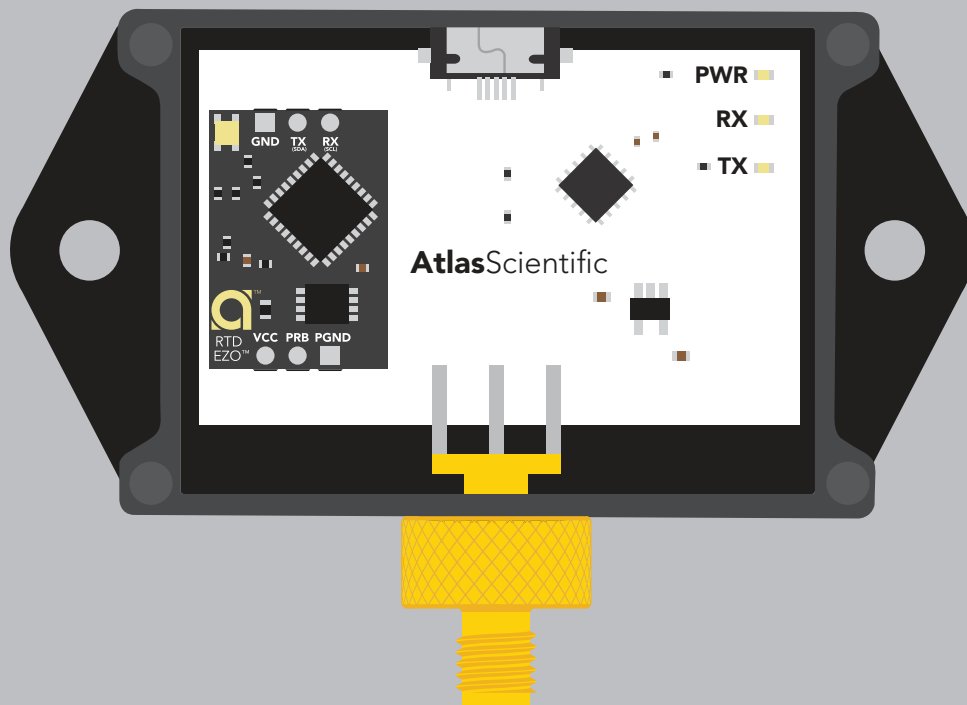


EZO Complete-TMPTM

USB Temperature meter

Datasheet for engineers



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



Written by Jordan Press
Designed by Noah Press

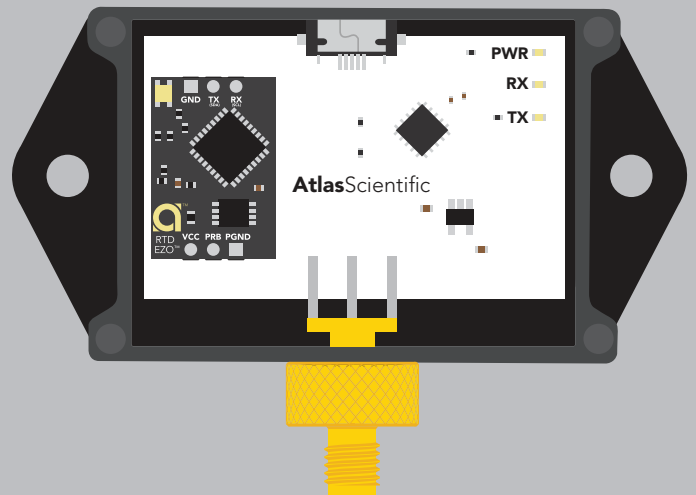
PATENT PROTECTED

This is an evolving document, check back for updates.

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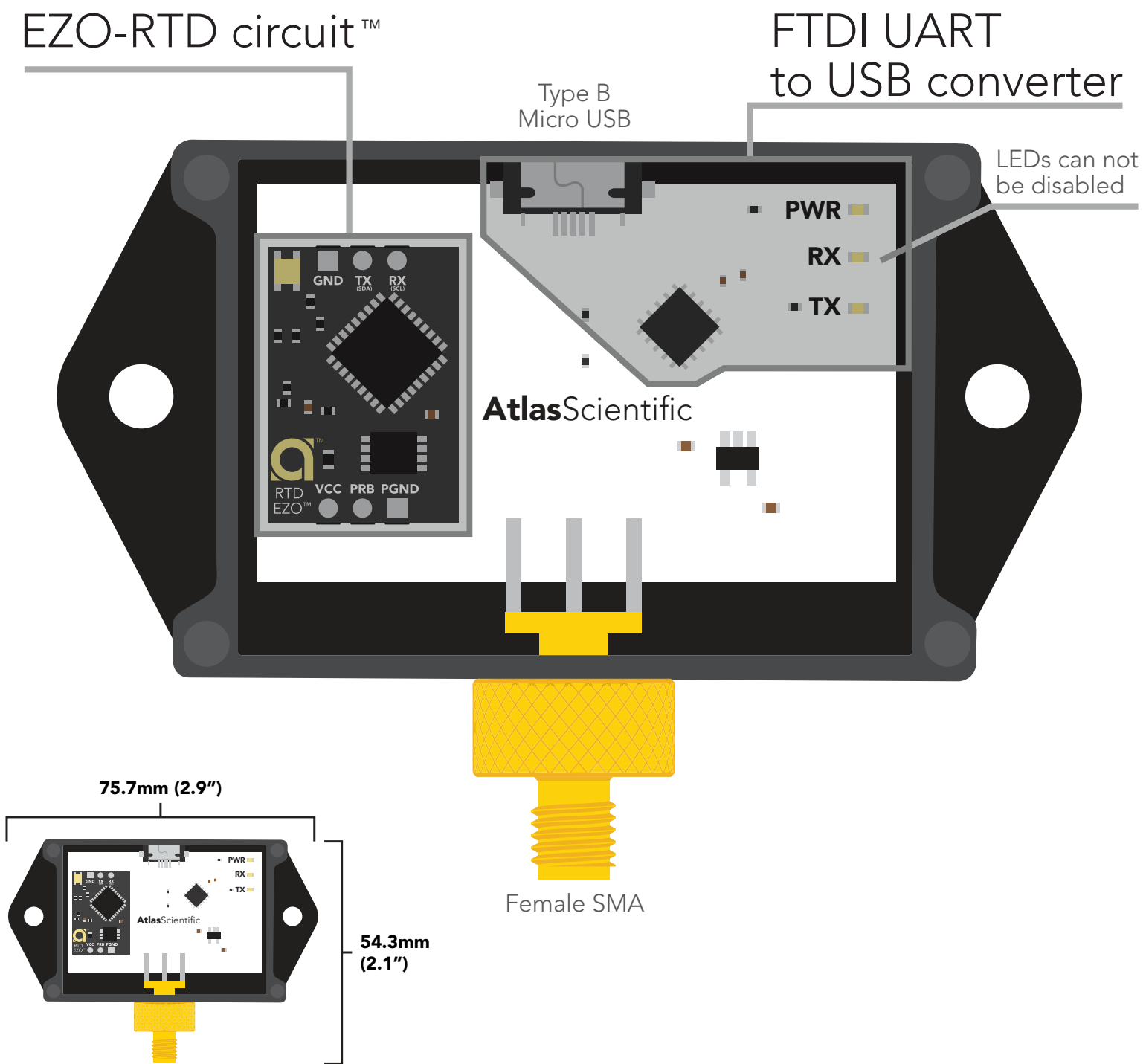
Power consumption	3
Absolute max ratings	3
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The EZO Complete-TMP™ consists of 2 major components.



Power consumption

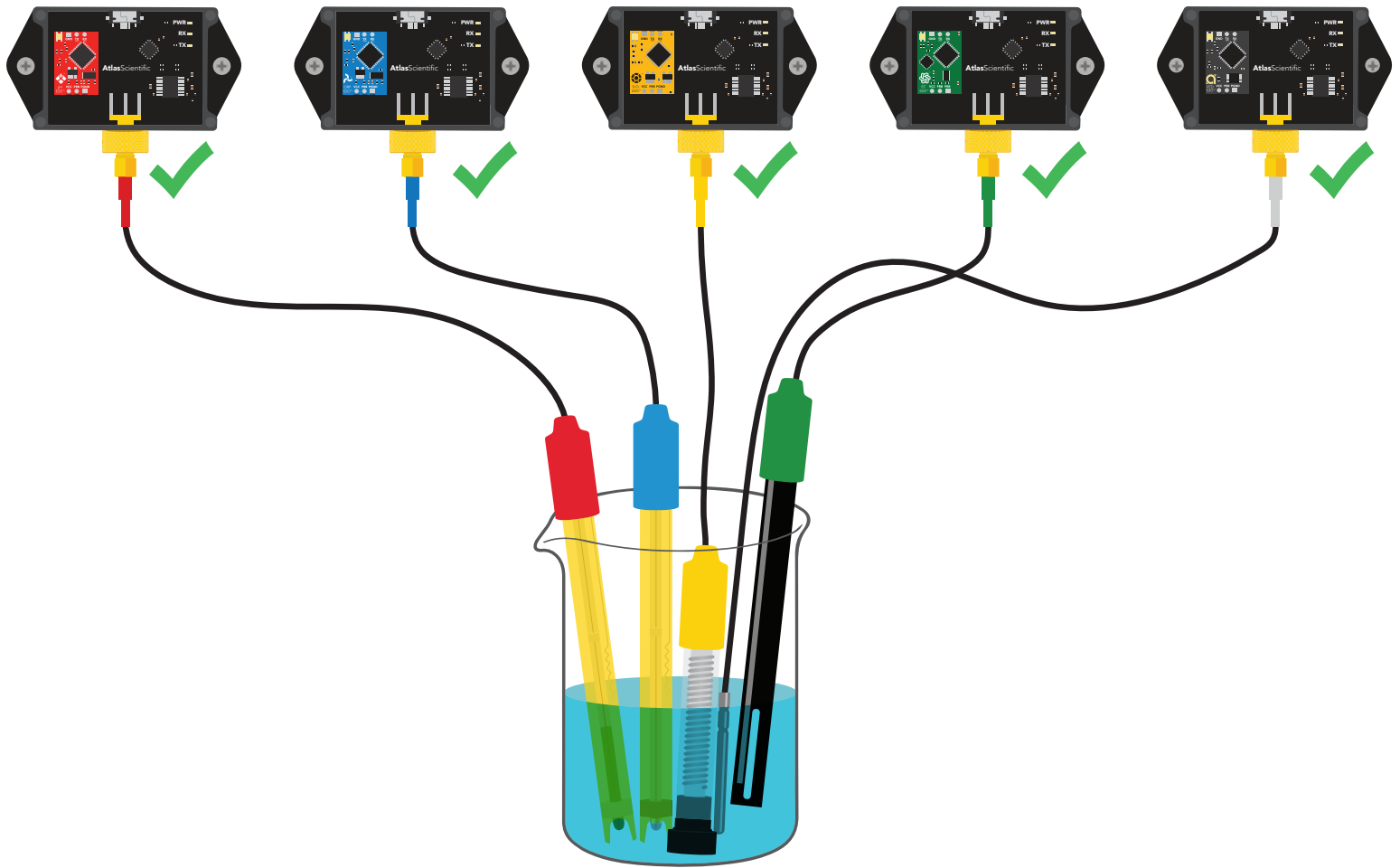
5V USB	MAX	STANDBY	SLEEP
	20 mA	17 mA	4 mA

Absolute max ratings

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

Interference free

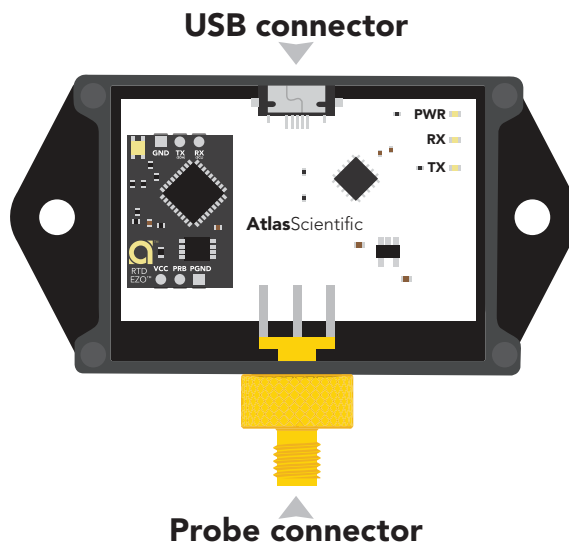
The EZO complete readings are unaffected by other sensors in the same water.



Ingress protection – IP62

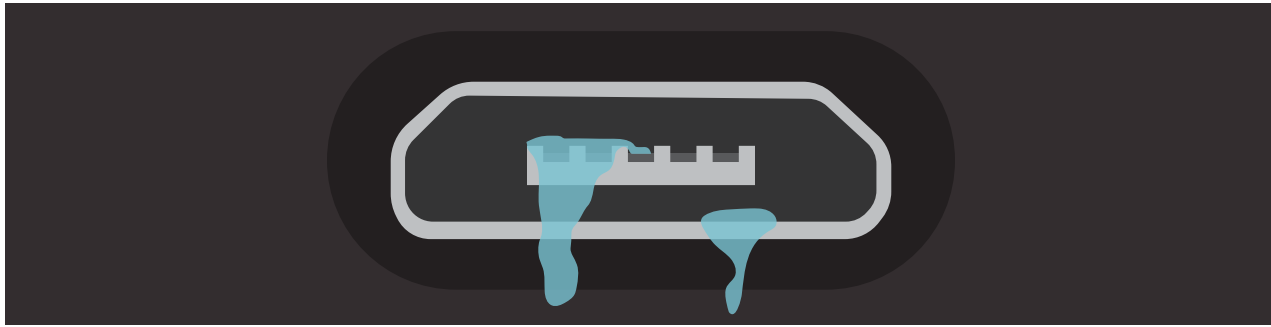
The EZO Complete-TMP™ is dust proof and resistant to splashing water.

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



Ingress protection – IP62

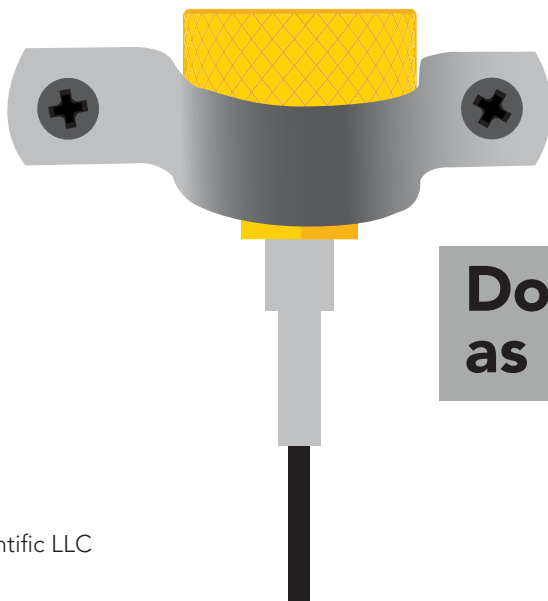
An electrical short can occur if water enters the USB connector. A USB short could permanently damage the EZO-Complete. A USB short is not covered under warranty.



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.



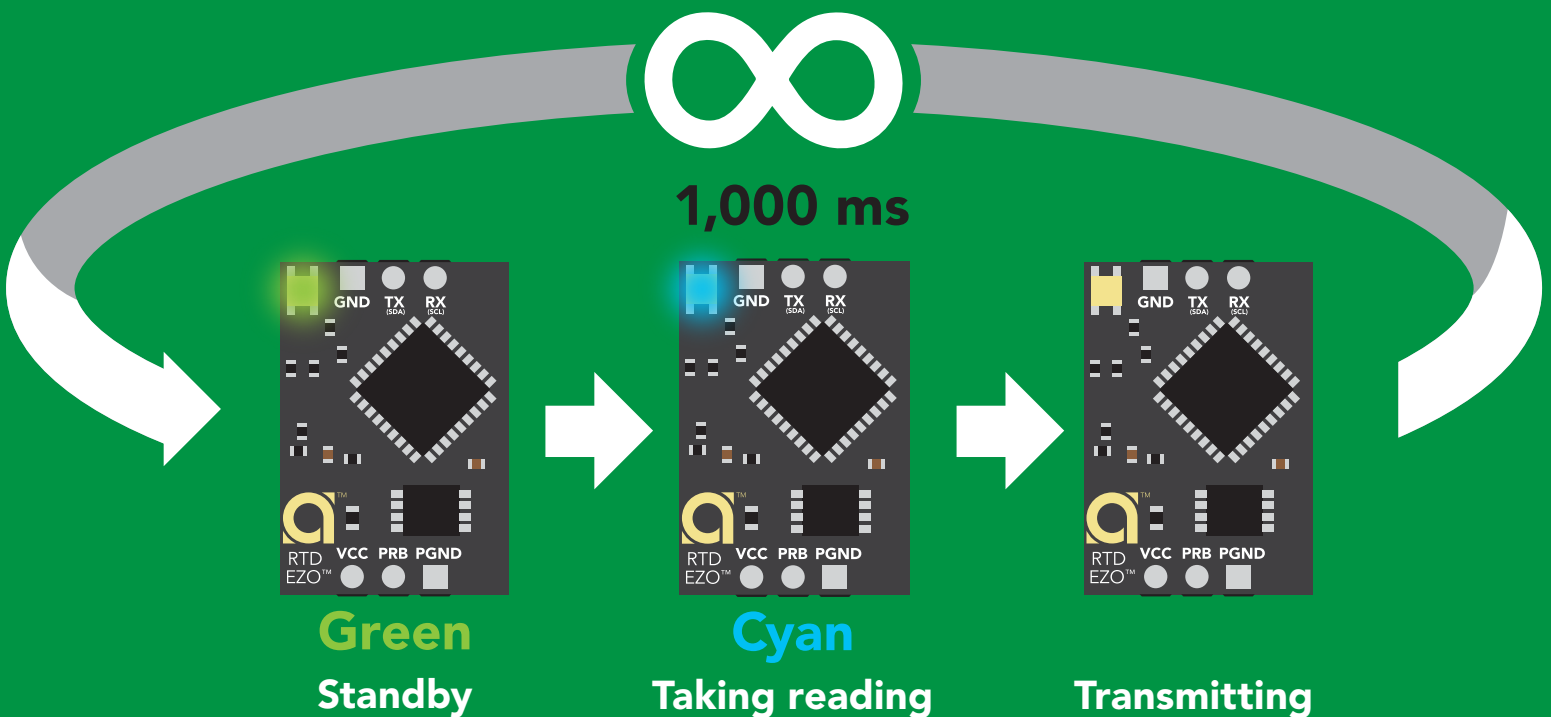
The SMA connector is part of your probe; Nothing should be in contact with this part.



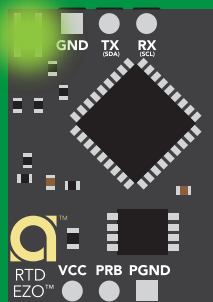
**Do not use this
as a mounting point!**

Default state

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

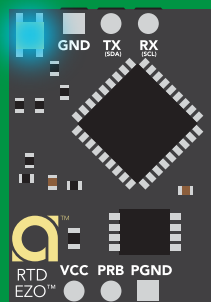


LED color definition



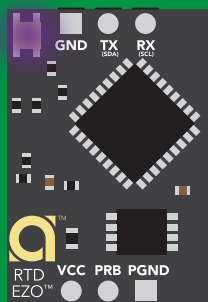
Green

UART standby



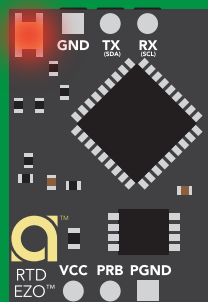
Cyan

Taking reading



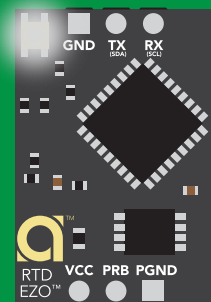
Purple

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

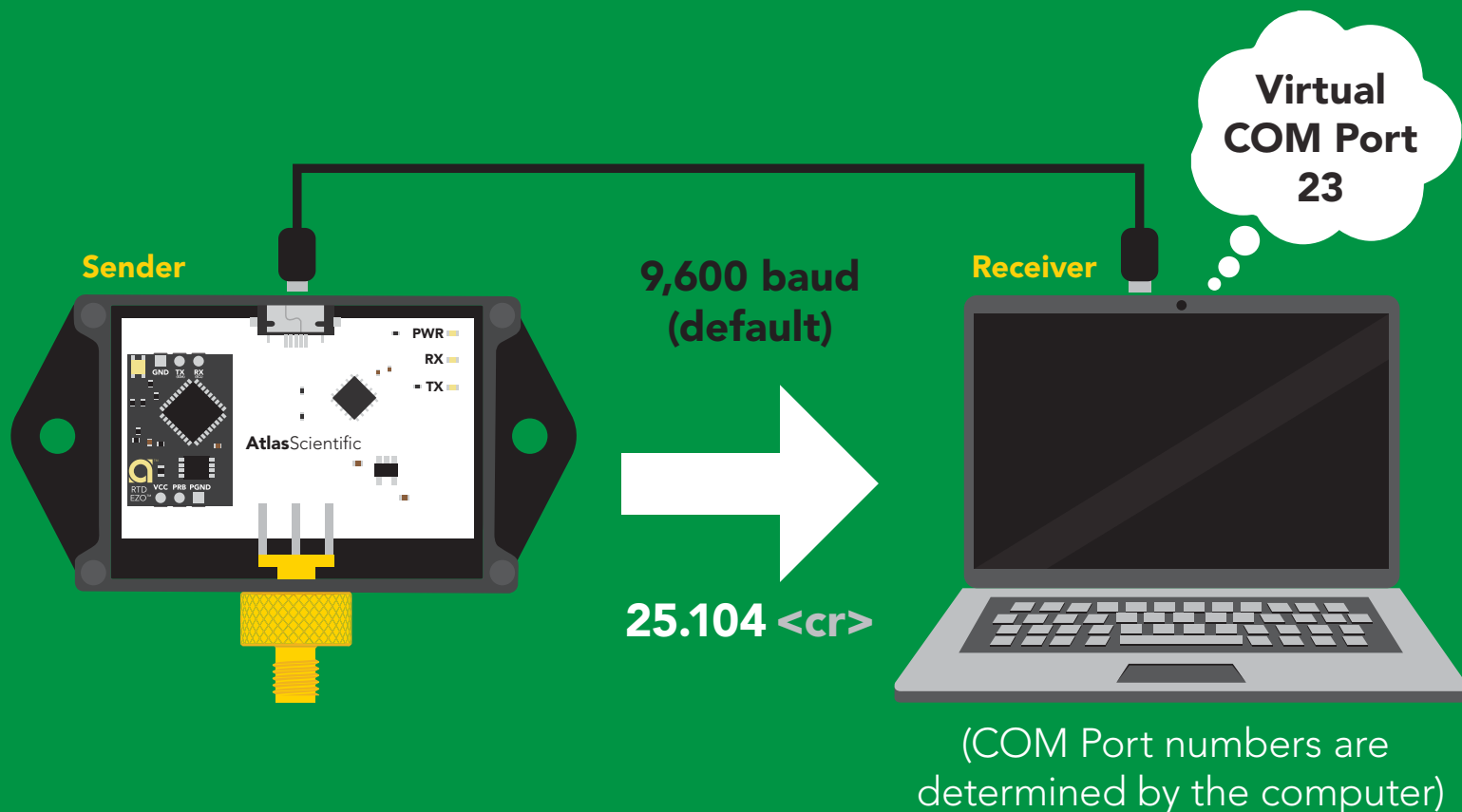
2 parts

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

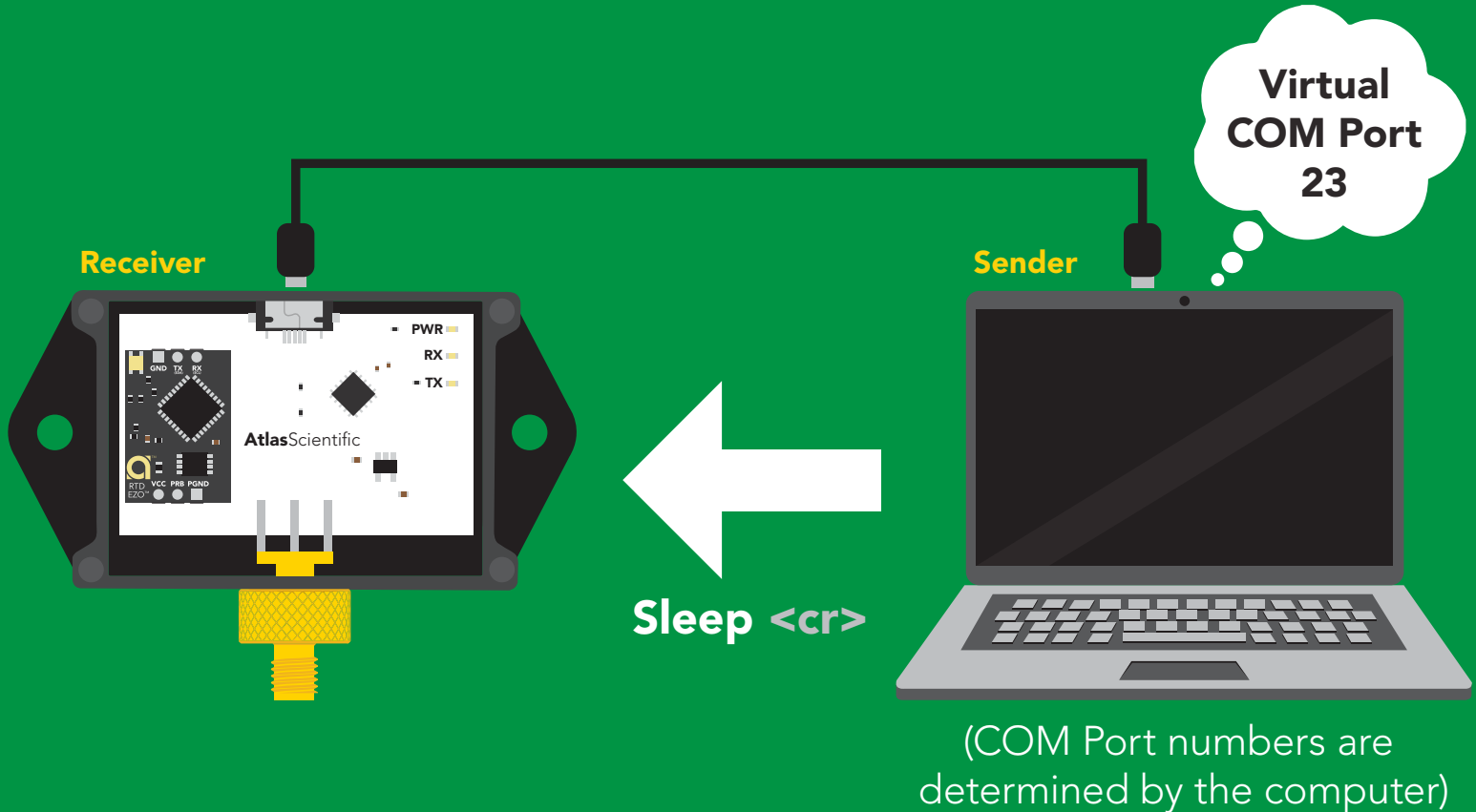
2 parts

Command (not case sensitive)

ASCII data string

Carriage return <cr>

Terminator



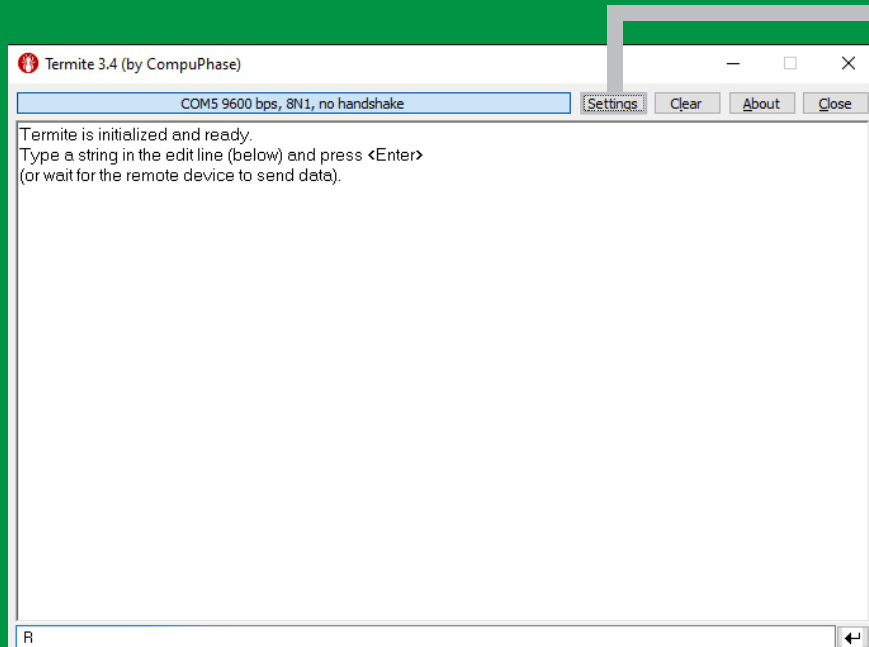
Advanced

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

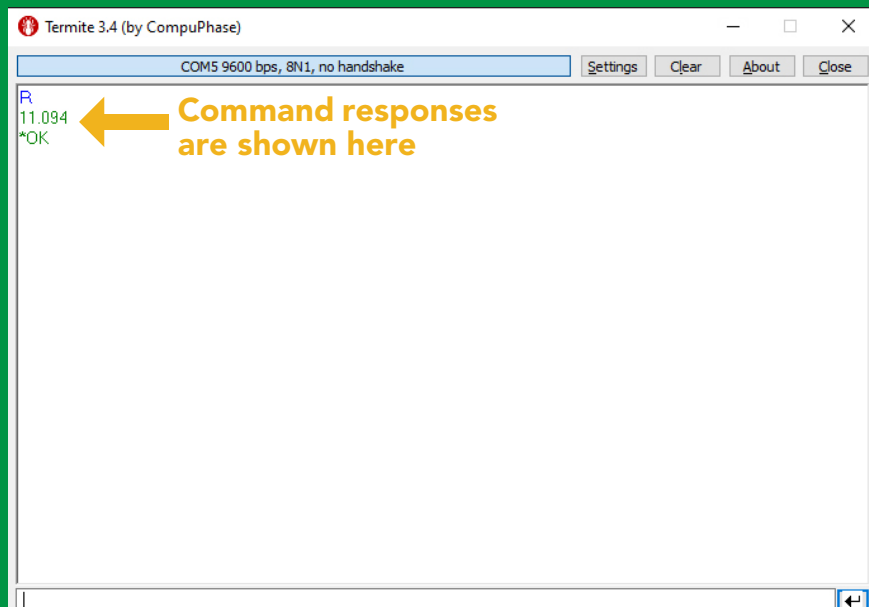
[Click here to download](#)



Settings

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

Enter commands here



Command responses
are shown 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>

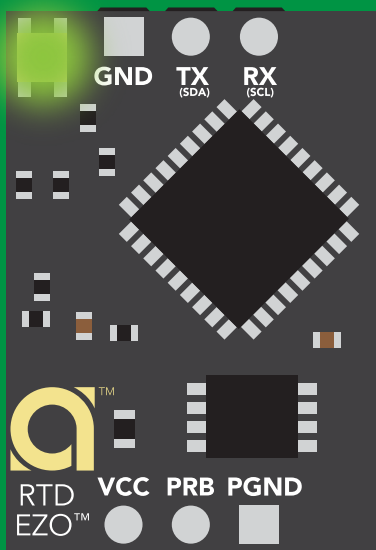
*OK <cr>

L,0 <cr>

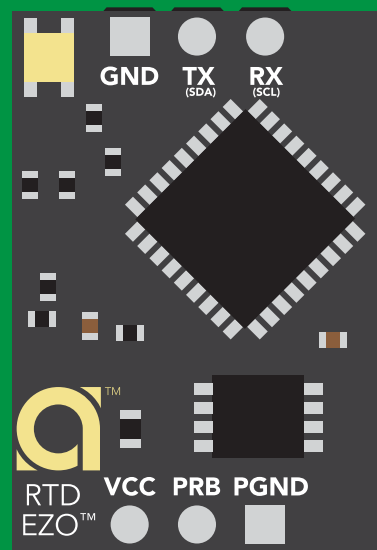
*OK <cr>

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.

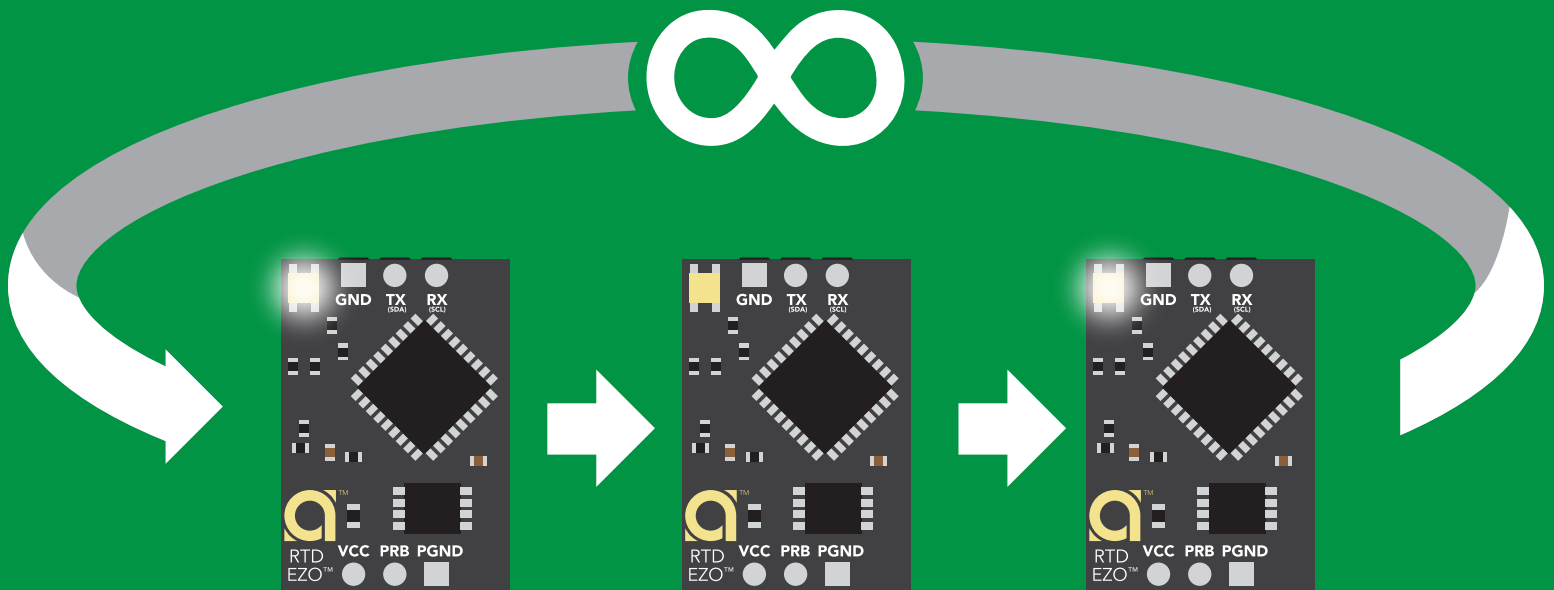
Find <cr> LED rapidly blinks white, used to help find device

Example

Find <cr>

Response

***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

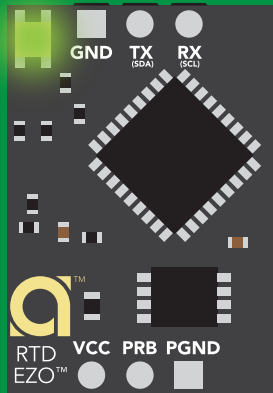
R <cr> takes single reading

Example

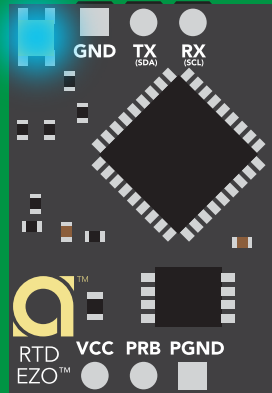
R <cr>

Response

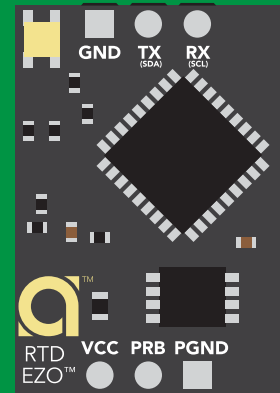
25.104 <cr>
***OK** <cr>



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>

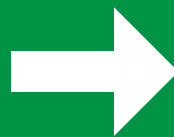
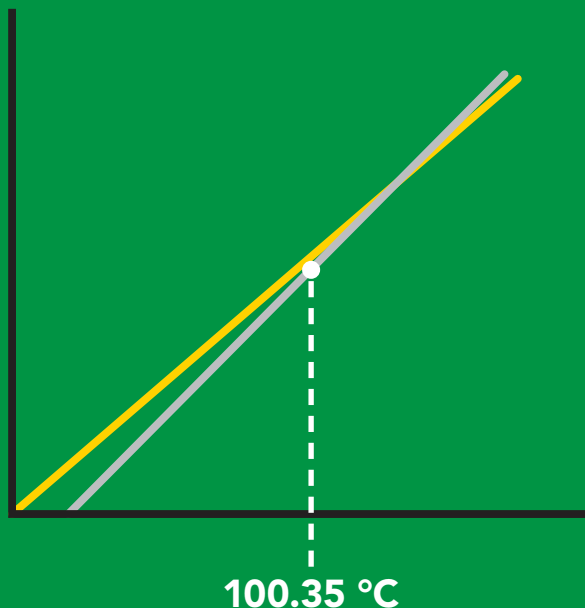
*OK <cr>

Cal,clear <cr>

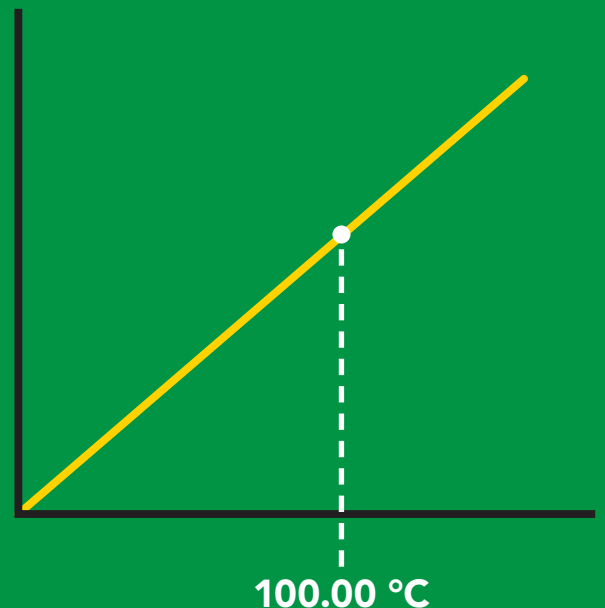
*OK <cr>

Cal,? <cr>

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



Cal,100.00 <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>

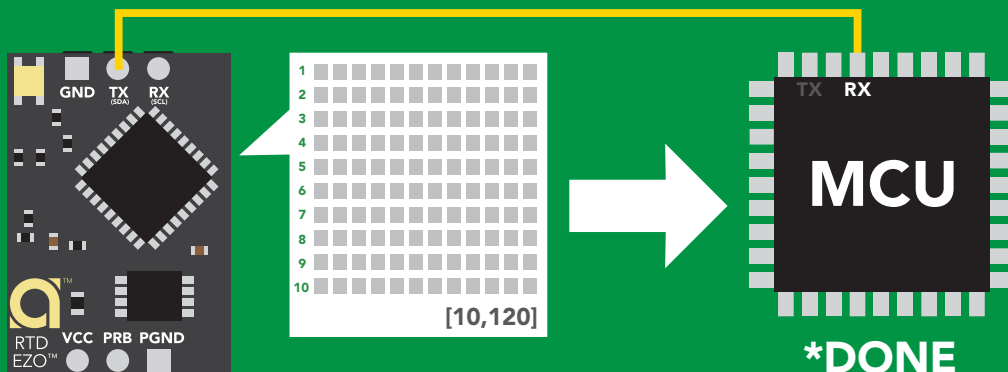
6F 6C 20 67 75 79 <cr> **(10 of 10)**

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

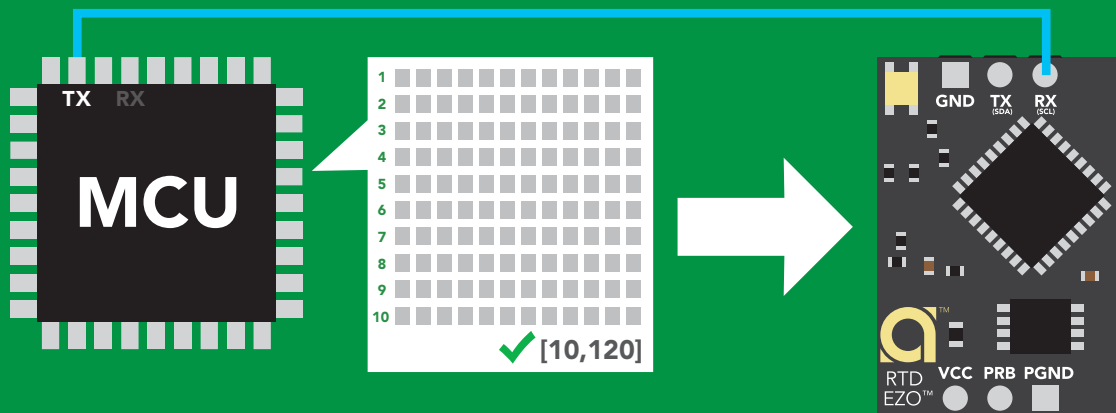
*OK <cr>

*OK <cr>

⋮

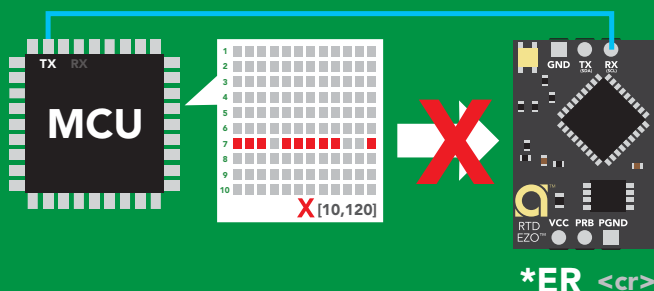
*OK <cr>

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>

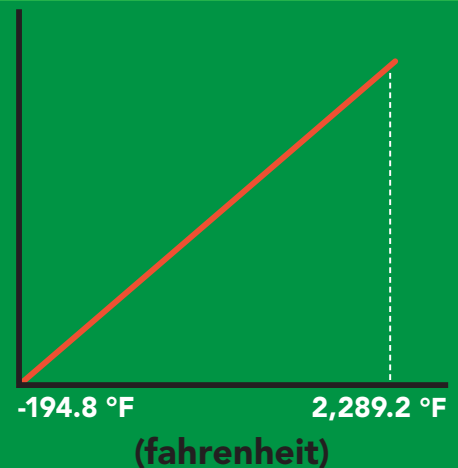
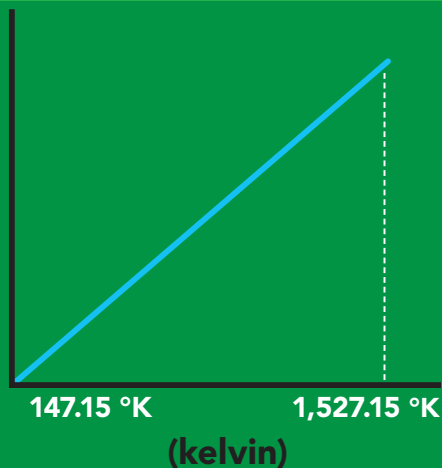
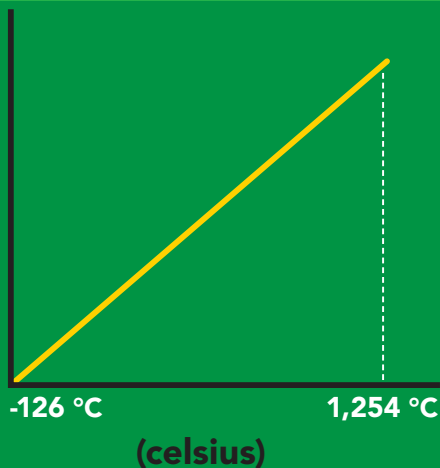
***OK** <cr>

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>

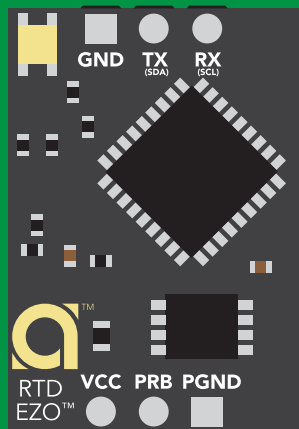
*OK <cr>

D,0 <cr>

*OK <cr>

D,? <cr>

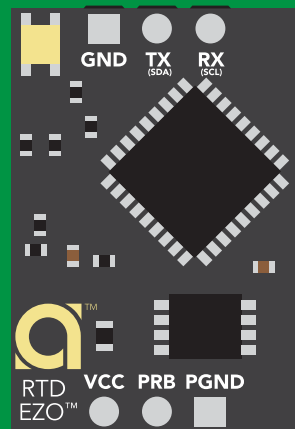
?D,6 <cr>
*OK <cr>



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>

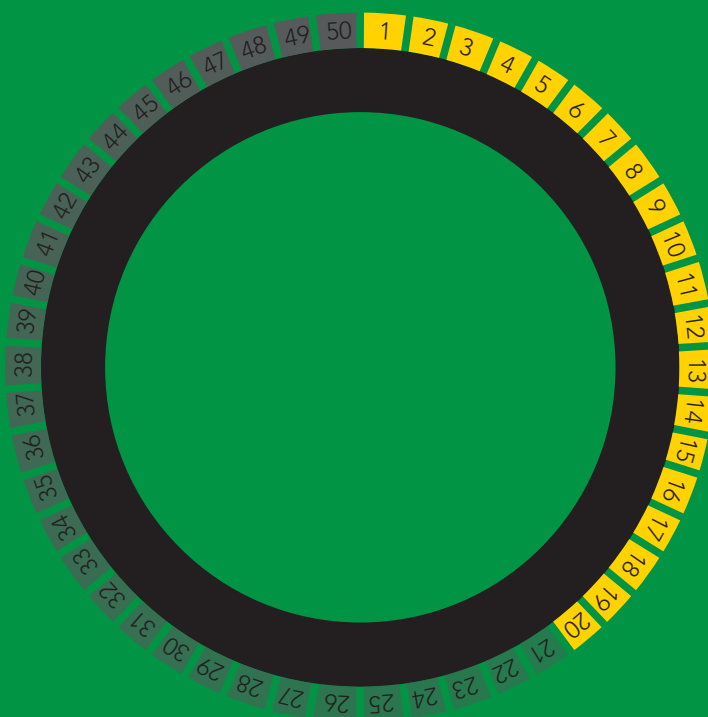
1,100.00 <cr> 2,104.00 <cr> *OK <cr>

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

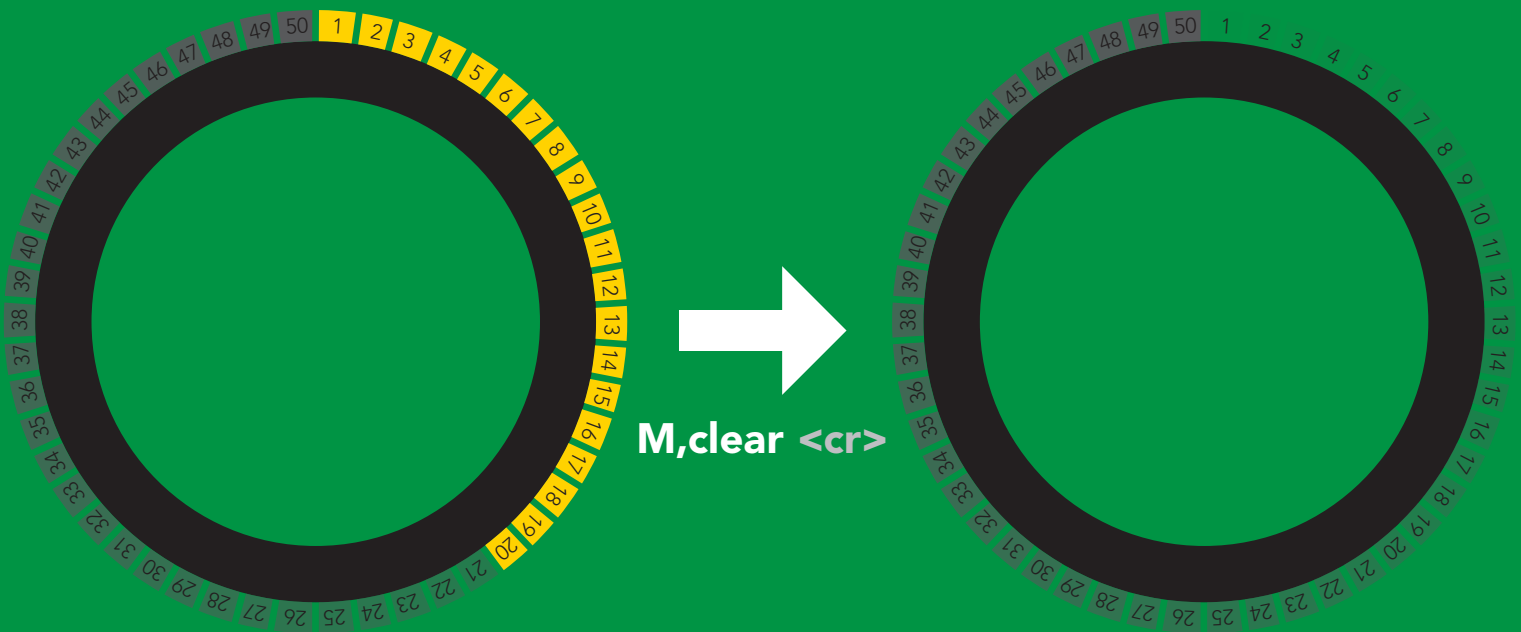
M,clear <cr> clear all stored memory

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

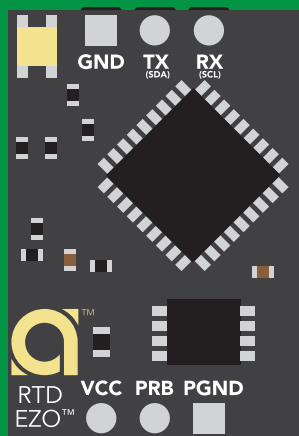
Name,zzt <cr>

*OK <cr>

Name,? <cr>

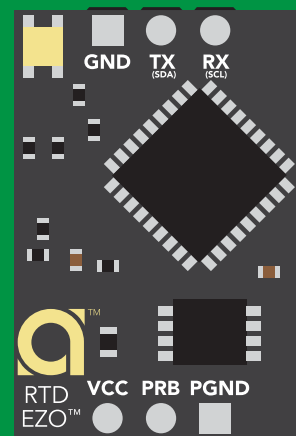
?Name,zzt <cr>
*OK <cr>

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

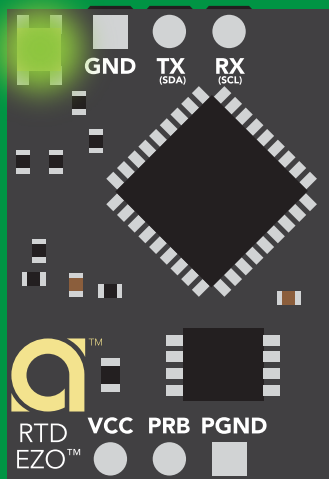
***WA** <cr> wakes up device

5V

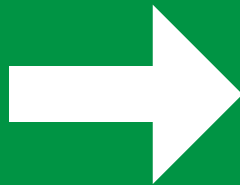
STANDBY	SLEEP
15.40 mA	0.4 mA

3.3V

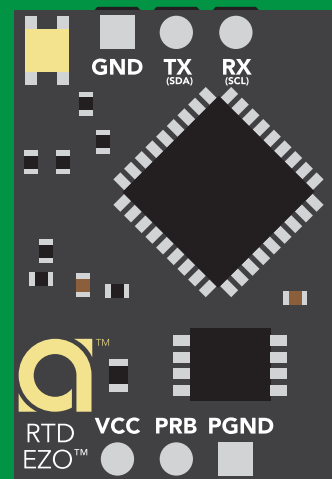
13.80 mA	0.09 mA
-----------------	----------------



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

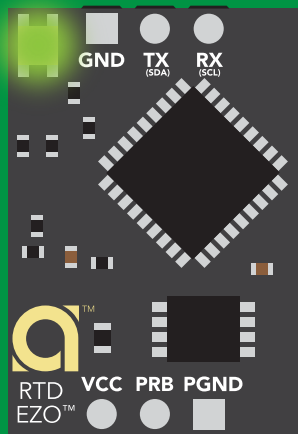
Example

Response

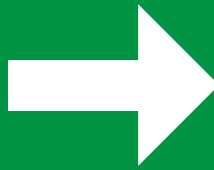
Factory <cr>

*OK <cr>

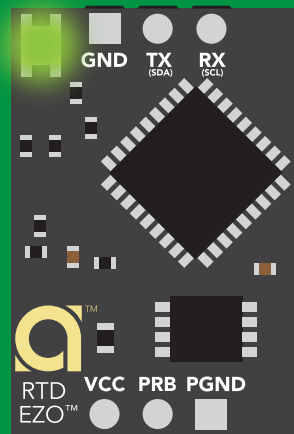
Factory <cr>



*OK <cr>



(reboot)



*RS <cr>

*RE <cr>

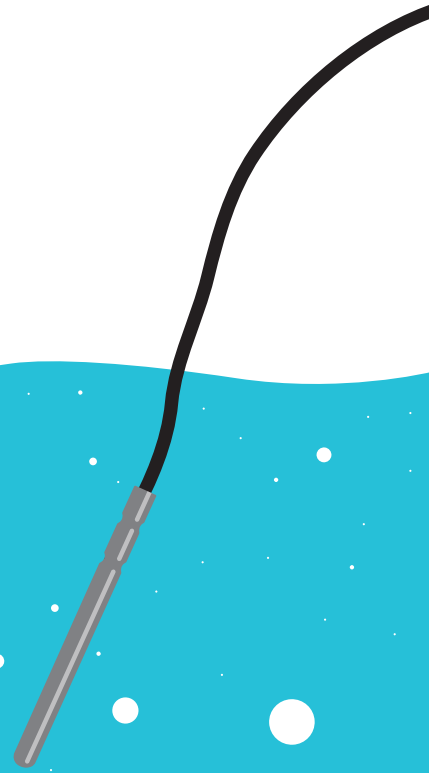
Baud rate will not change

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.



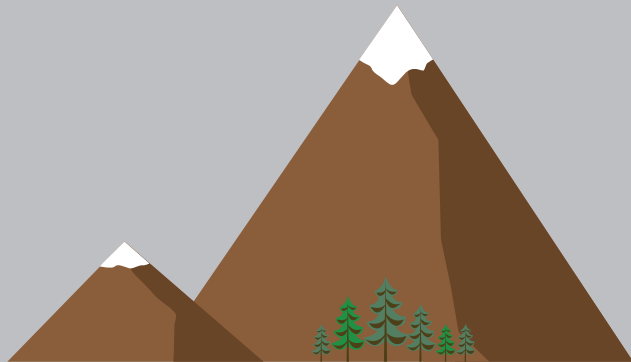
Elevation and boiling point table

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

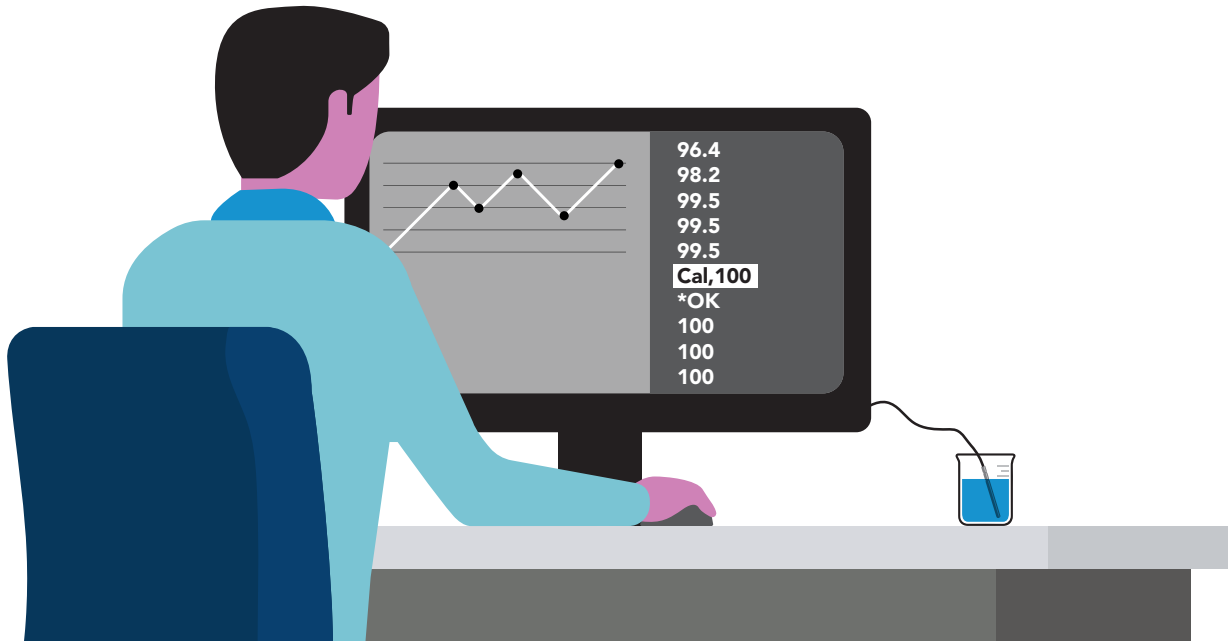


Use purified/distilled water

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.