

Micro footprint Dissolved Oxygen monitoring circuit

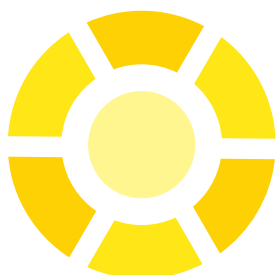
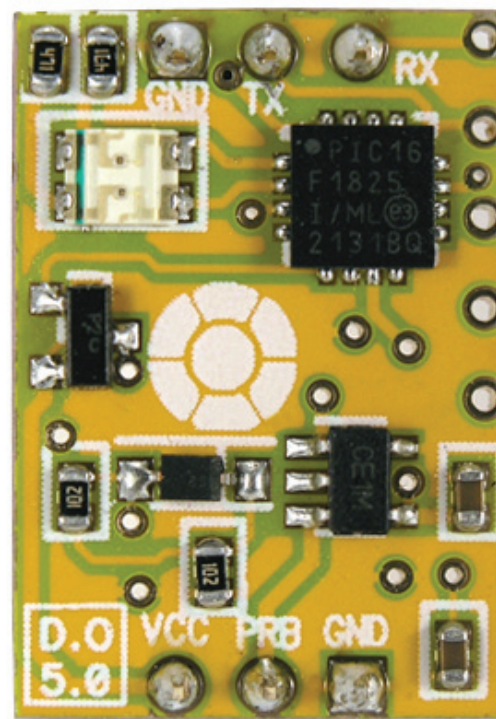
Features

- Full range Dissolved Oxygen readings ± 0.01
- Accuracy within three significant figures (XX.XXX Mg/L)
- Temperature dependent, or independent readings
- Fresh water/Saltwater/Brackish water readings
- Conductivity dependent, or independent readings
- Simple calibration
- Single reading, or continuous reading modes
- Simple asynchronous serial connectivity with 8 different baud rates
- Automatic baud rate detection
- Simple instruction set consisting of only 10 commands
- Debugging LED's
- 2.5V to 5.5V operational voltage
- Low power consumption
- ROHS compliant

4.7 mA at 3.3V in active mode*

4.0 mA at 3.3V in quiescent mode*

*LED's off



Description

Building upon our ever increasing expertise in the field of chemical analysis and robotics, D.O. 5 is our most advanced circuit yet. The Atlas Scientific D.O. 5 is even easier to use than any circuit before with simple calibration, accurate readings, new auto baud rate detection and improved LED debugging capabilities.

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System Overview

The Atlas Scientific D.O. 5 is a six pin microcomputer designed specifically to read dissolved oxygen from any galvanic HDPE Dissolved Oxygen Sensor (not included). The D.O. 5 is fully capable of compensating for temperature and salinity variations. The data output is a simple TTL RS-232 (0 to VCC) string consisting of the exact amount of Dissolved Oxygen in mg/L and the optional percentage D.O. Saturation. The default baud rate is set at 38,400 bps, however auto baud rate detection allows for eight different baud rates, ranging from 300 baud all the way up to 115.2k baud.

Pin Out

- GND** Return for the DC power supply. GND (& Vcc) must be ripple and noise free for best operation.
- Vcc** Operates on 2.5V – 5.5V
- TX** TX output delivers asynchronous serial data in TTL RS-232 format, voltages swings are 0-Vcc. The output is (up to 13) ASCII characters long representing the D.O. saturation percentage (optional) and the D.O. in **mg/L** each string ends with a carriage return (ASCII 13).

Example

1.37, 12.523

where 1.37, is the optional percentage of saturation and 12.523 is the D.O. in **mg/L**

The default baud rate is: **38400, 8 bits, no parity, with one stop bit.**

If standard voltage level RS232 is desired, connect an RS232 converter such as a MAX232. To see how to change baud rates, see page 9

- RX** TTL RS-232 receive pin
- PRB** D.O. Sensor connection
**For best results use an Atlas Scientific D.O. Sensor*

Absolute Maximum Ratings*

Parameter	MIN	TYP	MAX	Units
Storage temperature (D.O. Circuit)	-40		125	C°
Storage temperature (D.O. probe)	1	25	99	C°
VCC	2.5	3.3	5.5	V

An Atlas Scientific D.O. Sensor (not included) can operate continuously for approx. 24 months without needing recalibration. The D.O. Sensor (not included) can be fully submerged indefinitely excluding recalibration and cleaning.

***Note:** Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. Exposure to maximum rating conditions for extended periods may affect device reliability

Device operation

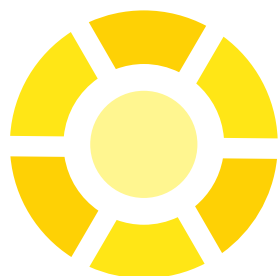
When the D.O. Circuit is first powered up it will immediately begin outputting D.O. Sensor readings Q 650ms whether a D.O. Sensor is connected or not. The data is the detected D.O. in mg/L (+/- 0.01 mg/L) transmitted through the TX pin at a baud rate of 38,400 bps (8 data bits, 1 stop bit, no parity, no flow control). The red LED will blink if an unknown command has been transmitted to the D.O Circuit. The D.O. Circuit will rapidly blink red/green if it has no set baud rate (see setting baud rate for more information).

A typical D.O. probe takes approximately 2 minutes to fully respond to a change in its environment. A small amount of fluctuation in the readings is normal.

There are a total of 10 different commands that can be given to the D.O. system.

All commands must be followed by a carriage return <CR>.

Commands are not case sensitive.



Command list

Quick reference

Command	Function	Default state
L1	Enables debugging LEDs	Enabled
L0	Disables debugging LEDs	Disabled
R	Returns a basic D.O. reading. Where the temperature is 20 ° Celsius and the conductivity is 0	Disabled
C	Returns continues readings Q 500ms at the temperature / conductivity previously used.	Enabled
%	Toggles on/off the percentage of D.O. saturation	Disabled
E	Stops all readings. Enter standby/quiescent mode.	N/A
TT.TT, CCCCC	Returns a temperature/ conductivity compensated D.O. reading (conductivity can be 0 if in fresh water)	N/A
TT.TT,B; TT.TT,S	Returns a temperature/ conductivity compensated D.O. reading. Where "s" is salt water or "b" is brackish water	N/A S= 54,000µs B=19,900 µs
X	Calibrates the D.O.	PO2 at sea level = .21
Z0	Change baud rate	38,400 bps
Z(1-8)	Set fixed baud rate	Z6 (38,400 bps)

Command Definitions

L1 This will enable both debugging LED's.

The D.O. Circuit has two LED's

Green LED Data output confirmation

Red LED Unknown command

By default, the LED's are enabled.

These LED's are designed to help the user determine that the D.O. Circuit is operating properly.

Changes to this setting are written to EEPROM memory and therefore will be retained even if the power is cut.

Keeping the LEDs on will consume an additional 30 mA

Full proper syntax: I1<cr> or L1<CR>

L0 This will disable both debugging LED's.

Changes to this setting are written to EEPROM memory and therefore will be retained even if the power is cut.

Full proper syntax: I0<cr> or L0<CR>

R Instructs the D.O. Circuit to return a single D.O. reading.

**This instruction takes 650 milliseconds to complete*

When using the "R" command the temperature is set at 20° C and the conductivity is set to 0.

**A conductivity of 0 may not seem realistic however; the conductivity is converted into salinity using the practical salinity scale. A salinity of < 2 is considered insignificant. Therefore the conductivity is set to 0 because; in freshwater it is irrelevant.*

Full proper syntax: r<cr> or R<CR>

The D.O. Circuit will respond: XX.XX<CR>

Where XX.XX is D.O. in mg/L

C Instructs the D.O. Circuit to take continues reading at the parameters previously set

% Instructs the D.O. Circuit to toggle on/off the percentage D.O. Saturation.

If the % command is transmitted the output of the D.O. circuit will append the percentage saturation followed by a comma.

Example

12.523 - Data output with percentage saturation disabled.

1.37, 12.523 - Data output after “%” command has been sent.

To disable this output, simply send the “%” command again.

Full proper syntax:

%<CR>

E Instructs the D.O. Circuit to cease continuous mode and enter its standby/quiescent mode.

Delivering this instruction when not in continuous mode will have no effect on the D.O. Circuit

Full proper syntax: e<cr> or E<CR>

The D.O. Circuit will respond by ceasing data transmission.

There is no ASCII response to this instruction.

TT.TT,CCCCC
TT.TT,B
TT.TT,S

Instructs the D.O. Circuit to return a single D.O. reading where temperature and/or conductivity are accounted for.

- Temperature is always in Celsius.
- Conductivity is always in Microsiemens
- "B" is a short hand way of setting the conductivity to that of brackish water: 19,900 μ s
- "S" is a short hand way of setting the conductivity to that of salt water: 54,000 μ s

Adding the Microsiemens (the conductivity) will have no positive effect on the readings **IN FRESH WATER AND SHOULD BE OMITTED. ADDING CONDUCTIVITY IN FRESH WATER MAY LEAD TO INACURATE READINGS.**

If you are taking a reading in fresh water simply set the conductivity to zero.

Example:

Temperature compensated reading in freshwater:
 19,0<CR>

Else

19,1200<CR> Here we take a temperature reading at 19 °C and at a conductivity of 1200 μ s.

Or

19,b<CR> Here we take a temperature reading at 19 °C and at a conductivity of brackish water 19,900 μ s

Or

19,s<CR> (here we take a temperature reading at 19 °C and at a conductivity of salt water 54,000 μ s

Or

19,80123 <CR> Here we take a temperature reading at 19 °C and at a conductivity of very salty water 80123 μ s

*The conductivity can be set as high as 99,999 or as low as 0

*The temperature can be set as high as 99 or as low as 0

X Instructs the D.O. Circuit to take a calibration reading.

Calibration should be done the first time the D.O. circuit is used. Dip your probe in water, just to get it wet. Let it sit in the air for 5 minutes. Do not leave it in water, it must calibrate to the oxygen level in the surrounding atmosphere. After 5 minutes, transmit the "x" command to calibrate. The **green** LED light will blink twice.

The D.O. Circuit will then transmit: "calibration set: nn"
Where nn is the atmospheric oxygen partial pressure, the D.O. Circuit will then return to standby mode. The calibration data will be stored in eeprom and will be used as the basis for all future readings. This data will not be lost due to power failure.

Full proper syntax: **x<cr>** or **X<CR>**

Setting baud rate

The Atlas Scientific D.O. circuit is set to a default rate of 38,400 bps. This baud rate can be changed to one of eight possible different baud rates.

- 1: 300 baud
- 2: 1200 baud
- 3: 2400 baud
- 4: 9600 baud
- 5: 19.2k baud
- 6: 38.4k baud
- 7: 57.6k baud
- 8: 115.2k baud

Z0 Set the auto baud rate

Transmitting the "Z0<cr>" command will set the D.O. Circuit to auto baud detection mode. The red/green LEDs will rapidly blink, the D.O. Circuit will be waiting to receive the letter "U" (Ascii 85) followed by a <cr> at one of the eight possible baud rates.

Example

(at default baud rate 38.4k bps)
Z0<CR> or z0<cr>
The D.O. circuit will now begin rapid **red/green** LED blinking

Change your TX baud rate to your desired setting - i.e. 9600 baud and send the "U" command
U<CR>

The D.O. Circuit will now operate at 9600 baud

*** By using the Z0 command the D.O. circuit will enter baud rate detection mode each time it is powered up. If this is not desired simply use the Z(1-8) command**

Z(1-8) Set fixed baud rate

Sending the Z(1-8) command will instantly set the D.O Circuit to a new baud rate.
This new baud rate will be stored to EEPROM and will be retained even if the D.O. Circuit is powered off.

Example

(at default baud rate 38.4k bps)

z4<cr> OR Z4<CR>

The D.O. Circuit baud rate has now been changed from 38.4k bps to 9600 bps
The baud rate can be changed at any time, and as many times as you like.

I Instructs the DO Circuit to transmit its version number.

A comma separated string will be transmitted that will contain 3 values.

- | | |
|---------------------------------|-------------------------|
| 1. The type of device: | "D" (for D.O.) |
| 2. The firmware version number: | "V5.0" |
| 3. The firmware version date: | "1/13" (January / 2013) |

Full proper syntax: i<cr> or I<CR>

The D.O. Circuit will respond:

D,V5.0,1/13<CR>

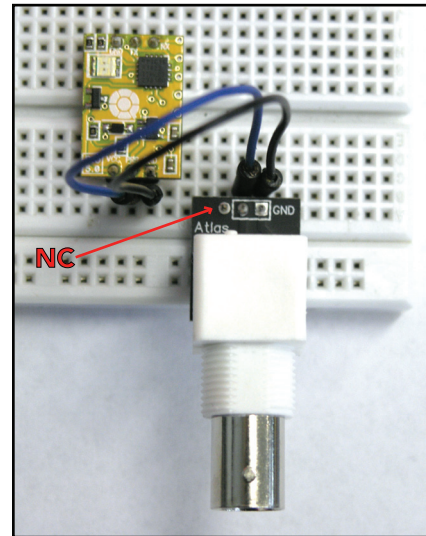
REMEMBER **ALL** TRANSMISSIONS ARE TERMINATED WITH A <CR>.
THEY ARE NOT TERMINATED WITH A <CR><LF>.
MAKE SURE YOUR CODE DOES NOT INADVERTENTLY SEND <CR><LF>
AT THE END OF A TRANSMISSION.

OK= I<CR>

NOT OK = I<CR><LF>

- * A typical D.O. Sensor should be considered inaccurate if it has been frozen
- * A typical D.O. Sensor should be considered inaccurate if it has been boiled

Do not use this type of connection



We recommend connecting the D.O. circuit as shown.

