Atlas Scientific™
Environmental Robotics

V 2.6
Revised 11/20

EZO-RGB™

Embedded Color Sensor

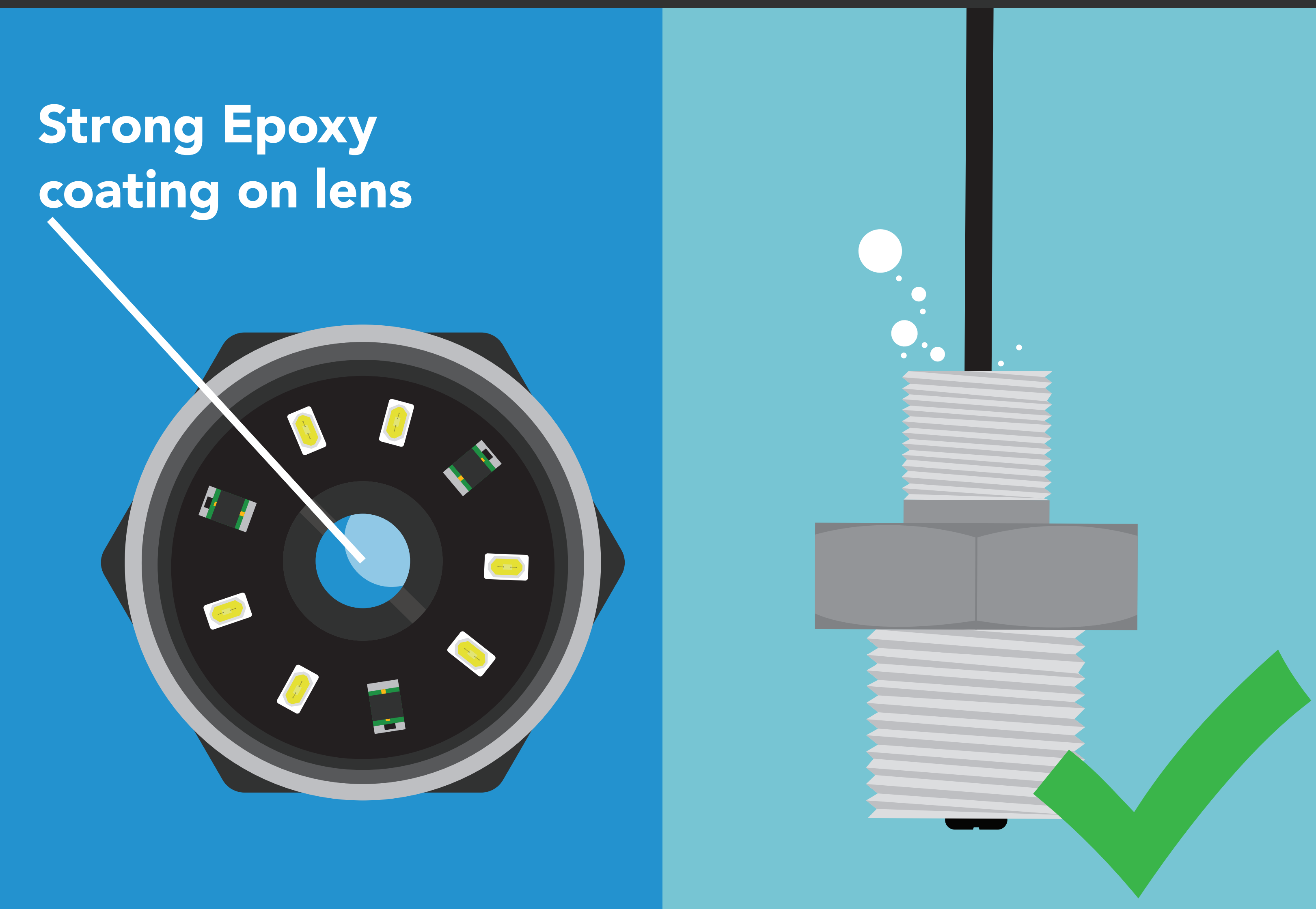
Reads	**RGB (24-bit)** **CIE (xyY)** **LUX (0 – 65535)** **Proximity (2 – 36cm)**
Features	**programmable color matching** **proximity triggering** **onboard LEDs**
Connector	**5 lead data cable**
Response time	**1 reading per 400 milliseconds**
Sensing area	**15° half angle**
Cable length	**1 meter**
Water resistant/dust proof	**IP67**
Data protocol	**UART & I²C**
Default I²C address	**112 (0x70)**
Data format	**ASCII**
Operating voltage	**3.3V – 5V**

Written by Jordan Press
Designed by Noah Press

This is an evolving document, check back for updates.

New Feature

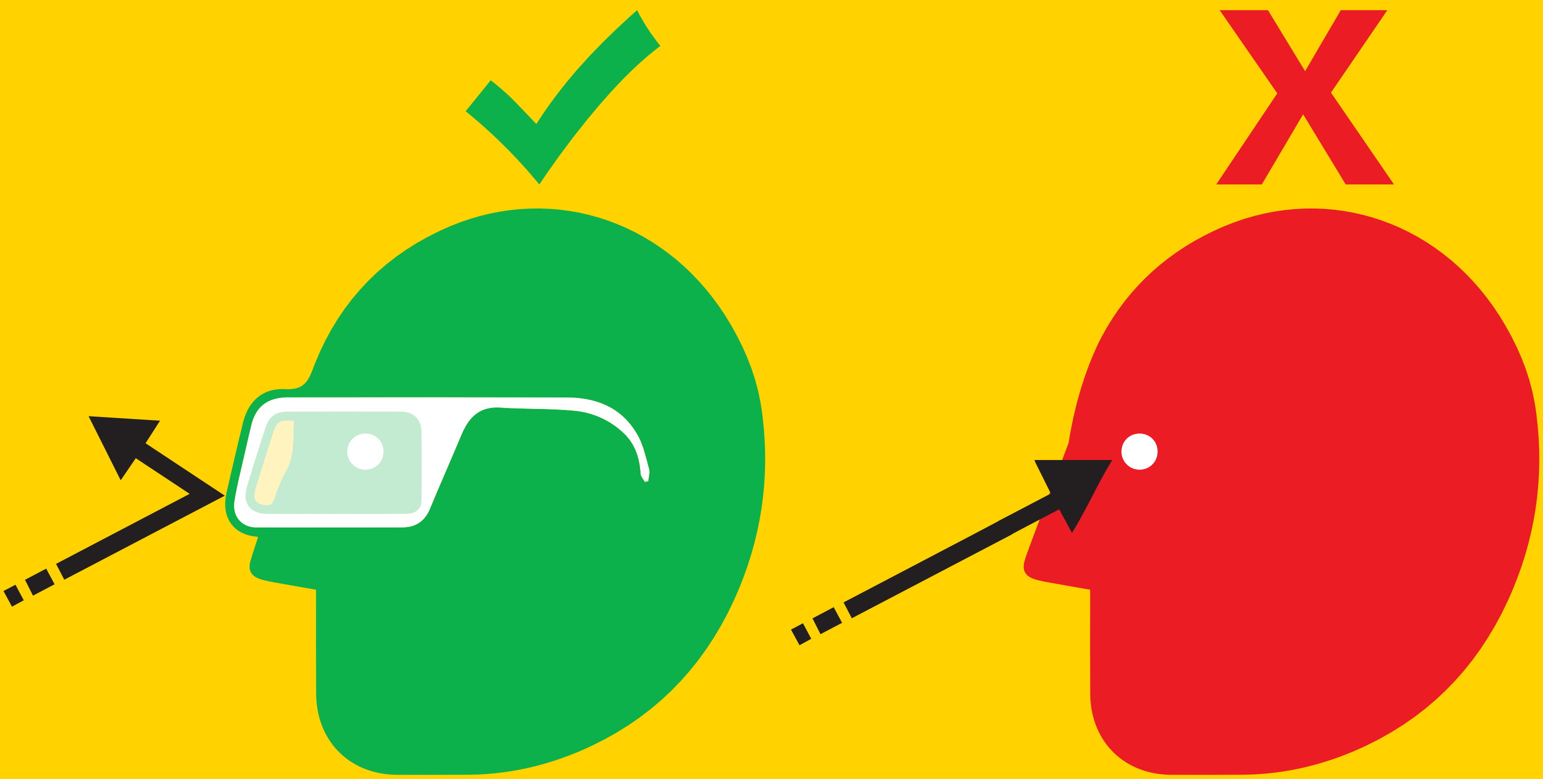
The EZO-RGB™ Embedded Color Sensor is now IP67 waterproof – up to 1 meter



All EZO-RGB™ Embedded Color Sensors purchased after November 13th 2020, will be IP67 waterproof.

Caution

At full power the onboard LEDs are *VERY* bright.
Do not look directly at the light without eye protection!



Minimum brightness = **~400 Lux**
Maximum brightness = **~*40,000* Lux at 5V (*36,000* Lux at 3.3V)**

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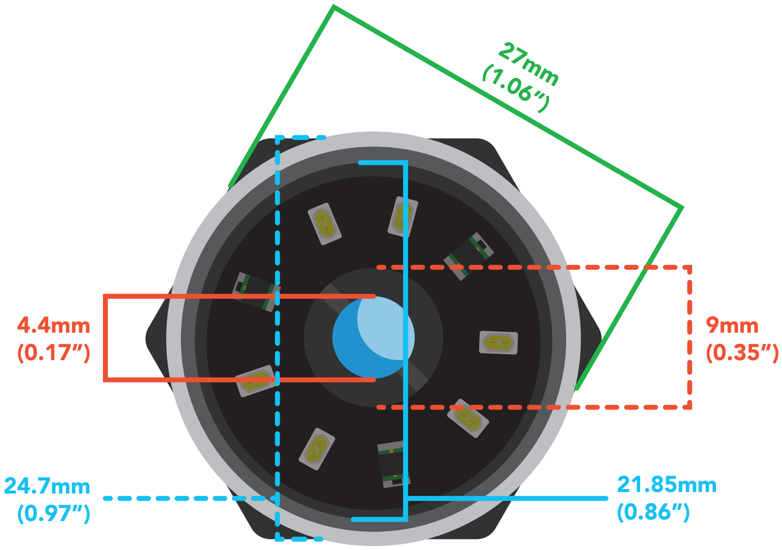
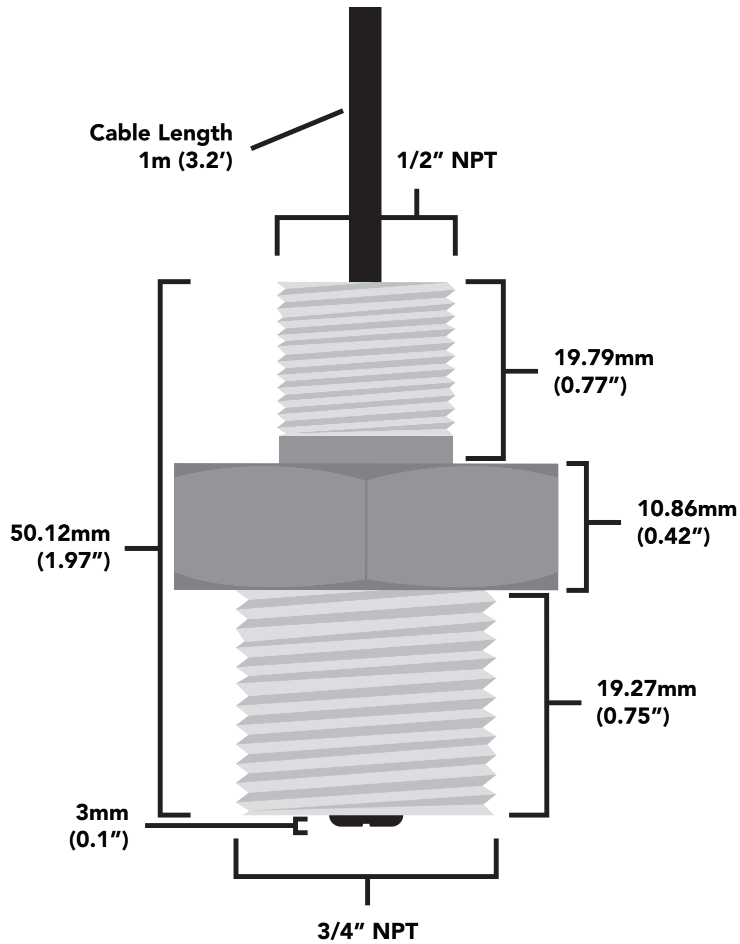
UART

I²C

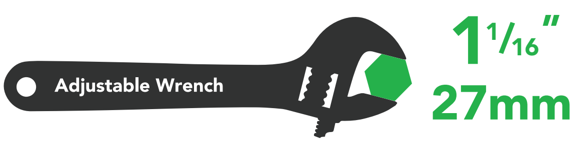
Physical properties

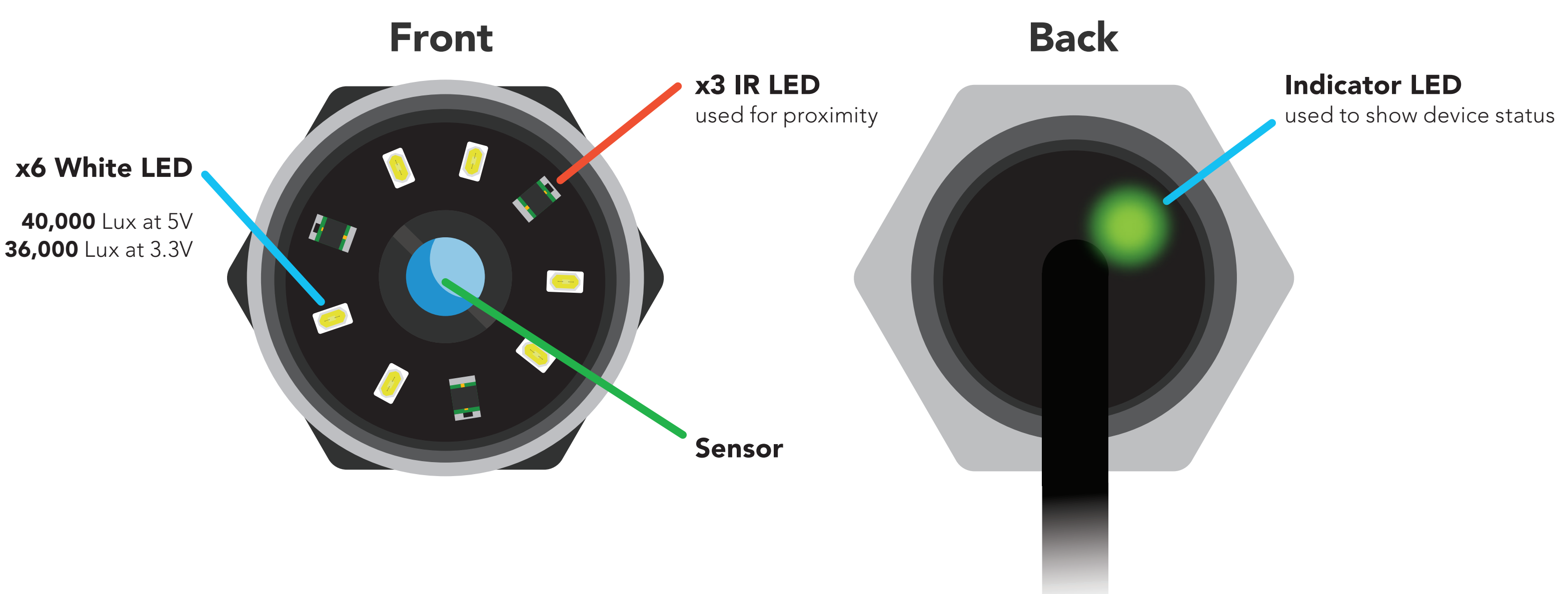




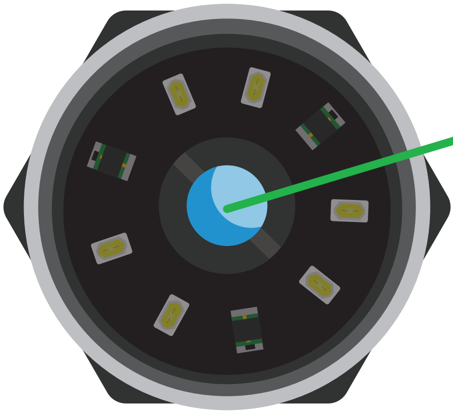
Weight 145g

Body 316 Stainless Steel



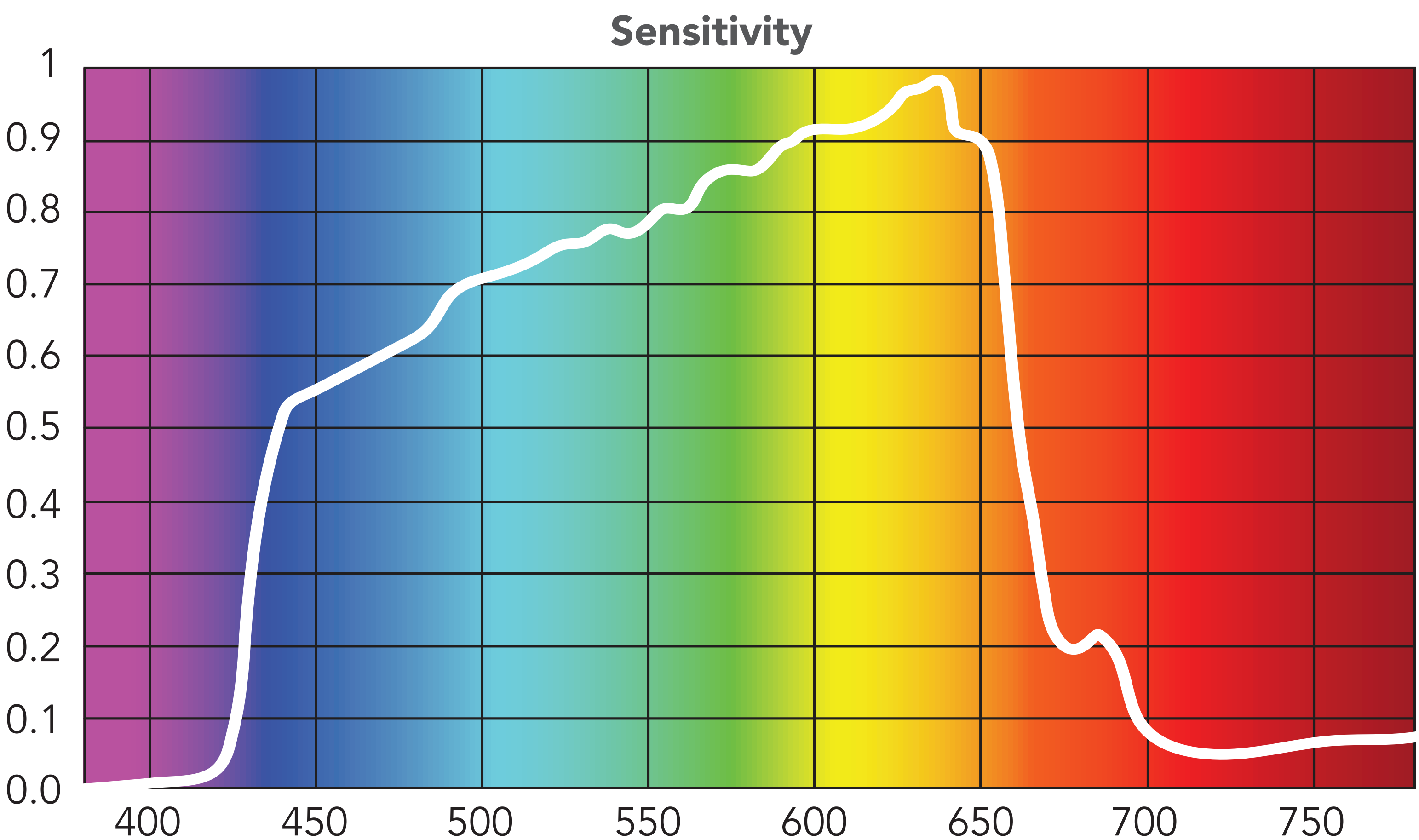


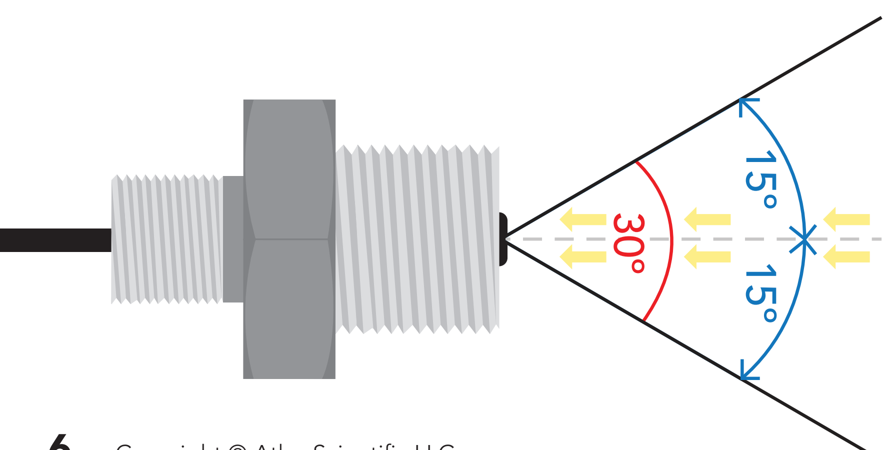
Sensor properties



Sensor

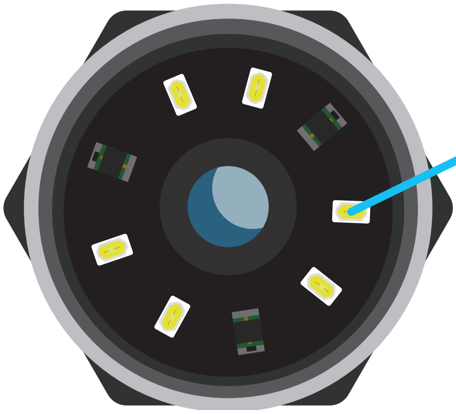
The sensor detects colored light in the red, green and blue spectrum. It is least sensitive to blue light and most sensitive to red light.





15˚ half angle field of view

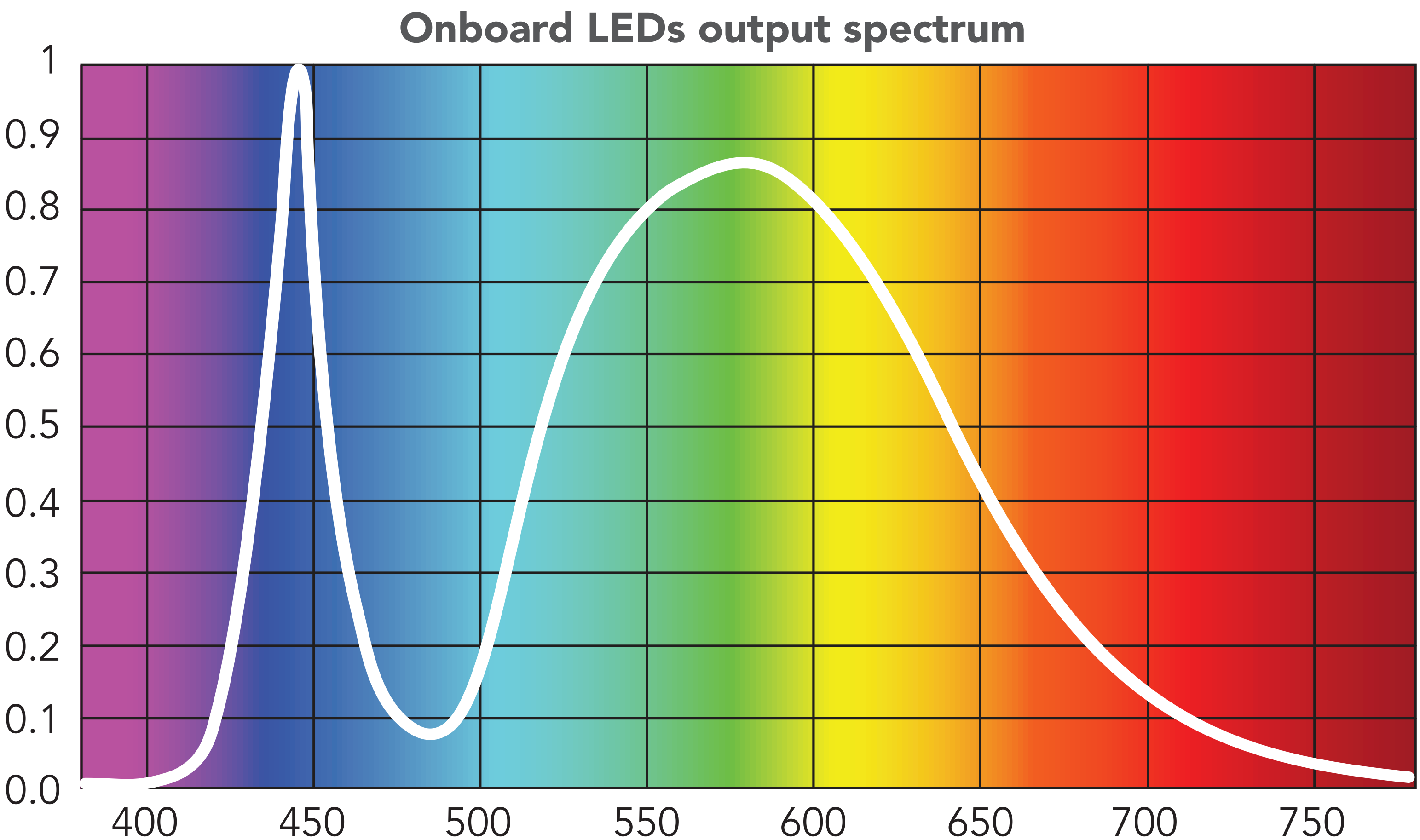
Target LED properties

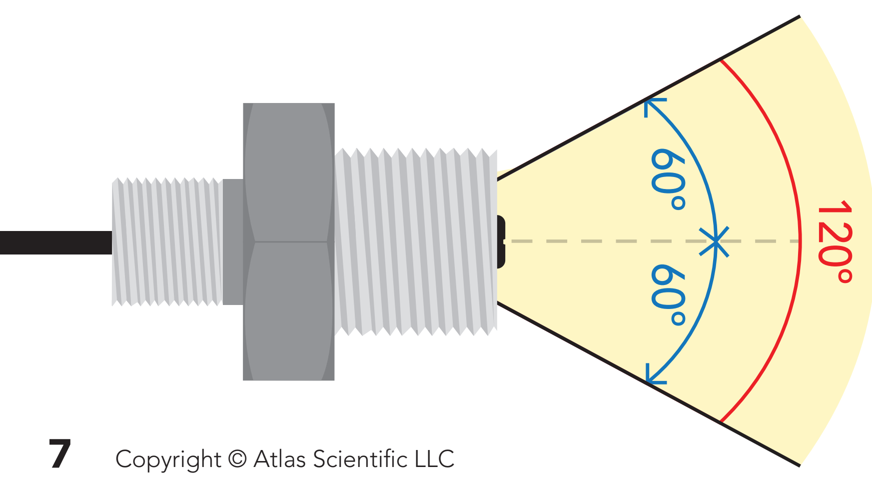


x6 White LED (5000K color temperature)

The spectrum output by the six onboard target LEDs is strongest in the blue spectrum and weakest in the red spectrum. This is the opposite of the color sensors sensitivity giving it the best possible color sensing performance.

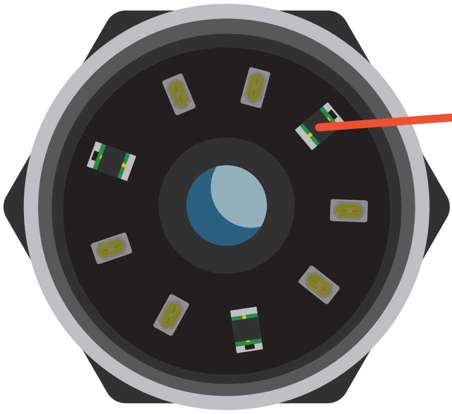
Target LED brightness
Minimum ~400 Lux
Maximum ~40,000 Lux





120° angle of illumination

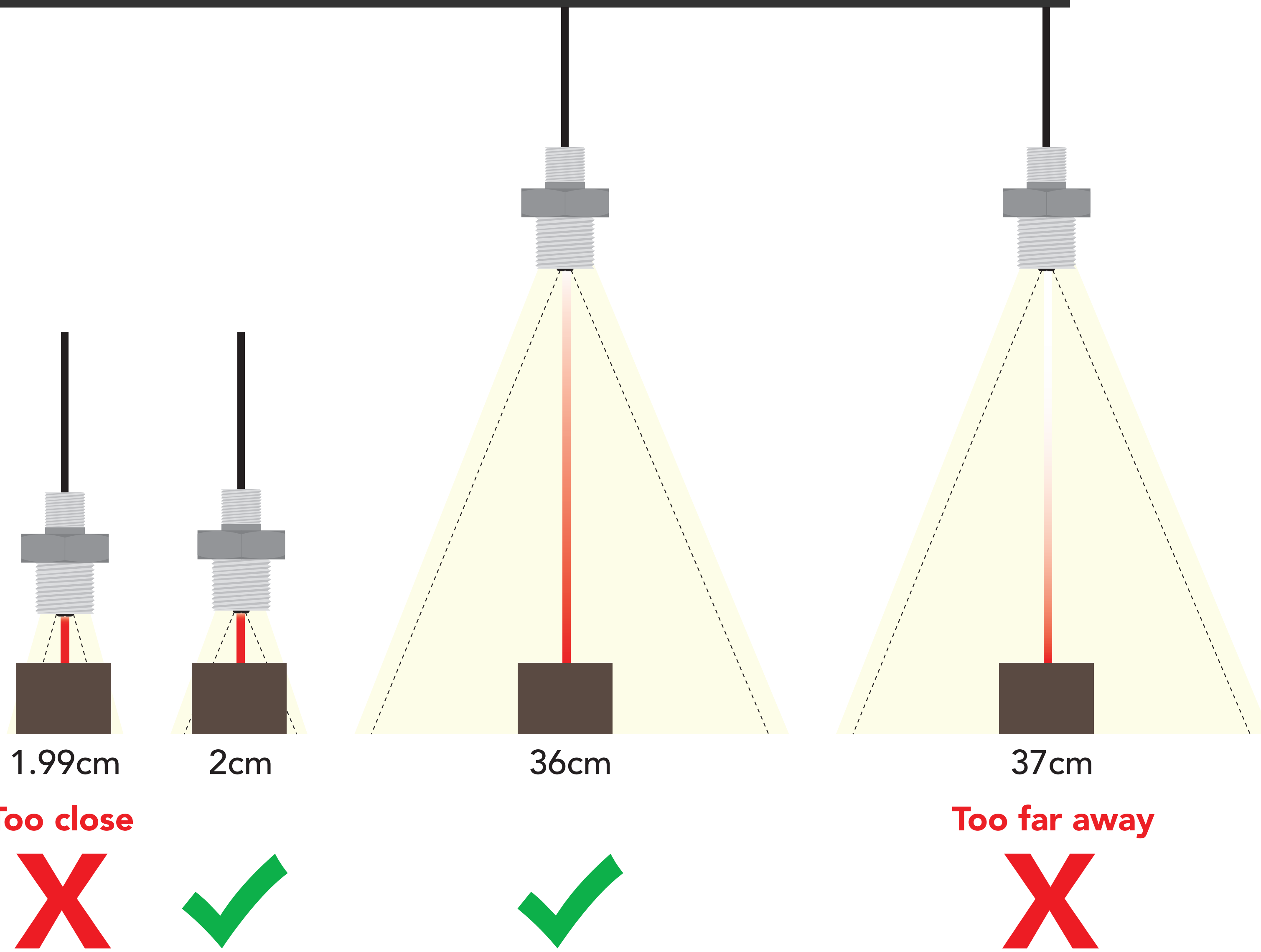
IR LED properties



x3 IR LED
Wavelength = 850nm

The three IR LEDs use reflected infrared radiation to detect proximity.

Proximity sensing range ~2cm – 36cm



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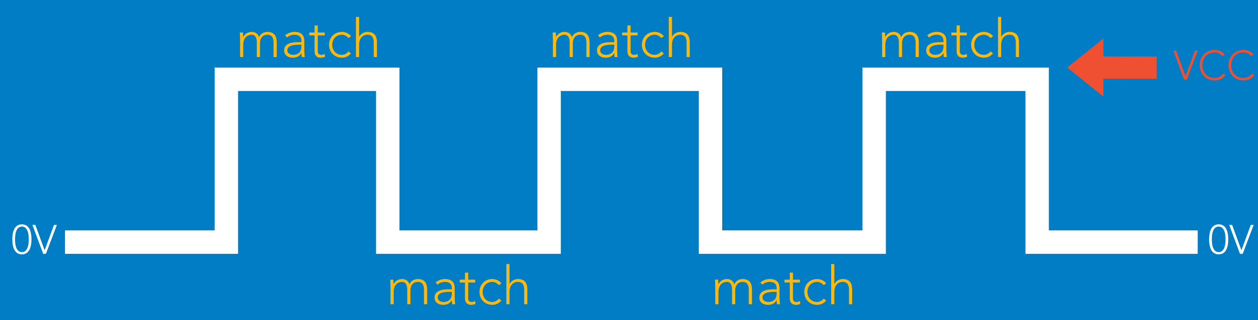
Pin out

Data and power cable pinout

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

The interrupt pin will change its state when a color match has been detected.



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

See page **34** to enable automatic color matching in UART mode.

Power consumption

	LED	MAX	SLEEP
5V	ON 100%	275 mA	
	ON 1%	15 mA	0.40 mA
	OFF	13 mA	
3.3V	ON 100%	100 mA	
	ON 1%	15 mA	0.14 mA
	OFF	12 mA	

Absolute max ratings

Parameter	MIN	TYP	MAX
Storage temperature	-65 °C		125 °C
Operational temperature	-40 °C	25 °C	85 °C
VCC	3.3V	3.3V	5.5V
Pressure			1379kPa (200 PSI)

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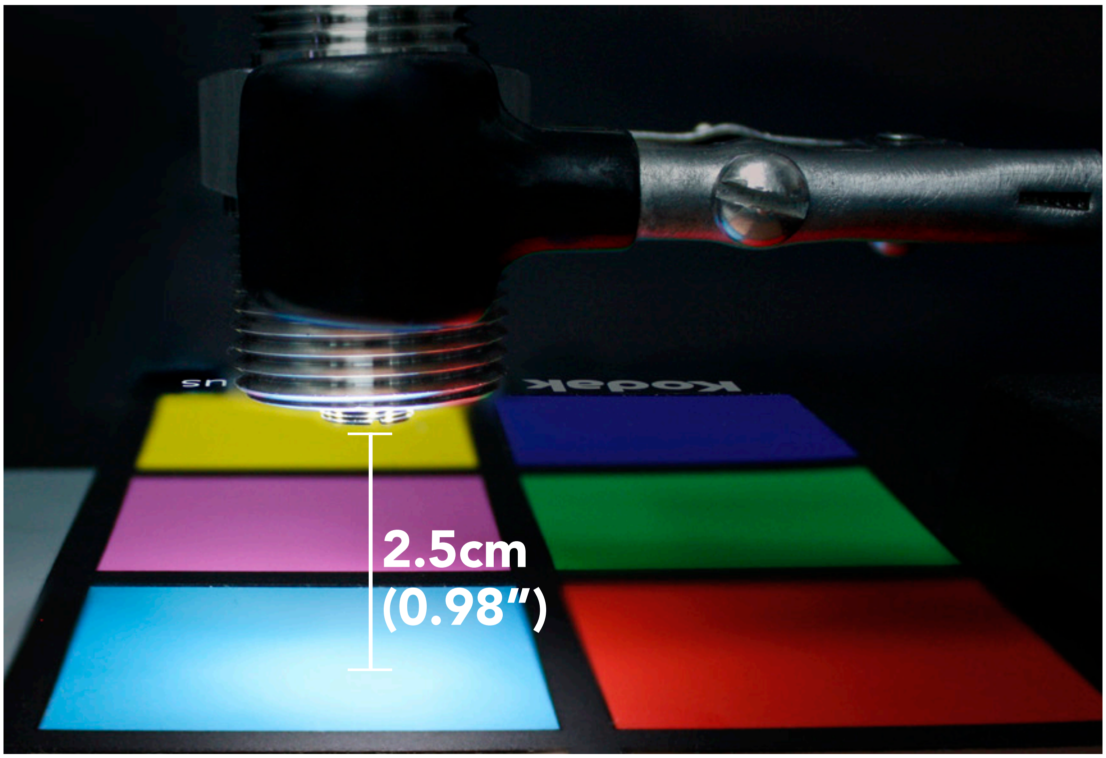
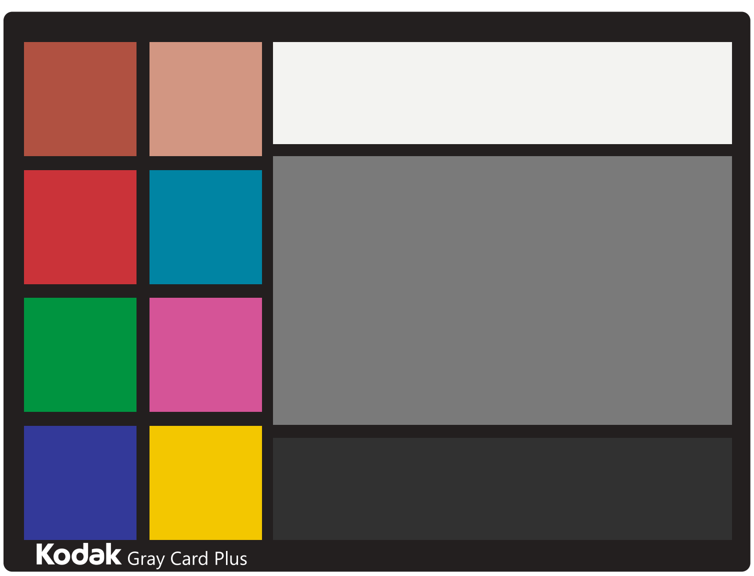
Performance testing

Color Sample Kodak™ Gray Card Plus
Distance 2.5cm
On-board LEDs 100% power
VCC 5V

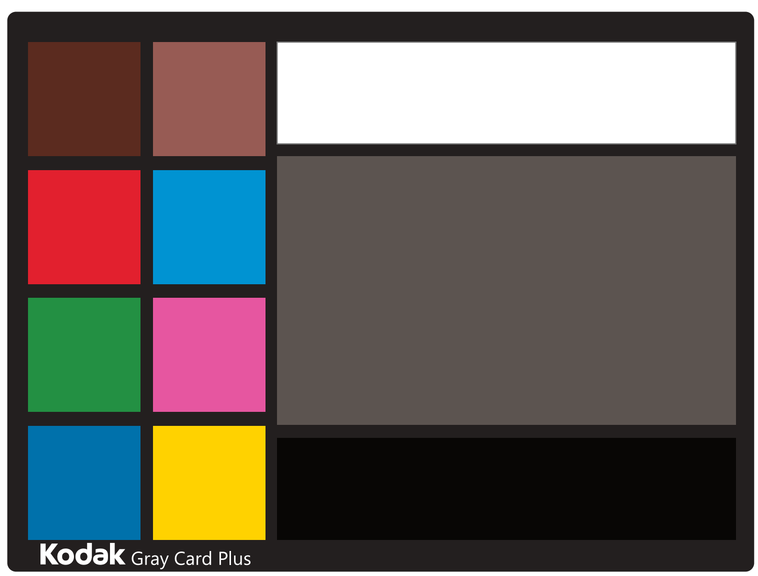
The color readings were displayed using the free software on the Atlas Scientific™ website located ***HERE***.



Kodak™ Gray Card Plus

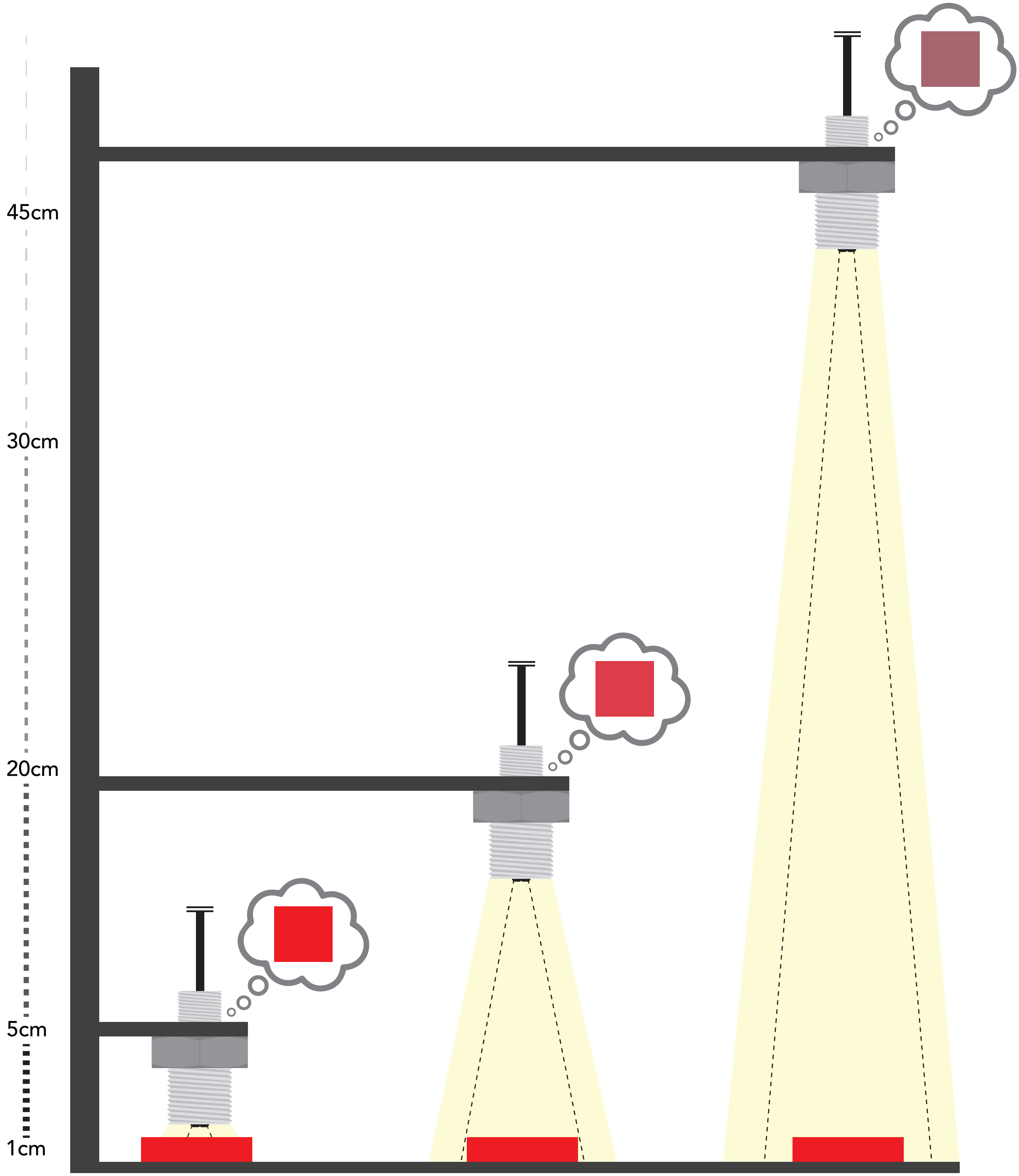


Color output from the EZO-RGB™



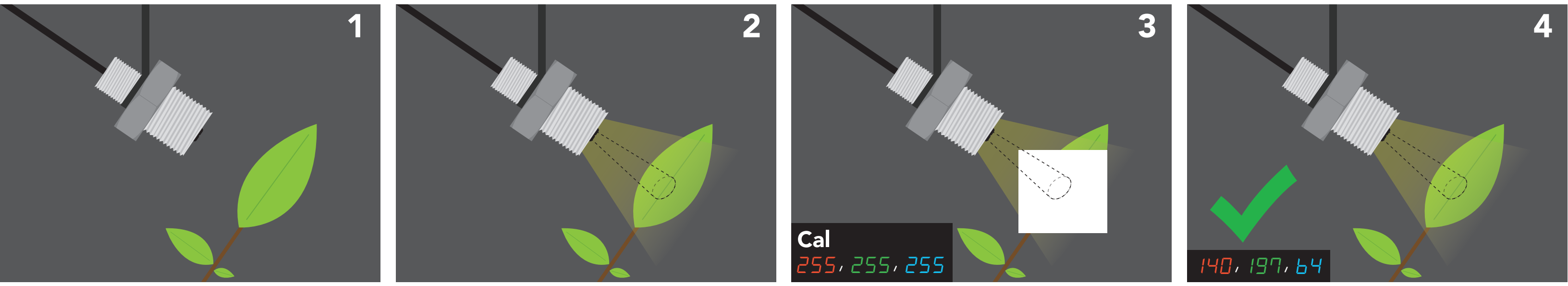
Sensitivity

As the EZO-RGB™ color sensor is placed further away from the target object, its ability to detect color is diminished. At distances greater than ***45cm*** most colors become varying shades of gray.

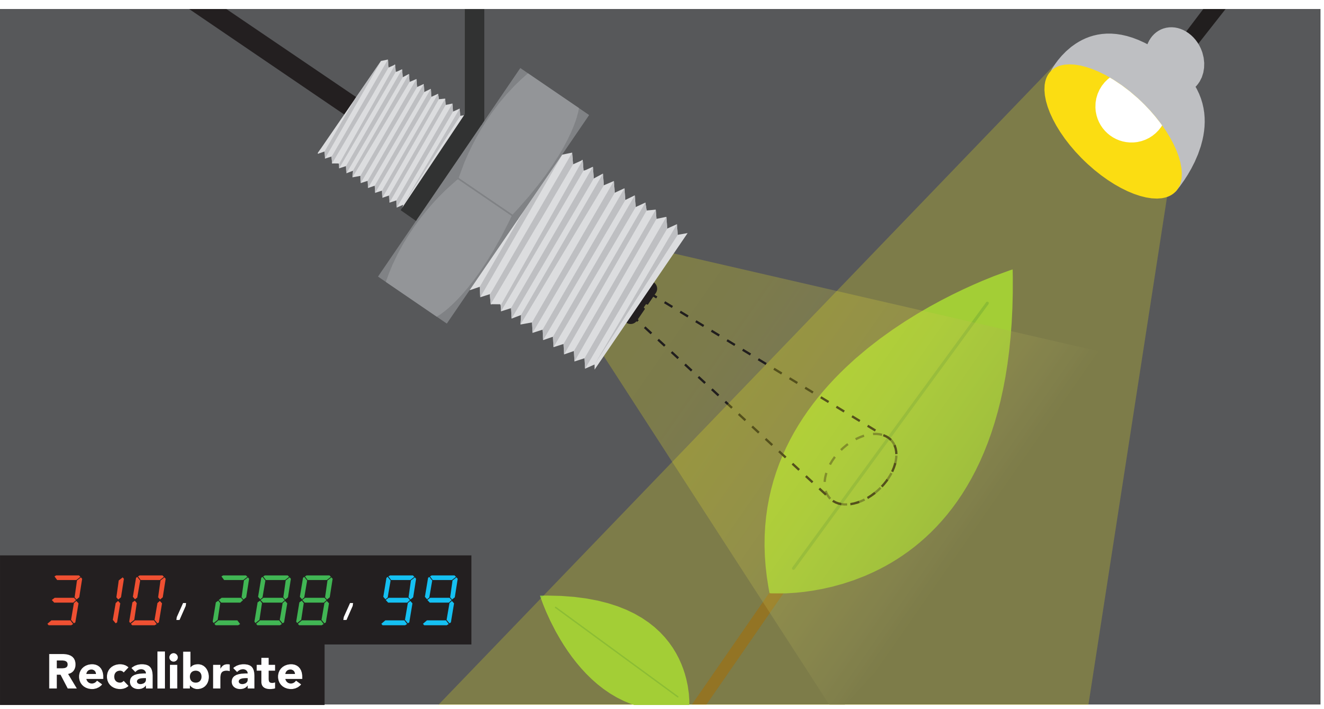


Calibration theory

The EZO-RGB™ color sensor is designed to be calibrated to a white object at the maximum brightness the object will be viewed under. In order to get the best results Atlas Scientific strongly recommends that the sensor is mounted into a fixed location. Holding the sensor in your hand during calibration will decrease performance.



1. Embed the EZO-RGB™ color sensor into its intended use location.
2. Set LED brightness to the desired level.
3. Place a white object in front of the target object and issue the calibration command "Cal".
4. A single color reading will be taken and the device will be fully calibrated.



The RGB output has a three comma separated value, ranging from 0–255. However, It is possible to get RGB readings where one, or all of the values are greater than 255. This is because brightness is encoded in a RGB reading, if the subject being viewed is brighter than the calibrated brightness, the RGB values can go above 255. If this happens, the EZO-RGB™ Embedded Color Sensor needs to be re-calibrated for the correct brightness.

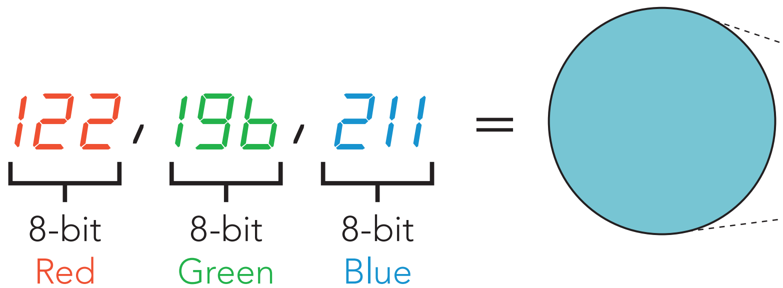
Data output

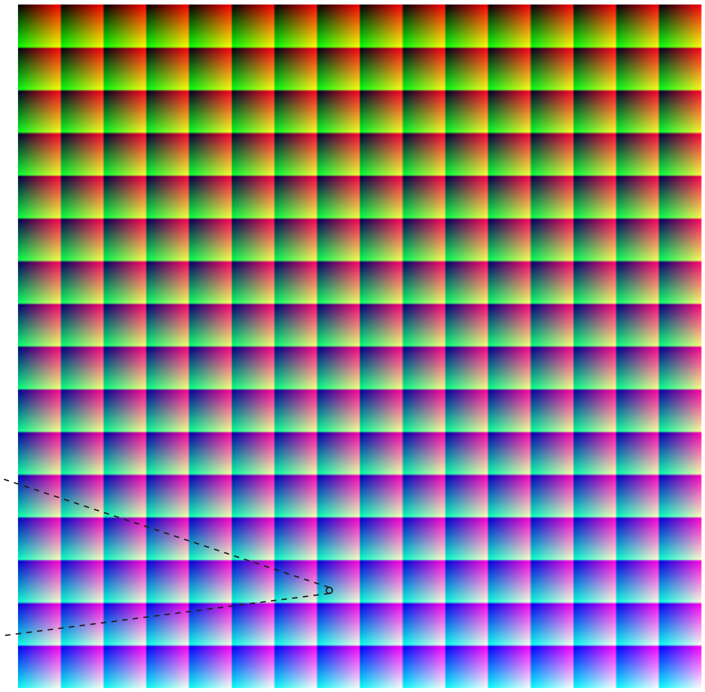
RGB 8-bit color graphics

Default output

8-bit Red
8-bit Green
8-bit Blue
24 bits in total

Color pallet 16,777,216 colors *(24 Bit)*
Output frequency 1 reading every 400ms
Output format CSV string 24 bits

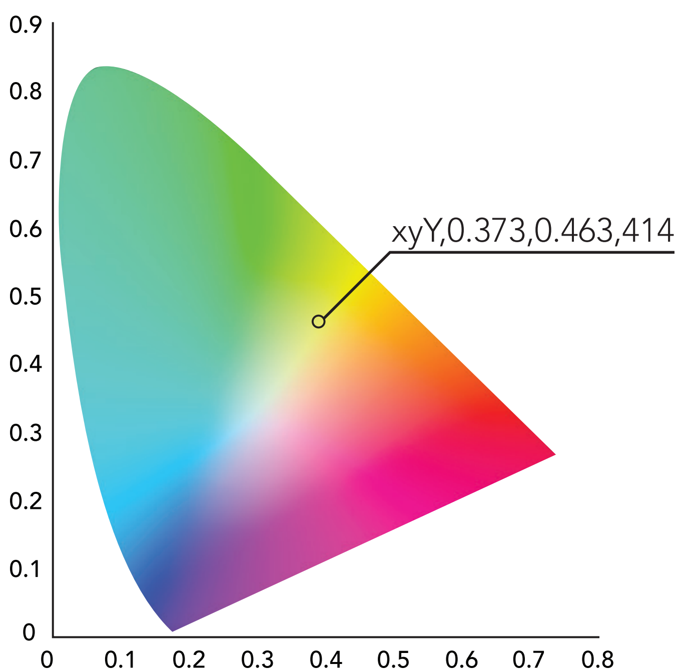




16,777,216 RGB colors

CIE 1931 color space

Human perception of color is not the same as a sensors perception of color. The CIE output is a representation of human color perception, while the RGB output is a representation of machine perception. While the two are close, they are not the same.



Identifier	x	y	Y
xyY,	0.373,	0.463,	414

xy = coordinates
Y = luminance

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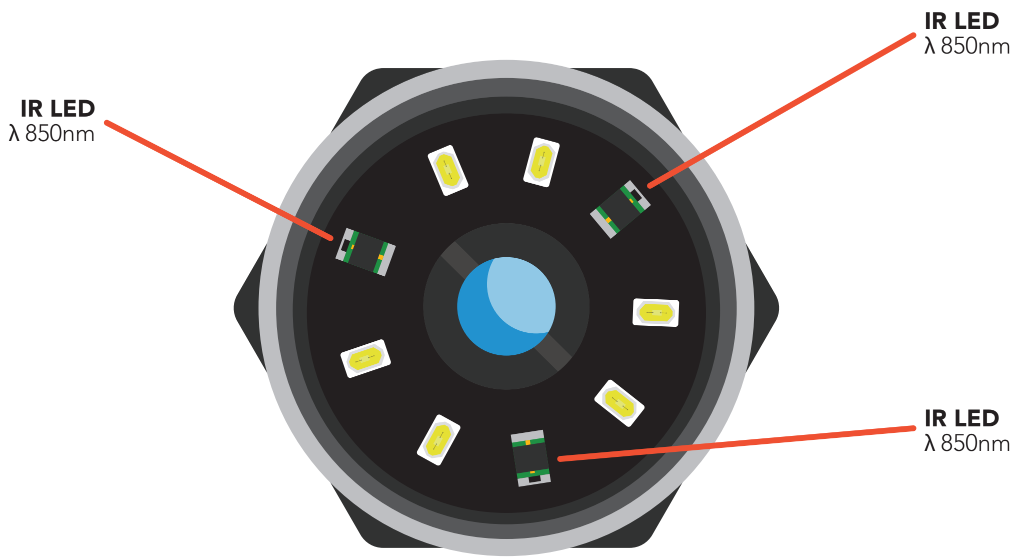
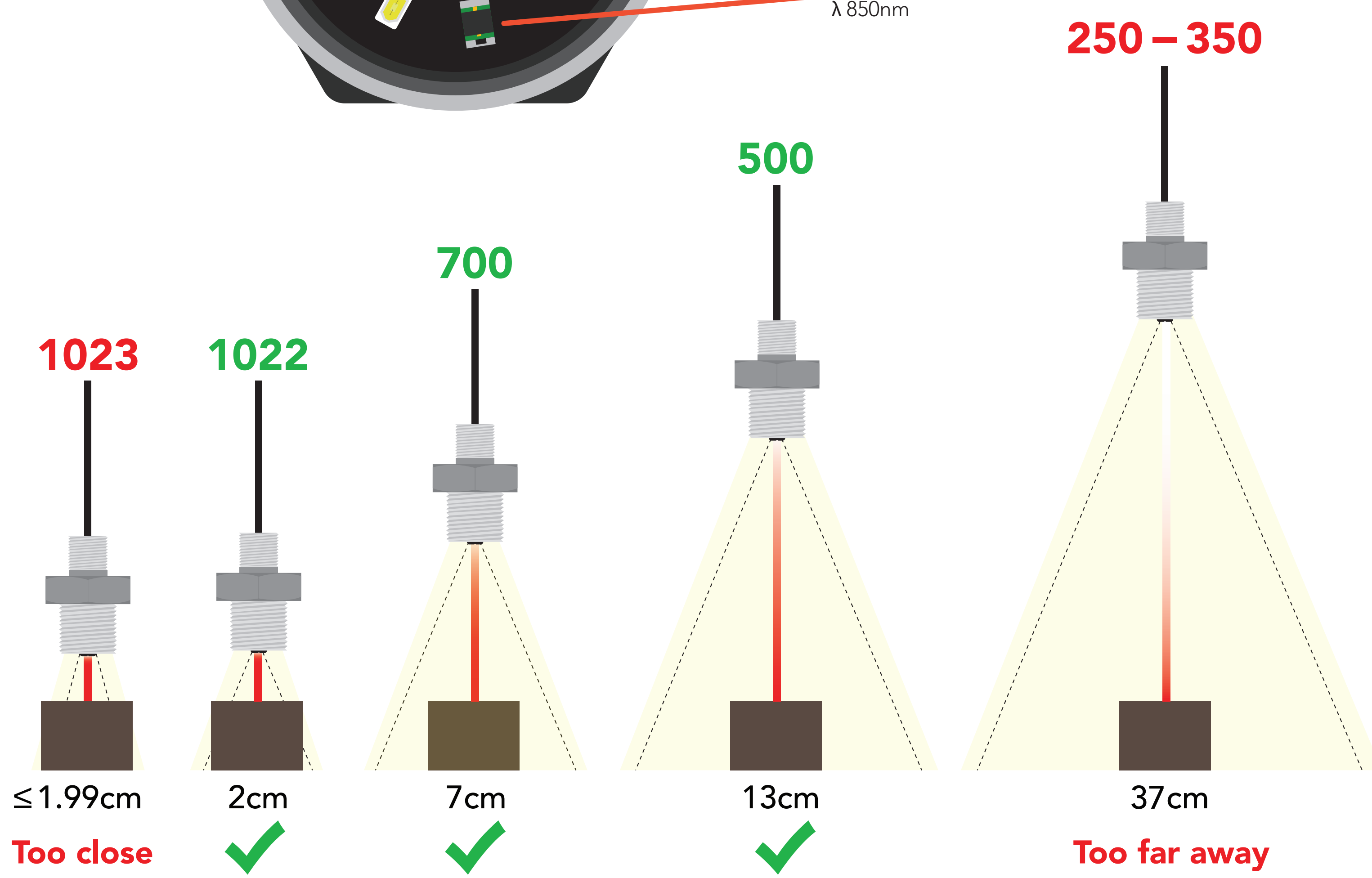
Proximity sensing

The EZO-RGB™ uses three IR emitters to detect its proximity to another object. The intensity of the reflected IR light is used to determine if an object is in front of it. Because the IR reflectivity of materials is not uniform, the EZO-RGB™ proximity sensing capabilities should not be used as a precise distance measuring device.

The proximity output has a comma separated identifier **"P"** followed by a single integer value from ~250–1023. When the proximity sensor detects nothing the readings will be ~250–350.

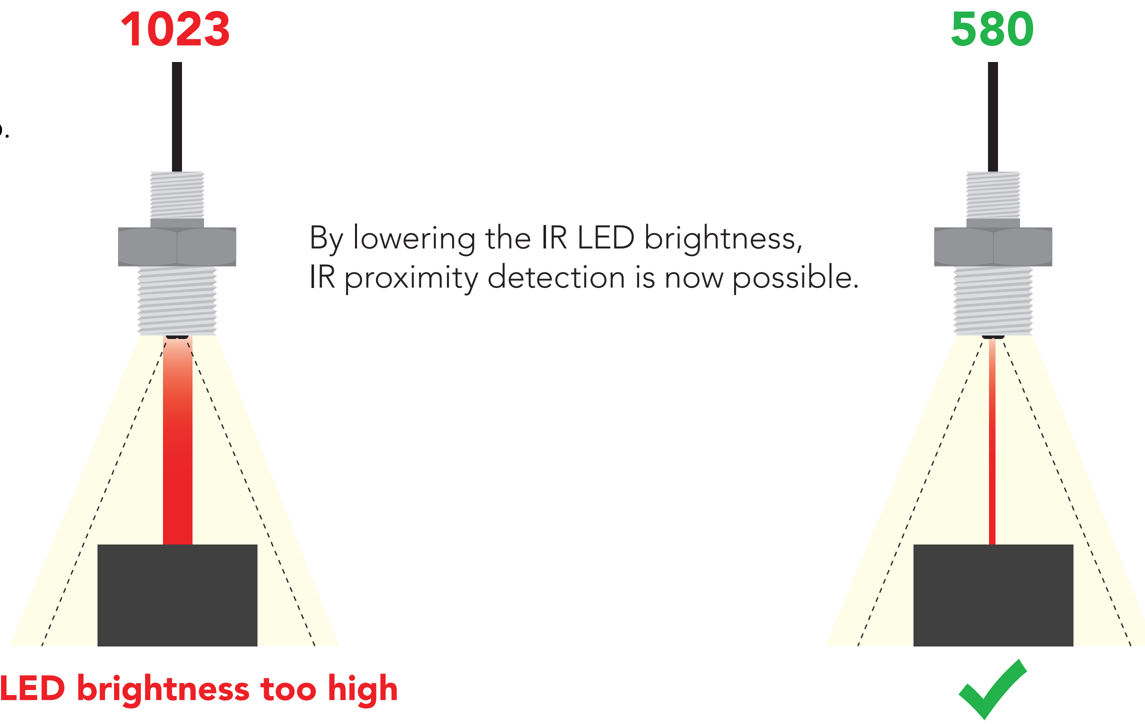




IR LED brightness control

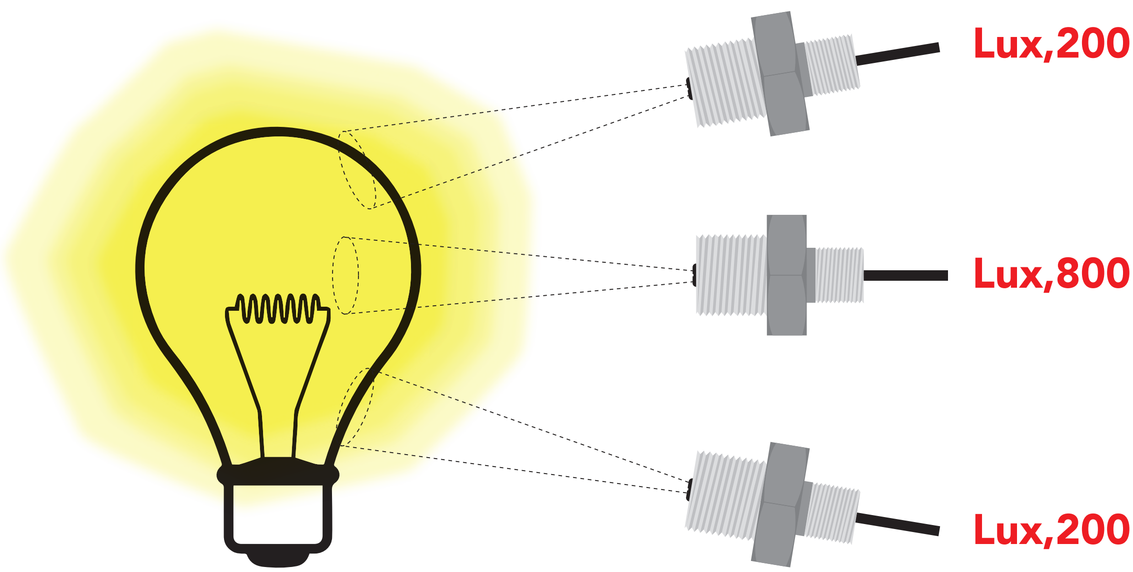
Controlling the IR LED brightness is necessary because, not all objects have the same IR reflectivity. Some objects can have an IR reflectivity that is too intense, therefore it is necessary to lower the brightness of the IR LEDs to achieve repeatable IR proximity detection.

High default
Medium
Low
See page **33** for more info.



Lux

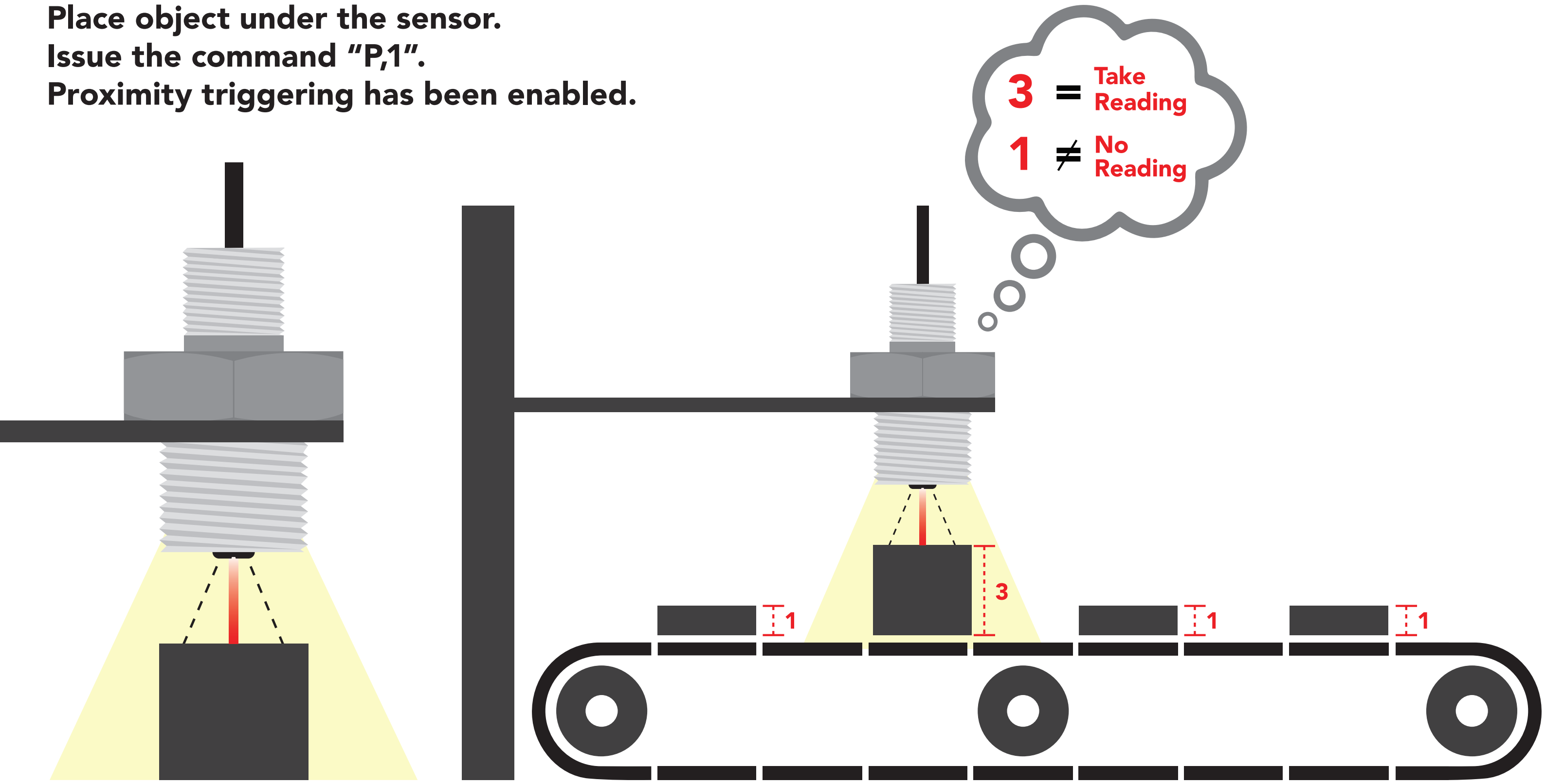
Lux is a measure of light intensity as perceived by the human eye. The lux output has a comma separated identifier **"Lux"** followed by a single integer value from 0 – 65535. Lux readings will be effected by the sensors position.



Proximity triggering

The EZO-RGB™ takes a color reading only when a set proximity is met or exceeded.

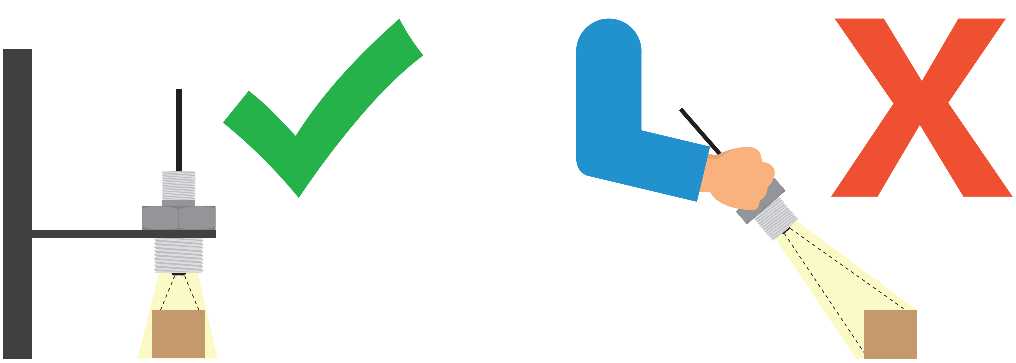
Place object under the sensor.
Issue the command "P,1".
Proximity triggering has been enabled.



Once proximity triggering has been enabled, no readings will be transmitted ***until*** an object of ***equal, or greater height*** has been detected under the EZO-RGB™.

Color readings that are taken when a proximity match has been detected will be appended with **"*P"**

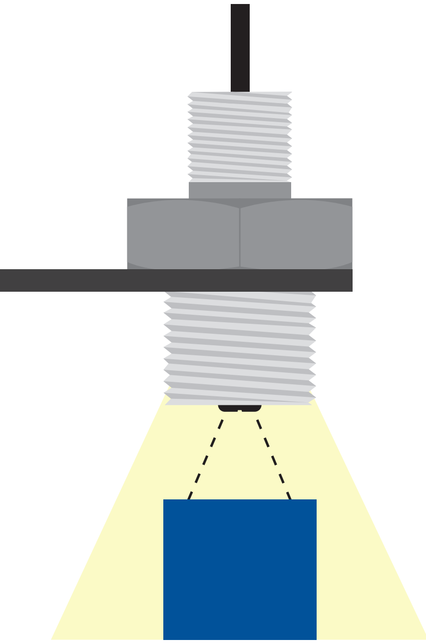
In order for proximity triggering to work the EZO-RGB™ must be securely mounted and remain a fixed distance from its target.

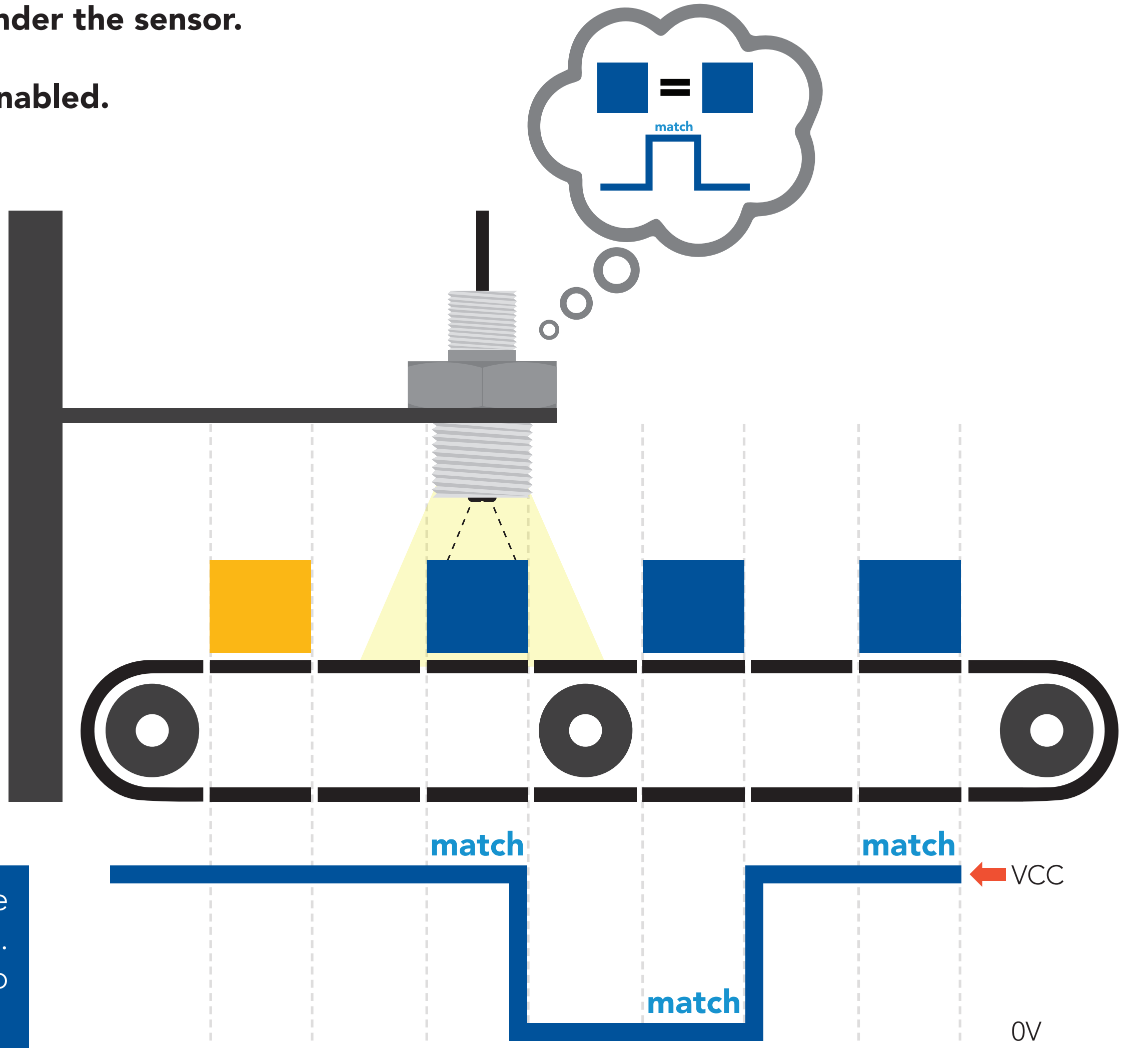


Color matching

The EZO-RGB™ can indicate when a preset color is detected.

Place object of any color under the sensor.
Issue command "M,1".
Color matching has been enabled.

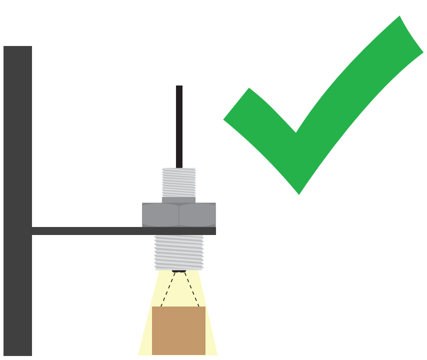


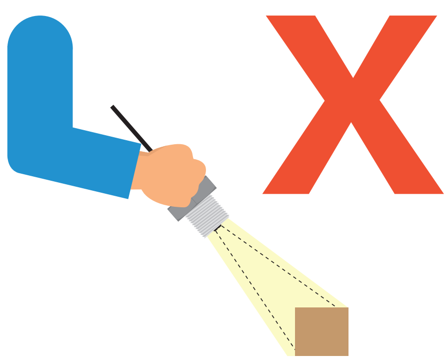


The interrupt pin can only be used to signal a color match. It cannot be programmed to signal any other condition.

When a color match has been detected the reading will be appended with **"*M"** and the interrupt pin will change its state.

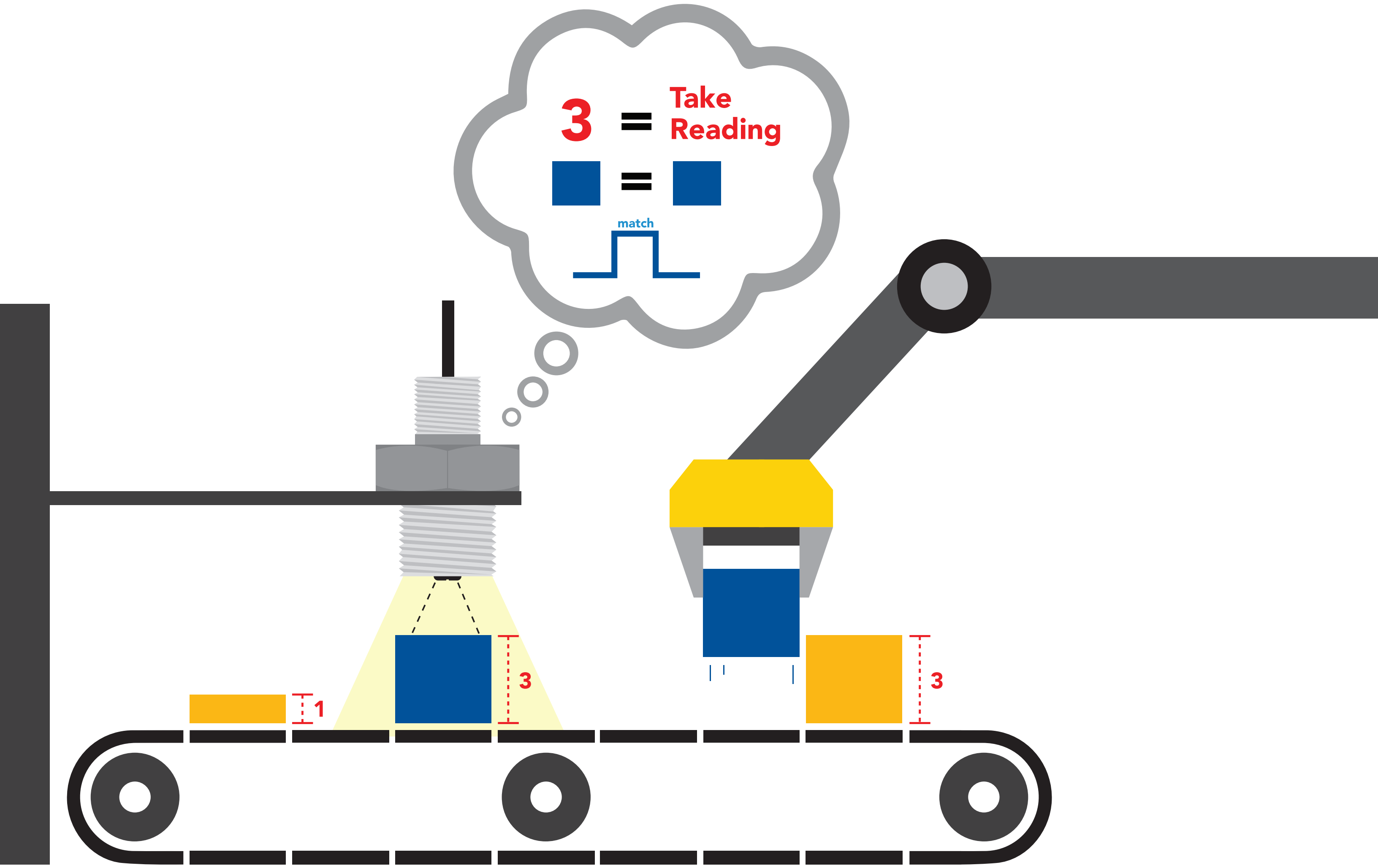
In order for color matching to work the EZO-RGB™ must be securely mounted and remain a fixed distance from its target.



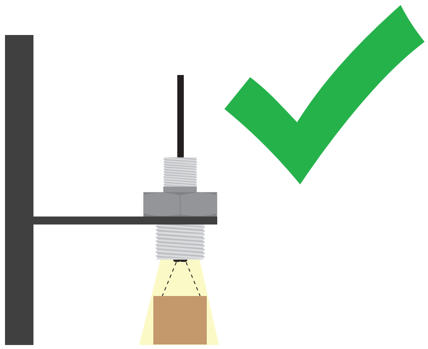


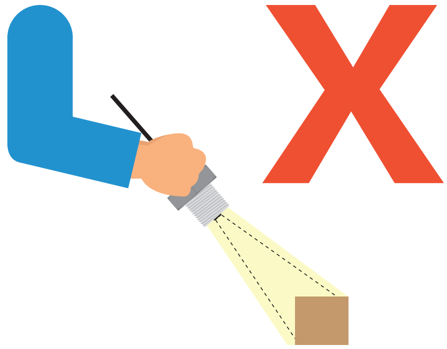
Proximity and color matching

Both proximity and color matching functions can be enabled simultaneously, permitting the engineer to quickly develop an object sorter with minimal coding.



In order for proximity triggering and color matching to work the EZO-RGB™ must be securely mounted and remain a fixed distance from its target.

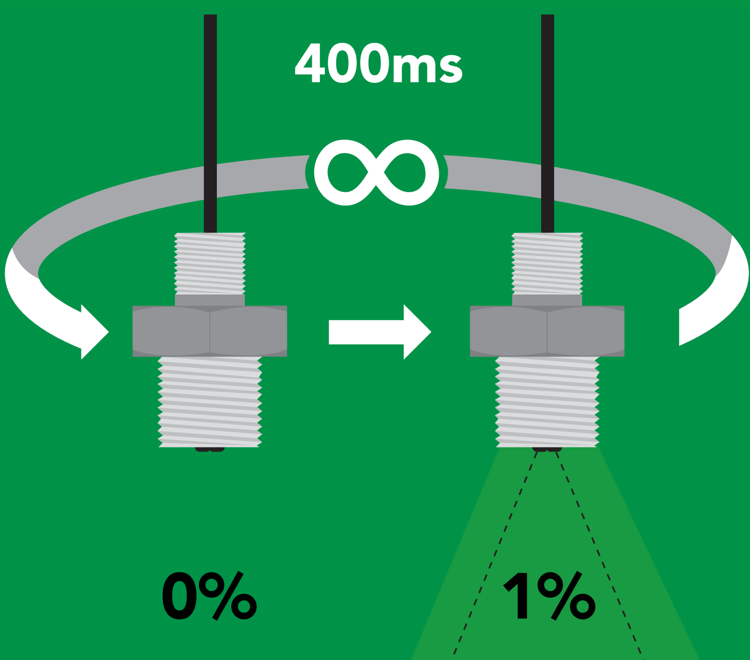


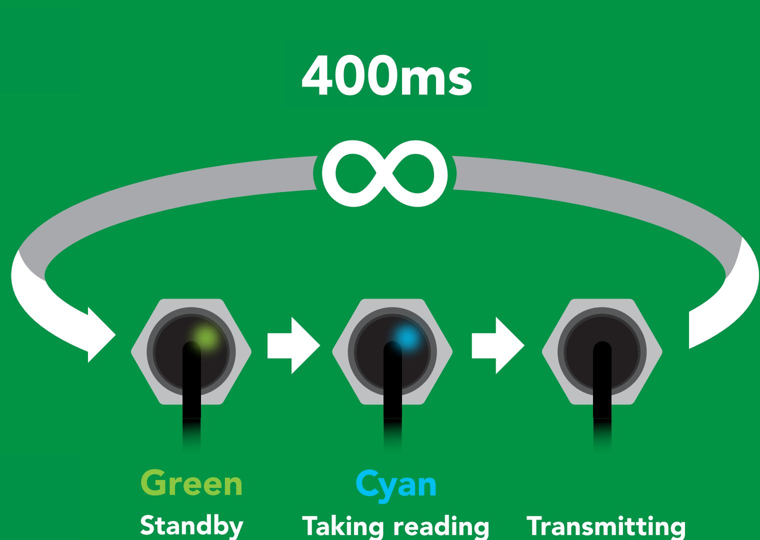


Default state

UART mode

Baud	9,600
Readings	continuous
Speed	400 milliseconds
LED	on, when taking reading





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Available data protocols

UART

default

I^{2}C

Unavailable data protocols

SPI

Analog

RS-485

Mod Bus

4–20mA

UART mode

Settings that are retained if power is cut

Automatic color matching
Baud rate
Calibration
Continuous mode
Device name
Enable/disable parameters
Enable/disable response codes
LED control

Settings that are *NOT* retained if power is cut

Sleep mode

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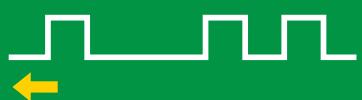
UART mode

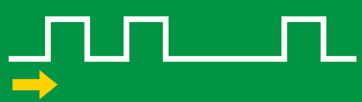
8 data bits	no parity
1 stop bit	no flow control

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

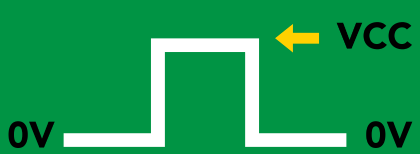
RX
Data in

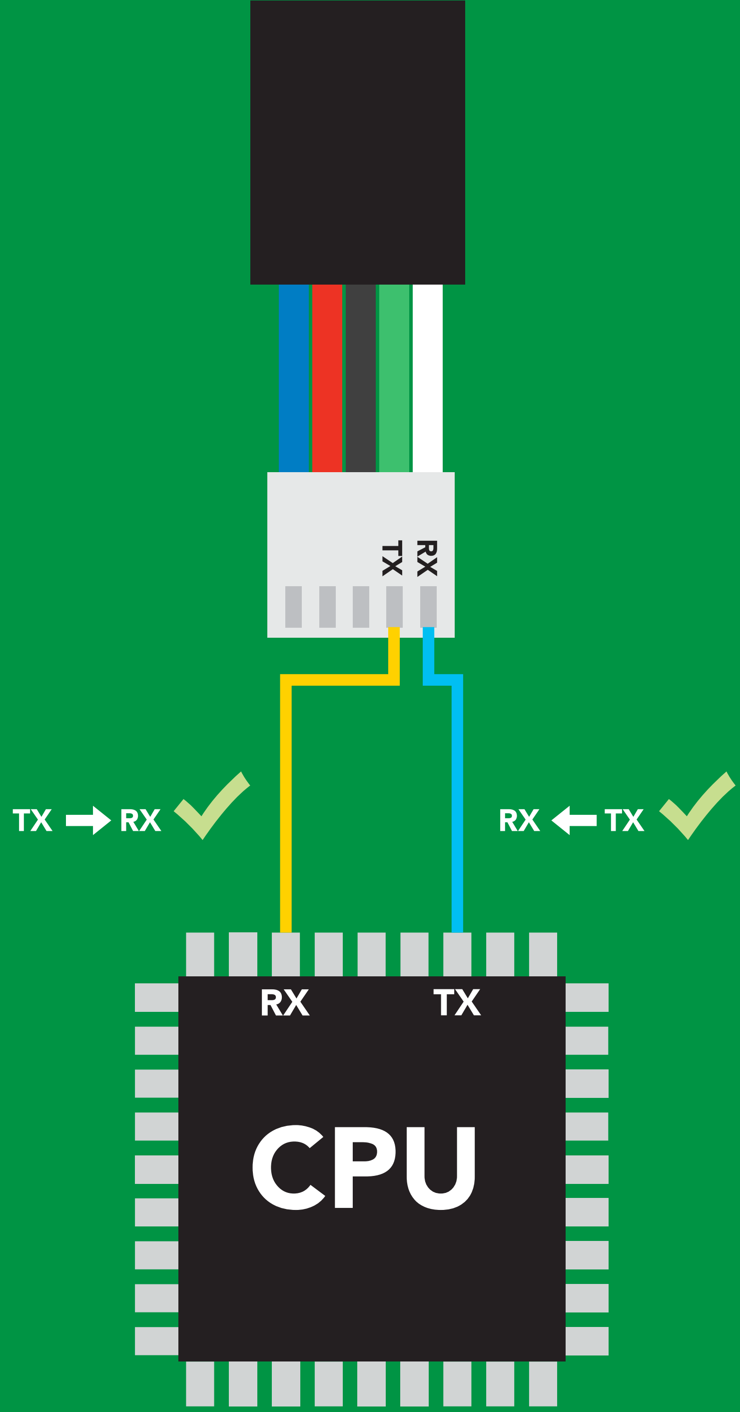


TX
Data out



Vcc 3.3V – 5V





Data format

Units	RGB, LUX, CIE, and proximity	**Data type**	integer & floating point
Encoding	ASCII	**Decimal places**	3
Format	string	**Smallest string**	4 characters
Terminator	carriage return	**Largest string**	52 characters

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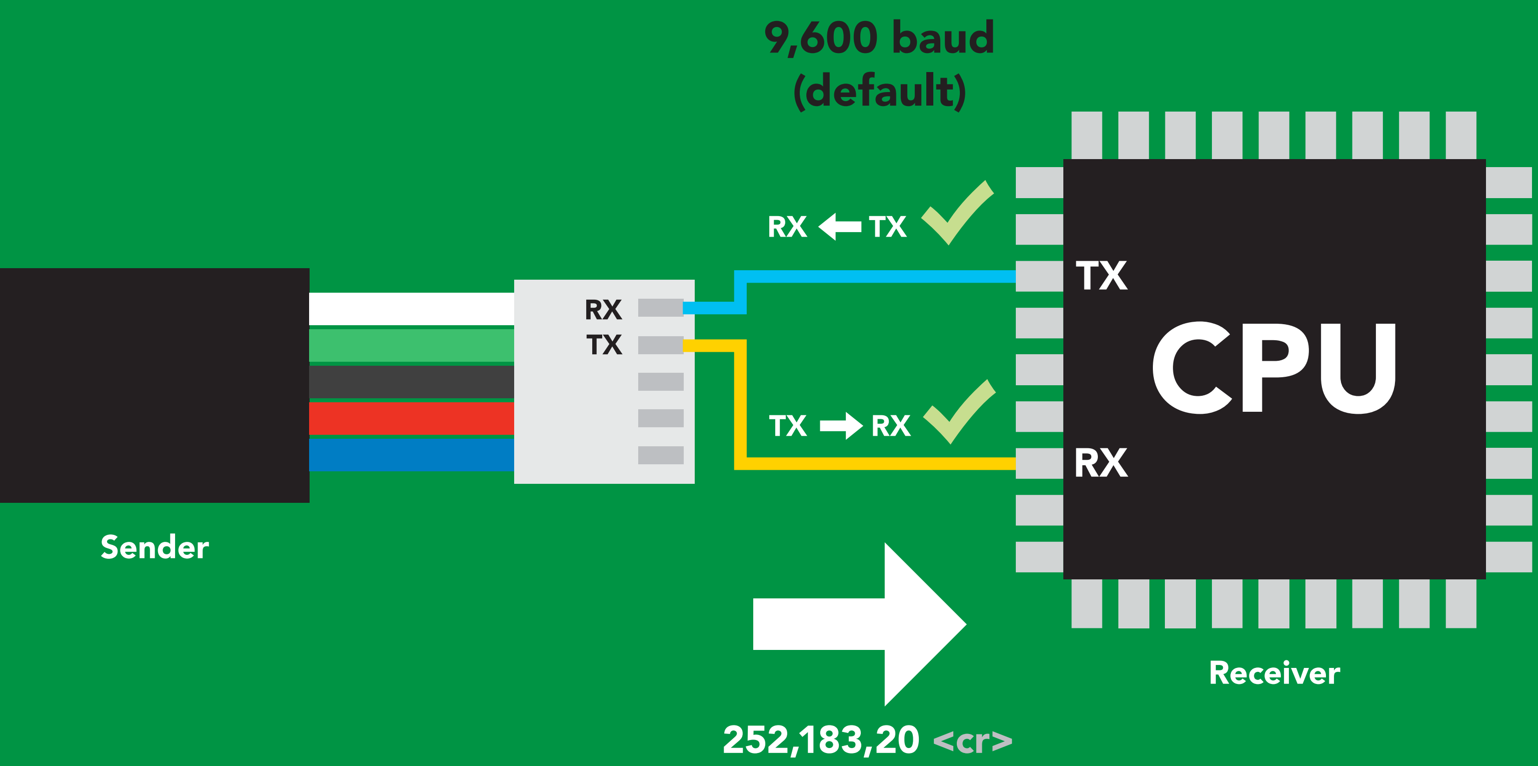
Receiving data from device



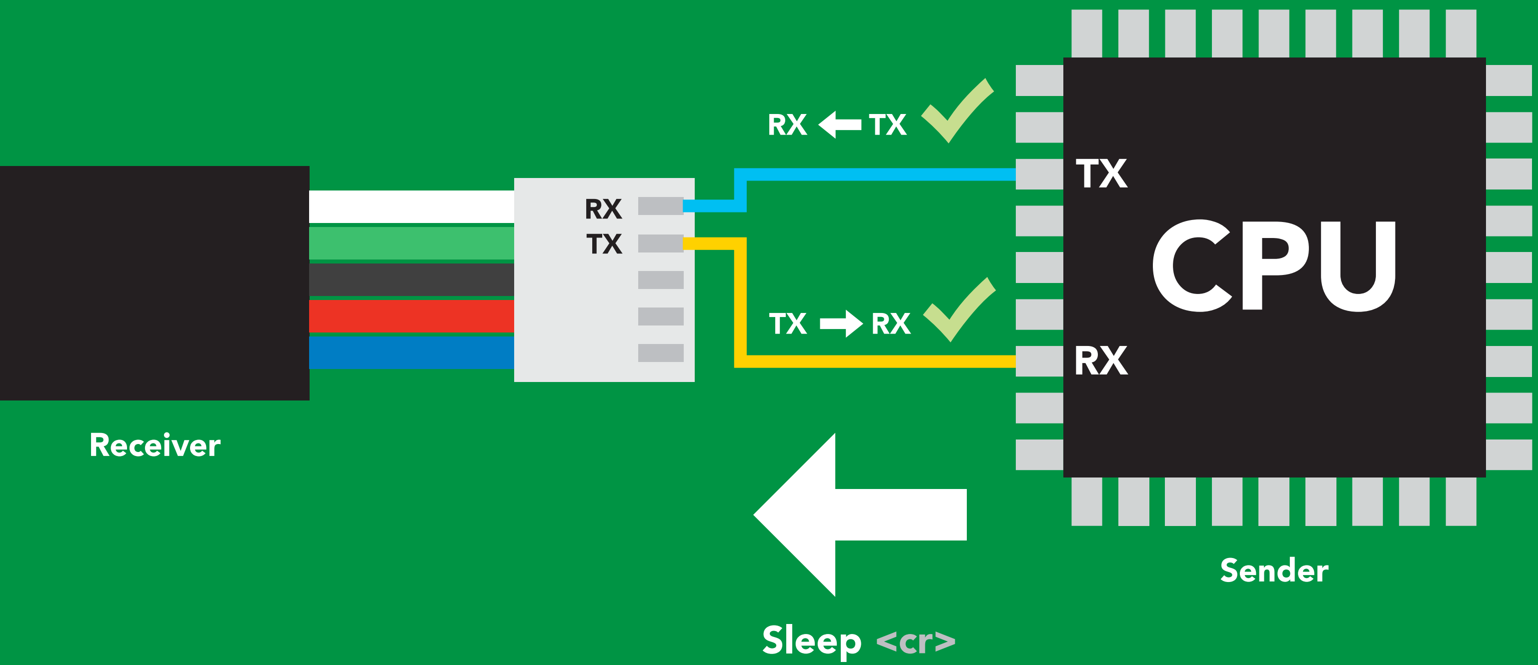
Advanced

ASCII:	2	5	2	,	1	8	3	,	2	0	<cr>
Hex:	32	35	32	2C	31	38	33	2C	32	30	0D
Dec:	50	53	50	44	49	56	51	44	50	48	13

Sending commands to device

2 parts

Command (not case sensitive)	**Carriage return <cr>**
ASCII data string	Terminator



Advanced

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

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Indicator LED definition

Green	UART standby
Cyan	Taking reading
Purple	Changing I²C address
Red	Command not understood
White	Find

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

UART mode

command quick reference

All commands are ASCII strings or single ASCII characters.

Command	Function		Default state
Baud	change baud rate	pg. 42	9,600
C	enable/disable continuous mode	pg. 30	enabled
Cal	performs calibration	pg. 32	n/a
Factory	enable factory reset	pg. 44	n/a
Find	finds device with blinking white LED	pg. 29	n/a
G	gamma correction	pg. 35	n/a
i	device information	pg. 38	n/a
iL	enable/disable indicator LED	pg. 28	enabled
I2C	change to I²C mode	pg. 45	not set
L	enable/disable target LED	pg. 27	enabled
M	automatic color matching	pg. 34	enabled
Name	set/show name of device	pg. 37	not set
O	enable/disable parameters	pg. 36	RGB
P	proximity detection	pg. 33	n/a
Plock	enable/disable protocol lock	pg. 43	n/a
R	returns a single reading	pg. 31	n/a
Sleep	enter sleep mode/low power	pg. 41	n/a
Status	Retrieve status information	pg. 40	n/a
*OK	enable/disable response codes	pg. 39	n/a

Target LED control

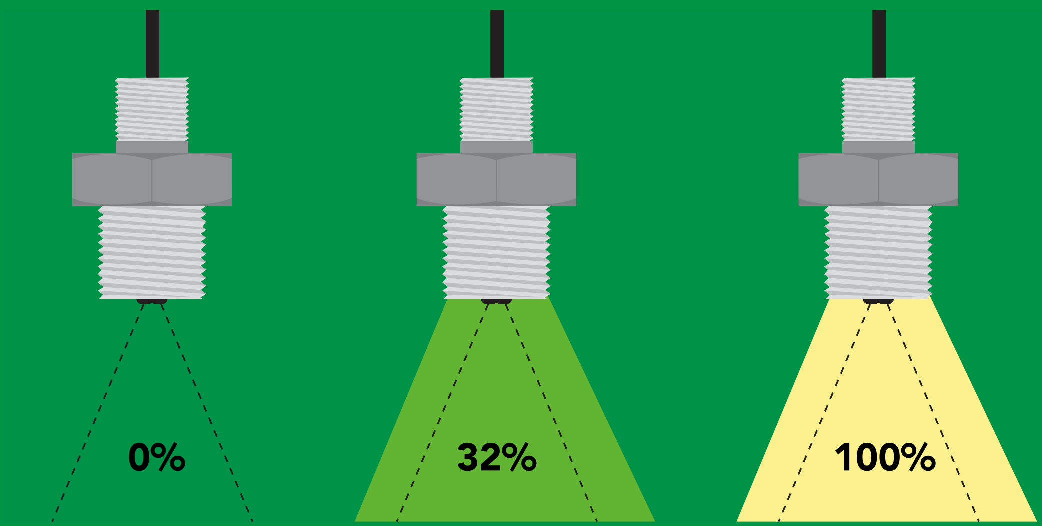
Command syntax

% represents the percentage of target LED brightness. (any number from 0 – 100)

L,%	<cr>	set target LED brightness
L,%,T	<cr>	set target LED brightness/trigger target LED only when a reading is taken *(power saving)*
L,?	<cr>	target LED state on/off?

Example	Response	
L,32 <cr>	*OK <cr>	target LED set to 32% brightness.
L,14,T <cr>	*OK <cr>	target LED set to 14% brightness, and will only turn on when a reading is taken.
L,? <cr>	?L, %, [T] <cr> *OK <cr>	

L,0 <cr> L,32 <cr> L,100 <cr>



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r 0.2

Indicator LED control

Command syntax

iL,1 <cr> indicator LED on **default**

iL,0 <cr> Indicator LED off

iL,? <cr> Indicator LED state on/off?

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

iL,1

iL,0

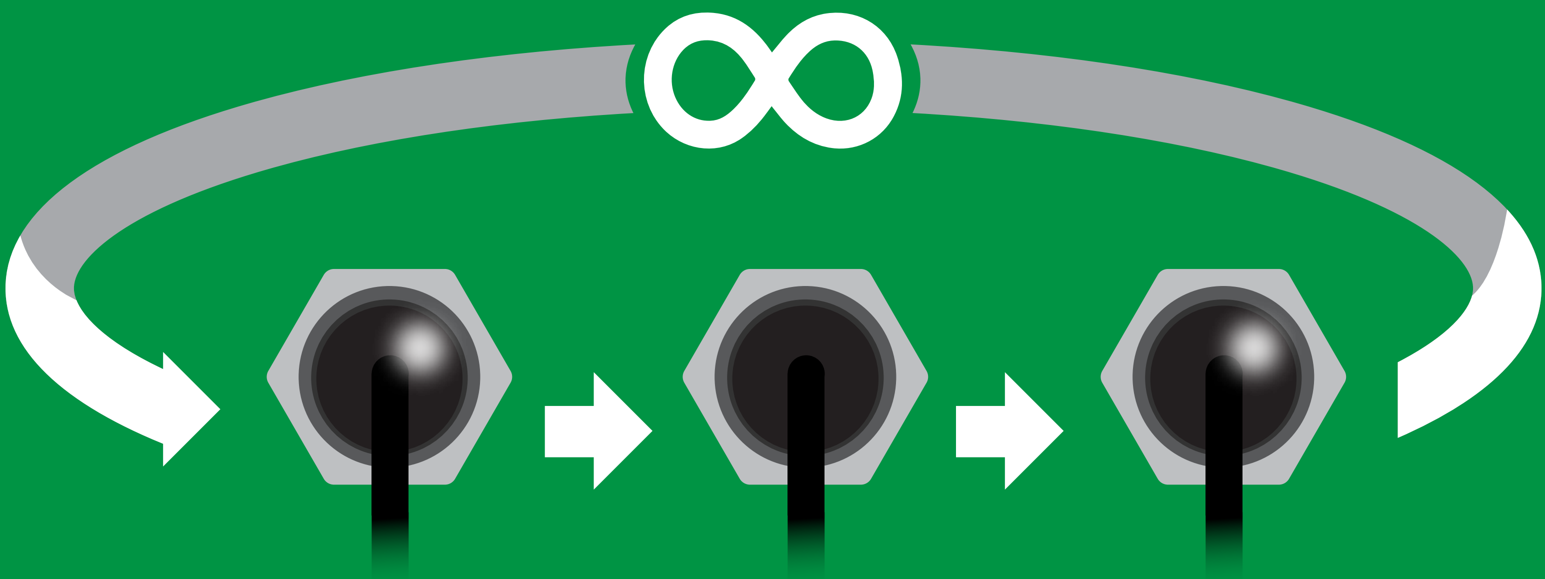
Find

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 mode

Command syntax

C,1	<cr>	enable continuous readings once per 400ms	default
C,n	<cr>	continuous readings every n x 400ms (n = 2 to 99)	
C,0	<cr>	disable continuous readings	
C,?	<cr>	continuous reading mode on/off?	

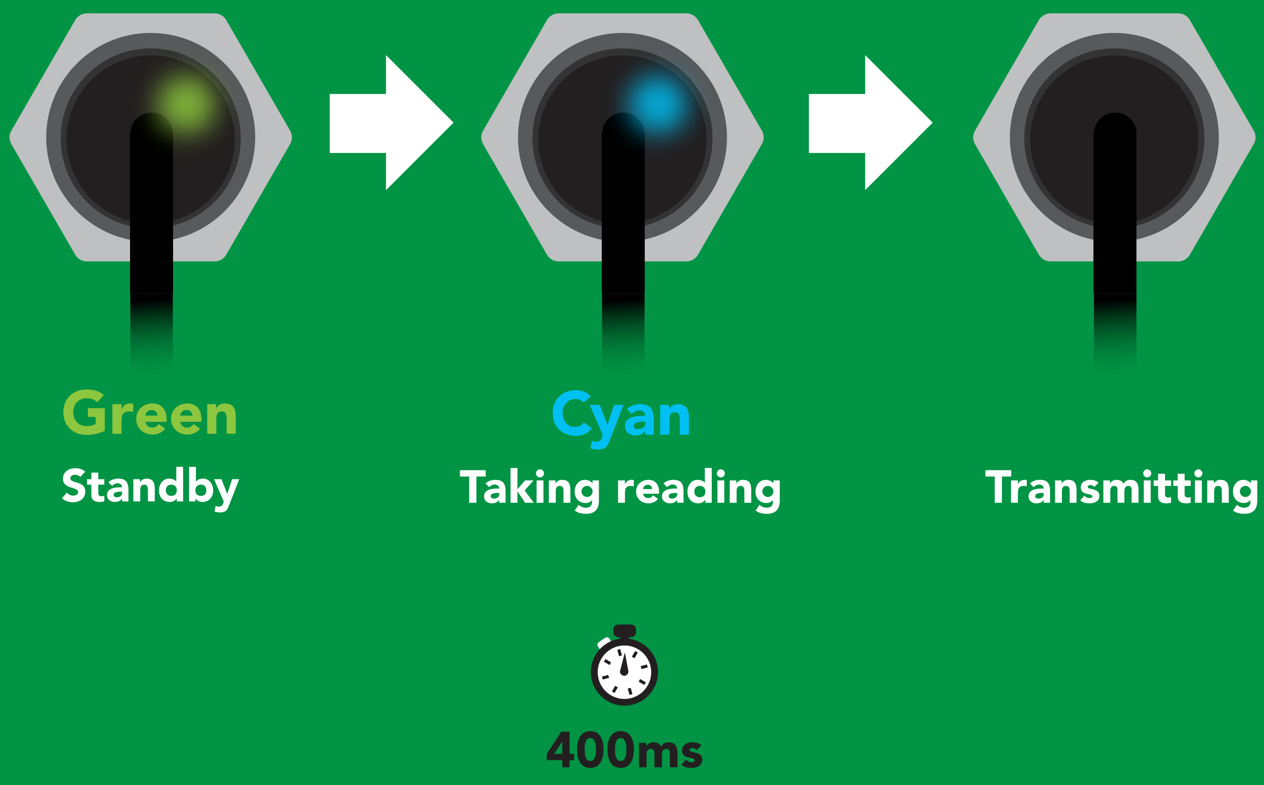
Example	Response
C,1 <cr>	*OK <cr> R,G,B (400ms) <cr> R,G,B (800ms) <cr> R,G,B (1200ms) <cr>
C,30 <cr>	*OK <cr> R,G,B (12,000ms) <cr> R,G,B (24,000ms) <cr> R,G,B (36,000ms) <cr>
C,0 <cr>	*OK <cr>
C,? <cr>	?C,1 <cr> or ?C,0 <cr> or ?C,30 <cr> *OK <cr>

Single reading mode

Command syntax

R <cr> **takes single reading**

Example	Response
R <cr>	R,G,B <cr> *OK <cr>



Calibration

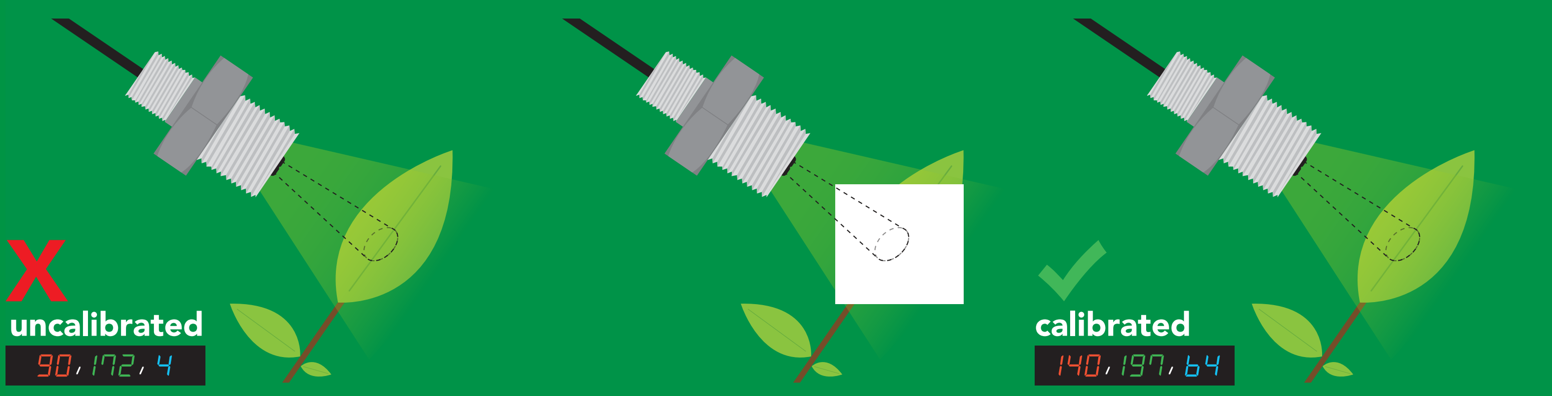
Command syntax

Cal <cr> **calibrates the EZO-RGB™**

1. place white object *(such as a piece of paper)* in front of target
2. Issue "cal" command

Example	Response
Cal <cr>	*OK <cr>

Cal <cr>



Proximity detection

Command syntax

P,[1,0]	<cr>	enable / disable
P,n	<cr>	manually enable proximity detection at n distance where n = any number from 250 – 1023
P,[H, M, L]	<cr>	set IR LEDs brightness to high, medium or low
P,?	<cr>	proximity state on/off?

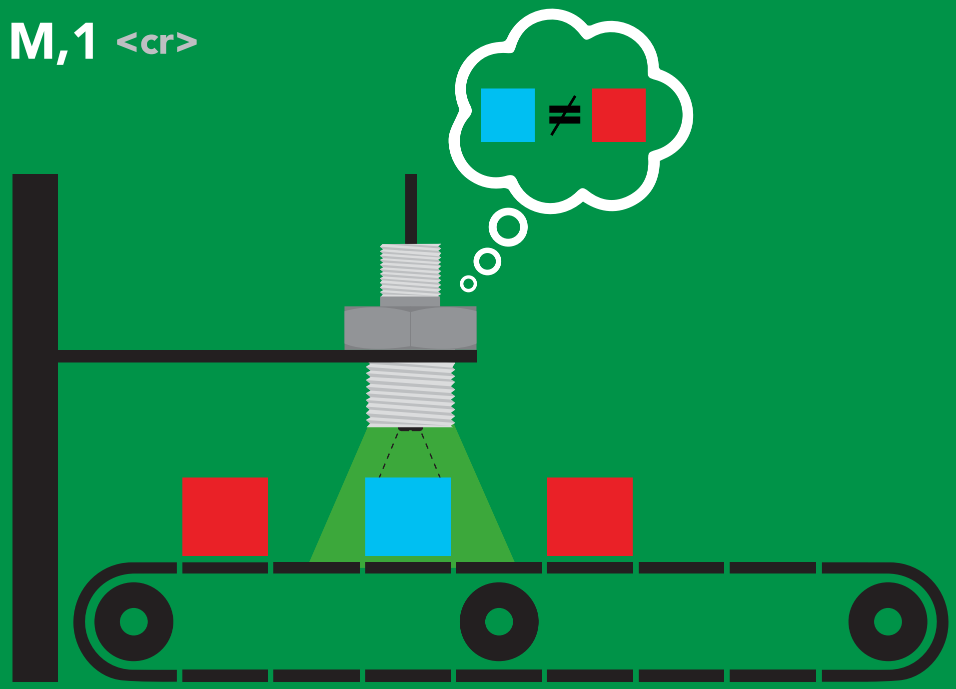
Example	Response
P,1 <cr>	*OK <cr>
P,800 <cr>	*OK <cr>
P,L <cr>	*OK <cr>
P,? <cr>	?P,0,L <cr>

Automatic color matching

Command syntax

M,1	<cr>	enables automatic color matching
M,0	<cr>	disables automatic color matching
M,?	<cr>	color matching on/off?

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



Gamma correction

Command syntax

Adjusting the gamma correction helps adjust the color seen by the sensor.

G,n <cr> **set gamma correction**

where n = a floating point number from 0.01 – 4.99

G,? <cr> **gamma correction value?**

**The default gamma correction is 1.00 which represents no correction at all.
A gamma correction factor is a floating point number from 0.01 to 4.99.**

Example	Response
G,1.99 <cr>	*OK <cr>
G,? <cr>	?G,1.99 <cr> *OK <cr>

Enable/disable parameters from output string

Command syntax

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

Example	Response
O,RGB,1 / O,RGB,0 <cr>	*OK <cr> enable / disable RGB
O,PROX,1 / O,PROX,0 <cr>	*OK <cr> enable / disable proximity
O,LUX,1 / O,LUX,0 <cr>	*OK <cr> enable / disable lux
O,CIE,1 / O,CIE,0 <cr>	*OK <cr> enable / disable CIE
O,? <cr>	?,O,RGB,PROX,LUX,CIE <cr> if all enabled

Parameters

RGB	red, green, blue
PROX	proximity
LUX	illuminance
CIE	CIE 1931 color space

Followed by 1 or 0

1	enabled
0	disabled

*** If you disable all possible data types your readings will display "no output".**

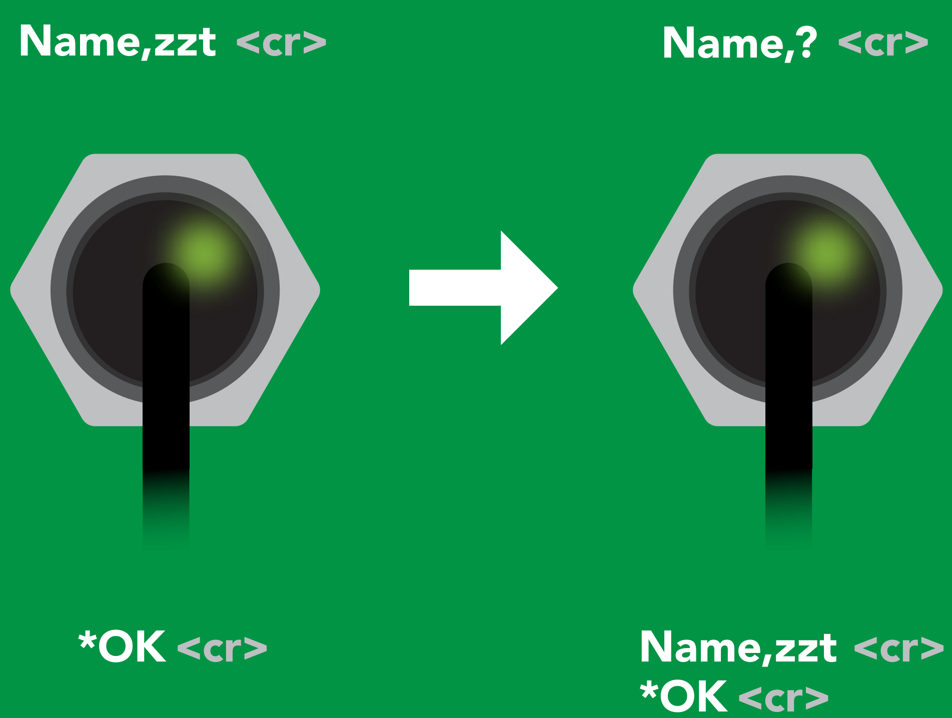
Naming device

Command syntax

Do not use spaces in the name

Name,n <cr>	set name	n = _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ (1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16)
Name,? <cr>	show name	Up to 16 ASCII characters

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



Device information

Command syntax

i <cr> **device information**

Example	Response
i <cr>	?i,RGB,1.3 <cr> *OK <cr>

Response breakdown

?i, RGB, 1.3

RGB = Device
1.3 = 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>	140,197,64 <cr> *OK <cr>
*OK,0 <cr>	no response, *OK disabled
R <cr>	140,197,64 <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

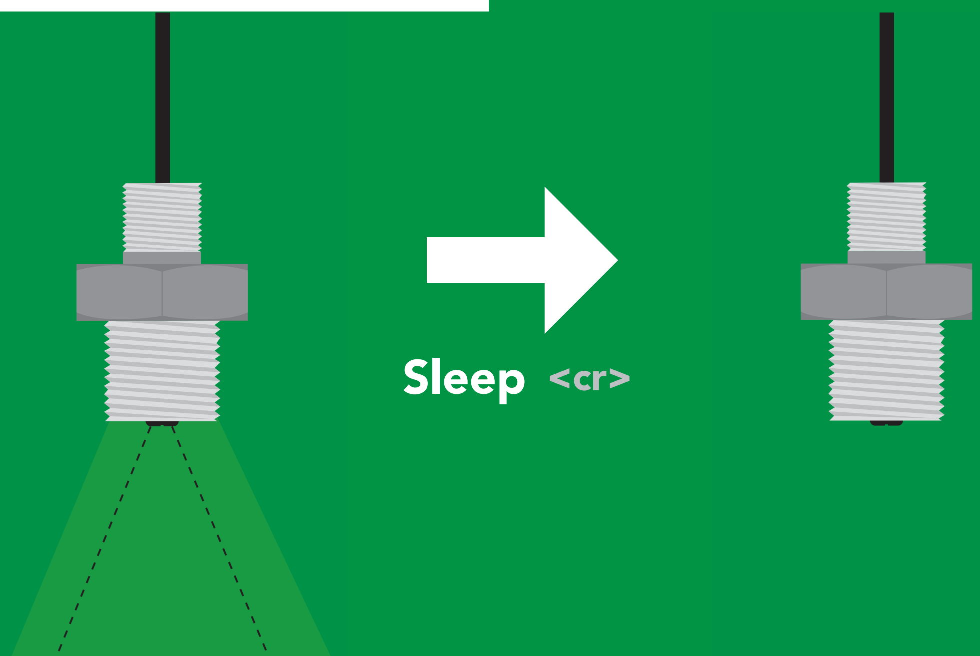
Command syntax

Send any character or command to awaken device.

Sleep <cr> enter sleep mode/low power

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

	MAX	SLEEP
5V	175 mA	0.40 mA
3.3V	138 mA	0.18 mA



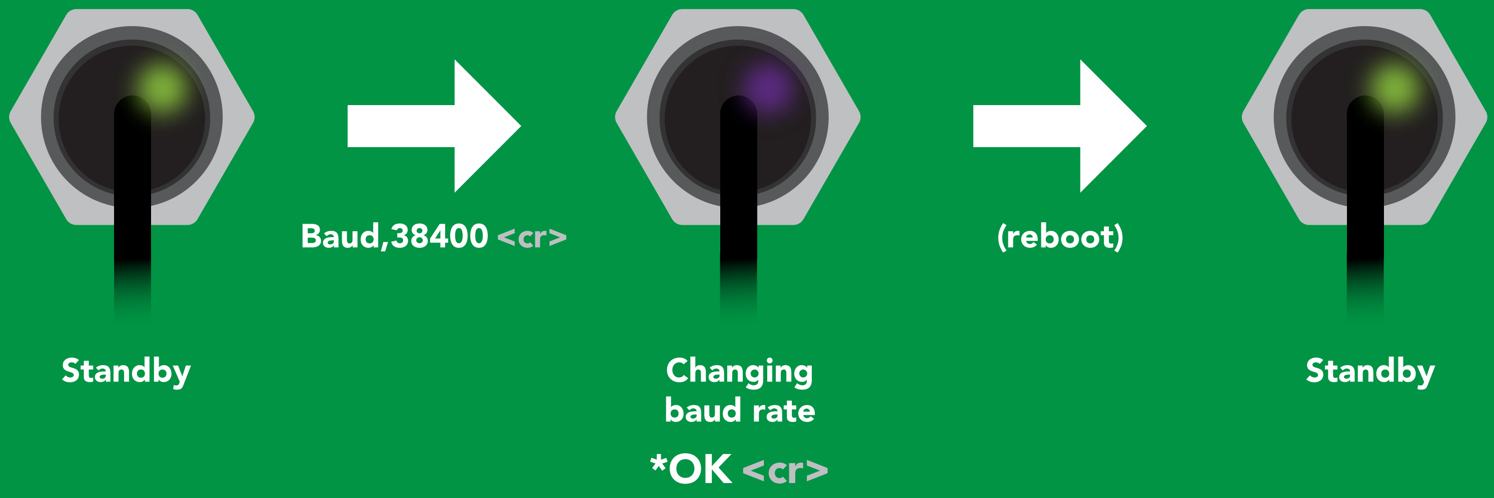
Change baud rate

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



Protocol lock

Command syntax

Locks device to UART mode.

Plock,1 <cr> enable Plock

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

Plock,? <cr> Plock on/off?

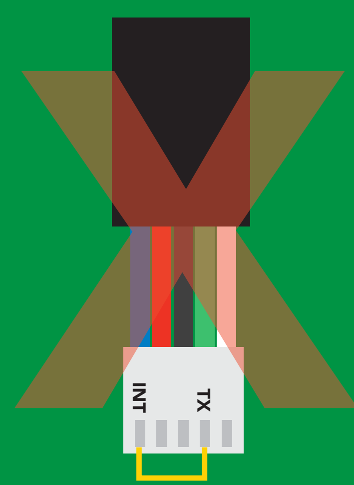
Example	Response
Plock,1 <cr>	*OK <cr>
Plock,0 <cr>	*OK <cr>
Plock,? <cr>	?Plock,1 <cr> or ?Plock,0 <cr>

Plock,1

*OK <cr>

I2C,100

cannot change to I²C
*ER <cr>



cannot change to I²C

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Factory reset

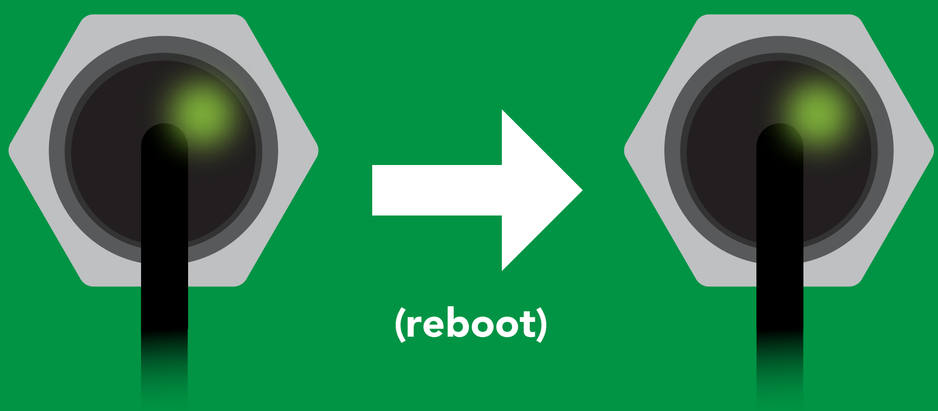
Clears calibration
Reset target LED brightness to 1%
Reset output to RGB
"*OK" enabled

Command syntax

Factory <cr> **enable factory reset**

Example	Response
Factory <cr>	*OK <cr>

Factory <cr>



*OK <cr>

*RS <cr>
*RE <cr>

Baud rate will not change

Change to I²C mode

Command syntax

Default I²C address 112 (0x70)

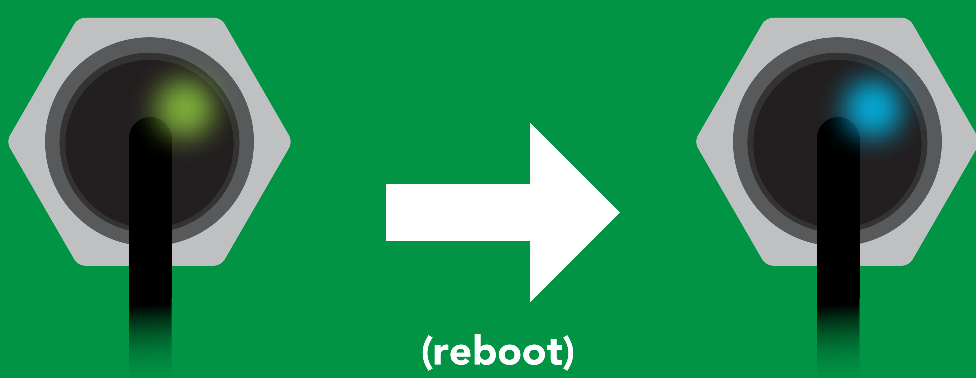
I2C,n <cr> sets I²C address and reboots into I²C mode

n = any number 1 – 127

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

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

I2C,100



(reboot)

Green
*OK <cr>

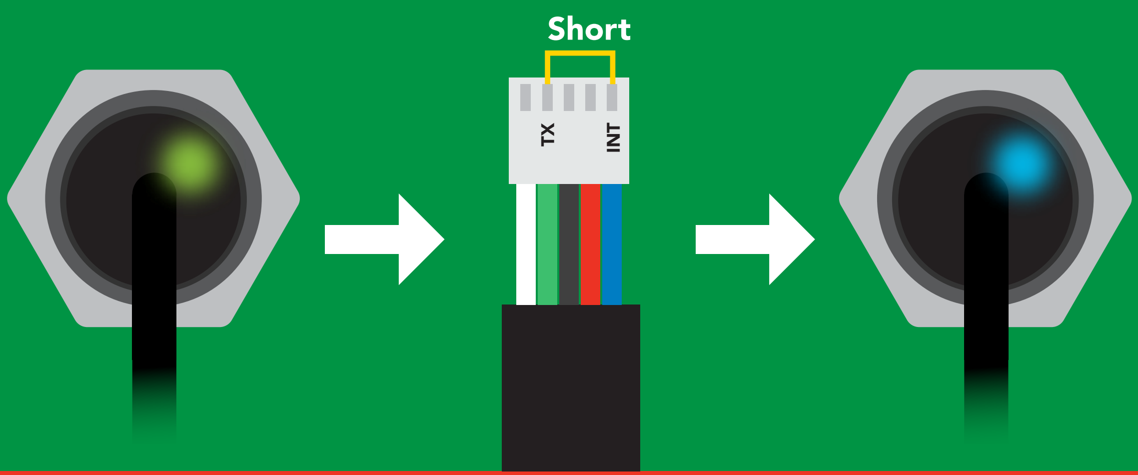
Blue
now in I²C mode

Manual switching to I²C

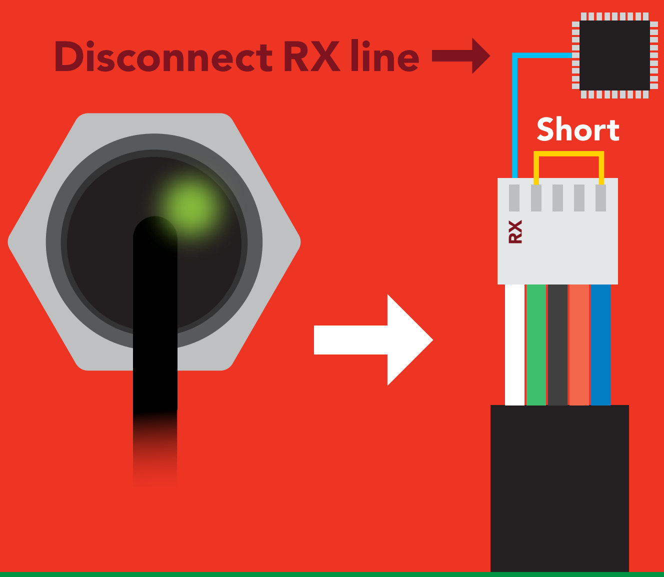
- Disconnect ground (power off)
- Disconnect TX and RX
- Connect TX to INT
- Confirm RX is disconnected
- Connect ground (power on)
- Wait for LED to change from Green to Blue
- Disconnect ground (power off)
- Reconnect all data and power

Manually switching to I²C will set the I²C address to 112 (0x70)

Example



Wrong Example



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

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

Settings that are *NOT* retained if power is cut

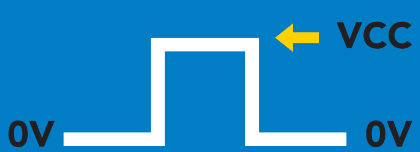
Sleep mode

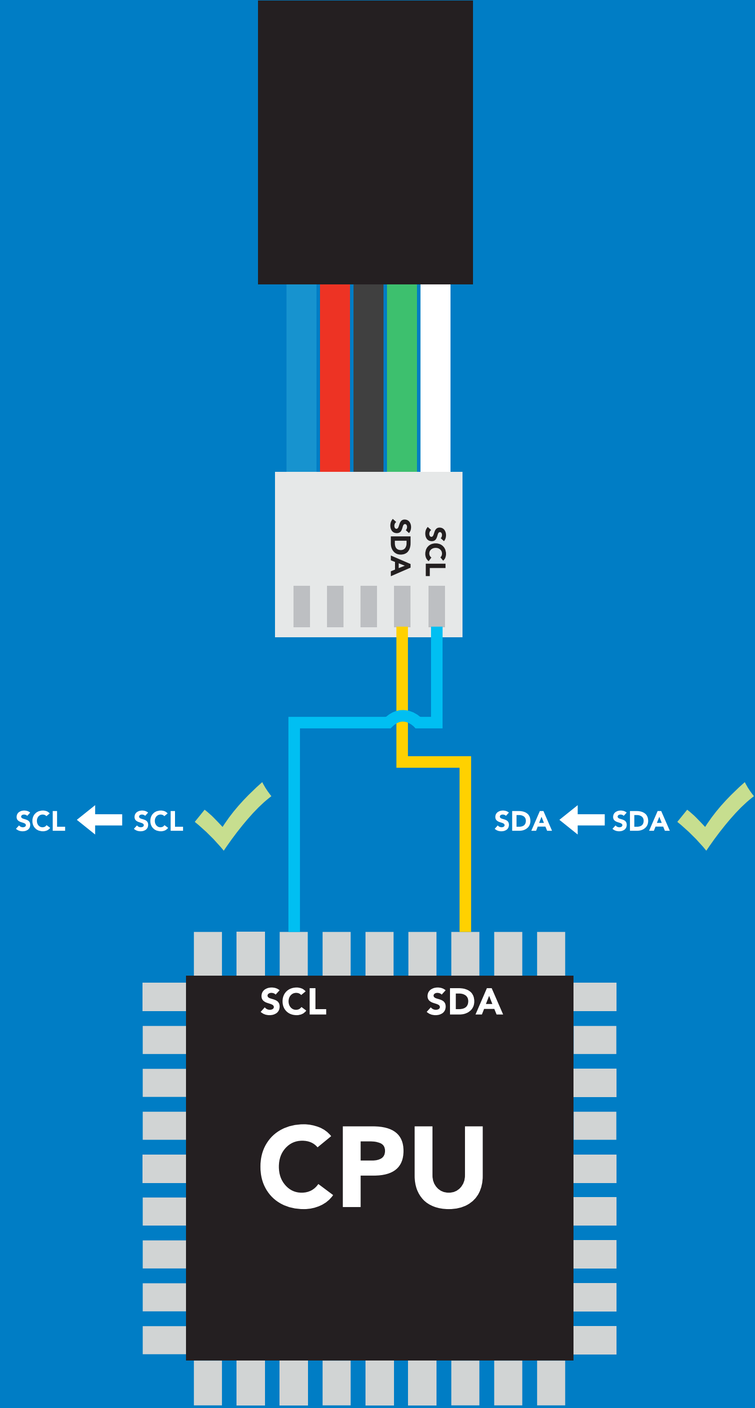
I^{2}C mode

I^{2}C address	(0x01 – 0x7F) 112 (0x70) **default**
Vcc	3.3V – 5.5V
Clock speed	100 – 400 kHz

SDA 

SCL 





Data format

Units	RGB, LUX, CIE, and proximity	**Data type**	integer & floating point
Encoding	ASCII	**Decimal places**	3
Format	string	**Smallest string**	4 characters
Terminator	carriage return	**Largest string**	52 characters

Sending commands to device

5 parts

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

I²C address: 112 (0x70)

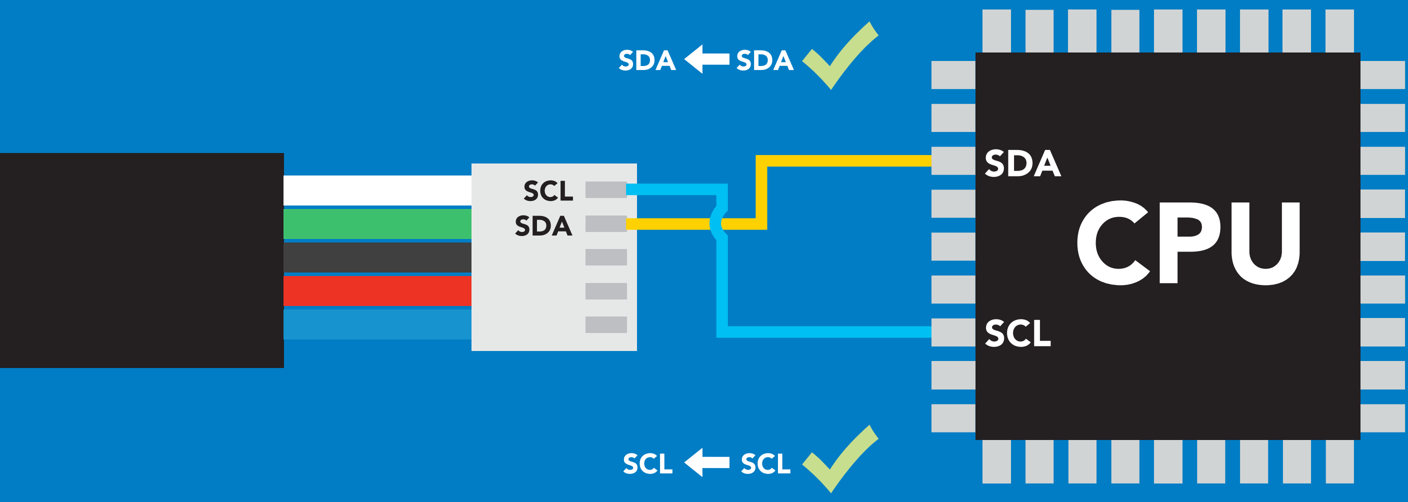
Command: ASCII command string

Example

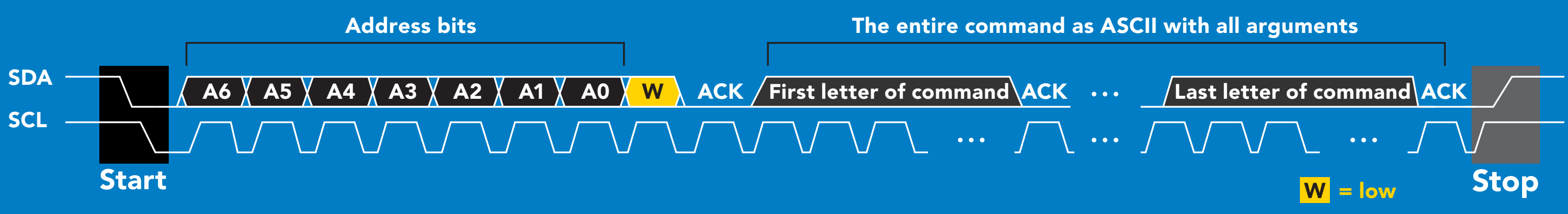
Start | 112 (0x70) | Write | Sleep | Stop

112 (0x70): I²C address

Sleep: Command



Advanced



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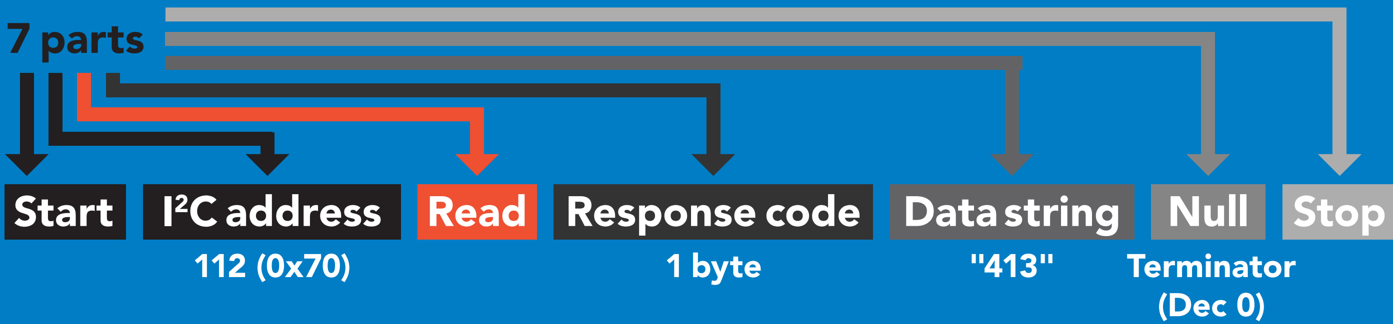
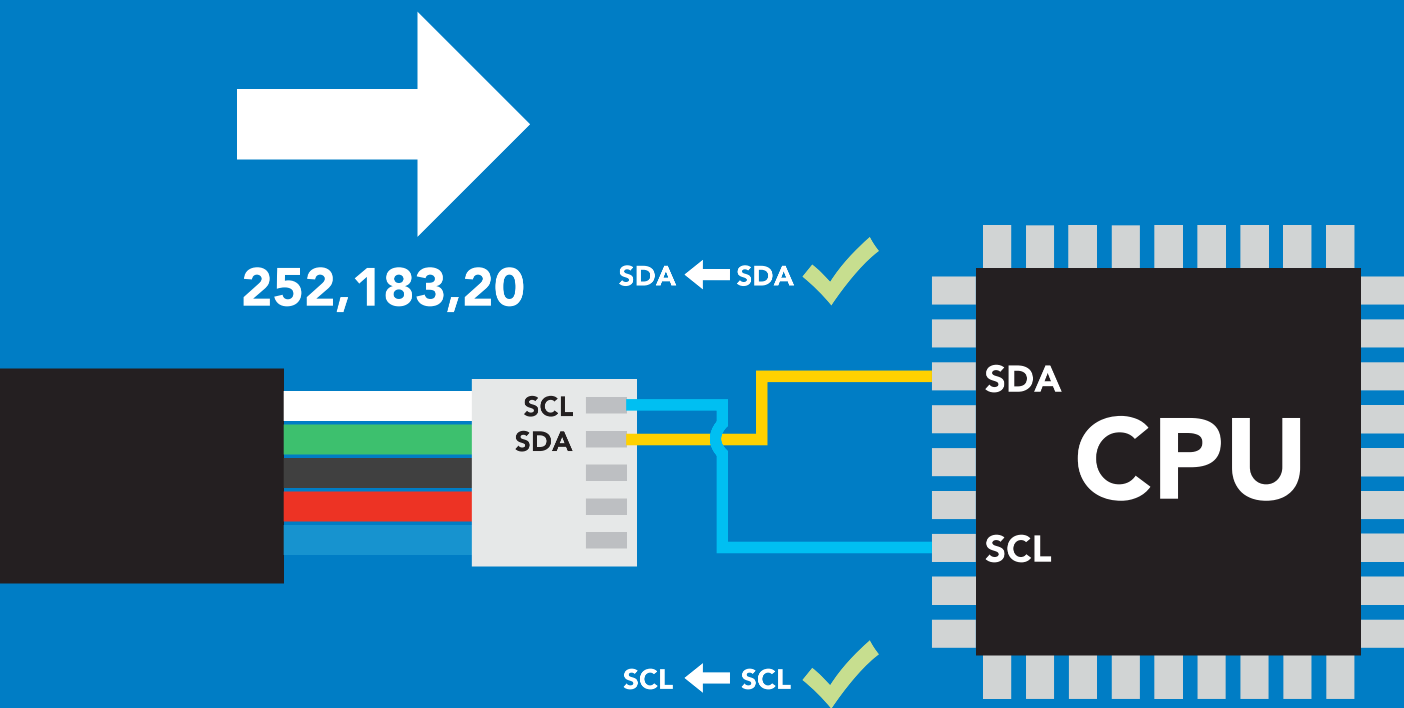
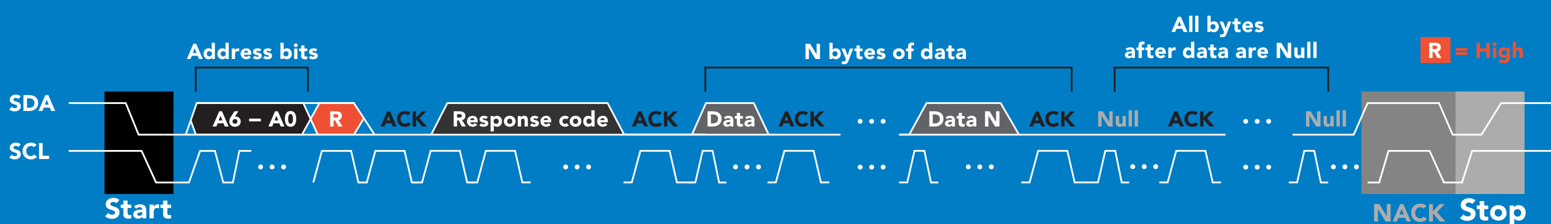
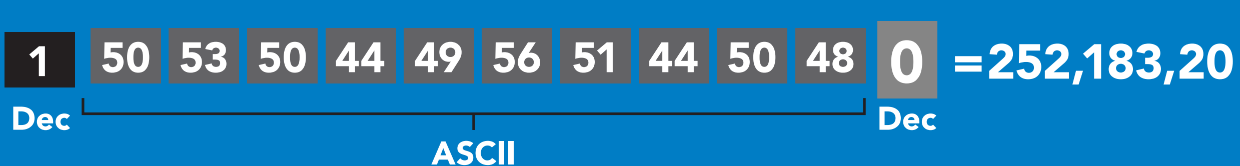
Requesting data from device





Advanced

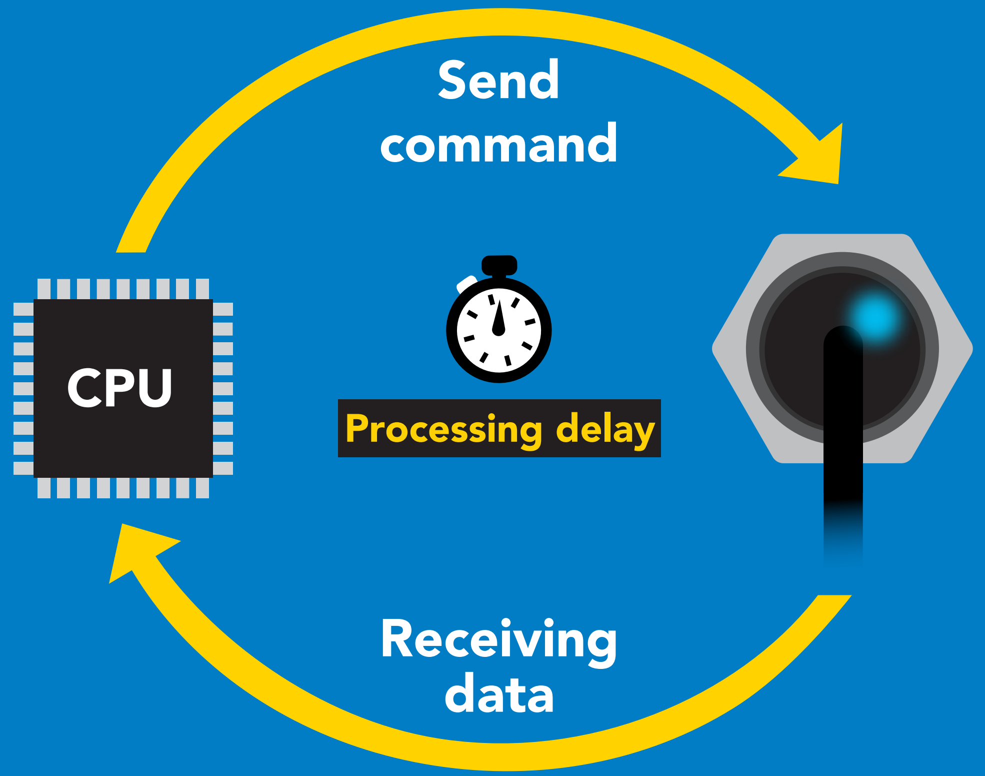




Response codes & processing delay

After a command has been issued, a 1 byte response code can be read in order to confirm that the command was processed successfully.

Reading back the response code is completely optional, and is not required for normal operation.



Example

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

delay(300);   Processing delay

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

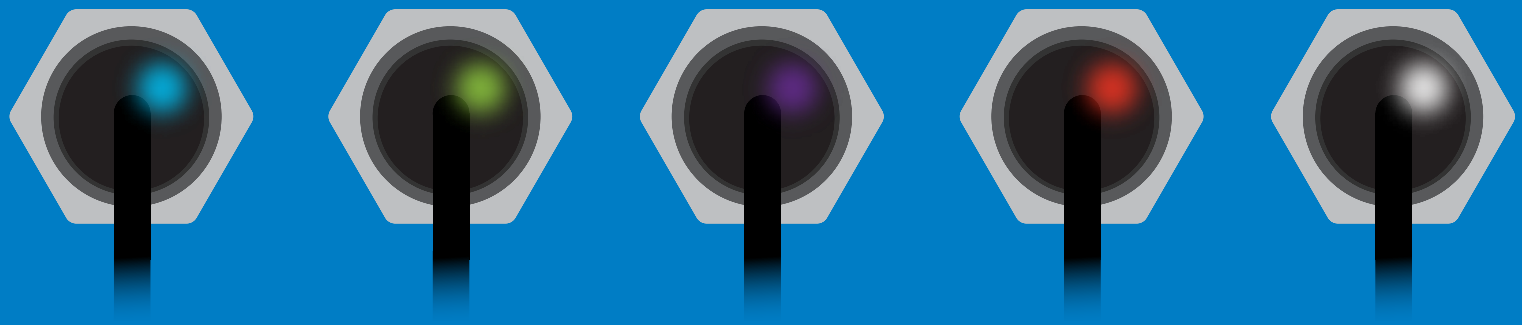
If there is no processing delay or the processing delay is too short, the response code will always be 254.

Response codes

Single byte, not string

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

Indicator LED control



Blue	Green	Purple	Red	White
I²C standby	Taking reading	Changing I²C address	Command not understood	Find

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

I²C mode
command quick reference

All commands are ASCII strings or single ASCII characters.

Command	Function	
Baud	switch back to UART mode	pg. 68
Cal	performs custom calibration	pg. 58
Factory	enable factory reset	pg. 67
Find	finds device with blinking white LED	pg. 56
G	gamma correction	pg. 59
i	device information	pg. 62
iL	enable/disable indicator LED	pg. 55
I2C	change I²C address	pg. 66
L	enable/disable target LED	pg. 54
Name	set/show name of device	pg. 61
O	enable/disable parameters	pg. 60
Plock	enable/disable protocol lock	pg. 65
R	returns a single reading	pg. 57
Sleep	enter sleep mode/low power	pg. 64
Status	retrieve status information	pg. 63

Target LED control

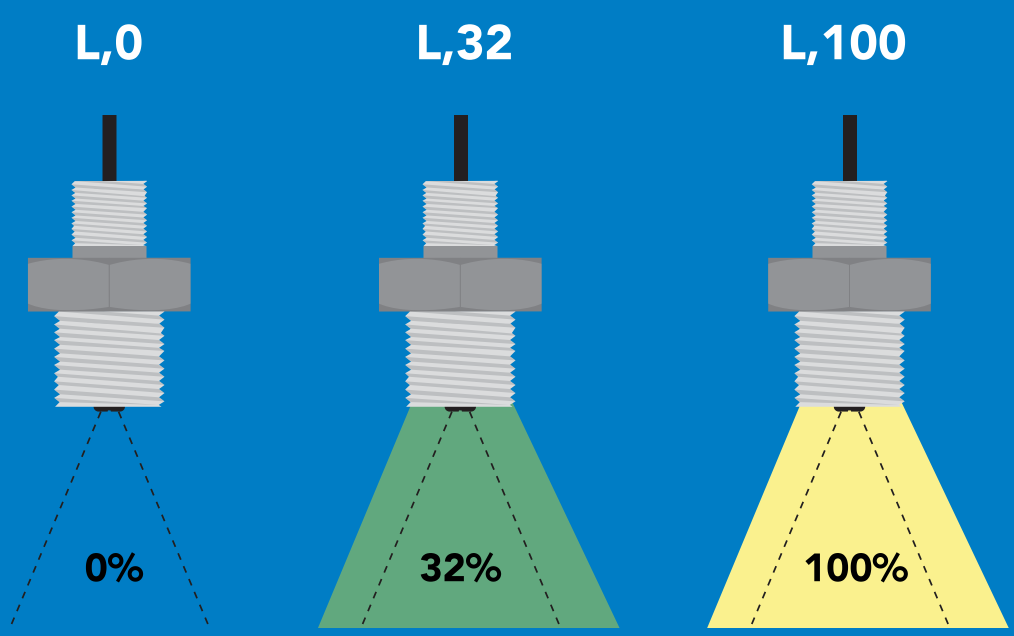
300ms processing delay

Command syntax

% represents the percentage of target LED brightness. (any number from 0 – 100)

L,%	set target LED brightness
L,%,T	set target LED brightness/trigger target LED only when a reading is taken *(power saving)*
L,?	target LED state on/off?

Example	Response	
L,32	Wait 300ms — 1 Dec — 0 Null	target LED set to 32% brightness.
L,14,T	Wait 300ms — 1 Dec — 0 Null	target LED set to 14% brightness, and will only turn on when a reading is taken.
L,?	Wait 300ms — 1 Dec — ?L, %, [T] ASCII — 0 Null	



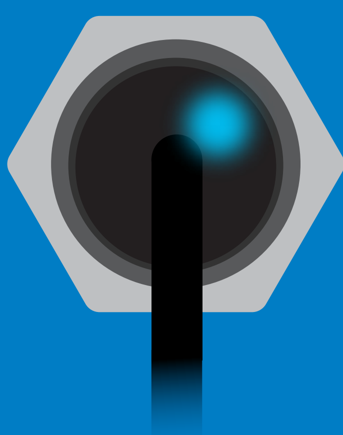
Indicator LED control

Command syntax

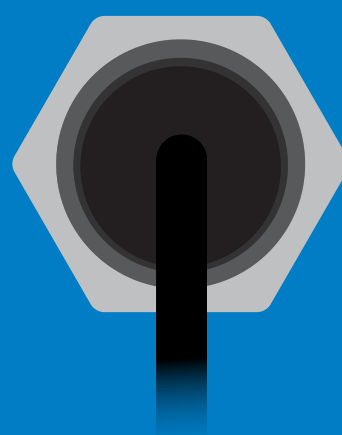
300ms processing delay

iL,1	indicator LED on	**default**
iL,0	Indicator LED off	
iL,?	Indicator LED state on/off?	

Example	Response
iL,1	Wait 300ms 1 Dec 0 Null
iL,0	Wait 300ms 1 Dec 0 Null
iL,?	Wait 300ms 1 Dec ?iL,1 ASCII 0 Null **or** Wait 300ms 1 Dec ?iL,0 ASCII 0 Null



iL,1



iL,0

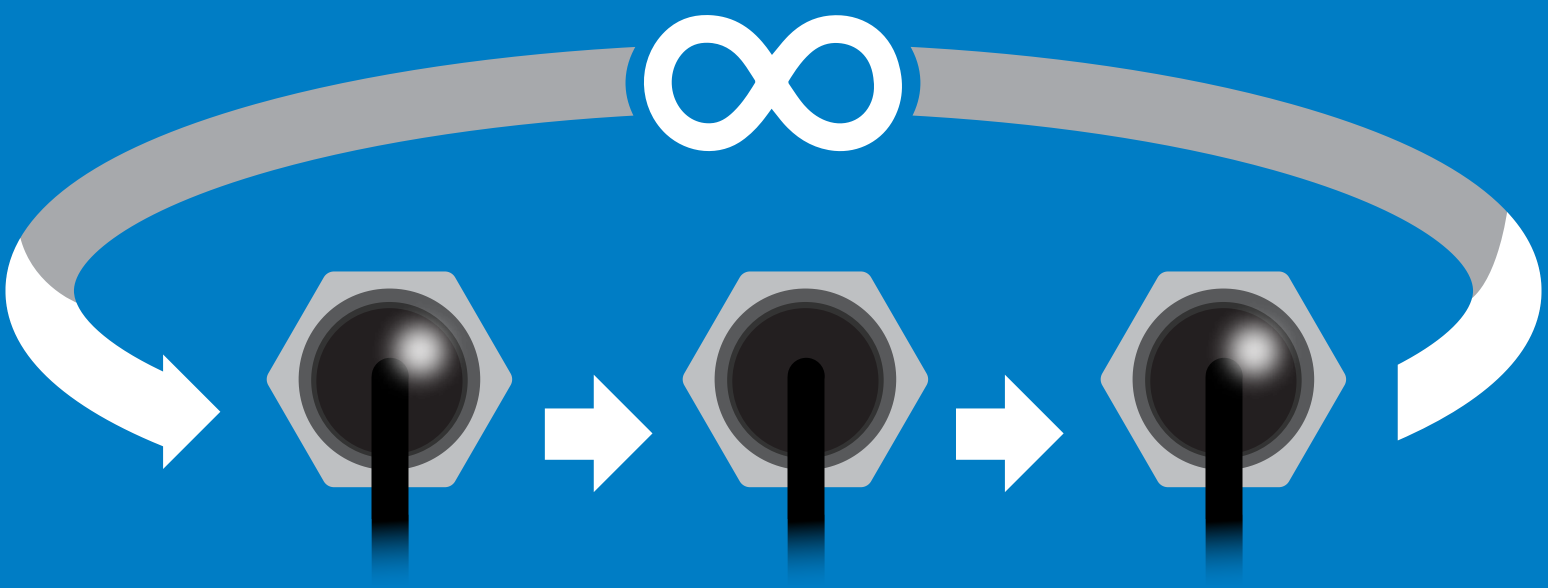
Find

Command syntax

300ms processing delay

Find	LED rapidly blinks white, used to help find device

Example	Response
Find	Wait 300ms 1 Dec 0 Null



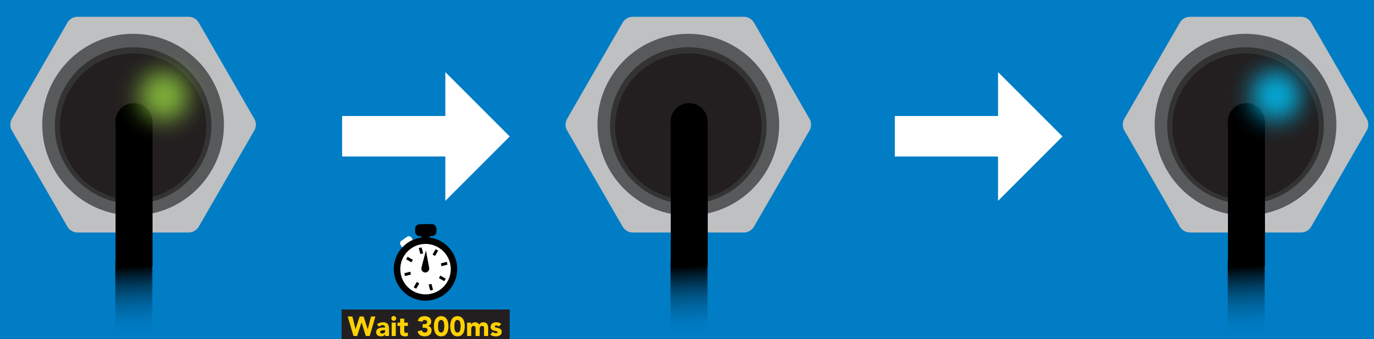
Taking reading

Command syntax

300ms processing delay

R	**return 1 reading**

Example	Response
R	Wait 300ms · 1 (Dec) · R,G,B (ASCII) · 0 (Null)



Calibration

Command syntax

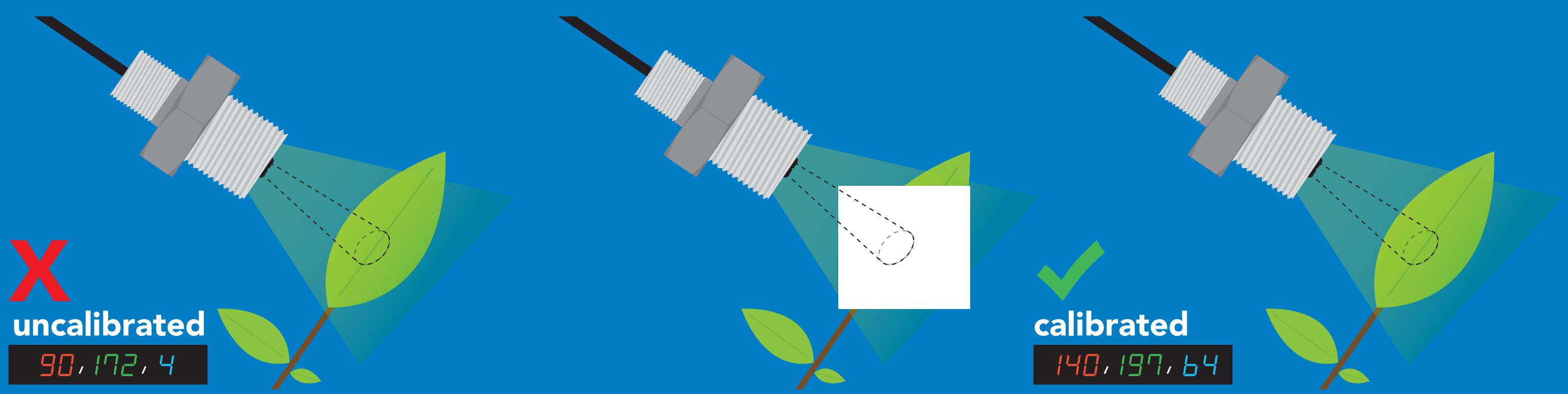
300ms processing delay

Cal calibrates the EZO-RGB™

1. place white object *(such as a piece of paper)* in front of target
2. Issue "cal" command

Example	Response
Cal	Wait 300ms 1 Dec 0 Null

Cal



Gamma correction

300ms processing delay

Command syntax

Adjusting the gamma correction helps adjust the color seen by the sensor.

G,n	**set gamma correction** where n = a floating point number from 0.01 – 4.99
G,?	**gamma correction value?**

The default gamma correction is 1.00 which represents no correction at all.
A gamma correction factor is a floating point number from 0.01 to 4.99.

Example	Response
G,1.99	Wait 300ms — 1 (Dec) 0 (Null)
G,?	Wait 300ms — 1 (Dec) ?G,1.99 (ASCII) 0 (Null)

Enable/disable parameters from output string

Command syntax

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

Example	Response
O,RGB,1 / O,RGB,0	Wait 300ms · 1 Dec · 0 Null · enable / disable RGB
O,LUX,1 / O,LUX,0	Wait 300ms · 1 Dec · 0 Null · enable / disable lux
O,CIE,1 / O,CIE,0	Wait 300ms · 1 Dec · 0 Null · enable / disable CIE
O,?	Wait 300ms · 1 Dec · ?,O,RGB,LUX,CIE ASCII · 0 Null · if all enabled

Parameters

RGB	red, green, blue
LUX	illuminance
CIE	CIE 1931 color space

Followed by 1 or 0

1	enabled
0	disabled

* If you disable all possible data types your readings will display "no output".

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Naming device

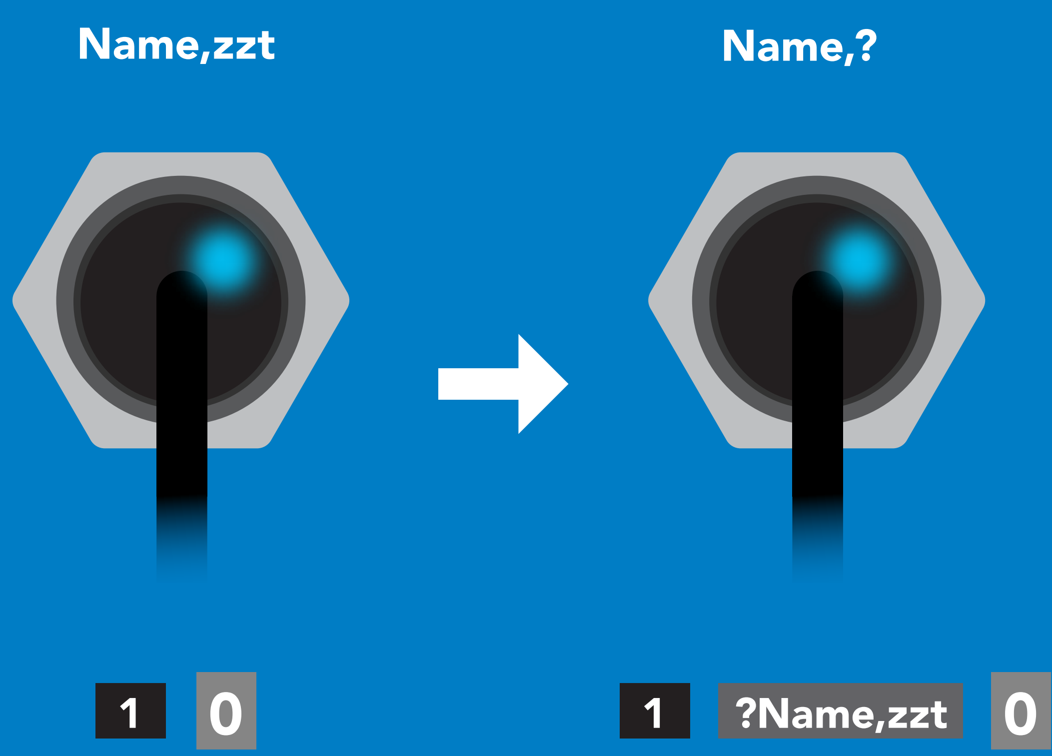
300ms processing delay

Command syntax

Do not use spaces in the name

Name,n	set name	n = _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ (1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16)
Name,?	show name	Up to 16 ASCII characters

Example	Response
Name,zzt	Wait 300ms — 1 (Dec) 0 (Null)
Name,?	Wait 300ms — 1 (Dec) ?Name,zzt (ASCII) 0 (Null)



Device information

Command syntax

300ms processing delay

i	device information

Example	Response
i	Wait 300ms · 1 (Dec) · ?i,RGB,1.3 (ASCII) · 0 (Null)

Response breakdown

?i, RGB, 1.3

RGB → Device

1.3 → 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

P, — Reason for restart

5.038 — Voltage at Vcc

Restart codes

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

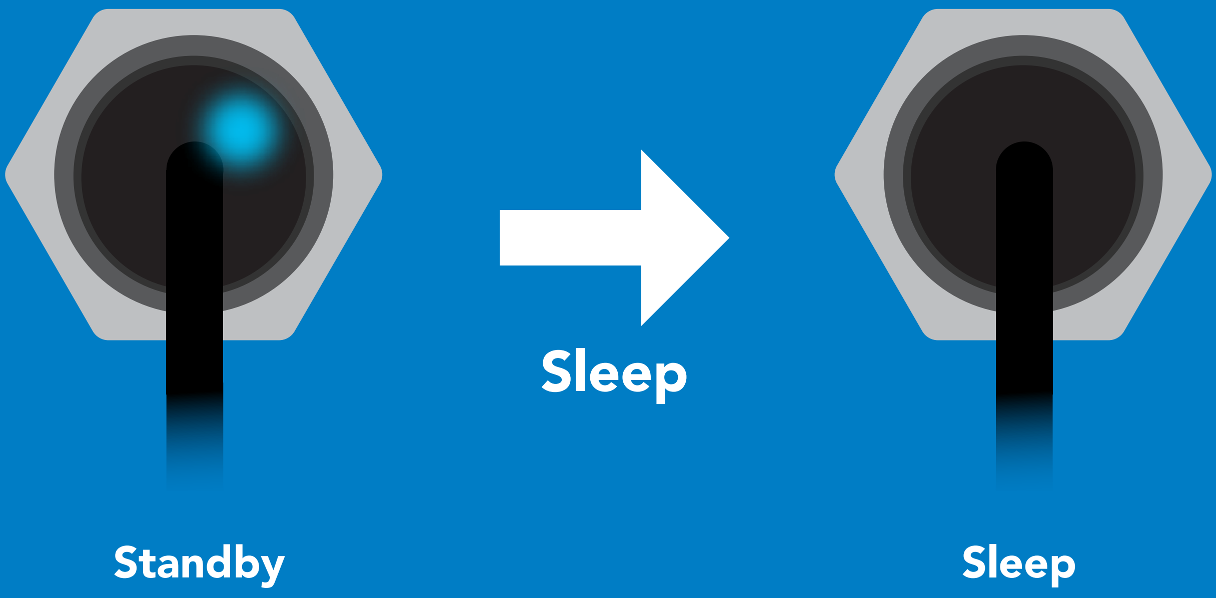
Sleep mode/low power

Command syntax

Sleep	enter sleep mode/low power	Send any character or command to awaken device.

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

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



Protocol lock

Command syntax

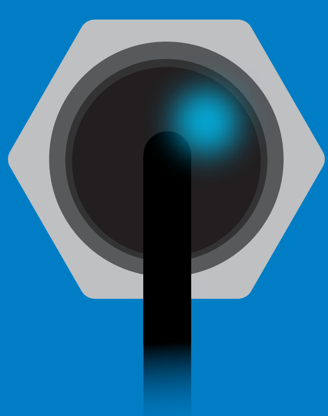
300ms processing delay

Plock,1	enable Plock	
Plock,0	disable Plock	default
Plock,?	Plock on/off?	

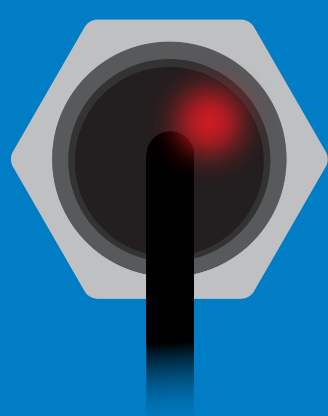
Locks device to I²C mode.

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)

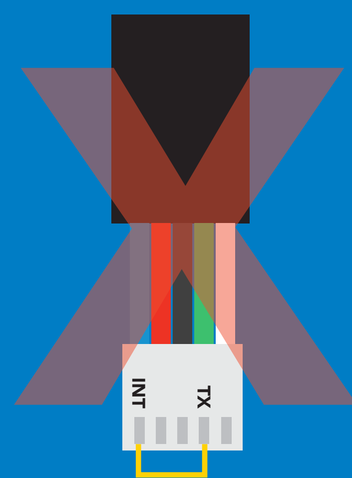
Plock,1



Baud, 9600



cannot change to UART



cannot change to UART

I²C address change

Command syntax

I2C,n	sets I²C address and reboots into I²C mode

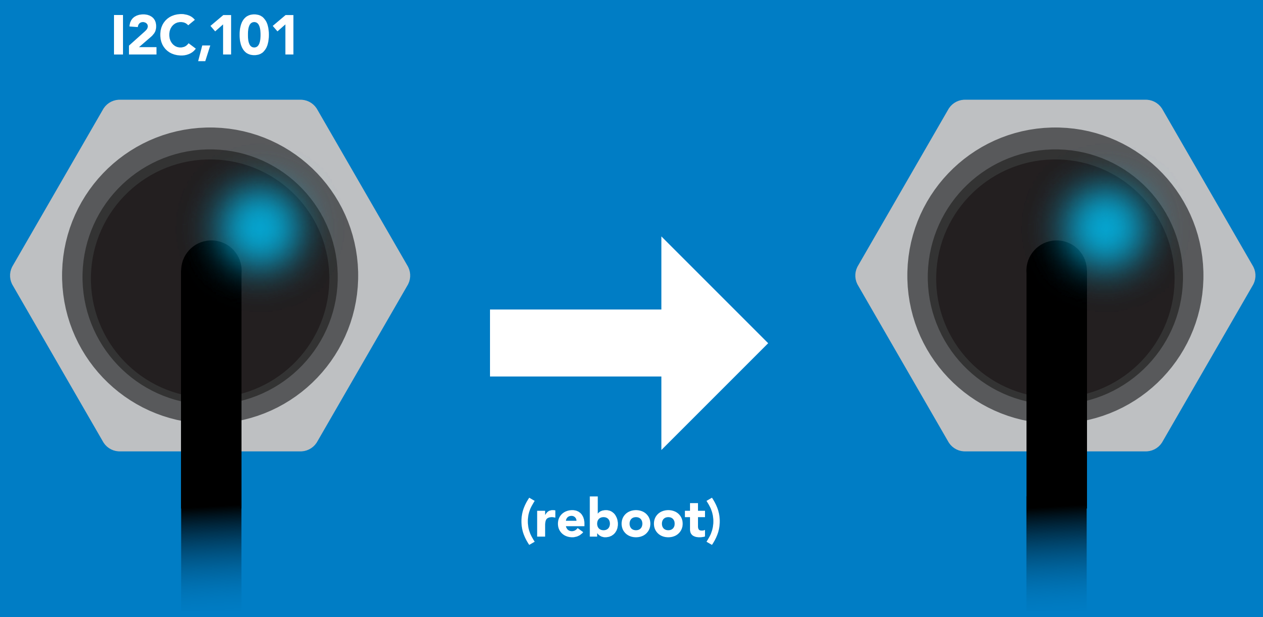
Example	Response
I2C,101	device reboot

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 112 (0x70).

n = any number 1 – 127



Factory reset

Command syntax

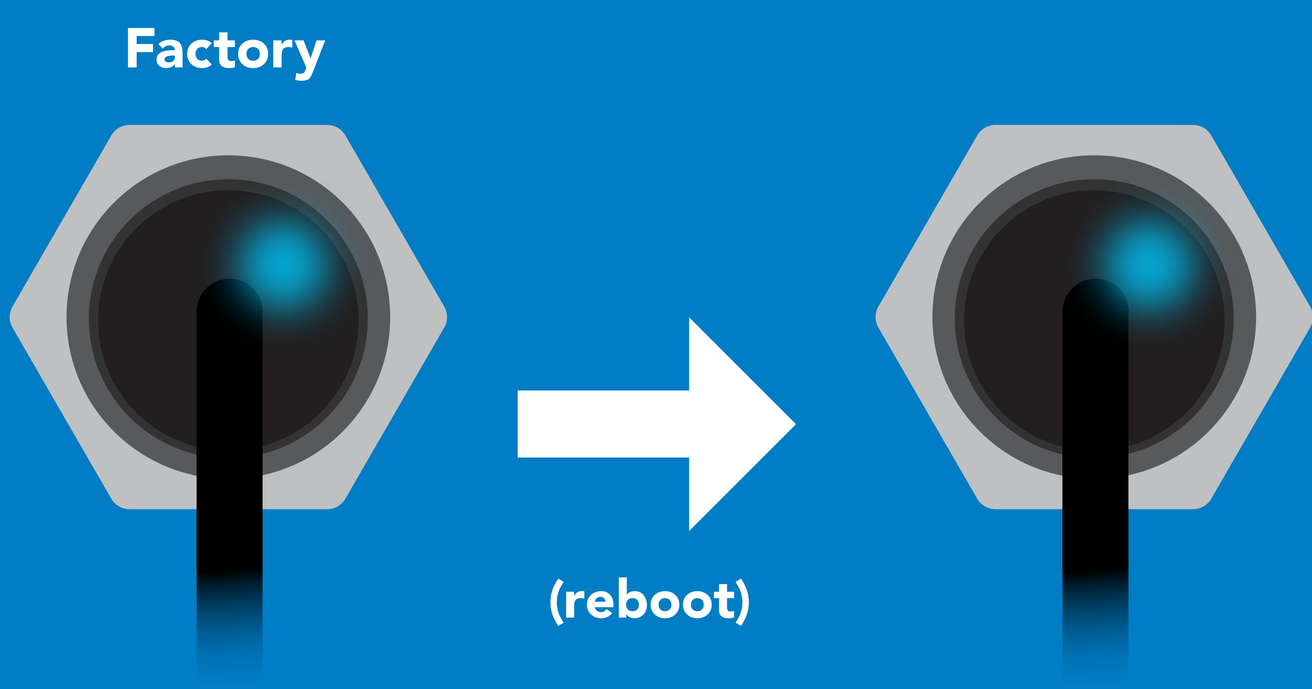
Factory reset will not take the device out of I²C mode.

Factory	**enable factory reset**

I²C address will not change

Example	Response
Factory	device reboot

Clears custom calibration
LED on
Response codes enabled



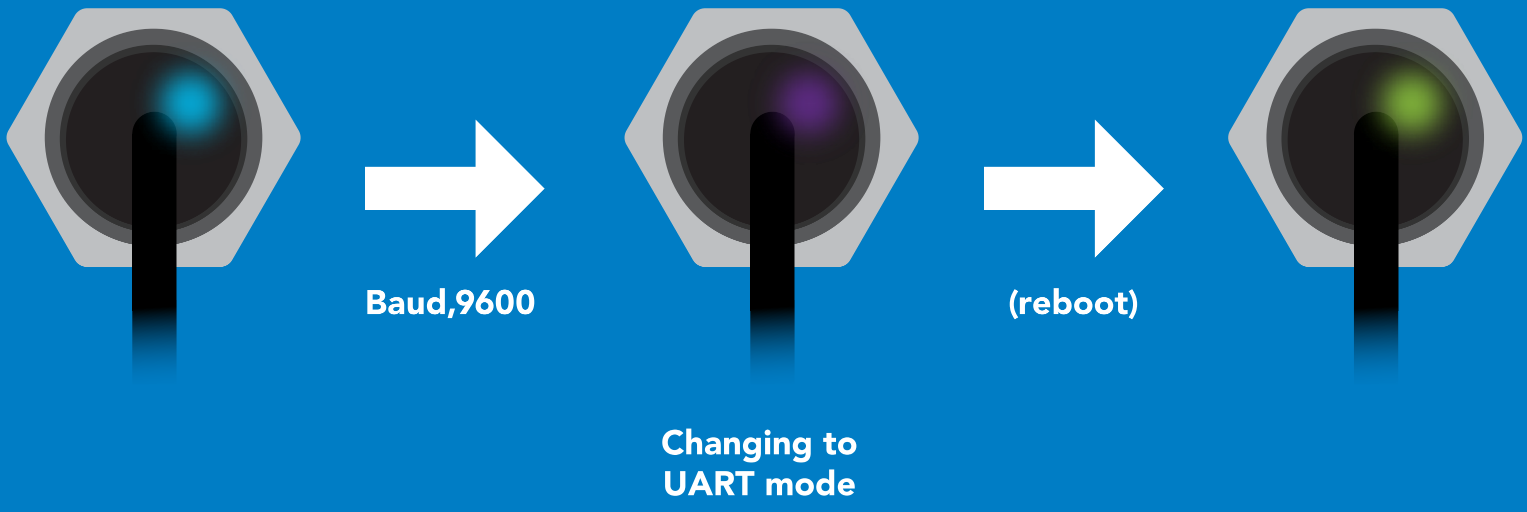
Change to UART mode

Command syntax

Baud,n	switch from I²C to UART

Example	Response
Baud,9600	reboot in UART mode

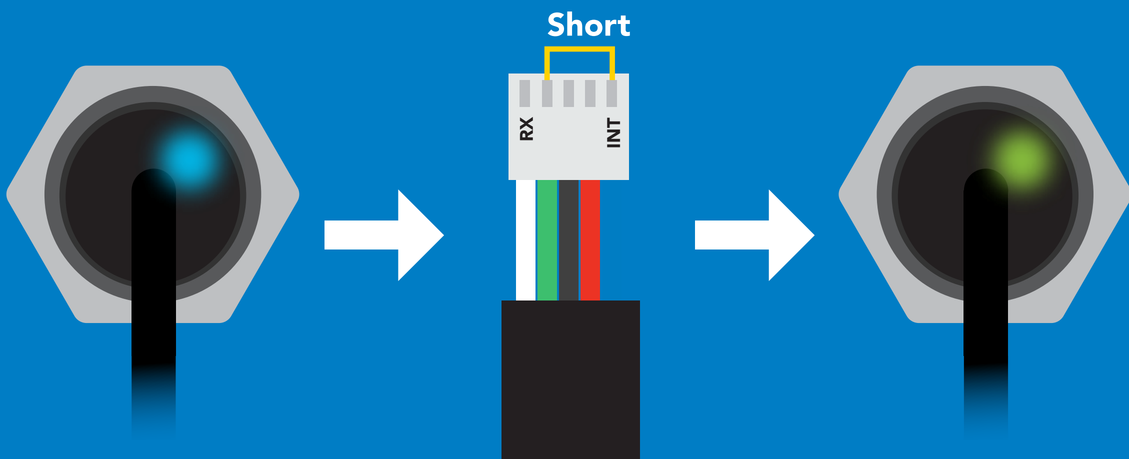
n =
- 300
- 1200
- 2400
- 9600
- 19200
- 38400
- 57600
- 115200



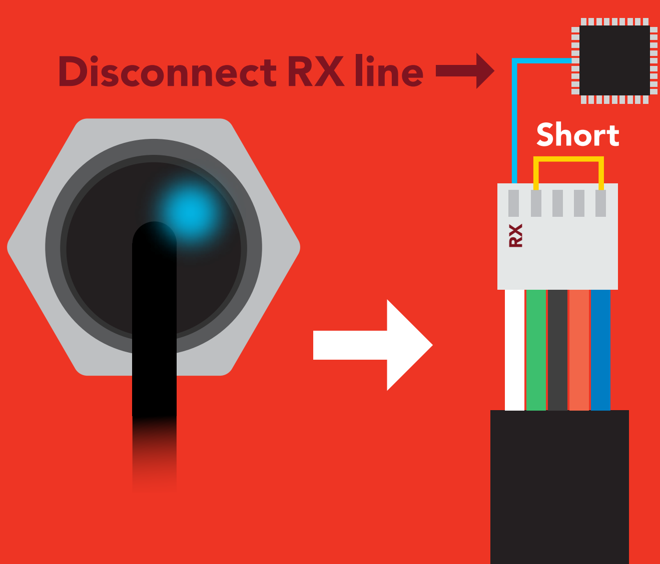
Manual switching to UART

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

Example



Wrong Example



Datasheet change log

Datasheet V 2.5

Corrected typo on pg 54.

Datasheet V 2.4

Moved Default state to pg 18.

Datasheet V 2.3

Changed the default I2C Address to 112 (0x70)

Datasheet V 2.2

Added an I²C section to the datasheet.

Datasheet V 2.1

Revised response for the sleep command in UART mode on pg 39.

Datasheet V 2.0

Revised entire datasheet

Firmware updates

V1.10 – (November 7, 2015)
- Fixed sleep mode bug.

V1.15 – (November 30, 2015)
- Fixed threshold bug.

V1.16 – (February 2, 2016)
- Fixed bug where excessive newline characters would be output for every line.

v1.18 - (Sept 19, 2016)
- Updated manufacturing process.

v1.2 - (June 29, 2017)
- Issuing the I²C command will return with an error.

v2.0 - (May 1, 2019)
- Added the RGB indicator LED and I²C mode, find command, C,n command

Warranty

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

The debugging phase

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

It is important for the embedded systems engineer to keep in mind that the following activities will void the EZO-RGB™ Embedded Color Sensor warranty:

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

Reasoning behind this warranty

Because Atlas Scientific™ does not sell consumer electronics; once the device has been embedded into a custom made system, Atlas Scientific™ cannot possibly warranty the EZO-RGB™ Embedded Color Sensor, against the thousands of possible variables that may cause the EZO-RGB™ Embedded Color Sensor to no longer function properly.

Please keep this in mind:

1. **All Atlas Scientific™ devices have been designed to be embedded into a custom made system by you, the embedded systems engineer.**

2. **All Atlas Scientific™ devices have been designed to run indefinitely without failure in the field.**

3. **All Atlas Scientific™ devices can be soldered into place, however you do so at your own risk.**

Atlas Scientific™ is simply stating that once the device is being used in your application, Atlas Scientific™ can no longer take responsibility for the EZO-RGB™ Embedded Color Sensor continued operation. This is because that would be equivalent to Atlas Scientific™ taking responsibility over the correct operation of your entire device.

