**MASSACHUSETTS INSTITUTE OF TECHNOLOGY**
Department of Electrical Engineering

# 6.331 Advanced Circuit Techniques

Design Problem 1 — Issued : September 22, 2011
Sample and Hold — Due : Thursday, October 6, 2011

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Design a sample-and-hold circuit for either (not both) of the sets of specifications listed below. Common requirements include operation from +15 and −15 volt supplies over a temperature range of 0°C to +50°C. Assume that you are supplied the sampling pulse from TTL levels.

**High-Accuracy Circuit** :

- Input Range from −10 to +10 volts.
- Total Sampling Time $< 100$ $\mu$s.
- Output must be available immediately following sampling interval.
- Hold Time $> 1.0$ s.
- Total Error $< 20$ mV. (Include sampling error and droop)
- Tracking Error $< 10$ mV for a 10 V/ms ramp.
- Low impedance source.
- Maximum Current drawn from source at any time $< 1$ mA.
- Minimum Output Load = 1 k$\Omega$

**High-Speed Circuit** :

- Input Range from −5 to +5 volts.
- Total Sampling Time $< 200$ ns from 'begin' signal until switch open.
- Output must be settled within 2 $\mu$s after sampling is completed.
- Hold Time $> 1$ ms.
- Total Error $< 20$ mV. (Include sampling error and droop)
- Tracking Error $< 20$ mV for a 1 V/$\mu$s ramp.
- Source Resistance = 1 k$\Omega$
- Maximum Current drawn from source at any time $< 1$ mA.
- Minimum Output Load = 2 k$\Omega$

Note: You should include calculations to show that you meet all specifications. (You may find our discussion on error coefficients of some help for the determination of ramp error.)