Version 1.0

SY-03B Syrinnge Pump Manual

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Chapter 1 Product Introduction

1.1 SY-03B Features at-a-Glance

SY-03B syringe pump is a high-precision micro syringe pump developed by Nanjing Runze Fluid Control Equipment Co., Ltd. A variety of dispensing valves and syringes can be selected to meet the needs of most users for high-precision liquid transferring. Multiple pumps can be used in series together. The excellent performance of the SY-03B syringe pump provides a guarantee for the user's development and application and achieves the expected purpose.

1.2 Naming Rules

The model is shown below:

ZSB-SY03B - 60 - M01 - 3

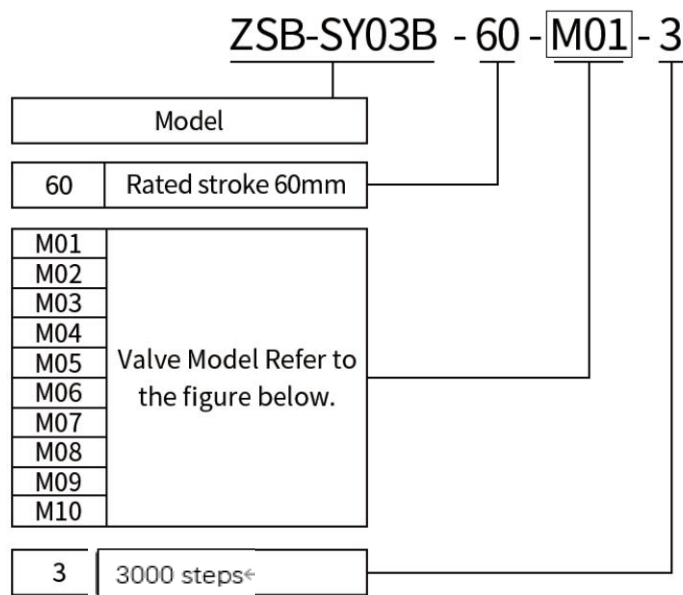|	
Model	
60	Rated stroke 60mm
M01 M02 M03 M04 M05 M06 M07 M08 M09 M10	Valve Model Refer to the figure below.
3	3000 steps

Figure 1-2

For example: the syringe pump with M03 valve, 3000 control steps is named as: ZSB-SY03B-60-M03-3.

The optional models of the syringe of SY-03B are shown as follows (the syringe stroke: 60mm)

	Imported syringe specification					Domestic syringe specification		
	25μl	50μl	100μl	250μl		250μl	500μl	1ml
	500μl	1ml	1.25ml	2.5ml		2.5ml	5ml	10ml

	5ml	10ml	25ml			25ml	

Table 1-2

1.3 Valve Configuration
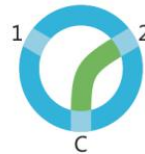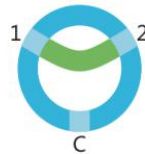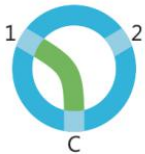
Valve Model：M01

Fluid Logic：Y Flow Path

(C-1 interlinked /1-2 interlinked /C-2 interlinked)
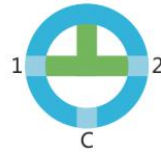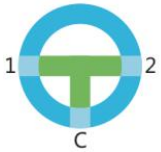
Valve Model：M02

Fluid Logic： T Flow Path
 (C-1-2 interlinked
C-1 interlinked /1-2 interlinked /C-2 interlinked)
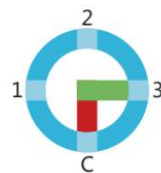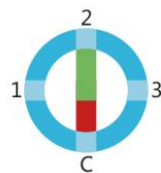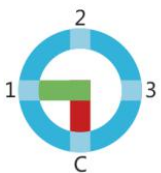
Valve Model：M03

Fluid Logic：Distribution Flow

(C-1 interlinked /C-2 interlinked /C-3 interlinked)
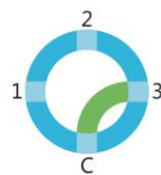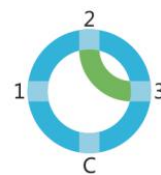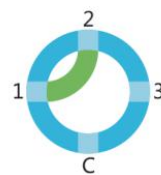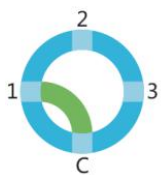
Valve Model：M04

Fluid Logic： Radio Flow Path
(C-1 interlinked /1-2 interlinked /2-3 interlinked / C-3 interlinked)
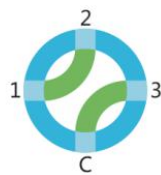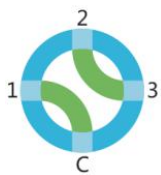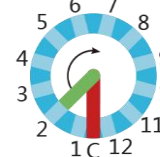
Valve Model: M05

Fluid Logic： Bi-pass Flow Path

(C-1/2-3 interlinked,C-3/1-2 interlinked)

Valve Model: M06 Fluid Logic: Distribution Flow Path (C selectively link to port 1-6)	**Valve Model: M07** Fluid Logic: Distribution Flow Path (C selectively link to port 1-8)	**Valve Model: M08** Fluid Logic: Distribution Flow Path (C selectively link to port 1-10)
Valve Model: M09 Fluid Logic: Distribution Flow Path (C selectively link to port 1-15)	**Valve Model: M10** Fluid Logic: Distribution Flow Path (C selectively link to port 1-12)	

## 1.4 Calculation of the injection accuracy & injection volume

Example 1: the resolution of 5ml syringe (stroke 60mm) is as follows:

5ml=5000μl

60mm=3000 steps

5000μl÷3000 steps=1.6667μl/step

Note: One step of the syringe pump corresponds to a capacity of 1.6667μl/step, which is also the minimum resolution of the 5ml syringe.

Example 2: the syringe pump needs to aspirate or dispense liquid of 3.8ml and the corresponding calculation should be as follows:

3.8ml=3800μl

3800μl÷1.6667μl/step=2280 steps (rounding off)

The parameter to be executed for the syringe pump for 3.8ml liquid is 2280 steps (hexadecimal is 0x08E8).

Note: The above calculations are all in decimal, and the parameter input when using debugging tools or writing codes are all in hexadecimal.

1.5 Syringe Pump Structure and Syringe Installation Method

①The overall dimensions and mounting hole dimensions are as follows:
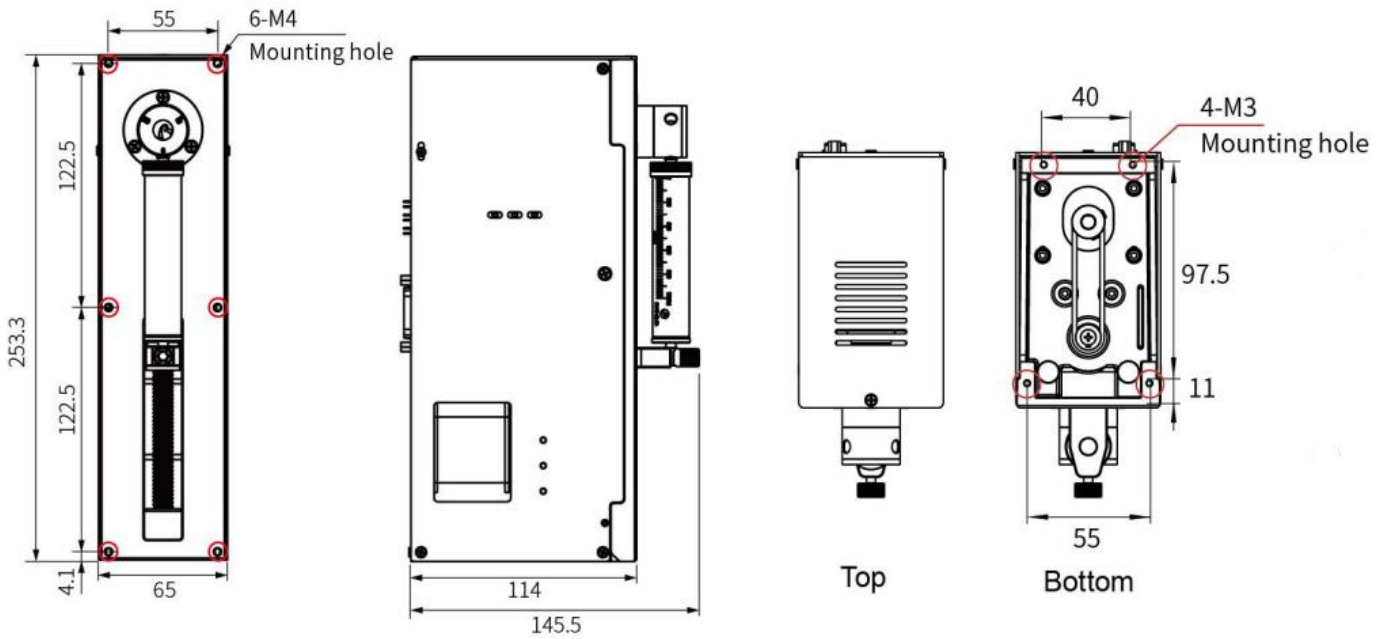
Figure 1-5-1 （unit：mm）

②The installation and disassembly diagram of syringe is as follows:

Syringe

Thumb screw
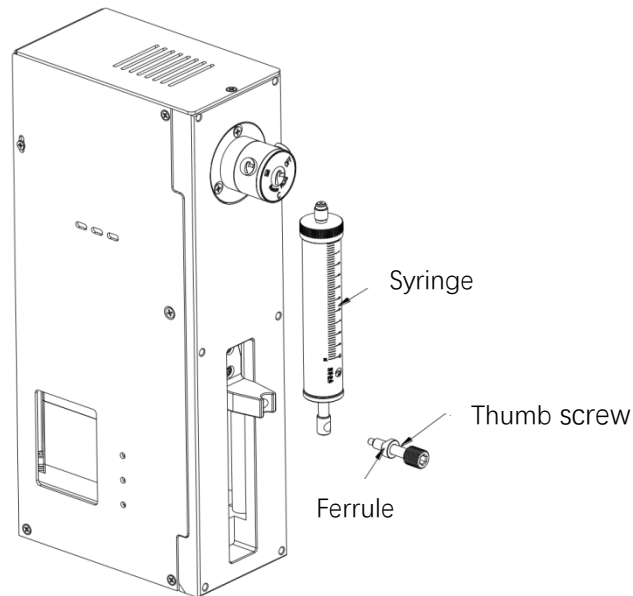
Ferrule

Figure 1-5-2

Note: when disassembling, the push rod runs to the bottom dead point. Loosen the thumb screw, remove the ferrule, and rotate the syringe counterclockwise to unscrew it.

Mounting threaded hole

plunger

plunger seat

Thumb screw

压环
Ferrule
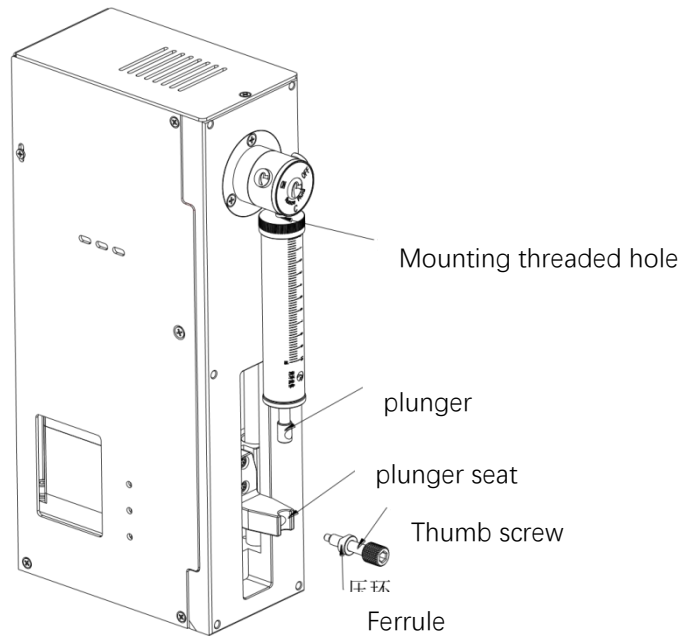
Figure 1-5-3

Note: When installing the syringe, align the syringe thread with the mounting hole and tighten it clockwise, then push the plunger to the plunger seat., Align the center holes of the two, Put the ferrule into the thumb screw and insert it into the bottom of the center hole and then tighten the thumb screw.

1.6 Device Port Definition
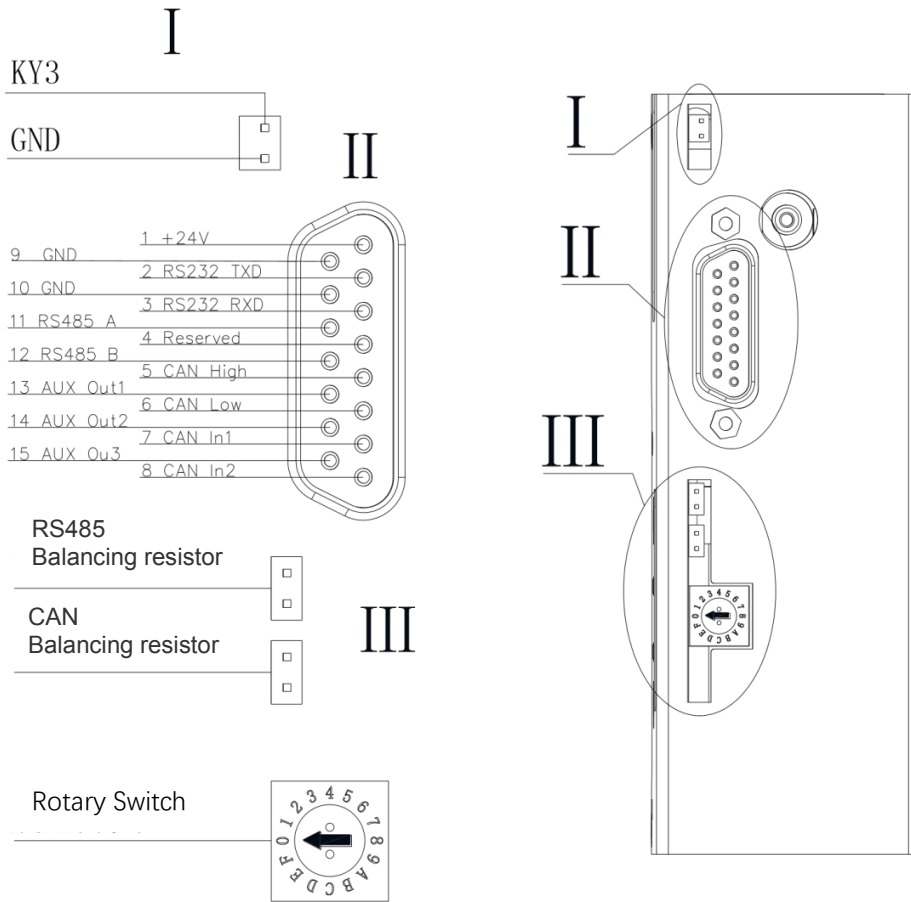
Figure 1-6

1.6.1 Wiring Diagram

①Multiple parallel control wiring diagram
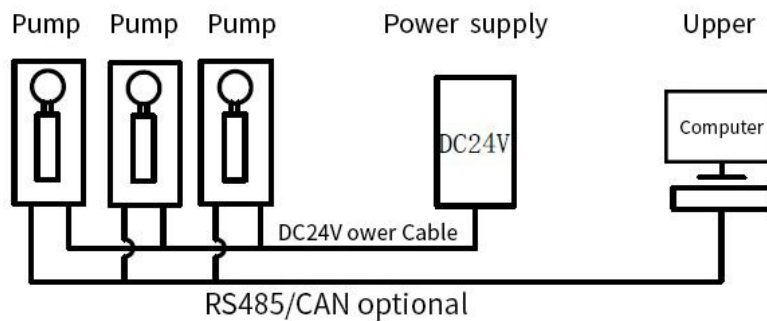
Figure 1-6-1-1

Note: 1. In this case, multiple devices communication needs to change the address of each device.

2. Please use the rated power supply correctly. If you use the laboratory linear power supply, please adjust the protection current to above the rated current of the device.

3. When multiple RS485 and CAN are used in parallel, the jumper caps of RS485 or CAN in the three figures in the figure should be short-connected to ensure normal communication.

4. The default address of the communication device is 00 and the baud rate is 9600.

5. It is recommended that no more than 20 devices are used in parallel to ensure communication stability, or to increase the communication amplifier to strengthen the communication ability to ensure normal communication.

②Single control wiring diagram
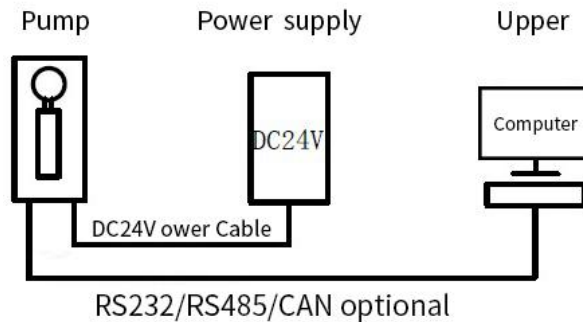
Figure 1-6-2

Note: 1. In this case, the default address of a single device communication is 00 and the baud rate is 9600.

2. Please use the rated power supply correctly. If the laboratory linear power supply is used, adjust the protection current above the rated current of the device

③Wiring instruction of the device accessories
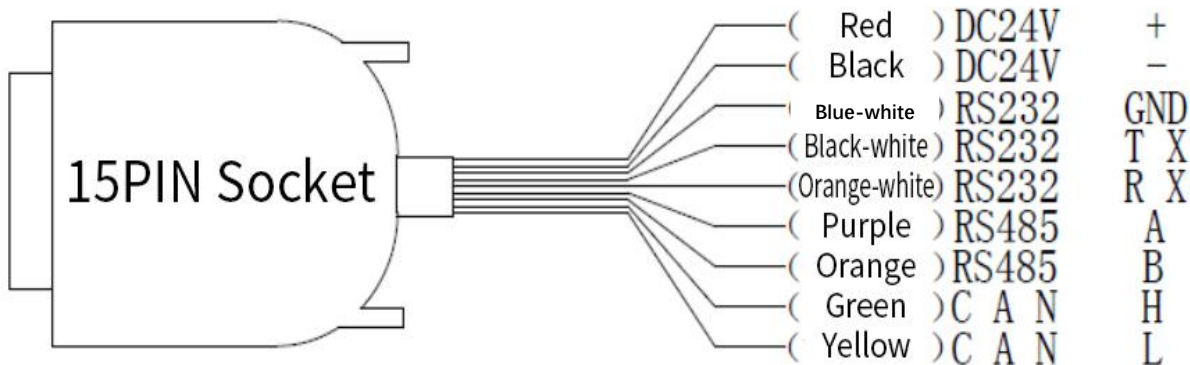
Note: 1. When connecting DC24V power supply, ensure that the switching power supply is

connected when the power is off. Do not reverse the polarity.

2. When connecting the communication line, ensure that the 24V power supply is off. Live connection of communication lines may burn the processor.

3. The syringe pump can only use one of the three communication modes when working. Do not use the three communication modes at the same time. The communication lines that are not in use can be cut or rolled up.

1.7 Technical Parameters

Name	Specification/Parameter
Accuracy	≤1% (rated stroke)
Precision (Repeatability)	0.3%-0.5% (rated stroke)
Rated stroke (Control steps)	60mm; 3000 steps
Maximum speed	900rpm
Linear speed	0.02mm/s-15mm/s
Running time (Per rated stroke)	4s-2400s (the test medium is water)
Resolution	0.02mm/1 step
Actuator	Trapezoidal screw (Lead 6mm/1mm)
Maximum piston drive	≥80N
Secondary piston drive	≥40N
Syringe specifications	Imported syringe: 25μL, 50μL, 100μL, 250μL, 500μL, 1ml, 1.25 ml, 2.5 ml, 5 ml, 10 ml, 25 ml
	Domestic syringe: 250μL, 500μL, 1ml, 1.25 ml, 2.5 ml, 5 ml, 10 ml, 25 ml
Valve specifications	M01、M02、M03、M04、M05、M06、M07、M08、M09、M10
Switching time	≤280ms (adjacent holes)
Wetted material	Borosilicate glass, PTFE piston, Sapphire
Max. Pressure	0.7Mpa
Tube connection	1/4-28UNF female thread
Syringe connection	1/4-28UNF female thread
Signal input	3-way TTL signal input
Communication interface	RS232/RS485/CAN
Baud rate	RS232/RS485：9600bps / 19200bps / 38400bps / 57600bps / 115200bps CAN：100Kbps/200Kbps/500Kbps/1Mbps

Address & Parameter setting	Via communication
Power supply	DC24V/3A
Operating temperature	5 ~ 55C°
Operating humidity	< 80%
Dimension (L*W*H)	150*65*254mm
Weight	2.2kg

Table 1-7

Chapter 2 Description of Syringe Pump Control Code

2.1 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 and data in communication must be in hexadecimal, expressed as 0x00~0xFF or 0x0000~0xFFFF. Parameters are stored in little-endian mode.

Communication interface: RS-232, RS-485, CAN bus;

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

RS232/RS485 baud rate: 9600bps, 19200bps, 38400bps, 57600bps, 115200bps；

CAN baud rate: 100Kbps, 200Kbps, 500Kbps, 1Mbps;

Data bit: 8 bit;

Parity check: no check.

2.2 Installation and Debugging

1. Installation and debugging tools, please refer to 《Debugging Tools Instructions》for details.
2. Instructions for use, please refer to《SY-03B Quick Use Guide》for details.

2.3 Command Format Instruction

2.3.1 Control Command Format

a: Pump & Valve Parameter Setting Command (Factory Command)

b: Pump & Valve Parameter Query Command (Common Command)

c: Pump & Valve Action Command (Common Command)

Table 2-3-1 Send Command (Common Command)

Interpretation of 0xXX: 0x means hexadecimal, XX is a two-digit hexadecimal number. The value inputted into the software all should be XX.

The message frame of "Send Command" is 8 bytes, and the complete format is as follows:

FH (frame header)	Address code	Function code	Parameter	EOF (end of frame)	Sum check

B0	B1	B2	B3	B4	B5	B6	B7
STX	ADDR	FUNC	1-8 bit	9-16 bit	ETX	Low byte	High byte

The 1ˢᵗ byte STX: Frame header (0XCC)

The 2ⁿᵈ byte ADDR: Address of slave device (0x00~0x7F)

Multicast Address (0x80~0xFE)

Broadcast Address (0xFF)

The 3ʳᵈ byte FUNC: Function code

The 4ᵗʰ and 5ᵗʰ byte: Parameters corresponding to the function code

The 6ᵗʰ byte ETX: End of frame (0xDD)

The 7ᵗʰ and 8ᵗʰ byte: Cumulative sum check code from byte 1 to 6

Note: The above command format refers to the common command. In particular, if a password bit is added to the factory command and the parameter bit has also changed, from the original 2 bytes to 4 bytes, the command format is as follows:

The message frame of "Factory Command" is 14 bytes, and the format is as follows:

Table 2-3-2 Send Command (Factory Command)

FH (frame header)	Address code	Function code	Pass word	Parameter				EOF (end of frame)	Sum check	
B0	B1	B2	B3,B4, B5,B6	B7	B8	B9	B10	B11	B12	B13
STX	ADDR	FUNC	PWD	1-8 bit	9-16 bit	17-24 bit	25-32 bit	ETX	Low byte	High byte

Table 2-3-3 Response Command

FH (frame header)	Address code	Status code	Parameter		EOF (end of frame)	Sum check	
B0	B1	B2	B3	B4	B5	B6	B7
STX	ADDR	STATUS	1-8 bit	9-16 bit	ETX	Low byte	High byte

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

2.3.2 Command Format Description

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

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：

Name	Abbreviation	Code B1	Remark
Address bit	Address	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 ~ 0x7F.

Table 2-3-4 Control Code Description

a: Pump & Valve Parameter Setting Command (Factory Command)(B2～B10)

Code (B2)	Abbreviation	Password B3 B4 B5 B6	Parameter B7 B8 B9 B10
0x00	Set device address	B3=0xFF B4=0xEE B5=0xBB B6=0xAA	B7=0xXX (B8=0x00 B9=0x00 B10=0x00) The value range of XX is 0x00 ~ 0x7F and the default is 00.
0x01	Set RS232 baud rate		Totally 5 baud rates: the factory default is 9600bps （B8=0x00 B9=0x00 B10=0x00） B7=0x00 corresponding baud rate is 9600bps B7=0x01 corresponding baud rate is 19200bps B7=0x02 corresponding baud rate is 38400bps B7=0x03 corresponding baud rate is 57600bps B7=0x04 corresponding baud rate is 115200bps
0x02	Set RS485 baud rate		
0x03	Set CAN baud rate		Totally 4 baud rates: the factory default is 100K （B8=0x00 B9=0x00 B10=0x00） B7=0x00 corresponding baud rate is 100Kbps B7=0x01 corresponding baud rate is 200Kbps B7=0x02 corresponding baud rate is 500Kbps B7=0x03 corresponding baud rate is 1Mbps
0x07	Set speed of syringe pump		B7=0xXX(B8=0x00 B9=0x00 B10=0x00) The value range of XX is 0x01 ~ 0x384 and the default is 12C.
0x10	Set CAN destination address		B7=0xXX(B8=0x00 B9=0x00 B10=0x00) The value range of XX is 0x00 ~ 0xFF and the default is 00.
0x50	Set multicast channel 1 address		B7=0xXX (B8=0x00 B9=0x00 B10=0x00) The value range of XX is 0x80 ~ 0xFE and the default is 00.
0x51	Set multicast channel 2 address		B7=0xXX (B8=0x00 B9=0x00 B10=0x00) The value range of XX is 0x80 ~ 0xFE and the default is 00.
0x52	Set multicast		B7=0xXX (B8=0x00 B9=0x00 B10=0x00)

	channel 3 address		The value range of XX is 0x80 ~ 0xFE and the default is 00.
0x53	Set multicast channel 4 address		B7=0xXX (B8=0x00 B9=0x00 B10=0x00) The value range of XX is 0x80 ~ 0xFE and the default is 00.
0xFC	Parameter lock		Parameters are 0x00
0xFF	Restore factory settings		Parameters are 0x00

Example: Use the 0x50/51/52/53 command to set the multicast address (only uses 0x50/51/52 commands in this example).

Use three RUNZE SY03B syringe valves with the same software version from. In RS485 communication mode, set their addresses into 00, 01, 02 and make a mark. Firstly, for the multicast channel 1 address of SY03B whose address is 00, set the parameter 0x81 into 81 by command 0x50; for the multicast channel 3 , the parameter 0x83 is set into 83 by the command 0x52; Secondly, for the multicast channel 1 address of SY03B whose address is 01, set the parameter 0x81 into 81 by command 0x50, for the multicast channel 2 , the parameter 0x82 is set into 82 by the command 0x51; finally, for the multicast channel 2 address of SY03B whose address is 02, set the parameter 0x82 into 82 by the command 0x51; for the multicast channel 3, the parameter 0x83 is set into 83 by the command 0x52. (See the table)

Items \ Device	Device1 (Address 0)	Device 2 (Address 1)	Device 3 (Address 2)
multicast address	81	81	
		82	82
	83		83
broadcast address	FF	FF	FF

After the setting is completed, connect the three devices in parallel to the serial debugging tool, and use RUNZE debugging tool software MotorTest V0.8 to debug. Set the address into 0x81, the command into 0x44, and the parameter into 0x01. Click to send and then observe that the action of switching valve port is carried out on device 1 & device 2. Set the address into 0x82, the command into 0x44, and the parameter into 0x03. Click to send and then observe that the action of switching valve port is carried out on device 2 & device 3. Set the address into 0x83, the command into 0x44, and the parameter into 0x05. Click to send and then observe that the action of switching valve port is carried out on device 1 & device 3. Set the address into 0xFF, the command into 0x44, and the parameter into 0x03. Click to send and then observe that the action of switching valve port is carried out on all the devices.

The newly added command to set the multicast address greatly meets the needs of customer groups, making it easier and more convenient for customers. You can choose the device you want to control so that you can complete your work more efficiently and quickly during usage.

b: Pump & Valve parameter query command (common command) (B2～B4)

Code B2	Abbreviation	Parameter B3 B4
0x20	Query address	The value range of address is 0x0000 ~ 0x007F and the default is 00.
0x21	Query RS232 baud rate	Totally 5 baud rates: the default is 9600bps B3B4=0x0000 corresponding baud rate is 9600bps B3B4=0x0001 corresponding baud rate is 19200bps B3B4=0x0002 corresponding baud rate is 38400bps B3B4=0x0003 corresponding baud rate is 57600bps B3B4=0x0004 corresponding baud rate is 115200bps
0x22	Query RS485 baud rate	
0x23	Query CAN baud rate	CAN baud rate is as follows: B3B4=0x0000 100Kbps B3B4=0x0001 200Kbps B3B4=0x0002 500Kbps B3B4=0x0003 1Mbps
0x27	Query speed	0x0001 ~ 0x0384(1 ~ 900)
0x2E	Query automatic reset when power on	B3B4 =0x0000
0x30	Query CAN destination address	B3B4 =0x0000
0x70	Query multicast channel 1 address	B3B4 =0x0000
0x71	Query multicast channel 2 address	B3B4 =0x0000
0x72	Query multicast channel 3 address	B3B4 =0x0000
0x73	Query multicast channel 4 address	B3B4 =0x0000
0xAE	Query current channel position	B3B4 =0x0000

0x3F	Query current version	B3=0x01 B4=0x09, above is an example, if the response parameter is the same as above parameter, it means the current version is V1.9, see the version number on the label for details
0x4A	Query motor status	B3B4 =0x0000
0x4D	Query valve status	B3B4 =0x0000

C: Pump & Valve Action Command（Common Command）(B2～B4)

code (B2)	Command function	Parameter range of command (B3,B4)
0x42	Dispense liquid	The value of B3B4 is greater than 0. When the number of steps corresponding to the setting B3B4 parameter is greater than the maximum number of stroke steps, the motor will not run, and return B3=08, B4=00; When the number of steps corresponding to the setting B3B4 parameter is less than the maximum number of stroke steps, the motor will follow the set number of steps.
0x43	Aspirate liquid	The value of B3B4 is greater than 0. When the number of steps corresponding to the setting B3B4 parameter is greater than the maximum number of stroke steps, the motor will not run, and return B3=08, B4=00; When the number of steps corresponding to the setting B3B4 parameter is less than the maximum number of stroke steps, the motor will follow the set number of steps.
0x44	The valve rotates through the code disc and automatically selects the optimal path.	According to the actual number of channels of the switching valve. For example, a 10-channel switching valve, then B3=0xXX B4=0x00, where the value range of XX is 01 ~ 0A.
0x4C	The valve resets.	B3=0x00 B4=0x00 The switching valve runs to the reset optocoupler and stops.
0x45	The syringe pump resets.	B3=0x00 B4=0x00 The syringe pump runs to the home position and stops.
0x4F	The syringe pump resets forcibly.	B3=0x00 B4=0x00 The syringe pump runs to the home position and stops.
0x49	Stop forcibly (syringe pump and valve)	B3=0x00 B4=0x00
0x4B	Set dynamic speed	The value range of B3B4 is 0x0001 ~ 0x0384 and the motor rotation speed is 1 ~ 900.
0x4E	The syringe pump runs to the absolute position.	The value range of B3B4 is 0x0000 ~ 0XBB8 and it is any position between the stroke of the syringe.

0x66	Query syringe pump address	B3=0x00 B4=0x00 After the syringe pump runs, the current position of the motor can be queried by commands, and the current distance between the motor and the zero position can be displayed (number of steps).
0x67	Synchronize the syringe pump position.	B3=0x00 B4=0x00 When the syringe pump is suddenly powered off during operation, the position will be memorized. If the 0x66 command is not used to synchronize the position of the syringe pump when the power is on again, the piston cannot move.

Status list

Category	Status (B2)	Status of response frame (B2)
Response status	0x00	Normal status
	0x01	Frame error
	0x02	Parameter error
	0x03	Optocoupler error
	0x04	Motor busy
	0x05	Motor stalled
	0x06	Unknown position
	0x07	Command rejected
	0x08	Illegal position
	0xFE	Task being executed
	0xFF	Unknown error

Note: In RS485 communication, when sending an action command, the B2 byte receives FE, indicating that the command is received and is being executed.

Chapter 3 Common Problems & Solutions

Problem	Possible Reason	Solution
Not working when powered on	The working voltage is not in the acceptable range.	Check whether there is any deviation between actual pin voltage and rated voltage
	The power connection is loose or disconnected	Manually check whether the connection is good, or use a multimeter to check the cables
Not aspirate liquid	It is blocked by particles	Take out the pump tube and check for blocked particles

Application Notice:

★　Please ensure that the voltage matches the standard voltage of the instrument.

★　Please use original serial port wires

★　Communication RS232, RS485, CAN are under Non-isolation mode, hot swapping unsupported.

★　Please cover the unused ports with suitable coned plugs when laid aside to avoid impurity substance and air

★　Do not disassemble the product parts at will. The tamper-evident label is not guaranteed.

★　Please read above operation instructions and communication protocols carefully, do not input data randomly.

★　Discard the instrument should be in line with the regulations on the disposal. Dispose of the waste in accordance with national environmental protection requirements. Users should not throw away at will.

●　When using CAN protocol to connect multiple devices, please refer to the connection method shown in Figure 3-1 below.。
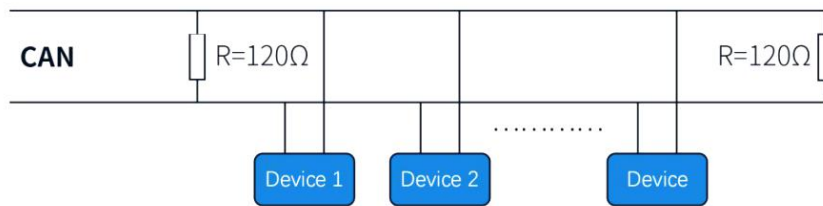

Figure 3-1

●　When using RS485 protocol to connect multiple devices, please refer to the connection method in Figure 3-2 below, but the resistance value needs to be determined according to the number of devices connected by the user.
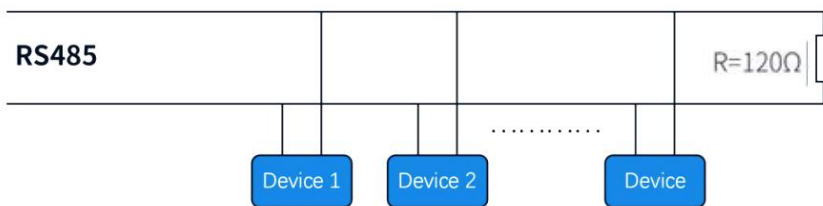

Figure 3-2

Chapter 4 Technical Service

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