AtlasScientific
Biology • Technology

ORP Circuit

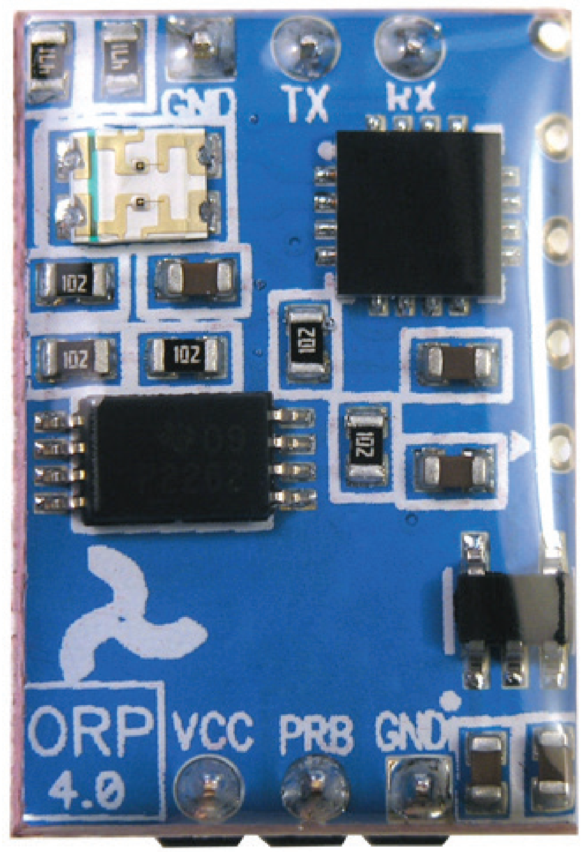
V 4.0
Reduced instruction length
Calibration

Micro footprint ORP monitoring subsystem

Features

- Full range ORP reading from 0 to +1023.99 and –1023.99 mV
- Single reading, or continuous reading modes
- Simple (optional) calibration protocol
- Simple asynchronous serial connectivity with eight different baud rates
- Automatic baud rate detection
- Simple instruction set consisting of only 10 commands
- 3.3V to 5.5V operational voltage
- Debugging LED's
- Micro footprint circuitry
- Low power consumption
- ROHS compliant

10 mA at 3.3V in active mode*
7.0 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, ORP 4 is our most advanced circuit yet. The Atlas Scientific ORP 4 is even easier to use than any circuit before with simple calibration, accurate readings, new auto baud rate detection and improved LED debugging capabilities.

Contents

System Overview

The Atlas Scientific ORP 4 is a six pin microcomputer designed specifically to read the Oxidation-Reduction Potential from any standard ORP sensor (not included). The data output is a simple asynchronous serial TTL RS-232 (0 to VCC) string consisting of the exact ORP in millivolts from -1023.99 to +1023.99mv 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 3.3V – 5.5V

TX TX output delivers asynchronous serial data in a TTL RS-232 format, except voltages are 0-Vcc. The output is (up to twelve) ASCII characters representing the ORP, or status messages; all ending with a carriage return (ASCII 13).

Example

273.00 <CR>

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 10.

RX Asynchronous serial TTL RS-232 receive pin (0-VCC, not +/- 12 volts)

PRB ORP Sensor connection
**For best results use an Atlas Scientific ORP Sensor*

Absolute Maximum Ratings*

Parameter	MIN	TYP	MAX	Units
Storage temperature (ORP Circuit)	-40		125	C°
Storage temperature (ORP probe)	1	25	35	C°
VCC	3.3	3.3	5.5	V

An Atlas Scientific ORP Sensor (not included) can operate continuously for approx. 24 months without needing recalibration. The ORP 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 ORP Circuit is first powered up it will immediately begin outputting ORP Sensor readings Q 320ms whether an ORP Sensor is connected or not. The data is the detected ORP in millivolts transmitted through the TX pin at a baud rate of 38,400 bps (8 data bits, 1 stop bit, no parity, no flow control followed by a green LED blink.). The red LED will blink if an unknown command has been transmitted to the ORP Circuit. The ORP Circuit will rapidly blink red/green if it has no set baud rate (see setting baud rate for more information).

There are a total of 10 different commands that can be given to the ORP Circuit.
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	Takes one ORP reading	N/A
C	Takes continuous ORP readings every .320 seconds	Enabled
E	Stops all readings. Enter standby/quiescent mode.	N/A
+	Calibration: increase ORP	N/A
–	Calibration: decrease ORP	N/A
X	Return Circuit to factory settings	N/A
I	Information: Type of Circuit| firmware version | date of firmware	N/A
Z0	Change Baud Rate	N/A
Z(1-8)	Set fixed baud rate	38,400 bps

Command Definitions

L1 This will enable both debugging LED's.

The ORP Circuit has two LED's
Green LED .... Instruction received/ORP transmit
Red LED .... Unknown instruction received

These LED's are designed to help the user determine
that the ORP 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: **l1<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: **l0<cr> or L0<CR>**

R Instructs the ORP Circuit to return a single ORP reading.

*This instruction takes 320 milliseconds to complete

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

The ORP Circuit will respond with a value representation of the ORP output
up to 8 ASCII characters followed by a <CR>

Full proper syntax: **-1024.00 <CR> or 1024.00<CR>**

C The ORP Circuit will operate in **continuous** mode and deliver an ORP reading every 320 milliseconds until the “e” command is transmitted.

Full proper syntax: C<CR>

XXX<CR> (320 milliseconds)
XXX<CR> (640 milliseconds)
XXX<CR> (960 milliseconds)
XXX<CR> (n+ 320 Seconds)

E This instructs the ORP Circuit to end continuous mode and enter its standby/quiescent mode.

Delivering the “E” (END) instruction, when not in continuous mode, will have no effect on the ORP Circuit.

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

The ORP Circuit will respond by ceasing data transmission.
There is no ASCII response to this instruction.

Calibration Instructions

It is strongly recommended that calibration be done through a terminal emulator on a PC.
That way it is easy to see the changes to the ORP readings.

+ This instructs the ORP Circuit to add an offset of 1 mV to the original ORP reading.

Full proper syntax: **+<CR>**

– This instructs the ORP Circuit to subtract an offset of 1 mV to the original ORP reading.

Full proper syntax: **-<CR>**

In order to calibrate the ORP Circuit, it MUST be in continues mode.

Step 1: Put ORP Circuit in continuous mode by transmitting the "C" command.
Step 2: Place ORP probe in known ORP solution.
Step 3: Stir the ORP probe in the solution for ~5 seconds.
Step 4: Let the ORP probe sit for ~1 minute.
Step 5: Transmit the +/- command depending on what is needed.

All calibration changes are stored in the ORP Circuit eeprom and will not be lost on power down.

If a mistake is made during the calibration process, the ORP Circuit can be returned to its original factory setting by transmitting the "x" command.

X Instructs the ORP Circuit to return to its original factory settings.

Transmitting this command will:

Reset calibration off set back to 0.
Set debugging LED to on.

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

The ORP Circuit will respond:

reset<CR>

I Instructs the ORP Circuit to transmit its version number.

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

1. The type of device:	"O" (for ORP)
2. The firmware version number:	"V4.4"
3. The firmware version date:	"2/13" (February / 2013)

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

The ORP Circuit will respond:

O,V4.4,2/13<CR>

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

OK= I<CR> **NOT OK = I<CR><LF>**

Setting baud rate

The Atlas Scientific ORP circuit is set to a default rate of 38,400 bps. This baud rare 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 ORP Circuit to auto baud detection mode. The red/green LEDs will rapidly blink, the ORP 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 ORP 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 ORP Circuit will now operate at 9600 baud

*** By using the Z0 command the ORP 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 ORP Circuit to a new baud rate.
This new baud rate will be stored to EEPROM and will be retained even if the ORP Circuit is powered off.

Example

(at default baud rate 38.4k bps)

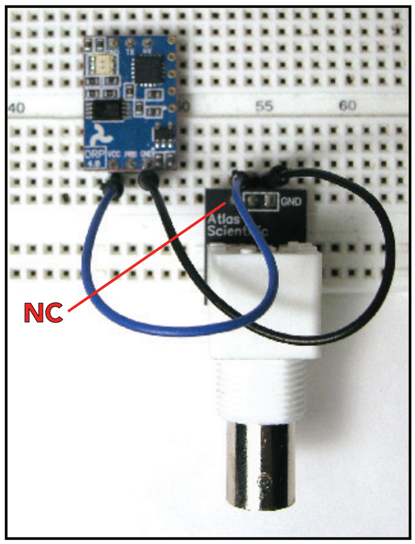
z4<cr> OR Z4<CR>

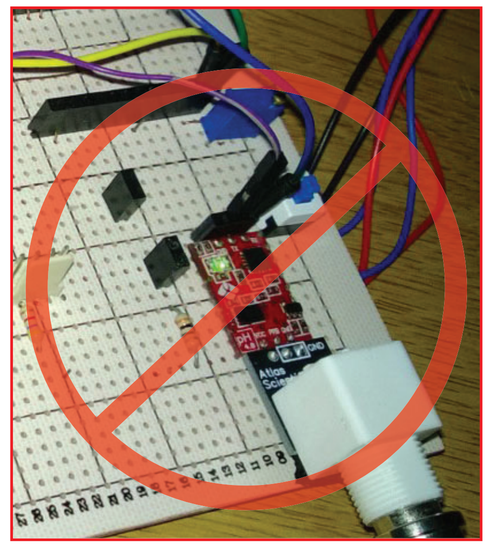
The ORP Circuit baud rate has now been changed from 38.4k bps to 9600 bps
The baud rate can be changed at any time, and as many times as you like.

***An ORP Sensor will typically last between three and four years**
***An ORP Sensor should be considered inaccurate if it has been frozen**
***An ORP Sensor should be considered inaccurate if it has been allowed to dry**
***An ORP Sensor should be considered inaccurate if it has been boiled**

*The Wire length, from the ORP Sensor to the ORP Circuit, should be as short as possible to reduce noise.

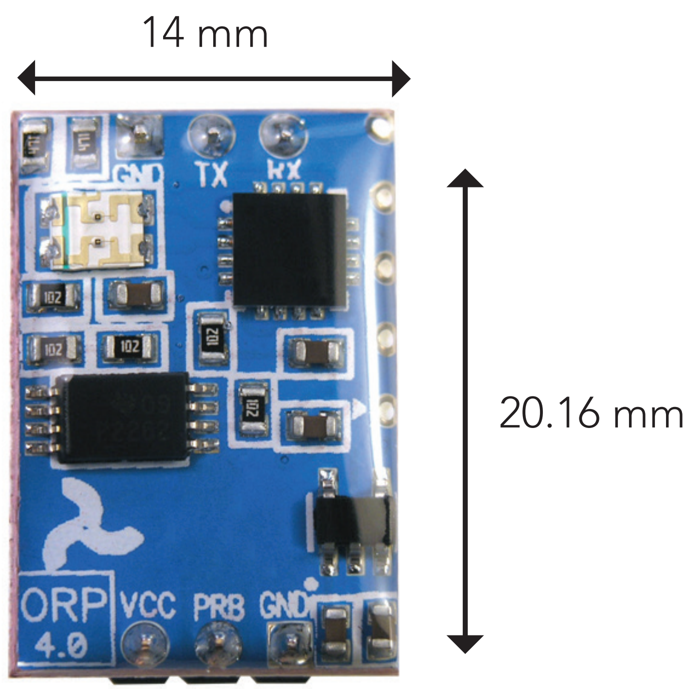
Do not use this type of connection



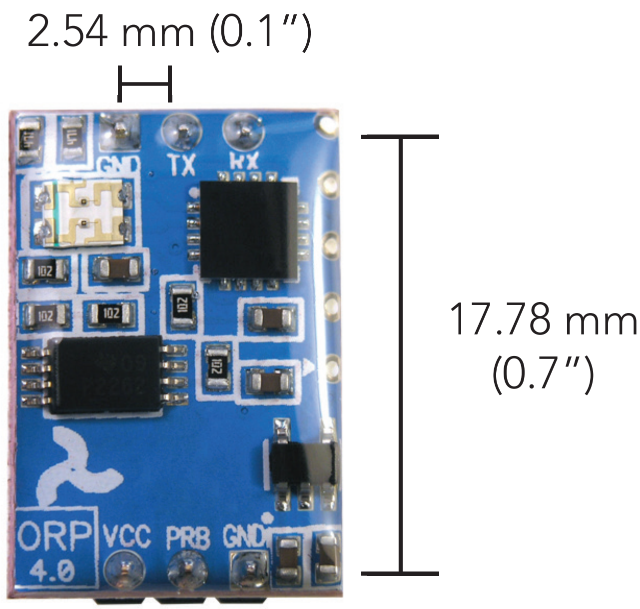


Do not use protoboard

We recommend connecting the ORP Circuit as shown.

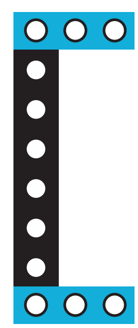


How to make a Footprint for the Atlas Scientific ORP Circuit

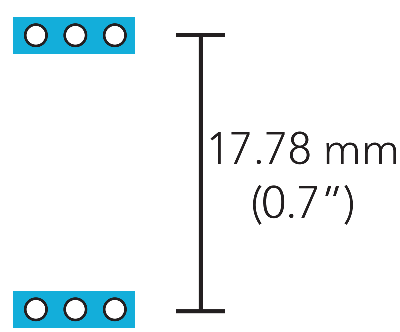


1. In your CAD software place an 8 position header.

2. Place a 3 position header at both top and bottom of the 8 position header as shown.



3. Once this is done you can delete the 8 position header. Make sure that the two 3 position headers are 17.78mm (0.7″) apart from each other.



Warranty

Atlas Scientific warranty's the ORP Circuit to be free of defect during the debugging phase of device implementation, or 30 days after receiving the ORP Circuit (which ever comes first).

The debugging phase

The debugging phase is defined by Atlas Scientific as the time period when the ORP Circuit is inserted into a bread board or shield and is connected to a microcontroller according to this wiring diagram. Reference this wiring diagram for a connection to USB debugging device, or if a shield is being used, when it is connected to its carrier board.

If the ORP Circuit is being debugged in a bread board, the bread board must be devoid of other components. If the ORP Circuit is being connected to a microcontroller, the microcontroller must be running code that has been designed to drive the ORP Circuit exclusively and output the ORP Circuit's data as a serial string.

It is important for the embedded systems engineer to keep in mind that the following activities will void the ORP Circuit's warranty:

- **Soldering any part of the ORP Circuit**
- **Running any code that does not exclusively drive the ORP Circuit and output its data in a serial string**
- **Embedding the ORP Circuit 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 ORP Circuit against the thousands of possible variables that may cause the ORP Circuit to no longer function properly.

Please keep this in mind:

1. **All Atlas Scientific devices have been designed to be embedded into a custom made system by you, the embedded systems engineer.**
2. **All Atlas Scientific devices have been designed to run indefinitely without failure in the field.**
3. **All Atlas Scientific devices can be soldered into place, however you do so at your own risk**

*Atlas Scientific is simply stating that once the device is being used in your application, Atlas Scientific can no longer take responsibility for the ORP Circuit continued operation. This is because that would be equivalent to Atlas Scientific taking responsibility over the correct operation of your entire device.