Atlas Scientific™
Environmental Robotics

V 1.8

Revised 3/22

EZO-CO2™

Embedded NDIR CO2 Sensor

Reads	**Gaseous CO2**
Range	**0 – 10,000 ppm**
Calibration	**Factory calibrated**
Response time	**1 reading per second**
Resolution	**1 ppm**
Accuracy	**(+/- 5%) + (+/- 50 ppm)**
Connector	**5 lead data cable**
Warmup time	**10 seconds**
Cable length	**1 meter**
Data protocol	**UART & I²C**
Default I²C address	**105 (0x69)**
Data format	**ASCII**
Operating voltage	**3.3V – 5V**
Life expectancy	**~5.5 years**



Written by Jordan Press
Designed by Noah Press

This is an evolving document, check back for updates.

Table of contents

Operating principle 6
Physical properties 7
Sensor properties 7
Pin out 8
Sensor warm-up 9
Calibration theory 10
Custom calibration 10
Default state 11
Available data protocol 12

UART

UART mode 14
Receiving data from device 15
Sending commands to device 16
LED color definition 17
UART quick command page 18
LED control 19
Find 20
Continuous mode 21
Single reading mode 22
Alarm 23
Custom calibration 24
Enable/disable internal temp 25
Naming device 26
Device information 27
Response codes 28
Reading device status 29
Sleep mode/low power 30
Change baud rate 31
Protocol lock 32
Factory reset 33
Change to I2C mode 34
Manual switching to I2C 35

I²C

I²C mode 37
Sending commands 38
Requesting data 39
Response codes 40
Processing delay 40
LED color definition 41
I²C quick command page 42
LED control 43
Find 44
Taking reading 45
Alarm 46
Custom calibration 47
Enable/disable internal temp 48
Naming device 49
Device information 50
Reading device status 51
Sleep mode/low power 52
Protocol lock 53
I²C address change 54
Factory reset 55
Change to UART mode 56
Manual switching to UART 57

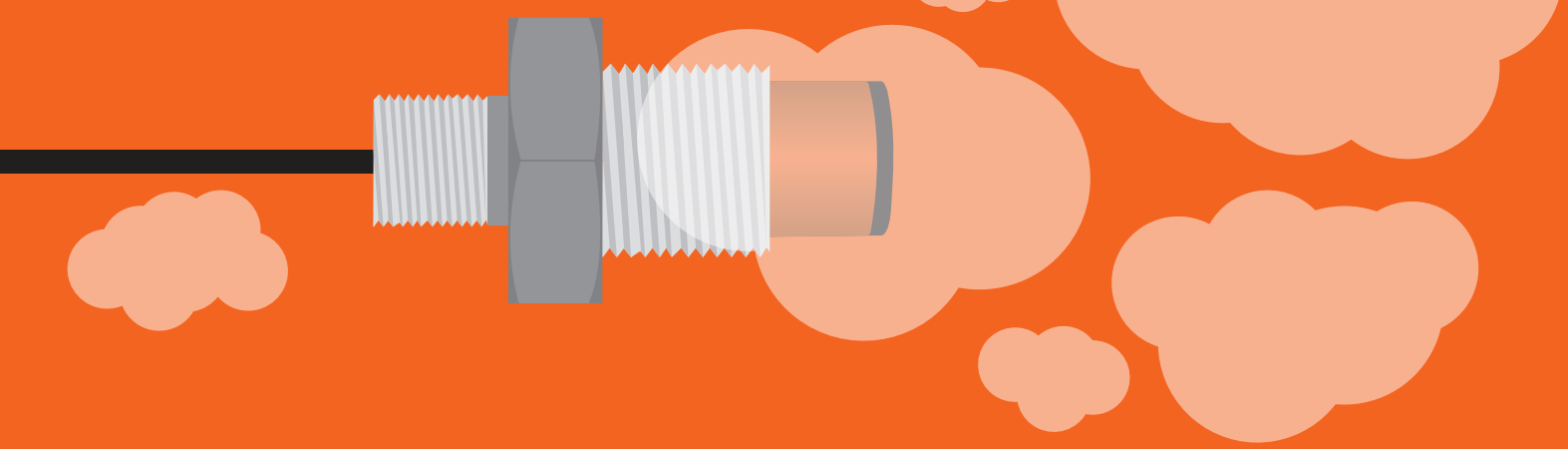
Datasheet change log 58
Firmware updates 58
Warranty 59

Copyright © Atlas Scientific LLC

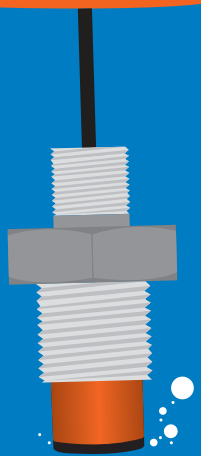
Attention

The EZO-CO2™ is 100% operational out of the box.
CALIBRATION IS UNNECESSARY

This sensor detects GASEOUS CO2



This sensor does not read dissolved CO2.
DO NOT SUBMERGE!

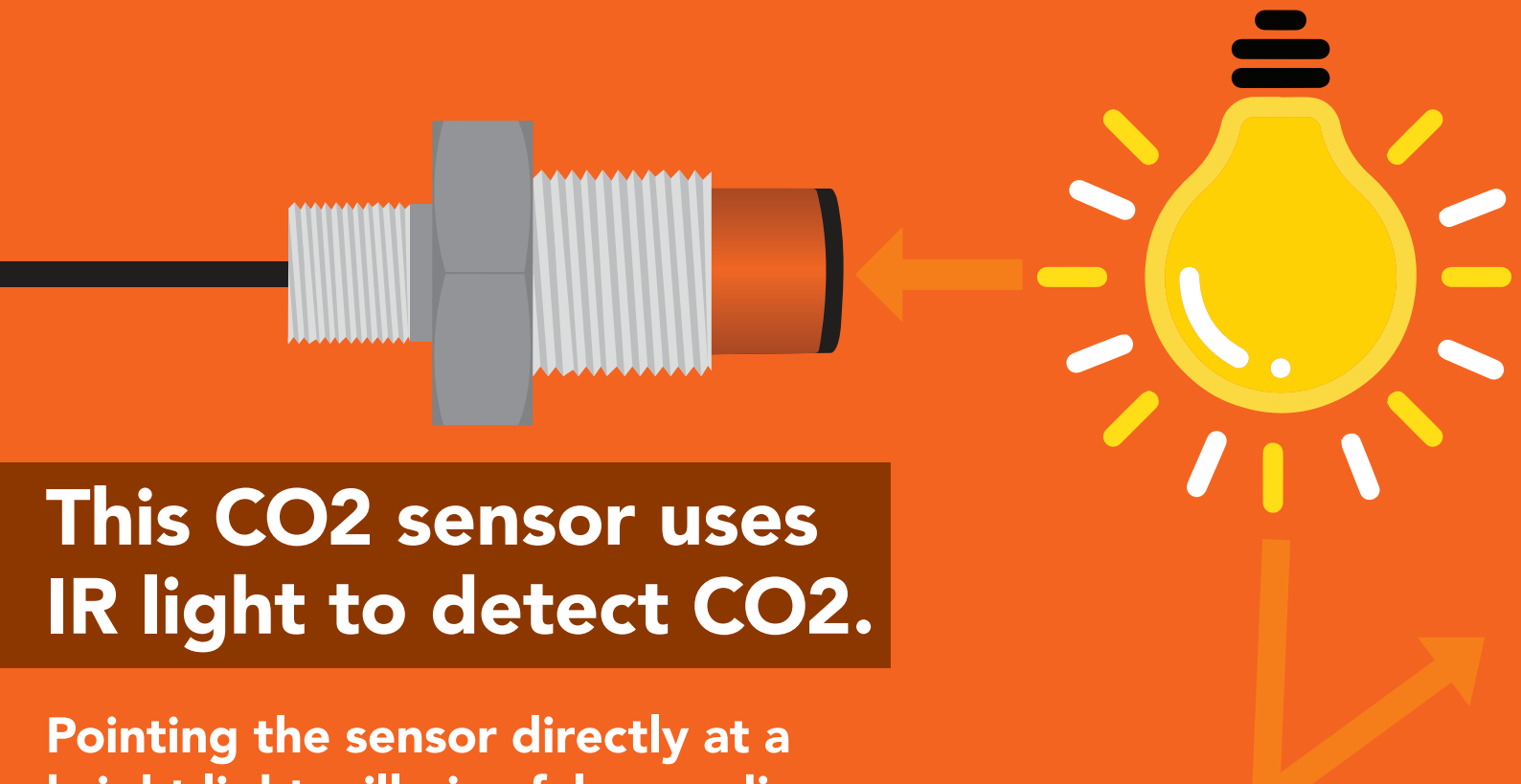


Copyright © Atlas Scientific LLC

AtlasScientific™
Environmental Robotics

Attention

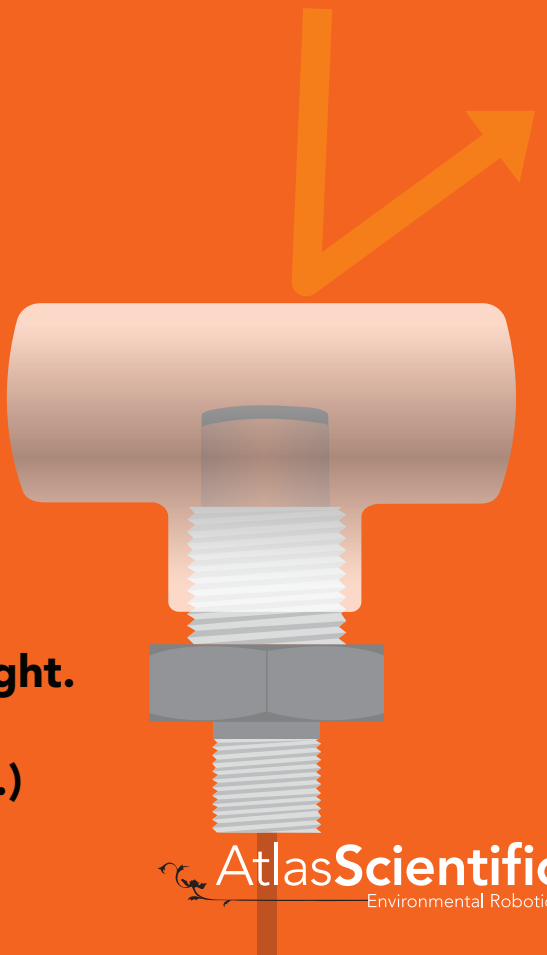
Do not point the sensor *directly* at bright lights



This CO2 sensor uses IR light to detect CO2.

Pointing the sensor directly at a bright light will give false readings.

(it will not damage the sensor.)



If the CO2 sensor is returning false readings when in a bright environment, try attaching a PVC Tee to the sensor, to block the direct light.

(or just don't point the sensor at bright lights.)

Copyright © Atlas Scientific LLC

Atlas Scientific™
Environmental Robotics

Attention

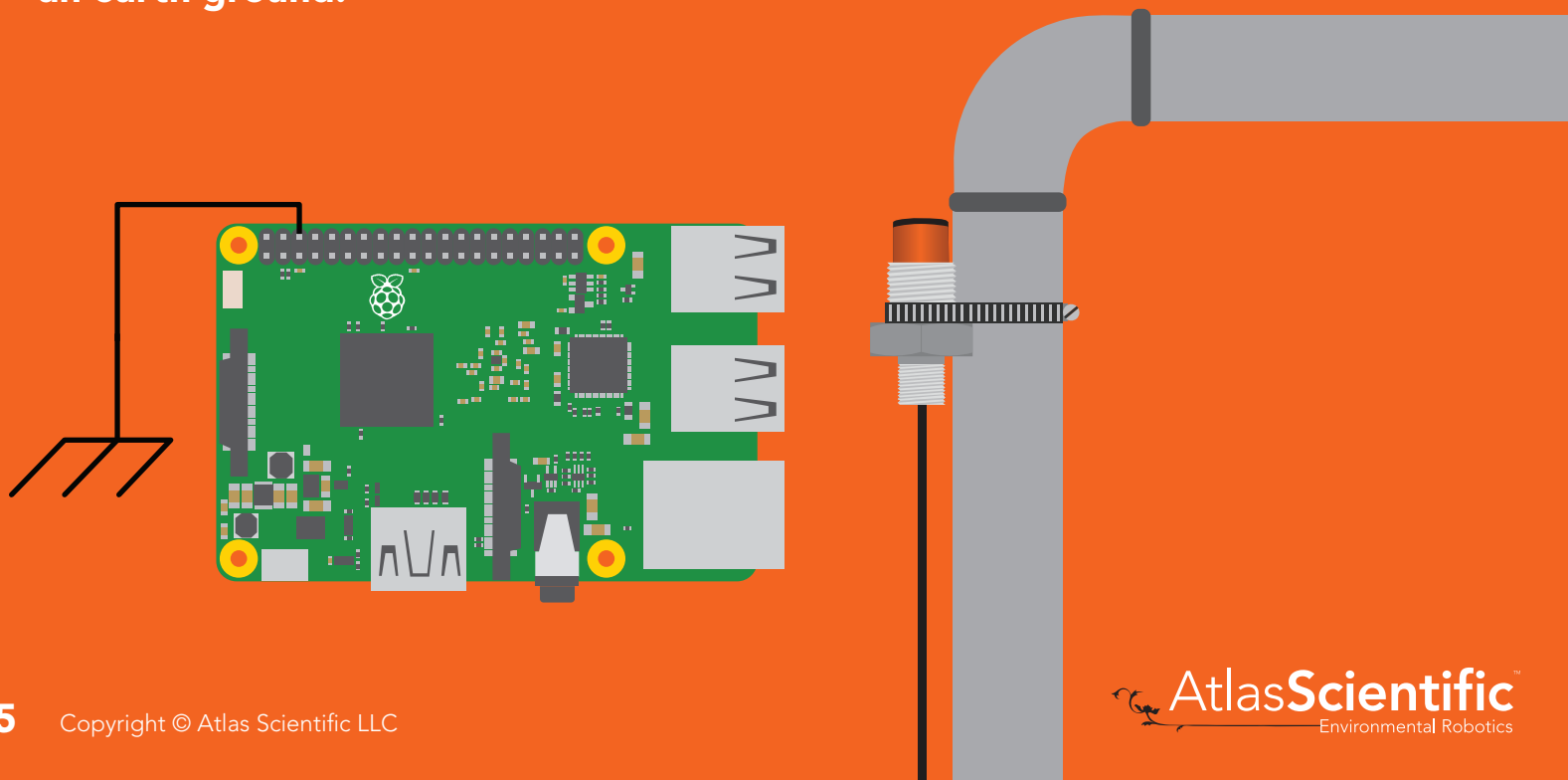
This CO2 sensor is sensitive to ground loops.

Put simply, a ground loop is when the ground line is not actually 0 volts. (It's the buzzing you hear in audio equipment)

If your system has a ground loop you will see readings that are between 100 and 250 ppm higher than expected. Atlas Scientific has detected ground loops on many different Raspberry Pi's. If this sensor is connected to a Raspberry Pi you should expect to have a ground loop.

There are two ways to fix this problem

1. Connect a ground pin from the Raspberry Pi (or other device) to an earth ground.
2. Connect the body of the CO2 sensor to a metal object that is connected to an earth ground.

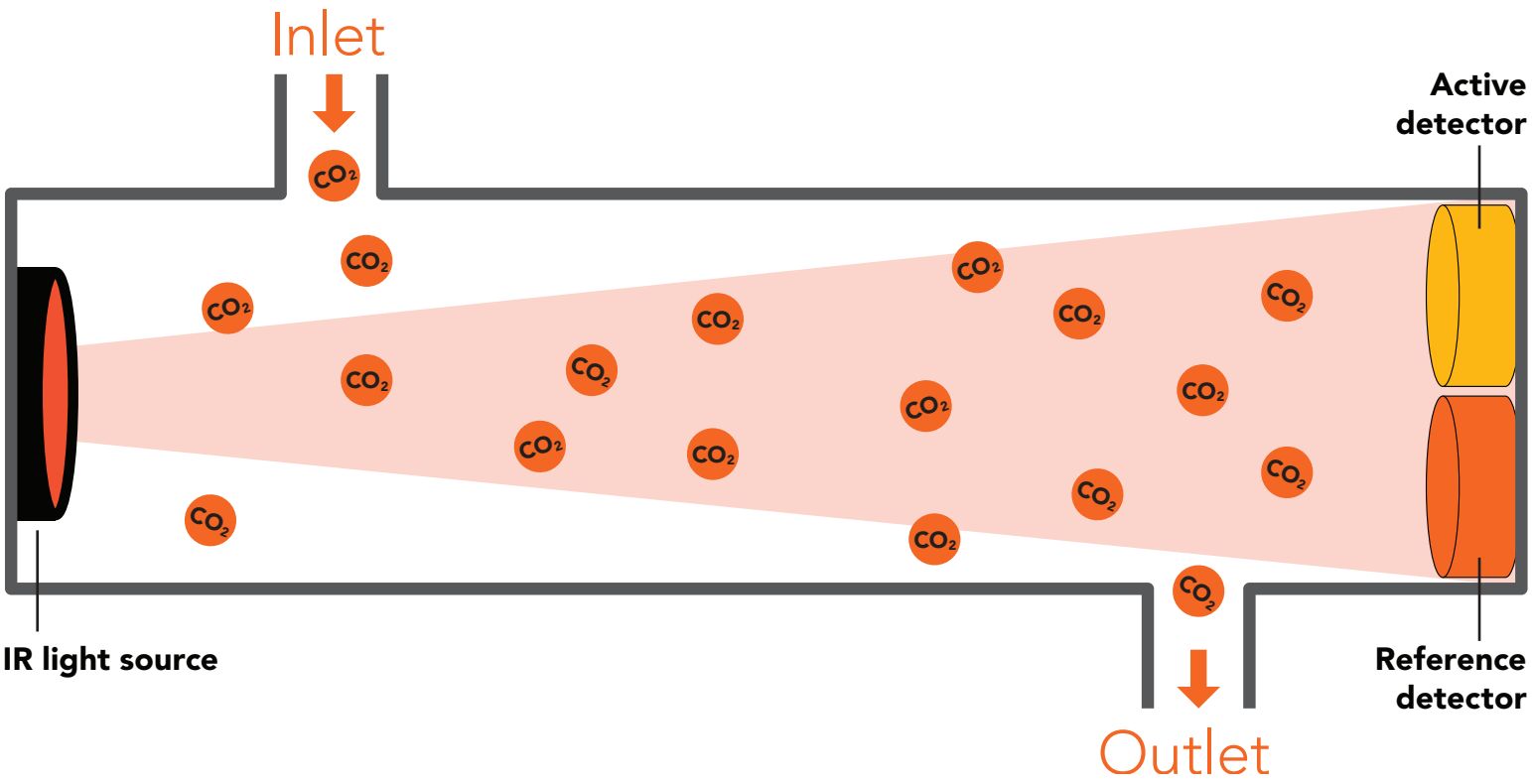


Copyright © Atlas Scientific LLC

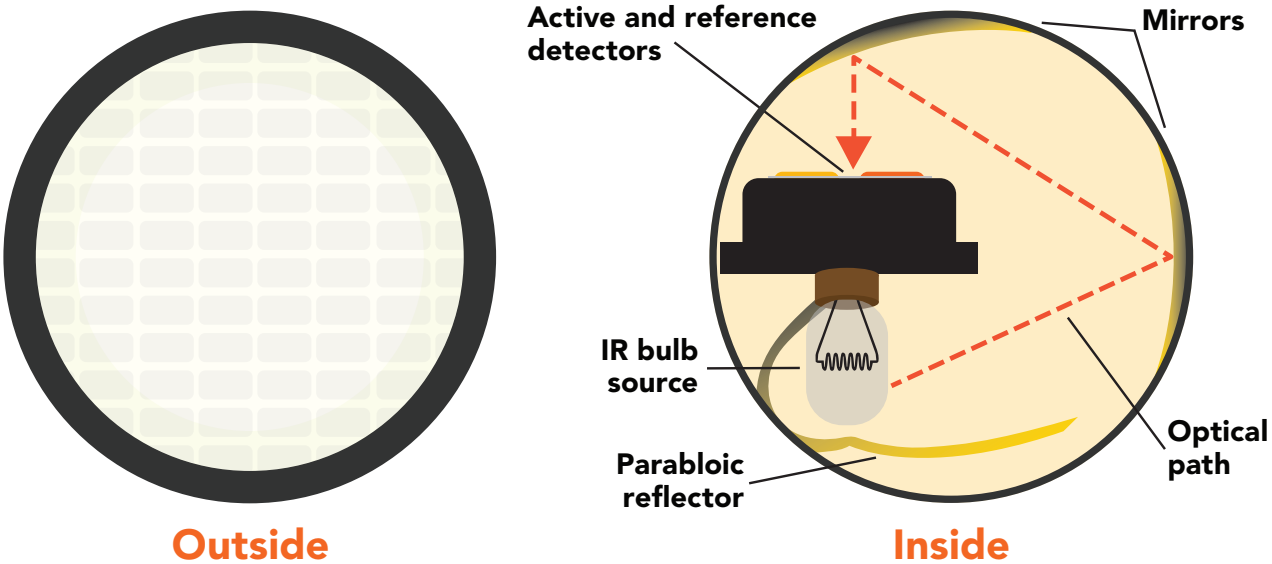
AtlasScientific™
Environmental Robotics

Operating principle

The Atlas Scientific EZO-CO2™ Embedded CO2 Sensor uses a non-dispersive infra-red (NDIR) gas detection cell to derive CO2 content in a gaseous matrix. The NDIR detection cell is a single wavelength spectrophotometer that has been specifically designed to detect 4.2µm infrared radiation.



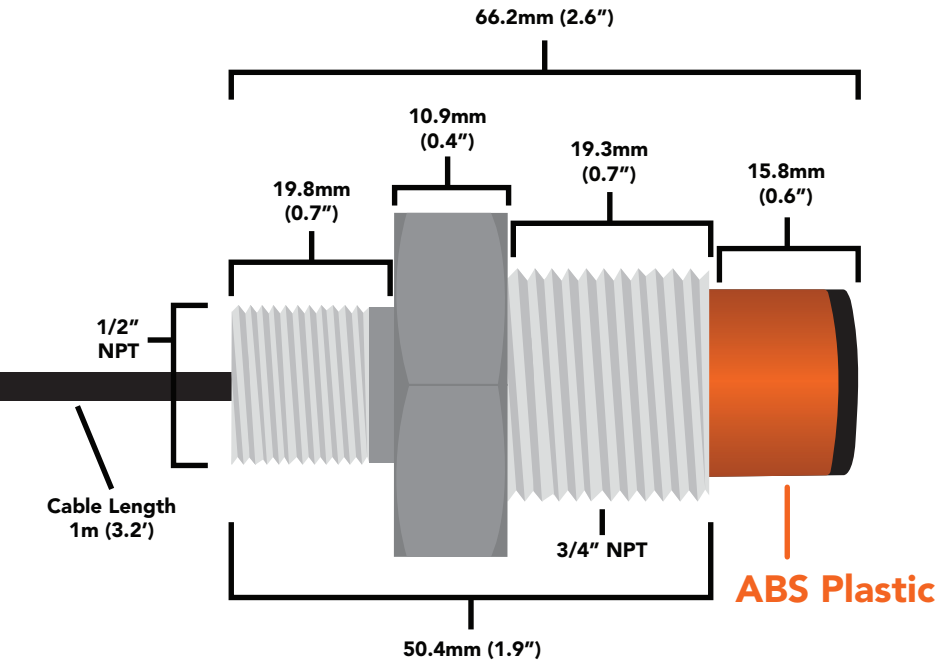
Gaseous CO2 has a prominent absorption band centered at 4.2µm. CO2 content is derived by quantifying how much light energy has been lost when it travels through a gaseous matrix over a fixed distance.

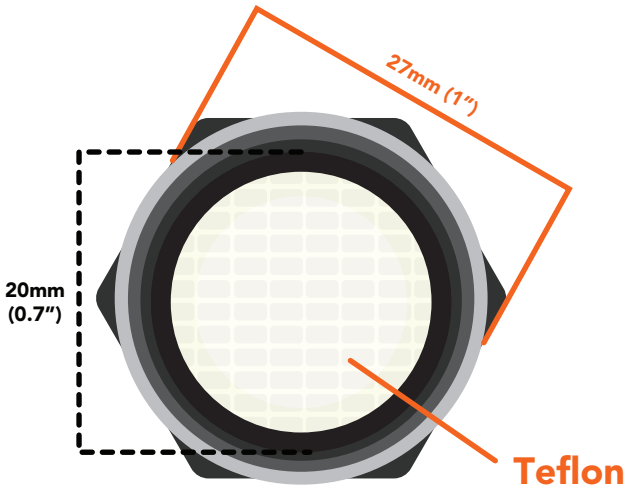


Copyright © Atlas Scientific LLC

Physical properties

The EZO-CO2™ sensor only detects gaseous CO2 levels. This device cannot read dissolved CO2 levels. *DO NOT SUBMERGE IN LIQUID.*





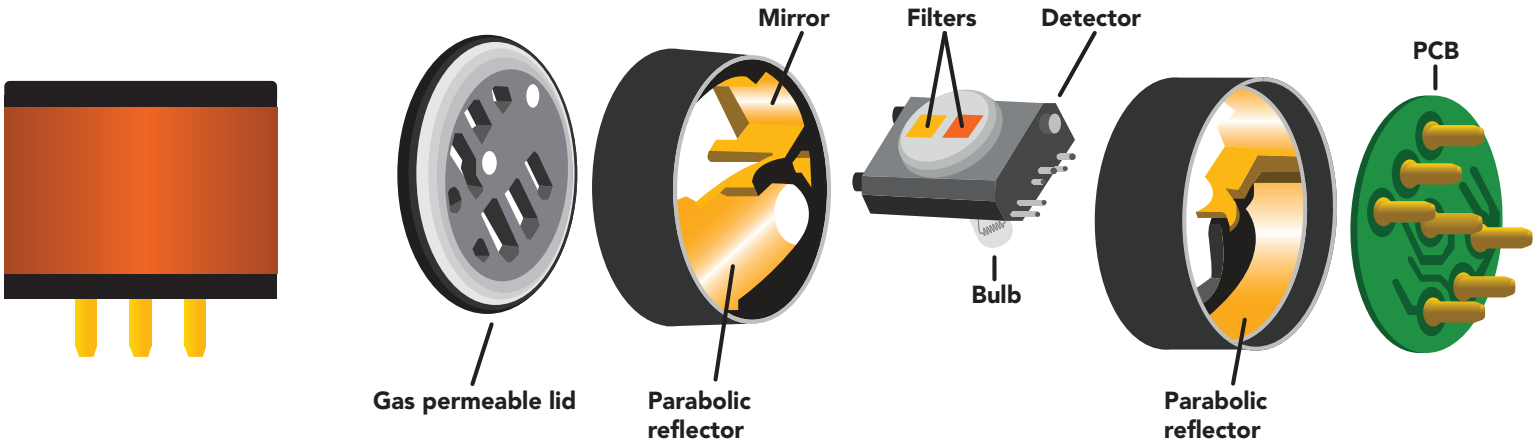


Weight 133g

Body 316 Stainless Steel

IP60

Sensor properties



Copyright © Atlas Scientific LLC

Atlas Scientific™ Environmental Robotics

Pin out

Data and power cable pinout

White – RX/SCL
Green – TX/SDA
Black – GND
Red – VCC
Blue – ALM



The alarm pin will go high when a set CO2 level has been crossed.



If unused leave **ALM** floating. Do not connect **ALM** to **VCC** or **GND**.

See page **23** to enable CO2 level alarm in UART mode.
See page **46** to enable CO2 level alarm in I2C mode.

Power consumption

	LED	MAX	SLEEP
5V	ON	45 mA	3.4 mA
	OFF	44 mA	
3.3V	ON	42 mA	3.0 mA
	OFF	41 mA	

Absolute max ratings

Parameter	MIN	TYP	MAX
Storage temperature	-65 °C		75 °C
Operational temperature	-20 °C	25 °C	50 °C
VCC	3.3V	3.3V	5.5V

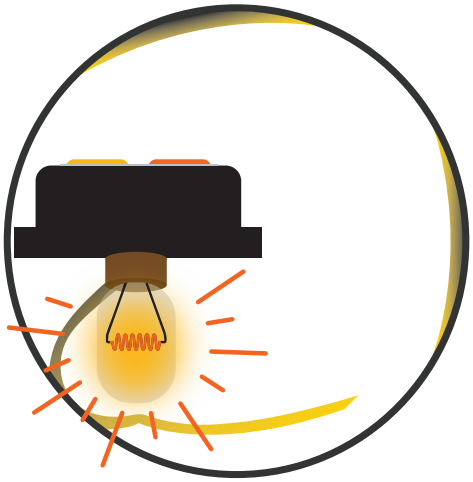
Humidity Range 0 to 95% rh non-condensing

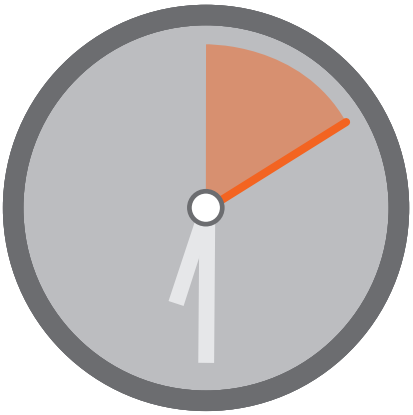
IP60

Copyright © Atlas Scientific LLC

Sensor warm-up

When the Atlas Scientific EZO-CO2™ Embedded CO2 Sensor is first powered on *(or wakes up from sleep mode)* the sensor must warm-up before it can output readings. The warm-up process takes 10 seconds to complete.

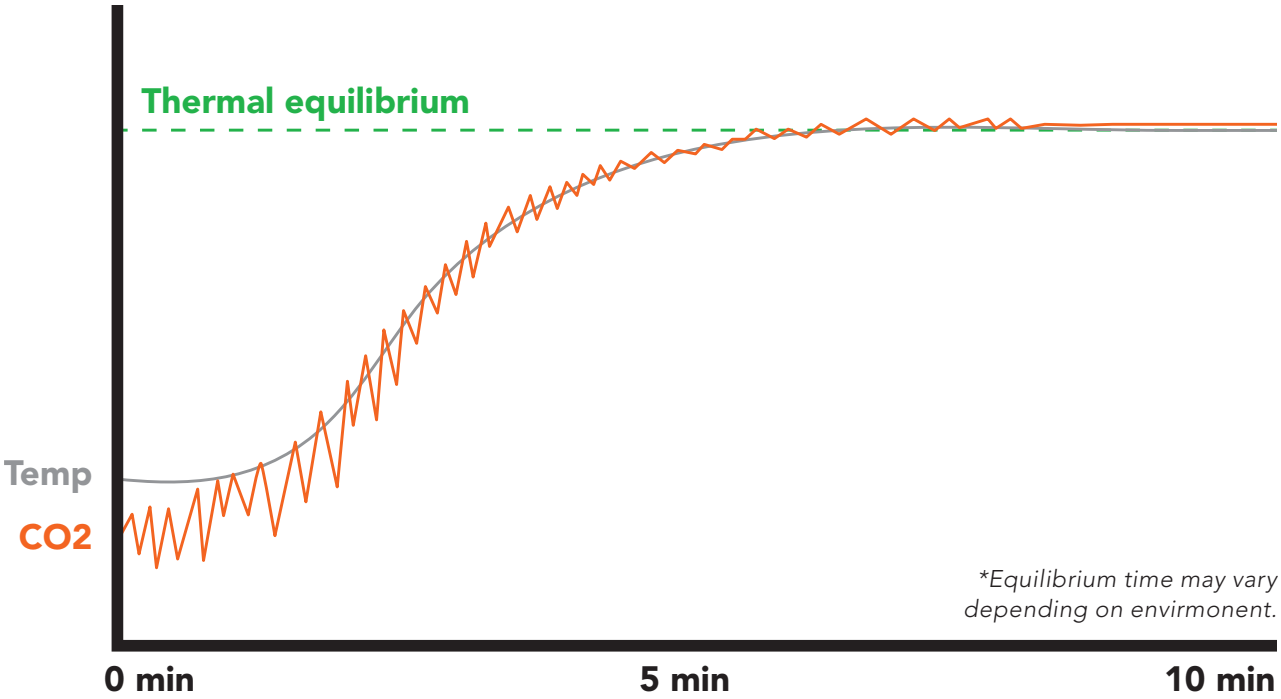




10 sec

During the first 10 seconds of operation the output will be: ***warm**

Once warming is finished, CO2 readings will be output. The device will continue to warm-up over several minutes. As the internal temperature stabilizes, so will the CO2 readings.

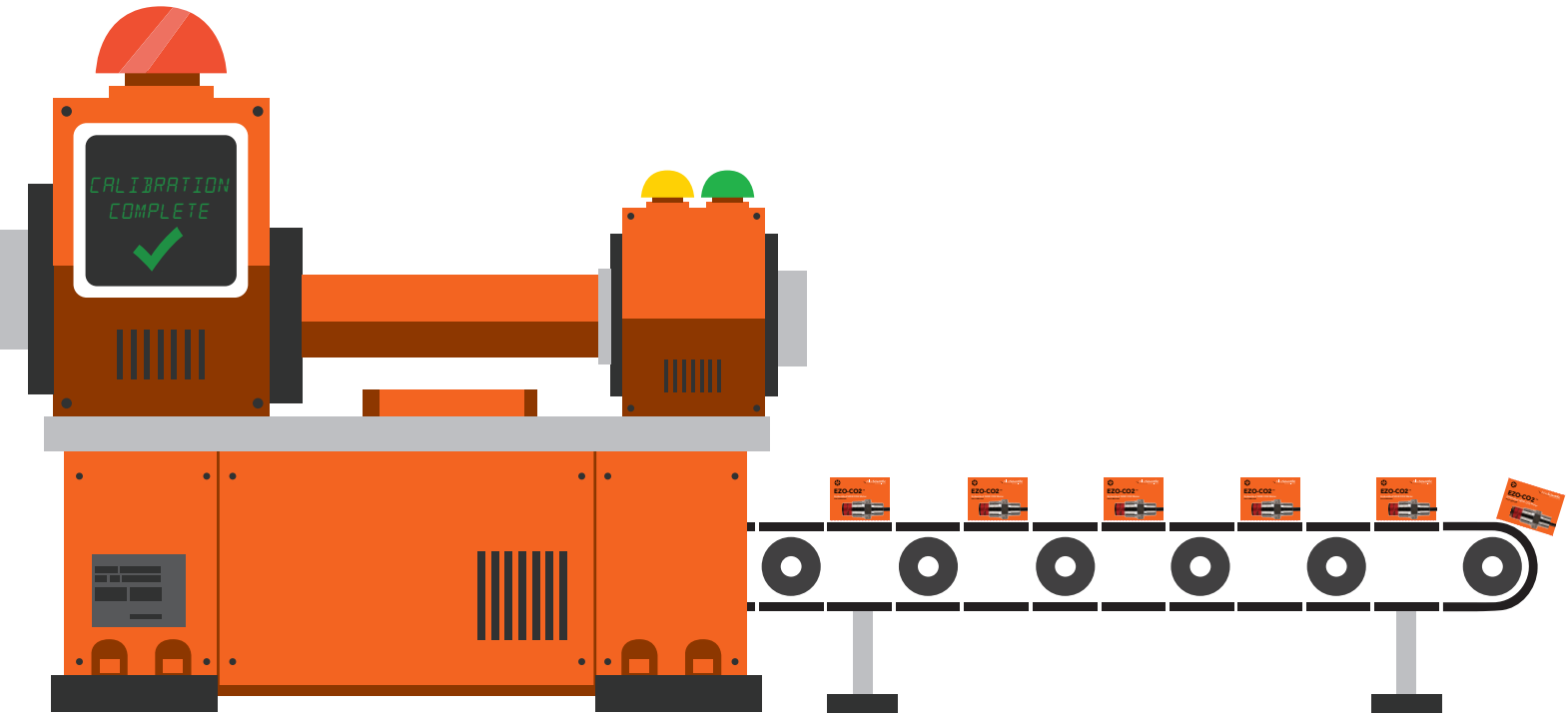


To see the internal temperature of the sensor and watch as it stabilizes, use the 'O' command found on page 24.

Copyright © Atlas Scientific LLC

Calibration theory

The Atlas Scientific EZO-CO2™ Embedded CO2 Sensor comes pre-calibrated, and does not need to be recalibrated. Atlas Scientific performs a two-point factory calibration as part of the manufacturing process.



Low point calibration = 0 ppm
High point calibration = 4,000 ppm

The factory calibration data is permanently stored in the sensor and cannot be erased.

Custom calibration

One or two-point calibration can be done at any time. When custom calibration is used, factory calibration will be ignored. To revert back to the factory calibration simply clear the custom calibration.

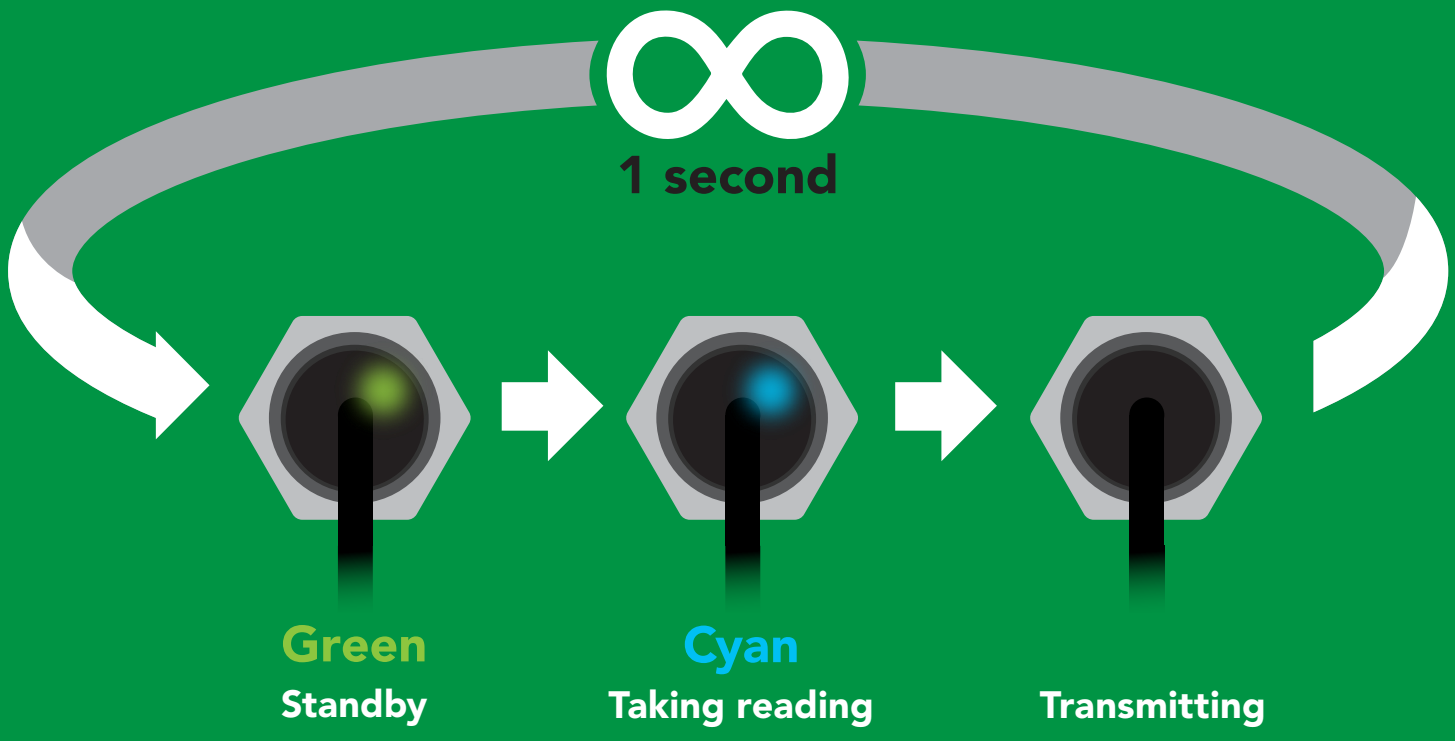
See page **24** or **47** for custom calibration commands.

 Copyright © Atlas Scientific LLC

Default state

UART mode

Baud	**9,600**
Readings	**continuous**
Speed	**1 second**
LED	**on**



 Copyright © Atlas Scientific LLC

AtlasScientific™ Environmental Robotics

✓ Available data protocols

UART

default

I²C

X Unavailable data protocols

SPI

Analog

RS-485

Mod Bus

4–20mA

 Copyright © Atlas Scientific LLC

UART mode

Settings that are retained if power is cut

Baud rate
Calibration
Continuous mode
Device name
Enable/disable response codes
Hardware switch to I^2C mode
LED control
Protocol lock
Software switch to I^2C mode

Settings that are *NOT* retained if power is cut

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

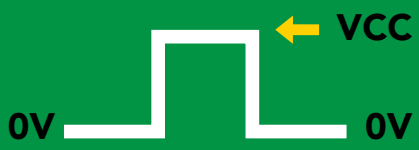
RX
Data in

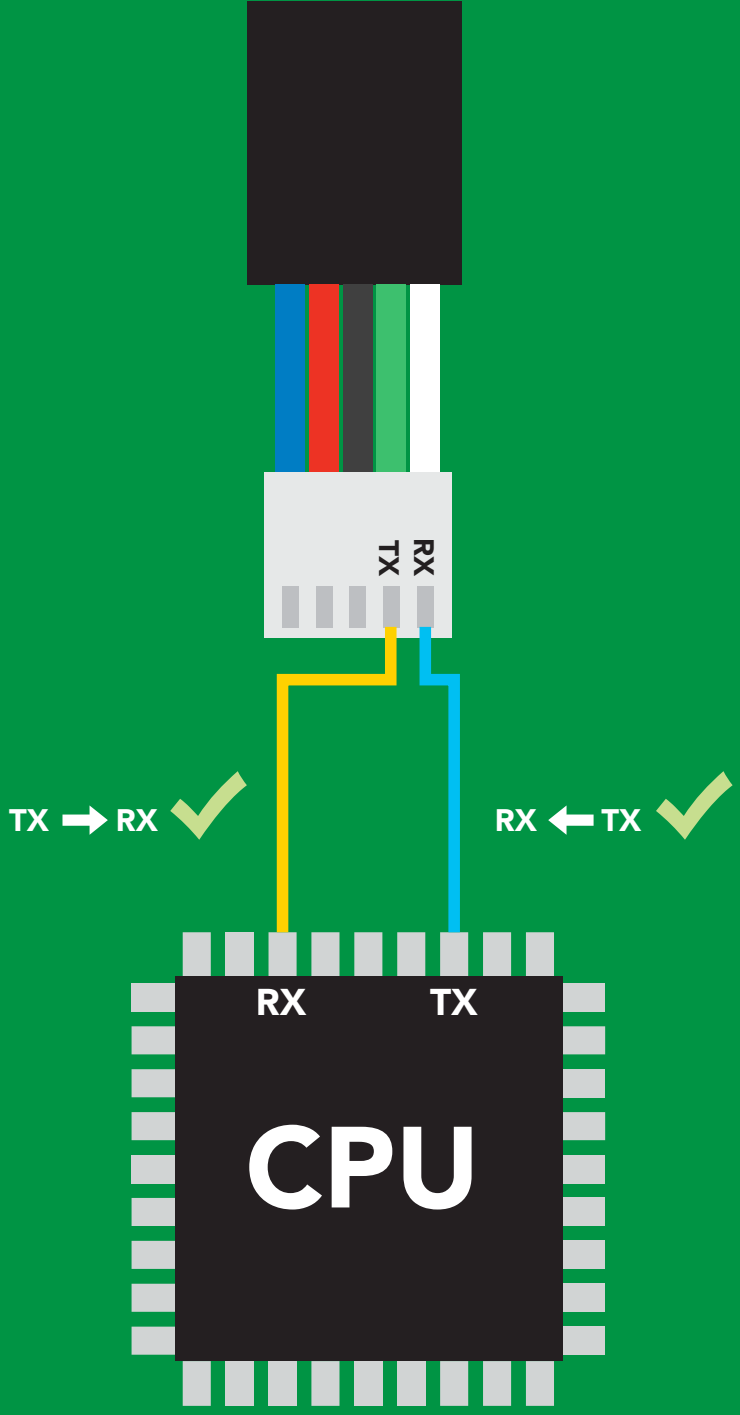


TX
Data out



Vcc 3.3V – 5V





Data format

Reading	Gaseous CO2	**Data type**	unsigned int
Units	PPM	**Decimal places**	0
Encoding	ASCII	**Smallest string**	2 characters
Format	string	**Largest string**	12 characters
Terminator	carriage return		

Copyright © Atlas Scientific LLC

AtlasScientific™
Environmental Robotics

Receiving data from device

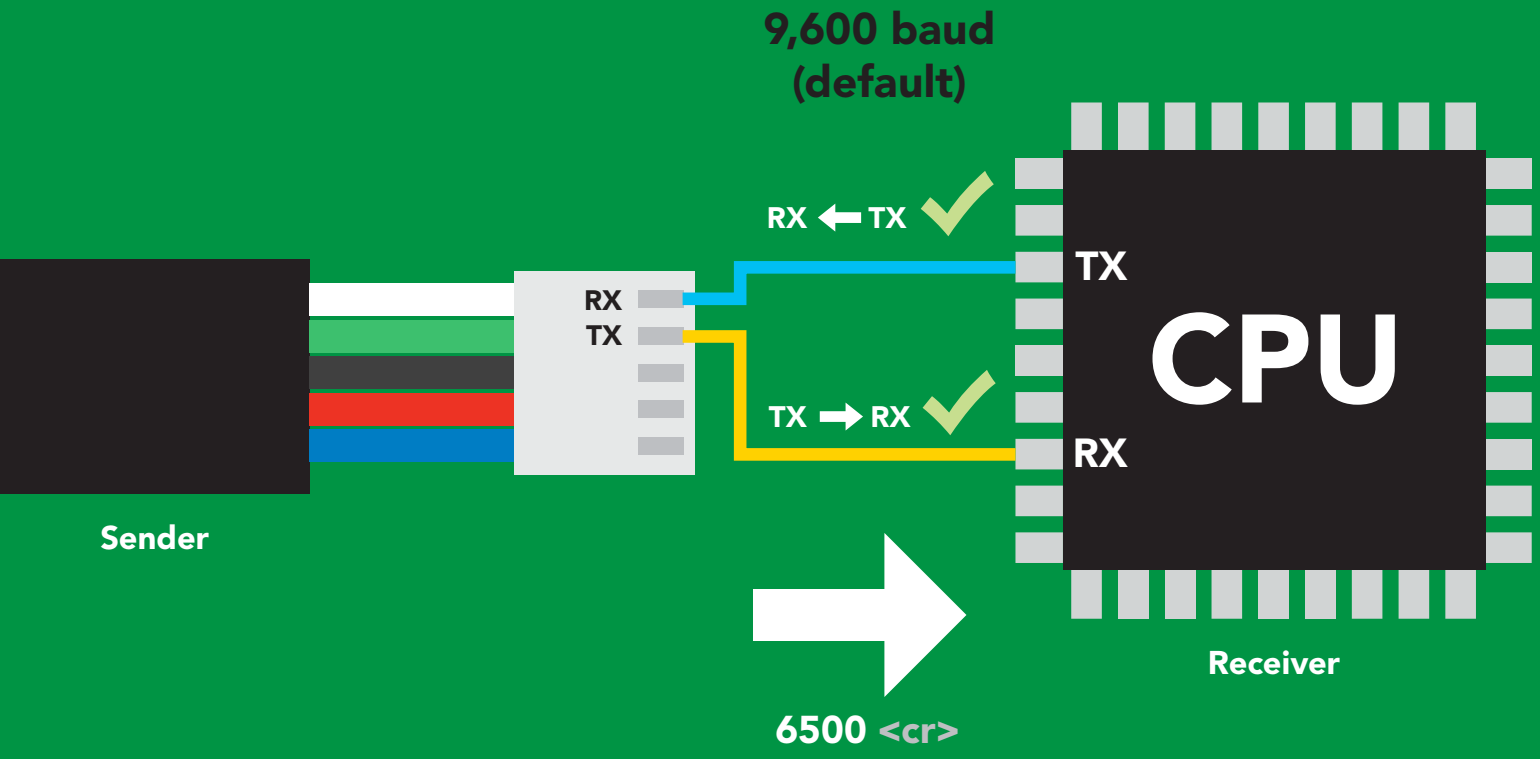
2 parts

ASCII data string

Command

Carriage return <cr>

Terminator



Advanced

ASCII:	6	5	0	0	<cr>
Hex:	36	35	30	30	0D
Dec:	54	53	48	48	13

Copyright © Atlas Scientific LLC

Atlas Scientific™ Environmental Robotics

r 0.1

Sending commands to device

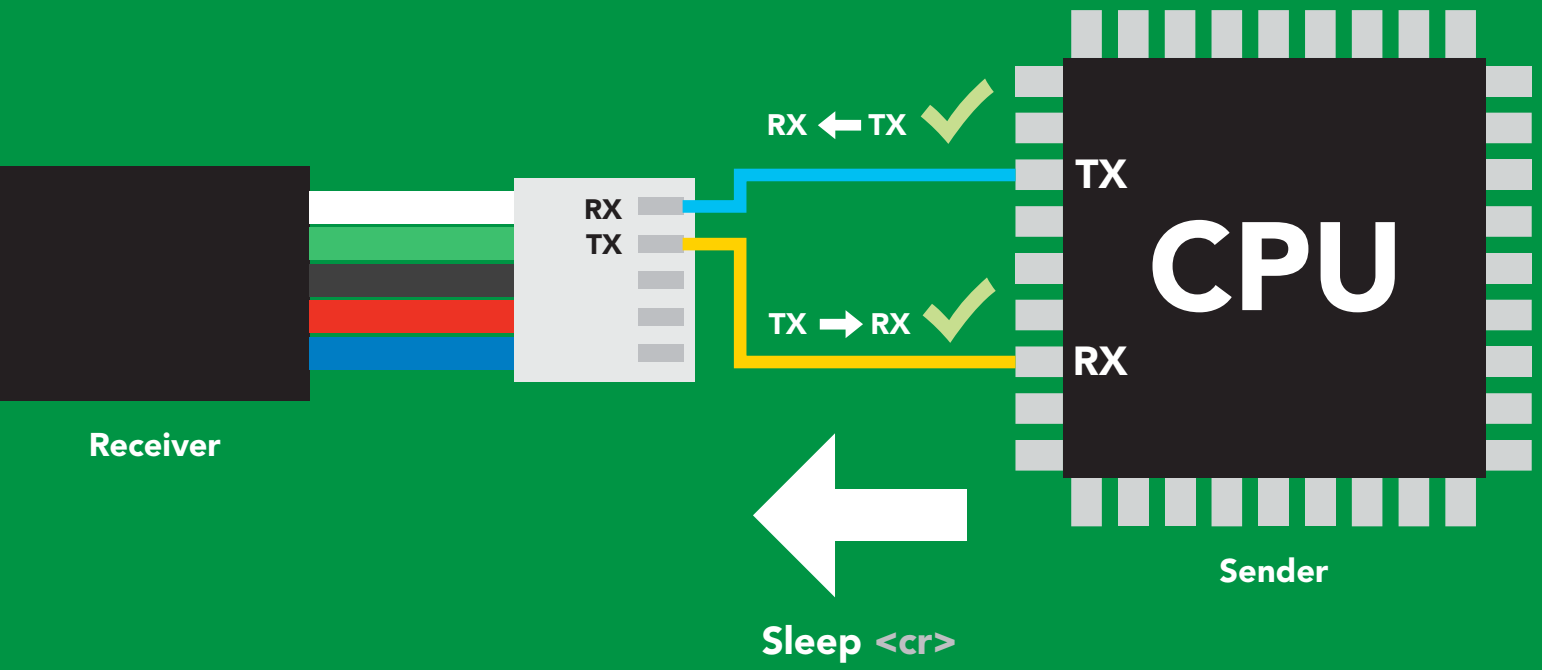
2 parts

Command (not case sensitive)

ASCII data string

Carriage return <cr>

Terminator



Advanced

ASCII:	S	l	e	e	p	<cr>
Hex:	53	6C	65	65	70	0D
Dec:	83	108	101	101	112	13

Copyright © Atlas Scientific LLC

Atlas Scientific™ Environmental Robotics

r 0.1

LED color definition



Green
UART standby

Cyan
Taking reading

Purple
Changing baud rate

Red
Command not understood

White
Find

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

Copyright © Atlas Scientific LLC

UART mode
command quick reference

All commands are ASCII strings or single ASCII characters.

Command	Function		Default state
Alarm	enable/disable alarm	pg. 23	n/a
Baud	change baud rate	pg. 31	9,600
C	enable/disable continuous mode	pg. 21	enabled
Cal	performs custom calibration	pg. 24	n/a
Factory	enable factory reset	pg. 33	n/a
Find	finds device with blinking white LED	pg. 20	n/a
i	device information	pg. 27	n/a
I2C	change to I²C mode	pg. 34	not set
L	enable/disable LED	pg. 19	enabled
Name	set/show name of device	pg. 26	not set
O	enable/disable internal temperature	pg. 25	disabled
Plock	enable/disable protocol lock	pg. 32	n/a
R	returns a single reading	pg. 22	n/a
Sleep	enter sleep mode/low power	pg. 30	n/a
Status	retrieve Status Information	pg. 29	n/a
*OK	enable/disable response codes	pg. 28	n/a

Copyright © Atlas Scientific LLC

LED control

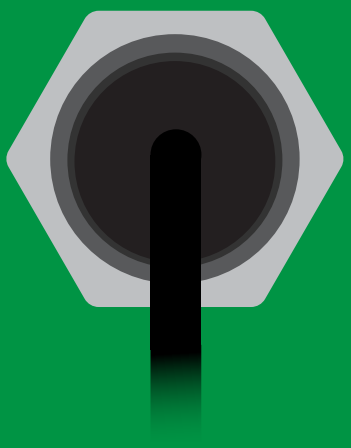
Command syntax

L,1 <cr> LED on **default**
L,0 <cr> LED off
L,? <cr> LED state on/off?

Example	Response
L,1 <cr>	*OK <cr>
L,0 <cr>	*OK <cr>
L,? <cr>	?L,1 <cr> or ?L,0 <cr> *OK <cr>



L,1



L,0

Copyright © Atlas Scientific LLC

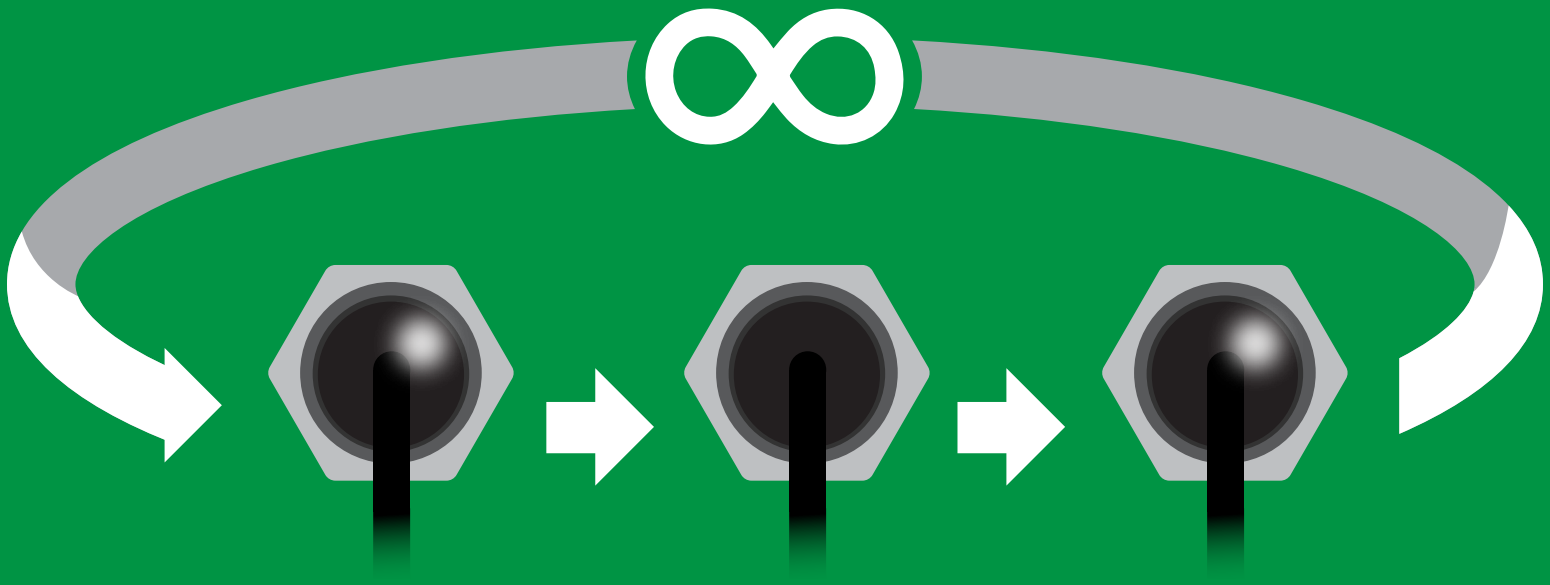
Find

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>



 Copyright © Atlas Scientific LLC

Continuous mode

Command syntax

C,1 <cr> enable continuous readings once per second **default**

C,n <cr> continuous readings every n seconds (n = 2 to 99 sec)

C,0 <cr> disable continuous readings

C,? <cr> continuous reading mode on/off?

Example	Response
C,1 <cr>	*OK <cr> CO2 (1 sec) <cr> CO2 (2 sec) <cr> CO2 (n sec) <cr>
C,30 <cr>	*OK <cr> CO2 (30 sec) <cr> CO2 (60 sec) <cr> CO2 (90 sec) <cr>
C,0 <cr>	*OK <cr>
C,? <cr>	?C,1 <cr> or ?C,0 <cr> or ?C,30 <cr> *OK <cr>

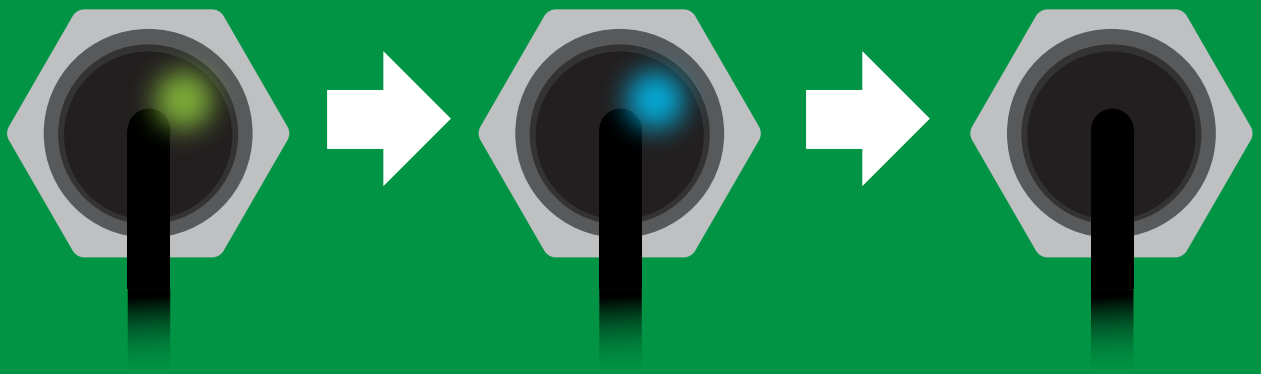
Copyright © Atlas Scientific LLC

Single reading mode

Command syntax

R <cr> takes single reading

Example	Response
R <cr>	6500 <cr> *OK <cr>



Green
Standby

Cyan
Taking reading

Transmitting



1 second

Copyright © Atlas Scientific LLC

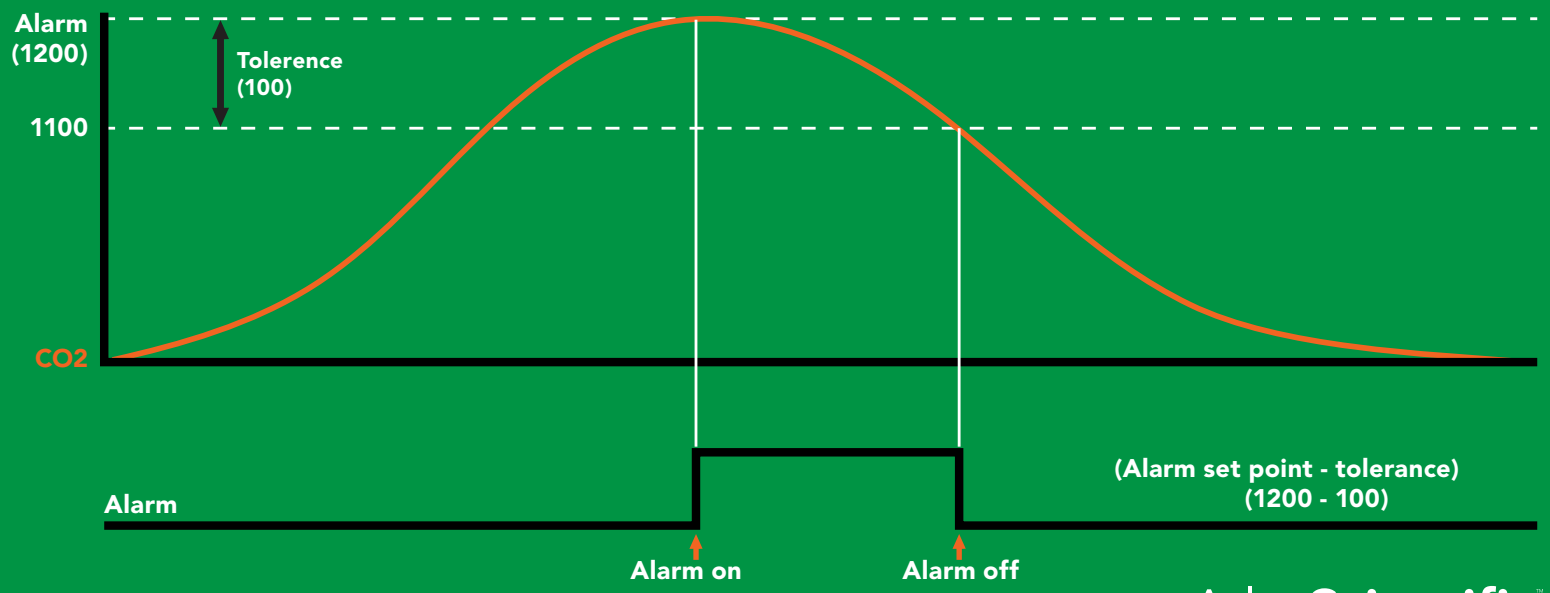
Alarm

Command syntax

The alarm pin will = 1 when CO2 levels are > alarm set point. Alarm tolerance sets how far below the set point CO2 levels need to drop before the pin will = 0 again.

Alarm,en,[1,0]	<cr>	enable / disable alarm
Alarm,n	<cr>	sets alarm
Alarm,tol,n	<cr>	sets alarm tolerance (0-500 ppm)
Alarm,?	<cr>	alarm set?

Example	Response
Alarm,en,1 <cr>	*OK <cr> Enable alarm
Alarm,1200 <cr>	*OK <cr>
Alarm,tol,100 <cr>	*OK <cr> CO2 level must fall 100 ppm below set point for alarm to reset.
Alarm,? <cr>	?,alarm,1200,100,1 <cr> if all are enabled



 Copyright © Atlas Scientific LLC

AtlasScientific™ Environmental Robotics

r 0.1

Custom calibration

Command syntax

High point calibration can be from 3,000 ppm to 5,000 ppm. Calibration outside of that range my lead to accuracy issues.

Cal,n	<cr>	calibrates the high point
Cal,0	<cr>	calibrates the zero point
Cal,clear	<cr>	restores calibration to factory settings
Cal,?	<cr>	device calibrated?

Example	Response
Cal,3900 <cr>	*OK <cr>
Cal,0 <cr>	*OK <cr>
Cal,clear <cr>	*OK <cr>
Cal,? <cr>	?Cal,0 <cr> (no calibration) or ?Cal,1 <cr> (only zero point calibration) or ?Cal,2 <cr> (only high point calibration) or ?Cal,3 <cr> (zero and high point calibration) *OK <cr>

This device comes pre-calibrated.

Custom calibration should not be performed without scientific grade calibration gasses.

Copyright © Atlas Scientific LLC

Atlas Scientific™ Environmental Robotics

r 0.1

Enable/disable internal temperature from output string

Command syntax

O,t,[1,0] <cr>	enable or disable internal temperature

Example	Response
O,t,1 <cr>	*OK <cr> enable temperature
O,t,0 <cr>	*OK <cr> disable temperature
O,? <cr>	?O,ppm,t <cr> if internal temp is enabled

Enabling the internal temperature should only be used to confirm that the device is at thermal equilibrium. Refer to page 6

 Copyright © Atlas Scientific LLC

Naming device

Command syntax

Do not use spaces in the name

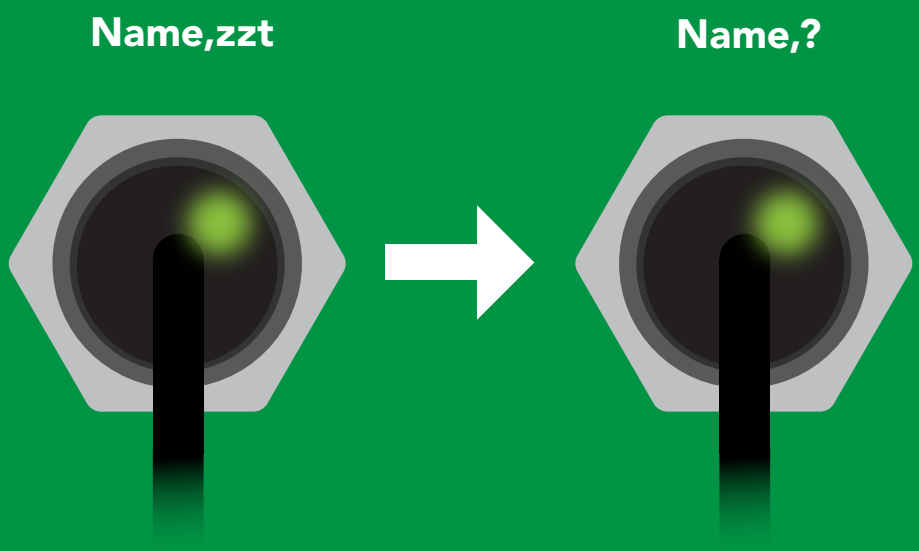
Name,n	<cr>	set name
Name,	<cr>	clears name
Name,?	<cr>	show name

n = _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

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

Up to 16 ASCII characters

Example	Response
Name, <cr>	*OK <cr> name has been cleared
Name,zzt <cr>	*OK <cr>
Name,? <cr>	?Name,zzt <cr> *OK <cr>



Copyright © Atlas Scientific LLC

AtlasScientific™ Environmental Robotics

Device information

Command syntax

i <cr> **device information**

Example	Response
i <cr>	?i,CO2,1.0 <cr> *OK <cr>

Response breakdown

?i, CO2, 1.0

CO2 ↑ Device

1.0 ↑ Firmware

 Copyright © Atlas Scientific LLC

Response codes

Command syntax

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

Example	Response
R <cr>	6,500 <cr> *OK <cr>
*OK,0 <cr>	no response, *OK disabled
R <cr>	6,500 <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

These response codes cannot be disabled

Copyright © Atlas Scientific LLC

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, 5.038

- P: Reason for restart
- 5.038: Voltage at Vcc

Restart codes

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

Copyright © Atlas Scientific LLC

Sleep mode/low power

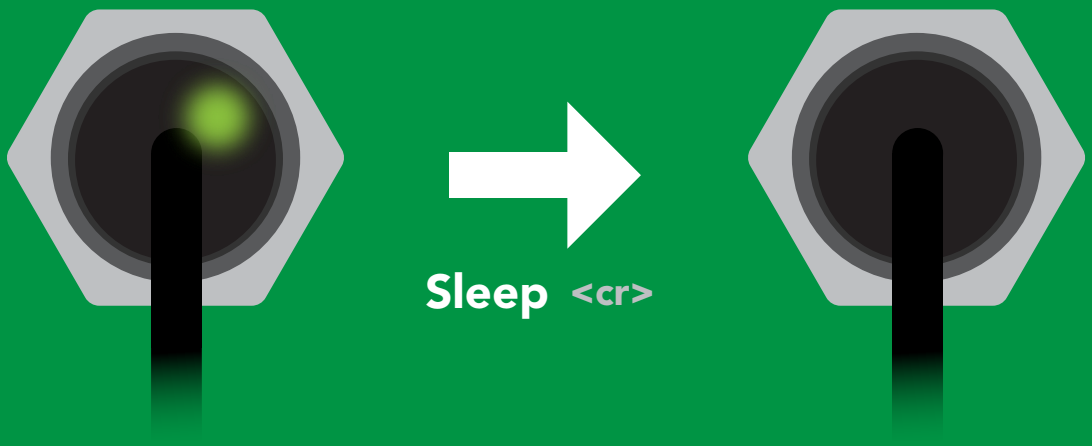
Command syntax

Send any character or command to awaken device.

Sleep <cr> enter sleep mode/low power

Example	Response
Sleep <cr>	***OK** <cr> ***SL** <cr>
Any command	***WA** <cr> **wakes up device**

	MAX	SLEEP
5V	**45 mA**	**3.4 mA**
3.3V	**42 mA**	**3.0 mA**



 Copyright © Atlas Scientific LLC

AtlasScientific™ Environmental Robotics

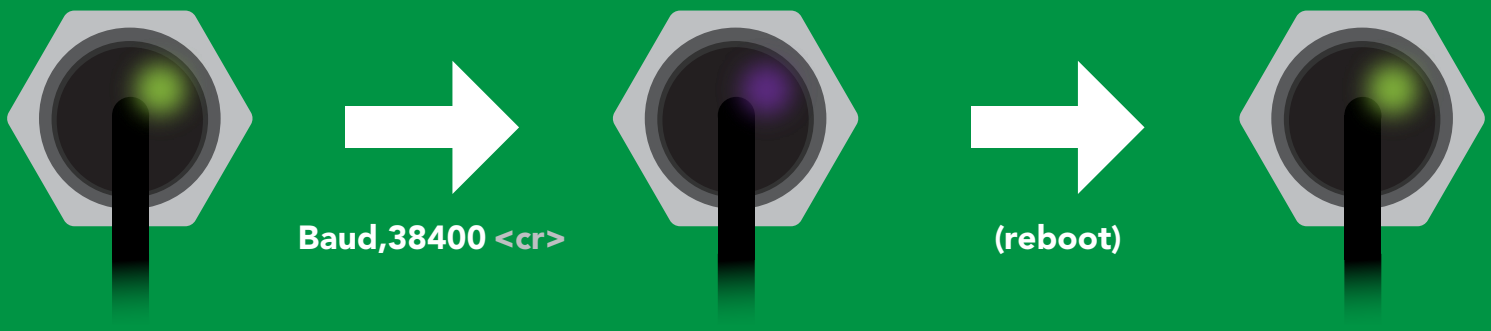
Change baud rate

Command syntax

Baud,n <cr> change baud rate

Example	Response
Baud,38400 <cr>	*OK <cr>
Baud,? <cr>	?Baud,38400 <cr> *OK <cr>

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



 Copyright © Atlas Scientific LLC

AtlasScientific™ Environmental Robotics

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?

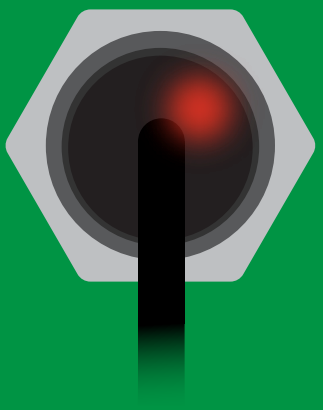
Example	Response
Plock,1 <cr>	*OK <cr>
Plock,0 <cr>	*OK <cr>
Plock,? <cr>	?Plock,1 <cr> or ?Plock,0 <cr>

Plock,1



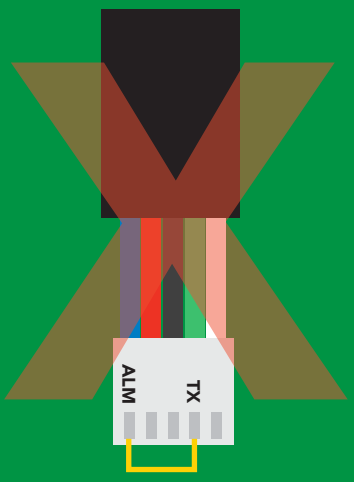
*OK <cr>

I2C,100



cannot change to I²C

*ER <cr>



cannot change to I²C

 Copyright © Atlas Scientific LLC

Factory reset

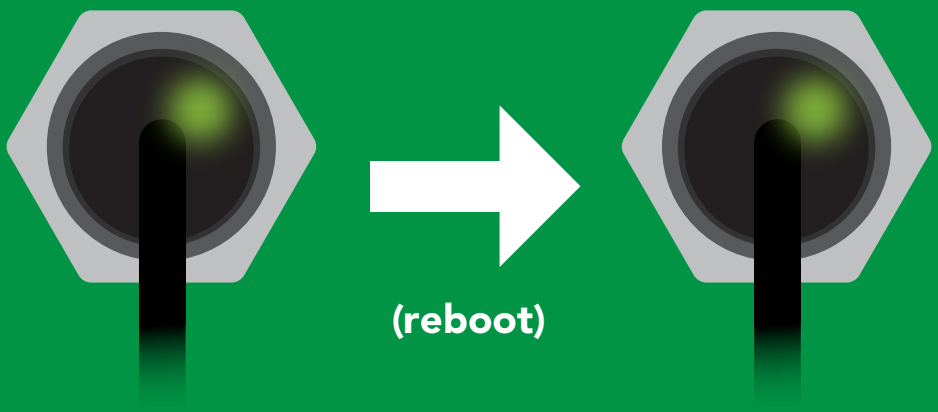
Command syntax

Clears custom calibration
"*OK" enabled

Factory <cr> enable factory reset

Example	Response
Factory <cr>	*OK <cr>

Factory <cr>



(reboot)

*OK <cr>

*RS <cr>
*RE <cr>

Baud rate will not change

 Copyright © Atlas Scientific LLC

AtlasScientific™ Environmental Robotics

Change to I²C mode

Command syntax

Default I²C address 105 (0x69)

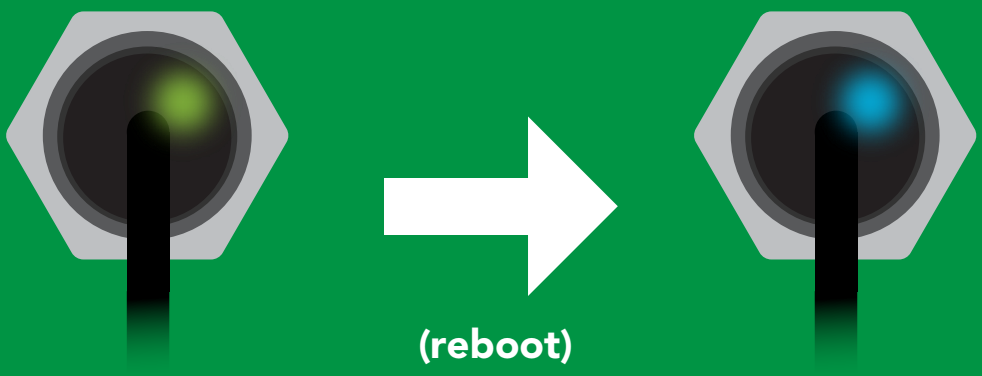
I2C,n <cr> sets I²C address and reboots into I²C mode

n = any number 1 – 127

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

Wrong example	Response
I2C,139 <cr> n ≯ 127	*ER <cr>

I2C,100



(reboot)

Green
*OK <cr>

Blue
now in I²C mode

Copyright © Atlas Scientific LLC

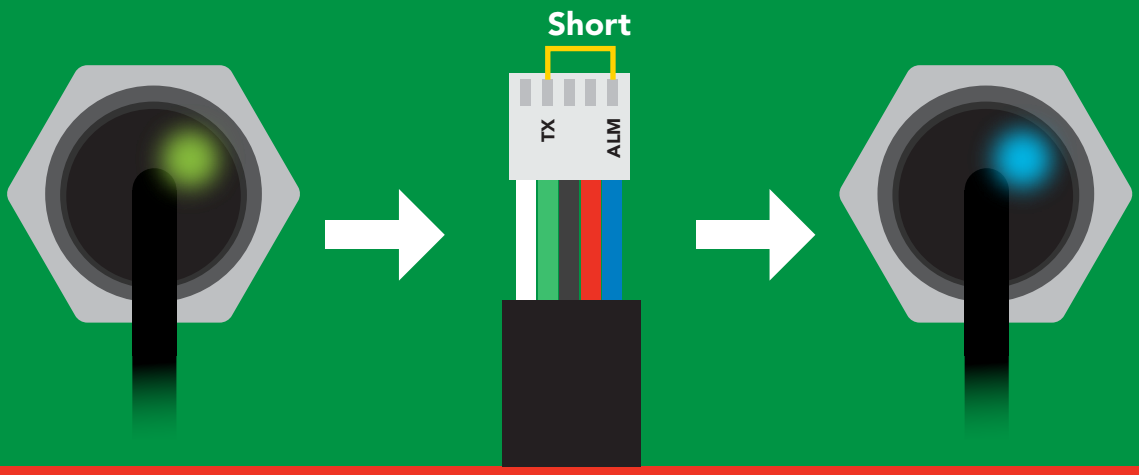
AtlasScientific™
Environmental Robotics
r 0.2

Manual switching to I²C

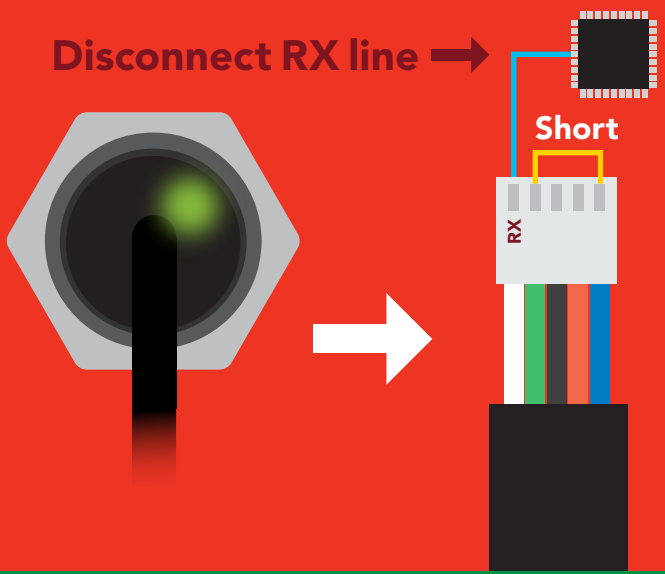
- Disconnect ground (power off)
- Disconnect TX and RX
- Connect TX to ALM
- Confirm RX is disconnected
- Connect ground (power on)
- Wait for LED to change from Green to Blue
- Disconnect ground (power off)
- Reconnect all data and power

Manually switching to I²C will set the I²C address to 105 (0x69)

Example



Wrong Example



Copyright © Atlas Scientific LLC

AtlasScientific™
Environmental Robotics
r 0.1

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™ device into I²C mode click here

Settings that are retained if power is cut

Calibration
Change I²C address
Hardware switch to UART mode
LED control
Protocol lock
Software switch to UART mode

Settings that are *NOT* retained if power is cut

Sleep mode

Atlas Scientific™
Environmental Robotics

I²C mode

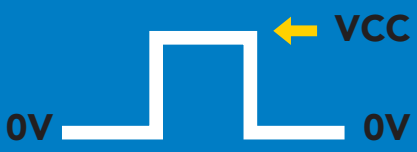
I²C address	(0x01 – 0x7F) 105 (0x69) default
Vcc	3.3V – 5.5V
Clock speed	100 – 400 kHz

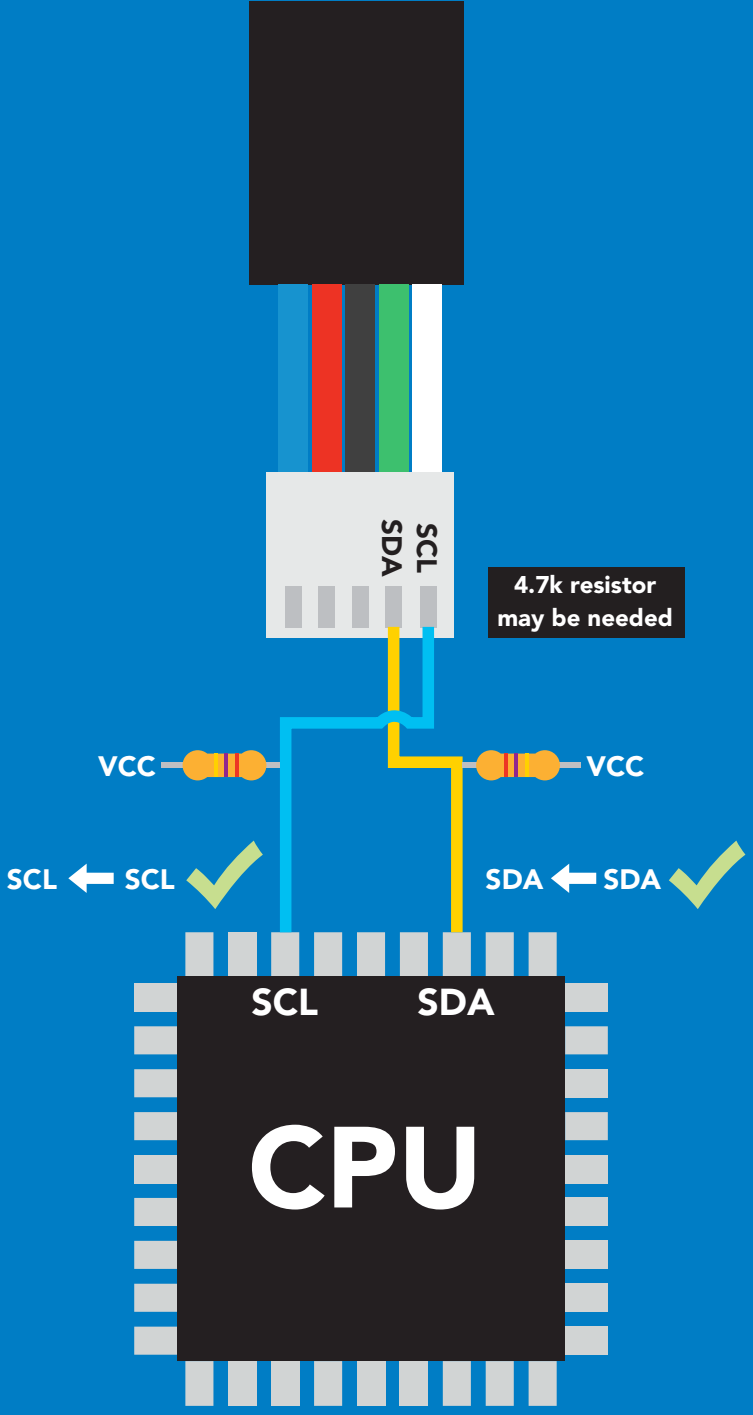
SDA



SCL





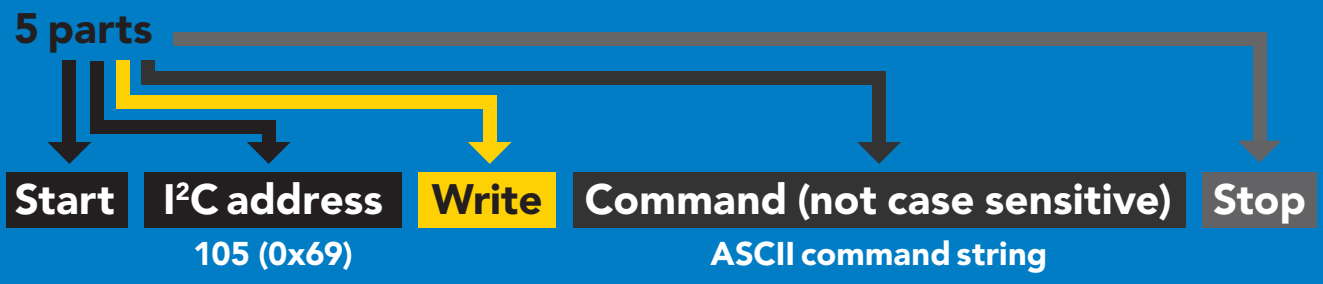


Data format

Reading	Gaseous CO2	Data type	unsigned int
Units	PPM	Decimal places	0
Encoding	ASCII	Smallest string	2 characters
Format	string	Largest string	12 characters

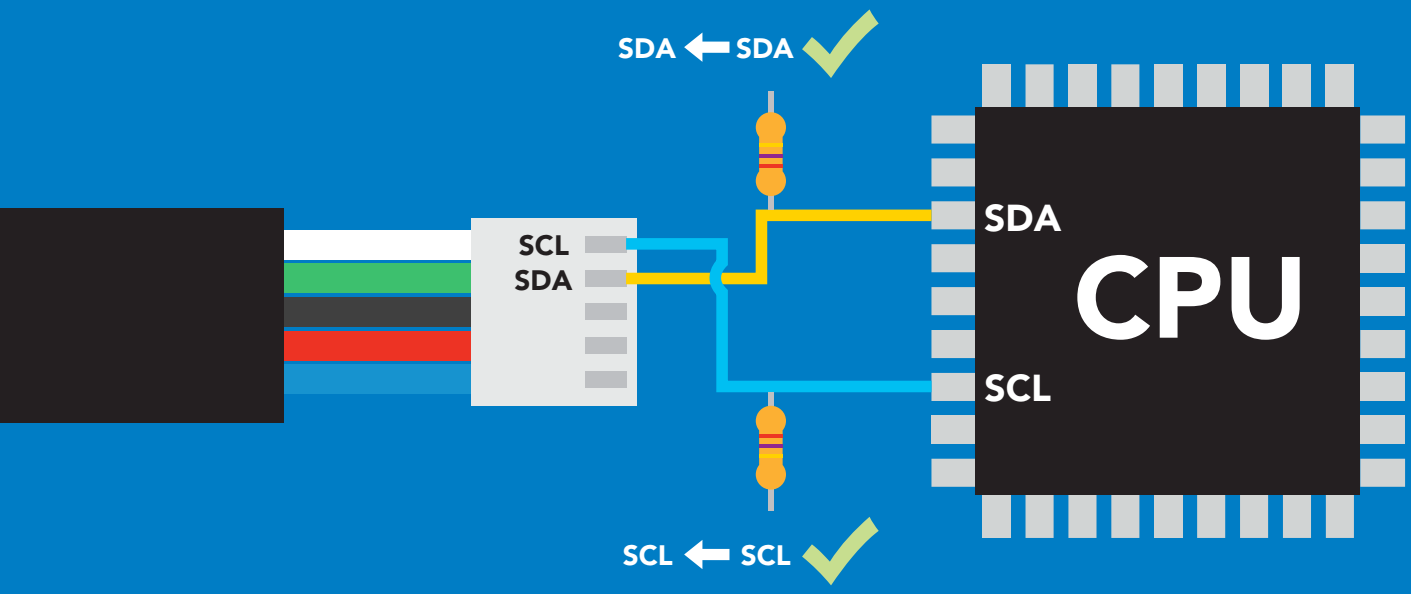
Copyright © Atlas Scientific LLC

Sending commands to device

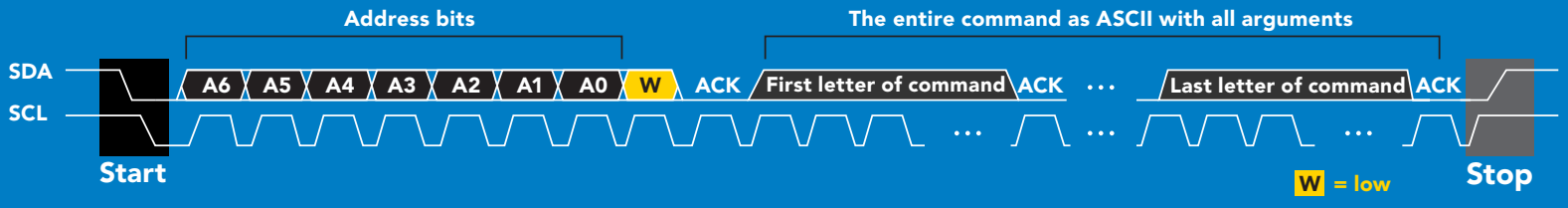


Example





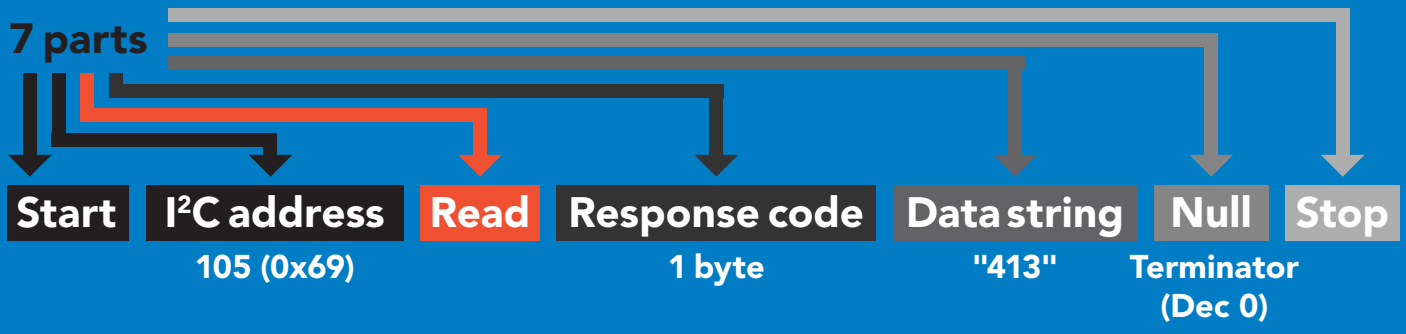
Advanced

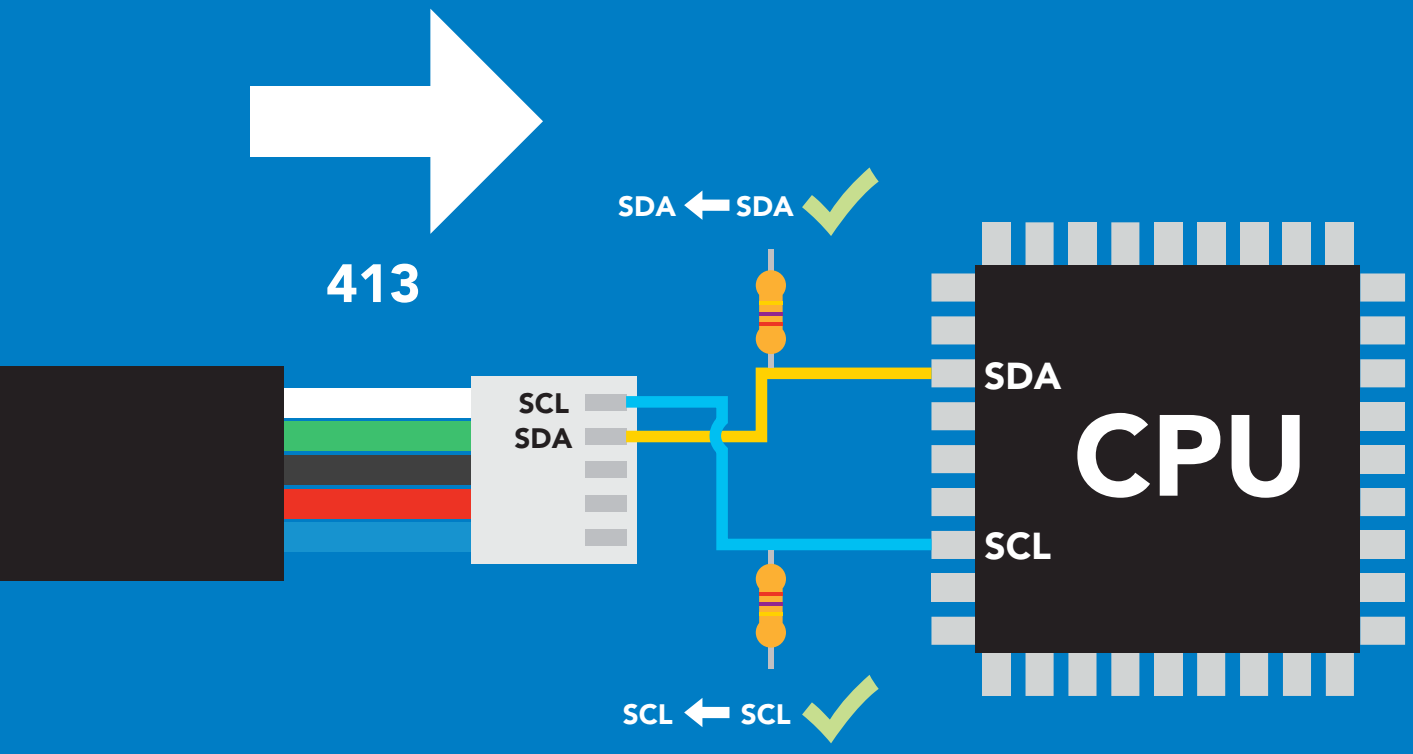


Copyright © Atlas Scientific LLC

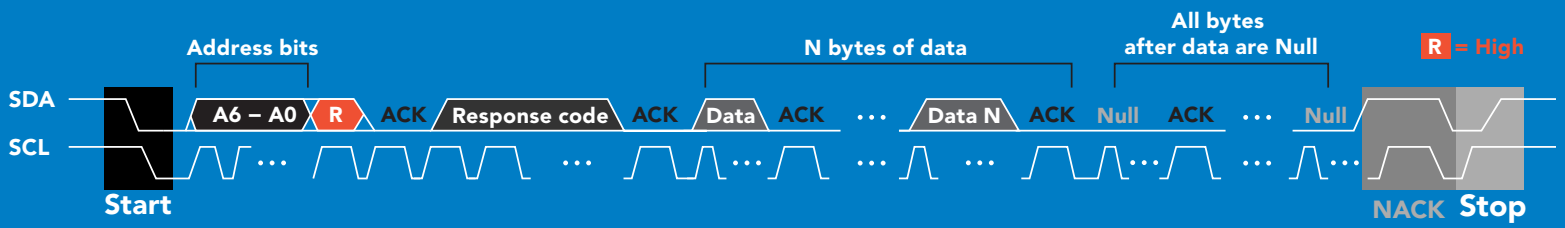
AtlasScientific™
Environmental Robotics
r 0.1

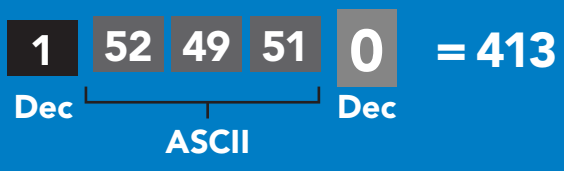
Requesting data from device





Advanced





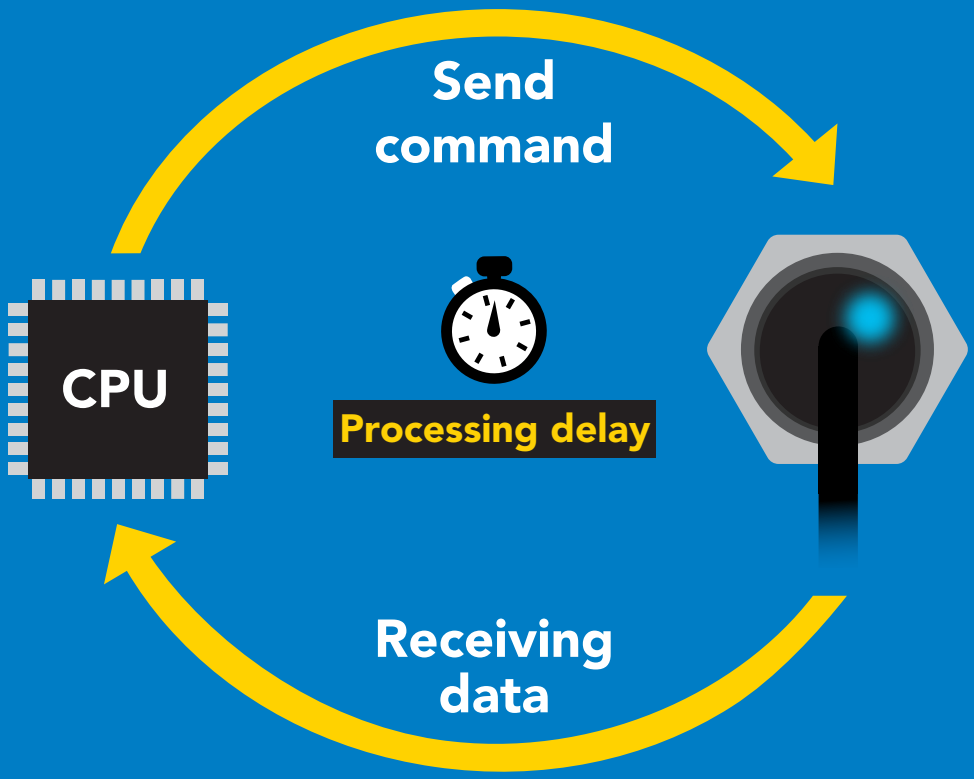
Copyright © Atlas Scientific LLC

AtlasScientific™
Environmental Robotics
r 0.1

Response codes & processing delay

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

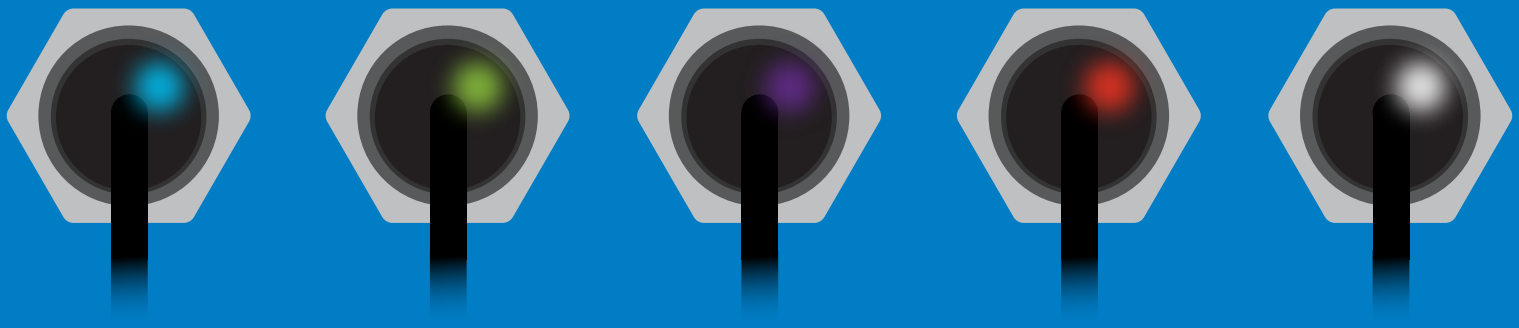
255	no data to send
254	still processing, not ready
2	syntax error
1	successful request

Copyright © Atlas Scientific LLC

Atlas Scientific™ Environmental Robotics

r 0.2

LED color definition



Blue
I²C standby

Green
Taking reading

Purple
Changing I²C address

Red
Command not understood

White
Find

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

Copyright © Atlas Scientific LLC

I²C mode
command quick reference

All commands are ASCII strings or single ASCII characters.

Command	Function	
Alarm	enable/disable alarm	pg. 46
Baud	switch back to UART mode	pg. 56
Cal	performs custom calibration	pg. 47
Factory	enable factory reset	pg. 55
Find	finds device with blinking white LED	pg. 44
i	device information	pg. 50
I2C	change I²C address	pg. 54
L	enable/disable LED	pg. 43
Name	set/show name of device	pg. 49
O	enable/disable internal temp	pg. 48
Plock	enable/disable protocol lock	pg. 57
R	returns a single reading	pg. 45
Sleep	enter sleep mode/low power	pg. 52
Status	retrieve status information	pg. 51

Copyright © Atlas Scientific LLC

LED control

Command syntax

300ms processing delay

L,1	LED on	default
L,0	LED off	
L,?	LED state on/off?	

Example Response

L,1

Wait 300ms → 1 (Dec) 0 (Null)

L,0

Wait 300ms → 1 (Dec) 0 (Null)

L,?

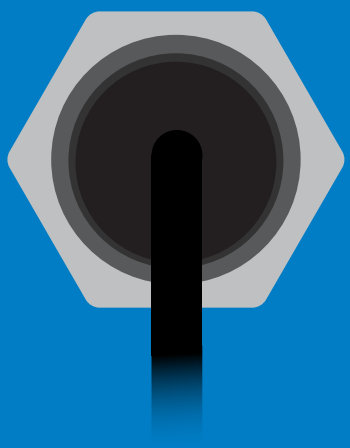
Wait 300ms → 1 (Dec) ?L,1 (ASCII) 0 (Null)

or

Wait 300ms → 1 (Dec) ?L,0 (ASCII) 0 (Null)



L,1



L,0

Copyright © Atlas Scientific LLC

AtlasScientific™ Environmental Robotics

r 0.1

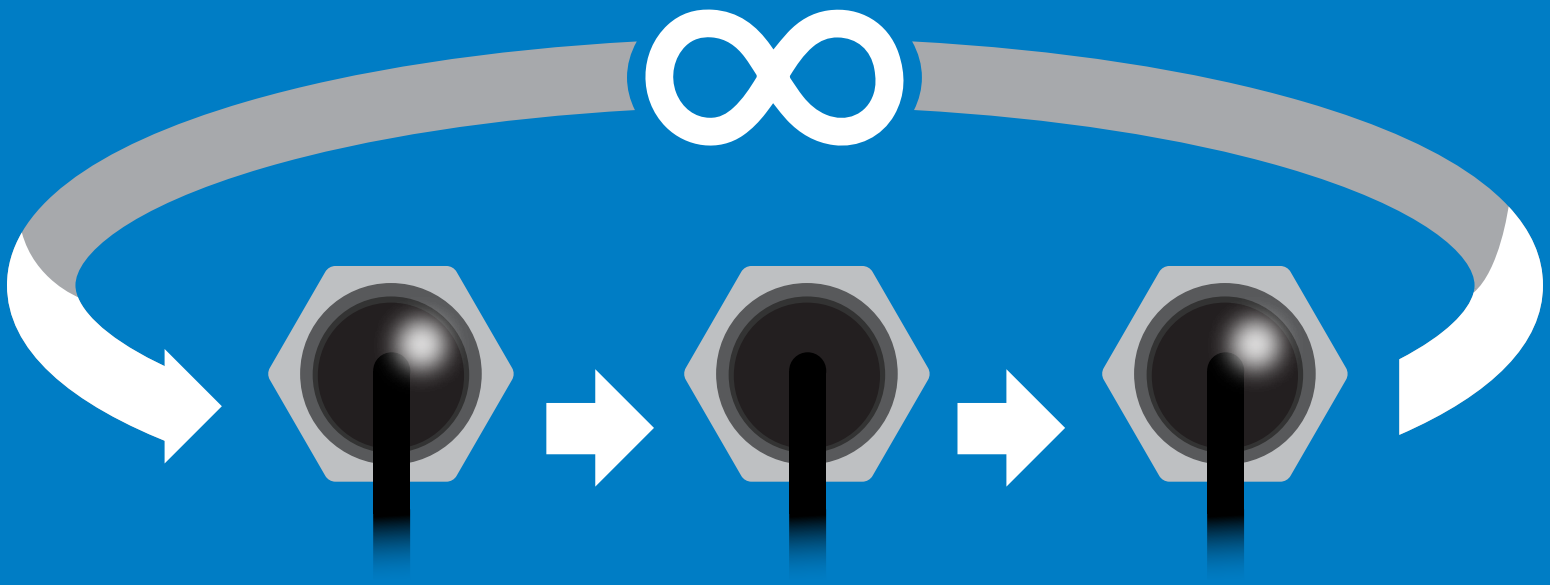
Find

300ms processing delay

Command syntax

Find	LED rapidly blinks white, used to help find device

Example	Response
Find	Wait 300ms 1 Dec 0 Null



Copyright © Atlas Scientific LLC

Atlas Scientific Environmental Robotics

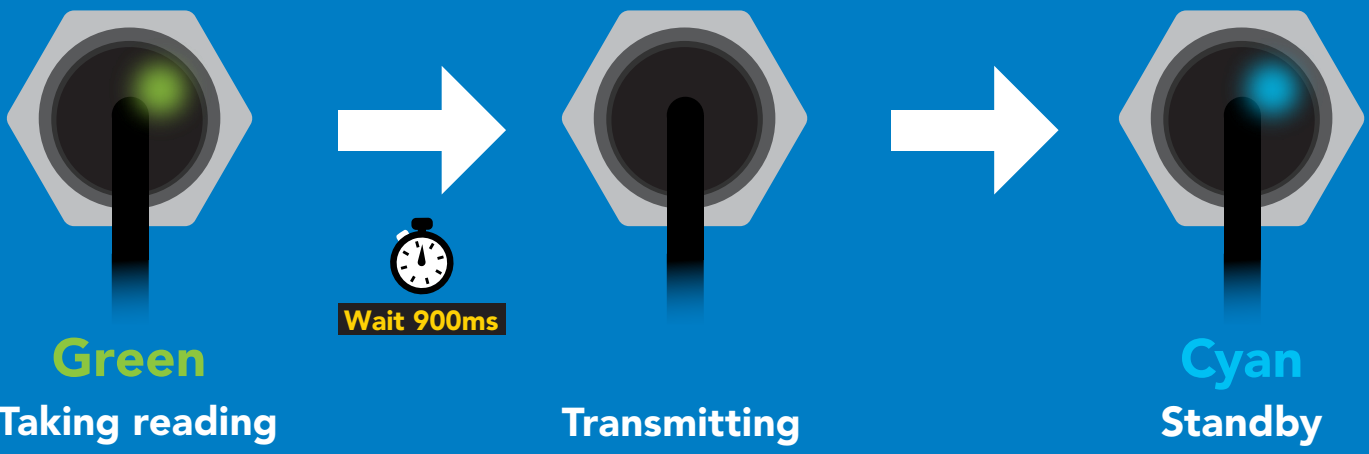
Taking reading

Command syntax

900ms processing delay

R return 1 reading

Example	Response
R	Wait 900ms; 1 Dec; 800 ASCII; 0 Null



Copyright © Atlas Scientific LLC

Alarm

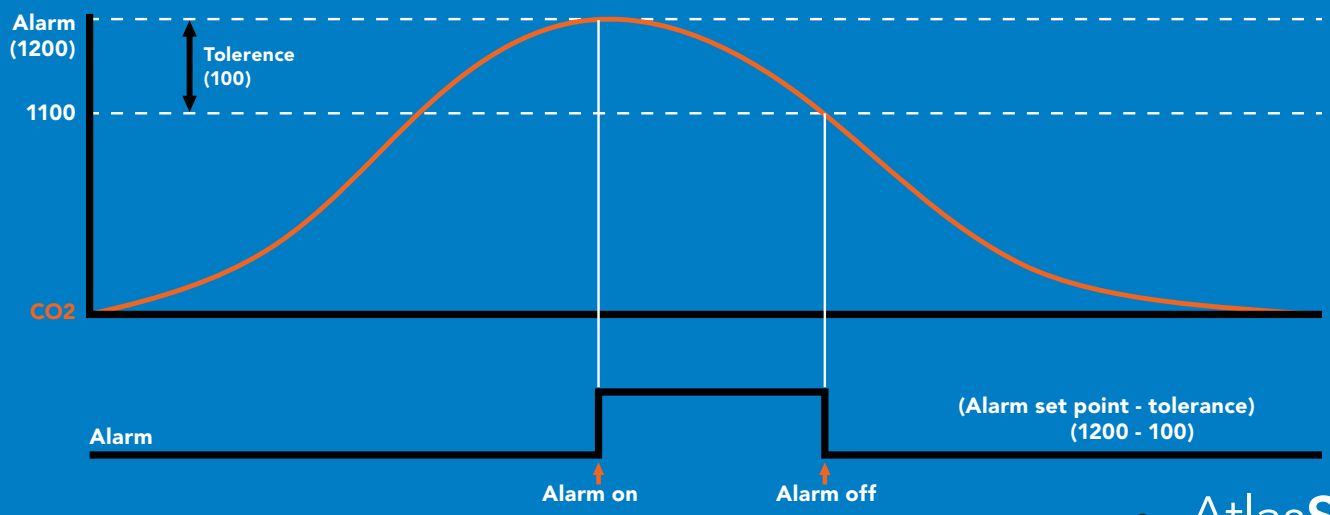
300ms processing delay

Command syntax

The alarm pin will = 1 when CO2 levels are > alarm set point. Alarm tolerance sets how far below the set point CO2 levels need to drop before the pin will = 0 again.

Alarm,en,[1,0]	enable / disable alarm
Alarm,n	sets alarm
Alarm,tol,n	sets alarm tolerance (0-500 ppm)
Alarm,?	alarm set?

Example	Response
Alarm,en,1	Wait 300ms → 1 (Dec) 0 (Null) Enable alarm
Alarm,1200	Wait 300ms → 1 (Dec) 0 (Null)
Alarm,tol,100	Wait 300ms → 1 (Dec) 0 (Null) CO2 level must fall 100 ppm below set point for alarm to reset.
Alarm,?	Wait 300ms → 1 (Dec) ?,alarm,1200,100,1 (ASCII) 0 (Null) if all are enabled



Copyright © Atlas Scientific LLC

AtlasScientific™ Environmental Robotics

Custom calibration

900ms processing delay

Command syntax

High point calibration can be from 3,000 ppm to 5,000 ppm. Calibration outside of that range my lead to accuracy issues.

Cal,n	calibrates the high point
Cal,0	calibrates the zero point
Cal,clear	restores calibration to factory settings
Cal,?	device calibrated?

Example	Response
Cal,3900	Wait 900ms → 1 (Dec) 0 (Null)
Cal,0	Wait 900ms → 1 (Dec) 0 (Null)
Cal,clear	Wait 300ms → 1 (Dec) 0 (Null)
Cal,?	Wait 300ms → 1 (Dec) ?Cal,0 (ASCII, no calibration) 0 (Null) or 1 (Dec) ?Cal,1 (ASCII, only zero point calibration) 0 (Null) or 1 (Dec) ?Cal,2 (ASCII, only high point calibration) 0 (Null) or 1 (Dec) ?Cal,3 (ASCII, zero and high point calibration) 0 (Null)

This device comes pre-calibrated.

Custom calibration should not be performed without scientific grade calibration gasses.

Copyright © Atlas Scientific LLC

Atlas Scientific Environmental Robotics

Enable/disable internal temperature from output string

Command syntax

300ms processing delay

O,t,[1,0]	enable or disable internal temperature

Example	Response
O,t,1	Wait 300ms → 1 (Dec) 0 (Null) — enable temperature
O,t,0	Wait 300ms → 1 (Dec) 0 (Null) — disable temperature
O,?	Wait 300ms → 1 (Dec) ?O,ppm,t (ASCII) 0 (Null) — if internal temp is enabled

Enabling the internal temperature should only be used to confirm that the device is at thermal equilibrium. Refer to page 6

Copyright © Atlas Scientific LLC

Naming device

300ms processing delay

Command syntax

Do not use spaces in the name

Name,n	set name
Name,	clears name
Name,?	show name

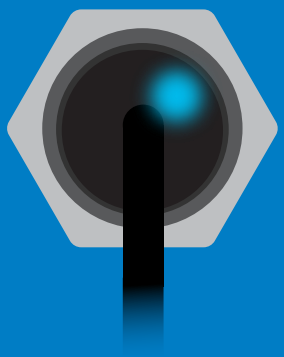
n = _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

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

Up to 16 ASCII characters

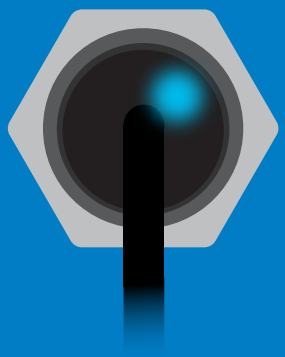
Example	Response
Name,	Wait 300ms — 1 Dec — 0 Null — name has been cleared
Name,zzt	Wait 300ms — 1 Dec — 0 Null
Name,?	Wait 300ms — 1 Dec — ?Name,zzt ASCII — 0 Null

Name,zzt



1 0

Name,?



1 ?Name,zzt 0

Copyright © Atlas Scientific LLC

AtlasScientific™ Environmental Robotics

r 0.1

Device information

Command syntax

300ms processing delay

i device information

Example

i

Response



1 Dec

?i,CO2,1.00 ASCII

0 Null

Response breakdown

?i, CO2, 1.00

CO2 = Device

1.00 = Firmware

Copyright © Atlas Scientific LLC

Reading device status

Command syntax

300ms processing delay

Status voltage at Vcc pin and reason for last restart

Example

Status

Response



1	?Status,P,5.038	0
Dec	ASCII	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

Copyright © Atlas Scientific LLC

Atlas Scientific Environmental Robotics

Sleep mode/low power

Command syntax

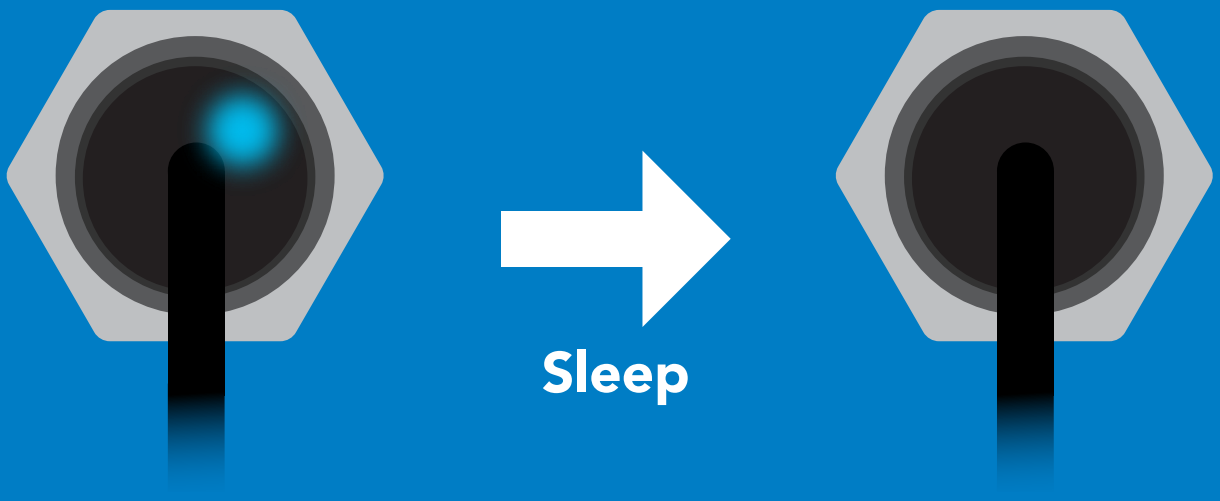
Sleep	enter sleep mode/low power

Send any character or command to awaken device.

Example	Response
Sleep	no response
Any command	wakes up device

Do not read status byte after issuing sleep command.

	STANDBY	SLEEP
5V	45 mA	3.4 mA
3.3V	42 mA	3.0 mA



Copyright © Atlas Scientific LLC

Protocol lock

Command syntax

300ms processing delay

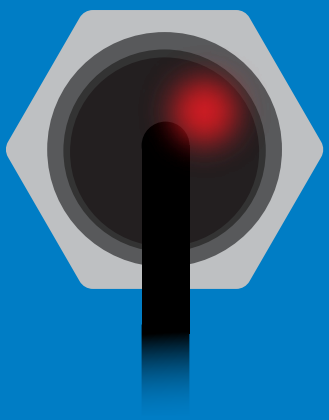
Plock,1	enable Plock	Locks device to I²C mode.
Plock,0	disable Plock	default
Plock,?	Plock on/off?	

Example	Response
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)

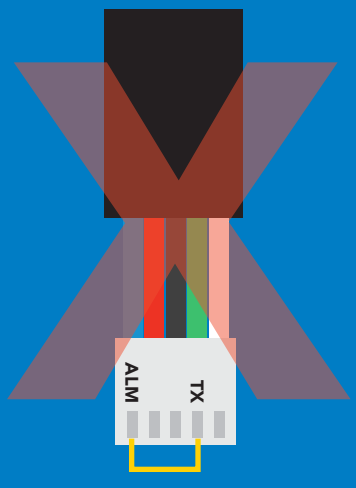
Plock,1



Baud, 9600



cannot change to UART



cannot change to UART

Copyright © Atlas Scientific LLC

AtlasScientific™ Environmental Robotics

r 0.1

I²C address change

Command syntax

300ms processing delay

I2C,n sets I²C address and reboots into I²C mode

Example	Response
I2C,101	device reboot (no response given)

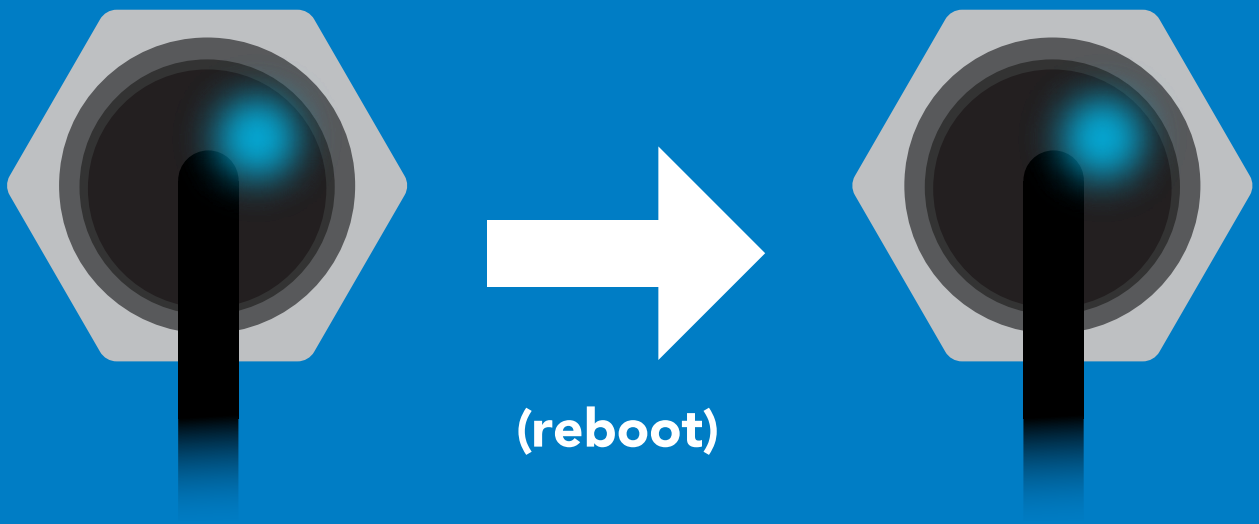
Warning!

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 105 (0x69).

n = any number 1 – 127

I2C,101



(reboot)

Copyright © Atlas Scientific LLC

AtlasScientific™
Environmental Robotics
r 0.2

Factory reset

Command syntax

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

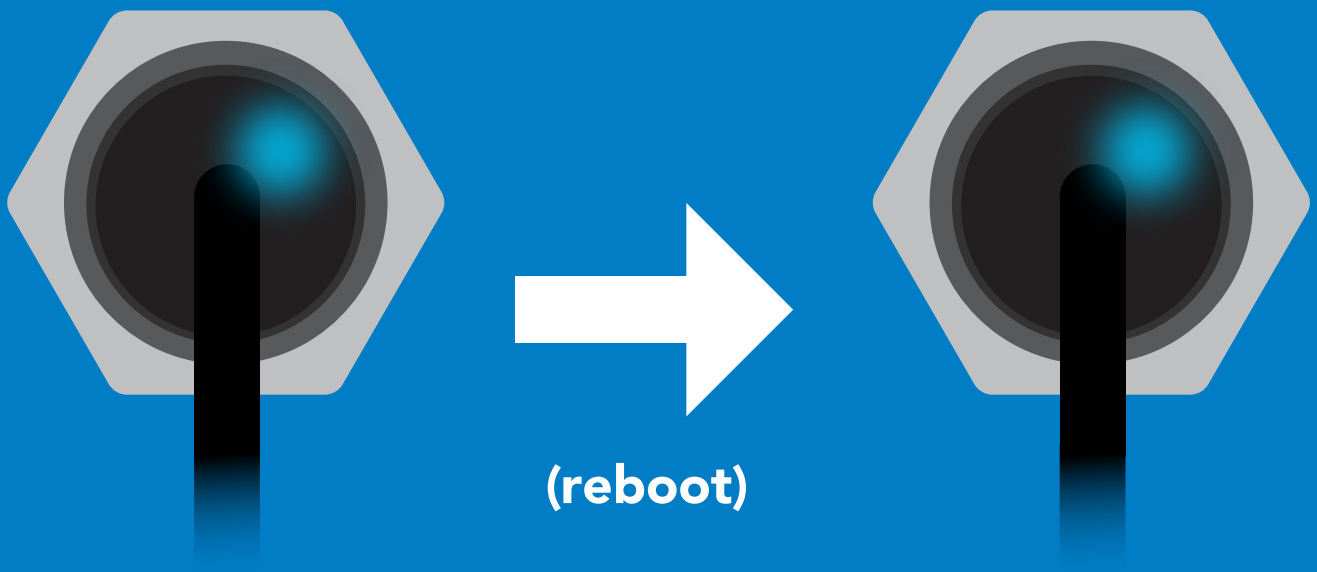
Factory enable factory reset

I²C address will not change

Example	Response
Factory	device reboot (no response given)

Clears custom calibration
LED on
Response codes enabled

Factory



Copyright © Atlas Scientific LLC

AtlasScientific™
Environmental Robotics
r 0.1

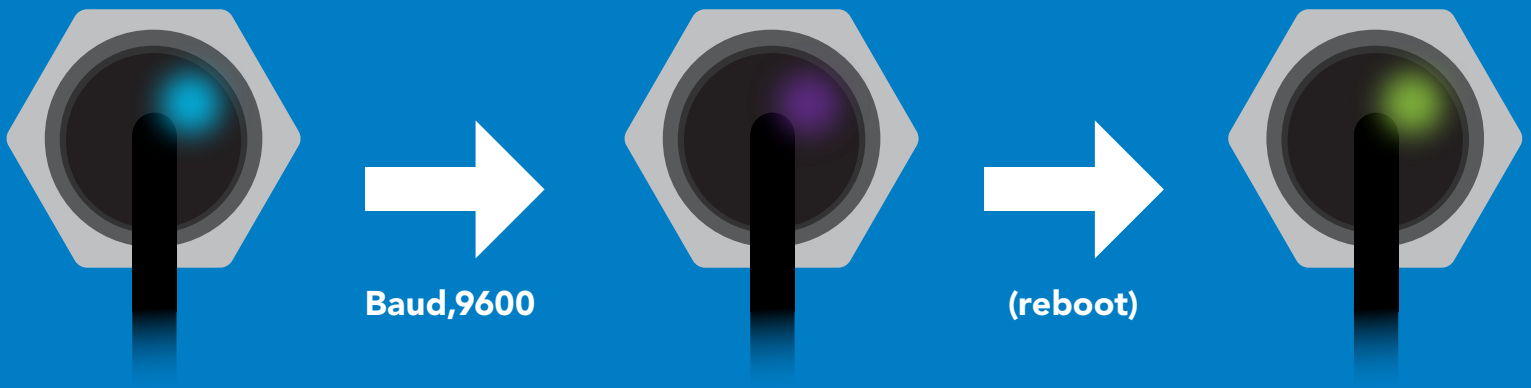
Change to UART mode

Command syntax

Baud,n switch from I²C to UART

Example	Response
Baud,9600	reboot in UART mode (no response given)

n =
- 300
- 1200
- 2400
- 9600
- 19200
- 38400
- 57600
- 115200



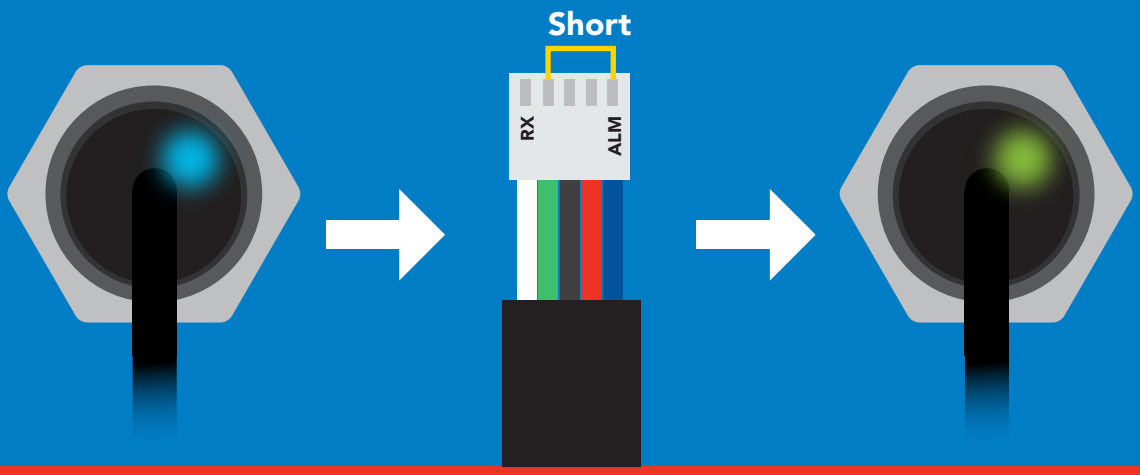
Copyright © Atlas Scientific LLC

AtlasScientific™
Environmental Robotics
r 0.1

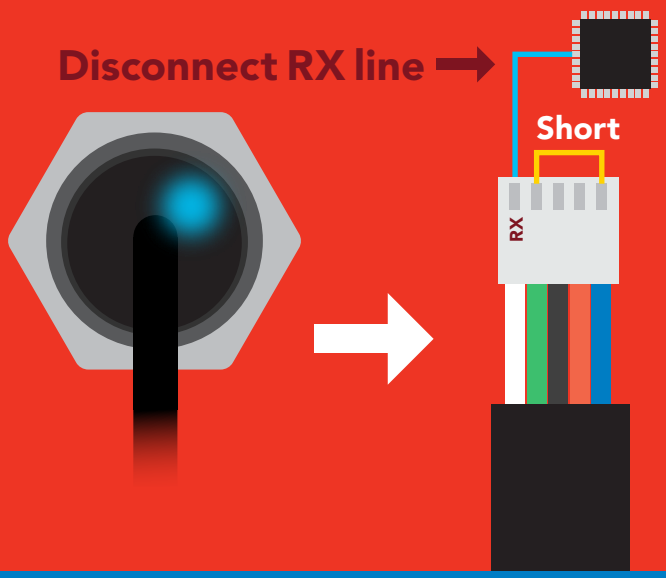
Manual switching to UART

- Disconnect ground (power off)
- Disconnect TX and RX
- Connect TX to ALM
- 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



Copyright © Atlas Scientific LLC

AtlasScientific™
Environmental Robotics
r 0.1

Datasheet change log

Datasheet V 1.8

Revised accuracy listed on cover page.

Datasheet V 1.7

Removed Import/Export commands from datasheet.

Datasheet V 1.6

Revised naming device info on pages 28 & 53.

Datasheet V 1.5

Revised info for "Pin out" on page 8.

Datasheet V 1.4

Added life expectancy to the cover page, and moved Default state to pg 11.

Datasheet V 1.3

Added page about pointing the CO2 sensor at bright lights on pg 4.

Datasheet V 1.2

Revised response for the sleep command in UART mode on pg 29.

Datasheet V 1.1

Added more information on the Export calibration and Import calibration commands.

Datasheet V 1.0

New datasheet

Firmware updates

V1.00 – (Sept 12, 2018)
- Initial release

V2.00 – (Jan 24, 2020)
- Changes the lamp power supply to 5V with boost converter, stops CO2 readings from going below 0.

V2.01 – (Nov 06, 2020)
- Adjusts lamp frequency to fit the lamp signal into the ADC range more consistently.

Warranty

Atlas Scientific™ Warranties the EZO-CO2™ Embedded NDIR CO2 Sensor to be free of defect during the debugging phase of device implementation, or 30 days after receiving the EZO-CO2™ Embedded NDIR CO2 Sensor (which ever comes first).

The debugging phase

The debugging phase as defined by Atlas Scientific™ is the time period when the EZO-CO2™ Embedded NDIR CO2 Sensor is connected into a bread board, or shield. If the EZO-CO2™ Embedded NDIR CO2 Sensor is being debugged in a bread board, the bread board must be devoid of other components. If the EZO-CO2™ Embedded NDIR CO2 Sensor is being connected to a microcontroller, the microcontroller must be running code that has been designed to drive the EZO-CO2™ Embedded NDIR CO2 Sensor exclusively and output the EZO-CO2™ Embedded NDIR CO2 Sensor 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-CO2™ Embedded NDIR CO2 Sensor warranty:

- **Soldering any part to the EZO-CO2™ Embedded NDIR CO2 Sensor.**
- **Running any code, that does not exclusively drive the EZO-CO2™ Embedded NDIR CO2 Sensor and output its data in a serial string.**
- **Embedding the EZO-CO2™ Embedded NDIR CO2 Sensor into a custom made device.**
- **Removing any potting compound.**

 Copyright © Atlas Scientific LLC

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-CO2™ Embedded NDIR CO2 Sensor, against the thousands of possible variables that may cause the EZO-CO2™ Embedded NDIR CO2 Sensor 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-CO2™ Embedded NDIR CO2 Sensor continued operation. This is because that would be equivalent to Atlas Scientific™ taking responsibility over the correct operation of your entire device.

 Copyright © Atlas Scientific LLC