HW9

SC ADC

now we have a DAC

V_{in} = V_{in} = \frac{B}{2^n} V_{ref}

V_{id} = V_{id} = \frac{B}{8} V_{ref} during \phi_2

Linear search is better than linear

3 bits 5, 4, 2 4 caps: 4C_0, 2C_0, C_0, C_0

V_\text{ref} = \frac{B}{8} V_{\text{ref}} during \phi_2

V_{id} = V_{in} - \frac{B}{8} V_{\text{ref}} during \phi_2

\text{do we need all of these?}
Sample:

- \( \frac{1}{7} \)?
- \( \frac{1}{4} \)?
- \( \frac{3}{8} \)?
- \( \frac{5}{8} \)?
- \( \frac{7}{8} \)?

Keep \( b_2 \) high, reset \( b_1 \).

000 001 010 011 100 101 110 111

Problem: tough to get comparator offset \( \pm 1 \text{LSB} \) over \((0, V_{DD})\).

\( V_{CM} \) varies \((0, V_{DD})\).

- \( V_{CM} \) small
- \( V_{CM} \) large

V_{CM} changes the decision point \( \Rightarrow \) input offset.

Need to find a way to compare at same voltage no matter \( V_{IN} \). How? S C cleverness.

Recall:

\[ V_x = \frac{B}{2^n} V_{REF} \]

What if this is \( V_z \)?

Initial voltage on caps is \( V_z \).

\[ V_z = \frac{B}{2^n} V_{REF} + V_z \]

Make \( \frac{V_z}{V_{REF}} = V_{IN} \) then change \( B/V_{REF} \).

\[ V_z = V_{REF} - V_{IN} \]

\[ x = \frac{B}{2^n} V_{REF} - V_{IN} + V_{REF} \]
During the LD plane

\[ Q_{x,LD} = (V_{ref} - V_{in}) 2^n C_0 \]

This chart is fixed when LD goes low.

How long will it stay?

Assume 1 pF cap, 1 pA leakage = 1 V/s 15nV in 1 second.

\[(V_{ref} - V_{in}) 2^n C_0 = V_x (2^n C_0) - V_{ref} B C_0 \]

\[ V_{ref} - V_{in} = V_x - V_{ref} \frac{B C_0}{2^n C_0} \]

\[ V_x = V_{ref} + V_{ref} \frac{B}{2^n} \Rightarrow V_{in} \]

\[ V_{id} = V_{ref} - V_x = V_{in} - V_{ref} \frac{B}{2^n} \]

One problem: if \( V_{in} \) small, during 1st compare

\[ b_n = 1 \quad V_x = 1.5 V_{ref} \]

Can be an issue.