

SEMINAR 3

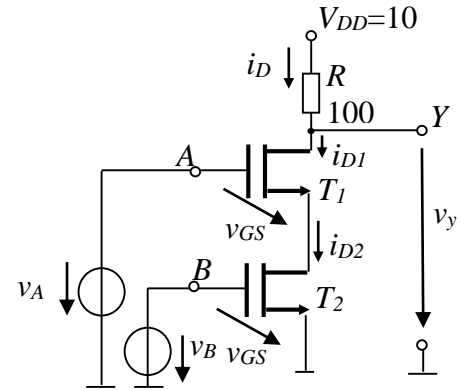
Contents:

- Logic circuits with TMOS

1.

For both n-type transistors, $V_{Thn}=3V$. The transistors operate as ideal switches; $v_A, v_B \in \{0V; 10V\}$. Assume the logic convention: 0V-“0”; 10V-“1”.

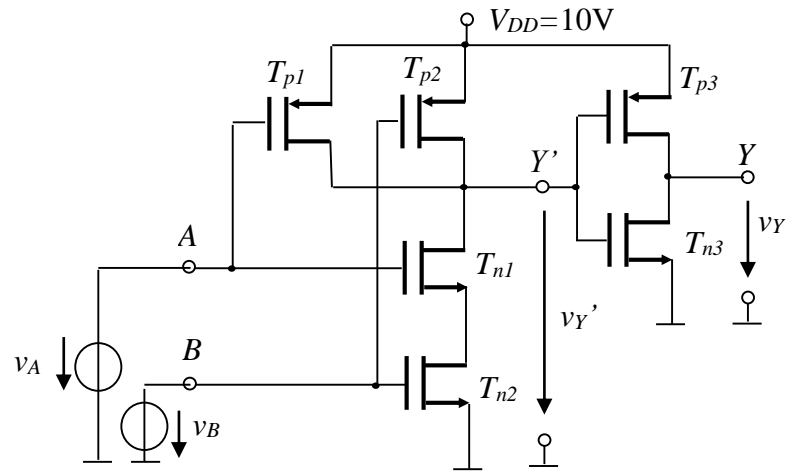
- a) Draw the electrical operating table of the circuit. Specify for each line in the table the state of both transistors (*on* or *off*).
- b) Draw the logic operating table of the circuit, considering the output Y. What is the logic function of this circuit?
- c) Compute the maximum output current. For what combinations of values of v_A and v_B does this current appear?



2.

For all n-type transistors T_{ni} , $V_{Thn}=3V$ and for all p-type transistors T_{pi} , $V_{Thp}= -3V$. The transistors operate as ideal switches; $v_A, v_B \in \{0V; 10V\}$. Assume the logic convention: 0V-“0”; 10V-“1”.

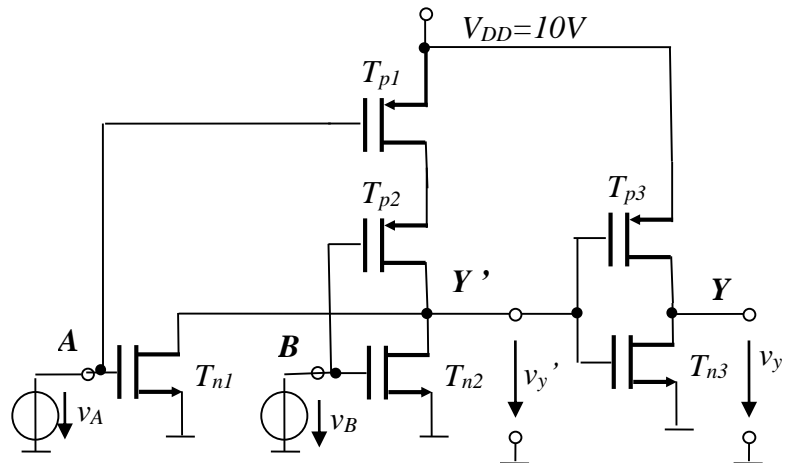
- a) Draw the electrical operating table of the circuit, for both outputs $v_{Y'}$, respectively v_Y . Specify for each line in the table the state of all six transistors (*on* or *off*).
- b) Draw the logic operating table of the circuit, considering the output Y. What is the logic function of this circuit?



3.

For all n-type transistors T_{ni} , $V_{Thn}=3V$ and for all p-type transistors T_{pi} , $V_{Thp}= -3V$. The transistors operate as ideal switches; $v_A, v_B \in \{0V; 10V\}$. Assume the logic convention: 0V-“0”; 10V-“1”.

- a) Draw the electrical operating table of the circuit, for both outputs $v_{Y'}$, respectively v_Y . Specify for each line in the table the state of all six transistors (*on* or *off*).
- b) Draw the logic operating table of the circuit, considering the output Y. What is the logic function of this circuit?
- c) Change the circuit to obtain the logic function $OUT= AND(A,B)$.



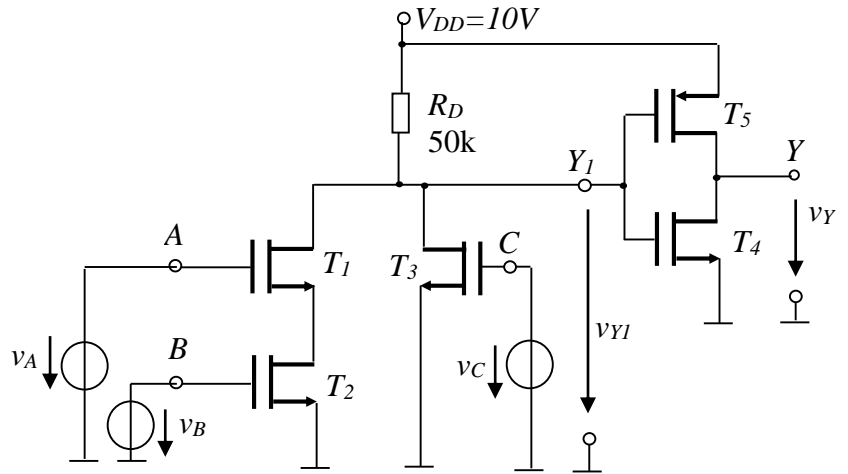
4.

For all n-type transistors T_{ni} , $V_{Thn}=2.5V$ and for p-type transistor T_5 , $V_{Thp}= -2.5V$. The transistors operate as ideal switches; $v_A, v_B \in \{0V; 10V\}$. Assume the logic convention: $0V$ -“0”; $10V$ -“1”.

a) Draw the electrical operating table of the circuit, for both outputs $v_{Y'}$, respectively v_Y . Specify for each line in the table the state of all five transistors (on or off).

b) Draw the logic operating table of the circuit, considering the output Y . What is the logic function of this circuit?

c) Change the circuit to obtain the logic function $OUT= AND(A,B)$.



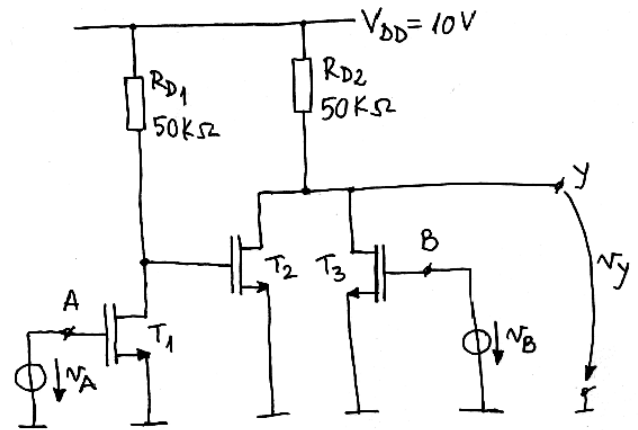
5.

For T_1, T_2, T_3 , $V_{Th}=3V$. T_1, T_2, T_3 operate as ideal switches. $v_A, v_B \in \{0V; 10V\}$. Assume the logic convention: $0V$ -“0”; $10V$ -“1”.

a) Draw the electrical operating table of the circuit for all the possible voltage combinations of v_A, v_B . Specify for each line in the table the state (on or off) of T_1, T_2 and T_3 .

b) Draw the logic operating table of the circuit. What is the logic function of the circuit?

c) Compute the maximum power consumption of the circuit from V_{DD} . For what combinations of values of v_A and v_B does this maximum power consumption appear?



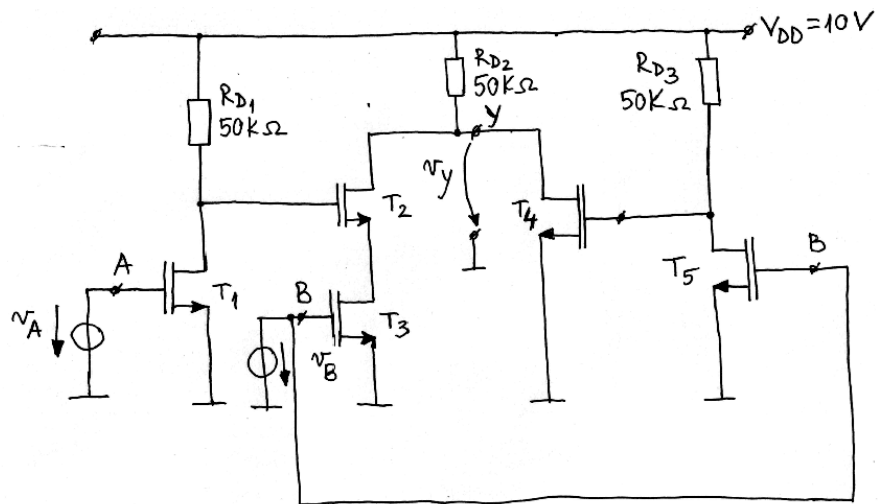
6.

For T_1, T_2, T_3, T_4, T_5 , $V_{Th}=3V$. T_1, T_2, T_3, T_4, T_5 operate as ideal switches. $v_A, v_B \in \{0V; 10V\}$. Assume the logic convention: $0V$ -“0”; $10V$ -“1”.

a) Draw the electrical operating table of the circuit considering the output v_Y . Specify for each line in the table the state (on or off) of all five transistors.

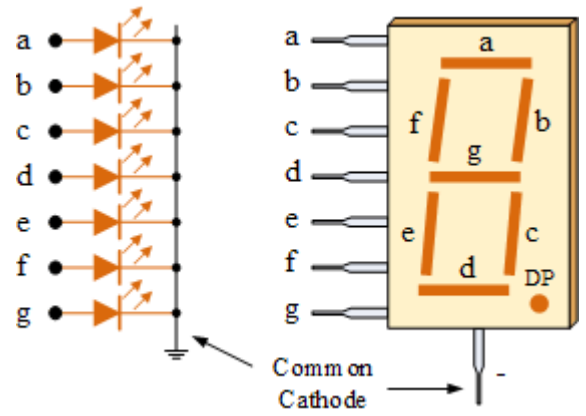
b) Draw the logic operating table of the circuit. What is the logic function of the circuit?

c) Compute the maximum currents through T_1, T_2, T_3, T_4 and T_5 and the maximum power consumption of the circuit from V_{DD} .



7. Using a 7-segment LED display, resistors and a +5V power supply, draw the schematic to display:

- a) 1.
- b) 8
- c) Size the necessary resistors to have 10mA through each conducting LED (segment).
- d) Using a n-channel MOSFET and an logic signal (En - enable) introduce (to the above solution) the possibility to enable/disable the 7-segment display.



8. The device LDD-M514RI-RA is described as a “Character LED Display Module Red 7-Segment, 2 Character Common Anode, 2V, 10mA”

- a) What is the significance of the device description?
- b) What will be the information on the display in the following cases:
 0V → logic 0; 5V → logic 1

En1	En2	A	B	C	D	E	F	G	DP
0	1	1	0	0	1	1	1	1	0
1	0	0	0	1	0	0	1	0	1
1	1	0	0	0	0	0	0	0	1

- c) What is the solution to see two different figures in the same time on the display?
Tip: the frequency of the digit selection should be fast enough so human eye don't detect the flicker such as 100Hz (10ms period).

