

# gPod Accessible Blood Glucose Meter

Week 10  
March 27- April 2  
David Price

## Work Completed

The beginning of the week was spent getting the speech module to work with the microprocessor. The speech module requires hexadecimal characters to be sent prior to the text to be spoken. The command sequence is shown in Table 1.

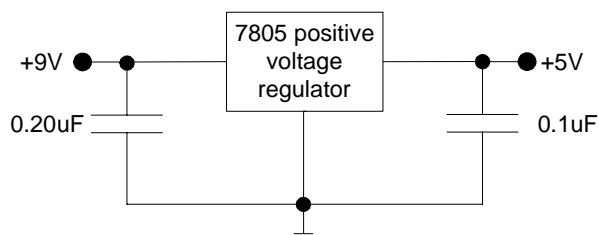
Command	Description
0x80	Start command
0x00	Full Volume
0x05	Speech Pitch (Level 5)
0x00	Speech Speed (Level 0)
ASCII text	Text phrase sent as a string of characters
0x1A	Stop command
0x00	Speak phrase

**Table 1, Speech module command sequence.**

The microprocessor sends each command and each character of the phrase individually. Once the speech module receives the '0x00' command, the phrase is spoken. The speech module's text buffer is limited to an 80 character string. Testing proved the speech module to work correctly and speak the glucose results as measured.

The rest of the week was spent working out problems with the glucose trigger, power supplies, and voltage regulators. We were experiencing trouble with the gPod whenever the switch on the protoboard was used to turn the meter on and off. The meter would not take a measurement or would read an incorrect result. The problem rarely occurred when the switch was not used and the bench power supply was connected directly.

I also wired in the voltage regulators to test the circuit under battery power. I first connected the voltage regulators to the bench supply set to +9 and -9 volts. The voltage regulators produced accurate voltages of +5 and -5 volts. The positive regulator was introducing noise into the glucose signal. The problem was solved by adding capacitors to the inputs and outputs of the voltage regulators. Figure 1 shows the configuration of the positive voltage regulator.



**Figure 1, Voltage regulator schematic.**

There was also a problem with the glucose trigger. When the switch or voltage regulators were used the glucose trigger would not rise above 200 mV. If the power supply was used the trigger would pulse to 5 V as expected. The problem turned out to be a software issue. The datasheet I was using from Microchip.com was for an older version of the 16F874A microprocessor. The A/D initialization routine was not correctly configuring the A/D to work with the 5 MHz clock. I made the changes to the code and the A/D and glucose trigger worked correctly with the voltage regulators and switch.

I also increased the A/D data from 8-bits to 10-bits. The extra 2 bits increase the resolution by 4. Figure 2 shows the difference in resolution from 8-bits to 10-bits.

$$V_{\text{ref}} / \text{counts} = \text{Resolution}$$

$$5 / 255 = 0.0196 \text{ volts / count}$$

$$5 / 1023 = 0.00489 \text{ volts / count}$$

**Figure 2, 8 bit resolution vs 10 bit resolution.**

The changes in the code allow the microprocessor to accurately take glucose measurements, display them on the LCD screen, and speak them. The entire circuit works on battery power and is ready to be put onto a printed circuit board. A comparison test with the gPod and OneTouch Ultra showed a difference of 8 mg/dL. The OneTouch Ultra showed a result of 128 mg/dL and the gPod displayed 136 mg/dL. The percent error between the results is 6.25%. Figure 3 shows the gPod and OneTouch Ultra results side by side.



**Figure 3, gPod and OneTouch results.**

## **Future Work**

This week will be spent finalizing the parts order and printed circuit board. While we are waiting for the parts to arrive I will work on the software to improve the user interface. The user interface will be made more accessible for our clients. More software features can be added now that the hardware is finished.

## **Project Review**

The trouble with the project at the beginning of the week delayed the printed circuit board order another week. The board and parts will be ordered by Tuesday. The numerous difficulties encountered with the project have significantly delayed the final board design. Now that the problems have been resolved and the hardware is working correctly and consistently we will have a circuit board by next week and will begin assembling and troubleshooting the final design. I am confident that the project will be finished and working correctly by the end of the semester. Total costs to date are \$895.67.

## **Hours Worked**

Hours spent on the project for Week 10: **38 Hours**