pH
EZO™
Circuit

Reads	**pH**
Range	**.001 – 14.000**
Accuracy	**+/– 0.002**
Max rate	**1 reading per sec**
Supported probes	**Any type & brand**
Calibration	**1, 2, 3 point**
Temp compensation	**Yes**
Data protocol	**UART & I²C**
Default I²C address	**99 (0x63)**
Operating voltage	**3.3V – 5V**
Data format	**ASCII**

GND TX (SDA) RX (SCL)

pH EZO™ VCC PRB PGND

RoHS
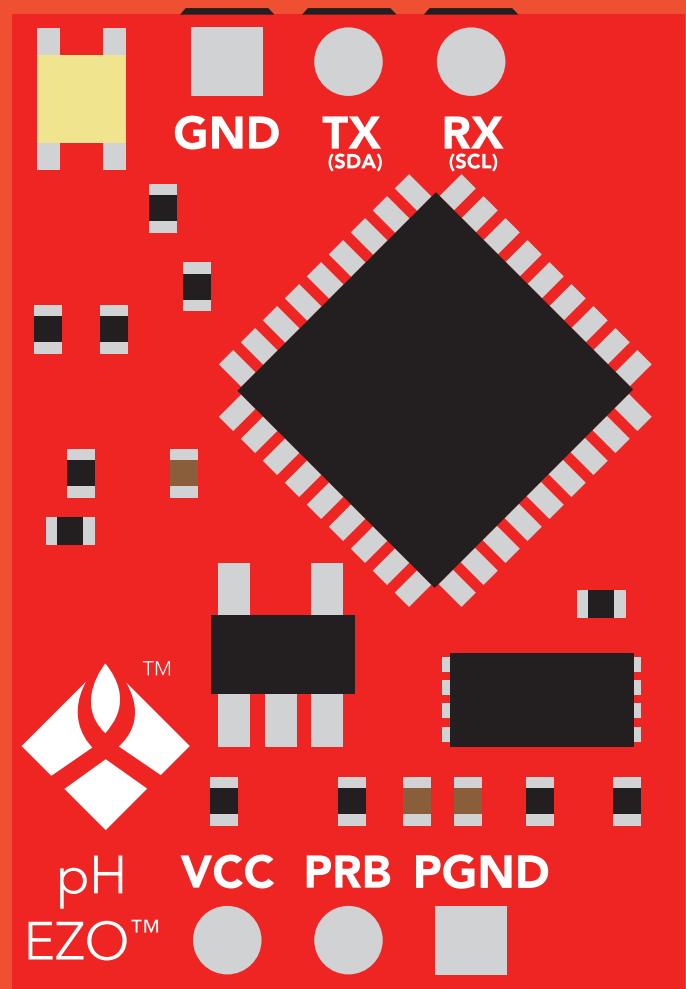
STOP

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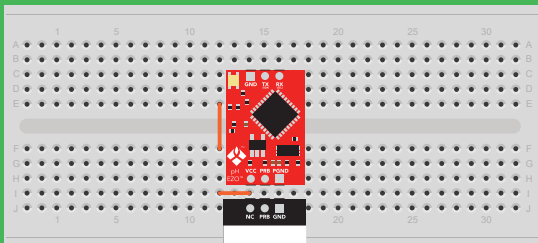
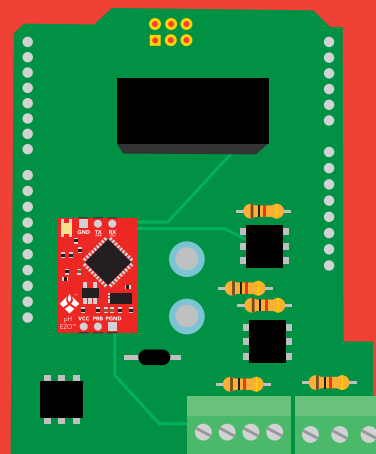**Do not embed this device without testing it in a solderless breadboard!**

r 0.1

Table of contents

UART

I²C

EZO™ circuit dimensions

13.97mm (0.55")

GND TX (SDA) RX (SCL)

pH EZO™   VCC PRB PGND

20.16mm (0.79")

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

Power consumption

	LED	MAX	STANDBY	SLEEP
5V	ON	18.3 mA	16 mA	1.16 mA
	OFF	13.8 mA	13.8 mA	
3.3V	ON	14.5 mA	13.9 mA	0.995 mA
	OFF	13.3 mA	13.3 mA	

Absolute max ratings

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

EZO™ circuit identification
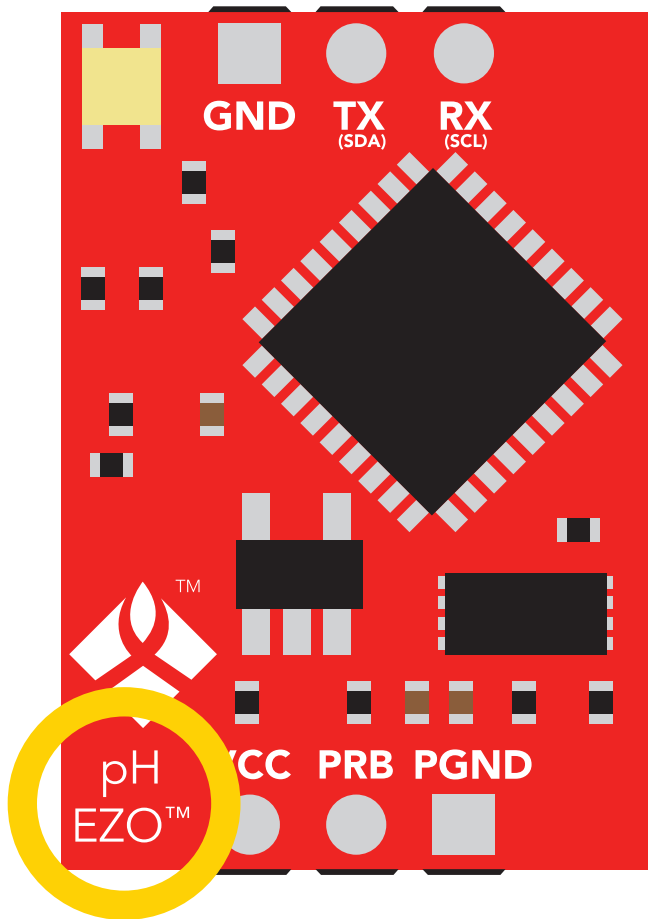
EZO™ pH circuit

Legacy pH circuit

Viewing correct datasheet

Viewing incorrect datasheet

Click here to view legacy datasheet

Operating principle

A pH (*potential of Hydrogen*) probe measures the hydrogen ion activity in a liquid. At the tip of a pH probe is a glass membrane. This glass membrane permits hydrogen ions from the liquid being measured to defuse into the outer layer of the glass, while larger ions remain in the solution. The difference in the concentration of hydrogen ions (outside the probe vs. inside the probe) creates a VERY small current. This current is proportional to the concentration of hydrogen ions in the liquid being measured.

| Acid: pH < 7 | Neutral: pH = 7 | Base: pH > 7 |

Silver wire

Junction

Silver chloride

KCL reference solution

Reference wire
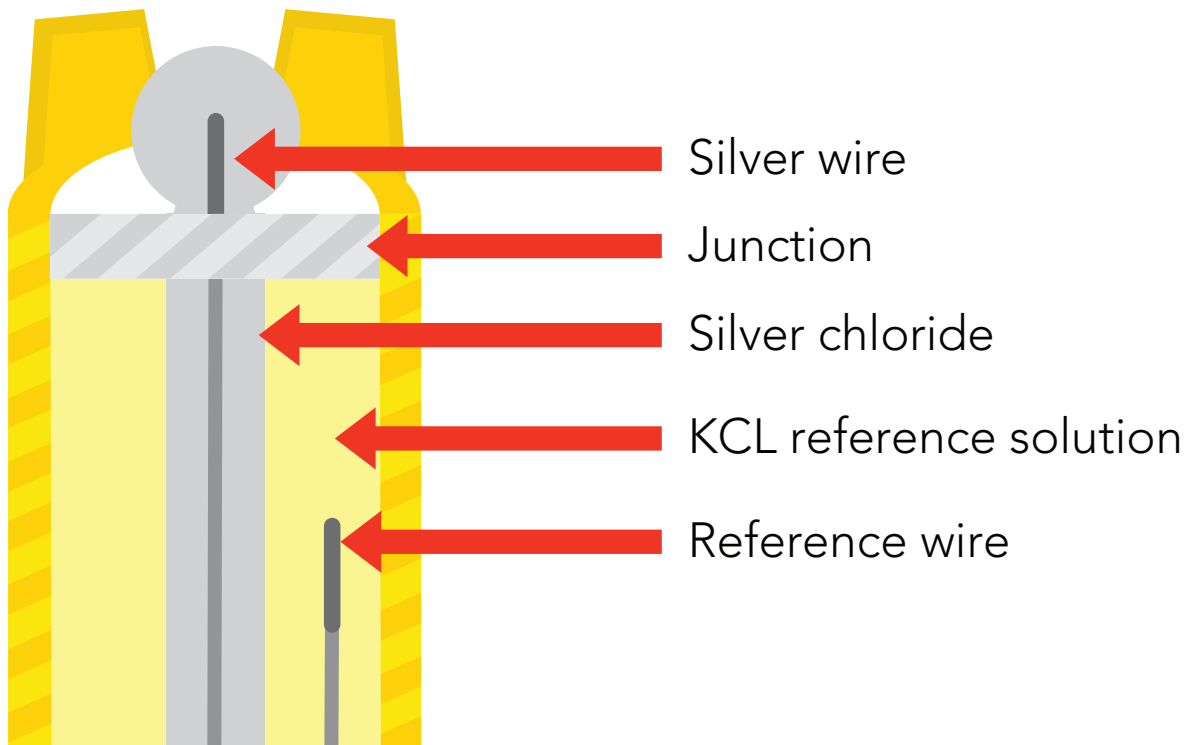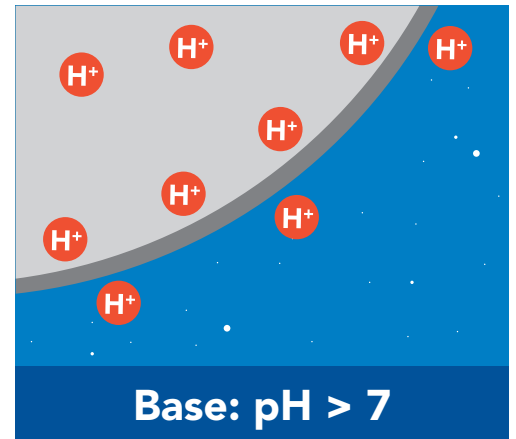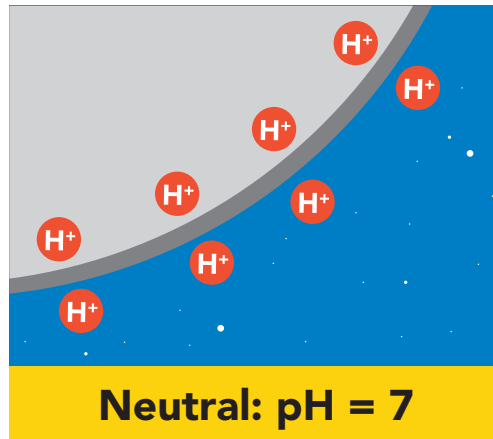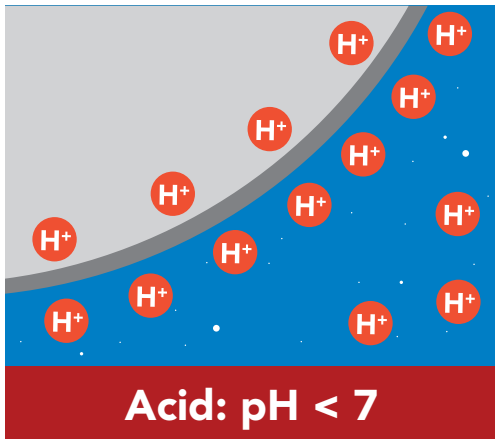
Calibration theory

The Atlas Scientific EZO™ class pH circuit has a flexible calibration protocol, allowing for *single point, two point,* or *three point* calibration.

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |

Lowpoint   **Midpoint**   **Highpoint**

"cal,low,n"   **"cal,mid,n"**   **"cal,high,n"**
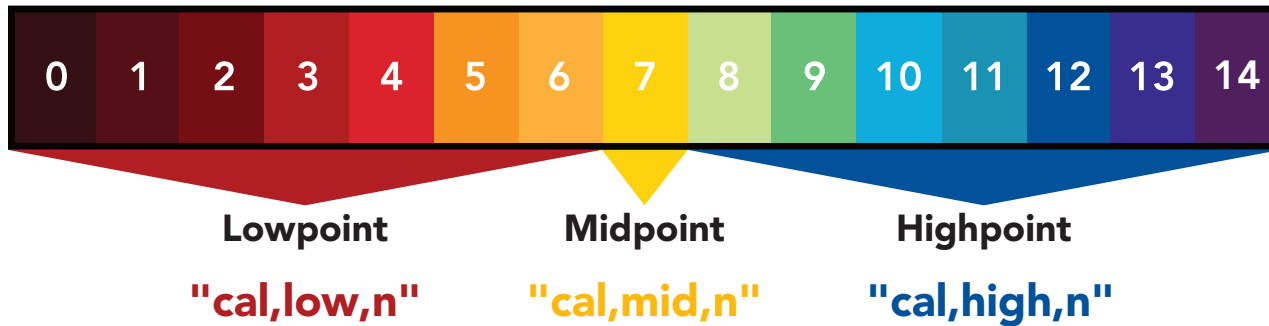
The first calibration point must be the Midpoint (pH 7)

The EZO™ pH circuits default temperature compensation is set to 25° C. If the temperature of the calibration solution is +/- 2° C from 25° C, consider setting the temperature compensation first. *Temperature changes of < 2° C are insignificant.*

Single point calibration
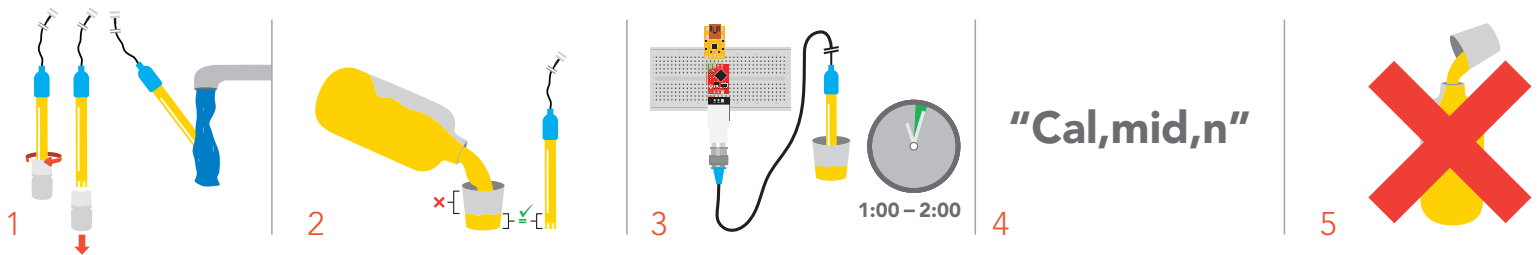
"Cal,mid,n"

1. Remove soaker bottle and rinse off pH probe.
2. Pour a small amount of the calibration solution into a cup.
3. Let the probe sit in calibration solution untill readings stabalize *(1 – 2 minutes).*
4. Calibrate the midpoint value using the command **"Cal,mid,n"**.
   Where "n" is any floating point value that represents the calibration midpoint.
5. Do not pour the calibration solution back into the bottle.

Two point calibration
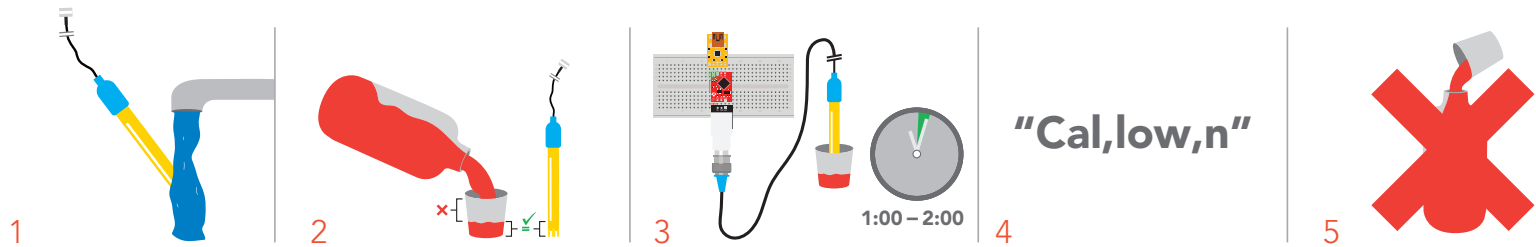
| 1 | 2 | 3 | 4 | "Cal,low,n" | 5 |

1. Rinse off pH probe.
2. Pour a small amount of the calibration solution into a cup
3. Let the probe sit in calibration solution untill readings stabalize *(1 – 2 minutes)*.
4. Calibrate the lowpoint value using the command **"Cal,low,n"**.
   Where "n" is any floating point value that represents the calibration lowpoint.
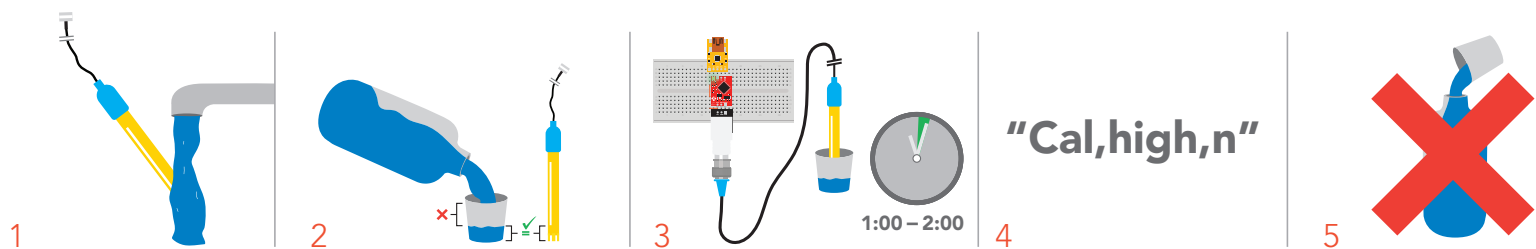5. Do not pour the calibration solution back into the bottle.

Three point calibration

| 1 | 2 | 3 | 4 | "Cal,high,n" | 5 |

1. Rinse off pH probe.
2. Pour a small amount of the calibration solution into a cup
3. Let the probe sit in calibration solution untill readings stabalize *(1 – 2 minutes)*.
4. Calibrate the highpoint value using the command **"Cal,high,n"**.
   Where "n" is any floating point value that represents the calibration highpoint.
5. Do not pour the calibration solution back into the bottle.

⚠️ **Issuing the cal,mid command after the EZO™ pH circuit has been calibrated will clear the other calibration points. Full calibration will have to be redone.** ⚠️

Power and data isolation

The Atlas Scientific EZO™ pH circuit is a very sensitive device. This sensitivity is what gives the pH circuit its accuracy. This also means that the pH 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 pH 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 pH probe in a cup of water by itself. The readings should stabilize quickly, confirming that electrical noise was the issue.
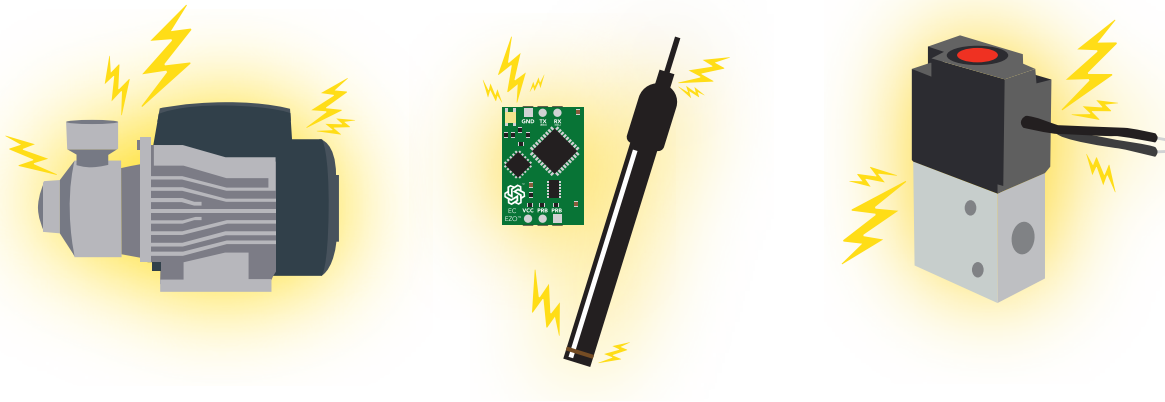
When reading pH and Conductivity together, it is *strongly recommended* that the EZO™ pH circuit is electrically isolated from the EZO™ Conductivity circuit.

**Basic EZO™
Inline Voltage Isolator**

Correct

Incorrect
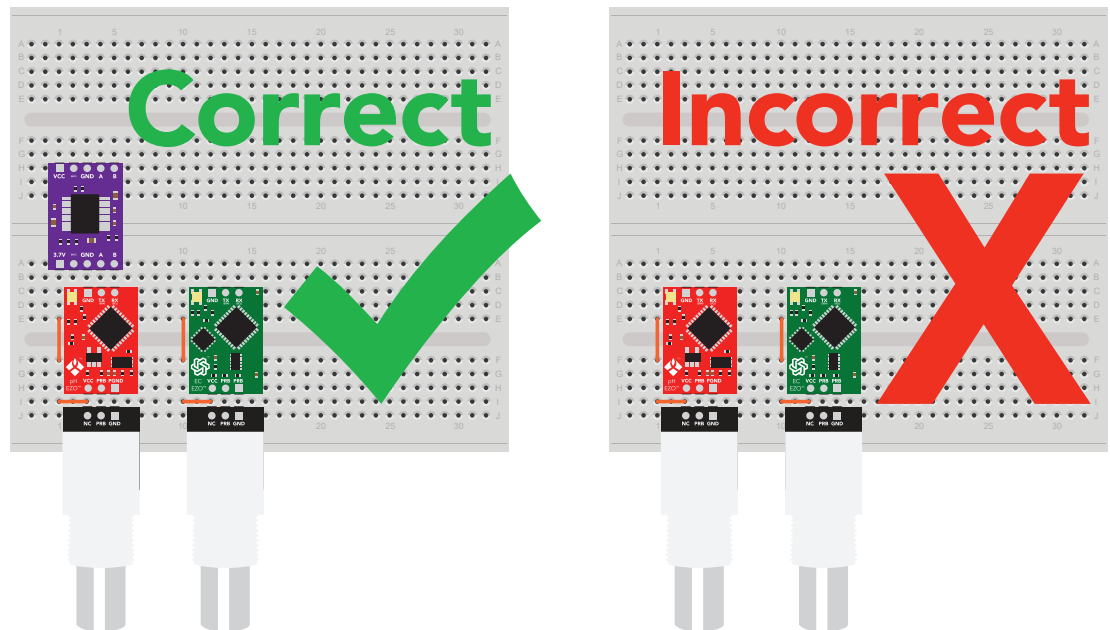
Without isolation, Conductivity readings will effect pH accuracy.

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
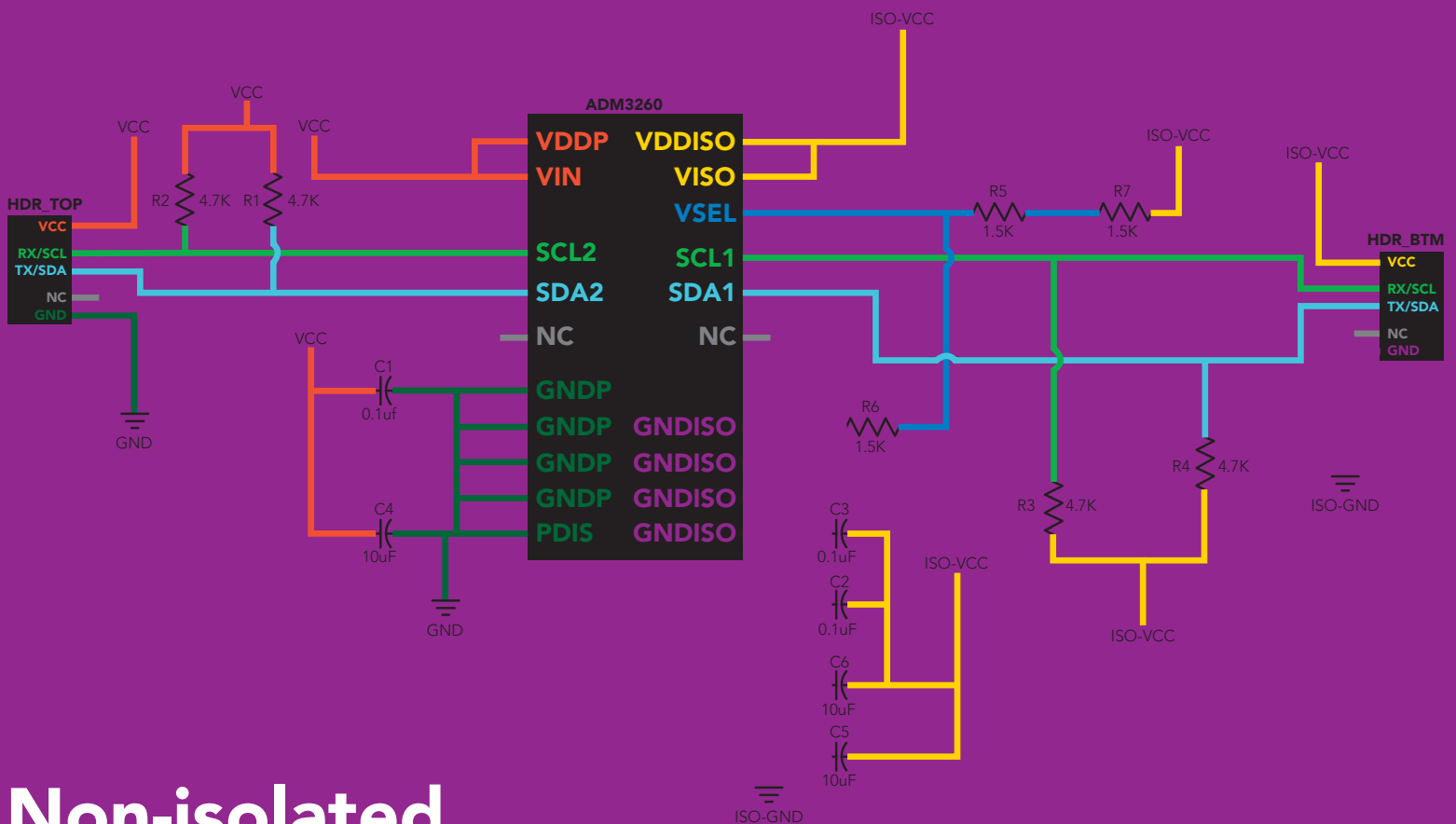
✓ Correct wiring

Bread board
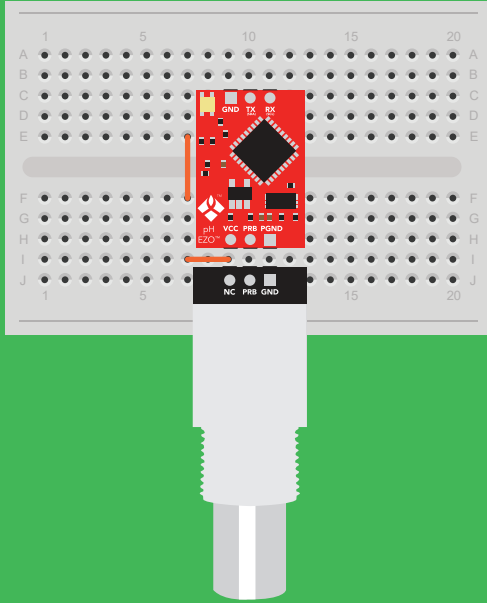
Bread board via USB

Part # COM-104
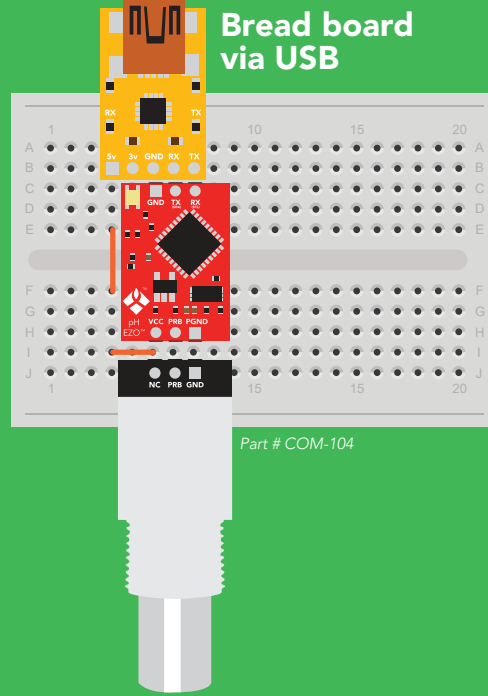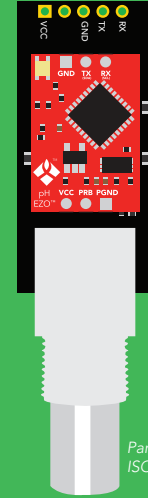
Carrier board

Part # ISCCB

USB carrier board
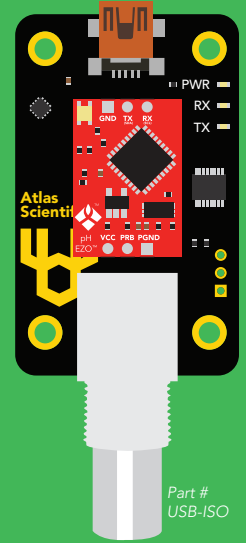
Part # USB-ISO

✗ Incorrect wiring

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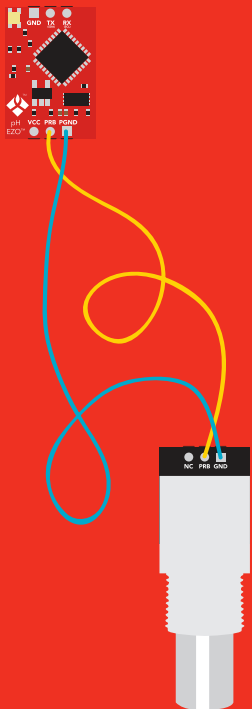
Sloppy setup
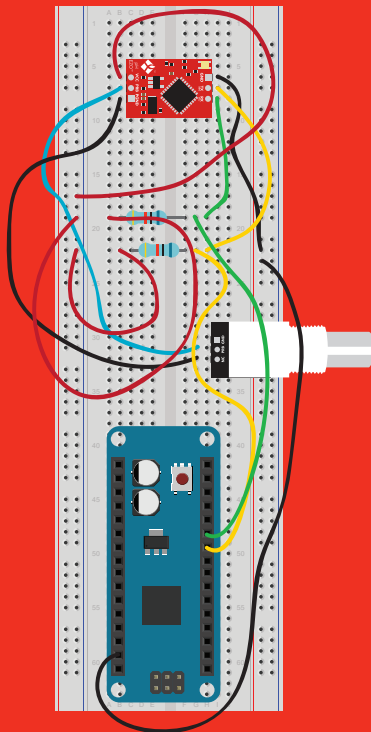
Perfboards or Protoboards
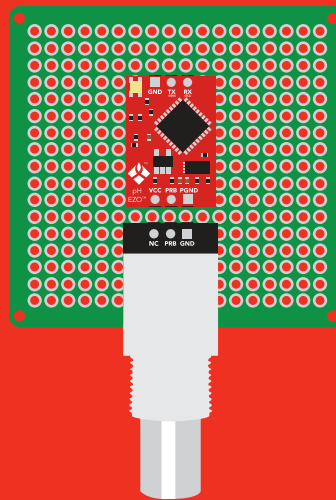
NEVER use Perfboards or Protoboards

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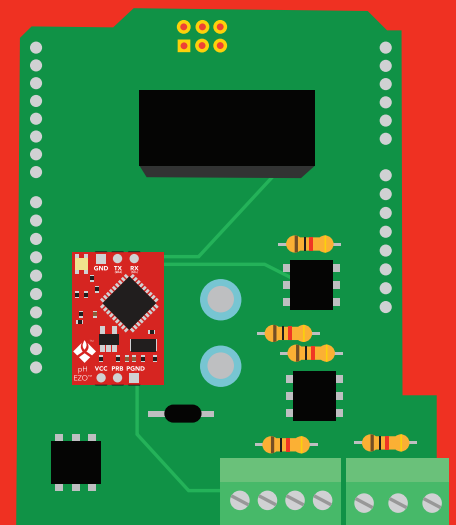
*Only after you are familar with EZO™ circuits operation

NEVER EXTEND THE CABLE WITH CHEAP JUMPER WIRES!
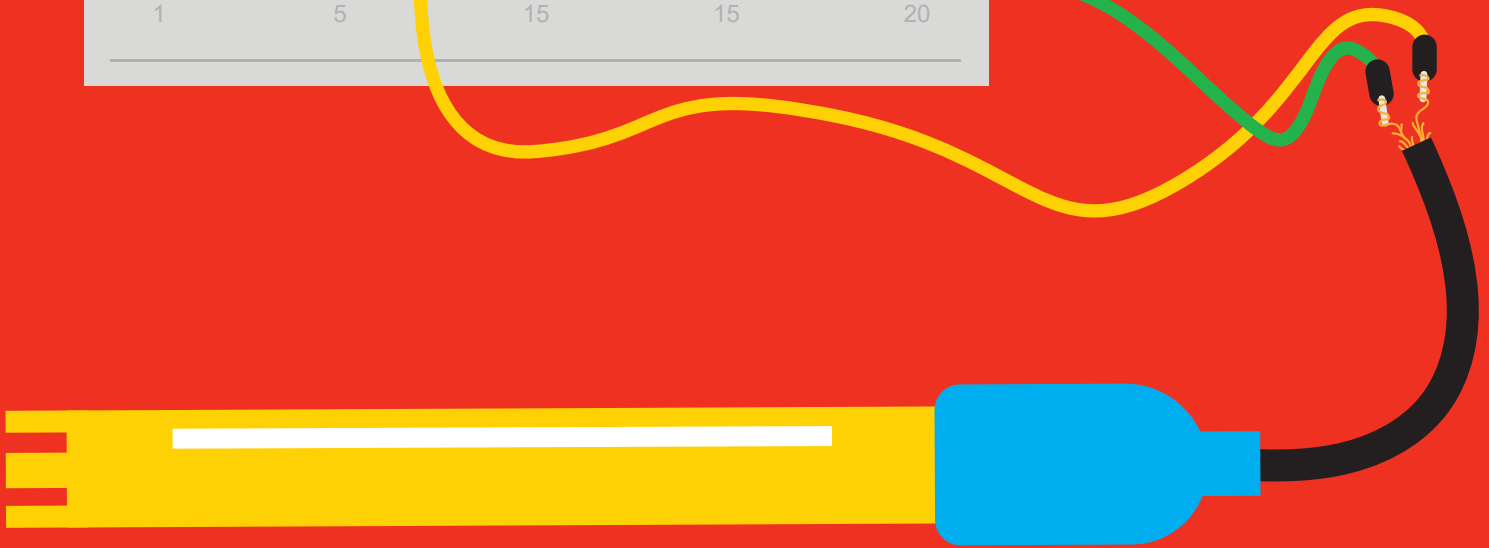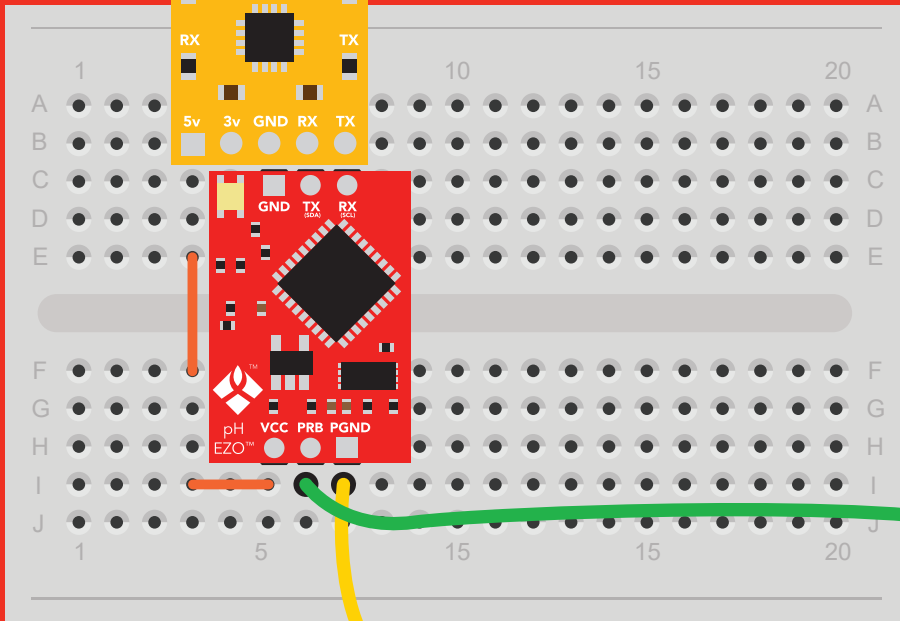
DO NOT CUT THE PROBE CABLE WITHOUT REFERING TO THIS DOCUMENT!

DO NOT MAKE YOUR OWN UNSHIELDED CABLES!
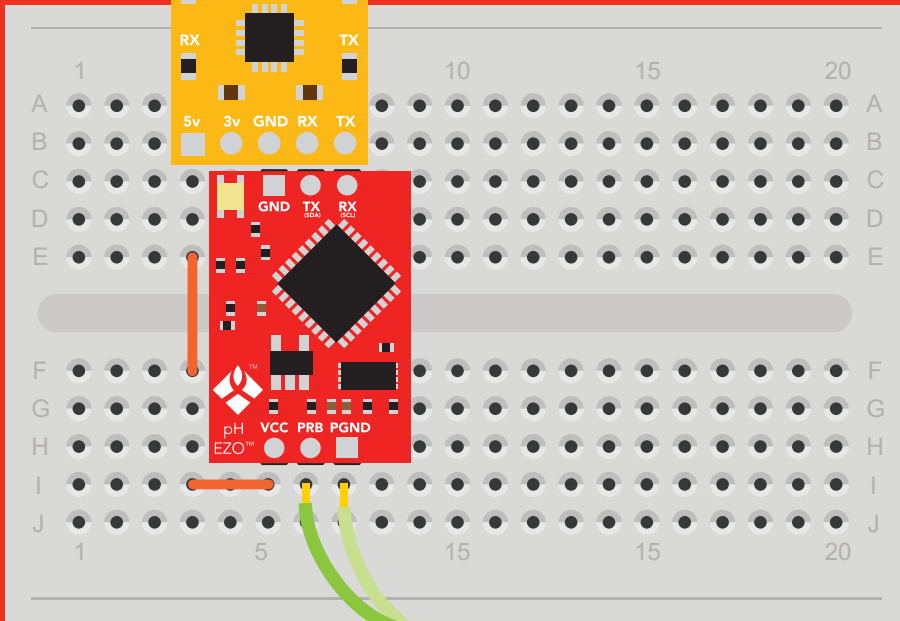
ONLY USE SHIELDED CABLES. REFER TO THIS DOCUMENT!

✔ Available data protocols

UART

Default

I²C

✗ Unavailable data protocols

SPI

Analog

RS-485

Mod Bus

4–20mA

UART mode

Baud rate
Calibration
Continuous mode
Device name
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
Sleep mode

UART mode

8 data bits   no parity
1 stop bit   no flow control

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

RX
Data in

TX
Data out

Vcc
3.3V – 5.5V

0V   ← VCC   0V
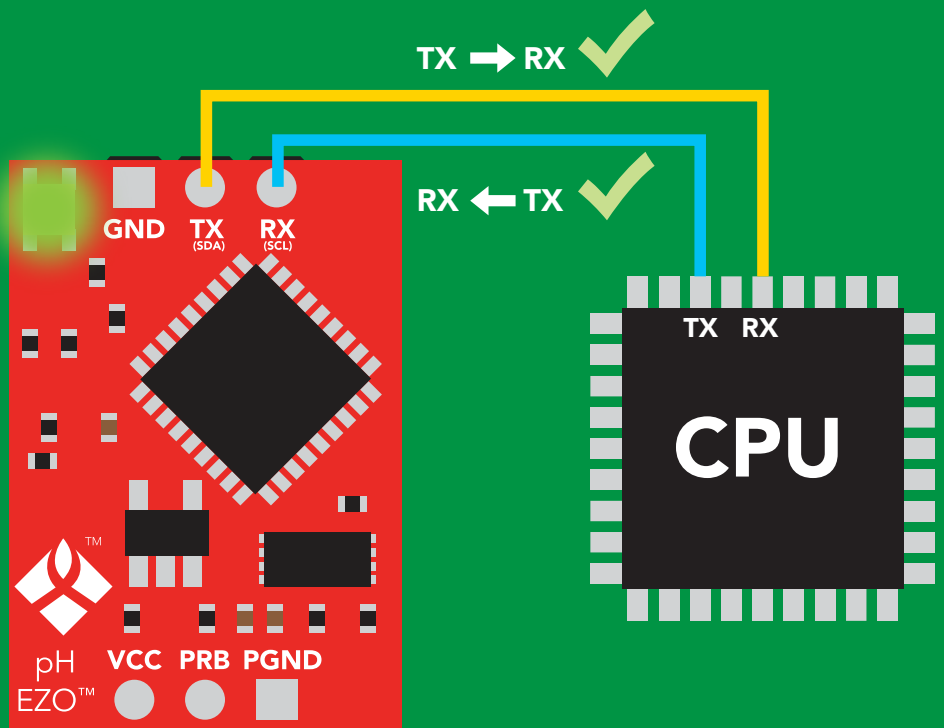
TX → RX ✔

RX ← TX ✔

GND TX(SDA) RX(SCL)

TX RX

CPU

pH EZO™

VCC PRB PGND

Data format

Reading	pH	Data type	floating point
Units	pH	Decimal places	2
Encoding	ASCII	Smallest string	4 characters
Format	string	Largest string	40 characters
Terminator	carriage return		

Default state

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

1,000 ms

Green
Standby

Cyan
Taking reading

Transmitting
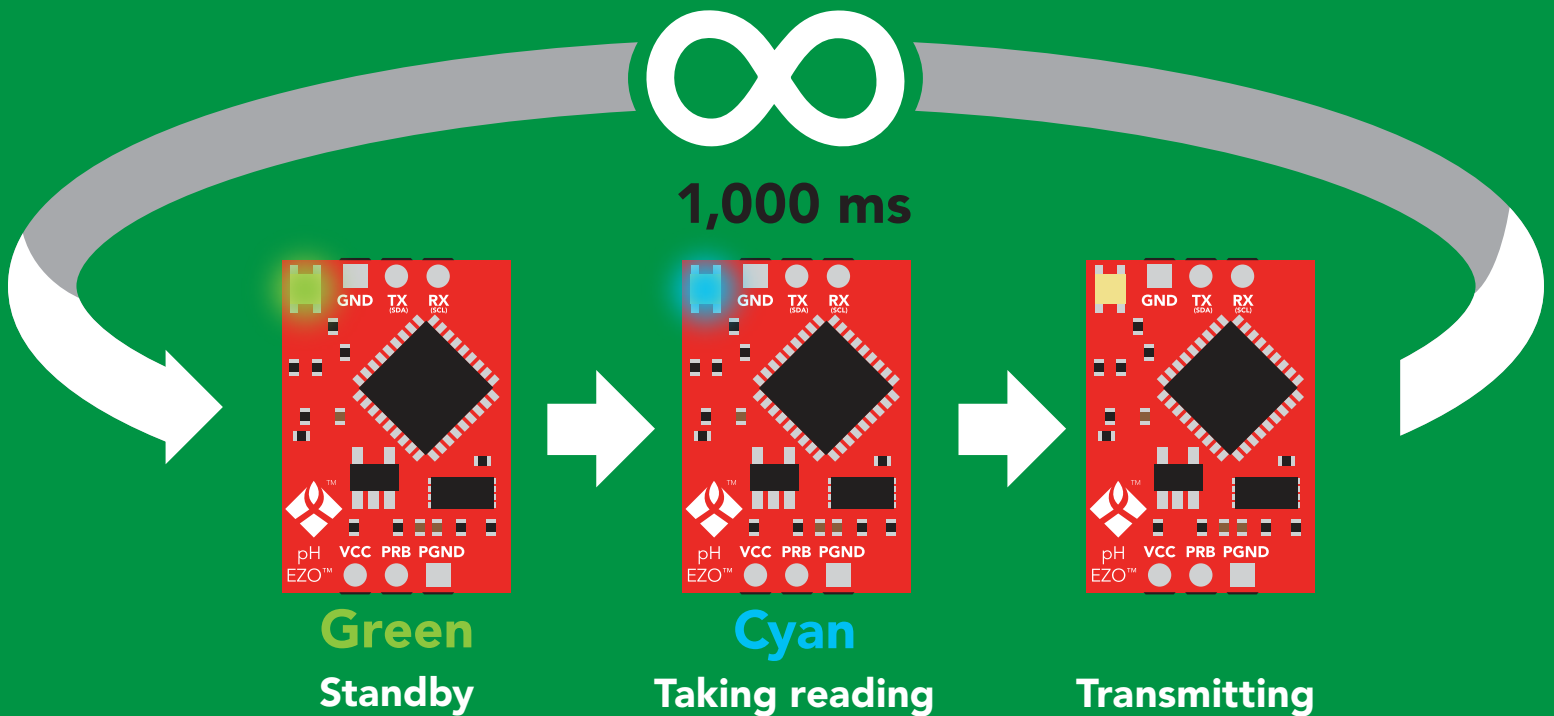
Receiving data from device

2 parts

ASCII data string	Carriage return <cr>
Command	**Terminator**

9,600 baud (default)

GND TX (SDA) RX (SCL)

9.56 <cr>

TX RX

CPU

Receiver

pH EZO™

VCC PRB PGND

Sender

Advanced

ASCII:	9	.	5	6	<cr>
Hex:	39	2E	35	36	0D
Dec:	57	46	54	53	13

Sending commands to device

2 parts

Command (not case sensitive)

ASCII data string

Carriage return <cr>

Terminator

GND   TX   RX
     (SDA) (SCL)

TX   RX

CPU

Sleep <cr>

Sender

pH
EZO™   VCC   PRB   PGND

Receiver
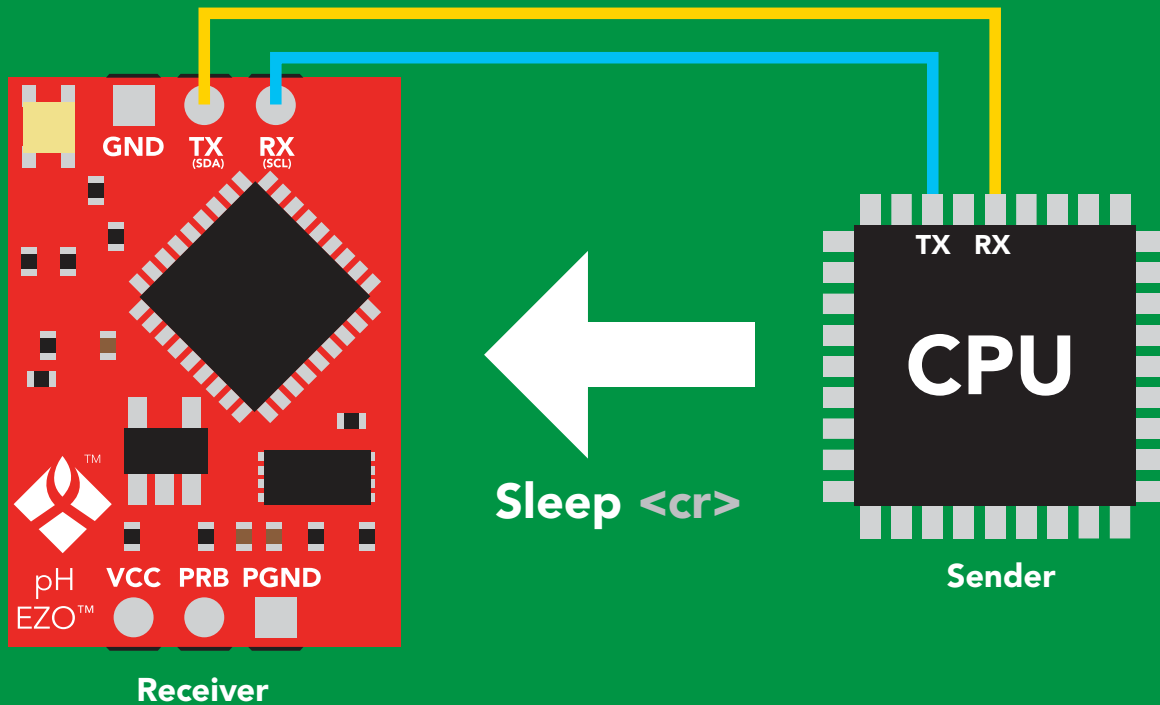
Advanced

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

LED color definition
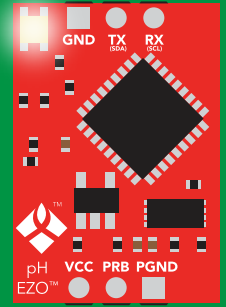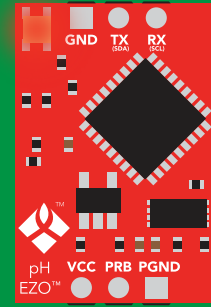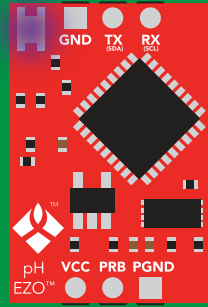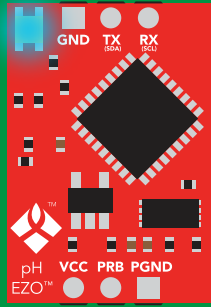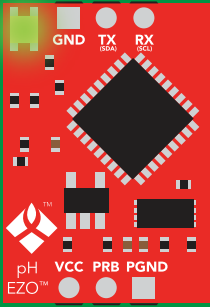
Green
UART standby

Cyan
Taking reading

Purple
Changing baud rate

Red
Command not understood

White
Find

5V	LED ON +2.2 mA
3.3V	+0.6 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. 24	enabled
Cal	performs calibration	pg. 26	n/a
Export/import	export/import calibration	pg. 27	n/a
Factory	enable factory reset	pg. 37	n/a
Find	finds device with blinking white LED	pg. 23	n/a
i	device information	pg. 31	n/a
I2C	change to I^{2}C mode	pg. 38	not set
L	enable/disable LED	pg. 22	enabled
Name	set/show name of device	pg. 30	not set
Plock	enable/disable protocol lock	pg. 36	disabled
R	returns a single reading	pg. 25	n/a
Sleep	enter sleep mode/low power	pg. 34	n/a
Slope	returns the slope of the pH probe	pg. 28	n/a
Status	retrieve status information	pg. 33	enable
T	temperature compensation	pg. 29	25°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>
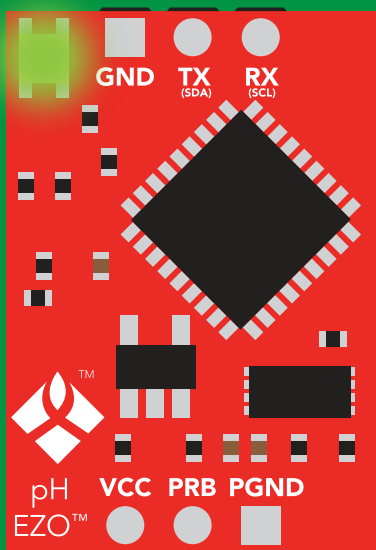
L,1
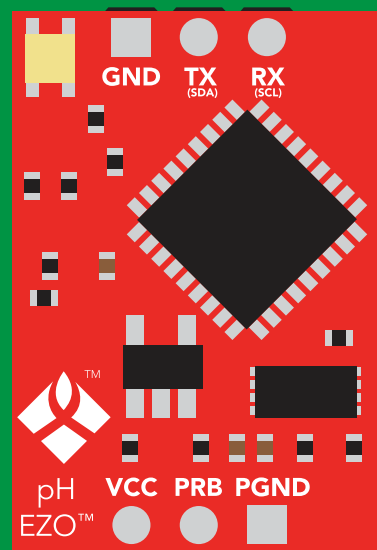
L,0

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>
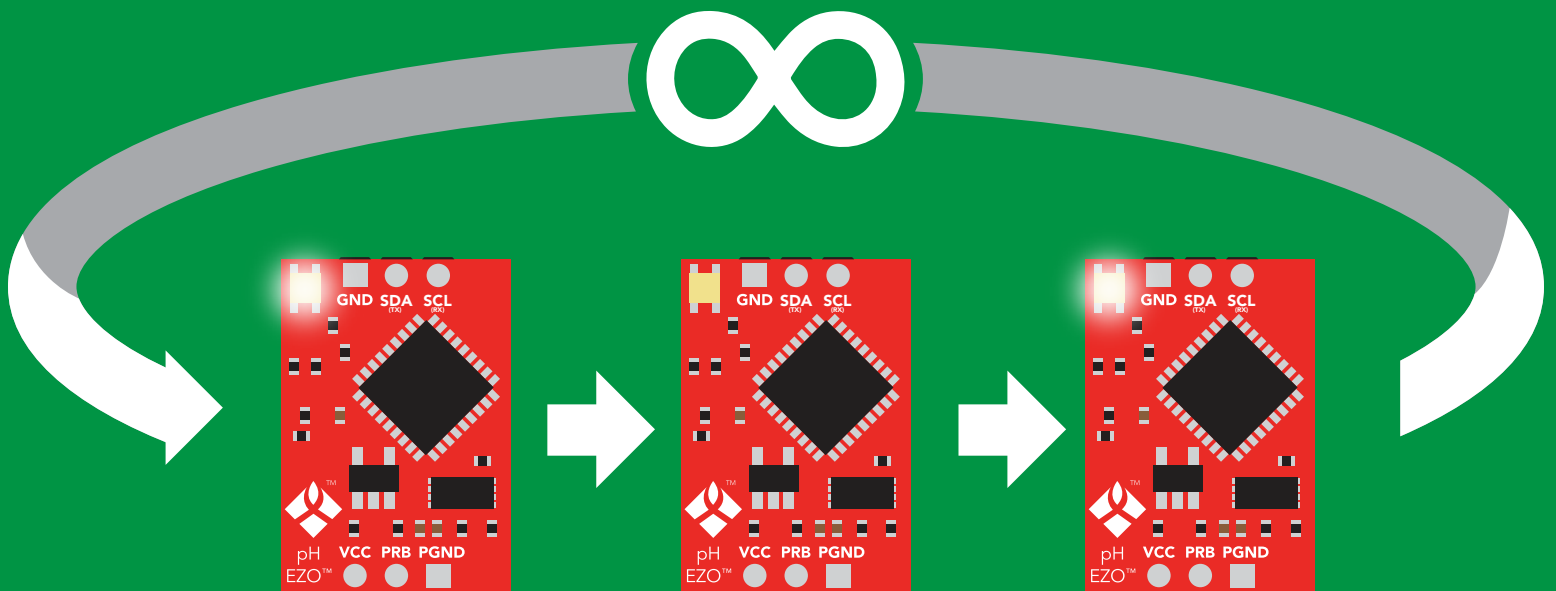
Continuous reading mode

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> pH (1 sec) <cr> pH (2 sec) <cr> pH (n sec) <cr>
C,30 <cr>	*OK <cr> pH (30 sec) <cr> pH (60 sec) <cr> pH (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>	9.56 <cr> *OK <cr>
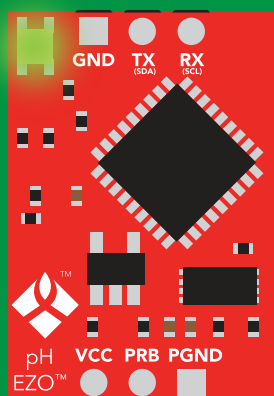
Green
Standby
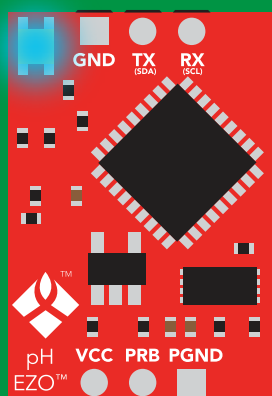
Cyan
Taking reading
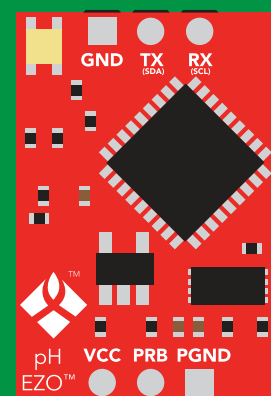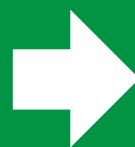
Transmitting

800 ms

Calibration

Command syntax

Command		Description
Cal,mid,n	<cr>	single point calibration at midpoint
Cal,low,n	<cr>	two point calibration at lowpoint
Cal,high,n	<cr>	three point calibration at highpoint
Cal,clear	<cr>	delete calibration data
Cal,?	<cr>	device calibrated?

Example	Response
Cal,mid,7.00 <cr>	*OK <cr>
Cal,low,4.00 <cr>	*OK <cr>
Cal,high,10.00 <cr>	*OK <cr>
Cal,clear <cr>	*OK <cr>
Cal,? <cr>	?Cal,0 <cr> or ?Cal,1 <cr> or one point ?Cal,2 <cr> or ?Cal,3 <cr> two point three point *OK <cr>

Export/import calibration

Export: Use this command to save calibration settings
Import: Use this command to load calibration settings to one or more devices.

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>

Export <cr>	59 6F 75 20 61 72 <cr> (1 of 10)
Export <cr>	65 20 61 20 63 6F <cr> (2 of 10)
(7 more)	⋮
Export <cr>	6F 6C 20 67 75 79 <cr> (10 of 10)
Export <cr>	*DONE

Disabling *OK simplifies this process

Import, n (FIFO)	Import, 59 6F 75 20 61 72 <cr> (1 of 10)

Slope

Command syntax

Slope,? <cr> returns the slope of the pH probe

Example

Response

Slope,? <cr>

?Slope,99.7,100.3 <cr>
*OK <cr>

Response breakdown

?Slope, 99.7, 100.3

99.7% is how closely the slope of the **acid** calibration line matched the "ideal" pH probe.

100.3% is how closely the slope of the **base** calibration matches the "ideal" pH probe.

△0.3% from ideal

Zero point

1 2 3 4 5 6 7 8 9

Calibrated probe

Ideal probe

△0.3% from ideal

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

8.91

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 (SDA) RX (SCL)

pH EZO™ VCC PRB PGND

GND TX (SDA) RX (SCL)

pH EZO™ VCC PRB PGND

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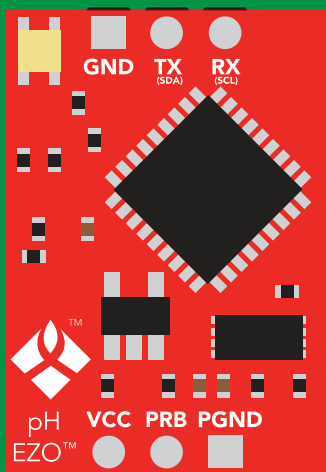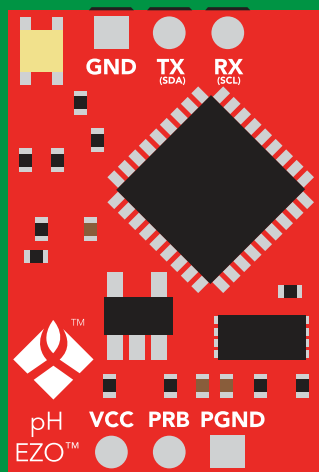
Name,zzt <cr>
*OK <cr>

Device information

Command syntax

i **<cr>** device information

Example

i **<cr>**

Response

?i,pH,1.98 **<cr>**
*OK **<cr>**

Response breakdown

?i,	pH,	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>	9.56 <cr> *OK <cr>
*OK,0 <cr>	no response, *OK disabled
R <cr>	9.56 <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 | Response

Status <cr>

?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	16 mA	1.16 mA
3.3V	13.9 mA	0.995 mA
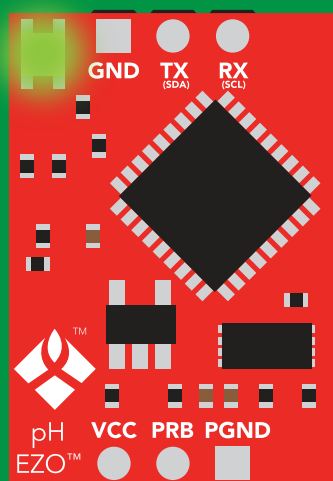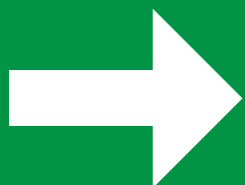
Sleep <cr>

Standby
16 mA
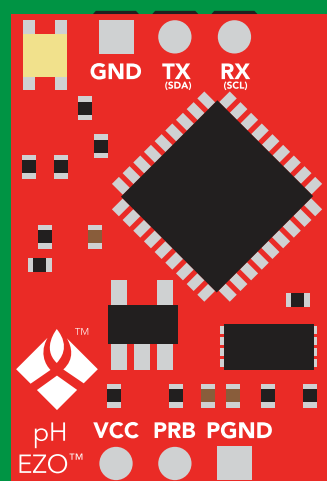
Sleep
1.16 mA

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
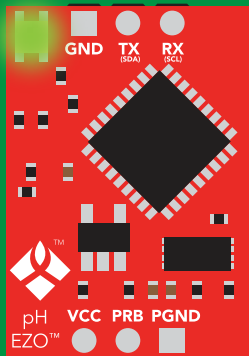
Standby

Baud,38400 <cr>
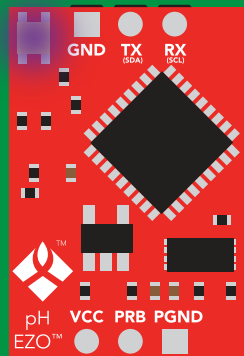
Changing
baud rate

*OK <cr>
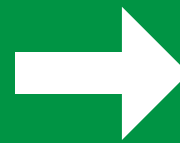
(reboot)
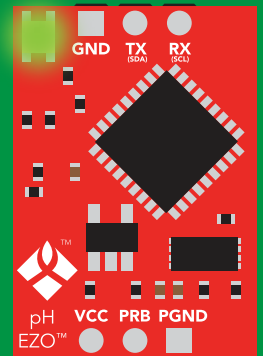
Standby

Protocol lock

Command syntax

Plock,1 <cr> enable Plock
Plock,0 <cr> disable Plock   default
Plock,? <cr> Plock on/off?

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

Plock,1
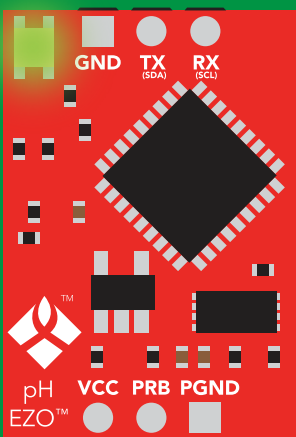
*OK <cr>

I2C,100
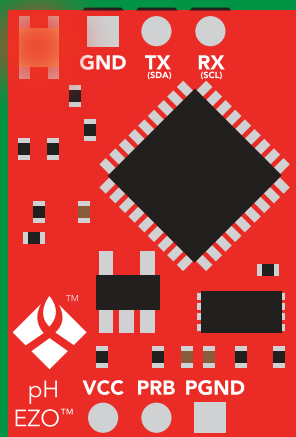
cannot change to I²C

*ER <cr>

Short
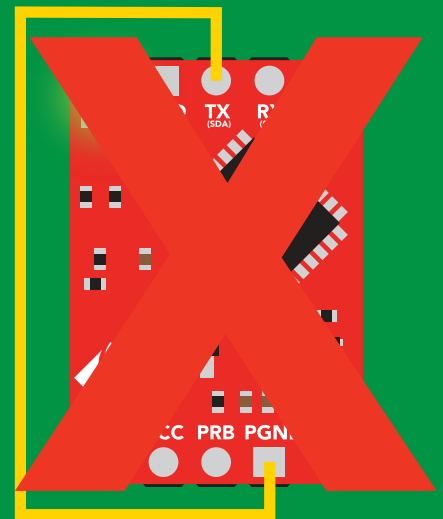
cannot change to I²C

Factory reset

Command syntax

Factory <cr> enable factory reset

Example

Response

Factory <cr>   *OK <cr>

Factory <cr>
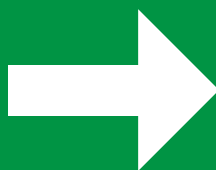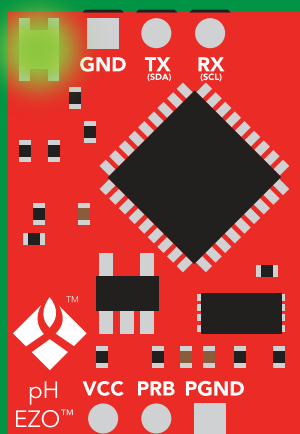
(reboot)
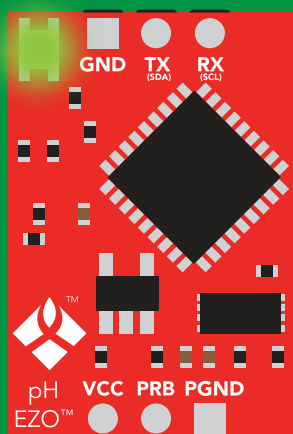
*OK <cr>

*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

GND   TX (SDA)   RX (SCL)

pH EZO™   VCC PRB PGND

Green
*OK <cr>

(reboot)

GND   TX (SDA)   RX (SCL)

pH EZO™   VCC PRB PGND
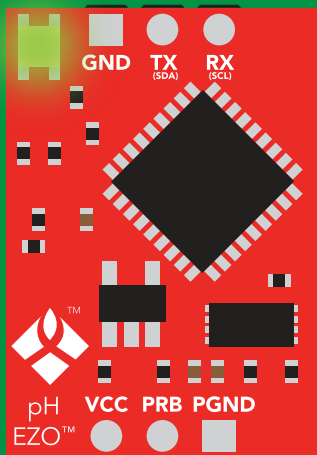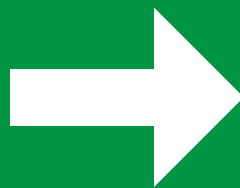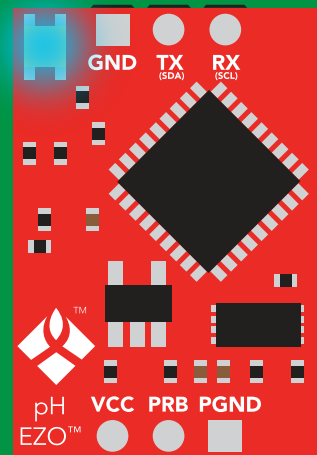
Blue
now in I²C mode

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 99 (0x63)

Example

Short

Wrong Example

Short
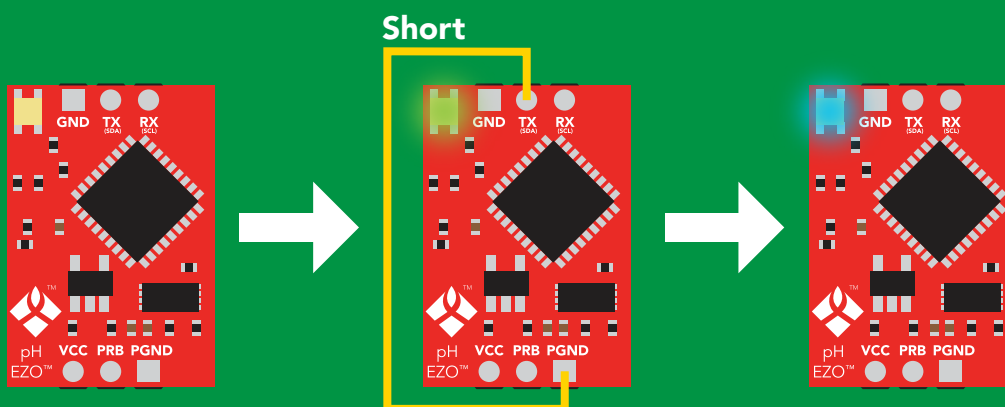
← Disconnect RX line
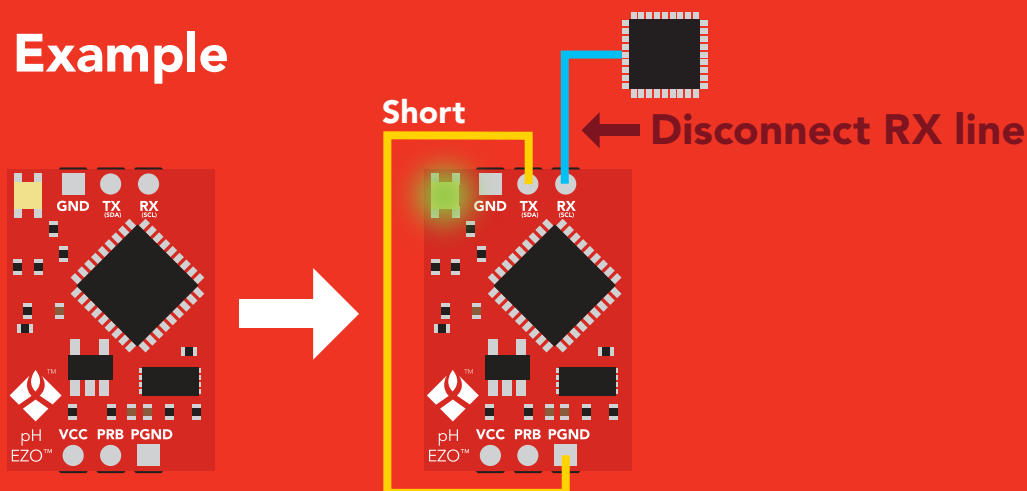
I²C mode

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

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

Find
Sleep mode

I²C mode

I²C address (0x01 – 0x7F)

99 (0x63) default

Vcc 3.3V – 5.5V

Clock speed 100 – 400 kHz

SDA

SCL
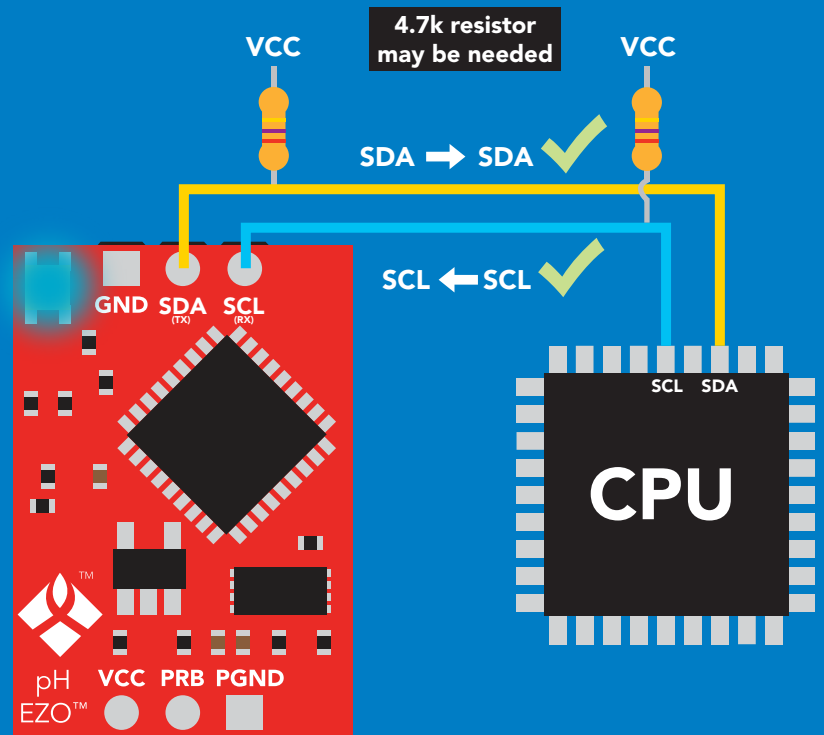
VCC

0V   0V

VCC   4.7k resistor may be needed   VCC

SDA ➡ SDA ✓

SCL ⬅ SCL ✓

GND SDA SCL
(TX) (RX)

SCL SDA

CPU

pH EZO™

VCC PRB PGND

Data format

Reading	pH	Data type	floating point
Units	pH	Decimal places	2
Encoding	ASCII	Smallest string	4 characters
Format	string	Largest string	399 characters

Sending commands to device

5 parts

Start	I²C address	Write	Command (not case sensitive)	Stop

I^2C address: 99 (0x63)

Command: ASCII command string

Example

Start	99 (0x63)	Write	Sleep	Stop

99 (0x63): I²C address

Sleep: Command

GND SDA (TX) SCL (RX)

pH EZO™

VCC PRB PGND

SCL SDA

CPU

Advanced

SDA
SCL

Address bits

The entire command as ASCII with all arguments

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

W = low

Requesting data from device

7 parts

Start	I²C address	Read	Response code	Data string	Null	Stop
	99 (0x63)		1 byte	"9.65"	Terminator (Dec 0)	

9.65

Advanced

Address bits

N bytes of data

All bytes after data are Null

R = High

SDA — | Start | A6 – A0 | R | ACK | Response code | ACK | Data | ACK | ⋯ | Data N | ACK | Null | ACK | ⋯ | Null | | NACK | Stop |

SCL

| 1 | 57 | 46 | 54 | 53 | 0 | = 9.65 |

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

Receiving data

GND SDA SCL
(TX) (RX)

pH
EZO™   VCC PRB PGND
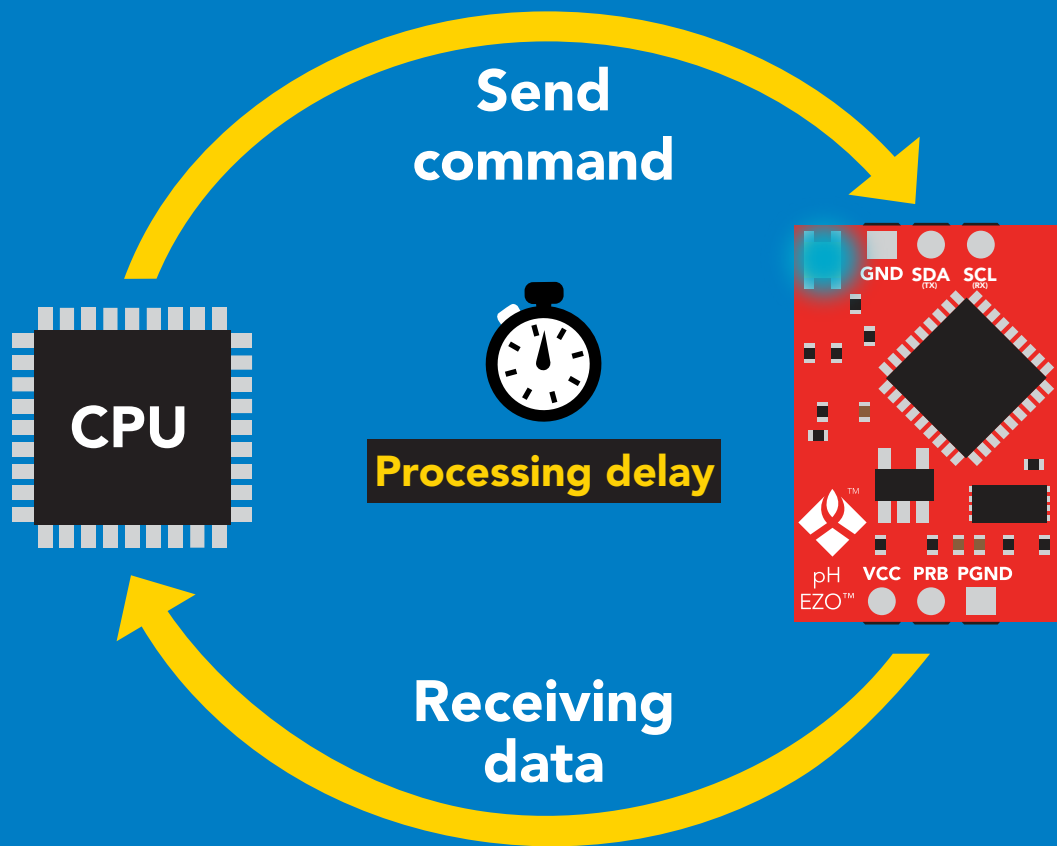
Example

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	error
1	successful request

LED color definition
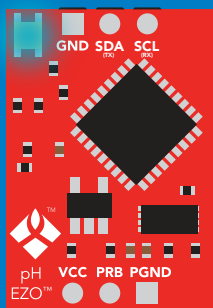
Blue	**Green**	**Purple**	**Red**	**White**
I²C standby	Taking reading	Changing I²C ID#	Command not understood	Find
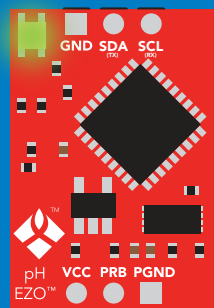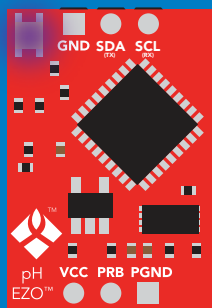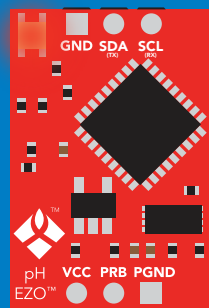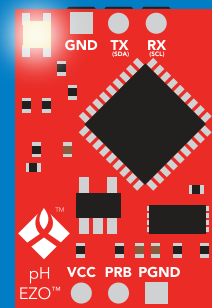
5V	LED ON **+2.2 mA**
3.3V	**+0.6 mA**

I²C mode
command quick reference

All commands are ASCII strings or single ASCII characters.

Command	Function	
Baud	switch back to UART mode	pg. 60
Cal	performs calibration	pg. 50
Export/import	export/import calibration	pg. 51
Factory	enable factory reset	pg. 59
Find	finds device with blinking white LED	pg. 48
i	device information	pg. 54
I2C	change I²C address	pg. 58
L	enable/disable LED	pg. 47
Plock	enable/disable protocol lock	pg. 57
R	returns a single reading	pg. 49
Sleep	enter sleep mode/low power	pg. 56
Slope	returns the slope of the pH probe	pg. 52
Status	retrieve status information	pg. 55
T	temperature compensation	pg. 53

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)

pH EZO™ VCC PRB PGND

L,1

GND SDA (TX) SCL (RX)

pH EZO™ VCC PRB PGND

L,0
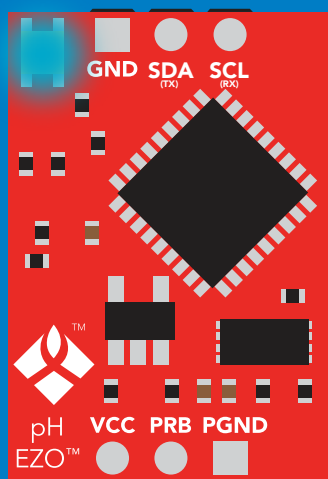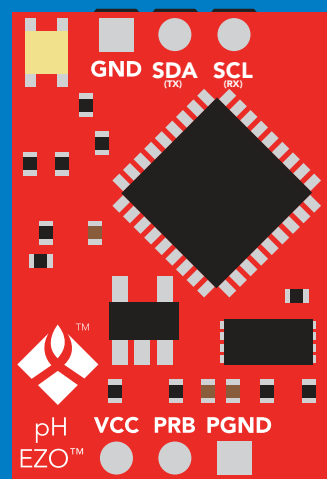
Find

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
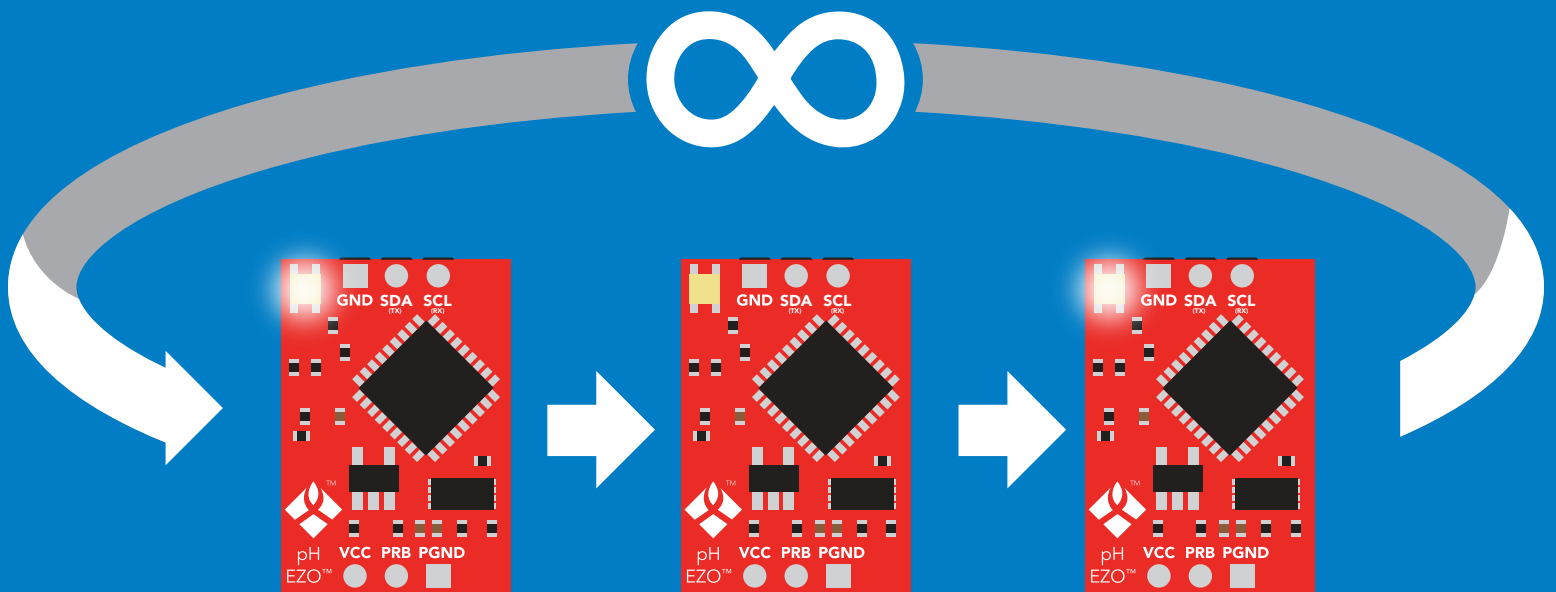
Taking reading

R return 1 reading

Example

R

Response

⏱ **Wait 900ms** | **1** Dec | **9.65** ASCII | **0** Null
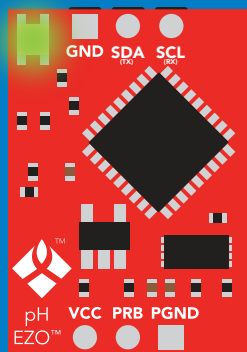
Green
Taking reading

Wait 900ms
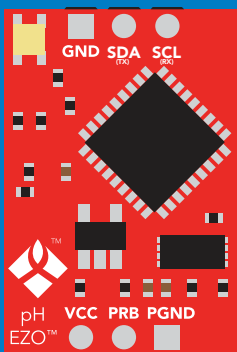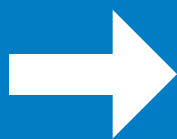
Transmitting

Blue
Standby

Calibration

Issuing the cal,mid command after the EZO™ pH circuit has been calibrated, will clear the other calibration points. Full calibration will have to be redone.

Command syntax

Cal,mid,n	single point calibration at midpoint
Cal,low,n	two point calibration at lowpoint
Cal,high,n	three point calibration at highpoint
Cal,clear	delete calibration data
Cal,?	device calibrated?

Example — Response

Example	Response
Cal,mid,7.00	⏱ Wait 900ms │ **1** Dec │ **0** Null
Cal,low,4.00	⏱ Wait 900ms │ **1** Dec │ **0** Null
Cal,high,10.00	⏱ Wait 900ms │ **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 (one point) │ **0** Null **1** Dec │ **?Cal,2** ASCII (two point) │ **0** Null or **1** Dec │ **?Cal,3** ASCII (three point) │ **0** Null

Export/import calibration

Command syntax

Export: Use this command to save calibration settings
Import: Use this command to load calibration settings to one or more devices.

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)

(8 more)

⋮

Export

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

Export

⏱ **Wait 300ms** `1` Dec `*DONE` ASCII `0` Null

Import, n (FIFO)

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

Slope

Command syntax

After calibrating a pH probe issuing the slope command will show how closely (in percentage) the calibrated pH probe is working compared to the "ideal" pH probe.

Slope,?   returns the slope of the pH probe

Example | Response

Slope,?

⏱ **Wait 300ms** | **1** Dec | **?Slope,99.7,100.3** ASCII | **0** Null

---

Response breakdown

?Slope, | **99.7,** | **100.3**
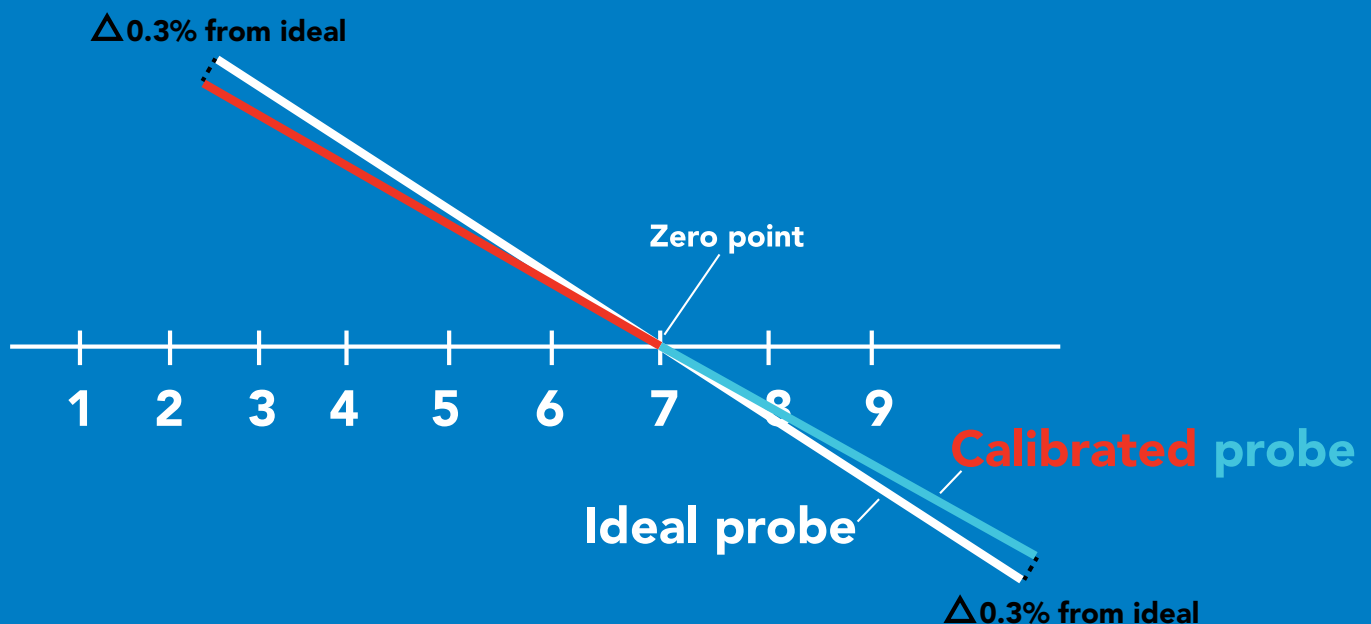
↑ 99.7% is how closely the slope of the **acid** calibration line matched the "ideal" pH probe.

↑ 100.3% is how closely the slope of the **base** calibration matches the "ideal" pH probe.

△0.3% from ideal

Zero point

1 2 3 4 5 6 7 8 9

Calibrated probe

Ideal probe

△0.3% from ideal

Temperature compensation

Command syntax

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

T,?   compensated temperature value?

Example	Response
T,19.5	⏱ **Wait 300ms** **1** Dec **0** Null
T,?	⏱ **Wait 300ms** **1** Dec **?T,19.5** ASCII **0** Null
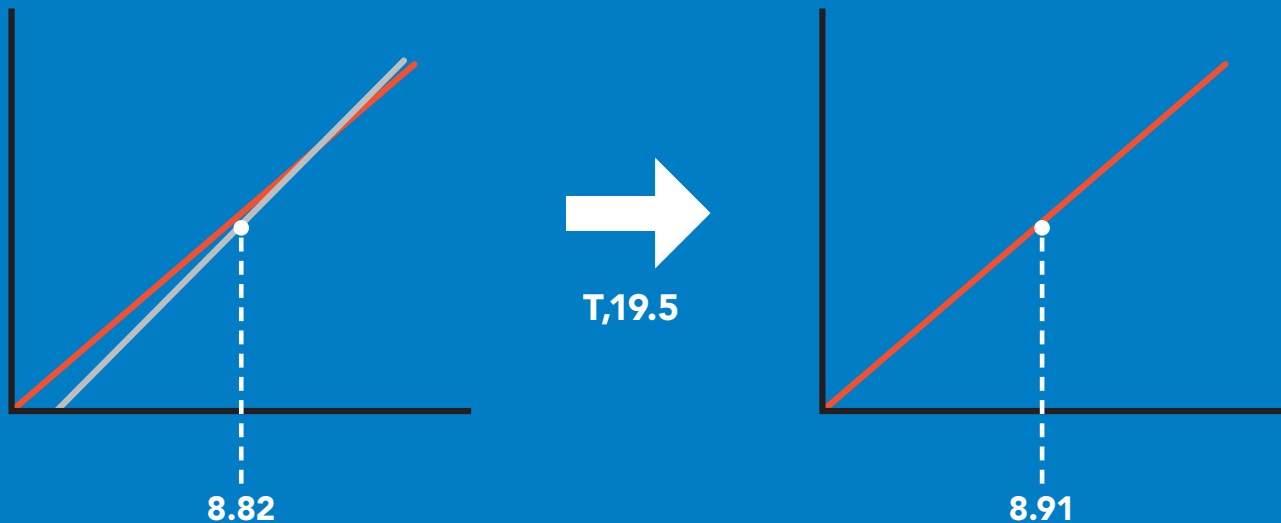
8.82   →   T,19.5   8.91

Device information

Command syntax

i   device information

Example

i

Response

Wait 300ms | **1** Dec | **?i,pH, 19.8** ASCII | **0** Null

Response breakdown

?i,   **pH,**   **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	**Send any character or command to awaken device.**

Example | Response

Example	Response	
Sleep	**no response**	**Do not read status byte after issuing sleep command.**
Any command	**wakes up device**	

	STANDBY	SLEEP
5V	**16 mA**	**1.16 mA**
3.3V	**13.9 mA**	**0.995 mA**
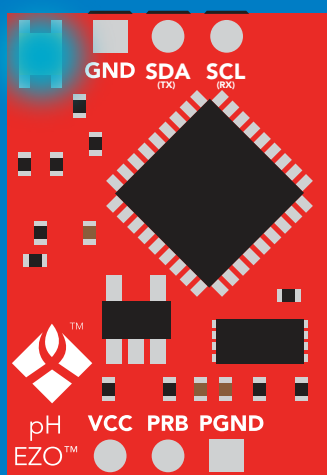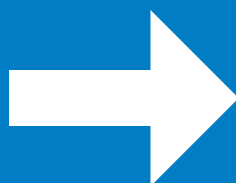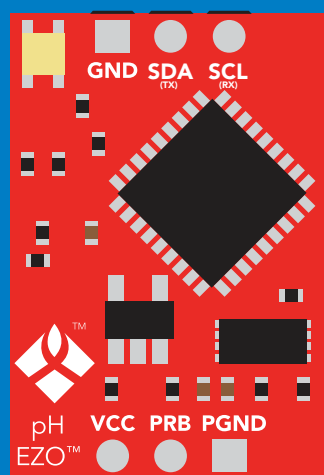
Standby → **Sleep** → **Sleep**

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   **Serial, 9600**

pH EZO™   GND   SDA (TX)   SCL (RX)   VCC   PRB   PGND

pH EZO™   GND   SDA (TX)   SCL (RX)   VCC   PRB   PGND

cannot change to UART

GND   SDA (TX)   VCC   PRB   PG.
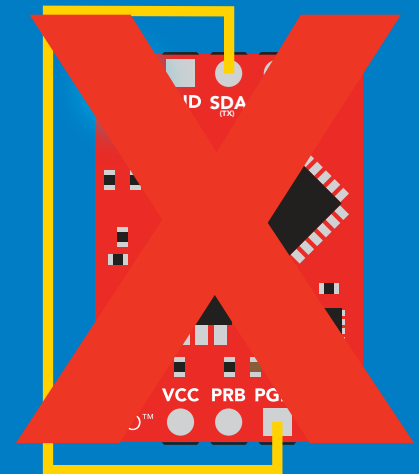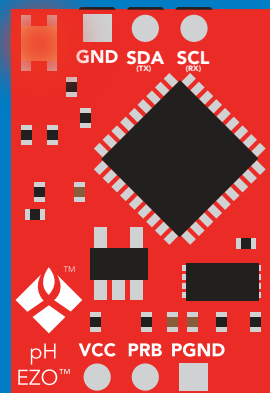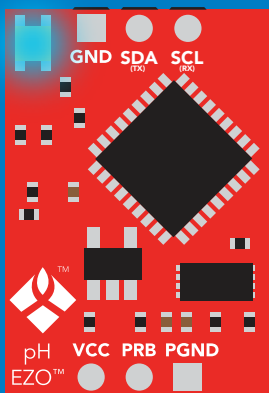
cannot change to UART

I²C address change

I2C,n   sets I²C address and reboots into I²C mode

Example   Response

Example	Response
I2C,100	device reboot

Warning!

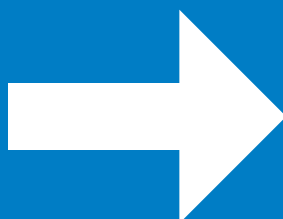Changing the I²C address will prevent communication between the circuit and the CPU, until the CPU is updated with the new I²C address.

Default I²C address is 99 (0x63).

n = any number 1 – 127

I2C,100
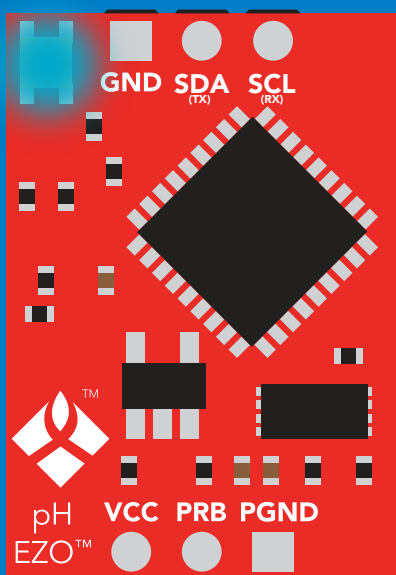
(reboot)
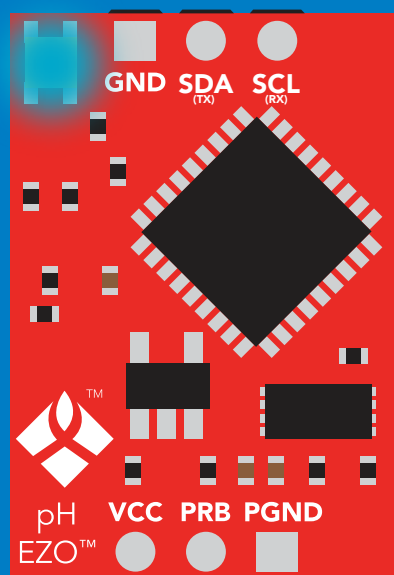
Factory reset

Command syntax

Factory	enable factory reset

Example	Response
Factory	device reboot

Clears calibration
LED on
Response codes enabled

Factory
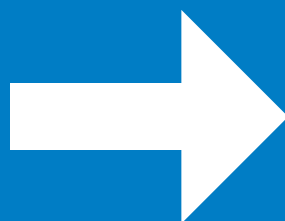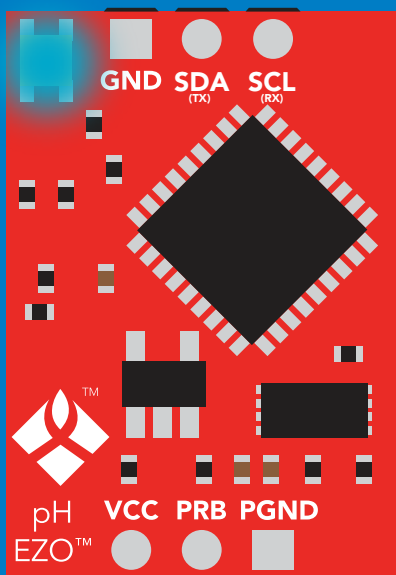
(reboot)
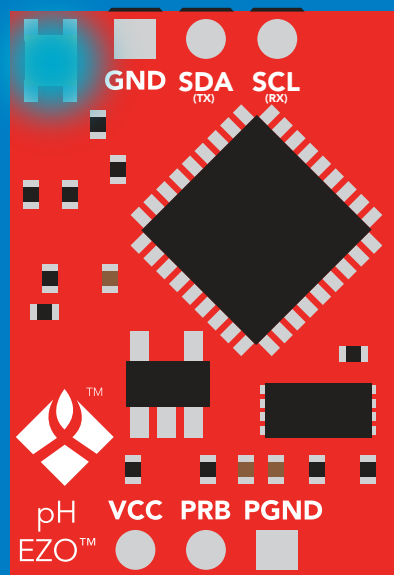
Change to UART mode

Command syntax

Baud,n   switch from I²C to UART

Example   Response

Baud,9600   **reboot in UART mode**

n = {
300
1200
2400
9600
19200
38400
57600
115200
}
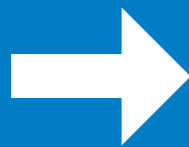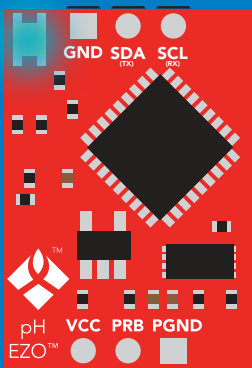
Serial,9600
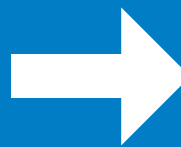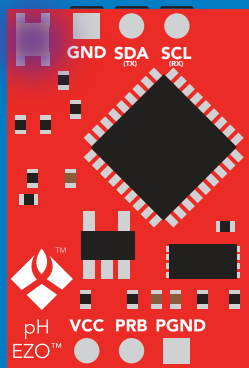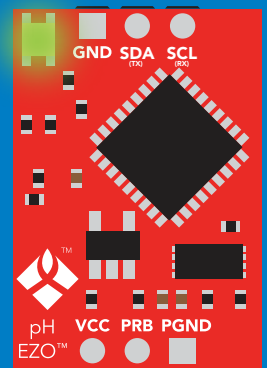
Changing to UART mode

(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)

pH
EZO™

VCC **PRB** **PGND**

**17.78mm
(0.7")**

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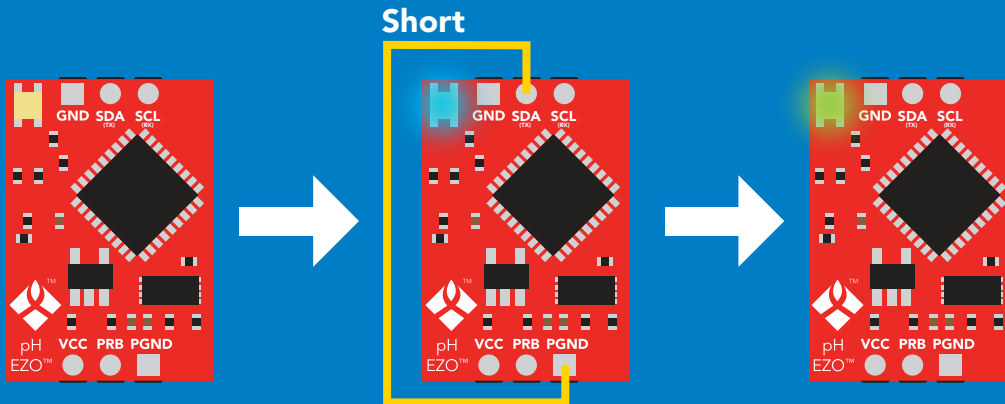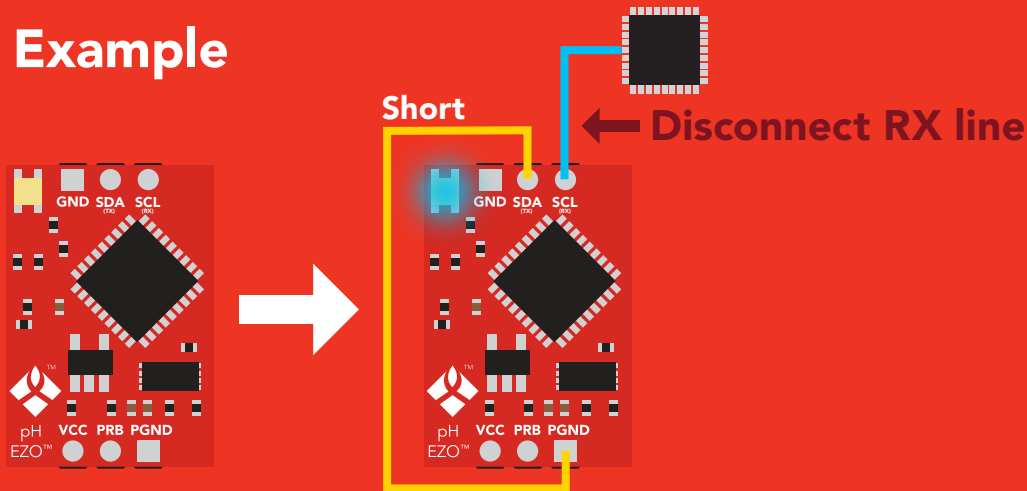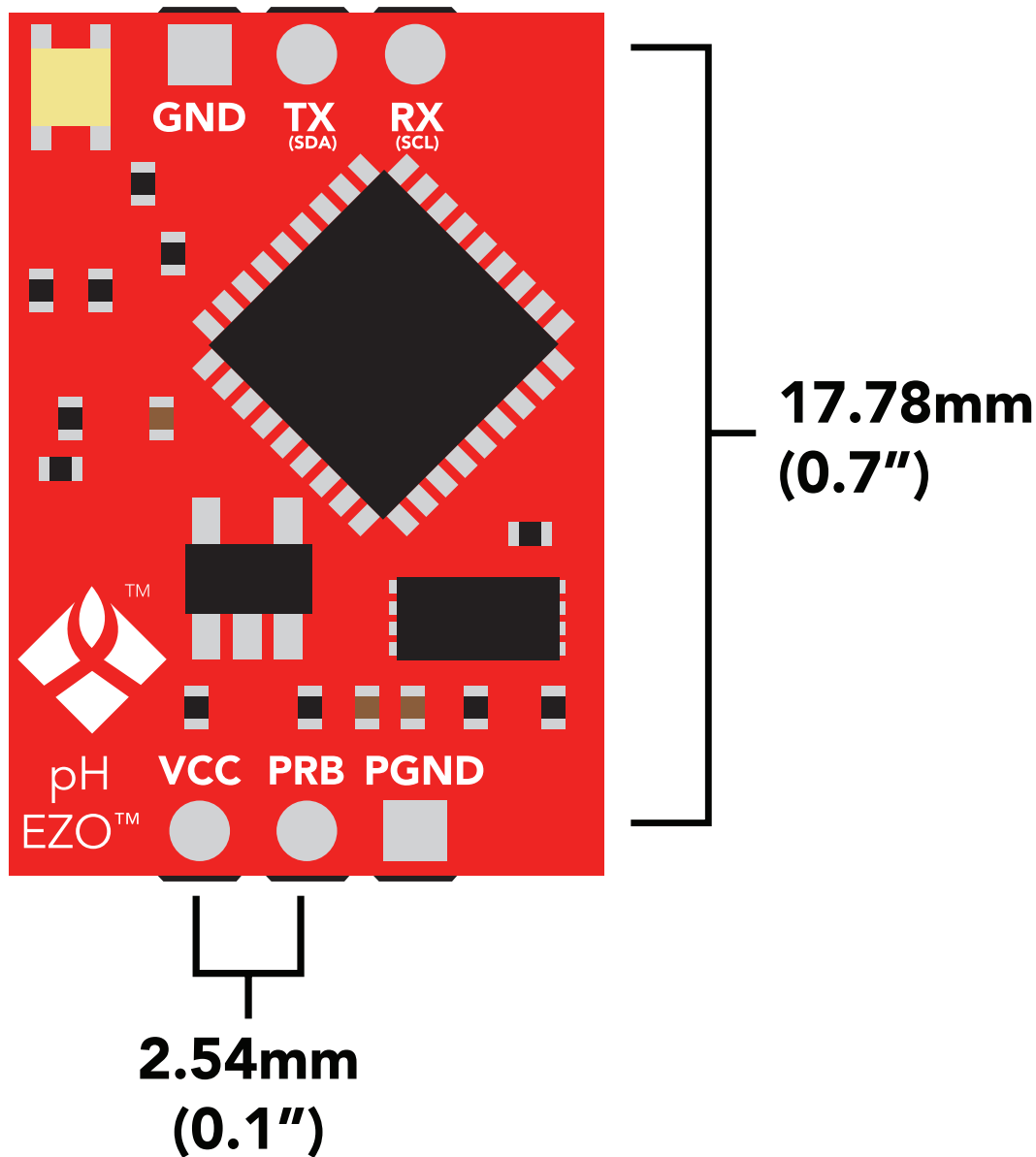
1 In your CAD software place an 8 position header.

2 Place a 3 position header at both top and bottom of the 8 position.
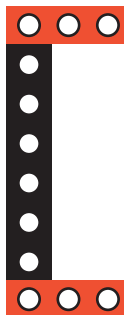
3 Delete the 8 position header. The two 3 position headers are now 17.78mm (0.7") apart from each other.

**17.78mm
(0.7")**
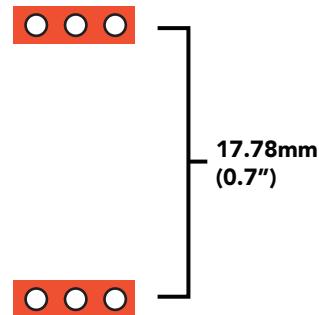
Datasheet change log

Datasheet V 4.2

Revised Plock pages to show default value.

Datasheet V 4.1

Added new commands:
"Find" pages 23 & 46.
"Export/Import calibration" pages 27 & 49.
  Added new feature to continous mode "C,n" pg 24.

Datasheet V 4.0

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

Datasheet V 3.9

Revised calibration theory on pg. 7

Datasheet V 3.8

Revised entire datasheet

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pH 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^{2}C bug (Dec 1, 2014)
• Fix I^{2}C bug where the circuit may inappropriately respond when other I^{2}C 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)
• Added the option to save and load calibration.

V1.98 – EEPROM (Nov 14, 2016)
• Fixed glitch during calibration process.

V2.10 – (May 9, 2017)
• Added "Find" command.
• Added "Export/import" command.
• Modified continuous mode to be able to send readings every "n" seconds.

V2.11 – (June 12, 2017)
• Fixed "I" command to return "pH" instead of "PH".

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Warranty

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

The debugging phase

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

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

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

- **Embedding the EZO™ class pH circuit into a custom made device.**

- **Removing any potting compound.**

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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 pH circuit, against the thousands of possible variables that may cause the EZO™ class pH 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 pH 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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