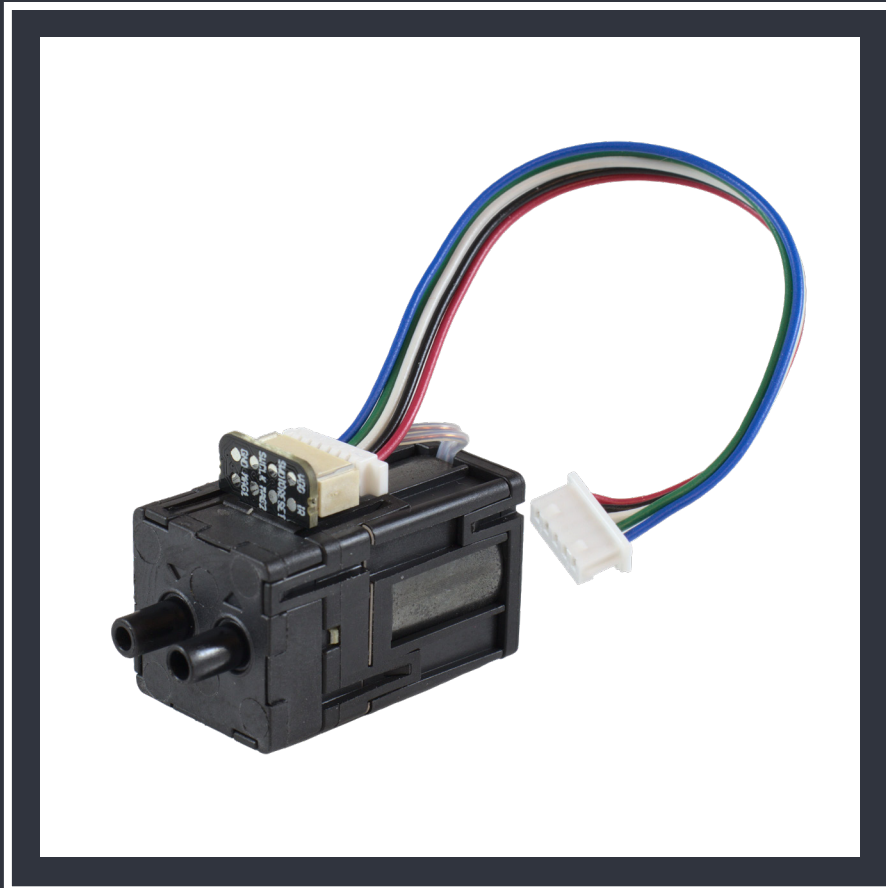
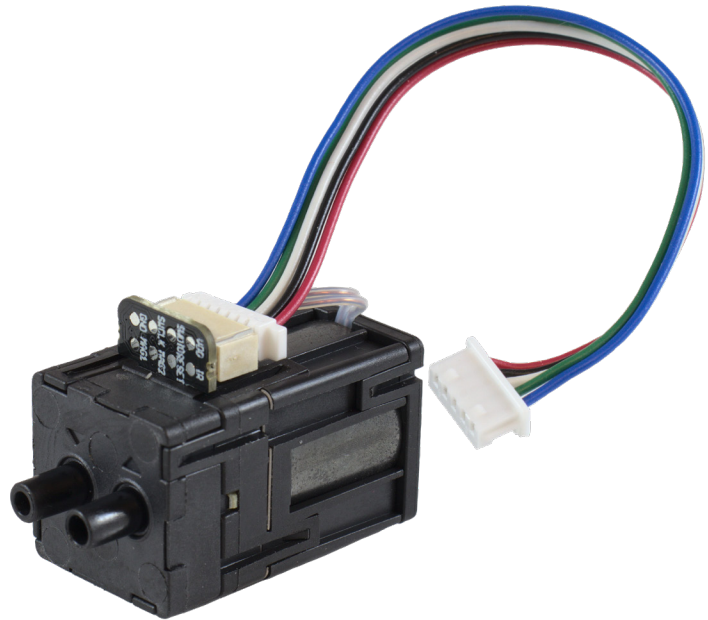


TECHNICAL DATA SHEET V100



Intelligent Black Edition Gas Pumps

2. General Information
3. General Flow Performance and Standard Models
4. Electronic Interface
6. Serial Interface
8. Pump Parameters
9. Drawings



BLACK EDITION MICRO PUMPS FROM XAVITECH

Xavitech's Black edition is our pump model with the most functionality and flexibility. Our goal is for you to be able to use this micropump in your new system or as a drop-in replacement in your existing system, in an easy and convenient way.

- 20 000 hours, 2-year warranty
- Small footprint
- Customized calibration

ADAPT THE BLACK EDITION TO YOUR REQUIREMENTS

The Black edition offers a wide variety of functions. We offer a standard Black edition pump with high quality and a great lifetime, but the Black edition pump can also be calibrated for your specific needs.

- Calibrated flow rate
- Choose operating voltage 3.3 – 12 V DC
- Custom firmware
- Blockage detection

CUSTOM CALIBRATION

The Intelligent Black edition pumps have built-in micro-controllers which makes it possible to create customized firmware for various purposes.

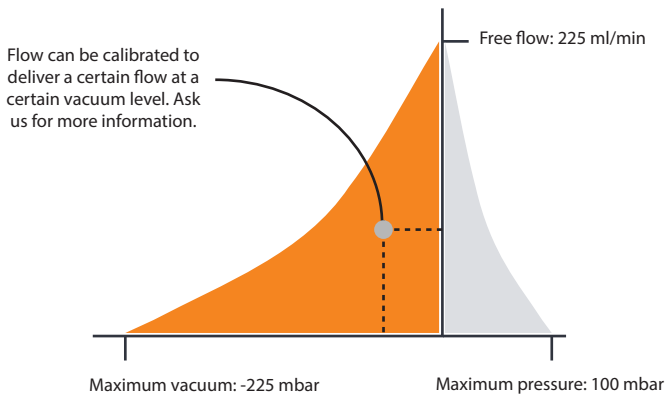
Examples of customized firmware:

- Set the flowrate to a specific value
- Silent mode
- Programmable Maximum Pressure
- Keep performance on battery operation

Contact us if you are wondering how the Black edition pump can best serve your system.

V100 BLACK INTELLIGENT PUMPS

General Flow Performance and Standard Models



IMPORTANT NOTES

- Pump Flow: Flow is one-directional, it cannot be reversed.
- Filters: To ensure lifetime, air filters should be used to prevent contaminations like dust to enter the pump.
- Connections: Incorrect lead connection can damage the pump.

STANDARD MODELS (PART NUMBER)

Xavitech provides several pre-calibrated standard models. For these models, the voltage and the maximum flow is calibrated to standard values. The only thing that needs to be defined before the pump can be ordered is the lifetime of the pump. The chart below lists the standard pumps models that Xavitech can offer. But custom calibration is also an option, please contact Xavitech for more information.

PART NUMBER	VOLTAGE (V DC)	FREE FLOW (ml/min)	MAXIMUM VACUUM (mbar)	CONNECTION INTERFACE	ANALOG FLOW CONTROL	SERIAL INTERFACE (I2C)	LIFE TIME (Hours)
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V100-5V	5	225	-225	5 Wires	✓	✓	20 000
V100-12V	12	225	-225	5 Wires	✓	✓	20 000

CONTROL

Read more about how to control the pump flow with either analog signal or with serial interface and how to choose your custom calibration point in the respective sections down below.

V100 BLACK INTELLIGENT PUMPS

Electronic Interface

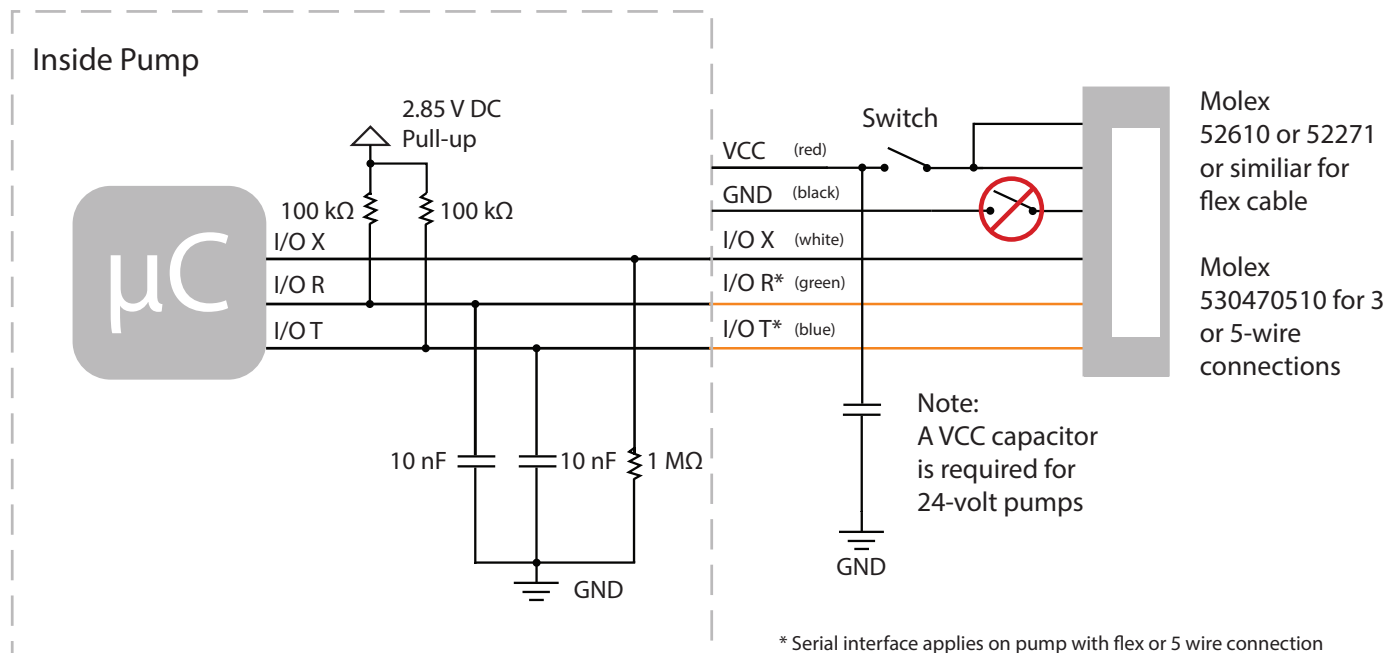


Figure 2: Electronic interface

INTERFACE DESCRIPTION

VCC (SUPPLY VOLTAGE)

Each pump is calibrated to run at an input voltage in the range of 3.2 to 12 V DC. The supply voltage can be customized for each customer's need.

Maximum input voltage: Calibrated voltage + 0.5 V DC. The pump can be damaged otherwise.

Minimum input voltage: 3.2 V DC. However, the pump performance is reduced if the voltage is set lower than calibrated value. Xavitech recommends to always run the pump at the calibrated voltage.

Figure 3 shows in terms of current consumption a typical pump stroke cycle. Since the motor of Xavitech pumps is based on an electromagnet, a negative current will occur when the electromagnet is turned off. It is because of this current a capacitor is needed between VCC and GND.

If your system cannot handle this spike generated by the electromagnet, a Schottky diode (flyback diode) can be used instead of the capacitor.

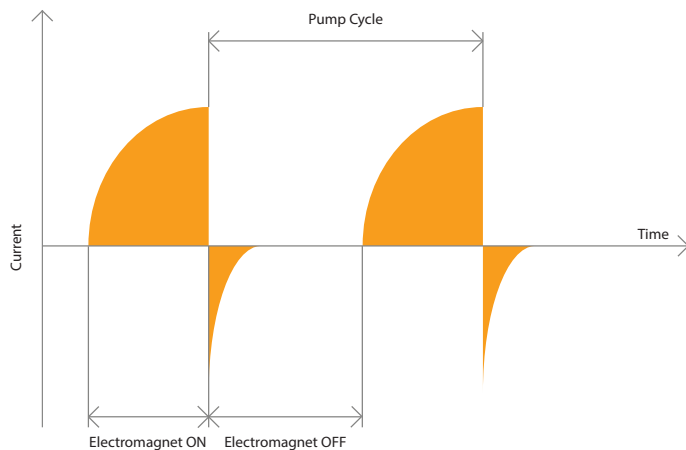


Figure 3: Typical pump cycle

V100 BLACK INTELLIGENT PUMPS

Electronic Interface

I/O X

This is a general I/O connected to an A/D converter of the microcontroller inside the pump.

The default functionality is frequency control:

- 0 - 0.05 V DC: Pump stops
- 0.06 - 2.7 V DC: Frequency control of the pump
- 2.7 - 2.8 V DC: Maximum frequency of the pump
- Max input voltage: 3.3 V DC (the pump can be damaged if exceeded)

Note that the frequency adjustment can only lower the frequency from the factory default frequency. Normally a pump is calibrated to have its maximum frequency (maximum flow) set as default at factory.

The use of I/O X can be customized for each customer's need. I/O X can be an analog- or digital input or output. Please contact an Xavitech representative for more information.

SCL AND SDA

SCL is the clock line and SDA is the data line of the I2C interface.

The I2C interface uses logic levels of 2.8 V DC. The maximum rating of this interface is 3.3 V DC. Read more about this in the section for the pumps I2C interface.

SWITCH THE PUMP ON AND OFF

The Xavitech pump can be turned on/off in three different ways:

- 1) Via the I/O X line: Ground the I/O X and the pump will stop. The pump will start within a few milliseconds (depending on what frequency the pump is calibrated in default) when a voltage higher than 0.05 V DC is applied. However, note that the internal microcontroller will still run so the pump will consume <10 mA.
- 2) Via the I2C interface: When set to digital control method, use the User Frequency command to turn it on and off. Note that the internal microcontroller will still run while stopped in this way, so the pump will consume <10 mA.
- 3) Switch power on and off: The power must be switched on the VCC line (see Figure 2). The pump will be damaged if the switch is placed on the GND line. The capacitor has to be placed between VCC and GND on the pump side of the switch. This is because of the back EMF current that the electromagnet generates. Using this method of turning the pump off, it will not consume any power, but the microcontroller will perform the start-up procedure which takes up to 3 s (depending on default pump frequency) when the power is turned on. During this time, the pump adjusts the stroke length to reach its calibrated length. The regulation adjusts the stroke length for every pump stroke thus it depends on the pump frequency.

CAPACITOR SPECIFICATIONS

Xavitech recommends using a capacitor parallel to the power supply (see Figure 2) to reduce the power spikes generated by the electromagnetic motor. See the recommended capacitors sizes below.

Pump	Recommended Capacitor
V100-5V	330 μ F, 10 V
V100-12V	330 μ F, 16 V

I²C Interface

To use the I²C interface, pull-up resistors needs to be added to the SDA and SCL lines (see Figure 2). Suitable values depend on the bus capacitance. Some master devices have built-in pull-up resistors. A Raspberry Pi for example has **1.8 kOhm resistors** installed. Recommended I²C speed grade is standard mode: **100 kbit/s**, but up to 400 kbit/s (full speed) is supported. Actual maximum speed depends on bus capacitance, pull-up resistors used and interference from other circuitry etc.

Logic levels are **2.8 V** (max 3.3 V). The standard 7-bit address is **0x4A (74)**.

Communication Protocol

The I²C protocol is either sending or receiving 9 bytes of data plus a checksum. The first 9 bytes are reserved for values, usually 1, 2 or 4 bytes are used for setting or read a value. During a write operation a command byte is also sent, which gives a total of 11 bytes, see example.

The checksum is calculated like this: **256 – mod(byte 1 + byte 2 + ... + byte 9)** Another way of describing it is: All bytes including the checksum should add up to zero if you use an **unsigned 8-bit integer** and let it roll-over. This means that checking is easy, just add all the numbers and check if they add to zero.

Write Operation

Master: I2C write address + 11 bytes. The 11 bytes consist of Command Number (1 byte) and Data (10 bytes including checksum)

[I2C address + Write], [Command], [Data 1], [Data 2], [...], [Data 10]

Arduino example:

```
// Set user frequency to maximum
uint8_t bytesToSend[] = {29,255,3,0,0,0,0,0,0,0,225};

Wire.begin();
Wire.setClock(100000);
Wire.beginTransmission(0x4A);           // Begin transmission (address: 0x4A)
Wire.write(bytesToSend,11);             // Write the bytes
Wire.endTransmission();                 // End transmission
```

Raspberry Pi example using C++ and bcm2835.h:

```
// Set user frequency to maximum
uint8_t bytesToSend[] = {29,255,3,0,0,0,0,0,0,0,225};

bcm2835_i2c_begin();                    //Start I2C operations.
bcm2835_i2c_setSlaveAddress(0x4A);      //I2C address
bcm2835_i2c_set_baudrate(100000);       //baud rate

bcm2835_i2c_write((char*)bytesToSend,11); // Write the bytes

bcm2835_i2c_end();                      // End transmission
bcm2835_close();
```

Read Operation

Master: I2C write address + 1 byte (Command Number).

[I2C address + Write], [Command]

Master: I2C read address

[I2C address + Read]

Slave: 10 bytes of data including checksum.

[Data 1], [Data 2], [...], [Data 10]

V100 BLACK INTELLIGENT PUMPS

Serial Interface

Arduino example:

```
// Get user frequency

uint8_t bytesToReceive[10];
uint8_t command = 29;

Wire.begin();
Wire.setClock(100000);

Wire.beginTransmission(0x4A);           // Begin transmission (address: 0x4A)
Wire.write(&command,1);                 // Write the command byte
Wire.endTransmission();                 // End transmission

Wire.beginTransmission(0x4A);           // Begin transmission (address: 0x4A)
Wire.requestFrom(0x4A, 10);             // Request 10 bytes of data

uint8_t counter = 0;

while(Wire.available() || counter < 10) // While bytes available, read bytes
{
    bytesToReceive[counter] = Wire.read(); // Read byte
    counter++;
}

Wire.endTransmission();                 // End transmission
```

Raspberry Pi example using C++ and bcm2835.h:

```
// Get user frequency

uint8_t bytesToReceive[10];
uint8_t command[1] = {29};

bcm2835_i2c_begin();                   //Start I2C operations.
bcm2835_i2c_setSlaveAddress(0x4A);     //I2C address
bcm2835_i2c_set_baudrate(100000);     //baud rate

bcm2835_i2c_write((char*)command,1);   // Write the command byte
bcm2835_i2c_read(bytesToReceive,10);   // Read 10 bytes

bcm2835_i2c_end();                     // End transmission
bcm2835_close();
```

Commands

Commands can generally be temporary settings or stored. To store a setting add **64 (0x40)** to the command number while writing the command. Do not use the respective store command for frequent changes. Excessive use of storing values will eventually corrupt the flash memory.

Control Method

Command number: **28** (store: 92)

Value: **0** – Digital frequency control, **2** – Analog frequency control (default)

User Frequency (Control Method needs to be set to 0 first)

Command number: **29** (store: 93)

Value: **0-1023** (10 bits). 2 bytes are needed, LSB to MSB. Max value (1023) corresponds to calibrated value. 1 corresponds to lowest possible setting and 0 will turn the pump off. Default value is 1023.

V100 BLACK INTELLIGENT PUMPS

Pump Parameters

The table below contains general parameters and model specific supply current data.

Flow media	Air and other gasses (Ask for compatibility)			
Wetted parts	EPDM and PPS (other materials on request) ¹			
	Min.	Typ.	Max.	Unit
Permissible ambient temperature ²	0	-	55	°C
Permissible medium temperature ²	0	-	55	°C
Supply voltage	3.3	Cal V ³	Cal V ³ + 0.5	V
I ² C Logic Levels	-	2.8	3.3	V
I ² C Speed Grade	-	100	400	kbit/s
V100-5V				
Average supply current (at max. free flow)	-	70	-	mA
Average supply current (at max. vacuum)	-	190	-	mA
Peak Supply Current		625		
Peak Back EMF Current	-	-550	-	mA
Peak Back EMF Current (with recommended capacitor)	-	-270	-	mA
V100-12V				
Average supply current (at max. free flow)	-	40	-	mA
Average supply current (at max. vacuum)	-	65	-	mA
Peak supply current	-	880	-	mA
Peak Back EMF Current	-	-1200	-	mA
Peak Back EMF Current (with recommended capacitor)	-	-380	-	mA

¹ Other materials can affect the performance, ask for information

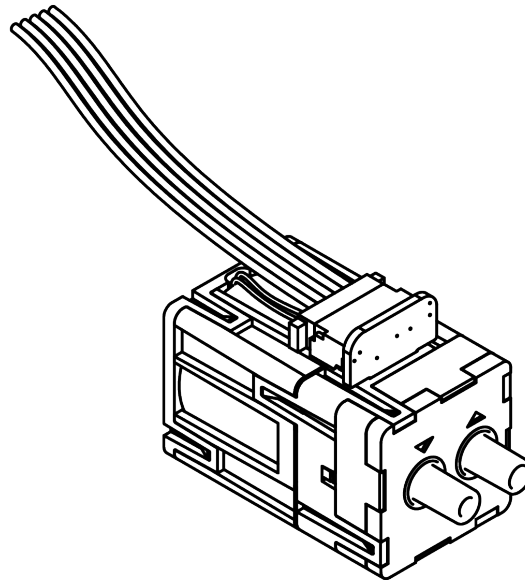
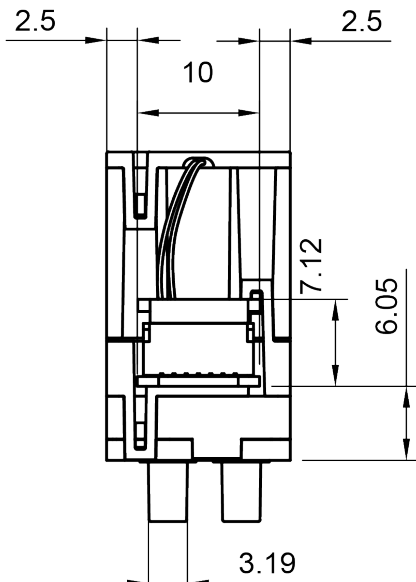
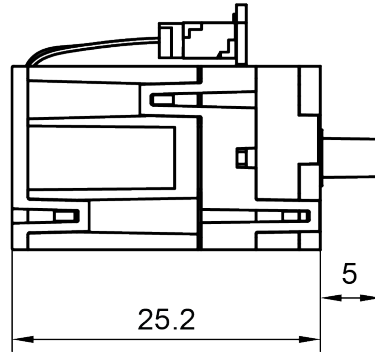
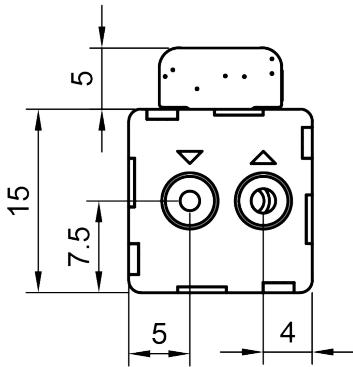
² Extended temperature range can be approved

³ Calibrated Voltage

V100 BLACK INTELLIGENT PUMPS

Drawings

BLACK EDITION V100 WITH 5 WIRE CONNECTION



PUMP MODEL	V100 BLACK EDITION
Connection	5 wires with connector
Drawing Scale	2:1
Dimension Tolerance	±0.2 mm
Pump Weight	18 ±1 g
Recommended Connectors	MOLEX 530470510 (Picoblade)
Recommended Tube Inner Diameter	1.6 - 2.8 mm (Material dependent)

This information is accurate and reliable. However, specifications mentioned in this publication are subject to change without notice. This publication supersedes and replaces all information previously supplied. Xavitech products are not authorized for use as critical components in life support devices or systems without express written approval of Xavitech.

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