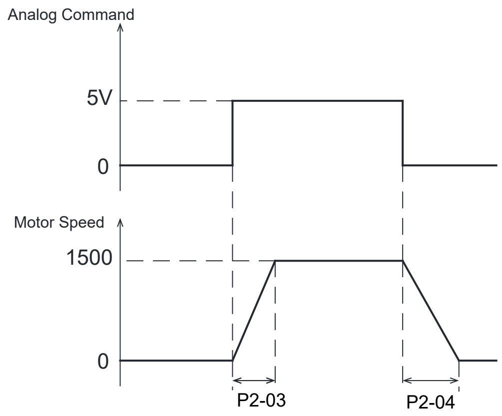
Parameter	Command	Description	Unit	Range	Default	Instructions
P4-07	AF1	Analog Input 1 Filter	0.1Hz	0 ~ 20000	1000	Low-pass filter for analog input 1

Note:

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

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.

7.4 Torque Control Mode

7.4.1 Commanded Torque Control

Torque control mode is used for precise torque control. MDX+ Series support commanded torque mode. Command torque mode uses communication commands to control the motor.

Parameter	Command	Value	Control Mode	Control Method	Description
P1-00	CM	1	Command Torque Mode	Command torque, communication command or Q programming	◆ Commanded torque mode ◆ Use Q programming control ◆ Use Modbus

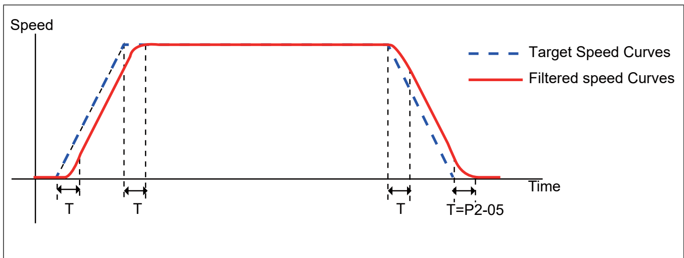
Parameter	Command	Description	Unit	Range	Default	Instructions
P1-05	GC	Current Command for Torque Control	0.1%	-3000 ~ 3000	0	Percent set times Motor Rated Current (ie. 50% equal half of rated current).
P2-30	VT	Speed Limit in Torque Control	rps	0 ~ 100	80	Set in advance to prevent unsafe high speeds

7.4.2 Torque Command Filter

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

Jerk time

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

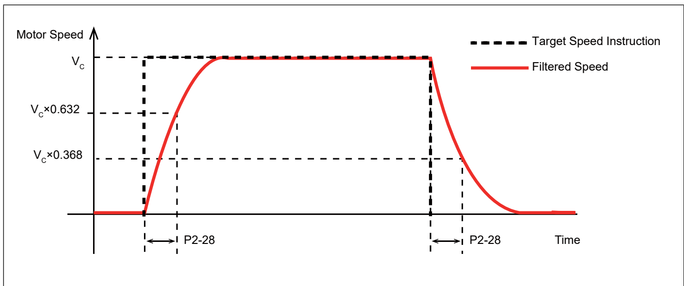


◆ Jerk time filter will produce a certain delay T for the instruction, but it will not affect the final positioning accuracy.

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

Low-pass Filter

Parameter P2-28 low-pass filter can take effect in internal trajectory modes position, speed, and torque, and communication based control mode.
The smoothing effect of the low-pass smoothing filter on the input command is shown in the figure below.



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

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

7.4.3 Rotation Direction Switch

In torque mode, the rotation direction of the motor is usually determined by the positive or negative command torque value. When a digital input is set to SPD-DIR for torque and speed direction switching, the motor takes the absolute value of the command torque and determines the final direction of rotation based on the logic state of the input signal.

When using torque and speed command direction switching SPD-DIR, the digital input needs to be assigned this function according to the signal logic.

Type	Abbreviation	Value	Logic	Function
Input	SPD-DIR	35	Closed	When the input signal is Low, the direction of the command torque is reversed.
			Open	The input signal is High, and the motor rotation direction is determined by the direction of the command torque.
		36	Open	When the input signal is High, the direction of the command torque is reversed.
			Closed	The input signal is Low, and the motor rotation direction is determined by the direction of the command torque.
	GP	0	-	When all input pins of the motorr are not configured with this function, the rotation direction of the motor is determined by the positive and negative of the command torque.

The actual rotation direction of the motor is determined by parameter P1-11 motor rotation direction, command torque (communication command), and torque and speed command direction switching SPD-DIR. The detailed relationship is as follows.

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

Parameter P1-11 motor rotation direction	command torque (communication command)	Input logic of SPD-DIR	Actual motor rotation direction
0	Positive	Input signal not used	CW
0	Negative		CCW
1	Positive		CCW
1	Negative		CW

◆ When the motor input pin is configured for torque and speed command direction switching SPD-DIR

Parameter P1-11 motor rotation direction	command torque (communication command)	Input Logic of SPD-DIR	Actual motor rotation direction
0	Positive	High	CW
0	Negative	High	
0	Positive	Low	CCW
0	Negative	Low	
1	Positive	High	CCW
1	Negative	High	
1	Positive	Low	CW
1	Negative	Low	

7.4.4 Velocity Limit Output

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

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

Note: Refer to 7.1.2 Output signal setting

7.4.5 Torque Reaches Output

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

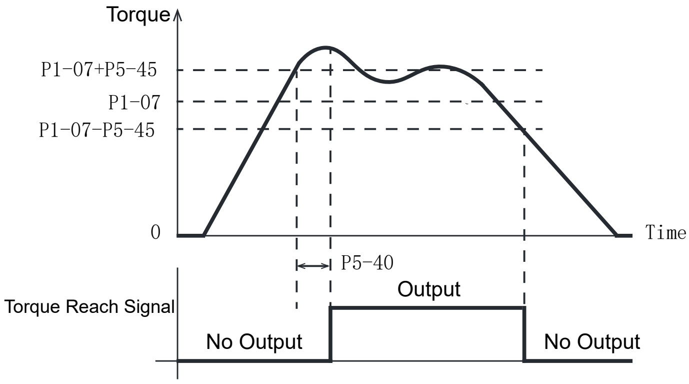
If any of the above conditions is not satisfied, the TQ-REACH signal will not be active.

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

Setting of torque reach signal TQ-REACH

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

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



Related Parameters

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

7.4.6 Torque Coincidence Output

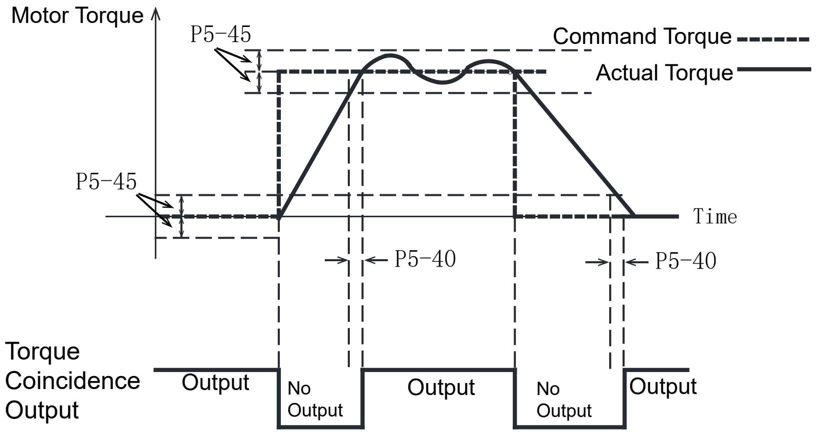
When fluctuations of the actual torque from the target torque are within P5-45 for the duration specified by P5-40, the actual torque is considered coincident with the target torque. The T-COIN signal is active to notify users of this.

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

Setting of torque coincidence signal T-COIN

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

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



Related parameters

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

7.5 Torque Limit

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

◆ Torque limiting method

Parameter P1-10 defines 6 torque limitation methods, each limitation method is as follows.

P1-10 Torque limit method	Forward torque limit source	Reverse torque limit source
0	OD[0x60E0]	OD[0x60E1]
1	P1-06	
2	P1-06	P1-25
3	TQ-LMT input is valid: P1-06	
	TQ-LMT input is invalid: P1-25	
5	TQ-LMT input is valid: P1-06	TQ-LMT input is valid: P1-25
	TQ-LMT input is invalid: P1-26	TQ-LMT input is invalid: P1-27
6	Register[Y]	Register[Z]

Parameter	Command	Name	Range	Default	Unit	Description
P1-10	LD	Torque Limiting Method	0 ~ 3, 5, 6	1	-	Torque limit method setting, please refer to the above description for details
P1-06	CC	1st Torque Limit	0~3000	3000	0.1%	The 1st torque limit of the motor
P1-25	CX	2nd Torque Limit	0~3000	3000	0.1%	The 2nd torque limit of the motor
P1-26	CY	3rd Torque Limit	0~3000	3000	0.1%	The 3rd torque limit of the motor
P1-27	CZ	4th Torque Limit	0~3000	3000	0.1%	The 4th torque limit of the motor

7.5.1 Torque Limiting Methods

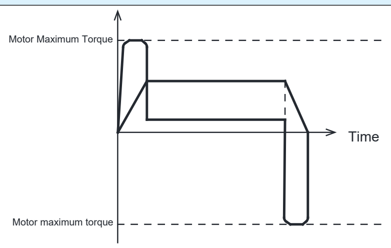
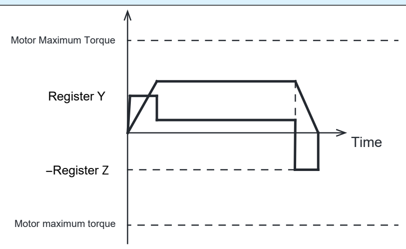
Register based torque limits --- effective immediately

When P1-10 = 6, the forward torque limit is determined by Register Y, and the reverse torque limit is determined by parameter Register Z.

Related parameters

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

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

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

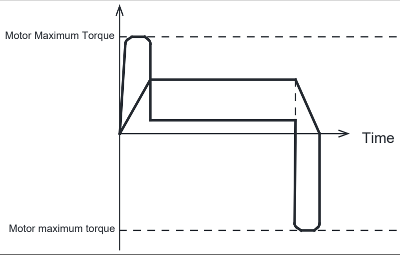
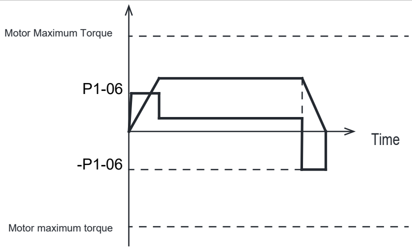
Parameter based torque limits (same limit value for forward and reverse directions)

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

Related parameters

Parameter	Instruction	Name	Value range	Defaults	Unit	Description
P1-06	CC	1st Torque Limit	0~3000	3000	0.1%	1st torque limit of the motor

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

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

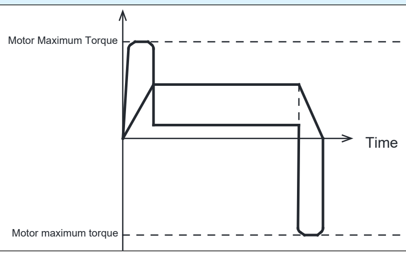
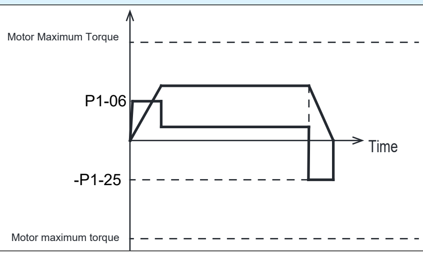
Forward and reverse torques are limited by different parameters

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

Related parameters

Parameter	Instruction	Name	Value range	Defaults	Unit	Description
P1-06	CC	1st Torque Limit	0~3000	3000	0.1%	1st torque limit of the motor
P1-25	CX	2nd Torque Limit	0~3000	3000	0.1%	2nd torque limit for motor

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

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

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

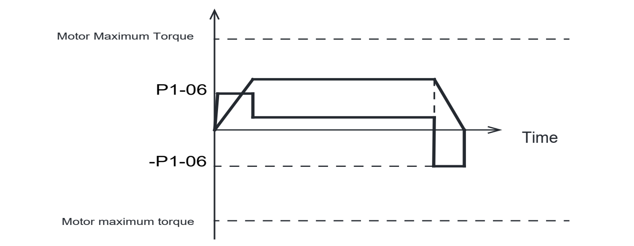
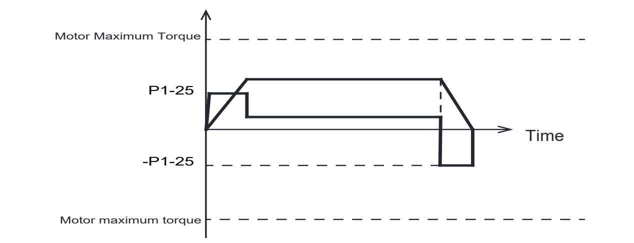
When P1-10 =3, the forward and reverse torque limit is determined by the logic state of the torque limit input TQ-LMT.

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

Related parameters

Parameter	Instruction	Name	Value range	Defaults	Unit	Description
P1-06	CC	1st Torque Limit	0~3000	3000	0.1%	1st torque limit of the motor
P1-25	CY	2nd Torque Limit	0~3000	3000	0.1%	2nd torque limit for motor

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

<table>
<tr><th>TQ-LMT input Low</th><th>TQ-LMT input High</th></tr>
<tr><td>
</td><td>
</td></tr>
<tr><td>When P1-10 = 3 and the TQ-LMT input is Low, the forward and reverse torque limits are defined by P1-06.</td><td>When P1-10 = 3 and the TQ-LMT input is High, the forward and reverse torque limits are defined by P1-25.</td></tr>
</table>

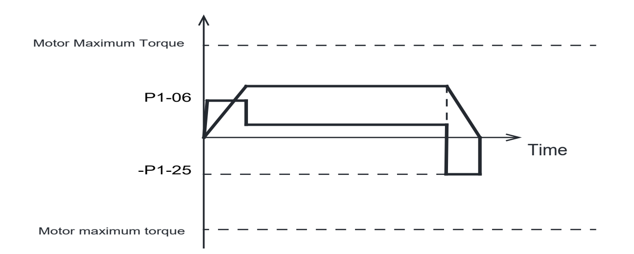
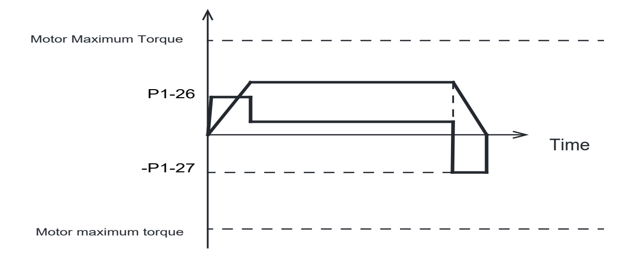
Torque limiting via TQ-LMT input (forward and reverse limits assigned differing values)

When P1-10 is set to 5, the forward and reverse torque limits are controlled by the TQ-LMT input state. Users must set the TQ-LMT logic (normally open or closed) in advance. Depending on whether the input is Low or High, different torque limits can be applied to the forward and reverse directions. This setup provides two possible torque limits for each direction.

Related parameters

Parameter	Instruction	Name	Value range	Defaults	Unit	Description
P1-06	CC	1st Torque Limit	0~3000	3000	0.1%	1st torque limit of the motor
P1-25	CX	2nd Torque Limit	0~3000	3000	0.1%	2nd torque limit for motor
P1-26	CY	3rd Torque Limit	0~3000	3000	0.1%	3rd torque limit for motor
P1-27	CZ	4th Torque Limit	0~3000	3000	0.1%	4th torque limit for motor

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

<table>
<tr><th>TQ-LMT torque limit input Low</th><th>TQ-LMT torque limit input is High</th></tr>
<tr><td>
</td><td>
</td></tr>
<tr><td>When P1-10 = 5. The TQ-LMT torque limit input is High, the motor output forward torque is limited to the set value of P1-06, and the reverse torque is limited to the set value of P1-25.</td><td>When P1-10 = 5. The TQ-LMT torque limit input is Low, the motor output forward torque is limited to the set value of P1-26, and the reverse torque is limited to the set value of P1-27</td></tr>
</table>

7.5.2 Torque Limit Reached Output

The Torque Limit Output (T-LMT) activates when the actual torque reaches the configured torque limit for the specified direction

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

Note: Refer to 7.1.2 Output signal configuration

7.6 Encoder Feedback Output Function

The encoder feedback is output as A/B/Z differential signals. The A/B/Z signals and the frequency division ratio, which affects the encoder feedback output frequency, can be configured through the following parameters.

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

7.6.1 Pulse Frequency Division Output Signal Pinout

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

Note:

1. **The output circuit is line driver type and the signals are 5V differential. To accept these differential signals, users will need to use a differential receiver. If this is not possible, then users will need to use a differential-to single-ended signal converter. Do not connect the OUT+ or OUT- to a power supply.**
2. **For reliable noise immunity, use shielded, twisted pair wires in the cable harness for transmitting encoder signals. The shield should be connected to the PE (Protective Earth) port, and the digital ground (DGND) should be connected to the motion controller's digital ground**
3. **Output signals are 5V differential. The maximum allowable current for each output pin is 20 mA.**

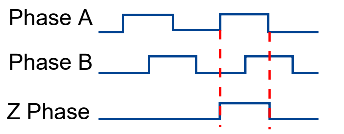
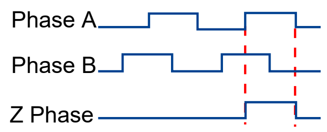
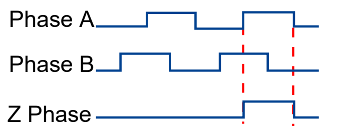
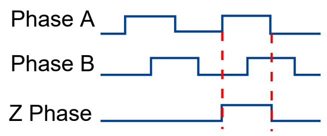
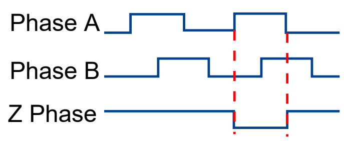
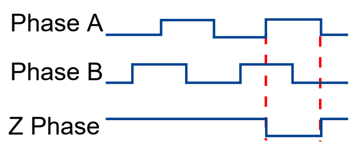
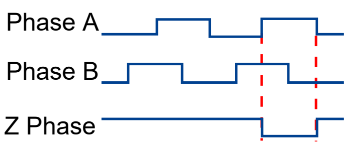
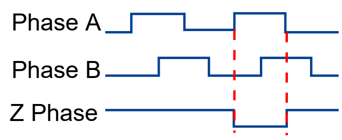
7.6.2 Pulse Frequency Division Output Mode Setting

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

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

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

Encoder feedback output settings

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

7.6.3 Pulse Output Gear Ratio

The pulse count per motor revolution for the MDX+ Series can be configured using parameters P3-13 and P3-14.

$$\text{Number of output pulses per revolution} = \frac{\text{P3-13 Encoder Pulse Output Ratio - Numerator}}{\text{P3-14 Encoder Pulse Output Ratio - Denominator}} \times 65535$$

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

Related parameters

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

Note:

1. **The numerator P3-13 must be less than the denominator P3-14**
2. **When P3-13 > P3-14, the number of pulses output per motor revolution (post quadrature) = P3-13**

Example:

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

- **If A/B is counted at the same time, and the frequency is multiplied by 4:**

  P3-13 = 1000

  P3-14 = 65535 or P3-14 = 1

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

  Then: P3-13 = 2000

  P3-14 = 65535 or P3-14 = 1

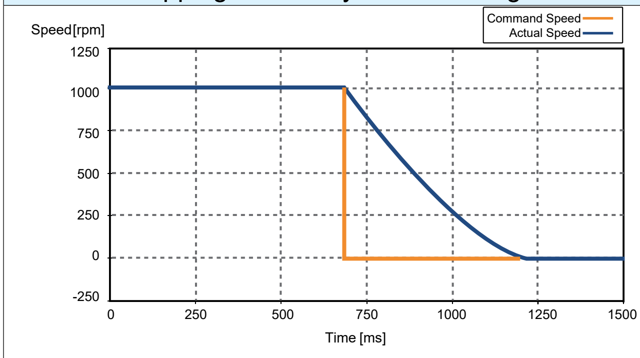
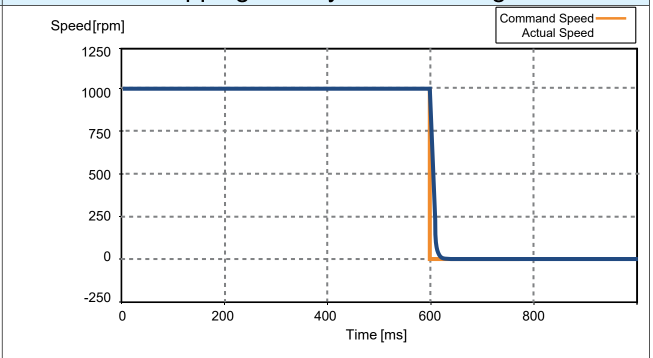
- **If only the A -phase output is counted, and only the rising edge or falling edge is counted when counting**

  Then: P3-13 = 4000

  P3-14 = 65535 or P3-14 = 1

7.7 Dynamic Braking

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

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

Note:

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

Related parameters

Parameter	Instruction	Name	Value range	Defaults	Unit	Description
P1-29	YV	Dynamic Brake Sequence when Servo Off	0 ~ 5	0	-	Dynamic braking sequence when motor receives Servo Off signal
P1-30	YR	Dynamic Brake Sequence when Fault Occurs	0 ~ 3	0	-	Dynamic braking sequence when fault occurs at the motor.
P1-31	YM	Dynamic Brake Action Time During Deceleration when Servo Off	0 ~ 30000	500	ms	Maximum time of dynamic braking when motor receives Servo Off signal.
P1-32	YN	Dynamic Brake Action Time During Deceleration when Fault Occurs	0 ~ 30000	0	ms	Maximum time of dynamic braking when a fault occurs
P1-37	DV	Dynamic Braking Action Speed	0 ~100	50	rps	Maximum motor velocity at which dynamic braking will be activated.
P5-42	ZV	Zero Speed Width	0.1 ~ 2	0.5	rps	When the speed is less than or equal to this set value, the motor considers that it is in the zero-speed state

7.7.1 Dynamic Braking when Servo Off

Various braking methods for when the Servo Off signal is trigered can be confirgured via P1-29. See below chart for details. The chart details the various deceleration process as well as the state of the motor after deceleration has finished.

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

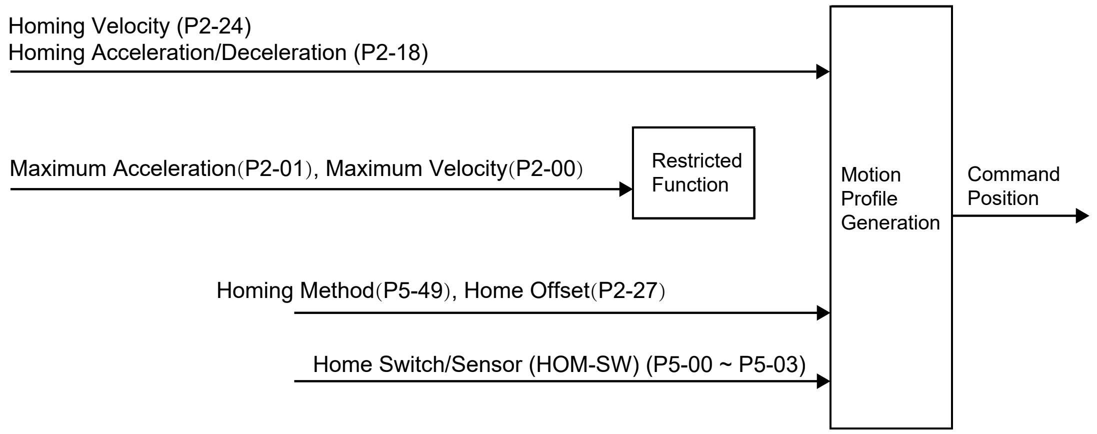
7.7.2 Dynamic Braking when Fault Occurs

Various braking methods for when a fault occurs at the motor can be configured via parameter P1-30. For details, see the chart below. The chart details the various deceleration processes as well as the state of the motor after deceleration has finished.

Value	Description	
	Deceleration process	Stop
0	Coast to Stop	Remain in free spin
1	Coast to Stop	Dynamic braking
2	Dynamic braking	Remain in free spin
3	Dynamic braking	Dynamic braking

7.8 Home Function

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



There are three ways to enable homing:

1. Return-To-Home Start Digital Input Function (S-HOM)

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

2. Using the Q program command

3. Using streamed commands (CANopen or SCL)

Related Parameters

Parameter	Instruction	Name	Value range	Defaults	Unit	Description
P5-49	HE	Homing Method	-4 ~ 35	1	-	Defines the return to home method
P2-18	HA1	1st Homing Acceleration/ Deceleration	0.167 ~ 5000	100	rps/s	Set acceleration/deceleration during return to home
P2-24	HV1	Homing Velocity 1	0.0042 ~ 100	10	rps	Set the first speed of the return to home motion profile.
P2-25	HV2	Homing Velocity 2	0.0042 ~ 100	1	rps	Set the second speed of the return to home motion profile
P2-27	HO	Home Offset	-2147483647 ~ +2147483647	0	pulses	Sets the offset position from the home switch or hardstop location
P2-00	VM	Maximum Speed	0 ~ 100	80	rps	Maximum speed limit, limiting motor speed in all control modes
P2-01	AM	Maximum Acceleration/ Deceleration	0.167 ~ 5000	3000	rps/s	Maximum deceleration during emergency stop
P5-00 ~ P5-03	MU1 ~ MU4	Digital Input Function	39 ~ 40	-	-	Set one of the numeric inputs X1~X4 as the home sensor

7.8.1 Introduction to Homing

When the home function is executed, the motor generates a motion profile based on parameters such as homing acceleration, deceleration, velocity, the home position, and the home offset position.

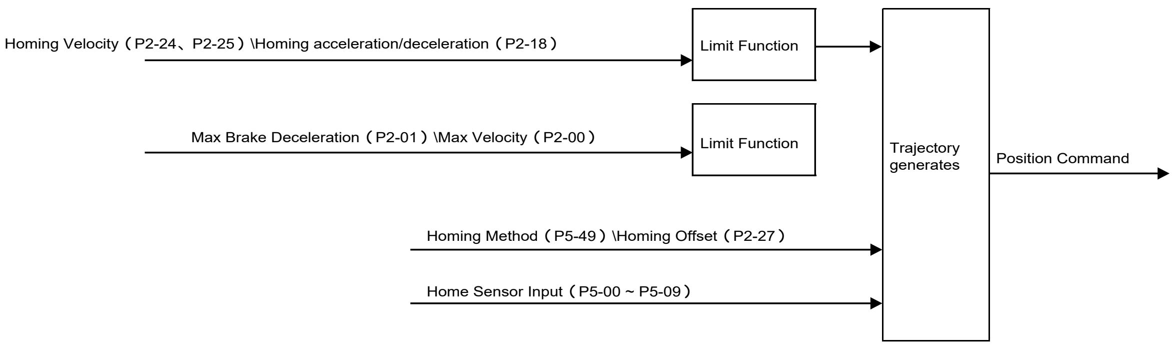
The MDX+ Series supports up to 39 different homing modes.

There are three ways to start homing.

- Start with digital input (S-HOM)

Signal Type	Signal Symbol	Setup Value	Signal Logic	Instructions
Input	S-HOME	15	Closed	When the input logic in ON (CLOSED), Homing Starts.
			Open	When the inout logic is OFF (OPEN), Homing does not start.
		16	Open	When the input logic is OFF(OPEN), Homing starts.
			Closed	When the input logic is ON (CLOSED), Homing does not start.

- Start with Q program
- Start with Modbus Command



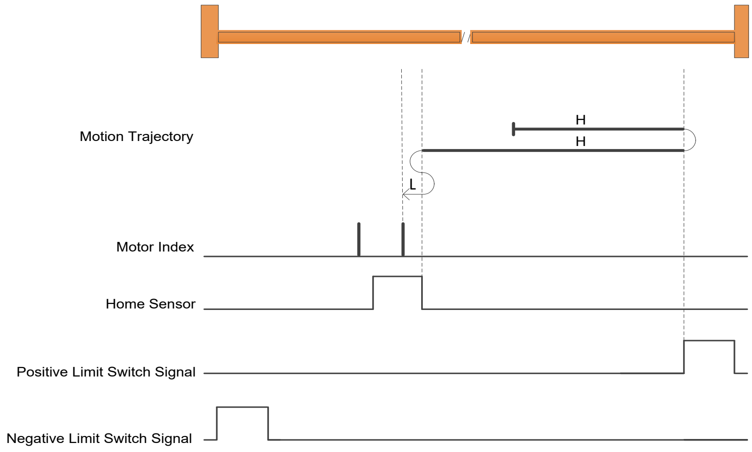
Related Parameters

Parameter	Command	Description	Range	Default	Unit	Instructions
P5-49	HE	Homing Method	-4 ~ 35	1	-	Set homing method.
P2-18	HA1	Homing Acceleration/ Decleration	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	Maximum 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.

7.8.2 Homing Method Instructions

Homing methods [P5-49] are used to find the desired "0" position for the application in relationship to the mechanical system. An example being the desired "0" position on a linear actuator in relationship with one of the hard limits of the slide.

The desired home position could very well be the same as a mechanical hard limit, a home sensor or the first index pulse of the motor encoder after offsetting a desired distance away from a mechanical hard limit. In many cases customers can simply use an offset distance away from a hard limit as the home position as well.



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.

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 adopted from the CANopen CiA402 specification.

Homing methods -4 ~ -1 are manufacturer specific. These four modes home using the hard stop homing method, which requires the motor move the load into a hard limit which will notify the drive a hard limit has been met via a current draw threshold. The drive may then choose to offset the motor position from that hard limit based on a pre-configured offset home position.

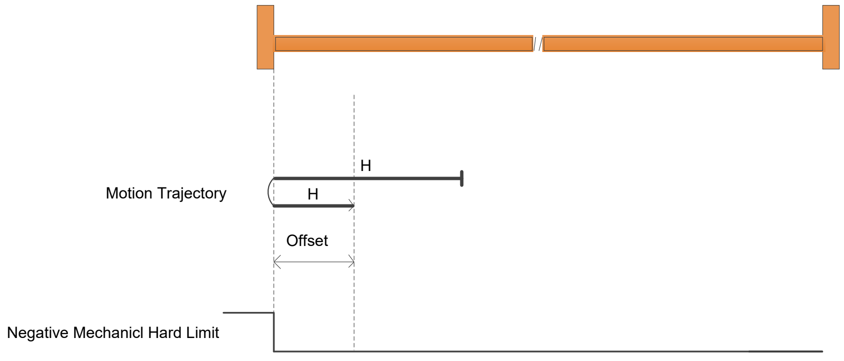
The current threshold is configured via parameter P1-08. This parameter should be set appropriately. If it is too small, the homing process will end prematurely. If it is too large, the motor risks colliding the load on the hard limit with great force. This could result in damage to equipment.

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.

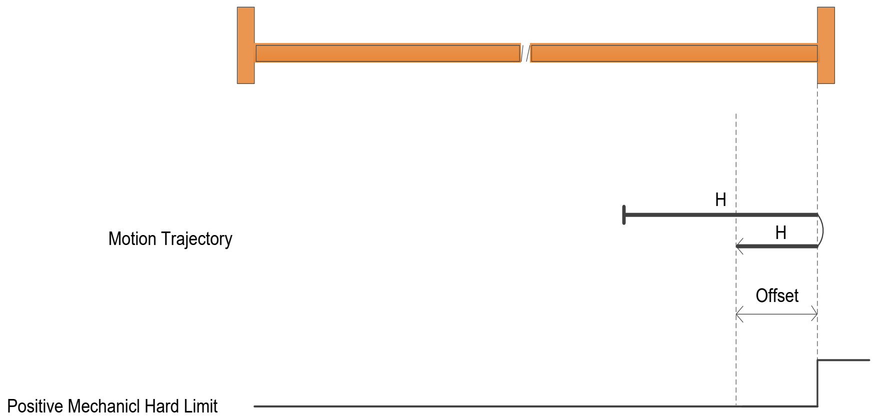
When using homing methods 1~35, the actual position after homing finished is the value set by P2-27.

Homing Method -4



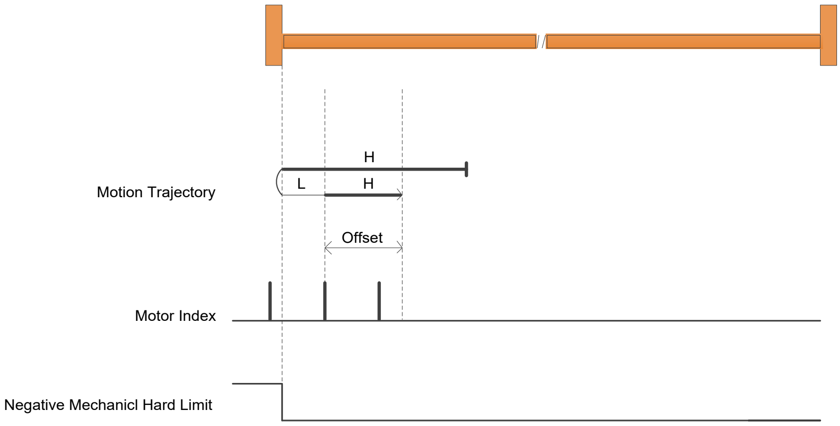
- The motor will home in the negative direction until contact with the hard limit causes the drive to meet the current threshold defined by P1-08. The motor then stops and the encoder position is set to 0 at this location.
- If the homing offset has been assigned a value greater than 0, the motor moves a distance equal to it away from the hard limit. This new offset position is then assigned as the 0 position. Please ensure the offset direction is opposite of the hard limit to prevent further motion in its direction.

Homing Method -3



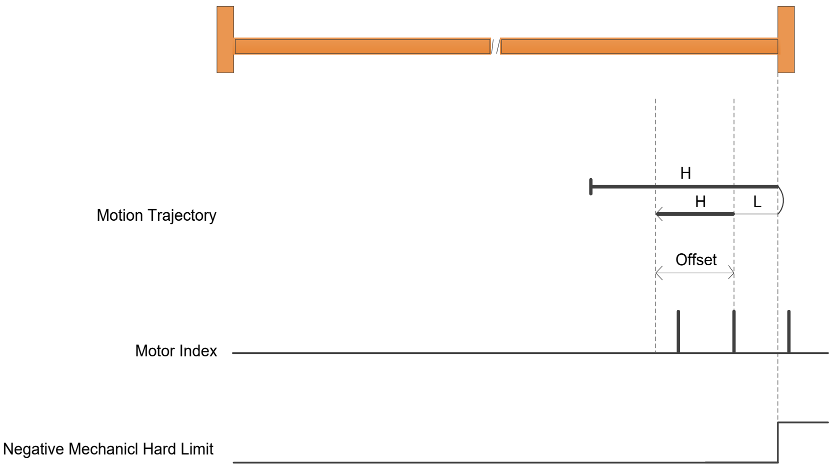
- The motor will home in the positive direction until contact with the hard limit causes the drive to meet the current threshold defined by P1-08. The motor then stops and the encoder position is set to 0 at this location.
- If the homing offset has been assigned a value greater than 0, the motor moves a distance equal to it away from the hard limit. This new offset position is then assigned as the 0 position. Please ensure the offset direction is opposite of the hard limit to prevent further motion in its direction.

Homing Method -2



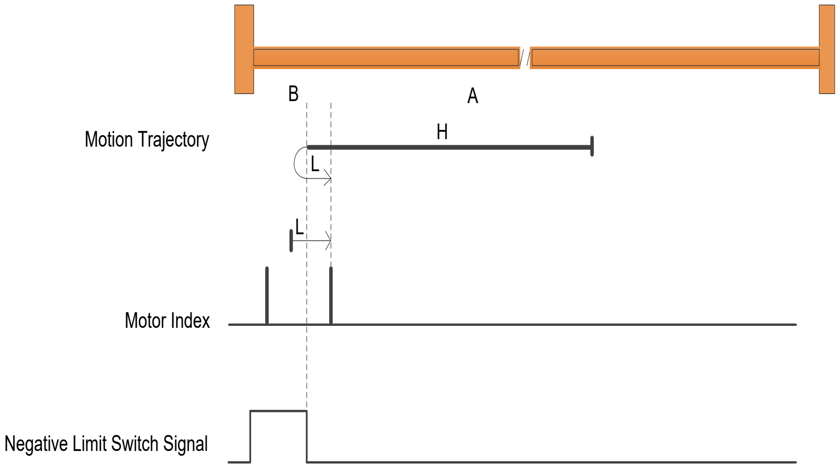
- The motor will home in the negative direction until contact with the hard limit causes the drive to meet the current threshold defined by P1-08. The motor then stops and reverses direction until the first encoder index (Z-phase) signal is detected by the drive. This location is assigned the 0 position.
- If the homing offset has been assigned a value greater than 0, the motor moves a distance equal to it away from the first detected encoder index. This new offset position is then assigned as the 0 position. Please ensure the offset direction does not direct the motor back into the hard limit to prevent mechanical damage.

Homing Method -1



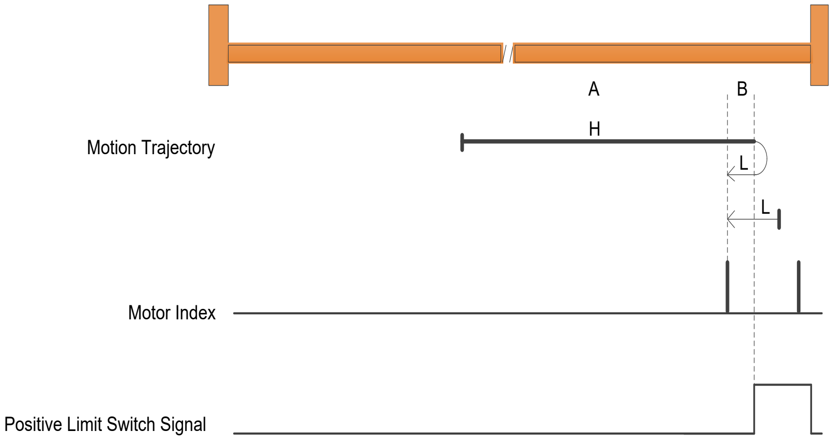
- The motor will home in the positive direction until contact with the hard limit causes the drive to meet the current threshold defined by P1-08. The motor then stops and reverses direction until the first encoder index (Z-phase) signal is detected by the drive. This location is assigned the 0 position.
- If the homing offset has been assigned a value greater than 0, the motor moves a distance equal to it away from the first detected encoder index. This new offset position is then assigned as the 0 position. Please ensure the offset direction does not direct the motor back into the hard limit to prevent mechanical damage.

Homing Method 1



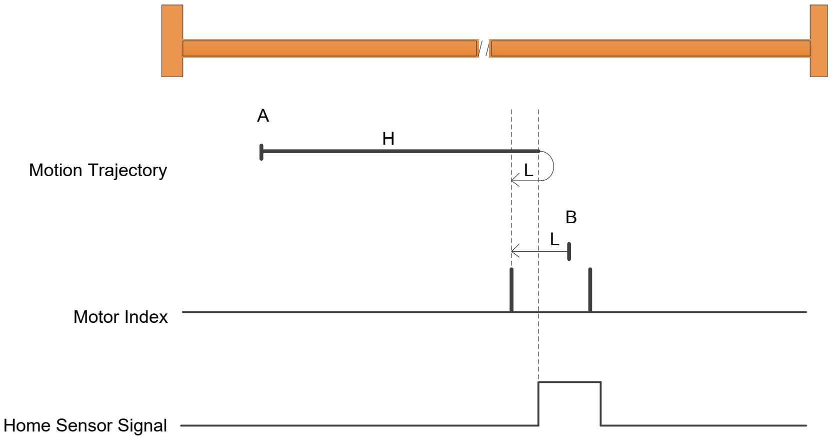
- Scenario A: The motor will home in the negative direction until the negative limit switch rising edge is detected. At the rising edge, the motor will change direction, backing away from the negative limit in the positive direction until the first encoder index pulse is detected after the negative limit falling edge.
- Scenario B: If the negative limit switch is already active when the homing method is initiated, the motor will move in the positive direction until the first encoder index pulse is detected after the negative limit fall edge.
- At the end of each scenario above, the final position will be assigned the 0 position. The drive will then output a homing finished signal.

Homing Method 2



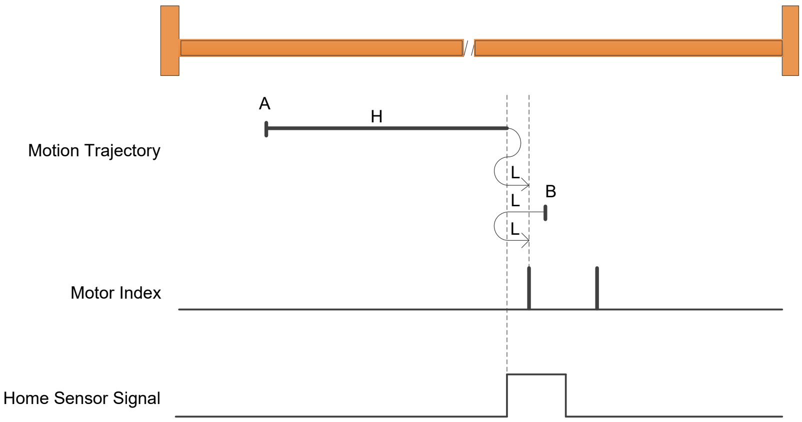
- Scenario A: The motor will home in the positive direction until the positive limit switch rising edge is detected. At the rising edge the motor will change direction, backing away from the positive limit in the negative direction until the first encoder index pulse is detected after the positive limit falling edge.
- Scenario B: If the positive limit switch is already active when the homing method is initiated, the motor will move in the negative direction until the first encoder index pulse is detected after the positive limit fall edge.
- At the end of each scenario above, the final position will be assigned the 0 position. The drive will then output a homing finished signal.

Homing Method 3



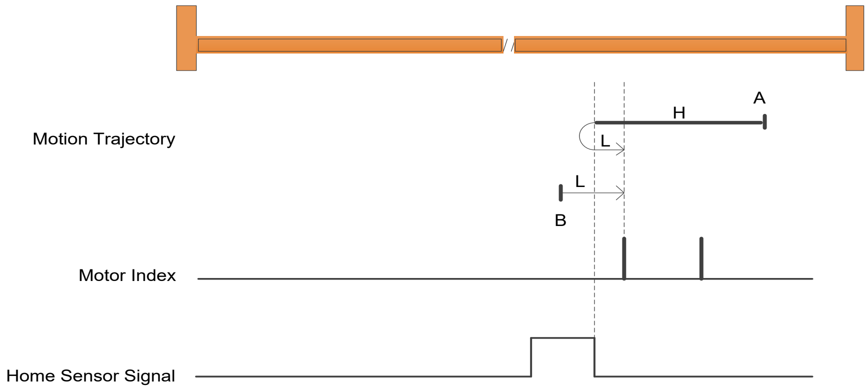
- The homing motion will vary depending on the state of the Home Switch when the homing sequence is initiated.
- Scenario A: The motor will home in the positive direction until the home switch rising edge is detected. At the rising edge, the motor will change direction, backing away from the home switch in the negative direction until the first encoder index pulse is detected after the Home switch falling edge.
- Scenario B: If the home switch is already active when the homing method is initiated, the motor will move in the negative direction until the first encoder index pulse is detected after the home switch falling edge.
- At the end of each scenario above, the final position will be assigned the 0 position. The drive will then output a homing finished signal.

Homing Method 4



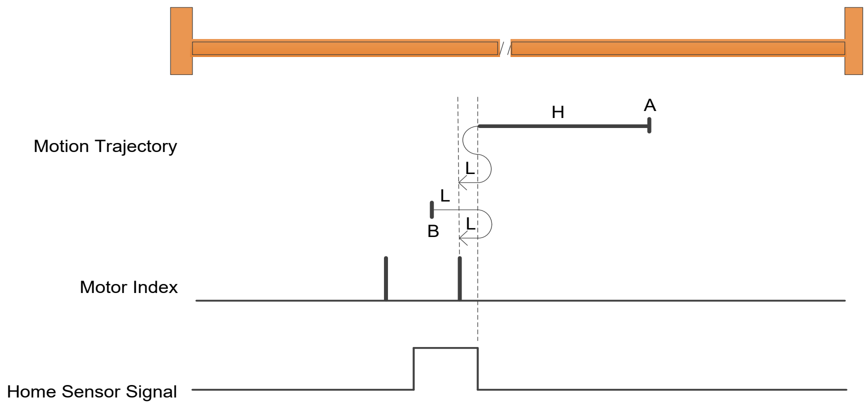
- The homing motion will vary depending on the state of the Home Switch when the homing sequence is initiated.
- Scenario A: The motor homes in the positive direction until the homing switch rising edge. At the rising edge, the motor will back up until the homing switch falling edge. After the falling edge, the motor will once again move in the positive direction, past the homing switch rising edge until the first motor encoder index pulse is detected.
- Scenario B: If the homing switch is already ON at the start of the homing sequence, the motor will move in the negative direction until the homing switch falling edge. Once the falling edge is detected, the motor will reverse in the positive direction past the homing switch rising edge until it detects the first motor encoder index.
- At the end of each scenario above, the final position will be assigned the 0 position. The drive will then output a homing finished signal.

Homing Method 5



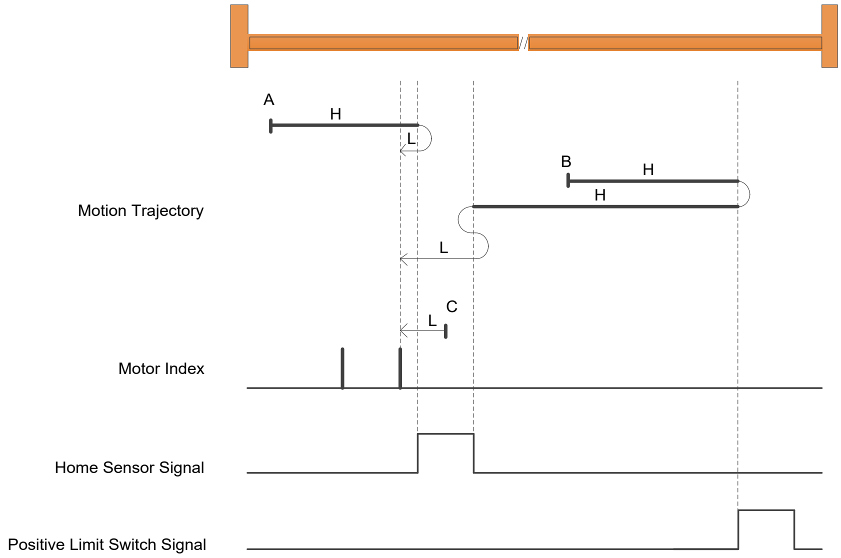
- The homing motion will vary depending on the state of the Home Switch when the homing sequence is initiated.
- Scenario A: The motor homes in the negative direction until the Home switch rising edge is detected. At the rising edge the motor will reverse direction, backing away from the Home switch in the positive direction until the first encoder index pulse is detected after the Home switch falling edge.
- Scenario B: If the home switch is already active when the homing method is initiated, the motor will move in the positive direction until the first motor encoder index pulse is detected after the home switch falling edge.
- At the end of each scenario above, the final position will be assigned the 0 position. The drive will then output a homing finished signal.

Homing Method 6



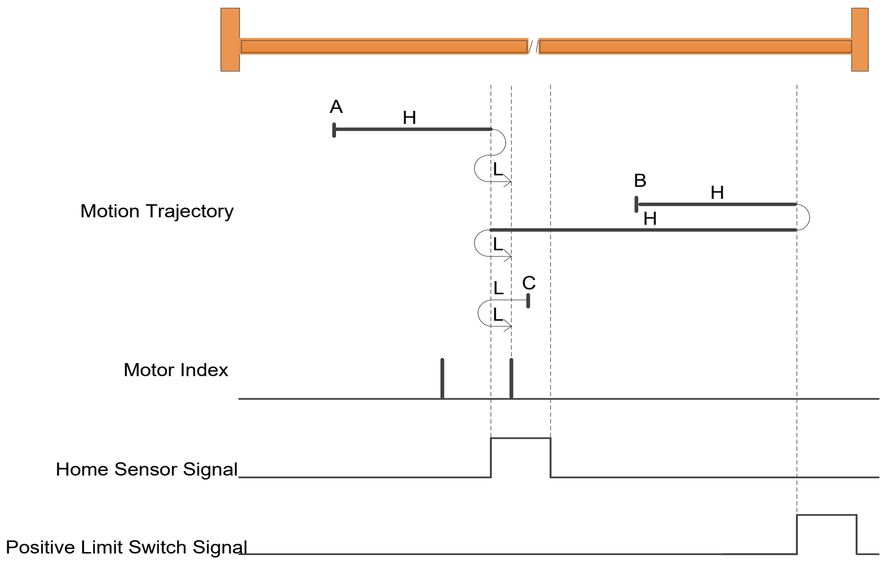
- The homing motion will vary depending on the state of the Home Switch when the homing sequence is initiated.
- Scenario A: The motor homes in the negative direction until the homing switch rising edge. At the rising edge, the motor will back up until the homing switch falling edge. After the falling edge, the motor will once again move in the negative direction, past the homing switch rising edge until the first motor encoder index pulse is detected.
- Scenario B: If the homing switch is already ON at the start of the homing sequence, the motor will move in the positive direction until the homing switch falling edge. Once the falling edge is detected, the motor will reverse in the negative direction past the homing switch rising edge until it detects the first motor encoder index.
- At the end of each scenario above, the final position will be assigned the 0 position. The drive will then output a homing finished signal.

Homing Method 7



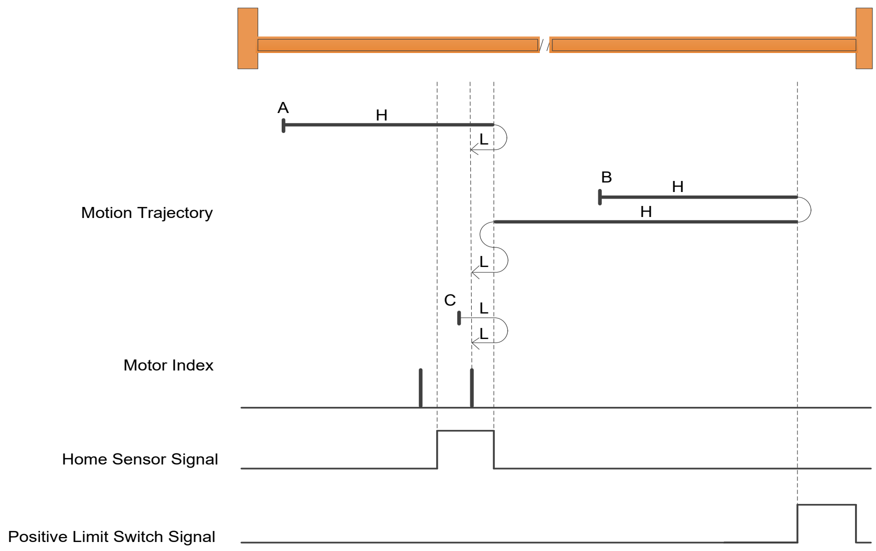
- The homing motion will vary depending on the state of the Home Switch when the homing sequence is initiated.
- Scenario A: The motor homes in the positive direction until the homing switch rising edge. At the rising edge, the motor will reverse direction until the first motor encoder index pulse is detected.
- Scenario B: The motor homes in the positive direction. If the home switch is never triggered, the motor continues until the positive limit switch rising edge. At the positive limit switch rising edge, the motor will reverse and move in the negative direction until the homing switch rising edge is finally detected. At this rising edge, the motor will reverse in the positive direction until the homing switch falling edge. After the falling edge, the motor will again reverse and move in the negative direction, past the homing switch rising and falling edges (square waveform) until it detects the first motor encoder index.
- Scenario C: If the homing switch is already active at the start of the homing sequence, the motor moves in the negative direction past the homing switch falling edge until it detects the first motor encoder index.
- At the end of each scenario above, the final position will be assigned the 0 position. The drive will then output a homing finished signal.

Homing Method 8



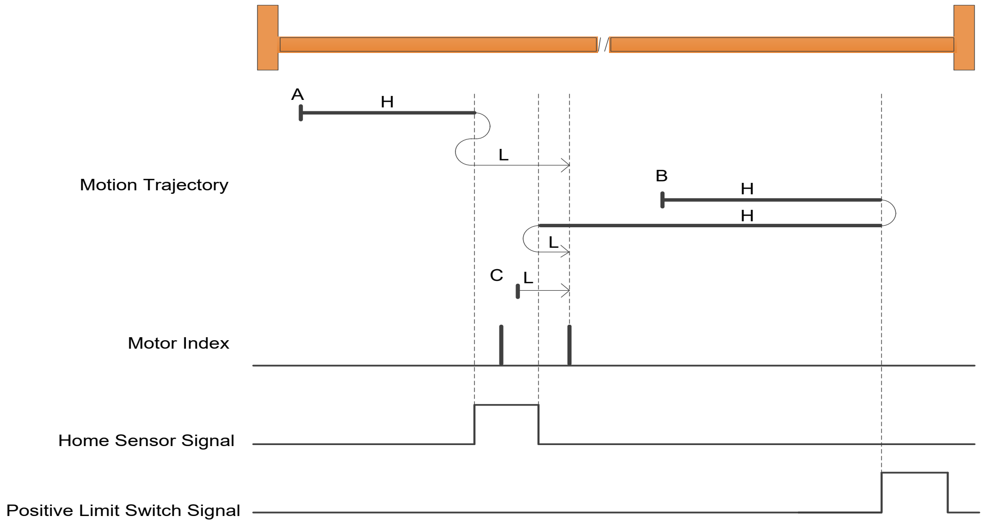
- The homing motion will vary depending on the state of the Home Switch when the homing sequence is initiated.
- Scenario A: The motor homes in the positive direction until the homing switch rising edge. At the rising edge, the motor will reverse direction until the homing switch falling edge. After the falling edge, the motor will then move again in the positive direction past the homing switch rising edge until the first motor encoder index pulse is detected.
- Scenario B: The motor homes in the positive direction. If the home switch is never triggered, the motor continues until the positive limit switch rising edge. At the positive limit switch rising edge, the motor will reverse and move in the negative direction past the homing switch rising edge and falling edge (square waveform). After the falling edge, the motor will reverse in the positive direction past the homing switch rising edge until it detects the first motor encoder index.
- Scenario C: If the homing switch is already active at the start of the homing sequence, the motor moves in the negative direction past the homing switch falling edge. After the falling edge, the motor will reverse in the positive direction past the homing switch rising edge until it detects the first motor encoder index.
- At the end of each scenario above, the final position will be assigned the 0 position. The drive will then output a homing finished signal.

Homing Method 9



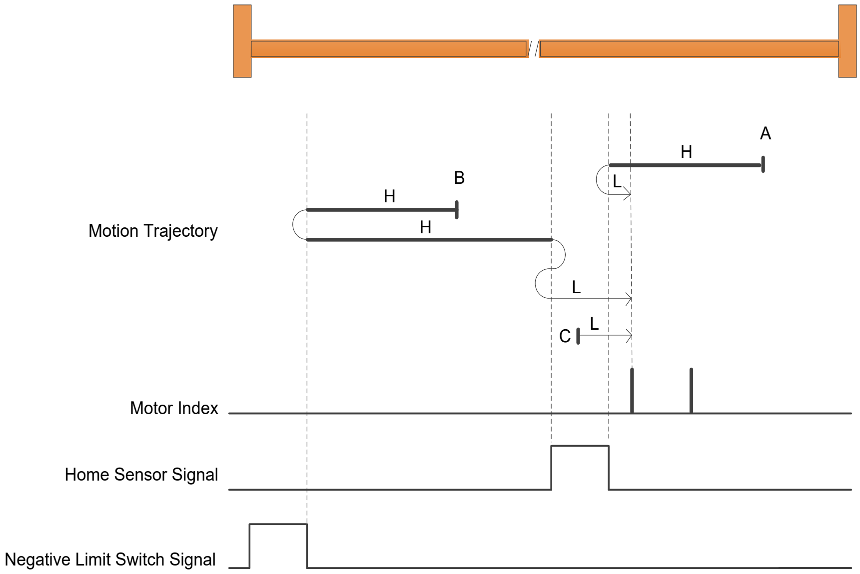
- The homing motion will vary depending on the state of the Home Switch when the homing sequence is initiated.
- Scenario A: The motor homes in the positive direction until it passes both the homing switch rising and falling edges (square waveform). At the falling edge, the motor will reverse and move in the negative direction until the first motor encoder index is detected.
- Scenario B: The motor homes in the positive direction. If the home switch is never triggered, the motor continues until the positive limit switch rising edge. At the positive limit switch rising edge, the motor will reverse and move in the negative direction until it detects the home switch rising edge. At the rising edge, it will reverse in the positive direction until the home switch falling edge. After the falling edge occurs, the motor will again reverse to move in the negative direction past the home switch rising edge until the first motor encoder index is detected.
- Scenario C: If the homing switch is already active at the start of the homing sequence, the motor moves in the positive direction past the homing switch falling edge. After the falling edge, the motor will reverse in the negative direction past the homing switch rising edge until it detects the first motor encoder index.
- At the end of each scenario above, the final position will be assigned the 0 position. The drive will then output a homing finished signal.

Homing Method 10



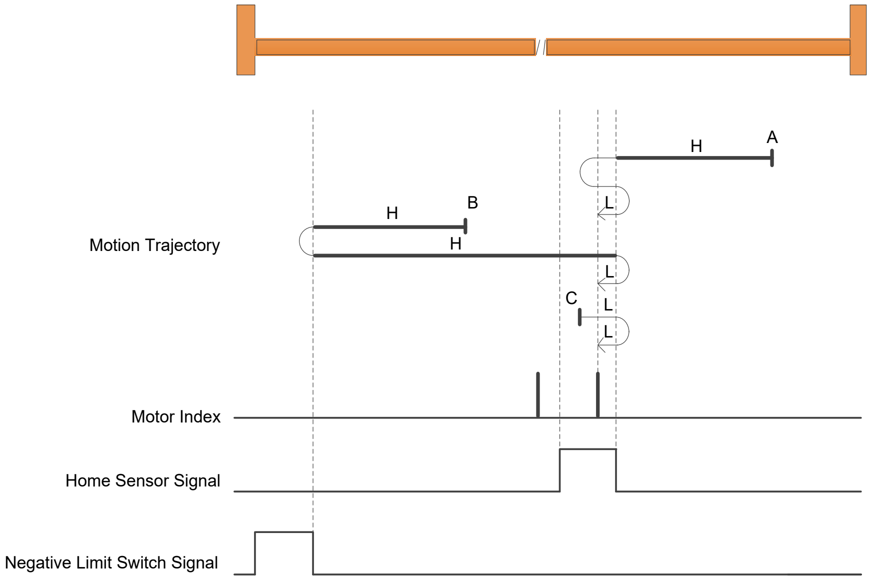
- The homing motion will vary depending on the state of the Home Switch when the homing sequence is initiated.
- Scenario A: The motor homes in the positive direction until it detects the home switch rising edge. At the rising edge, the motor will reverse and move in the negative direction until the home switch falling edge. At the falling edge, it will again reverse in the positive direction past the home switch rising/falling edges until it detects the first motor encoder index.
- Scenario B: The motor homes in the positive direction. If the home switch is never triggered, the motor continues until the positive limit switch rising edge. At the positive limit switch rising edge, the motor will reverse and move in the negative direction until it detects the home switch rising edge. At the rising edge, it will reverse in the positive direction past the home switch falling edge and continue on until the first motor encoder index is detected.
- Scenario C: If the homing switch is already active at the start of the homing sequence, the motor moves in the positive direction past the homing switch falling edge and until the first motor encoder index is detected.
- At the end of each scenario above, the final position will be assigned the 0 position. The drive will then output a homing finished signal.

Homing Method 11



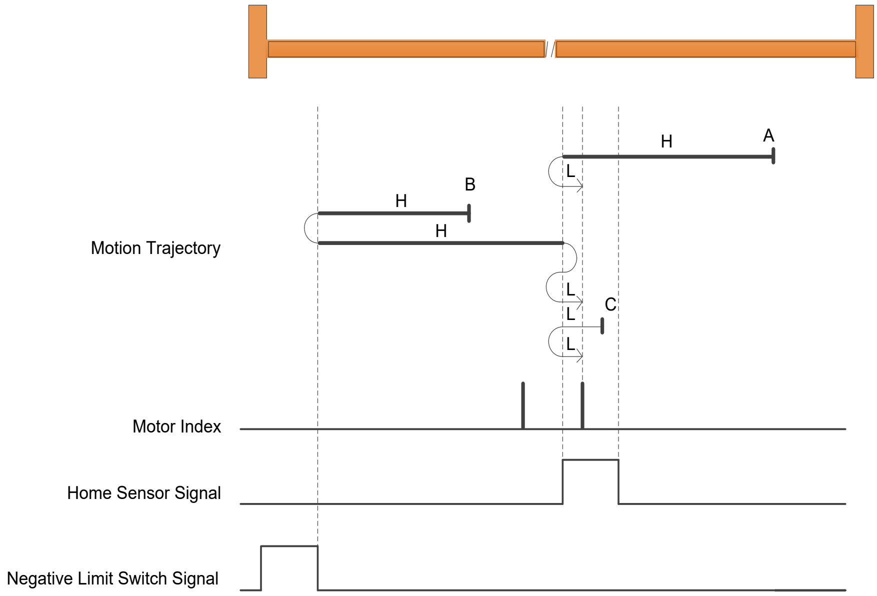
- The homing motion will vary depending on the state of the Home Switch when the homing sequence is initiated.
- Scenario A: The motor homes in the negative direction until it detects the home switch rising edge. At the rising edge, the motor will reverse and move in the positive direction past the home switch falling edge and stop at the first motor encoder index.
- Scenario B: The motor homes in the negative direction. If the home switch is never triggered, the motor continues until the negative limit switch rising edge. At the negative limit switch rising edge, the motor will reverse and move in the positive direction until it detects the home switch rising edge. At the rising edge, it will reverse in the negative direction until the home switch falling edge. At the falling edge, it will reverse direction once again, moving in the positive direction past the home switch rising and falling edges (square waveform), stopping at the first motor encoder index.
- Scenario C: If the homing switch is already active at the start of the homing sequence, the motor moves in the positive direction past the homing switch falling edge and until the first motor encoder index is detected.
- At the end of each scenario above, the final position will be assigned the 0 position. The drive will then output a homing finished signal.

Homing Method 12



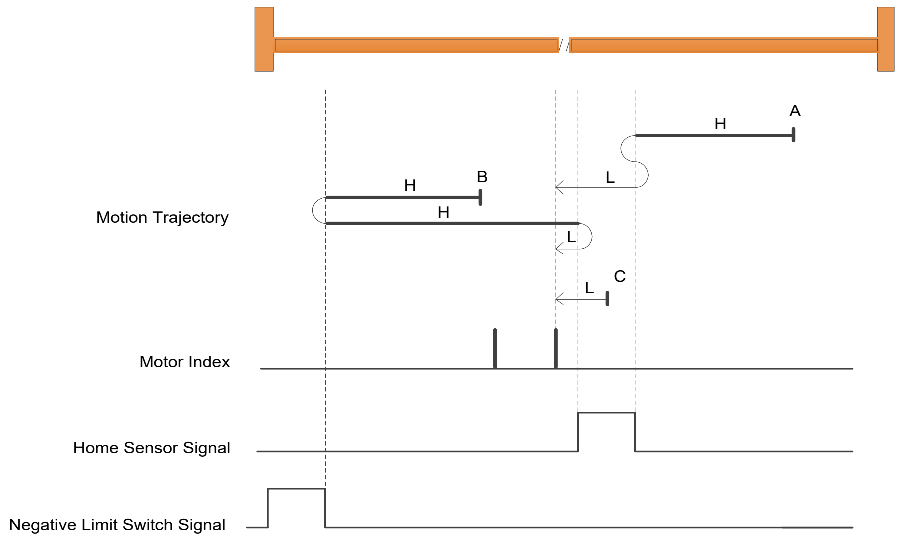
- The homing motion will vary depending on the state of the Home Switch when the homing sequence is initiated.
- Scenario A: The motor homes in the negative direction to the first motor encoder index pulse past the the home switch rising edge. At the index pulse, the motor will reverse direction, moving in the positive direction past the home switch falling edge. At the home switch falling edge, the motor will again reverse direction, moving in the negative direction past the homing switch rising edge until reaching the first motor encoder index past the rising edge again.
- Scenario B: The motor homes in the negative direction. If the home switch is never triggered, the motor continues until the negative limit switch rising edge. At the negative limit switch rising edge, the motor will reverse and move in the positive direction until it goes past both the rising and falling edges of the home switch. At the falling edge, it will reverse in the negative direction until reaching the first motor encoder index pulse past the rising edge of the home switch.
- Scenario C: If the homing switch is already active at the start of the homing sequence, the motor moves in the positive direction past the homing switch falling edge. At the falling edge it will reverse and move in the negative direction until the first motor encoder index is detected.
- At the end of each scenario above, the final position will be assigned the 0 position. The drive will then output a homing finished signal.

Homing Method 13



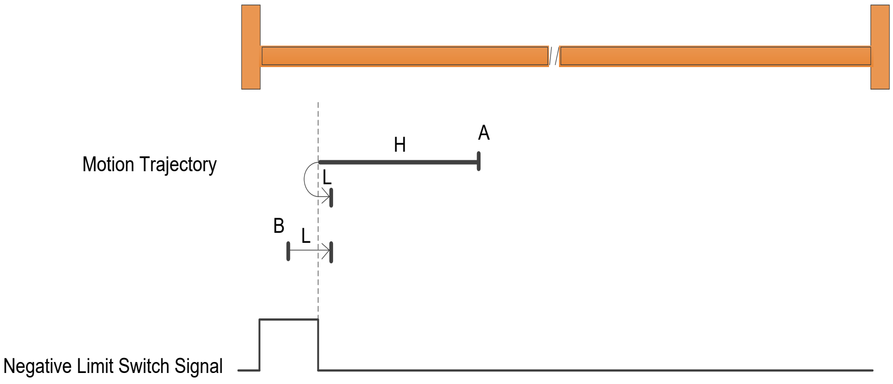
- The homing motion will vary depending on the state of the Home Switch when the homing sequence is initiated.
- Scenario A: The motor homes in the negative direction until it passes both the homing switch rising and falling edges. At the falling edge, the motor will reverse and move in the positive direction until the first motor encoder index is detected.
- Scenario B: The motor homes in the negative direction. If the home switch is never triggered, the motor continues until the negative limit switch rising edge. At the negative limit switch rising edge, the motor will reverse and move in the positive direction until it detects the home switch rising edge. At the rising edge, it will reverse in the negative direction until the home switch falling edge. After the falling edge occurs, the motor will again reverse to move in the positive direction past the home switch rising edge until the first motor encoder index is detected.
- Scenario C: If the homing switch is already active at the start of the homing sequence, the motor moves in the negative direction past the homing switch falling edge. After the falling edge, the motor will reverse in the positive direction past the homing switch rising edge until it detects the first motor encoder index.
- At the end of each scenario above, the final position will be assigned the 0 position. The drive will then output a homing finished signal.

Homing Method 14



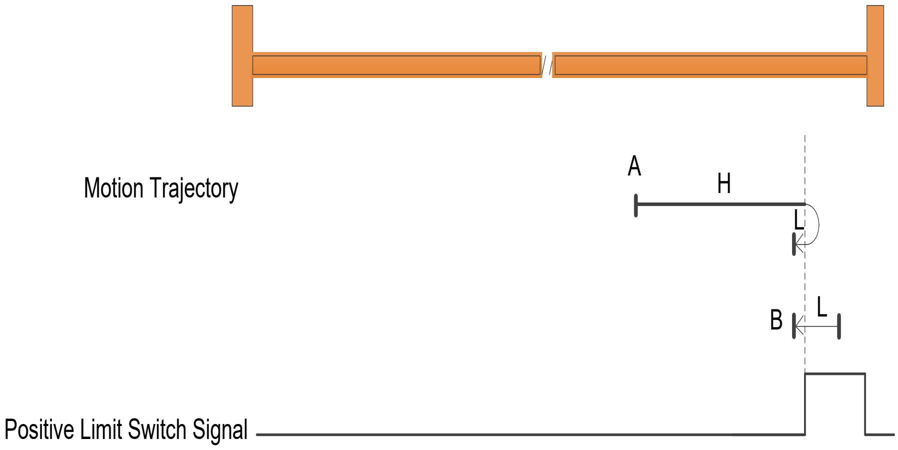
- The homing motion will vary depending on the state of the Home Switch when the homing sequence is initiated.
- Scenario A: The motor homes in the negative direction until it detects the home switch rising edge. At the rising edge, the motor will reverse and move in the positive direction until the home switch falling edge. At the falling edge, it will again reverse in the negative direction past the home switch rising/falling edges until it detects the first motor encoder index.
- Scenario B: The motor homes in the negative direction. If the home switch is never triggered, the motor continues until the negative limit switch rising edge. At the negative limit switch rising edge, the motor will reverse and move in the positive direction until it detects the home switch rising edge. At the rising edge, it will reverse in the negative direction past the home switch falling edge and continue on until the first motor encoder index is detected.
- Scenario C: If the homing switch is already active at the start of the homing sequence, the motor moves in the negative direction past the homing switch falling edge and until the first motor encoder index is detected.
- At the end of each scenario above, the final position will be assigned the 0 position. The drive will then output a homing finished signal.

Homing Method 17



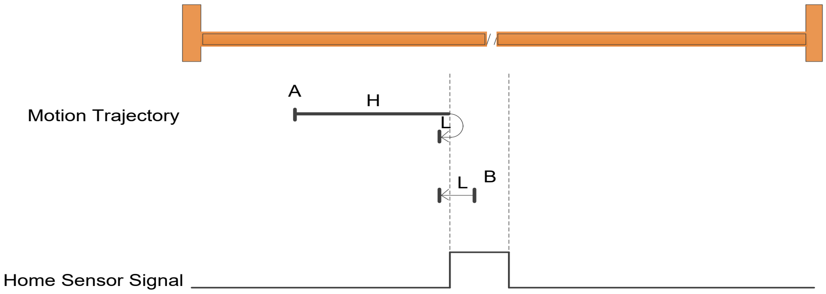
- The homing motion will vary depending on the state of the Home Switch when the homing sequence is initiated.
- Scenario A: The motor homes in the negative direction until the negative limit switch rising edge. At the rising edge, the motor will reverse in the positive direction until the negative limit switch falling edge.
- Scenario B: If the negative limit switch is active at the start of the homing sequence, the motor will move in the positive direction until the negative limit switch falling edge is detected.
- At the end of each scenario above, the final position will be assigned the 0 position. The drive will then output a homing finished signal.

Homing Method 18



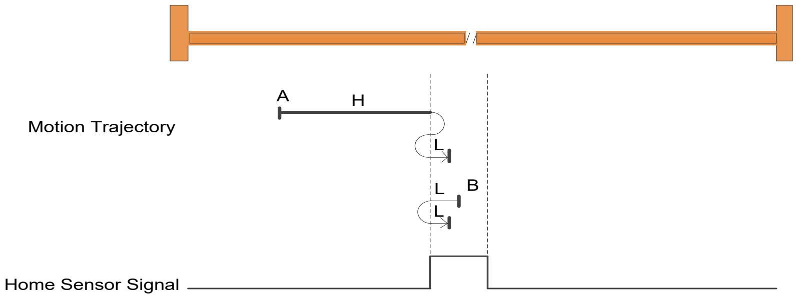
- The homing motion will vary depending on the state of the Home Switch when the homing sequence is initiated.
- Scenario A: The motor homes in the positive direction until the positive limit switch rising edge. At the rising edge, the motor will reverse in the negative direction until the positive limit switch falling edge.
- Scenario B: If the positive limit switch is active at the start of the homing sequence, the motor will move in the negative direction until the positive limit switch falling edge is detected.
- At the end of each scenario above, the final position will be assigned the 0 position. The drive will then output a homing finished signal.

Homing Method 19



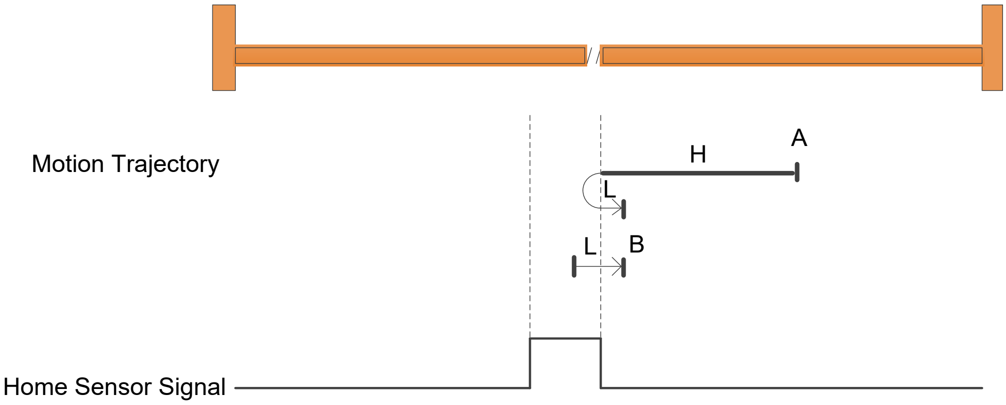
- The homing motion will vary depending on the state of the Home Switch when the homing sequence is initiated.
- Scenario A: The motor will home in the positive direction until the home switch rising edge is detected. At the rising edge, the motor reverse direction, backing away from the home switch in the negative direction until the home switch falling edge.
- Scenario B: If the home switch is already active when the homing method is initiated, the motor will move in the negative direction until the home switch falling edge.
- At the end of each scenario above, the final position will be assigned the 0 position. The drive will then output a homing finished signal.

Homing Method 20



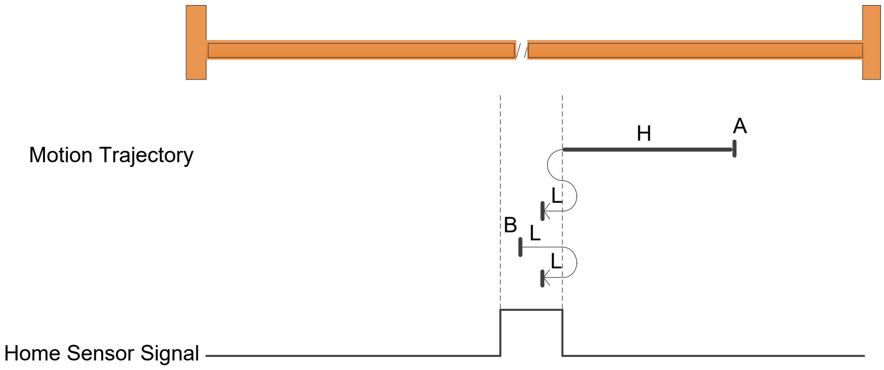
- The homing motion will vary depending on the state of the Home Switch when the homing sequence is initiated.
- Scenario A: The motor homes in the positive direction until the homing switch rising edge. At the rising edge, the motor will back up until the homing switch falling edge. After the falling edge, the motor will once again move in the positive direction and stop after detecting the home switch rising edge again.
- Scenario B: If the homing switch is already ON at the start of the homing sequence, the motor will move in the negative direction until the homing switch falling edge. Once the falling edge is detected, the motor will reverse in the positive direction and stop after detecting the homing switch rising edge again.
- At the end of each scenario above, the final position will be assigned the 0 position. The drive will then output a homing finished signal.

Homing Method 21



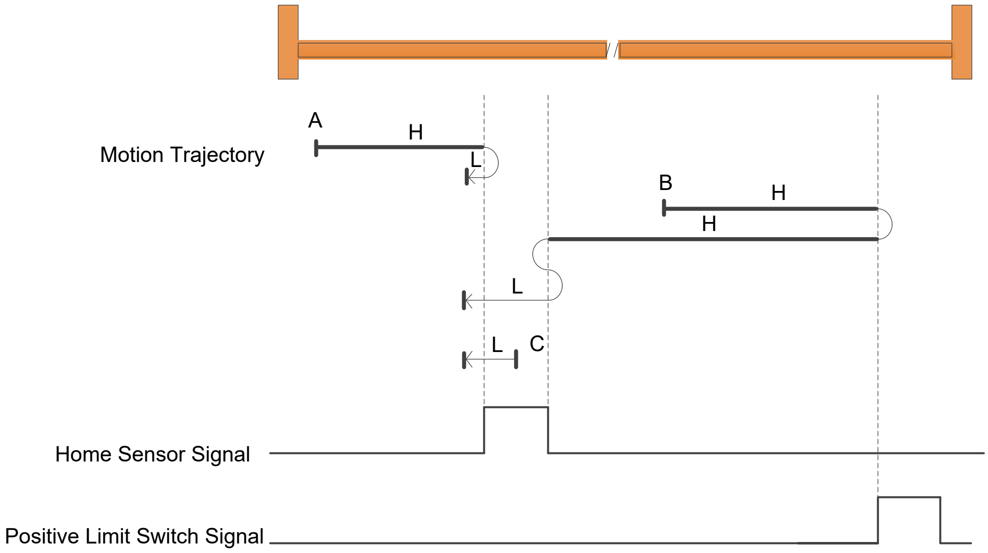
- The homing motion will vary depending on the state of the Home Switch when the homing sequence is initiated.
- Scenario A: The motor homes in the negative direction until the Home switch rising edge is detected. At the rising edge the motor will reverse direction, backing away from the Home switch in the positive direction and stopping after the home switch falling edge.
- Scenario B: If the home switch is already active when the homing method is initiated, the motor will move in the positive direction and stop at the home switch falling edge.
- At the end of each scenario above, the final position will be assigned the 0 position. The drive will then output a homing finished signal.

Homing Method 22



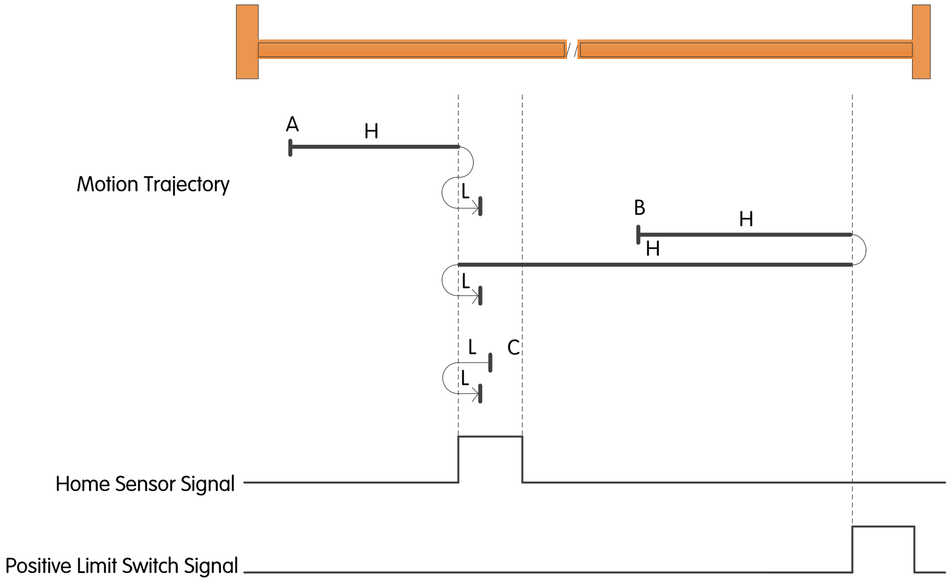
- The homing motion will vary depending on the state of the Home Switch when the homing sequence is initiated.
- Scenario A: The motor homes in the negative direction until the homing switch rising edge. At the rising edge, the motor will back up until the homing switch falling edge. After the falling edge, the motor will once again move in the negative direction, until the homing switch rising edge.
- Scenario B: If the homing switch is already ON at the start of the homing sequence, the motor will move in the positive direction until the homing switch falling edge. Once the falling edge is detected, the motor will reverse in the negative direction until the homing switch rising edge.
- At the end of each scenario above, the final position will be assigned the 0 position. The drive will then output a homing finished signal.

Homing Method 23



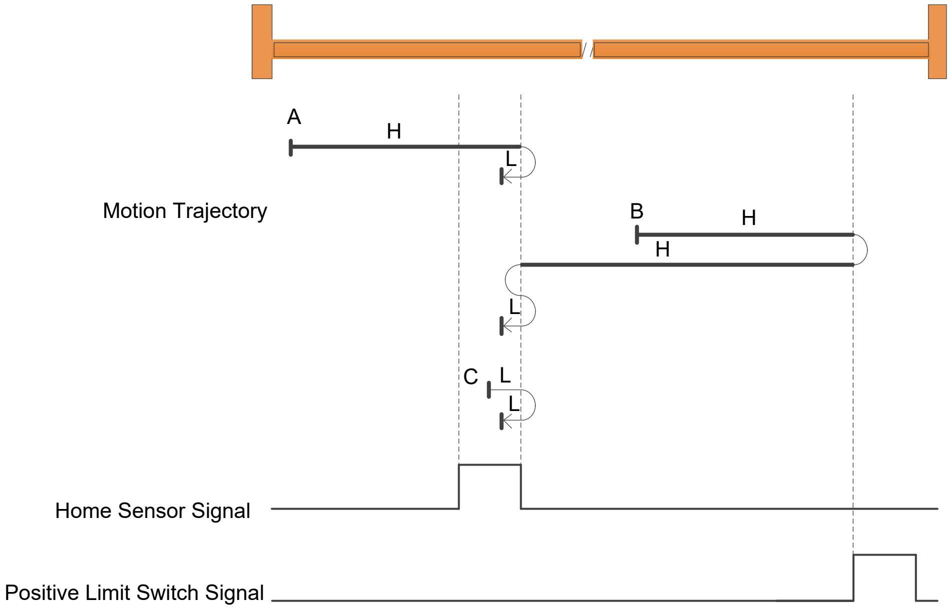
- The homing motion will vary depending on the state of the Home Switch when the homing sequence is initiated.
- Scenario A: The motor homes in the positive direction until the homing switch rising edge. At the rising edge, the motor will reverse direction and stop after the home switch falling edge.
- Scenario B: The motor homes in the positive direction. If the home switch is never triggered, the motor continues until the positive limit switch rising edge. At the positive limit switch rising edge, the motor will reverse and move in the negative direction until the homing switch rising edge is finally detected. At this rising edge, the motor will reverse in the positive direction until the homing switch falling edge. After the falling edge, the motor will again reverse and move in the negative direction, past the homing switch rising and falling edges (square waveform). After the falling edge, the motor will stop.
- Scenario C: If the homing switch is already active at the start of the homing sequence, the motor moves in the negative direction and stop at the homing switch falling edge.
- At the end of each scenario above, the final position will be assigned the 0 position. The drive will then output a homing finished signal.

Homing Method 24



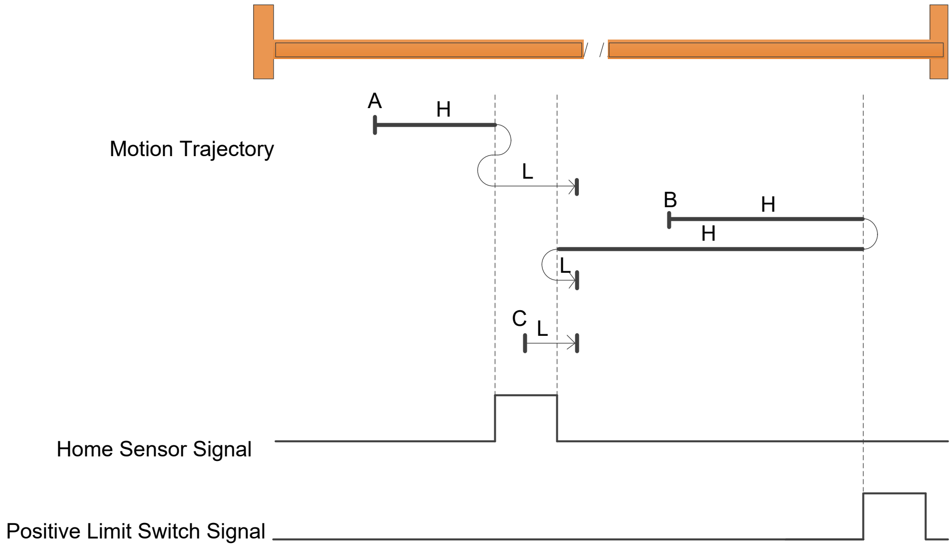
- The homing motion will vary depending on the state of the Home Switch when the homing sequence is initiated.
- Scenario A: The motor homes in the positive direction until the homing switch rising edge. At the rising edge, the motor will reverse direction until the homing switch falling edge. After the falling edge, the motor will then move again in the positive direction and stop at the homing switch rising edge.
- Scenario B: The motor homes in the positive direction. If the home switch is never triggered, the motor continues until the positive limit switch rising edge. At the positive limit switch rising edge, the motor will reverse and move in the negative direction past the homing switch rising edge and falling edge (square waveform). After the falling edge, the motor will reverse in the positive direction and stop at the homing switch rising edge again.
- Scenario C: If the homing switch is already active at the start of the homing sequence, the motor moves in the negative direction past the homing switch falling edge. After the falling edge, the motor will reverse in the positive direction and stop at the homing switch rising edge.
- At the end of each scenario above, the final position will be assigned the 0 position. The drive will then output a homing finished signal.

Homing Method 25



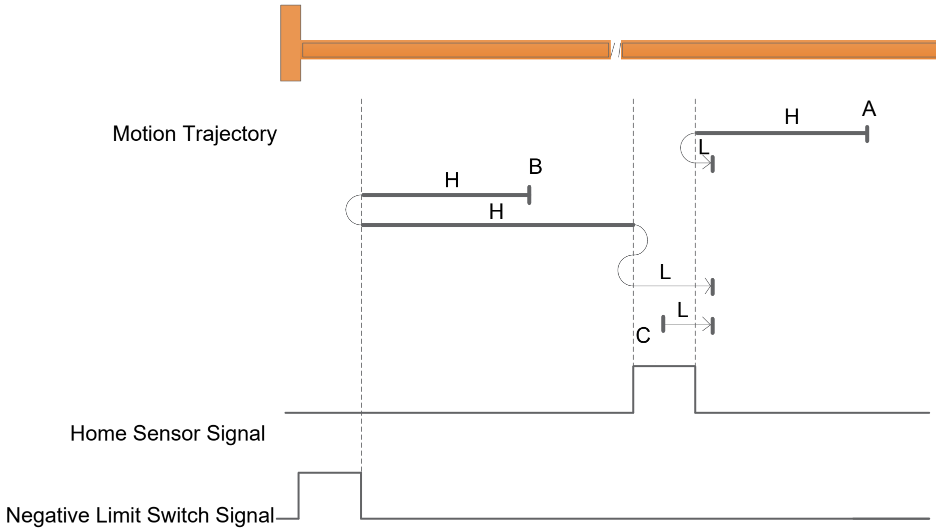
- The homing motion will vary depending on the state of the Home Switch when the homing sequence is initiated.
- Scenario A: The motor homes in the positive direction until it passes both the homing switch rising and falling edges (square waveform). At the falling edge, the motor will reverse and move in the negative direction until the Home switch has a rising edge again.
- Scenario B: The motor homes in the positive direction. If the home switch is never triggered, the motor continues until the positive limit switch rising edge. At the positive limit switch rising edge, the motor will reverse and move in the negative direction until it detects the home switch rising edge. At the rising edge, it will reverse in the positive direction until the home switch falling edge. After the falling edge occurs, the motor will again reverse to move in the negative direction until the home switch rising edge has a rising edge again.
- Scenario C: If the homing switch is already active at the start of the homing sequence, the motor moves in the positive direction past the homing switch falling edge. After the falling edge, the motor will reverse in the negative direction and stop at the homing switch rising edge.
- At the end of each scenario above, the final position will be assigned the 0 position. The drive will then output a homing finished signal.

Homing Method 26



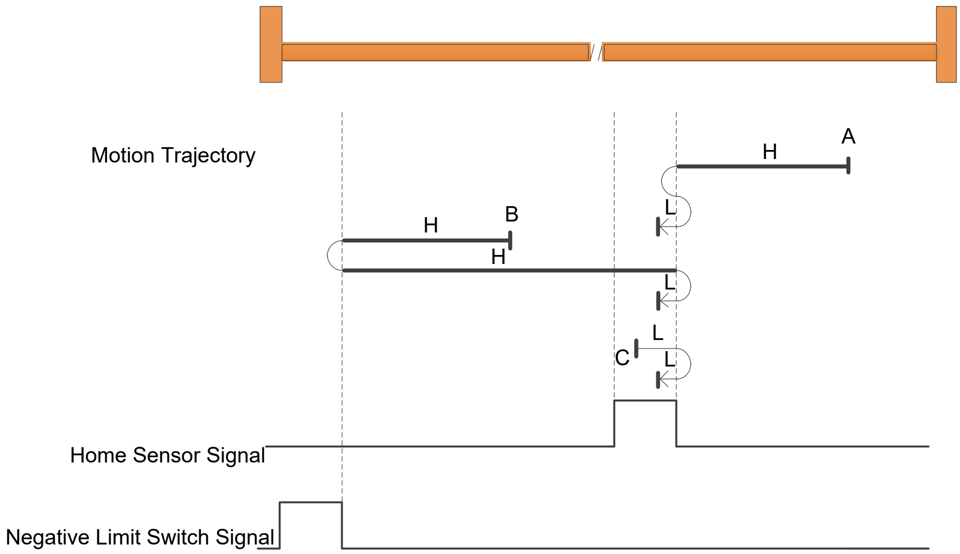
- The homing motion will vary depending on the state of the Home Switch when the homing sequence is initiated.
- Scenario A: The motor homes in the positive direction until it detects the home switch rising edge. At the rising edge, the motor will reverse and move in the negative direction until the home switch falling edge. At the falling edge, it will again reverse in the positive direction past the home switch rising and stop once the homing switch falling edge is detected.
- Scenario B: The motor homes in the positive direction. If the home switch is never triggered, the motor continues until the positive limit switch rising edge. At the positive limit switch rising edge, the motor will reverse and move in the negative direction until it detects the home switch rising edge. At the rising edge, it will reverse in the positive direction and stop at the home switch falling edge.
- Scenario C: If the homing switch is already active at the start of the homing sequence, the motor moves in the positive direction and stops at the homing switch falling edge.
- At the end of each scenario above, the final position will be assigned the 0 position. The drive will then output a homing finished signal.

Homing Method 27



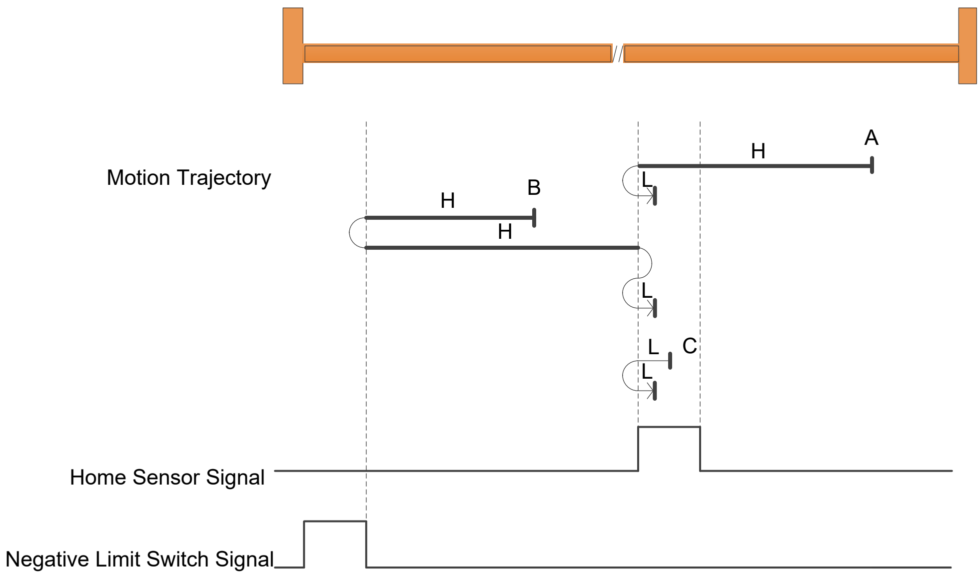
- The homing motion will vary depending on the state of the Home Switch when the homing sequence is initiated.
- Scenario A: The motor homes in the negative direction until it detects the home switch rising edge. At the rising edge, the motor will reverse and move in the positive direction, stopping once the homing switch falling edge is detected.
- Scenario B: The motor homes in the negative direction. If the home switch is never triggered, the motor continues until the negative limit switch rising edge. At the negative limit switch rising edge, the motor will reverse and move in the positive direction until it detects the home switch rising edge. At the rising edge, it will reverse in the negative direction until the home switch falling edge. At the falling edge, it will reverse direction once again, moving in the positive direction past the home switch rising edge, stopping once the homing switch has another falling edge.
- Scenario C: If the homing switch is already active at the start of the homing sequence, the motor moves in the positive direction. The motor stops when the homing switch falling edge is detected.
- At the end of each scenario above, the final position will be assigned the 0 position. The drive will then output a homing finished signal.

Homing Method 28



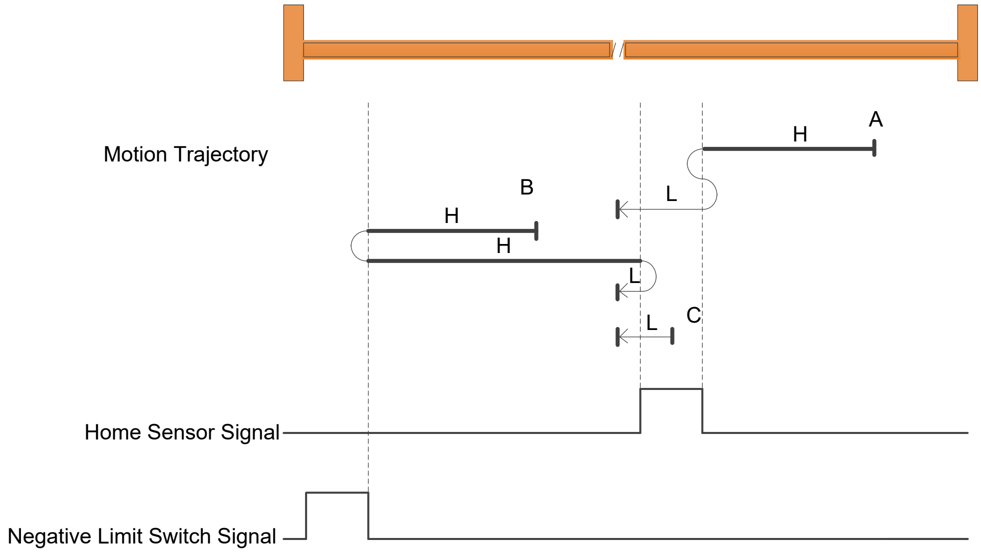
- The homing motion will vary depending on the state of the Home Switch when the homing sequence is initiated.
- Scenario A: The motor homes in the negative direction until the home switch rising edge. At the rising edge, the motor will reverse direction, moving in the positive direction past the home switch falling edge. At the home switch falling edge, the motor will again reverse direction, moving in the negative direction. The motor will stop once the homing switch rising edge is detected again.
- Scenario B: The motor homes in the negative direction. If the home switch is never triggered, the motor continues until the negative limit switch rising edge. At the negative limit switch rising edge, the motor will reverse and move in the positive direction until it goes past both the rising and falling edges of the home switch. At the falling edge, it will reverse in the negative direction until the the home switch rising edge is detected again.
- Scenario C: If the homing switch is already active at the start of the homing sequence, the motor moves in the positive direction past the homing switch falling edge. At the falling edge it will reverse and move in the negative direction until the home switch rising edge is detected again.
- At the end of each scenario above, the final position will be assigned the 0 position. The drive will then output a homing finished signal.

Homing Method 29



- The homing motion will vary depending on the state of the Home Switch when the homing sequence is initiated.
- Scenario A: The motor homes in the negative direction until it passes both the homing switch rising and falling edges. At the falling edge, the motor will reverse and move in the positive direction until a homing switch rising edge is detected again.
- Scenario B: The motor homes in the negative direction. If the home switch is never triggered, the motor continues until the negative limit switch rising edge. At the negative limit switch rising edge, the motor will reverse and move in the positive direction until it detects the home switch rising edge. At the rising edge, it will reverse in the negative direction until the home switch falling edge. After the falling edge occurs, the motor will again reverse, moving in the positive direction until the homing switch has a rising edge again.
- Scenario C: If the homing switch is already active at the start of the homing sequence, the motor moves in the negative direction past the homing switch falling edge. After the falling edge, the motor will reverse in the positive direction until a homing switch rising edge is detected again.
- At the end of each scenario above, the final position will be assigned the 0 position. The drive will then output a homing finished signal.

Homing Method 30

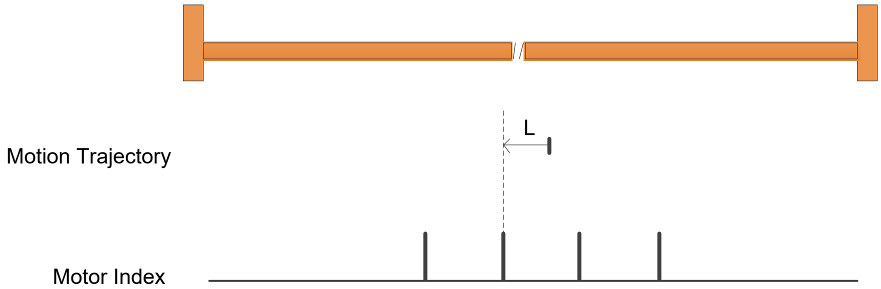


- The homing motion will vary depending on the state of the Home Switch when the homing sequence is initiated.
- Scenario A: The motor homes in the negative direction until it detects the home switch rising edge. At the rising edge, the motor will reverse and move in the positive direction until the home switch falling edge. At the falling edge, it will again reverse in the negative direction past the home switch rising edge and stopping at the next falling edge.
- Scenario B: The motor homes in the negative direction. If the home switch is never triggered, the motor continues until the negative limit switch rising edge. At the negative limit switch rising edge, the motor will reverse and move in the positive direction until it detects the home switch rising edge. At the rising edge, it will reverse in the negative direction and stop once the homing switch falling edge is detected.
- Scenario C: If the homing switch is already active at the start of the homing sequence, the motor moves in the negative direction and stops at the homing switch falling edge.
- At the end of each scenario above, the final position will be assigned the 0 position. The drive will then output a homing finished signal.

Homing Method 31 and 32: Reserved

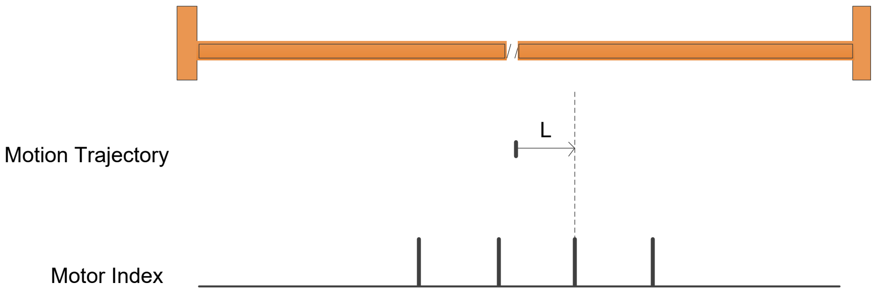
These two homing methods are reserved for future expansion of the homing mode.

Homing Method 33



- 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.

Homing Method 34

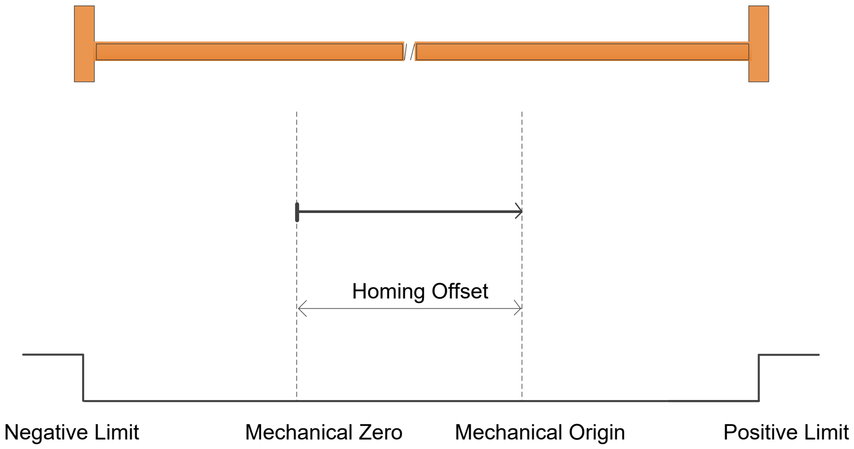


- The motor moves in the positive direction with a homing speed set by P2-25 until the first motor index pulse is detected, the motor stops, Homing has been finished.

Homing Method 35

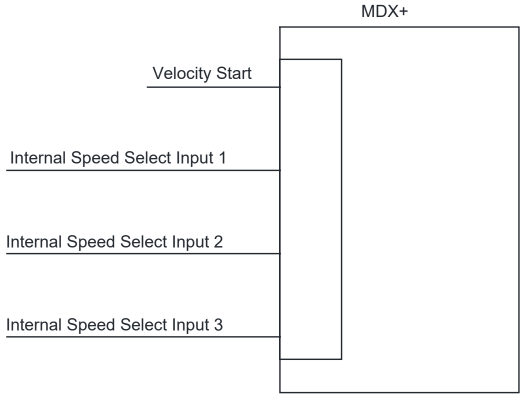
In this Method, the current position is taken to be the home position.

If Home Offset(parameter P2-27) is set, the motor will move an equivalent distance away from the current (home) position in the configured direction.



7.9 Internal Velocity Control

MDX+ series motor 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 motor, the speed mode can be controlled without analog input.



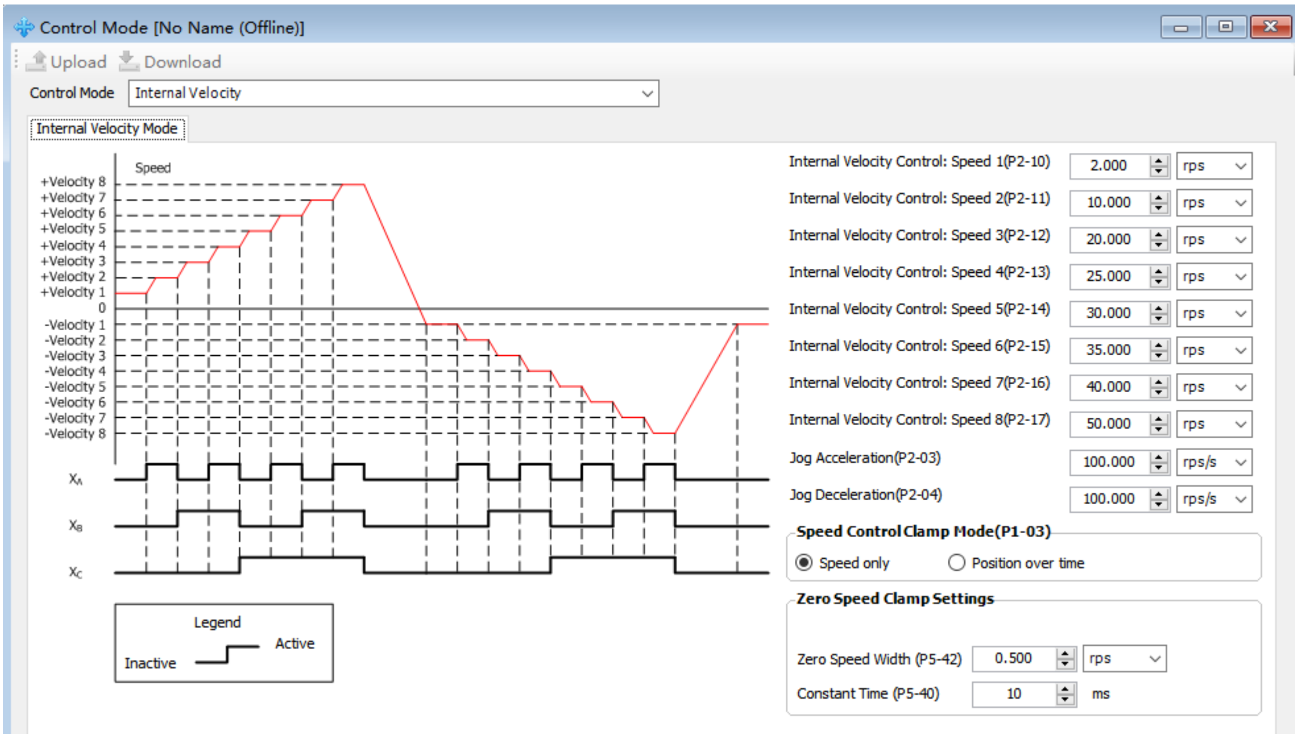
7.9.1 Set the Control Mode to Internal Velocity

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.



7.9.2 Digital Inputs Settings

When using the internal velocity mode, it is necessary to set the corresponding function for the digital inputs. Parameters P5-00 ~ P5-05 are used to set the functions of digital inputs X1 ~ X6.

Signals	Symbol	Setup value and corresponding input logic state of P5-00 ~ P5-05.		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.

7.9.3 Internal Velocity Settings

Target Speed Setting
Parameters P2-10 to P-17 are used to set 8 different speeds of the internal velocity mode.

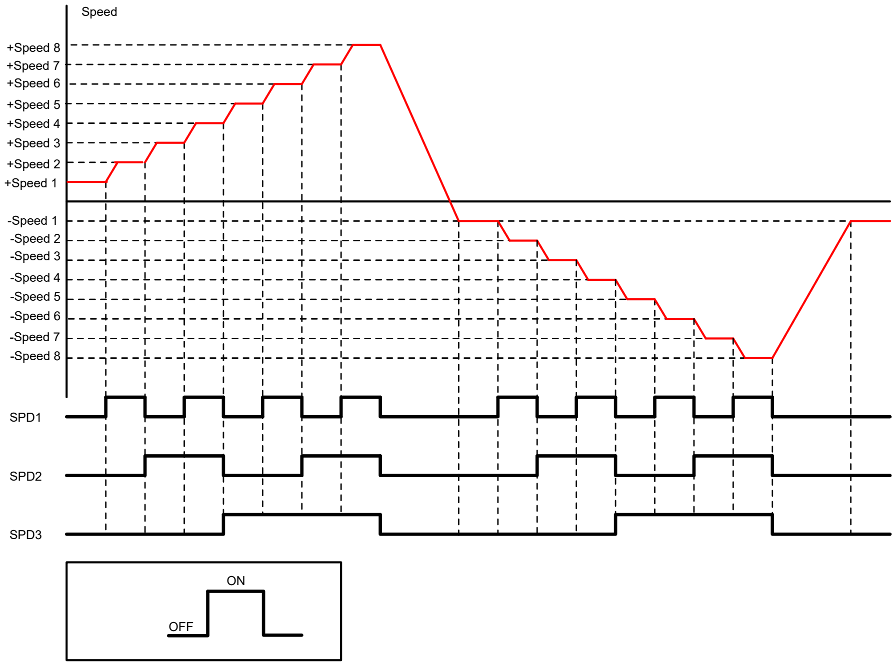
Parameters	SCL Com.	Description	Default	Range	Unit
P2-10	JC1	Internal Velocity Control: Speed 1	0	-100 ~ 100	rps
P2-11	JC2	Internal Velocity Control: Speed 2	10	-100 ~ 100	rps
P2-12	JC3	Internal Velocity Control: Speed 3	20	-100 ~ 100	rps
P2-13	JC4	Internal Velocity Control: Speed 4	25	-100 ~ 100	rps
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

7.9.4 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.



7.9.5 Rotation Direction Switching in Internal Velocity Mode

The rotation direction is usually determined by the positive and negative sign 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 Switch) 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

Parameter P1-11 motor rotation direction	command torque(communication command)	Input logic of SPD-DIR	Actual motor rotation direction
0	Positive	Input signal not used	CW
0	Negative		CCW
1	Positive		CCW
1	Negative		CW

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

Parameter P1-11 motor rotation direction	command torque(communication command)	Input logic of SPD-DIR	Actual motor rotation direction
0	Positive	High	CW
0	Negative	High	
0	Positive	Low	CCW
0	Negative	Low	
1	Positive	High	CCW
1	Negative	High	
1	Positive	Low	CW
1	Negative	Low	

8 Parameter Setting

8.1 Parameter Classification

The MDX+ series parameters are divided into six groups.

Group	Type	Instruction
Group 0: P0-XX	PID Gain Parameters	Set the gain parameters of the servo and related parameters
Group 1: P1-XX	Configuration Parameters	Set or configure various motor functions
Group 2: P2-XX	Trajectory & Motion Profile Parameters	Set the parameters related to the internal motion trajectory
Group 3: P3-XX	Encoder & Pulse/Dir Parameters	Set parameters related to encoder and input/output pulses
Group 4: P4-XX	Analog Parameters	Set parameters related to analog input and output
Group 5: P5-XX	Digital I/O Signal Parameters	Set the parameters of digital input and output related functions

8.2 List of Parameters

P0-XX: PID Gains

Parameter	SCL Command	Function	Defaults	Range	Unit	Effective
P0-00	UM	Tuning Mode	0	0 ~ 2	——	
P0-01	LY	Load Type	0	0 ~ 2	——	
P0-02	NR	Load Inertia Ratio	0	0 ~ 100	——	
P0-03	KG	1st Mechanical Stiffness Level	5	0 ~ 20	——	
P0-04	KX	2nd Mechanical Stiffness Level	5	0 ~ 20	——	
P0-05	KP	1st Position Loop Gain	52	0 ~ 20000	0.1Hz	
P0-07	KD	1st Position Loop Derivative Time Constant	2000	0 ~ 30000	ms	
P0-08	KE	1st Position Loop Derivative Filter	20000	0 ~ 40000	0.1Hz	
P0-09	KL	Velocity Feedforward Gain	10000	-30000 ~ 30000	0.01%	
P0-10	KR	Velocity Feedforward Filter Frequency	20000	0 ~ 40000	0.1Hz	
P0-11	KF	1st Velocity Command Gain	10000	-30000 ~ 30000	0.01%	
P0-12	VP	1st Velocity Loop Gain	183	0 ~ 30000	0.1Hz	
P0-13	VI	1st Velocity Loop Integral Time Constant	189	0 ~ 30000	ms	
P0-14	KK	Acceleration Feed Forward Gain	3000	0 ~ 20000	0.01%	
P0-15	KT	Acceleration Feedforward Filter Frequency	20000	0 ~ 40000	0.1Hz	
P0-16	KC	1st Command Torque Filter Frequency	1099	0 ~ 40000	0.1Hz	
P0-17	UP	2nd Position Loop Gain	52	0 ~ 20000	0.1Hz	
P0-19	UD	2nd Position Loop Derivative Time Constant	2000	0 ~ 30000	ms	
P0-20	UE	2nd Position Loop Derivative Filter Frequency	15000	0 ~ 40000	0.1Hz	
P0-21	UF	2nd Velocity Command Gain	10000	-30000 ~ 30000	0.01%	
P0-22	UV	2nd Velocity Loop Gain	183	0 ~ 30000	0.1Hz	
P0-23	UG	2nd Velocity Loop Integral Time Constant	189	0 ~ 30000	ms	
P0-24	UC	2nd Command Torque Filter Frequency	1099	0 ~ 40000	0.1Hz	
P0-33	SD	Automatic Gain Switching Method	0	0 ~ 4	——	
P0-34	PN	Gain Switching Condition - Position Error	0	0 ~ 2147483647	Pulses	
P0-35	VN	Gain Switching Condition - Actual Velocity	0	0 ~ 100	rps	
P0-36	TN	Gain Switching Condition - Actual Torque	10	0 ~ 3500	0.1%	
P0-37	SE1	Delay Time - 2nd Group Gains to 1st Group Gains	10	0 ~ 10000	ms	
P0-38	SE2	Delay Time - 1st Group Gains to 2nd Group Gains	0	0 ~ 10000	ms	
P0-39	LR	Velocity Feedback Filter	0	0 ~ 3	——	

P1-XX: Motor Configuration

Parameter	SCL Command	Function	Defaults	Range	Unit	Effective
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	Control Mode On Power Up	10	8 ~ 10, 13	-	
P1-03	JM	Jog Mode	2	1 ~ 2	-	
P1-05	GC	Current Command for Torque Control	0	-3000 ~ 3000	0.1%	
P1-06	CC	1st Torque Limit	3000	0 ~ 3000	0.1%	
P1-07	CV	Target Value of Torque Reach	0	0 ~ 3000	0.1%	
P1-08	HC	Hard Stop Home Torque Limit	200	0 ~ 3000	0.1%	
P1-09	CL	Current Foldback Timer	2000	0 ~ 30000	ms	
P1-10	LD	Torque Limit Method	1	0 ~ 3, 5 ~ 6	-	
P1-11	RN	Rotation Direction	0	0, 1	-	
P1-13	PR	Protocol	5	1 ~ 511	-	
P1-14	TD	Transmit Delay	2	0 ~ 20	ms	
P1-15	BR	RS-485 Baud Rate	1	1 ~ 5	-	
P1-16	DA	RS-485 Address	32	1 ~ 32	-	
P1-17	CO	CANopen Node ID	1	1 ~ 127	-	
P1-18	CB	CANopen Baud Rate	0	0 ~ 7	-	
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 when Servo Off	500	0 ~ 30000	ms	
P1-32	YN	Dynamic Brake Action Time when Fault Occurs	0	0 ~ 30000	ms	
P1-34	RT	Current Ramp Limit	1000	0 ~ 3000	0.1%	
P1-37	DV	Dynamic Brake Velocity	50	0 ~ 100	rps	
P1-39	ZS	Watchdog Trigger Time	500	0 ~ 10000	ms	
P1-40	ZA	Action After Watchdog is Triggered	1	1 ~ 16	-	

P2-XX: Trajectory & Motion Profile

Parameter	SCL Command	Function	Defaults	Range	Unit	Effective
P2-00	VM	Maximum Velocity	80	0 ~ 100	rps	
P2-01	AM	Maximum Acceleration/Deceleration	3000	0.167 ~ 5000	rps/s	
P2-02	JS	Jog Velocity	10	-100 ~ 100	rps	
P2-03	JA	Jog Acceleration	100	0.167 ~ 5000	rps/s	
P2-04	JL	Jog Deceleration	100	0.167 ~ 5000	rps/s	
P2-05	JT	Jerk Time	10	0 ~ 250	ms	
P2-06	VE	Target Velocity (Point-to-Point)	10	0.0042 ~ 100	rps	
P2-07	AC	Target Acceleration (Point-to-Point)	100	0.167 ~ 5000	rps/s	
P2-08	DE	Target Deceleration (Point-to-Point)	100	0.167 ~ 5000	rps/s	
P2-09	VC	Velocity Change (Point-to-Point)	2	0 ~ 100	rps	
P2-10	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	
P2-24	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 ~ 250	ms	
P2-30	VT	Speed Limit in Torque Mode	80	0 ~ 100	rps	

P3-XX: Encoder & Pulse/Dir Parameters

Parameter	SCL Command	Function	Defaults	Range	Unit	Effective
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	Pulse Input Setting	9	0 ~ 31		
P3-04	PF	Position Fault Limit	100000	0 ~ 2147483647	pulses	
P3-05	EG	Electronic Gearing	10000	200 ~ 131072	pulses/rev	
P3-12	PO	Encoder Pulse Output Mode	1	0 ~ 256	-	
P3-13	ON	Encoder Pulse Output Ratio - Numerator	10000	0 ~ 13107200	-	
P3-14	OD	Encoder Pulse Output Ratio - Denominator	131072	0 ~ 13107200	-	
P3-15	ES	Absolute Encoder Setting	1	0 ~ 4	-	
P3-16	PU	Electronic Gearing Mode	0	0 ~ 1	-	

P4-XX: Analog Input Parameters

Parameter	SCL Command	Function	Defaults	Range	Unit	Effective
P4-00	AP	Analog Input Position Gain	8000	-2147483647 ~ +2147483647	pulses/10V	
P4-01	AG	Analog Input Velocity Gain	50	0 ~ 100	rps/10V	
P4-02	AN	Analog Input Torque Gain	1000	0 ~ 3000	0.1%/10V	
P4-03	AV1	Analog Input 1 Offset	0	-10000 ~ 10000	mV	
P4-05	AD1	Analog Input 1 Dead-Band	0	0 ~ 255	mV	
P4-07	AF1	Analog Input 1 Filter	1000	0 ~ 2000	0.1Hz	
P4-09	AT1	Analog Input 1 Threshold	5000	-10000 ~ 10000	mV	
P4-11	FA1	Velocity Limit Setting in Torque Control	1	0 ~ 1		

P5-XX Digital I/O Signal Parameters

Parameter	SCL Command	Function	Defaults	Range	Unit	Effective
P5-00	MU1	Digital Input 1 Function		0 ~ 48	-	
P5-01	MU2	Digital Input 2 Function		0 ~ 48	-	
P5-02	MU3	Digital Input 3 Function		0 ~ 48	-	
P5-03	MU4	Digital Input 4 Function		0 ~ 48	-	
P5-04	MU5	Digital Input 5 Function		0 ~ 48	-	
P5-05	MU6	Digital Input 6 Function		0 ~ 48	-	
P5-12	MO1	Digital Output 1 Function		0 ~ 34	-	
P5-13	MO2	Digital Output 2 Function		0 ~ 34	-	
P5-14	MO3	Digital Output 3 Function		0 ~ 34	-	
P5-24	BD	Motion Delay after Brake Release	200	0 ~ 32000	ms	
P5-25	BE	Servo Off Delay after Brake Applied	200	0 ~ 32000	ms	
P5-27	HX	Home Sensor	5	1 ~ 10	-	
P5-28	FI1	Digital Input 1 Filter	1	0 ~ 8000	ms	
P5-29	FI2	Digital Input 2 Filter	1	0 ~ 8000	ms	
P5-30	FI3	Digital Input 3 Filter	1	0 ~ 8000	ms	
P5-31	FI4	Digital Input 4 Filter	1	0 ~ 8000	ms	
P5-32	FI5	Digital Input 5 Filter	1	0 ~ 8000	ms	
P5-33	FI6	Digital Input 6 Filter	1	0 ~ 8000	ms	
P5-38	PL	Position Error Signal Threshold	10	0 ~ 2147483647	pulses	
P5-39	PD	Positioning Complete Error Margin	40	0 ~32000	pulses	
P5-40	PE	Motion Condition Timer	10	0 ~ 30000	ms	
P5-42	ZV	Zero Speed Width	0.5	0.1 ~ 2	rps	
P5-43	VR	Velocity Coincidence Width	0.1	0 ~ 100	rps	
P5-44	VV	Velocity Reached Threshold	10	0 ~ 100	rps	
P5-45	TV	Torque Coincidence Width	10	0 ~ 3000	0.1%	
P5-46	DG	Near Target Position 1	10000	-2147483647 ~ +2147483647	pulses	
P5-47	LP	Positive Software Limit	0	-2147483647 ~ +2147483647	pulses	
P5-48	LM	Negative Software Limit	0	-2147483647 ~ +2147483647	pulses	
P5-49	HE	Homing Method	1	-4 ~ 40	-	
P5-50	EO	E-Stop Method	1	1 ~ 8	-	
P5-51	MS	Zero Speed Clamp Function	1	0 ~ 4	-	

8.3 Parameter Description

8.3.1 Group P0-XX: PID Gain Parameters

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P0-00	UM	Tuning Mode	0	0 ~ 2	---	P	V		

Set the parameter tuning method.

Set value	Parameter setting mode	Description	Note
0	No Tuning	Set the gain value of servo system by setting P0-03.	In this mode, only modification of P0-03 is valid. Manual adjustment of all other gain and tuning parameters is not allowed.
1	Auto Tuning	Parameters are automatically set (load inertia, mechanical stiffness and gains). Only the 1st Mechanical Stiffness (P0-03) and the Load Inertia Ratio (P0-02) can be manually edited.	In this mode, adjustment of P0-03 stiffness level and P0-02 load inertia ratio are valid. Manual adjustment of other gain parameters is not allowed.
2	Fine Tuning	Fine tuning allows users to manually configure all gain, filter and load characteristics for tuning. A recommended method is to first use auto-tuning to get a close estimate of the required tuning parameter values and then manually adjust those estimates until a more accurate tuning profile is reached.	In this mode, adjustment of all gain parameters is allowed.

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P0-01	LY	Load Type	0	0 ~ 2	---	P	V	T	

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

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

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P0-02	NR	Load Inertia Ratio	0	0 ~ 100	---	P	V	T	

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

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P0-03	KG	1st Mechanical Stiffness Level	5	1 ~ 20	---	P	V	T	

The mechanical stiffness level of the [first] system. When the parameter tuning mode P0-00 is set to No Tuning or auto tuning, the higher the mechanical stiffness level is set, the stronger the gain and the faster the response of the servo system will be. An excessively high stiffness level will cause system vibrations.

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P0-04	KX	2nd Mechanical Stiffness Level	5	1 ~ 20	---	P	V	T	

The mechanical stiffness level of the [second] system. When the gain switch is turned on, the second stiffness level will be effective under the corresponding conditions. Gain switching occurs if a digital input is configured as GAIN-SEL or according to parameter P0-33: Automaitc Gain Switching Method. When parameter P0-00 is set to No Tuning or Auto-Tuning, the higher the mechanical stiffness level is, the stronger the gain and the faster the response of the servo system will be. An excessively high stiffness level will cause system vibrations.

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P0-05	KP	1st Position Loop Gain	52	0 ~ 20000	0.1Hz	P	V	T	

Set the proportional gain for position control. 0 means not used, 20000 means the proportional effect is maximized. Increasing this parameter can improve the responsiveness of the system, reduce the position error, and shorten the positioning time.
When the proportional gain of the position loop is too small, the system response will be delayed and position errors will decrease slowly. If set too high, system vibrations may occur.

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P0-07	KD	1st Position Loop Derivative Time Constant	0	0 ~ 30000	ms	P	V	T	

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

◆ A value of 0 means no effect. As the set value decreases, the derivative effect strengthens. If this value is set too high, the the ability to suppress vibrations weakens, causing oscillations during acceleration, deceleration, constant speed, and when stopped in position. These oscillations eventually reach steady state.

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

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

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P0-08	KE	1st Position Loop Derivative Filter	20000	0 ~ 40000	0.1Hz	P	V	T	

Set the Position Loop Derivative filter for position control. 0 means no filtering effect. This filter is a one-pole, low-pass filter intended for attenuating high frequency oscillations. This value is a constant that must be calculated from the desired roll off frequency.

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P0-09	KL	Velocity Feedforward Gain	10000	-30000 ~ 30000	0.01%	P	V	T	

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

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P0-10	KR	Velocity Feedforward Filter Frequency	20000	0 ~ 40000	0.1Hz	P	V	T	

Sets the low-pass filter for velocity feedforward. 0 means no filtering effect.

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P0-11	KF	1st Velocity Command Gain	10000	-30000 ~ 30000	0.01%	P	V	T	

The velocity command from the position control loop is multiplied by the ratio of this parameter and used for the velocity control loop.

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P0-12	VP	1st Velocity Loop Gain	183	0 ~ 30000	0.1Hz	P	V	T	

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

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P0-13	VI	1st Velocity Loop Integral Time Constant	189	0 ~ 30000	0.1Hz	P	V	T	

Set the integral time constant of the velocity loop. 0 means no integral effect, the smaller the set value, the stronger the integral effect. This integral gain term is used to increase stiffness and reduce steady-state velocity error.

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P0-14	KK	Acceleration Feedforward Gain	3000	0 ~ 20000	0.01%	P	V	T	
Acceleration feedforward gain in servo control. A value of 0 means that the feedforward is not used, and a value of 10000 means that the feedforward effect is maximized.									

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

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P0-16	KC	1st Command Torque Filter	1099	0 ~ 40000	0.1 Hz	P	V	T	
Filter the command torque. 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). System operation needs to be considered when setting this value. The smaller the value, the lower the filtering frequency and the more obvious the filtering effect. The default value of 1099 works for most applications. This value can be modified in cases of motor vibrations or abnormal audible noise. An example use case is when a system is prone to mechanical resonance. The low pass filter cutoff frequency can be set below the resonance frequency of the system to prevent the motor control loop from exciting the system into its resonance frequency. In large inertia applications, increasing KP can help improve the system response but a KP value set too high can induce vibrations. To reduce those vibrations, this filter's frequency may be reduced.									

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

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P0-19	UD	2nd Position Loop Derivative Time Constant	0	0 ~ 30000	ms	P	V	T	
◆ Set the position loop derivative time constant for position control used by the 2nd group gains. ◆ A value of 0 means no effect. As the set value decreases, the derivative effect strengthens. If this value is set too high, the the ability to suppress vibrations weakens, causing oscillations during acceleration, deceleration, constant speed, and when stopped in position. These oscillations eventually reach steady state. ◆ When the set value of the derivative time constant (UD) is reasonable, the system's ability to suppress vibration is significantly enhanced, and it tends to stabilize quickly. ◆ When the differential time constant (UD) is set too small, the motion system will be too sensitive, easily vibrate and generate noise.									

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P0-20	UE	2nd Position Loop Derivative Filter	20000	0 ~ 40000	0.1Hz	P	V	T	
Set the position loop derivative low-pass filter for position control used by the 2nd gain group. 0 means no filtering effect. This filter is a one-pole, low-pass filter intended for attenuating high frequency oscillations. This value is a constant that must be calculated from the desired roll off frequency.									

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P0-21	UF	2nd Velocity Command Gain	10000	-30000 ~ 30000	0.01%	P	V	T	
The velocity command from the position control loop is multiplied by the ratio of this parameter and used for the velocity control loop when the 2nd gain group is active.									

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P0-22	UV	2nd Velocity Loop Gain	183	0 ~ 30000	0.1Hz	P	V	T	
Set the proportional gain of the velocity loop, used when 2nd gain group is active. In order to improve the overall response of the servo system, it is necessary to increase the velocity loop gain value. Setting the value too high will cause vibration.									

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P0-23	UG	2nd Velocity Loop Integral Time Constant	189	0 ~ 30000	ms	P	V	T	
Set the integral time constant of the velocity loop, used when 2nd gain group is active. 0 means no integral effect, the smaller the set value, the stronger the integral effect. This integral gain term is used to increase stiffness and reduce steady-state velocity errors									

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P0-24	UC	2nd Command Torque Filter Frequency	1099	0 ~ 40000	0.1 Hz	P	V	T	

Command Torque Filter Frequency for the 2nd gain group. The filter is a single-output low-pass filter, which is used to low-pass filter the output of the PID controller (that is, the reference current). System operation needs to be considered when setting this value.
The smaller the value, the lower the filtering frequency and the more obvious the filtering effect. The default value of 1099 works for most applications. This value can be modified in cases of motor vibrations or abnormal audible noise.
An example use case is when a system is prone to mechanical resonance. The low pass filter cutoff frequency can be set below the resonance frequency of the system to prevent the motor control loop from exciting the system into its resonance frequency. In large inertia applications, increasing KP can help improve the system response but a KP value set too high can induce vibrations. To reduce those vibrations, this filter's frequency may be reduced.

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P0-33	SD	Automatic Gain Switching Method	0	0 ~ 4	——	P	V	T	

Set the switch condition between the 1st gain group and 2nd gain group. The gradual switch time is set by parameters P0-37 and P0-38.

Set value	Switching mode	Switching condition	Switching Delays
0	Fixed in Group One	Fixed in Group One	-
1	According to positional error	Switch to Group 2: Absolute position error ≥ P0-34 setting	P0-37
		Switch back to Group 1: Absolute position error < P0-34 setting	P0-38
2	According to the actual speed of the motor	Switch to group 2 conditions: absolute value of actual speed 35 P0-35 set value	P0-37
		Switch back to Group 1: Absolute value of actual speed < P0-35 set value	P0-38
3	According to the actual output torque of the motor	Switch to Group 2: Absolute value of actual torque > P0-36 set value	P0-37
		Switch back to Group 1: Absolute value of actual torque < P0-36 set value	P0-38
4	Positioning Complete (In Position)	Switch to Group 2 condition: Position Complete (IN-POS) condition is valid.	P0-37
		Switch back to Group 1 condition: Position Complete condition not valid	P0-38

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P0-34	PN	Gain Switching Condition - Position Error	0	0 ~ 2147483647	Pulses	P	V	T	

Set the condition for position error-based gain switching.
In position control mode, when the P0-33 is set to '1', this parameter defines the criteria for triggering the switch..

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P0-35	VN	Gain Switching Condition - Actual Velocity	0.000	0 ~ 100	rps	P	V	T	

Set the gain switching judgment condition based on the actual motor speed.
In position, velocity, or torque control modes, when the P0-33 is set to '2', this parameter defines the criteria for triggering the switch.

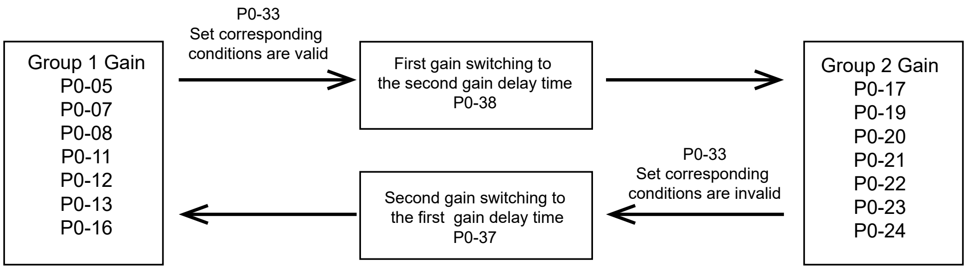
Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P0-36	TN	Gain Switching Condition - Actual Torque	10	0 ~ 3000	0.1%	P	V	T	

Set the gain switching judgment condition based on the actual output torque of the motor.
In position, velocity, or torque control modes, when the P0-33 is set to '3', this parameter defines the criteria for triggering the switch

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes
P0-37	SE1	Delay Time - 2nd Group Gains to 1st Group Gains	10	0 ~ 10000	ms	P V T

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes
P0-38	SE2	Delay Time - 1st Group Gains to 2nd Group Gains	10	0 ~ 10000	ms	P V T

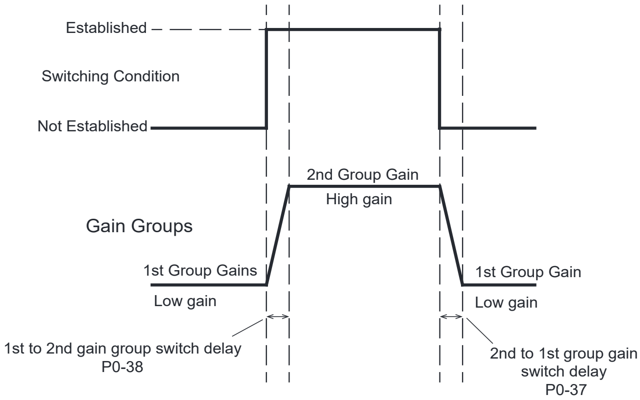
When switching gains is required in an application, users will need to configure two delay periods. P0-37 and P0-38 define the delay times for switching to and from Group 1 and Group 2 of gains. The delay allows the gradual switch between the gain values to maintain stability.



The switching transition time is shown below

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

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



Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes
P0-39	LR	Velocity Feedback Filter	0	0 ~ 3	——	P V T

Low-pass filter for Velocity Feedback in PID Controller's Velocity Control Loop.

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

8.3.2 Group P1-XX: Configuration Parameters

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P1-00	CM	Main Control Mode	21	1,2,7,11,15,21	-	P	V	T	

Parameter P1-00 is used to set the Main Control Mode of the motor.

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 Quadrature	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	Point-to-point position mode control using communication instructions

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P1-01	CN	Secondary Control Mode	21	1,2,7,11,15,21	-	P	V	T	

Parameter P1-01 is used to set the Secondary Control Mode of the motor.

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 Quadrature	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	Instruction	Name	Defaults	Range	Unit	Contol mode			
P1-03	JM	Jog Mode	2	1 ~ 2	-	P	V	T	

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

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

Parameter	Instruction	Name	Defaults	Range	Unit	Contol mode			
P1-05	GC	Current Command for Torque Control	0	-3000 ~ 3000	0.1%	P	V	T	

When the motor is operated in torque control (command based), this parameter defines the commanded current. This value is percentage of rated current/torque, 100% corresponds to the rated torque of the motor usually found on the motor label.

Note:

- This current value is not maintained after power cycles.

- Set P2-30 Velocity Limit in Torque Control before setting this value.

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P1-06	CC	1st Torque Limit	3000	0 ~ 3000	0.1%	P	V	T	

Sets the maximum peak current level for the servo motor when operating in Point-to-Point mode and Velocity Control Mode. Behaves as the first torque limit when operating in Torque Control.

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P1-07	CV	Torque Value of Torque Reach	0	0 ~ 3000	0.1%	P	V	T	

Sets the Torque Value for when the TQ-REACH output signal will be valid. Units are in percent of the motor rated torque. 100% means if the actual torque is equal to the motor rated torque, TQ-REACH output signal is valid. Refer to Section 7.4.5

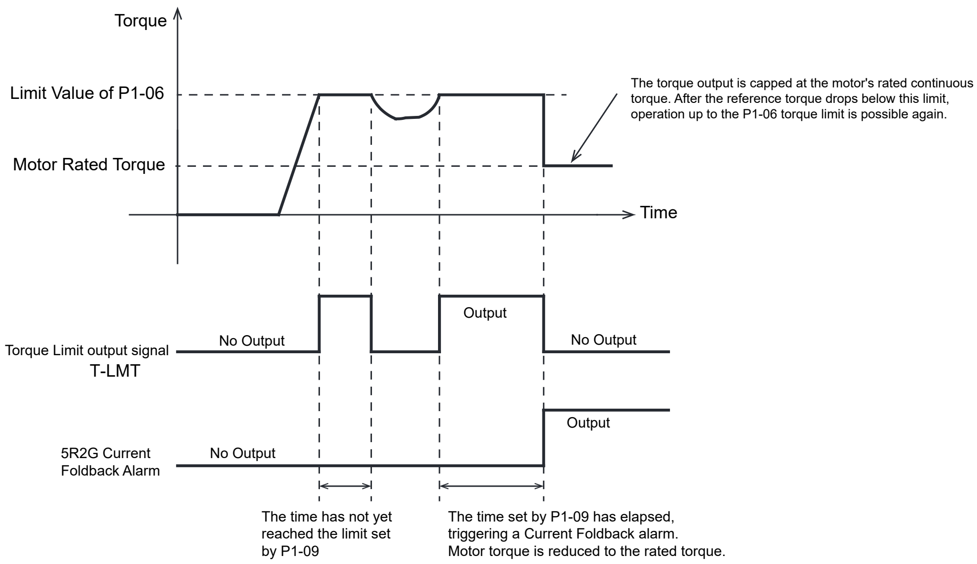
Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P1-08	HC	Hard Stop Home Torque Limit	200	0 ~ 3000	0.1%	P	V	T	

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

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P1-09	CL	Current Foldback Timer	0	0 ~ 30000	ms	P	V	T	

Servo motors have the ability to provide peak torque (overload torque), above the rated torque value. This parameter sets the duration of torque overload.

- When the Current Foldback time exceeds this set value, "5R2G" Current Foldback alarm will be generated
- If the set value is too high, the motor may overheat and sustain damage from prolonged overload
- During torque control, this function is invalid
- When the set value is "0", the "5R2G" Current Foldback alarm will not be generated, and the servo motor provides an overload output capability of 2 seconds.



Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P1-10	LD	Torque Limit Method	1	0 ~ 3, 5 ~ 6	ms	P	V	T	

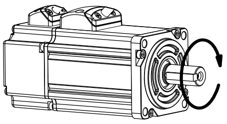
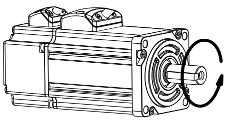
Parameter P1-10 defines 5 torque limit modes, each of which is as follows.

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

Refer to chapter 7.5 Torque limit

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P1-11	DR	Rotation Direction	0	0, 1	-	P	V	T	

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

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

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P1-12	IF	Immediate Format	H	D,H	-	P	V	T	

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

Set value	Mode
D	Decimal system
H	Hexadecimal system

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

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P1-13	PR	Protocol	5	1 ~ 511	-	P	V	T	

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

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P1-14	TD	Transmit Delay	2	0 ~ 20	ms	P	V	T	

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

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P1-15	BR	RS-485 Baud Rate	1	1 ~ 5	-	P	V	T	

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

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

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P1-16	DA	RS-485 Address	32	1 ~ 32	-	P	V	T	

In Modbus/RTU communication mode, set the node address of the motor

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P1-17	CO	CANopen Node ID	1	1 ~ 127	-	P	V	T	

In CANopen communication mode, set the motor node address

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P1-18	CB	CANopen Baud Rate	0	0 ~ 7	-	P	V	T	

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

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

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P1-24	MA	Alarm Mask	4294967295	0 ~ 4294967295	-	P	V	T	

When the motor generates some non-serious warning information, the corresponding bit of this parameter can shield the LED alarm display function of the corresponding warning information. When the shielded warning information is generated, it will no longer flash on the status light.

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P1-25	CX	2nd Torque Limit	3000	0 ~ 3000	0.1%	P	V	T	
Sets the second limit value of the motor output torque. Used according the parameter P1-10: Torque Limit Method. Refer to Chapter 7.5 Torque Limit									

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P1-26	CY	3rd Torque Limit	3000	0 ~ 3000	0.1%	P	V	T	
Set the third limit value of motor output torque. Refer to Chapter 7.5 Torque Limit									

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P1-27	CY	4th Torque Limit	3000	0 ~ 3000	0.1%	P	V	T	
Set the fourth limit value of motor output torque. Refer to Chapter 7.5 Torque Limit									

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P1-28	HT	Motor Stall Protection Time	0	0 ~ 30000	ms	P	V	T	
In position mode or position-based velocty mode, stalling causes the motor to always output the rated torque of the motor. Stalling for a long time can cause the motor to overheat. This parameter sets the protection time of the motor stall, when the actual output current of the motor is equal to the rated current of the motor, and the time exceeds the setting of this parameter. Motor stall protection alarm (7R3G) will be generated and the motor will be disabled.									

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P1-29	YV	Dynamic Brake Sequence when Servo Off	0	0 ~ 5	---	P	V	T	

When the servo is disabled (Servo Off) during motion, dynamic braking takes effect according to parameter P1-29, while the dynamic brake maximum deceleration action time is controlled by parameter P1-31. During the deceleration process, dynamic braking activates to reduce the motor's speed from its current level to within the zero speed width specified in parameter P5-42, or until the dynamic brake deceleration time reaches the limit set by P1-31.

Value	Description	
	Deceleration process	After stopping
0	Decelerate using parameter P2-01	Remain free-moving state
1	Decelerate using parameter P2-01	Dynamic braking action
2	Coast to Stop	Remain free-moving state
3	Coast to Stop	Dynamic braking action
4	Dynamic braking action	Remain free-moving state
5	Dynamic braking action	Dynamic braking action

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P1-30	YR	Dynamic Brake Sequence when Fault Occurs	0	0 ~ 3	---	P	V	T	

When the servo reports a fault, dynamic braking takes effect according to parameter P1-30, while the dynamic brake maximum deceleration action time is controlled by parameter P1-32. During the deceleration process, dynamic braking activates to reduce the motor's speed from its current level to within the zero-speed threshold specified in parameter P5-42, or until the dynamic brake deceleration time reaches the limit set by P1-32.

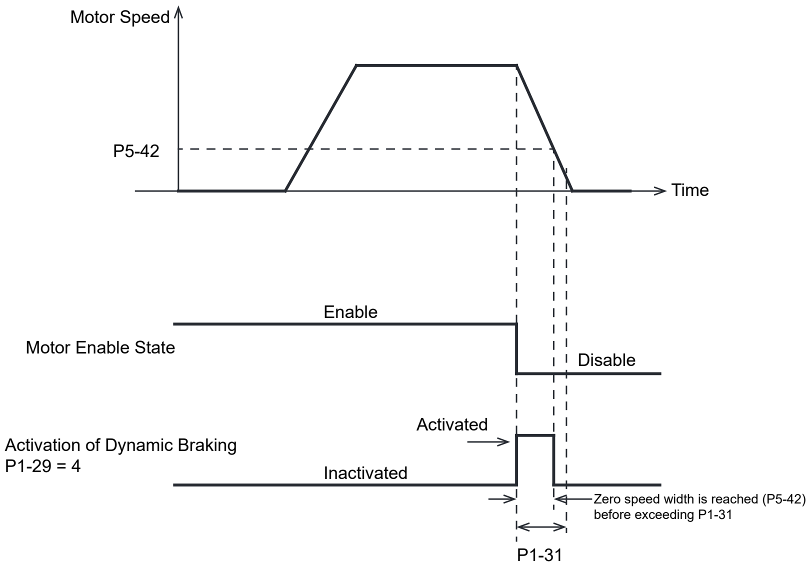
Value	Description	
	Deceleration process	After stopping
0	Coast to Stop	Remain free-moving state
1	Coast to Stop	Dynamic braking action
2	Dynamic braking action	Remain free-moving state
3	Dynamic braking action	Dynamic braking action

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P1-31	YM	Dynamic Brake Action Time when Servo Off	500	0 ~ 30000	ms	P	V	T	

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

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

The figure below is when P1-29 = 4.

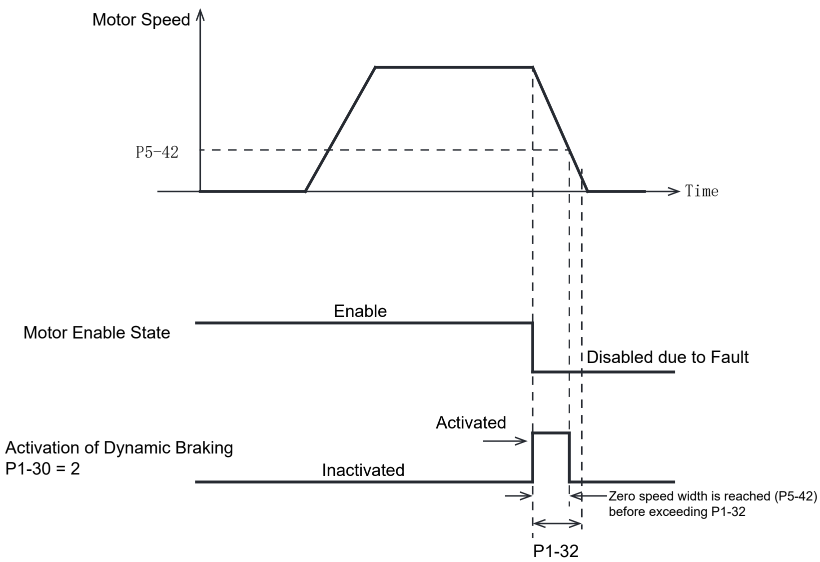


Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P1-32	YN	Dynamic Brake Action Time when Faults Occurs	0	0 ~ 30000	ms	P	V	T	

This parameter sets the longest action time of the dynamic brake during the deceleration process after the servo reports an error.
The deceleration process means that the actual speed of the motor decelerates from the effective speed to within the zero-speed threshold of parameter P5-42 when the dynamic brake is effective, or the deceleration time reaches the setting of P1-32.

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

The figure below is when P1-30 = 2.



Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P1-34	RT	Current Ramp Limit	1000	00 ~ 3000	0.1%	P	V	T	
Sets the allowable instantaneous change in current. If the motor current control loop suddendly demands a current value higher than the one set by this parameter, a Motor Collision Fault (7R4G) is triggered, disabling the motor.									

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P1-37	DV	Dynamic Brake Velocity	50	0 ~50	rps	P	V	T	
Sets the maximum speed at which the dynamic brake can activate. For dynamic braking to engage, the motor must first decelerate (typically controlled by AM or DE) to the speed specified by this parameter.									

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

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P1-40	ZA	Action After Watchdog is Triggered	1	1 ~ 16	——	P	V	T	
Sets or requests the action taken when communication loss has been detected.									

8.3.3 Group P2-XX: Trajectory & Motion Profile Parameters

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P2-00	VM	Maximum Velocity	80	0 ~ 100	rps	P	V	T	

Set the maximum running speed of the motor.
If the actual speed goes above the limit set in P2-00, a "Motor Speed Exceeds Limit" fault (5R3G sequence) will activate, and the motor will stop.

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P2-01	AM	Maximum Acceleration/Deceleration	3000	0.167 ~ 5000	rps/s	P	V	T	

Sets or requests the maximum allowable acceleration and deceleration. If the commanded acceleration or deceleration exceeds this maximum, the actual values will be limited accordingly. This parameter also defines the maximum braking deceleration after an emergency stop command or when a limit switch is triggered.

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P2-02	JS	Jog Velocity	10	-100 ~ 100	rps	P	V	T	

Sets or requests the speed for Jog moves in rev/sec.

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P2-03	JA	Jog Acceleration	100	0.167 ~ 5000	rps/s	P	V	T	

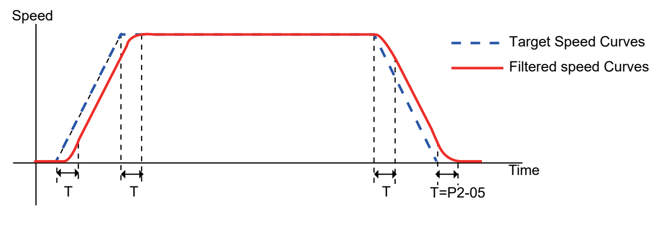
Sets or requests the accel rate for Jog moves in rev/sec/sec. Sending JA with no parameter causes motor to respond with present jog accel rate. The Jog Acceleration Parameter value cannot be changed while jogging.

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P2-04	JL	Jog Deceleration	100	0.167 ~ 5000	rps/s	P	V	T	

Sets or requests the deceleration rate for Jog moves and velocity (oscillator) modes in rev/sec/sec. The JL value cannot be changed while jogging.

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P2-05	JT	Jerk Time	10	0 ~ 250	ms	P	V	T	

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



◆ The Jerk Time causes a delay to the motion command equal to the set parameter. This will not affect final positioning accuracy.

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

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P2-06	VE	Target Velocity (Point-to-Point)	10	0.0042 ~ 100	rps	P	V	T	

The target speed command in point-to-point command position mode.

Parameter	Instruction	Name	Defaults	Range	Unit	Contol Modes			
P2-07	AC	Target Acceleration (Point-to-Point)	100	0.167 ~ 5000	rps/s	P	V	T	

Acceleration rate used in point-to-point move commands in rev/sec/sec.

Parameter	Instruction	Name	Defaults	Range	Unit	Contol mode			
P2-08	DE	Target Deceleration (Point-to-Point)	100	0.167 ~ 5000	rps/s	P	V	T	

Deceleration rate used in point-to-point move commands in rev/sec/sec.

Parameter	Instruction	Name	Defaults	Range	Unit	Contol mode			
P2-09	VC	Velocity Change (Point-to-Point)	2	0 ~ 100	rps	P	V	T	
The internal position mode provides point-to-point positioning control with variable speed. This parameter sets the speed for the second stage of motion.									

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 7.9 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	Instruction	Name	Defaults	Range	Unit	Control Modes			
P2-18	HA1	1st Homing Acceleration/ Deceleration	100	0.167 ~ 5000	rps/s	P	V	T	
Sets or requests the acceleration/deceleration rate used in the homing function.									

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P2-24	HV1	Homing Velocity 1	10	0.0042 ~ 100	rps	P	V	T	

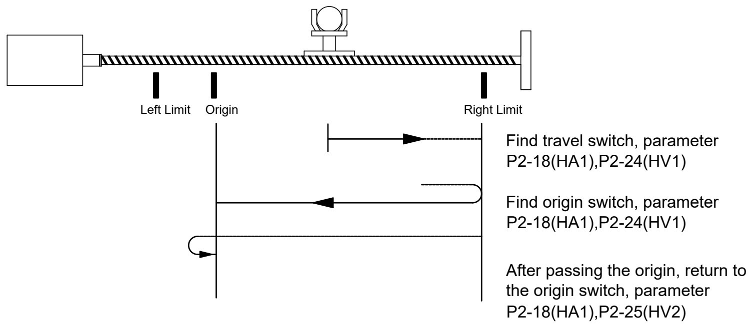
Sets the velocity used in the first state of a homing operation.

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P2-25	HV2	Homing Velocity 2	1	0.0042 ~ 100	rps	P	V	T	

Sets the velocity used in the second stage of a homing operation.

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P2-27	HO	Homing Offset	0	-2147483647 ~ +2147483647	pulses	P	V	T	

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

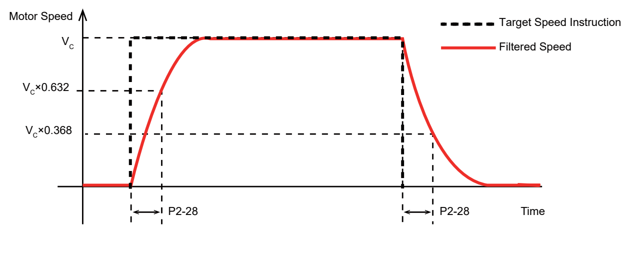


P2-18, P2-24, P2-25, P2-27 parameters are the configuration parameters of the built-in homing function of the motor. For detailed functions of homing, refer to section 7.8 Home Function.

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P2-28	KJ	Jerk Filter	0	0 ~ 1000	ms	P	V	T	

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

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



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

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

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P2-30	VT	Velocity Limit in Torque Mode	80	0 ~ 100	rps	P	V	T	

In torque control mode, this parameter can be used as the direct speed limit. No input is required to enable this speed limit. It will be enabled as soon as torque control mode is enabled. Set VT<VM to avoid velocity limit faults.

8.3.4 Group P3-XX: Encoder & Pulse/Dir Parameters

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P3-00	EN	Electronic Gear Ratio - Numerator	32000	1 ~ 2147483647	-	P	V	T	

This parameter defines the numerator of Electronic Gear Ratio.
The electronic gear ratio is used to define the relationship between pulse input commands (STP/DIR and CW/CCW control modes) and angular displacement of the motor shaft.

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P3-01	EU	Electronic Gear Ratio - Denominator	32000	1 ~ 2147483647	-	P	V	T	

This parameter defines the denominator of Electronic Gear Ratio.
The electronic gear ratio is used to define the relationship between pulse input commands (STEP/DIR and CW/CCW control modes) and angular displacement of the motor shaft.

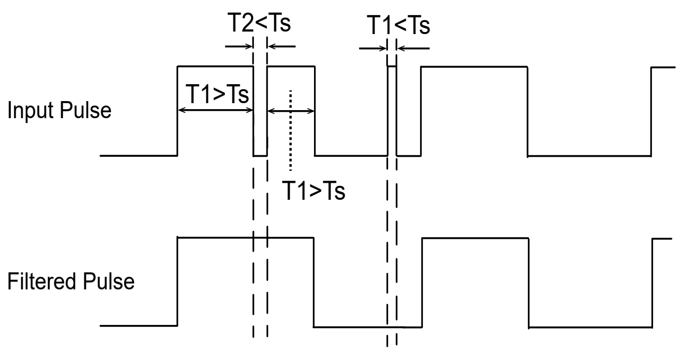
$$\begin{array}{c}\text{External Position Pulse Command}\\ \text{(External Pulse Quantity)}\end{array} \times \frac{\text{P3-00 (Electronic Gear Ratio-Numerator)}}{\text{P3-01 (Electronic Gear Ratio-Denominator)}} = \text{Position Command to Motor}$$

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P3-02	SZ	Pulse Input Noise Filter	5	0 ~ 32000	0.1μs	P	V	T	

The Parameter P3-02 Pulse Input Noise Filter is designed to filter input pulse signals, mitigating interference that could lead to inaccurate positioning and other issues. The filter specifies the length of time the HIGH and LOW levels of an input pulse to be considered HIGH and LOW. See below illustration.

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.



- ◆ If T1 or T2 are longer than Ts. then the input pulse is considered valid.
- ◆ If T1 or T2 is shorter then Ts, then the input pulse is filtered out.

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

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

Parameter	Command	Description	Default	Range	Unit	Contol mode			
P3-03	PT	Pulse Input Setting	9	0 ~ 31		P	V	T	

Code	Command	Name	Default	Range	Unit	Support Mode			
P3-04	PF	Position Fault Limit	100000	0 ~ 2147483647	pulses	P	V	T	

When the difference between target position and actual position (encoder based) is greater than this value, a position error fault will occur at the drive.

Code	Command	Name	Default	Range	Unit	Control Modes			
P3-05	EG	Electronic Gearing	10000	200 ~ 131072	pulses/ rev	P	V	T	

This parameter directly sets the number of counts per motor revolution. It is an alternative to the ratio constituted by parameters P3-00 and P3-01.

The setting of P3-16 will switch between P3-05 and the combination of P3-0/P3-02.

Code	Command	Name	Default	Range	Unit	Control Modes			
P3-12	PO	Encoder Pulse Output Mode	1	0 ~ 256	-	P	V	T	

P3-12 sets the source of output pulses from the drive, the relationship between A/B phases of the output as well as the polarity of the Z index. The definition of each bit of P3-12 is below:

<table>
<tr><th colspan="8">P3-12 Setting</th></tr>
<tr><th>bit7</th><th>bit6</th><th>bit5</th><th>bit4</th><th>bit3</th><th>bit2</th><th>bit1</th><th>bit0</th></tr>
<tr><td rowspan="3">0</td><td rowspan="3">0</td><td rowspan="3">0</td><td rowspan="3">0</td><td>Z pulse output polarity</td><td>A/B Phase Sequence in CW direction</td><td colspan="2">Motor Encoder as Output Pulse Source</td></tr>
<tr><td>0: Rising Edge</td><td>0: A leads B by 90°</td><td rowspan="2">0</td><td rowspan="2">1</td></tr>
<tr><td>1: Falling Edge</td><td>1: B leads A by 90°</td></tr>
</table>

Note: When using an external pulse command as the signal source, parameters P3-13 and P3-14 will be ignored. The command pulse is output directly without any processing. Additionally, the settings for bit 2 and bit 3 of parameter P3-12 will also be disregarded

For more information, refer to Section 7.6

Code	Command	Name	Default	Range	Unit	Control Modes			
P3-13	ON	Encoder Pulse Output Ratio - Numerator	10000	0 ~ 13107200	-	P	S	T	

Sets the numerator for the ratio defining the relationship between encoder output pulses per motor revolution.

Code	Command	Name	Default	Range	Unit	Control Modes			
P3-14	OD	Encoder Pulse Output Ratio - Denominator	131072	0 ~ 13107200	-	P	V	T	

Sets the denominator for the ratio defining the relationship between encoder output pulses per motor revolution.

$$\text{Number of output pulses per revolution} = \frac{\text{P3-13 Encoder Pulse Output Ratio - Numerator}}{\text{P3-14 Encoder Pulse Output Ratio - Denominator}} \times 65535$$

Note:

- The numerator of P3-13 must be smaller than the denominator, P3-14
- if P3-13 > P3-14, then the output pulses from the drive per revolution of the motor will be equivalent to P3-13.

For more information, refer to Section 7.6 Encoder Feedback Output Function

Code	Command	Name	Default	Range	Unit	Control Modes			
P3-15	ES	Absolute Encoder Usage	1	0 ~ 4	-	P	V	T	

Sets how the motor's absolute encoder will be used. This command is only relevant to motors with Absolute Encoder. Refer to Motor Part Numbering System for more information.

Value	Effect	Description
0	Incremental Encoder	Use encoder as incremental encoder and clear position on power up
1	Incremental Encoder w/ Position Storage	Use encoder as incremental encoder and retain position on power up
2	Multi-Turn Encoder w/ Overflow	Use as Multi-Turn absolute Encoder with overflow
3	Multi-Turn w/out overflow	Use as Multi-Turn absolute encoder with overflow alarm
4	Multi-Turn w. configurable overflow	Use as Multi-Turn absolute encoder with configurable overflow threshold

Parameter	Command	Description	Default	Range	Unit	Control Modes			
P3-16	PU	Electronic Gearing Mode	1	0 ~ 1	-	P	V	T	

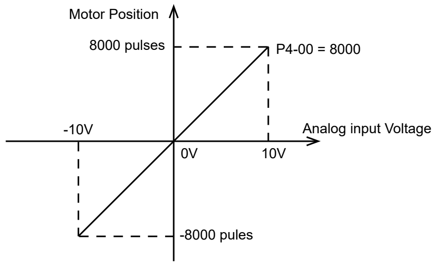
MDX+ series have two electronic gearing systems, parameter P3-16 is used to switch between them.

Parameter P3-16	Effect	Instructions
0	Electronic gearing set by P3-05	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 gearing set by ratio of P3-00 and P3-01	◆ Electronic gearing is set by ratio of P3-00 and P3-01. P3-05 is no longer referenced for this setting.

8.3.5 Group P4-XX: Analog Input Parameters

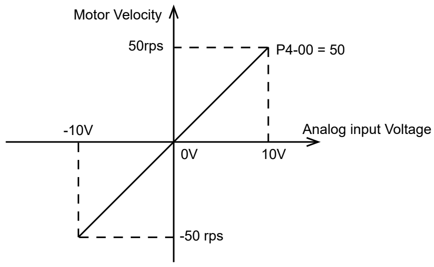
Parameter	Command	Description	Default	Range	Unit	Control Modes
P4-00	AP	Analog Input Position Gain	8000	-2147483647 ~ +2147483647	pulses/10V	P V T

The analog Input gain that relates to motor position when the drive is in analog position command mode. Gain value sets the commanded position when the analog input is at the configured full scale value of 10V.



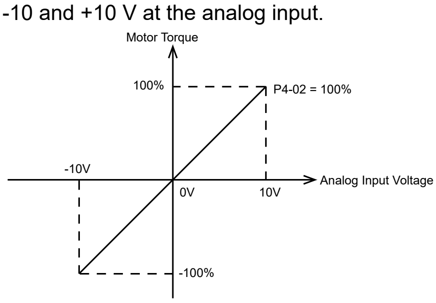
Parameter	Command	Description	Default	Range	Unit	Control Modes
P4-01	AG	Analog Input Velocity Gain	50	0 ~ 100	rps/10V	P V T

Sets the motor velocity when 10 V is applied to the Analog Input. This is in essence a maximum velocity setting for Analog Velocity control.



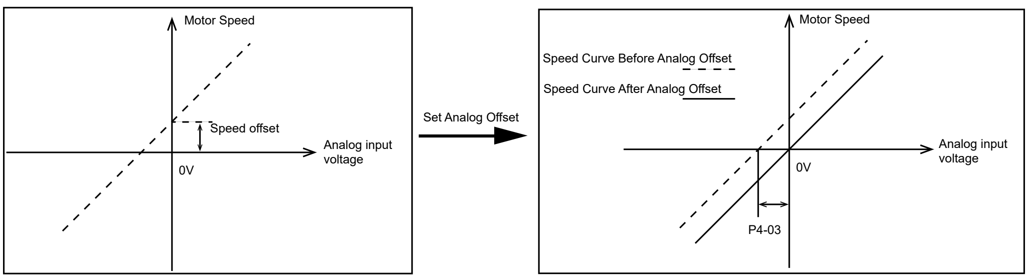
Parameter	Command	Description	Default	Range	Unit	Control Modes
P4-02	AN	Analog Input Torque Gain	1000	0 ~ 3000	0.1%/10V	P V T

Sets the torque limit when 10 V is applied to the analog input. This is in essence a maximum torque limit when operating in analog torque control. This limit is relevant to both -10 and +10 V at the analog input.



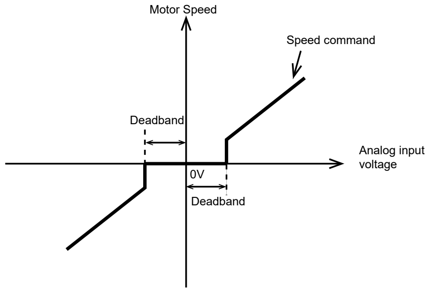
Parameter	Command	Description	Default	Range	Unit	Control Modes
P4-03	AV1	Analog Input 1 Offset	0	-10000 ~ 10000	mV	P V T

When operating in an analog control mode, analog input signals can suffer from deviations at the input of the drive and after processing. These deviations or "offset" is caused by tolerances in electronics and design factors. To make up for the bias in analog signal voltage, users can apply an offset to zero out these deviations at the input of the drive. See below diagram for a visual representation.



Parameter	Command	Description	Default	Range	Unit	Contol modes
P4-05	AD1	Analog Input 1 Dead-band	0	0 ~ 255	mV	P V T

The analog input deadband value of the analog input 1.
The deadband value is the zone around the "zero" value of the analog input. This deadband defines the area of the analog input range that the motor 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 modes
P4-07	AF1	Analog Input 1 Filter	1000	0 ~ 20000	0.1Hz	P V T

This parameter sets the low-pass filter for analog input 1.

Parameter	Command	Description	Default	Range	Unit	Contol modes
P4-09	AT1	Analog Input 1 Threshold	5000	-10000 ~ 10000	mV	P V T

The Analog Input Threshold that is used by the “Feed to Sensor” command. The threshold value sets the Analog voltage that determines a sensor state or a trigger value.

Parameter	Command	Description	Default	Range	Unit	Contol modes
P4-11	FA1	Velocity Limit Setting in Torque Control	1	0 ~ 1	---	P V T

In Torque Control, the motor will immediately accelerate to the maximum velocity limit stored on the drive. It is therefore necessary to set a speed limit. This parameter, P4-11, sets what the source of that velocity limit is. If the value is set to 0, P2-30 sets the Speed Limit in Torque Control. See below chart for the effects of this parameter.

Setup Value	Description
0	Speed Limit Set via Software/Command
1	Speed Limit Set by Analog Input 1

8.3.6 Group P5-XX: Digital IO Signals Parameters

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P5-00	MU1	Digital Input 1 Function	7	0 ~ 48	-	P	V	T	

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P5-01	MU2	Digital Input 2 Function	5	0 ~ 48	-	P	V	T	

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P5-02	MU3	Digital Input 3 Function	39	0 ~ 48	-	P	V	T	

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P5-03	MU4	Digital Input 4 Function	13	0 ~ 48	-	P	V	T	

Parameters P5-00~P5-03 sequentially set the function of digital input X1~X4. The following functions and logic states can be assigned to the inputs.

Signal name	Shorthand notation	Set value and effective logic	
		Valid when closed	Valid when Open
General Purpose Input	GP	0	-
Servo Enable	S-ON	1	2
Alarm Clear	A-CLR	3	4
Forward Rotation Limit	CW-LMT	5	6
Reverse Rotation Limit	CCW-LMT	7	8
Control Mode Switch	CM-SEL	9	10
Gain Switching	GAIN-SEL	11	12
Emergency Stop	E-STOP	13	14
Homing Start	S-HOM	15	16
Position Error Clear		17	18
Torque Limit Input	TQ-LMT	19	20
Zero Speed Clamp Input	ZCLAMP	21	22
Pulse Inhibit		25	26
Internal Speed Input 1	SPD1	27	28
Internal Speed Input 2	SPD2	29	30
Internal Speed Input 3	SPD3	31	32
Velocity/Torque Control Start		33	34
Velocity/Torque Control Direction	SPD-DIR	35	36
Velocity Limit Select	V-LMT-SEL	37	38
Home Switch	HOM-SW	39	40
Execute The Q Program	START-Q	45	46
Brake Override Input		47	48

Parameter	Command	Description	Default	Range	Unit	Contol modes			
P5-04	MU5	Digital Input 5 Function	0	0 ~ 46	-	P	V	T	

Parameter	Command	Description	Default	Range	Unit	Contol modes			
P5-05	MU6	Digital Input 6 Function	0	0 ~ 46	-	P	V	T	

Parameter	Instruction	Name	Defaults	Range	Unit	Contol modes			
P5-12	MO1	Digital Output 1 Function	2	0 ~ 34	-	P	V	T	

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P5-13	MO2	Digital Output 2 Function	9	0 ~ 34	-	P	V	T	

Parameters P5-12 ~P5-14 define the functions for digital output ports Y1 ~ Y3, respectively. The digital outputs can be assigned a variety of functions and logic states, as outlined below.

Signal name	Shorthand notation	Logic and set value when output signal is valid	
		Output when the signal is valid Closed	Output when the signal is valid Open
General Purpose	GPOUT	0	-
Fault Output	FAULT	1	2
Warning Output (Alarm)	WARN	3	4
Brake Release Output	BRK	5	Not Supported
Servo-On Status Output	SON-ST	7	8
In-Position Output	IN-POS	9	10
Dynamic Position Error 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 Reaches Output	AT-SPD	19	20
Velocity Limit Output	V-LMT	21	22
Servo Ready Output	S-RDY	23	24
Homing Finished Output	HOMED	25	26
CW Software Limit Triggered	SLCW	27	28
CCW Software Limit Triggered	SLCCW	29	30
Near Target Position 1	P-COIN	31	32
Zero Speed Detected	Z-SPD	33	34
Torque Coincidence Output	T-COIN	35	36
Near Target Position 2		37	38
Near Target Position 3		39	40

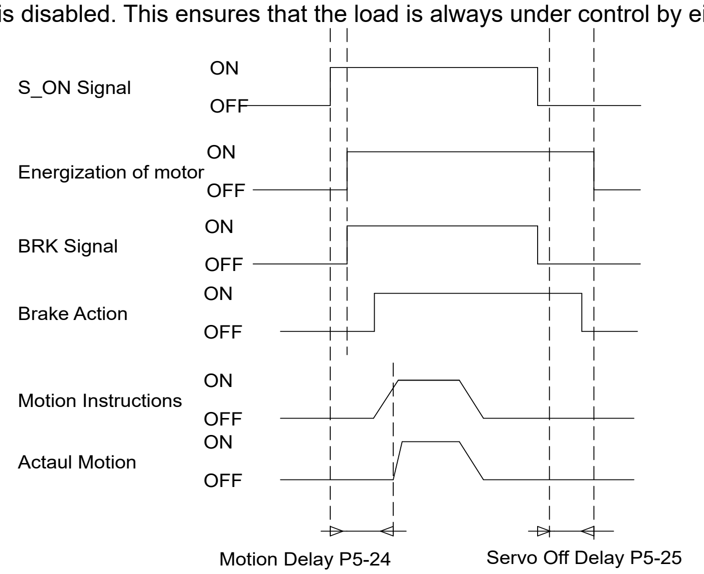
Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P5-14	MO3	Digital Output 3 Function	7	0 ,5	-	P	V	T	

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P5-24	BD	Motion Delay after Brake Release	200	0 ~ 32000	ms	P	V	T	

Sets the delay time after brake release before any motion is executed. This is to ensure that the brake is fully removed before moving to avoid damaging it or the motor. See timing chart in description of P5-25 for visualization.

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P5-25	BE	Servo Off Delay after Brake Applied	200	0 ~ 32000	ms	P	V	T	

Sets the time delay between brake engagement and motor disable. Brake engagement should occur before the motor is disabled. This ensures that the load is always under control by either the motor or the brake.



Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P5-27	HX	Home Sensor	4	1 ~ 4	-	P	V	T	

This parameter is simply to monitor which input pin has been assigned the "Home Sensor" function. To assign the "Homing Sensor" function to an input, this must be configured separately via the P5-00 ~ P5-03 parameters.

Display value	Digital input pin
1	X1
2	X2
...	Sequential order

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P5-28	FI1	Digital Input 1 Filter	2	0 ~ 8000	ms	P	V	T	

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P5-29	FI2	Digital Input 2 Filter	2	0 ~ 8000	ms	P	V	T	

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P5-30	FI3	Digital Input 3 Filter	2	0 ~ 8000	ms	P	V	T	

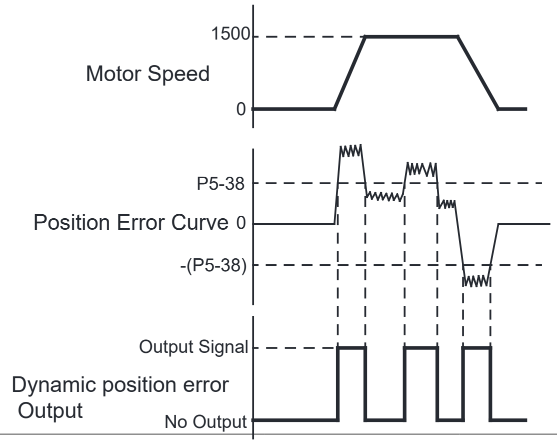
Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P5-31	FI4	Digital Input 4 Filter	2	0 ~ 8000	ms	P	V	T	

Parameter	Command	Description	Default	Range	Unit	Control Modes			
P5-32	FI5	Digital Input 5 Filter	2	0 ~ 8000	ms	P	V	T	

Parameter	Command	Description	Default	Range	Unit	Contol Modes			
P5-33	FI6	Digital Input 6 Filter	2	0 ~ 8000	ms	P	V	T	

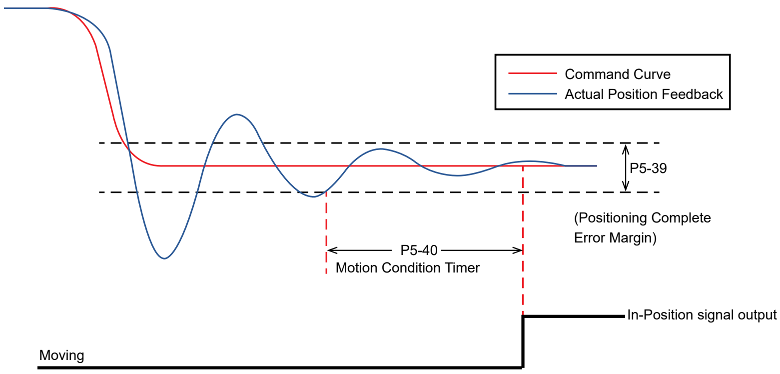
Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P5-38	PL	Position Error Signal Threshold	10	0 ~ 2147483647	pulses	P	V	T	

In Position control mode, when an output is configured as DYM-LMT, parameter P5-38 defines the condition under which the signal becomes active. This parameter not be confused with Position Fault Limit.



Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P5-39	PD	Positioning Complete Error Margin	40	0 ~32000	pulses	P	V	T	

Sets the permissible position error margin within which positioning can be considered completed.



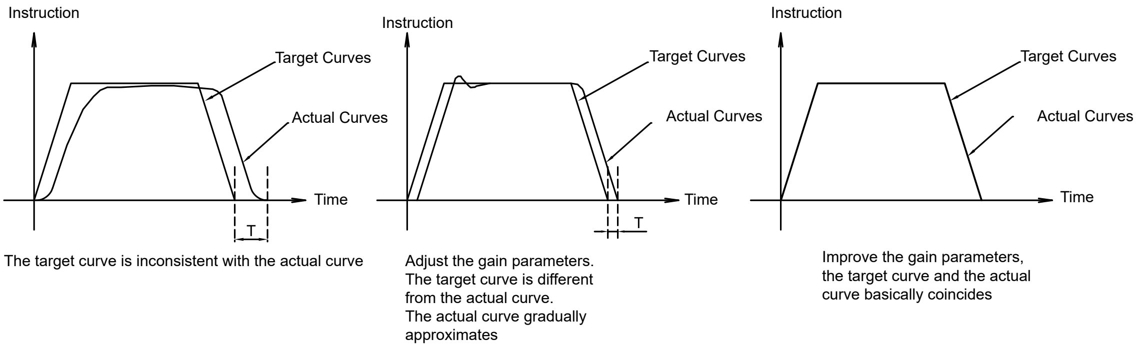
Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P5-40	PE	Motion Condition Timer	10	0 ~ 30000	ms	P	V	T	

Sets the timer for various motion conditions. Depending on the control mode used, this timer will be relevant to different motion characteristics. See the following sections for detailed information.
7.2.3 In-Position Signal Output
7.3.5 Velocity Reached Output
7.3.6 Velocity Coincidence Output

9 Servo Gain Setting

Servo gain tuning is a function to optimize the response of the servo motor.

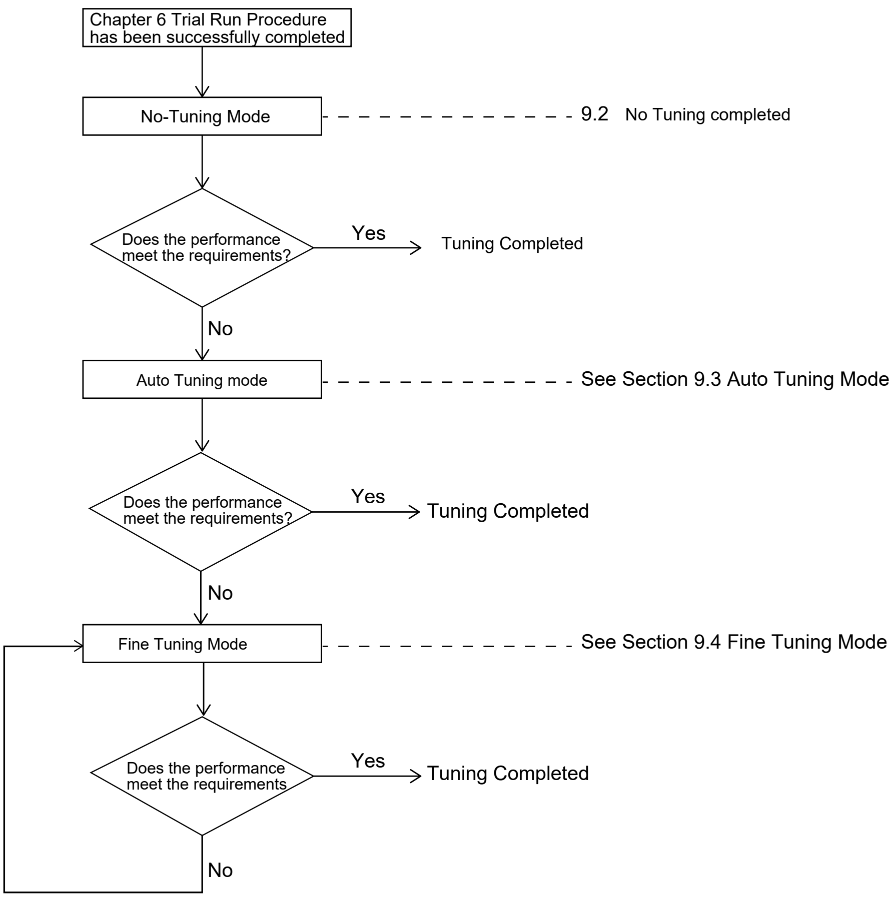
In order to closely match the commanded motion, it might be necessary for users to adjust tuning parameters. The requirement to tune is based on operation performance requirements and load characteristics and should not be considered a blanket requirement for all applications. The factory default tuning parameters can meet a wide range of applications, especially when there exists a mechanical reduction in the system.



9.1 Servo Tuning Introduction

9.1.1 Servo Tuning Flow Chart

The servo tuning flow chart is as follows. Before starting the servo tuning, make sure that the servo system can run normally according to the test run in Chapter 6.



9.1.2 Introduction to Parameter Tuning Mode

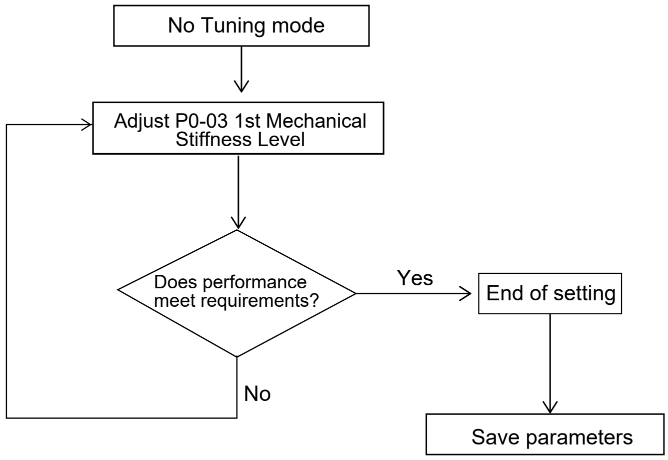
There are three Tuning Modes. The desired tuning mode is selected by parameter P0-00. See below for details.

Parameter P0-00 set value	Parameter tuning mode	Accessible Tuning Parameters	Introduce
0	No Tuning	P0-03 1st mechanical stiffness level P0-04 2nd mechanical stiffness level	When No Tuning is selected, the available parameters for performance modification are limited. Users will only have access to the mechanical stiffness parameters.
1	Auto-Tuning	P0-03 1st mechanical stiffness level P0-04 2nd mechanical stiffness level P0-02 Load inertia ratio	In "Auto-Tuning mode", the servo system will automatically identify the external load inertia ratio, automatically select the appropriate stiffness level, and automatically adjust the following ◆ (Manual modification is invalid): ◆ Gain (position loop, velocity loop) ◆ Filter (torque filter) ◆ Vibration suppression and other parameters
2	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 Fine Tuning mode, the user will have access to all servo tuning parameters and can modify them to meet their application needs.

9.2 No-Tuning Mode

"No Tuning" mode is the default setting for the servo upon leaving the factory. In this mode, the servo system is relatively stable with low mechanical stiffness, allowing it to be powered on and operated immediately after installation, which satisfies most application requirements.

Users can select an initial mechanical stiffness level to ensure normal servo movement and gradually adjust it to meet specific application requirements.



Note in this mode:

- **The inertia ratio P0-02 is forced to the default value of 0 and cannot be modified.**
- **Modification of other gain parameters is not available.**
- **When using Gain Select function, ensure to adjust P0-04, the 2nd Mechanical Stiffness Level using this process.**

9.3 Auto Tuning Mode

In "Auto-Tuning Mode," the servo system will automatically identify the external load inertia ratio, automatically select the appropriate mechanical Stiffness level, and automatically optimize and adjust the following contents:

- Gain (position loop, velocity loop)
- Filter (torque filter)

The parameters in the table below are automatically adjusted and stored.

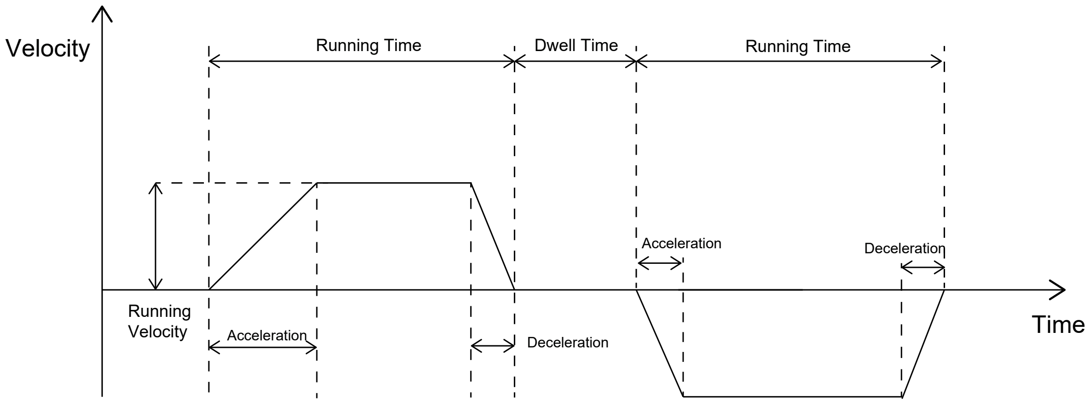
Parameter	Name	Is manual modification allowed in auto-tuning mode
P0-02	Load Inertia Ratio	Yes
P0-03	1st Mechanical Stiffness Level	Yes
P0-05	1st Position Loop Gain	No
P0-07	1st Position Loop Derivative Time Constant	No
P0-08	1st Position Loop Derivative Filter	No
P0-09	Velocity Feedforward Gain	No
P0-10	Velocity Feedforward Filter Frequency	No
P0-11	1st Velocity Command Gain	No
P0-12	1st Velocity Loop Gain	No
P0-13	1st Speed Loop Integral Time Constant	No
P0-14	Acceleration Feed Forward Gain	No
P0-15	Acceleration Feedforward Filter Frequency	No
P0-16	1st Command Torque Filter Frequency	No

9.3.1 Auto-Tuning Motion Profile Conditions

To accurately complete the Auto-Tuning of parameters, it is essential to set a reasonable motion trajectory. This includes defining the distance, running velocity, running time, acceleration, deceleration, and dwell time between movements.

Recommended Motion Profile Values:

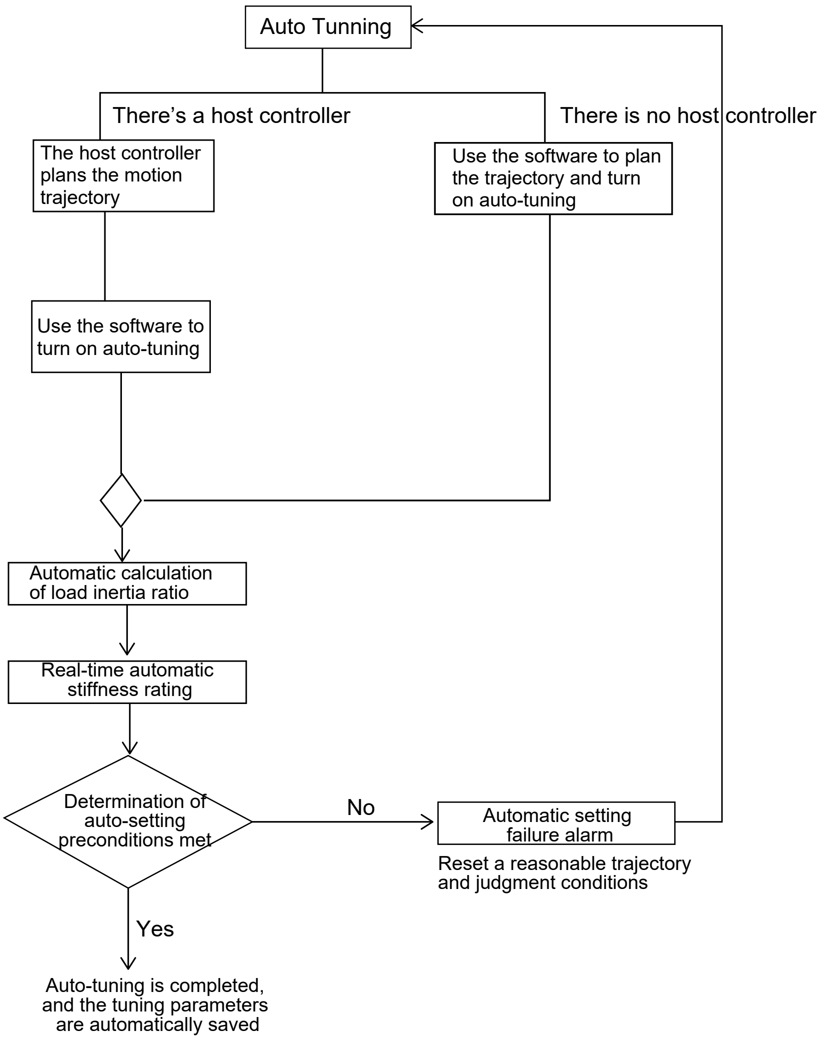
Running time: greater than 0.5 seconds
Running velocity: greater than 180rpm
Acceleration and deceleration: greater than 30rps/s
Dwell time: greater than 1.5 seconds



Before starting Auto-Tuning, it is recommended that the Mechanical Stiffness Level, P0-03 is set to 5

9.3.2 Auto-Tuning Flowchart

Users can perform automatic parameter tuning through Luna software or the operation panel on the driver. The flow chart of automatic tuning is as follows

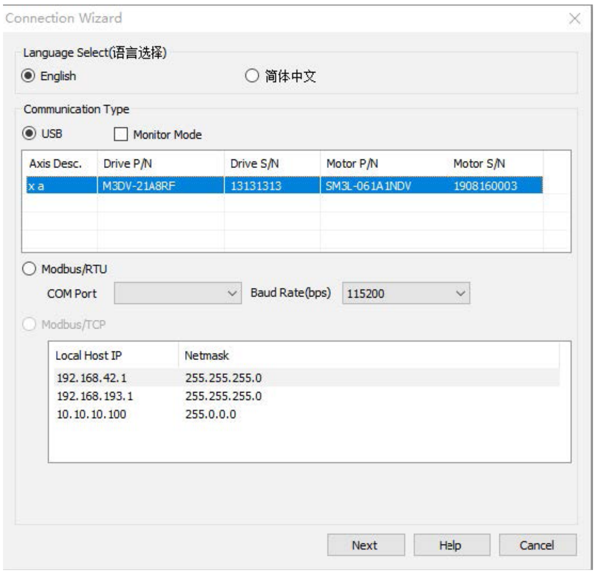


After completing the auto tuning, you can continue to use parameters P0-03 and P0-04 to adjust the stiffness levels of the servo system.

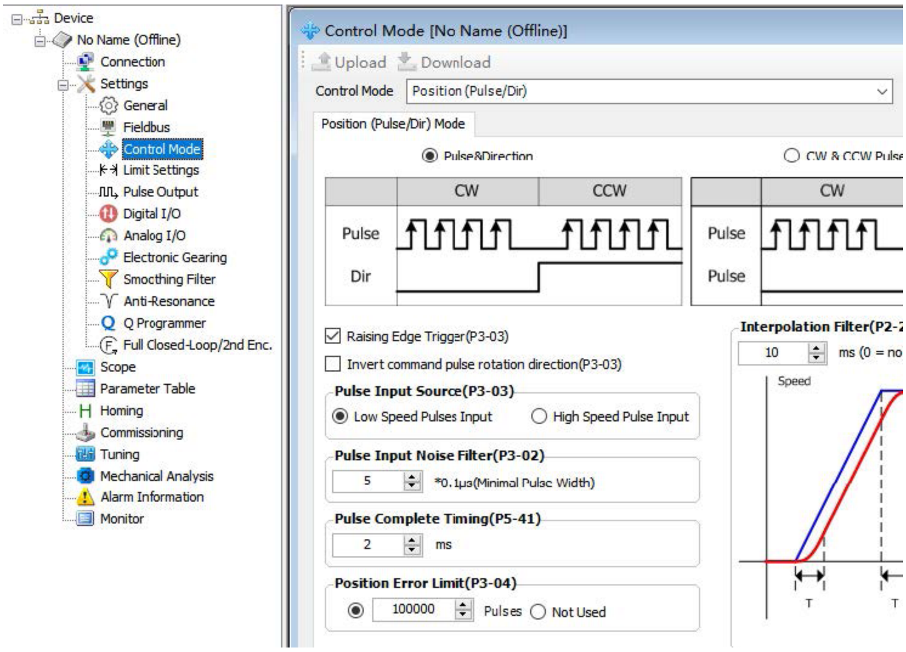
9.3.3 Start Auto-Tuning -- Software Operation On

It is recommended that Luna software be used for auto tuning mode. The steps are as follows.

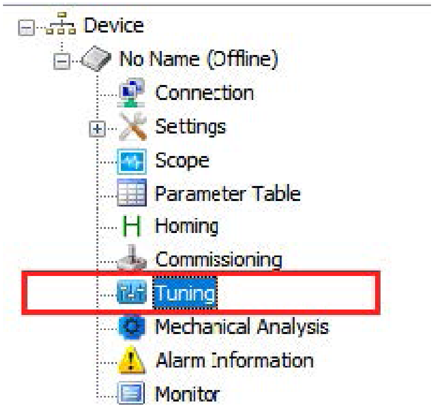
Step 1: Use the connection wizard ---- select the drive to be connected ---- click "Next" to establish communication with the drive



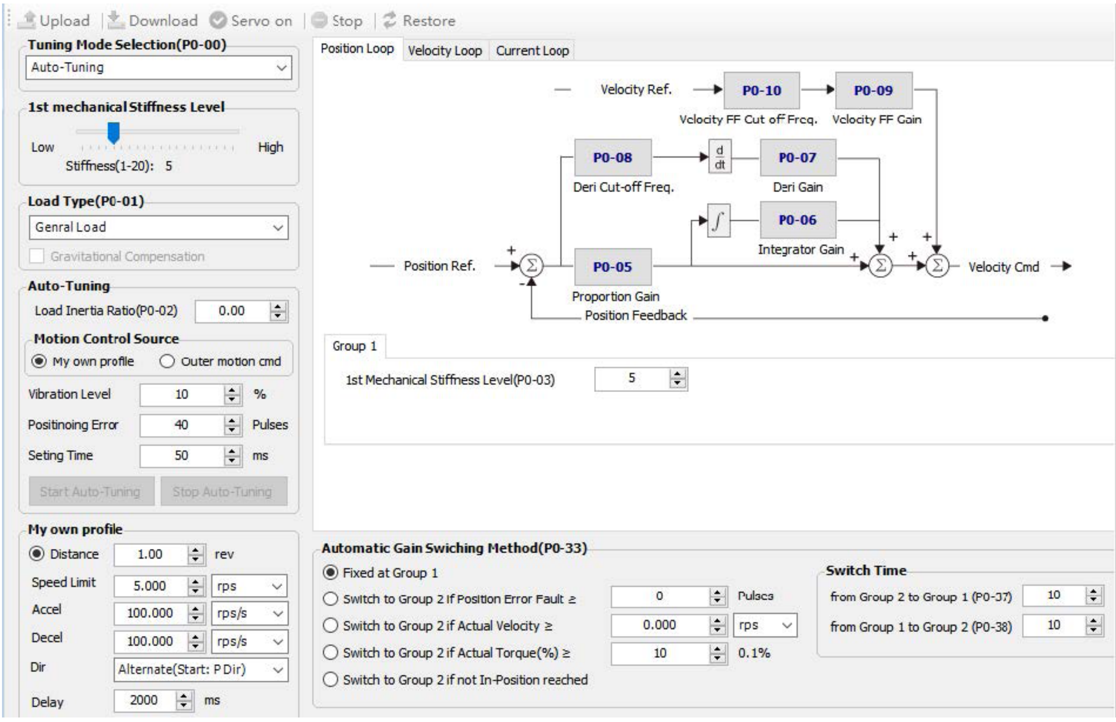
Step 2: Set the control mode to position control



Step 3: Select the "Tuning" function in the device tree interface



Step 4: In the interface window, set the parameter tuning mode to "Auto tuning"



- First mechanical Stiffness grade:

  Set the appropriate first mechanical Stiffness level (P0-03), the general recommended value is “5” when running for the first time

- Load type

  According to the current load, select the corresponding load type

Load type	Description
Normal load	Suitable for most loads except belt loads
Rigid load	Horizontal turntable, ball screw, etc. with good mechanical mechanical Stiffness
Flexible load	Suitable for loads with poor mechanical Stiffness such as belts and chains

Load Inertia Ratio

If the current load inertia ratio is known it can be entered into "Load Inertia Ratio (P0-02)" to improve system rigidity and expedite the autmatic tuning process. If the current load inertial ratio is unknown, it does not need to be entered as the system will automatically identify it.

Motion Control Source

- **Custom Trajectory Planning:** use software's "Custom Trajectory Planning" to generate motion profiles.
- **External Motion Commands:** choose this option when motion profiles are sent from an external controller. Limiting Conditions for Automatic Tuning.
- **Vibration Level:** set the maximum vibration value that the servo system must meet after automatic tuning a higher set value results in higher system rigidity
- **Positioning Error Range:** set the maximum position tracking error that the servo system must meet after auto-tuning, a smaller value results in higher system rigidity
- **Positioning Completion Time:** set the longest tuning time for postioning that the servo system must meet after automatic tuning a smaller set value results in higher system rigidity

Typically, these parameters do not need to be adjusted, and the default values provided by the software are sufficient. Modifying these parameters can optimize the results of auto-tuning, but large values can lead to poorer tuning results, system oscillations, and instability.

Step 5: Start the Auto Tuning

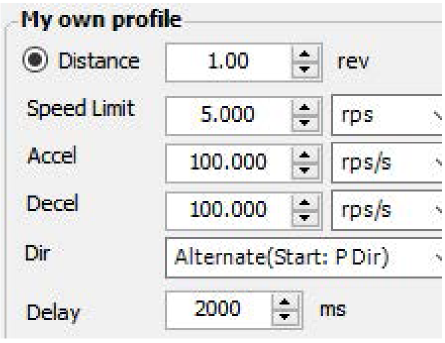
After the above configurations are set, set the motion profile that meets the following conditions, and then click the "Start Auto Tuning" button to start the tuning process. The source of motion command can be choosen by "My own profile" or "Outer motion profile".

- **Use external motion command**

  Click the "Start Auto-Tuning" button, and use the host controller to send motion commands directly.

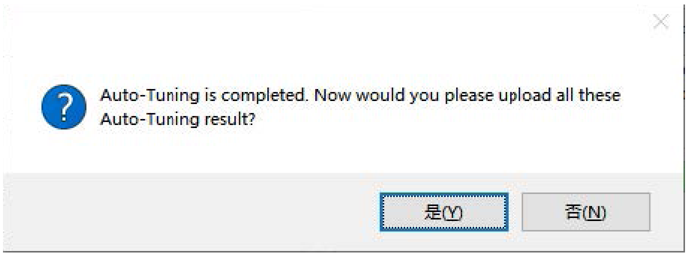
- **Custom trajectory planning**

  Users can also use custom trajectory planning. Set a reasonable motion trajectory according to section 9.3.1, Auto-Tuning Motion Profile Conditions, and click the "Start Auto-Tuning" button.



- **Complete automatic tuning**

After completion, the following dialog box will prompt. After confirming the upload, you can see that the first mechanical Stiffness level and the load inertia ratio have been updated.



- **Error prompt**

If the Auto Tuning process cannot be completed, 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"

9.4 Fine Tuning Mode

Fine tuning mode is suitable for the following situations:

- When auto tuning fails to complete due to performance demands
- When auto tuning and adjustments of stiffness levels fails to meet performance requirements. The user may switch to Fine Tuning afterwards to parameterize the results of auto tuning in more granular way.
- When the user understands the requirements of each gain and filter ahead of time.
- Fine tune the servo system gain to meet the needs of higher servo system mechanical Stiffness, faster response time and minimum tuning time.

9.4.1 Introduction to Fine Tuning Mode

The PID loop of the servo system can be configured via multiple parameters such as position loop gain, position loop, velocity feed forward gain, velocity loop gain and a collection of filters and other gains.

- After the tuning mode is switched from "Auto Tuning" to "Fine Tuning," it will inherit the parameter values after the automatic tuning is completed, and it needs to be saved manually after the tuning is completed.
- If directly switching from "No Tuning Mode" to "Fine Tuning," the servo system will inherit the factory default tuning parameters. This might require that users manually tune the servo system.

9.4.2 Parameters in Fine Tuning Mode

Parameter	Command	Function	Type
P0-01	LY	Load Type	
P0-02	NR	Load Inertia Ratio	
P0-03	KG	1st Mechanical Stiffness Level	First set of gains
P0-04	KX	2nd Mechanical Stiffness Level	
P0-05	KP	1st Position Loop Gain	
P0-07	KD	1st Position Loop Derivative Time Constant	
P0-08	KE	1st Position Loop Derivative Filter	
P0-09	KL	Velocity Feedforward Gain	
P0-10	KR	Velocity Feedforward Filter Frequency	
P0-11	KF	1st Velocity Command Gain	First set of gains
P0-12	VP	1st Velocity Loop Gain	
P0-13	VI	1st Speed Loop Integral Time Constant	
P0-14	KK	Acceleration Feed Forward Gain	
P0-15	KT	Acceleration Feedforward Filter Frequency	
P0-16	KC	1st Command Torque Filter Frequency	First set of gains
P0-17	UP	2nd Position Loop Gain	2nd set of gains activated via Gain Select method
P0-19	UD	2nd Position Loop Derivative Time Constant	
P0-20	UE	2nd Position Loop Derivative Filter Frequency	
P0-21	UF	2nd Velocity Command Gain	
P0-22	UV	2nd Velocity Loop Gain	
P0-23	UG	2nd Velocity Loop Integral Time Constant	
P0-24	UC	2nd Command Torque Filter Frequency	
P0-39	LR	Velocity Feedback Filter	

Note:

When using gain switching, the second group of gains is valid.

9.4.3 Servo Tuning Guidelines

A servo system is composed of current loop, speed loop and position loop. Each loop is composed of several parameters which can be modified to properly tune a servo system. If one parameter is changed, other parameters also need to be re-adjusted. Ensure that while tuning, changes to parameters are gradual, about 5% at time. Making major changes to only one parameter could result in poor tuning and unstable operation of the servo system.

When tuning, you can generally observe the following guidelines. These guidelines are meant provide direction, but do not offer a complete path to a properly tuned system. This is because tuning for two different systems can very and two different tuning profiles can result in stable operation for the same system. Iteration and observation are key to tuning servo systems.

When you need to improve the servo system's response:

- Increase the mechanical stiffness level
- Increase the position loop gain
- Increase the velocity loop gain
- Reduce the velocity loop integral time constant

When the system has overshoot and vibrations:

- Reduce the mechanical stiffness level
- Reduce the position loop gain
- Reduce the velocity loop gain
- Reduce the velocity loop integral time constant
- Reduce the torque filter frequency
- Appropriately adjust the position loop derivative filter frequency

Gain Parameters of the Position Loop:

Position loop gain

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P0-05	KP	1st Position Loop Gain	52	0 ~ 20000	0.1Hz	P	V	T	

Set the proportional gain for position control. Increasing this parameter can improve the responsiveness of the system, reduce the position error, and shorten the positioning time. 0 means not used, 20000 means the proportional effect is maximized. When the proportional gain of the position loop is too small, the response of the system will not be fast enough, and the decreasing trend of the position error will be slow. However, if the setting is too large, it may cause positioning overshoot or machine vibration. Generally speaking, the position loop gain cannot be greater than the velocity loop gain.

Position loop differential gain

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P0-07	KD	1st Position Loop Derivative Time Constant	0	0 ~ 30000	ms	P	V	T	

Set the position loop differential time constant for position control.

0 means no derivative effect, the smaller the set value, the stronger the effect of the derivative term.

When the value of the derivative time constant (KD) is too large, the system's ability to suppress vibration i sinsufficient, and obvious oscillation will occur during acceleration / deceleration, at constant speed and at standstill. A trend os settling (decreasing) oscillations will be observed.

When the set value of the derivative time constant (KD) is set approprately, the system's ability to suppress vibration is significantly enhanced, and the system tends to stabilize quickly. When the differential time constant (KD) is set too small, the motion system will be too sensitive, easily vibrate and generate noise. WHen there is vibration in the system, the derivative time constant can be adjusted with the recommended initial value of 2000.

9.4.4 Gain Parameter of Velocity Loop

Velocity Loop Gain

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P0-12	VP	1st Velocity Loop Gain	183	0 ~ 30000	0.1Hz	P	V	T	

Proportional gain term used to increase stiffness of motor response in direct proportion to the velocity error. The larger the set value, the faster the speed loop response of the servo system. Setting the value too high will cause vibration.

The gain of the velocity loop must be larger than the position loop by 4 ~ 6 times. However, when the gain of the position loop is larger than that of the velocity loop, it will cause vibration or positioning overshoot.

Velocity Loop Integral Time Constant

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P0-13	VI	1st Speed Loop Integral Time Constant	189	0 ~ 30000	ms	P	V	T	

Set the integral time constant of the velocity loop.

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

Under proportional gain control, the speed error may not return to zero, or it may take a long time to return to zero. The integral time constant accumulates all errors and acts together with the proportional gain. A smaller integral time constant (VI) setting value can improve the response and responsiveness of the servo system and reduce the following error.

When the integral time constant (VI) is too large, the system response will be slow and the followability will be poor.

When the integral time constant (VI) is too small, the excessive mechanical Stiffness of the system will cause vibration and noise of the entire servo system. This noise and vibration will be observed throughout the entire motion profile of the system. It is usually oscillatory in nature and will not stabilize on its own very easily.

9.5 Resonance Suppression

The mechanical system has an inherent resonance frequency. If the whole system runs at this mechanical resonance frequency point, vibration and noise may be caused.

MDX+ series provide 4 methods to suppress mechanical resonance.

- Torque Command Filter
- Notch Filters
- End Effector Suppression
- Load Disturbance Suppression

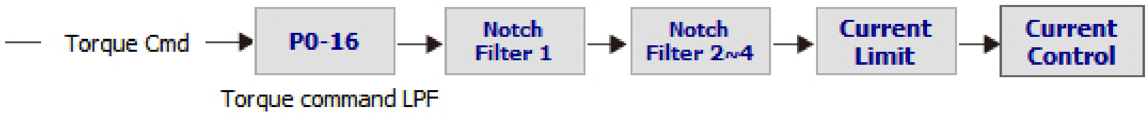
9.5.1 Torque Command Filter

Parameter	Instruction	Name	Defaults	Range	Unit	Control Modes			
P0-16	KC	1st Torque Command Filter	1099	0 ~ 40000	0.1Hz	P	V	T	

The filter is a single-output low-pass filter (LPF), 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.

Guidelines for setting this filter are the following:

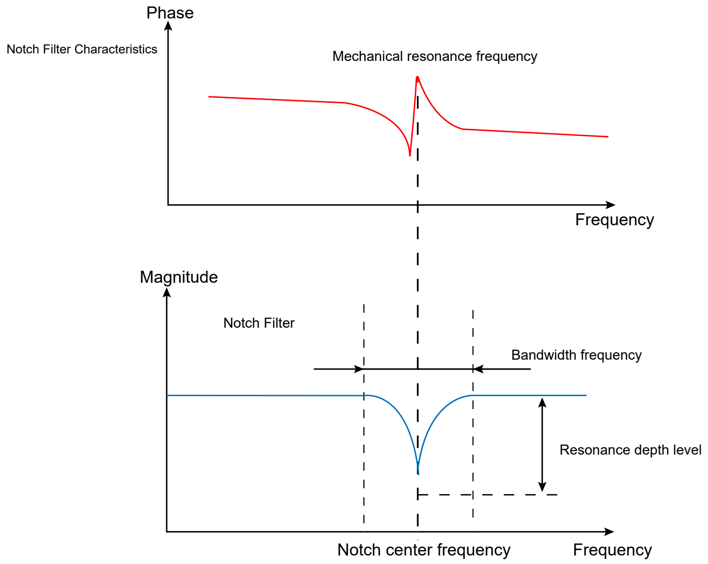
- Make sure the frequency of Torque Command Filter(KC) is 3 time higher than Velocity Loop Gain.
- If there are vibrations with audible noise in the mechanical system, try reducing this value.
- If there is mechanical resonance, the low pass filter cut off frequency can be set below the resonance point so that the output of the control loop does not drive the servo system to its resonance point.
- 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 reduce jitter and vibration



9.5.2 Notch Filters

Reducing the Torque Command Filter could solve vibrations due to resonance, but it also reduces the system response bandwidth and phase margin, thereby potentially causing instability during operation. In some case, it may cause a counter-action that the resonance may not be suppressed.

If you know the system's resonance frequency, the notch filter can be used to suppress the resonance by reducing the gain at the specific resonance frequency range of the system.



This resonance frequency can be detected through open-loop mechanical analysis. If the resonance frequency changes over time or is impacted by other causes, using a notch filter is not suggested.

There are 4 notch filters in the MDX+ series and each notch filter has three parameters for configuration. These are the following:

- Center frequency of Notch Fitler
- Notch Bandwidth
- Notch Depth Level(Notch Filter Attenuation Level)

The first and second notch filter are user-defined filters, and all parameters need to be set by the user. The third and the fourth filters can be set manually or be set as adaptive notch filters 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 the Torque Command Filter(P0-16).

Adaptive Notch Filter

When there are resonance issues present in a servo system, using an adaptive notch filter is recommended.

Scope of application and precautions:

- Applicable to all control mode except Torque Mode

Conditions may affect nomal operation of the Adaptive Notch Filter:

- The resonance frequency is lower than 3 times the Velocity Loop Gain
- The frequency between two resonance points is less than 100Hz

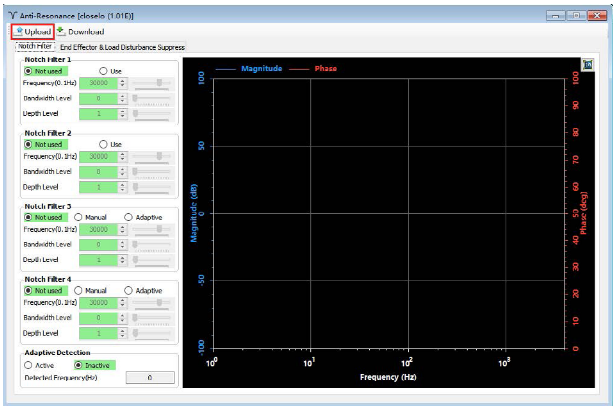
Steps for usage:

- In the "Anti-resonance" interface of Luna software, change the usage mode of "Notch Filter 3" to "Adaptive," and then click the "Download" button to enable a self-adaptive notch filter.
- When the servo system is running, it will automatically detect resonance frequency and take effect to suppress.
- If there is a new resonance, enable the "Notch Filter 4" with same operation.
- When the system is running ,the third and fourth goups of notch filter parameters are automatically updated, but will not be displayed in the software interface.
- Although these parameters are updated automatically, they will not be saved automatically. After the servo system is powered on again, the system will automatically update these parameters when the servo is enabled and running.

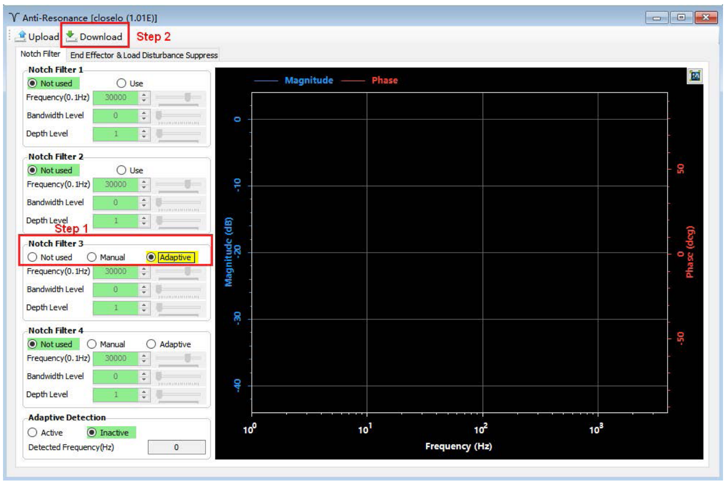
This setting can prevent abnormal movement of the servo system during operation, resulting in the notch filter parameters being updated to wrong values, which may increases vibration.

Software settings for Adaptive Notch Filter

Step 1: In the tree list on the left, open "Anti-Resonance," and click the "Upload" button in the Anti-Resonance interface



Step 2: Change the method of "Resonance Suppression Filter 3" to "Adaptive," and then click to download



Step 3: After the download is complete, the MDX+ will automatically update these parameters when it is enabled and running.

9.5.3 Setting the Notch Filter Manually

Analyze resonance frequencies

To manually set the notch filter, it is necessary to measure the actual frequency when resonance occurs. You can use the "Mechanical Analysis" function in the Luna software.

Analysis Type	Applicable Load	Method Description	Precautions
Mechnical Open-Loop	Horizontal load	Mechanical Open-Loop analysis allows users to analyze the real time resonance frequency of the entire system. This is because open loop mode does not use the PID of the controller which might otherwise try to react to resonance and thereby provide a skewed analysis.	For mechanical open-loop analysis, the motor must be disabled, so it cannot be used for vertical loads
Velocity Closed-Loop	Horizontal load Vertical load	Velocity Closed-Loop analysis allows users to analyze the closed loop system response with the servo gains, filters (including notch filters). However, it is necessary to ensure that PID loop parameters are set reasonably so that the closed loop nature of the system will not skew analysis of the resonance frequency.	◆ The control mode of the drive needs to be in the command Velocity Mode, that is, the set value of P1-00 is 10. ◆ The drive needs to be enabled when speed closed-loop analysis is performed ◆ For vertical loads, ensure that there is mechanical protection against falling.

Using Mechanical Open Loop Resonance Analysis

Step 1

Before performing a mechanical open-loop analysis, ensure that

- The drive has passed the trial operation described in Section 6 Trial Operation.
- Servo system has completed parameter tuning
- Make sure the drive is not enabled

Step 2

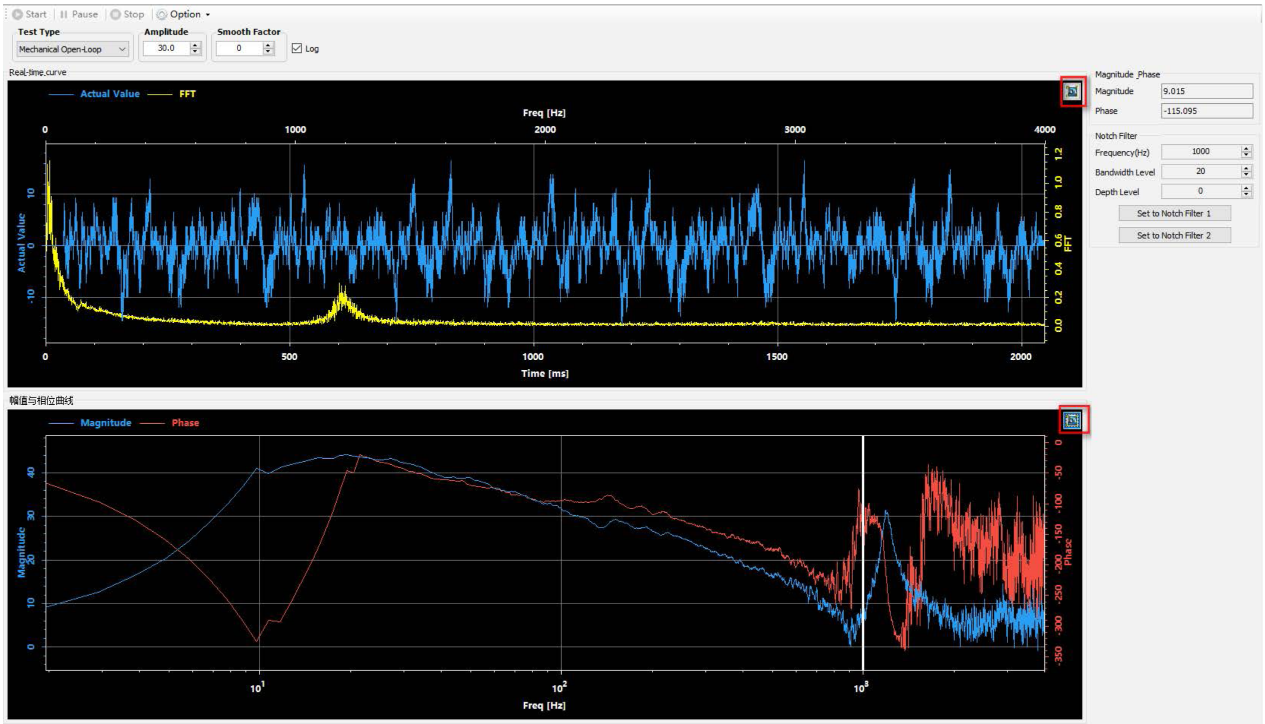
Select an appropriate amplitude to start the system, be aware that an excessively large amplitude will cause mechanical movement.

Smoothing factor:

Impacts the sampling frequency of the waveform function. The larger the value, the smoother the waveform appears. This parameter is useful during resonance analysis.

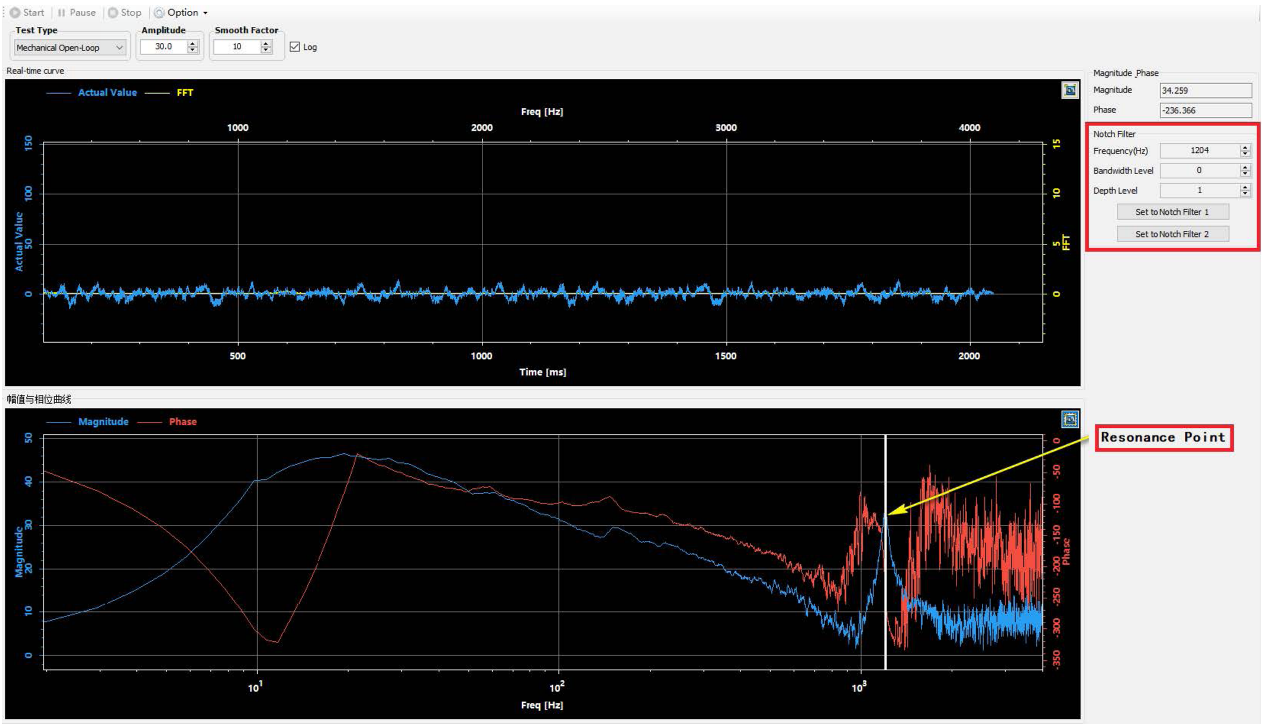
Step 3

Click the "Start Analysis" button, the servo system starts the mechanical open-loop analysis and displays the resulting curve. Click the icon in the upper right corner of the drawing area to optimize the display curve.



Step 4

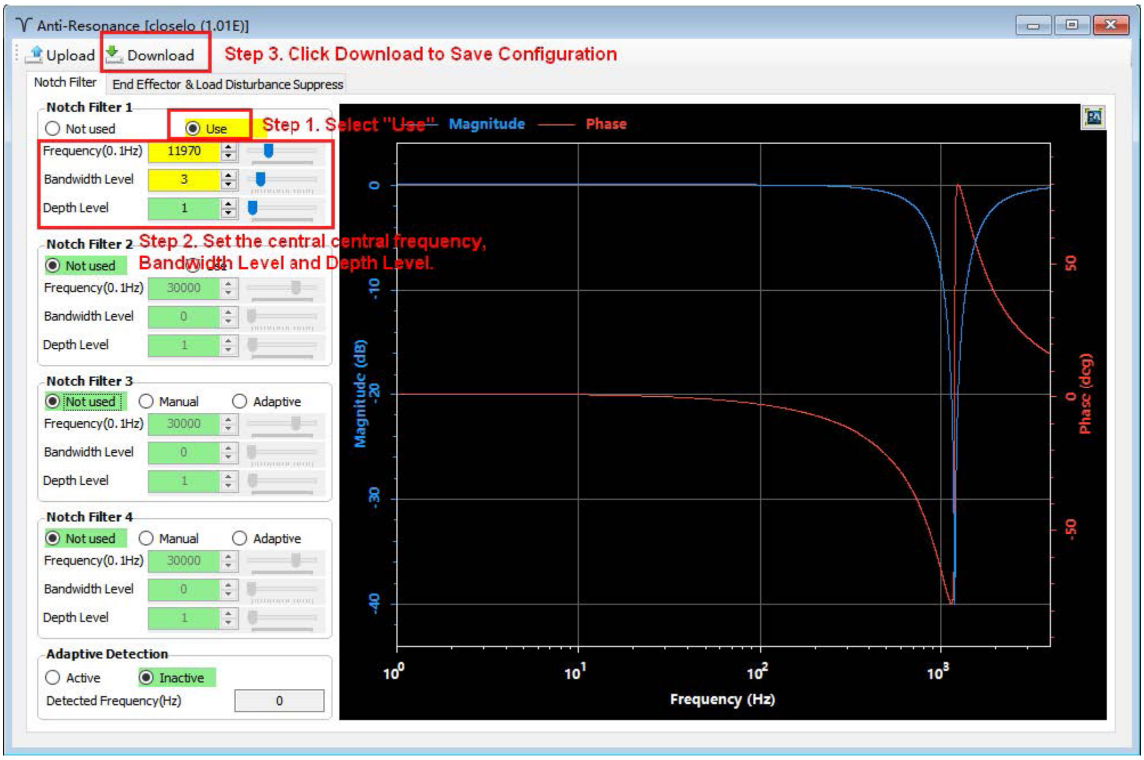
Move the reference line in the "Magnitude and Phase Curves" to the place where the amplitude curve (blue curve in the figure below) has abnormal protrusions



The reference line will update the Notch Filter Frequency (red square) in real time Click "Set to Notch Filter 2" or "Set to Notch Filter 2" to set the center frequencies to be used by the notch filters.

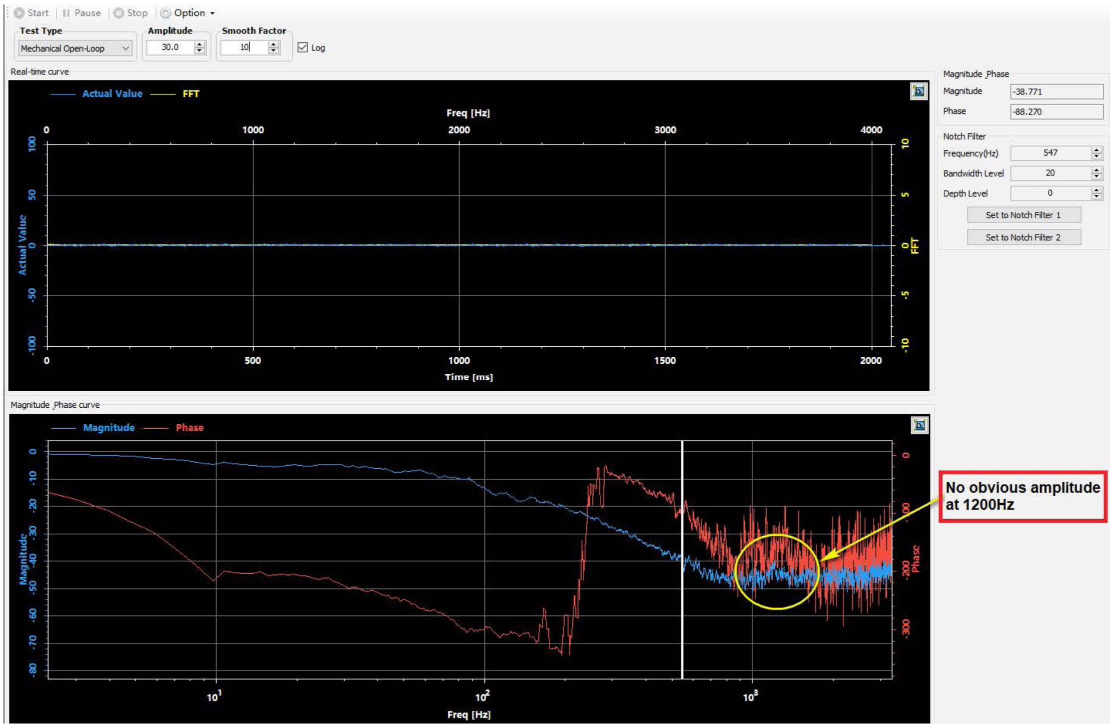
Step 5

On the Anti-Resonance interface, select "Use" to enable the corresponding resonance suppression filter, set the appropriate "Bandwidth Level" and "Depth Level," and click "Download" to set the Notch Filters.



Note: Because Mechanical Open Loop analysis does not include the closed loop of the servo controller, any previously downloaded Notch Filters will not be active during the analysis. If users wish to test the Notch Filters impact on the resonance of the system, they will need to run the motor in the "Velocity Closed Loop" mode. Otherwise, the system will run in open loop without the Notch Filter equipped.

The image below is the result viewed using the Velocity Closed Loop analysis.



Using the Velocity Closed Loop Mode to Analyze Resonance Frequency

Step 1

Before performing a velocity closed-loop analysis, make sure that:

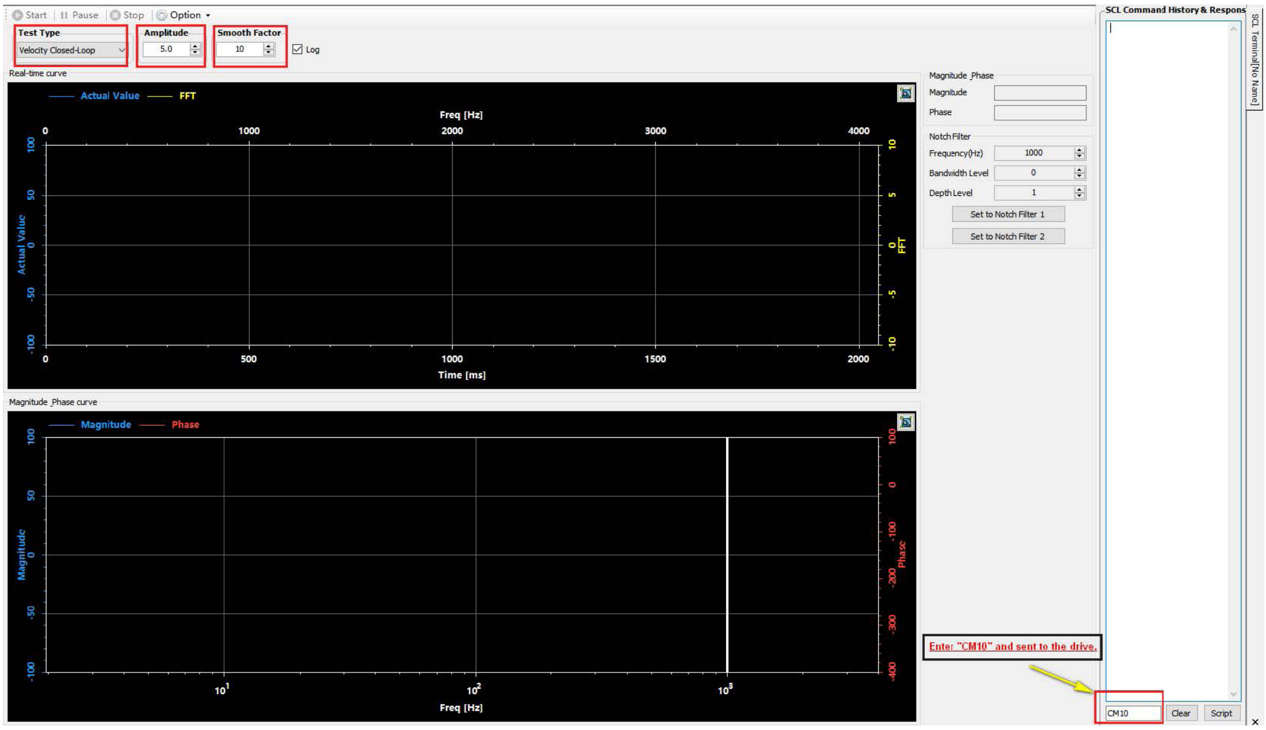
- The drive has completed the trial operation described in Section 6 Trial Run.
- Servo system has completed parameter tuning
- The control mode of the drive is: command Velocity Mode (CM10 or P1-00 set to 10)
- Drive is enabled
- For vertical axis loads, it is best to use a motor with a brake to avoid accidental load drop

Step 2

- Select an appropriate amplitude to allow the system to vibrate.

Note that an excessively large amplitude may cause mechanical movement.

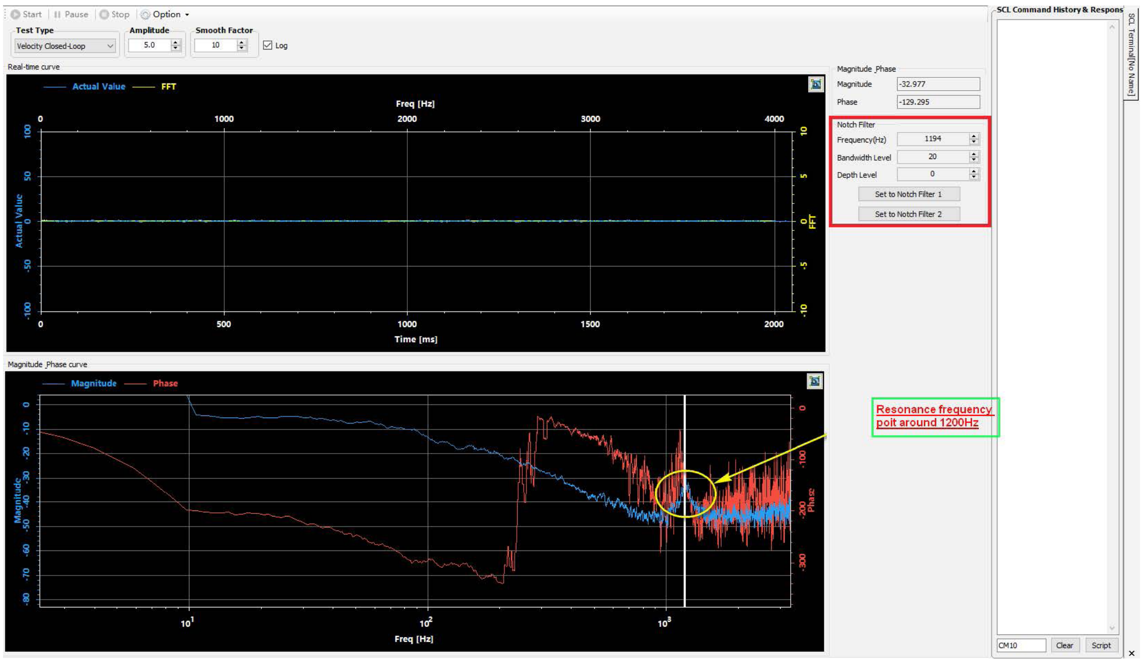
- Enable the driver



Step 3

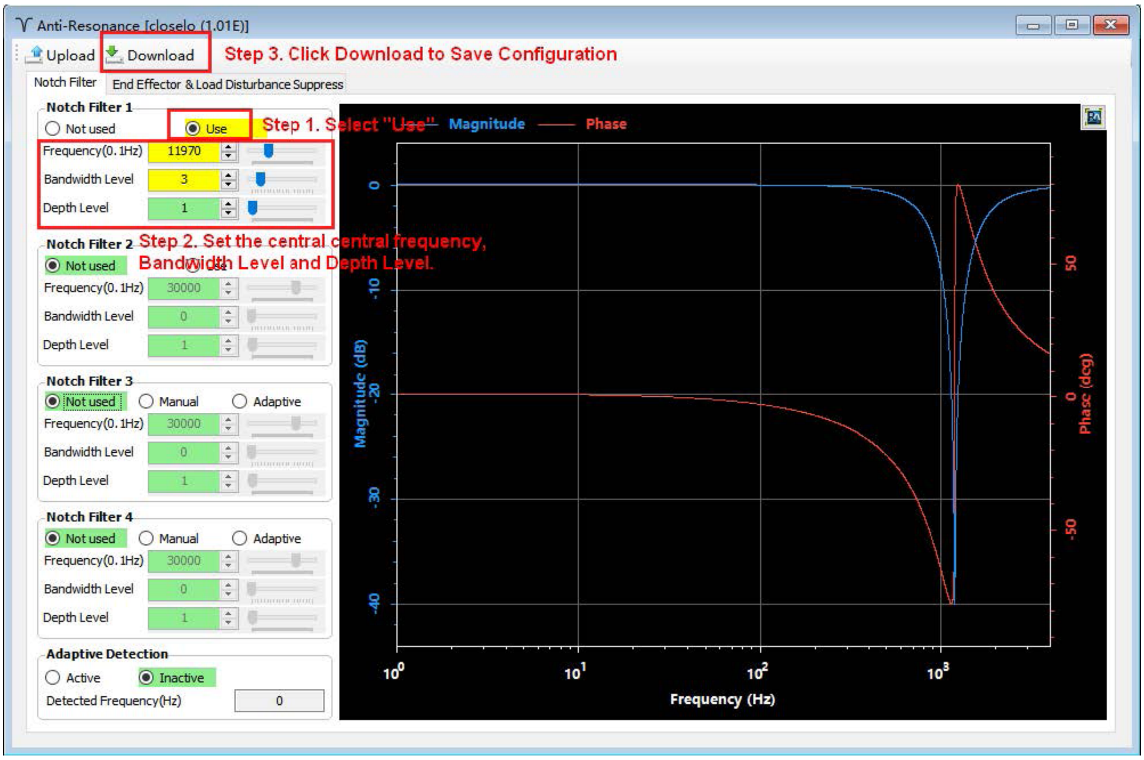
- Click the "Start Analysis" button, the servo system starts the speed closed-loop analysis, and the curve of the result is displayed.
- Click the icon in the upper right corner of the graph area to optimize the display curve.
- Move the reference line in "Magnitude and Phase Curve" to the place where the amplitude curve (blue curve in the figure below) has abnormal oscillations

The following figure shows obvious vibration at 1200Hz. Click "Set to Notch Filter 1" or "Set to Notch Filter 2" to set the center frequency for the Notch Filter 1 or the Notch Filter 2.



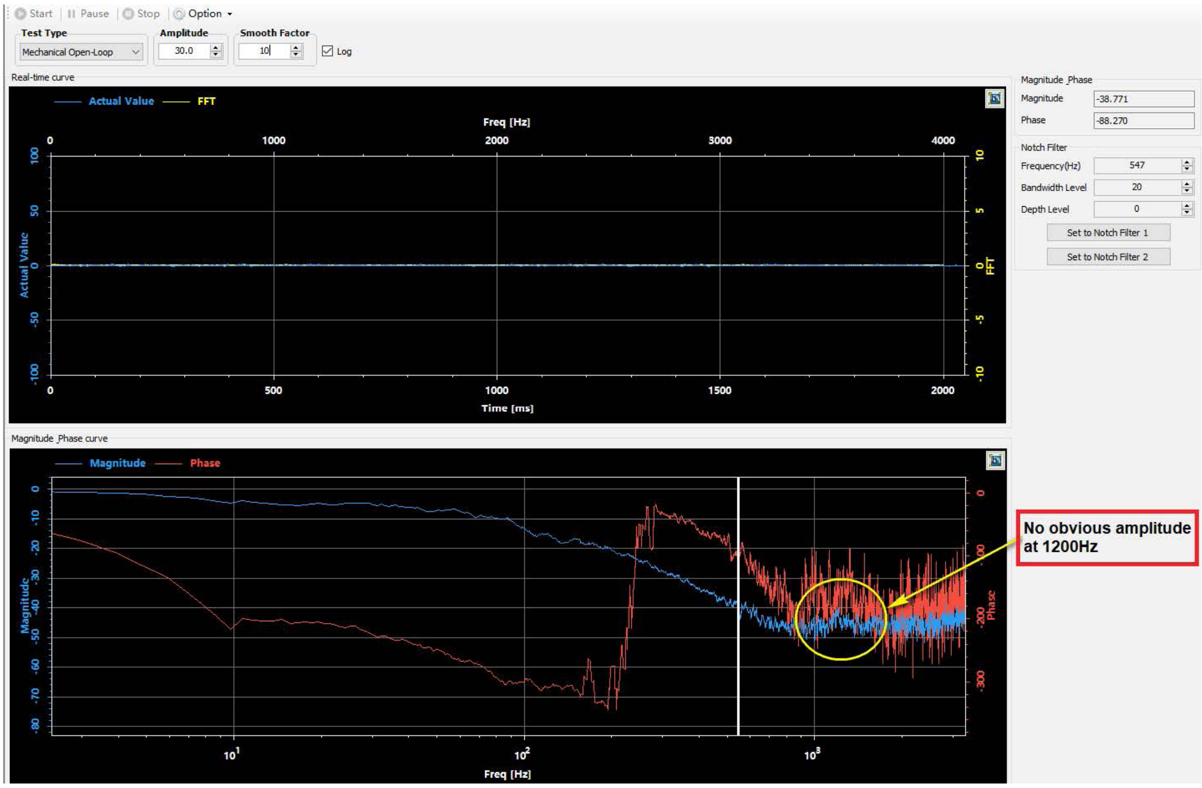
Step 4

To set a notch filter, select the "Anti-Resonance" option in the device tree to the left of the Luna Software. On the desired filter, select "Use" to enable the filter, set the appropriate Bandwidth Level and Depth Level. Then click Download.



Step 5

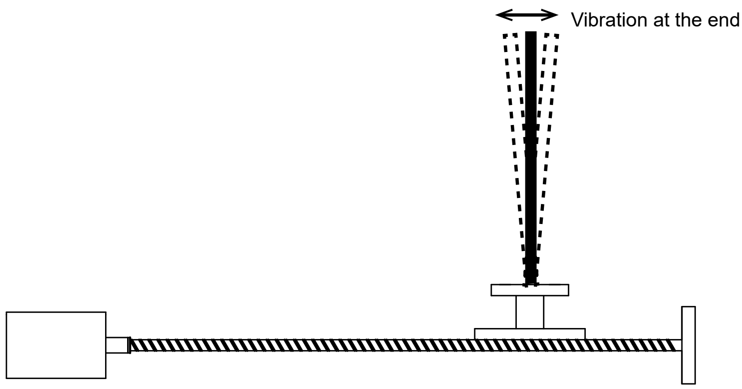
The below waveforms showcase the results of Velocity Closed Loop analysis



9.6 End Effector Vibration Suppression

Warning: do not use Jog when End Effector & Load Disturbance Supression is enabled

As illustrated in the image below, mechanical loads can generate low-frequency vibrations during operation and when coming to a full stop. These low frequency vibrations are enerally within 100 Hz but can affect the positioning accuracy and settling time of the entire mechanism.

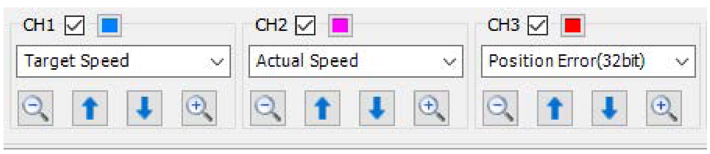


The use of end vibration suppression can better suppress such vibrations, thereby improving the positioning accuracy of the mechanical system and shortening the positioning and settling time.

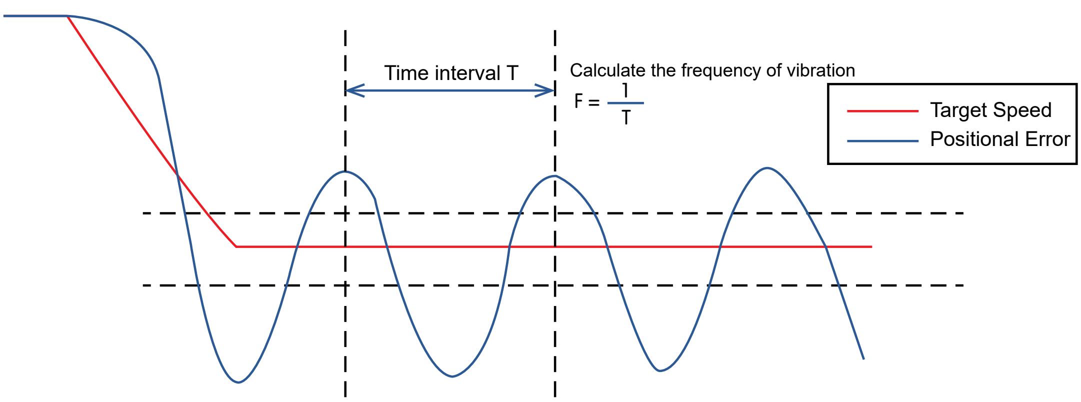
Instructions to Implement End Vibration Suppression

Step 1: Analyze Frequency

Use the Scope function of Luna software to observe the curves of "target speed" and "position error" during the motor stop phase.

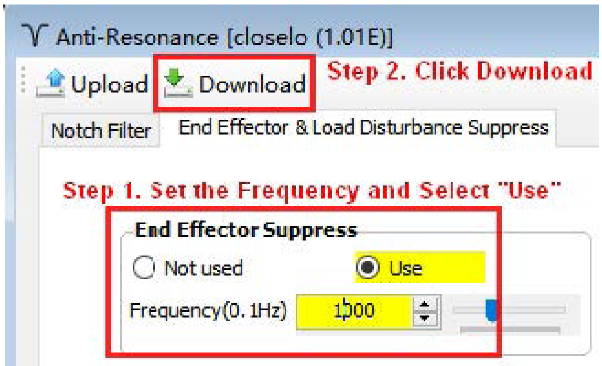


While monitoring the two curves mentioned above, analyze the frequency of position error fluctuations after the target speed is zero. Of great interest is the interval of time, T, in between fluctuations. Using the formula of 1/T will provide the frequency of fluctuations. See below image for example.



Step 2: Set and enable end vibration suppression

Select the Anti-Resonance interface on Luna Software. Select the End Effector Suppression Tab, enter the vibration frequency as measured in Step 1.



Note:

- **Wrong vibration frequency will cause the end vibration suppression effect to become worse or even increase the vibration**
- **Only the vibration frequency within 1-300Hz can be well suppressed**
- **This function may not work for vibrations due to reasons other than those related to reaching the mechanical end of a mechanism.**

10 Contacting Applied Motion Products

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