

EZO-PMP™

Embedded Dosing Pump

Flow rate **0.5ml to 105ml/min**

Accuracy **+/- 1%**

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

Calibration **Single point**

Supplied tubing **61 cm**

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**

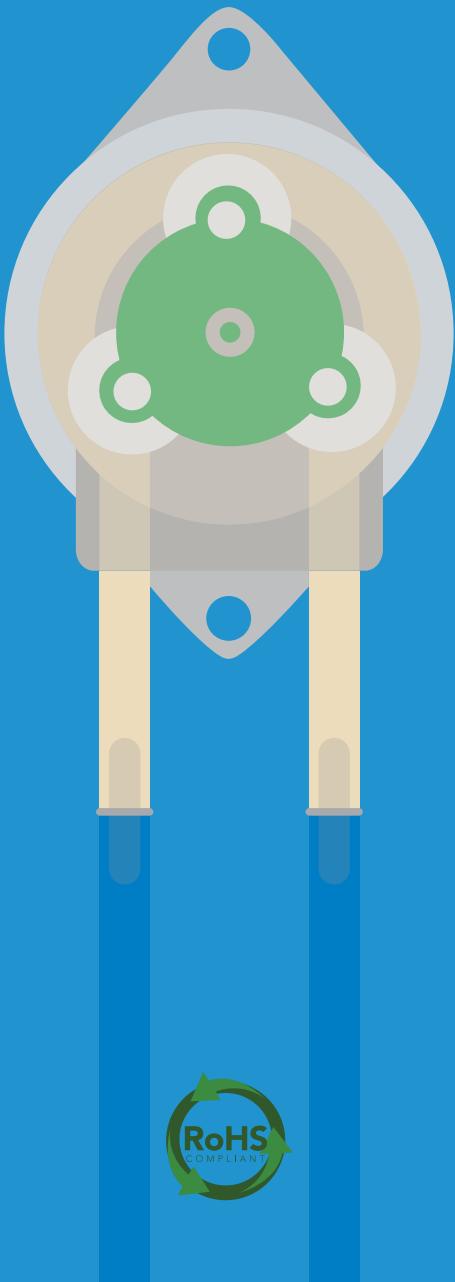


Table of contents

EZO-PMP™ dimensions	3	Operating principle	5
Power consumption	3	Operating modes	5
Absolute max ratings	3	Calibration theory	10
EZO-PMP™ tubing	4	Accuracy	12
		Available data protocols	13

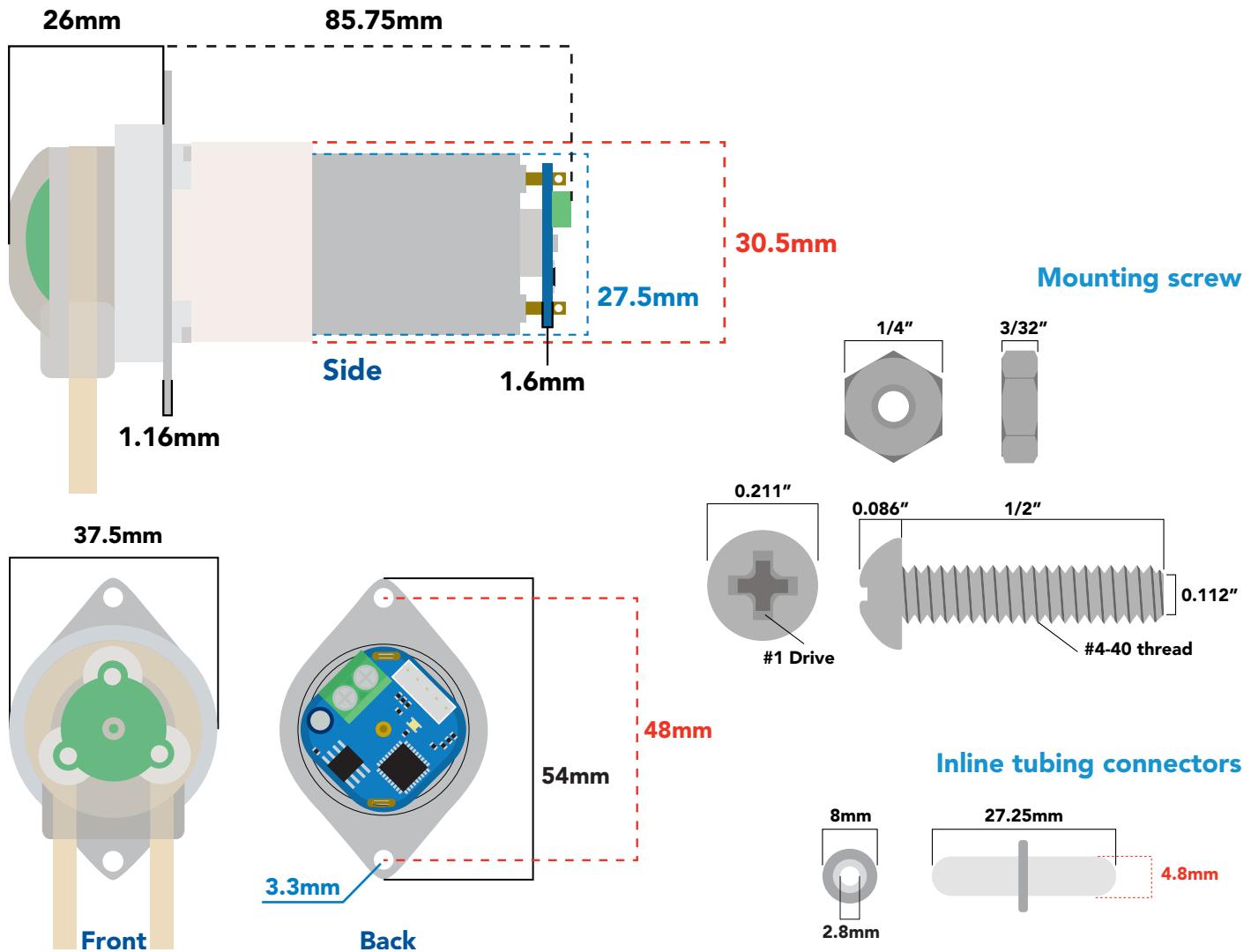
UART

UART mode	15
Default state	16
Receiving data from device	17
Sending commands to device	18
LED color definition	19
UART quick command page	20
LED control	21
Find	22
Continuous mode	23
Single reading mode	24
Continuous dispensing	25
Volume dispensing	26
Dose over time	27
Constant flow rate	28
Pause dispensing	29
Stop dispensing	30
Total volume dispensed	31
Calibration	32
Enable/disable parameters	33
Pump voltage	34
Naming device	35
Device information	36
Response codes	37
Reading device status	38
Sleep mode/low power	39
Change baud rate	40
Protocol lock	41
Factory reset	42
Change to I ² C mode	43
Manual switching to I ² C	44

I²C

I ² C mode	46
Sending commands	47
Requesting data	48
Response codes	49
LED color definition	50
I²C quick command page	51
LED control	52
Find	53
Single report mode	54
Continuous dispensing	55
Volume dispensing	56
Dose over time	57
Constant flow rate	58
Pause dispensing	59
Stop dispensing	60
Total volume dispensed	61
Calibration	62
Enable/disable parameters	63
Pump voltage	64
Device information	65
Reading device status	66
Sleep mode/low power	67
Protocol lock	68
I ² C address change	69
Factory reset	70
Change to UART mode	71
Manual switching to UART	72
Mounting the EZO-PMP™	73
Datasheet change log	74
Warranty	75

EZO-PMP™ dimensions



Power consumption

	LED	MAX	STANDBY	SLEEP
5V	ON	13.7 mA	13.4 mA	0.415 mA
	OFF	13.1 mA	12.8 mA	
3.3V	ON	12.5 mA	12.4 mA	0.13 mA
	OFF	12.3 mA	12.2 mA	
Motor	12V = ~400mA	24V = ~200mA		

Absolute max ratings

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

EZO-PMP™ tubing

Tan tubing

Saint-Gobain™ PharMed™ BPT tubing

Outer diameter: 5mm

Inner diameter: 3mm

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



Inline tubing connectors

HDPE

Outer diameter: 8mm

Inner diameter: 2.8mm



Blue tubing

Silicone

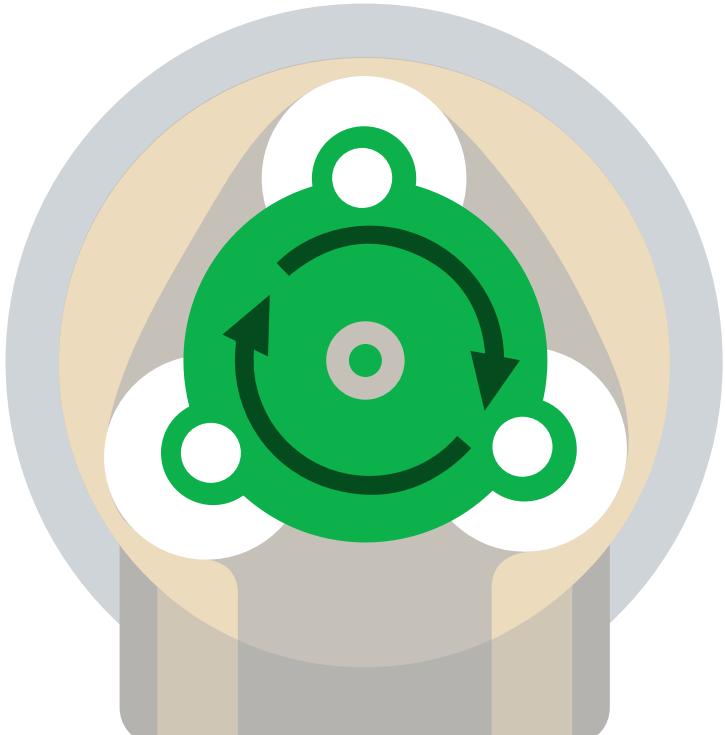
Outer diameter: 5mm

Inner diameter: 3mm

Bend radius: 15mm

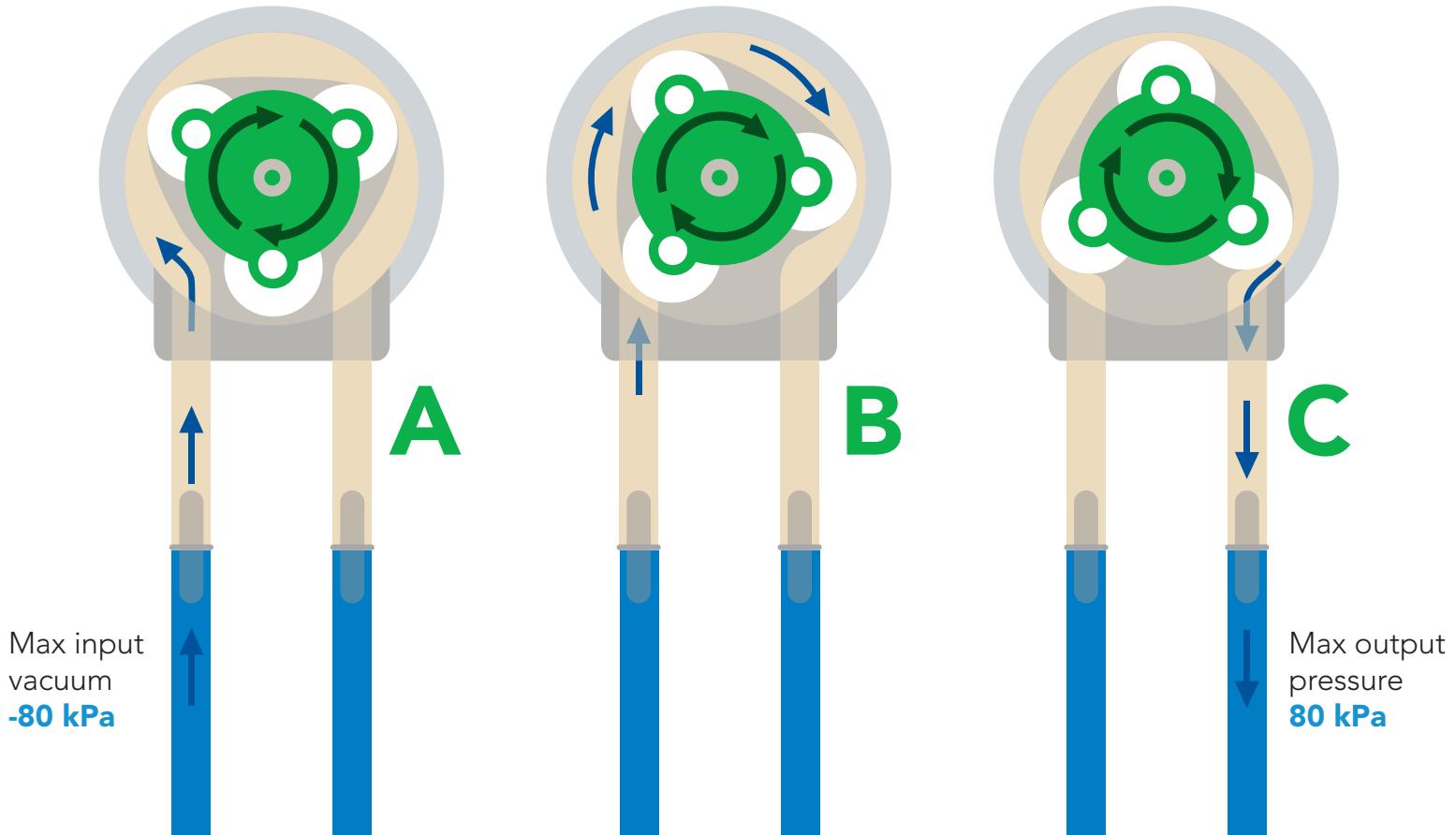
Temperature -67°C to 200°C

Max pressure: 69 kPa (10 PSI)



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

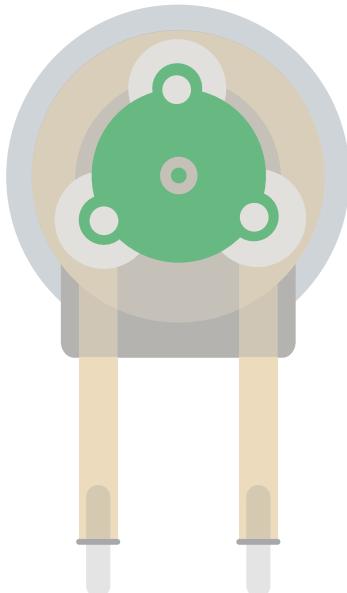
Volume is always in ml.

This device requires two power supplies

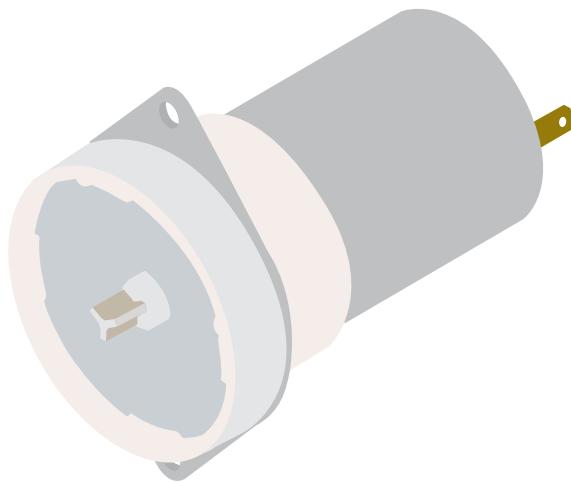
3.3V–5.5V for the control system

12V–24V to drive the motor

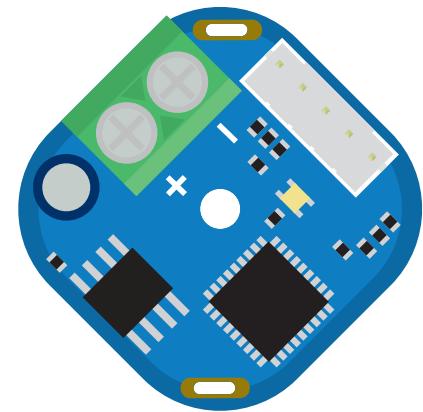
The Atlas Scientific EZO-PMP™ consists of three main components.



Cassette



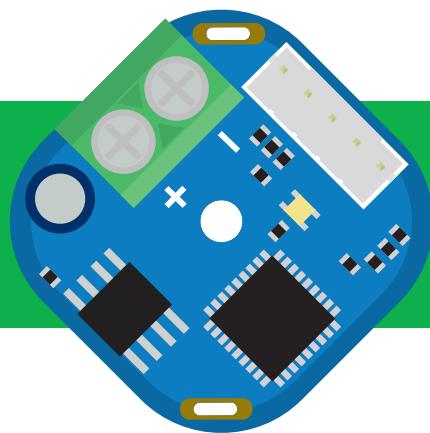
12 volt motor



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

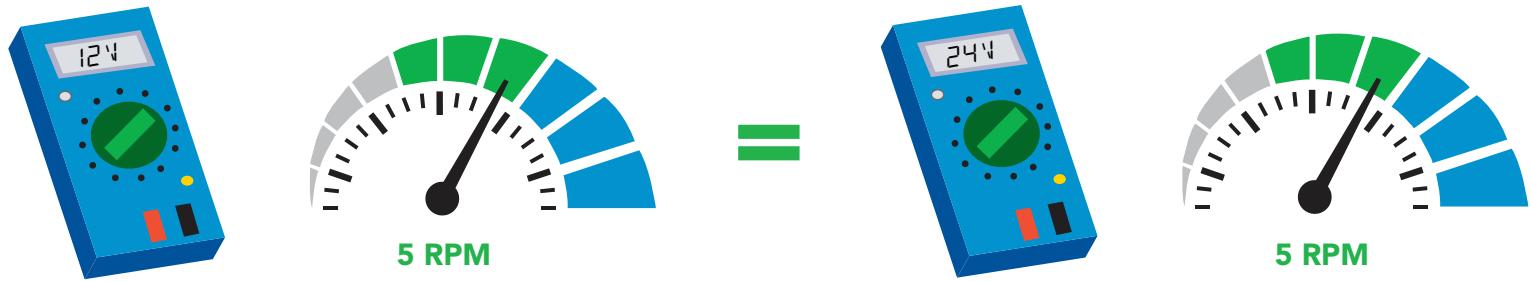
Data and power cable pinout

White	- RX/SCL
Green	- TX/SDA
Black	- GND
Red	- VCC
Blue	- INT



Pump speed vs. voltage

There is no change in pump speed at different voltages.

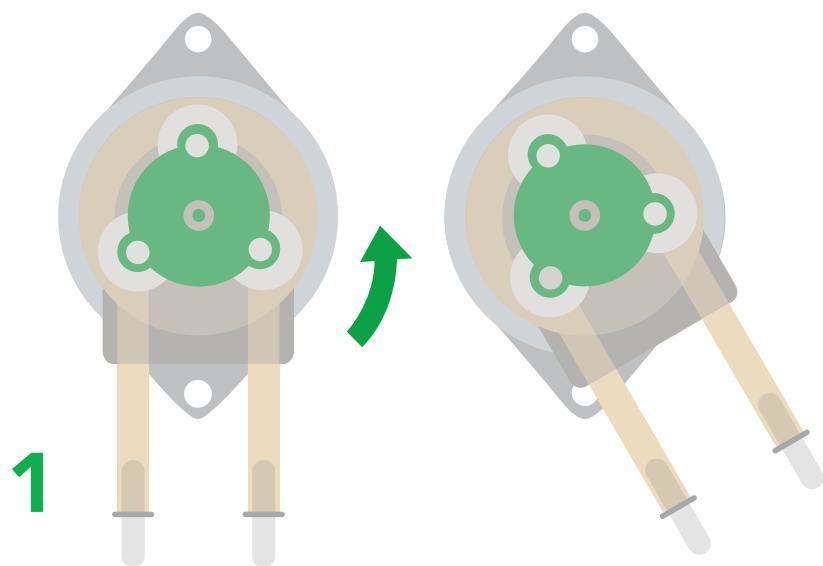


Interrupt pin

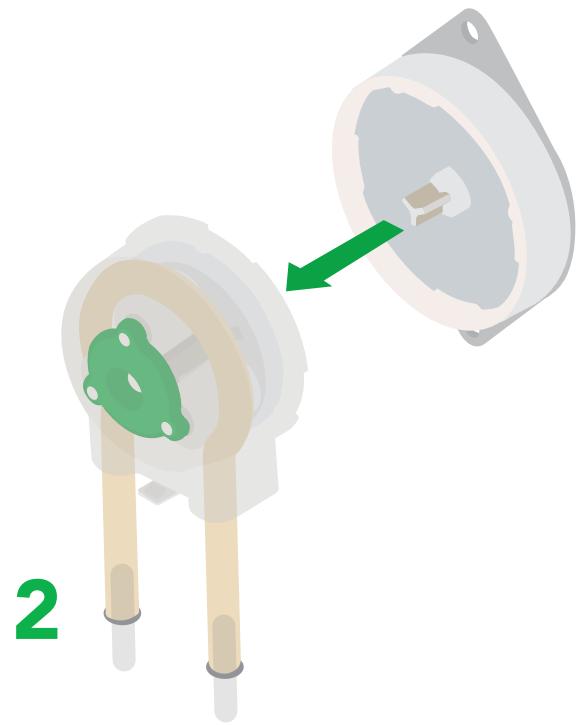
When the pump is dispensing the interrupt pin goes high.



Removing cassette



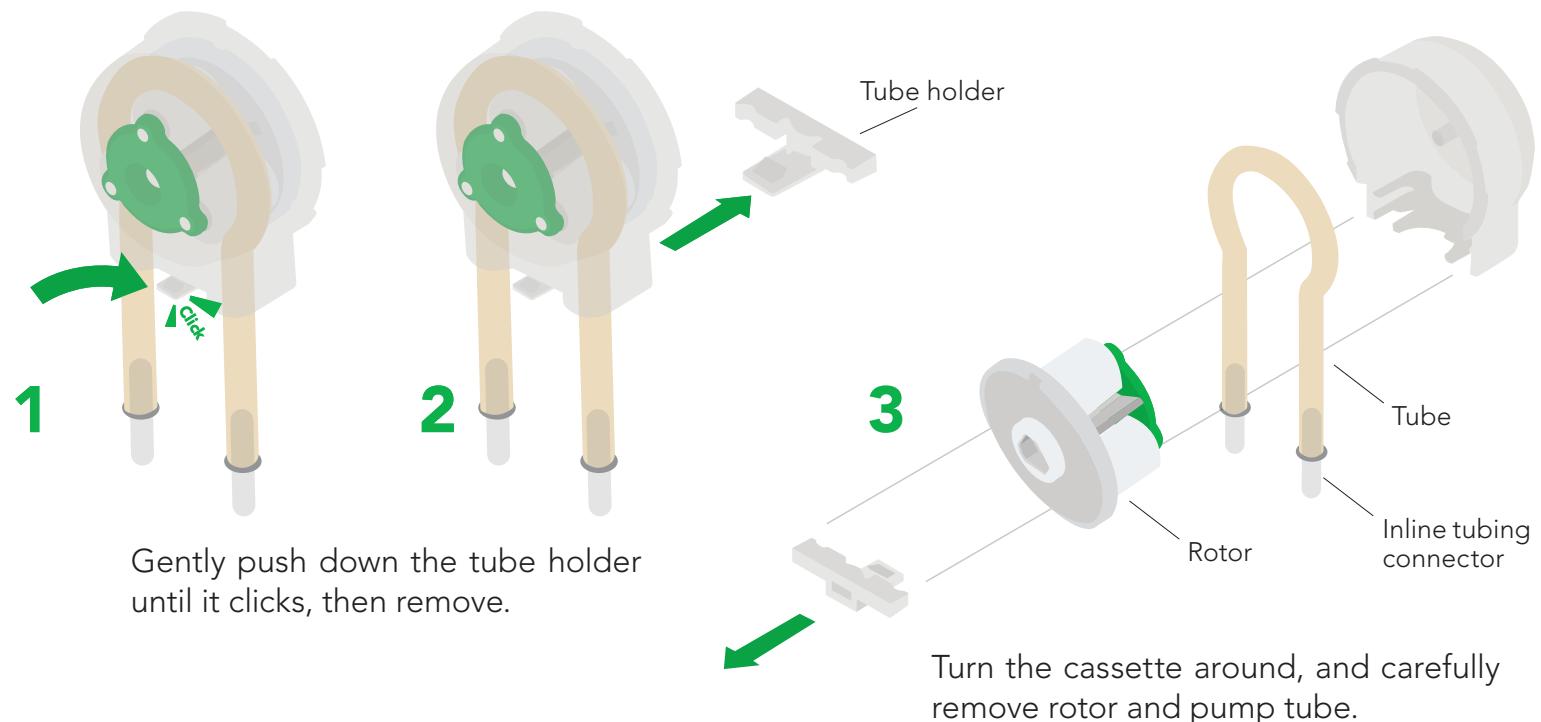
Turn cassette counterclockwise until it stops.



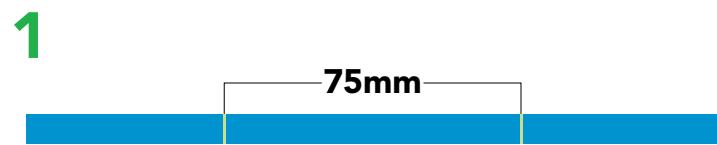
Pull cassette off the motor.

Removing tube assembly

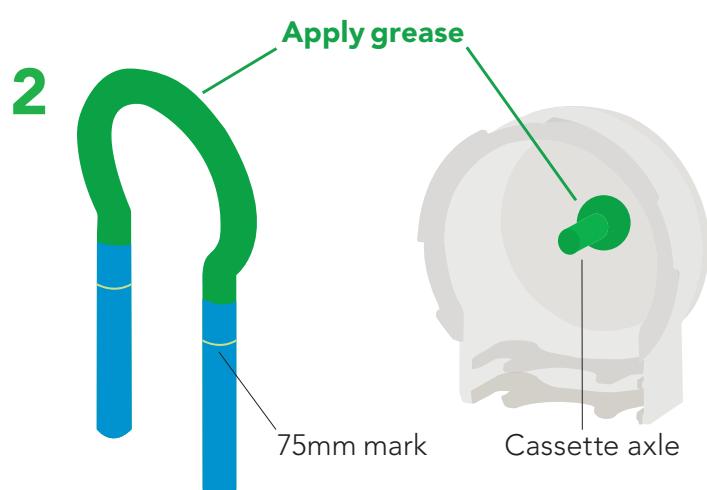
The inner workings of the cassette are fragile and must be dismantled by hand.
Using tools can damage or break the cassette.



Installing new tube assembly



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

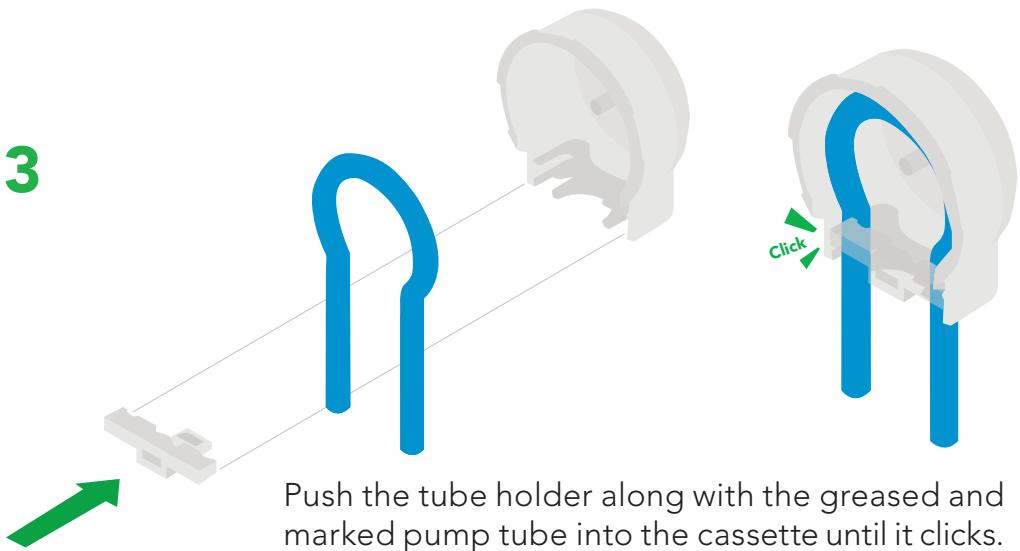


Apply silicone lubricating grease to the marked areas on both the tubing and cassette axle.

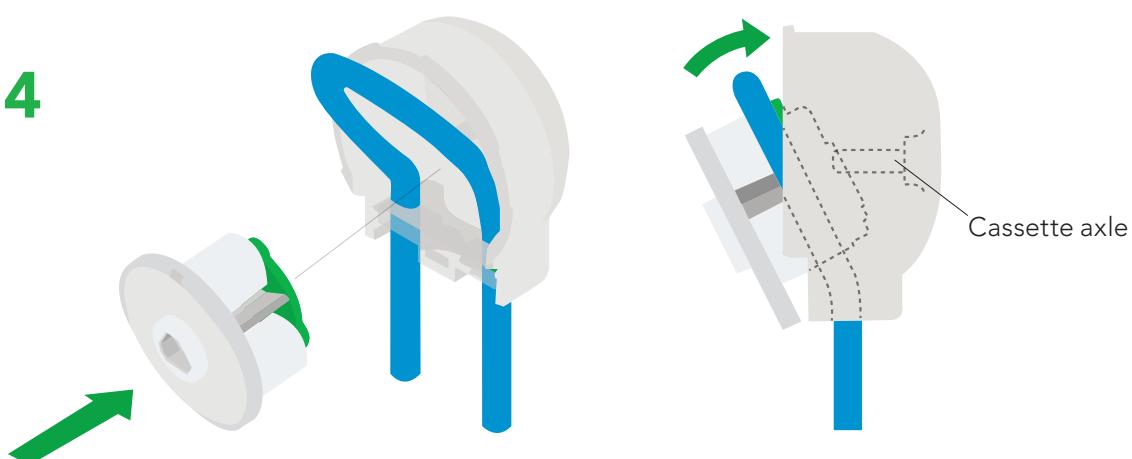
Do not operate this device without lubrication!

Atlas Scientific recommends using **Super Lube** silicone lubricating grease.



3

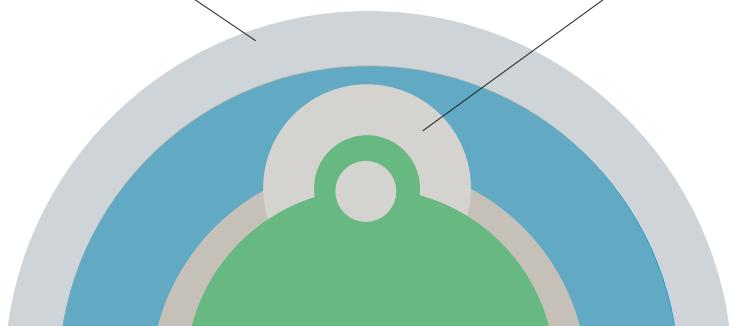
Push the tube holder along with the greased and marked pump tube into the cassette until it clicks.

4

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

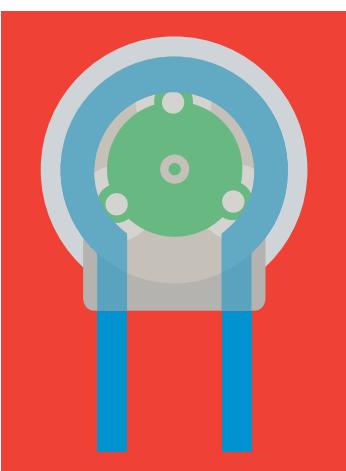
Cassette

Roller



✓ Correct

✗ Incorrect



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

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.**

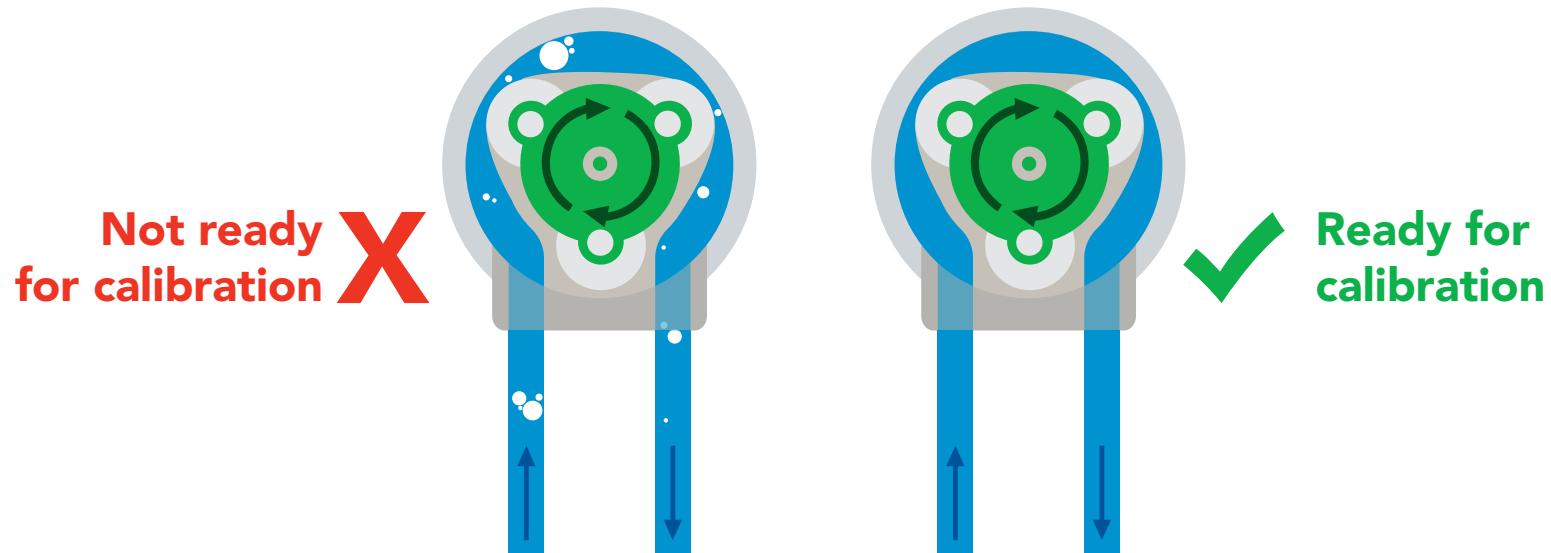
9

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Calibration theory

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

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.



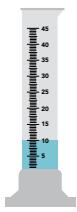
Calibration types

Volume calibration

Volume over time calibration

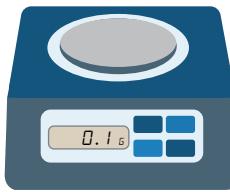
Calibration is optional. Both types of calibration are independent of each other and can be done at any time. Calibration can be done at any volume however; Atlas Scientific recommends using volumes above 5ml.

Equipment needed for calibration



An accurate graduated cylinder of at least 10ml.

Or



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

An accurate scale with a resolution of at least 0.1 grams

Calibration procedure

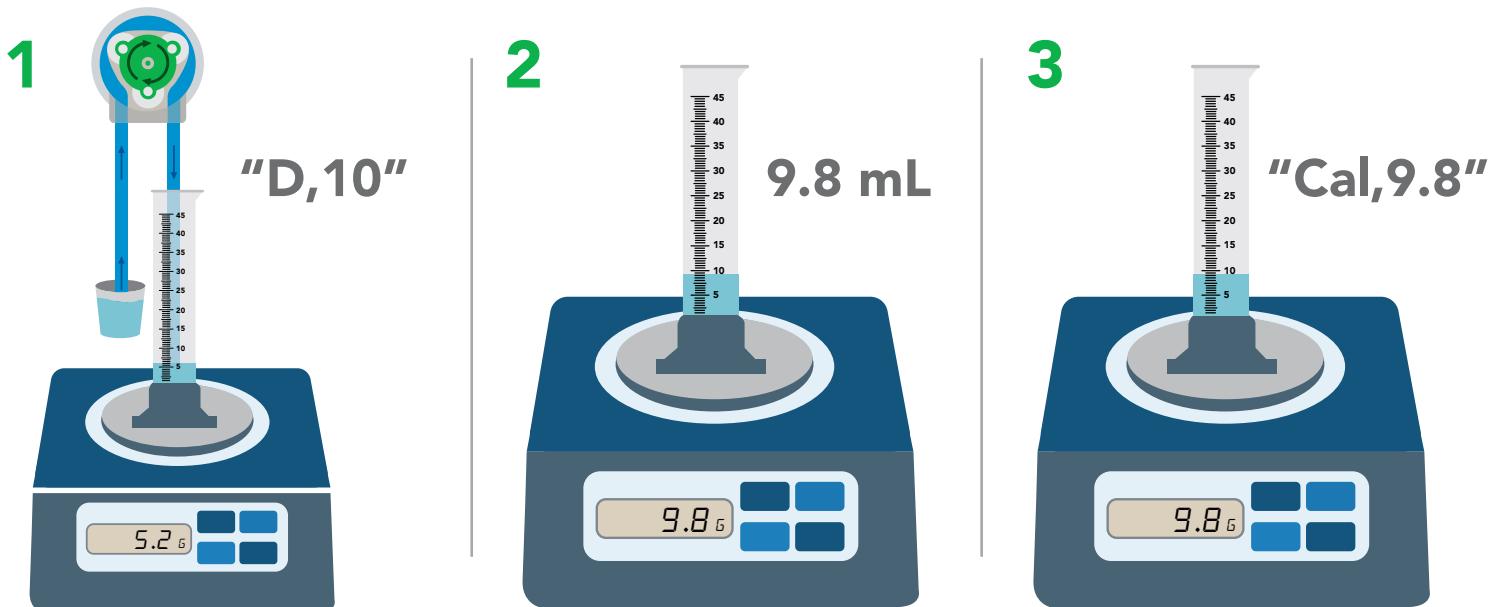
Calibration should be done with water and not a chemical

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.

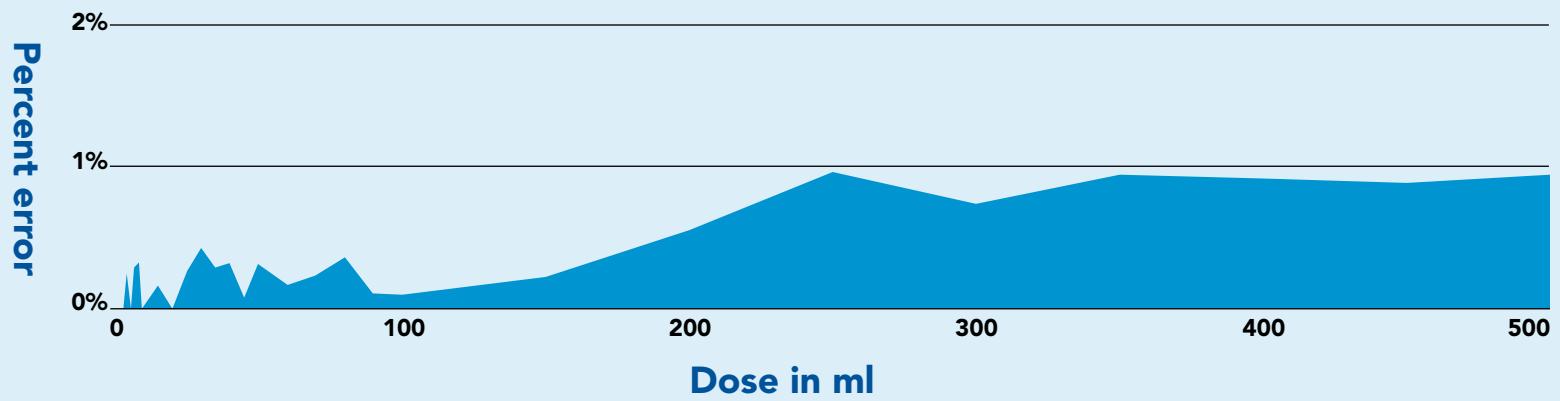
Once the pump has been calibrated it will accurately dispense any volume of liquid. It has not been calibrated specifically to the volume used during the calibration procedure (10 ml). It has now been calibrated to all volumes.

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

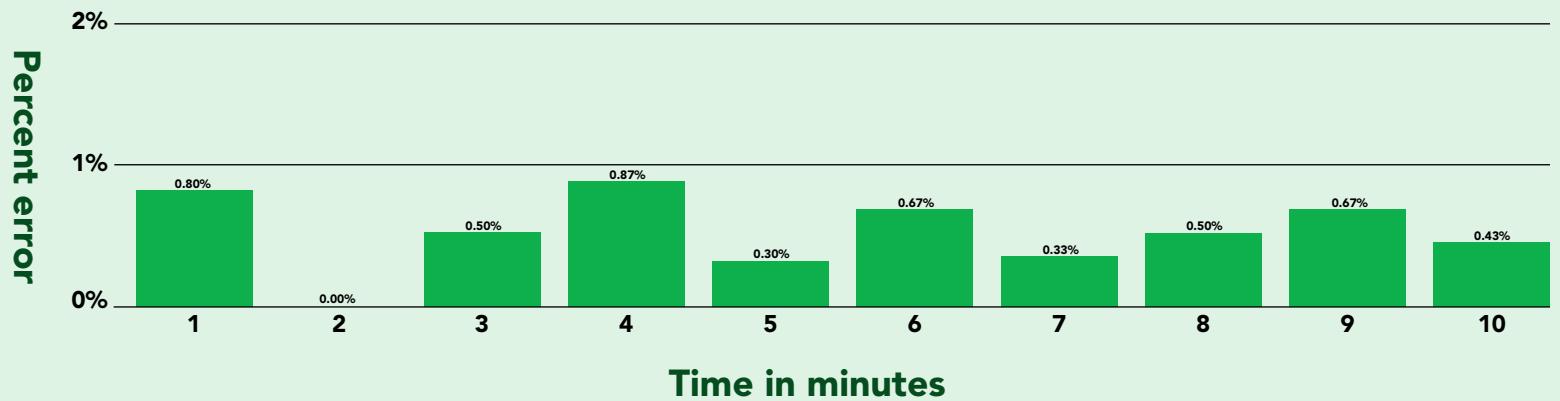
Accuracy

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

Volume dispensing mode calibrated at 10ml



Dose over time mode calibrated at 10ml over 90 seconds



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').

 Available data protocols

UART

Default

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

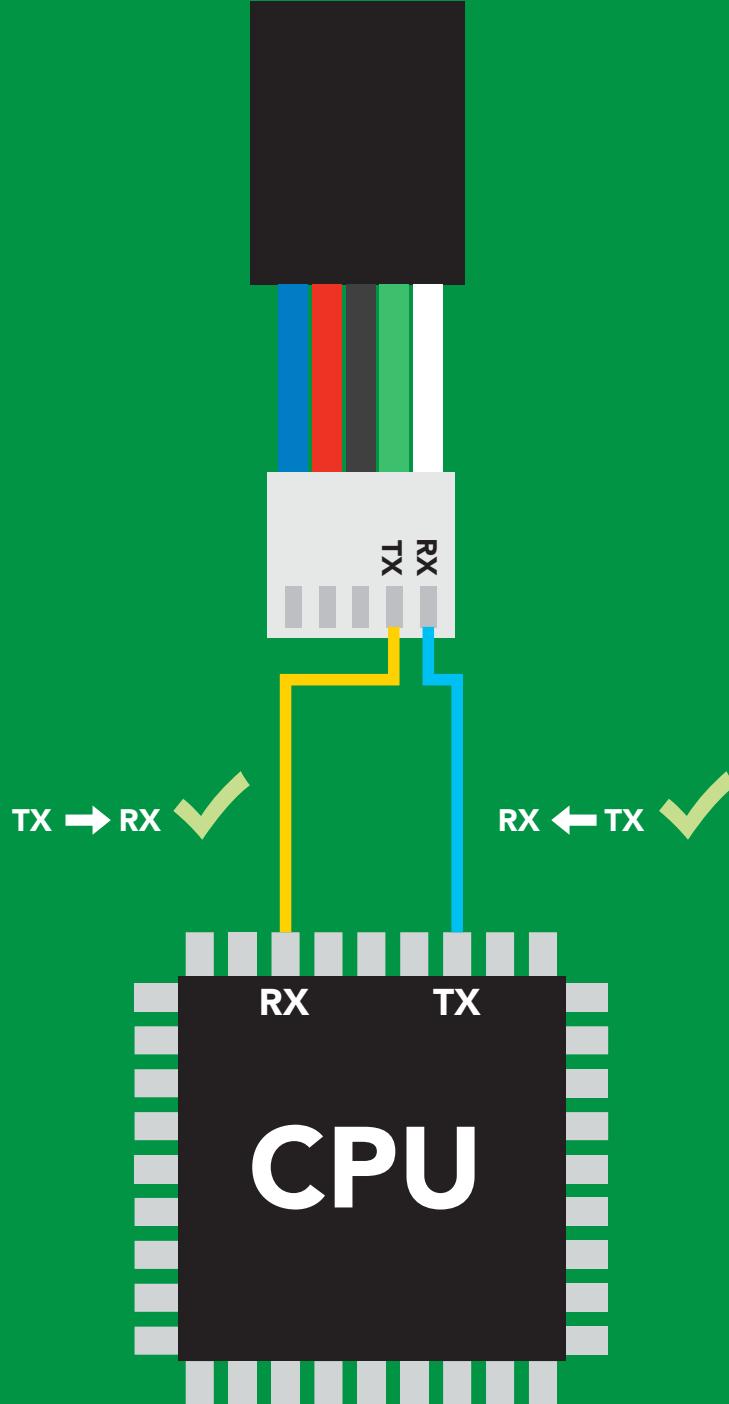
Baud 300
1,200
2,400
9,600 default
19,200
38,400
57,600
115,200

RX Data in


TX Data out


Vcc 3.3V – 5.5V

 VCC
0V 0V



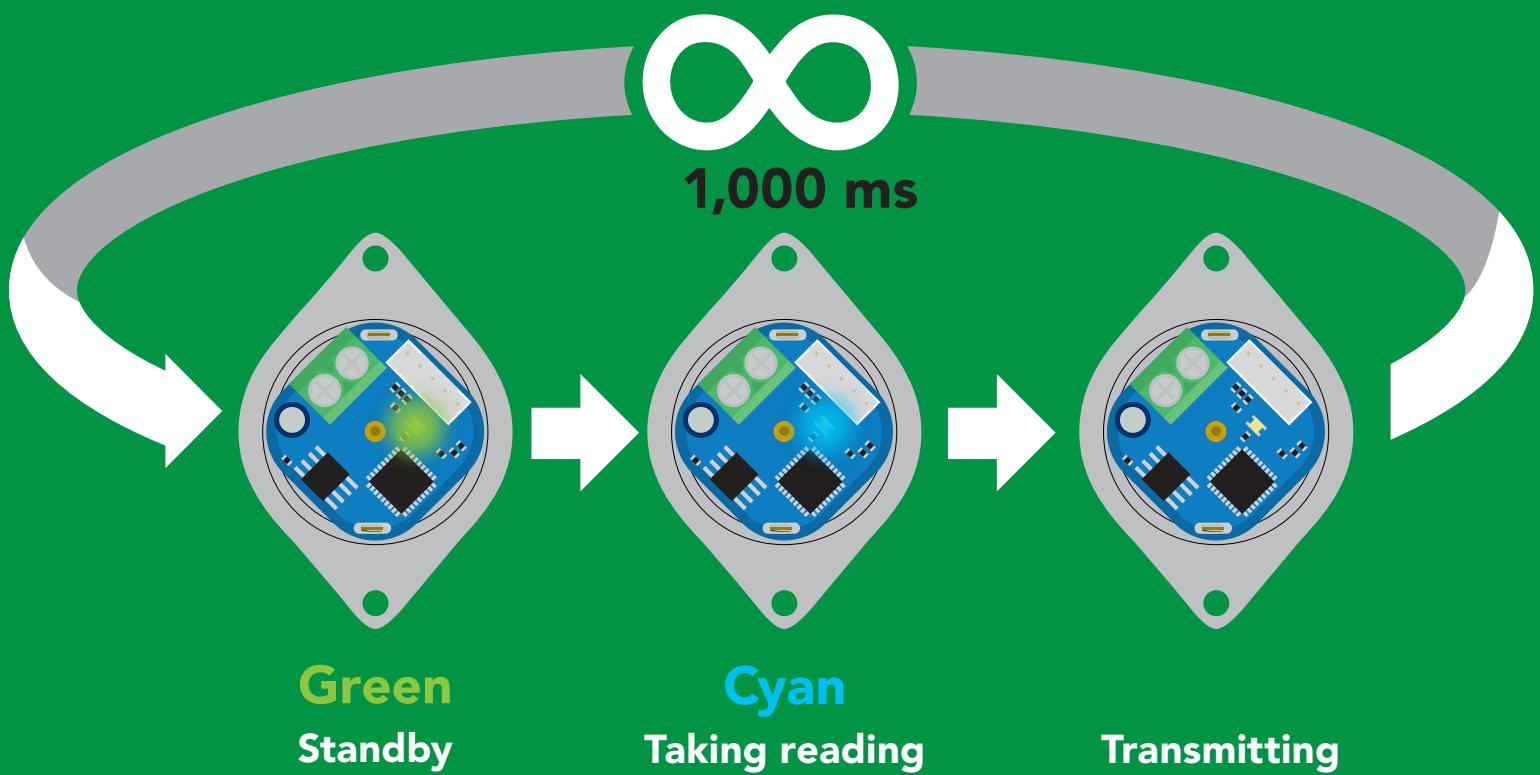
Data format

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

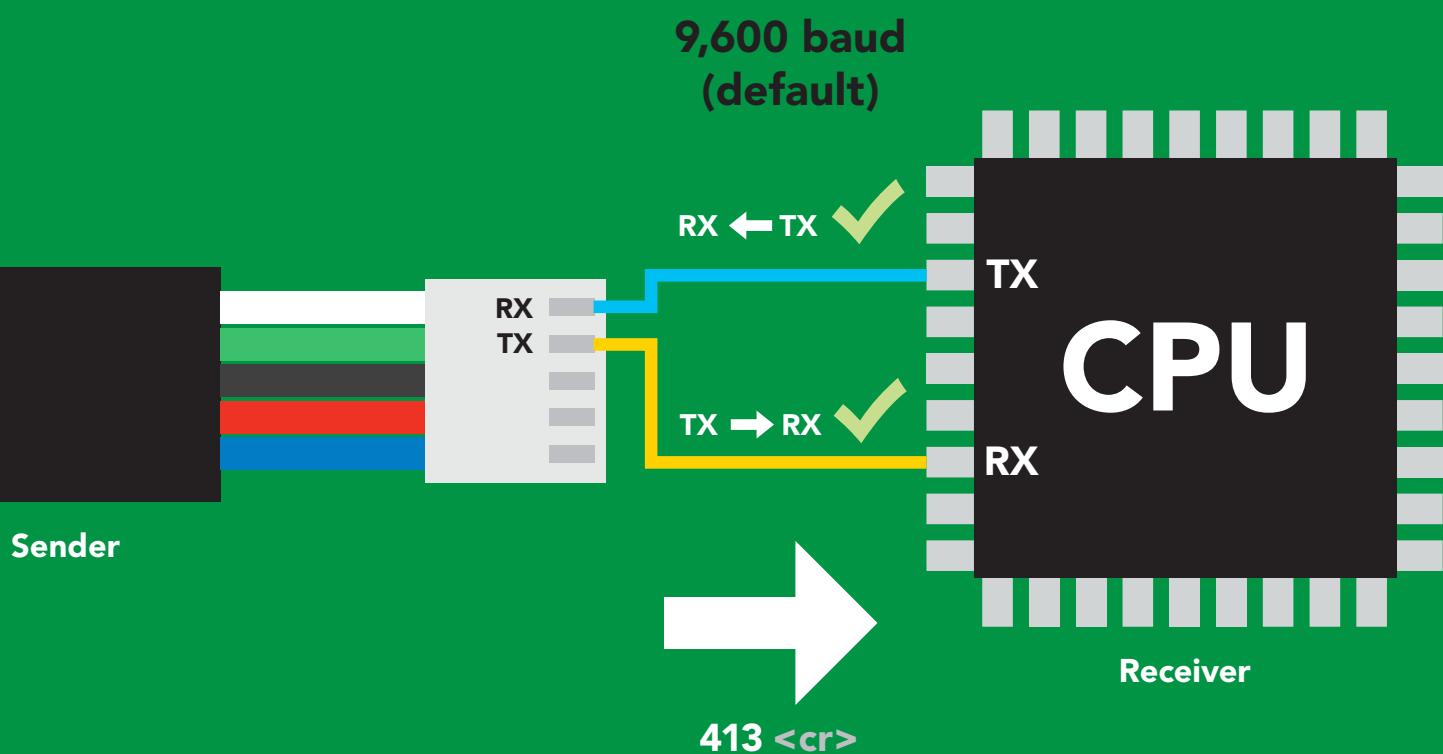
Default state

Mode	UART
Baud	9,600
Readings	continuous
Speed	1 reading per second
LED	on



Receiving data from device

2 parts

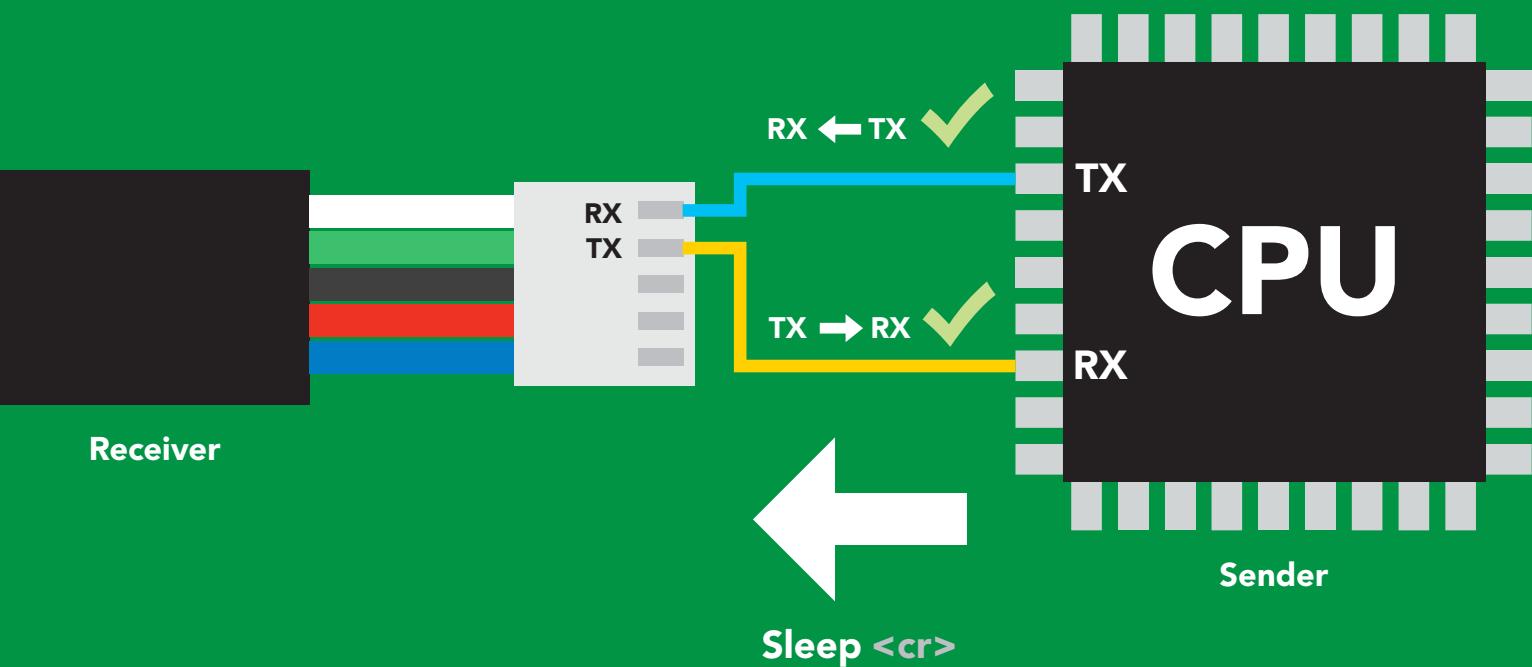
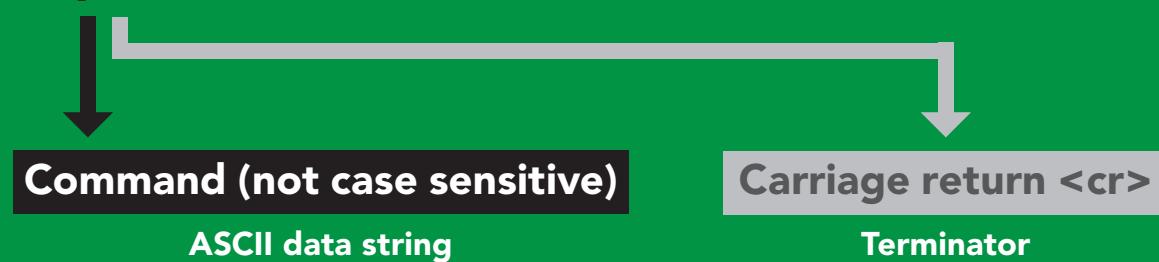


Advanced

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

Sending commands to device

2 parts



Advanced

ASCII: S I e e p <cr>

Hex: 53 6C 65 65 70 0D

Dec: 83 108 101 101 112 13

LED color definition



Green
UART standby



Cyan
Taking reading



Purple
Changing baud rate



Red
Command
not understood



White
Find

5V	LED ON +2.5 mA
3.3V	+1 mA

UART mode

command quick reference

All commands are ASCII strings or single ASCII characters.

Command	Function		Default state
Baud	change baud rate	pg. 40	9,600
C	enable/disable continuous mode	pg. 23	enabled
Cal	performs calibration	pg. 32	n/a
D	dispense modes	pg. 25 – 28	n/a
Factory	enable factory reset	pg. 42	n/a
Find	finds device with blinking white LED	pg. 22	n/a
i	device information	pg. 36	n/a
I2C	change to I ² C mode	pg. 43	not set
L	enable/disable LED	pg. 21	enabled
Name	set/show name of device	pg. 35	not set
O	enable/disable parameters	pg. 33	all enabled
P	pause dispensing	pg. 29	n/a
Plock	enable/disable protocol lock	pg. 41	disabled
Pv	check pump voltage	pg. 34	n/a
R	returns a single reading	pg. 24	n/a
Sleep	enter sleep mode/low power	pg. 39	n/a
Status	retrieve status information	pg. 38	enable
Tv	total volume dispensed	pg. 31	n/a
X	stop dispensing	pg. 30	n/a
*OK	enable/disable response codes	pg. 37	enable

LED control

Command syntax

L,1 <cr> LED on **default**

L,0 <cr> LED off

L,? <cr> LED state on/off?

Example

L,1 <cr>

*OK <cr>

L,0 <cr>

*OK <cr>

L,? <cr>

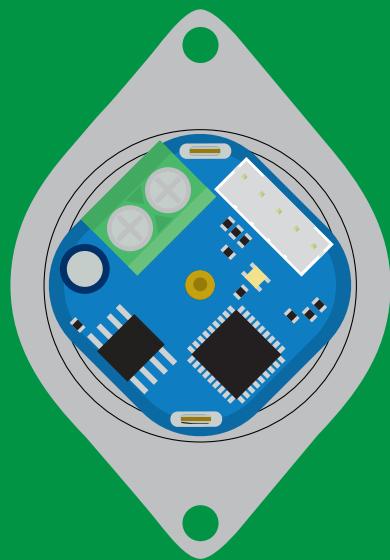
?L,1 <cr> or ?L,0 <cr>

*OK <cr>

Response



L,1



L,0

Find

Command syntax

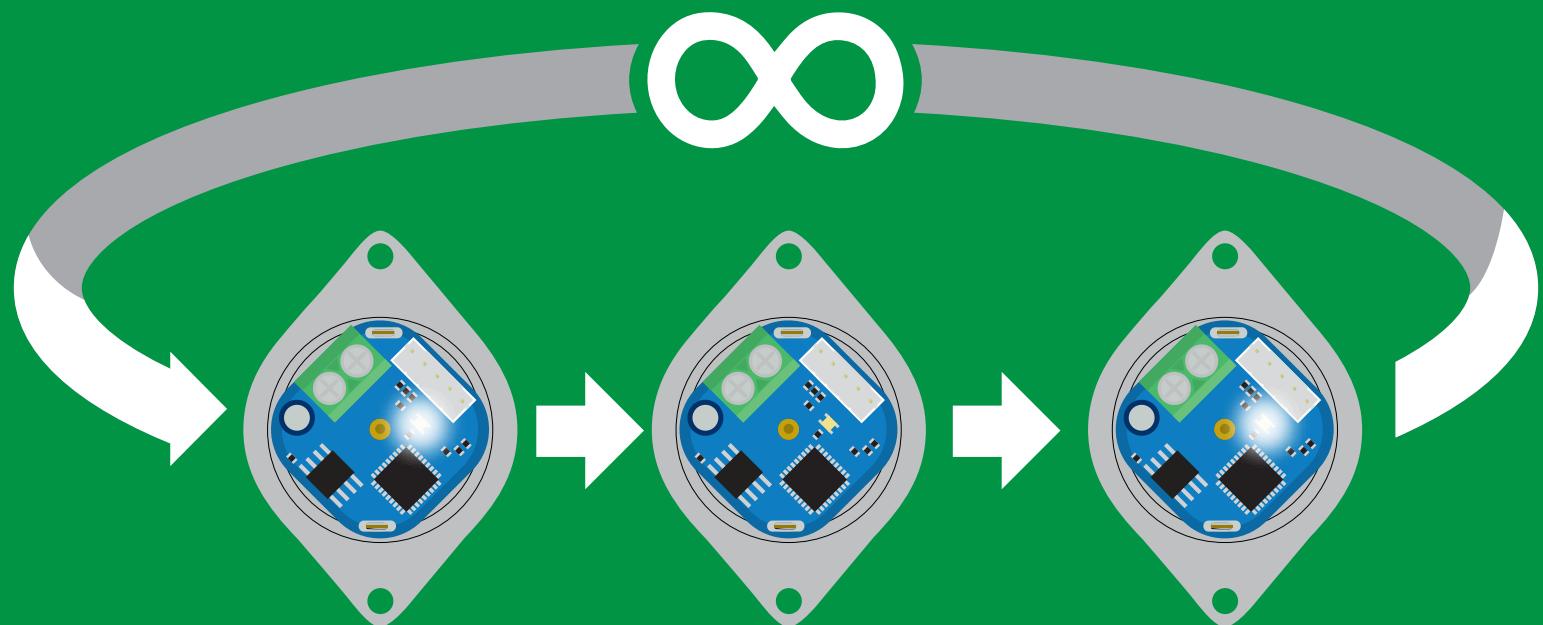
This command will disable continuous mode
Send any character or command to terminate find.

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

Example Response

Find <cr>

*OK <cr>



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 Response

dispense 3ml

C,* <cr>

1.2 <cr>
3.0 <cr>
***Done,3.00 <cr>**
3.0 <cr>
3.0 <cr>

C,1 <cr>

1.2 <cr>
3.0 <cr>
***Done,3.00 <cr>**

C,0 <cr>

***Done,3.00 <cr>**

C,? <cr>

?C,1 <cr> or ?C,0 <cr> or ?C,* <cr>
***OK <cr>**

Single reading mode

Command syntax

R <cr> returns a single value showing dispensed volume

Example Response

R <cr>

2.50 <cr> (If issued half way through dispensing 5ml)
***OK <cr>**

5.00 <cr> (If issued once dispensing has stopped)
***OK <cr>**

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

Response

D,* <cr>

*OK <cr> pump will continuously run at ~105ml/min
(with supplied tubing)

D,-* <cr>

*OK <cr> pump will continuously run in reverse
at ~105ml/min (with supplied tubing)

D,? <cr>

?D,*,1 <cr>
*OK <cr>

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

Response

D,15 <cr>

*OK <cr> 15 ml will be dispensed

D,-405 <cr>

*OK <cr> 405 ml will be dispensed *in reverse*

D,? <cr>

?D,22.50,0 <cr>

*OK <cr>

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] <cr> Dispense [this volume], [over this many minutes]

Example

D,85,10 <cr>

Response

***OK <cr> Dispense 85ml over 10 minutes**



Constant flow rate

Maintain a constant flow rate

Command syntax

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

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 Response

DC,25,40 <cr>

***OK <cr> Dispense 25ml per minute for 40 minutes**

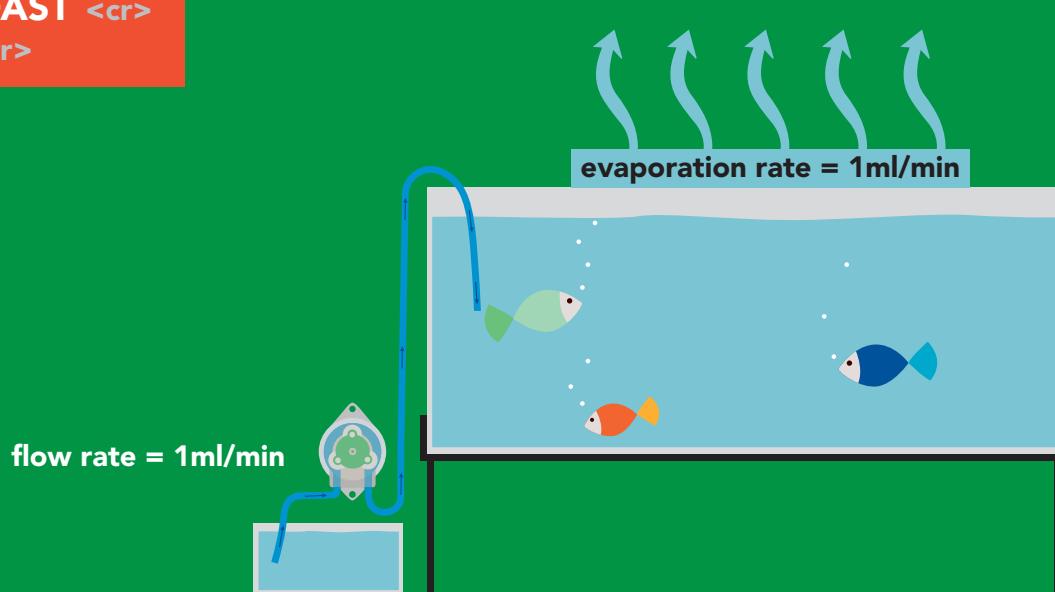
DC,? <cr>

**?MAXRATE,58.5 <cr>
*OK <cr>**

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>**



Pause dispensing

Command syntax

Issue the command again to resume dispensing

P <cr> pauses the pump during dispensing

P? <cr> pause status

Example

P <cr>

*OK <cr>

P? <cr>

?P,1 <cr> or ?P,0 <cr>
paused
unpaused

*OK <cr>

P

dispensing

P

paused

dispensing

Stop dispensing

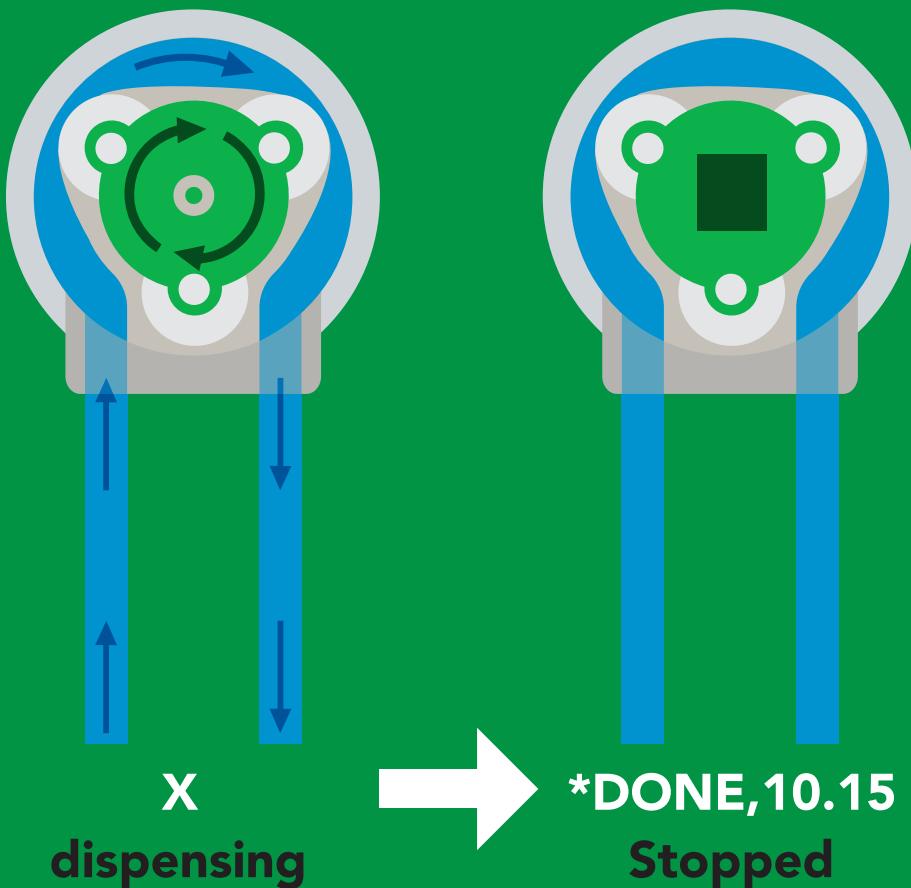
Command syntax

X <cr> stop dispensing

Example Response

X <cr>

*DONE,v <cr> v = volume dispensed



Total volume dispensed

Command syntax

TV,? <cr> shows total volume dispensed

ATV,? <cr> absolute value of the total volume dispensed

Clear <cr> clears the total dispensed volume

Example

TV,? <cr>

Response

?total,434.50 <cr>

ATV,? <cr>

?total,623.00 <cr>

Clear <cr>

*OK <cr> total now 0.00

Calibration

Command syntax

Calibrate to the actual volume dispensed.

Cal,v <cr> v = corrected volume

Cal,clear <cr> delete all calibration data

Cal,? <cr> device calibrated?

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

Example

Cal,24.01 <cr>

*OK <cr>

Cal,clear <cr>

*OK <cr>

Cal,? <cr>

?Cal,1 <cr> or ?Cal,2 <cr> or
fixed volume
?Cal,3 <cr> or ?Cal,0 <cr>
volume/time
both
uncalibrated

*OK <cr>

Response

Enable/disable parameters from output string

Command syntax

O, [parameter],[1,0] <cr> enable or disable output parameter

O,? <cr> enabled parameter?

Example

O,V,1 <cr>

Response

*OK <cr> enable volume being pumped

O,TV,0 <cr>

*OK <cr> disable total volume pumped

O,ATV,1 <cr>

*OK <cr> enable absolute volume pumped

O,? <cr>

? ,O,V,TV,ATV <cr> if all three are enabled

Pump voltage

Command syntax

PV,? <cr> check pump voltage

Example Response

PV,? <cr>

**?PV,13.86 <cr>
*OK <cr>**

Response breakdown

?PV, 13.86

Pump input voltage

Naming device

Command syntax

Name,n <cr> set name

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

Name,? <cr> show name

Up to 16 ASCII characters

Example

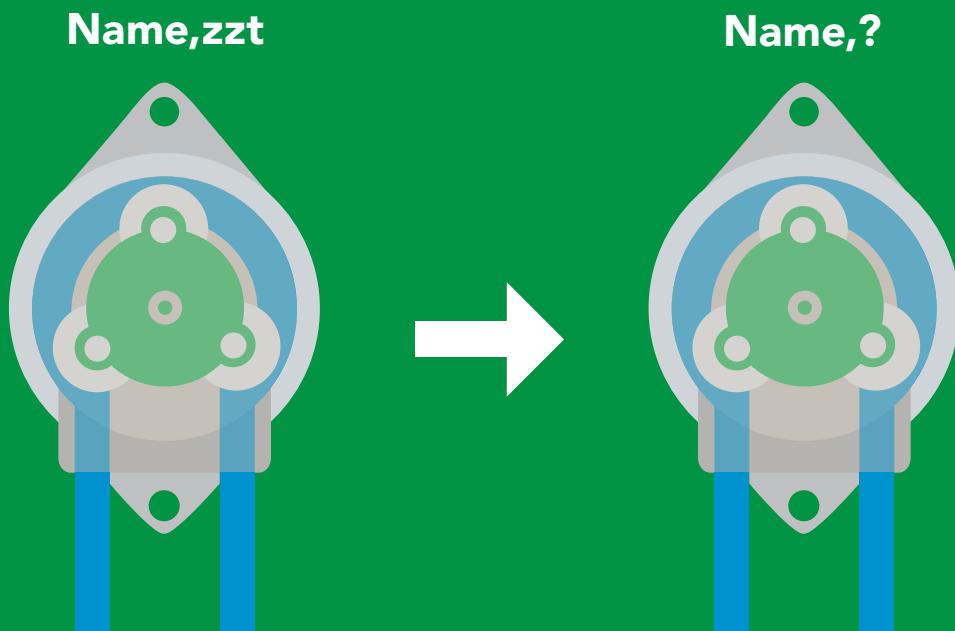
Name,zzt <cr>

*OK <cr>

Name,? <cr>

?Name,zzt <cr>
*OK <cr>

Response



*OK <cr>

Name,zzt <cr>
*OK <cr>

Device information

Command syntax

i <cr> device information

Example Response

i <cr>

**?i,PMP,1.1 <cr>
*OK <cr>**

Response breakdown

?i, PMP, 1.1

↑
Device

↑
Firmware

Response codes

Command syntax

*OK,1 <cr> enable response **default**
*OK,0 <cr> disable response
*OK,? <cr> response on/off?

Example	Response
R <cr>	413 <cr> *OK <cr>
*OK,0 <cr>	no response, *OK disabled
R <cr>	413 <cr> *OK disabled
*OK,? <cr>	?*OK,1 <cr> or ?*OK,0 <cr>

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

Status <cr> voltage at Vcc pin and reason for last restart

Example Response

Status <cr>

?Status,P,5.038 <cr>

*OK <cr>

Response breakdown

?Status, P,
↑
Reason for restart 5.038
 ↑
 Voltage at Vcc

Restart codes

P	powered off
S	software reset
B	brown out
W	watchdog
U	unknown

Sleep mode/low power

Command syntax

Send any character or command to awaken device.

Sleep <cr> enter sleep mode/low power

Example

Sleep <cr>

Response

***SL**

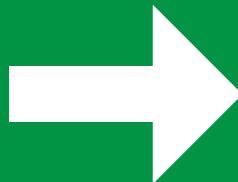
Any command

***WA <cr> wakes up device**

	STANDBY	SLEEP
5V	13.4 mA	0.415 mA
3.3V	12.4 mA	0.13 mA



Standby
13.4 mA



Sleep <cr>



Sleep
0.415 mA

Change baud rate

Command syntax

Baud,n <cr> change baud rate

Example

Baud,38400 <cr>

Response

*OK <cr>

Example

Baud,? <cr>

?Baud,38400 <cr>

*OK <cr>

n = [300
1200
2400
9600 default
19200
38400
57600
115200]



Baud,38400 <cr>



(reboot)



Protocol lock

Command syntax

Locks device to UART mode.

Plock,1 <cr> enable Plock

Plock,0 <cr> disable Plock **default**

Plock,? <cr> Plock on/off?

Example

Plock,1 <cr>

*OK <cr>

Plock,0 <cr>

*OK <cr>

Plock,? <cr>

?Plock,1 <cr> or ?Plock,0 <cr>

Plock,1

I2C,100

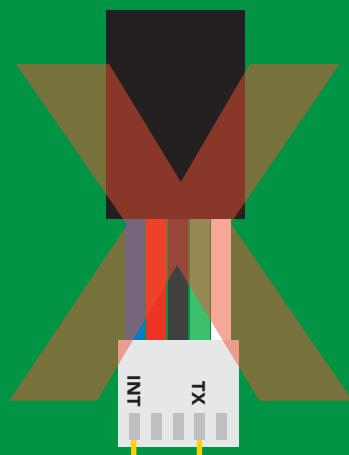


*OK <cr>



cannot change to I²C

*ER <cr>



cannot change to I²C

Factory reset

Command syntax

Clears calibration
LED on
"*OK" enabled

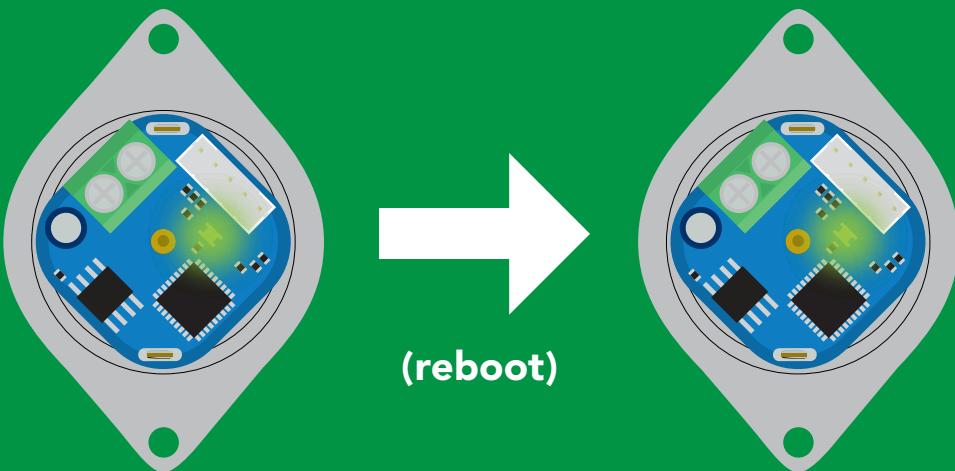
Factory <cr> enable factory reset

Example Response

Factory <cr>

*OK <cr>

Factory <cr>



*OK <cr>

*RS <cr>

*RE <cr>

Baud rate will not change

Change to I²C mode

Command syntax

Default I²C address 103 (0x67)

I²C,n <cr> sets I²C address and reboots into I²C mode

n = any number 1 – 127

Example Response

I²C,100 <cr>

*OK (reboot in I²C mode)

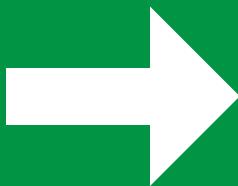
Wrong example

I²C,139 <cr> n ≠ 127

Response

*ER <cr>

I²C,100



Green
*OK <cr>

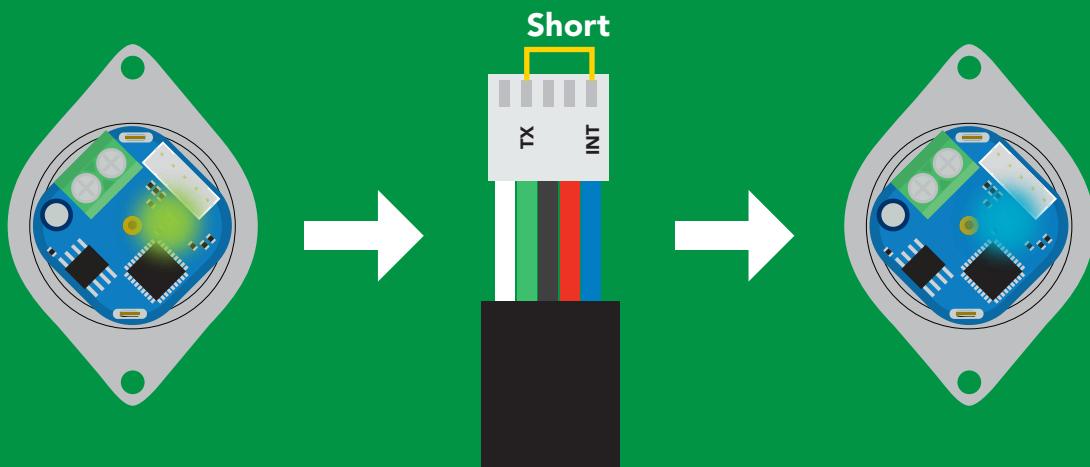
Blue
now in I²C mode

Manual switching to I²C

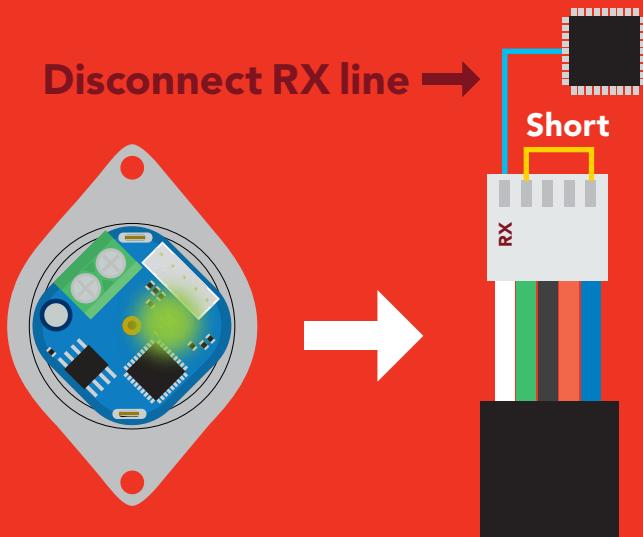
- Make sure Plock is set to 0
- Disconnect ground (power off)
- Disconnect TX and RX
- Connect TX to INT
- Confirm RX is disconnected
- Connect ground (power on)
- Wait for LED to change from Green to Blue
- Disconnect ground (power off)
- Reconnect all data and power

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

Example



Wrong Example



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

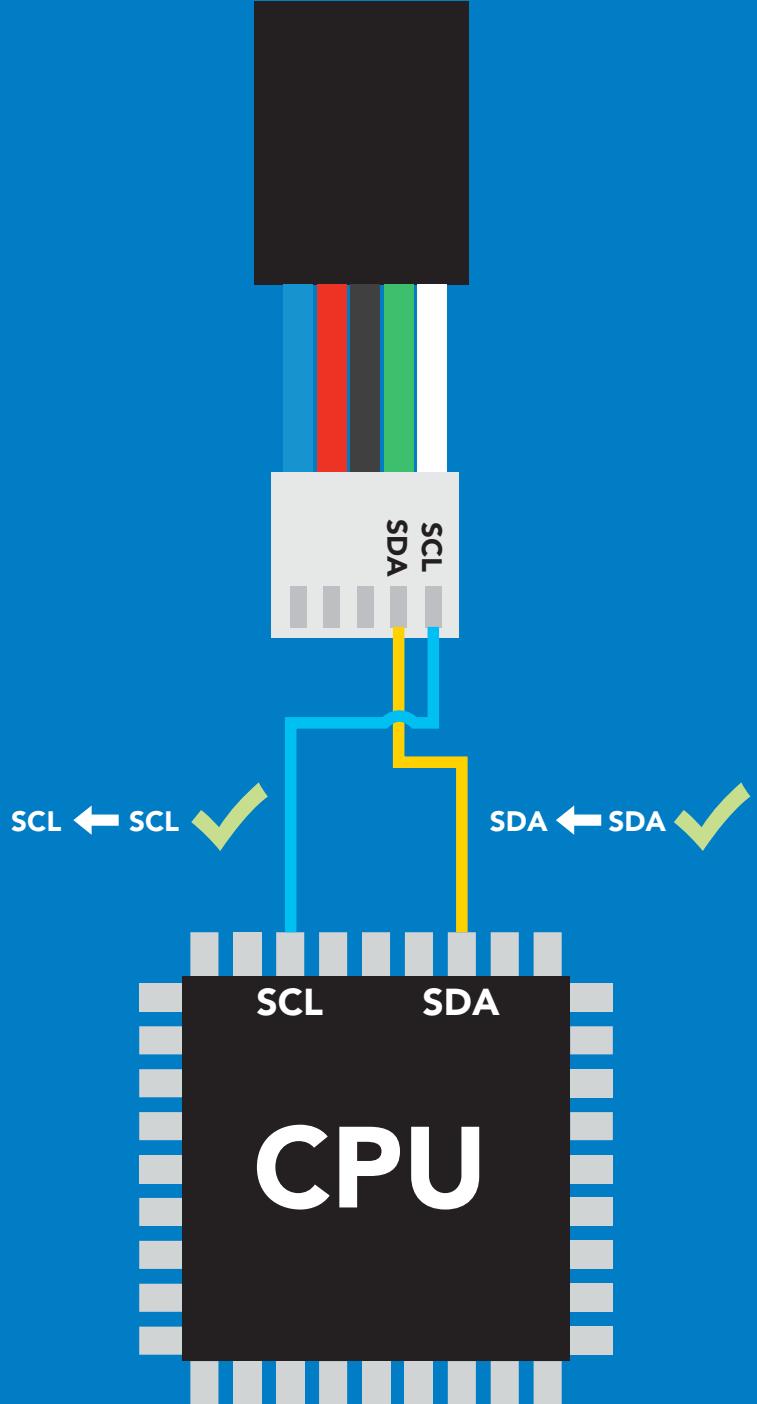
Vcc 3.3V – 5.5V

Clock speed 100 – 400 kHz

SDA 

SCL 

0V 



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

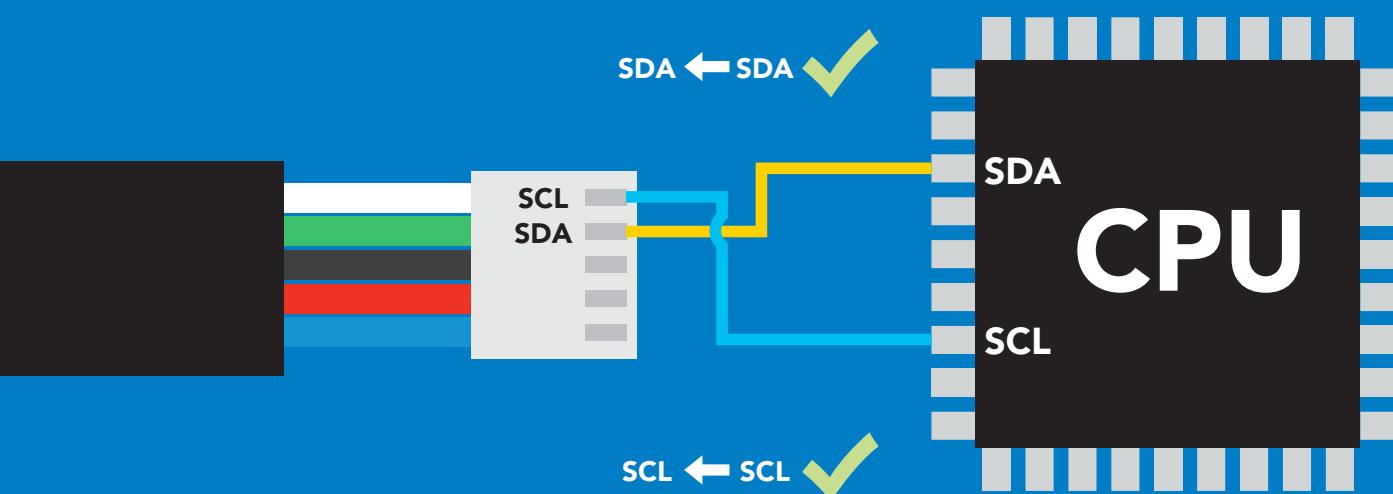
Sending commands to device



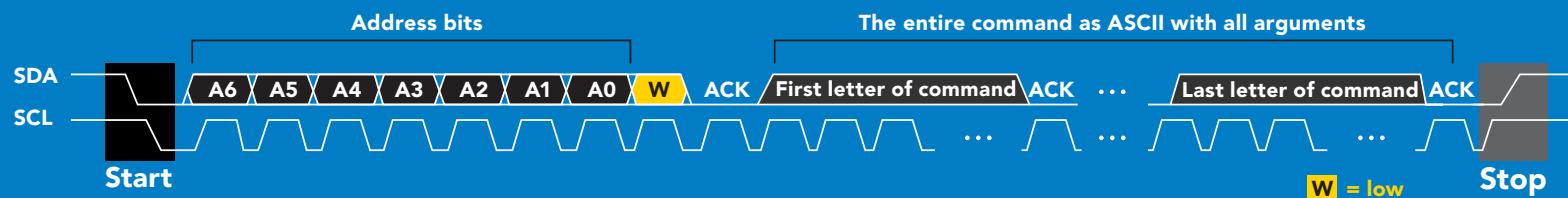
Example

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

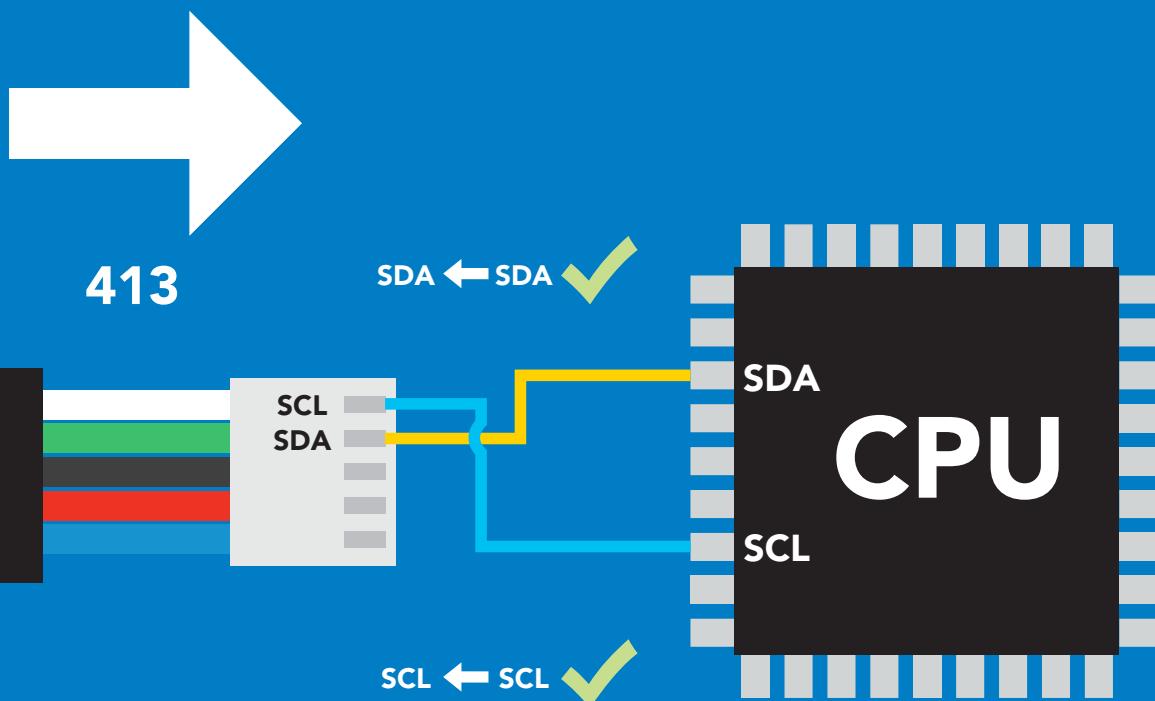
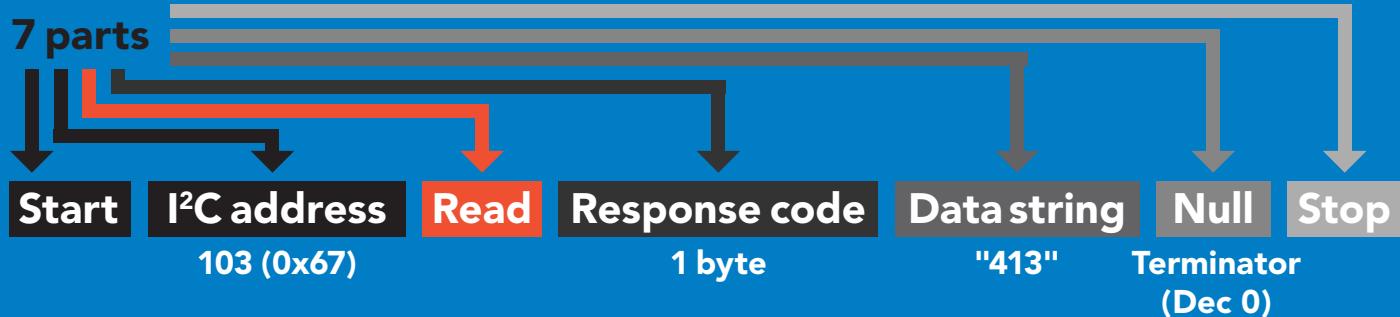
I²C address **Command**



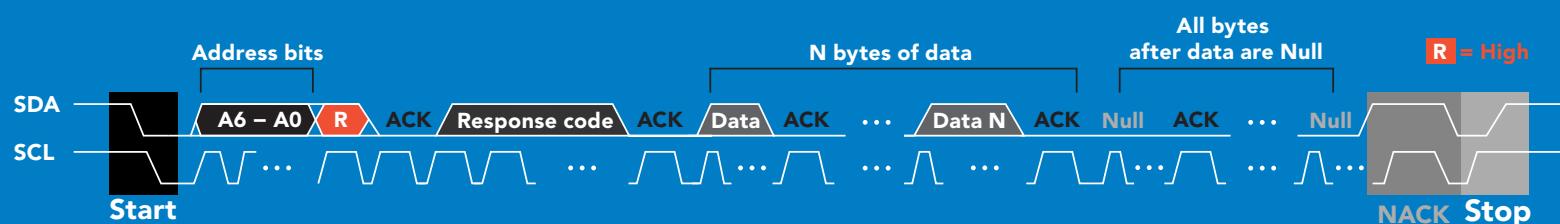
Advanced



Requesting data from device



Advanced

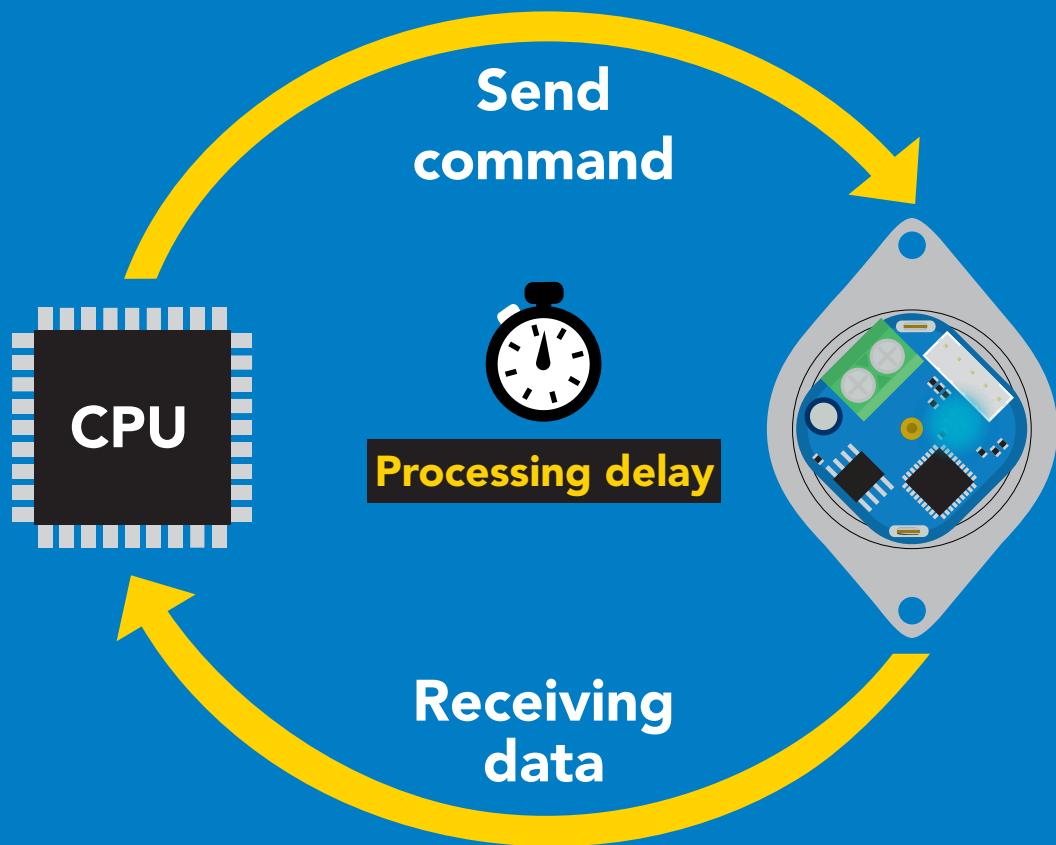


1 52 49 51 0 = 413
Dec Dec
ASCII

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); →  Processing delay
```

```
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

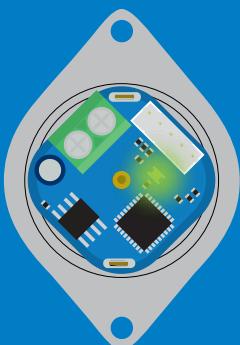
Single byte, not string

255	no data to send
254	still processing, not ready
2	syntax error
1	successful request

LED color definition



Blue
I²C standby



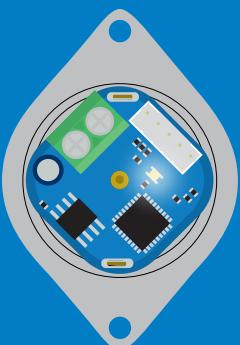
Green
Taking reading



Purple
Changing
I²C ID#



Red
Command
not understood



White
Find

5V	LED ON +2.5 mA
3.3V	+1 mA

I²C mode

command quick reference

All commands are ASCII strings or single ASCII characters.

Command	Function	
Baud	switch back to UART mode	pg. 71
Cal	performs calibration	pg. 62
D	dispense modes	pg. 55 – 58
Factory	enable factory reset	pg. 70
Find	finds device with blinking white LED	pg. 53
i	device information	pg. 65
I2C	change I ² C address	pg. 69
L	enable/disable LED	pg. 52
O	enable/disable parameters	pg. 63
P	pauses the pump during dispensing	pg. 59
Plock	enable/disable protocol lock	pg. 68
Pv	check pump voltage	pg. 64
R	returns a single reading	pg. 54
Sleep	enter sleep mode/low power	pg. 67
Status	retrieve status information	pg. 66
Tv	total volume dispensed	pg. 61
X	stop dispensing	pg. 60

LED control

Command syntax

300ms  processing delay

L,1 LED on **default**

L,0 LED off

L,? LED state on/off?

Example

L,1


Wait 300ms

1
Dec **0**
Null

L,0


Wait 300ms

1
Dec **0**
Null

L,?

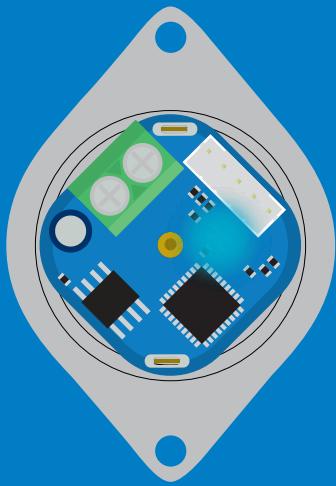

Wait 300ms

1 **?L,1** **0**
Dec ASCII Null

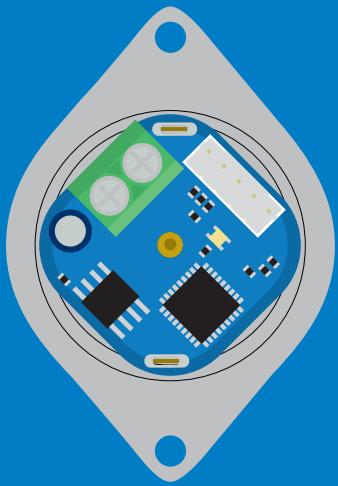
or


Wait 300ms

1 **?L,0** **0**
Dec ASCII Null



L,1



L,0

Find

300ms  processing delay

Command syntax

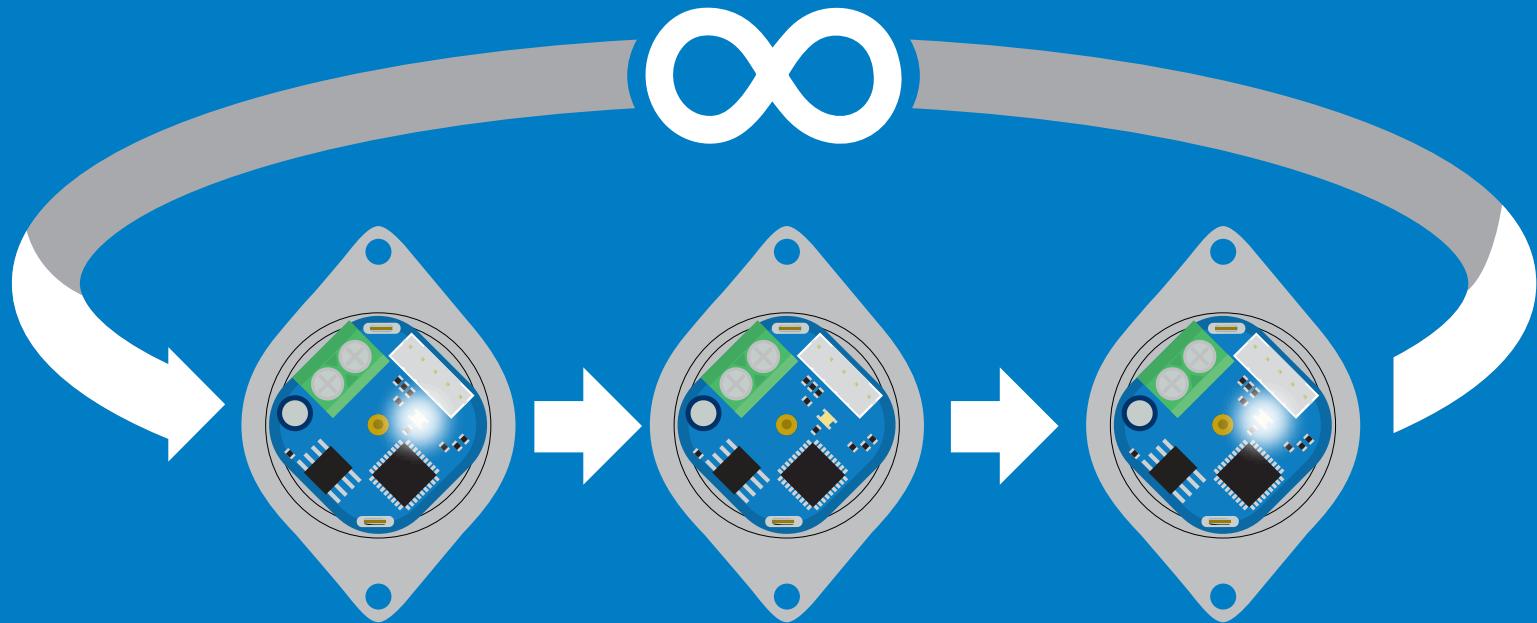
This command will disable continuous mode
Send any character or command to terminate find.

Find LED rapidly blinks white, used to help find device

Example Response

Find

 Wait 300ms
1 Dec 0 Null



Single report mode

Command syntax

300ms  processing delay

R returns a single value showing dispensed volume

Example

Response

R



1
Dec

2.50
ASCII

0
Null

(If issued half way through dispensing 5ml)

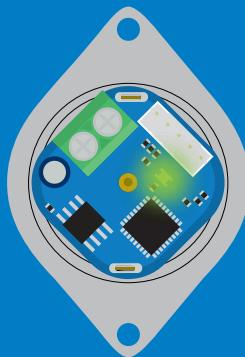


1
Dec

5.00
ASCII

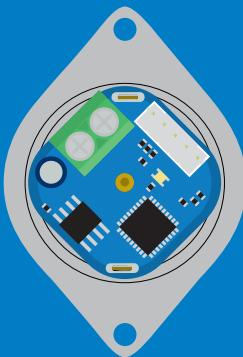
0
Null

(If issued once dispensing has stopped)

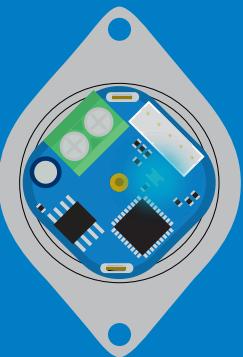
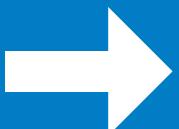


Green

Taking reading



Transmitting



Blue

Standby

Continuous dispensing

Pump on/pump off

300ms  processing delay

Command syntax

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

D,* dispense until the stop command is given

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

D,? dispense status

Example

Response

D,*



1 Dec 0 Null

pump will continuously run at
~105ml/min (with supplied tubing)

D,-*



1 Dec 0 Null

pump will continuously run in reverse
at ~105ml/min (with supplied tubing)

D,?



1 Dec ?D,10.00,1 0 Null

ASCII

Response breakdown

?D,*,1

↑
last volume
↑
pump on
requested

Volume dispensing

Pump a specific volume

300ms  processing delay

Command syntax

where [ml] is any volume in millimeters ≥ 0.5

D,[ml] dispense [this specific volume]

D,-[ml] dispense [in reverse this specific volume]

D,? dispense status

Example

D,15


Wait 300ms

1 Dec 0 Null

15 ml will be dispensed

D,-405


Wait 300ms

1 Dec 0 Null

405 ml will be dispensed
in reverse

D,?


Wait 300ms

1 Dec ?D,22.50,0 0 Null

Response breakdown

?D,22.50,0

↑
last volume
dispensed ↑
pump off

Dose over time

Pump a fixed volume over a fixed time

Command syntax

300ms  processing delay

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

Example

D,85,10

Response

 Wait 300ms

1 Dec **0** Null

Dispense 85ml over 10 mins



Constant flow rate

Maintain a constant flow rate

300ms  processing delay

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

DC,25,40



1
Dec
0
Null

Dispense 25ml per minute
for 40 minutes

DC,?

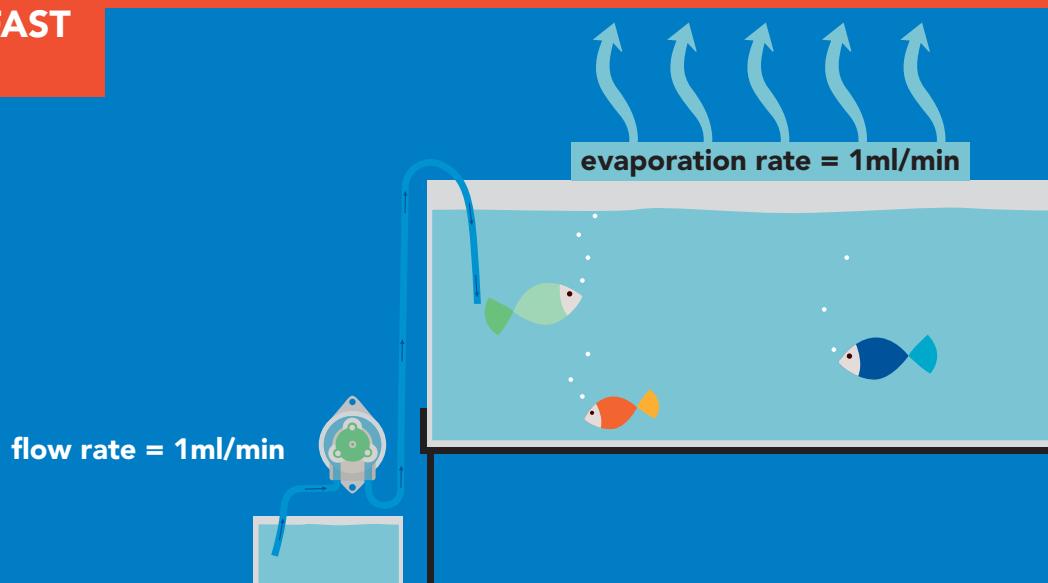


1
Dec
?maxrate,58.5
ASCII
0
Null

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

*TOOFAST

*ER



Pause dispensing

Command syntax

300ms  processing delay

Issue the command again to resume dispensing

P pauses the pump during dispensing

P? pause status

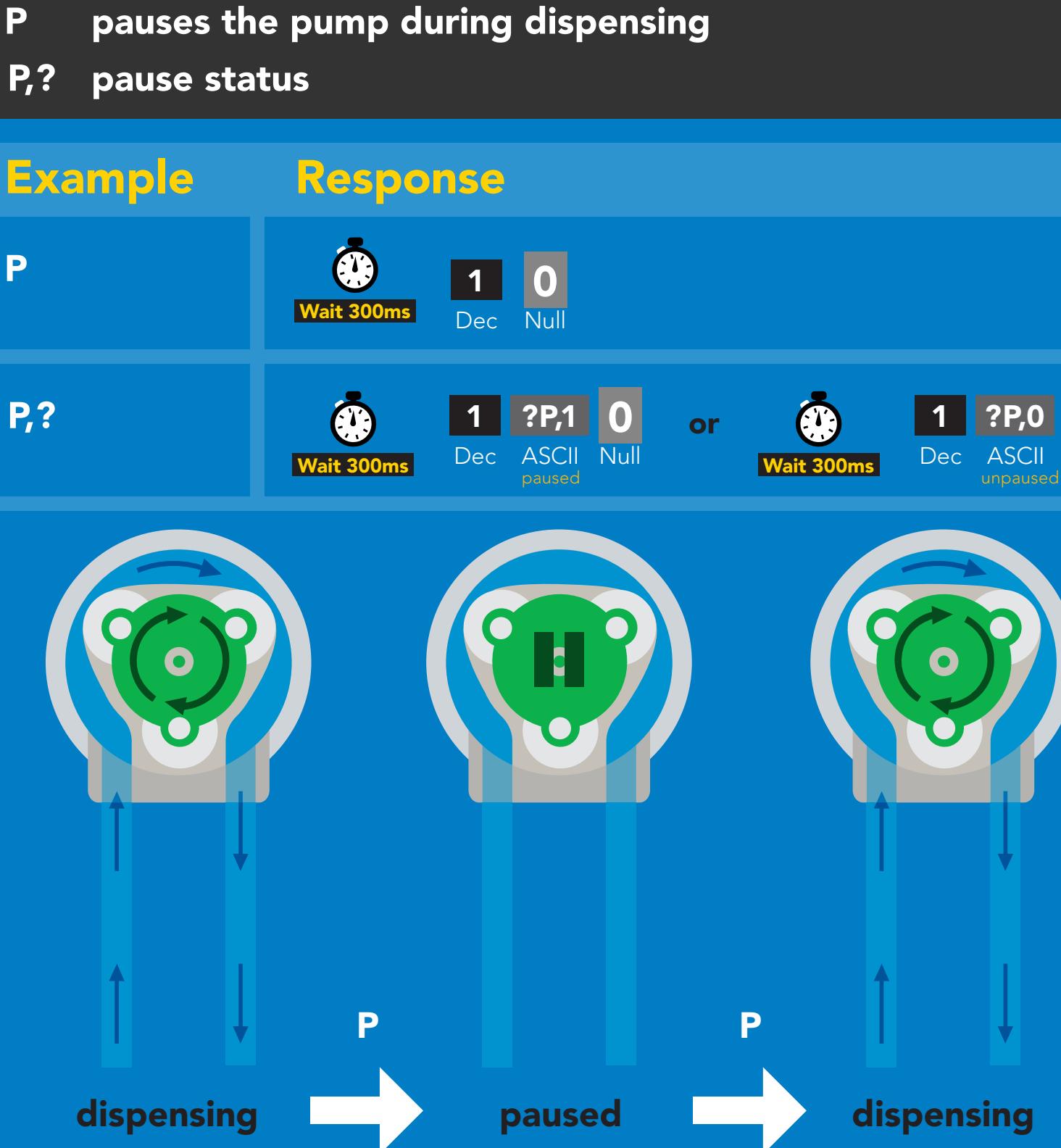
Example

P

 Wait 300ms
1 Dec 0 Null

P?

 Wait 300ms
1 Dec ?P,1 0 ASCII paused or
 Wait 300ms
1 Dec ?P,0 0 ASCII unpause Null



Stop dispensing

Command syntax

300ms  processing delay

X stop dispensing

Example

Response

X



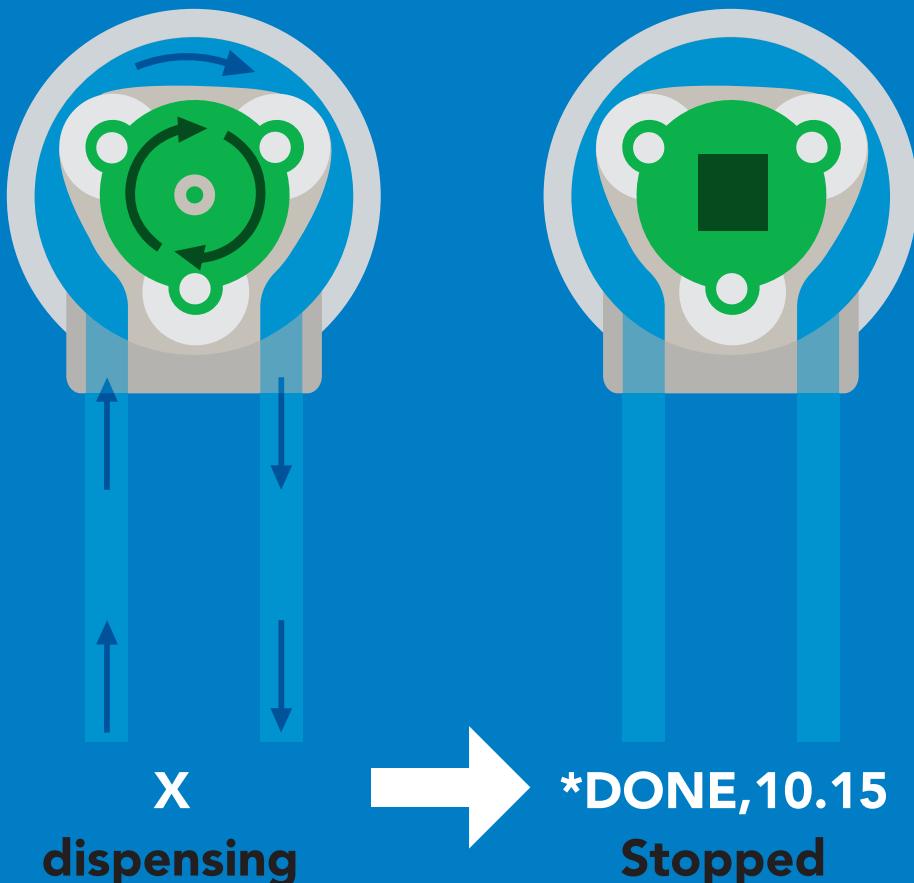
Wait 300ms

1
Dec

*DONE,v
ASCII

0
Null

v = volume dispensed



Total volume dispensed

Command syntax

300ms  processing delay

TV,? shows total volume dispensed

ATV,? absolute value of the total volume dispensed

Clear clears the total dispensed volume

Example

TV,?

Response

 1 ?total,623.00 0
Wait 300ms Dec ASCII Null

ATV,?

 1 ?total,434.50 0
Wait 300ms Dec ASCII Null

clear

 1 0 total now 0.00
Wait 300ms Dec Null

Calibration

Command syntax

300ms processing delay

Calibrate to the actual volume dispensed.

- Cal,v** **v = corrected volume**
- Cal,clear** **delete calibration data**
- Cal,?** **device calibrated?**

Example

Cal,24.01

Response

Wait 300ms

Cal, clear

Wait 300ms

1 Dec Null

Cal,?

The diagram illustrates four calibration modes, each consisting of a clock icon, a sequence of bytes, and a duration:

- fixed volume:** 1 Dec ASCII Null. Duration: Wait 300ms.
- volume/time:** 1 Dec ASCII Null. Duration: Wait 300ms.
- both:** 1 Dec ASCII Null. Duration: Wait 300ms.
- uncalibrated:** 1 Dec ASCII Null. Duration: Wait 300ms.

The sequence of bytes (1, ?Cal, X, 0) is enclosed in a grey box, where X corresponds to the mode number (1, 2, 3, or 0).

Enable/disable parameters from output string

Command syntax

300ms  processing delay

O, [parameter],[1,0] enable or disable output parameter

O,? enabled parameter?

Example

O,V,1

Response



Wait 300ms

1
Dec

0
Null

enable volume being pumped

O,TV,0



Wait 300ms

1
Dec

0
Null

disable total volume pumped

O,ATV,1



Wait 300ms

1
Dec

0
Null

enable absolute
volume pumped

O,?



Wait 300ms

1
Dec

?
ASCII

0
Null

if all three
are enabled

Pump voltage

Command syntax

300ms  processing delay

PV,? check pump voltage

Example

Response

PV,?



Wait 300ms

1

?PV,13.86

Dec

ASCII

0

Null

Response breakdown

?PV, 13.86

↑
Pump input voltage

Device information

Command syntax

300ms  processing delay

i device information

Example Response

i



Wait 300ms

1

Dec

?i,PMP, 1.1

ASCII

0

Null

Response breakdown

?i, PMP, 1.1
↑ ↑
Device Firmware

Reading device status

Command syntax

300ms  processing delay

Status voltage at Vcc pin and reason for last restart

Example Response

Status



Wait 300ms

1

?Status,P,5.038

Dec

ASCII

0

Null

Response breakdown

?Status, P, 5.038

Reason for restart

Voltage at Vcc

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

Do not read status byte after issuing sleep command.

Any command

wakes up device

	STANDBY	SLEEP
5V	13.4 mA	0.415 mA

3.3V	12.4 mA	0.13 mA
-------------	----------------	----------------



Protocol lock

Command syntax

300ms  processing delay

Plock,1 enable Plock

Locks device to I²C mode.

Plock,0 disable Plock **default**

Plock,? Plock on/off?

Example

Plock,1


Wait 300ms

1
Dec
0
Null

Plock,0


Wait 300ms

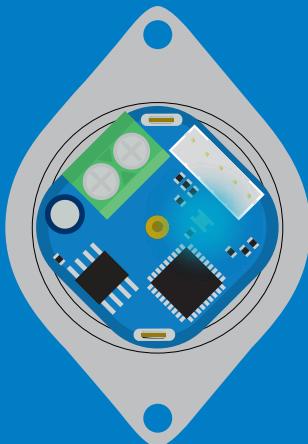
1
Dec
0
Null

Plock,?

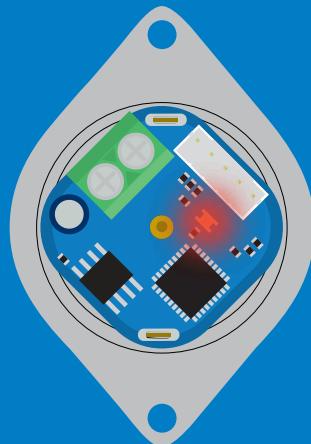

Wait 300ms

1
Dec
?Plock,1
ASCII
0
Null

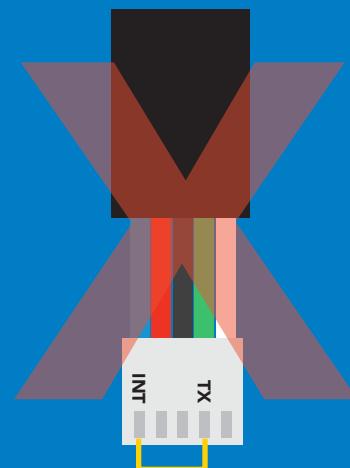
Plock,1



Baud, 9600



cannot change to UART



cannot change to UART

I²C address change

Command syntax

300ms  processing delay

I2C,n sets I²C address and reboots into I²C mode

Example Response

I2C,101

device reboot

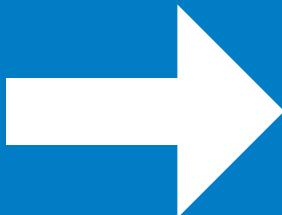
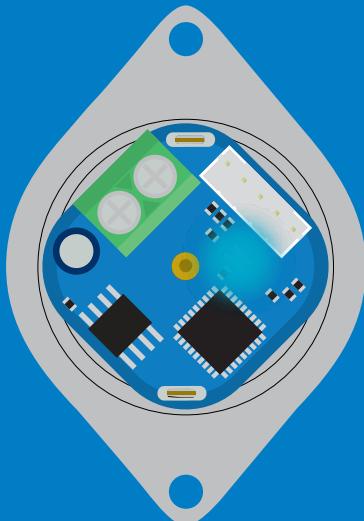
Warning!

Changing the I²C address will prevent communication between the circuit and the CPU, until the CPU is updated with the new I²C address.

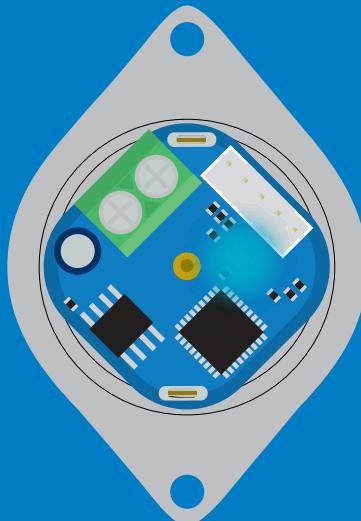
Default I²C address is 103 (0x67).

n = any number 1 – 127

I2C,101



(reboot)



Factory reset

Command syntax

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

Factory enable factory reset

I²C address will not change

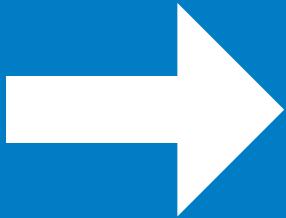
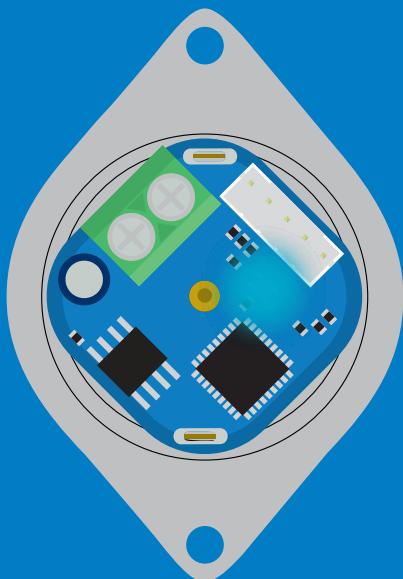
Example Response

Factory

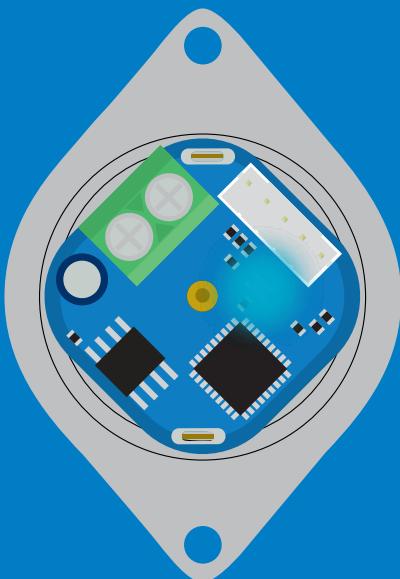
device reboot

Clears calibration
LED on
Response codes enabled

Factory



(reboot)



Change to UART mode

Command syntax

Baud,n switch from I²C to UART

Example Response

Baud,9600

reboot in UART mode

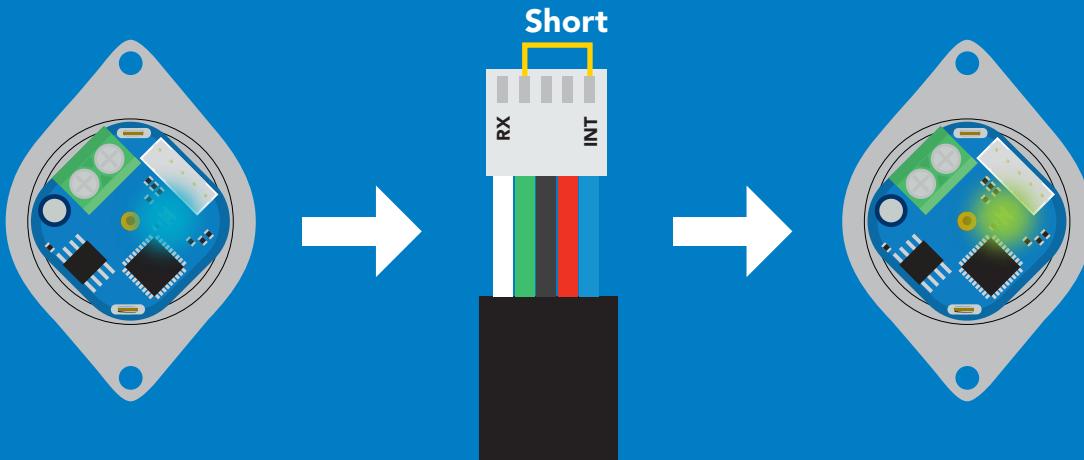
n = [300
1200
2400
9600
19200
38400
57600
115200]



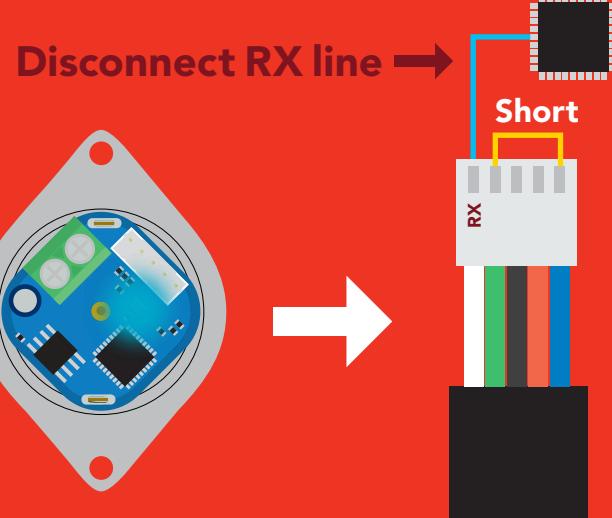
Manual switching to UART

- 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

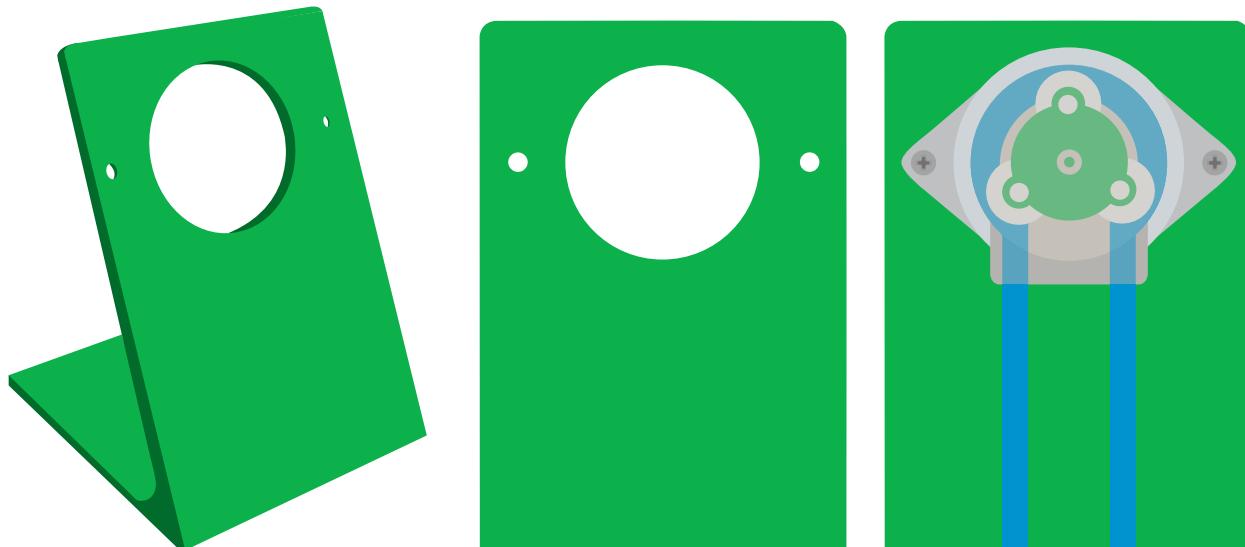


Wrong Example

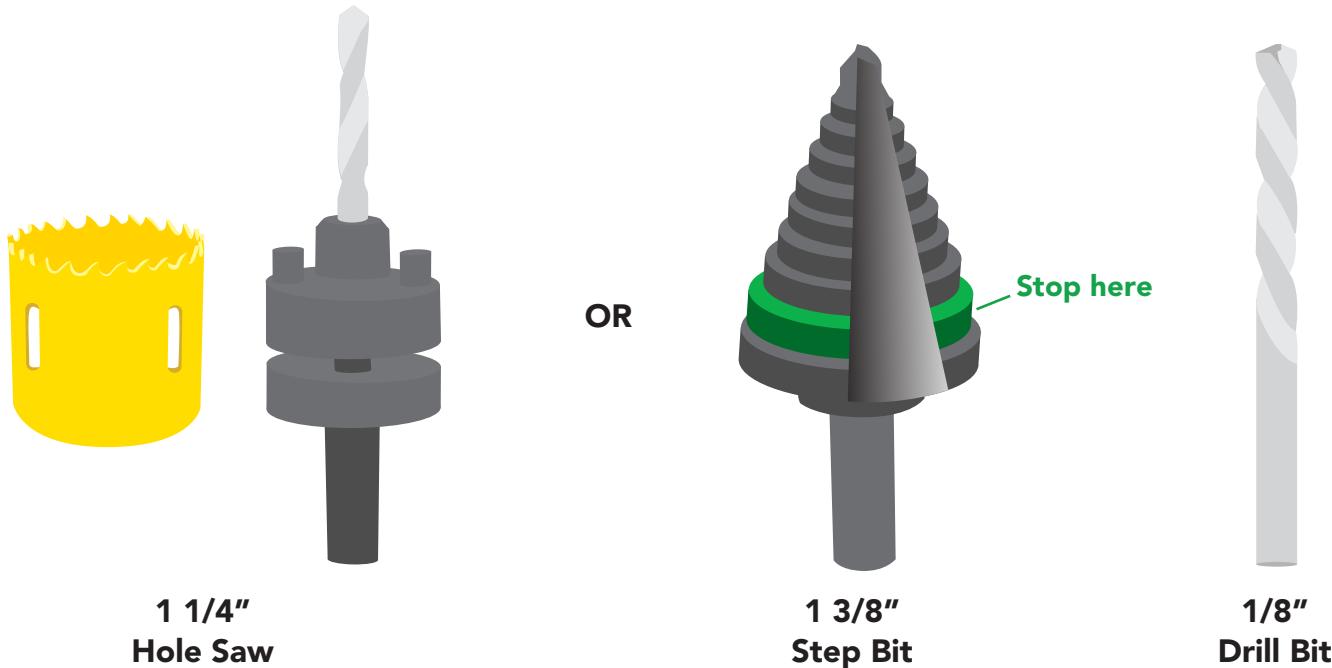


Mounting the EZO-PMP™

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

OR

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 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™ Warranties 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.