EZO-PMP™

Embedded Dosing Pump

Flow rate  
0.5ml to 105ml/min

Accuracy  
+/- 1%

Viscosity  
0.1 – 2,000 cP

Modes of operation  
Continuous dispensing
Volume dispensing
Constant flow rate
Dose over time mode

Connector  
5 lead data cable

Calibration  
Single point

Tubing size  
Any 5mm O.D. tubing

Data protocol  
UART & I²C

Default I²C address  
103 (0x67)

Operating voltage  
3.3V – 5V (logic)
12V – 24V (motor)

Pump head  
2 meters

Data format  
ASCII

Written by Jordan Press  
Designed by Noah Press

This is an evolving document, check back for updates.
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**Power consumption**

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<th>LED STANDBY</th>
<th>LED SLEEP</th>
</tr>
</thead>
<tbody>
<tr>
<td>5V</td>
<td>13.7 mA</td>
<td>13.4 mA</td>
<td>0.415 mA</td>
</tr>
<tr>
<td></td>
<td>13.1 mA</td>
<td>12.8 mA</td>
<td></td>
</tr>
<tr>
<td>3.3V</td>
<td>12.5 mA</td>
<td>12.4 mA</td>
<td>0.13 mA</td>
</tr>
<tr>
<td></td>
<td>12.3 mA</td>
<td>12.2 mA</td>
<td></td>
</tr>
<tr>
<td>Motor</td>
<td>12V = ~400mA</td>
<td>24V = ~200mA</td>
<td></td>
</tr>
</tbody>
</table>

**Absolute max ratings**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>MIN</th>
<th>TYP</th>
<th>MAX</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage temperature (EZO-PMP™)</td>
<td>-65 °C</td>
<td>125 °C</td>
<td></td>
</tr>
<tr>
<td>Operational temperature (EZO-PMP™)</td>
<td>-40 °C</td>
<td>25 °C</td>
<td>85 °C</td>
</tr>
<tr>
<td>VCC</td>
<td>3.3V</td>
<td>5V</td>
<td>5.5V</td>
</tr>
<tr>
<td>Motor</td>
<td>10.8V</td>
<td>12V</td>
<td>24V</td>
</tr>
<tr>
<td>Max input / output pressure</td>
<td></td>
<td></td>
<td>80 kPa</td>
</tr>
<tr>
<td>Tubing life span</td>
<td>+1,000 hrs.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cassette life span</td>
<td></td>
<td></td>
<td>1,500 hrs.</td>
</tr>
</tbody>
</table>

**EZo-PMP™ dimensions**

- **Power consumption:**
  - LED MAX STANDBY SLEEP
    - LED ON 13.7 mA 13.4 mA 0.415 mA
    - LED OFF 13.1 mA 12.8 mA
    - Motor 12V = ~400mA 24V = ~200mA

- **Absolute max ratings:**
  - Storage temperature (EZO-PMP™): -65 °C to 125 °C
  - Operational temperature (EZO-PMP™): -40 °C to 85 °C
  - VCC: 3.3V to 5.5V
  - Motor: 10.8V to 24V
  - Max input / output pressure: 80 kPa
  - Tubing life span: +1,000 hrs.
  - Cassette life span: 1,500 hrs.

**EZo-PMP™ dimensions:**

- **Side:** 26mm x 85.75mm
- **Front:** 37.5mm x 3.3mm
- **Back:** 3.3mm x 48mm
- **Mounting screw:** 1/4" x 0.211" #1 Drive, 0.112" #4-40 thread
- **Inline tubing connectors:** 0.086" x 1/2", 3/32" x 8mm
- **Dimensions:**
  - Side: 26mm x 85.75mm
  - Front: 37.5mm x 3.3mm
  - Back: 3.3mm x 48mm

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**EZO-PMP™ tubing**

**Tan tubing**
Saint-Gobain™ PharMed™ BPT tubing
- Length: 15.24cm
- Outer diameter: 5mm
- Inner diameter: 3mm

This tubing is highly chemically resistant and has 30X more resistant to mechanical wear than silicone tubing.

**Inline tubing connectors**
HDPE
- Length: 2.54cm
- Outer diameter: 8mm
- Inner diameter: 2.8mm

**Blue tubing**
Silicone
- Length: 2x 30.48cm
- Outer diameter: 5mm
- Inner diameter: 3mm
- Bend radius: 15mm
- Temperature: -67°C to 200°C
- Max pressure: 69 kPa (10 PSI)

**Food safe**
Operating principle

- Self-priming
- Run dry

Operating modes

The EZO-PMP™ can operate in four different modes.

**Continuous dispensing**
Run the pump continuously
105 ml/min ∞ (with supplied tubing)

**Volume dispensing**
Pump a specific volume
(Smallest possible volume is 0.5 ml)

**Constant flow rate**
Pump a specific volume per minute

**Dose over time mode**
Pump a specific volume over a set time

Volume is always in ml.
This device requires two power supplies
3.3V–5.5V for the control system
12V–24V to drive the motor

The Atlas Scientific EZO-PMP™ consists of three main components.

Cassette

12 volt motor

Control system

The actual peristaltic pumping is done within the cassette. It has been designed to be easily detached from the motor and disassembled.

The 12 volt motor and control system have been soldered together. Both components are designed to operate as one single unit.

The control system has three main components
Keyed data and power connector
12–24 volt power input
Status indicator LED

Data and power cable pinout

<table>
<thead>
<tr>
<th>Color</th>
<th>Pin</th>
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</thead>
<tbody>
<tr>
<td>White</td>
<td>RX/SCL</td>
</tr>
<tr>
<td>Green</td>
<td>TX/SDA</td>
</tr>
<tr>
<td>Black</td>
<td>GND</td>
</tr>
<tr>
<td>Red</td>
<td>VCC</td>
</tr>
<tr>
<td>Blue</td>
<td>INT</td>
</tr>
</tbody>
</table>
**Pump speed vs. voltage**

There is no change in pump speed at different voltages.

![Voltmeter](image)

**Interrupt pin**

When the pump is dispensing the interrupt pin goes high.

![Interrupt Pin](image)

**Removing cassette**

1. Turn cassette counterclockwise until it stops.
2. Pull cassette off the motor.
Removing tube assembly

The inner workings of the cassette are fragile and must be dismantled by hand. Using tools can damage or break the cassette.

1. Gently push down the tube holder until it clicks, then remove.
2. Turn the cassette around, and carefully remove rotor and pump tube.

Installing new tube assembly

1. Measure 75mm of pump tubing, and mark both ends with a soft-tip pen or marker.

2. Apply silicone lubricating grease to the marked areas on both the tubing and cassette axle.

Do not operate this device without lubrication!

Atlas Scientific recommends using Super Lube silicone lubricating grease.
Push the tube holder along with the greased and marked pump tube into the cassette until it clicks.

Gently pull out the pump tube, and insert the rotor into the pump tube. Align pump tube and rotor with the cassette axle.

Cassette axle

Make sure the pump tube is held between the roller and cassette.

Correct  X Incorrect

Once the tubing has been replaced, run the pump for 3–5 minutes to break in the new tubing. Remember, this pump can be run dry and does not need to pump liquid for the 3–5 minute break in period.
Calibration theory

Before calibration is attempted all the air bubbles should be removed from the tubing. This is done by running the pump while tapping the tubing. If air bubbles are not removed from the tubing they will slowly group together into larger air bubbles. Over time this will lead to accuracy issues.

Calibration types

Volume calibration
Volume over time calibration

Calibration is optional. Both types of calibration are independent of each other and can be done at any time. Calibration can be done at any volume however; Atlas Scientific recommends using volumes above 5ml.

Equipment needed for calibration

An accurate graduated cylinder of at least 10ml. Or An accurate scale with a resolution of at least 0.1 grams

1 gram of water = 1ml
23.56 grams of water = 23.56ml
Calibration procedure

Calibration should be done with water and not a chemical

Make sure the tubing is full of water and has no bubbles before calibrating.
1. Instruct the pump to dispense a volume of water.
2. Measure the dispensed amount to determine how much water was actually dispensed.
3. Calibrate the pump by sending it the volume of liquid you have measured.

Example
Calibrate the pump by dispensing 10ml

1. Instruct the pump to dispense 10ml into a graduated cylinder or beaker on a scale.
2. Measure the amount of liquid that was actually dispensed.
3. Inform the pump how much liquid was actually dispensed.
4. Calibration is now complete.

Once the pump has been calibrated it will accurately dispense any volume of liquid. It has not been calibrated specifically to the volume used during the calibration procedure (10 ml). It has now been calibrated to all volumes.

Use the same procedure to perform a volume over time calibration.
Accuracy

Uncalibrated accuracy +/- 5%
Calibrated accuracy +/- 1%

Volume dispensing mode
calibrated at 10ml

Dose over time mode
calibrated at 10ml over 90 seconds
Viscosity

The EZO-PMP™ is capable of pumping liquids within a viscosity range of 0.1 – 2,000 cP.

Dispense accuracy

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<th>Maple Syrup</th>
<th>Honey</th>
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</thead>
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<tr>
<td>0.1 – 200 cP</td>
<td>Accurate</td>
<td>Mostly accurate</td>
<td>Inaccurate</td>
</tr>
<tr>
<td>200 – 2,000 cP</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2,000 – 25,000 cP</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Pump head

Pump head refers to the maximum vertical height a pump can dispense. The EZO-PMP™ has a pump head of 2 meters (6.5’).
Default state

UART mode

Baud
9,600

Readings
continuous

Speed
1 reading per second

LED
on

1,000 ms

Green
Standby

Cyan
Taking reading

Transmitting
Available data protocols

UART

I²C

Unavailable data protocols

SPI
Analog
RS-485
Mod Bus
4–20mA
UART mode

**Settings that are retained if power is cut**
- Baud rate
- Calibration
- Continuous mode
- Device name
- Enable/disable parameters
- Enable/disable response codes
- Hardware switch to I²C mode
- LED control
- Protocol lock
- Software switch to I²C mode

**Settings that are NOT retained if power is cut**
- Find
- Sleep mode
UART mode

8 data bits  no parity
1 stop bit  no flow control

<table>
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<th>Baud</th>
<th>300</th>
<th>1,200</th>
<th>2,400</th>
<th>9,600 default</th>
<th>19,200</th>
<th>38,400</th>
<th>57,600</th>
<th>115,200</th>
</tr>
</thead>
</table>

RX
Data in

TX
Data out

Vcc
3.3V – 5.5V

Output volume
Units ml
Encoding ASCII
Format string

Terminator carriage return
Data type floating point
Decimal places 3
Smallest string 3 characters
Largest string 39 characters
Receiving data from device

2 parts

ASCII data string
Command

Carriage return <cr>
Terminator

9,600 baud (default)

Advanced

ASCII: 4 1 3 <cr>
Hex: 34 31 33 0D
Dec: 52 49 51 13
Sending commands to device

2 parts

Command (not case sensitive)

ASCII data string

Carriage return <cr>

Terminator

Advanced

ASCII: S l e e p <cr>

Hex: 53 6C 65 65 0D

Dec: 83 108 101 112 13
LED color definition

Green
UART standby

Cyan
Taking reading

Purple
Changing baud rate

Red
Command not understood

White
Find

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<th>LED ON</th>
<th>Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>5V</td>
<td>+2.5 mA</td>
<td></td>
</tr>
<tr>
<td>3.3V</td>
<td>+1 mA</td>
<td></td>
</tr>
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</table>
# UART mode

## command quick reference

All commands are ASCII strings or single ASCII characters.

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<th>Default state</th>
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<td>C</td>
<td>enable/disable continuous mode</td>
<td>pg. 24</td>
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<td>Cal</td>
<td>performs calibration</td>
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<td>finds device with blinking white LED</td>
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<td>i</td>
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<td>Name</td>
<td>set/show name of device</td>
<td>pg. 36</td>
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<td>O</td>
<td>enable/disable parameters</td>
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<tr>
<td>P</td>
<td>pause dispensing</td>
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<td>enable/disable protocol lock</td>
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<td>retrieve status information</td>
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<tr>
<td>Tv</td>
<td>total volume dispensed</td>
<td>pg. 32</td>
</tr>
<tr>
<td>X</td>
<td>stop dispensing</td>
<td>pg. 31</td>
</tr>
<tr>
<td>*OK</td>
<td>enable/disable response codes</td>
<td>pg. 38</td>
</tr>
</tbody>
</table>
## LED control

### Command syntax

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<thead>
<tr>
<th>Command</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>L,1</td>
<td>LED on (default)</td>
<td>L,1 &lt;cr&gt;</td>
</tr>
<tr>
<td>L,0</td>
<td>LED off</td>
<td>L,0 &lt;cr&gt;</td>
</tr>
<tr>
<td>L,?</td>
<td>LED state on/off?</td>
<td>L,? &lt;cr&gt;</td>
</tr>
</tbody>
</table>

### Example Response

<table>
<thead>
<tr>
<th>Command</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>L,1 &lt;cr&gt;</td>
<td>*OK &lt;cr&gt;</td>
</tr>
<tr>
<td>L,0 &lt;cr&gt;</td>
<td>*OK &lt;cr&gt;</td>
</tr>
<tr>
<td>L,? &lt;cr&gt;</td>
<td>?L,1 &lt;cr&gt; or ?L,0 &lt;cr&gt;</td>
</tr>
</tbody>
</table>
Find

Command syntax

This command will disable continuous mode
Send any character or command to terminate find.

Find  <cr>  LED rapidly blinks white, used to help find device

Example          Response

Find  <cr>          *OK  <cr>

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# Continuous mode

**Command syntax**

- **C,* <cr>** continuously reports volume once per second  **default**
- **C,1 <cr>** continuously reports volume only when pumping
- **C,0 <cr>** disable continuous reporting
- **C,? <cr>** continuous reporting mode on/off?

**Example**

<table>
<thead>
<tr>
<th>Command</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>dispense 3ml</td>
<td></td>
</tr>
<tr>
<td>C,* &lt;cr&gt;</td>
<td>1.2 &lt;cr&gt;</td>
</tr>
<tr>
<td></td>
<td>3.0 &lt;cr&gt;</td>
</tr>
<tr>
<td></td>
<td>*Done,3.00 &lt;cr&gt;</td>
</tr>
<tr>
<td></td>
<td>3.0 &lt;cr&gt;</td>
</tr>
<tr>
<td></td>
<td>3.0 &lt;cr&gt;</td>
</tr>
<tr>
<td><strong>C,1 &lt;cr&gt;</strong></td>
<td>1.2 &lt;cr&gt;</td>
</tr>
<tr>
<td></td>
<td>3.0 &lt;cr&gt;</td>
</tr>
<tr>
<td></td>
<td>*Done,3.00 &lt;cr&gt;</td>
</tr>
<tr>
<td><strong>C,0 &lt;cr&gt;</strong></td>
<td>*Done,3.00 &lt;cr&gt;</td>
</tr>
<tr>
<td><strong>C,? &lt;cr&gt;</strong></td>
<td>?C,1 &lt;cr&gt; or ?C,0 &lt;cr&gt; or ?C,* &lt;cr&gt;</td>
</tr>
<tr>
<td></td>
<td>*OK &lt;cr&gt;</td>
</tr>
</tbody>
</table>
## Single reading mode

### Command syntax

\[ R \ (\text{cr}) \] returns a single value showing dispensed volume

<table>
<thead>
<tr>
<th>Example</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>R (\text{cr})</td>
<td>2.50 (\text{cr}) (If issued half way through dispensing 5ml) *OK (\text{cr})</td>
</tr>
<tr>
<td></td>
<td>5.00 (\text{cr}) (If issued once dispensing has stopped) *OK (\text{cr})</td>
</tr>
</tbody>
</table>
Continuous dispensing
Pump on/pump off

Command syntax

After running in continuous mode for 20 days the EZO-PMP™ will reset.

D,* <cr> dispense until the stop command is given
D,-* <cr> dispense in reverse until the stop command is given
D,? <cr> dispense status

Example

<table>
<thead>
<tr>
<th>Command</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>D,* &lt;cr&gt;</td>
<td>*OK &lt;cr&gt; pump will continuously run at ~105ml/min (with supplied tubing)</td>
</tr>
<tr>
<td>D,-* &lt;cr&gt;</td>
<td>*OK &lt;cr&gt; pump will continuously run in reverse at ~105ml/min (with supplied tubing)</td>
</tr>
<tr>
<td>D,? &lt;cr&gt;</td>
<td>?D,*,1 &lt;cr&gt; *OK &lt;cr&gt;</td>
</tr>
</tbody>
</table>

Response breakdown

?D,*,1

last volume requested
pump on
Volume dispensing

Pump a specific volume

Command syntax

where [ml] is any volume in millimeters >= 0.5

D,[ml] <cr> dispense [this specific volume]
D,[-ml] <cr> dispense [in reverse this specific volume]
D,? <cr> dispense status

Example

<table>
<thead>
<tr>
<th>Example</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>D,15 &lt;cr&gt;</td>
<td>*OK &lt;cr&gt; 15 ml will be dispensed</td>
</tr>
<tr>
<td>D,-405 &lt;cr&gt;</td>
<td>*OK &lt;cr&gt; 405 ml will be dispensed in reverse</td>
</tr>
<tr>
<td>D,? &lt;cr&gt;</td>
<td>?D,22.50,0 &lt;cr&gt;</td>
</tr>
<tr>
<td></td>
<td>*OK &lt;cr&gt;</td>
</tr>
</tbody>
</table>

Response breakdown

?D,22.50,0

↑ last volume dispensed
↑ pump off

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Dose over time
Pump a fixed volume over a fixed time

Command syntax

\[D_{[\text{ml}],[\text{min}] < \text{cr}> \text{ Dispense [this volume], [over this many minutes]}\]

Example  

\[D_{85,10} < \text{cr}>\]

Response  

*OK \[< \text{cr}>\] Dispense 85ml over 10 minutes
# Constant flow rate

Maintain a constant flow rate

## Command syntax

```
DC,[ml/min],[min or *] <cr>  [maintain this rate],[for this much time]
DC,? <cr>  reports maximum possible flow rate
```

- `[ml/min]` = a single number (int or float) representing the desired flow rate
- `[min or *]` = the number of minutes to run or (*) indefinitely
- A negative value for ml/min = reverse

## Example

<table>
<thead>
<tr>
<th>Example</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC,25,40</td>
<td>*OK &lt;cr&gt;  Dispense 25ml per minute for 40 minutes</td>
</tr>
<tr>
<td>DC,?</td>
<td>?MAXRATE,58.5 &lt;cr&gt; *OK &lt;cr&gt;</td>
</tr>
</tbody>
</table>

The maximum flow rate is determined after calibration. If the flowrate entered is too fast the EZO-PMP™ will send an error.

- *TOOFAST <cr>
- *ER <cr>

---

After running in continuous mode for 20 days the EZO-PMP™ will reset.
Pause dispensing

Command syntax

P <cr>  
pauses the pump during dispensing

P,? <cr>  
pause status

Example

<table>
<thead>
<tr>
<th>Command</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>P &lt;cr&gt;</td>
<td>*OK &lt;cr&gt;</td>
</tr>
</tbody>
</table>
| P,? <cr>| ?P,1 <cr> or ?P,0 <cr>  
  paused  
  unpaused  
  *OK <cr> |

Dispensing

Paused

Dispensing
## Stop dispensing

### Command syntax

\[ X \langle cr\rangle \text{ stop dispensing} \]

### Example

<table>
<thead>
<tr>
<th>( X \langle cr\rangle )</th>
<th>( *\text{DONE},v \langle cr\rangle )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( v ) = volume dispensed</td>
<td></td>
</tr>
</tbody>
</table>

### Response

- Dispensing
- Stopped

![Diagram](image)

Example:

```
X <cr>  
*DONE, v <cr>  
v = volume dispensed

dispensing

STOPPED
```

Copyright © Atlas Scientific LLC
## Total volume dispensed

### Command syntax

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TV,? &lt;cr&gt;</td>
<td>shows total volume dispensed</td>
</tr>
<tr>
<td>ATV,? &lt;cr&gt;</td>
<td>absolute value of the total volume dispensed</td>
</tr>
<tr>
<td>Clear &lt;cr&gt;</td>
<td>clears the total dispensed volume</td>
</tr>
</tbody>
</table>

### Example

<table>
<thead>
<tr>
<th>Example</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>TV,? &lt;cr&gt;</td>
<td>?total,434.50 &lt;cr&gt;</td>
</tr>
<tr>
<td>ATV,? &lt;cr&gt;</td>
<td>?total,623.00 &lt;cr&gt;</td>
</tr>
<tr>
<td>Clear &lt;cr&gt;</td>
<td>*OK &lt;cr&gt;  total now 0.00</td>
</tr>
</tbody>
</table>
## Calibration

**Command syntax**

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cal,v</td>
<td>v = corrected volume</td>
</tr>
<tr>
<td>Cal,clear</td>
<td>delete all calibration data</td>
</tr>
<tr>
<td>Cal,?</td>
<td>device calibrated?</td>
</tr>
</tbody>
</table>

This command is used for both, single dose and dose over time calibrations.

### Example Response

<table>
<thead>
<tr>
<th>Command</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cal,24.01</td>
<td>*OK &lt;cr&gt;</td>
</tr>
<tr>
<td>Cal,clear</td>
<td>*OK &lt;cr&gt;</td>
</tr>
<tr>
<td>Cal,?</td>
<td>?Cal,1 &lt;cr&gt; or ?Cal,2 &lt;cr&gt; or ?Cal,3 &lt;cr&gt; or</td>
</tr>
<tr>
<td></td>
<td>?Cal,0 &lt;cr&gt; fixed volume</td>
</tr>
<tr>
<td></td>
<td>volume/time fixed volume/time</td>
</tr>
<tr>
<td></td>
<td>both uncalibrated</td>
</tr>
<tr>
<td></td>
<td>*OK &lt;cr&gt;</td>
</tr>
</tbody>
</table>
Enable/disable parameters from output string

**Command syntax**

<table>
<thead>
<tr>
<th>Command Syntax</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>O, [parameter],[1,0] &lt;cr&gt;</td>
<td>enable or disable output parameter</td>
</tr>
<tr>
<td>O,? &lt;cr&gt;</td>
<td>enabled parameter?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Example</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>O,V,1 &lt;cr&gt;</td>
<td>*OK &lt;cr&gt; enable volume being pumped</td>
</tr>
<tr>
<td>O,TV,0 &lt;cr&gt;</td>
<td>*OK &lt;cr&gt; disable total volume pumped</td>
</tr>
<tr>
<td>O,ATV,1 &lt;cr&gt;</td>
<td>*OK &lt;cr&gt; enable absolute volume pumped</td>
</tr>
<tr>
<td>O,? &lt;cr&gt;</td>
<td>?,O,V,TV,ATV &lt;cr&gt; if all three are enabled</td>
</tr>
</tbody>
</table>
## Pump voltage

### Command syntax

<table>
<thead>
<tr>
<th>Command syntax</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PV,? &lt;cr&gt;</td>
<td>check pump voltage</td>
</tr>
</tbody>
</table>

### Example

<table>
<thead>
<tr>
<th>Command</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>PV,? &lt;cr&gt;</td>
<td>?PV,13.86 &lt;cr&gt; *OK &lt;cr&gt;</td>
</tr>
</tbody>
</table>

### Response breakdown

<table>
<thead>
<tr>
<th>Command</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>?PV, 13.86</td>
<td>Pump input voltage</td>
</tr>
</tbody>
</table>

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Naming device

Command syntax

Name,n <cr> set name
Name,? <cr> show name

n = 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

Up to 16 ASCII characters

Example

<table>
<thead>
<tr>
<th>Command</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name,zzt</td>
<td>*OK &lt;cr&gt;</td>
</tr>
<tr>
<td>Name,?</td>
<td>?Name,zzt &lt;cr&gt;</td>
</tr>
<tr>
<td></td>
<td>*OK &lt;cr&gt;</td>
</tr>
</tbody>
</table>

Example Response

*OK <cr>
Name,zzt <cr>
*OK <cr>
# Device Information

## Command Syntax

```
i <cr> device information
```

<table>
<thead>
<tr>
<th>Example</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>i &lt;cr&gt;</code></td>
<td><code>?i,PMP,1.1 &lt;cr&gt;</code></td>
</tr>
<tr>
<td></td>
<td><code>*OK &lt;cr&gt;</code></td>
</tr>
</tbody>
</table>

## Response Breakdown

```
?i, PMP, 1.1
```

↑
Device  Firmware
### Response codes

#### Command syntax

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>*OK,1 &lt;cr&gt;</td>
<td>enable response</td>
</tr>
<tr>
<td>*OK,0 &lt;cr&gt;</td>
<td>disable response</td>
</tr>
<tr>
<td>*OK,? &lt;cr&gt;</td>
<td>response on/off?</td>
</tr>
</tbody>
</table>

**Example**

<table>
<thead>
<tr>
<th>Command</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>R &lt;cr&gt;</td>
<td>413 &lt;cr&gt;</td>
</tr>
<tr>
<td></td>
<td>*OK &lt;cr&gt;</td>
</tr>
</tbody>
</table>

**Response**

<table>
<thead>
<tr>
<th>Command</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>*OK,0</td>
<td>no response, *OK disabled</td>
</tr>
<tr>
<td>R &lt;cr&gt;</td>
<td>413 &lt;cr&gt; *OK disabled</td>
</tr>
<tr>
<td>*OK,?</td>
<td>*OK,1 &lt;cr&gt; or *OK,0 &lt;cr&gt;</td>
</tr>
</tbody>
</table>

#### Other response codes

- **ER** unknown command
- **OV** over volt (VCC>=5.5V)
- **UV** under volt (VCC<=3.1V)
- **RS** reset
- **RE** boot up complete, ready
- **SL** entering sleep mode
- **WA** wake up
- **DONE** dispensing complete
- **MINVOL** dispense amount too low
- **TOOFAST** ml/min set to fast

These response codes cannot be disabled
# Reading device status

## Command syntax

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>Status &lt;cr&gt;</code></td>
<td>Voltage at Vcc pin and reason for last restart</td>
</tr>
</tbody>
</table>

## Example

<table>
<thead>
<tr>
<th>Command</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>Status &lt;cr&gt;</code></td>
<td><code>?Status,P,5.038 &lt;cr&gt;</code></td>
</tr>
<tr>
<td></td>
<td><code>*OK &lt;cr&gt;</code></td>
</tr>
</tbody>
</table>

## Response breakdown

<table>
<thead>
<tr>
<th>Command</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>?Status,</code></td>
<td>P,</td>
</tr>
<tr>
<td><code>5.038</code></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Reason for restart</th>
<th>Voltage at Vcc</th>
</tr>
</thead>
<tbody>
<tr>
<td>P</td>
<td>powered off</td>
</tr>
<tr>
<td>S</td>
<td>software reset</td>
</tr>
<tr>
<td>B</td>
<td>brown out</td>
</tr>
<tr>
<td>W</td>
<td>watchdog</td>
</tr>
<tr>
<td>U</td>
<td>unknown</td>
</tr>
</tbody>
</table>

## Restart codes

- P: powered off
- S: software reset
- B: brown out
- W: watchdog
- U: unknown
Sleep mode/low power

Command syntax

Sleep <cr> enter sleep mode/low power

Example

<table>
<thead>
<tr>
<th>Command</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sleep &lt;cr&gt;</td>
<td>*OK &lt;cr&gt;</td>
</tr>
<tr>
<td>Any command</td>
<td>*WA &lt;cr&gt; wakes up device</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Voltage</th>
<th>STANDBY (mA)</th>
<th>SLEEP (mA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5V</td>
<td>13.4 mA</td>
<td>0.415 mA</td>
</tr>
<tr>
<td>3.3V</td>
<td>12.4 mA</td>
<td>0.13 mA</td>
</tr>
</tbody>
</table>

Sleep <cr> wakes the device up.

Example Response

Sleep 0.415 mA
# Change baud rate

**Command syntax**

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baud,n &lt;cr&gt;</td>
<td>change baud rate</td>
</tr>
</tbody>
</table>

## Example

<table>
<thead>
<tr>
<th>Command</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baud,38400 &lt;cr&gt;</td>
<td>*OK &lt;cr&gt;</td>
</tr>
</tbody>
</table>
| Baud,? <cr> | ?Baud,38400  
*OK <cr> |

## n =

- 300
- 1200
- 2400
- **9600** default
- 19200
- 38400
- 57600
- 115200

---

**Change baud rate**

- **Standby**
  - Baud,38400 <cr>
    - Changing baud rate
    - *OK <cr>
  - (reboot)
  - **Standby**
## Protocol lock

### Command syntax

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plock,1</td>
<td>enable Plock</td>
</tr>
<tr>
<td>Plock,0</td>
<td>disable Plock (default)</td>
</tr>
<tr>
<td>Plock,?</td>
<td>Plock on/off?</td>
</tr>
</tbody>
</table>

### Example

#### Response

<table>
<thead>
<tr>
<th>Command</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plock,1</td>
<td>*OK &lt;cr&gt;</td>
</tr>
<tr>
<td>Plock,0</td>
<td>*OK &lt;cr&gt;</td>
</tr>
<tr>
<td>Plock,?</td>
<td>?Plock,1 &lt;cr&gt; or ?Plock,0 &lt;cr&gt;</td>
</tr>
</tbody>
</table>

### Example Response

- **Plock,1**:
  - *OK <cr>

- **Plock,0**:?
  - *OK <cr>

- **Plock,?**:
  - ?Plock,1 <cr> or ?Plock,0 <cr>

- **I2C,100**:
  - cannot change to I²C
  - *ER <cr>
Factory reset

Command syntax

Factory `<cr>` enable factory reset

Example

```
Factory `<cr>`
```

Response

```
*OK `<cr>`
```

```
Factory `<cr>`
```

(reboot)

```
*OK `<cr>`
```

Baud rate will not change

*RS `<cr>`
*RE `<cr>`
Change to I²C mode

Command syntax

\[ I²C, n <\text{cr}> \] sets I²C address and reboots into I²C mode

\[ n = \text{any number 1 – 127} \]

Default I²C address 103 (0x67)

Example

| I²C,100 <cr> | *OK (reboot in I²C mode) |

Wrong example

| I²C,139 <cr> | n \( \neq \) 127 | *ER <cr> |

I²C,100

(reboot)

Green

*OK <cr>

Blue

now in I²C mode
Manual switching to I²C

- Make sure Plock is set to 0
- Disconnect ground (power off)
- Disconnect TX and RX
- Connect TX to INT
- Confirm RX is disconnected
- Connect ground (power on)
- Wait for LED to change from Green to Blue
- Disconnect ground (power off)
- Reconnect all data and power

Manually switching to I²C will set the I²C address to 103 (0x67)

Example

Wrong Example

Disconnect RX line
I²C mode

The I²C protocol is considerably more complex than the UART (RS–232) protocol. Atlas Scientific assumes the embedded systems engineer understands this protocol.

To set your EZO-PMP™ into I²C mode click here

Settings that are retained if power is cut
- Calibration
- Change I²C address
- Enable/disable parameters
- Hardware switch to UART mode
- LED control
- Protocol lock
- Software switch to UART mode

Settings that are NOT retained if power is cut
- Find
- Sleep mode
I²C mode

**I²C address** (0x01 – 0x7F)
- **103 (0x67)** default

**Vcc**  3.3V – 5.5V

**Clock speed**  100 – 400 kHz

**SDA**

**SCL**

Data format

**Reading**  volume
**Units**  ml
**Encoding**  ASCII
**Format**  string

**Data type**  floating point
**Decimal places**  3
**Smallest string**  3 characters
**Largest string**  39 characters
Sending commands to device

5 parts

Start | I2C address | Write | Command (not case sensitive) | Stop

ASCII command string

Example

Start | 103 (0x67) | Write | Sleep | Stop

I2C address | Command

Sending commands to device

Advanced

Address bits

The entire command as ASCII with all arguments

W = low
Requesting data from device

7 parts:
- Start
- I²C address
- Read
- Response code
- Data string
- Null
- Terminator (Dec 0)

Start: 103 (0x67)
Read: 1 byte
Response code: "413"
Data string: Null
Terminator: (Dec 0)

Advanced

413

Address bits
A6 – A0
R
ACK
Response code
ACK
Data
ACK
... Data N
ACK
Null
ACK
... Null
NACK
Stop

SDA
SCL
Start

SDA
SCL
SDA
SCL

R = High

1 52 49 51 0
Dec
= 413

ASCII
Dec
Response codes

After a command has been issued, a 1 byte response code can be read in order to confirm that the command was processed successfully.

*Reading back the response code is completely optional, and is not required for normal operation.*

**Example**

```
I2C_start;
I2C_address;
I2C_write(EZO_command);
I2C_stop;
```

```
delay(300);
```

```
I2C_start;
I2C_address;
Char[] = I2C_read;
I2C_stop;
```

If there is no processing delay or the processing delay is too short, the response code will always be 254.

**Response codes**

- Single byte, not string
- 255: no data to send
- 254: still processing, not ready
- 2: syntax error
- 1: successful request
LED color definition

Blue
I²C standby

Green
Taking reading

Purple
Changing I²C address

Red
Command not understood

White
Find

<table>
<thead>
<tr>
<th>Voltage</th>
<th>LED ON</th>
</tr>
</thead>
<tbody>
<tr>
<td>5V</td>
<td>+2.5 mA</td>
</tr>
<tr>
<td>3.3V</td>
<td>+1 mA</td>
</tr>
</tbody>
</table>
# I²C mode command quick reference

All commands are ASCII strings or single ASCII characters.

<table>
<thead>
<tr>
<th>Command</th>
<th>Function</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baud</td>
<td>switch back to UART mode</td>
<td>72</td>
</tr>
<tr>
<td>Cal</td>
<td>performs calibration</td>
<td>63</td>
</tr>
<tr>
<td>D</td>
<td>dispense modes</td>
<td>56-59</td>
</tr>
<tr>
<td>Factory</td>
<td>enable factory reset</td>
<td>71</td>
</tr>
<tr>
<td>Find</td>
<td>finds device with blinking white LED</td>
<td>54</td>
</tr>
<tr>
<td>i</td>
<td>device information</td>
<td>66</td>
</tr>
<tr>
<td>I2C</td>
<td>change I²C address</td>
<td>70</td>
</tr>
<tr>
<td>L</td>
<td>enable/disable LED</td>
<td>53</td>
</tr>
<tr>
<td>O</td>
<td>enable/disable parameters</td>
<td>64</td>
</tr>
<tr>
<td>P</td>
<td>pauses the pump during dispensing</td>
<td>60</td>
</tr>
<tr>
<td>Plock</td>
<td>enable/disable protocol lock</td>
<td>69</td>
</tr>
<tr>
<td>Pv</td>
<td>check pump voltage</td>
<td>65</td>
</tr>
<tr>
<td>R</td>
<td>returns a single reading</td>
<td>55</td>
</tr>
<tr>
<td>Sleep</td>
<td>enter sleep mode/low power</td>
<td>68</td>
</tr>
<tr>
<td>Status</td>
<td>retrieve status information</td>
<td>67</td>
</tr>
<tr>
<td>Tv</td>
<td>total volume dispensed</td>
<td>62</td>
</tr>
<tr>
<td>X</td>
<td>stop dispensing</td>
<td>61</td>
</tr>
</tbody>
</table>
## LED control

### Command syntax

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>L,1</td>
<td>LED on (default)</td>
</tr>
<tr>
<td>L,0</td>
<td>LED off</td>
</tr>
<tr>
<td>L,?</td>
<td>LED state on/off?</td>
</tr>
</tbody>
</table>

### Example

<table>
<thead>
<tr>
<th>Command</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>L,1</td>
<td><img src="clock.png" alt="" /> 1 0 Dec Null</td>
</tr>
<tr>
<td>L,0</td>
<td><img src="clock.png" alt="" /> 1 0 Dec Null</td>
</tr>
<tr>
<td>L,?</td>
<td><img src="clock.png" alt="" /> 1 ?L,1 0 Dec ASCII Null or <img src="clock.png" alt="" /> 1 ?L,0 0 Dec ASCII Null</td>
</tr>
</tbody>
</table>

300ms processing delay

---

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Find

**Command syntax**

Find LED rapidly blinks white, used to help find device

**Example Response**

This command will disable continuous mode
Send any character or command to terminate find.

**Example**

Find

**Response**

```
300ms
```

Send any character or command to terminate find.

**Wait 300ms**

<table>
<thead>
<tr>
<th>1</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dec</td>
<td>Null</td>
</tr>
</tbody>
</table>

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# Single report mode

## Command syntax

300ms processing delay

R returns a single value showing dispensed volume

<table>
<thead>
<tr>
<th>Example</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>1 Dec 2.50 ASCII 0 Null (If issued half way through dispensing 5ml)</td>
</tr>
<tr>
<td></td>
<td>1 Dec 5.00 ASCII 0 Null (If issued once dispensing has stopped)</td>
</tr>
</tbody>
</table>

**Green**
- Taking reading

**Transmitting**

**Blue**
- Standby
**Continuous dispensing**

**Pump on/pump off**

After running in continuous mode for 20 days the EZO-PMP™ will reset.

**Command syntax**

- **D,*** dispense until the stop command is given
- **D,-*** dispense in reverse until the stop command is given
- **D,?** dispense status

**Example**

<table>
<thead>
<tr>
<th>Command</th>
<th>Response</th>
</tr>
</thead>
</table>
| **D,*** | ![Wait 300ms](image)  
  1 Dec 0 Null  
  pump will continuously run at ~105ml/min (with supplied tubing) |
| **D,-*** | ![Wait 300ms](image)  
  1 Dec 0 Null  
  pump will continuously run in reverse at ~105ml/min (with supplied tubing) |
| **D,?** | ![Wait 300ms](image)  
  1 Dec ?D,10.00,1 0  
  ASCII Null |

**Response breakdown**

- **?D,*;1**  
  last volume requested  
  pump on
Volume dispensing

Pump a specific volume

Command syntax

\[ D, [\text{ml}] \] dispense [this specific volume]

\[ D, [-\text{ml}] \] dispense [in reverse this specific volume]

\[ D, ? \] dispense status

300ms processing delay

where [ml] is any volume in millimeters \( \geq 0.5 \)

Example

<table>
<thead>
<tr>
<th>Command</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ D,15 ]</td>
<td>15 ml will be dispensed</td>
</tr>
<tr>
<td>[ D,-405 ]</td>
<td>405 ml will be dispensed in reverse</td>
</tr>
<tr>
<td>[ D,? ]</td>
<td>?D,22.50,0 ASCII</td>
</tr>
</tbody>
</table>

Response breakdown

?D,22.50,0

last volume dispensed

pump off
Dose over time
Pump a fixed volume over a fixed time

Command syntax

D,[ml],[min]  Dispense [this volume], [over this many minutes]

Example  Response

D,85,10  Wait 300ms  Dec  1  Null  Dispense 85ml over 10 mins
Constant flow rate
Maintain a constant flow rate

300ms processing delay

After running in continuous mode for 20 days the EZO-PMP™ will reset.

Command syntax

DC,[ml/min], [min or *]
[maintain this rate], [for this much time]
DC,?
reports maximum possible flow rate

[ml/min] = a single number (int or float) representing the desired flow rate
[min or *] = the number of minutes to run or (*) indefinitely
A negative value for ml/min = reverse

Example

<table>
<thead>
<tr>
<th>Command</th>
<th>Response</th>
</tr>
</thead>
</table>
| DC,25,40 | Wait 300ms
          | 1 Dec 0 Null |
|          | Dispense 25ml per minute for 40 minutes |
| DC,?     | Wait 300ms
          | 1 Dec ASCII |
|          | ?maxrate,58.5 0 Null |

The maximum flow rate is determined after calibration. If the flowrate entered is too fast the EZO-PMP™ will send an error.

*TOOFAST
*ER

flow rate = 1ml/min

evaporation rate = 1ml/min
Pause dispensing

Command syntax

P  pauses the pump during dispensing
P,?  pause status

Example

<table>
<thead>
<tr>
<th>Command</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>P</td>
<td><img src="image1.png" alt="Image" /></td>
</tr>
<tr>
<td>P,?</td>
<td><img src="image2.png" alt="Image" /></td>
</tr>
</tbody>
</table>

300ms processing delay

Issue the command again to resume dispensing
Stop dispensing

Command syntax

X stop dispensing

Example

| X dispensing | *DONE,10.15 Stopped |

Response

<table>
<thead>
<tr>
<th>Wait 300ms</th>
<th>Dec</th>
<th>*DONE,v</th>
<th>ASCII</th>
<th>Null</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>0</td>
<td></td>
<td>v = volume dispensed</td>
</tr>
</tbody>
</table>

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**Command syntax**

- **TV,** shows total volume dispensed
- **ATV,** absolute value of the total volume dispensed
- **Clear** clears the total dispensed volume

<table>
<thead>
<tr>
<th>Example</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TV,</strong></td>
<td><img src="image" alt="Wait 300ms" /> Dec ASCII</td>
</tr>
<tr>
<td><strong>ATV,</strong></td>
<td><img src="image" alt="Wait 300ms" /> Dec ASCII</td>
</tr>
<tr>
<td><strong>clear</strong></td>
<td><img src="image" alt="Wait 300ms" /> Dec Null</td>
</tr>
</tbody>
</table>
## Calibration

### Command syntax

- **Cal, v**  \( v = \text{corrected volume} \)
- **Cal, clear**  delete calibration data
- **Cal, ?**  device calibrated?

### Example

<table>
<thead>
<tr>
<th>Command</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cal,24.01</strong></td>
<td><img src="image" alt="Wait 300ms" /> Dec 0&lt;br&gt;<img src="image" alt="Wait 300ms" /> Dec 0&lt;br&gt;? Cal,1 1 Dec ASCII fixed volume 0&lt;br&gt;? Cal,0 1 Dec ASCII both 0&lt;br&gt;or&lt;br&gt;? Cal,2 1 Dec ASCII volume/time 0&lt;br&gt;or&lt;br&gt;? Cal,3 1 Dec ASCII uncalibrated 0</td>
</tr>
<tr>
<td><strong>Cal,clear</strong></td>
<td><img src="image" alt="Wait 300ms" /> Dec 0&lt;br&gt;<img src="image" alt="Wait 300ms" /> Dec 0</td>
</tr>
<tr>
<td><strong>Cal,</strong></td>
<td><img src="image" alt="Wait 300ms" /> Dec 0&lt;br&gt;<img src="image" alt="Wait 300ms" /> Dec 0&lt;br&gt;? Cal,1 1 Dec ASCII fixed volume 0&lt;br&gt;? Cal,0 1 Dec ASCII both 0&lt;br&gt;or&lt;br&gt;? Cal,2 1 Dec ASCII volume/time 0&lt;br&gt;or&lt;br&gt;? Cal,3 1 Dec ASCII uncalibrated 0</td>
</tr>
</tbody>
</table>
Enable/disable parameters from output string

### Command syntax

| O, [parameter],[1,0] | enable or disable output parameter |
| O,? | enabled parameter? |

#### Example Response

<table>
<thead>
<tr>
<th>Example</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>O,V,1</td>
<td>[Wait 300ms][1][Dec][0][Null] enable volume being pumped</td>
</tr>
<tr>
<td>O,TV,0</td>
<td>[Wait 300ms][1][Dec][0][Null] disable total volume pumped</td>
</tr>
<tr>
<td>O,ATV,1</td>
<td>[Wait 300ms][1][Dec][0][Null] enable absolute volume pumped</td>
</tr>
<tr>
<td>O,?</td>
<td>[Wait 300ms][1][Dec][?][O,V,TV,ATV][ASCII][0][Null] if all three are enabled</td>
</tr>
</tbody>
</table>
# Pump voltage

## Command syntax

PV,? check pump voltage

## Example

<table>
<thead>
<tr>
<th>PV,?</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>PV,?</td>
<td><img src="image" alt="Wait 300ms" /> 1 ?PV,13.86 0 ASCII Null</td>
</tr>
</tbody>
</table>

## Response breakdown

?PV, 13.86

Pump input voltage
# Device information

## Command syntax

### Wait 300ms

### i device information

### Example

<table>
<thead>
<tr>
<th>Command</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>i</td>
<td>?i,PMP, 1.1</td>
</tr>
</tbody>
</table>

### ASCII Dec

<table>
<thead>
<tr>
<th>Device</th>
<th>Firmware</th>
</tr>
</thead>
<tbody>
<tr>
<td>?i</td>
<td>PMP, 1.1</td>
</tr>
</tbody>
</table>

### 300ms processing delay

---

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# Reading device status

## Command syntax

**Status**  voltage at Vcc pin and reason for last restart

### Example

<table>
<thead>
<tr>
<th>Status</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wait 300ms</td>
<td>1 Dec</td>
</tr>
</tbody>
</table>

## Response breakdown

<table>
<thead>
<tr>
<th>?Status, P,</th>
<th>5.038</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reason for restart</td>
<td>Voltage at Vcc</td>
</tr>
</tbody>
</table>

## Restart codes

- **P** powered off
- **S** software reset
- **B** brown out
- **W** watchdog
- **U** unknown
# Sleep mode/low power

## Command syntax

**Sleep**  enter sleep mode/low power

Send any character or command to awaken device.

### Example | Response
--- | ---
Sleep | no response

**Any command**  wakes up device

### Standby vs Sleep

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Standby Current</th>
<th>Sleep Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>5V</td>
<td>13.4 mA</td>
<td>0.415 mA</td>
</tr>
<tr>
<td>3.3V</td>
<td>12.4 mA</td>
<td>0.13 mA</td>
</tr>
</tbody>
</table>

Do not read status byte after issuing sleep command.

---

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## Protocol lock

### Command syntax

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plock,1</td>
<td>enable Plock</td>
</tr>
<tr>
<td>Plock,0</td>
<td>disable Plock (default)</td>
</tr>
<tr>
<td>Plock,?</td>
<td>Plock on/off?</td>
</tr>
</tbody>
</table>

### Example

<table>
<thead>
<tr>
<th>Plock,1</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Wait 300ms</td>
</tr>
<tr>
<td></td>
<td>1  Dec 0  ASCII</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Plock,0</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Wait 300ms</td>
</tr>
<tr>
<td></td>
<td>1  Dec 0  ASCII</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Plock,?</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Wait 300ms</td>
</tr>
<tr>
<td></td>
<td>1  Dec ASCII</td>
</tr>
</tbody>
</table>

### Example Response

- **300ms processing delay**
- **Locks device to I²C mode.**
- **Plock,1 Baud, 9600**
  - cannot change to UART
- **Plock,0**
  - cannot change to UART
I²C address change

Command syntax

I²C,n  sets I²C address and reboots into I²C mode

Example  |  Response
----------|----------
I²C,101   |  device reboot

Warning!
Changing the I²C address will prevent communication between the circuit and the CPU until the CPU is updated with the new I²C address.
Default I²C address is 103 (0x67).

n = any number 1 – 127
Factory reset

Command syntax

Factory enable factory reset

Factory reset will not take the device out of I2C mode.

I2C address will not change

Example

<table>
<thead>
<tr>
<th>Factory</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factory</td>
<td>device reboot</td>
</tr>
</tbody>
</table>

Clears calibration
LED on
Response codes enabled

Factory (reboot)
### Change to UART mode

**Command syntax**

| Baud, n | switch from I²C to UART |

### Example and Response

<table>
<thead>
<tr>
<th>Example</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baud, 9600</td>
<td>reboot in UART mode</td>
</tr>
</tbody>
</table>

\[ n = \begin{array}{c} 300 \\ 1200 \\ 2400 \\ 9600 \\ 19200 \\ 38400 \\ 57600 \\ 115200 \end{array} \]
Manual switching to UART

- Make sure Plock is set to 0
- Disconnect ground (power off)
- Disconnect TX and RX
- Connect TX to INT
- Confirm RX is disconnected
- Connect ground (power on)
- Wait for LED to change from Blue to Green
- Disconnect ground (power off)
- Reconnect all data and power

Example

Wrong Example
Mounting the EZO-PMP™

There are many different ways to mount the EZO-PMP™ Embedded Dosing Pump. If you have a 3D printer you can use the dosing pump stand we created, by clicking here. The dosing pump stand has been measured to perfectly fit the EZO-PMP™ and even has screw holes in place for you to help mount the dosing pump to the stand. Feel free to modify this stand design as needed.

However, if you would like to mount the EZO-PMP™ Embedded Dosing Pump into other materials, you will need the following tools:

- 1 1/4” Hole Saw
- 1 3/8” Step Bit
- 1/8” Drill Bit

Either are fine to make the larger hole. Perfect for screw holes.
Datasheet change log

Datasheet V 2.1
Moved Default state to pg 14.

Datasheet V 2.0
Revised response for the sleep command in UART mode on pg 40.

Datasheet V 1.9
Added section on viscosity on page 13.

Datasheet V 1.8
Added Find command on pages 22 & 53.

Datasheet V 1.7
Added information on pump tubing on pg 4.

Datasheet V 1.6
Added life span of tubing and cassette on pg 3.

Datasheet V 1.5
Added max input / output pressure info to pg 3 and pg 4.

Datasheet V 1.4
Revised definition of response codes on pg 47.

Datasheet V 1.3
Revised art and added pump head information on pg 11.

Datasheet V 1.2
Revised Plock pages to show default value.

Datasheet V 1.1
Added mounting information on pg 70.
Firmware updates

V1.0 – Initial release (April 28, 2017)
Warranty

Atlas Scientific™ Warrants the EZO-PMP™ Embedded Dosing Pump to be free of defect during the debugging phase of device implementation, or 30 days after receiving the EZO-PMP™ Embedded Dosing Pump (which ever comes first).

The debugging phase

The debugging phase as defined by Atlas Scientific™ is the time period when the EZO-PMP™ Embedded Dosing Pump is inserted into a bread board, or shield. If the EZO-PMP™ Embedded Dosing Pump is being debugged in a bread board, the bread board must be devoid of other components. If the EZO-PMP™ Embedded Dosing Pump is being connected to a microcontroller, the microcontroller must be running code that has been designed to drive the EZO-PMP™ Embedded Dosing Pump exclusively and output the EZO-PMP™ Embedded Dosing Pump data as a serial string.

It is important for the embedded systems engineer to keep in mind that the following activities will void the EZO-PMP™ Embedded Dosing Pump warranty:

- Soldering any part of the EZO-PMP™ Embedded Dosing Pump.
- Running any code, that does not exclusively drive the EZO-PMP™ Embedded Dosing Pump and output its data in a serial string.
- Embedding the EZO-PMP™ Embedded Dosing Pump into a custom made device.
- Removing any potting compound.
Reasoning behind this warranty

Because Atlas Scientific™ does not sell consumer electronics; once the device has been embedded into a custom made system, Atlas Scientific™ cannot possibly warranty the EZO-PMP™ Embedded Dosing Pump, against the thousands of possible variables that may cause the EZO-PMP™ Embedded Dosing Pump to no longer function properly.

Please keep this in mind:

1. All Atlas Scientific™ devices have been designed to be embedded into a custom made system by you, the embedded systems engineer.

2. All Atlas Scientific™ devices have been designed to run indefinitely without failure in the field.

3. All Atlas Scientific™ devices can be soldered into place, however you do so at your own risk.

Atlas Scientific™ is simply stating that once the device is being used in your application, Atlas Scientific can no longer take responsibility for the EZO-PMP™ Embedded Dosing Pumps continued operation. This is because that would be equivalent to Atlas Scientific™ taking responsibility over the correct operation of your entire device.