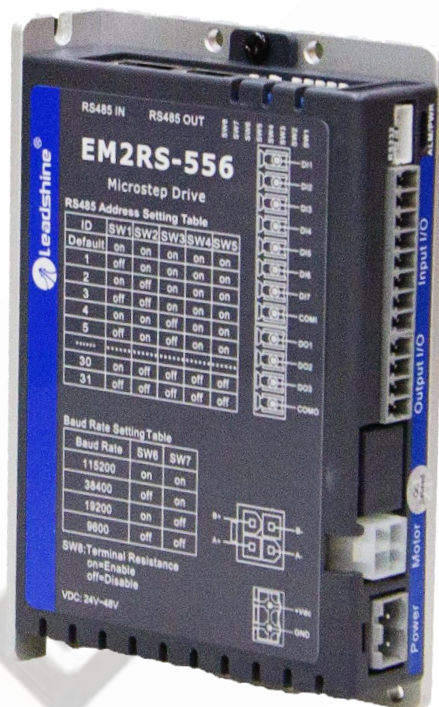


User Manual

EM2RS Series

RS485 Stepper Drive



Revision 1.0

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- ◆ **Thank you for purchasing Leadshine EM2RS Series Products**
- ◆ **Please read this manual carefully before operating**
- ◆ **Please keep this manual appropriately**

Notice

Read this manual carefully before any assembling and using. Incorrect handling of products in this manual can result in injury and damage to persons and machinery. Strictly adhere to the technical information regarding installation requirements.

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Record of Revisions

Reversion	Data	Description of Release	Signed
V1.00	20191217	Initial Release	Max

Preface

Thank you for choosing EM2RS series RS485 stepper drive system of Leadshine Technology Co., Ltd. This manual gives required knowledge & precautions for using EM2RS series stepper drives.

EM2RS Series are stepper drive based on standard Modbus RTU protocol, using RS485 communication can network up to 31 axes, built-in single axis control function with 16-segment position table (PR Mode). After programming the drives, the motion can be started by RS485 communication, or external I/O, or HMI, which has the characteristics of simple use, stable and reliable, rich function and so on.

The Manual of CS3RS Series Include:

- <EM2RS Series RS485 stepper drive User Manual >

The user manual is about hardware, function description, Modbus communication protocol, object dictionary, etc.

Please make sure to read carefully and refer to this specification after understanding the contents fully.

- <EM2RS Series RS485 Stepper Drive Software Manual>, coming soon.

The user manual is coming soon, includes how to connect with Leadshine PC software, operation steps and parameters configuration, etc. Customer also can configure object dictionary through master station PC software.

Please Pay Attention to The Following Reminders:

- Only technical personnel are allowed to install debug or maintain the product.
- Make sure wiring is correct before power-on test.
- Incorrect voltage or power polar connection can cause damage to drive or other accidents.
- Contents of this manual are subject to change without prior notice for functional improvement, change of specifications or use's better understandings.
- Leadshine will not undertake any responsibility in case of user's unauthorized product changes reconstruction, product warranty will also be invalid.

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1 Introduction

1.1 Product Introduction

EM2RS Series are stepper drive based on standard Modbus RTU protocol, using RS485 communication can network up to 31 axes. They built-in PR feature with 16-segment position table (PR Mode) can save additional controllers in most of point-to-point applications, to greatly enhance system reliability and reduce the cost. EM2RS Series also support the feature of teaching, the operation modes of Profile Position, Profile Velocity and Homing. They can power 2-phase NEMA 8, 11, 14, 17, 23, 24, 34 stepper motors.

The EM2RS series is highly reliable and affordable and performs excellently in many industrial applications such as solar equipment, textile, civil, robotics, power generation equipment, 3C, packaging...

1.2 Features

- Low noise and vibration, smooth motion
- Support Modbus RTU protocol, Internal 16-segment position instructions
- Motion can be started by External IO or RS485 or HMI
- Support operation modes: Profile Position, Profile Velocity, Homing
- 7 configurable digital inputs, 3 optically isolated digital outputs
- Limit +, Limit -, Origin, Quick stop, Enable, JOG +, JOG - and Position Table inputs
- Alarm, Brake, Homing complete, In Position complete, instructions complete, Path complete outputs
- 20-50VDC supply voltage for EM2RS-522, max output current 2.2A
20-50VDC supply voltage for EM2RS-556, max output current 5.6A
20-72VDC supply voltage for EM2RS-870, max output current 7.0A
20-80VAC or 30-100VDC supply voltage for EM2RS-A882, max output current 8.2A
- RS232 communication for parameters configuration
- Protections for over voltage, over current, motor cable error, etc.

1.3 Compare with Step/Direction

- Built-in single-axis control can save the PLC in most of point-to-point applications to reduce cost;
- Built-in rich diagnostic functions and input and output signals to setup easily;
- Modbus brings more expansion possibility to add value;

1.4 Check of Product

1.4.1 Arrival inspection

- Check whether the surface of the product is damaged or not during transportation.
- Check the nameplate models of the drive and motor are what you have ordered.
- Check if it is fully equipped with accessories. Accessories include power supply and I/O signals connector.

CAUTION


- Neither the damaged nor missing accessories of stepper system is allowed to install.
- Contact Leadshine or local distributor if any failure was found.

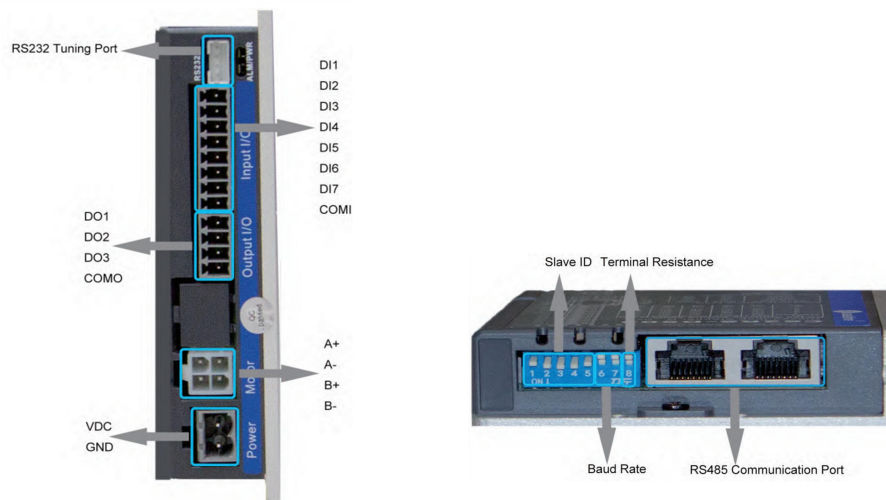
1.4.2 Nameplate information

1.4.3 Part number

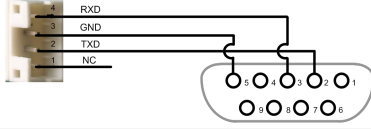

EM2 RS- □ 5 22 - □



- 1 Series Name
EM2: 2nd generation stepper drives
- 2 Communication Mode
RS: RS485
- 3 AC or DC
A: AC power voltage
Blank: DC power voltage
- 4 Maximum Operating Voltage
5: 50V
8: 80V
- 5 Maximum Output Current
22: 2.2A
56: 5.6A
- 6 Customized Code
Blank: standard

1.4.4 Parts description


1.4.5 Accessories Information

Name	Necessary	Picture	Description	Need to cost extra
Tuning Cable ⁽²⁾	No		CABLE-PC-1 cable	Yes
Network cable ⁽³⁾	Yes		(CABLE-TX*M*-BUS) Optional length: 0.1m, 0.2m, 0.3m, 0.4m, 1m, 1.5m, 2m, 3m, 5m, 7m, 10m, 15m, 20m	Yes

Note:

- (1) Motor connector model: [39012040](#), [39000038](#), [Molex](#)
- (2) Tuning cable is not necessary, you can also modify parameters by controller PC software.
- (3) Network cable is necessary, but you can also buy shielded network cable through 3rd party.

2 Installation

2.1 Storage and Installation Conditions

2.1.1 Storage condition

- Correctly packaged and store in a clean and dry environment where direct sunlight is avoided.
- Store within an ambient temperature ranging from -20°C to +65°C.
- Store within a relative humidity ranging from 40% to 90% and non-condensed.
- Avoid any type of exposure to corrosive gases.

2.1.2 Operating ambience conditions

- Temperature ranging from 0°C to 50°C. The ambient temperature of drive for long-term reliability should be under 40°C. Please install the drive in a well-ventilated area.
- Operation within a relative humidity ranging from 40% to 90% and non-condensed.
- Vibration lower than 0.15mm at a frequency of 10Hz-55Hz.

CAUTION



- DO NOT mount the drive and motor in a location subjected to corrosive or flammable gases, and combustibles.
- Please mount the drive and motor in an indoor electric control cabinet without liquid where direct sunlight is avoided.
- DO NOT mount the drive and motor in a location subjected to airborne dust.
- Please ensure grounding wires are securely connected

2.2 Mechanical Specification

Unit: mm, 1inch=25.4mm

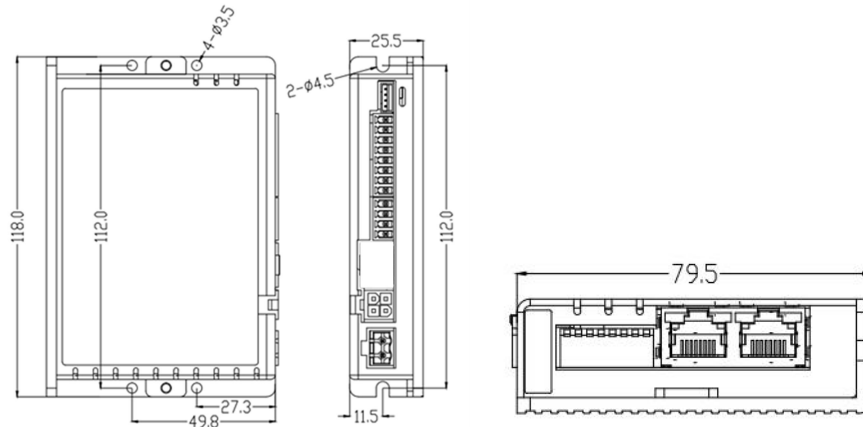


Figure 2.1: EM2RS series mechanical drawing

2.3 Installation Direction and Space

- The mounting of drive, wiring and motor should be under the regulations of EN 61800-5-1.
- Incorrect installation may result in a drive malfunction or premature failure of the drive and /or motor. Please follow the guidelines in this manual when installing
- The drive should be mounted perpendicular to the wall or in the control panel.
- In order to ensure the drive is well ventilated, ensure that the all ventilation holes are not obstructed and sufficient free space is given to the drive, and a cooling fan is mounted in the control panel.
- Please ensure grounding wires are securely connected.

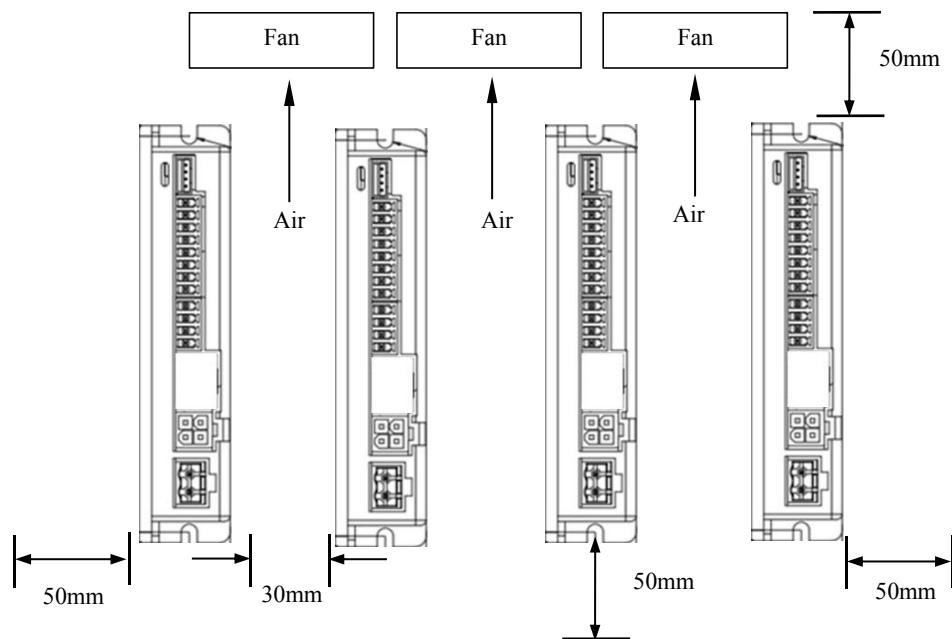


Figure 2.2: EM2RS series installation drawing

3 Product Specifications

CAUTION



- Don't hot plug the motor wiring, encoder wiring and RS232 communication wiring during power on.
- Be sure to check the connections and make sure the power lead polarity is correct, or there could result in injury or fire.
- Be sure wait for 5 minutes or longer to touch drives after turning off power
- Be sure to give the power supply voltage dose not exceed the drive's input range.
- If using a motor with small phase current, be sure to modify the driver output current before enabling the motor

3.1 Electrical and Operating Specifications

3.1.1 Electrical and Operating Specifications

Name	EM2RS-522	EM2RS-556	EM2RS-D870	EM2RS-D1008 (coming soon)
Supply Voltage	20-50VDC	20-50VDC	20-72VDC	30-100VDC or 20-80VAC
Output Current (Peak)	0.5-3.0A	1.0-7.0A	1.0-8.0A	2.1-8.0A
Size (H*W*L mm)	118*79.5*25.5			Coming soon
Weight (kg)	0.65			Coming soon
Matched Motor	NEMA 8, 11, 14, 17	NEMA 17, 23, 24	NEMA 24, 34	NEMA34
Input Signals	Limit +, Limit -, Origin, Quick stop, Enable, JOG +, JOG - and Position Table			
Output Signals	Brake, Alarm, In Position, GPIOs			
Protection Functions	Over Current, Over Voltage, Motor Cable Error, etc.			
PC Software	Leadshine ProTuner (coming soon)			
Operating Environment	Environment	Avoid dust, oil ,fog and corrosive gases		
	Operating Temperature	0-50°C (32 F – 122 F)		
	Storage Temperature	-20°C -65°C (-4 F – 149 F)		
	Humidity	40-90%RH		
	Vibration	10-55Hz/0.15mm		
	Mount	Vertical or horizontal mounting		

3.2 Wiring Instructions

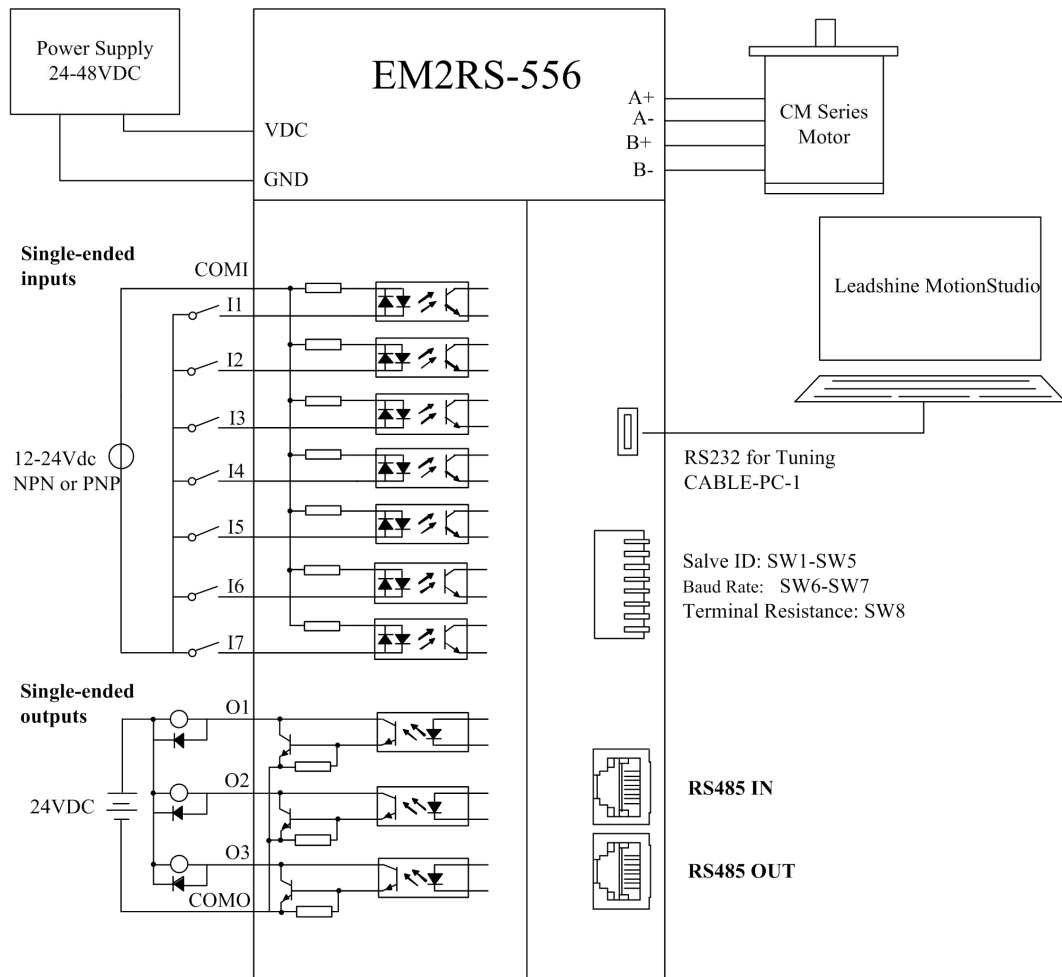


Figure 3.1 Wiring Instructions

Note:

- (1) There are two RS485 communication ports above, one of them is input port which connects with master station or previous slave, and the other is output port which connects with the following slave.
- (2) Single-ended inputs I1, I2, I3, I4, I5, I6 and I7 connection types can be common-cathode and common-anode.
- (3) Single-ended outputs connection type is common-anode

3.2.1 Power Supply Cable & Motor Cable

- Wire diameter: +VDC, GND, A+, A-, B+, B- terminal wire diameter $\geq 0.3\text{mm}^2$ (AWG15-22)
- A noise filter which can improve anti-interference performance is recommended to be connected between power supply and drive.

3.2.2 I/O Signal Cable

- Wire diameter: I1 - I7, O1 - O3, COM wires diameter $\geq 0.12\text{mm}^2$ (AWG24-26)
- Recommend to adopt shielded twisted pair cable with a length of less than 3 meters (the shorter the better).
- Wiring: As far as possible away from the power line wiring, in order to prevent interference

- Please connect surge absorber to inductive device, such as anti-parallel diode for DC coil, parallel RC-snubbers circuit for AC coil.

3.2.3 RS485 Communication Cable

It is recommended to use shielded Ethernet network cables that do not exceed 100 meters.

3.3 Interface Specifications

3.3.1 Connectors Definition

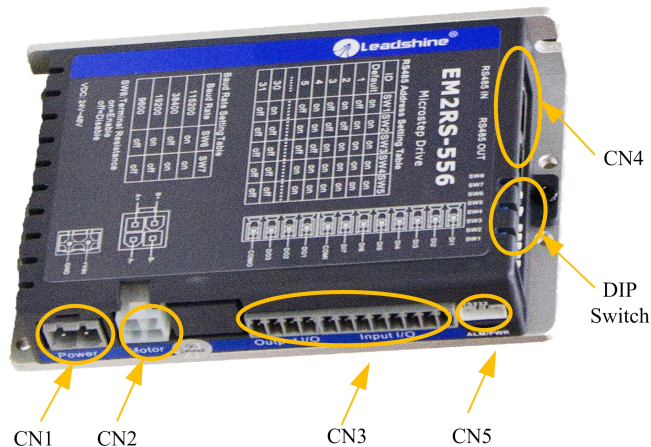



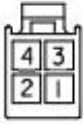
Figure 3.2: EM2RS series connectors

Name	Description
CN1	Input power connector
CN2	Motor connector
CN3	Encoder input signals connector
CN4	Digital inputs and outputs connector
CN5	RS485 communication connector
CN6	RS232 tuning connector
DIP Switch	Salve ID: SW1-SW5 Baud Rate: SW6-SW7 Terminal Resistance: SW8

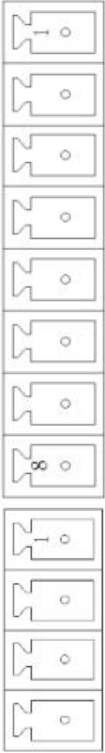
3.3.2 CN1-Input Power Connector

Name	Pic	PIN	Signal	Description
CN1		1	VDC	24V- 48V
		2	GND	GND

3.3.3 CN2-Motor Connector

Name	Pic	PIN	Signal	Description
CN2		1	A+	Motor phase A+
		2	B+	Motor phase B+
		3	A-	Motor phase A-
		4	B-	Motor phase B-

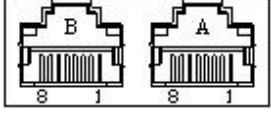
3.3.4 CN3-I/O Signals Connector

Name	Pic	PIN	Signal	I/O	Description
CN4		1	DI1	I	Configurable Single-ended Digital Inputs DI1-DI7, 12V - 24V. DI1 is enabling signal default, DI2-DI7 are GPIOs
		2	DI2	I	
		3	DI3	I	
		4	DI4	I	
		5	DI5	I	
		6	DI6	I	
		7	DI7	I	
		8	COMI	I	
		9	DO1	O	Configurable Single-ended Outputs Signals DO1-DO3 (common-cathode or common-anode), Max. 24V/100mA, GPIOs.
		10	DO2	O	
		11	DO3	O	
		12	COMO	O	


Note:

- (1) DI1 is normally closed, default by Enable signal. It means the motor is locked shaft after the driver powered on.
- (2) When using Brake output signals, you need to connect a relay and a diode

3.3.5 CN4-RS485 Communication Connector

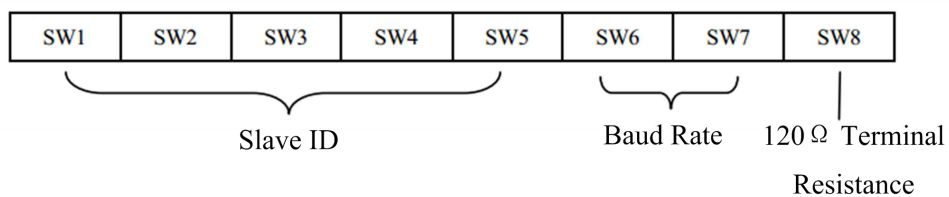
Name	Pic	PIN	Signal	Description
CN4		A-1	RS485+	RS485 TxD+
		A-2	RS485-	RS485 TxD-
		A-5	GND	GND
		A-6	GND	GND
		B-1	RS485+	EtherCAT RxD+
		B-2	RS485-	EtherCAT RxD-
		B-5	GND	GND
		B-6	GND	GND
		Others	Reserved	NC

3.3.6 CN5-RS232 Tuning Port

Name	Pic	PIN	Signal
CN6		1	RxD
		2	GND
		3	TxD
		4	NC

3.3.8 DIP Switches

The EM2RS series drives use an 8-bit DIP switched to set Salve ID (also called Site Alias), Baud Rate and Terminal Resistance, they are shown as below:



(1) Slave ID: SW1-SW5 (off=1, on=0)

Slave ID	SW1	SW2	SW3	SW4	SW5
1 (default)	on	on	on	on	on
1 (factory)	off	on	on	on	on
2	on	off	on	on	on
3	off	off	on	on	on
4	on	on	off	on	on

5	off	on	off	on	on
6	on	off	off	on	on
7	off	off	off	on	on
8	on	on	on	off	on
9	off	on	on	off	on
10	on	off	on	off	on
11	off	off	on	off	on
12	on	on	off	off	on
13	off	on	off	off	on
14	on	off	off	off	on
15	off	off	off	off	on
16	on	on	on	on	off
17	off	on	on	on	off
18	on	off	on	on	off
19	off	off	on	on	off
20	on	on	off	on	off
21	off	on	off	on	off
22	on	off	off	on	off
23	off	off	off	on	off
24	on	on	on	off	off
25	off	on	on	off	off
26	on	off	on	off	off
27	off	off	on	off	off
28	on	on	off	off	off
29	off	on	off	off	off
30	on	off	off	off	off
31	off	off	off	off	off

Note:

(1) When the SW1-SW5 is default (all are on), the Slave ID can be configured by the PC software

(2) Baud Rate: SW6 - SW7

Baud Rate	SW6	SW7
115200	on	on
38400 (factory)	off	on
19200	on	off
9600 (default)	off	off

Note:

(1) When the SW6-SW7 is default (all are off), the Baud Rate can be configured by the PC software

(3) Terminal Resistance Selection: SW8

SW8=ON: terminal resistance is valid;

SW8=OFF: terminal resistance is invalid(Factory setting)

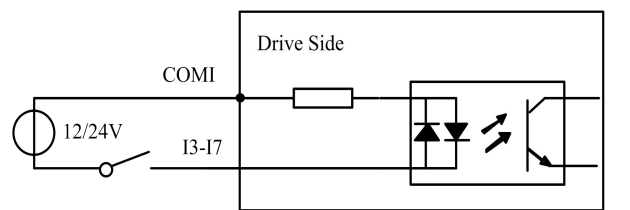
Note:

(1) The last slave in the network needs to connect a 120Ω terminal resistance, it means set the SW8 to on

3.4 I/O Connection

3.4.1 Digital Inputs

The connections of input signals are as below:



COMI: can be connected to 12 / 24 V (common-anode), or 0 V (common-cath)

Figure 3.3: Input Interface Connection

3.4.2 Digital Output

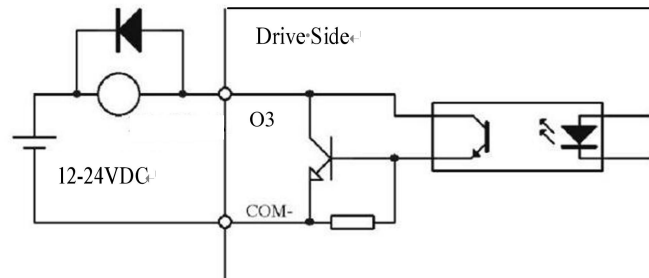


Figure 3.4: Output Interface Wiring

Note:

(1) The power supply (12-24VDC) above is provided by user, and if the polarity of power supply is reversed, it will damage the drive.

(2) Digital output is OC output with the maximum capacity of 100mA/24V (recommended 50mA/24V), the provided power supply should be under 30V (recommended 24V), otherwise it will cause damage to the drive.

3.4.3 Brake Output

Use PC software(from Leadshine or Controller or PLC vendor) to configure this output as a BRAKE CONTROL output. In this case, this signal can be used for automatic brake control while system power failure. It is recommended to connect a fly-wheel diode in parallel to a 24VDC relay and brake coil connection. Refer to the following figure for brake connection.

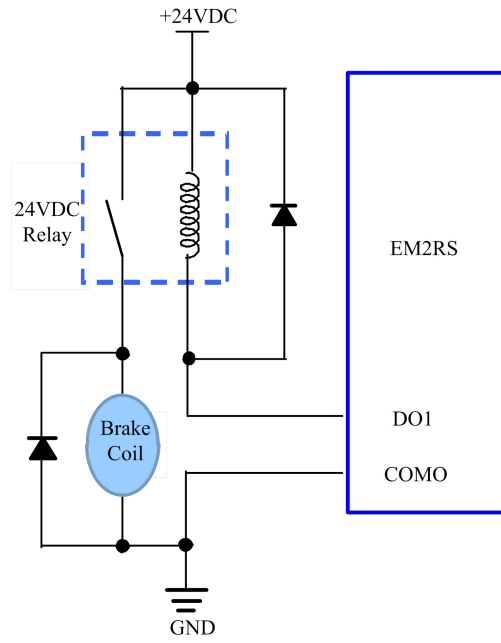


Figure 3.5: Brake output connection

4 Modbus RTU

4.1 Communication Specifications

Items	Specifications	Remarks	
Communication	Communication Port	RS485 and RS232 RS232 only for tuning RS485 for motion control	
	Baud Rate	9600/19200/38400/115200[bps] parameter setting	
	Synchronous Mode	Start / Stop Synchronization -	
	Communication Mode	Half-duplex, Master-slave Mode Slave/slave communication is prohibited	
	Character Composition	Starting bit:1bit Data length:8bit Check bit:even/ odd/ no Stop bit:0/1/2 -	
Protocol	Communicating Protocol	Modbus RTU ASCII is not supported	
	Slave ID	0:broadcast 1-31:valid sub-devices Numbers -	
	-	Function code (FC)	Function
		0x03	Read single or multiple data -
		0x06	Write single data
		0x10	Write multiple data
	Check Mode	CRC-16 Left is Low-bit, Right is high-bit	
Message Length	Variable, the max length is 100byte -		

Single message communication rate of RS485: (Unit: ms)

Baud rate	Start receiving to send completion time	Receive wait time	Time from transmission completion to recovery of receiving state	Total
115200	2.44	0.64	0.6	3.08
38400	5.5	1.16	0.46	7.12
19200	10.76	2.2	0.38	13.34
9600	20.5	3.8	0.6	24.9

4.2 Function Codes

The current supported function codes as below

- 0x03: Read single or multiple data;
- 0x06: Write single data;
- 0x10: Write multiple data;

4.2.1 0x03-- Read single or multiple data

Example A: Read value of output peak current

Send message: 01 03 01 91 00 01 D3 1B

Receive message: 01 03 02 00 0A 38 43

Details as following:

Master->slave data:

Message:	01	03	01 91	00 01	D3 1B
Description:	Address	Function code	Register address	Read Number of registers	CRC check code

Slave->master data:

Message:	01	03	02	00 0A	38 43
Description:	Address	Function code	Number of bytes returned	Register value	CRC check code

Note: 0x0191-- output peak current, 000A(Hexadecimal)=10(decimal, unit: 0.1A), it means the current 1A.

Example B: Continuous reading parameters of RS485

Send message: 01 03 01 BC 00 06 05 D0

Receive message: 01 03 0C 00 00 00 02 00 00 00 01 00 00 00 04 B6 13

Details as following:

Master->slave data:

Message	01	03	01 BC	00 06	05 D0
Description	Address	Function code	Register address	Read Number of registers	CRC check code

Slave>master data:

Message	01	03	0C	00 00	00 02	00 00	00 01	00 00	00 04	9D B3
Description	Address	Function code	Read register	Address 0x01BC	Address 0x01BD	Address 0x01BE	Address 0x01BF	Address 0x01C0	Address 0x01C1	CRC check code

Note:

(1) The above example shows reading the value of Pr5.22, Pr5.23, Pr5.24, their corresponding address are 0x01BD, 0x01BF, 0x01C1.

(2) The data type of parameter is 32bit, which include high 16bit register and low 16bit register. usually, we use low 16bits only, but it need to take the high 16 bits as beginning when we read/write multiple parameters continuously.

4.2.2 0x06-- Write single data

Example C: Write value of output peak current

Send message: 01 06 01 91 00 20 DD 7B

Receive message: 01 06 01 91 00 20 DD 7B

Details as following:

Master->slave data:

Message	01	06	01 91	00 20	DD 7B
Description	Address	Function code	Register address	Write data	CRC check code

Slave>master data:

Message	01	06	01 91	00 20	DD 7B
Description	Address	Function code	Register address	Write data	CRC check code

Note: 0x0191-- output peak current, write the data 0x0020=32(decimal, unit: 0.1A), it means the current 3.2A.

Example D: Save the written value to EEPROM

Send message: 01 06 18 01 22 11 06 06

Receive message: 01 06 18 01 22 11 06 06

Details as following:

Master->slave data

Message:	01	06	18 01	22 11	06 06
Description	Address	Function code	Register address	Write data	CRC check code

Slave>master data:

Message:	01	06	18 01	22 11	06 06
Description	Address	Function code	Register address	Write data	CRC check code

Note: 0x1801-- Auxiliary control word, and 0x2211 is to save the value to EEPROM. This step is required

after the parameter has been modified, to prevent losing the written value after power-off.

4.2.3 0x10-- Write multiple data

Example E: Modify the configuration of digital input (DI)

Send message:01 10 01 46 00 04 08 00 00 00 28 00 00 00 29 1C 14

Receive message:01 10 01 46 00 04 21 E3

Details as following:

Master->slave data:

Message	01	10	01 46	00 04	08	00 00, 00 28, 00 00, 00 29	1C 14
Description	Address	Function code	Beginning address 0x0146	Number of registers	Number of bytes	Written value	CRC check code

Slave>master data:

Message	01	10	01 46	00 04	21 E3
Description	Address	Function code	Beginning address 0x0146	Number of registers	CRC check code

Note:

- (1) In above example, modify the function of DI2/DI3, and write the value as DI2=0x28 (means path address 0), DI2=0x29 (means path address 1);
- (2) The data type of parameter is 32bit,which include high 16bit register and low 16bit register.usually , we use low 16bits only, but it need to take the high 16 bits as beginning when we read/write multiple parameters continuously.

4.3 Modbus RTU Parameters

4.3.1 Drive basic parameters

The data type of parameter is 32bit,which include high 16bit register and low 16bit register.usually , we use low 16bits only , but it need to take the high 16 bits as beginning when we read/write multiple parameters continuously.

Register Address	Parameter NO.	Definition	Description	Range	Default value	unit
0x0001	Pr0.00	Pulse/revolution	Can not be modified	200-51200	10000	P/R
0x0005	Pr0.02	Control mode source	Invalid	0-10	1	--
0x0007	Pr0.03	Motor direction	0: CW	0-1	0	--

			1:CCW			
0x0009	Pr0.04	Motor inductance	Invalid	0-10000	1499	0.001m H
0x00A1	Pr2.00	Command filter time	To configure the time for internal command filtering	0-512	15	0.1ms
0x0145	Pr4.02	DI1(input 1)	Default is normal-open(N.O) type, it can be set to normal-closed(N.C) type by setting the corresponding port +0x80 DI1 is enable(default), N.C type input. 0:invalid; 7:alarm clear; 8:enable; 0x20:Trigger; 0x21: homing Trigger; 0x22: emergency stop; 0x23: CW JOG; 0x24: CCW JOG; 0x25: positive limit; 0x26: negative limit; 0x27: homing signal; 0x28: path address 0; 0x29: path address 1; 0x2A: path address 2; 0x2B: path address 3;	0-65535	136 (0x88)	--
0x0147	Pr4.03	DI2(input 2)		0-65535	0	--
0x0149	Pr4.04	DI3(input 3)		0-65535	0	--
0x014B	Pr4.05	DI4(input 4)		0-65535	0	--
0x014D	Pr4.06	DI5(input 5)		0-65535	0	--
0x014F	Pr4.07	DI6(input 6)		0-65535	0	--
0x0151	Pr4.08	DI7(input 7)		0-65535	0	--
0x0157	Pr4.11	DO1(output 1)		Default is normal-open(N.O) type, it can be set to normal-closed(N.C) type by setting the corresponding port +0x80 0:invalid; 0x20: command completed; 0x21: path completed; 0x22: homing completed; 0x23: in-position completed; 0x24: brake output; 0x25: alarm output;	0-65535	0
0x0159	Pr4.12	DO2(output 2)	0-65535		0	--
0x015B	Pr4.13	DO3(output 3)	0-65535		0	--
0x0167	Pr4.19	delay of brake released	Keep default normally	0-1500	250	ms
0x0169	Pr4.20	delay of brake locked	Keep default normally	0-1500	250	ms
0x016B	Pr4.21	Threshold value of brake locking speed	Keep default normally	0-500	10	--

0x0177	Pr4.27	Bus-voltage	Invalid	0-65535	0	0.1V
0x0179	Pr4.28	Input status	Bit0-Bit6: DI1-DI7	0-65535	0	--
0x017B	Pr4.29	Output status	Bit0-Bit2: DO1-DO3	0-65535	0	--
0x0187	Pr4.35	DIP switches status	Invalid	0-65535	0	--
0x0191	Pr5.00	Output peak current	Default is 1.0A (the value is refer to the 1.2 - 1.4 times of motor rated current)	0-56	10	0.1A
0x0197	Pr5.03	Percentage of shaft locked current(power on)	Keep default normally	0-100	100	--
0x0199	Pr5.04	shaft locking time	Keep default normally	0-1500	200	1ms
0x019F	Pr5.07	Rising time of shaft locked current (power on)	Keep default normally	1-60	1	100ms
0x01A5	Pr5.10	The max Stop time	Keep default normally	100-1000	1000	ms
0x01AB	Pr5.13	Auto tuning	0--No, 1--Yes	0-1	1	--
0x01BD	Pr5.22	RS485 baud rate	When SW6 and SW7 are all OFF, it can be set by PC software. 0:2400 1:4800 2:9600 3:19200 4:38400 5:57600 6:115200	0-6	4	--
0x01BF	Pr5.23	RS485 ID	When SW1- SW5 are all ON, it can be set by PC software	0-127	1	--
0x01C1	Pr5.24	RS485 data type	0: 8-bit data, even check, 2 stop bits; 1: 8-bit data, odd check, 2 stop bits 2: 8-bit data, even check, 1 stop bit; 3: 8-bit data, odd check, 1 stop bit: 4: 8-bit data, no check,1 stop bit: 5: 8-bit data, no check,2 stop bits;	0-11	4	--
0x01C3	Pr5.25	RS485 control word	-	0-32767	0	--
0x01D1	Pr5.32	Holding time	The time when dynamic current becomes idle current	10-65535	200	ms
0x01D3	Pr5.33	Percentage of holding current	Idle current setting	0-100	50	

0x01E1	Pr6.00	JOG speed	This JOG is triggered by RS485. For JOG triggered by IO, please use Pr8.40/8.41	0-5000	60	r/min
0x01E3	Pr6.01	Interval		0-10000	100	ms
0x01E5	Pr6.02	Running times		0-30000	1	--
0x01E7	Pr6.03	Acceleration		0-10000	200	--
0x01FF	Pr6.15	version	Invalid	0-65535	0	--
0x0201	Pr6.16	version	Invalid	0-65535	0	--
0x0231	Pr7.00	Motor model	Invalid	0-100	0	--
0x0235	Pr7.02	Back EMF coefficient	Invalid	0-32767	100	1ms
0x0237	Pr7.03	Current loop Kp	When auto-tuning is disabled, this can be modified	0-3000	1500	--
0x0239	Pr7.04	Current loop Ki		0-1500	300	--
0x023B	Pr7.05	Adjustment Percentage of current loop	Invalid	0-1024	100	--
0x023D	Pr7.06	Current loop Kc	Invalid	0-32767	300	--
0x0243	Pr7.09	Over voltage threshold	Invalid	0-1000	90	V

4.3.2 Status monitoring parameters

Register address	definition	operation	unit	description
0x1003	running state	R	/	Bit0: faulty Bit1: enable Bit2: running Bit4: Command completed Bit5: path completed Bit6: Homing completed

4.3.3 Auxiliary function parameters

- (1) The related function is started by sending the control word,
- (2) The completion is judged by checking the status word. The status word is automatically returned to its initial state after it is read.

Control word:

Register address	definition	operation	unit	description
0x1801	Control word	W	/	Below table

Control word	Auxiliary function
0x1111	Reset current alarm

0x1122	Reset history alarm
0x2211	Save all parameters to EEPROM
0x2222	Parameter reset(exclude motor parameters)
0x2233	All parameters are reset to default values
0X4001	JOG CW(100ms/time)*
0X4002	JOG CCW(100ms/time)*

Note:

(1) The continuous movement is triggered only when interval is less than 100ms, otherwise, it is only JOG movement .

Status word of Saving Parameter:

Register address	definition	operation	unit	description
0x1901	status word	R	/	Below table

Status word	Description
0x5555	Saving parameter OK
0xAAAA	Saving parameter fault

4.3.4 Input and output function configuration

Digital Input port function assignment:

bit7 =0: normal-open (N.O); bit7 =1: normal-closed (N.C).

Definition	Symbol	Setting value		Description
		N.O	N.C	
Invalid	—	00h	—	
Trigger instructions	CTRG	20h	A0h	
Homing trigger	HOME	21h	A1h	
Emergency stop	STP	22h	A2h	
JOG CW	PJOG	23h	A3	
JOG CCW	NJOG	24h	A4h	
Positive limit	POT	25h	A5	
Negative limit	NOT	26h	A6h	
homing signal	ORG	27h	A7h	
path address0	ADDR0	28h	A8h	
path address1	ADDR1	29h	A9h	
path address2	ADDR2	2Ah	AAh	
path address3	ADDR3	2Bh	ABh	
enable	SRV-ON	8h	88h	

Digital Output port function assignment

bit7 =0: normal-open (N.O); bit7 =1: normal-closed (N.C).

Definition	Symbol	setting value		Description
		N.O	N.C	
Invalid	—	00h	80h	
Command completed	CMD_OK	20h	A0h	
Path completed	MC_OK	21h	A1h	
homing completed	HOME_OK	22h	A2h	
in-position completed	INP	23h	A3h	
brake output	BRK	24h	A4h	
Alarm output	ALM	25h	A5h	

Note:

- (1) When the functionality of multiple input or output ports is repeatedly set up, you need to restart the drive to detect errors
- (2) After modifying and saving the input or output function configuration, it needs to restart power make configuration valid.

4.4 Error Codes and Troubleshooting

4.4.1 Communication error code

No.	Return Instructions (slave->master)		
1	ID	Slave ID	0-31
2	FC	Function code	FC+0x80
3	Error code	Address	-
4	CRC	check code	Low
			High

Error code:

Return Error Code	Description
0x01	Wrong FC(This supports FC beside of 01h/ 03h/ 05h/ 08h/ 0Fh/ 10h)
0x02	Wrong access address
0x03	Wrong data, the data written over limit
0x08	Wrong CRC check code

Example F: CRC check code error

Master-> slave data::

Message	01	03	00 01	00 01	D5 C1
Description	address	Function code	Register address	Read Number of registers	CRC check code

slave-> Master data:

Message	01	83	08	40 F6
Description	address	Function code+0x80	Error code	CRC check code

Example F: Function code error

Master-> slave data::

Message	01	02	00 01	00 01	E8 0A
Description	address	Function code	Register address	Read Number of registers	CRC check code







slave-> Master data:

Message	01	82	01	81 60
Description	address	Function code+0x80	Error code	CRC check code

4.4.2 Alarm information parameter

Register Address	definition	operation	unit	description
0x2203	Current alarm	R	/	Below table

Error code and cause:

Error code	Content	RED LED flash times	Sequence wave of RED LED
0x01	Over current	1	
0x02	Over voltage	2	
0x40	Current sampling circuit error	3	
0x80	Shaft locking error	4	
0x200	EEPROM error	5	
0x100	Parameter auto tuning error	6	

4.4.3 LED display and troubleshooting

The green light is always on after the drive power on. When the error is occurred, the drive will stop working and red light will be flashed indicates the current error code. Whatever error occurs, the user need to power off the drive and restart it after removing the error.

The user can read the corresponding error code through the PC software. The latest errors will be saved to EEPROM which supports 10 historical errors in the list.

he red LED is the error indicator, which flashes periodically for 5 seconds in the event of error occurred. The flash frequency of red LED is 2Hz, that is 200ms on and 300ms off.

4.4.4 Troubleshooting

Symptoms	Possible Problems	Solutions
Green LED is off	Power is off	Check the power connection
Red LED flash 1 times	Over current	Re-power; If the error is still existed after re-power,, then check the motor connection (circuit short or not)
Red LED flash 2 times	Over voltage	Re-power; If the error is still existed after re-power, check the power supply(voltage is too high)
Red LED flash 3 times	Amplifier error	Re-power; If the error is still existed after re-power, hardware issue .

Red LED flash 4 times	Shaft locking error	Check the motor wiring whether broken or not
Red LED flash 5 times	Storage error	Connect to Leadshine ProTuner and reset drive; If the error is still existed after parameter setting, hardware issue.
Red LED flash 6 times	Parameter auto tuning error	Restart power; Close auto tuning function via Leadshine ProTuner
Motor not running	Disabled Motor shaft	Check whether the enable input is configured or not and is normal closed
Can not connect to master	Communication error	Check the network cable RS485 ID setting is not correct(check the address setting)

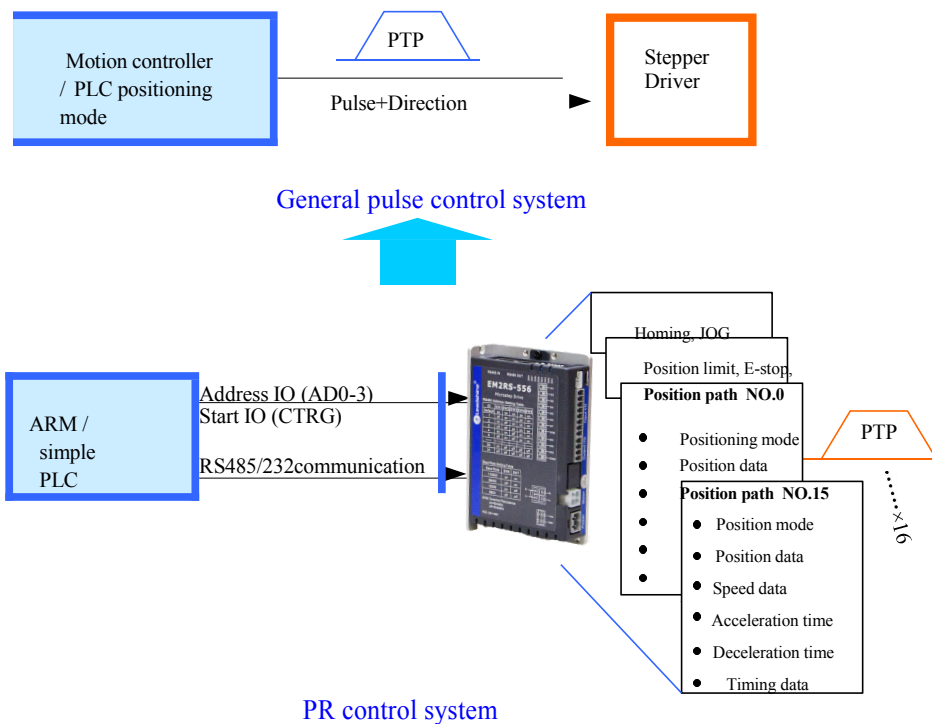
4.4.5 Error clear

Check the error via Leadshine ProTuner

Current Error	Current happened error	Over current,over voltage,etc
History error	History happened error .	Over current,over voltage,etc
Read error	Read Historical error .	Check the Historical happened error .
Clear current error	Current error	(1) It can clear over voltage error, but can not clear over current error; (2) There are two methods to clear the current alarm: one is via Leadshine ProTuner, and the second is via external I/O. (3) If the current error cannot be cleared, please check the drive
Clear history error	History error	All history error records can be cleared by Leadshine ProTuner

5 PR Functions

PR is uni-axial motion control function which is controlled by procedure software. Mainly uni-axial motion instructions control to, save the motion control function of the controller.



5.1 PR Main Features

Features	Description
Homing	<p>The drive can detect homing signal by homing processing, and confirm the homing point of mechanical coordinate system</p> <ul style="list-style-type: none"> ● Homing by detecting limit signal, homing by detecting original signal, set homing point by manual; ● Homing direction can be set; ● Homing offset can be set; ● move to the Specified position after homing; ● Acc/Dec of homing speed can be set; <p>Note: 1) Control instruction can not be sent to drive during homing 2) The above functions are valid at PR mode only</p>
JOG	<p>JOG can be realized by IO or RS485, which can be used for debugging.</p> <ul style="list-style-type: none"> ● CW JOG; ● CCW JOG; ● JOG teaching function; ● the speed and ACC of JOG can be set; <p>Note: JOG function triggered by input signal level</p>
Limit	<p>Protect the machine by limiting the working area range</p> <ul style="list-style-type: none"> ● Positive/negative hardware limit; ● Software limit setting; ● Acc/Dec limit can be set <p>Note: 1) software limit is valid after homing completed; 2) The above functions is valid at PR mode only</p>
Emergency stop	<p>The movement stop immediately when the emergency stop input is on. it is valid at PR mode only</p>
Positioning	<p>Select the positioning path number by positioning the address IO (ADD0-3), and then start the positioning path movement by starting IO (CTRG) or RS485</p> <ul style="list-style-type: none"> ● Include positioning mode, speed mode, homing mode ● Support IO rising edge trigger, double edge trigger, level trigger, RS485 trigger ● Support continuously positioning ● The max is 16 segments ● Position, speed, ACC/DEC can be set ● pause time or timing time can be set ● support interrupt, re, jump and other functions
RS485 control	<p>The above PR functions are controlled by RS485</p>

Note:

1) In PR control mode, the Pulse/revolution is 10000P/r and can not be modified 2) PR mode is valid when P0.01=0.

5.2 Homing

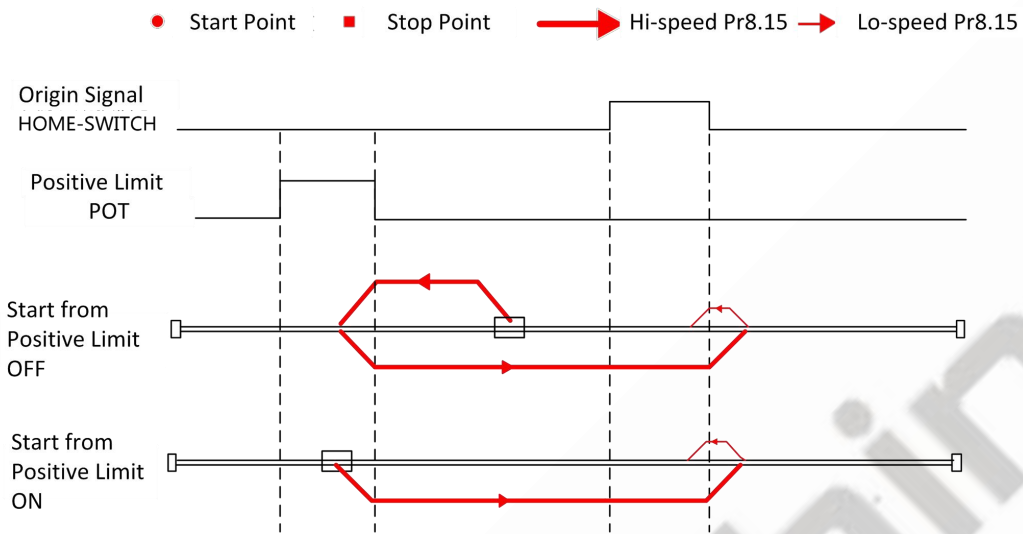
Homing includes Homing by detecting limit signal , homing by detecting original signal, set homing point by manual, auto homing after enabling drive.

5.2.1 Parameters

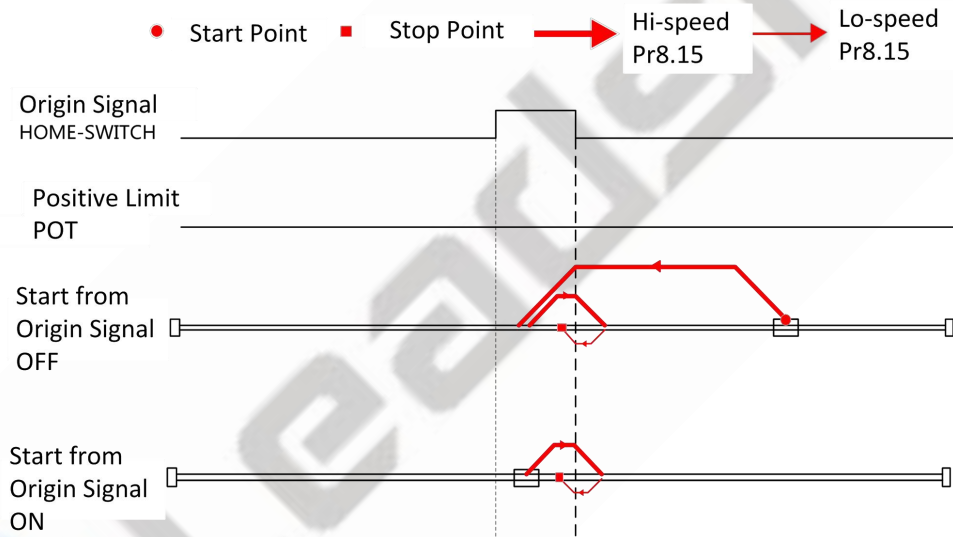
Parameters	Register address	Definition	Description
Pr8.10	0x600A	Homing mode	Bit0: homing direction =0:CCW; =1:CW. Bit1: move to the Specified position after homing? =0: No; =1: Yes. Bit2: homing type =0: Homing by detecting limit signal =1: Homing by detecting origin signal Note: (1) Write 0x21 to the address 0x6002, or click the "manual homing" button to set the current point to origin signal); (2) Write 1 to the bit2 of address 0x6000 can set to auto-homing after enabling drive; (3) Except for all of the above, the other homing mode is invalid.
Pr8.11	0x600B	Origin signal position high bits	The origin signal position on the coordinate system . Pr8.11 is high 16 bits, and Pr8.12 is low 16 bits
Pr8.12	0x600C	Origin signal low bits	
Pr8.13	0x600D	Homing stop position high bits	The motor moves to the Specified position after homing. If bit1 of Pr8.10=1, the motor will move to Specified absolute position. Pr813 is high 16 bits , and Pr814 is low 16 bits.
Pr8.14	0x600E	Homing stop position low bits	
Pr8.15	0x600F	Homing high speed	The 1 st segment speed of homing, unit: rpm
Pr8.16	0x6010	Homing low speed	The 2 nd segment speed of homing, unit: rpm
Pr8.17	0x6011	Homing Acc	Acc of homing, unit: ms/1000rpm
Pr8.18	0x6012	Homing Dec	Dec of homing, unit: ms/1000rpm
Note: Generally homing to find the origin signal, the motion is decelerating to stop, so after finding the origin will also move a distance, resulting in the actual read position value may not be 0, but in fact the position is accurate, and will output homing completion signal. If the motion is an absolute position mode, it does not matter whether the origin is at 0. But if the user does care about the 0 position, you can set the parameters by PC software			

5.2.2. Homing by Origin Signal

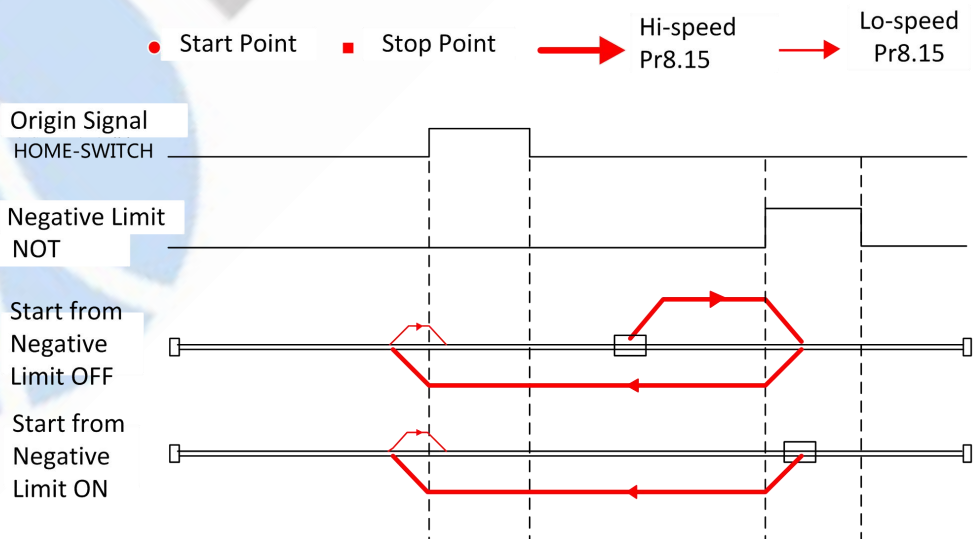
(1) Origin Signal and Positive Limit Switch



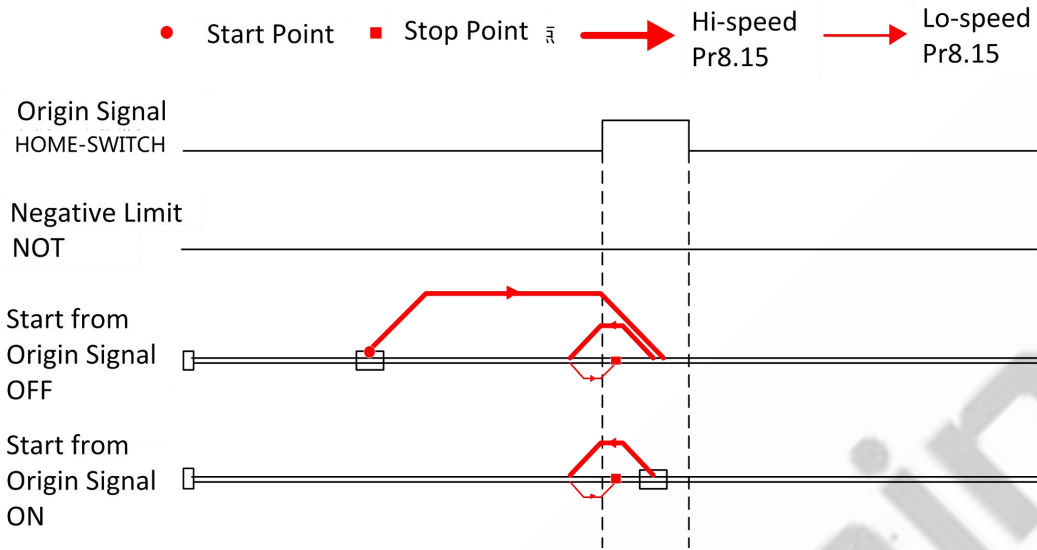
(2) Origin Signal at Positive Direction



(3) Origin Signal and Negative Limit Switch

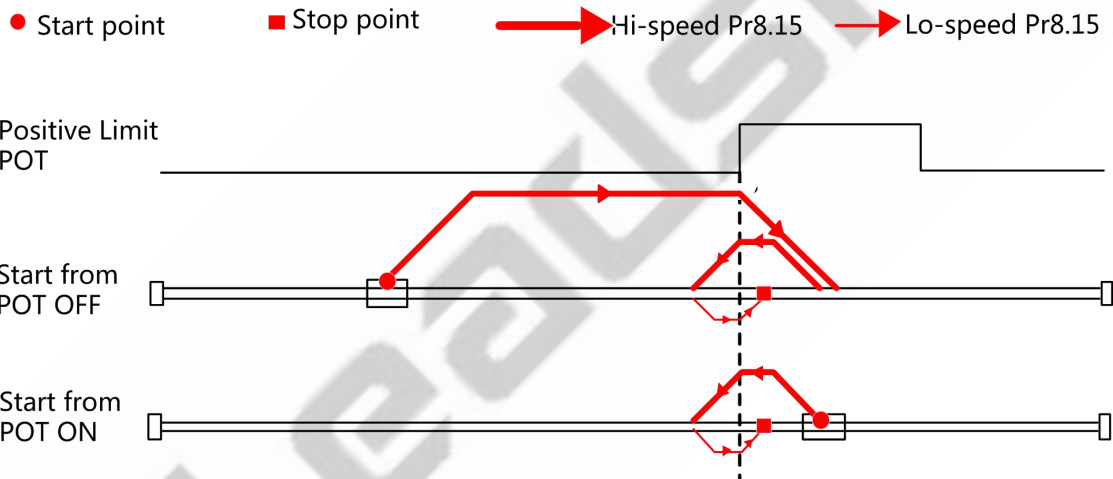


(4) Origin Signal at Negative Direction

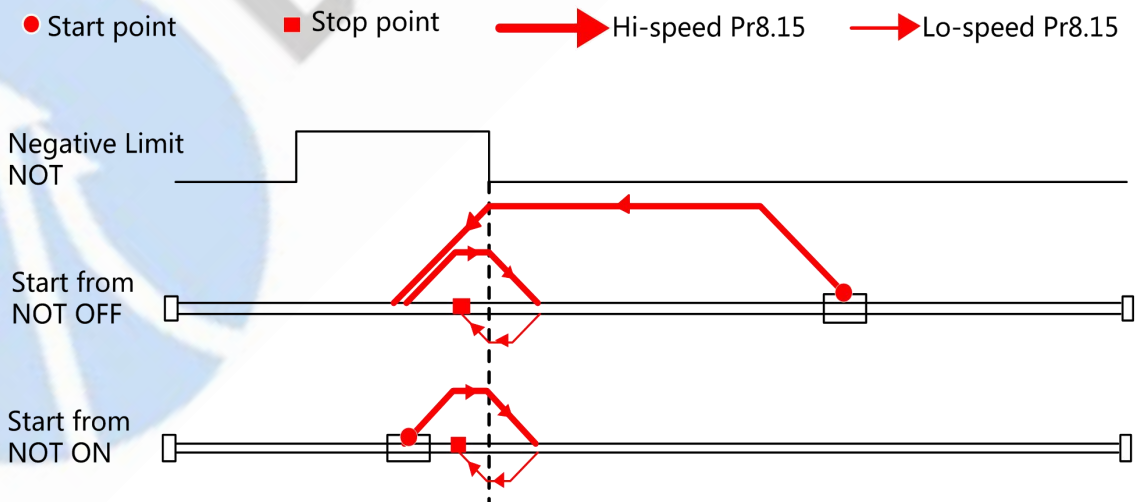


5.2.3. Homing by Limit Switch

(1) Positive Limit Switch



(2) Negative Limit Switch



5.3 Position limit, JOG and E-stop function

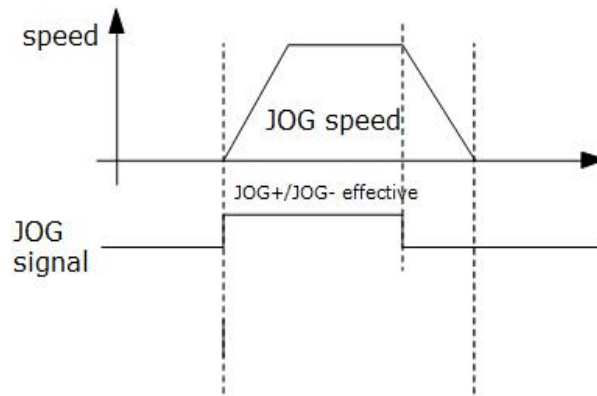
Parameter	Register address	Definition	Description															
Pr8.00	0x6000	PR Control parameter	Bit1: Software limit is valid															
Pr8.06	0x6006	Limit+ H	Software limit positive high bits															
Pr8.07	0x6007	Limit+ L	Software limit positive low bits															
Pr8.08	0x6008	Limit- H	Software limit negative high bits															
Pr8.09	0x6009	Limit- L	Software limit negative low bits															
Pr8.22	0x6016	Limit stop time	Deceleration time after limit, unit:ms															
Pr8.23	0x6017	E-STOP time	Deceleration time after emergency stop, unit:ms															
Pr8.39	0x6027	JOG Speed	Unit: rpm															
Pr8.40	0x6028	JOG Acceleration	Unit: ms/1000rpm															
Pr8.41	0x6029	JOG Deceleration	Unit: ms/1000rpm															
Pr8.42	0x602A	Profile position H	Read only, High 16-bit (0-65535)															
Pr8.43	0x602B	Profile position L	Read only, Low 16-bit (0-65535)															
Pr8.44	0x602C	Actual position H	Read only, High 16-bit (0-65535)															
Pr8.45	0x602D	Actual position H	Read only, Low 16-bit (0-65535)															
Pr4.02	0x0145	Input port DI1	<table border="1"> <tr> <td>Forced E-stop</td> <td>STP</td> <td>22h</td> </tr> <tr> <td>Forward JOG</td> <td>JOG+</td> <td>23h</td> </tr> <tr> <td>ReverseJOG</td> <td>JOG-</td> <td>24h</td> </tr> <tr> <td>Positive limit</td> <td>PL</td> <td>25h</td> </tr> <tr> <td>Negative limit</td> <td>NL</td> <td>26h</td> </tr> </table>	Forced E-stop	STP	22h	Forward JOG	JOG+	23h	ReverseJOG	JOG-	24h	Positive limit	PL	25h	Negative limit	NL	26h
Forced E-stop	STP	22h																
Forward JOG	JOG+	23h																
ReverseJOG	JOG-	24h																
Positive limit	PL	25h																
Negative limit	NL	26h																
Pr4.03	0x0147	Input port DI2																
Pr4.04	0x0149	Input port DI3																
Pr4.05	0x014B	Input port DI4																
Pr4.06	0x014D	Input port DI5																
Pr4.07	0x014F	Input port DI6																
Pr4.08	0x0151	Input port DI7																

Note:

- (1) Pr8.40 (JOG Acceleration) and Pr8.41(JOG Deceleration) are available when triggered by I/O
- (2) Pr6.03 (JOG Acc/Dec) is available when triggered by RS485

5.3.1 JOG

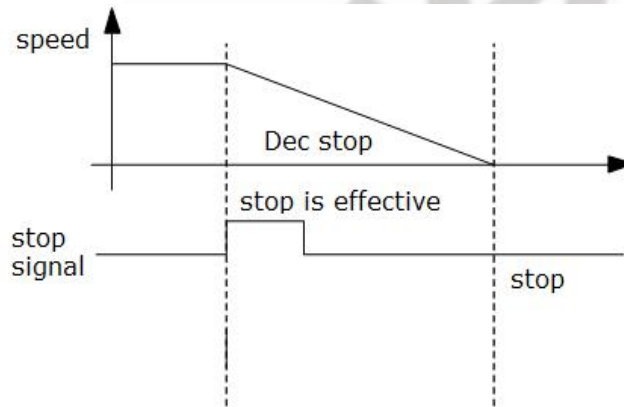
JOG function



JOG time sequence

5.3.2 Limit and E-stop

Used for emergency stops



E-stop time sequence

5.4 Trigger Method

Parameter	Register address	Definition	Description
Pr8.00	0x6000	PR control setting	Global Control function of PR: Bit0: CTRG =0: Rising edge trigger =1: Double edge trigger; Bit1: =0: Software limit is invalid =1: Software limit is valid; Bit2: =0: homing after power up is invalid =1: homing after power up is valid; Bit4: =0: level trigger is invalid =1: level trigger is valid; (if bit4=1, both the trigger type setting of bit0 and triggered by RS485 are invalid)
Pr8.02	0x6002	Trigger register	Write corresponding command to the 0x6002 to realize the selection and startup of each action. Write value 0x01P----P-segment positioning, (P indicates path NO. 0-15); Write value 0x020---- Homing; (edge triggered) Write value 0x021---- Set the current position as origin by manual; Write value 0x040---- E-stop; Read value 0x000---- Positioning is completed and new data can be received; Read value 0x01P, 0x020, 0x040---- Not responding to the command; Read value 0x10P---- Path is running; Read value 0x200---- Command is completed and waiting for positioning. Note: (P indicates path NO. 0-15);

5.4.1 Fixed trigger method

Fixed trigger mode is after configuring homing and path (less than 16-segment), then use Pr8.02(0x6002) to start the operation path which replace CTRG and HOME. This mode apply to fixed motion and simple operation system.

Steps as below:

1. Firstly, configure required homing and path, it can be set through controller/PLC software after power-on , or through Leadshine PC software;
2. Enable drive;
3. Write corresponding command to the 0x6002 to realize the selection and startup of each action.
 - Write value 0x01P----P-segment positioning, (P indicates path NO. 0-15);
 - Write value 0x020---- Homing; (edge triggered)
 - Write value 0x021---- Set the current position as origin by manual;
 - Write value 0x040---- E-stop;
 - Read value 0x000---- Positioning is completed and new data can be received;
 - Read value 0x01P, 0x020, 0x040---- Not responding to the command; (P indicates path NO. 0-15)
 - Read value 0x10P---- Path is running; (P indicates path NO. 0-15)
 - Read value 0x200---- Command is completed and waiting for positioning.

5.4.2 Immediately trigger method

Fixed trigger is limited by 16-segment position, but immediately trigger method is more flexible, so that the current path is written at the same time as it is triggered. And can realize position, speed , homing and such actions by a data frame.

This method uses PR path0 which has 8 data in total to implement, the last data Pr9.07 of it will mapped to Pr8.02, if write in 0x10 can trigger PR path0 motion immediately.

Steps as below:

1. Firstly, configure required homing and path, it can be set through controller/PLC software after power-on , or through Leadshine PC software;
2. Enable drive.
3. Operate fixed path by Pr8.02 (0x6002)
4. Or write in immediate data by Pr9.00-9.07, and Pr9.07=0x10, implement immediately running path 0.

For example:

Order	Sending orders (Master->Slave)			Return command (Slave->Master)		
1	ID	Slave ID.	0-31	ID	Sub-station No.	0-31
2	FC	Function code	0x10	FC	Function code	0x10
3	ADDR	Address	0x62	ADDR	Address	0x62
4			0x00			0x00
5	NUM1	Number of Word	0x00	NUM	Actually written Number of	0x00
6			0x08			0x08
7	NUM2	Number of Byte	0x10	CRC	check code	Lo
						Hi
8-9	Pr9.00	Mode	XXXX			

10-11	Pr9.01	High position	XXXX			
12-13	Pr9.02	Low position	XXXX			
14-15	Pr9.03	Speed	XXXX			
16-17	Pr9.04	Acceleration	XXXX			
18-19	Pr9.05	Deceleration	XXXX			
20-21	Pr9.06	Delay time	XXXX			
22-23	Pr9.07	Trigger control	0x0010			
24	CRC	Check code	Lo			
25			Hi			

5.5 Trigger Path

The positioning path can be run with single segment movement or continuous movement, which includes three motion types: position positioning type, speed movement type, homing type, There are 16 PR paths, and each path sets the motion type, the position mode, the speed, the acceleration and deceleration and the pause time.

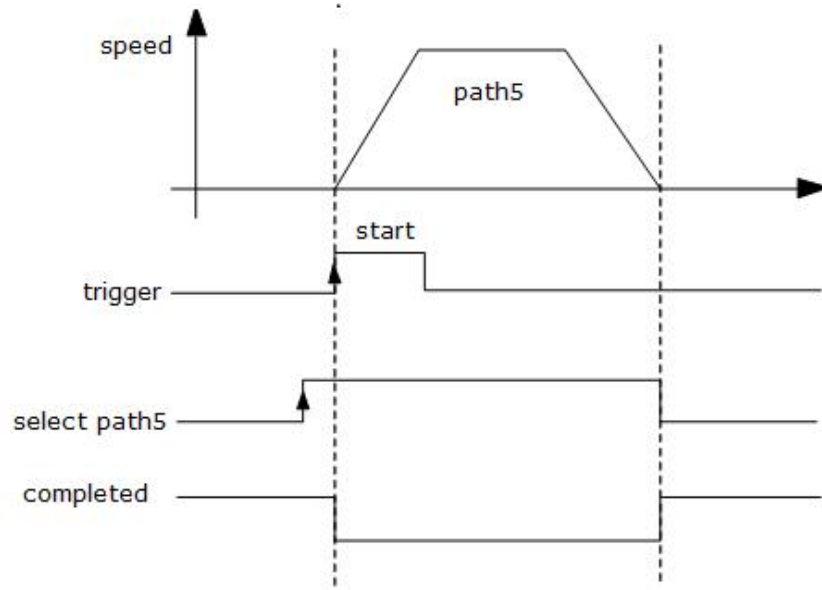
5.5.1 Related parameters

NO.	Register Address	Definition	Description
Pr9.00	0x6200	PR path 0	The corresponding functions can be selected for different bit Bit0-3: TYPE, =0---- no action =1---- position positioning =2---- speed movement =3---- homing; Bit4: INS, =0---- No interrupt =1---- interrupt(all the current ones are 1.); Bit5: OVLP, =0---- Non overlapping =1---- Overlapping Bit6: =0----absolute position =1----relative instructions Bit8-13: Jump to the corresponding PR path 0-15; bit14: JUMP, =0---- No jump =1---- jump
Pr9.01	0x6201	Position H	High 16 bit,

Pr9.02	0x6202	Position L	Low 16 bit
Pr9.03	0x6203	Speed	Unit: rpm
Pr9.04	0x6204	Acc	Unit: ms/1000rpm
Pr9.05	0x6205	Dec	Unit: ms/1000rpm
Pr9.06	0x6206	Suspend time	Suspend time after the command is stopped
Pr9.07	0x6207	Special parameter	PR Path 0 maps directly to Pr8.02, Others are reserved
Pr9.08	0x6208	PR path 1	---
Pr9.09	0x6209	Position	---
Pr9.10	0x620A	Position	---
Pr9.11	0x620B	Speed	---
Pr9.12	0x620C	Acc	---
Pr9.13	0x620D	Dec	---
Pr9.14	0x620E	Suspend time	---
Pr9.15	0x620F	Special parameter	---
Pr9.16	0x6210	PR path 2	---
Pr9.17	0x6211	Position	---
Pr9.18	0x6212	Position	---
Pr9.19	0x6213	Speed	---
Pr9.20	0x6214	Acc	---
Pr9.21	0x6215	Dec	---
Pr9.22	0x6216	Suspend time	---
Pr9.23	0x6217	Special parameter	---
Pr9.24- Pr9.31	Similar as above paths	Similar as above paths	Each path has 8 data
Pr9.32- Pr9.39	Similar as above paths	Similar as above paths	Each path has 8 data
Pr9.40- Pr9.47	Similar as above paths	Similar as above paths	Each path has 8 data
Pr9.48- Pr9.55	Similar as above paths	Similar as above paths	Each path has 8 data
Pr9.56- Pr9.63	Similar as above paths	Similar as above paths	Each path has 8 data
Pr9.64- Pr9.71	Similar as above paths	Similar as above paths	Each path has 8 data

5.5.2 Timing sequence

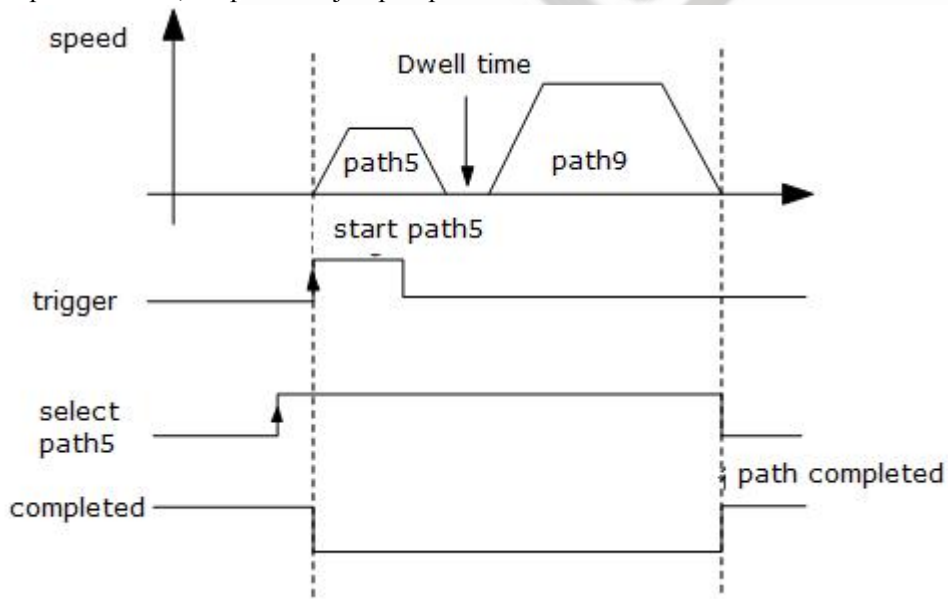
For example, the motion timing sequence after setting path 5



Single-end path sequence diagram

5.5.3 Multi-segment jump

For example: set paths 5 and 9, set path 5 to jump to path 9.

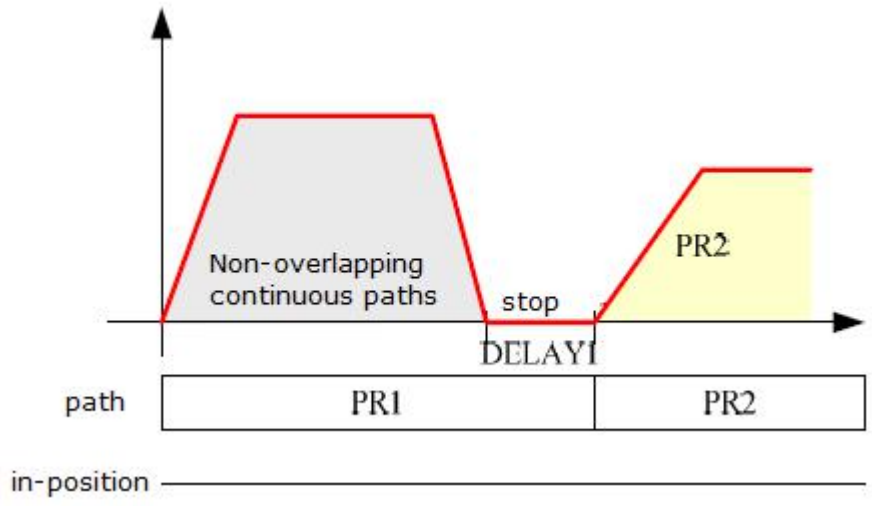


Multi-segment jump path sequence diagram

5.5.4 Continuous movement

The bit5 of Pr9.00 is 0, which does not overlap the continuous path.

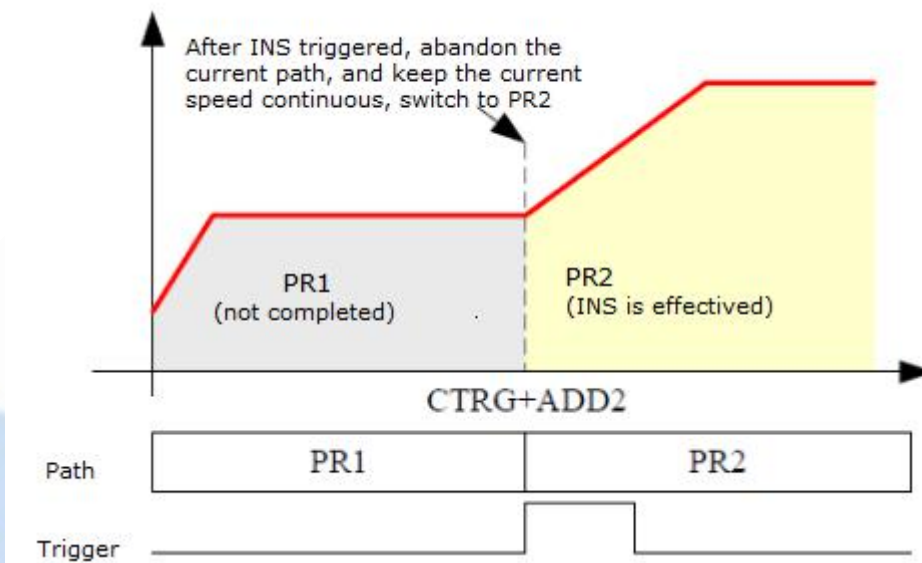
As shown in the figure below, set PR1 (PR path1) and PR2 (PR path2) to run continuously and PR1 jump. There is no in-position signal in the intermediate delay from PR1 jump to PR2.



Continuous movement timing sequence (no overlap).

5.5.5 Interrupt function

The interrupt function is the priority of a PR path. Interrupts a valid path means that interrupting and abandoning the current path under trigger, and runs another path directly, which is similar as Interrupt priority of function.. As below example, interrupt the PR1 (PR path1) to run PR2 (PR path2)



Interrupt function timing sequence

5.6 Trigger the Motion of Multi-Segment PR Path

You can configure up to 16 PR paths by digital input DI1-DI7.

5.6.1 16-segment PR paths, which can be selected by combination

Set DI1 as path address 0 (ADD0),

Set DI2 as path address 1 (ADD1),

Set DI3 as path address 2 (ADD2),

Set DI4 as path address 3 (ADD3),

Set DI5 as trigger (CTRG)

As shown in the table below, “on” means signal input on , “off“ means signal input off

IO / PR path	DI1 (ADD0)	DI2 (ADD1)	DI3 (ADD2)	DI4 (ADD3)	DI5 (CTRG)
Path 0	off	off	off	off	on
Path 1	on	off	off	off	on
Path 2	off	on	off	off	on
Path 3	on	on	off	off	on
Path 4	off	off	on	off	on
Path 5	on	off	on	off	on
Path 6	off	on	on	off	on
Path 7	on	on	on	off	on
Path 8	off	off	off	on	on
Path 9	on	off	off	on	on
Path 10	off	on	off	on	on
Path 11	on	on	off	on	on
Path 12	off	off	on	on	on
Path 13	on	off	on	on	on
Path 14	off	on	on	on	on
Path 15	on	on	on	on	on

5.6.2 8-segment PR path, which can be selected by combining

Set DI1 as path address 0 (ADD0),

Set DI2 as path address 1 (ADD1),

Set DI3 as path address 2 (ADD2),

Set DI5 as trigger (CTRG)

As shown in the table below, “on” means signal input on, “off” means signal input off

IO / PR path	DI1 (ADD0)	DI2 (ADD1)	DI3 (ADD2)	DI5 (CTRG)
Path 0	off	off	off	on
Path 1	on	off	off	on
Path 2	off	on	off	on
Path 3	on	on	off	on
Path 4	off	off	on	on
Path 5	on	off	on	on
Path 6	off	on	on	on
Path 7	on	on	on	on

5.6.3 4-section PR path, which can be selected by combining

Set DI1 as path address 0 (ADD0),

Set DI2 as path address 1 (ADD1),

Set DI5 as trigger (CTRG).

As shown in the table below, on means signal input on, off means signal input off

IO/running path	DI1 (ADD0)	DI2 (ADD1)	DI5 (CTRG)
Path 0	off	off	on
Path 1	on	off	on
Path 2	off	on	on
Path 3	on	on	on