POTENTIOSTAT–SENSOR INTERFACE HARDWARE

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ABSTRACT

To best demonstrate the advantages of point-of-care electrochemical sensors, a portable potentiostat with small form factor and simple user interface is needed. To satisfy this need, the EmStat and Multiplexer OEM boards were purchased from PalmSens Compact Electrochemical Interfaces, and a breakout board with protective packaging was developed to provide a clean user interface.

1 INTRODUCTION

BioMicroSystems Lab is developing point-of-care electrochemical sensors for measuring heavy metal concentrations in environmental samples, such as manganese and lead in lake water [**?**]. Three electrodes are submerged in the sample and a potential is applied between two electrodes. A different pair of two electrodes is used to measure current. At some voltage level, an oxidation-reduction reaction between the metal of interest and the electrode surface becomes favorable. As the metal changes oxidation state, charge is emitted so measuring and integrating the current gives the quantity of metal reactant in the sample.

In a three electrode system, one electrode must be common to both the voltage pair and the current pair, and this is termed the counter electrode. For the other two electrodes (reference and working) to accurately separate voltage and current, they must be virtually grounded by amplifier electronics. A device which drives the virtual ground, sets a potential, and measures resulting current is called a potentiostat.

The possible advantages of the point-of-care electrodes being developed by BMS Lab include low cost, portability, measurement speed, and simplicity for non-technical operators. To realize these advantages, a small, portable potentiostat is needed with a simple user interface.

2 METHODS

An OEM potentiostat board measuring only 2x1.35 inches was purchased from PalmSens, called EmStat. Also from PalmSens, a Multiplexer was purchased that allows EmStat to switch between multiple sensors. See figure 1. However, before these could be used in the field, a breakout board for connecting the Multiplexer to the BMS Lab sensors and protective packaging was needed.

3 BREAKOUT BOARD

3.1 Multiplexer and Sensor Interfaces

3.2 Physical Constraints

3.3 Schematic Diagram

3.4 Board Design

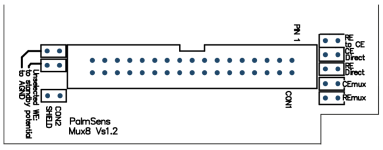
4 PACKAGING

4.1 Initial Base and Lid Designs

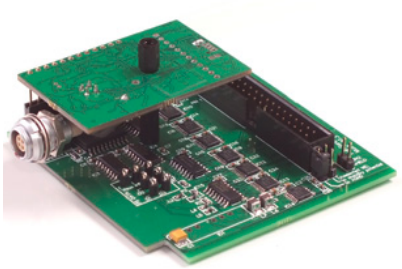
4.2 Revision History

4.3 3D Printing and Tapping

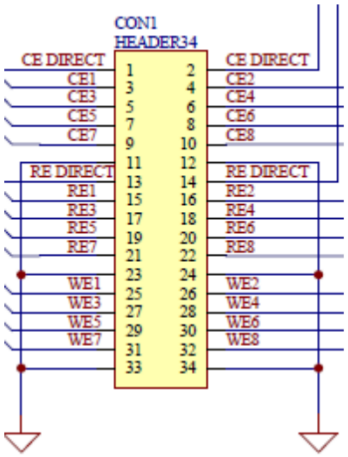
(a) EmStat Potentiostat.



(b) Multiplexer Pinout Diagram.



(c) EmStat and Multiplexer Connected.



(d) Multiplexer Pinout Schematic.

Figure 1: A number of pictures with no common theme.