

## CEG3470 – Digital Circuits (Fall 2009)

Assigned: Oct 23, 2009

Total Mark: 30

Due: Nov 1, 2009 23:59

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### Lab 2: 1-bit Full Adder MAGIC Layout

2's complement addition and subtraction is the most important arithmetic in computer design. Efficient adder has to be carefully designed to optimize speed performance of binary addition and subtraction. A 1-bit full adder is the basic unit for building large adders.

The specification of a full adder (FA) is as follows:

Inputs:  $A$ ,  $B$  and  $C_{in}$

Outputs:  $S$  and  $C_{out}$

Boolean functions:

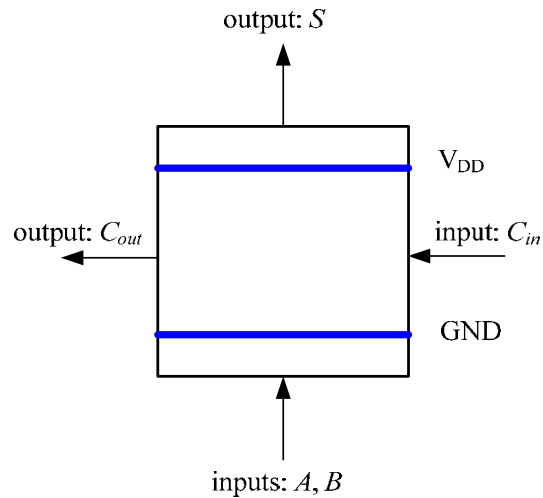
$$S = A \oplus B \oplus C_{in}, C_{out} = AB + C_{in}(A \oplus B) = AB + BC_{in} + AC_{in}$$

In this lab, use **MAGIC** to layout a 1-bit full adder.

Your layout **must conform** to the following rules:

1.  $V_{DD}$  rail is on the top of cell while GND rail is on the bottom of the cell. Both rails must run through the whole cell. You can only use metal 1 (M1/Blue) for  $V_{DD}$  and GND
2. You can **ONLY** use the following materials in your layout: **m1** (blue), **m2**(purple), **ndiff** (green), **pdiff** (brown), **poly** (red) and contacts/vias between the above layers.
3. All inputs  $A$ ,  $B$  must be entered on the bottom side of the cell. Input  $C_{in}$  must be entered on the right hand side of the cell.
4. Output  $S$  must be generated at the top of your cell while  $C_{out}$  has to be generated on the right hand side.
5. Always use  $4\lambda \times 2\lambda$  NMOS and  $8\lambda \times 2\lambda$  PMOS.
6. Your cell can be abutted side by side **without** DRC violations.

The following figure explains the above rules:



Submit your layout (.mag) electronically.

Use **IRSIM** to simulate your layout. Verify your cell with **ALL** possible input combinations. Submit your simulation command file (.cmd) electronically.

- End -

### Who's Get the Smallest Layout Competition

**The student who submit a FA cell with the smallest cell area among all other submissions will be awarded a special prize. Keep improving your layout techniques!**

**LEARN & ENJOY!**

What to Submit?

1. MAGIC layout (\*.mag)
2. IRSIM simulation commands (\*.cmd)

How to Submit?

Electronic submission procedure available at  
<http://www.cse.cuhk.edu.hk/~ceg3470/submission/index.html>