BlepH - A reliable, power efficient and low cost bluetooth pH sensor

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# Existing Product

**HI11312 - HALO™ pH Probe with Bluetooth® Smart Technology**

$195.00

- **Be the first to review this product**
- **Ships within 1-2 Business Days**
- **Available in US only**

**The World's First pH Electrode with Bluetooth® Smart Technology**

HALO™ is the world’s first professional pH probe with Bluetooth® Smart technology (Bluetooth® 4.0). It is a high quality, double junction, refillable glass pH probe with a built-in temperature sensor that can be used virtually anywhere: in the field, laboratory or classroom. Its flexibility and ease of use will revolutionize the way pH is measured. HALO™ transmits measurement data directly to an iPad® (not included) running the Hanna Lab App.

**One press Connect**

Easily connect to the Hanna Lab App (required for use) at the press of a button via Bluetooth® wireless technology (10 m range (33')).

**Status Indicator**
Motivation

- Most pH sensing devices on the market are very expensive.
- There is an increasing demand for such devices in agriculture, food and health care.
- Most usage requires the device to run in a remote location for a long time
Goal

- Measure pH value of a solution remotely.
- Run a long lasting measurement probe with tight energy budget
- Access the characteristics of the system’s power consumption.
Finished Product
State Machine - BLE Service
Main Function State Diagram (Concept)

- boardOff
  - true/
  - turnOffBoard/
  - turnOnBoard/

- standby
  - true/
  - measureOnce/
  - stopContinuousMeasure/
  - startContinuousMeasure/

- Single Measure
- Continuous Measure
Available Features

- Control ON/OFF of the pH interface board
- Single Measurement
- Continuous Measurement
- Periodical Measurement
Additional Details

● A control system built up with sleep and interrupts
  ○ UART interrupt used to control communication with pH measurement circuit
  ○ BLE interrupt used to control communication with phone
  ○ Timer interrupt used to control periodical measurements.
  ○ NO busy wait.

● Additional hardware to enable and disable pH measurement circuit
Power Efficiency Analysis

- Assume 600mAh power budget from an 9V battery
- 1 year of intended battery lifetime
- Consists of THREE parts, pH sensing board, nRF51822(BLE), MK20 companion chip
- Data acquired using LabView @ 1k sample/s, 9V rail, 10 uA current resolution
Power Efficiency Analysis

- Overall power profile
- Includes consumption from all 3 components
Power Efficiency Analysis

- BLE power profile when connected
- 6% duty cycle
- 0.247mAh
- Superimposed on others
- Can be made much smaller
Power Efficiency Analysis

- Power profile after applying 15-point median filter
- Power consumption of pH sensing board & MK20
Power Efficiency Analysis

- Periodical measurement power profile
- Depends on Period and Measure Time
Estimated Battery Life

- Only 1.5 days
- Total standby current for nRF51822 (BLE) and MK20 is > 16mA
- Bottleneck is on nRF51822 and MK20
Estimated Battery Life

- Assume no MK20 companion chip
- A better procedure for BLE standby, i.e., disconnect while waiting -> 30uA standby current for nRF51822(BLE)
- Can easily achieve 2 years battery life
## Cost

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
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<tbody>
<tr>
<td>RedBear Lab nRF51822 Board</td>
<td>$39.90</td>
</tr>
<tr>
<td>American Marine pH Probe</td>
<td>$39.99</td>
</tr>
<tr>
<td>pH Probe Interface Circuit</td>
<td>$34.00</td>
</tr>
<tr>
<td>Arduino Rapid Development Shield</td>
<td>$24.00</td>
</tr>
<tr>
<td>Battery &amp; Connectors</td>
<td>$4.00</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$141.89</strong></td>
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Future Plan

- Design and validate customized an integrated circuit such that any unnecessary components are excluded
- Improve software features such as a better iPhone app and BLE standby procedure
- Build a distributed system for large scale data acquisition
- Enables the design of other BLE systems.
Thank You

Questions