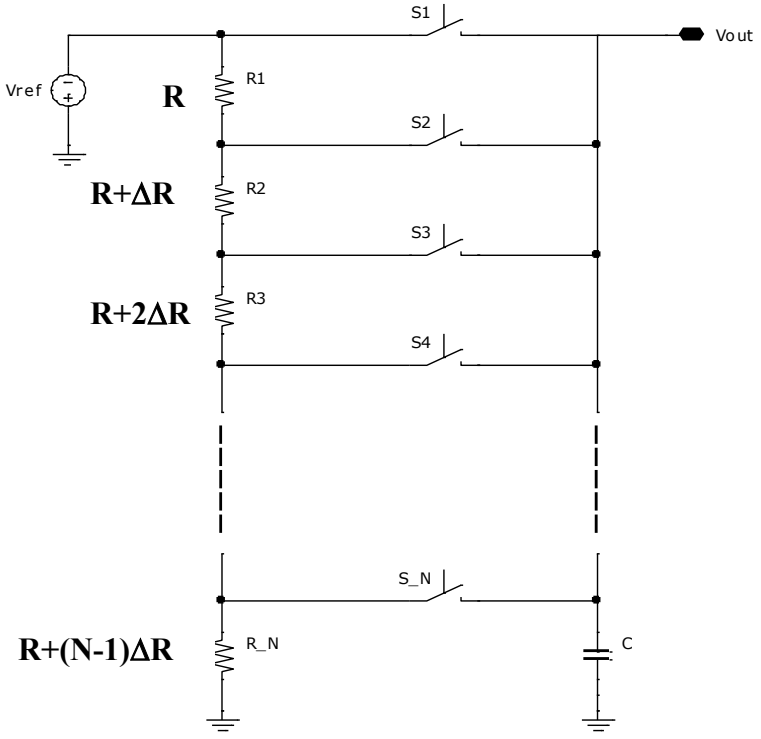
UNIVERSITY OF CALIFORNIA
College of Engineering
Department of Electrical Engineering
and Computer Sciences

	Homework 5	**EECS 247**
H. Khorramabadi	**Due Thurs., November 4th, 2010**	**FALL 2010**

1. An R-string DAC is fabricated with resistors with $\sigma_{\Delta R/R}$=0.2%. For the INL and DNL to be better than 0.5 LSB,
   a) What is the expected yield of a 14-bit DAC?
   b) What is the maximum achievable resolution (no trimming or calibration), if a yield of 99% good parts is desired?

2. Consider a resistor string DAC with a deterministic, linear error gradient as illustrated below. The j^{th} resistor in the ladder deviates from its ideal value R by $j \cdot \Delta R$. Assume that the total number of unit elements (N) is large and that $N \cdot \Delta R << R$ to simplify your derivation process and the final result.
   a) Derive an expression for the worst case DNL and INL of the DAC. At which taps do they occur?
   b) What is the maximum tolerable relative gradient $\Delta R/R$ in percent that yields a worst case INL of less than 0.5 LSB for a 12-bit DAC?



3. Study the publication below:
   Chi-Hung Lin and Klaas Bult, "A 10-b, 500-MSample/s CMOS DAC in 0.6 mm2"
   IEEE JOURNAL OF SOLID-STATE CIRCUITS, VOL. 33, NO. 12, DECEMBER 1998

   1. What application is this DAC intended for?

   2. What are the special system requirements for the DAC discussed in this paper and why?

   3. What are the advantages and disadvantages of utilizing thermometer-coded DAC compared to binary-weighted DAC?

   4. Explain why the authors perform 100 MATLAB simulations (Fig.7.)?

   5. How did they obtain results shown in Fig. 8? Do the results agree with the ones discussed in the lectures?

   6. In Fig. 9 what do the authors mean by 0% segmentation and 100% segmentation (x-axis)?

   7. Explain the considerations for the optimal point in Fig. 9.

   8. Assume equation (2) can be expressed as:

      $$\sigma^2 = k / \text{Area}$$

      This DAC is going to be implemented in a more advanced technology, with all minimum feature sizes scaled by a factor of 1/2 compared to the 0.35μ technology used by the authors. Assuming k remains the same for the new technology, on the copy of Fig. 9 shown below; draw the portions, which will change for the new technology. Based on your new drawing, would the choice of segmentation be any different for the new technology? If the answer were positive, then would it be more towards 100% or 0% segmentation on the x-axis?

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   9. Add the curve associated with the more stringent DNL requirement of 0.25LSB. Would this affect the choice of segmentation percentage found in the previous part?

   10. Explain why in Fig. 22. the measured SFDR drops for the extremes of I_{BIAS}.