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.
Monday, March 4, 2002

PROBLEM 1 (50 points)

1a (15 points) Draw the block diagram for the 12-bit half-flash A/D converter, showing and labeling all principal components and interconnecting lines. (*Hint:* this converter has two internal 6-bit flash A/D converters and a 6-bit R-2R D/A converter, and these can be drawn as single boxes).

1b (10 points) Describe the operation of the 12-bit half-flash A/D converter.

1c (5 points) How many resistors are used in each internal 6-bit flash converter? (Only 10% accuracy is required here.)

1d (5 points) How many resistors are used in the internal 6-bit D/A converter? (Only 10% accuracy is required here.)

1e (5 points) If the absolute accuracy of the 12-bit half-flash A/D converter is 1/8 LSB (i.e. 1/8 step size), what can you say about the required accuracy of the resistors in the two internal 6-bit flash A/D converters and in the 6-bit D/A converter?

1f (5 points) If the absolute accuracy of the 12-bit half-flash A/D converter is 1/8 LSB and if it takes 100 ns to sample the analog input, what is the maximum frequency that can be converted with an accuracy of 1/2 LSB?

1g (5 points) If a Sample-and-Hold amplifier with a time jitter of 100 ps is used before the input of the 12-bit half-flash A/D converter, what is the maximum frequency that can be converted with an accuracy of 1/2 LSB?

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PROBLEM 2 (50 points)

Design an interface and computer program that allows a computer to simultaneously start two temperature sensors and read them as soon as possible after their values are ready.

- The computer has a digital I/O port with 16 lines of input and 16 lines of output
- Each temperature sensor has a "ready for data" (RD) control line. When the RD line goes from low to high the sensor converts the temperature into a 12-bit digital number.
- Each temperature sensor also produces a "data available" (DA) line that goes from low to high when its 12 digital output lines are stable and valid.
- The output data are asserted so long as DA is high
- When the RD line is brought low, the temperature sensor brings its DA line low.
- Your program can use "GetSingleValue(&value)" and "PutSingleValue(value)" functions to read from and write to the digital I/O port.
- After "PutSingleValue(value)", the value is continually asserted on the output lines until a new value is written.
- You have available two 16-bit tri-state drivers. Each has 16 inputs, 16 outputs, and an "output enable" (OE) input. When the OE line is low, all 16 outputs are the same as the corresponding inputs. When the OE is high, all 16 outputs are in a high impedance state.

2a (20 points) Draw a block diagram of your circuit design, showing and labeling all essential components, connections, and signals.

2b (20 points) In proper time sequence, list the program and hardware steps necessary for your system to simultaneously start both temperature sensors and read them as soon as they are ready. (You may assume that initially all “ready for data” and “data available” lines are low.)

2c (10 points) Draw a timing diagram (i.e. digital state vs. time) for the signals described in part 2b.