

Physics 314, Fall 2016
Lab 6: Digital/analog and Analog/digital conversion

1. D/A conversion

A. R2R Ladder DAC

Build a 4-bit R-2R ladder D/A converter on a breadboard. Choose the resistor values yourself, making sure that power dissipation limits are respected. Take the input for each bit from the 0/5V logic switches on the board.

What is the voltage step associated with the least significant bit? Verify your answer.

For several (at least 3) additional non-trivial input combinations, predict what the output voltage will be and measure the output voltage. Record your results and comment on the agreement between predicted and measured values. What is probably responsible for any discrepancies? Explain your reasoning.

B. Pulse width modulation (PWM) DAC

Sending repetitive pulses into an RC circuit will keep the capacitor at some average level of charge. By varying the duty cycle of the pulses, the voltage across the capacitor can be controlled.

On the Board of Education build an RC circuit with a time constant of 10 ms; the input should come from pin 8 of the Stamp, and the output is to be measured across the capacitor. Choose reasonable R and C values.

Now program the Stamp using the PWM command to send out 40 cycles of a pulse with duty cycle 50% (see the BASIC Stamp Command Reference handout for the PWM command). Use the BK meter to measure the output voltage, and run the program. What happens? Can you explain the observed behavior? (Hint: what's the input resistance of the BK meter?)

Now modify your program so that the Stamp repeats the 40-cycle pulse train over and over. What is the output voltage? How does it compare to what you expect?

Change your program to produce a different output voltage. Explain in your lab book how you did this and what the results were.

2. A/D conversion

A. Using the Stamp as a 1-bit ADC

Hook up a 5k potentiometer between Vdd and Vss, and connect the wiper to pin 7. Program in the following code:

```
Debug cls
Input 7
Output 12
Loop:
Out12=in7
Debug home, "The state of P7 is ", bin in7
Goto loop
```

Use the BK meter to monitor the voltage at pin 7, and run this program. Describe what happens.

B. Successive-approximation ADC0831

Do Experiment #3 (Basic Analog to Digital Conversion) in the handout.