D15 Micro Vacuum Pump and Compressor Series

User Guide

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About This Document

Purpose

This document is related to the D15 micro vacuum pump and compressor 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
08	2024-10-22	01	ZZH	Modified the brushless motor wiring diagram and model name
09	2024-10-23	01	LYZ	Added wide voltage description, FKM option
10	2024-10-24	01	YBN	Modified the dimensions and installation drawings
11	2024-10-25	01	YBN	Added lateral installation diagrams and content, modified DC model average flow parameters
12	2024-10-25	01	LYZ	Added descriptions related to low-temperature environment type and liquid water resistance
13	2024-11-01	01	YBN	Added configuration option pump head orientation diagram
14	2024-11-13	01	YBN	Modified BA model average flow parameters
15	2024-12-05	01	LYZ	BL/BA wiring instructions errata

Contents

1 Characteristics

1.1 Compact Size,High Flow

The product weighs about 40g and has an overall appearance size of approximately 40x37x25mm. While maintaining a tiny volume, the output peak flow rate can reach 3.0 L/min.

1.2 Low Power Consumption and High Efficiency

The D15M with optional DI motor is designed for low-energy applications such as battery power supply. It can operate at a voltage of 2-5V and can achieve a high flow rate of 0.6LPM at an ultra-low operating power consumption of 0.2W@2V.

1.3 Excellent low temperature operating performance

The low-temperature environment model of this product with special design and low-temperature-resistant materials can start and operate stably and reliably at -20°C ~ -0°C. The low-temperature environment model with a heater can start stably and reliably in low-temperature environments as low as -30°C. and operation, with excellent low temperature performance.

1.4 High Air Tightness

This product has good air tightness and extremely low gas leakage rate.

1.5 Stable and Reliable Pressure Output and Gas Transmission

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

1.6 Multiple Motor Options

According to application requirements, motor configuration options with long life, high performance, low cost, and multiple input voltage specifications can be provided to meet different cost and reliability application requirements.

1.7 Corrosion-resistant Material Options

In addition to the standard EPDM rubber, FKM fluororubber material with better high temperature resistance and corrosion resistance can also be selected according to 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 Speed Feedback

Products equipped with brushless motors can know the speed of the pump through the speed feedback signal, which facilitates working condition monitoring and closed-loop control.

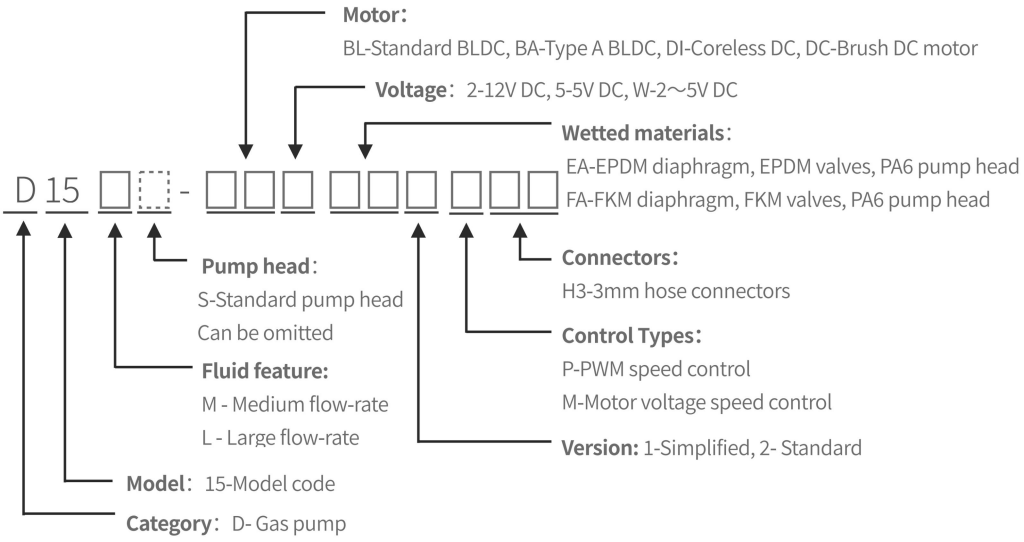
2.3 Protection Function

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; the simplified version is equipped with a DC motor, and the standard version is equipped with other motors



Note: Example 1: D15L-BL2EA2PH3 (D15 high-flow air pump, standard brushless motor 12V power supply, material combination: EPDM diaphragm, EPDM valve plate, reinforced nylon pump head, standard version, PWM speed control, 3mm hose connector)

Example 1: D15L-DC2EA1MH3 (D15 high-flow air pump, standard brush motor 12V power supply, material combination: EPDM diaphragm, EPDM valve plate, reinforced nylon pump head, simplified version, motor voltage speed control, 3mm hose connector)

4 Technical Specifications

4.1 Key Specifications

Model	Rated voltage (V DC)	Load current（mA)	Peak flow (L/min)	Average flow（L/min）	Max pressure (kPa)	Relative Vacuum (-kPa)	Weight（g)
Material and configuration	Standard BL motor,Diaphragm：EPDM ; Check valve：EPDM; Pump head:reinforced nylon						
D15L-BL2	12	≤90	≥1.8	≥1.2	≥40	≥40	≈45
D15L-BL5	5	≤220	≥1.8	≥1.2	≥40	≥40	
Material and configuration	Type A BLDC,Diaphragm：EPDM ; Check valve：EPDM; Pump head:reinforced nylon						
D15L-BA2	12	≤150	≥3.0	≥1.5	≥40	≥40	≈43
Material and configuration	Iron Core DC,Diaphragm：EPDM ; Check valve：EPDM; Pump head:reinforced nylon						
D15M-DIW	4(2~5V)	≤200	≥2.2	≥1.1	≥26	≥28	≈39
Material and configuration	Brush DC,Diaphragm：EPDM ; Check valve：EPDM; Pump head:reinforced nylon						
D15L-DC2	12	≤60	≥1.4	≥0.8	≥35	≥35	≈63
D15L-DC5	5	≤150	≥1.4	≥0.8	≥35	≥35	≈64
This parameter is a preliminary calibration parameter before the official release of the product,and may be further revised with subsequent product releases							

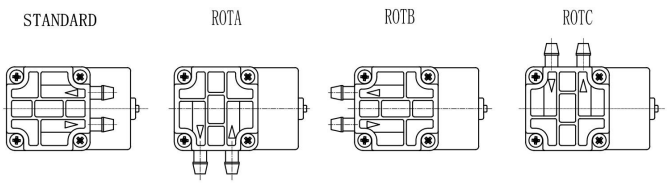
Note: 1. The DC motor input voltage is required not to exceed the rated voltage;

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

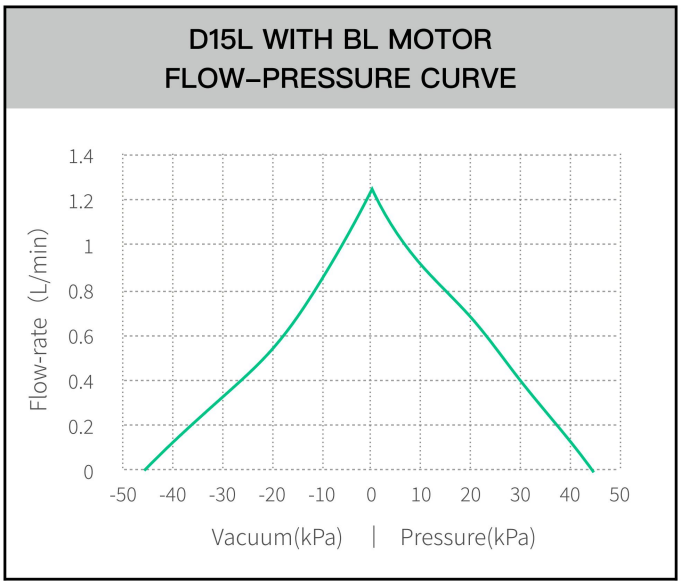
Material option	**Defalut**	**Optional Items**		
Pump head	Reinforced nylon			
Diaphragm	EPDM	FKM		
One-way valve	EPDM	FKM		
Motor option	**Simplified version**	**Standard version**		
Motor type	DC Brushed motor	DI Coreless motor, BL/BA Standard brushless motor		
Rated Voltage	5V/12V DC	4V/5V/12V DC		
Connector option	**Defalut**	**Optional Items**		
Nozzle type	Hose connector			
	（For detailed connector introduction, see the following chapters）			
Pump head option	**Defalut**	**Optional Items**		
Pump head type	Standard Pump head	Low temperature environment type	Low temperature environment type with heater	
Pump head orientation	Standard orientation	ROTA	ROTB	ROTC
	 ROTA: Rotate 90° clockwise based on the standard orientation of the valve; ROTB: Rotate 180 ° clockwise based on the standard orientation of the valve; ROTC: rotate 270° clockwise based on the standard orientation of the valve;			
	（For detailed function introduction, see the following chapters）			

4.3 Reliability Parameters

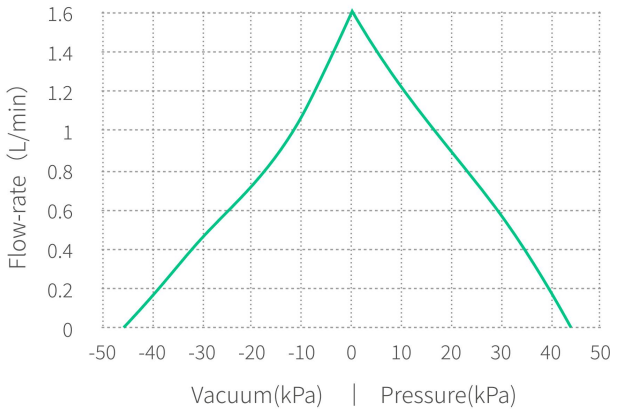
Models	D15L D15M		
Versions	**Simplified DC motor**	**Standard BL/BA motor**	**Standard DI motor**
Fully Loaded Lifetime（hrs）	2500	8000*	4000*
Unloaded Lifetime（hrs）	3000	12000*	5000*
Motor Lifetime（hrs）	3000	15000*	8000*
Lifetime test instructions:	Full-load life test conditions: The suction port is blocked, the exhaust port is connected to the atmosphere, and the pump is operated continuously for a long time		
	No-load life test condition: The air inlet and outlet are connected to the atmosphere, and the pump operates continuously for 24 hours without stopping.		
	Motor life test conditions: Under good ventilation and heat dissipation conditions, the motor runs continuously for 24 hours without load		
	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 inlet and exhaust ports can be operated with full load (i.e. the output pressure is below the rated maximum pressure), but the load applied to the inlet cannot exceed the maximum vacuum of the pump, and the load applied to the exhaust port cannot exceed the maximum output pressure of the pump

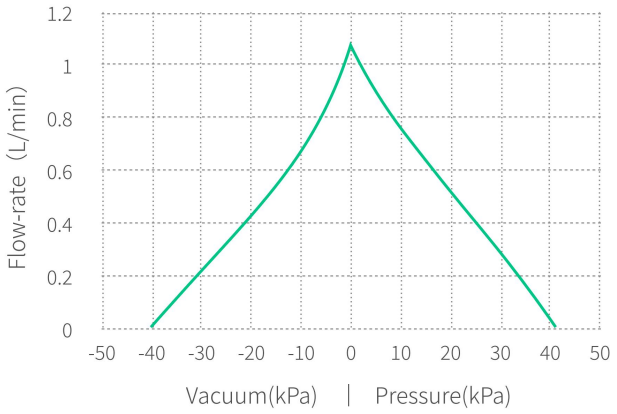
4.4 Pressure-Flow Curve



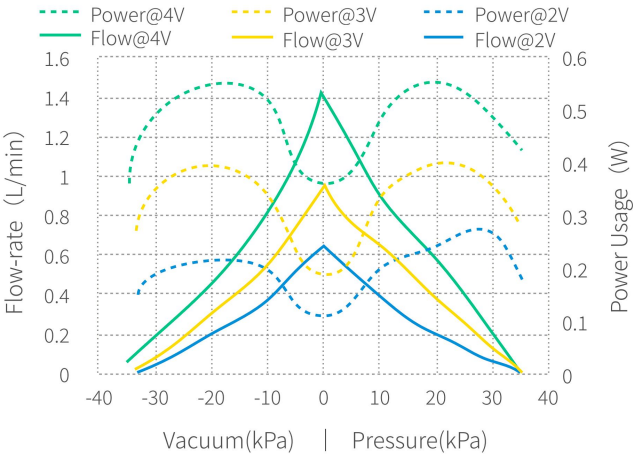
D15L WITH BA MOTOR FLOW–PRESSURE CURVE



D15L WITH DC MOTOR FLOW–PRESSURE CURVE



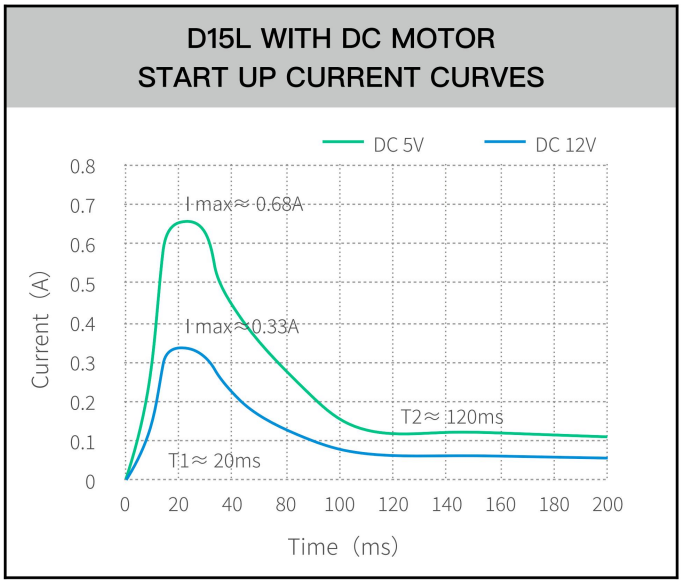
D15L WITH DI MOTOR FLOW–PRESSURE–POWER CURVE

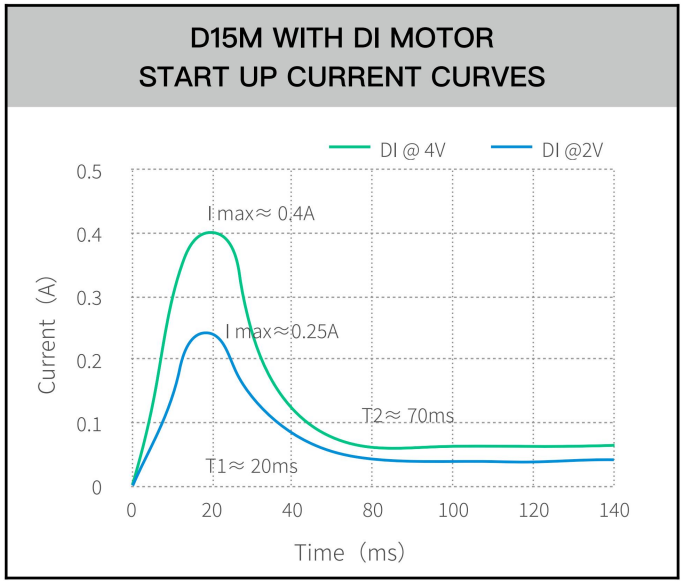


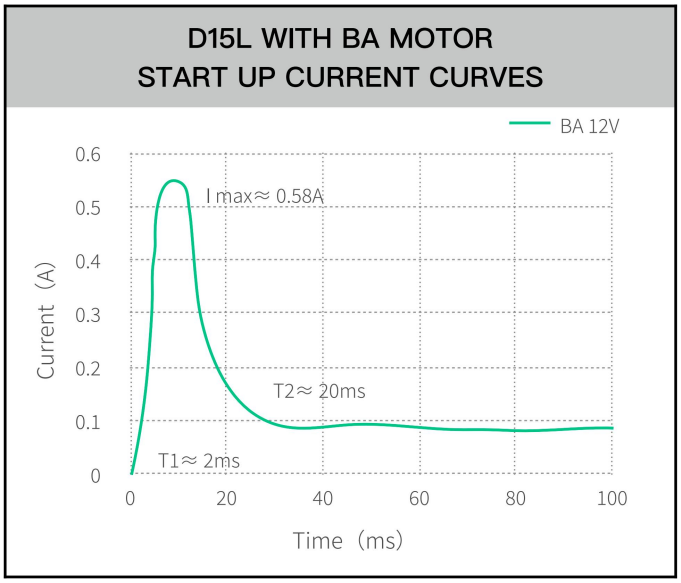
Note: 1. Due to individual differences between different micro pumps and different test pipelines having different effects on measured parameters, this curve is a statistical value;

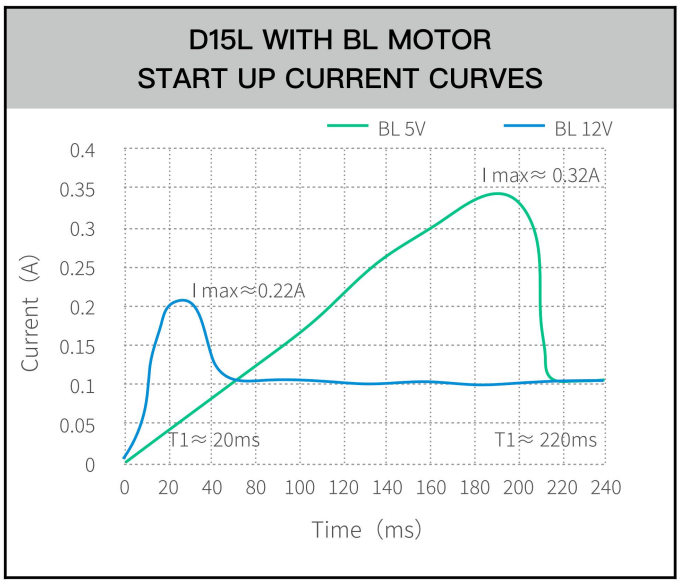
2. The values of this curve are only for the technical reference of the user to confirm the working point and are not used as a basis for product acceptance.

4.5 Starting Current Curve









Note: 1. The starting current curve is measured under the condition that the inlet and the outlet are directly connected to the atmosphere. There are individual differences between different micro pumps.

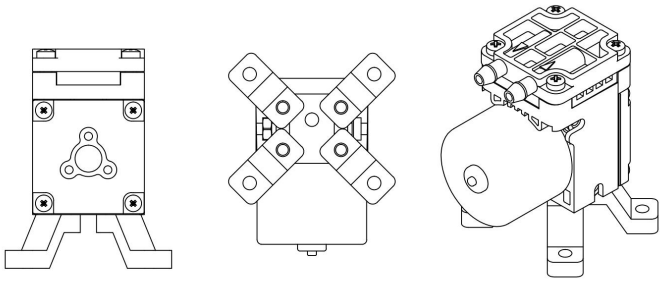
2. This curve is a statistical value and is only used as a technical reference for users to determine the power supply system. It is not used as acceptance data

5 Installation Instructions

5.1 Upright installation and fixation of pump body

Four mounting holes are reserved at the bottom of the pump, which can be installed with M3* (T+4) flat-tail self-tapping screws with pads. T is the thickness of the installation material; for example, if the plate thickness is 2mm, use M3*6*7 flat-tail self-tapping screws. .

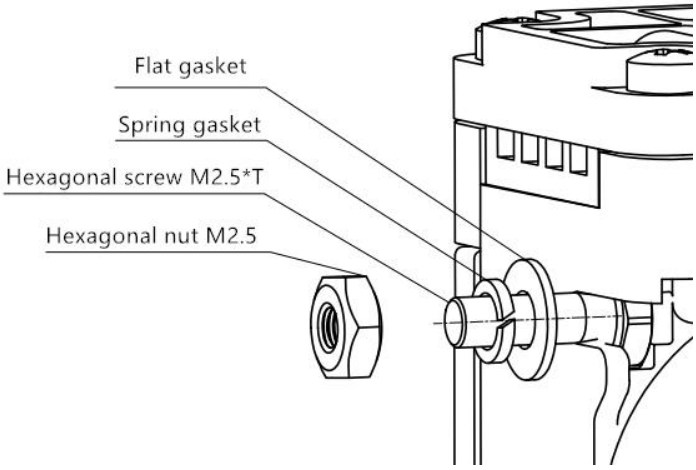
In vibration-sensitive situations, you can also choose to use our company's shock-absorbing feet for installation, and use M3*6*7 flat-tail self-tapping screws for installation. Please refer to the picture below for the installation method.



5.2 Side installation and fixing of pump body

The M2.5 hexagonal nut/screw mounting position is reserved on the side of the pump body of this product, which supports the pump body to be installed upright or tilted through the side mounting nuts. The screw length can be selected according to needs.

During installation, you need to install the screws or nuts first in the mounting holes on the side of the pump, then add 2.5*5*0.5 flat washers and M2.5 spring washers in sequence, and finally fix them with M2.5 hex nuts/screws. The installation example is as shown below:

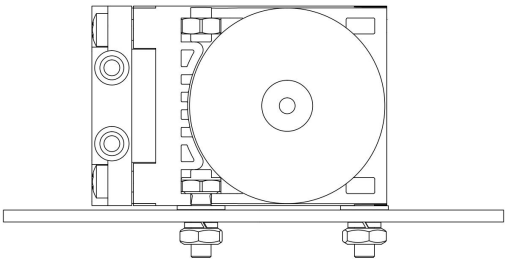


Example:

When the installation plate thickness is δ=2mm, the length of the hexagonal screws should be L≥6mm.

(Spring washer thickness + flat washer thickness + plate thickness + nut thickness = 0.8 + 0.5 + 2 + 2 = 5.3mm)

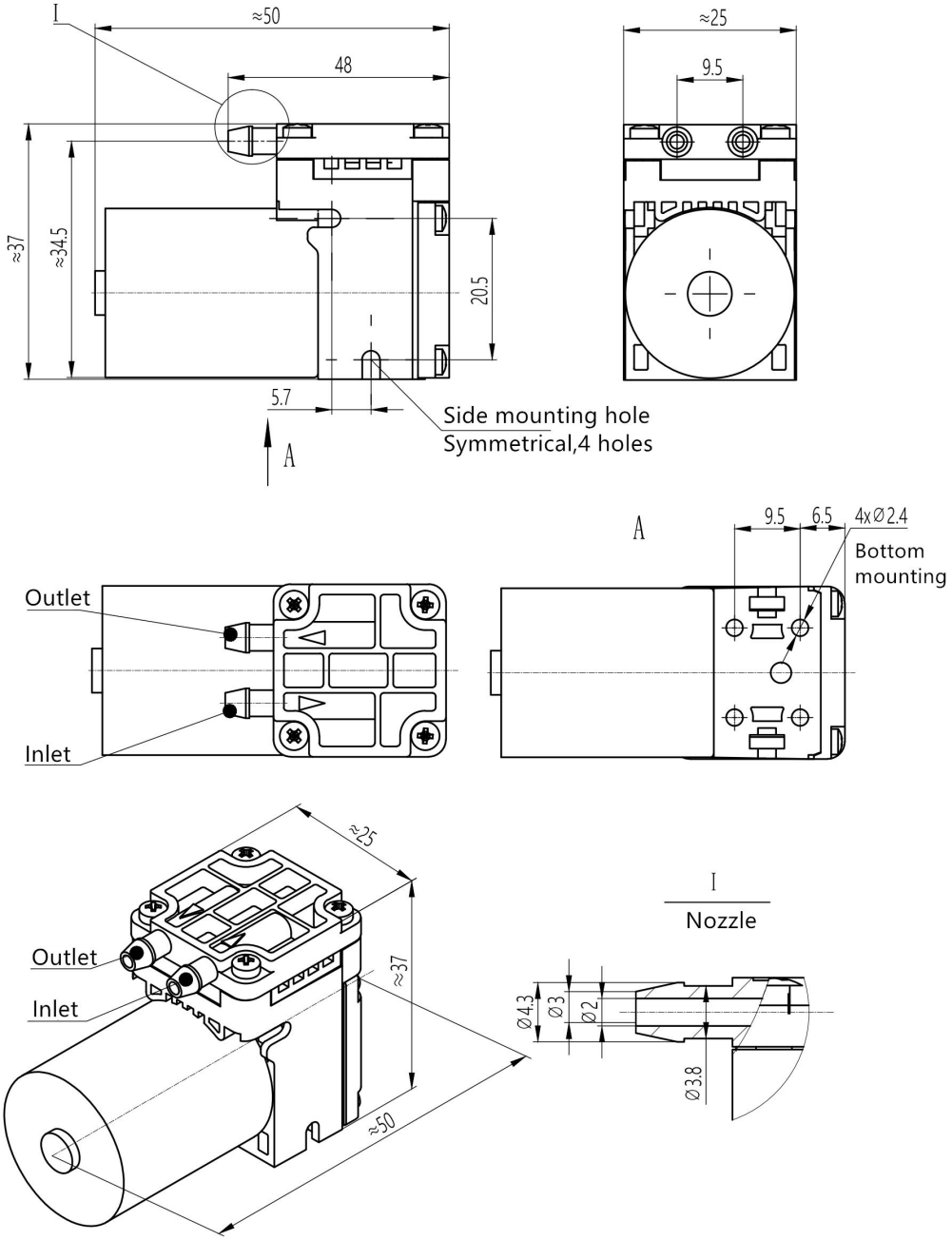
Among the standard screw specifications, there are 6mm, 8mm, 10mm, 12mm, etc. screws to choose from. It is recommended to choose longer screws.



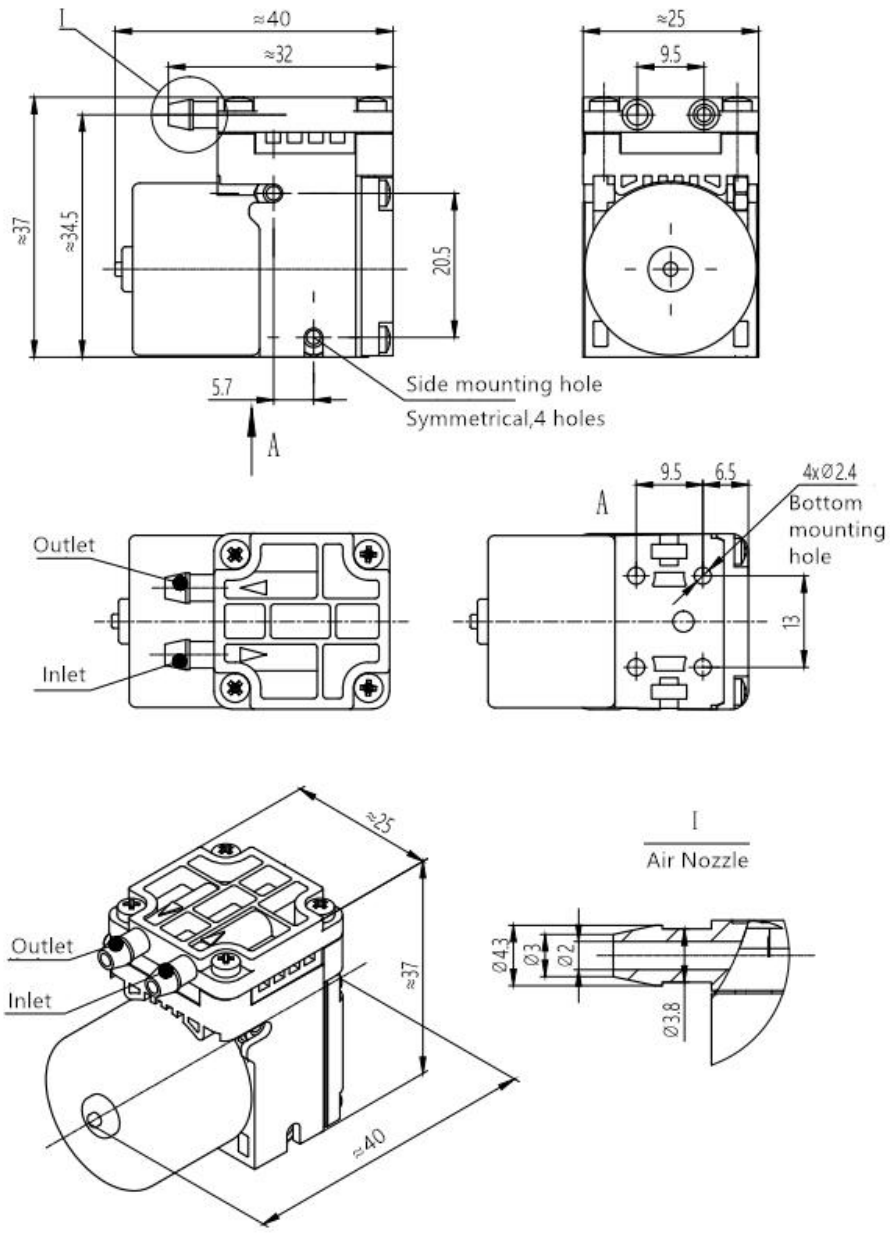
5.3 Pipe connection of hose connector

According to the size of the pump head nozzle, a ϕ 3mm inner diameter silicone rubber hose should be selected for connection

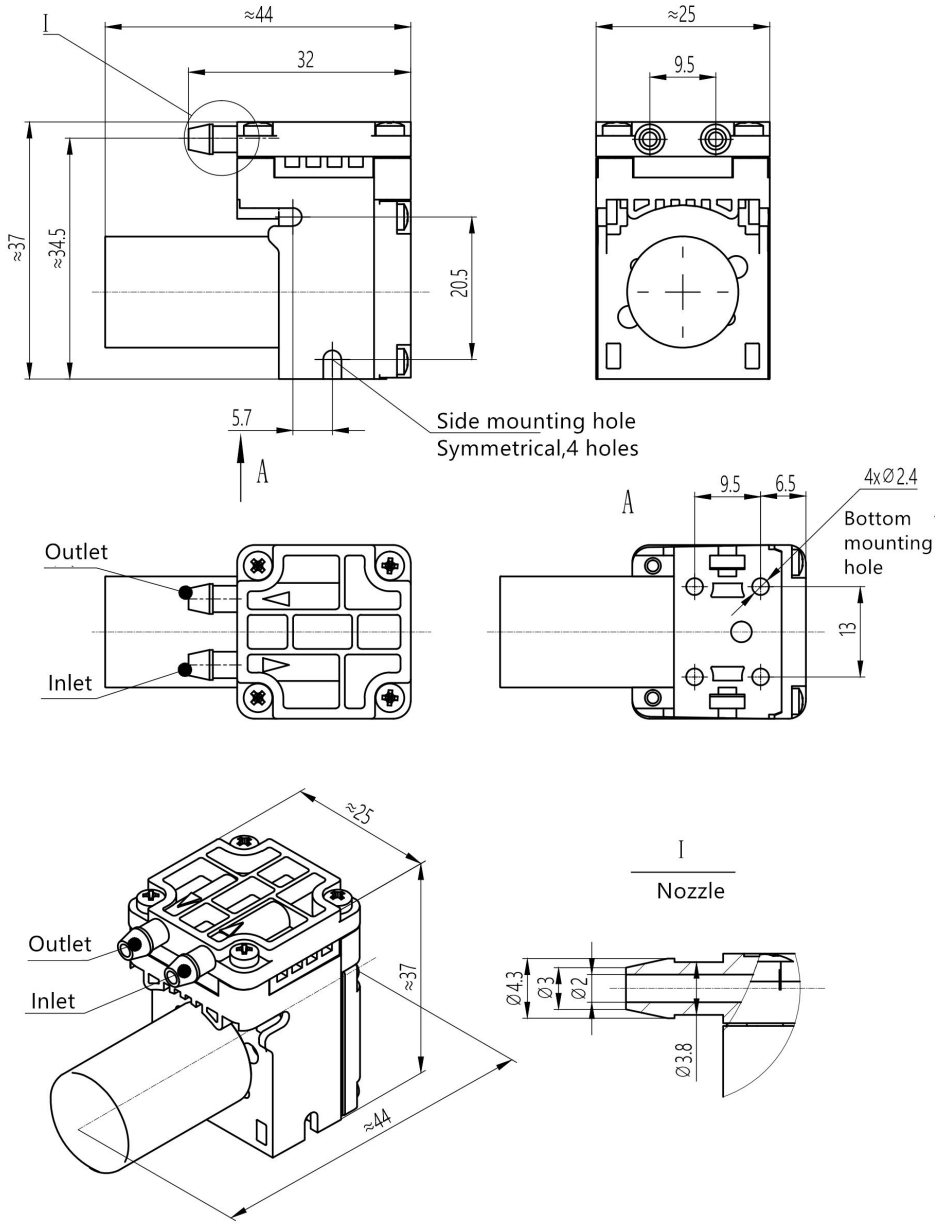
D15L: DC brush motor installation dimensions



D15L: Installation dimensions of BL/BA brushless motor



D15M: Coreless DC brush motor installation dimensions



Installation instructions:

1. The screws on the pump cannot be removed, otherwise the pump will be damaged;

2. The installation holes are self-tapping screw holes, which are not easy to tighten and disassemble repeatedly, otherwise the installation will become loose and unreliable.

6 Electrical Connection

The wiring instructions are for the external power supply and signal cable connection instructions of this product. This product comes with a standard connection cable, and the cable definitions are distinguished by color. Before reading this section, you need to check the specific model of the D15 product and the type of motor and motor voltage configured.

6.1 D15 DC/DI Brushed Motor Interface Definition

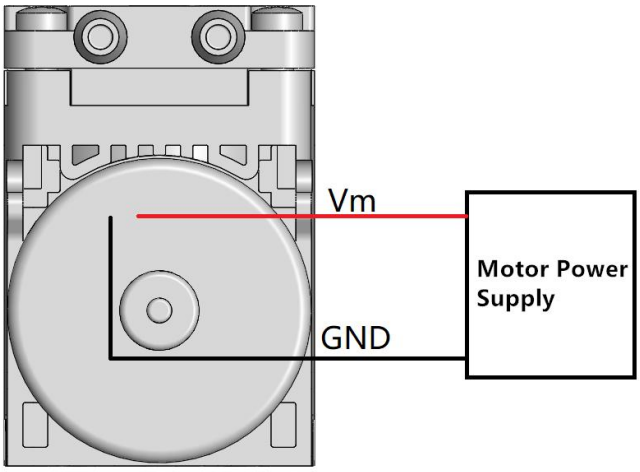


Figure 4-1 Wiring Instructions for Basic Type

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 5V DC12V DI 4V	Models equipped with DC motors must confirm the rated voltage of 12V/5V according to the product model. The voltage cannot exceed the maximum voltage range, otherwise the motor will burn out or the product life will end prematurely; models equipped with DI motors have a rated working voltage of 4V and can work in the range of 2V-4V.
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 D15 DC/DI Brushed DC Motor

The DC brushed motor can control the motor speed by adjusting the motor input voltage. When the motor voltage is used for speed regulation, the input voltage must not exceed the rated voltage of the motor, otherwise the motor will be damaged prematurely.

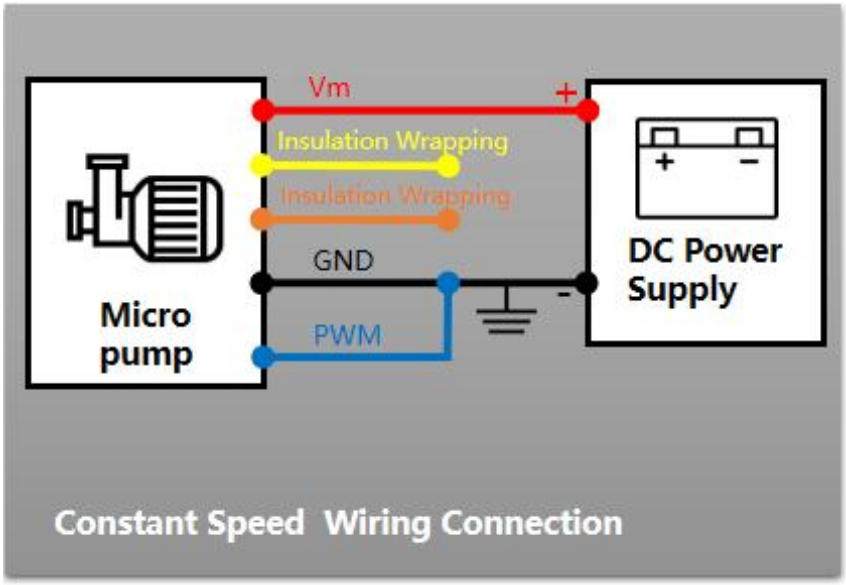
When the pump works with load at a voltage lower than the rated voltage, or works under conditions where the pipeline pressure exceeds the rated pressure, it may cause stalling or start failure due to excessive load; when stalling occurs, the power supply should be cut off immediately to avoid motor burning. It is recommended to add a circuit module with stalling/overcurrent protection in 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.

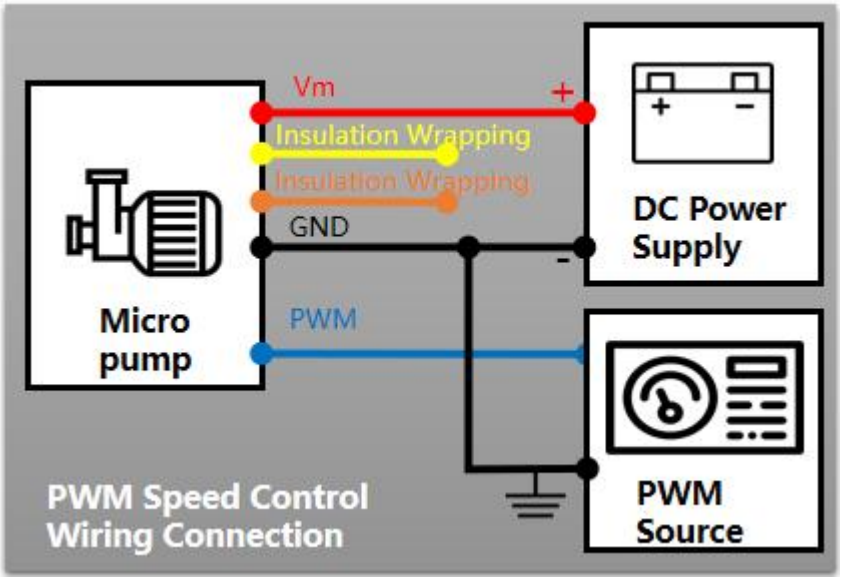
6.3 Wiring of D15 with BL type DC brushless motor

The product model with the words BL5/BL2 or BA5/BA2 means that the product is equipped with a brushless DC motor with a rated voltage of 5V/12V DC. For example, the BL2 in D15L-BL2EA2PH4 represents a BL-type brushless motor equipped with a rated voltage of 12V 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 and blue wires to the negative pole of the power supply; the yellow and orange wires are insulated and wrapped, and the pump will work at rated speed.

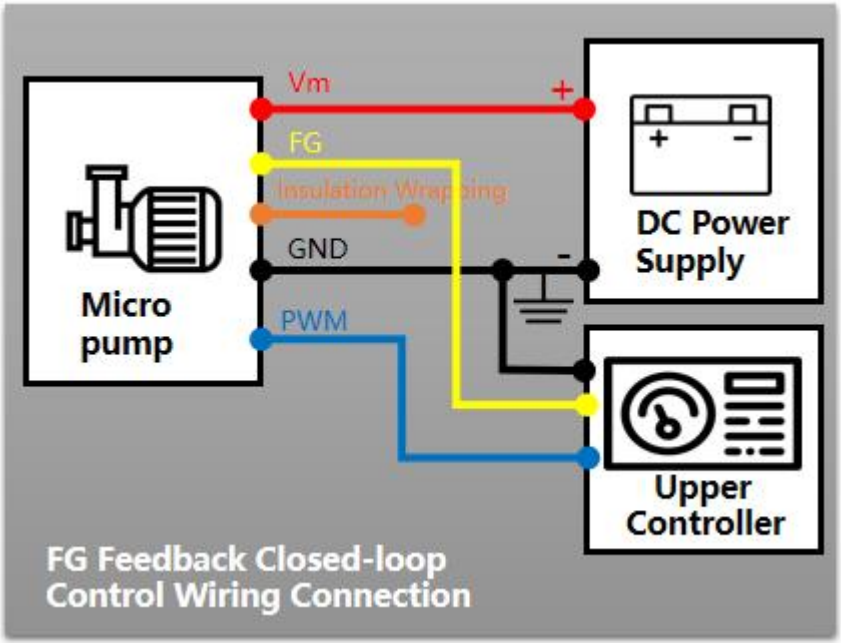


When you need to use the PWM speed control function, you need to use a signal source that supports PWM signal output (function signal generator, MCU, PLC and other controllers), connect the signal source output to the blue PWM input cable, and connect the PWM signal source ground Connect it to the DC power ground, the yellow and orange wire is 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 signal source output to the blue PWM input cable, and connect the PWM signal source ground to the DC power supply ground. The orange wire is insulated and wrapped. The yellow FG feedback signal output cable is connected to the FG signal input end of the upper controller. The machine detects the FG signal to monitor the motor speed, and controls the PWM signal output for closed-loop speed
control.



6.4 BL type brushless DC motor signal definition

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

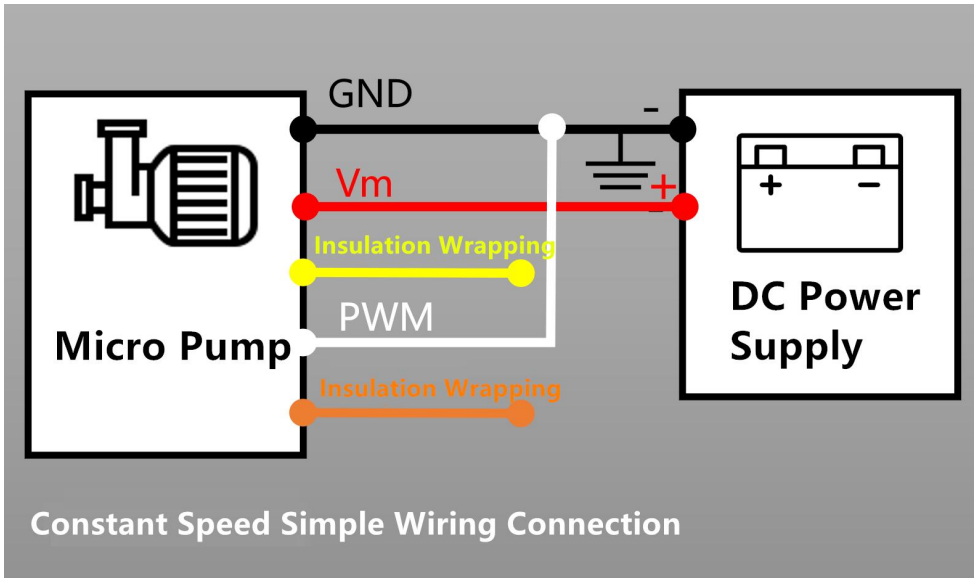
S.N.	Wire	Function	Signal Definition	Description
1	Red	Positive pole	DC5V （±10%） DC12V （±10%）	Determine the voltage according to the model, see Chapter 3 for details
2	Yellow	FG feedback signal (motor speed feedback signal, pulse signal), the motor outputs 6 pulses per rotation.	Output: 3V≤high level Low level≤0.6V The maximum rated current of the FG feedback signal is 3mA.	
3	Orange	No function for this model (FR)	Grounding or insulation wrapping is recommended	

4	Black	GND	Negative pole,Ground	Ground
5	Blue	Pulse Width Modulation (PWM)	Input: 0V≤VIL≤0.8V 2V≤VIH≤5V （10KHz～15KHz）	Use PWM to change the motor speed and adjust the flow rate. PWM input signal frequency range: 15KHz. This port cannot be used to control the start and stop of the pump.

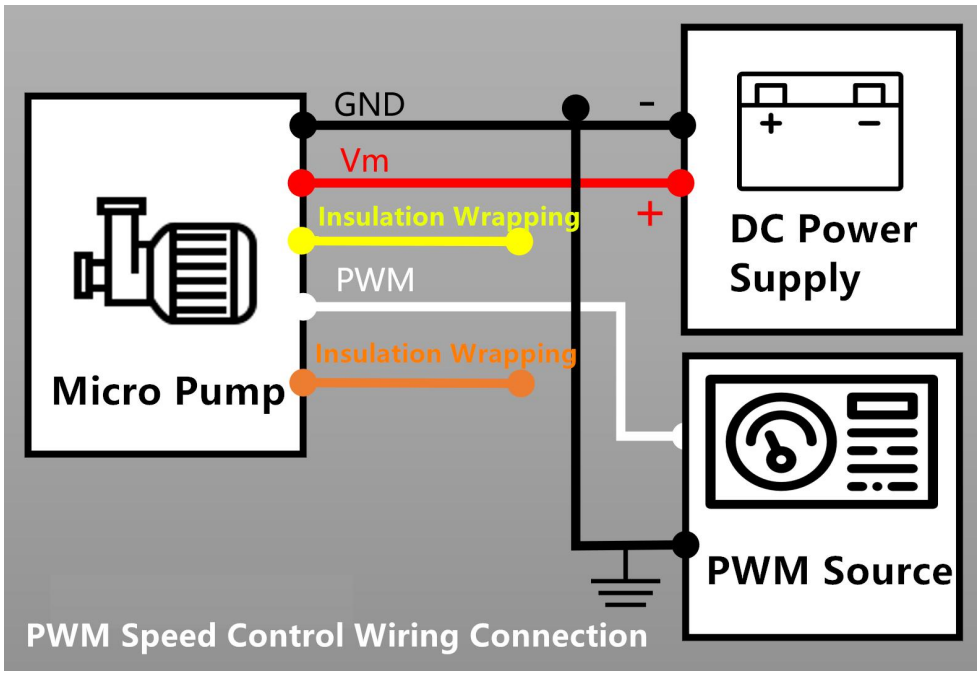
6.5 Wiring of D15 with BA type DC brushless motor

The product model number contains the word BA2, which means that the product is equipped with a DC brushless motor with a rated voltage of 12V DC. For example, BA2 in D15L-BA2EA2PH4 represents a BA-type brushless motor with a rated voltage of 12V DC.

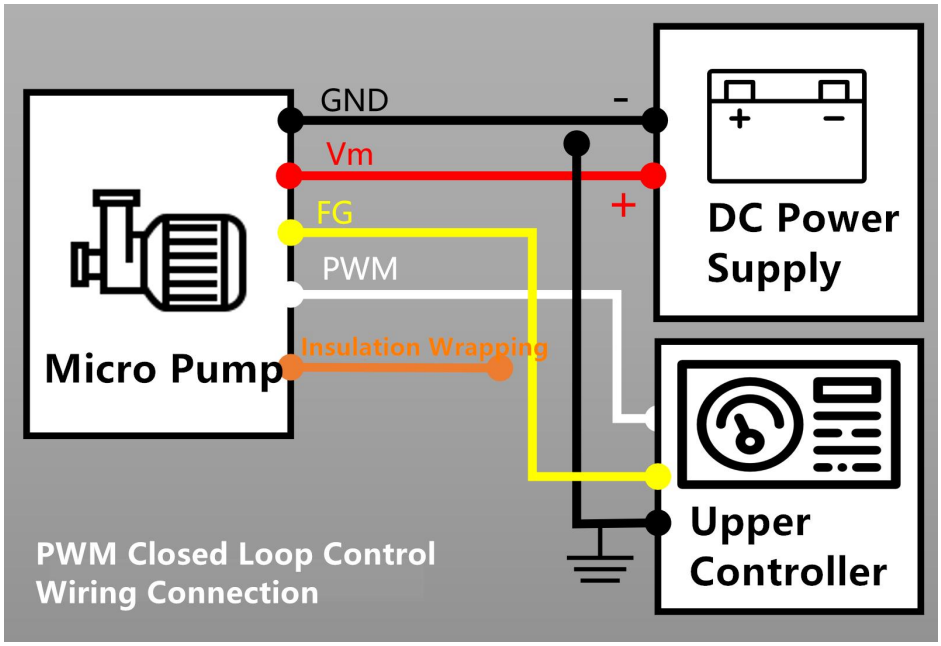
If speed regulation and speed feedback are not required, the red wire is connected to the positive pole of the power supply, and the black and white wires are connected to the negative pole of the power supply; the yellow and orange wires are insulated and wrapped, and the pump will work at the rated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



When you need to use the PWM speed regulation 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 white PWM input cable, and connect the PWM signal source ground to the DC power supply ground. Insulate the yellow and orange wires. At this time, the motor speed can be open-loop controlled through the PWM signal.



When you need to use the PWM speed control function and monitor the pump operation or perform closed-loop feedback control through the FG signal, you need to use a host controller (MCU, PLC, host computer, etc.) that supports PWM signal output and FG signal input. Connect the signal source output to the blue PWM input cable, and connect the PWM signal source ground to the DC power supply ground. Connect the green FG feedback signal output cable to the FG signal input terminal of the host controller. The host computer detects the FG signal to monitor the motor speed and controls the PWM signal output for closed-loop speed control.



6.6 BA type brushless DC motor signal definition

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

S.N.	Wire	Function	Signal Definition	Description
1	Black	Negative pole		
2	Red	Positive pole	DC12V （±10%）	
3	Yellow	FG feedback signal (motor speed feedback signal, pulse signal), the motor outputs 6 pulses per rotation.	Output: 4V≤high level Low level≤0.6V The maximum rated current of the FG feedback signal is 3mA.	The motor is in an open-drain state, so it needs to be pulled up externally. The voltage is DC5V and the resistance is 4.7kΩ.
4	White	Pulse Width Modulation (PWM)	Input: 0V≤VIL≤0.8V 4.3V≤VIH≤5V （15KHz～25KHz）	Use PWM to change the motor speed and adjust the flow rate. PWM input signal frequency range: 15kHz ~ 25kHz. This port cannot be used to control the start and stop of the pump.
5	Orange (or gray)	CW/CCW	NC	This signal cable has no actual function on this model of product and does not need to be connected. It is recommended to provide insulation protection.

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 according to the instruction manual!

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

3. Please use this product within the specified and nominal environment and medium temperature and gas and electrical parameters in this document. Exceeding the range of use may cause damage and safety hazards!

4. Before extracting the medium, the chemical composition of the medium and the corrosion tolerance and chemical compatibility of the pump head, diaphragm, check valve, and sealing materials must be evaluated!

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

6. Products equipped with brushed motors should be equipped with overcurrent protection circuits to prevent motor stalling and burning!

7. Before thorough harmless treatment, our company does not accept return repair services for toxic, harmful, and corrosive products that may pose a threat to personal injury based on employee personal safety protection and social security reasons. If there is a need for related product repairs, please sign the harmless declaration form and contact our company in advance!

8. Self-disassembly and repair without the permission and guidance of the original manufacturer will cause product damage and will void 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.

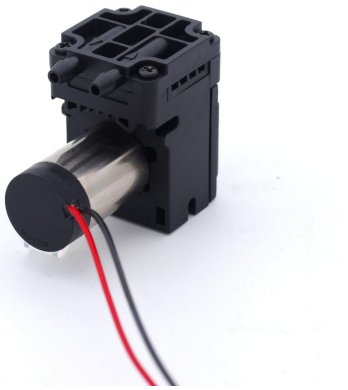
Item	Content
Model	
S.N number	
List of medium components that have been extracted	
Statement content	This repair/replacement product has been thoroughly cleaned and decontaminated, and does not contain potentially corrosive, radioactive, biohazardous or other toxic and harmful hazardous components,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

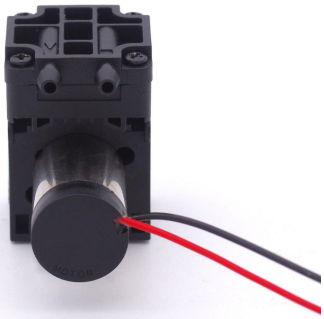
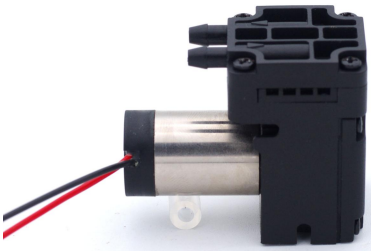
Company Stamp

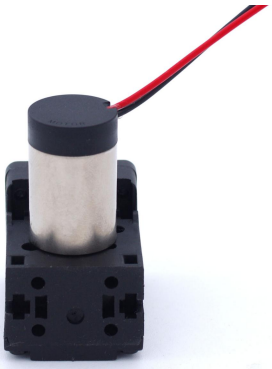
Signature/Date

9 Appearance

D15 with DI Coreless DC Motor





D15 with BA BLDC Motor

D15 with BL BLDC Motor






D15 with DC Brushed Motor