

MOSFET (n-channel) Exercises

Question 1

Draw the circuit symbol for an n-channel MOSFET

Label the connections with the correct names

Question 2

Describe the action of an n-channel MOSFET (when used as a transducer driver) in terms of current and voltage

Question 3

Write down the equation connecting current and the input voltage for a MOSFET

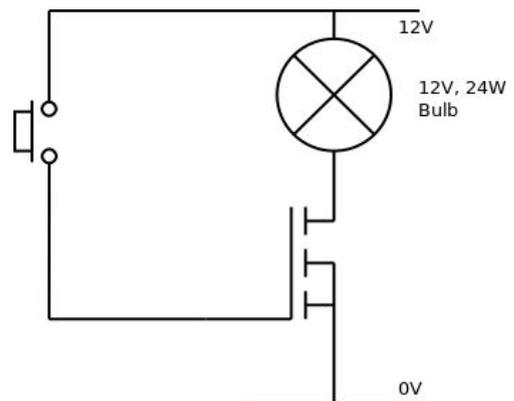
Explain what each of the terms in the equation represent

Question 4

A MOSFET is used to control a 24 W lamp from a 12V supply. The push button is connected to the same 12V supply

The threshold voltage of the MOSFET is 3V

Calculate the minimum transconductance of the MOSFET



Question 5

What other component is required in the circuit in question 4 to make sure the circuit works as expected?

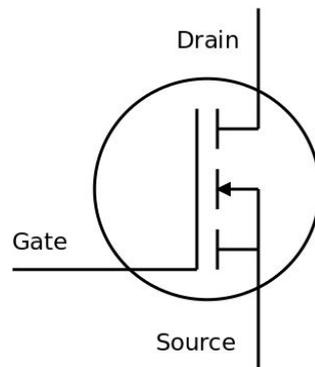
Question 6

A logic circuit is used to control a motor using a MOSFET. The motor works from a 24V supply and requires a maximum current of 1.5A. The transconductance of the MOSFET is 800mS and the threshold voltage is 2V

- What is the Drain current of the MOSFET?
- What additional component is needed in this circuit?
- Calculate the minimum output voltage from the logic gate

MOSFET (n-channel) Answers

Question 1



Question 2

When the potential difference between the source and the gate (gate-source voltage, V_{GS}) is less than the threshold voltage then the resistance between the drain and the source is very high and no current flows. When the gate-source voltage is greater than the threshold voltage, current flows into the drain and out of the source. The drain current depends on the transconductance of the MOSFET and on how much bigger the gate-source voltage is than the threshold voltage.

Question 3

$$I_D = g_M (V_{GS} - V_{TH})$$

I_D = Drain current g_M = transconductance

V_{GS} = Gate - Source Voltage

V_{TH} = Threshold Voltage

Question 4

- Using $I = P/V$, the current in the bulb is $24/12 = 2\text{ A}$
- Therefore the Drain current is $I_D = 2\text{ A}$
- $V_{GS} = 12\text{ V}$ because the gate is connected to the 12V supply
- In the MOSFET equation $2 = g_M (12 - 3)$
- Rearranging $g_M = 2 / 9 = 0.22\text{ S}$
- The minimum transconductance for the MOSFET is 0.22 Siemens

Question 5

A high value pull down resistor needs to connect the gate to 0V

Question 6

- a) $I_D = 1.5\text{A}$ as the motor and MOSFET are in series
- b) A diode reverse biased across the motor to protect the transistor
- c) In the MOSFET equation, $I_D = 1.5\text{A}$, $g_M = 0.8\text{S}$ and $V_{TH} = 2\text{V}$
 $1.5 = 0.8 (V_{GS} - 2)$ therefore $V_{GS} = 3.9\text{V}$

The output voltage of the logic gate must be at least 3.9V