

# Micro footprint pH monitoring subsystem

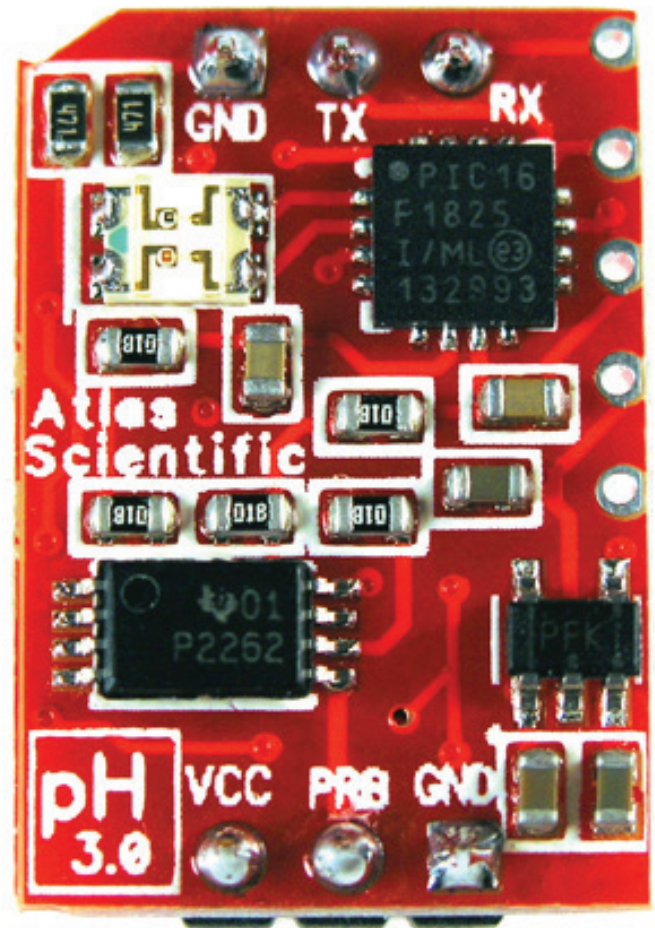
## Features

- Full range pH reading from .01 to 14.00
- Accuracy within two significant figures (XX.XX)
- Single reading or continuous reading modes
- **Temperature dependent or independent readings**
- Simple calibration protocol
- Simple RS-232 connectivity (**voltage swing 0-VCC**)
- Simple instruction set consisting of only 11 commands
- Micro footprint circuitry
- Debugging LED's
- 2.5V to 5.5V operational voltage
- Low power consumption

1.6 mA at 3.3V in active mode\*

0.7 mA at 3.3V in quiescent mode\*

\*LED's off



## Description

The pH Circuit is a highly compact pH monitoring system that fits into any breadboard. This design configuration allows the user to accurately monitor pH without having to add any additional circuitry or components to your design. Communication with the pH Circuit is done using only 11 simple commands. The pH Circuit provides scientific grade readings to any embedded system that has an RS232 connection interface (voltage swing 0-VCC, not +/- 12 volts).

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# System Overview

Standard pH circuitry can be bulky and complex, often operating at voltages outside of the typical logic level realm. Atlas Scientific has reinvented the way pH monitoring is done. The pH-Stamp is an embedded solution designed to output quick, calibration free, scientific grade pH readings in a simple RS-232 data transmission. From a single “as needed” pH reading to an infinite number of readings, the pH Circuit will deliver an accurate reading in just 262 milliseconds (462 milliseconds with LEDs on).

**It is important to keep in mind that only temperature dependent readings can be considered scientific grade pH readings. Without adding temperature information to your reading request the pH stamp will use a default temperature of 25 C°. See page 6 for more information.**

## 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 RS232 format, except voltages are 0-Vcc. The output is (up to twelve) ASCII characters representing the pH or status messages; all ending with a carriage return (ASCII 13).

Example

4.60<CR>

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

The voltage swing 0-VCC, **not** +/- 12 volts

If standard voltage level RS232 is desired, connect an RS232 converter such as a MAX232.

**RX** RS-232 receive pin

**BNC** pH probe connection  
*\*For best results use an Atlas Scientific pH probe*

# Absolute Maximum Ratings\*

Parameter	MIN	TYP	MAX	Units
Storage temperature (pH Circuit)	-40		125	C°
Storage temperature (pH probe)	1	25	35	C°
VCC	2.5	3.3	5.5	V

**\*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 pH Circuit is connected to a power supply (2.5v to 5.5v) the **green** "power on" indicator LED will be lit. The device will immediately enter standby mode and wait for a command.

There are a total of 11 different commands that can be given to the pH Stamp.

**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 pH reading	N/A
C	Takes continuous pH readings every .262 seconds with LEDs off. Every .462 seconds with LEDs on.	N/A
TT.TT	Take temperature dependent reading.	25 C°
E	Stops all readings. Enter standby/quiescent mode.	N/A
S	Calibration at pH <b>Seven</b>	N/A
F	Calibration at pH <b>Four</b>	N/A
T	Calibration at pH <b>Ten</b>	N/A
X	Return stamp to factory settings	N/A
I	Information: Type of stamp • firmware version • firmware creation date	N/A

## Command Definitions

**L1** This will enable both debugging LED's.

The pH Circuit has two LED's

**Green LED** .....Power indicator

**Red LED** .....Instruction received/pH transmit

By default, the LED's are enabled.

These LED's are designed to help the user determine that the pH 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 pH Circuit to return a single pH reading.

*\*This instruction takes 262 milliseconds to complete (462 milliseconds with the LED's on)*

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

The pH Circuit will respond:    XX.XX<CR>

If the pH Circuit detects that a Ph probe is not connected or damaged it will not transmit a pH reading. Instead it will respond with the error message "check probe"

**check probe <CR>**

- C** The pH-Stamp will operate in continuous mode and deliver a pH reading every 262 milliseconds (262 milliseconds with the LEDs off) until the "e" command is transmitted.

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

The pH Circuit will respond: (LED'S ON)\*

**XX.XX<CR> (262 milliseconds)**

**XX.XX<CR> (524 milliseconds)**

**XX.XX<CR> (786 milliseconds)**

**XX.XX<CR> (n+ 264 Seconds)**

*\* (LED's on the pH-Stamp off will respond every 462 milliseconds)*

If pH Circuit detects that a Ph probe is not connected or damaged it will not transmit a pH reading. Instead it will respond with the error message "check probe"

**check probe <CR>**

- tt.tt** (where "t" is temperature in °C) By transmitting a temperature to the pH Circuit a temperature compensated pH reading will be returned in the same manner as is seen when using the "R" command. However, the temperature entered will now be the new default temperature. Therefore it is not necessary to transmit a temperature each time a reading is taken. A temperature can be transmitted one time and then a "C" command can be issue. This will return continuous pH readings at the new temperature.

Temperature data will be lost if Circuit is powered off. When the pH Circuit is powered on again temperature will go back to its default of 25°C

**Full proper syntax: 35<CR> or 35.67<CR>**

- E** This instructs the pH 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 pH Circuit.

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

The pH-Stamp will respond by ceasing data transmission. There is no ASCII response to this instruction.

**X** Instructs the pH Circuit to return to its original factory settings.

Transmitting this command will:

Reset calibration off set back to 0.

Reset default temperature back to 25°C

Set debugging LED to on.

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

The pH Circuit will respond:   **reset<CR>**

**I** Instructs the pH Circuit to transmit its version number.

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

1. The type of device:                   "P" (for pH)

2. The firmware version number:       "V3.0"

3. The firmware version date:         "8/11" (August / 2011)

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

The pH Circuit will respond:   **P,V3.0,8/11<CR>**

**S** This instructs the pH Circuit to calibrate itself to a pH7 solution.

**Full proper syntax:   s<CR> or S<CR>**

The pH Circuit will respond with a calibrated pH reading:

**7.00<CR>**

Sending the S command when the pH probe is not immersed a pH 7 will calibrate the pH stamp to see that whatever it was reading to now be a pH 7 and could lead to significant errors. Do not do this.

**F** This instructs the pH Circuit to calibrate itself to a pH4 solution.

**Full proper syntax: f<CR> or F<CR>**

The pH-Stamp will respond with a calibrated pH reading:

**4.00<CR>**

Sending the S command when the pH probe is not immersed a pH 4 will calibrate the pH Circuit to see that whatever it was reading to now be a pH 4 and could lead to significant errors. Do not do this.

**T** This instructs the pH Circuit to calibrate itself to a pH10 solution.

**Full proper syntax: t<CR> or T<CR>**

The pH Circuit will respond with a calibrated pH reading:

**10.00<CR>**

Sending the S command when the pH probe is not immersed a pH 10 will calibrate the pH Circuit to see that whatever it was reading to now be a pH 10 and could lead to significant errors. Do not do this.



# Calibration Instructions

In order to provide the engineer with the greatest possible accuracy pH stamps now ship uncalibrated. This is because micro voltage changes in your circuit design cannot be compensated for at the factory.

**The pH Circuit must be calibrated in the following order:**

4. pH 7

5. pH 4

6. pH 10

1. First place you pH probe in the yellow pH 7 calibration solution.
2. Instruct the stamp to go into continues mode.
3. Wait 1 to 2 minutes.
4. TX the **S** command. Your pH Circuit is now calibrated for pH7.
5. Rinse off pH probe, dry with paper towel.
6. Place pH probe in the red pH 4 calibration solution.
7. Wait 1 to 2 minutes (Circuit should still be in continues mode).
8. TX the **F** command.  
Your pH stamp is now calibrated for pH4.
9. Rinse off pH probe, dry with paper towel.
10. Place pH probe in the blue pH 10 calibration solution.
11. Wait 1 to 2 minutes (Circuit should still be in continues mode).
12. TX the **T** command. Your pH Circuit is now calibrated for pH10.
13. Transmit the E command.
14. The pH Circuit is now calibrated. The calibration data is stored in the EEPROM and will be retained even if the stamp is powered off.

REMEMBER **ALL** TRANSMISSION 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.

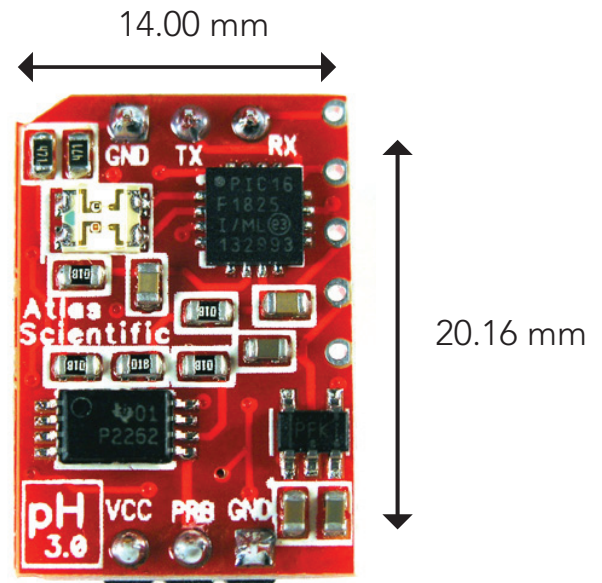
**OK= I<CR>**

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

- \*A pH probe will typically last between three and four years
- \*A pH probe should be considered inaccurate if it has been frozen
- \*A pH probe should be considered inaccurate if it has been allowed to dry
- \*A pH probe should be considered inaccurate if it has been boiled

\*The Wire length from the pH probe to the pH Circuit should be as short as possible to reduce noise.

Do not use this type of connection



## Known Issues:

During calibration; rapidly switching the pH probe from a pH 4 to a pH 10 when the pH Circuit is in continues mode can cause a device reset. This will **NOT** damage the pH Circuit. Simply re-send the "c" command and continue with calibration.

Touching the pH Circuit can cause false readings; these readings can last as long as 5 minutes. As the pH Circuit returns to normal operation the pH readings will progressively return to normal.

Uneven heating can cause the pH Circuit to return false readings. Thermal stability should be considered when using this product.

