Dissolved Oxygen
EZO™
Circuit

Reads	**Dissolved Oxygen**
Range	**0.01 – 100+ mg/L** **0.1 – 400+ % saturation**
Accuracy	**+/– 0.05 mg/L**
Max rate	**1 reading per sec**
Supported probes	**Any galvanic probe**
Calibration	**1 or 2 point**
Temperature, salinity and pressure compensation	**Yes**
Data protocol	**UART & I²C**
Default I²C address	**97 (0x61)**
Operating voltage	**3.3V – 5V**
Data format	**ASCII**

GND TX (SDA) RX (SCL)

D.O. EZO™ VCC PRB PGND

RoHS COMPLIANT
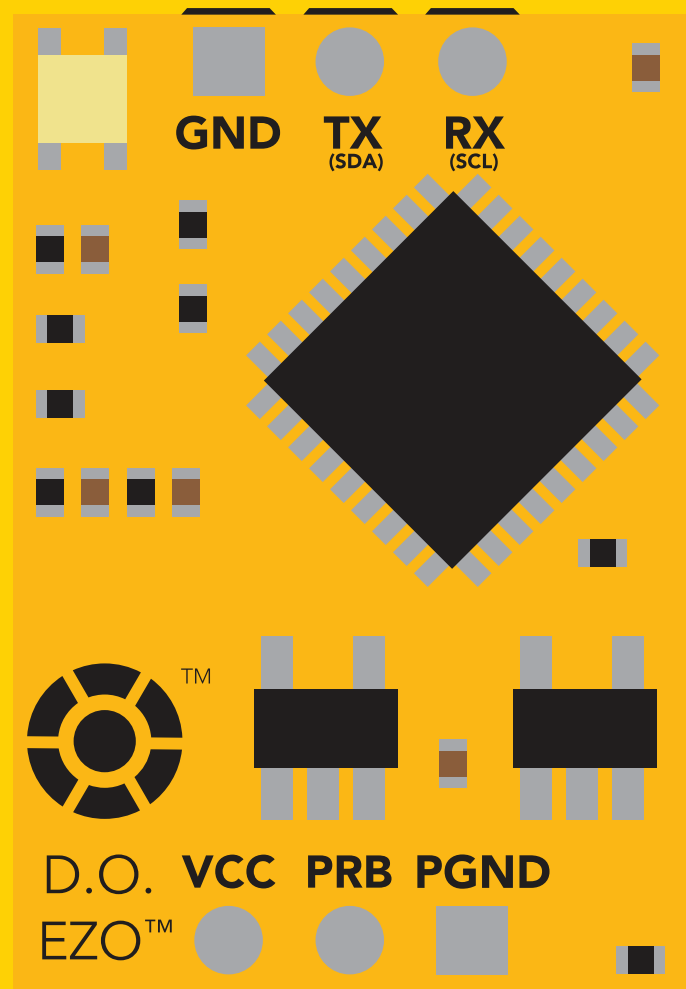
STOP

SOLDERING THIS DEVICE VOIDS YOUR WARRANTY.

This is sensitive electronic equipment. Get this device working in a solderless breadboard first. Once this device has been soldered it is no longer covered by our warranty.

This device has been designed to be soldered and can be soldered at any time. Once that decision has been made, Atlas Scientific no longer assumes responsibility for the device's continued operation. The embedded systems engineer is now the responsible party.

Get this device working in a solderless breadboard first!
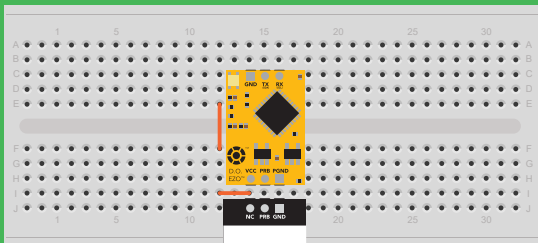
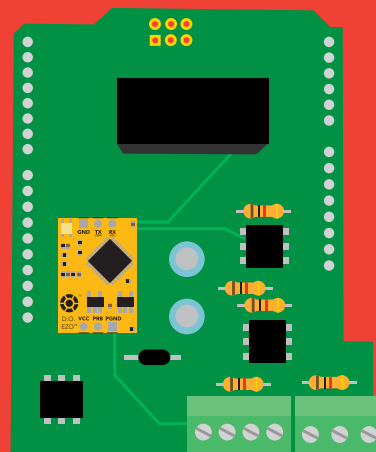**Do not embed this device without testing it in a solderless breadboard!**

r 0.1

Table of contents

UART

I²C

EZO™ circuit dimensions

13.97mm (0.55")

GND TX (SDA) RX (SCL)

20.16mm (0.79")

D.O. EZO™ VCC PRB PGND

5.8mm (0.22") **8.38mm (0.32")** **10.8mm (0.4")**

Power consumption

	LED	MAX	STANDBY	SLEEP
5V	ON	13.5 mA	13.1 mA	0.66 mA
	OFF	12.7 mA	12.7 mA	
3.3V	ON	12.1 mA	12 mA	0.3 mA
	OFF	11.9 mA	11.9 mA	

Absolute max ratings

Parameter	MIN	TYP	MAX
Storage temperature (EZO™ D.O.)	-65 °C		125 °C
Operational temperature (EZO™ D.O.)	-40 °C	25 °C	85 °C
VCC	3.3V	5V	5.5V

EZO ™ circuit identification

GND **TX** (SDA) **RX** (SCL)

D.O. EZO™

VCC **PRB** **PGND**

EZO™ Dissolved Oxygen circuit

GND **TX** (SDA) **RX** (SCL)

D.O. 6.0

CC **PRB** **PGND**
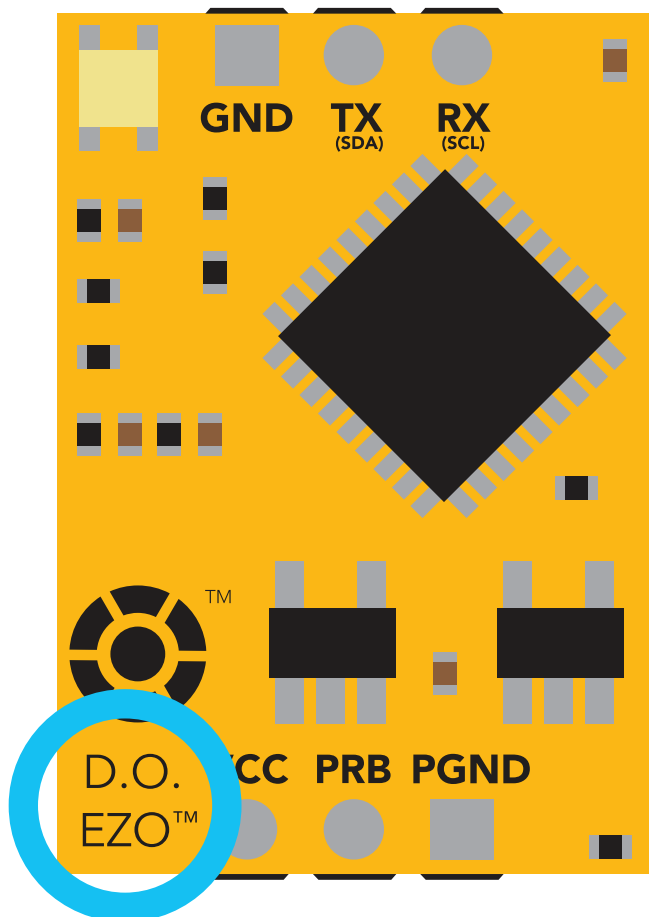
Legacy Dissolved Oxygen circuit

✓

Viewing correct datasheet

✗

Viewing incorrect datasheet

Click here to view legacy datasheet

Operating principle

A galvanic dissolved oxygen probe consists of a Polytetrafluoroethylene membrane, an anode bathed in an electrolyte and a cathode. Oxygen molecules defuse through the probes membrane at a constant rate (without the membrane the reaction happens to quickly). Once the oxygen molecules have crossed the membrane they are reduced at the cathode and a small voltage is produced. If no oxygen molecules are present, the probe will output 0 mV. As the oxygen increases so does the mV output from the probe. Each probe will output a different voltage in the presence of oxygen. The only thing that is constant is that **0mV = 0 Oxygen**. (A galvanic dissolved oxygen probe can also be used to detect the Oxygen content in gases).

Membrane

Cathode (Pure silver rod)

Electrolyte

Anode (Zinc)
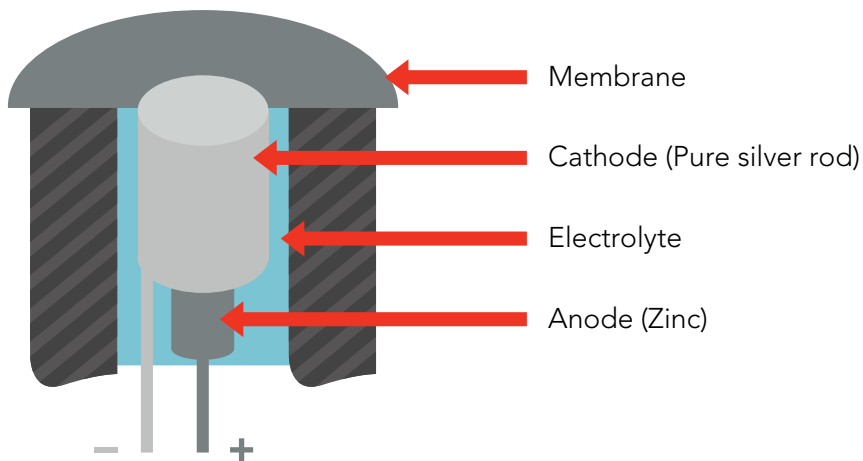
Flow Dependence
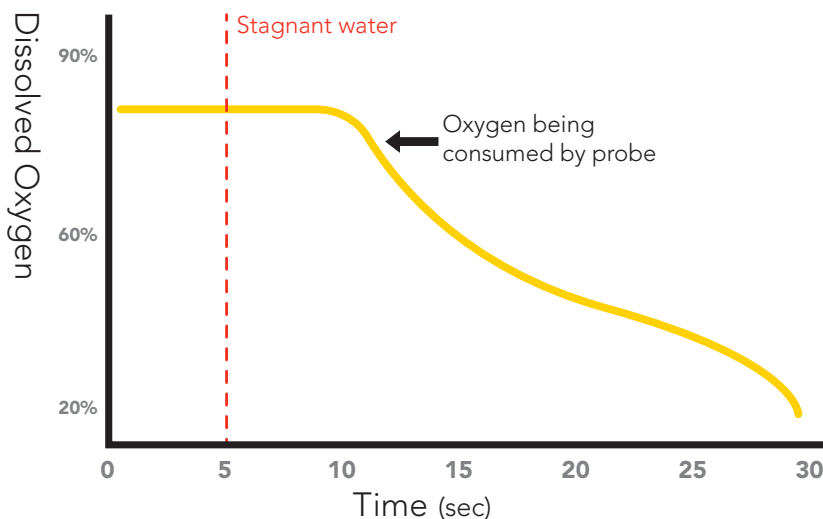
One of the drawbacks from using a galvanic probe is that it consumes a **_VERY_** small amount of the oxygen it reads. Therefore, a small amount of water movement is necessary to take accurate readings. **Approximately 60 ml/min**.
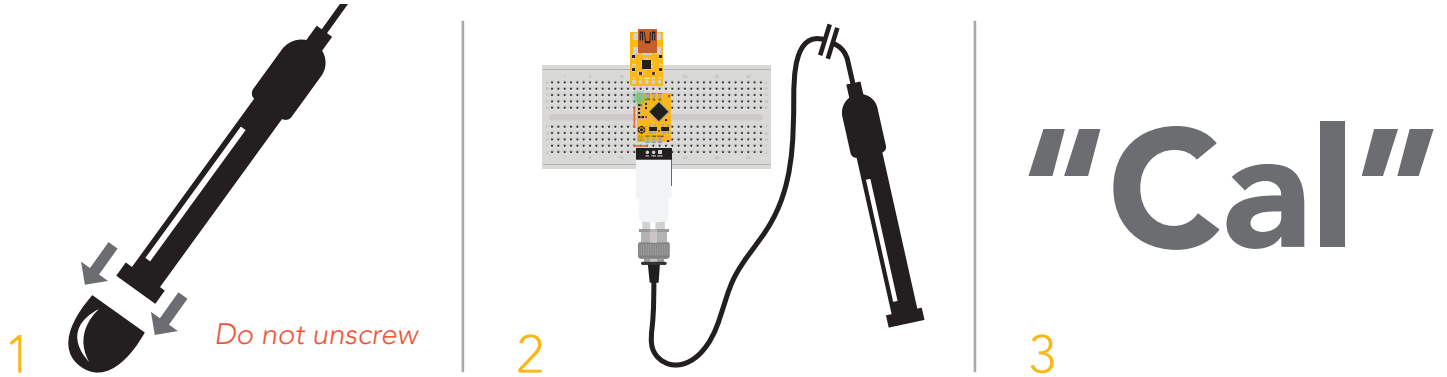
Calibration theory

Calibrate first, compensate later.
Temperature, salinity and pressure compensation values have no effect on calibration.

The Atlas Scientific EZO™ Dissolved Oxygen circuit, has a flexible calibration protocol, allowing for **single point** or **dual point** calibration.

Single point calibration

1   *Do not unscrew*   2   **"Cal"**   3

1. Pull off and discard cap from the Dissolved Oxygen probe. *(only used to protect probe during shipping)*
2. Let the Dissolved Oxygen probe sit, exposed to air untill readings stabalize *(5 – 30 sec)*.
3. Calibrate using the command "Cal".
4. After calibration is complete, you should see readings **~8.82mg/L**
    (only if temperature, salinity and pressure compensation are at default values)

Dual point calibration (*optional*)

Only perform this calibration if you require accurate readings *below* 1.0 mg/L

After you have calibrated using the command "Cal"

1   **Trapped air**   2   **AtlasScientific**   **Dissolved Oxygen**   0:10 – 1:30   **"Cal,0"**   3
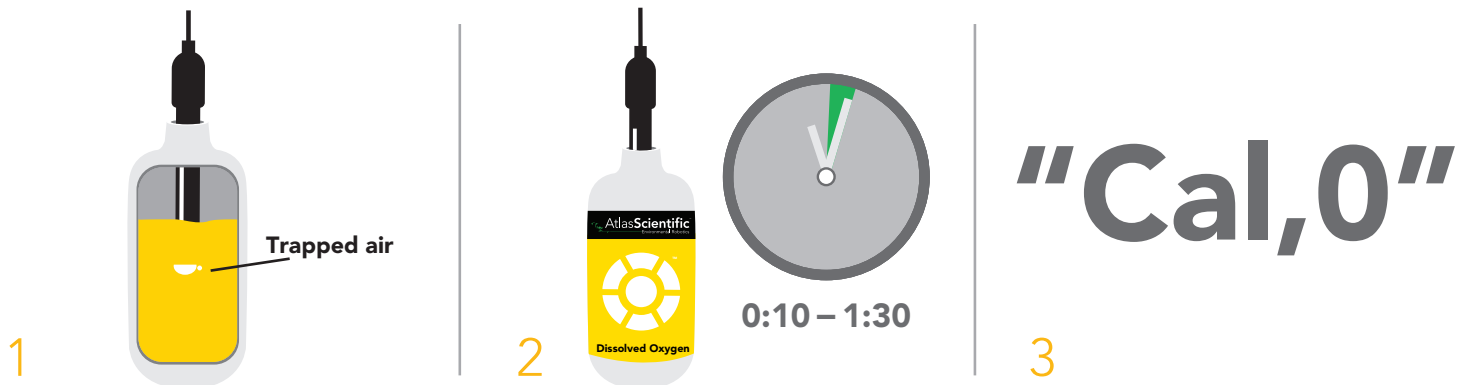
1. Stir probe in Zero D.O. calibration solution to remove trapped air, *(which could cause readings to go high)*.
2. Let the probe sit in Zero D.O. calibration solution untill readings stabalize *(0:10 – 1:30)*.
3. Calibrate using the command "Cal,0".

How to preserve the Zero D.O. calibration solution

Oxygen is everywhere. The Zero D.O. calibration solution has been designed to chemically absorb oxygen. Once the bottle has been opened the test solution has been exposed to oxygen and will slowly stop working.

Only the gas.
(not the flame)

Void space

N_2 N_2

O_2 O_2

Gas

N_2 N_2
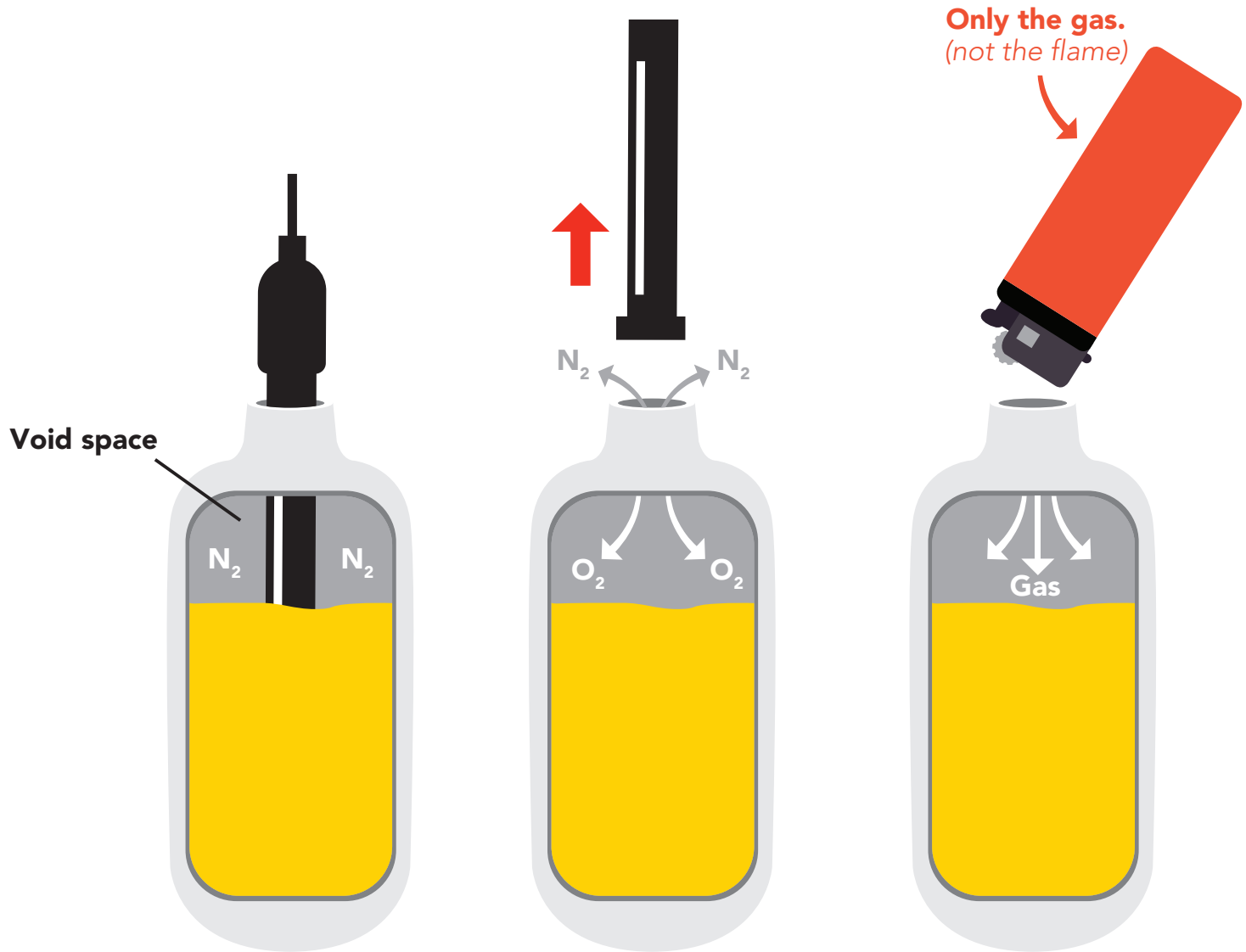
Inside each bottle of the calibration solution is a small amount of nitrogen gas that helps displace oxygen out of the bottle during the filling process. When the Dissolved Oxygen probe is removed from the bottle, oxygen will enter the bottle and begin to dissolve into the solution.

In order slow down this process, fill the void space of the bottle with any gas *(other than oxygen)* to preserve the calibration solution. Gas from a lighter works great if other gases are currently unubtainable.

Power and data isolation

The Atlas Scientific EZO™ Dissolved Oxygen circuit is a very sensitive device. This sensitivity is what gives the Dissolved Oxygen circuit its accuracy. This also means that the Dissolved Oxygen circuit is capable of reading micro-voltages that are bleeding into the water from unnatural sources such as pumps, solenoid valves or other probes/sensors.

When electrical noise is interfering with the Dissolved Oxygen readings it is common to see rapidly fluctuating readings or readings that are consistently off. To verify that electrical noise is causing inaccurate readings, place the Dissolved Oxygen probe in a cup of water by itself. The readings should stabilize quickly, confirming that electrical noise was the issue.
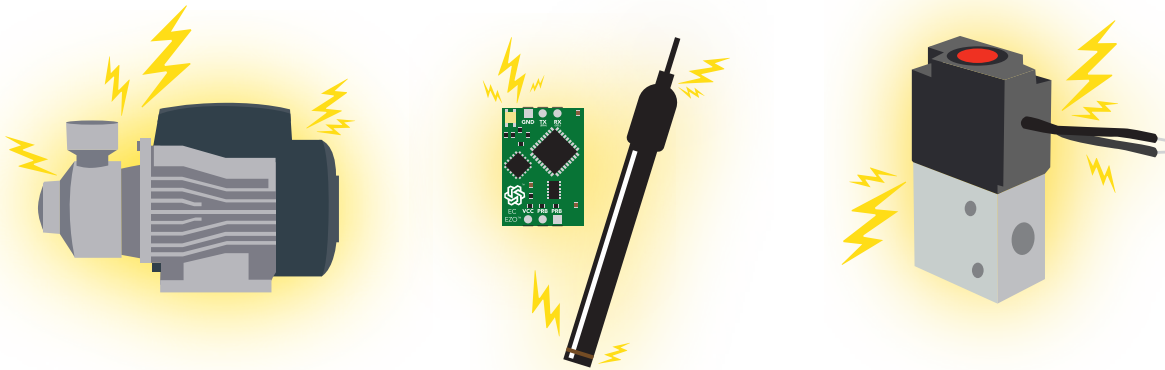
When reading Dissolved Oxygen and Conductivity together, it is **strongly recommended** that the EZO™ Dissolved Oxygen circuit is electrically isolated from the EZO™ Conductivity circuit.

Basic EZO™
**Inline Voltage Isolator**

Correct

Incorrect
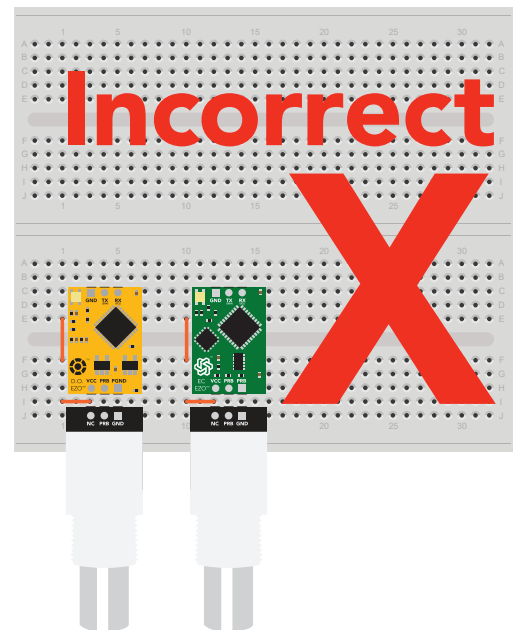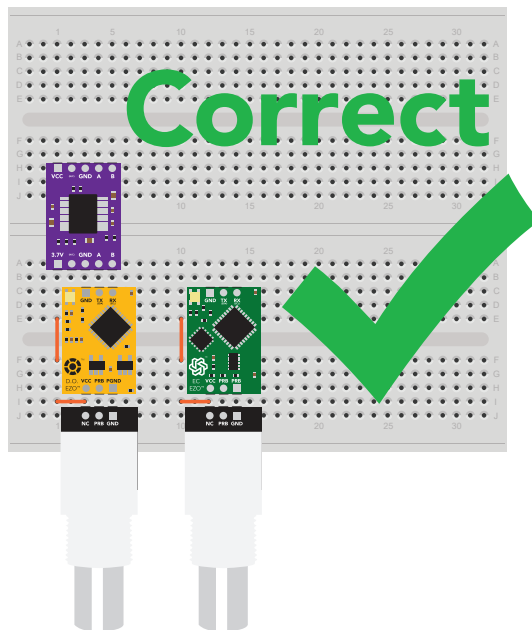
Without isolation, Conductivity readings will effect Dissolved Oxygen accuracy.

This schematic shows exactly how we isolate data and power using the *ADM3260* and a few passive components. The ADM3260 can output isolated power up to 150 mW and incorporates two bidirectional data channels.

This technology works by using tiny transformers to induce the voltage across an air gap. PCB layout requires special attention for EMI/EMC and RF Control, having proper ground planes and keeping the capacitors as close to the chip as possible are crucial for proper performance. The two data channels have a 4.7kΩ pull up resistor on both the isolated and non-isolated lines (R1, R2, R3, and R4) The output voltage is set using a voltage divider (R5, R6, and R,7) this produces a voltage of 3.7V regardless of your input voltage.
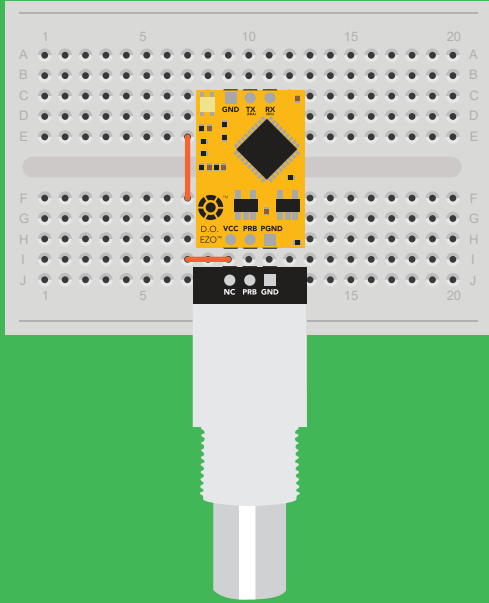
Isolated ground is different from non-isolated ground, these two lines should not be connected together.
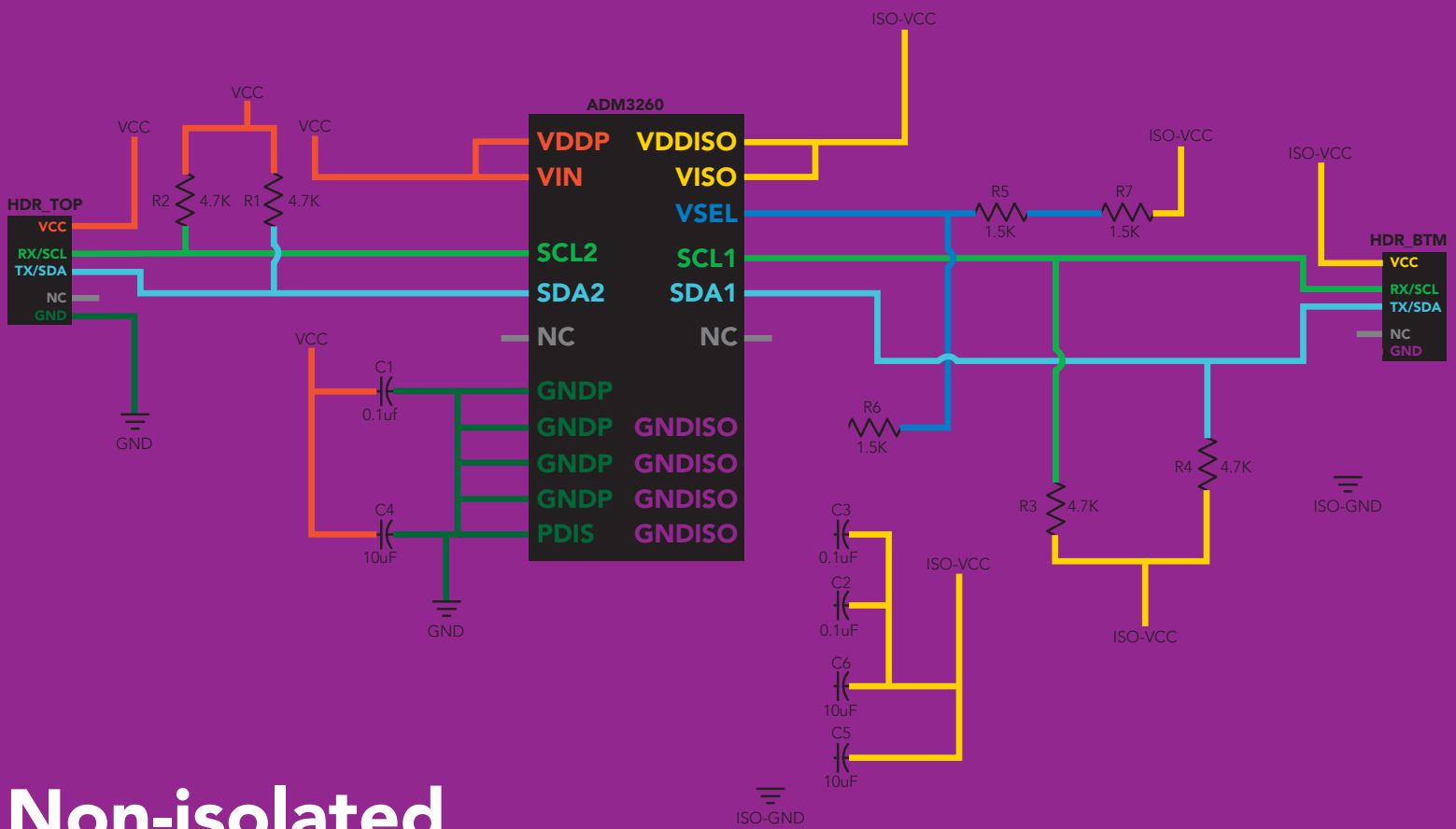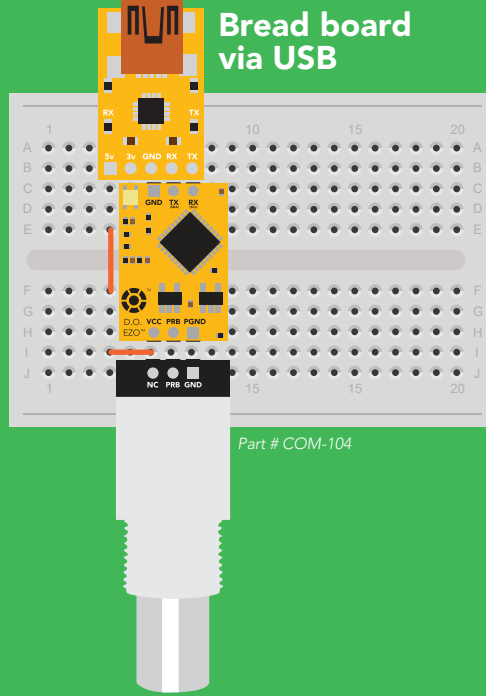

Non-isolated

✓ Correct wiring

Bread board

Bread board via USB

Part # COM-104

Carrier board

Part # ISCCB

USB carrier board

Atlas Scientific

Part # USB-ISO
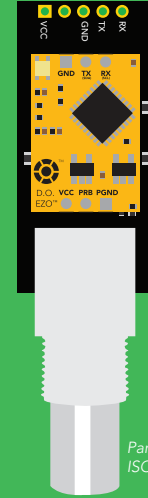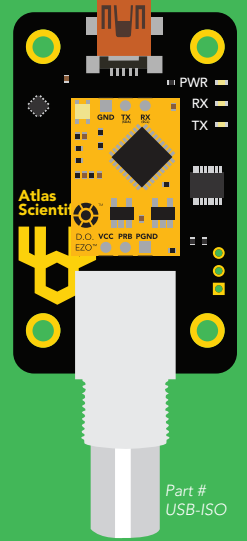
X Incorrect wiring

Extended leads
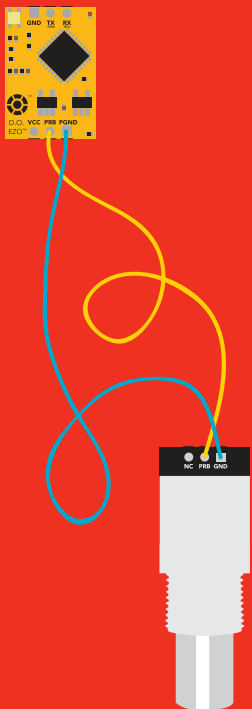
Sloppy setup
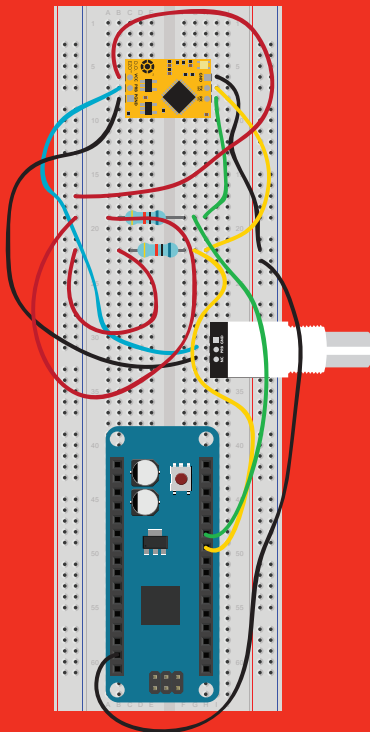
Perfboards or Protoboards
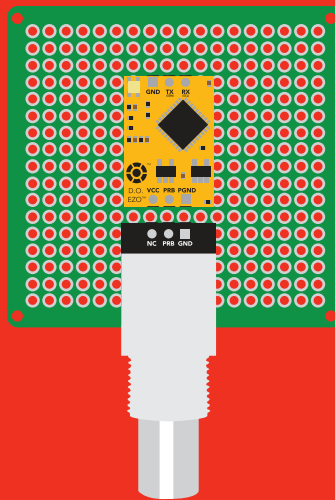
NEVER
use Perfboards
or Protoboards

*Embedded into your device
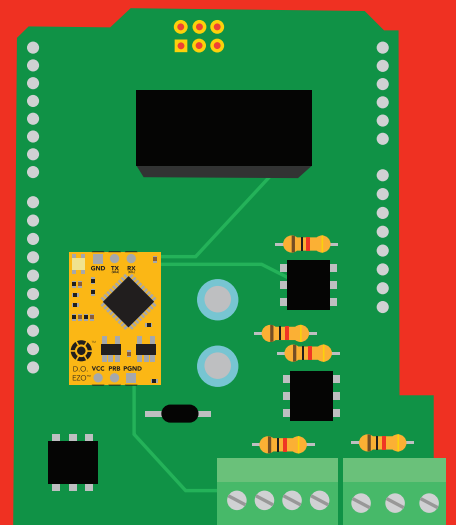
***Only after you are familar
with EZO™ circuits operation**

✔ **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 I^{2}C mode
LED control
Protocol lock
Software switch to I^{2}C mode

Settings that are *NOT* retained if power is cut

Find
Pressure compensation
Salinity compensation
Sleep mode
Temperature compensation

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

TX ➡ RX ✓
RX ⬅ TX ✓

GND   TX (SDA)   RX (SCL)

TX   RX

CPU

D.O. EZO™   VCC   PRB   PGND

Data format

Reading	D.O.	Data type	floating point
Units	mg/L & (% sat) when enabled	Decimal places	mg/L = 2 % sat = 1
Encoding	ASCII	Smallest string	4 characters
Format	string (CSV string when % sat is enabled)	Largest string	16 characters
Terminator	carriage return		

Default state

Mode	UART
Baud	9,600
Readings	continuous
Speed	1 reading per second
Readings without probe	18.17
Temperature compensation	20 °C
Salinity compensation	0 (Fresh water)
Pressure compensation	101.3 kPa (Sea level)
LED	on

∞

1,000 ms

Green
Standby

Cyan
Taking reading

Transmitting
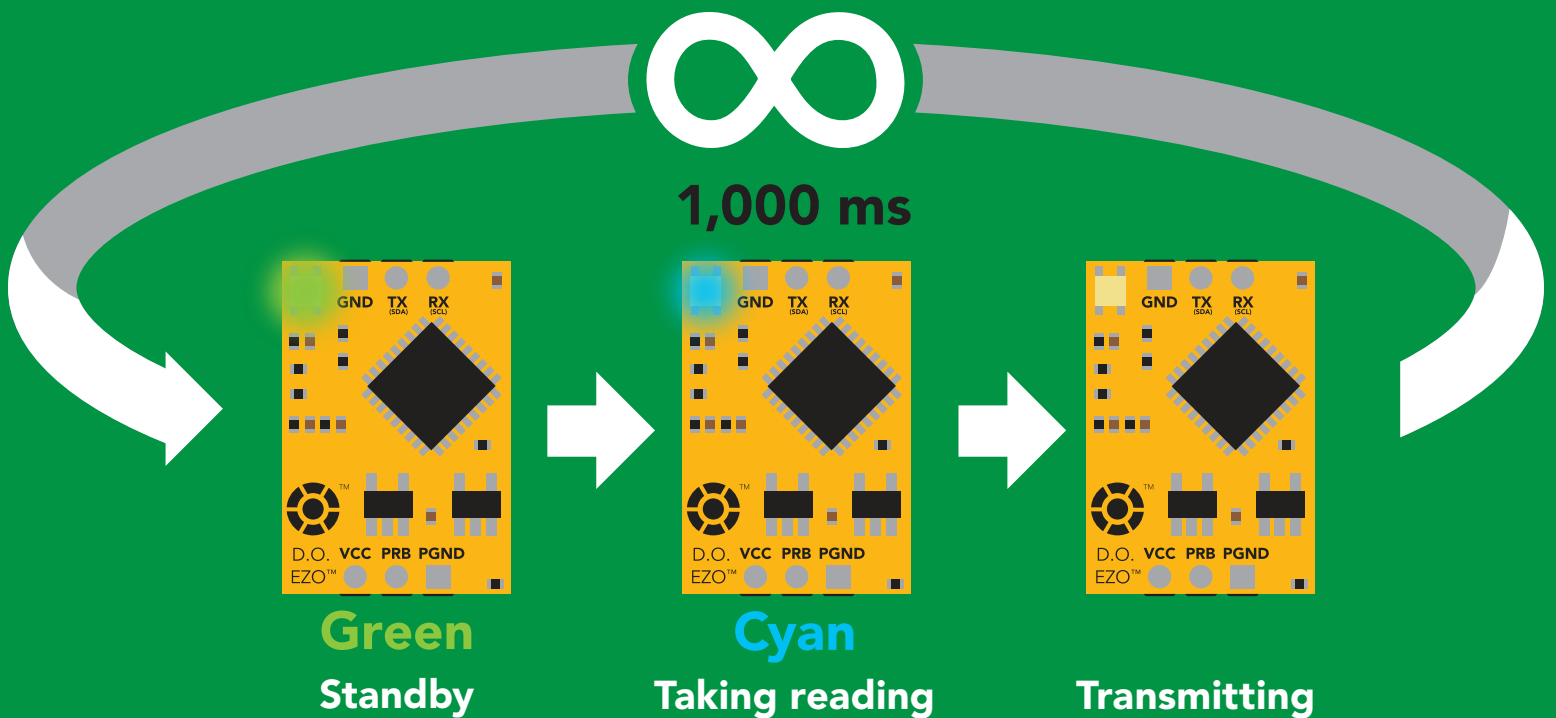
Receiving data from device

2 parts

ASCII data string

Command

Carriage return <cr>

Terminator

GND TX (SDA) RX (SCL)

9,600 baud (default)

D.O. EZO™   VCC PRB PGND

Sender

7.82 <cr>

TX RX

CPU

Receiver
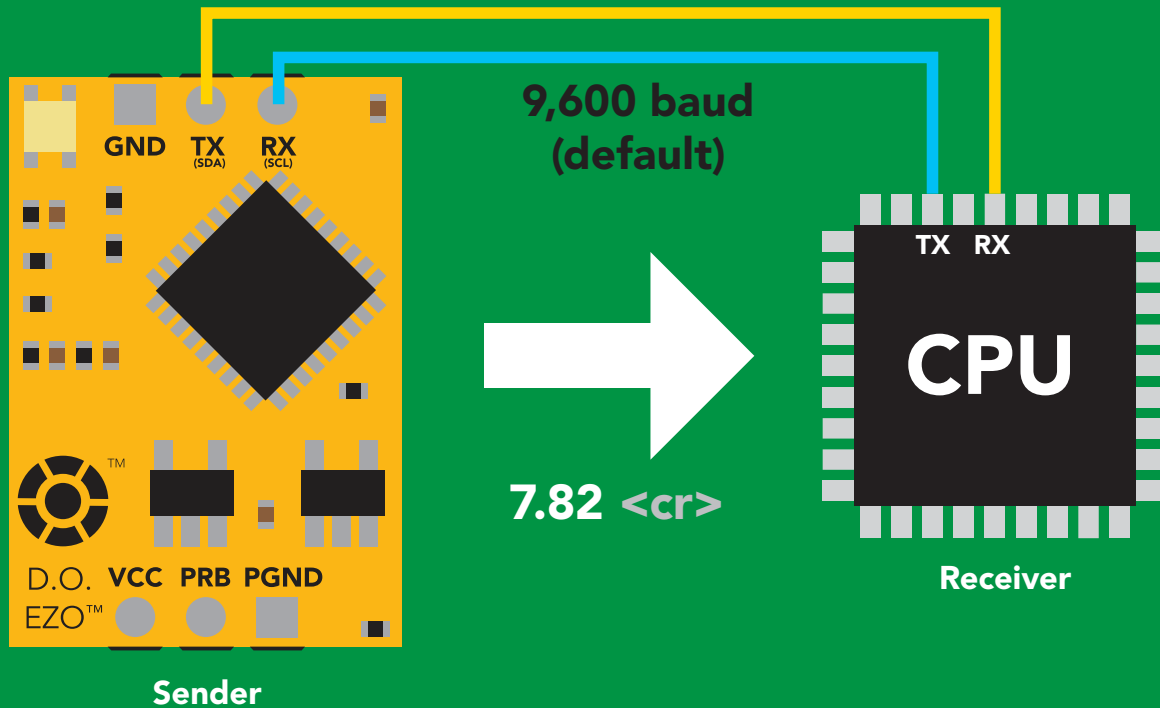
Advanced

ASCII:	7	.	8	2	<cr>
Hex:	37	2E	38	32	0D
Dec:	55	46	56	50	13

Sending commands to device

2 parts

Command (not case sensitive)

ASCII data string

Carriage return <cr>

Terminator

GND TX (SDA) RX (SCL)

TX RX

CPU

Sleep <cr>

Sender

D.O. EZO™ **VCC PRB PGND**

Receiver
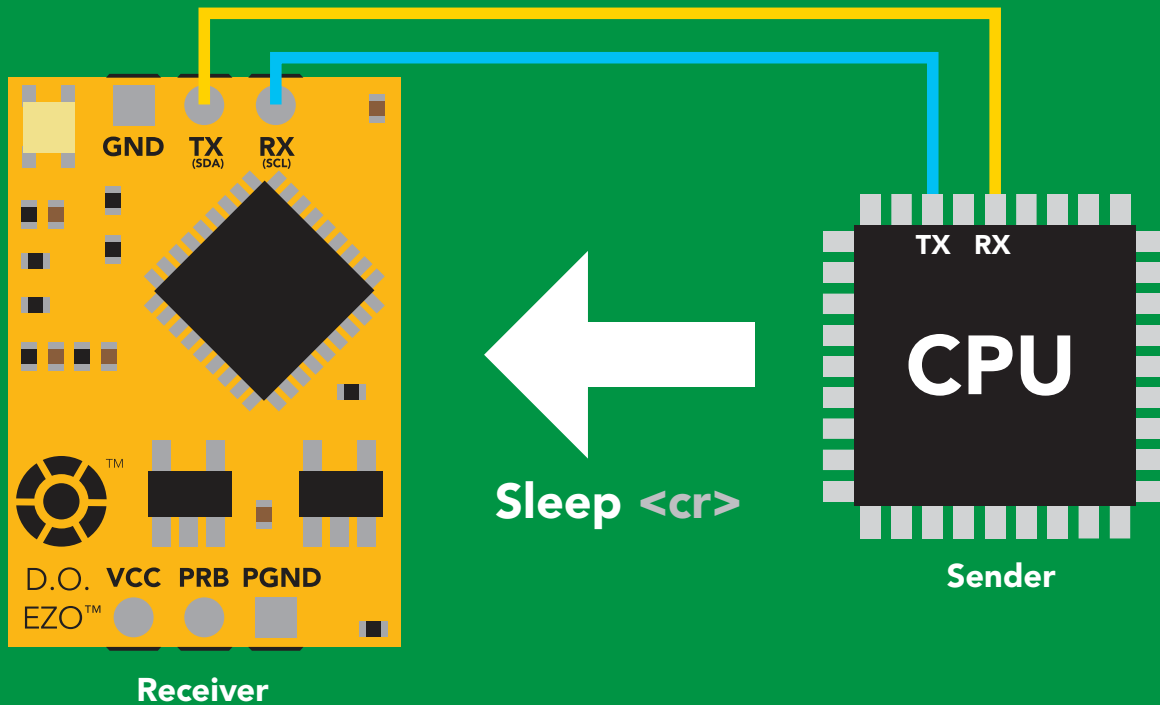
Advanced

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

LED color definition
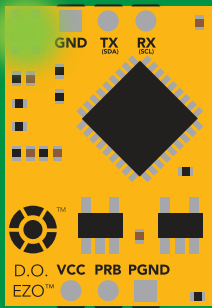
Green
UART standby
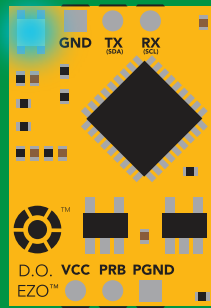
Cyan
Taking reading
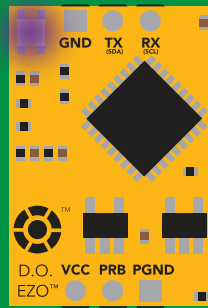
Purple
Changing
baud rate
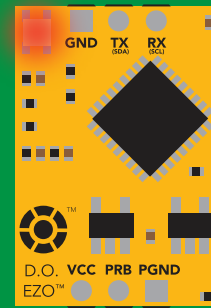
Red
Command
not understood
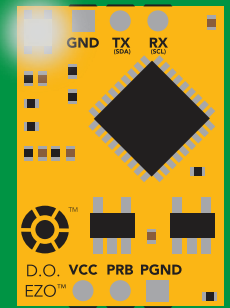
White
Find

	LED ON
5V	**+0.4 mA**
3.3V	**+0.2 mA**

UART mode
command quick reference

All commands are ASCII strings or single ASCII characters.

Command	Function		Default state
Baud	change baud rate	pg. 35	9,600
C	enable/disable continuous reading	pg. 22	enabled
Cal	performs calibration	pg. 24	n/a
Export/import	export/import calibration	pg. 25	n/a
Factory	enable factory reset	pg. 37	n/a
Find	finds device with blinking white LED	pg. 21	n/a
i	device information	pg. 31	n/a
I2C	change to I^2C mode	pg. 38	not set
L	enable/disable LED	pg. 20	enabled
Name	set/show name of device	pg. 30	not set
O	enable/disable parameters	pg. 29	mg/L
P	pressure compensation	pg. 28	101.3 kPa
Plock	enable/disable protocol lock	pg. 36	disabled
R	returns a single reading	pg. 23	n/a
S	salinity compensation	pg. 27	n/a
Sleep	enter sleep mode/low power	pg. 34	n/a
Status	retrieve status information	pg. 33	n/a
T	temperature compensation	pg. 26	20°C
*OK	enable/disable response codes	pg. 32	enable

LED control

Command syntax

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

L,0 <cr>   **LED off**

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

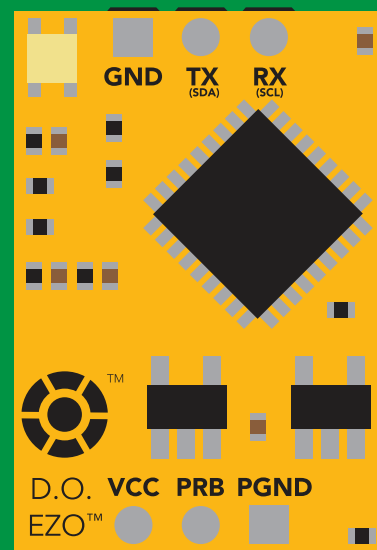| Example	Response
L,1 <cr>	***OK** <cr>
L,0 <cr>	***OK** <cr>
L,? <cr>	**?L,1** <cr> **or** **?L,0** <cr> ***OK** <cr>
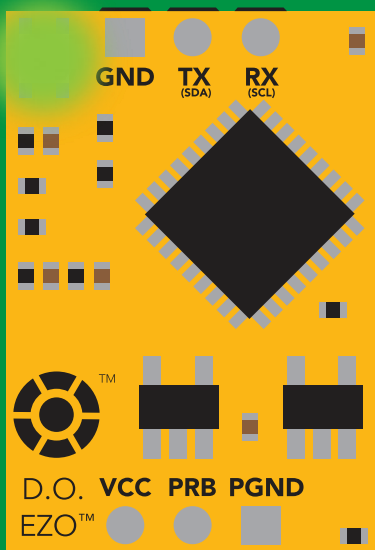
L,1

L,0

Find

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*

*This command is only available for
firmware version 2.10 and above.

Example

Response

Find <cr>

*OK <cr>

iSweek www.isweek.com
Add: 16/F, Bldg. #3, Zhongke Mansion, No.1 Hi-Tech S. Rd, Hi-Tech Park South, Shenzhen, Guangdong, 518067 P.R.China
Tel: + 86-755-83289036   Fax: + 86-755-83289052   E-mail: sales@isweek.com
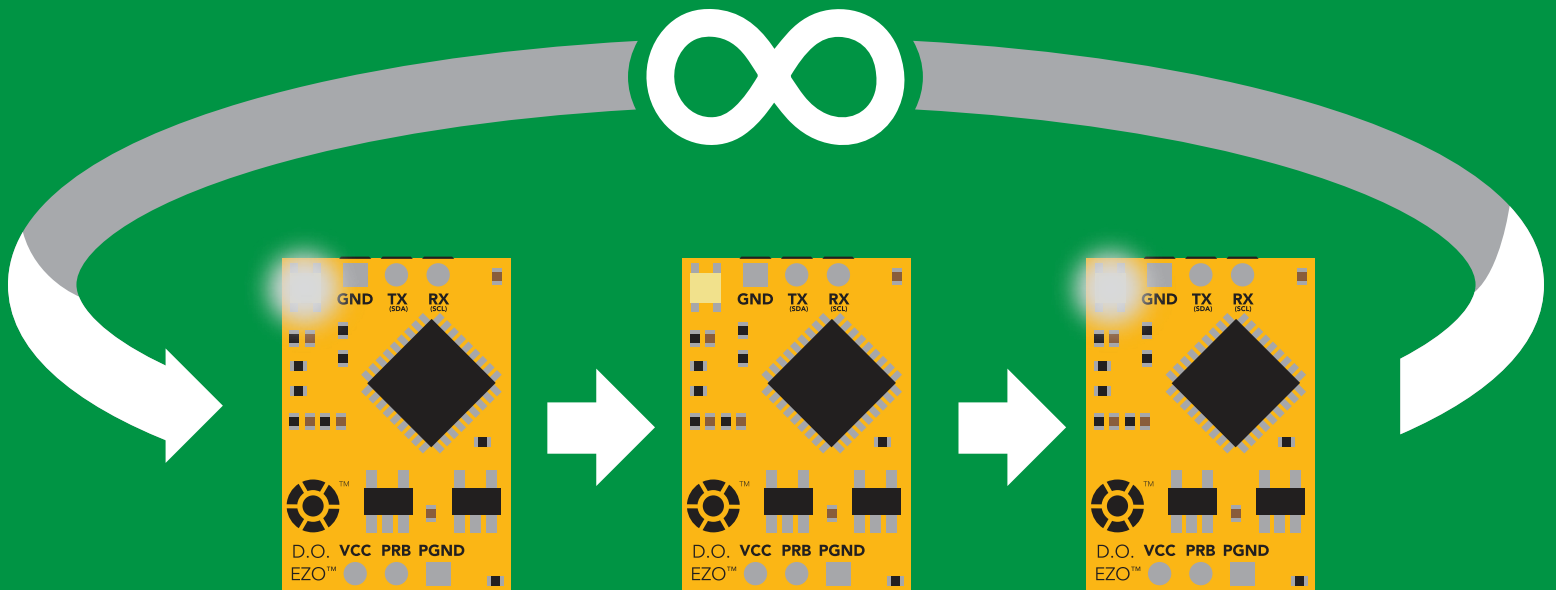
Continuous reading mode

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?

*This command is only available for firmware version 2.10 and above.

Example	Response
C,1 <cr>	*OK <cr> DO (1 sec) <cr> DO (2 sec) <cr> DO (3 sec) <cr>
C,30 <cr>	*OK <cr> DO (30 sec) <cr> DO (60 sec) <cr> DO (90 sec) <cr>
C,0 <cr>	*OK <cr>
C,? <cr>	?C,1 <cr> or ?C,0 <cr> or ?C,30 <cr> *OK <cr>

Single reading mode
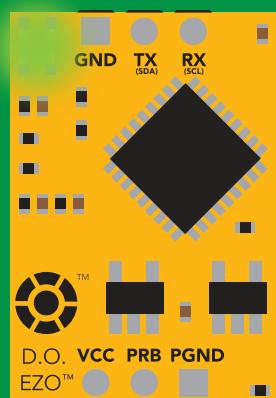
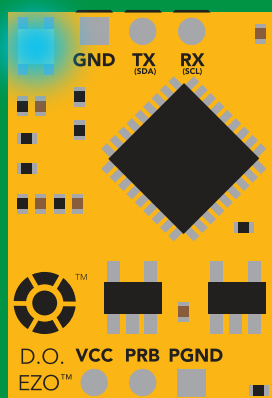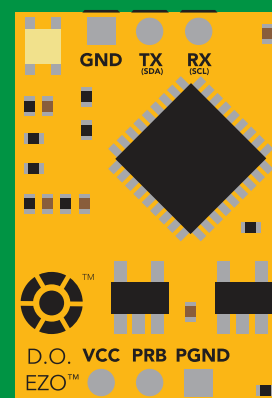## Command syntax

R <cr> takes single reading

Example	Response
R <cr>	**7.82** <cr> ***OK*** <cr>

Green

Standby

Cyan

Taking reading

Transmitting

600 ms

Calibration

Command syntax

Cal	<cr>	calibrate to atmospheric oxygen levels
Cal,0	<cr>	calibrate device to 0 dissolved oxygen
Cal,clear	<cr>	delete calibration data
Cal,?	<cr>	device calibrated?

Example	Response
Cal <cr>	*OK <cr>
Cal,0 <cr>	*OK <cr>
Cal,clear <cr>	*OK <cr>
Cal,? <cr>	?Cal,0 <cr> or ?Cal,1 <cr> or ?Cal,2 <cr> *OK <cr> single point two point
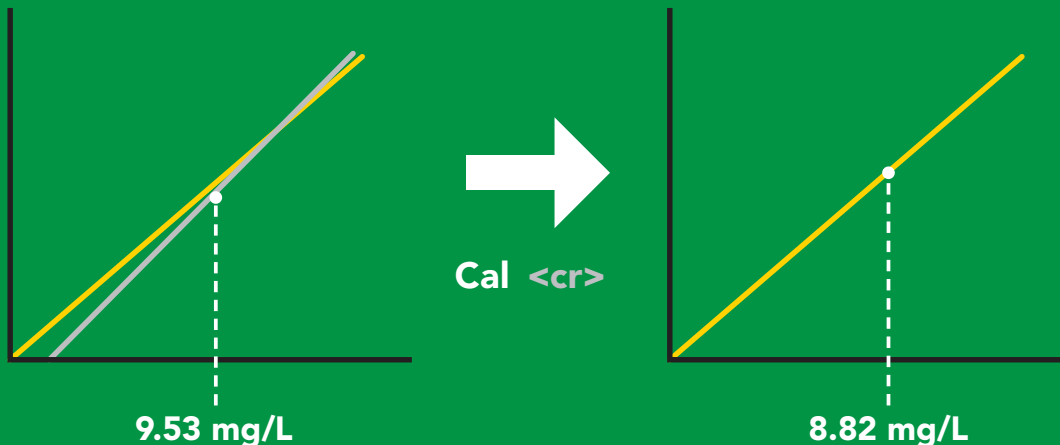
Cal <cr>

9.53 mg/L

8.82 mg/L

Export/import calibration

Command syntax

Export   `<cr>`   export calibration string from calibrated device*

Import   `<cr>`   import calibration string to new device*

Export,? `<cr>`   calibration string info*

*This command is only available for firmware version 2.10 and above.

Example	Response
Export,? `<cr>`	10,120 `<cr>`

Response breakdown

10,   **120**

↑ # of strings to export   ↑ # of bytes to export

Export strings can be up to 12 characters long, and is always followed by `<cr>`

Example	Response
Export `<cr>`	59 6F 75 20 61 72 `<cr>` (1 of 10)
	Export `<cr>`
	65 20 61 20 63 6F `<cr>` (2 of 10)
	Export `<cr>`
	6F 6C 20 67 75 79 `<cr>` (3 of 10)
	...
	Disabling *OK simplifies this process
Import, n (FIFO)	Import, 59 6F 75 20 61 72 `<cr>` (1 of 10)
	...

Temperature compensation

Command syntax

T,n <cr> n = any value; floating point or int

T,? <cr> compensated temperature value?

Example	Response
T,19.5 <cr>	*OK <cr>
T,? <cr>	?T,19.5 <cr> *OK <cr>

T,19.5 <cr>

8.82 mg/L

8.91 mg/L

Salinity compensation

Command syntax

S,n	<cr>	n = any value in microsiemens
S,n,ppt	<cr>	n = any value in ppt
S,?	<cr>	compensated salinity value?

Example	Response
S,50000 <cr>	*OK <cr>
S,37.5,ppt <cr>	*OK <cr>
S,? <cr>	?S,50000,µS <cr> or ?S,37.5,ppt <cr> *OK <cr>

S,50000 <cr>

8.91 mg/L   8.01 mg/L

Pressure compensation

Command syntax

P,n <cr> n = any value in kPa

P,? <cr> compensated pressure value?

Example	Response
P,90.25 <cr>	*OK <cr>
P,? <cr>	?,P,90.25 <cr> *OK <cr>

P,90.25 <cr>

8.01 mg/L

6.94 mg/L
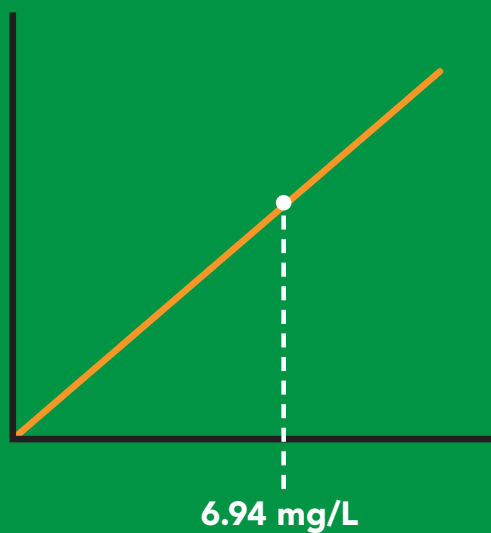
Enable/disable parameters from output string

Command syntax

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

Example

Example	Response	
O,%,0 <cr>	*OK <cr>	disable percent saturation
O,%,1 <cr>	*OK <cr>	enable percent saturation
O,mg,0 <cr>	*OK <cr>	disable mg/L
O,mg,1 <cr>	*OK <cr>	enable mg/L
O,? <cr>	?,O,%,mg <cr>	if both are enabled

Parameters

%   percent saturation
mg   mg/L

Followed by 1 or 0
1   enabled
0   disabled

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   Response

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

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

Name,zzt   Name,?

GND TX   RX   GND TX   RX
     (SDA) (SCL)   (SDA) (SCL)

D.O. VCC PRB PGND   D.O. VCC PRB PGND
EZO™   EZO™
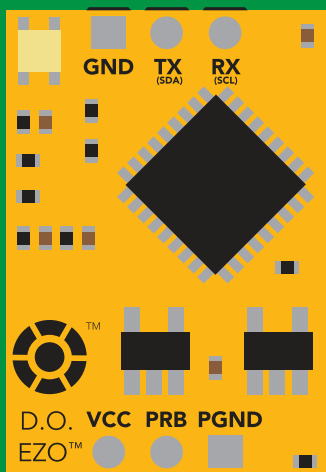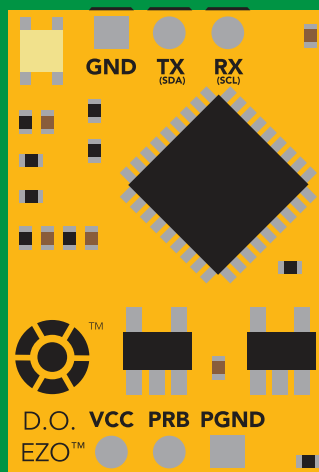
*OK `<cr>`   Name,zzt `<cr>`
                         *OK `<cr>`

Device information

Command syntax

i `<cr>` device information

Example

i `<cr>`

Response

?i,D.O.,1.98 `<cr>`
*OK `<cr>`

Response breakdown

?i, D.O., 1.98
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>	7.82 <cr> *OK <cr>
*OK,0 <cr>	no response, *OK disabled
R <cr>	7.82 <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

Reading device status

Command syntax

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

Example

Status \<cr\>

Response

?Status,P,5.038 \<cr\>
*OK \<cr\>

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 <cr> enter sleep mode/low power

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

	STANDBY	SLEEP
5V	13.1 mA	0.66 mA
3.3V	12 mA	0.3 mA
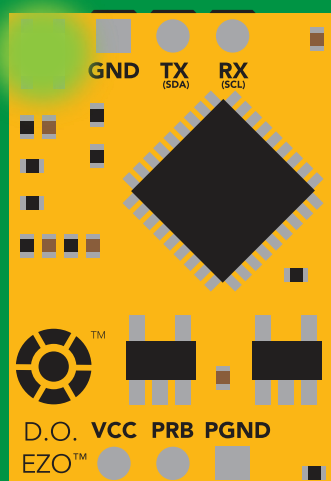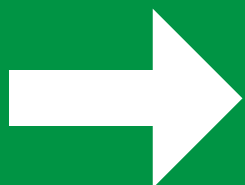
Sleep <cr>

Standby
13.1 mA
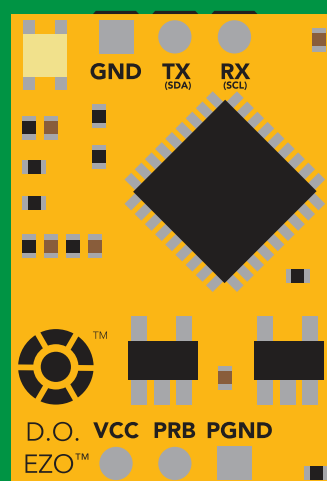
Sleep
0.66 mA

Change baud rate

Command syntax

Baud,n `<cr>` change baud rate

Example

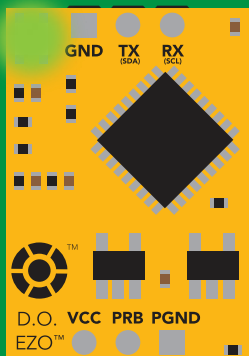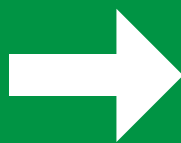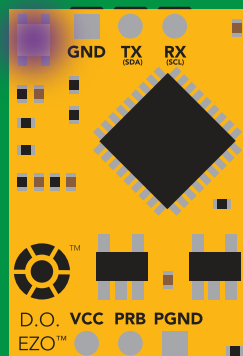| Example	Response
Baud,38400 `<cr>`	*OK `<cr>`
Baud,? `<cr>`	?Baud,38400 `<cr>` *OK `<cr>`

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

Standby

Baud,38400 `<cr>`

Changing
baud rate
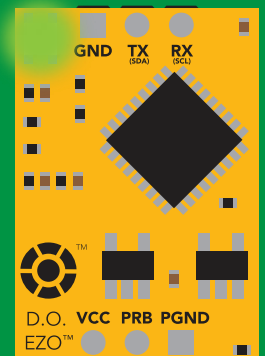
*OK `<cr>`

(reboot)

Standby

Protocol lock

Command syntax

Plock,1 `<cr>` enable Plock

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

Plock,? `<cr>` Plock on/off?

Example | Response

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

Plock,1
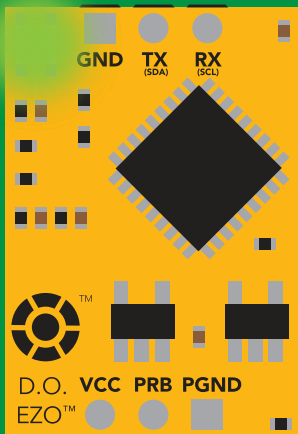
*OK `<cr>`

I2C,100
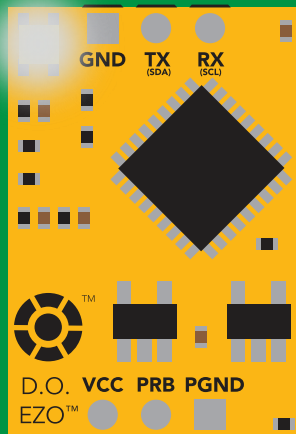
cannot change to I²C

*ER `<cr>`

Short
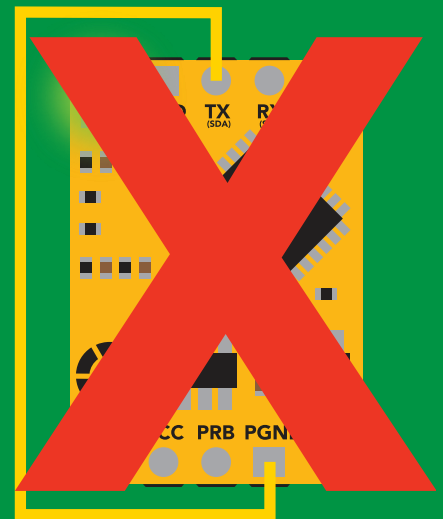
cannot change to I²C

Factory reset

Command syntax

Factory **<cr>** **enable factory reset**

Example   Response

Factory **<cr>**   ***OK** **<cr>**

Factory **<cr>**

(reboot)

*OK **<cr>**
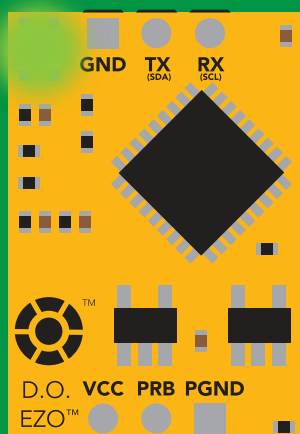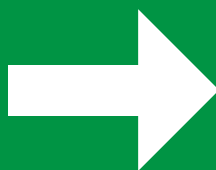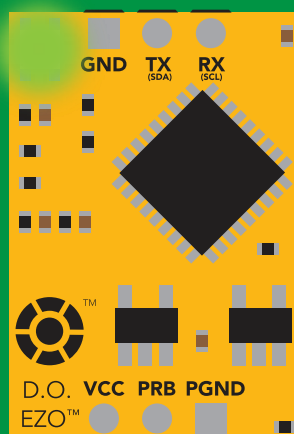
*RS **<cr>**
*RE **<cr>**

Baud rate will not change

Change to I²C mode

Command syntax

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
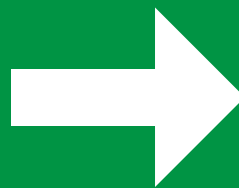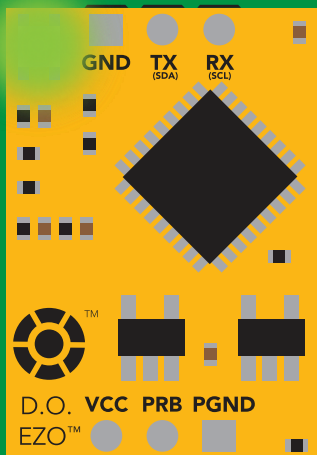
(reboot)
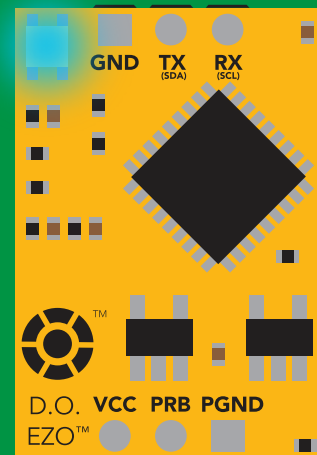
Green
*OK <cr>

Blue
now in I²C mode

Manual switching to I²C

- **Make sure Plock is set to 0**
- **Disconnect ground (power off)**
- **Disconnect TX and RX**
- **Connect TX to PGND**
- **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 97 (0x61)

Example
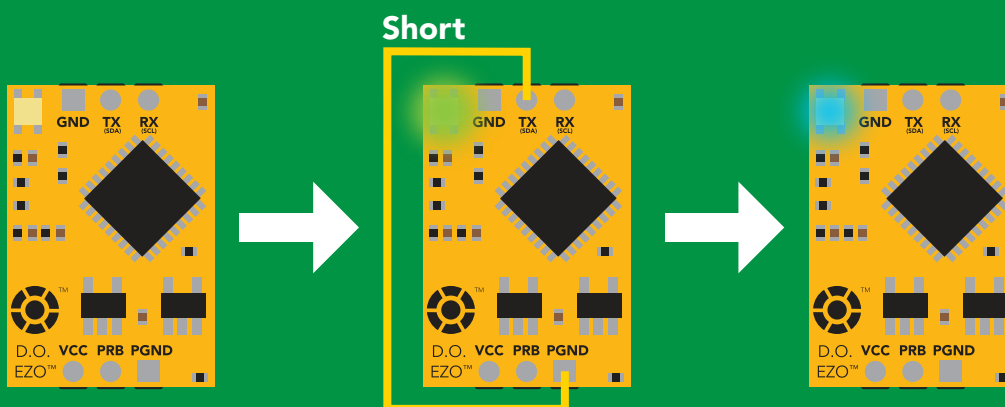
Wrong Example

Disconnect RX line
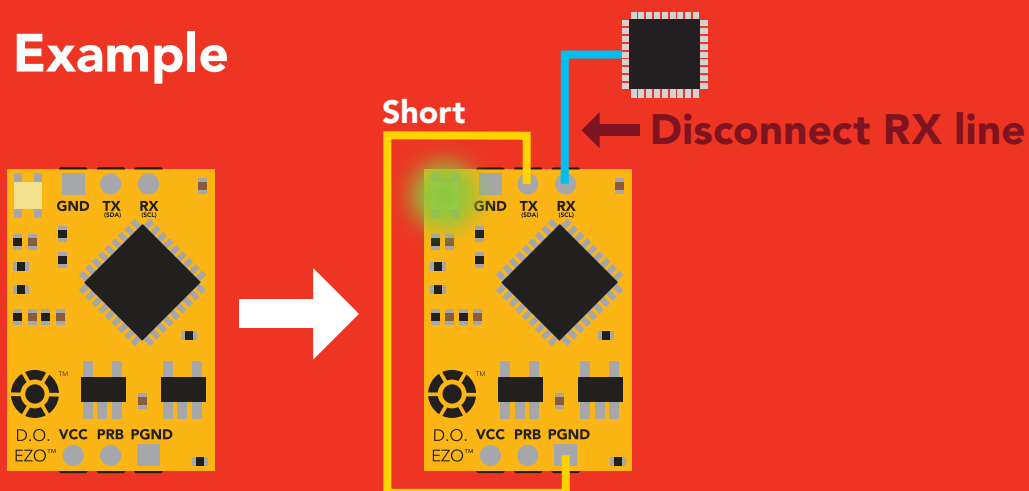
I²C mode

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™ device into I²C mode click here

Settings that are retained if power is cut	Settings that are *NOT* retained if power is cut
Calibration	Find
Change I²C address	Pressure compensation
Enable/disable parameters	Salinity compensation
Hardware switch to UART mode	Sleep mode
LED control	Temperature compensation
Protocol lock	
Software switch to UART mode	

I²C mode

I²C address (0x01 – 0x7F)
97 (0x61) default

Vcc 3.3V – 5.5V

Clock speed 100 – 400 kHz

SDA

SCL

0V — VCC ← — 0V

VCC

4.7k resistor may be needed

VCC

SDA ➡ SDA ✓

SCL ← SCL ✓

GND SDA (TX) SCL (RX)

D.O. EZO™

VCC PRB PGND

SCL SDA

CPU

Data format

Reading	D.O.	**Data type**	**floating point**
Units	mg/L & (% sat) *when enabled*	**Decimal places**	mg/L = 2 % sat = 1
Encoding	ASCII	**Smallest string**	4 characters
Format	string *(CSV string when % sat is enabled)*	**Largest string**	16 characters
Terminator	carriage return		

Sending commands to device

5 parts

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

97 (0x61)   ASCII command string

Example

| Start | 97 (0x61) | Write | Sleep | Stop |

I²C address   Command

GND SDA (TX) SCL (RX)

SCL SDA

CPU

D.O. EZO™ VCC PRB PGND

Advanced

Address bits   The entire command as ASCII with all arguments

SDA

A6 A5 A4 A3 A2 A1 A0 W ACK First letter of command ACK ... Last letter of command ACK

SCL

Start   **W** = low   Stop
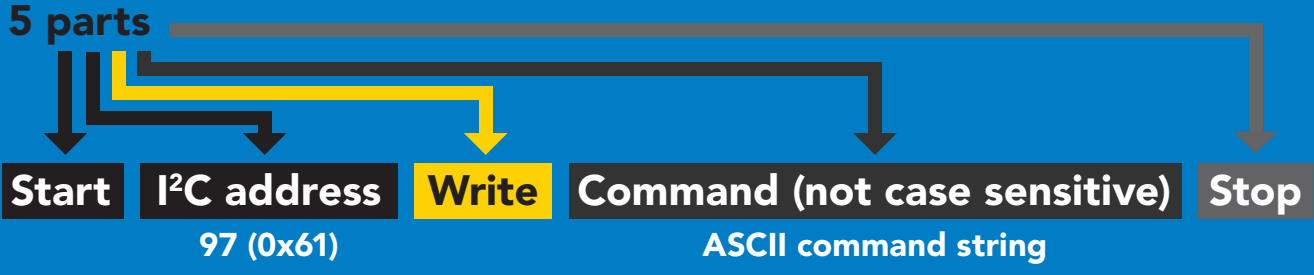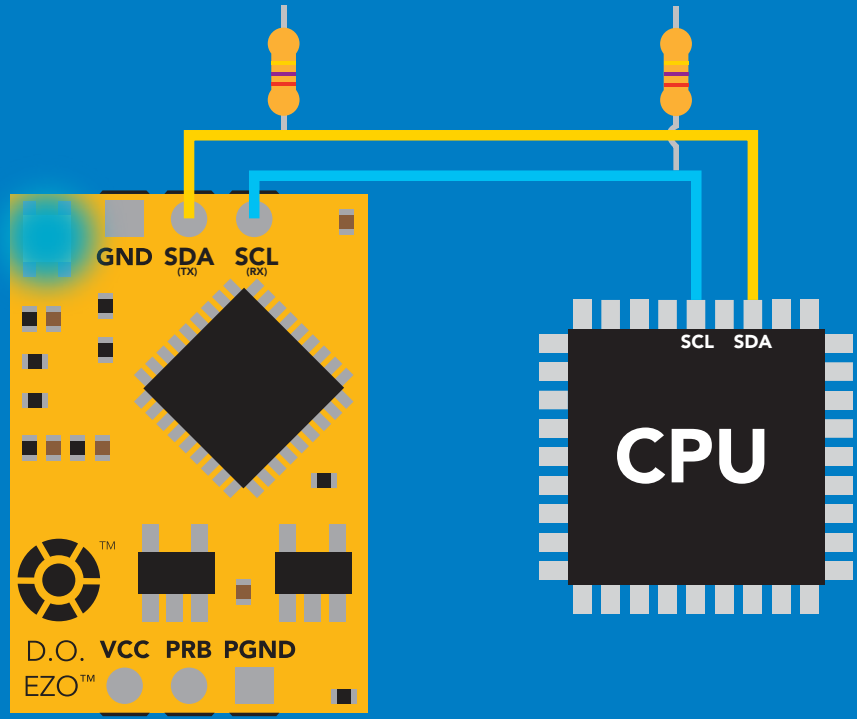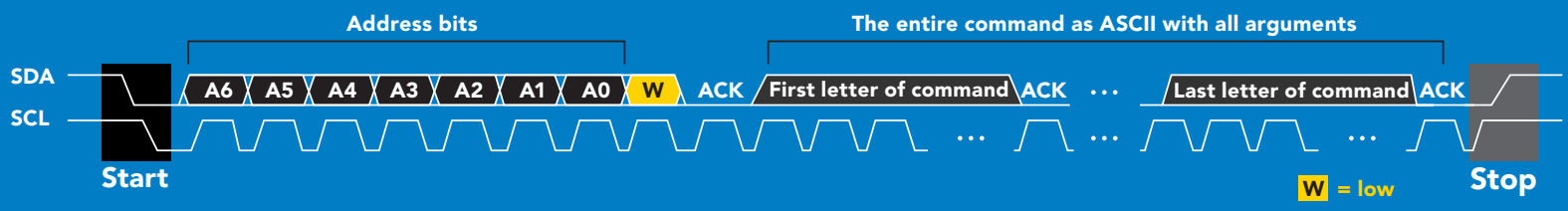
Requesting data from device

7 parts

Start	I²C address	Read	Response code	Data string	Null	Stop
	97 (0x61)		1 byte	"7.82"	Terminator (Dec 0)	

7.82

Advanced

| Address bits | | N bytes of data | | All bytes after data are Null | | R = High |

SDA
SCL

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

1	55	46	56	50	0	= 7.82
Dec		ASCII			Dec	
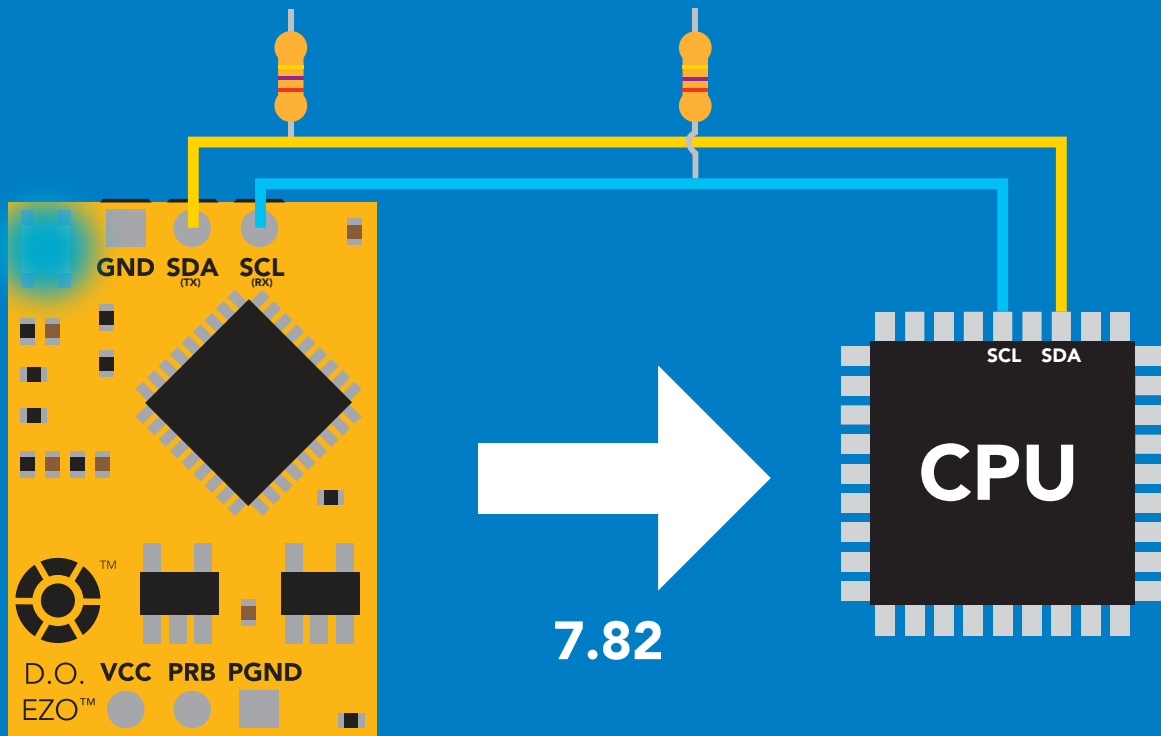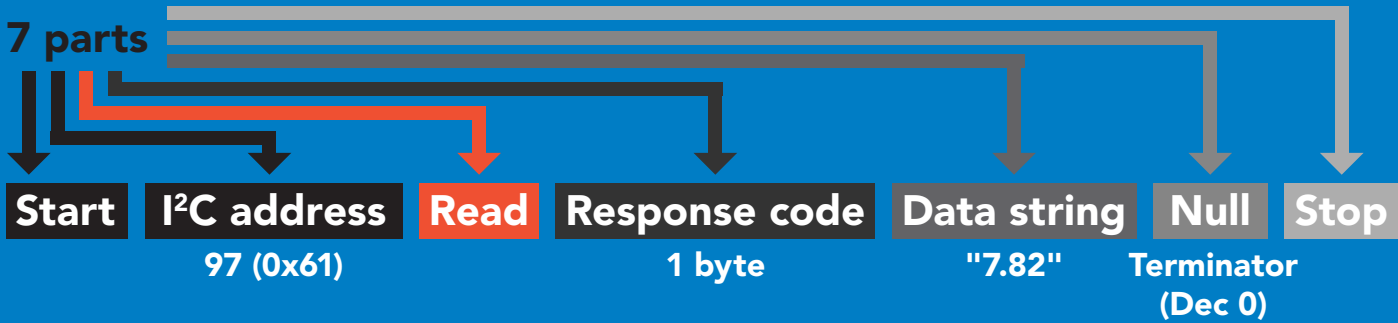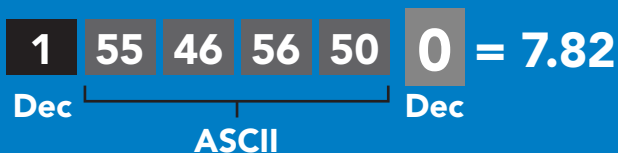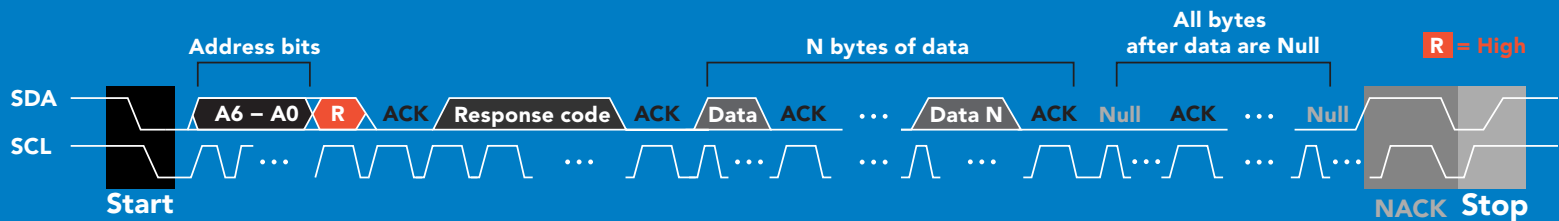
Response codes

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.

Send command

Processing delay

GND SDA (TX) SCL (RX)

D.O. EZO™ VCC PRB PGND

Receiving data
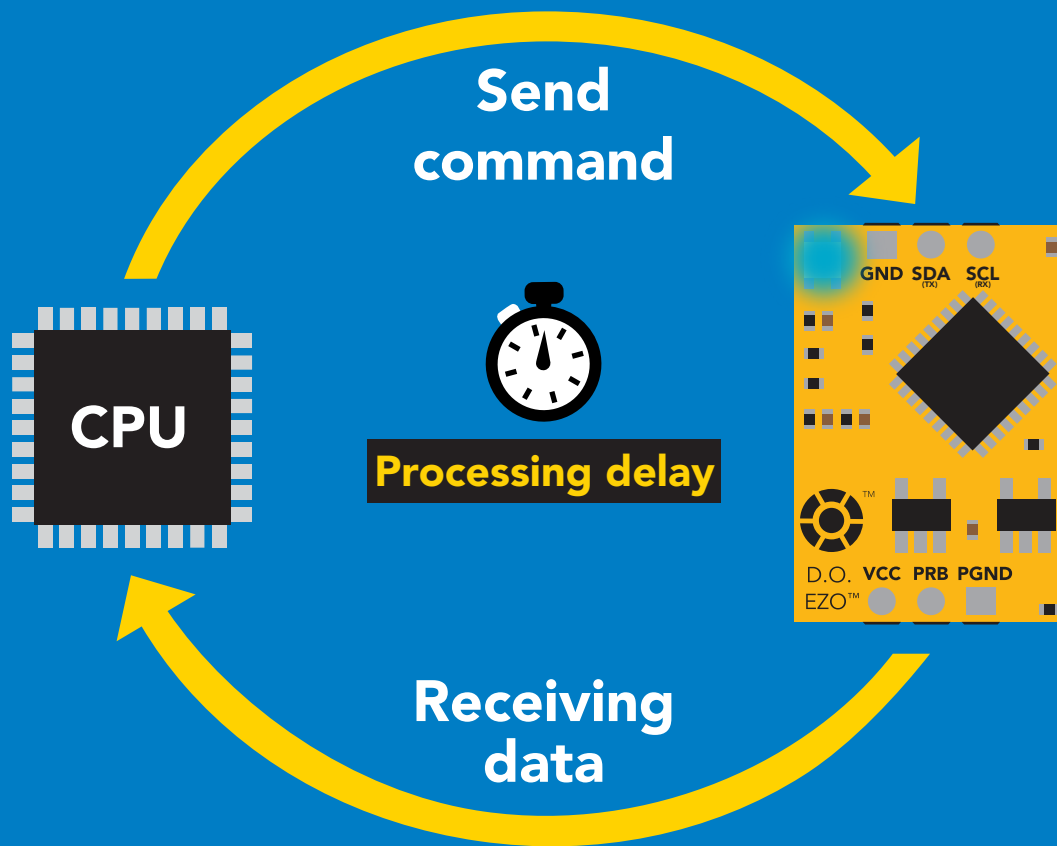
Example

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

delay(300);          Processing delay

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

The response code will always be 254, if you do not wait for the processing delay.

Response codes

Single byte, not string

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

LED color definition
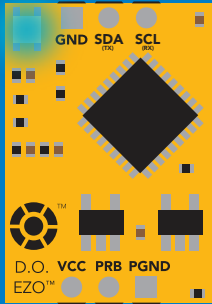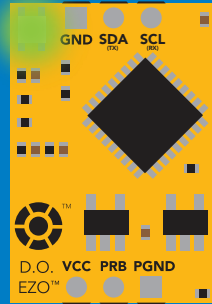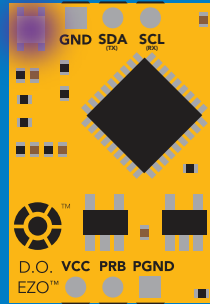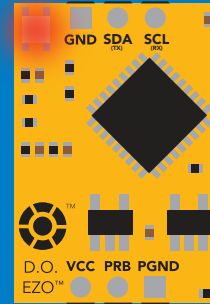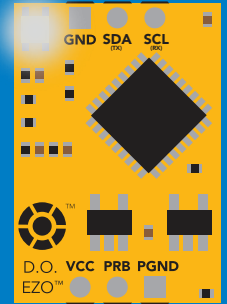
Blue	**Green**	**Purple**	**Red**	**White**
I²C standby	Taking reading	Changing I²C ID#	Command not understood	Find

5V	LED ON **+0.4 mA**
3.3V	**+0.2 mA**

I²C mode
command quick reference

All commands are ASCII strings or single ASCII characters.

Command	Function	
Baud	change back to UART mode	pg. 62
Cal	performs calibration	pg. 50
Export/import	export/import calibration	pg. 51
Factory	enable factory reset	pg. 61
Find	finds device with blinking white LED	pg. 48
i	device information	pg. 56
I2C	change I²C address	pg. 62
L	enable/disable LED	pg. 47
O	removing parameters	pg. 55
P	pressure compensation	pg. 54
Plock	enable/disable protocol lock	pg. 59
R	returns a single reading	pg. 49
S	salinity compensation	pg. 53
Sleep	enter sleep mode/low power	pg. 58
Status	retrieve status information	pg. 57
T	temperature compensation	pg. 52

LED control

Command syntax

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

GND   SDA (TX)   SCL (RX)

D.O. EZO™   VCC   PRB   PGND

L,1

GND   SDA (TX)   SCL (RX)

D.O. EZO™   VCC   PRB   PGND

L,0
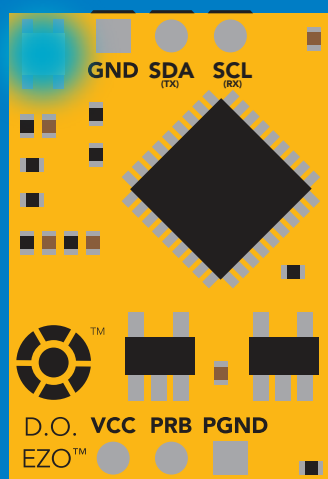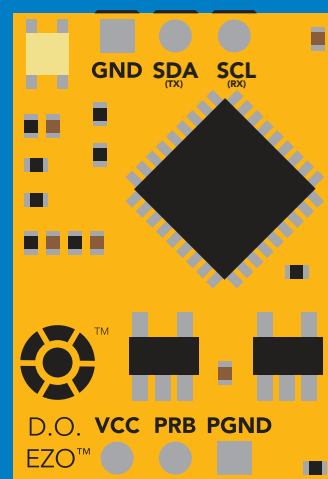
Find

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*

*This command is only available for
firmware version 2.10 and above.

Example

Response

Find **<cr>**

⏱
Wait 300ms

1
Dec

0
Null

∞

iSweek www.isweek.com
Add: 16/F, Bldg. #3, Zhongke Mansion, No.1 Hi-Tech S. Rd, Hi-Tech Park South, Shenzhen, Guangdong, 518067 P.R.China
Tel: + 86-755-83289036   Fax: + 86-755-83289052   E-mail: sales@isweek.com
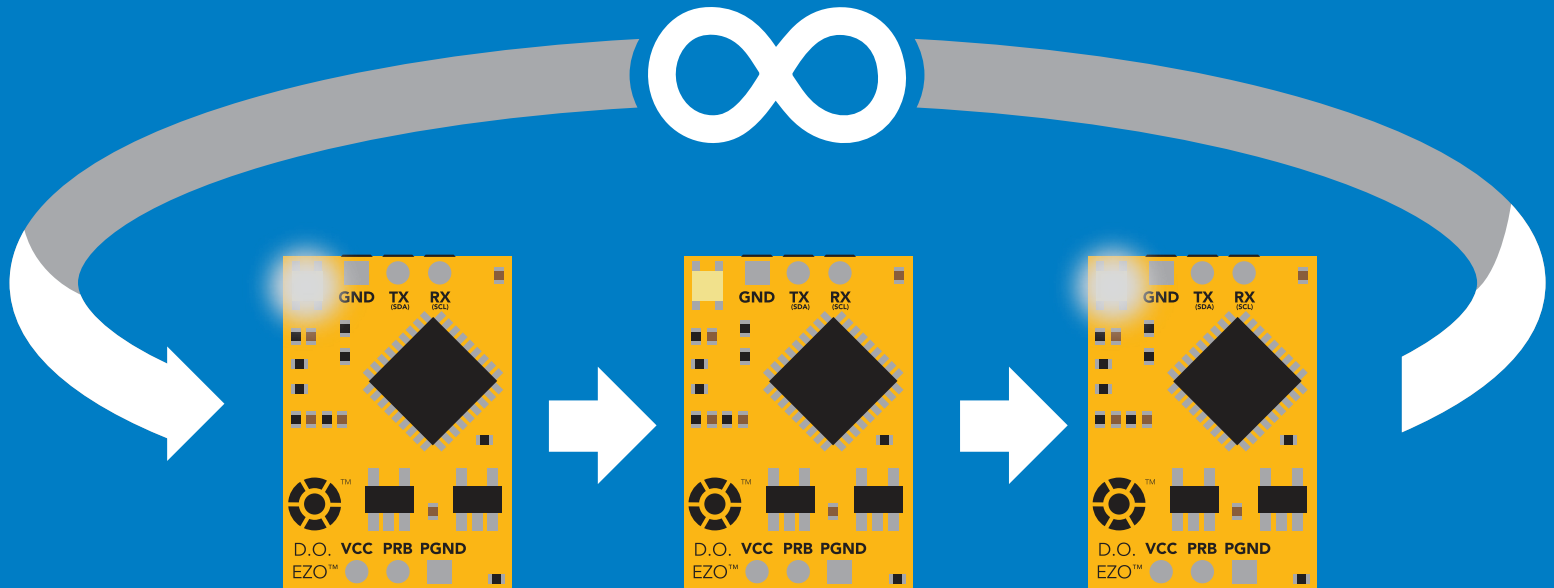
Taking reading

R   return 1 reading

Example	Response
R	⏱ **Wait 600ms** **1** Dec **7.82** ASCII **0** Null
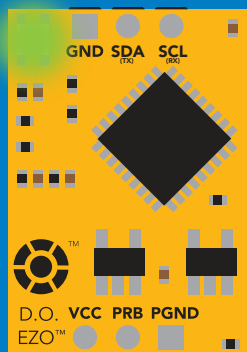
Green

Taking reading

Wait 600ms
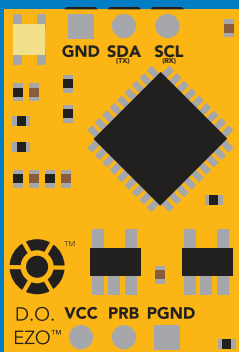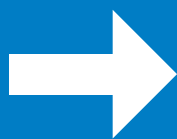
Transmitting
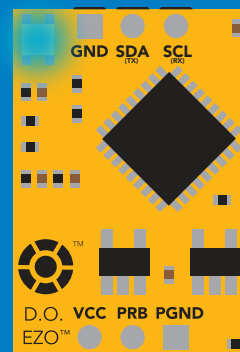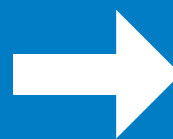
Blue

Standby

Calibration

Command syntax

1300ms ⏱ processing delay

Cal	calibrate to atmospheric oxygen levels
Cal,0	calibrate device to 0 dissolved oxygen
Cal,clear	delete calibration data
Cal,?	device calibrated?

The EZO™ Dissolved Oxygen circuit uses single and/or two point calibration

Example | Response

Cal

⏱ Wait 1300ms
`1` Dec `0` Null

Cal,0

⏱ Wait 1300ms
`1` Dec `0` Null

Cal,clear

⏱ Wait 300ms
`1` Dec `0` Null

Cal,?

⏱ Wait 300ms
`1` Dec `?Cal,0` ASCII `0` Null   or   `1` Dec `?Cal,1` ASCII `0` Null

or   `1` Dec `?Cal,2` ASCII `0` Null

Export/import calibration

Command syntax

Export	export calibration string from calibrated device*
Import	import calibration string to new device*
Export,?	calibration string info*

300ms processing delay

*This command is only available for firmware version 2.10 and above.

Example Response

Export,?

Wait 300ms | **1** Dec | **10,120** ASCII | **0** Null

Response breakdown

10,   **120**

# of strings to export   # of bytes to export

Export strings can be up to 12 characters long

Export

Wait 300ms | **1** Dec | **59 6F 75 20 61 72** ASCII | **0** Null (1 of 10)

Export

Wait 300ms | **1** Dec | **65 20 61 20 63 6F** ASCII | **0** Null (2 of 10)

...

Import, n (FIFO)

Import, 59 6F 75 20 61 72   (1 of 10)
ASCII

...

Temperature compensation

Command syntax

T,n   n = any value; floating point or int

T,?   compensated temperature value?

Temperature is always in Celsius

Example	Response
T,19.5	⏱ **Wait 300ms** **1** Dec **0** Null
T,?	⏱ **Wait 300ms** **1** Dec **?T,19.5** ASCII **0** Null

T,19.5

8.82 mg/L → 8.91 mg/L
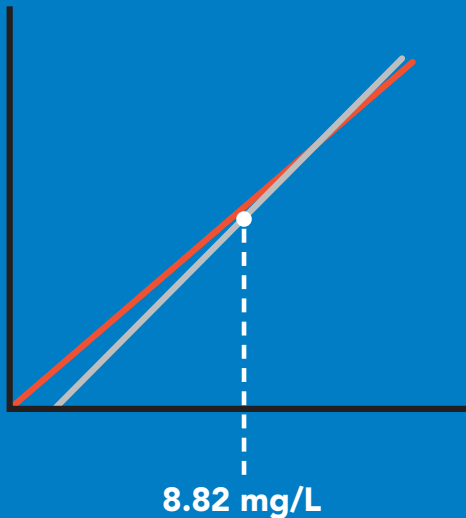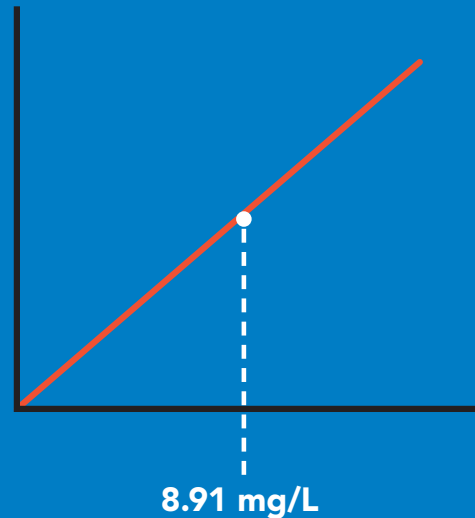
Salinity compensation

Command syntax

300ms ⏱ **processing delay**

S,n	n = any value in microsiemens	**default**
S,n,ppt	n = any value in ppt	
S,?	compensated salinity value?	

Example | Response

S,50000

⏱ Wait 300ms | **1** Dec | **0** Null

S,37.5,ppt

⏱ Wait 300ms | **1** Dec | **0** Null

S,?

⏱ Wait 300ms | **1** Dec | **?S,50000,µS** ASCII | **0** Null

or

1 Dec | **?S,37.5,ppt** ASCII | **0** Null

If the conductivity of your water is less than 2,500µS this command is irrelevant

Pressure compensation

Command syntax

P,n   n = any value in kPa

P,?   compensated pressure value?

This parameter can be omitted if the water is less than 10 meters deep

Example | Response

P,90.25

⏱ Wait 300ms   **1** Dec   **0** Null

P,?

⏱ Wait 300ms   **1** Dec   **?,P,90.25** ASCII   **0** Null

P,90.25

8.01 mg/L → 6.94 mg/L
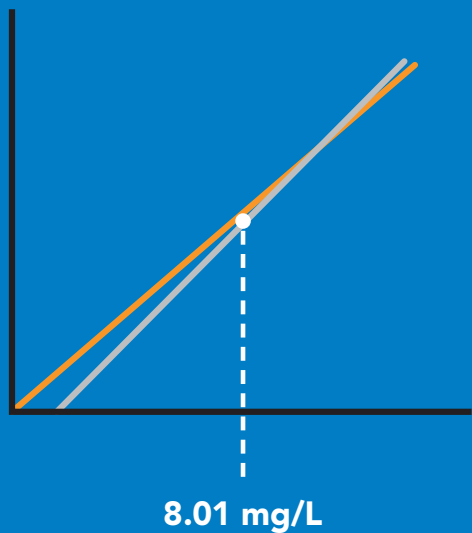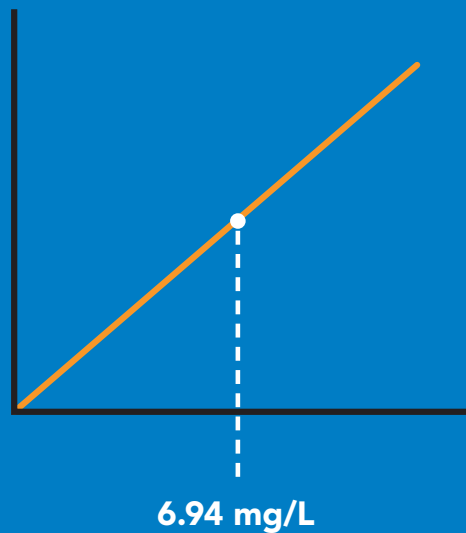
Removing parameters from the output string

Command syntax

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

Example	Response			
O,%,0	Wait 300ms ⏱	**1** Dec	**0** Null	disable percent saturation
O,%,1	Wait 300ms ⏱	**1** Dec	**0** Null	enable percent saturation
O,mg,0	Wait 300ms ⏱	**1** Dec	**0** Null	disable mg/L
O,mg,1	Wait 300ms ⏱	**1** Dec	**0** Null	enable mg/L
O,?	Wait 300ms ⏱	**1** Dec	?,O,%,mg ASCII · **0** Null	if both are enabled

Parameters
% saturation percentage
DO dissolved oxygen

Followed by 1 or 0
1 enabled
0 disabled

Device information

Command syntax

i   device information

Example   Response

i

⏱ **Wait 300ms** | **1** Dec | **?i,D.O.,1.98** ASCII | **0** Null |

Response breakdown

?i,	**D.O.,**	**1.98**
	↑ 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** Dec	**?Status,P,5.038** 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	

Example | Response

Sleep	no response	
Any command	wakes up device	

	STANDBY	SLEEP
5V	**13.1 mA**	**0.66 mA**
3.3V	**12 mA**	**0.3 mA**

Standby → **Sleep** → **Sleep**

GND SDA(TX) SCL(RX)
D.O. EZO™ VCC PRB PGND
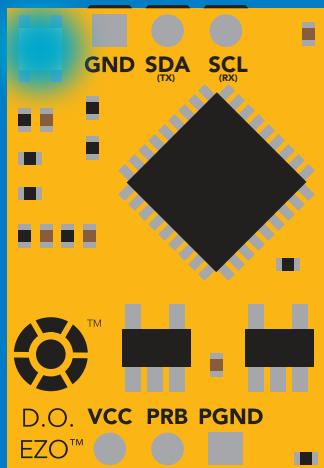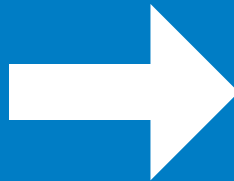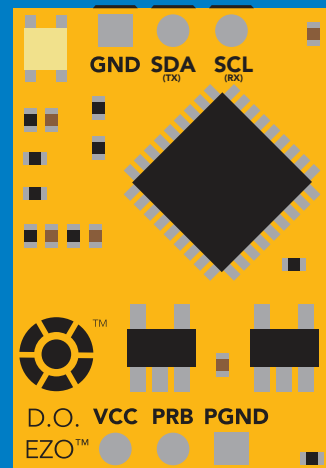
Protocol lock

Command syntax

300ms ⏱ processing delay

Plock,1   enable Plock

Plock,0   disable Plock   **default**

Plock,?   Plock on/off?

Locks device to I²C mode.

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

GND SDA (TX) SCL (RX)

D.O. EZO™ VCC PRB PGND

Serial, 9600

GND SDA (TX) SCL (RX)

D.O. EZO™ VCC PRB PGND

ND SDA (TX)

VCC PRB PG
O™
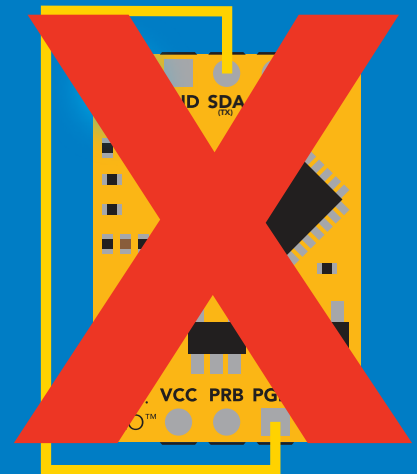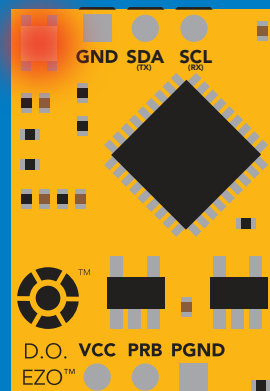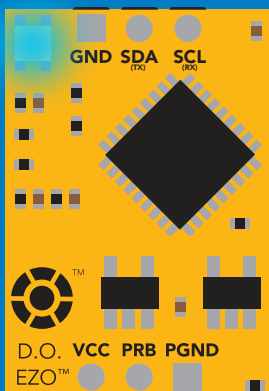
cannot change to UART

cannot change to UART

I²C address change

I2C,n   sets I²C address and reboots into I²C mode

Example	Response
I2C,100	**device reboot**

Warning!

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

Default I²C address is 97 (0x61).

n = any number 1 – 127

I2C,100
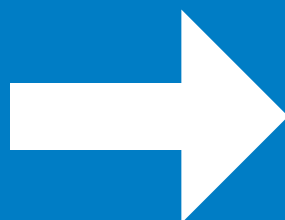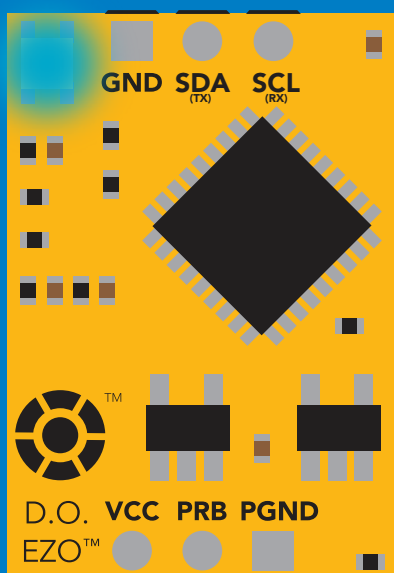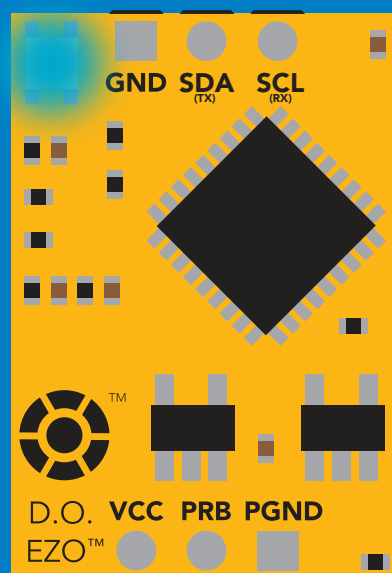
GND SDA (TX) SCL (RX)

D.O. EZO™   VCC PRB PGND

(reboot)

GND SDA (TX) SCL (RX)

D.O. EZO™   VCC PRB PGND

Factory reset

Command syntax

Factory   enable factory reset

Example	Response
Factory	device reboot

**Clears calibration
LED on
Response codes enabled**

Factory

(reboot)

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Tel: + 86-755-83289036   Fax: + 86-755-83289052   E-mail: sales@isweek.com
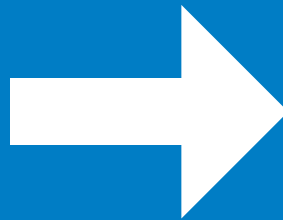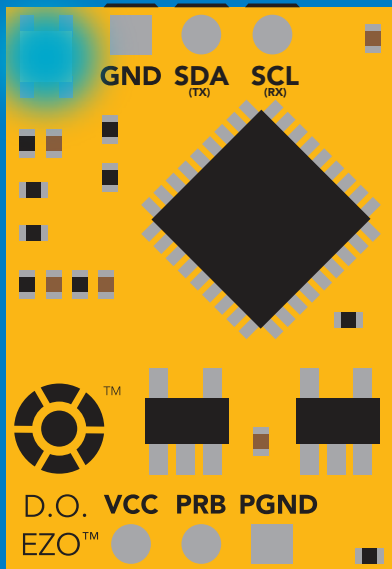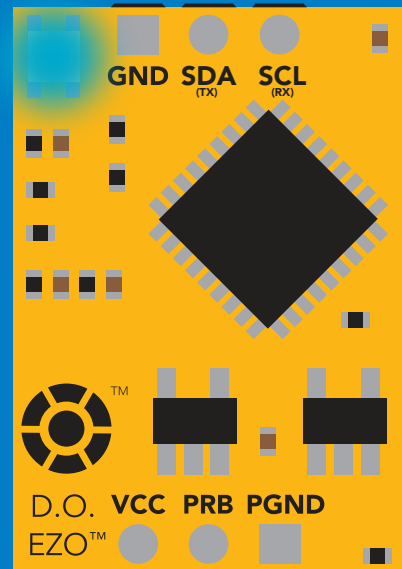
Change to UART mode

Command syntax

Baud,n   switch from I²C to UART

Example   Response

Baud,9600   reboot in UART mode

$$n = \begin{cases} 300 \\ 1200 \\ 2400 \\ 9600 \\ 19200 \\ 38400 \\ 57600 \\ 115200 \end{cases}$$
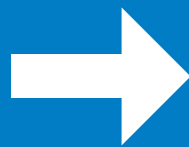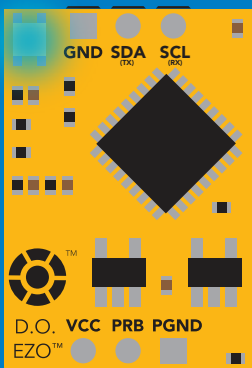
Serial,9600
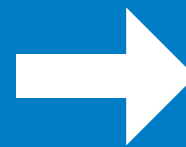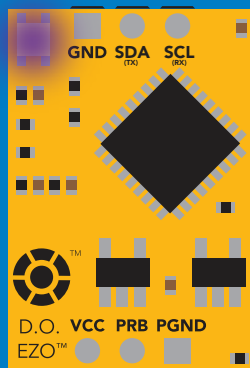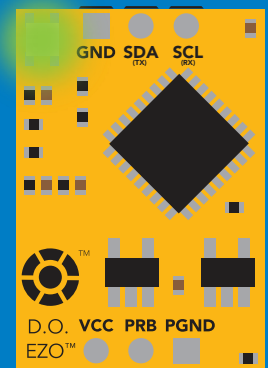
Changing to UART
mode

(reboot)

Manual switching to UART

- **Make sure Plock is set to 0**
- **Disconnect ground (power off)**
- **Disconnect TX and RX**
- **Connect TX to PGND**
- **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

Short

Wrong Example

Short

← Disconnect RX line

EZO™ circuit footprint

GND **TX** (SDA) **RX** (SCL)

17.78mm (0.7")

™

D.O.
EZO™

VCC **PRB** **PGND**

2.54mm (0.1")
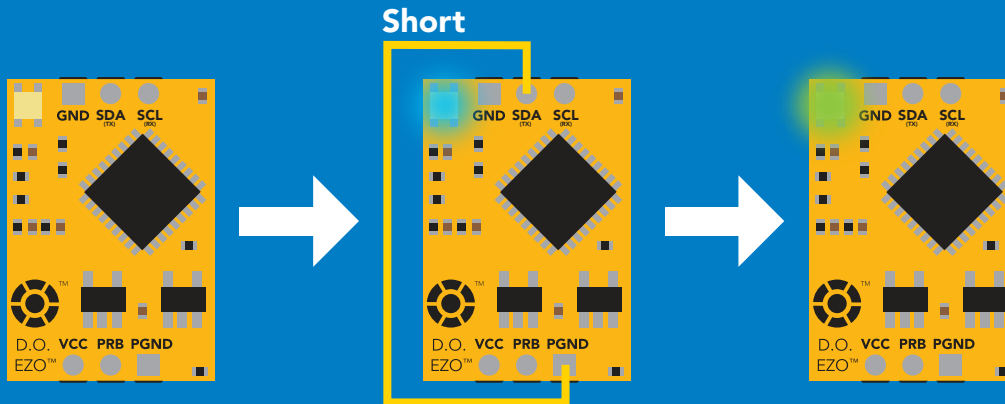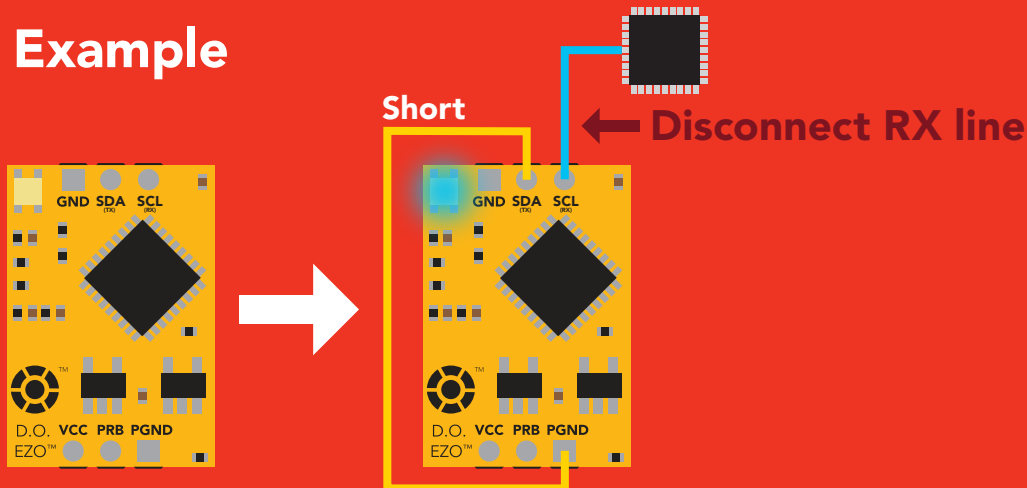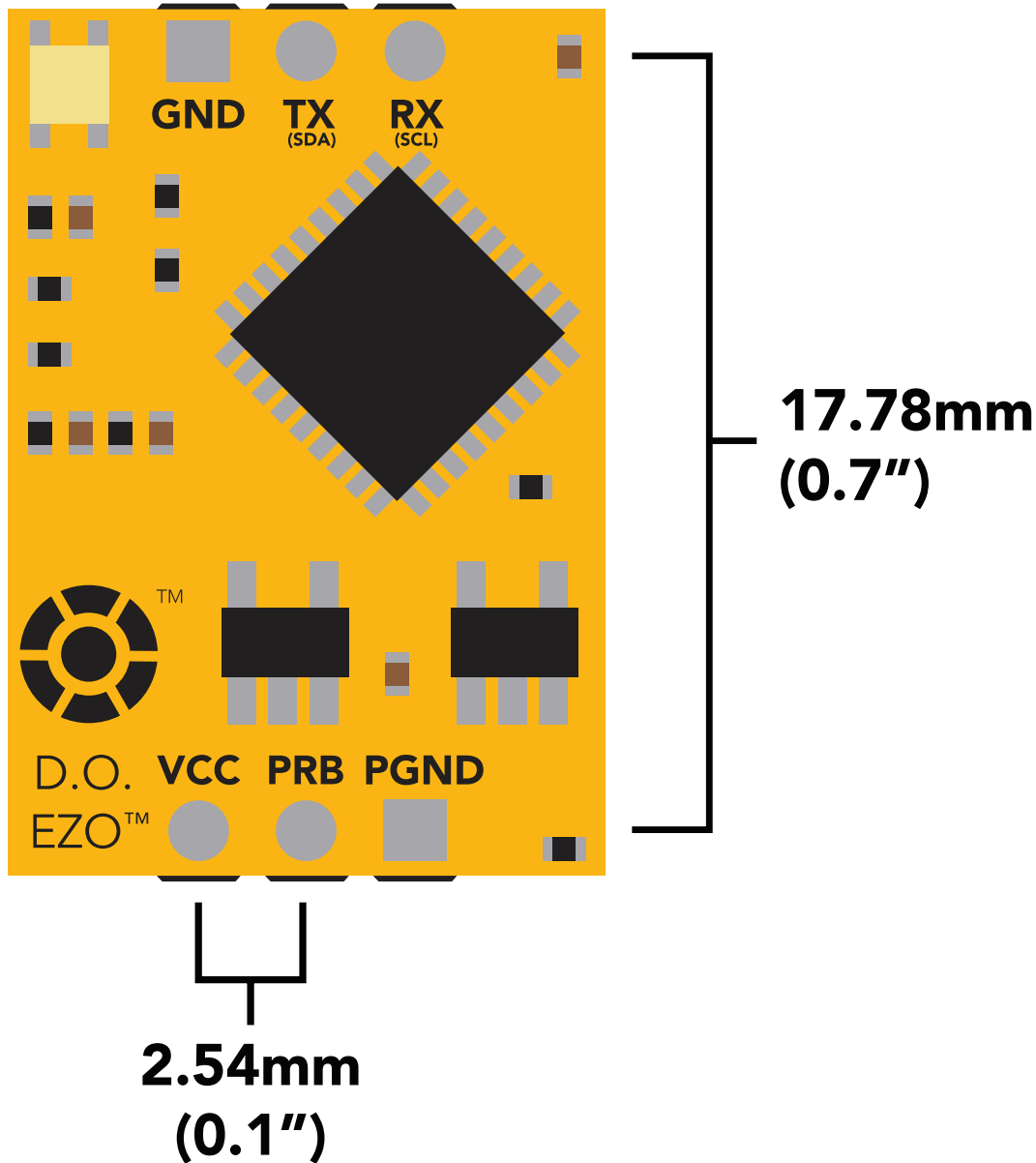
1 In your CAD software place an 8 position header.

2 Place a 3 position header at both top and bottom of the 8 position.

3 Delete the 8 position header. The two 3 position headers are now 17.78mm (0.7") apart from each other.

17.78mm (0.7")
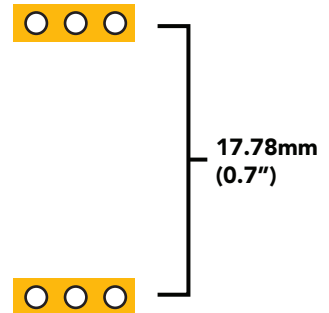
Datasheet change log

Datasheet V 3.9

Revised information on cover page.

Datasheet V 3.8

Update firmware changes on pg. 66

Datasheet V 3.7

Revised Plock pages to show default value.

Datasheet V 3.6

Added new commands:
"Find" pages 21 & 48.
"Export/Import calibration" pages 25 & 51.
 Added new feature to continous mode "C,n" pg 22.

Datasheet V 3.5

Added accuracy range on cover page, and revised isolation info on pg 10.

Datasheet V 3.4

Added manual switching to UART information on pg. 59

Datasheet V 3.3

Updated firmware changes to refeclt V1.99 update

Datasheet V 3.2

Revised entire datasheet

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Dissolved Oxygen circuit firmware changes

V1.1 – Initial release (Oct 30, 2014)
• Change output to mg/L, then percentage (was previously percentage, then mg/L)

V1.5 – Baud rate change (Nov 6, 2014)
• Change default baud rate to 9600

V1.6 – I^2C bug (Dec 1, 2014)
• Fix I^2C bug where the circuit may inappropriately respond when other I^2C devices
  are connected.

V1.7 – Factory (April 14, 2015)
• Changed "X" command to "Factory"

V1.95 – Plock (March 31, 2016)
• Added protocol lock feature "Plock"

V1.96 – EEPROM (April 26, 2016)
• Fixed glitch where EEPROM would get erased if the circuit lost power 900ms
  into startup

V1.97 – EEPROM (Oct 10, 2016)
• Fixed glitch in the cal clear command, improves how it calculates the DO,
  adds calibration saving and loading

V1.98 – EEPROM (Nov 14, 2016)
• Updated firmware for new circuit design.

V1.99 – (Feb 2, 2017)
• Revised "O" command to accept mg.

V2.10 – (April 12, 2017)
• Added "Find" command.
• Added "Export/import" command.
• Modified continuous mode to be able to send readings every "n" seconds.

V2.11 – (Sept 28, 2017)
• fixed glitch where the temperature would default to 0 on startup

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Warranty

Atlas Scientific™ Warranties the EZO™ class Dissolved Oxygen circuit to be free of defect during the debugging phase of device implementation, or 30 days after receiving the EZO™class Dissolved Oxygen circuit (which ever comes first).

The debugging phase

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

- **Soldering any part of the EZO™ class Dissolved Oxygen circuit.**

- **Running any code, that does not exclusively drive the EZO™ class Dissolved Oxygen circuit and output its data in a serial string.**

- **Embedding the EZO™ class Dissolved Oxygen circuit 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™ class Dissolved Oxygen circuit, against the thousands of possible variables that may cause the EZO™ class Dissolved Oxygen circuit 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™ class Dissolved Oxygen circuits continued operation. This is because that would be equivalent to Atlas Scientific™ taking responsibility over the correct operation of your entire device.

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