

Experiment 1

MOSFET as an Inverter

In this lab, we are going to observe propagation delay in a simple NOT gate circuit. Propagation delay is the time delay between the input and the output signals. It takes place due to the inherent capacitance of the MOSFET. Fig. 1.1 gives us the NOT gate circuit. We have applied V_{cc} as 5V. The threshold voltage V_{th} of the inverter is half of V_{cc} . The input is supplied at point A and the output is taken at point B. When the input Gate Voltage is less than the threshold voltage, the MOSFET comes in the cut-off region and there is no voltage drop which makes output voltage equal to V_{DD} . When the input Gate voltage is greater than the threshold voltage, the MOSFET starts conducting current and is in the linear region. Further increase in the voltage (V_{DS}) takes it to reaches the saturation region, where transistor acts as closed switch.

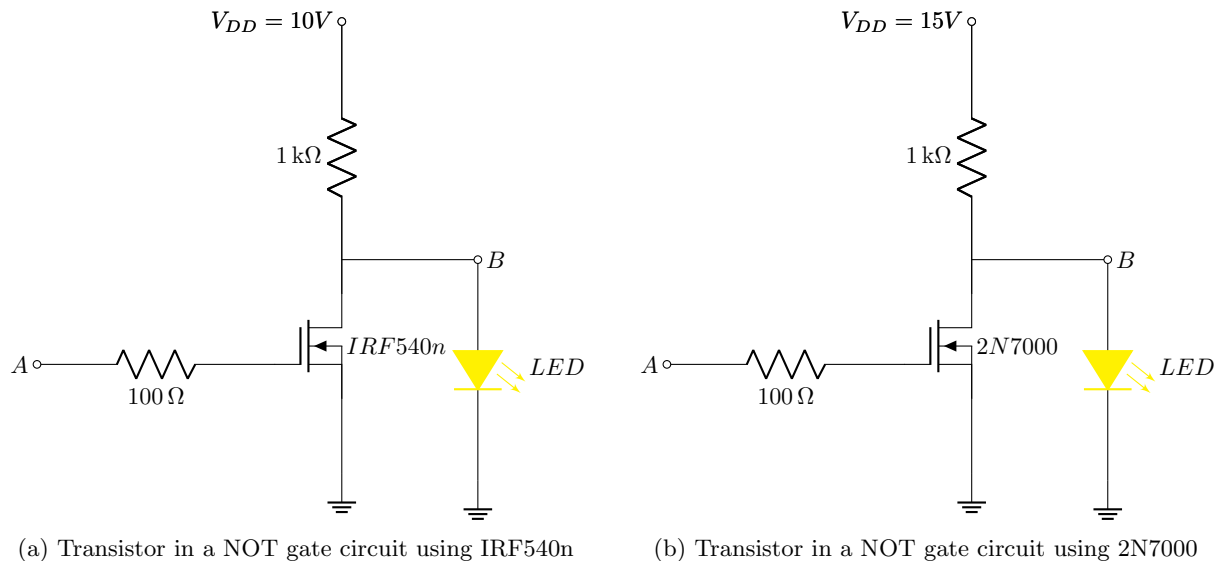


Fig. 1.1: Transistor in a NOT gate circuit

Tasks

Patch the NOT gate circuit as shown in Fig. 1.1a or Fig. 1.1b on the breadboard.

1. Apply 5V at terminal A, what is the voltage at terminal B? Does the LED glow?
2. Apply 0V at terminal A, what is the voltage at terminal B? Does the LED glow?
3. Apply a 1 kHz, 5V peak voltage square wave at terminal A using the signal generator. Plot the input voltage at terminal A and the output voltage at terminal B using C.R.O. When the input goes from high voltage to low voltage, how much time does the output take to go from low voltage to high voltage (propagation delay)? Similarly, find the time the output takes to go from high to low voltage.
4. Repeat the above step by applying the frequency of 100kHz at the input terminal.
5. **How does the change of frequency affect the mode of operation of a transistor?**

Fig. 1.2 gives the propagation delay using the CRO where the propagation delay is 48 microseconds.

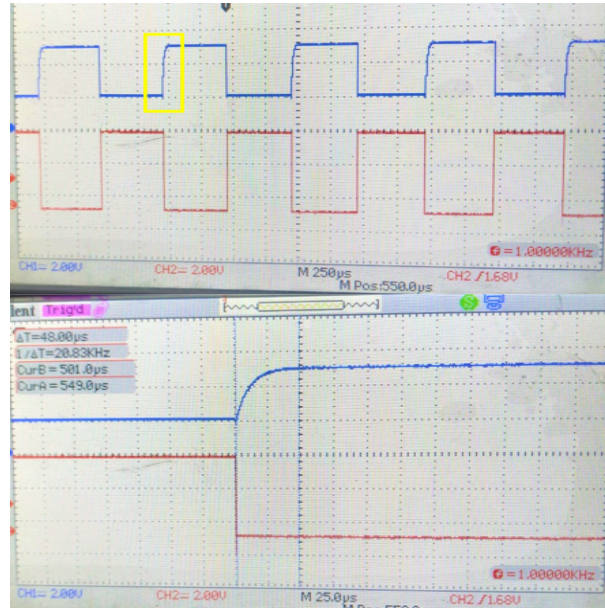


Fig. 1.2: Input wave(Red) and output wave(Blue) of an inverter circuit

Deliverable

A report containing the following items:

- The answers to the questions given in Section 1.
- The picture of the input-output waveform with the propagation delay just like the one given in Fig. 1.2.

The collaboration between students is encouraged, but blind code sharing/copying is not allowed. If you are unable to explain anything in your work, it will be assumed you have copied it. So make sure you know everything you have written in your report. We are least concerned about how you have learnt something as long as you have learnt it well. Copied assignments will get ZERO marks.

Acknowledgements

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