IRO23 Integrated RS485 Open-loop Stepper Motor User's Manual

Integrated RS485 open-loop stepping motor User's Manual

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Foreword

Thank you for using our open-loop step drive.

Before using this product, please read this manual carefully to understand the necessary safety information, precautions, and operation methods. Incorrect operation can have extremely serious consequences.

This product is designed and manufactured without the ability to protect personal safety from mechanical system threats. Users are advised to consider safety precautions during mechanical system design and manufacturing to prevent accidents caused by improper operation or product abnormalities.

Due to product improvements, the contents of this manual are subject to change without notice. Our company will not be responsible for any modification of the product by the user.

> **Note:** Reminds you to pay attention to key points in the text.

> **Caution:** Indicates that incorrect operation may cause personal injury and equipment damage.

This product has passed the national mandatory 3C certification, CE certification, ROHS certification.

1. Overview

1.1 Product Introduction

IRO23 is a newly introduced digital integrated RS485 control drive motor. The driver is designed with 32-bit DSP digital processing technology, variable current technology, low heating technology, and more. It features low vibration, smooth running, low heating, high reliability, and other advantages.

Users can control the drive motor through RS485, which can meet the application needs of most occasions. Low, medium, and high-speed operation are very smooth, with ultra-low noise.

The driver internally integrates a power-on auto-adaptive motor function, which can automatically generate optimal operating parameters for different motors, maximizing the motor's performance.

1.2 Characteristics

- New 32 Bit DSP Technology
- Low vibration, low noise, smooth operation
- Automatic parameter power-on setting function
- Variable current control greatly reduces the heat generation of the motor
- Automatic halving of current at rest
- Can drive 4, 6, 8-wire two-phase stepping motors
- Photoelectric isolation of single-ended signal input (left limit, back to zero, right limit)
- Standard Modbus RS485 bus protocol
- Current setting is convenient and can be selected between 0.5-5.6 A
- Address dials set to 1-16
- Protection functions of overvoltage, undervoltage, and overcurrent

1.3 Application Areas

Suitable for a variety of small and medium-sized automatic equipment and instruments, such as: Engraving Machine, marking machine, cutting machine, medical equipment, laser phototypesetting, plotter, CNC machine tools, automatic assembly equipment.

Ideal for applications where the user expects low noise, low vibration, low heat, and high speed.

2. Performance Index

2.1 Electrical Characteristics

Explanation	**IRO23**			
	Minimum Value	**Typical Value**	**Maximal Value**	**Unit**
Continuous output current	0.5	-	5.6	A
Power Supply Voltage (DC)	15	24/36	50	VDC
Control signal input current	6	10	16	mA
Control signal input Voltage	-	5	-	VDC
Overvoltage point	54	55	56	VDC
Step frequency	1	-	1000	KHz
Insulation Resistance	100	-	-	MΩ

2.2 Suitable for Standard Motor

The integrated driver can be used for 57 open-loop hybrid stepper motors and linear screw stepper motors of different specifications from major motor manufacturers. The driver can be sold separately.

If you need to purchase our driver and motor complete set of products, we generally recommend the following two standard models. Other models of stepper motors or suitable screw stepper motors can be customized according to customer needs.

Model No.	**Holding Torque (N.m)**	**Motor Length (mm)**	**Driver Thickness (mm)**	**Weight (kg)**
IRO23-10	1.0	56±1	21.5±1	0.9
IRO23-20	2.0	80±1	21.5±1	1.2

> **Note:** The driver can be customized to match any specifications of 57 open-loop stepper motor and 57 open-loop linear screw motor.

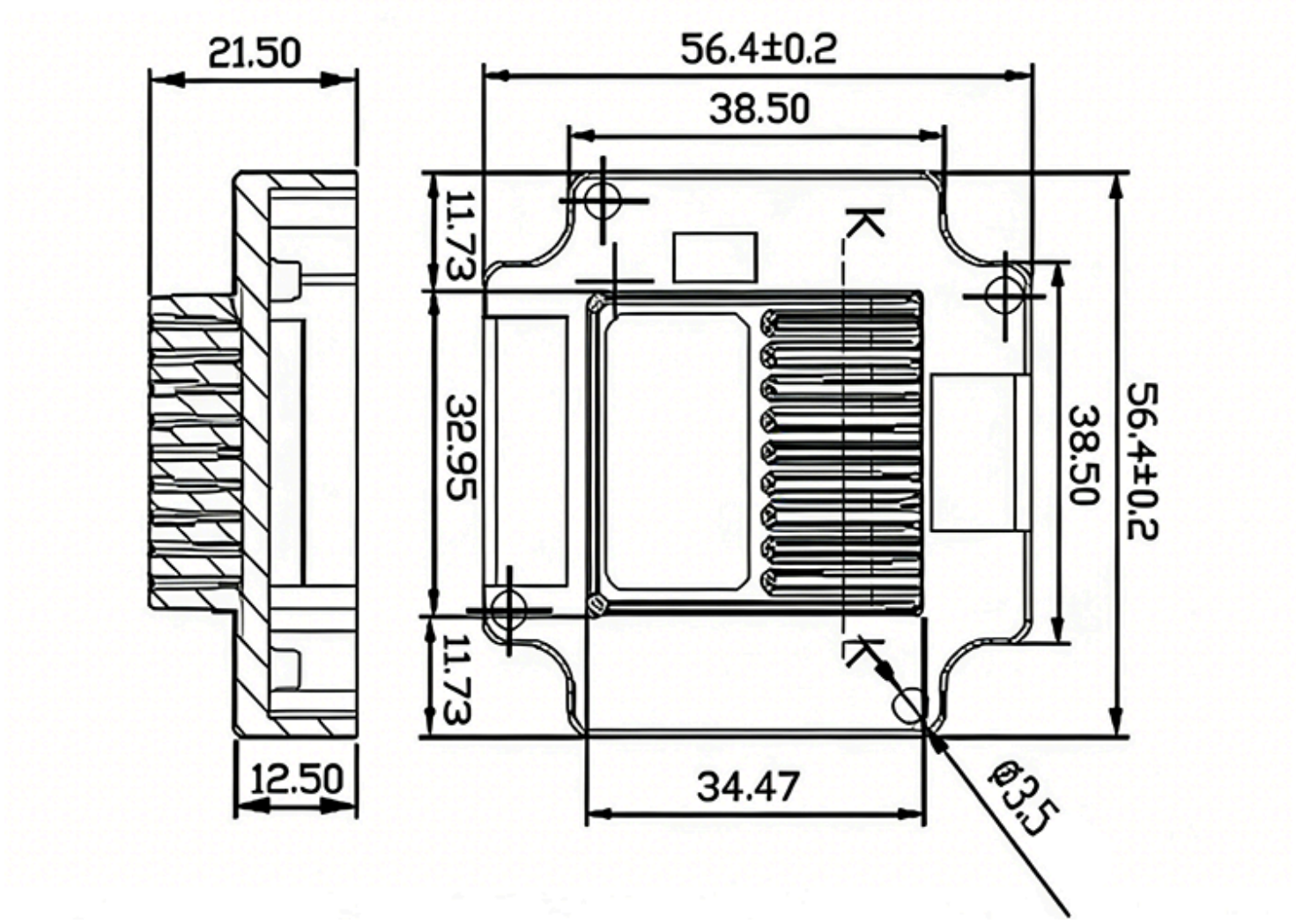
2.3 Use Environment

Cooling Mode	**Natural Cooling or forced air cooling**
Service Environment - Occasion	Cannot be placed next to other heating equipment. Avoid dust, oil mist, corrosive gases, high humidity, and strong vibration sites. Combustible gases and conductive dust are prohibited.
Temperature	-10°C ～ +50°C
Humidity	40 ～ 90% RH
Vibration	5.9 m/s² MAX
Storage temperature	-20°C ～ 60°C
Use Elevation	Below 1000 meters
Weight	0.7 KG

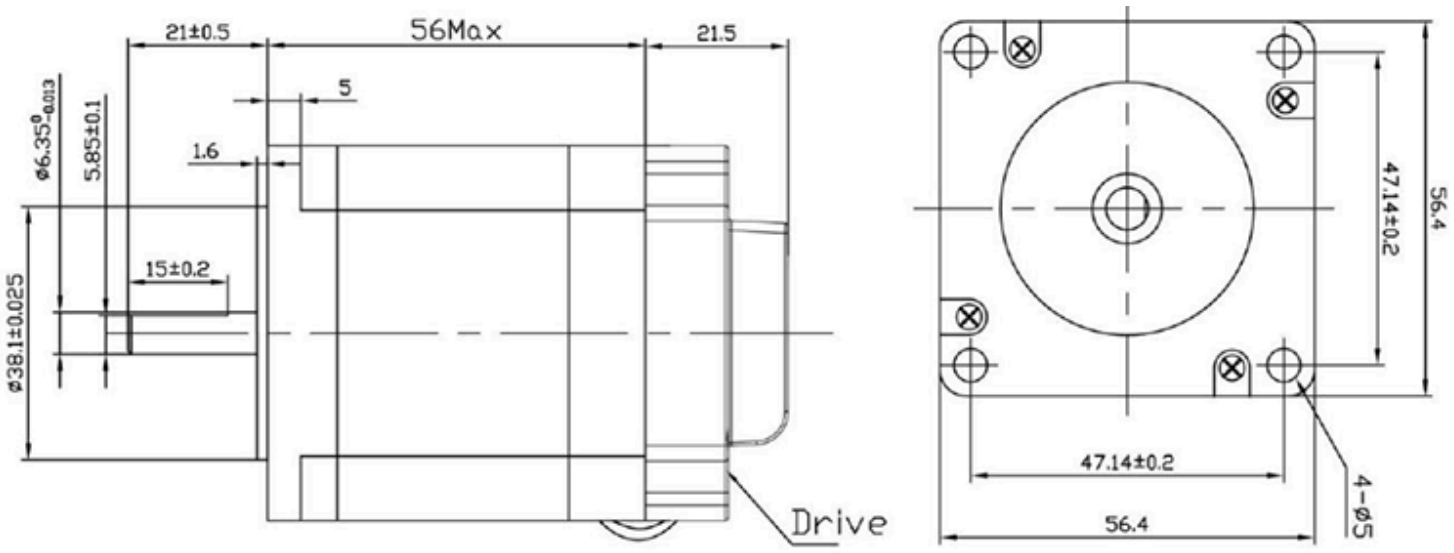
3. Installation

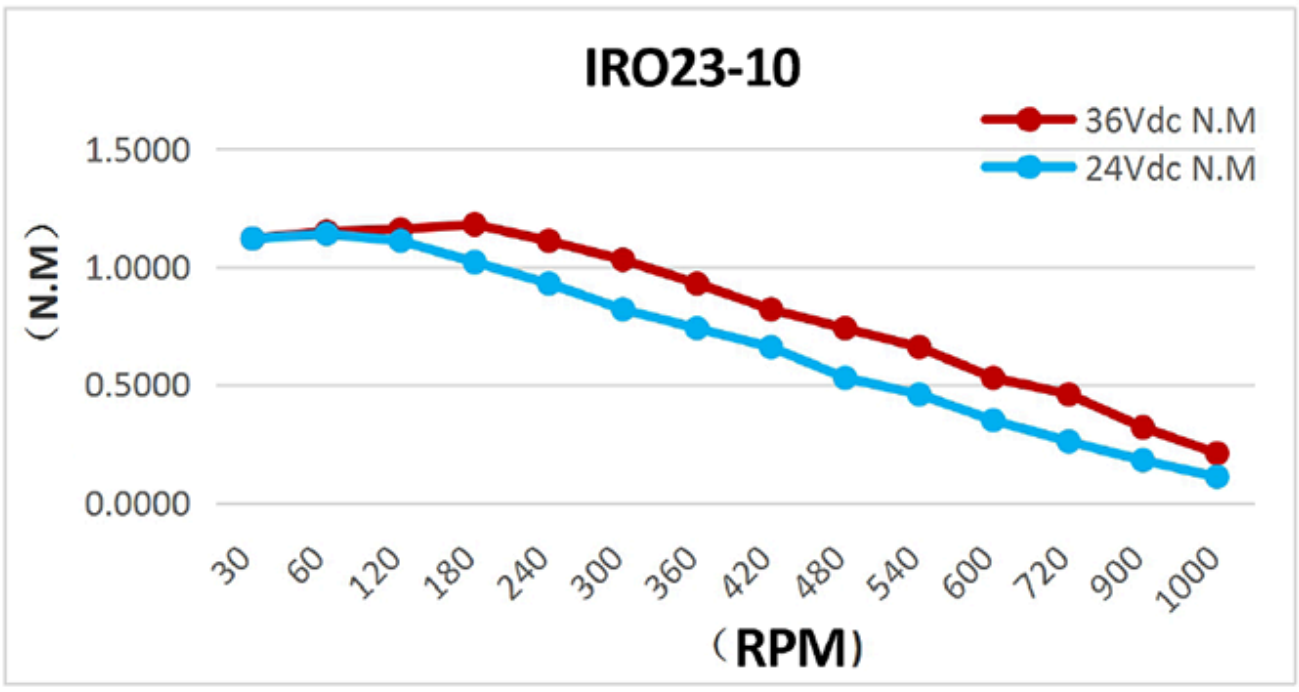
3.1 Mounting Dimensions

IRO23 RS485 stepper motor driver dimensions:

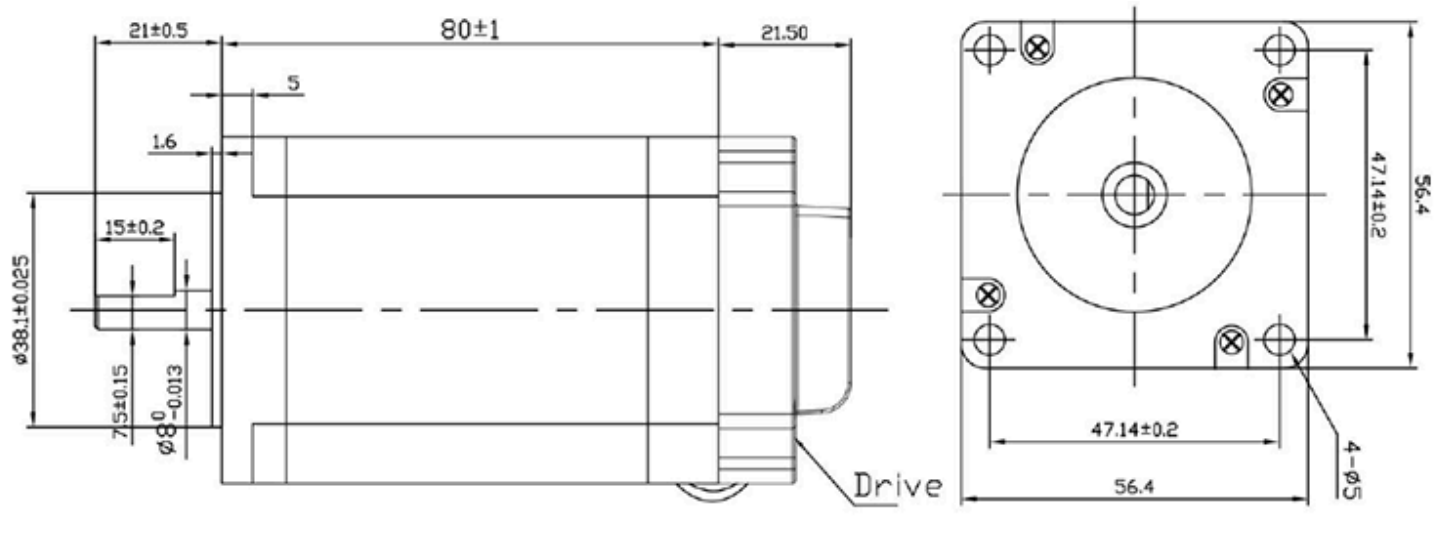


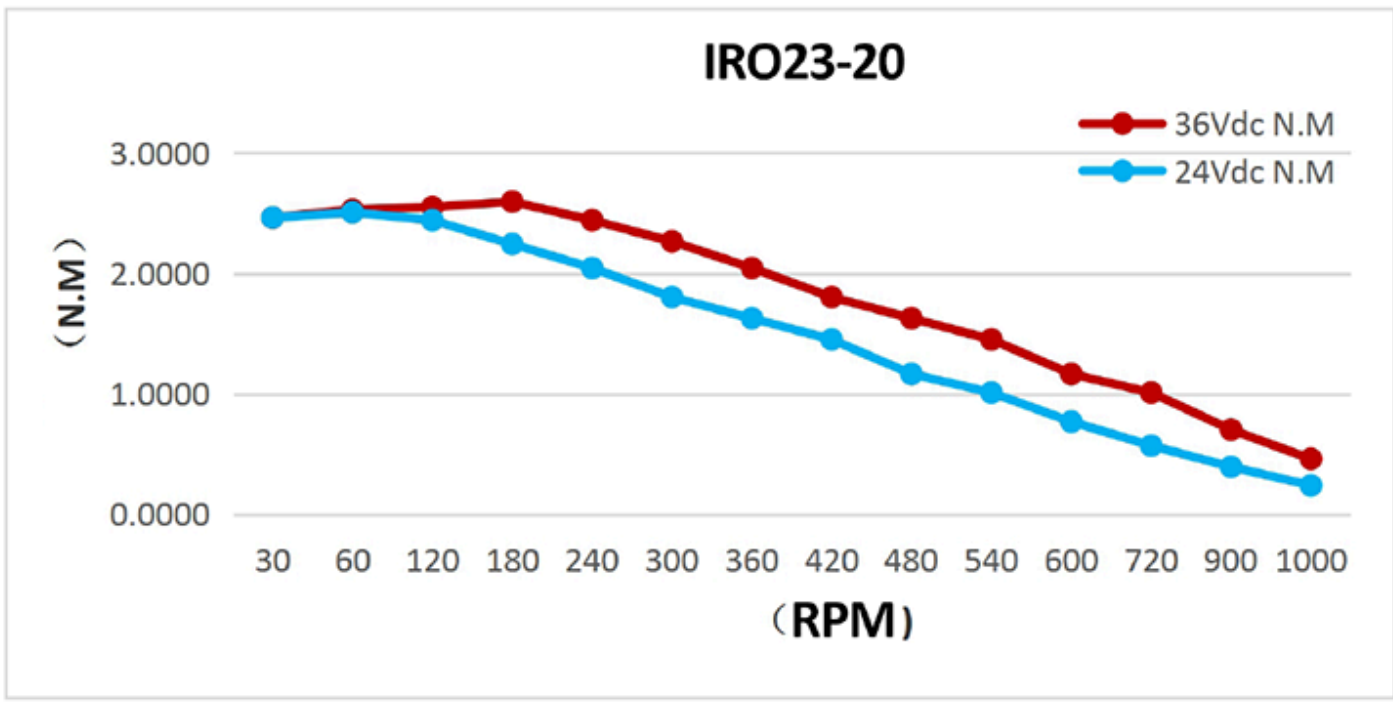
IRO23-10 RS485 integrated stepper motor specifications and motor torque-frequency characteristic curve:





IRO23-20 RS485 integrated stepper motor specifications and motor torque-frequency characteristic curve:





3.2 Installation Method

The reliable operating temperature of the driver is usually within 60°C, and the motor operating temperature is within 80°C.

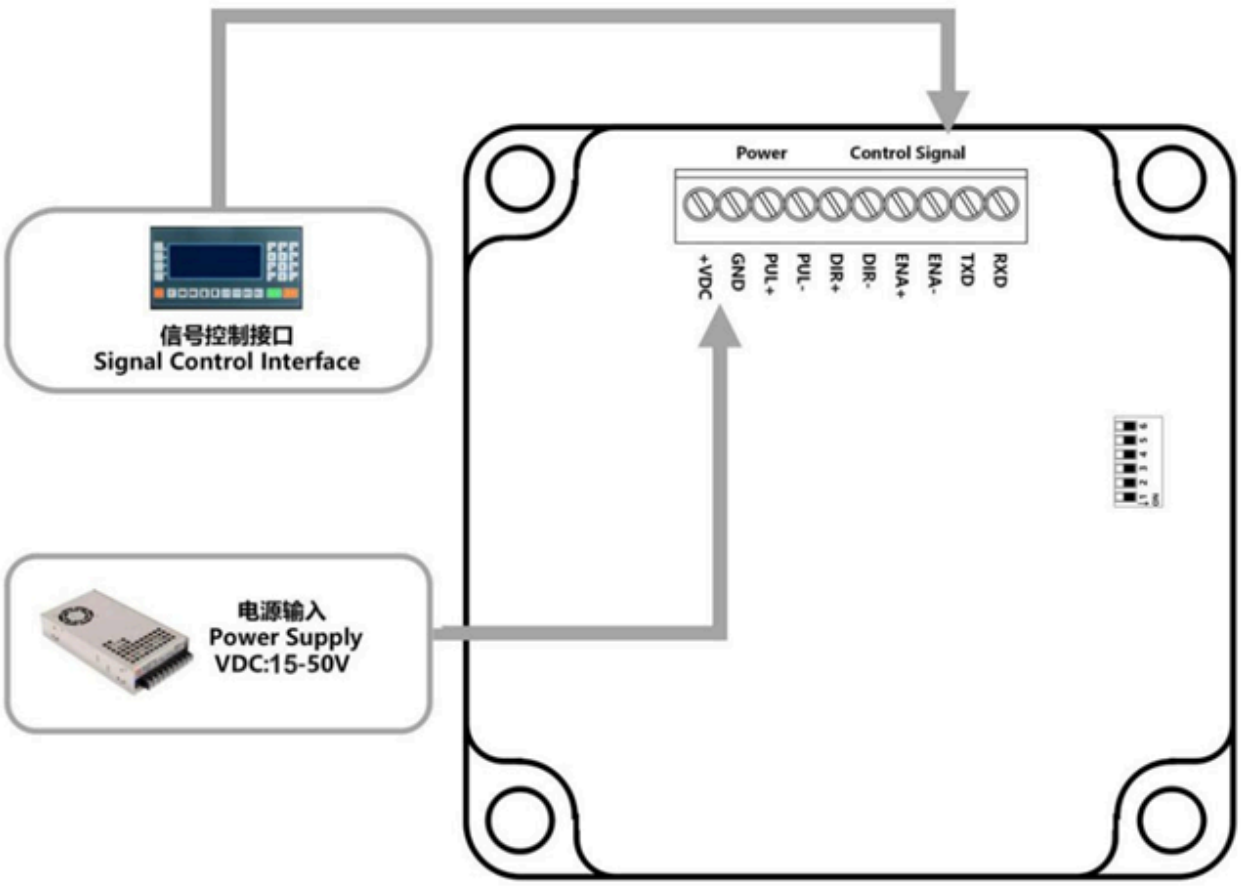
It is recommended to use the automatic semi-flow mode when using the motor. When the motor stops, the current is automatically reduced by half to reduce the heat of the motor and the drive.

Install the drive with vertical side mounting so that the heat dissipating teeth form strong air convection.

Install a fan near the drive when necessary to force heat dissipation to ensure that the drive works within a reliable operating temperature range.

4. Driver Ports and Wiring

4.1 Schematic Diagram of Wiring



4.2 Port Definition

4.2.1 LED Status Indication

The green LED is the power indicator. When the driver is connected to power, the LED is constantly bright; when the driver cuts off power or a failure occurs, the LED is extinguished.

4.2.2 Control Signal Input Port

Control Signal Interface:

The control signal and the power supply input port use the 8Pin 2.0 mm terminal.

Pin Number	Signal Name	Function Description
1	VDC	Power positive input: DC VOLTAGE 15-50VDC
2	GND	Negative power input: GND of DC voltage
3	PUL+	Receiving level 5VDC, pulse control signal input (negative) (left limit)
4	PUL-	-
5	DIR+	Receiving level 5VDC, direction control signal input (negative) (back to zero)
6	DIR-	-
7	ENA+	Receiving level 5VDC, enable control signal input (negative) (right limit)
8	ENA-	-
9	TXD	Serial port RS485 TXD
10	RXD	RXD serial port RS485

> **Note:** The pulse, direction, and enable interface signal levels can only accept 5V TTL level. If 24V is needed, a current limiting resistor of 2kΩ/1W should be connected in series before the signal input port, or inform us at the time of ordering to order products which can only accept 24V TTL signal level.

4.2.3 Power Supply and Motor Output Ports

Motor Interface:

4 Pin 3.5 mm terminal is used as motor connection port.

Pin Number	Signal Name	Function Description
1	A+	Two-phase stepping motor A+ phase
2	A-	Two-phase stepping motor A- phase
3	B+	Two-phase stepping motor B+ phase
4	B-	Two-phase stepping motor B- phase

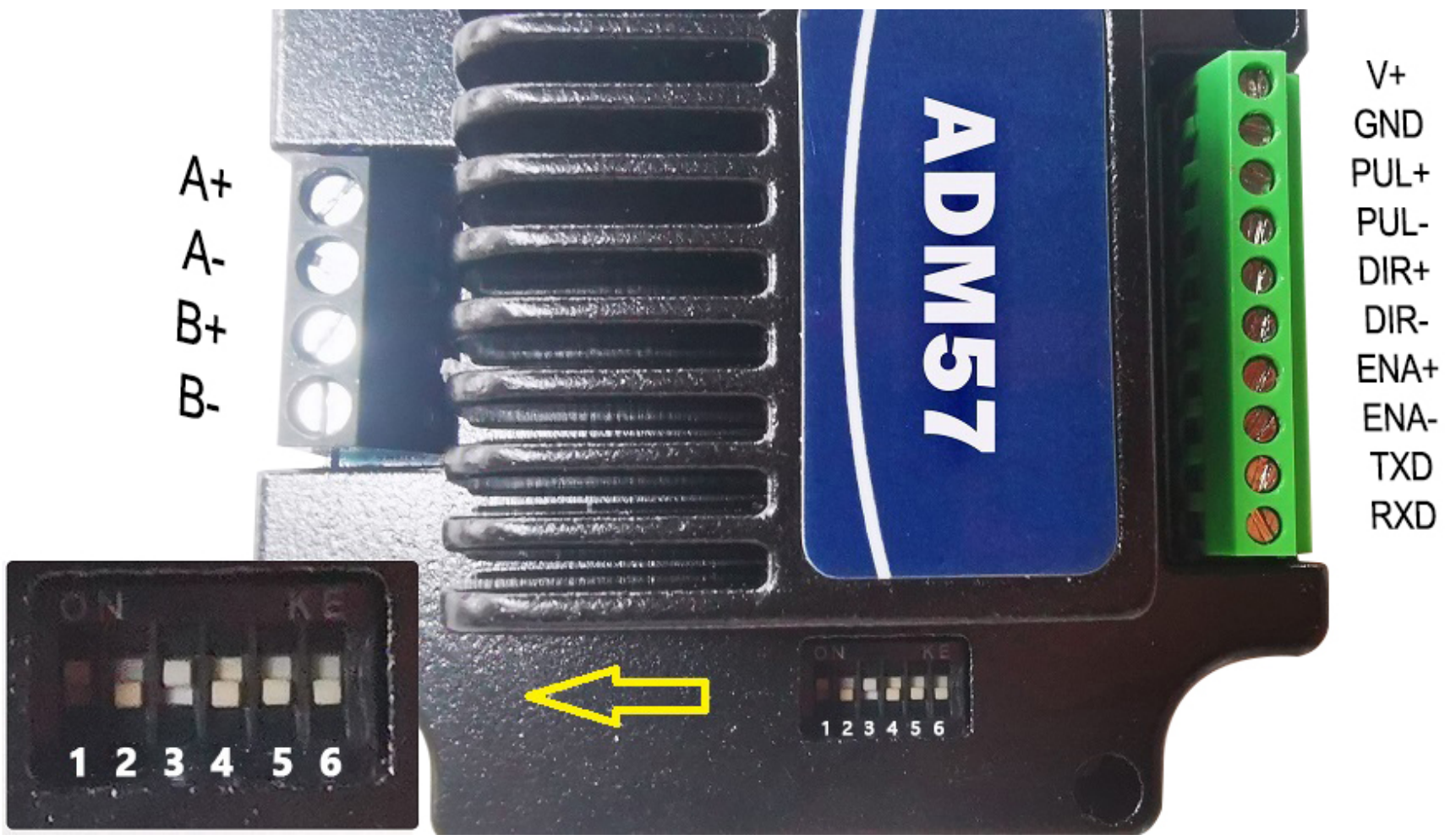
The power supply voltage can work normally between the specified ranges. The driver is preferably powered by an unregulated DC power supply, or a transformer buck + bridge rectifier + capacitor filter. Note, however, that the peak voltage ripple after rectification should not exceed its specified maximum voltage. It is recommended that the user supply power with a DC voltage lower than the maximum voltage to prevent the grid from fluctuating beyond the operating range of the driver voltage.

If using a regulated switching power supply, be aware that the output current range of the switching power supply must be set to maximum.

> **Please Note:**
>
> - When wiring, pay attention to the positive and negative poles of the power supply; do not reverse the connection.
> - It is better to use an unregulated power supply.
> - When using an unregulated power supply, the output capacity of the power supply current should be greater than 60% of the set current of the driver.
> - When a regulated switching power supply is adopted, the output current of the power supply shall be greater than or equal to the working current of the driver.
> - To reduce costs, two or three drives can share a power supply, but the power supply should be large enough.

5. Dial Definition

The IRO23 RS485 Stepper Motor Driver uses a 6-bit dial switch to set the address and Baud rate. The details are as follows:



Baud Rate Setting

Baud Rate	SW5	SW6
9600	on	on
19200	off	on
38400	on	off
57600	off	off

Baud rate can be customized according to customer needs. If custom, factory SW5 and SW6 status are ON for the custom baud rate.

RS485 ID Table (Address Setting)

ID	SW1	SW2	SW3	SW4
Reserved (Broadcast address)	on	on	on	on
1	off	on	on	on
2	on	off	on	on
3	off	off	on	on
4	on	on	off	on
5	off	on	off	on
6	on	off	off	on
7	off	off	off	on
8	on	on	on	off
9	off	on	on	off
10	on	off	on	off
11	off	off	on	off
12	on	on	off	off
13	off	on	off	off
14	on	off	off	off
15	off	off	off	off

> **Note:** The formula for calculating the value of the RS485 ID table is: ID = 1 * S1 + 2 * S2 + 4 * S3 + 8 * S4. The Default ID value is 0, where 0 represents the broadcast address. Other addresses can be set through the host computer.

6. Description of Communications and Communication Protocols

6.1 Network Layout

Built-in trapezoidal acceleration and deceleration curve generator. Trapezoidal acceleration and deceleration can be performed. Fixed-length operation, continuous operation, deceleration stop, and immediate stop can be realized through communication commands.

Internal operation supports absolute position mode and relative position mode control. Built-in common return to zero function simplifies development.

The internal pulse generator uses 32-bit speed, acceleration, and travel, enabling a wide range of trajectory generation.

6.2 Communication Protocol

Communication uses standard MODBUS protocol, supporting 0x03 (read register), 0x06 (write single register), 0x10 (16) (write multiple registers).

Serial communication format: Baud rate 9600～115200, 8 data bits, no parity, 1 stop bit.

6.2.1 Definition of MODBUS Register Address

Address	Parameter Name	Attr	Default	Value Range	Register Description
0	Peak Current	R/W/S	5000	1～6000	Unit: mA
1	Subdivision (Pulses per rev)	R/W/S	6000	200～51200	Pulses required for one motor revolution.
2	Standby Time	R/W/S	300	100～10000	Time for driver to enter standby, Unit: ms
3	Standby Current Percentage	R/W/S	50	0～100	Unit: %
4	Dial Status	R	-	-	-
10	Filter Time	R/W/S	4000	50～25600	Set filter time of filter: μs
15	Current Loop Kp	R/W/S	1000	10～32767	Read-only when auto-tuning is enabled; User writable when disabled.
16	Current Loop Ki	R/W/S	200	0～32767	Read-only when auto-tuning is enabled; User writable when disabled.
18	Baud Rate Selection	R/W/S	96	96~1152	96 represents 9600
22	RMS Current	R/W/S	3500	1～4200	Unit: mA
31	Device ID	R	-	-	-
39	Total Pulse Count L	R	-	-	External pulses received, Low 16 bits
40	Total Pulse Count H	R/W	-	-	External pulses received, High 16 bits. Write: Write 1 to clear counter.
48	Bus Voltage	R	-	-	Return bus voltage, Unit: 0.1V
51	Motor Running Direction	R/W/S	1	0/1	0: Motor direction unchanged; 1: Motor direction reversed.
60	Return to Zero Speed	R/W/S	200	0～65535	Unit: pulse/s
62	Deceleration Low 16bit	R/W/S	3200	0～65535	Unit: pulse/s^2
63	Deceleration High 16bit	R/W/S	0	0～65535	Unit: pulse/s^2
64	Speed Low 16bit	R/W/S	1600	0～65535	Unit: pulse/s
65	Speed High 16bit	R/W/S	0	0～65535	Unit: pulse/s
66	Acceleration Low 16bit	R/W/S	3200	0～65535	Unit: pulse/s^2
67	Acceleration High 16bit	R/W/S	0	0～65535	Unit: pulse/s^2
68	Travel Low 16bit	R/W/S	1600	0～65535	Unit: pulse
69	Travel High 16bit	R/W/S	0	0～65535	Unit: pulse
70	Motion Command	R/W	0	0~5	Trigger corresponding motion, then address becomes 6. 0 — Deceleration stop 1 — Forward fixed-length motion 2 — Reverse fixed-length motion 3 — Forward continuous motion 4 — Reverse continuous motion 5 — Immediate stop 6 — Default value, meaningless
71	Return to Zero Command	R/W	0	0~2	0 — Exit return to zero 1 — Return to zero with forward limit signal as zero 2 — Return to zero with negative limit signal as zero
72	Fixed-length Motion Mode	R/W	0	0/1	0: Incremental mode 1: Absolute mode
73	Device Control Register	R/W/S	-	-	See 6.2.1 for specific bit definitions.
74	Return to Zero Limit Filter Time	R/W/S	10	0~65535	1 represents 50μs
75	Device Status Register	R	-	-	See 6.2.2 for specific bit definitions.
90	Save Parameters	R/W	0	0/1	Read address: Return 0: Save not complete; Return 1: Save complete.

Address	Parameter Name	Attr	Default	Value Range	Register Description
91	Restore Factory Default Parameters	R/W	0	0/1	Write 1 to start clearing; Read address: Return 0: Clearing not complete; Return 1: Clearing complete.
92~150	Reserved	R	-	-	Reserved

Device Control Register (Address 73) Bit Definition:

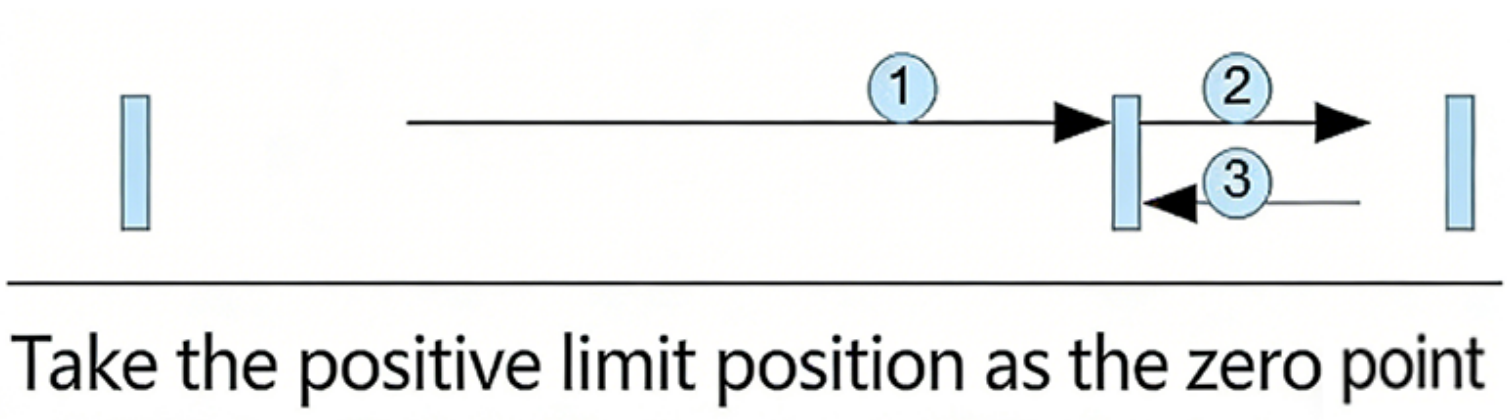
Bit	Name	Default	Description
7~15	Reserved	0	None
6	IO Trigger Motion Enable (Default IN1 is trigger port)	0	0 — Trigger port has no function 1 — Trigger port can trigger motion
2~5	Reserved	0	None
1	Negative Limit Signal Level (Default IN3 is negative limit)	1	0 — Negative limit occurs when optocoupler is OFF 1 — Negative limit occurs when optocoupler is ON
0	Positive Limit Signal Level (Default IN2 is positive limit)	1	0 — Positive limit occurs when optocoupler is OFF 1 — Positive limit occurs when optocoupler is ON

6.2.2 Drive Status Register (Address 75)

Bit	Name	Default	Description
8~15	Reserved	0	Reserved
7	Motion Complete	1	1 — Internal pulse transmission complete 0 — Internal pulse transmission incomplete
6	Reserved	0	0
5	Negative Limit	0	0 — No negative limit signal 1 — Negative limit signal present
4	Positive Limit	0	0 — No positive limit signal 1 — Positive limit signal present
2~3	Reserved	0	-
1	Overvoltage	0	0 — No overvoltage 1 — Overvoltage occurred
0	Overcurrent	0	0 — No overcurrent 1 — Overcurrent occurred

6.3 Return to Zero Function

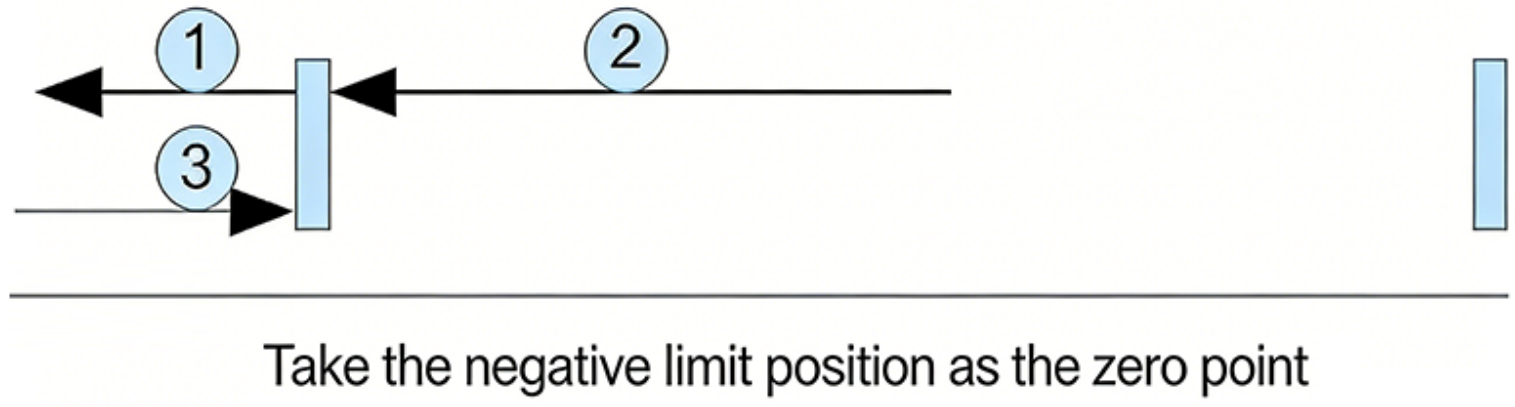
6.3.1 Return to Zero with Positive Limit Signal as Zero



After writing "1" to register address 71 (Return to Zero Command), the process is as follows:

1. Run forward to the positive limit at the speed and acceleration set in registers 62~67.
2. After detecting the positive limit signal, decelerate to stop.
3. Run in the negative direction at the speed set in register address 60 (Return to Zero Speed) until the limit signal is cleared.

6.3.2 Return to Zero with Negative Limit Signal as Zero



After writing "2" to register address 71 (Return to Zero Command), the process is as follows:

1. Run backward to the negative limit at the speed and acceleration set in registers 62~67.
2. After detecting the negative limit signal, decelerate to stop.
3. Run in the positive direction at the speed set in register address 60 (Return to Zero Speed) until the limit signal is cleared.

6.3.3 Exit Return to Zero

After writing "0" to register address 71 (Return to Zero Command), the driver exits the return to zero process and decelerates to stop.

After completing return to zero, the customer can clear the pulse counter by writing 1 to register address 40 as needed (e.g., in absolute position mode).

6.4 MODBUS Common Function Code

6.4.1 Read Hold Register Command 0x03

Master -> Slave Data:

Device Addr	Func Code	Register Addr		Read Count		CRC Check	
01	03	**00**	**00**	00	01	85	0A

Slave -> Master Data:

Device Addr	Func Code	Byte Count	Register Data		CRC Check	
01	03	02	**0A**	**8C**	BF	41

Read the stepper motor driver's current value (Register Address 00) as 2700(0xA8C)mA, 2.7A

6.4.2 Write Single Register Command 0x06

Master -> Slave Data:

Device Addr	Func Code	Register Addr		Write Data		CRC Check	
01	06	**00**	**40**	**06**	**40**	8A	4E

Slave -> Master Data:

Device Addr	Func Code	Register Addr		Write Data		CRC Check	
01	06	00	40	**06**	**40**	8A	4E

Writes 1600(0x640) pulse/s to the stepper motor's Speed Low 16bit (Register Address 64).

6.4.3 Write Multiple Register Commands 0x10

Master -> Slave Data:

Device Addr	Func Code	Start Addr		Write Count		Bytes	Data 1		Data 2		CRC	
01	10	00	**44**	00	**02**	**04**	**38**	**80**	**00**	**01**	3B	24

Slave -> Master Data:

Device Addr	Func Code	Start Addr		Write Count		CRC Check	
01	10	00	44	00	02	01	DD

Writes 14464 to the stepper motor's Travel Low 16bit (Register Address 68) and 1 to Travel High 16bit (Register Address 69), meaning total travel is 80000 (0x13880)pulses.

6.5 CRC Check Routine

The following example calculates CRC using C language:

```
Uint16 Funct_CRC16(unsigned char *puchMsg, Uint16 DataLen)
{
   Uint16 i, j, tmp;
   Uint16 crcdata = 0xFFFF;
   for(i = 0; i < DataLen; i++) {
      crcdata = (*puchMsg) ^ crcdata;
      puchMsg++;
      for(j = 0; j < 8; j++) {
         tmp = crcdata & 0x0001;
         crcdata = crcdata >> 1;
         if(tmp) {
            crcdata = crcdata ^ 0xA001;
         }
      }
   }
   return crcdata;
}
```

7. Warranty and After-sales Service

Please keep the packing box for transportation, storage, or return to the company for maintenance.

One Year Warranty Period:

Damage caused by the product itself within one year of using this drive is covered by the warranty.

Not Covered by Warranty:

- Damage caused by improper wiring, power supply voltage, and user peripheral configuration.
- Unauthorized changes to the product by the user without written authorization from the company.
- Use beyond electrical and environmental requirements.
- Driver serial number has been torn off or is unreadable.
- The outer shell was visibly damaged.
- Irresistible disasters (Force Majeure).

After-sales Service

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IRO23 RS-485 Integrated Stepper Motor