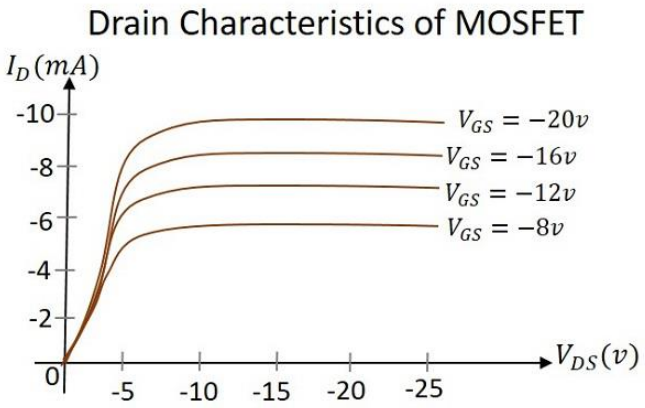
Experiment 9.1: MOSFET drain curve

Theory: The drain characteristics of a MOSFET are drawn between the drain current ID and the drain source voltage VDS. The characteristic curve is as shown below for different values of inputs.

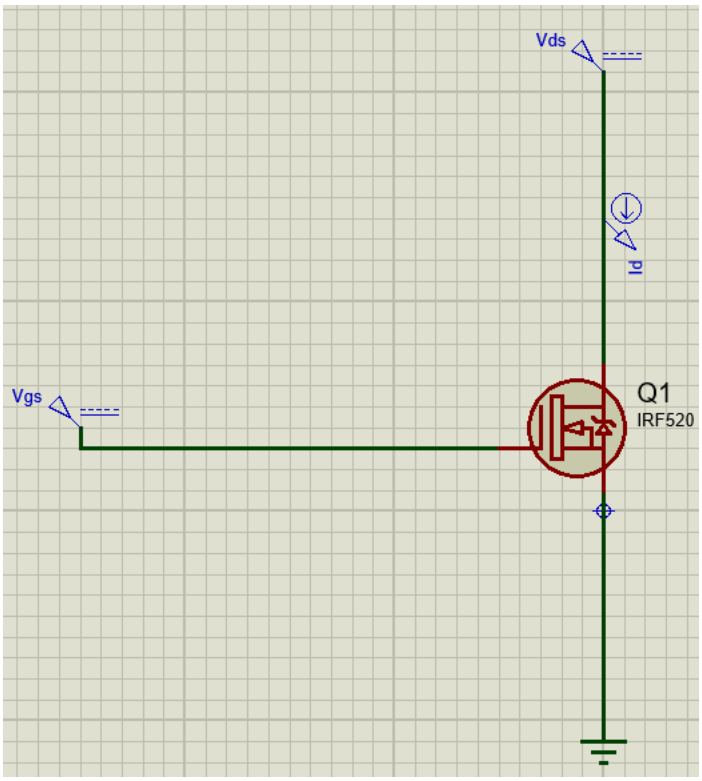


Actually when VDS is increased, the drain current ID should increase, but due to the applied VGS, the drain current is controlled at certain level. Hence the gate current controls the output drain current.

Equipment and Software Requirements:

- Proteus simulation software
    - MOSFET(IRF520)
    - DC voltage source
    - Current probe
- Computer with Proteus installed

Circuit Diagram:



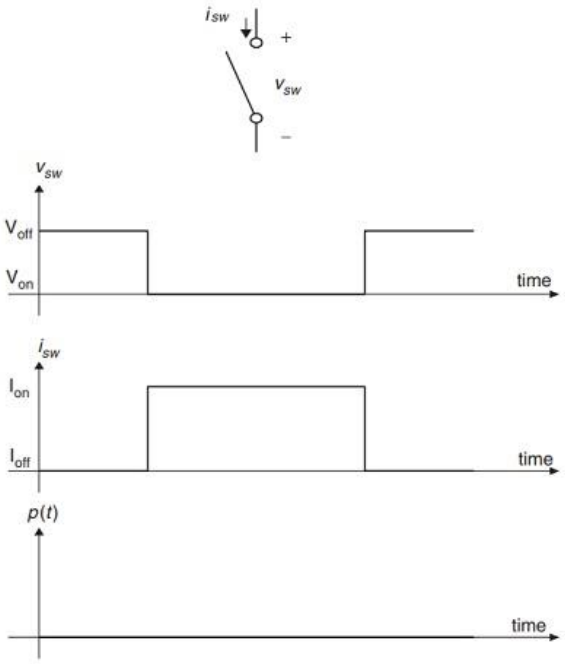
Experiment 9.2: MOSFET as a Switch

Theory: Semiconductor switching in electronic circuit is one of the important aspects. A semiconductor device like a BJT or a MOSFET are generally operated as switches i.e., they are either in ON state or in OFF state.

Ideal Switch Characteristics

For a semiconductor device, like a MOSFET, to act as an ideal switch, it must have the following features:

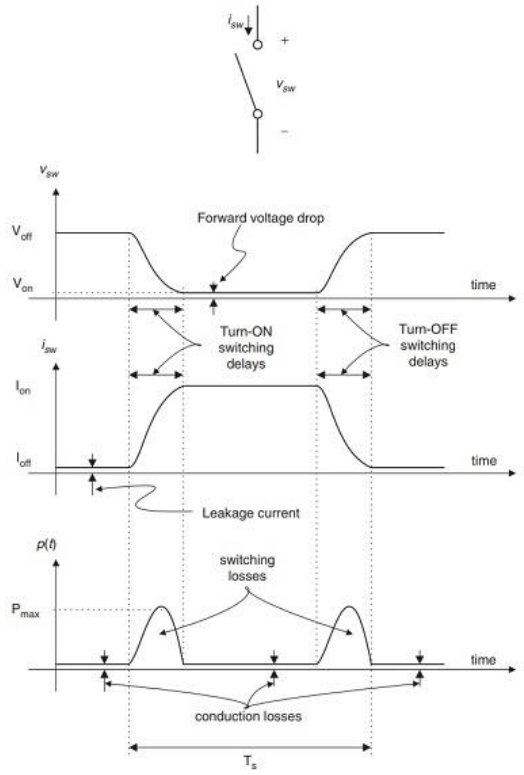
- During ON state, there should not be any limit on the amount of current it can carry.
- In OFF state, there should not be any limit on the blocking voltage.
- When the device is in ON state, there should be zero voltage drop.
- OFF state resistance should be infinite.
- Operating speed of the device has no limits.



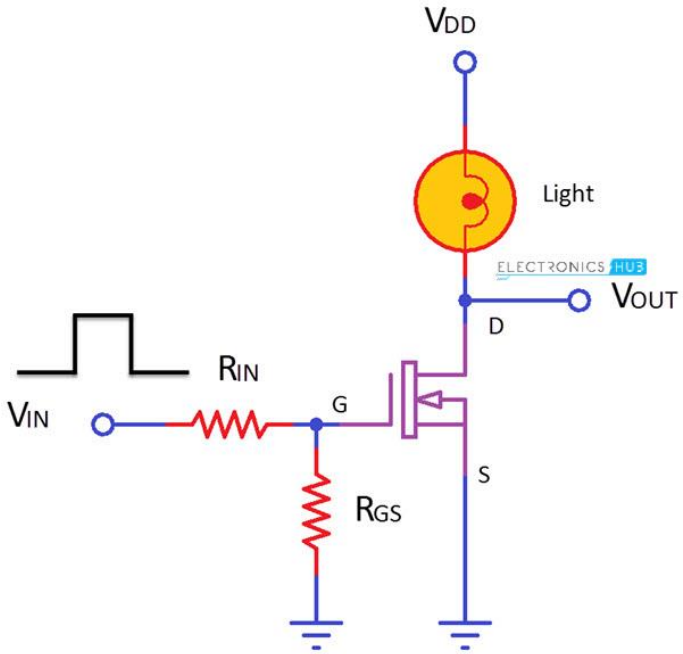
Practical Switch Characteristics

But the World isn't ideal and it is applicable even to our semiconductor switches. In a practical situation, a semiconductor device like a MOSFET has the following characteristics.

- During ON state, the power handling capabilities are limited i.e., limited conduction current. The blocking voltage during OFF state is also limited.
- Finite turn on and turn off times, which limit the switching speed. Maximum operating frequency is also limited.
- When the device is ON, there will be a finite on state resistance resulting in a forward voltage drop. There will also be a finite off state resistance which results in a reverse leakage current.
- A practical switch experiences power loses during on state, off state and also during the transition state (on to off or off to on).



he operation of a MOSFET as a switch by considering a simple example circuit.



This is a simple circuit, where an N-Channel Enhancement mode MOSFET will turn ON or OFF a light. In order to operate a MOSFET as a switch, it must be operated in cut-off and linear (or triode) region.

Assume the device is initially OFF. The voltage across Gate and Source i.e., VGS is made appropriately positive (technically speaking, VGS > VTH), the MOSFET enters linear region and the switch is ON. This makes the Light to turn ON.
If the input Gate voltage is 0V (or technically < VTH), the MOSFET enters cut-off state and turns off. This in turn will make the light to turn OFF.

Equipment and Software Requirements:

- Proteus simulation software
  - MOSFET(2N6660)
  - Resistor (10k)
  - Motor
  - DC supply (12V)
- Computer with Proteus installed

Circuit Diagram:

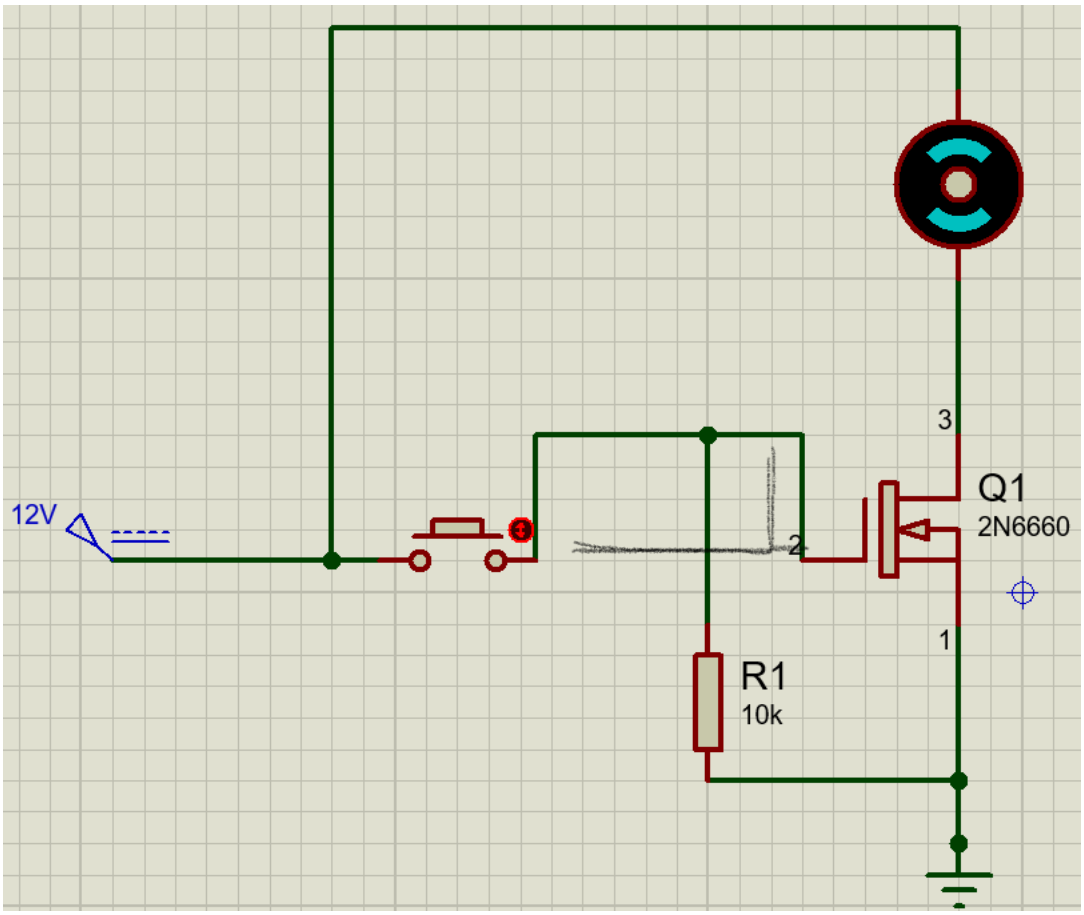


Figure-1: MOSFET as Switch

Precautions:

- Ensure proper connections in the circuit.
- Use appropriate units and scales for measurements.
- Be cautious when using simulation software to avoid incorrect configurations.

Questions and Exercises:

1. What are the advantages of using a MOSFET as a switch compared to other devices?
2. What are the key parameters to consider when selecting a MOSFET for switching applications?
3. How does the gate voltage affect the switching behavior of a MOSFET?
4. What is the difference between enhancement-mode and depletion-mode MOSFETs in switching applications?
5. What are some common applications of MOSFET switches?

Experiment 9.2: MOSFET as a Switch with lamp brightness control.

Equipment and Software Requirements:

- Proteus simulation software
    - MOSFET(IRFZ44N)
    - POT HG
    - Power (6V)
    - Lamp
    - Battery
    - DC voltmeter
    - DC ammeter
- Computer with Proteus installed

Circuit Diagram:

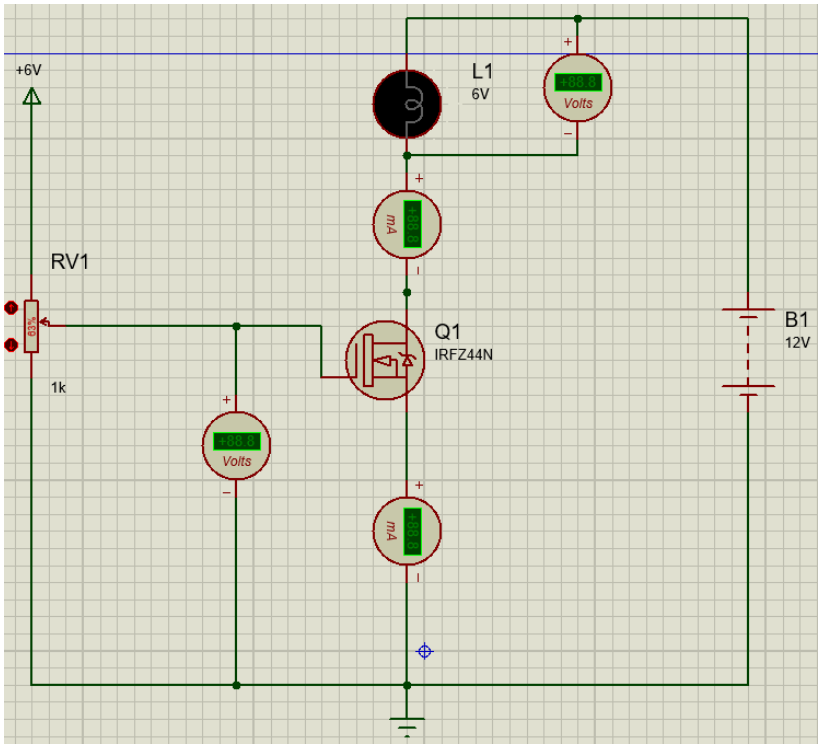


Figure-1: MOSFET as Switch