Digital Logic Worked Example: Schematic to Function*

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Abstract

This is a worked example demonstrating how to obtain the function from a given transistor level schematic.

In the following exercise, a transistor level schematic will be analyzed and it's underlying function will be found.

Exercise 1: Schematic to Function ***(Solution on p. 3.)***

Fill out the truth table for the following mystery schematic (Fig 1) and determine the function.

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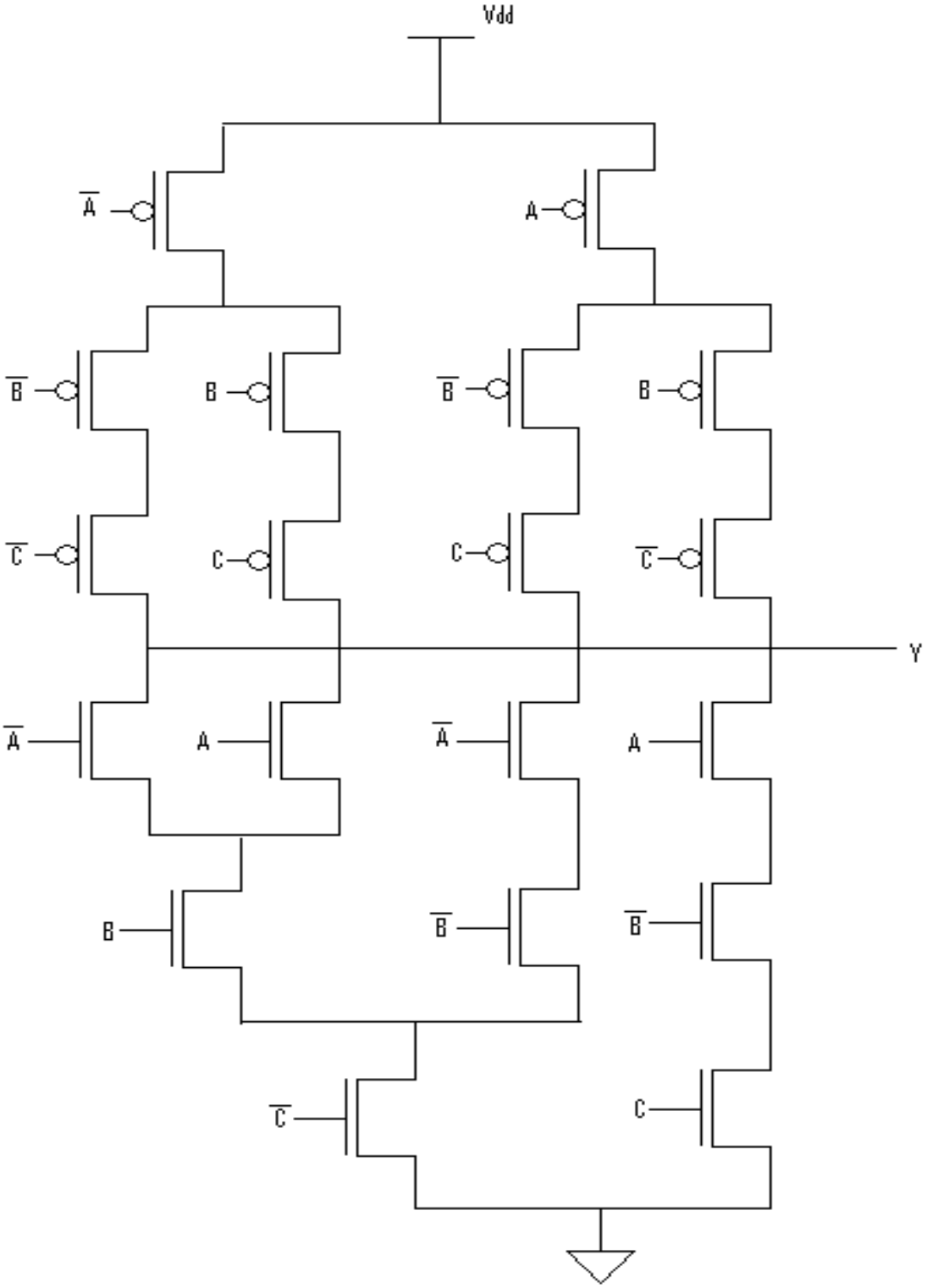
Vdd
$\overline{A}$
A
$\overline{B}$
B
$\overline{B}$
B
$\overline{C}$
C
C
$\overline{C}$
Y
$\overline{A}$
A
$\overline{A}$
A
B
$\overline{B}$
$\overline{B}$
$\overline{C}$
C

Figure 1

Solutions to Exercises in this Module

Solution to Exercise (p. 1)
Working It Out

Step 1: **States of a transistor**

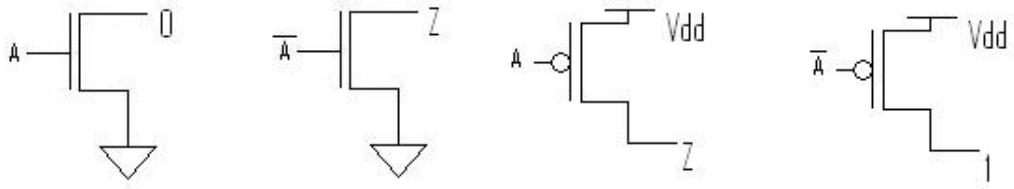

Figure 2: Consider A to be high (1)

Note that this is a valid schematic and that the p-MOS transistors are connected to the ground and the n-MOS transistors are connected to Vdd

.

Step 2: **Truth Table**

A	B	C	Y
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

Figure 3

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Step 3: Complete the truth table with the corresponding output Y to its input

Truth Table

A	B	C	Y
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	1

Figure 4

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Step 4: Y = A'B'C + A'BC' + AB'C' + ABC OR Y = (A' + B' + C').(A' + B + C).(A + B' + C').(A + B + C')

.

Step 5: Also, try to notice patterns that you have already learned about. Clearly, the output is high only when there is an odd number of inputs high. Thus, we can conclude that this is a 3 - input XOR.
Answer: Y = XOR(A, B, C)