Name (Last, First) ____________________________ Student ID number _________________

UNIVERSITY OF CALIFORNIA

College of Engineering
Electrical Engineering and Computer Sciences Department

EECS 145M: Microcomputer Interfacing Laboratory

Spring Midterm #1 (Closed book- equation sheet provided- calculators OK)
Full credit can only be given if you show your work.
Wednesday, March 5, 2008

PROBLEM 1 (10 points) Briefly describe the operation of the successive-approximation A/D converter.

Problem 2 (45 points) Design a **computer-controlled** system for testing **eight** 12-bit A/D converters.

You are provided with the following:

- eight A/D converters (to be tested eight at a time)
- eight 16-bit tri-state drivers
- a microcomputer with the following:
  - a 16-bit D/A converter with 1/2 LSB absolute accuracy and 10 μs settling time
  - two 16-bit parallel input ports
  - two 16-bit parallel output ports

You may assume the following:

- The 16-bit parallel output port is in "transparent" mode (no handshaking). New data can be written to the port every 2 μs.
- You have a timer function wait(*N*), that can delay program execution for *N* μs.

- The A/D converter requires a "start conversion" low-to-high edge signal and after conversion provides an "output data available" low-to-high edge. The A/D converter sets "output data available" low and resets all internal functions when "start conversion" goes low.
- You must wait until the A/D has signaled that its data are ready before reading its output.

Hint: Think about Laboratory Exercise 9 (A/D converters) and how you would automate the measurement and data analysis procedures.

2.1 (18 points) Draw a block diagram of the major components, including two of the eight A/D converters being tested. Show and label all essential data and control lines.

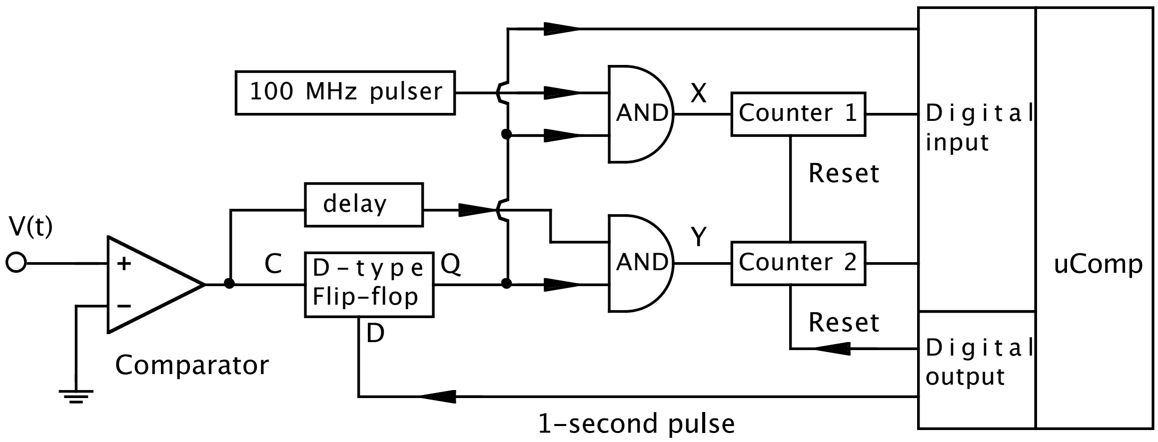
2.2 (9 points) List the steps your program must do to measure the first transition voltage V(0,1) of the first A/D converter (pseudocode is OK, so long as the logic is clear).

2.3 (9 points) How would you determine the maximum linearity error?

2.4 (9 points) With what accuracy could this system measure the quantities in parts **2.2** and **2.3** in units of 1 LSB of the A/D?

Problem 3 (45 points)
You are given a system for measuring the frequency of a sinewave $V(t) = V_0 \sin(2\pi ft)$ over a measurement time of one second.

- The purpose of the delay in line C is to insure that a pulse edge on C reaches the AND gate slightly after the corresponding pulse edge on Q
- The D-type flip-flop has (rising edge) clock input C, data input D and data output Q.
- Counters 1 and 2 can be reset and read by the computer, count on rising input edges, and have a maximum counting rate of 100 MHz.
- Assume that the frequency of the 100 MHz pulser is exact
- Assume that the 1-second pulse is logic high and its duration is not exact



3.1 (18 points) Draw a timing diagram of the signals C, D, Q, X, and Y.

3.2 (15 points) List the program steps necessary to control the system and compute the frequency in Hz. (pseudocode is OK, so long as the logic is clear)

3.3 (6 points) What are the minimum and maximum frequencies that your design can measure and why?

3.4 (6 points) At the minimum and maximum frequencies, what are the uncertainties (in Hz) in the frequency measurements? (Hint: you do not need to use the formal error propagation formula, just consider the range of measured values for a fixed input frequency.)