S09 Micro Vacuum Liquid Pump Series

# User Guide

Issue 01

Date 2024-12

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# About This Document

## Purpose

This document is related to the S09 micro vacuum liquid pump products,which is used to guide relevant technical personnel to initially understand the characteristics of the product.

## Intended Audience

This document is intended for technical personnel. You should have a good understanding of your product and have a clear concept of the relevant parameters, specifications, and other information of the applications of the micro pump.

## Keyword

PWM speed control, related parameters, wiring instructions

# Change History

The change history accumulates each update of this document. The latest version of the document contains all the previous updates.

| Issue | Date | Product Version | Issuer | Modification |
|---|---|---|---|---|
| 01 | 2024-12-06 | 01 | LYZ | first release |

# Contents



# 1 Characteristics

## 1.1 Compact Size

The size of this product is similar to AA battery;

This product is equipped with a DC brush motor and weighs about 25g, and the overall appearance size is about 43.5x19x19mm.

This product is equipped with a DC brushless motor and weighs about 19g, and the overall appearance size is about 45.5x19x19mm.

## 1.2 Liquid-Gas Dual Use

It is dual-purpose for liquid and gas, and can be used as a liquid pump or a vacuum pump, and can also be used to transport gas-liquid mixed media.

It has stable and reliable self-priming performance, can automatically suck in liquid in the dry pump state, and the fluid transmission is stable and reliable.

## 1.3 Wide Voltage Supply

S09S is equipped with a DC brush motor that can operate in the voltage range of 1 to 6V.

S09M is equipped with a brushless motor that can operate in the voltage range of 3~6V.

The wide-voltage operating characteristics are particularly suitable for battery-powered scenarios. When the battery voltage drops, the pump can still run continuously.

## 1.4 Small Size and High Flow

This product has stable and large flow characteristics. In a very small volume, the output flow can reach 400mL/min, which is far more than the conventional single-chamber diaphragm pump of the same size.

## 1.5 Stable Output and Low Pulsation

This series of products adopts an innovative three-pump chamber design, with smooth and stable output airflow and low pulsation.

## 1.6 Low Power Consumption and High Efficiency

This series of products can be equipped with extremely low energy consumption coreless brushless motors, with rated power consumption within 2W and high operating efficiency.

## 1.7 Industrial Grade Reliability

Designed for high-reliability applications that operate 24/7, with stable pressure output and liquid compression and transmission capabilities

## 1.8 Multiple Motor Options

According to application requirements, long-life, high-performance, and low-cost motor configuration options are available to meet different cost and reliability application requirements.

# 2 Special Functions

## 2.1 Speed Control Function

Brushless motors can change the flow rate by adjusting the motor speed of the pump (by adjusting the PWM duty cycle), and brushed motors can achieve speed adjustment by controlling the input voltage.

## 2.2 Start and Stop Function

Products equipped with brushless motors can control the start and stop of the pump through the start and stop control level signals, which is suitable for working conditions with frequent starts and stops; brush motor models can choose different voltage models to meet the required working conditions.

## 2.3 Speed Feedback

Products equipped with brushless motors can control the start and stop of the pump through the start and stop control level signals, which is suitable for working conditions with frequent starts and stops; brush motor models can choose different voltage models to meet the required working conditions.

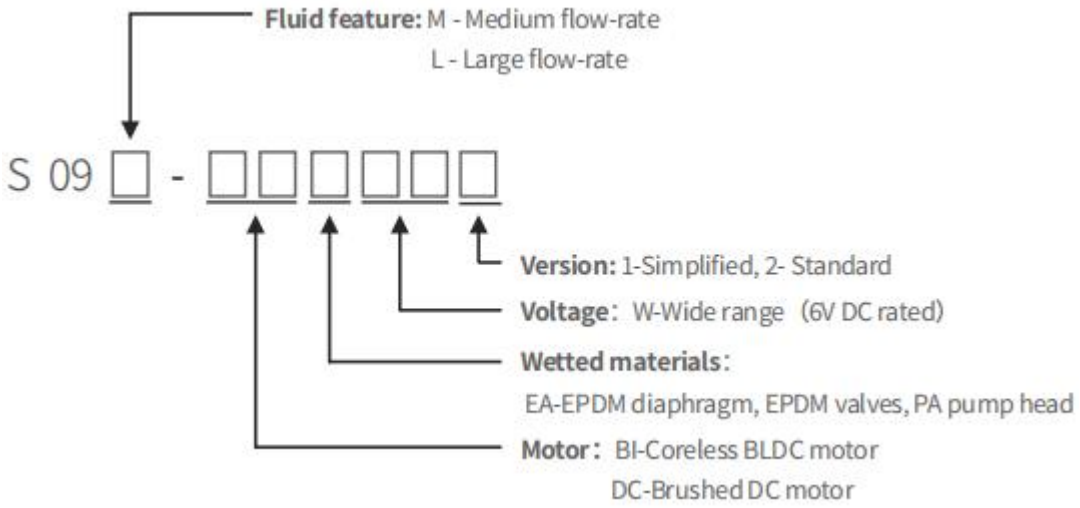
## 2.4 Protection Function

Models equipped with brushless motors are equipped with stall and over-current protection functions to reduce and avoid the possibility of accidental damage to the pump under high load..

# 3 Product Model Description

## 3.1 Brief Description of Model Naming

This series of pumps is divided into two versions: simplified version and standard version;




**Note:** Example 1: S09S-DCWEA1 (S09 small flow diaphragm liquid pump, standard DC brush motor 1-6V wide voltage power supply, material combination EA is: EPDM diaphragm, EPDM valve, PA pump head, simplified version;

Example 2: S09M-BIWEA2 (S09 medium flow diaphragm liquid pump, standard hollow cup brushless motor 3-6V wide voltage power supply, material combination EA is: EPDM diaphragm, EPDM valve, PA pump head, standard version;

# 4 Technical Specifications

## 4.1 Key Specifications

| Model | Voltage (V DC) | As a Liquid Pump | | | | As a Vacuum Pump | | |
|---|---|---|---|---|---|---|---|---|
| | | Load current | Free Flow Rate (mL/min) | Max. Pressure (kPa) | Suction Height (mWg) | Average Flow Rate (mL/min) | Relative Vacuum (-kPa) | Pressure (kPa) |
| Material and configuration | Coreless BLDC Motor,Diaphragm：EPDM ； Check valve：EPDM; Pump head:reinforced nylon | | | | | | | |
| S09M-BIW | 6V (3~6V DC) | 250 | 400 | 80 | 2 | 450 | 19 | 28 |
| Material and configuration | Brushed DC Motor,Diaphragm：EPDM ； Check valve：EPDM; Pump head:reinforced nylon | | | | | | | |
| S09S-DCW | 6V (1~6V DC) | 200 | 350 | 40 | 1 | 250 | 10 | 15 |
| This parameter is a preliminary calibration parameter before the official release of the product,and may be further revised with subsequent product releases | | | | | | | | |

**Note:** 1. This model can operate in a wide voltage range;

2. The parameters in the table are measured at the rated voltage and the maximum speed of the motor;

3. Unless otherwise specified, technical parameters are measured at 20° C and standard atmospheric pressure of 101kPa;

4. The average flow rate in the table is the flow value measured with a soap film flowmeter, and the peak flow rate is the value measured with a glass rotor flowmeter.

## 4.2 Configuration Options

| Material option | Default | Optional Items |
|---|---|---|
| Pump head | PA reinforced nylon | / |
| Diaphragm | EPDM | / |
| One-way valve | EPDM | / |
| **Motor option** | **Simplified version** | **Standard version** |
| Motor type | DC Brushed motor | Coreless motor |
| Rated Voltage | 5V DC（1～6V） | 5V DC（3～6V） |
| **Connector option** | **Default** | **Optional Items** |
| Nozzle type | Hose connector | / |
| | （For detailed connector introduction, see the following chapters） | |

## 4.3 Reliability Parameters

| Models | S09 | |
|---|---|---|
| Versions | Simplified Version | Standard Version |
| Fully Loaded Lifetime（hrs） | 3000* | 6000* |
| Unloaded Lifetime（hrs） | 5000* | 8000* |

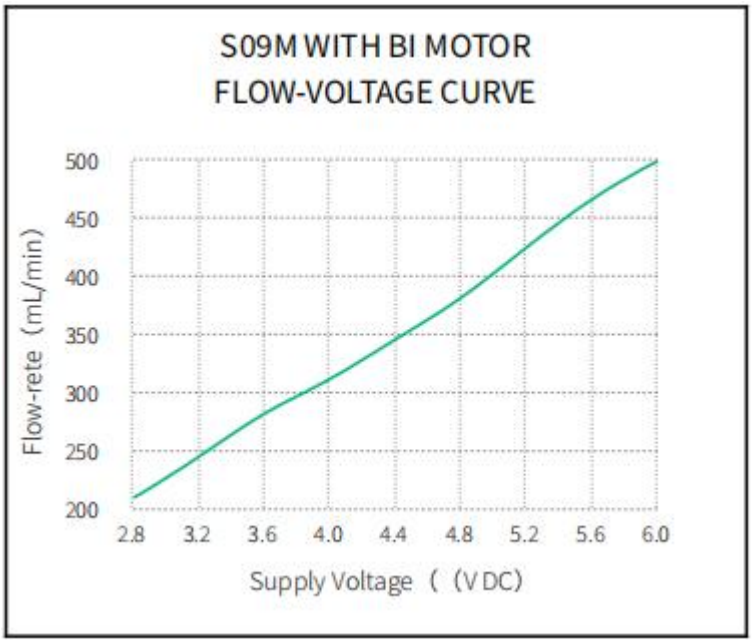
| | | |
|---|---|---|
| Motor Lifetime（hrs） | 3000 | 10000 |
| Lifetime test instructions: | The pump is at full load (the water inlet is connected to a hose and immersed under the tap water surface, and the drain outlet has the maximum output pressure) so that the pump can work for 24 hours without stopping and continuously pumping water) | |
| | The pump is unloaded (the water inlet and drain outlet are immersed under the liquid surface to maintain smooth drainage and continuous pumping), allowing the pump to work continuously for 24 hours without stopping. | |
| | Motor life test conditions: Under good ventilation and heat dissipation conditions, the motor runs continuously without load for 24 hours without stopping. | |
| | Life test environment conditions: in a clean and corrosion-free laboratory, the ambient temperature is 5~33℃, fluctuating with the climate, the relative humidity is 50%~85%, fluctuating with the climate | |
| | * Represents the design target parameters, the actual life is under testing. | |
| | The source of the experimental data is from Hilin Technology Aging and life laboratory and supplier laboratory | |

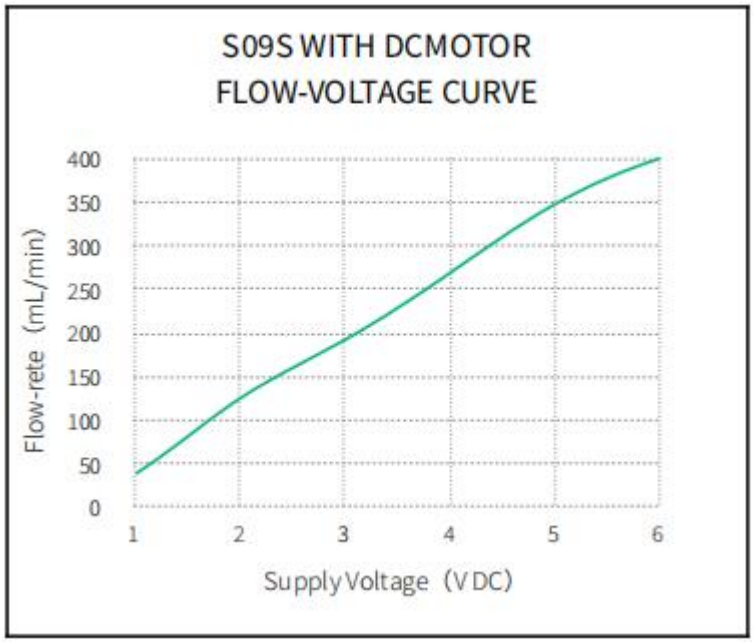
| **Working Conditions** | |
|---|---|
| Environment | The ambient temperature is 0℃~50℃. It is not suitable to be exposed to the sun outdoors. You should work in a clean and ventilated environment. |
| Medium | Medium temperature is 0℃～40℃air |
| Load | Both the water inlet and the drain port can operate with full load (that is, the output pressure is below the rated maximum pressure). The load exerted on the inlet port cannot exceed the maximum vacuum of the pump, and the |

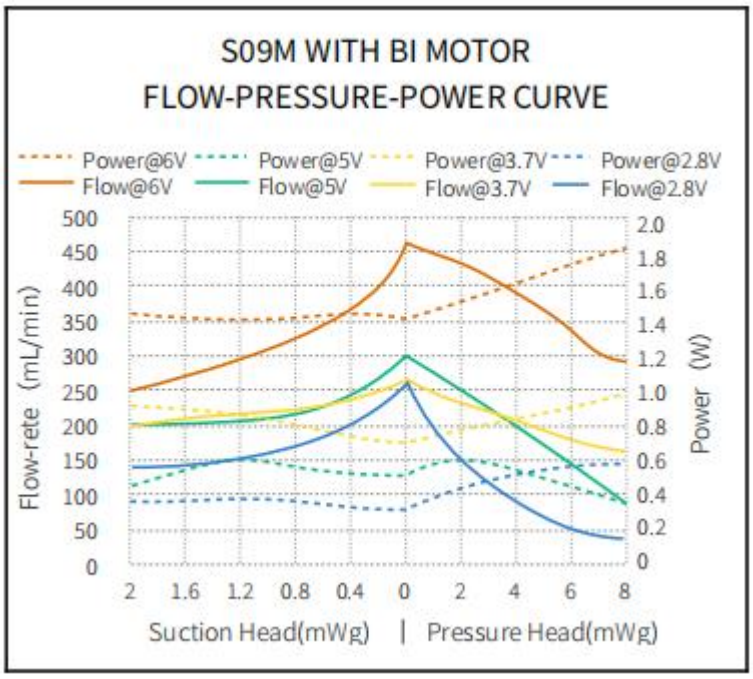
| | |
|---|---|
| | load exerted on the drain port cannot exceed the maximum output pressure of the pump. |

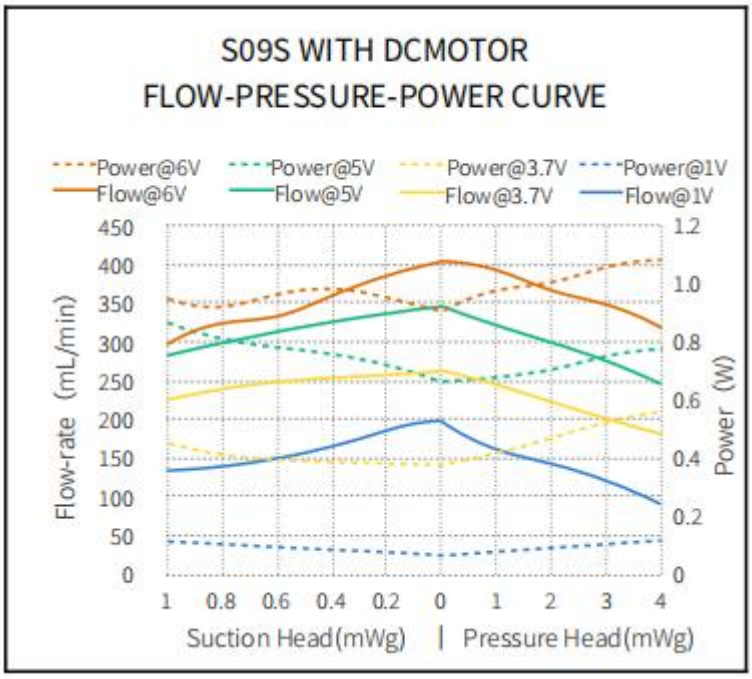
## 4.4 Pressure-Flow Curve



## 4.5 Pressure-Flow-Power Consumption Curve




Note: 1. Due to individual differences between different micro pumps and different test pipelines having different effects on measured parameters, this curve is a statistical value;

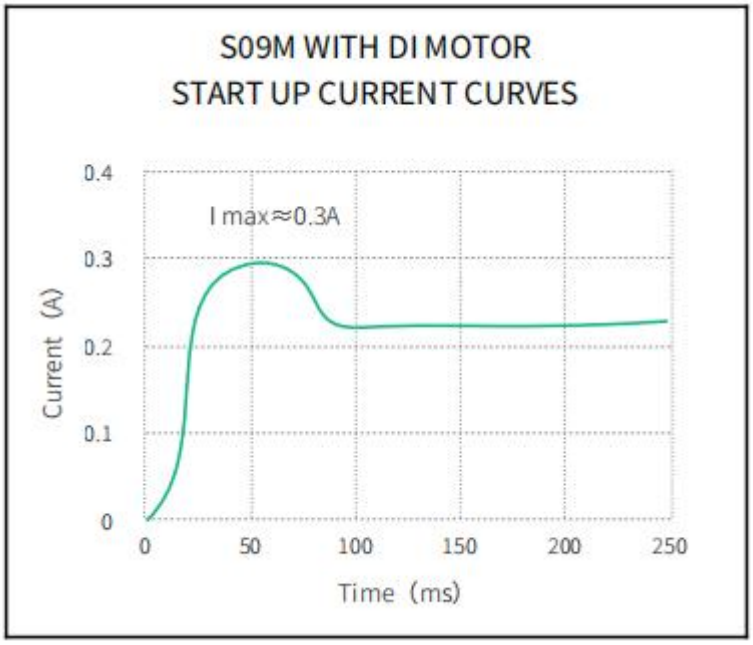
2. The values of this curve are only for the technical reference of the user to confirm the working point and are not used as a basis for product acceptance.

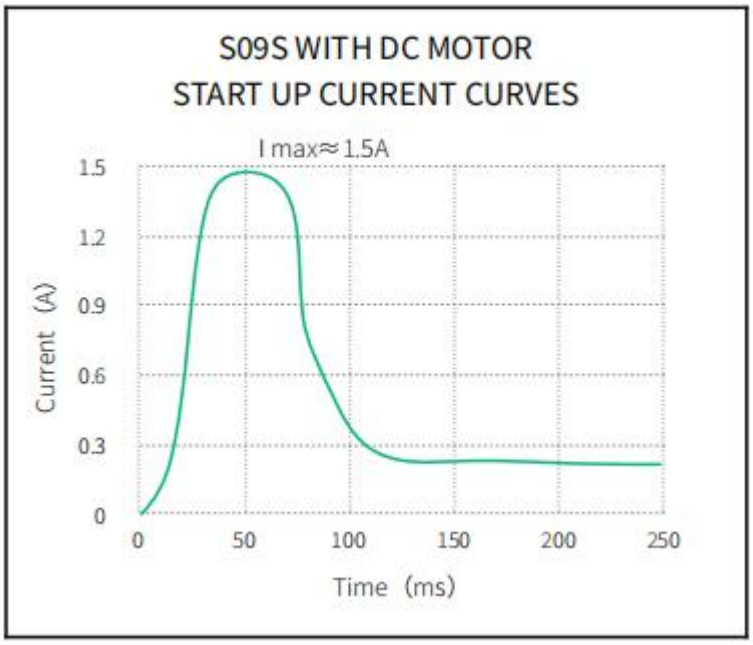
## 4.6 Starting Current Curve

The starting current curve is measured under the condition that the air suction port and the exhaust port are directly connected to the atmosphere.

There are individual differences among them. This curve is a statistical value and is only used as a technical guide when users determine the power supply system.

Technical reference, no acceptance data



# 5 Installation Instructions

## 5.1 Installation and fixation of pump body

This product is small in size and light in weight. There are no mounting screw holes reserved on the pump body. It can be fixed by bonding with double-sided foam tape or by special mounting brackets to avoid displacement.

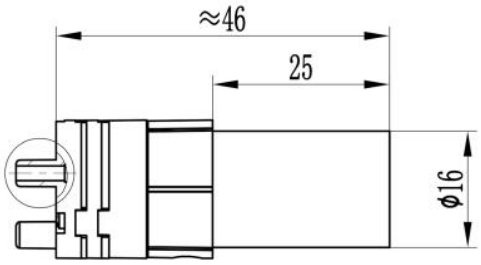
## 5.2 Pipe connection of hose connector

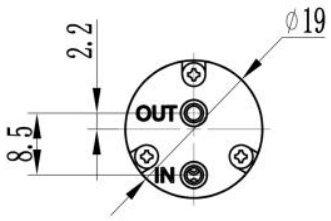
According to the size of the pump head air nozzle, it is recommended to choose a Φ2mm inner diameter and Φ4mm outer diameter silicone rubber hose connection.

## 5.3 Installation dimensions

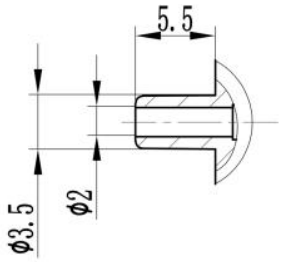
S09 with BI Brushless motor installation dimensions

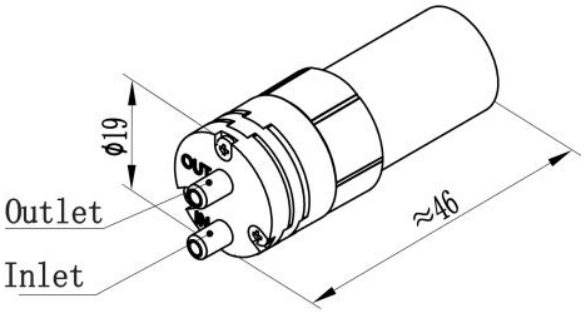
Unit:mm



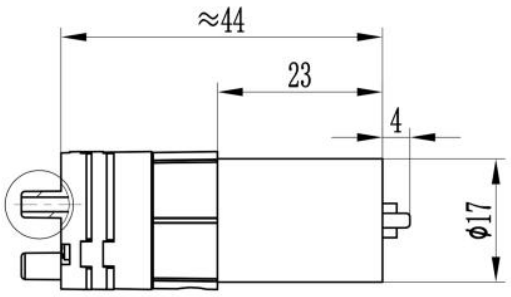

Hose connectors

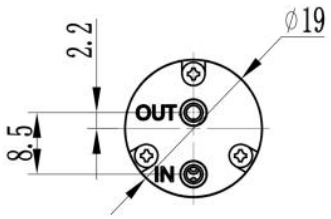


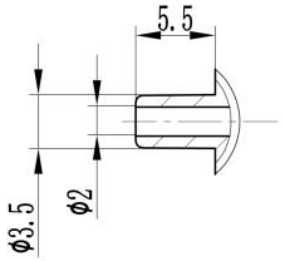

S09 with DC brush motor installation dimensions:

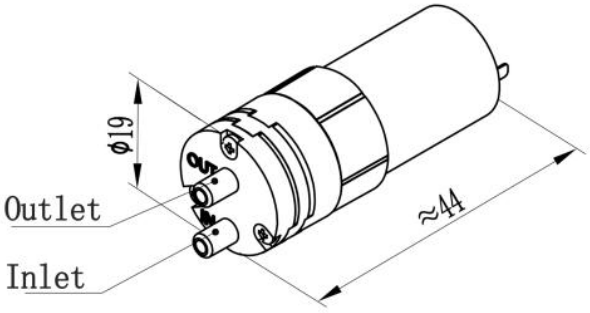
Unit:mm



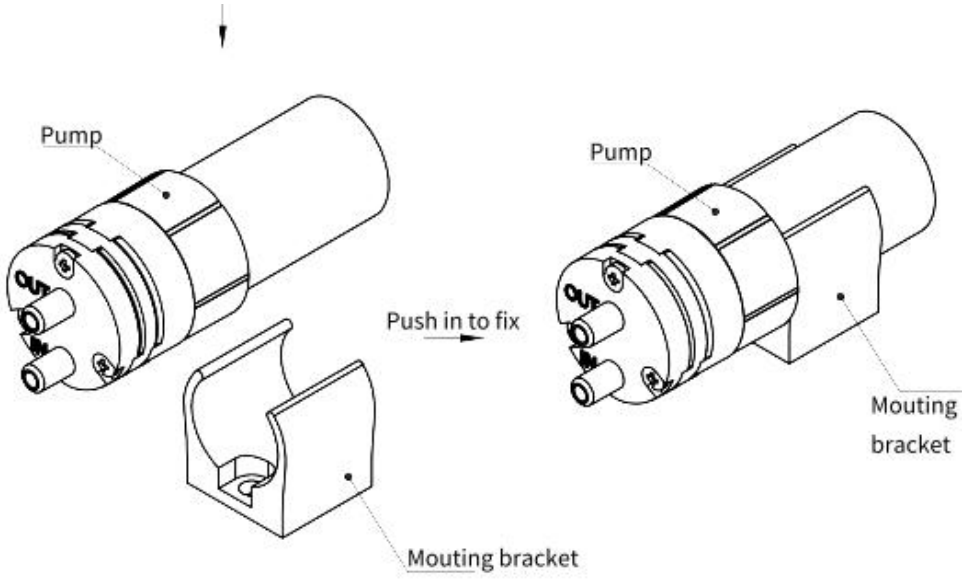

Hose connectors



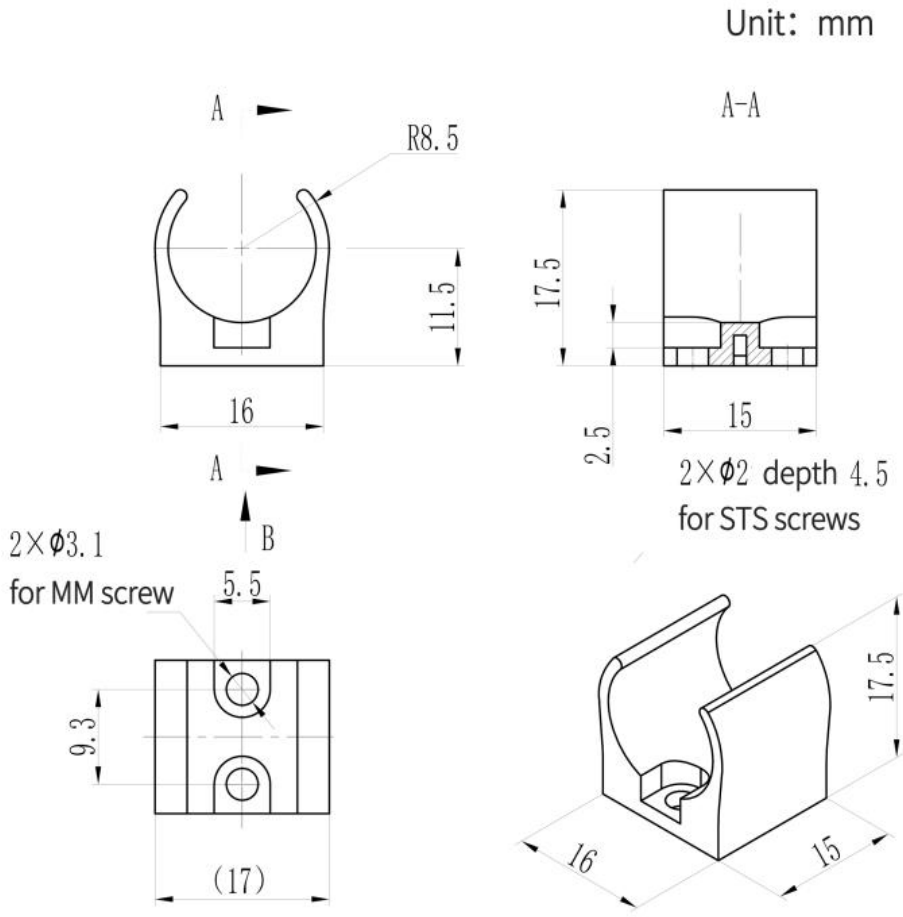



## 5.4 S09 Installation with bracket

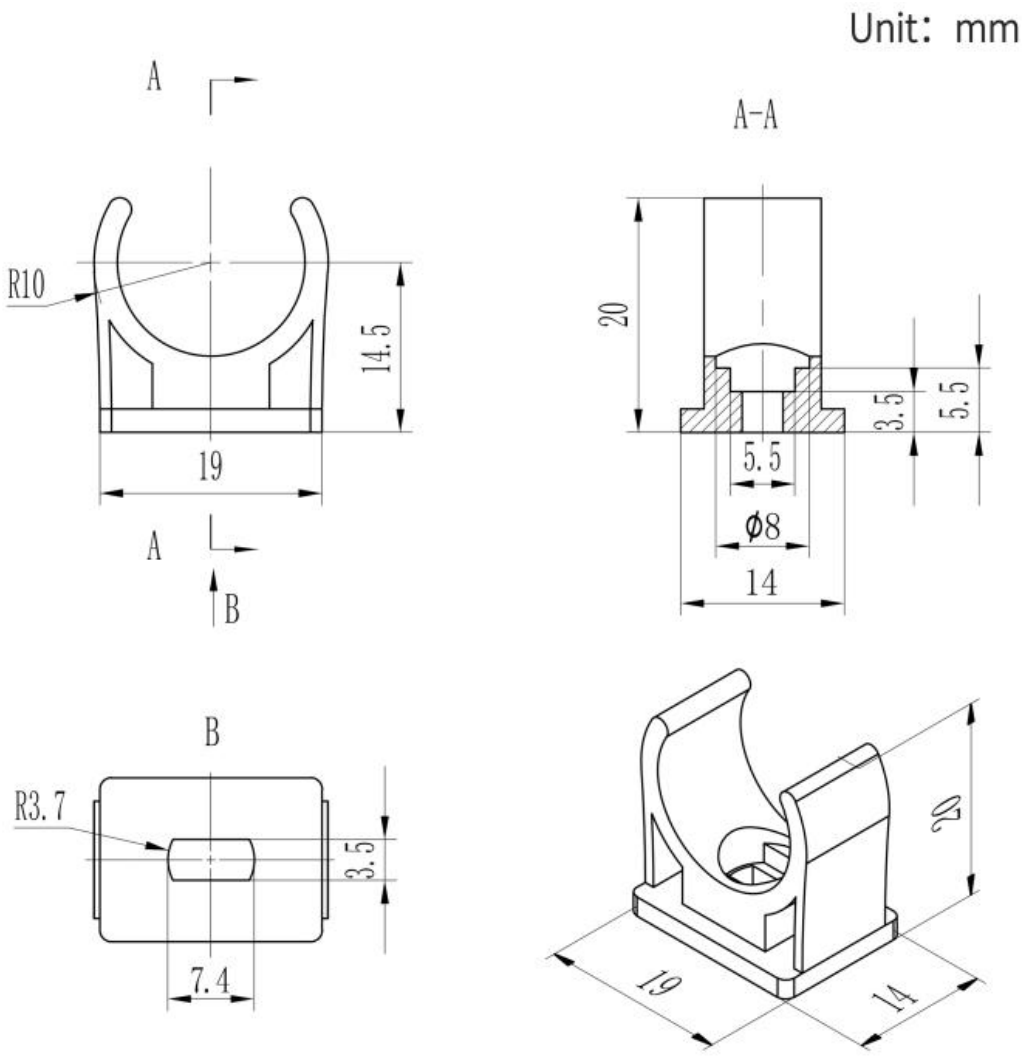
The special mounting bracket can be fixed in the equipment with screws, and then the pump is stuck into the bracket to achieve fixation and limitation.




S09 with BI brushless motor bracket dimensions



S09 with DC brush motor bracket dimensions



# 6 Electrical Connection

The wiring instructions are instructions for connecting the external power supply and signal cables of this product. This product is shipped with standard connection cables, and the cable definitions are distinguished by color. Before reading this chapter, you need to check the specific model and configured motor type and motor voltage of the S09 product based on the product model nameplate information and product model explanations in Chapter 3.

## 6.1 S09 with Brushed Motor Interface Definition

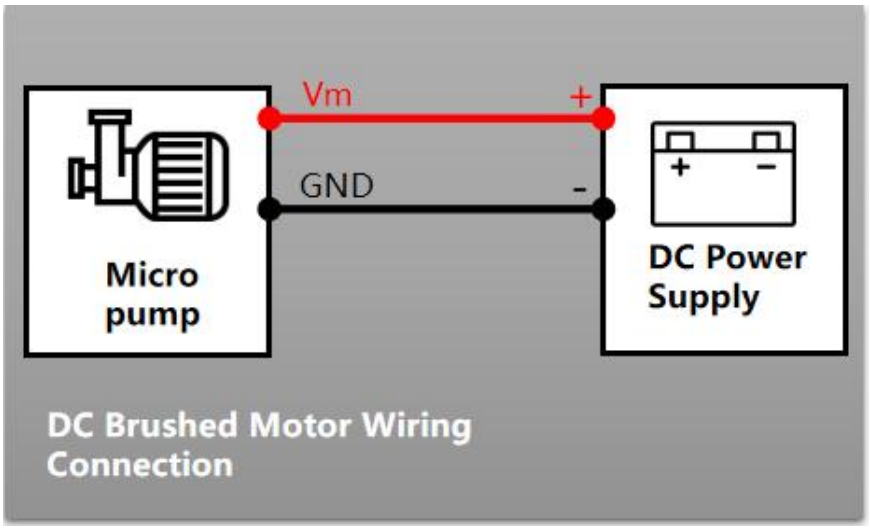



Figure 6-1 Wiring Instructions for Brushed Motor

Note: The red wire of the motor lead is connected to the positive pole of the DC power supply, and the black wire is connected to the negative pole of the power supply.

| S.N. | Wire | Input | Function | Signal Definition | Description |
|---|---|---|---|---|---|
| 1 | Red | Vm | Positive pole | DC 6V | The rated voltage 6V motor can operate at a wide voltage of 1-6V; use of voltages exceeding 6V will reduce the life of the motor. |
| 2 | Black | GND | Negative pole，Ground | Ground | |

Note: The red DC power supply of the motor lead needs to have sufficient output power. If the power is insufficient, the pump may fail to start or fail to reach the rated pressure.

## 6.2 Speed Control of S09 Brushed DC Motor

DC brush motors can control the motor speed by adjusting the motor input voltage. When using the motor voltage for speed regulation, the input voltage must not exceed the rated voltage of the motor, otherwise the motor will be damaged in advance.

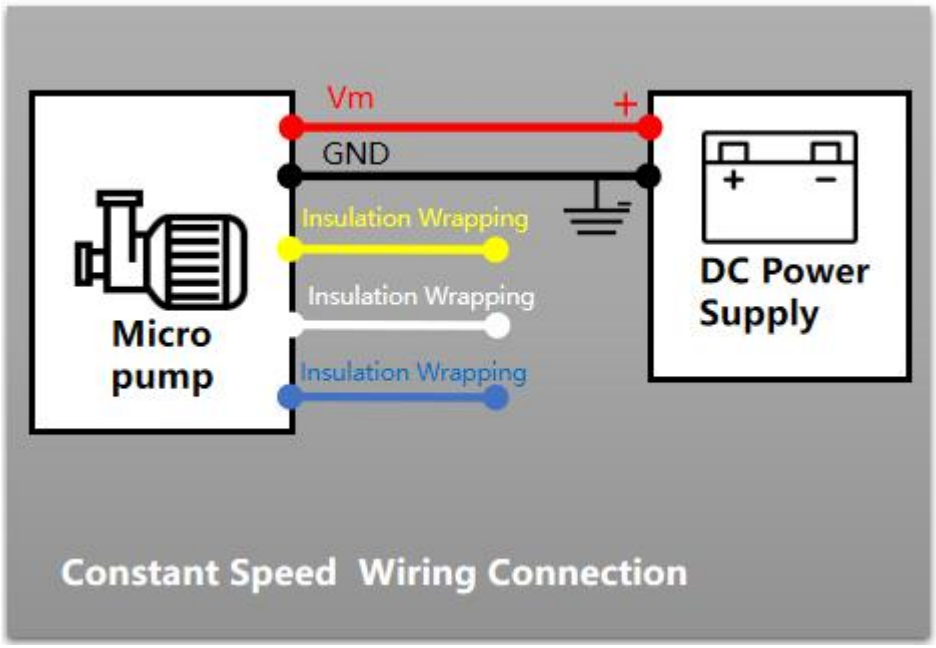
When the pump operates with load below the rated voltage, or when the pipeline pressure exceeds the rated pressure, it may cause stalling or startup failure due to excessive load; the power supply should be cut off immediately after stalling occurs. To avoid motor burnout, it is recommended to add a circuit module with stall/overcurrent protection to the power supply line to avoid motor damage.

Note: Stalling will cause the motor current to increase significantly and generate heat and burn out. Models equipped with brushed motors should avoid working conditions that may cause stalling, or install a stall/overcurrent protection module to protect the motor from burning out.

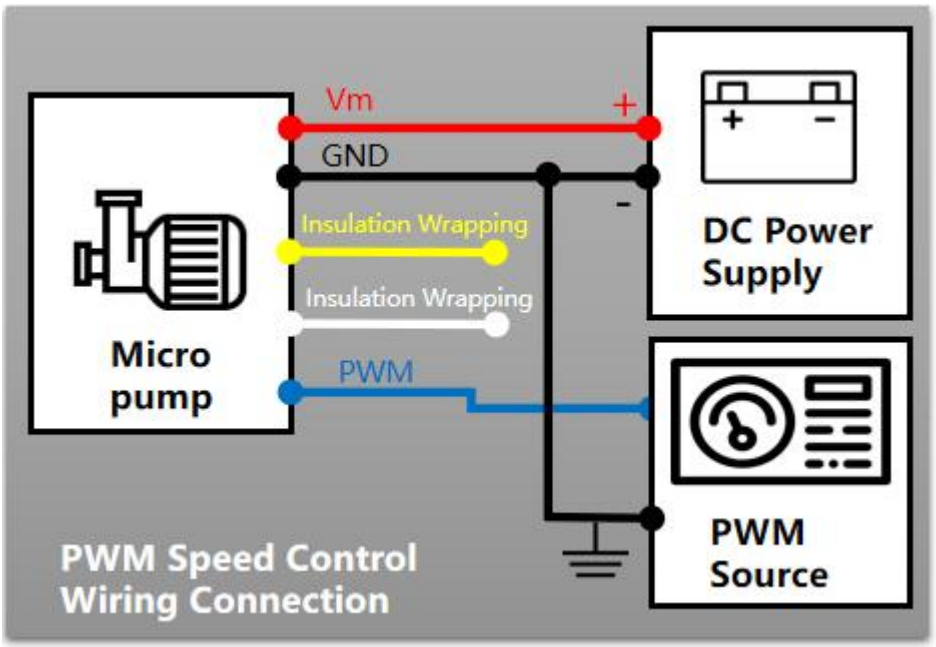
## 6.3 Wiring of S09 with Coreless BLDC Motor

The word BIW in the product model indicates that the product is equipped with a wide voltage coreless brushless DC motor with a rated voltage of 6V DC. For example, the BIW in S09M-BIWEA2PH2 represents a BI-type coreless wide voltage brushless motor equipped with a rated voltage of 6V DC.

If speed regulation and speed feedback are not required, connect the red wire to the positive pole of the power supply and the black wire to the negative pole of the power supply; the yellow, white and blue wires are insulated and wrapped respectively, and the pump will work at the rated speed.



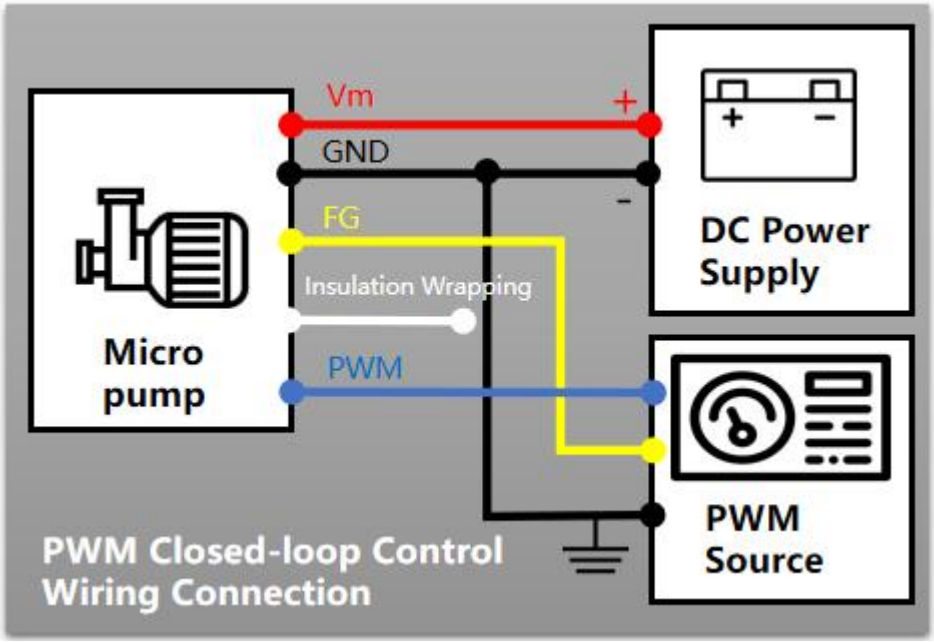

When you need to use the PWM speed control function, you need to use a signal source that supports PWM signal output (function signal generator, MCU, PLC and other controllers), connect the signal source output to the blue PWM input cable, and connect the PWM signal source ground Connect to the DC power supply ground, and the yellow and white wires are insulated and wrapped. At this time, the motor speed can be controlled in an open loop through the PWM signal.




When you need to use the PWM speed control function and monitor the pump operation through FG signals or perform closed-loop

feedback control, you need to use a host controller (MCU, PLC, host computer, etc.) that supports PWM signal output and FG signal input. Connect the source output to the blue PWM input cable, and connect the PWM signal source ground to the DC power supply ground. The yellow FG feedback signal output cable is then connected to the FG signal input end of the host controller. The host computer detects the FG signal to monitor the motor speed and control the PWM. The signal output performs closed-loop speed control.




## 6.4 BI type coreless BLDC motor signal definition

There are 5 leads for the BI motor. The wiring and usage instructions are shown in the following table.

| S.N. | Wire | Function | Signal Definition | Description |
|---|---|---|---|---|
| 1 | Red | Positive pole | DC 6V | Can operate with a wide voltage of 3-6V |
| 2 | Black | GND | Negative pole,Ground | Ground |
| 3 | Yellow | FG feedback signal (motor speed feedback signal, pulse signal), the motor outputs 3 pulses per revolution. | Output:<br>3V≤high level≤5.5V<br>Low level≤0.5V<br>The maximum rated current of the FG feedback signal is 2mA. | |
| 4 | White | No function for this model (FR) | Grounding or insulation wrapping is | |

| | | | | |
|---|---|---|---|---|
| | | | recommended | |
| 5 | Blue | Pulse Width Modulation (PWM) | Input:<br>0V≤VIL≤0.5V<br>2V≤VIH≤5V<br>（10KHz～30KHz） | Use PWM to change the motor speed and adjust the flow. Input low level or ground, stop operation;<br>Input high level or left floating, the motor runs at full speed. |

# 7 Cautions

Please read the instructions in this chapter carefully and follow the instructions strictly before use.

**1. Only technicians with corresponding skills training can install, use, test and maintain the pump!**

**2. This product has no waterproof, dustproof or explosion-proof properties and cannot be used in flammable and explosive environments!**

**3. Please use this product within the ambient and medium temperatures, gas and electrical parameters specified and nominal in this document. Use outside the range may cause damage and safety hazards!**

**4. Before pumping the medium, it is necessary to evaluate the corrosion resistance and chemical compatibility of the chemical composition of the medium and the pump head, piston, one-way valve, and sealing materials!**

**5. Electrical connection cables should be kept away from heat sources and the connectors and cables should be insulated and protected!**

**6. Supporting piping components and containers must have sufficient strength to ensure personal safety!**

**7. Products equipped with brush motors should be equipped with an overcurrent protection circuit to prevent the motor from stalling and burning!**

**8. Before thorough harmless treatment, our company will not accept toxic, harmful and corrosive products that have been extracted that may pose a threat to personal harm and return them to the factory for maintenance services for the reasons of employee personal safety protection and social safety. If any For related product maintenance needs, please sign the harmless declaration form and contact our company in advance!**

**9. Self-disassembly and repair without the permission and guidance of the original manufacturer will cause product damage and will result in the loss of the original manufacturer's warranty service!**

# 8 Customer Repair Declaration of Harmlessness

In order to protect the personal and environmental safety of our employees, logistics company personnel and related personnel in the whole society, please check the toxic, harmful, corrosive, biohazardous and radioactive materials before sending the repaired and returned products back to Hailin Technology. Products containing hazardous media and other hazardous media should be thoroughly cleaned and detoxified, and this detoxification statement should be included with the pump. Otherwise, our company will refuse to carry out further repairs on the above products.

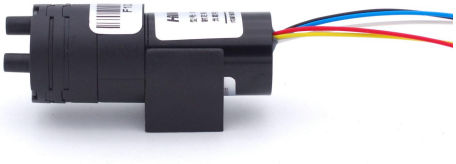
| Item | Content |
|---|---|
| Model | |
| S.N number | |
| List of medium components that have been extracted | |
| | |
| | |
| | |
| | |
| | |
| | |
| Statement content | This repair/replacement product has been thoroughly cleaned and decontaminated, and does not contain potentially corrosive, radioactive, biohazardous or other toxic and harmful hazardous components, and is not harmful to the personal safety of the carrier, maintenance personnel and other related handling personnel. Security does not pose a risk. |

Company Stamp

Signature/Date

# 9 Appearance

S09M with BI Coreless DC Brushless Motor



S09S with DC Brushed Motor