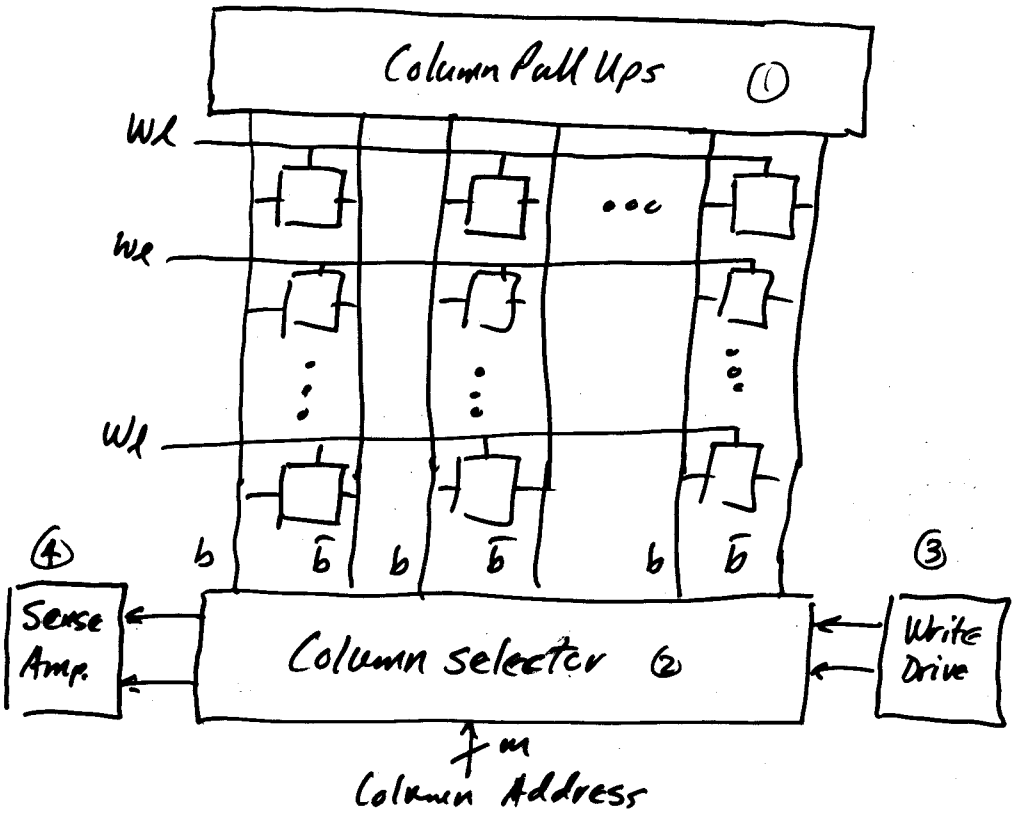
SRAM COLUMN I/O CIRCUITRY

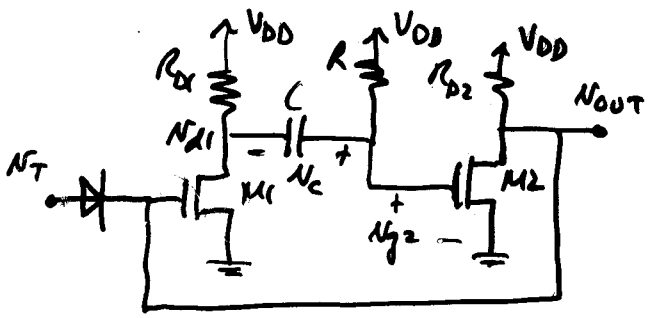
General Architecture

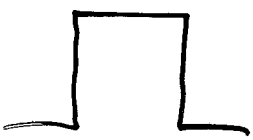


Column Pull-Ups

(See slides)

Monstable Pulse Generator





Normally,

$N_{g2} = V_{DD}$ → M2 ON & M1 OFF

also $N_c = 0$

Application of a positive trigger

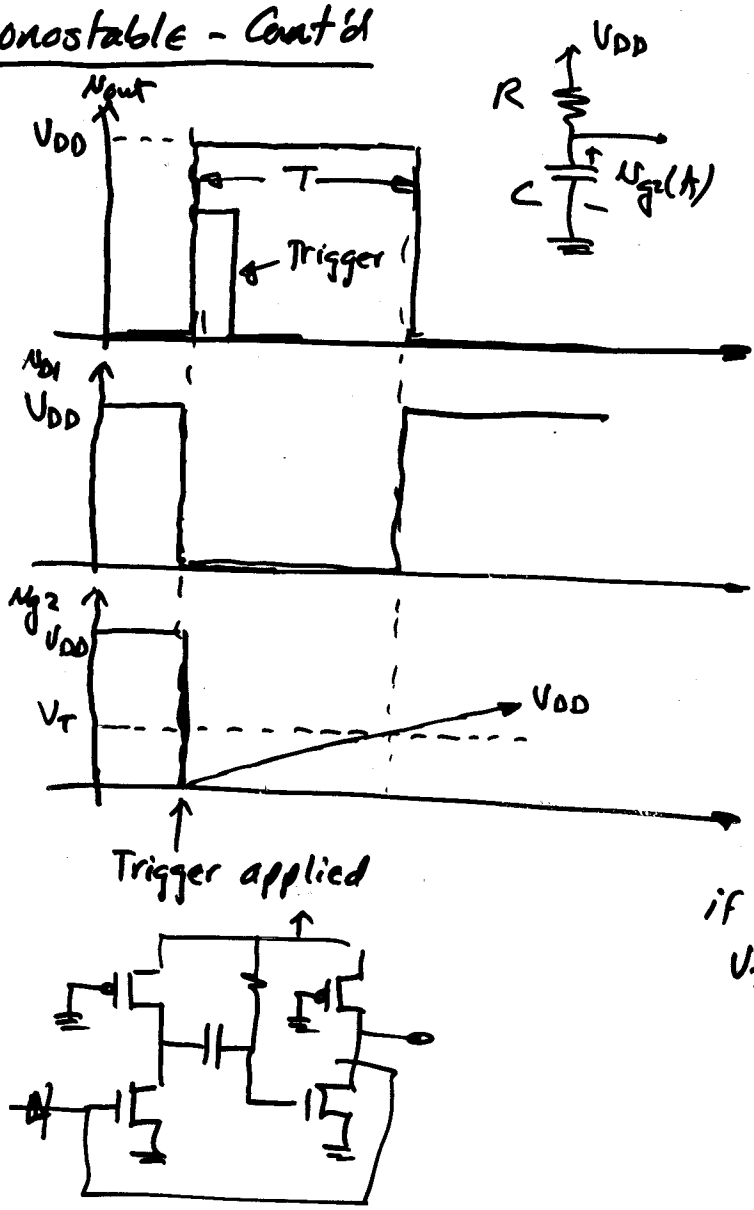
turns M1 ON → $N_{D1} \to 0$ → $N_{g2} = 0$

M2 OFF → $N_{out} = V_{DD}$

N_{g2} charges up to V_T and turns M2 back on so

now $N_{out} = 0$

Monostable - Cont'd



$T = ?$

$V_{g2}(t) = A + Be^{-t/\tau}$

$\tau = RC$

$V_{g2}(0) = A + B = 0$

$V_{g2}(\infty) = V_{DD} = A$

$V_{g2}(t) = V_{DD}\left(1 - e^{-t/\tau}\right)$

$\therefore V_T = V_{DD}\left(1 - e^{-T/\tau}\right)$

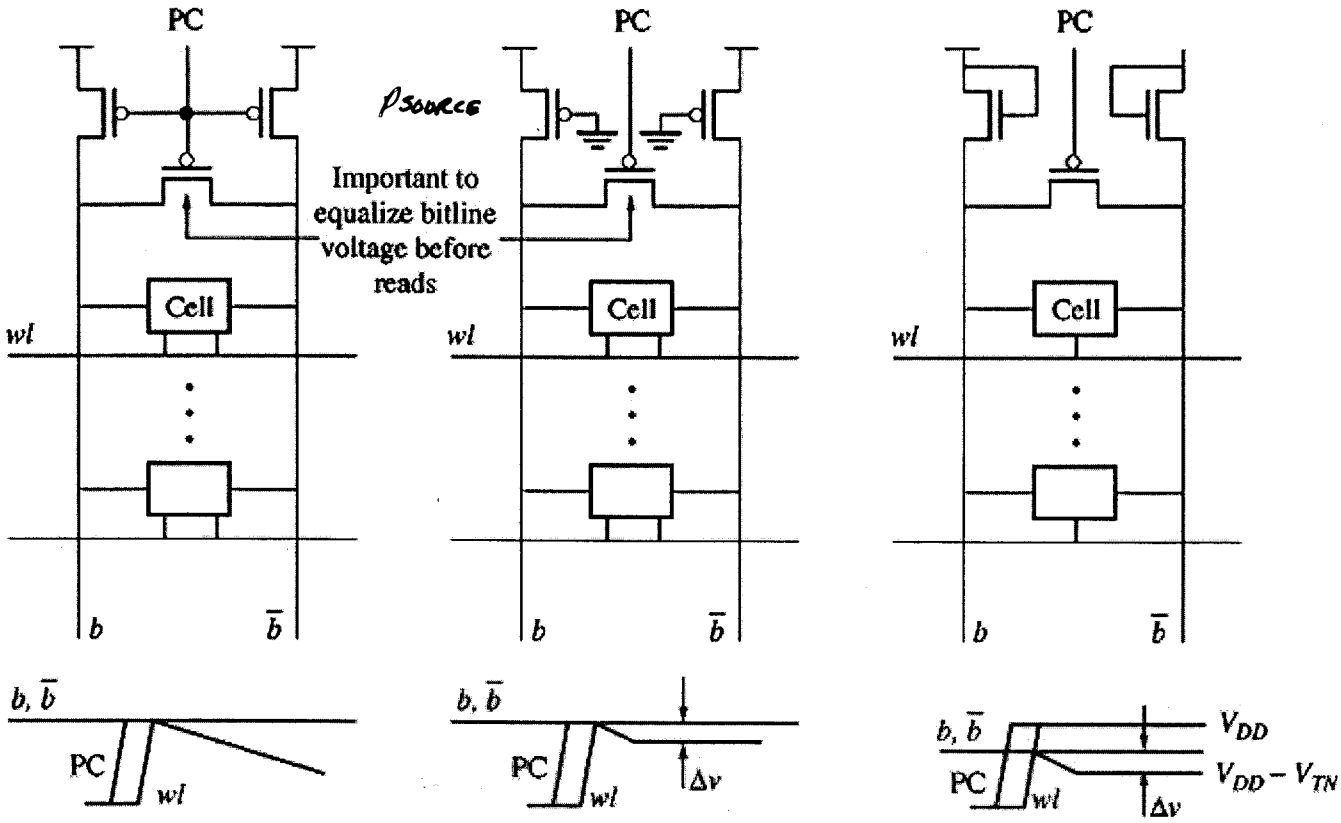
$T = \tau \ln\left(\frac{V_{DD}}{V_{DD} - V_T}\right)$

For example,

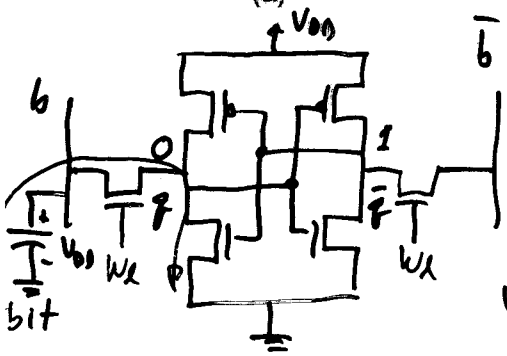
if $T = 10ns$, $V_{DD} = 2V$ and $V_T = 0.5 \rightarrow T = \underline{2.9ns}$

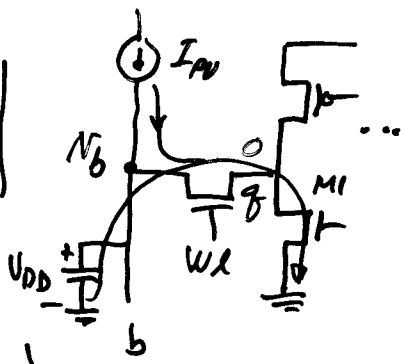
Column Pull-Ups

FIGURE 8.13 – COLUMN PULL-UP CONFIGURATIONS



← Good for sensing with a diff. amp





M1

$$N_b \approx \frac{V_{DD}\, R_{NSINK}}{R_{NSINK} + R_{PSOURCE}}$$

$$\Delta V \approx V_{DD} - N_b$$

Continuous current ⇒ Good for sensing using current sensing sense amplifiers

Column Selection

Figure 8.15 – Column decoding and multiplexing.

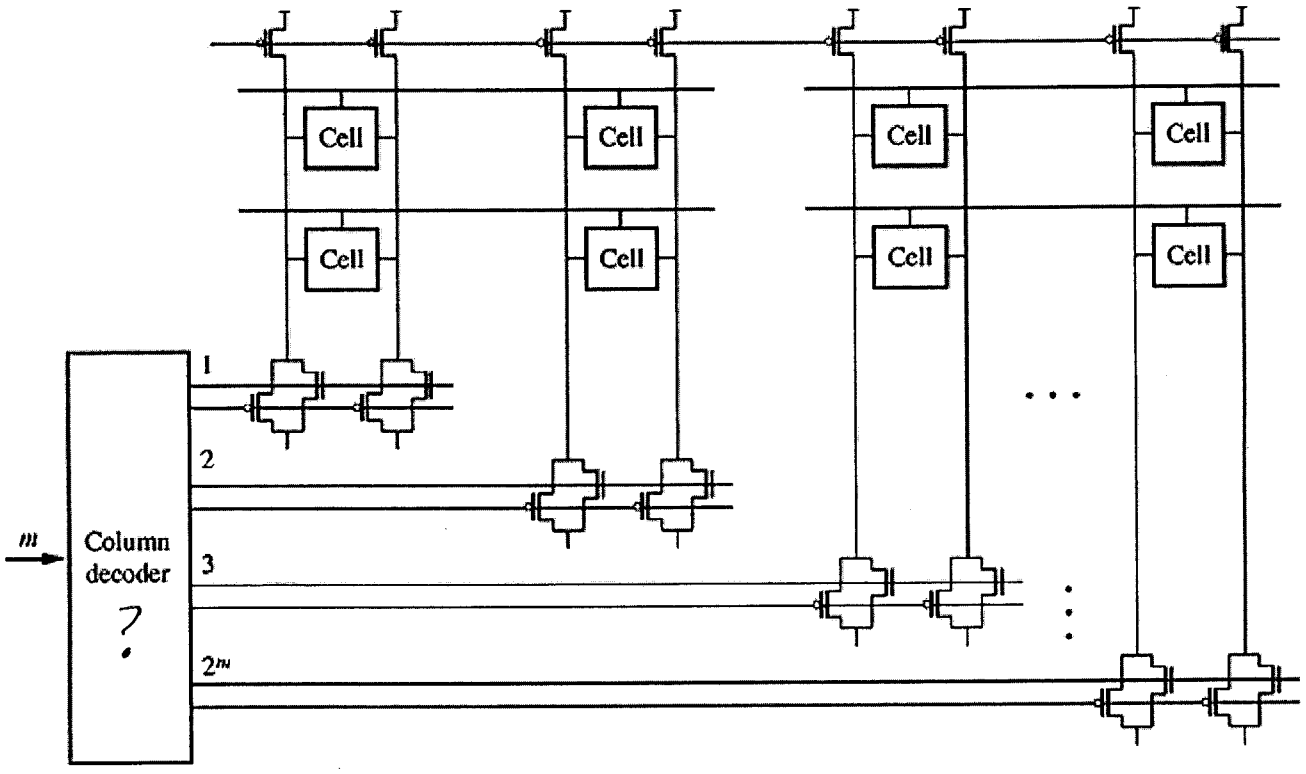


Figure 8.16 – Column selection.

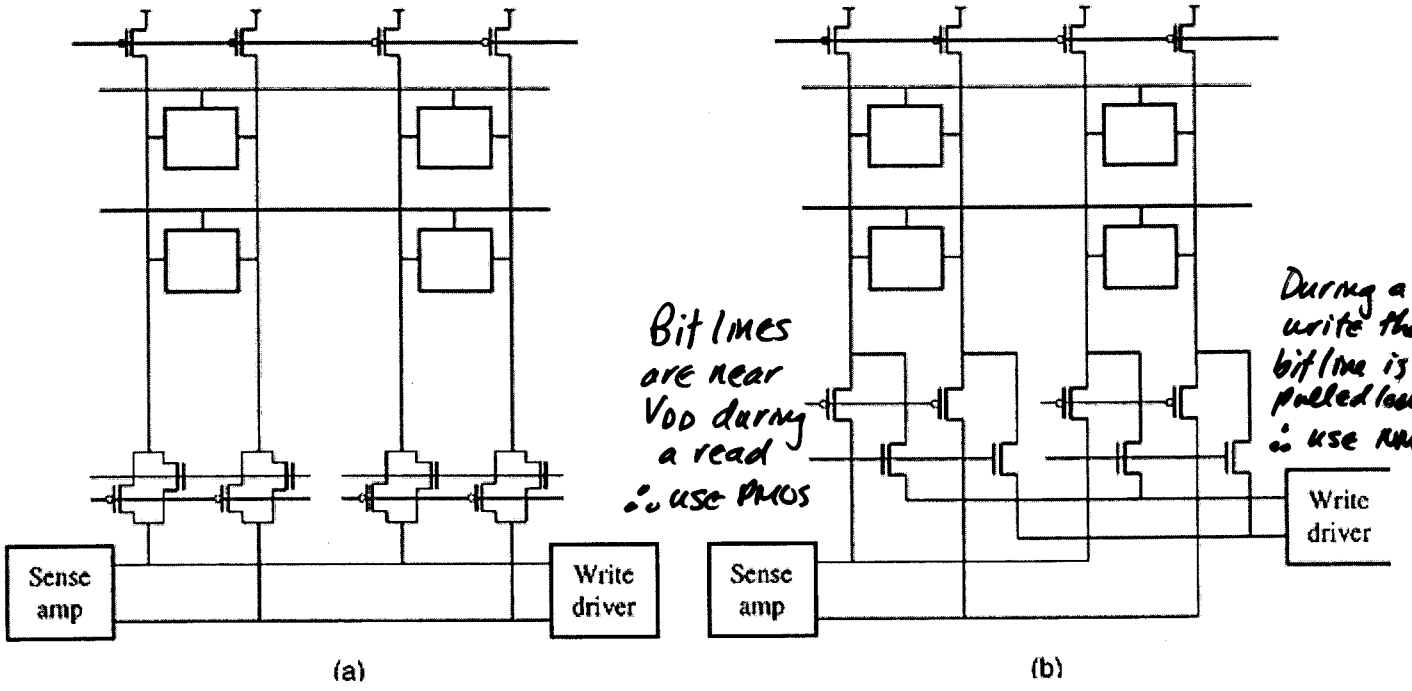
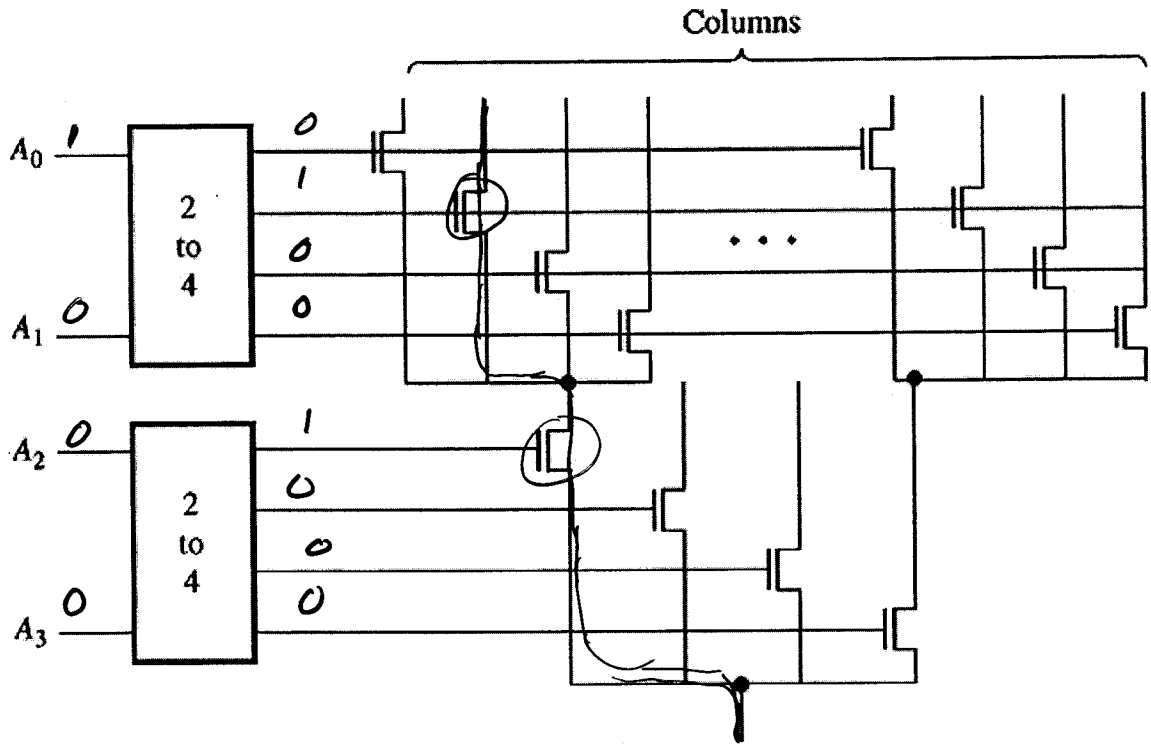


Figure 8.17 – Two-level tree decoder for a 4-bit column address.



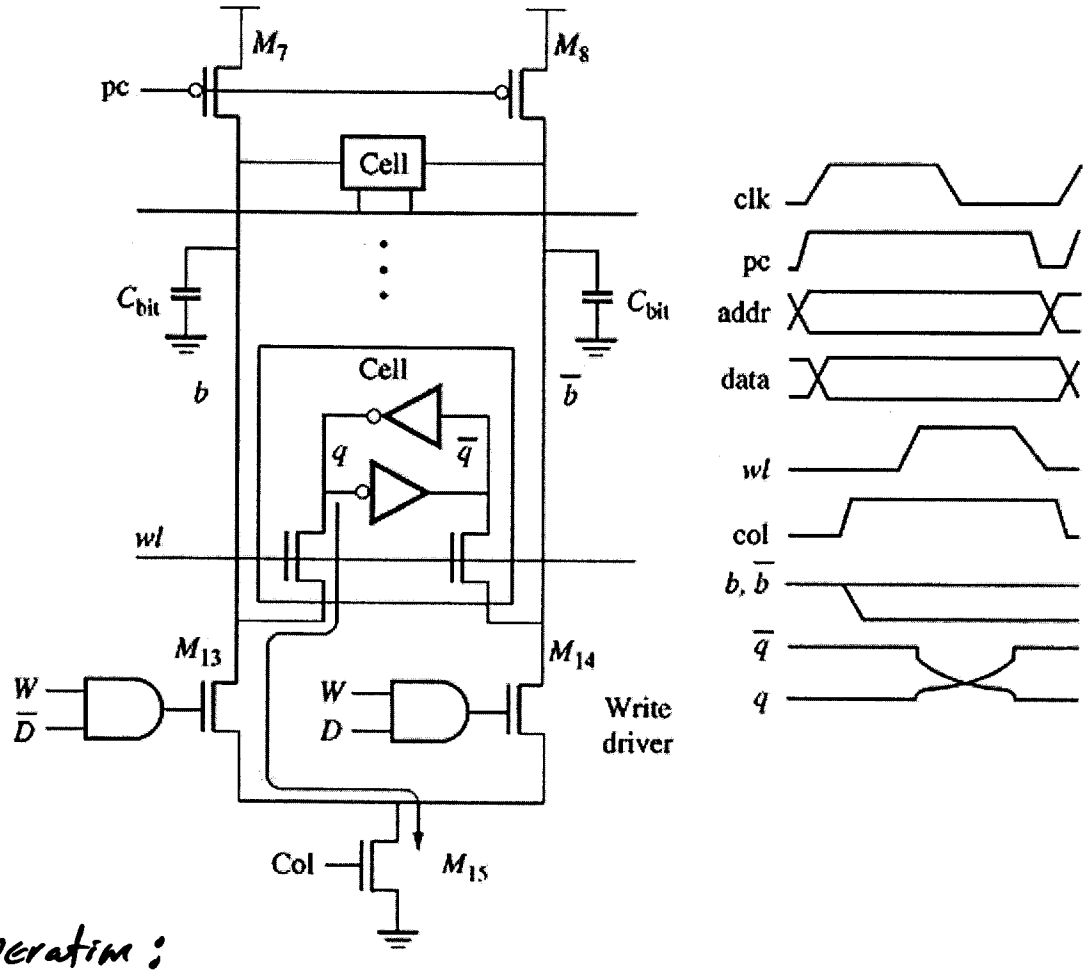
Also you need a PMOS tree structure

Tradeoffs

- Less area
- Less power
- Slow

Write Circuitry

Figure 8.18 – Write driver circuit.



Operation:

1.) Columns are precharged to V_{DD} with M7 and M8.
2.) Address and data signals are applied and held stable for the required amount of time before the clock is applied.
3.) The clock converts the address signals into column select and word line activation signals
4.) The data and write signals are applied to pull one column to ground while leaving the other side at V_{DD}.
(This done by ANDing the input data with the write signal)
5.) When the word line goes high, current flows out of the cell and flips the sense of the cell.
6.) Once the cell flips, the word line and column select lines go to their standby values.