

ECE321 – Electronics I

Lecture 22: Combinational Logic: Transmission Gates

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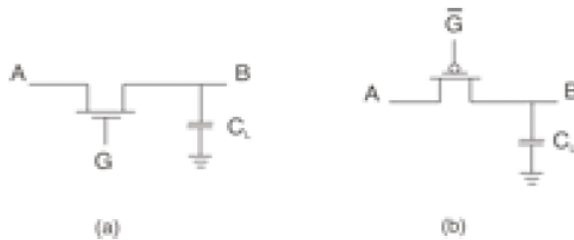
Review of Last Lecture

- NAND Gate**
 - Basic circuit for CMOS NAND Gate
 - Circuit analysis techniques
 - Proper transistor sizing
- NOR Gate**
 - Basic circuit for CMOS NOR Gate
 - Circuit analysis techniques
 - Proper transistor sizing

Today's Lecture

- Transmission Gates
 - Basic circuit for Transmission Gate
 - Circuit analysis Techniques
 - Complex Logic Gates using Pass Transistors

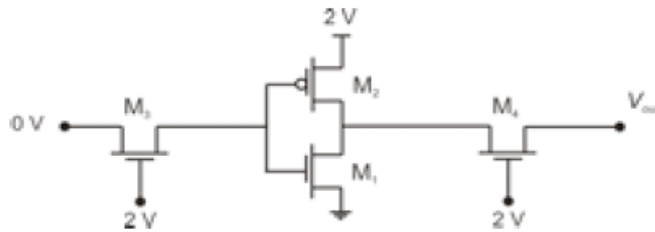
NMOS and PMOS as Switching Elements



- In circuit (a), if A has a full swing, what is the range of output voltages?
- In circuit (b), if A has a full swing, what is the range of output voltages?

Example 1: Transmission Buffer

□ Assuming $|V_{tp}| = V_{tn} = 0.5V$, what is V_{out} ?

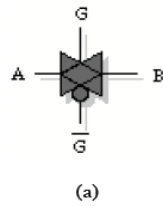


Example 2: Some Other Examples

Given the pass transistor circuit with $V_m = 0.5V$. Ignore the body effect. What is the output voltage?

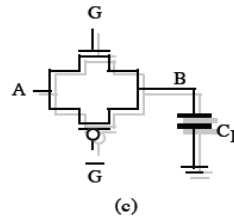


CMOS Transmission Gate

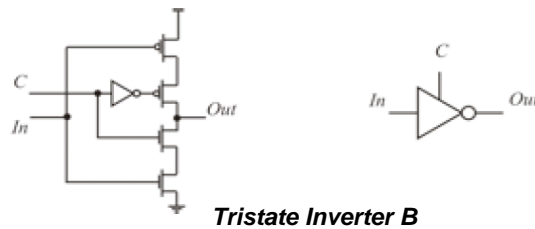
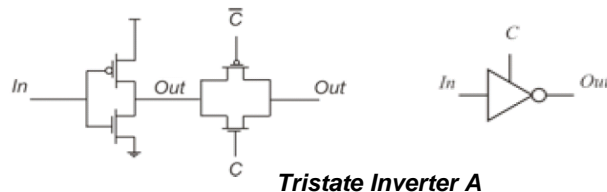


A	G	C
0	1	0
1	1	1
0	0	Z
1	0	Z

(b)



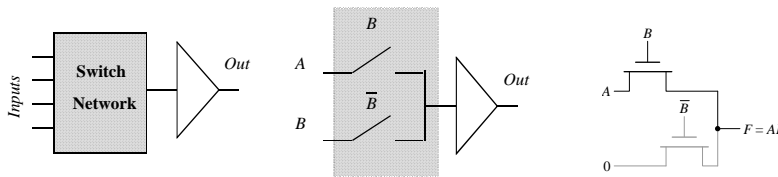
Tri-state CMOS Inverter



❑ Which circuit, A, or B, is better to use?

Complex Logic with Transmission Gates

- Another way of reducing the number of transistors in complex logic gate is to use switch network.
- For instance AND gate can be implemented by only 4 transistors (instead of 6 transistor in CMOS implementation)



- N transistors
- No static consumption

Examples: Pass Transistor Networks

- Differential logics can be implemented using pass-transistor logic.
- These examples show that a complicated logic gate can be implemented with only few transistors

