



V1.3

LM60B Intelligent Peristaltic Pump

Instruction Manual

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Chapter 1 Product Introduction

1.1 Overview

LM60B intelligent filling peristaltic pump, using high-performance processor and motor drive, controlling stepper motor, motor subdivision adaptive, the minimum speed can reach 0.1rpm; rich application scenarios, support keyboard control mode, communication control mode (RS232 /RS485), external control mode (optional multiple signal conversion modules); passive contact status output.

1.2 Product Features

The product is composed of main machine, pump head, pump tube and other parts. The product can perform flow control, speed control, liquid volume control, and time control through the button panel. The four control modes are calibrating mode, continuous mode, rationing mode, booking mode. The interface functions are clear and intuitive, and customers can perform various combined operations, which are convenient and simple.

Chapter 2 Instruction of Port and Structure

2.1 Technical Parameters

Item	Parameters
Speed range	0.1rpm ~ 300/400.0rpm (Maximum speed vary from different pump heads, tube type and tube sizes)
Speed resolution	±0.1rpm
Flow range	0.03~117 ml/min
Pedal signal port	Foot switch control start/stop (only keyboard control mode)
Speed signal port	Support multiple switching control inputs(external control mode only)
Direction signal port	Support steering switch control input (external control mode only)
ON/OFF signal port	Support ON/OFF switch control input (external control mode only)
Communication por	RS232/RS485 (only in communication control mode)
Power supply	DC24V±10%
Power	20W
Operating temperature	0C° ~ 40C°
Operating humidity	< 80% relative humidity, non-condensing
Dimensions (Unit: mm)	173(L)×105 (W) ×96(H)
Net weight	1.45 Kg
Protection level	IP31

2.2 Overall Structure Diagram



Figure 2-1 Schematic diagram of LM60B intelligent filling peristaltic pump

2.3 Definition of Communication Interface

NO.	Item	Description
1	+24V	DC24V Power
2	RXD	RS232 Data output
3	TXD	RS232 Data input
4	COM	Passive contact output-common port
5	+5V	+5V power
6	CB	Passive contact output-normally closed port
7	CK	Passive contact output-normally open port
8	FT_EXST	Foot pedal / external start stop signal input interface
9	GND	Ground wire
10	EX_DIR	External steering signal input interface
11	A	RS485-A port
12	B	RS485-B port
13	SWD-DIO	SWD data
14	SWD-CLK	SWD clock
15	ADC-IN	External speed signal input interface (3.3V interface)

Table 2-1 DB15 external terminal attribute definition

2.4 Pump Head/Pump Tube Selection

Pump head	Applicable Tube	Maximum flow	Maximum speed
RZ1030	Thickness 0.8mm inner diameter within 2.54mm	117ml/min	400rpm

Table 2-2 Pump head /pump tube model & corresponding maximum flow reference

Note: (1) When selecting pump head or pump tube, please refer to Chapter 6 Flow Curve.

(2) For the same tube diameter and specifications, different materials, tube ductility, resilience, hardness are different, the maximum flow is for reference only.

2.5 Special Function Switching

(1) **Restore factory settings:** Press the "Edit" (EDIT) button to turn on the pump and restore the factory settings.

(2) **Chinese/ English language interface switching:** Press the "CW/CCW" key and turn on the pump to switch on the interface between Chinese and English.

(3) **Keyboard control mode:** Press the "HOME" key to switch to the normal keyboard mode.

(4) **Communication control mode:** Press the "Left Button" to switch to the communication control mode. Support RS232/RS485 communication control.

(5) **External control mode:** Press the "right button" to switch to the external control mode. Support external speed/steering/starting input control.

(6) **Query version function:** Press the "ENTER" key and boot, to check the software version and software release time.

Chapter 3 Keyboard Control Mode

3.1 Main Menu

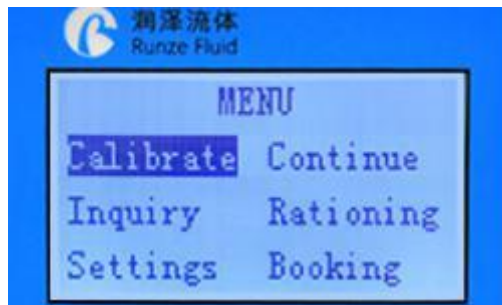


Figure 3-1 Main menu

The Main Menu lists 6 functions: Continue, Booking, Rationing, Calibrate, Settings, Inquiry.

In the main menu, press $[\wedge]$ 、 $[V]$ $[<]$ 、 $[>]$ to switch functions. When a function is displayed in reverse, press "ENTER" key to enter the standby interface of the function; Press "Edit" key to the editing interface of this function.

In the editing interface, $[\wedge]$ 、 $[V]$ change the value, $[<]$ / $[>]$ change the position; Press the "HOME" key, if there is an error in the editing content, the error message will be displayed and the system will return to the main menu with a delay of three seconds; otherwise, the parameter will be saved and immediately return to the main menu; Press "ENTER" key, if there is an error, the error message will be displayed, otherwise the parameters will be saved. Then immediately return to the standby interface.

In the main menu or standby interface, press the "ANGLE" key to quickly switch to the suction angle editing interface, the arrow keys to change the value or position, and press the "ENTER" key or "HOME" key to save.

3.2 Working Mode Description

3.2.1 Calibrate Mode

After the instrument is used for the first time, or after the pump head or pump tube is replaced, in order to obtain an accurate liquid volume result, it is necessary to perform a "calibration" operation and input the calibration result. The specific calibration process is as follows:

(1) Determine the calibration speed. According to the flow demand, query the flow curve of the corresponding pump head/pipeline (corresponding flow curve in Chapter 6) to obtain the approximate calibrated speed. Take RZ1030 pump head and 0.8mm inner diameter 2.54mm pipe as an example. If the flow rate is 81ml/min, find the approximate position of 81ml/min on the vertical axis, and draw a horizontal line to intersect the blue line of the flow curve of a pipe with a wall thickness of 0.8mm and an inner diameter of 2.54mm, and draw a vertical line from the intersection point to the horizontal axis. The intersection point of the vertical line and the horizontal axis is the calibrated target speed (about 275rpm)

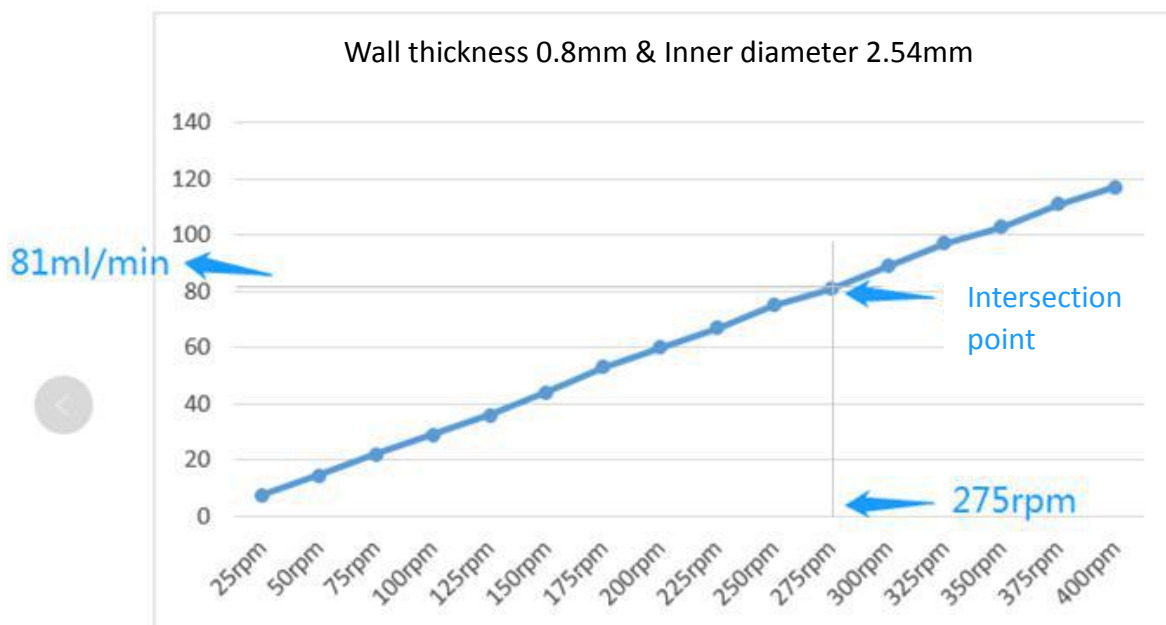


Figure 3-2 Use of flow curve table

(2) Set the calibration parameters. In the calibration editing interface, input the speed, time, and set the fluid volume value to 0, and press the "Enter" key to save.

(3) Perform the calibration process. Press the "CW/CCW" keys, select the appropriate steering, pre-fill the pipeline, and empty the liquid in the calibration container. In the calibration standby interface, press "ON/OFF" to start the peristaltic pump. After running the "calibration time", the obtained liquid volume is the calibration "liquid volume" for this calibration operation. Use a measuring cup to weigh the liquid in milliliters.

(4) Set calibration result. After calibration, follow the prompts and press the "Edit" key, input the above calibration result (calibration fluid volume in milliliters), and press "ENTER" to save, the system will automatically return to the main menu. If it prompts "Maximum flow overflows the default

value!" when saving, you need to recheck the calibration process to see if the test value is wrong.

Note: The default is 60 seconds, which can appropriately extend the "calibration time", repeat the test several times, and obtain the average value of the liquid volume obtained from multiple calibrations, which can improve the accuracy of the calibration results.

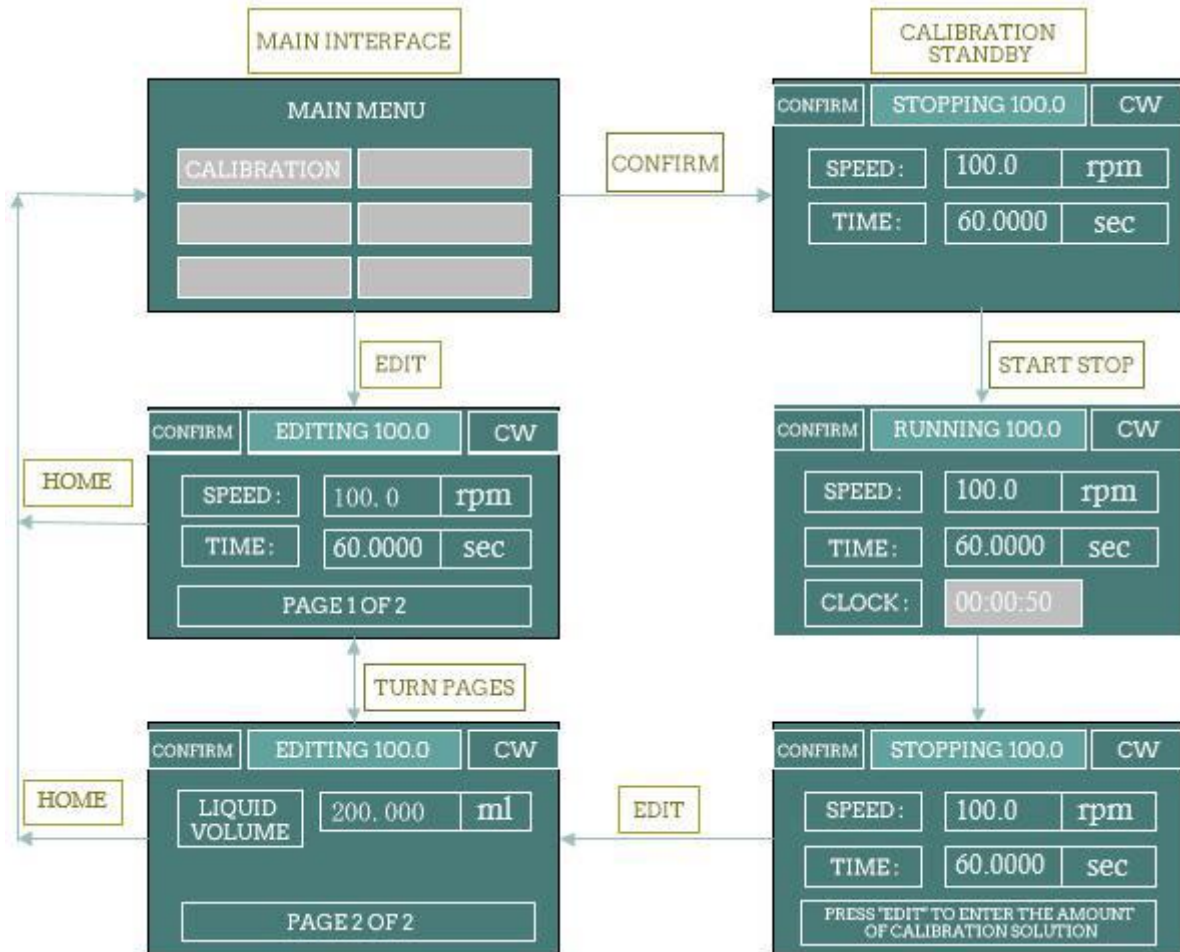


Figure 3-3 "Calibration" edit setting process

3.2.2 Inquiry Mode

The standard speed, calibration flow, minimum flow, maximum flow, standard ratio and other parameters can be queried through this mode.

(1) Calibration speed : Calibrate and confirm the speed value of the liquid volume for the last time. The default is 100.0 rpm/min.

(2) Calibration flow : After the calibration is completed, input the calibration speed and the fluid volume under the fixed time conditions, and the calculated calibration flow rate. Flow unit:(ml/min).

(3) Minimum flow : According to the calibration speed and the minimum speed (0.1rpm) and the

calibration flow rate, the minimum flow rate is calculated.

(4) Maximum flow : According to the calibration speed, the maximum speed and the calibration flow rate, the maximum flow rate is calculated.

(5) Calibration ratio : Calibration ratio = calibration flow / calibration speed. Calibration ratio unit:(ml/r). This is a reference unit for running calculations.

3.2.3 Setting Mode

Parameters such as maximum speed, full speed, backlight time, contrast, current code, and foot pedal operating mode can be set through the setting mode.

(1) Maximum speed : The upper limit of the motor speed. The maximum speed is generally related to the pump head model/pump tube model and does not need to be changed after leaving the factory. If the maximum speed is changed, it needs to recalibrate and enter the calibration result correctly.

(2) Full speed : When the motor is in the standby interface, the motor speed value when the "full speed" (FULL) key is pressed. It is generally used for emptying/fulling. To ensure reliable rotation, the full speed is generally lower than the maximum speed.

(3) Backlight time : The retention time after the backlight is turned on, in seconds (SEC). Each time there is a new button operation, the backlight retention time is recalculated.

(4) Contrast: Contrast is used to adjust the brightness of the LCD screen.

(5) Current code: The current code is used to set the maximum current of the motor.

The corresponding table of current code definition is as follows:

Current code	Maximum motor output Current (A)	Motor effective output Current (A)	Current Code	Maximum motor output Current (A)	Motor effective output current (A)
7	1.000	0.700	20	2.625	1.840
8	1.125	0.790	21	2.750	1.925
9	1.250	0.875	22	2.875	2.013
10	1.375	0.960	23	3.000	2.100
11	1.500	1.050	24	3.125	2.188
12	1.625	1.140	25	3.250	2.275
13	1.750	1.225	26	3.375	2.363
14	1.875	1.300	27	3.500	2.450
15	2.000	1.400	28	3.625	2.540

16	2.125	1.490	29	3.750	2.625
17	2.250	1.575	30	3.875	2.710
18	2.375	1.660	31	4.000	2.800
19	2.500	1.750	-	-	

Table 3-1 Comparison table of current code and motor maximum output current

(6) Foot pedal: The foot switch function has three working states: disabled, inching, and continuous.

Disable: Foot pedal unworkable.

Inching switch: In the "continuous" mode, the foot switch is stepped on and the motor runs. When it is released, the motor stops.

Linked switch: In the "continuous" mode, When step on foot pedal then step off, motor starts working, when step on the foot pedal in non-"continuous" mode, the foot pedal is set to " Inching switch " or " Linked switch ", both of which are trigger switches for start and stop.

3.2.4 Continuous Mode

In continuous mode, the default machine has been in the normal calibration process.

(1) Continuous mode speed regulation

Continuous mode means motor constant running in the direction of CW or CCW. Motor speed and flow rate value settings can realize adjusting the flow rate. Under continue mode, the speed can be changed by [$\wedge$], [$\vee$] to $\pm 0.1\text{rpm}$; the speed can be changed by [$<$], [$>$] to $\pm 1\text{rpm}$; you can also hold down a certain direction key and hold it for 1 second without releasing, realize the rapid change of speed/flow.

(2) Rotary encoder

In continuous mode operation, short press the encoder button, the speed adjustment gears are variable, respectively ($\pm 10\text{rpm}$, $\pm 1\text{rpm}$, $\pm 0.1\text{rpm}$); long press the encoder button to stop. If the encoder button is pressed shortly in the continuous mode standby, the operation will start.

3.2.5 Rationing Mode

(1) In rationing mode, the device has been through the normal calibration process by default.

(2) In the main menu, select "Rationing" and press the "Edit" key to enter the rationing editing interface.

(3) In the main menu, select "Rationing" and press the "Enter" key to enter the rationing standby interface.

(4) In the rationing editing interface, enter the required liquid volume and time, and press "Enter" to save, and it will automatically jump to the standby interface.

(5) In the rationing standby interface, press "ON/OFF" to realize a rationing process.

3.2.6 Booking Mode

In booking mode, the device has been through the normal calibration process by default.

Booking mode to realize "waiting-running 1-interval-running 2-interval-... running n, running times "n", n can be set (n=0000 means infinite loop, the maximum is 9999), and the corresponding liquid volume and corresponding running time (related to speed and calibration ratio) can also be set.

Booking Mode	Action	Result
Waiting	Press "ON/OFF"	End booking, running 0001#directly
	Press "HOME" buttons	End booking, back to main menu
Running	Press "ON/OFF"	End running and enter into interval waiting time, if it is the last running, device will automatically finish the booking process.
Interval	Press "ON/OFF"	End this interval and enter the pause process
Stopping	Press "ON/OFF"	Enter the next running process
	Press "HOME" buttons	Quit booking process, back to mode selection interface

Table 3-2-6 List of the functions of the "ON/OFF" key and "HOME" key during the "reservation" process

Chapter 4 Communication Control Mode

4.1 Command Format

4.1.1 Common Command Format (send 10 bytes, 10 bytes received)

Byte send :

1	2	3	4	5	6	7	8	9	10
FH (Frame header)	Address code	Function code	Function parameters				EOF (End of frame)	Cumulative sum	
STX	ADDR	FUNC	1-8 bit	9-16 bit	17-24 bit	25-32 bit	ETX	Low byte	High byte

The 1st byte STX: frame header (CCH)

The 2nd byte ADDR: slave address (01H~ F7H)

The 3rd byte FUNC: function code

The 4-7th bytes: parameters corresponding to the function code

The 8th byte ETX: end of frame (DDH)

The 9th-10th bytes: cumulative sum check code from byte 1 to 8

Byte received:

1	2	3	4	5	6	7	8	9	10
FH (Frame header)	Address code	State code	State parameters				EOF (End of frame)	Cumulative sum	
STX	ADDR	STATE	1-8 bit	9-16 bit	17-24 bit	25-32 bit	ETX	Low byte	High byte

The 1st byte STX: frame header (CCH)

The 2nd byte ADDR: slave address (01H~ F7H)

The 3rd byte STATE: state code

The 4-7th bytes: parameters corresponding to the state code

The 8th byte ETX: end of frame (DDH)

The 9th-10th bytes: cumulative sum check code from byte 1 to 8

4.1.2 Factory Common Format (send 14 bytes, 8 bytes received)

Byte send:

1	2	3	4-7	8	9	10	11	12	13	14
FH (Frame header)	Address code	Function code	Pass word	Function Parameters				EOF (End of frame)	Cumulative sum	
STX	ADDR	FUNC		1-8 bit	9-16 bit	17-24 bit	25-32 bit	ETX	Low byte	High byte

The 1st byte STX: frame header (CCH)

The 2nd byte ADDR: slave address (01H~ F7H)

The 3rd byte FUNC: function code

The 4-7th bytes: password of factory command

The 8th-11th bytes: parameters corresponding to the function code

The 12th byte ETX: end of frame (DDH)

The 13th-14th bytes: cumulative sum check code from byte 1 to 12

Byte received :

1	2	3	4	5	6	7	8
FH(frame header)	Address code	State code	State parameters		EOF (End of frame)	Cumulative sum	
STX	ADDR	STATE	1-8bit	9-16bit	ETX	low byte	High byte

The 1st byte STX: frame header (CCH)

The 2nd byte ADDR: slave address (01H~ F7H)

The 3rd byte STATE: state code

The 4-5th bytes: parameters corresponding to the state code

The 6th byte ETX: end of frame (DDH)

The 7th-8th bytes: cumulative sum check code from byte 1 to 6

4.2 Setting Command (Suitable for factory command format)

The password to set the command is AABBEFFH (The front is the low bit)。

Serial number	Function code	Function	Parameter	Note
1	00H	Set device address	00000001H-000000F7H (1-247)	0x00 is broadcast address and it only accepts, but does not reply.
2	01H	Set the RS232 baud rate	00000000H-00000004H	0 : 9600bps (Default) 1 : 19200bps 2 : 38400bps 3 : 57600bps 4 : 115200bps
3	02H	Set the RS485 baud rate	00000000H-00000004H	
4	03H	Set the suction Angle	00000000H-00000E10H (0-3600degrees)	Default value: 36 degrees
5	04H	Set the veer	00000000H~00000001H	0 : reverse 1 : forward (Default value)

6	05H	Set the maximum speed	00000001H~00000FA0H (0.1~400.0rpm)	10 times more storage, Need fixed parameters (1~4000) The default value is 3000
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Table 4-1 List of setting commands

4.3 Query Command (Suitable for common command format)

Serial number	Function code	Function	Parameter	Note
1	20H	Set device address	No parameter	The slave does not recognize the command address, and there is a risk of hardware conflict when the RS485 bus has more than one device.
2	21H	Set the RS232 baud rate	No parameter	
3	22H	Set the RS485 baud rate	No parameter	
4	23H	Set the suction Angle	No parameter	
5	24H	Query storage steering	No parameter	
6	25H	Query maximum speed	No parameter	10 times the storage, the system is relatively fixed

Table 4-2 List of query commands

4.4 Control Command (Suitable for common command format)

Serial number	Function code	Function	Parameter	Note
1	40H	Take a number of steps clockwise	00000001H-FFFFFFFFH	
2	41H	Take several steps counterclockwise	00000001H-FFFFFFFFH	
3	42H	Proceed clockwise for a number of steps, and at the end press the suction Angle setting to run	00000001H-FFFFFFFFH	
4	43H	Go counterclockwise for a number of steps, and press the back suction Angle setting to run at the end	00000001H-FFFFFFFFH	

5	44H	Turn the specified circle clockwise	00000001H-FFFFFFFFH	
6	45H	Turn counterclockwise to specify a circle	00000001H-FFFFFFFFH	
7	46H	Query motor state (number of remaining turns)	No parameter	Returns the current status. The state parameter is the number of remaining turns
8	47H	Rotate continuously clockwise	No parameter	The recovered state parameter is 0
9	48H	Counterclockwise continuous rotation	No parameter	
10	49H	Forced to stop	No parameter	The recovered state parameter is 0
11	4AH	Query motor state (number of remaining steps)	No parameter	Returns the current status. The state parameter is the number of remaining turns
12	4BH	Set the dynamic speed	0001H~ FA0H (0.1rpm~400.0rpm)	The actual speed value is 10 times
13	4CH	Query dynamic speed	No parameter	Returns 10 times the dynamic speed

Table 4-3 List of control commands (including status query commands)

4.5 Communication Control Mode Interface

4.5.1 Control command (example)

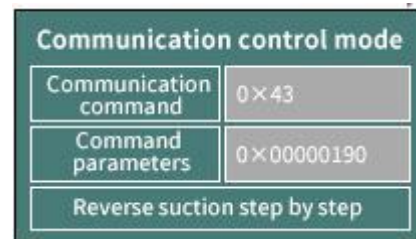


Figure 4-5-1-1 CW 0xC8(200 Steps) Figure 4-5-1-2 CCW 0x190 (400 Steps) with suction

4.5.2 Status query command (example)

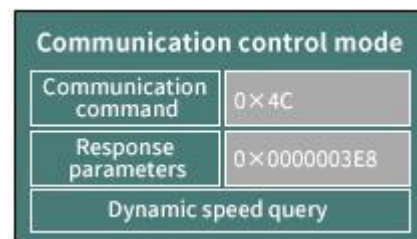
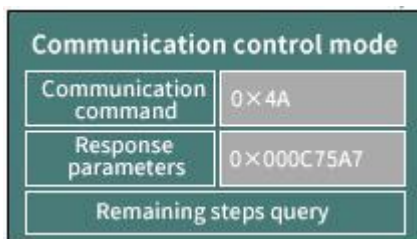


Figure 4-5-2-1 Query steps left during motor running Figure 4-5-2-2 Query dynamic speed 0x3E8(100rpm)

4.5.3 Set command (factory command) and query (example)

Setting address interface (address setting command is 0x00, address query command is 0x20)

Communication control mode	
Communication command	0x00
Command parameters	0x00000002
Address setting	

Figure 4-5-3-1 address setting interface

Communication control mode	
Communication command	0x20
Response parameters	0x00000002
Address query	

Figure 4-5-3-2 address query interface

Chapter 5 External Control Mode

5.1 External Speed Control Operation

(1) Press the [>] to switch to the external control mode. The default is in the stop state of the external control mode.

(2) Press the "ON/OFF" button on the keypad or the middle button of the rotary encoder (under the condition of enabling the encoder) to switch between start and stop.

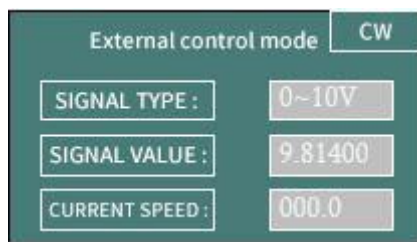


Figure 5-1 Stop state

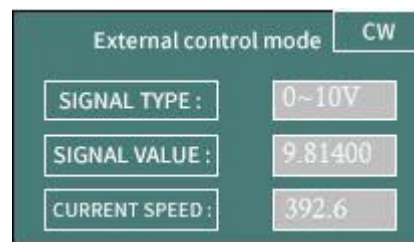


Figure 5-2 Running state

(3) When the motor stops, press the [^], [V] to switch the type of external control signal. The type code of the speed control signal is defined as follows:

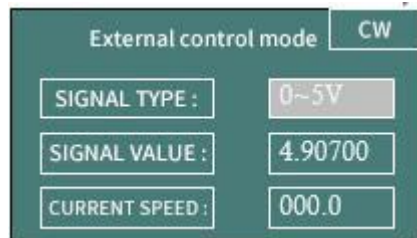


Figure 5-3 When the motor stops, press the [^], [V] to change the signal category

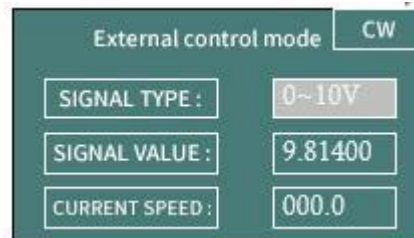


Figure 5-4 When the motor stops, press "CW/CCW" key to change switching direction

(5) The external steering input port EXDIR, whether the motor is stopped or running, can switch the steering. Set EXDIR high (open circuit with ground) to turn forward, and set EXDIR low (short circuit with ground) to turn reverse.

(6) External start/stop input port EXST. Setting EXST high (open circuit with ground) prohibits

rotation, and setting EXST low (short circuit with ground) allows rotation.

(7) The external speed control input port ADC-IN can be used for signal adjustment. The port voltage property is 0~DC3.3V. If other types of input speed control signals are required, the corresponding signal converters need to be connected for correct operation.

External control speed signal type	meaning	Remark
0	0~3. 3V external control speed regulation	The voltage signal of 0~3.3V is directly added to the ADC-IN port
1	0~5V external control speed regulation	Requires optional 0~5V to 0~3.3V dedicated conversion module
2	0~10V external control speed regulation	Requires optional 0~10V to 0~3.3V dedicated conversion module
3	4~20mA external control speed regulation	Requires optional 4~20mA to 0~3.3V dedicated conversion module
4	0~10KHz external control speed regulation	Requires optional 0~10KHz to 0~3.3V dedicated conversion module

Table 5-1 External control speed control signal type list

Note: The external control speed will correspond to 0-maximum speed. Due to the error of AD collection, the actual minimum speed will be greater than 0.1rpm, and the actual maximum speed will be less than the theoretically set maximum speed.

5.2 Maximum Speed Setting

The maximum speed is set through RS232/RS485 when the motor stops, please refer to Chapter 4.2 0x05 command. When the instrument leaves the factory, the suitable maximum speed will be preset according to the optional pump head/pump tube. The user does not need to set.

Chapter 6 Technical Parameters of Peristaltic Pump Tube

6.1 Table of Commonly Used Flexible Tube

Model No.	LM60B
Wall thickness (metric: mm)	0.8
Inner diameter (metric: mm)	2.54

Table 6-1 Table of Commonly Used Flexible Tube

6.2 Peristaltic Pump Head-Tube Reference Flow Curve

RZ1030 (LM60B) Flow-Speed Curve

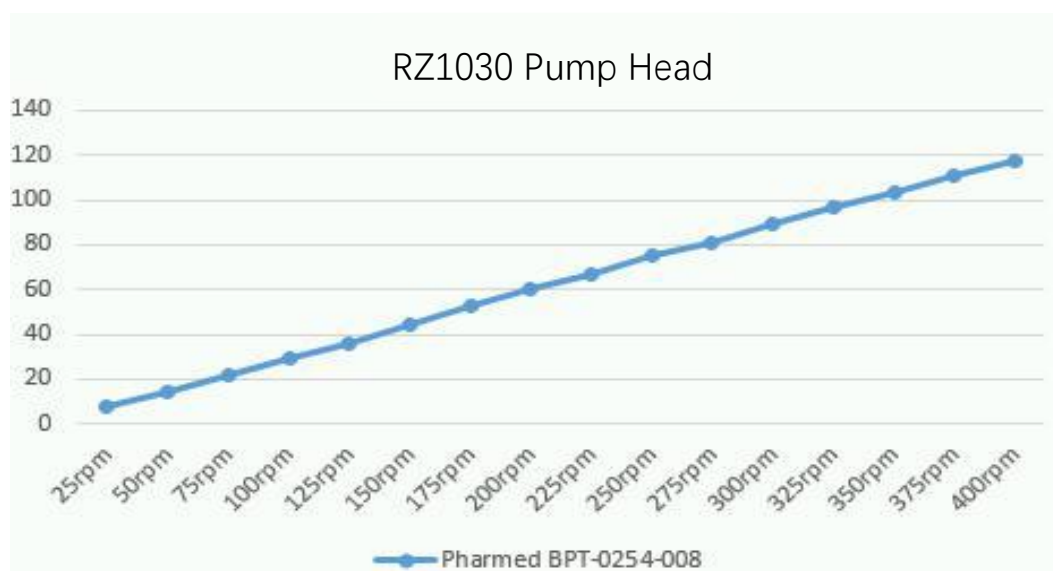


Table 6-2 RZ1030 Flow-Speed Curve

Note 1: The above "Flow-Speed" of different pump heads and different tubes is the actual test curve, without any modification, for reference only;

Note 2: The above tested liquid is water under normal temperature conditions, and the test temperature is about 25C°;

Note 3: There are many factors that affect the actual test value, including the following aspects: the material and elasticity of the tube, the tightness of the tube installation, and the viscosity of the test liquid;

Note 4: The thickness and wall thickness of the tube will affect the maximum speed of the actual pump head for stable operation;

Note 5: If you have higher requirements for dosing accuracy, please choose a type of product such as a syringe pump.

Chapter 7 Equipment Maintenance

7.1 Common Equipment Maintenance Process

1. Regular maintenance of tube

When the tube is not used for a long time, please empty the liquid in the tube in time, open the protective lock on the pump head and loosen the pump tube.

2. Check tube connectors regularly

Regularly check whether the tube connector is loose or damaged. If it is abnormal, it must be replaced in time

3. Regular or irregular calibration

Recalibration is necessary after the tube is replaced or loosened.

7.2 Common Problems and Solutions

Problems	Problems Description	Solutions
The backlight is not bright	The value of backlight time in the Settings menu is set to 0	In the Settings menu, in backlight Time Settings, increase the value.
	Backlight lamp hardware or backlight lamp power control part failure	Backlight does not affect the application function, but is required in dark environments. In case of hardware failure, it can be returned to the factory for repair.
	The contrast TAB in the Settings menu is set to 1	The "Contrast" setting in the "Settings" menu, increase the value
LCD blurred screen	There are large disturbance sources nearby	Keep away from interference sources when the instrument is working
	An unknown cause has caused the location of the data refreshed to the LCD screen to be confused	The display disorder of the screen does not affect the control operation of the motor. If the motor is in operation, press the "start stop" button to stop the motor first. On the standby interface, press the "HOME" button five times to refresh the screen.
Fan does not rotate	Too much fan dust clogs	After power is cut off, remove dust with a soft brush
	Bad fan or bad fan power contact	Return to factory for repair
Motor does not rotate	The screen shows motor rotation It's not actually rotating	Check whether the pump body joint is loose and reliable
		Check to see if the Current code in Settings is too small. Set to the current code consistent with the product.
		The motor connection is loose. Return to factory for repair
		The motor power supply cord is loose. Return to factory for repair
Motor stalled	The original valve head/pipeline can run at a certain speed, but the new valve head/pipeline cannot run	The new valve head/line should be run in for one or two minutes at low speed.
	Exceeding maximum RPM of valve head/line	Refer to the above operating curve, select the reasonable speed corresponding to the valve head/pump tubing.
Inaccurate flow or liquid volume	After replacing the tube, the liquid volume or flow rate varies greatly	Recalibrate and enter accurate calibration parameters. You can do multiple calibrations to take the mean, and then you put in the mean.
	For a long time, the return force of the tubing decreases	Replace the tube.
	The accuracy requirement is not appropriate	The flow rate/speed/diameter is inversely proportional to the accuracy. When operating under working conditions, try to use pipes with smaller diameters

Chapter 8 Version Description

Version	Description	Release time
V1.0	Initial version	2019.09.27
V1.1	1. Increase current code correspondence table; 2. Correct the maximum speed of the tube; 3. Modify the description of "Inquiry/Setting/Continuous Mode"	2020-02-28
V1.2	1. Delete the instruction with asterisk 2. Correction of RS232 interface usage 3. Update the header VI logo	2020-8-26
V1.3	1. LM60A/LM60B manual separate 2. Delete LM60A flow curve, weight, icon, pump tube and other parameters	2020-10-9

Chapter 9 Technical Service



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