

User Manual



Hangzhou Scala Cryo Equipment Co., Ltd

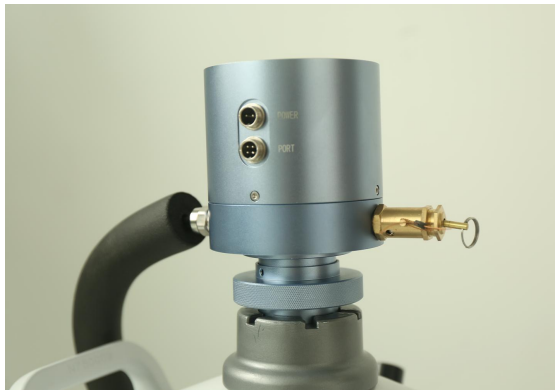
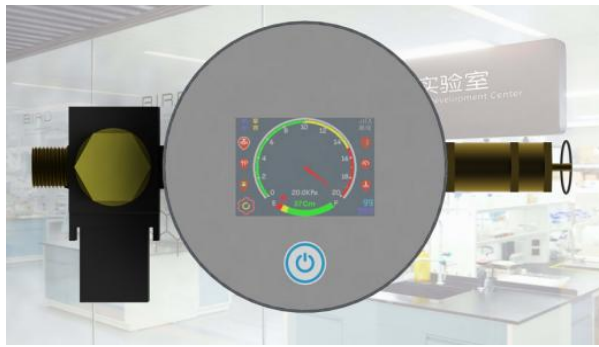
<https://www.scalacryo.com>

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Overview

Compared to traditional liquid nitrogen pumps, **4-20MA** Automatic Liquid Nitrogen Pump offers advantages such as stable liquid nitrogen output and controllable flow rate. It adjusts pressure to control the liquid output flow rate, maintaining a constant and steady discharge. The pump comes with real-time liquid level display, low liquid level alarm, prohibition of discharge at low liquid levels, real-time pressure display, high-pressure alarm, pressure compensation, over-temperature protection, emergency pressure relief and RS-485 communication interface, allowing convenient integration with other products. The product diagram is shown below:



Technical Data

The technical data are presented in Table 2.1:

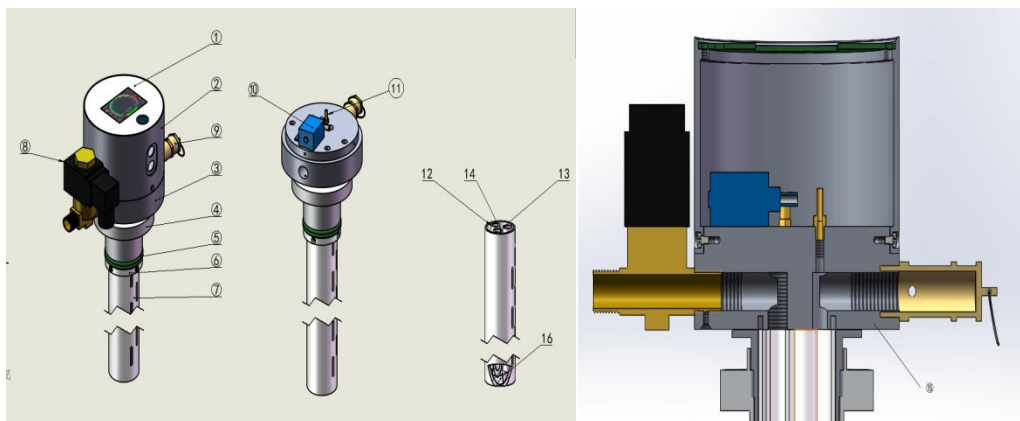
Parameter	Minimum Value	Typical Value	Maximum Value	Unit
Operating Voltage	21.6	24	26.4	Volts (V)
Operating Current	≤5	5		Amperes (A)
Pressure Stability Error		±0.2		Kilopascals (kPa)
Pressure Monitoring Range	0		30	Kilopascals (kPa)
Pressure Adjustable Range	0		30	Kilopascals (kPa)
Liquid Level Error		±2		Centimeters (cm)
Liquid Output	≥0		≤1.9	Flow Rate: (L/min)
Discharge Time	≤5	8	≥30	Seconds: (s)
Evaporation Rate			0.994	Liters per Day: (L/day)
Emergency Pressure Relief		50		Kilopascals (kPa)
Backup Battery Duration	≤10	14	≥16	Days: (day)
Control Interface		RS485 Communication Control and 4–20 mA Current Signal Control and Manual Control		
Head Lift			≤5	Meters: (m)

Table 2.1

Structural Description

As shown in Figures 3.1 and 3.2, the constant flow liquid nitrogen pump primarily comprises the following components: 1 circuit board, 2 terminal posts, 9 safety valve, 8 drain valve, 11 air nozzle, 3 base, 15 flange head external threaded pipe, 4 threaded locking component, 5 sealing ring, 6 anti-fall component, 7 casing,

14 drain pipe, 13 sensor, 12 support tube, 16 pipe fixing clip, and other parts. The base features conduit holes, threaded ports for air nozzles, and mounting holes for the pressure relief solenoid valve. The base, sealing gasket, and flange external threaded pipe are secured and compressed for sealing with screws; the sleeve, flange external threaded pipe, and anti-detachment parts are fastened using screws.



Figures 3.1 and 3.2

Installation

The Automatic Liquid Nitrogen Pump is compatible with all liquid nitrogen tanks with a 50 mm diameter port. During installation, it is mandatory to wear cryogenic gloves and splash-resistant goggles to prevent injury from liquid nitrogen exposure. During installation, the pump body must be slowly inserted into the liquid nitrogen tank, as the pump body is initially at ambient temperature upon placement, which causes significant liquid nitrogen evaporation inside the tank. Slow insertion reduces nitrogen evaporation and enhances safety. **Before inserting the pump body, power on the equipment to release the pressure generated during the insertion into the liquid nitrogen tank.** When the pump body reaches the threaded locking component, it indicates full insertion into the tank. At this stage, rotate the threaded locking component counterclockwise to tighten and seal the tank. Once the pump body is installed, the automatic liquid nitrogen pump can be operated normally.

Function Description

1. Discharge Control

The Automatic Liquid Nitrogen Pump can control discharge via a 4~20mA current

signal or through the RS485 interface using the ModBus-RTU Protocol. The discharge control method can be configured by setting the 'Control Mode' through the ModBus Protocol. For configuration procedures, please refer to the 'ModBus-RTU Communication' section in this document.

When controlling discharge using the 4~20mA current signal, if the current signal is $\leq 4\text{mA}$, the discharge will stop; If the current signal is between 4~20mA, the discharge is controlled by proportional pressure between the set Minimum Pressure Value and Maximum Pressure Value. For example: if the Minimum Pressure Value is set to 2 KPa and the Maximum Pressure Value to 10 KPa, an input current of 4mA corresponds to a discharge pressure of 2 KPa, and an input current of 20mA corresponds to 10 KPa discharge. When the current is 12 mA, the liquid is discharged at a pressure of $(10 - 2) / (20 - 4) \times 12 = 6 \text{ kPa}$.

When controlling via the ModBus-RTU Protocol, please refer to the 'ModBus-RTU Communication' section of this manual.

2. Display Functions

The main interface shows real-time liquid level, real-time temperature, real-time pressure, operation indicator light, status indicator light, and other relevant information. Refer to Figure 5.1 for detailed display information.

The calibration page enables calibration of the liquid level and temperature.



Figure 5.1



Figure 5.2

3. Calibration Functions

(1) Liquid Level Calibration

Procedure for Calibrating Full Liquid Level:

- Ensure the liquid nitrogen tank is fully filled with liquid nitrogen.
- Slowly insert the liquid nitrogen pump into the liquid nitrogen tank.
- Wait until the liquid nitrogen in the tank ceases boiling. This can be confirmed by observing whether the pressure gauge stabilizes, indicating boiling has stopped. (This step is essential and must not be omitted.)
- Click the icon at the lower-left corner to enter the calibration interface.
- Select the full checkbox in the Liquid Level Calibration row.
- Click the icon in the Liquid  Level Calibration row and wait for the icon background color to change to light blue, indicating that full liquid level calibration is complete.

Procedure for calibrating the empty liquid level:

- Remove the liquid nitrogen pump from the liquid nitrogen tank.
- Wait until the displayed temperature rises above -180°C . Confirm the temperature exceeds -180°C by checking the first temperature value displayed in the Temperature Calibration row (this step is critical and must not be omitted).
- Select the empty checkbox in the Liquid Level Calibration row.
- Click the icon in the  Liquid Level Calibration row and wait until the icon's background color changes to match the display screen background color; this completes the empty liquid level calibration.

(2) Temperature Calibration

Ensure the temperature sensor is immersed in the liquid  nitrogen, then click the icon in the Temperature Calibration row to calibrate the temperature to -196°C .

Note: The temperature sensor cannot be calibrated if the temperature is above

-190 °C or below -200 °C.

4. Alarm Function

The liquid level pump is equipped with alarms for excessive pressure, low liquid level, and liquid output prohibition. Alarm information can be viewed on the main interface display.

ModBus-RTU Communication

5. Protocol Format

Standard ModBus-RTU Slave Communication Protocol. Default Configuration: Baud Rate 19200 bps, Data Bits 8 bit, Stop Bit 1 bit, Even Parity, Big-Endian Byte Order, Slave Address 1.

6. Set Parameters

Parameter Name	Parameter Address	Parameter Description
Adjustable Maximum Pressure Value	0x00	3Kpa~40Kpa
Adjustable Minimum Pressure Value	0x01	0.3Kpa~40Kpa
Liquid Nitrogen Tank Height	0x03	200~1000mm
Set Tank Pressure Value	0x04	Adjustable Minimum Pressure Value ~ Adjustable Maximum Pressure Value
Drainage Control	0x05	0 -> Drainage Off, 1 -> Drainage On
Control Mode	0x06	0 -> 4~20 mA Signal Control, 1 -> 485 Control (Added 2023-07-25)
Slave Address Setting	0x07	Liquid Nitrogen Pump ModBus-RTU Address (Added 2024-01-08) <i>Note ①</i>
Baud Rate Setting	0x08	Communication Baud Rate (Added 20240108)
Parity Setting	0x09	0->No Parity, 1->Odd Parity, 2->Even Parity (Added 20240108)

Note ①: The maximum baud rate supported by the factory-configured communication cable is 19200 bps. Baud rate values are transmitted divided by 100;

for example, if the baud rate is set to 9600, the transmitted data value is $9600 / 100 = 96$.

7. Read Parameters

Parameter Name	Parameter Address	Parameter Description
Real-Time Pressure	0x00	0~40Kpa
Real-Time Liquid Level	0x01	0~(200--1000mm)
Real-Time Temperature	0x02	$\geq -196^{\circ}\text{C}$
Pressure Relief Valve Status	0x03	0->Off, 1->On
Heater Status	0x04	0->Off, 1->On
Liquid Discharge Valve Status	0x05	0->Off, 1->On
Liquid Discharge Status	0x06	0->Liquid Discharge On, 1->Liquid Discharge Off
Input Current	0x07	4000-20000 nA (4-20 mA control is required for querying) Note ①
External Temperature Sensor Reading	0x07	≥ -200 (Queryable only with external temperature sensor) Note ①
Set Pressure	0x09	0.3Kpa~40Kpa
Pressure Relief Setpoint	0x09	(0.3Kpa--40Kpa)+500pa

Note ①: The parameter addresses for “Input Current” and “External Temperature Sensor Temperature” are identical because they share a common hardware port. Selection during operation depends on the user’s functional requirements. Therefore, if 4–20 mA control is required, the queried data corresponds to the input current; If temperature control is required, the queried data corresponds to the external temperature sensor reading.

8. Message Example

1) Set Adjustable Maximum Pressure Value to 18 kPa

Slave Address	Function Code	Parameter Starting Address	Parameter Value	CRC Checksum
01	06	00 00	46 50	bb 96

2) Set Adjustable Minimum Pressure Value to 1.8 kPa

Slave Address	Function Code	Parameter Starting Address	Parameter Value	CRC Checksum
01	06	00 01	07 08	db fc

3) Set Tank Pressure Value to 10 kPa

Slave Address	Function Code	Parameter Starting Address	Parameter Value	CRC Checksum
01	06	00 04	27 10	d2 37

4) Start Liquid Discharge

Slave Address	Function Code	Parameter Starting Address	Parameter Value	CRC Checksum
01	06	00 05	00 01	58 0b

5) Stop Liquid Discharge

Slave Address	Function Code	Parameter Starting Address	Parameter Value	CRC Checksum
01	06	00 05	00 00	99 cb

6) Read Real-Time Pressure

Slave Address	Function Code	Parameter Starting Address	Read Length	CRC Checksum
01	04	00 00	00 01	31 ca
Slave Response				
Slave Address	Function Code	Data Length	Data Value	CRC Checksum
01	04	02	01 40	b9 50

7) Read Real-Time Temperature

Slave Address	Function Code	Parameter Starting Address	Read Length	CRC Checksum
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01	04	00 02	00 01	90 0a
Slave Response				
Slave Address	Function Code	Data Length	Data Value	CRC Checksum
01	04	02	00 6c	b9 1d

Usage of MThings Software

MThings Software is an eco-friendly application that requires no installation to operate. The following outlines the operational steps for MThings Software:

- Place the MThings Software compressed package at any desired location on the computer, such as the desktop.
- Extract the MThings Software to the computer desktop.
- Open the MThings folder and double-click the MThings.exe icon to launch the software, as illustrated in Figure 7.1.

名称	修改日期	类型	大小
bearer	2020/11/9 10:53	文件夹	
iconengines	2020/11/9 10:53	文件夹	
imageformats	2020/11/9 10:53	文件夹	
platforms	2020/11/9 10:53	文件夹	
styles	2020/11/9 10:53	文件夹	
translations	2020/11/9 10:53	文件夹	
blood_component_separators.mthings	2023/10/25 20:21	MThings File	38 KB
blood_component_separators_tube_valve.mthin...	2023/8/1 14:34	MThings File	29 KB
config.csv	2024/1/8 14:11	Microsoft Excel ...	1 KB
D3Dcompiler_47.dll	2020/4/25 20:37	应用程序扩展	3,386 KB
libEGL.dll	2020/4/25 20:37	应用程序扩展	22 KB
libGLESv2.dll	2020/4/25 20:37	应用程序扩展	2,729 KB
mthing_YDB_4-20ma.mthings	2023/8/24 11:29	MThings File	8 KB
mthing_YDB_485ctrl.mthings	2024/1/8 14:11	MThings File	12 KB
mthing_YDB_all.mthings	2022/12/15 15:51	MThings File	30 KB
mthing_YDB_constant_temp.mthings	2023/6/8 18:18	MThings File	6 KB
MThings.exe	2020/11/9 9:26	应用程序	1,302 KB
mthings_cfg_demo.mthings	2023/9/1 16:15	MThings File	30 KB
mthings_jot_ACpanel.mthings	2023/9/15 10:16	MThings File	9 KB
mthings_jot_ACpanel_rtu_master.mthings	2023/12/27 19:24	MThings File	12 KB
mthings_jot_ACpanel_rtu_slave.mthings	2023/11/17 9:46	MThings File	12 KB
mthings_jot_ACpanel_slave.mthings	2023/9/15 10:16	MThings File	8 KB
mthings_jot_ACpanel_tcp_master.mthings	2023/9/23 22:23	MThings File	9 KB
mthings_jot_ACpanel_tcp_slave.mthings	2023/9/19 13:42	MThings File	9 KB
MThings_Log_202312.txt	2023/12/29 14:13	文本文档	24 KB
MThings_Log_202401.txt	2024/1/8 14:11	文本文档	16 KB
mthings_sampling_system.mthings	2023/11/14 13:56	MThings File	9 KB
MThings使用手册.pdf	2020/11/9 10:51	WPS PDF 文档	5,164 KB
opengl32sw.dll	2020/4/25 20:37	应用程序扩展	15,621 KB
Qt5Core.dll	2020/4/25 20:37	应用程序扩展	4,998 KB
Qt5Gui.dll	2020/4/25 20:37	应用程序扩展	5,261 KB
Qt5Network.dll	2020/4/25 20:37	应用程序扩展	1,029 KB
Qt5SerialPort.dll	2020/4/25 20:37	应用程序扩展	70 KB
Qt5Svg.dll	2020/4/25 20:37	应用程序扩展	267 KB
Qt5Widgets.dll	2020/4/25 20:37	应用程序扩展	4,437 KB
Readme.txt	2020/11/9 10:16	文本文档	4 KB

Figure 7.1

- Click the area indicated in Figure 7.2 to import the provided configuration file, named 'mthing_YDB_485ctrl.mthings.'

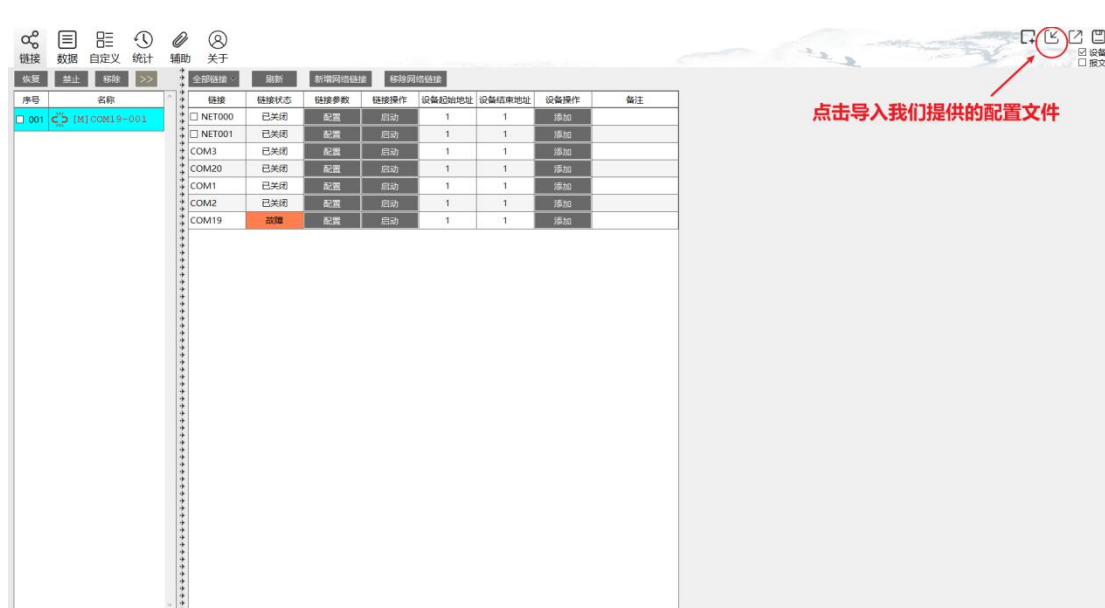


Figure 7.2

E. As per the steps shown in Figure 7.3, select the port connected to the pump.



Figure 7.3

F. Following the steps in Figure 7.4, configure the parameters associated with the liquid nitrogen pump.

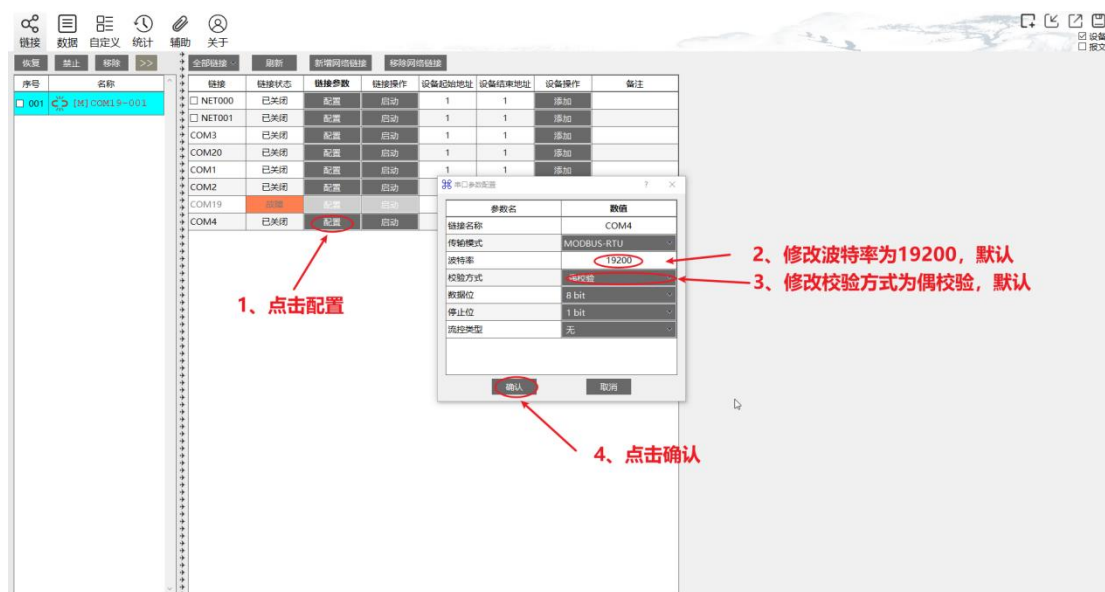


Figure 7.4

G. Click on the data in Figure 7.5 to perform the corresponding read and write operations.

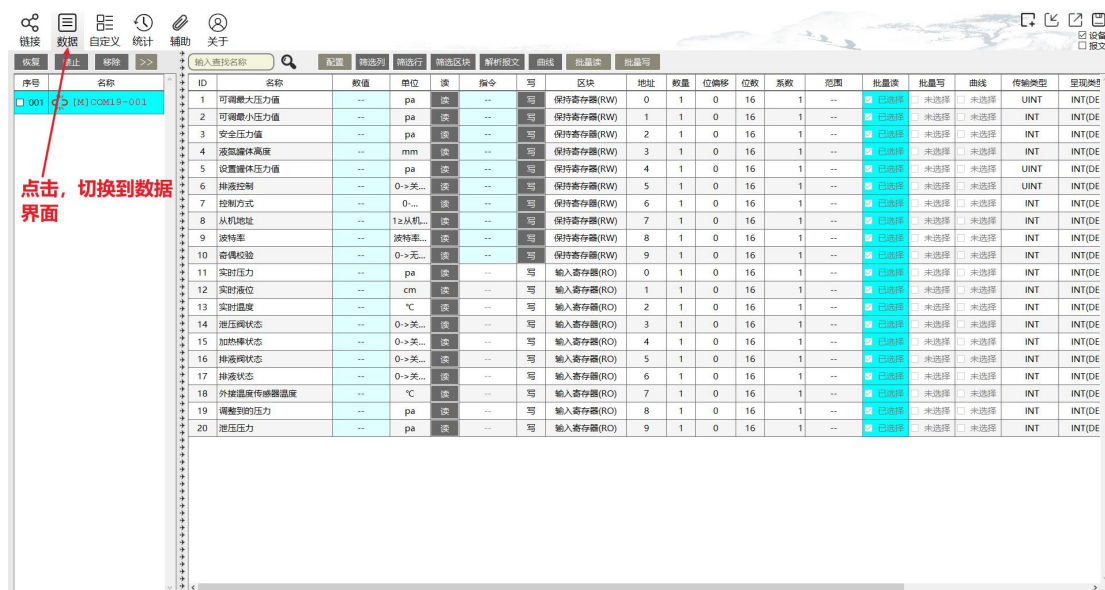


Figure 7.5

Wiring Instructions



Black: RS485 Signal B; White: RS485 Signal A; Brown: 4-20mA Signal Positive (+);
Blue: 4-20mA Signal Negative (-).

Precautions

1. During the liquid discharge process, avoid direct contact between the body and the pump body to prevent frostbite.
2. When the pump is not in use for an extended period, remove it from the tank to reduce liquid nitrogen evaporation.
3. The pump is covered by a one-year warranty.

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