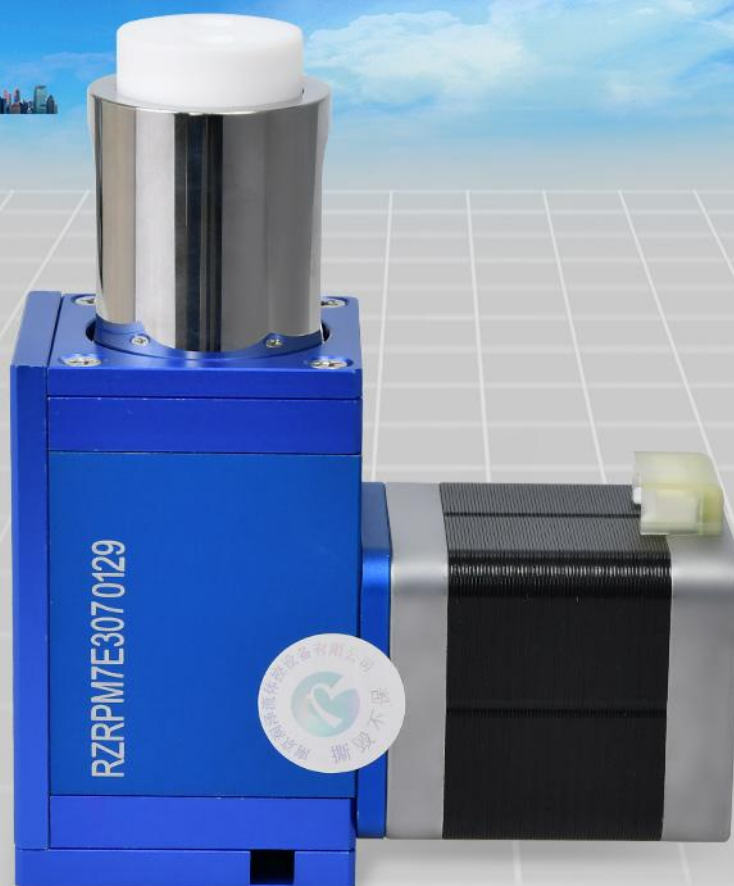




V 2.5

Rpm-01 Syringe Pump Manual

南京润泽流体控制设备有限公司
NANJING RUNZE FLUID CONTROL EQUIPMENT CO.,LTD

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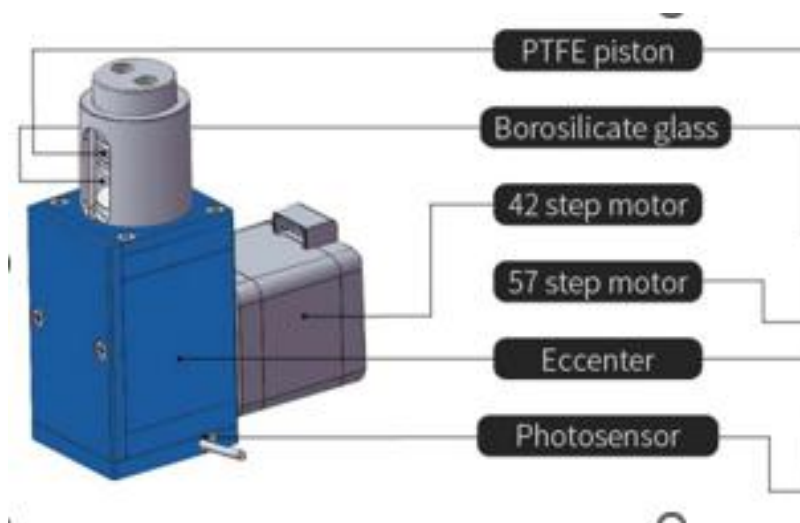
Chapter 1 Overview

1.1 Company Overview

Nanjing Runze Fluid Control Equipment Co., Ltd., established in 2014, is a national high-tech enterprise focusing on R&D and production of fluid accessories for numerous analytical instruments. We engineer, manufacture and market differentiated standard products such as syringe pumps, multiport valves, peristaltic pumps, gastight syringes, plastic fittings, etc. We persevere in providing our customers with best quality and service in the fields of environmental monitoring, biopharmaceuticals, medical equipment, industrial automation and laboratory instruments, etc.

In past years, we have accumulated rich technical and practical experience that bring us honors of ISO9001, National High-tech Enterprise, Jiangsu Province Private Science and Technology Enterprise, 5A Bank Credit Assessment, 44 technical patents and software copyright including 2 invention patents, 27 utility model patents, 13 design patents, 2 software copyright.

1.2 Product Overview



Components: The physical appearance of the product is shown on the figure above (take the single-head syringe pump as an example), which is composed of eccentric wheel, 42 stepper motor, crank arm, push rod, piston, borosilicate glass, and imported photoelectric sensor.

Photoelectric sensor: The built-in Panasonic photoelectric sensor design has more advantages. It is not easy to be touched by mistake or damaged by squeezing. It counts more accurately and has excellent anti-interference ability. This device is optional. According to the buyer's needs, such as counting control of motor rotation, this device needs to be added. If there is no such demand, this device is not added.

Note: Use a low speed during adjustment to prevent the piston from squeezing to the upper end.

Main use: Mainly used in biological laboratories. The controller and execution unit are of separate structure, and the execution unit has a clamping mechanism. The reciprocating syringe pump is small, compact, easy to install, convenient to operate, and the installation structure can be conveniently used with biological instruments such as micromanipulators and stereotaxic devices, so it is widely used in various biological analysis fields.

Chapter 2 Main Technology and Function

2.1 Product Feature

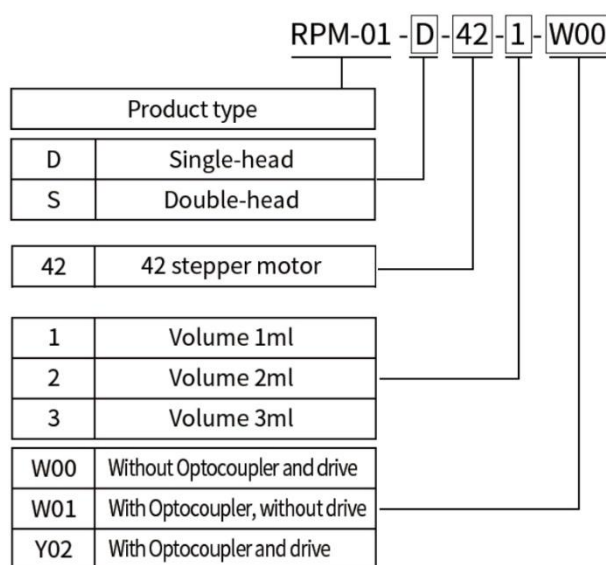
- a. Rpm-01 syringe pump has the advantages of maintenance-free and long life.
- b. High repeatability; compared with peristaltic pumps, it solves the problems of pump tube aging and inaccurate flow.
- c. Strong corrosion resistance; high borosilicate glass and PTFE piston have good chemical properties and are not easy to react with chemical reagents.

2.2 Naming Rules

The model parameters are as follows:

Example: 1ml single-head reciprocating syringe pump, 42 stepper motor, without optocoupler and drive:

Rpm-01-D-42-1-W00



2.3 Product Classification and Characteristics

- a. Divided into 1ml, 2ml, 3ml syringe pump according to specifications.

Description: 1ml, 2ml, and 3ml refer to the volume of liquid aspirated/discharged per rotation of the motor.

- b. According to single-head and double-head, it is divided into single-head reciprocating syringe pump and double-head reciprocating syringe pump.

Description: The single-head reciprocating syringe pump is composed of a motor and a syringe pump structure, and the double-head reciprocating syringe pump is composed of a motor and two syringe pump

structures.

2.4 Technical Parameters

2.5.1 Basic Datasheet

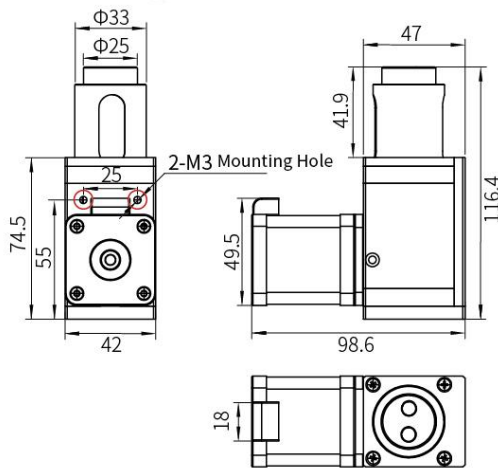
Name	Parameter		
Rated volume	1ml	2ml	3ml
Resolution	1ml		
Accuracy	±1% (one reciprocating stroke)		
Precision (repeatability)	0.3% ~ 0.7%		
Pressure	0.3 Mpa		
Service life	3 million times no leakage (media: water)		
Maximum speed	180 rpm (single-head)		
Minimum speed	1rpm		
Actuator	Eccentric wheel		
Wetted material	Borosilicate glass, PTFE piston		
Interface	1/4-28UNF		
Communication	RS485/RS232/CAN 总线		
Power supply	DC24V/1.5A		
Operating temperature	5 ~ 55C°		
Operating humidity	≤80% relative humidity, non-condensing		
Dimension (L*W*H)	98.3*42*116.4 mm		
Weight	0.8 kg		

Chapter 3 Hardware Setting

3.1 Dimensions (unit: mm)

The single-head reciprocating syringe pump is shown on the figure, and the injection interface adopts the internal thread 1/4-28UNF, which is used with two check valves (one in and one out).

single-head reciprocating syringe pump



3.2 Manual of Rpm-01 Motor

特性 CHARACTERISTICS			
項目	ITEM	規格 SPECIFICATIONS	記事 NOTE
定格電圧	RATED VOLTAGE	4.2 V	1
定格電流	RATED CURRENT / PHASE	1.1 A	1
最大入力	MAX. INPUT	9.2 W	
ステップ角度	STEP ANGLE	1.8°	
角度誤差 (ポジション)	STEP ACCURACY (POSITIONAL)	1.8° ±0.09°	
最大静止トルク at 1.1A	MAX. HOLDING TORQUE at 1.1A	392 mNm { 4 000 gfcm } MIN.	3
最大静止トルク at 1.8A	MAX. HOLDING TORQUE at 1.8A	608 mNm { 6 200 gfcm } MIN.	3
プルアウトトルク	PULL OUT TORQUE	— mNm { — gfcm } MIN. at — Hz	4, 10
プルイントルク	PULL IN TORQUE	— mNm { — gfcm } MIN. at — Hz	4, 10
プルイントルク	PULL IN TORQUE	— mNm { — gfcm } MIN. at — Hz	4, 10
最大自起動周波数	MAX. NO. LOAD RESPONSE	— Hz MIN.	10
最大応答周波数	MAX. SLEW SPEED	— Hz MIN.	10
巻線抵抗	WINDING RESISTANCE	3.8 Ω ±0.38 Ω	
インダクタンス	WINDING INDUCTANCE	5.2 mH REF.	5
絶縁抵抗	INSULATION RESISTANCE	100 MΩ MIN.	6
絶縁耐力	DIELECTRIC STRENGTH	AC 500 V	7
温度上昇	TEMPERATURE RISE	80 °C MAX.	8
絶縁耐熱区分	CLASS OF INSULATION	B	
ラジアルプレイ	RADIAL PLAY	20 μm MAX at 4.4 N [450 gf] [LOAD]	
エンドプレイ	END PLAY	80 μm MAX at 4.4 N [450 gf] [LOAD]	
ローターイナーシャ	ROTOR INERTIA	75 gcm² REF.	
デテンントルク	DETENT TORQUE	23 mNm { 235 gfcm } REF.	
質量	MASS	350 g REF.	

記事

- この値は0 Hzの時の値である。
- シャフトの回転方向は、図1の結線において、図2の様に励磁された時、取付け面側より見て時計方向。
- 指定の電流で、2相が励磁された時の値。
- 全ての測定結果は弊社指定回路、及び図2の励磁方法で、小野測器製PV-900で測定したものである。
- 1 kHz、1 V [RMS] にて測定する。
- 巻線とケース間、及び巻線間を、DC500 V メガーにて測定する。
- 巻線とケース間に (50 or 60) Hzを60 sかけ、異常の無い事。
- 温度上昇は、A相及びB相が定格電圧で励磁された時、抵抗法により決定される。
- 全ての規格は、室温で温度上昇前の値である。
- 駆動回路は、SLA7033M 使用。電源電圧 DC 24 V、1相あたり 1.8 Aの電流にて測定する。
- 構成される部品は、RoHS適合品である。

NOTE

- At 0 Hz
- ROTATION OF SHAFT TO BE CW FACING MOUNTING END WHEN SEQUENCED AS FIG. 2.
- AT SPECIFIED CURRENT AND 2 PHASES ON.
- ALL SPECIFICATION APPLY OUR COMPANY DRIVER CIRCUIT SWITCHING SEQUENCE AS FIG. 2. MEASURED BY PV-900.
- MEASURED AT 1 kHz 1 V [RMS].
- WITH DC 500 V INSULATION RESISTANCE TESTER APPLIED BETWEEN WINDING AND CASE.
- THERE SHALL BE NO BREAKDOWN AT (50 or 60) Hz APPLIED FOR 60 s BETWEEN WINDING AND CASE.
- DETERMINED BY MEANS OF RESISTANCE METHOD WITH 'A' PHASE AND 'B' PHASE ENERGIZED SIMULTANEOUSLY AT RATED VOLTAGE.
- ALL SPECIFICATIONS APPLY BEFORE TEMPERATURE RISE AT ROOM TEMPERATURE ONLY.
- UNDER DRIVER CIRCUIT SLA7033M AND AT POWER SUPPLY VOLTAGE DC 24 V, CURRENT 1.8 A PER PHASE.
- COMPONENT PARTS ARE RoHS COMPLIANT.

単位 UNIT	材質 MATERIAL	作成日 DATE	JUL. / 24 / 09
寸法 SCALE	表面粗さ SURF. ROUGH	品名 DESCRIPTION	HYBRID STEP MOTOR
寸法	寸法	品番 PART NO. (MODEL NO.)	17PM-K446-04VS
寸法	寸法	図番 DRAWING NO.	17PM-K446-04VS
寸法	寸法	設計 REV.	

FIG. 2			
STEP	赤 RED	青 BLU	黄 YEL
1	—	0	0
2	—	0	0
3	0	—	0
4	0	—	0
5	0	—	0
6	0	—	0
7	0	0	—
8	—	0	0

FIG. 1

FIG. 3

3.3 Manual of Rpm-01 Optocoupler

Warning:

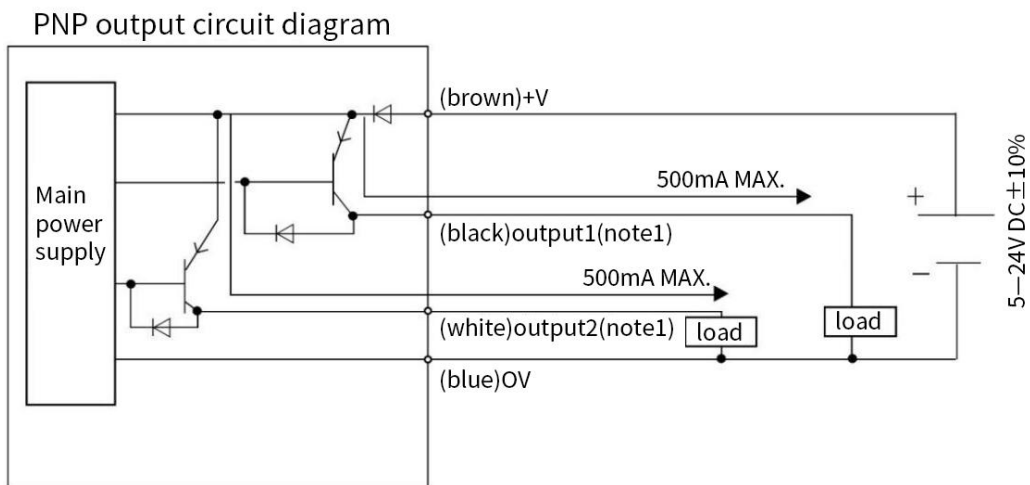
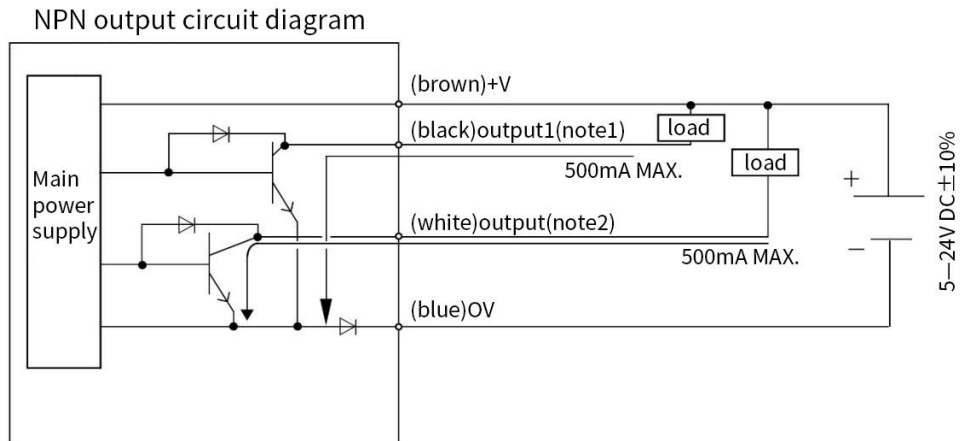
- For safety, it is forbidden to use this product as a legendary device.

2. For safety, please use products that comply with relevant national laws and regulations and OSHA, ANSI, or IEC.

Applicable specifications/regulations

Products with CE standards, EU directives, EMC directives

Input and output circuit diagram

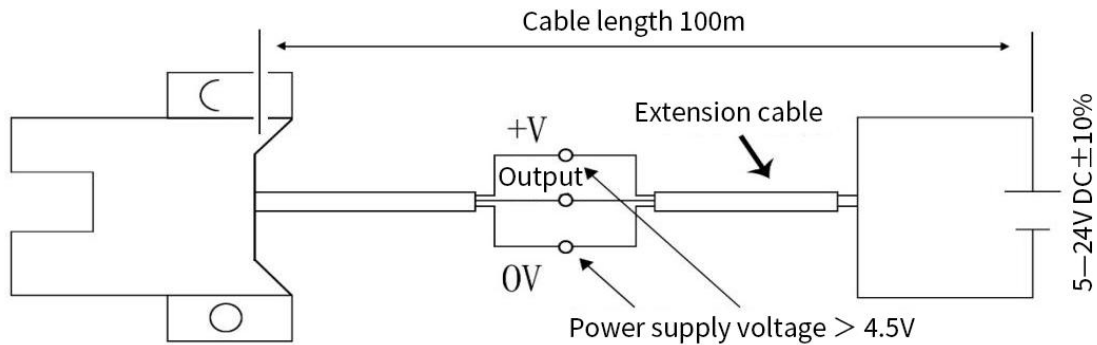


(Note 1) The unused output wire must be insulated.

Precautions

1. This product is only for industrial use.
2. Because the sensor is used inside the machine, it cannot sense external light signals. Please note that the external light signal cannot directly reflect the light receiving area.

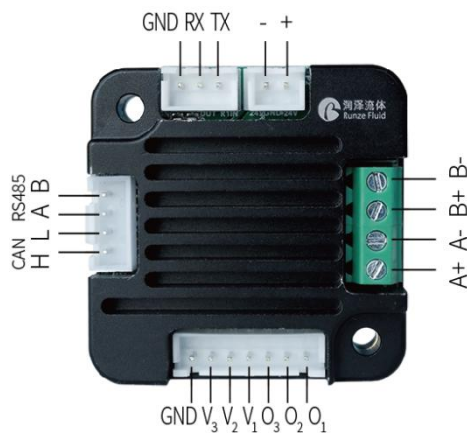
3. If the sensor is used in dusty environment, please use a dry and soft cotton cloth to clean the signal sending and receiving area regularly. Wires of 0.3 mm² or thicker can be extended up to a total length of 100 meters. However, because the extension of the wire reduces the voltage, it is necessary to ensure that the power supply voltage of the wire at the end of the sensor must be the rated voltage.



3.4 Port Definition

Note: This control board description is only for users who purchased the Rpm-01 syringe pump that contains a control module. If the purchased drive board does not contain a control module, ignore this part.

Diagram of drive control board



Port	Description	Port	Description
+	DC24V positive	A+、A-	Stepper motor phase A wiring
-	DC24V negative	B+、B-	Stepper motor phase B wiring
TX	RS232 data input	O1	IO1 optocoupler signal
RX	RS232 data output	O2	IO2 optocoupler signal
GND	RS232 Grounding	O3	IO3 optocoupler signal
H	CAN H	V1	V1 power positive

L	CAN L	V2	V2 power positive
A	RS485 A	V3	V3 power positive
B	RS485 B	GND	GND

Chapter 4 Software Communication

4.1 Overview

The data transmission between the syringe pump and the host controlling system (Computer, MCU, PLC, etc.) adopts serial communication (RS232, RS485, CAN bus). Description of the communication format as following: the communication adopts asynchronous serial communication, and the sum check with two bytes (2Byte) is adopted by the command & data frame. Commands & data in communication must be in hexadecimal. Parameters are stored in little-endian mode.

Communication interface: RS232, RS485, CAN bus;

Communication mode: two-way asynchronous, master-slave mode;

Baud rate: RS232&RS485: 9600bps, 19200bps, 38400bps, 57600bps, 115200bps;

CAN : 100K, 200K, 500K, 1M;

Data bit: 8 Bit;

Parity check: no check;

Response time: <1 second after receiving the command

4.2 Installation & Debugging

1. Install the debugging tools, please refer to 《Debugging Tools Instruction》 for details.
2. Instructions for use, please refer to 《Rpm-01 Quick Use Guide》 for details.

4.3 Code Instruction

4.3.1 Control Command Format

The frame of "send command" is 8 bytes and the complete format is as follows:

Table 4-3-1 Send command (common command)

Send command	Frame header	Address bit	Control command	Command parameter	End of frame	Sum check
Byte code	B0	B1	B2	B3, B4	B5	B6, B7
Byte number	1	1	1	2	1	2

Note: The above command format refers to the common sent command. In particular, the factory command has more password bits, and the parameter bits have also changed, from the original 2 bytes to 4 bytes. The command format is as follows:

The frame of "factory command" is 14 bytes, and the format is as follows:

Table 4-3-2 Send command (factory command)

Send command	Frame header	Address bit	Control command	Password	Parameter	End of frame	Sum check
Byte code	B0	B1	B2	B3,B4,B5,B6	B7,B8,B9,B10	B11	B12,B13
Byte number	1	1	1	4	4	1	2

The frame of "response command" is 8 bytes and the complete format is as follows:

Table 4-3-3 Response command

Response command	Frame header	Address bit	Response state	Parameter	End of frame	Sum check
Byte code	B0	B1	B2	B3, B4	B5	B6, B7
Byte number	1	1	1	2	1	2

Note: The send command and response command format of common command are the same, and all the frame of response command is 8 bytes.

4.3.2 Command Format Instruction

Definition of frame header and end of frame B0, B5(B11)

Table 3-3-4 Definition of frame header and end of frame

Name	Code	Remark
------	------	--------

Frame header B0	0xCC	
End of frame B5(B11)	0xDD	

Note: The send command and response command of the common command are the same. The frame header and end of frame are B0 and B5 respectively. Specially, the end of frame of factory command is B11.

Definition of address bit B1

Table 4-3-5 Definition of address bit

Name	Abbreviation	Code B1	Remark
Address bit	ADDR	0xXX	

Note: 1. The send command and response command are the same.

2. The XX in "0xXX" means that it can be set, the factory default is 0x00, and the parameter value range is 0x00 ~ 0xFF.

Control Code Instruction (B2 ~ B10)

Code B2	Abbreviation	Password B3 B4 B5 B6	Parameter B7 B8 B9 B10
0x00	Set address	B3=0xFF B4=0xEE B5=0xBB B6=0xAA	B7=0xXX (B8=0x00 B9=0x00 B10=0x00) The value range of XX is 00 ~ FF and the default is 00.
0x01	Set RS232 baud rate	B3=0xFF B4=0xEE B5=0xBB B6=0xAA	Totally 5 baud rates, the factory default is 9600bps. (B8=0x00 B9=0x00 B10=0x00) B7=0x0000 corresponding baud rate 9600bps B7=0x0001 corresponding baud rate 19200bps B7=0x0002 corresponding baud rate 38400bps B7=0x0003 corresponding baud rate 57600bps B7=0x0004 corresponding baud rate 115200bps
0x02	Set RS485 baud rate	B3=0xFF B4=0xEE B5=0xBB B6=0xAA	
0x03	Set CAN baud rate	B3=0xFF B4=0xEE B5=0xBB B6=0xAA	Totally 4 baud rates, the factory default is 100K. (B8=0x00 B9=0x00 B10=0x00) B7=0x0000 corresponding baud rate 100Kbps B7=0x0001 corresponding baud rate 200Kbps B7=0x0002 corresponding baud rate 500Kbps B7=0x0003 corresponding baud rate 1Mbps
0x05	Set subdivision	B3=0xFF B4=0xEE B5=0xBB B6=0xAA	Totally 9 subdivisions (B8=0x00 B9=0x00 B10=0x00) B7=0x0001 subdivision 2

			B7=0x0002 subdivision 4 B7=0x0003 subdivision 8 B7=0x0004 subdivision 16 B7=0x0005 subdivision 32 B7=0x0006 subdivision 64 B7=0x0007 subdivision 128 B7=0x0008 subdivision 256
0x07	Set maximum speed	B3=0xFF B4=0xEE B5=0xBB B6=0xAA	B7=0xFF B8=0xFF (B9=0x00 B10=0x00) The value range of B8B7 is 0x0005 ~ 0x00B4. The set rotation speed is 5 ~ 180 rpm (factory default speed is 100 rpm, B7=64) Note: The maximum speed of single-head: 180rpm, the maximum speed of double-head: 160rpm Note: The rotation speed here is set to 5 ~ 180 rpm, which means that the best operating speed of the reciprocating syringe pump is 5 ~ 180 rpm. It is not that the speed beyond this range cannot be set. When the speed of the Rpm-01 is lower than 5 rpm or higher than 180 rpm, errors may occur in the operation.
0x10	Set CAN destination address	B3=0xFF B4=0xEE B5=0xBB B6=0xAA	B7=0xFF (B8=0x00 B9=0x00 B10=0x00) The value range of XX is 00 ~ FF and default is 00.

Table 4-3-6 Control Code Instruction

Set command (factory command) (B2 ~ B10)

Query command (common command) (B2 ~ B4)

Code B2	Abbreviation	Parameter B3 B4
0x20	Query address	B3=0x00 B4=0x00
0x21	Query RS232 baud rate	B3=0x00 B4=0x00
0x22	Query RS485 baud rate	B3=0x00 B4=0x00
0x23	Query CAN baud rate	B3=0x00 B4=0x00
0x27	Query maximum speed	B3=0x00 B4=0x00
0x30	Query CAN destination address	B3=0x00 B4=0x00
0x3F	Query current version	B3=0x00 B4=0x00

Control command (common command) (B2 ~ B4)

Note: If you encounter unexpected power failure, there are two measures:

1. Send the command 0x4D, the the parameter is 0xC8 to make the pump reach the counting optocoupler.
2. Send the command 0x46, and the parameter is 0x01 to make the pump reach the counting optocoupler.

Code B2	Abbreviation	Parameter B3 B4
0x46	Rotate the designated circle clockwise, and finally stop at the counting optocoupler	B3=0x00 B4=0x00 The syringe runs to the octocoupler and stops.
0x47	Continuously rotate clockwise	B3=0x00 B4=0x00
0x48	Continuously rotate counterclockwise	B3=0x00 B4=0x00
0x49	Forcibly stop	B3=0x00 B4=0x00
0x4A	Query motor status	B3=0x00 B4=0x00
0xFF	Reset the internal data of the drive	B3=0x00 B4=0x00

Sum check (B6, B7)

Table 4-3-7 Sum check

Name	Abbreviation	Code B6, B7	Remark
Sum check	Sum check	0xXX 0xXX	The sum from frame header to end of frame

Note: the sum check bit of factory command is B12, B13

Response parameter instruction B2 B3 B4

Table 4-3-8 Response parameter

Code B2	Description	Other parameter B3 B4
0x00	Normal status	B3=0x00 B4=0x00
0x01	Frame error	Parameter=0x00 0x00
0x02	Parameter error	Parameter=0x00 0x00
0x03	Octocoupler error	Parameter=0x00 0x00
0x04	Motor busy	Parameter=0x00 0x00
0x05	Motor stalled	Parameter=0x00 0x00
0x06	Unknown position	Parameter=0x00 0x00
0xFE	Task being executed	Parameter=0x00 0x00
0xFF	Unknown error	Parameter=0x00 0x00

Note: In RS485 communication, when sending an action command, the B2 byte receiving FE indicates that the command has been received and is being executed.

Explanation: (1) The code B2 in the response command indicates the current running state of the motor. Only when B2=0x00, the motor runs normally. The other parameters are shown in the above table,

and different abnormal states are shown respectively. In principle, the command 0X4A should be sent to query the motor status after the motor is running. Only when the B2 parameter in the response command is 00, other commands can be executed correctly.

Note: The code parameters of all the above commands are set in little-endian mode. In little-endian mode storage, the low-order data is stored in the low-order address, and the high-order data is stored in the high-order address.

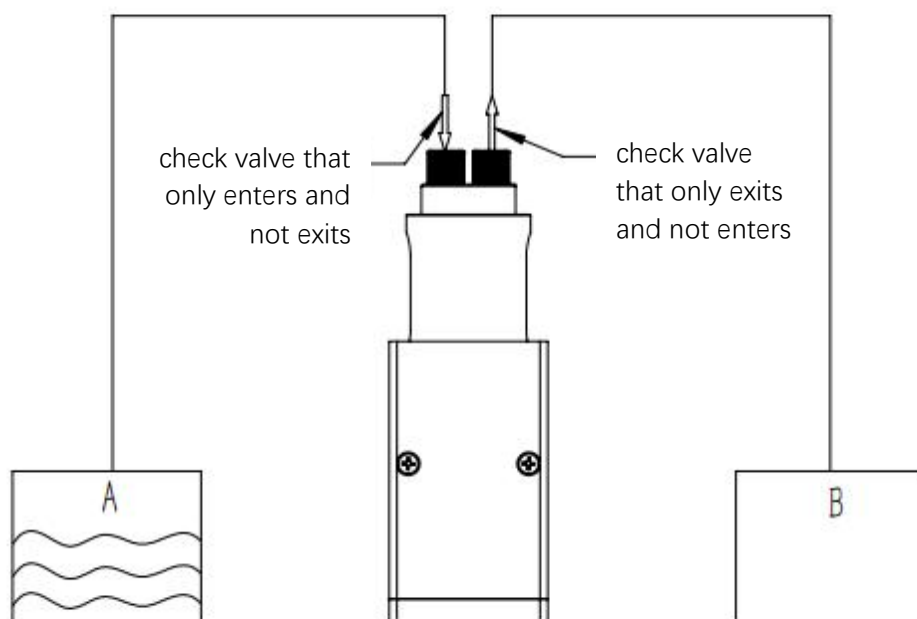
Chapter 5 Application Examples

5.1 Rpm-01 Syringe Pump

Work process of single-head Rpm-01 syringe pump:

1. The connection method is shown on the figure below:
2. Workflow action:

When the syringe pump aspirates liquid, the liquid in tank A is pumped into the cavity of the syringe pump through the check valve that only enters and not exits; when the syringe pump discharges liquid, the liquid is discharged into the tank B through the check valve that only exits and not enters.



Work process of single-head Rpm-01 syringe pump

Power on, press the start button, the motor rotates to drive the internal eccentric wheel to rotate, and the eccentric wheel rotates to drive the piston to move up and down one circle. When the piston moves down, it aspirates liquid from the tank A, and when the piston moves up, the liquid is discharged to the tank B, so as to achieve one-time aspirating and discharge. Such circular movement can achieve the transfer of liquid from tank A to tank B.

Chapter 6 Common Problems and Solutions

Phenomenon	Possible problems
Not working when powered on	1. The working voltage is not within the qualified range.
	2. The connection is loose or disconnected.
Not aspirating liquid	1. Whether it is blocked by particles.
	2. Whether the direction of the check valve is reversed.
Solutions	
1. Check whether there is deviation between the actual pin voltage and the rated voltage.	
2. Manually check whether the contact is good, or check the circuit with a multimeter.	
3. Take out the pump tube and remove foreign objects	

4. Check the check valve interface. The aspirating port is connected to the check valve that only enters, and the discharge port is connected to the check valve that only exits.

Chapter 7 Quick Commands

Code B2	Abbreviation	B3 B4 Parameters Description
0x20	Query address	0x0000 ~ 0x00FF,default 00
0x27	Query maximum speed	0x0005 ~ 0x00B4
0x3F	Check the current version	B3=0x01 B4=0x09, above is just an example, the above parameters is for version 1.9, please check the mark for details
0x46	Turn clockwise in a specified circle and finally stop at the counting optocoupler	B3=0x00 B4=0x00 Syringe stop at the optocoupler
0x47	Continuously turn clockwise	B3=0x00 B4=0x00

0x48	Continuously rotating counterclockwise	B3=0x00 B4=0x00
0x49	Strong stop	B3=0x00 B4=0x00
0x4A	Query motor status	B3=0x00 B4=0x00

Chapter 8 Version Description

Version	Description	Release Time
V1.0	Initial version	2022.4.18
V2.3	Update contacts	2022.6.28
V2.5	1. Delete double-headed reciprocating syringe pump 2. Add quick command	2022.7.22

Chapter 9 Technical Service

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