3-INPUT NAND GATE USING CMOS

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***Abstract*—The Logic gates are used to carry out logical operations using single or multiple binary inputs and a single binary output. The input and output of a logic gate are based on certain logic, which is explained using Boolean algebra. Boolean algebra uses only two variables zero or one. The most basic type of logic gates are OR gate, AND gate and NOT gate. In addition to the basic logic gate, there are combination gates like NAND gate, NOR gate, XOR gate, etc made by combining basic logic gates in different ways.The NAND gate or "NotAND" gate is the combination of two basic logic gates, the AND gate and the NOT gate connected in series. The NAND gate and NOR gate can be called the universal gates since the combination of these gates can be used to accomplish any of the basic operations. Hence, NAND gate and NOR gate combination can produce an inverter, an OR gate or an AND gate.**

I. Introduction

THE output of a NAND gate is high when either of the inputs is high or if both the inputs are low. In other words, the output is always high and goes low only when both the inputs are high.. It consists of three series nMOS transistors between OUT and GND and three parallel pMOS transistors between OUT and VDD. If any one of the inputs in1 or in2 or in3 is 0, at least one of the nMOS transistors will be OFF, breaking the path from OUT to GND. But at least one of the pMOS transistors will be ON, creating a path from OUT to VDD. Hence, the output OUT will be 1. If all the inputs are 1, all the nMOS transistors will be ON and all the pMOS transistors will be OFF. Hence, the output will be 0.[1]

The equation for nand gate is given by

$$OUT = \overline{ABC} \tag{1}$$

TABLE I: NAND gate

in1	in2	in3	OUT
0	0	0	1
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	0

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II. Reference Circuit design

The 3 input nand gate is given by

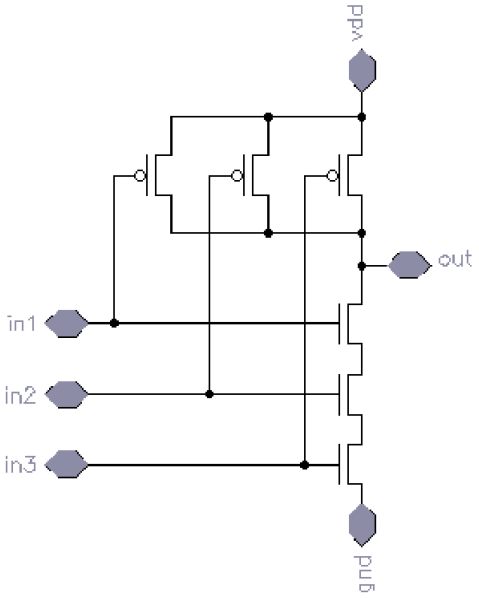

Fig. 1: 3-input NAND gate

III. Reference Waveform

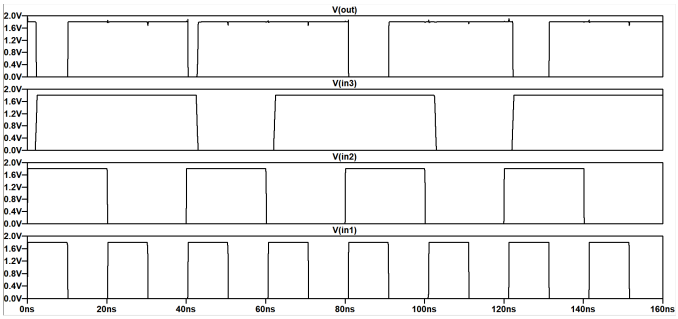

Fig. 2: 3-input NAND gate waveform

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References

[1] Neil H. E. Weste Macquarie University , The University of Adelaide and David Money Harris ,Harvey Mudd College CMOS VLSI Design - A Circuits and Systems Perspective,4th Edition,pearson Education India,2011.