Lab Report: Glucose monitor

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December 1, 2015

1 Voltage Source

Having my younger siblings visiting for Family Weekend, I asked them to find a pair of resistors ending in "k" with a ratio of approximately 2 : 3. The resulting resistor values were nominally $4k\Omega$ and $6.04k\Omega$, for a theoretical voltage divider output of

$$5V * \frac{4k\Omega}{4k\Omega + 6.04k\Omega} = 1.992V$$

The actual measured value was slightly lower, at $1.97V$, but the difference wasn't significant enough to be a problem.

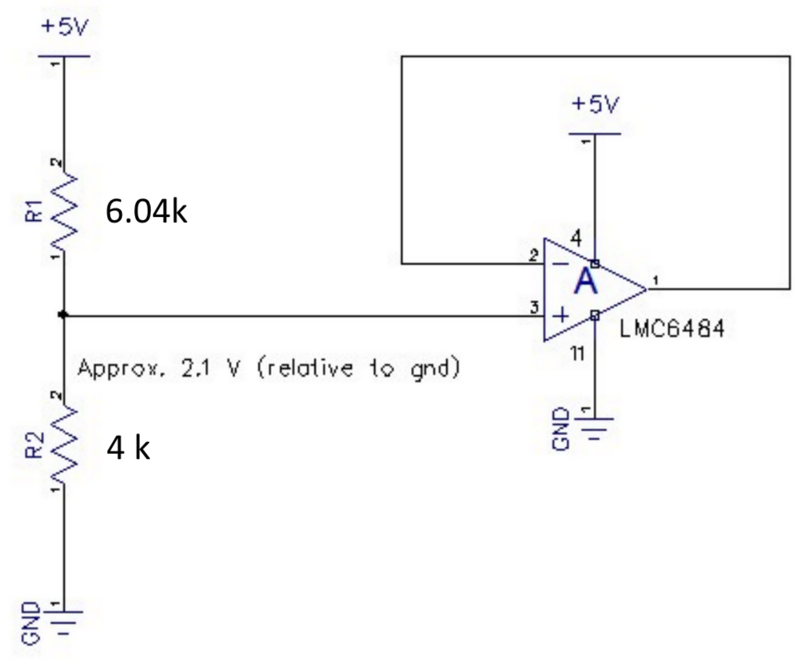

Figure 1: Voltage Divider circuit

Ch	Name	Value
C1	Average	1.976 V

Figure 2: Voltage Divider results

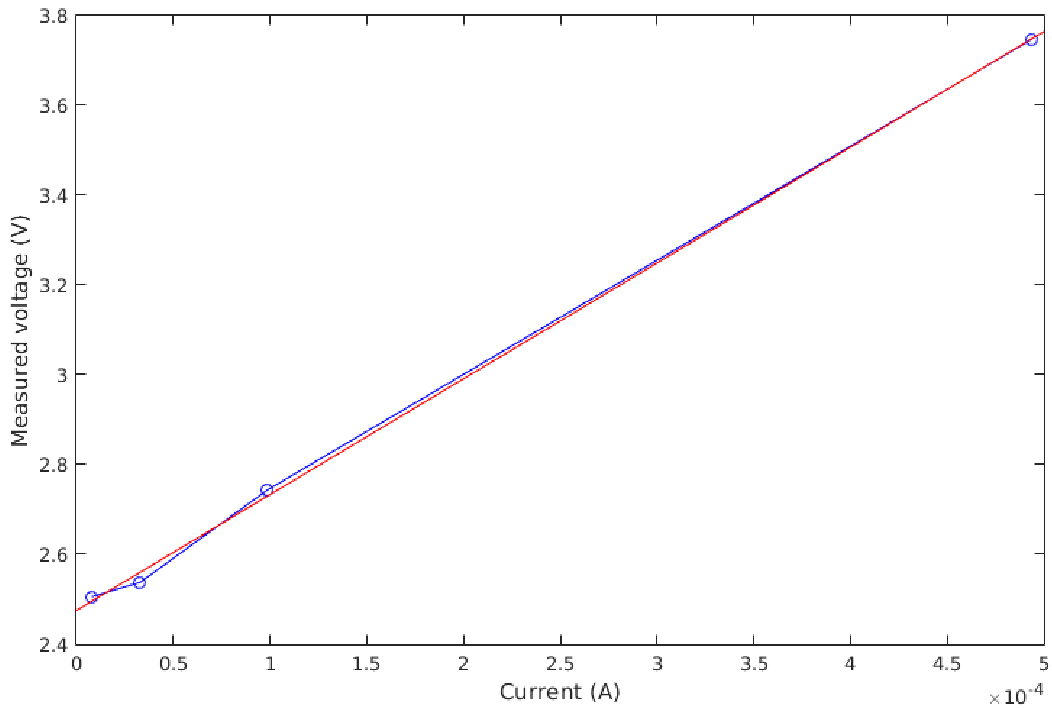

Figure 3: Partial current measurement results

2 Measure Resistance

!!! NEED THEORY !!! Five resistor values were tested, as shown below. For each resistor, the current it theoretically allowed was calculated as $\frac{1.976V}{[Resistance]}$, also in the table.

Table 1: Resistor testing data

Resistance	Calculated Current (mA)	Measured voltage
604	3.272	4.96
4000	0.494	3.75
20000	0.099	2.74
60000	0.033	2.54
249000	0.008	2.50

Shown here is a plot of the Currents and measurements for the lower four rows in the table, those with less than $1mA$ theoretical current flow. As expected, the data points fall nicely along a line, giving an accurate way to measure small currents. (Figure 3)

Unfortunately, the 604Ω resistor proved to allow more current to pass than the system could reliably measure, as seen by the fact that its data point falls well off the line. (Figure 4 on the next page)

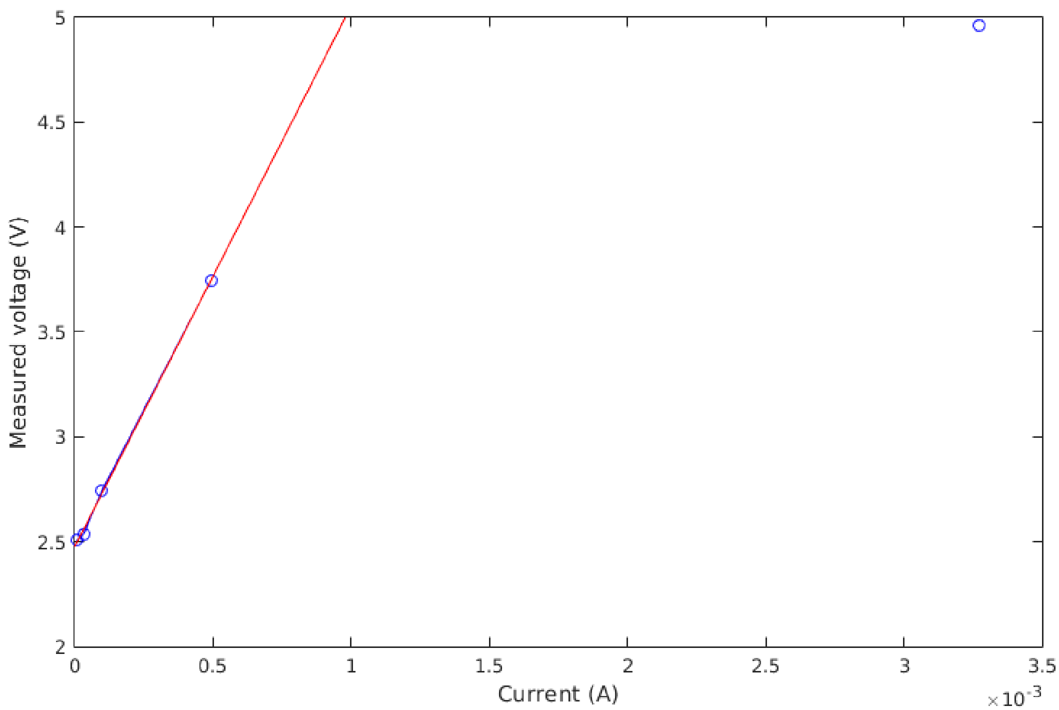

Figure 4: Full current measurement results

3 Integrator

In figure 5, the orange line charts the input to the circuit, and the blue line charts the output. Clearly, when the orange line is HIGH, the blue line rises and inversely. This is the expected behavior of an integrator.

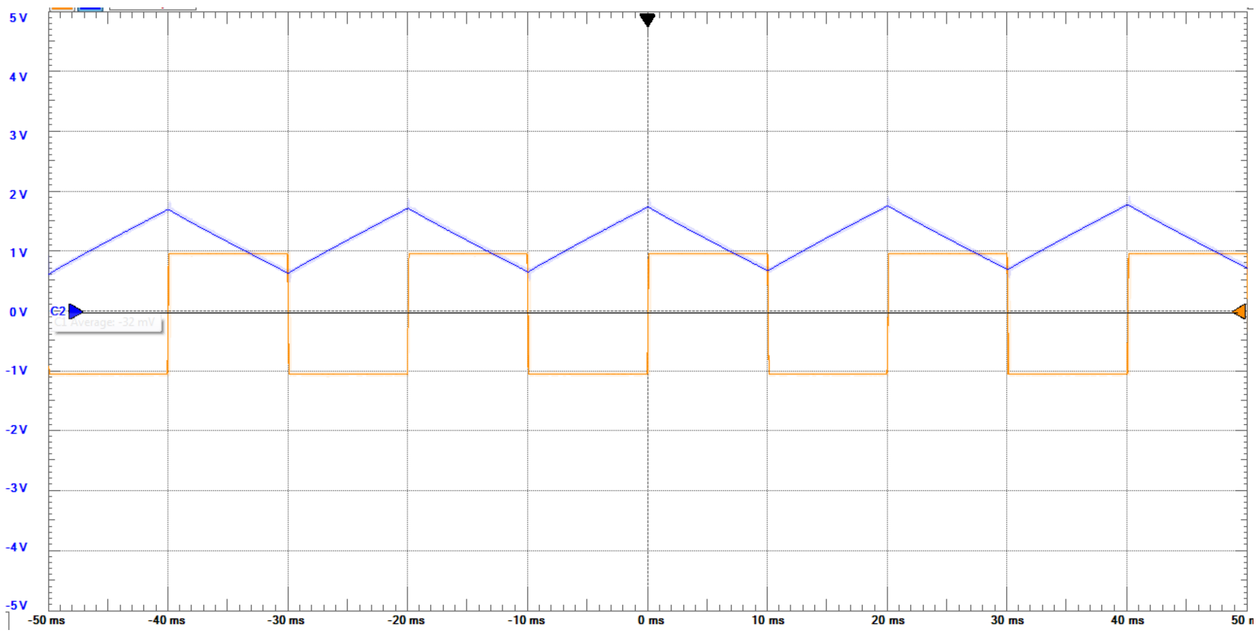

Figure 5: Integrator testing results

4 Glucose sensor

The glucose monitor, as expected, produced substantially higher currents when the concentration of the glucose in the solution was higher. The raw data collected can be seen in figure 6 on the next page, where concentrations are measured in mg/dL. Figure 7 on the following page shows some values extracted from these curves, including the maximum amount of current measured, the current flow measured after 10 seconds, and the value of the integrator after 10 seconds (adjusted for the starting value).

These results indicate that the maximum amount of current is a poor indicator of the concentration, with the points substantially deviating from a line. The integral of current is better, but still does not display quite as much regularity as the absolute current measurement after 10 seconds. This could be a measurement peculiarity from this specific trial. Further investigation is needed to determine whether some combination of these signals could be used to create an even more consistent measurement.

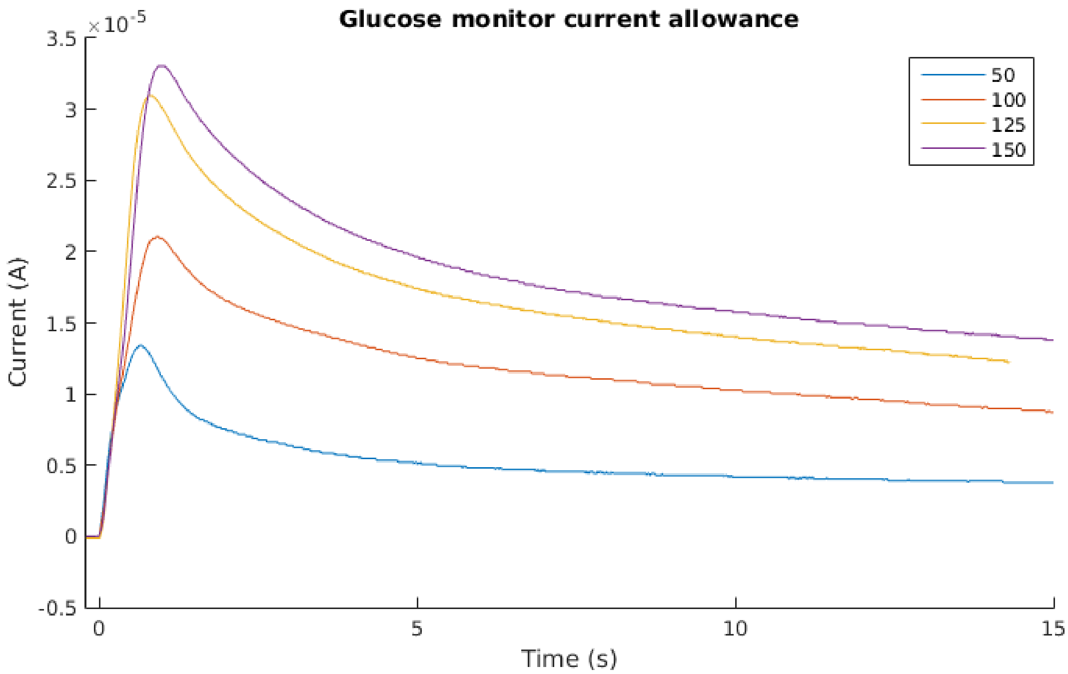

Figure 6: Time series data for various glucose concentrations

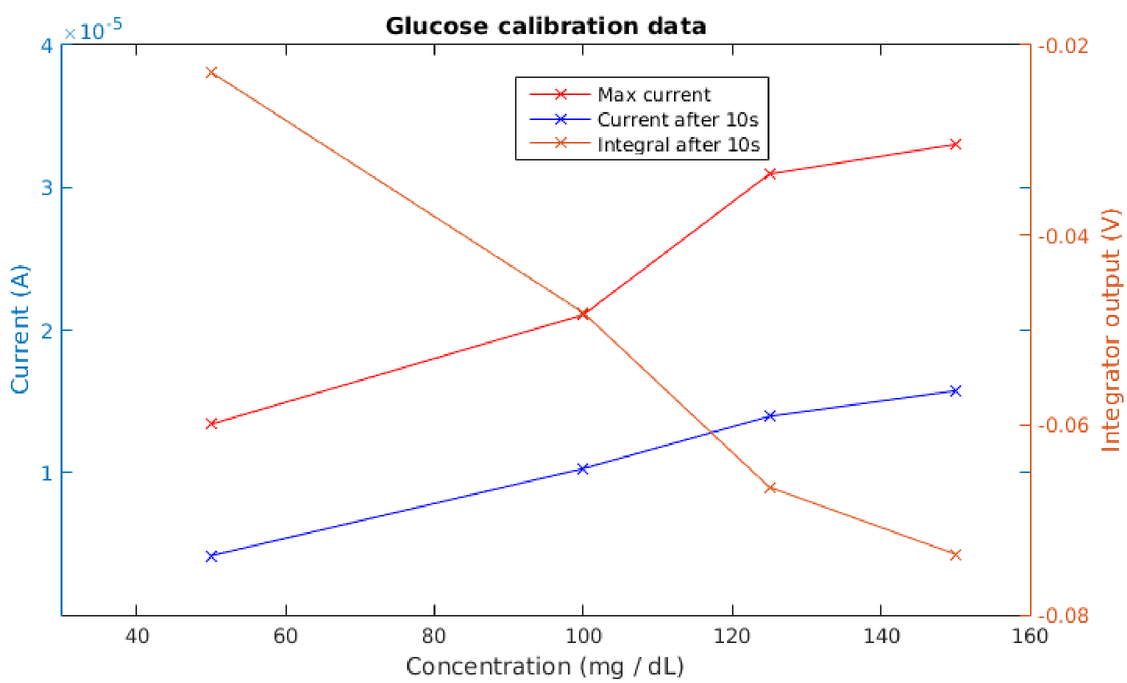

Figure 7