MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Department of Electrical Engineering

6.331 Advanced Circuit Techniques

Design Problem 2
D/A Converter

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Due : Thursday, November 3, 2011

Design a D/A converter for either of the following sets of specifications. Your design should operate from 15 ± 0.5 volt supplies. Input digital signals are TTL compatible.

High-Accuracy Circuit :

Design a 14 bit D/A converter with an output scale factor of 5V/MSB. A settling time of 100 μs is required. Assume that standards which can measure absolute voltages to an accuracy of ±5 ppm are available. You may use these standards for final trim. Develop an error budget for your circuit and convince us that it can maintain 1/2 LSB accuracy for ambient temperature variations of ±10°C, supply variations of 0.5 volt, and any resistive loading in excess of 1kΩ.

High-Speed Circuit :

Design an 8 bit D/A converter which provides an unloaded scale factor of 2.5V/MSB and has a settling time of 50 ns to 1/2 LSB. The circuit should have an output resistance less than 500Ω and will not be loaded with more than 10pF of capacitance when high speed operation is required. Your design should operate over a temperature range of 25° ± 10°C. This design is not intended for integration, so the use of unlimited numbers of components is discouraged.

In order to simplify your design of the high speed DAC, you may have an unloaded scale factor of either plus or minus 2.5V/MSB. The output may be either positive, negative, or both (which ever is most convenient for your design), however, the output voltage must be referenced to ground.

Build a 2-bit version (MSB and LSB) of your design in order to demonstrate feasibility. We would like to see your circuit operating. At checkoff, we will want to measure your scale factor, TTL noise imunity, and settling time (with your window circuit).