EE 97 Fall 2014

Lab#3: A Simple Light-Controlled Switch

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Station 3

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**Experiment 1**

A MOSFET also known as Metal Oxide Semiconductor Field Transistor is used as a user controlled switch in a simple light bulb and resistor circuit. The N-Channel MOSFET (part number: IRF640A) is connected in series with a 1Ω resistor and a light bulb (part number: 756LAMP). Setting the power supply at 12V and using potentiometer also known as POT (part number: CRMT103) are connected in parallel. With this setup many different properties can be observed and calculated about this light-controlled circuit.

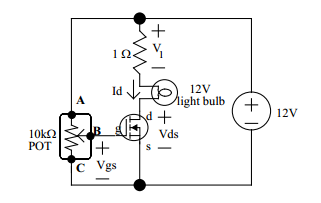


Figure 1: Schematic for Experiment 1

The resistance between G and D and between G and S are very high, so high that DMM (Agilent 34405A) is unable to measure a recordable value. In other words the resistance measured between the three terminals of the MOSFET are maxed out while measuring with lab equipment. From appendix b of the EE97 Lab Manual by P.Hsu the DMM has a max limit of resistance measured to be 100MΩ with a ±5kΩ error.

**Table 1: Data for Experiment 1**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Vds V/[V]** | **Vgs V/ [V]** | **V1 V/[V]** | **Source Current I/ [A]** | **Vds/Id R/ [Ω]** | **MOSFET Power [W]** | **Light Bulb Power [W]** | **Brightness of Bulb** |
| 12 | 0.0001 | 0 | 0 | 0 | 0 | 0 | No Light |
| 10 | 3.25 | 0.055 | 0.06 | 0.055 | 0.55 | 0.106975 | No Light |
| 8 | 3.35 | 0.103 | 0.098 | 0.103 | 0.824 | 0.401391 | Barley Visible |
| 6 | 3.38 | 0.121 | 0.124 | 0.121 | 0.726 | 0.711359 | Bright |
| 4 | 3.47 | 0.144 | 0.144 | 0.144 | 0.576 | 1.131264 | Bright |
| 2 | 3.5 | 0.155 | 0.159 | 0.155 | 0.31 | 1.525975 | Very Bright |
| 0 | 4.79 | 0.18 | 0.186 | 0.18 | 0 | 2.1276 | Very Bright |

To calculate the MOSFET power the voltage across the resistor V1 multiplied by Vds, which is the voltage across the drain and source of the MOSFET. The voltage across the resistor can be considered as the current across the MOSFET this is due to ohms law and convention of components connected in series.

To calculate power for the light bulb the remaining voltage needs to be found between the resistor and the potentiometer. Due to the voltage drop being the same at every major node twelve can be subtracted from the MOSFET voltage and Potentiometer voltage. For the current it will be the voltage across the resister V1.

Sample Calculations

MOSFET Power

P=V\*I =10\*0.055=0.55W

Light Bulb Power

P=V1\*(12-(V1+Vds)=.055\*(12-(.055+10))= .1069W

**Graph 1: Vds/Id vs Vgs**

**Graph 2: Vds vs Vgs**

From graph two we can se the MOSFET allows maximum flow of current at 8V. Also we can see that the MOSFET resistance decreases as the voltage is increased.

**Conclusion**

This experiment introduced a new component, which can be considered as a switch due to its controllable resistance through the amount of voltage passed through its terminals. This is known as the deprecation layer within the silicon based component. For this experiment the MOSFET had a threshold at 8V to 6V, within that range the MOSFET allows a maximum flow of current. The data shows that the power of the light bulb increases as the potentiometer is adjusted. To get better results and a more precise graph instead of adjusting the Vgs like stated in the lab manual, Vds was varied from 12V to 0V. This created a graph that shows a clear drop, which indicates the threshold being reached for the MOSFET. Overall this labs focus was to understand and learn how a MOSFET functions and how it can be utilized in a circuits.