

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, February 22, 2006

PROBLEM 1 (10 points) Briefly describe the cause of glitches (unwanted transients) in the output of the D/A converter.

PROBLEM 2 (45 points)

Design a microcomputer-based system for converting two lists of digital numbers into two analog waveforms (like left and right stereo).

- You will use a single 12-bit D/A converter whose output responds to changes in input within 100 ns and whose output glitches last at most 10 ns.
- Your computer has a single 16-bit digital output port and all 16 bits must be written simultaneously.
- Your computer can write digital data to the output port at a maximum rate of 1 Mhz.
- You can set a software loop to cycle at any integer multiple of a 25 ns clock period.
- The digital waveforms are stored in memory as 12-bit numbers in the arrays `right[i]` and `left[i]`, where $i = 1$ to N .
- The two analog voltages converted from the i th digital values `right[i]` and `left[i]` are to appear at the two analog outputs of your circuit as simultaneously as possible ($\ll 1 \mu\text{s}$).
- The elements of the arrays `right[i]` and `left[i]` are to be output at a frequency of 40 kHz.
- The two analog waveforms must be glitch free.
- *Hint:* You will want to use **four** sample-and-hold amplifiers.

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- 2.1** (20 points) Draw a block diagram of your system, showing and labeling all essential components, connections, and signals.

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2.2 (20 points) In proper time sequence, list the program steps necessary for your system to produce the two analog waveforms. Make it clear in your description how the two analog outputs are updated simultaneously at 40 kHz and are glitch-free.

2.3 (5 points) How much memory would be required to store 2 hours of stereo music for this system?

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PROBLEM 3 (45 points)

3.1 (15 points) Draw the block diagram for the 12-bit half-flash A/D converter, showing and labeling all principal components and interconnecting lines. (*Note*: this converter has two internal flash A/D converters and one internal R-2R D/A converter, and these can be drawn as single boxes).

3.2 (10 points) Describe the operation of the 12-bit half-flash A/D converter.

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3.3 (5 points) How many resistors are used in each internal flash A/D converter? (Only 10% accuracy is required here.)

3.4 (5 points) How many resistors are used in the internal R-2R D/A converter? (Only 10% accuracy is required here.)

3.5 (10 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 A/D converters and in the D/A converter?