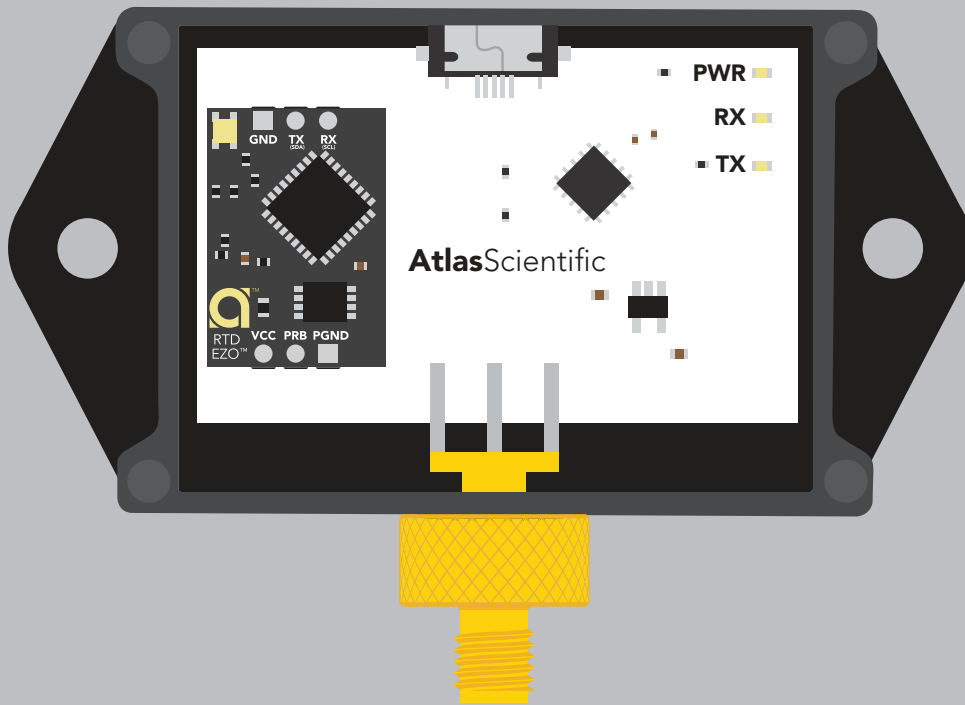


# EZO Complete-TMP™

USB Temperature meter

**Datasheet for engineers**



Reads	<b>Temperature</b>	Data protocol	<b>Serial data through FTDI virtual comport</b>
Range	<b>-126.000 °C to 1254 °C</b>	Supported probes	<b>Any type &amp; brand PT-100 or PT-1000</b>
Accuracy	<b>+/- (0.1 + 0.0017 x °C)</b>	Data format	<b>ASCII</b>
Temp reading time	<b>800ms</b>	Ingress protection	<b>IP62</b>
Calibration	<b>Single point</b>		



Written by Jordan Press  
Designed by Noah Press

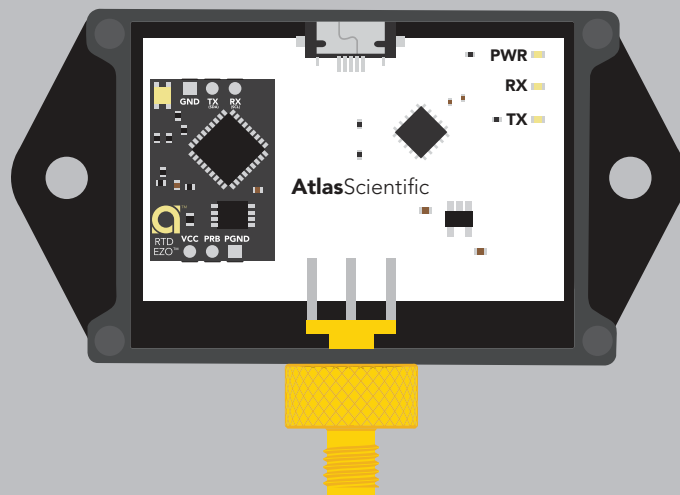
**PATENT PROTECTED**

This is an evolving document, check back for updates.

# Table of contents

Power consumption	3
Absolute max ratings	3
Interference free	4
Ingress protection – IP62	4
Default state	6

LED color definition	7
Receiving data from device	8
Sending commands to device	9
Simple serial monitor	10
<b>UART quick command page</b>	<b>11</b>
LED control	12
Find	13
Continuous reading mode	14
Single reading mode	15
Calibration	16
Export calibration	17
Import calibration	18
Temperature scale	19
Enable/disable data logger	20
Memory recall	21
Memory clear	22
Naming device	23
Device information	24
Response codes	25
Reading device status	26
Sleep mode/low power	27
Factory reset	28

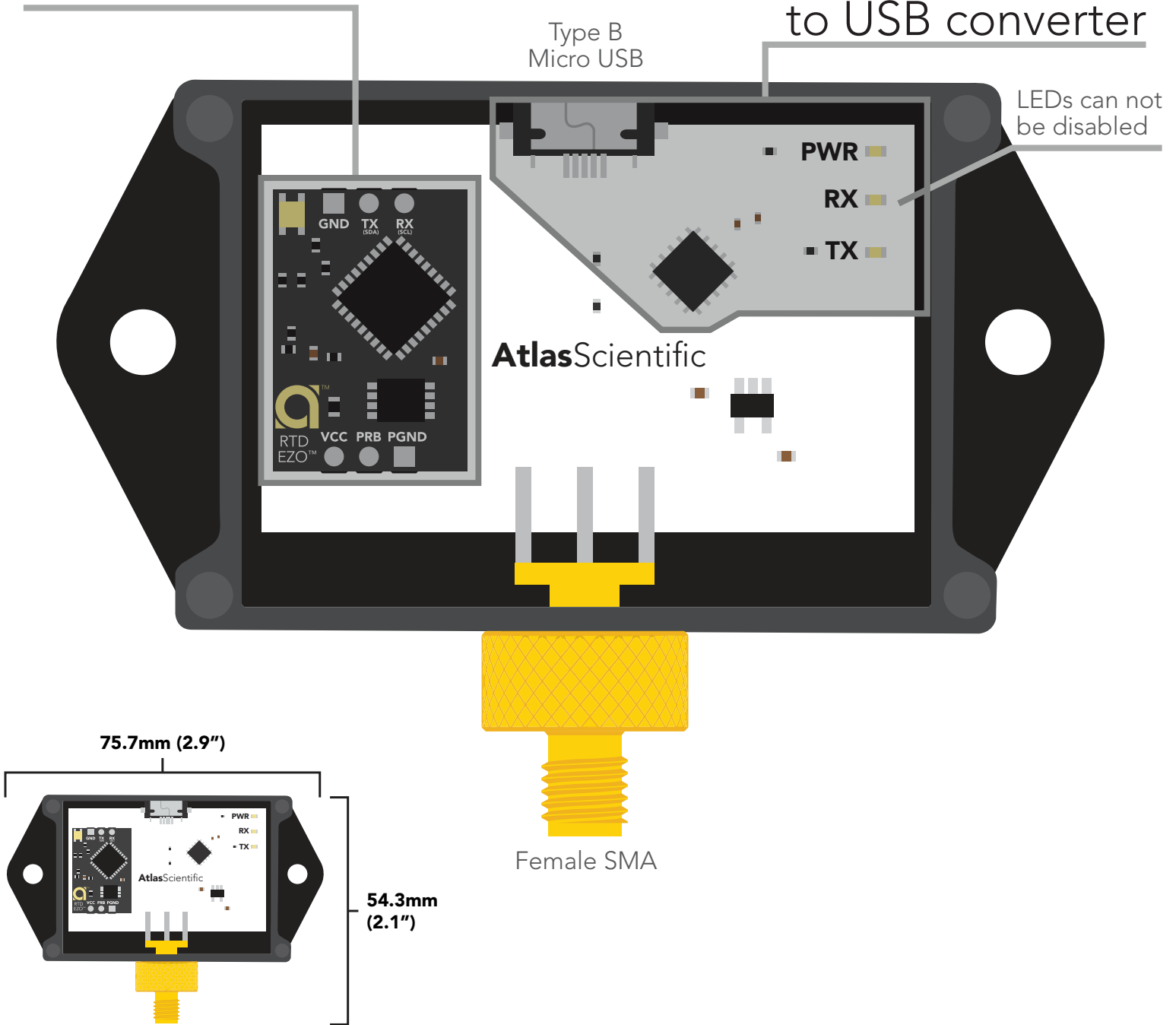


Calibration theory	29
Datasheet change log	31
Firmware updates	32
Warranty	33

The EZO Complete-TMP™ consists of 2 major components.

EZO-RTD circuit™

FTDI UART to USB converter



## Power consumption

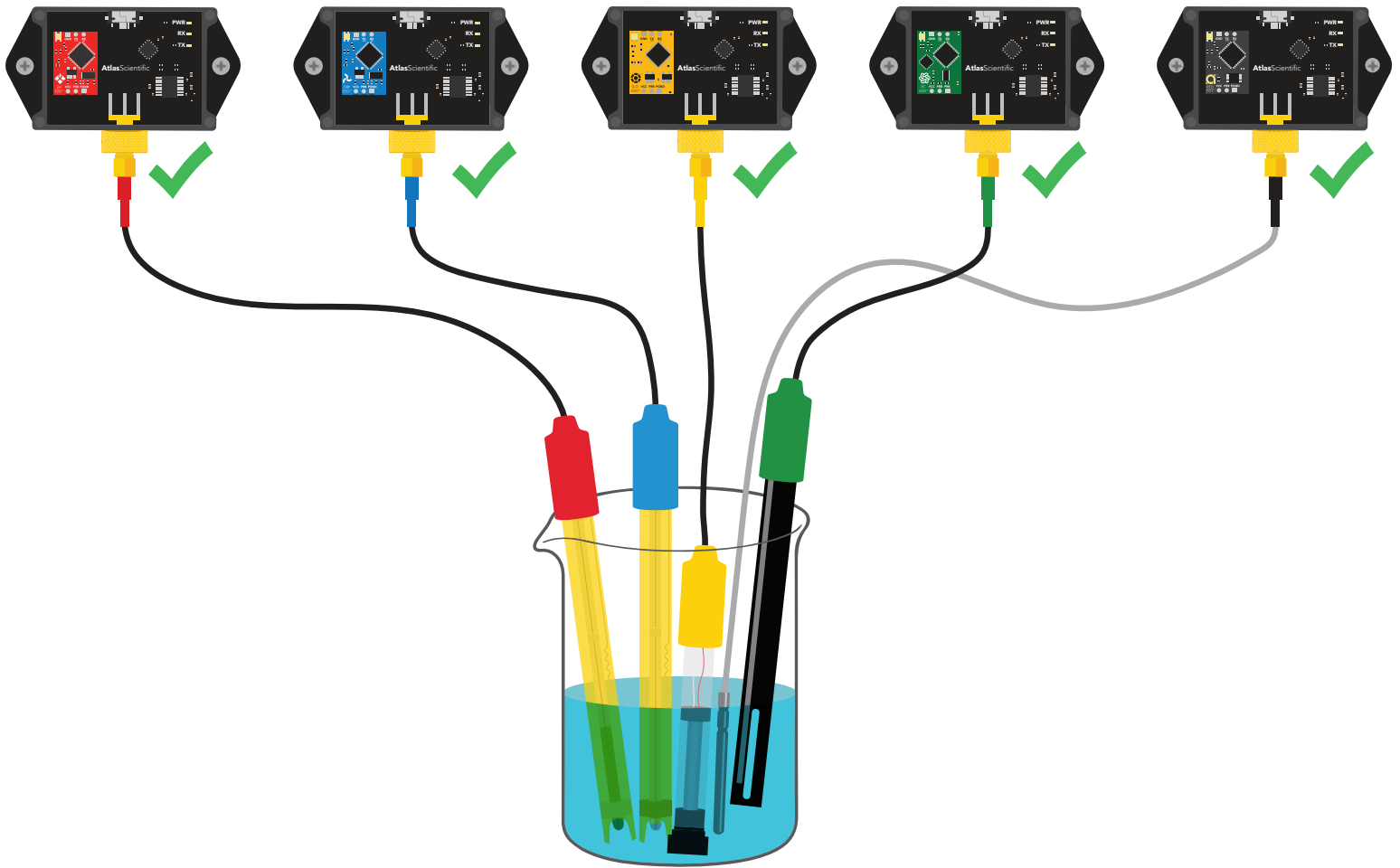
5V USB	MAX	STANDBY	SLEEP
	20 mA	17 mA	4 mA

## Absolute max ratings

Parameter	MIN	TYP	MAX
Storage temperature	-65 °C		125 °C
Operational temperature	-40 °C	25 °C	85 °C

# Interference free

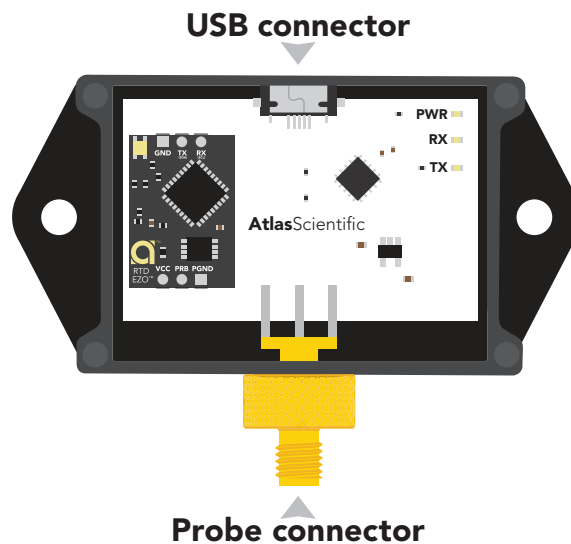
The EZO complete readings are unaffected by other sensors in the same water.



# Ingress protection – IP62

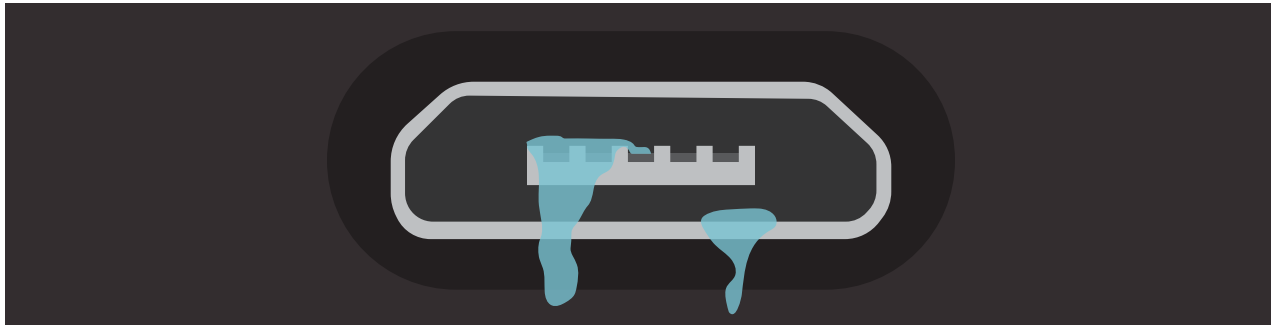
The EZO Complete-TMP™ is dust proof and resistant to splashing water.

**Two areas of concern are the *USB connector* and the *probe connector*.**

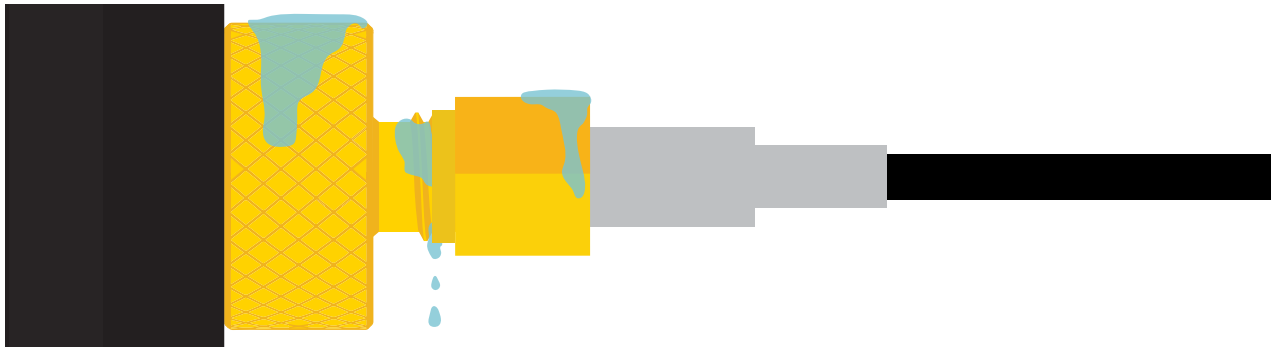


# Ingress protection – IP62

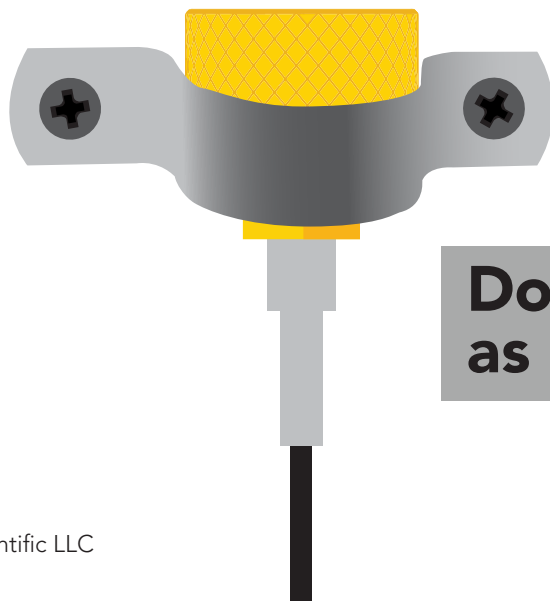
An electrical short can occur if water enters the USB connector. A USB short could permanently damage the EZO-Complete. A USB short is not covered under warranty.



A connector short can occur if water enters the SMA connector. A connector short will cause the temperature readings to pin to -1023, or the probe will respond slowly to changes in temperature. A connector short is reversible and will not damage the EZO-Complete. However, frequent shorts will eventually damage the temperature probe.



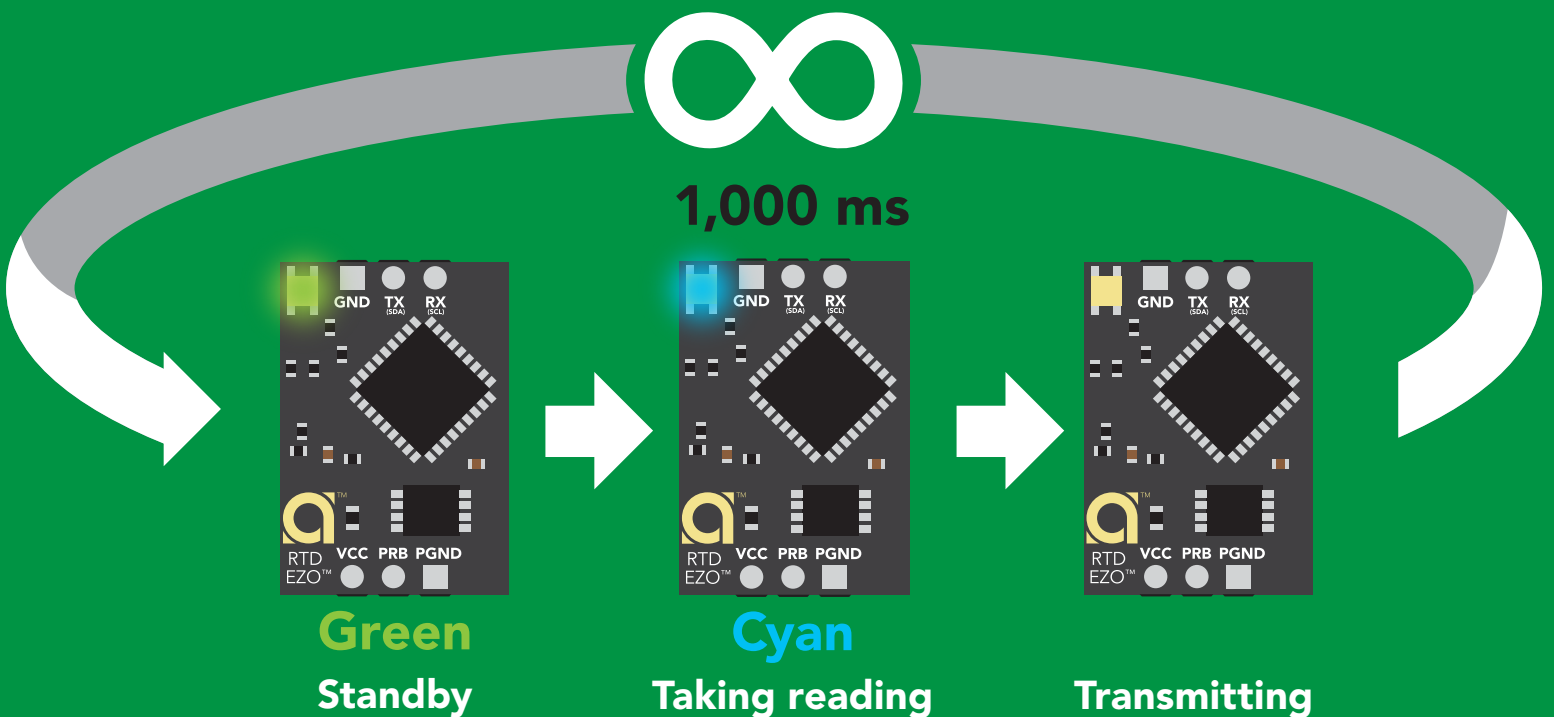
The SMA connector is part of your probe; Nothing should be in contact with this part.



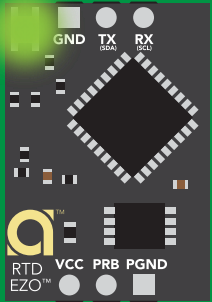
**Do not use this  
as a mounting point!**

# Default state

<b>Baud</b>	<b>9,600</b>
<b>Readings</b>	<b>continuous</b>
<b>Speed</b>	<b>1 reading per second</b>
<b>Temperature</b>	<b>°C</b>
<b>With probe</b>	<b>ttt.ttt</b>
<b>Without probe</b>	<b>-1023.000</b>

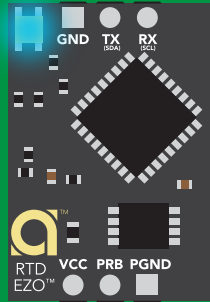


# LED color definition



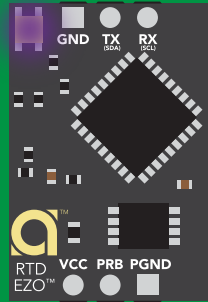
**Green**

UART standby



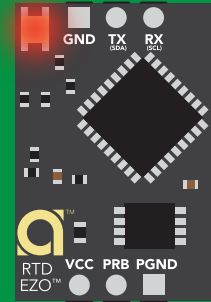
**Cyan**

Taking reading



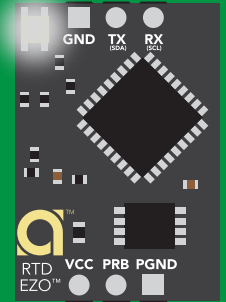
**Purple**

Changing  
baud rate



**Red**

Command  
not understood



**White**

Find

**5V**

LED ON  
**+2.2 mA**

**3.3V**

**+0.6 mA**

## Settings that are retained if power is cut

- Calibration
- Continuous mode
- Device name
- Enable/disable response codes
- LED control
- Protocol lock

## Settings that are **NOT** retained if power is cut

- Find
- Sleep mode
- Temperature compensation

# Receiving data from device

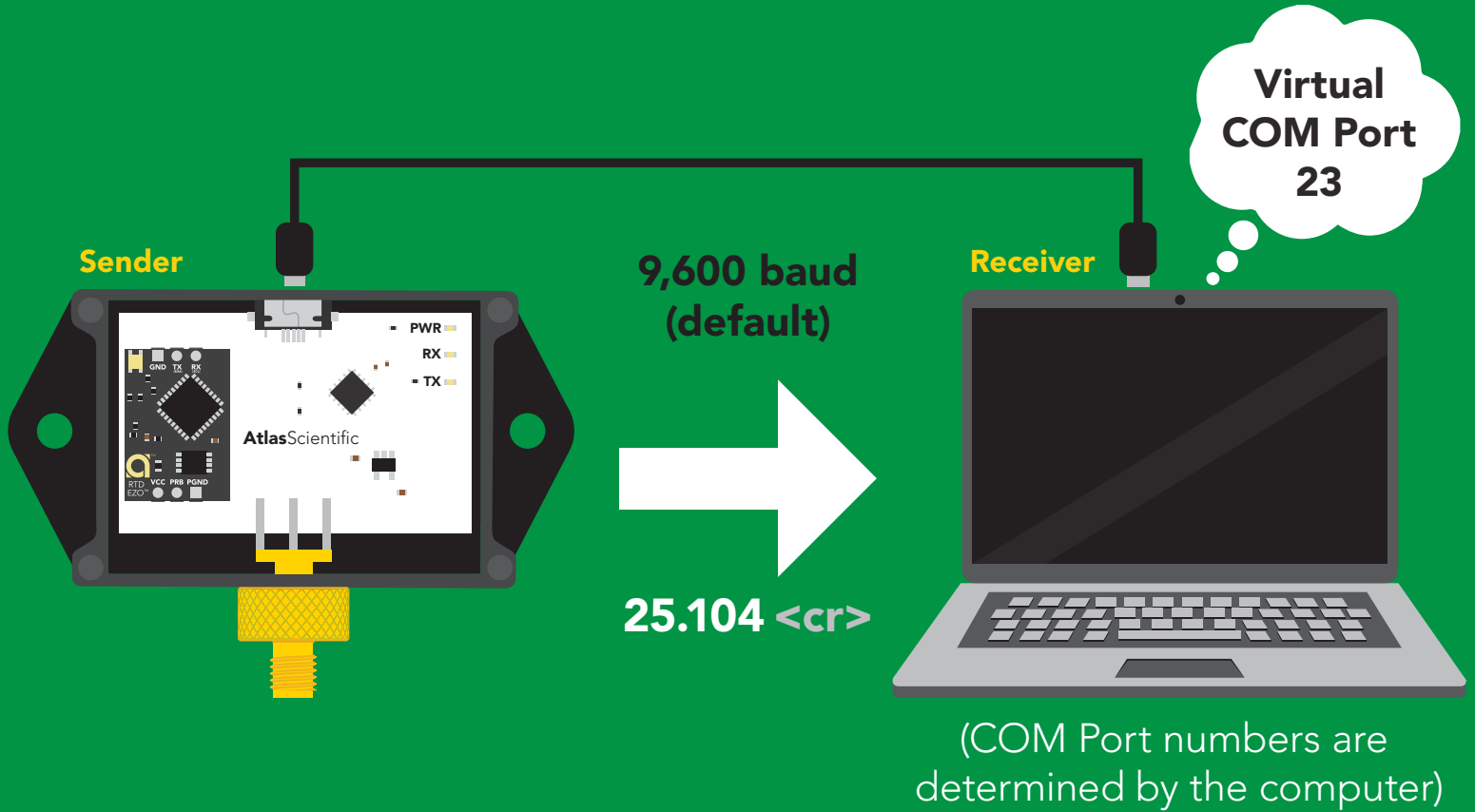
2 parts

ASCII data string

Command

Carriage return <cr>

Terminator



## Advanced

ASCII:	2	5	.	1	0	4	<cr>
Hex:	32	35	2E	31	30	34	0D
Dec:	50	53	46	49	48	52	13



# Sending commands to device

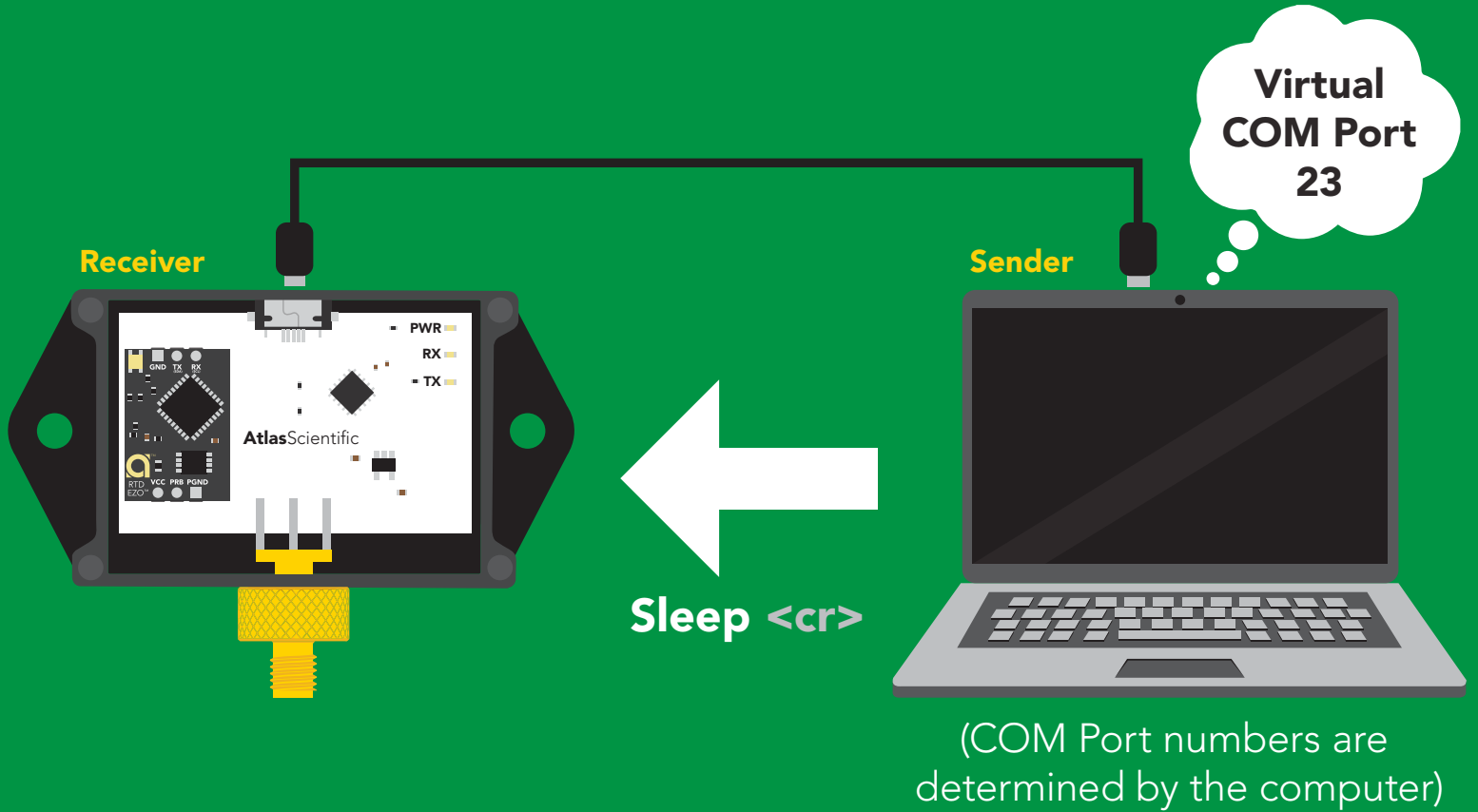
2 parts

**Command (not case sensitive)**

ASCII data string

**Carriage return <cr>**

Terminator



## Advanced

ASCII: **S** **I** **e** **e** **p** **<cr>**

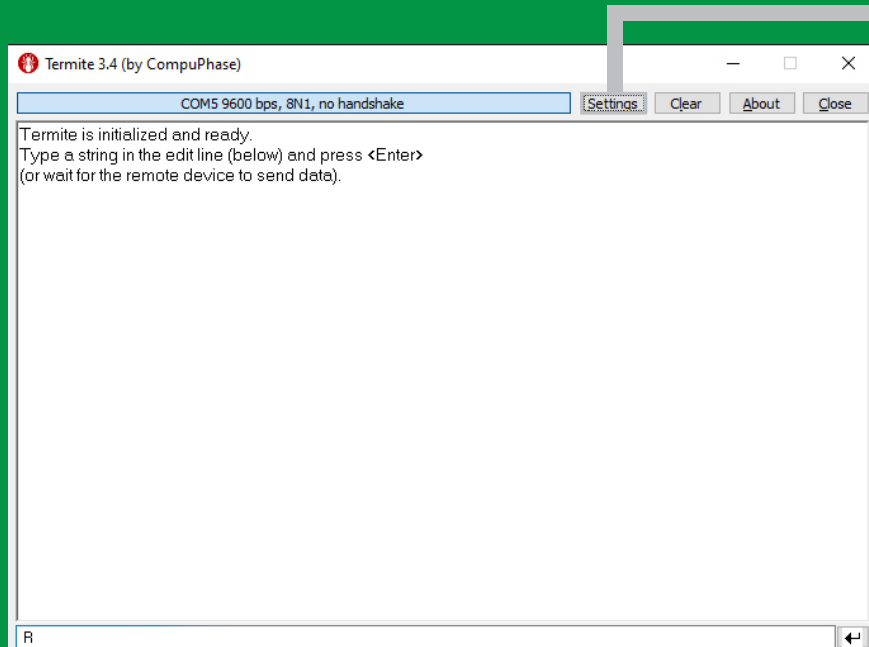
Hex: **53** **6C** **65** **65** **70** **0D**

Dec: **83** **108** **101** **101** **112** **13**

# Looking for a simple serial monitor for debugging?

**Termite:** a simple RS232 terminal

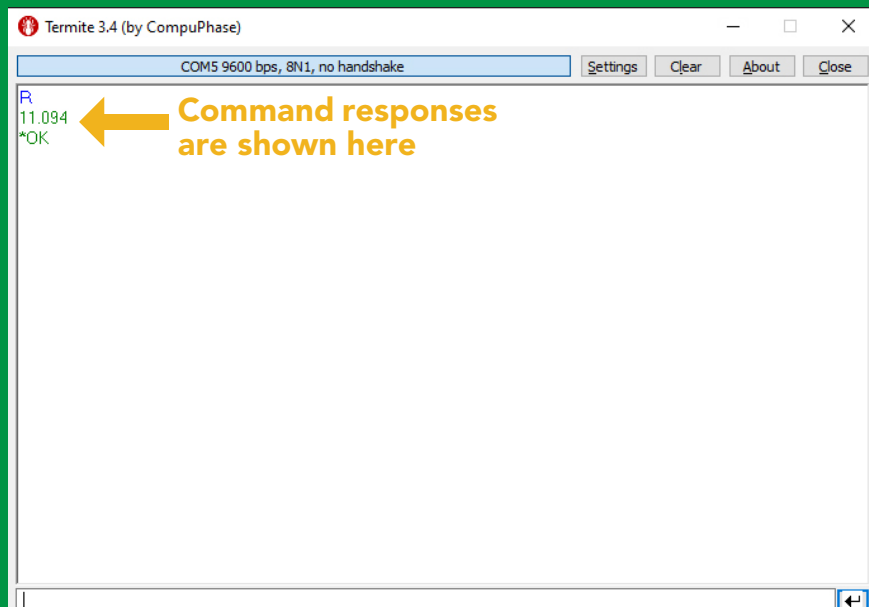
[Click here to download](#)



## Settings

<b>Baud</b> 9600	<b>Parity</b> none
<b>Data bits</b> 8	<b>flow control</b> none
<b>Stop bits</b> 1	<b>Forward</b> none
<b>Transmitted text</b> append CR	

Enter commands here



# Command quick reference

All commands are ASCII strings or single ASCII characters.

Command	Function		Default state
C	enable/disable continuous reading	pg. 14	enabled
Cal	performs calibration	pg. 16	n/a
D	enable/disable data logger	pg. 20	disabled
Export	export calibration	pg. 17	n/a
Factory	enable factory reset	pg. 28	n/a
Find	finds device with blinking white LED	pg. 23	n/a
i	device information	pg. 24	n/a
Import	import calibration	pg. 18	n/a
L	enable/disable LED	pg. 12	enabled
M	memory recall/clear	pg. 21	n/a
Name	set/show name of device	pg. 23	not set
R	returns a single reading	pg. 15	n/a
S	temperature scale (°C, °K, °F)	pg. 19	celsius
Sleep	enter sleep mode/low power	pg. 27	n/a
Status	retrieve status information	pg. 26	n/a
*OK	enable/disable response codes	pg. 25	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>

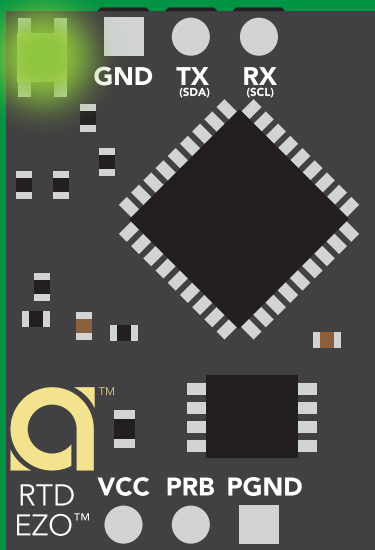
\*OK <cr>

L,0 <cr>

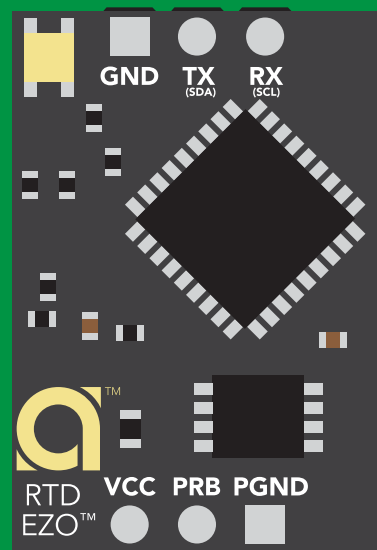
\*OK <cr>

L,? <cr>

?L,1 <cr> or ?L,0 <cr>  
\*OK <cr>



L,1



L,0

# Find

## Command syntax

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

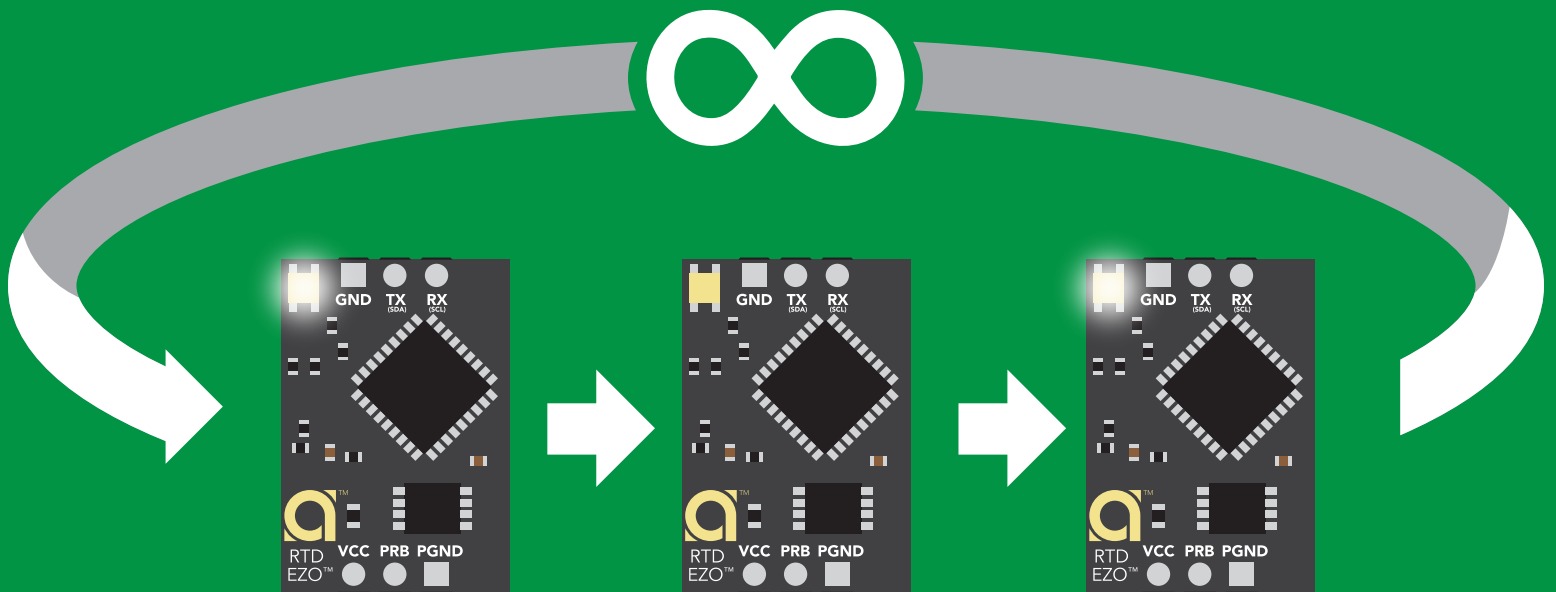
Find <cr> LED rapidly blinks white, used to help find device

## Example

## Response

Find <cr>

\*OK <cr>



# Continuous 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?

## Example

## Response

**C,1 <cr>**

**\*OK <cr>**  
**°C (1 sec) <cr>**  
**°C (2 sec) <cr>**  
**°C (n sec) <cr>**

**C,30 <cr>**

**\*OK <cr>**  
**°C (30 sec) <cr>**  
**°C (60 sec) <cr>**  
**°C (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

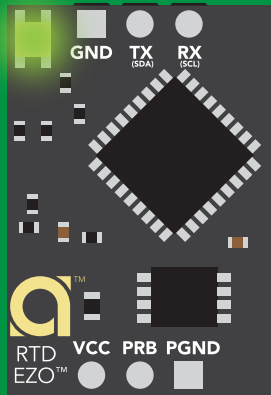
R <cr> takes single reading

### Example

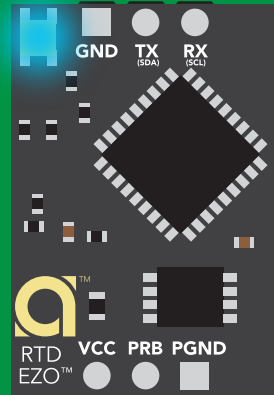
R <cr>

### Response

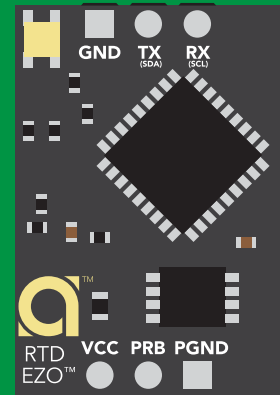
25.104 <cr>  
\*OK <cr>



**Green**  
Standby



**Cyan**  
Taking reading



**Transmitting**



600 ms

# Calibration

## Command syntax

The EZO™ RTD circuit uses single point calibration.

**Cal,t** <cr> t = any temperature

**Cal,clear** <cr> delete calibration data

**Cal,?** <cr> device calibrated?

## Example

## Response

**Cal,100.00** <cr>

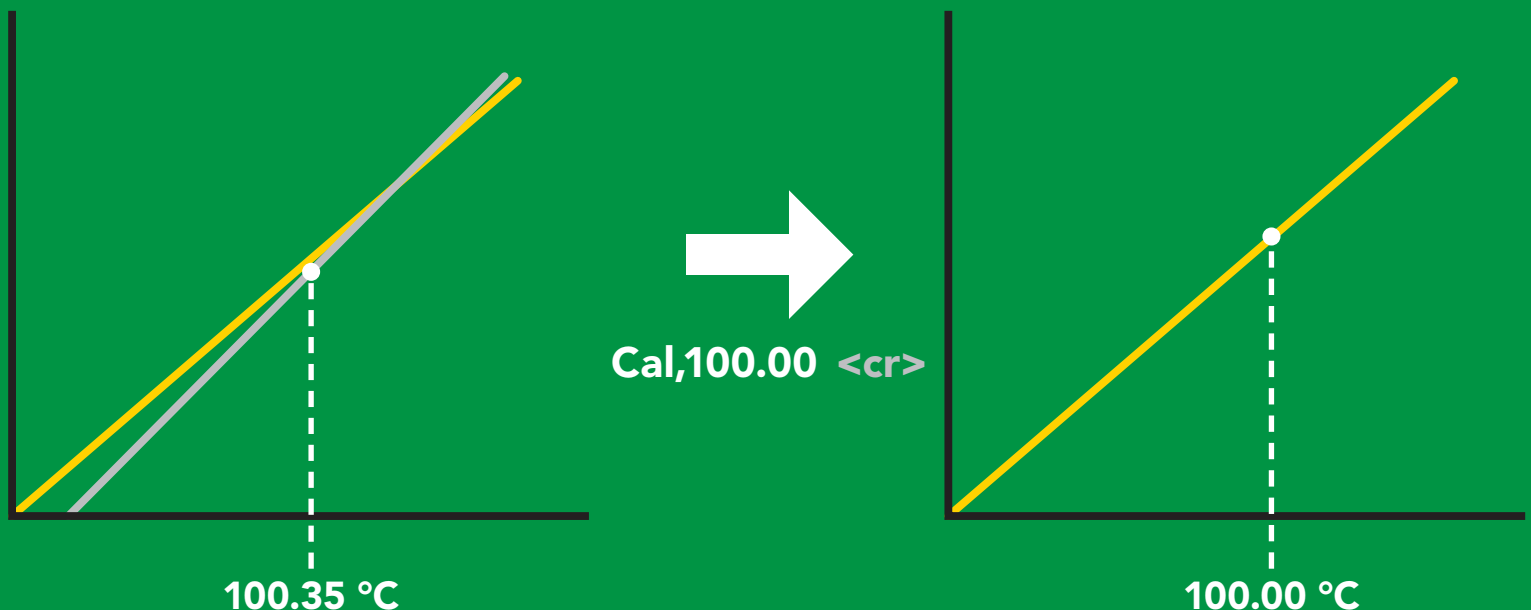
**\*OK** <cr>

**Cal,clear** <cr>

**\*OK** <cr>

**Cal,?** <cr>

**?Cal,1** <cr> or **?Cal,0** <cr>  
**\*OK** <cr>





# Export calibration

## Command syntax

Export: Use this command to download calibration settings

Export,? <cr> calibration string info

Export <cr> export calibration string from calibrated device

## 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>

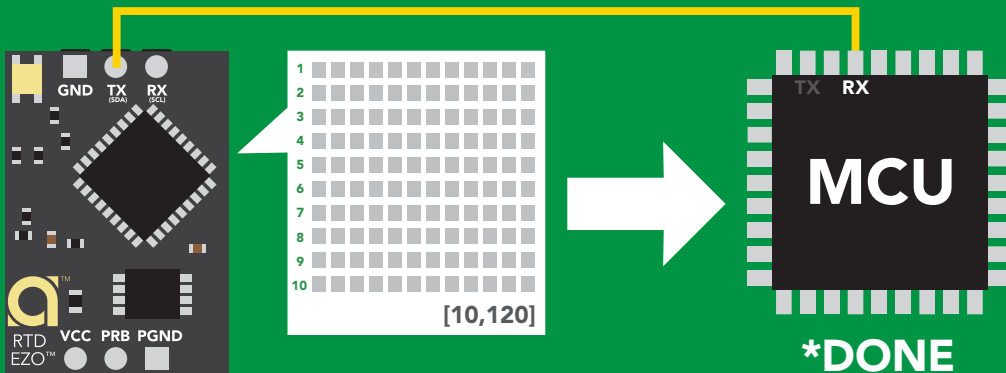
6F 6C 20 67 75 79 <cr> (10 of 10)

Export <cr>

**\*DONE**

Disabling \*OK simplifies this process

Export <cr>



# Import calibration

## Command syntax

Import: Use this command to upload calibration settings to one or more devices.

Import,n <cr> import calibration string to new device

## Example

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

Import, 65 20 61 20 63 6F <cr> (2 of 10)

⋮

Import, 6F 6C 20 67 75 79 <cr> (10 of 10)

## Response

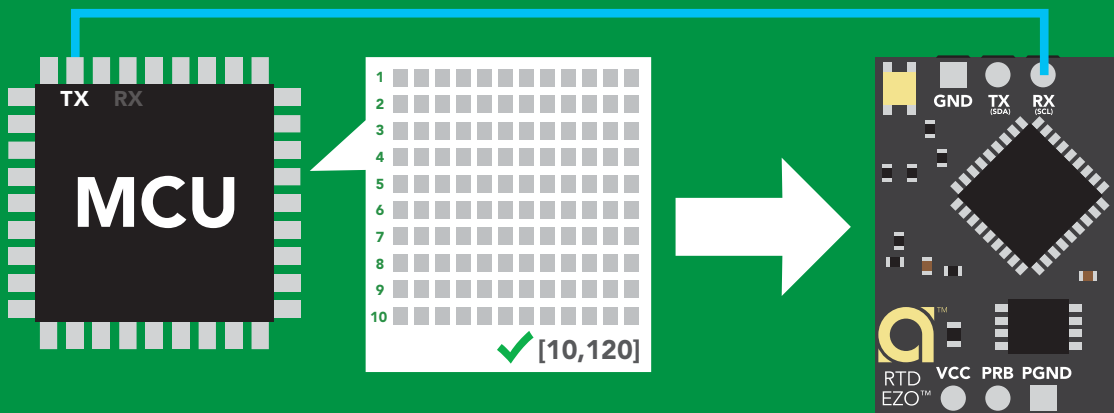
\*OK <cr>

\*OK <cr>

⋮

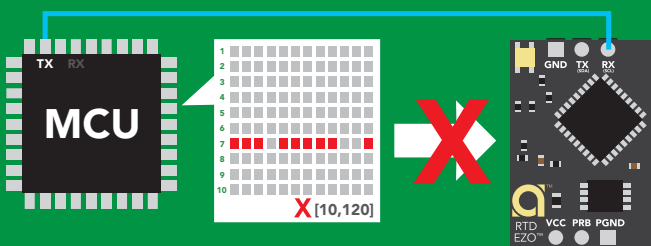
\*OK <cr>

Import,n <cr>



\*OK <cr>

system will reboot



\*ER <cr>

\* If one of the imported strings is not correctly entered, the device will not accept the import, respond with \*ER and reboot.

# Temperature scale (°C, °K, °F)

## Command syntax

S,c <cr> celsius **default**

S,k <cr> kelvin

S,f <cr> fahrenheit

S,? <cr> temperature scale?

## Example

## Response

S,c <cr>

\*OK <cr>

S,k <cr>

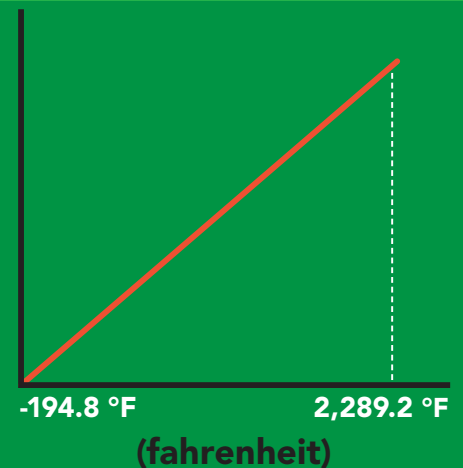
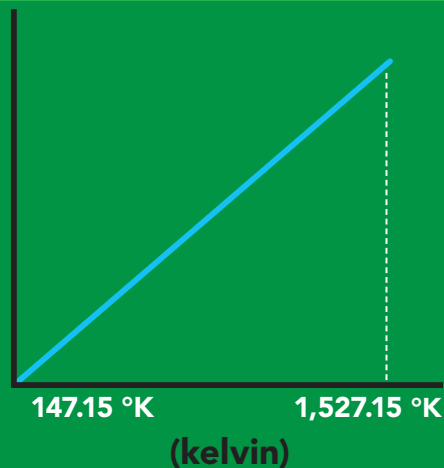
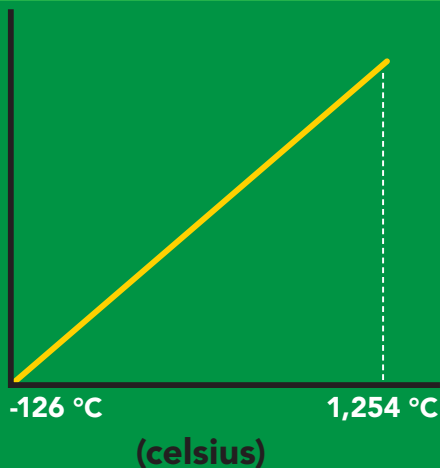
\*OK <cr>

S,f <cr>

\*OK <cr>

S,? <cr>

?S,c <cr> or ?S,k <cr> or ?S,f <cr>  
\*OK <cr>



# Enable/disable data logger

## Command syntax

The time period (n) is in 10 second intervals and can be any value from 1 to 32,000.

D,n <cr> n = (n x 10 seconds)

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

D,? <cr> data logger storage interval?

## Example

## Response

D,6 <cr>

\*OK <cr>

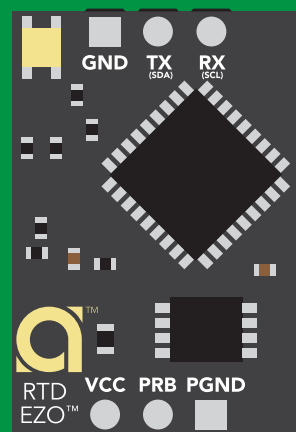
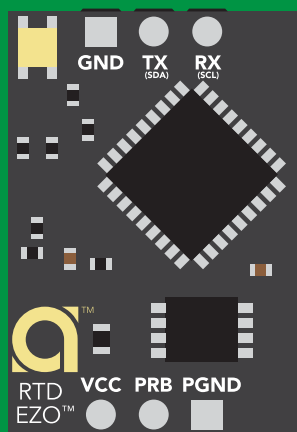
D,0 <cr>

\*OK <cr>

D,? <cr>

?D,6 <cr>

\*OK <cr>



D,6



60 seconds

\* <cr>

\* indicates reading has been logged

# Memory recall

## Command syntax

Disable data logger to recall memory.

**M** <cr> recall 1 sequential stored reading

**M,all** <cr> recall all readings in a CSV string

**M,?** <cr> display memory location of last stored reading

## Example

## Response

**M** <cr>

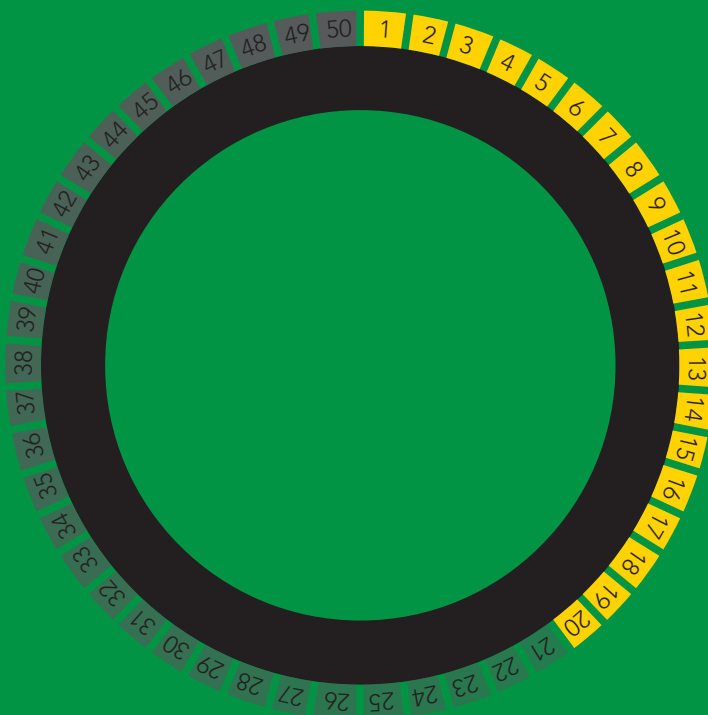
**1,100.00** <cr> **2,104.00** <cr> **\*OK** <cr>

**M,all** <cr>

**100.00,104.00,108.00,112.00** <cr>  
Oldest Newest

**M,?** <cr>

**?M,4** <cr>  
**\*OK** <cr>



# Memory clear

## Command syntax

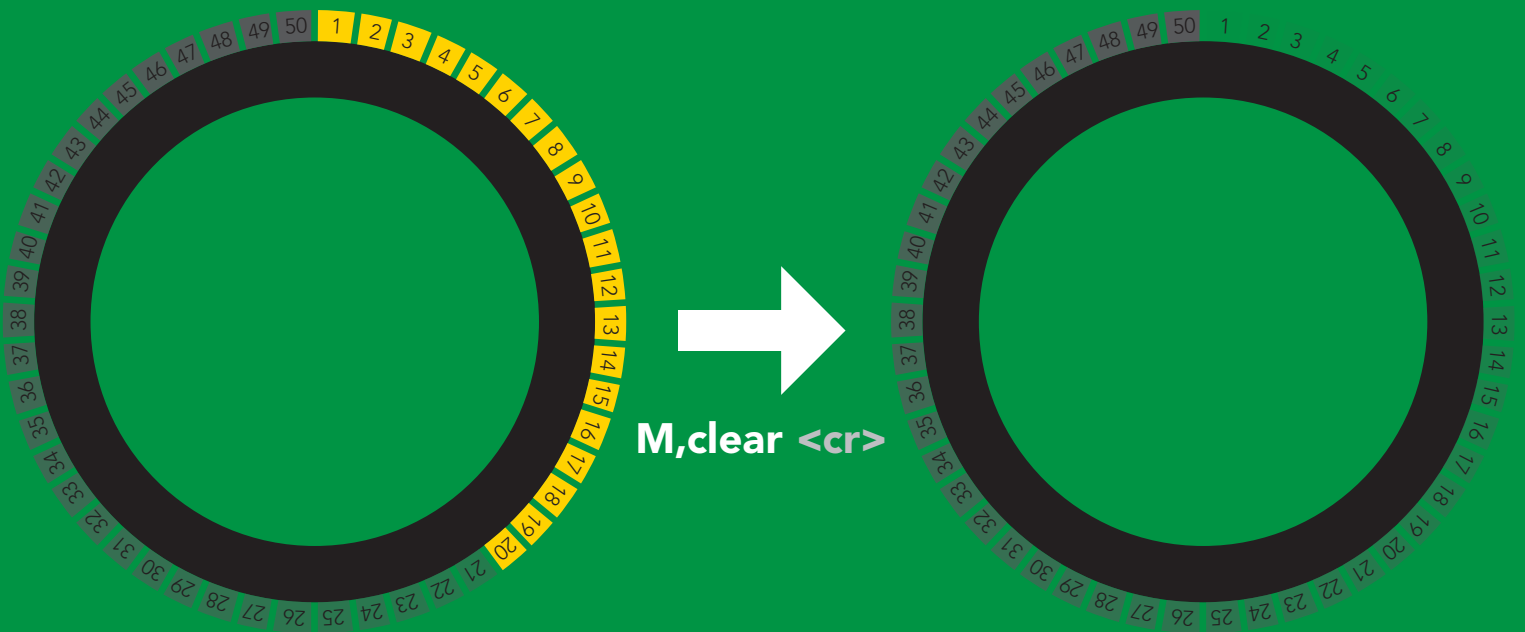
**M,clear** <cr> clear all stored memory

### Example

**M,clear** <cr>

### Response

**\*OK** <cr>



# Naming device

## Command syntax

Do not use spaces in the name

Name,n <cr> set name

Name, <cr> clears name

Name,? <cr> show name

n =

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

Up to 16 ASCII characters

## Example

## Response

Name, <cr>

\*OK <cr> name has been cleared

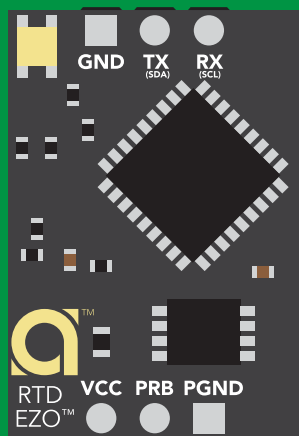
Name,zzt <cr>

\*OK <cr>

Name,? <cr>

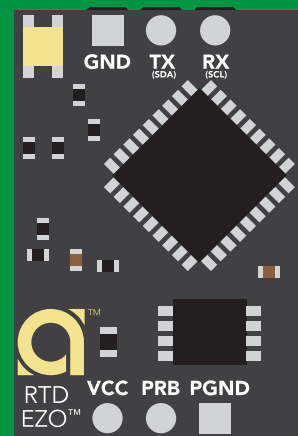
?Name,zzt <cr>  
\*OK <cr>

Name,zzt



\*OK <cr>

Name,?



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

# Device information

## Command syntax

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

### Example

```
i <cr>
```

### Response

```
?i,RTD,2.01 <cr>  
*OK <cr>
```

## Response breakdown

```
?i, RTD, 2.11  
    ↑    ↑  
  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>

**25.104** <cr>  
**\*OK** <cr>

**\*OK,0** <cr>

no response, **\*OK** disabled

**R** <cr>

**25.104** <cr> **\*OK** disabled

**\*OK,?** <cr>

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

## Other response codes

- \*ER** unknown command
- \*OV** over volt ( $VCC \geq 5.5V$ )
- \*UV** under volt ( $VCC \leq 3.1V$ )
- \*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

Send any character or command to awaken device.

Sleep <cr> enter sleep mode/low power

## Example

## Response

Sleep <cr>

\*OK <cr>

\*SL <cr>

Any command

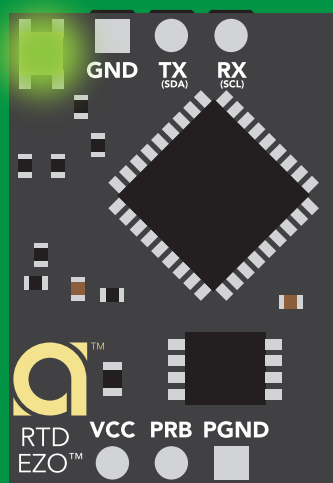
\*WA <cr> wakes up device

5V

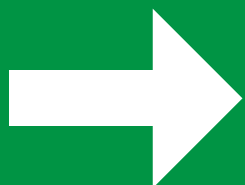
STANDBY	SLEEP
15.40 mA	0.4 mA

3.3V

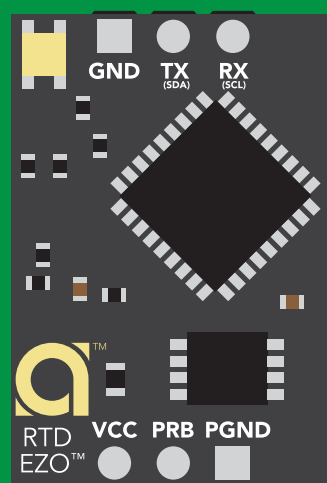
13.80 mA	0.09 mA
----------	---------



Standby  
15.40 mA



Sleep <cr>



Sleep  
3.00 mA

# Factory reset

## Command syntax

Clears calibration  
LED on  
"\*OK" enabled  
Clears data logger

Factory <cr> enable factory reset

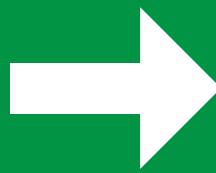
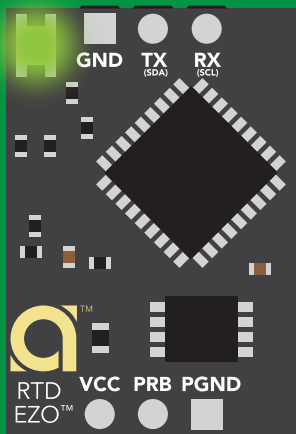
### Example

Factory <cr>

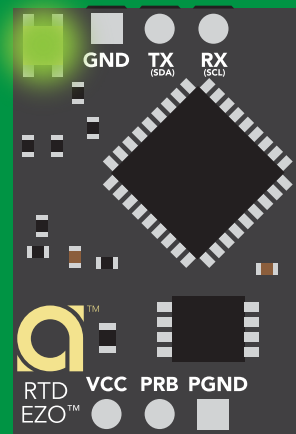
### Response

\*OK <cr>

Factory <cr>



(reboot)



\*OK <cr>

\*RS <cr>

\*RE <cr>

Baud rate will not change

# Calibration theory

The most important part of calibration is watching the readings during the calibration process. Calibration can be done at any value, a simple method is to calibrate the probe in boiling water.

# 100 °C

Atlas Scientific recommends calibration be done every three years.

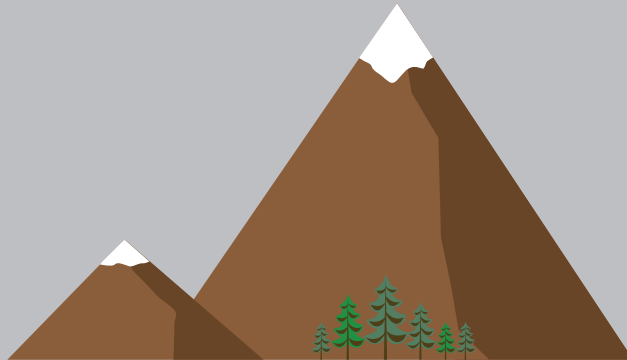
## Elevation and boiling point table

### Elevation in meters

305  
229  
152  
76  
0  
-76  
-152

### Boiling point

98.9 °C  
99.2 °C  
99.5 °C  
99.7 °C  
100 °C  
100.3 °C  
100.5 °C



### Use purified/distilled water

For accurate calibration using different temperature values, you must use a tool called a "dry block calibrator."

# Best practices for calibration

Always watch the readings throughout the calibration process.  
Issue calibration commands once the readings have stabilized.



**⚠ Never do a blind calibration! ⚠**

Issuing a calibration command before the readings stabilize will result in drifting readings.



# Datasheet change log

## Datasheet V 1.1

Revised artwork.

## Datasheet V 1.0

New document

# Firmware updates

V1.5 – Baud rate change (Nov 6, 2014)

- Change default baud rate to 9600



# Warranty

Atlas Scientific™ Warranties the EZO Complete device to be free of defects during the debugging phase of device implementation or 30 days after receiving the EZO Complete device (*whichever comes first*).

## The debugging phase

As defined by Atlas Scientific™, the debugging phase is when the EZO Complete device is connected to a computer to evaluate its output and/or is being integrated into custom software.

**The following activities will void the EZO Complete device warranty:**

- **Soldering any part of the EZO™ class device.**
- **Removing any potting compound.**
- **Embedding the EZO Complete device into a custom machine.**

## Reasoning behind this warranty

**Atlas Scientific™ does not sell consumer electronics.** Once the device has been embedded into a custom-made machine, Atlas Scientific™ cannot possibly warranty the EZO Complete device against the thousands of possible variables that may cause the device to malfunction.

## Please keep this in mind:

- 1. All Atlas Scientific™ devices have been designed to be embedded into a custom-made machine by you, the embedded systems engineer.**
- 2. All Atlas Scientific™ devices have been designed to run indefinitely without failure in the field.**

Atlas Scientific™ is simply stating that once the device is being used in your machine or application, Atlas Scientific™ can no longer take responsibility for the device's continued operation. Doing so would be equivalent to Atlas Scientific™ taking responsibility for the correct operation of your entire machine.