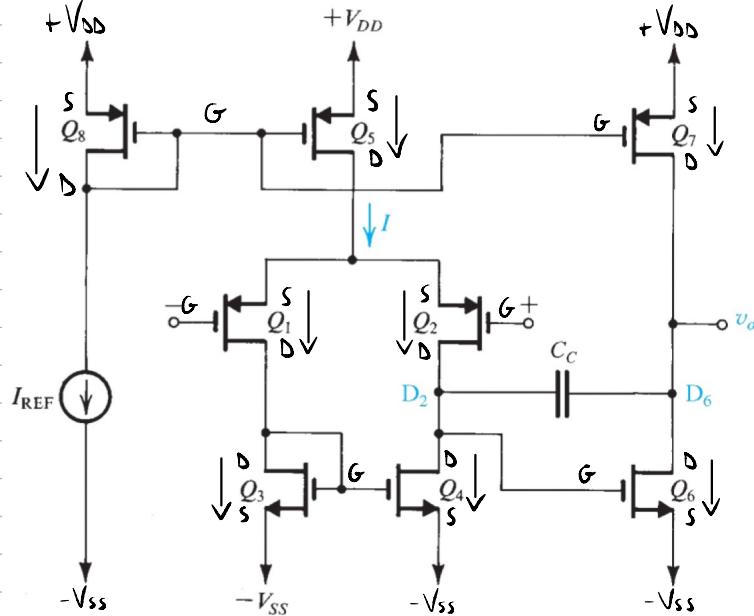


1.



1.1

INIZIAMO CON LE CORRENTE DEI TRANSISTOR

$$|I_{DS8}| = |I_{REF}| = 90 \mu\text{A}$$

$$|I_{DS5}| = |I_{DS8}| \frac{\left(\frac{W}{L}\right)_5}{\left(\frac{W}{L}\right)_8} = |I_{REF}| = 90 \mu\text{A}$$

$$|I_{DS1}| = |I_{DS2}| = |I_{DS3}| = |I_{DS4}| = \frac{|I_{DS5}|}{2} = \frac{|I_{REF}|}{2} = 45 \mu\text{A}$$

POLCHE' Q7 E' ABBINATO A Q5 E Q8:

$$|I_{DS7}| = |I_{DS6}| = |I_{REF}| = 90 \mu\text{A}$$

POTEREMMO ORA TUTTI I TRANSISTOR IN SATURAZIONE, QUINDI:

$$I = \frac{1}{2} (\mu C_{ox}) (W/L) V_{OV}^2$$

DA QUI POSSIAMO CALCOLARCI TUTTI I V<sub>OV</sub> DEI VARI TRANSISTOR

$$V_{OV} = \sqrt{2I / (\mu C_{ox})(W/L)}$$

$$|V_{ov8}| = |V_{ov5}| = \sqrt{2} I / k' p (W/L)_5 = 0.3 \text{ V}$$

$$|V_{ov1}| = |V_{ov2}| = \sqrt{2} I / k' p (W/L)_1 = 0.3 \text{ V}$$

$$|V_{ov3}| = |V_{ov4}| = \sqrt{2} I / k' n (W/L)_3 = 0.3 \text{ V}$$

$$|V_{ov6}| = \sqrt{2} I / k' n (W/L)_6 = 0.3 \text{ V}$$

$$|V_{ov7}| = \sqrt{2} I / k' p (W/L)_7 = 0.3 \text{ V}$$

$$V_{ov} = V_{GS} - V_T$$

$$|V_{SG8}| = |V_{SG5}| = 1.1 \text{ V}$$

$$|V_{SG2}| = |V_{SG4}| = 1.1 \text{ V}$$

$$|V_{GS3}| = |V_{GS4}| = 1 \text{ V}$$

$$|V_{GS6}| = 1 \text{ V}$$

$$|V_{SG7}| = 1.1 \text{ V}$$

$$|V_{SD8}| = |V_{SG8}| = 1.1 \text{ V}$$

$$|V_{G8}| = V_{DD} - V_{SD8} = 1.4 = V_{GS}$$

$$|V_{SS}| = V_{SGS} - V_{GS} = 1.1 \text{ V}$$

$$|V_{SD5}| = V_{DS} - V_{SS} = V_{DD} - V_{SS} = 1.4 \text{ V}$$

$$|V_{DS3}| = |V_{DS4}| = |V_{GS3}| = 1 \text{ V}$$

$$|V_{SD2}| = |V_{SD2}| = |-V_{SS} + V_{DS4} - V_{SS}| = 2.6 \text{ V}$$

$$|V_{DS6}| = |V_{DS4}| = 1 \text{ V} \quad |V_{SD7}| = |-V_{SS} + V_{DS6} - V_{DD}| = 4 \text{ V}$$

1.2

$$g_{m1} = g_{m2} = g_{m3} = g_{m4} = -\frac{2 \cdot 10}{V_{ov}} = 3 \cdot 10^{-4}$$

$$g_{m5} = g_{m6} = g_{m7} = g_{m8} = -\frac{2 \cdot 10}{V_{ov}} = 6 \cdot 10^{-4}$$

$$r_o = \frac{V_A}{I_D}$$

$$r_{o2} = r_{o3} = r_{o4} = 222 \cdot 222 \Omega$$

$$r_{o5} = r_{o6} = r_{o7} = r_{o8} = 111 \cdot 111 \Omega$$

1.3

### STADIO 1

$$A_{d1} = -g_{m1} (r_{o2} \parallel r_{o4}) = -0.3 (222 \parallel 222) = -33.3 \text{ V/V}$$

### STADIO 2

$$A_{d2} = -g_{m6} (r_{o6} \parallel r_{o7}) = -0.6 (111 \parallel 111) = -33.3 \text{ V/V}$$

IL GUADAGNO COMPLESSIVO RISULTA

$$A_d = A_{d1} \cdot A_{d2} = (-33.3) \times (-33.3) = 1109 \text{ V/V}$$

1.4

$Q_2$  NON È PIÙ IN SATURAZIONE QUANDO

$$V_{DS} > V_{GS} - V_{TH}$$

$$V_{DS} > -1,1 + 0,8$$

$$V_{DS} > -0,3 \text{ V}$$

$$\text{INOLTRE } V_{DS} = V_o - 2,5$$

$$V_o - 2,5 > -0,3 \quad V_o > 2,2 \text{ V}$$

Q<sub>7</sub> NON È PIÙ IN SATURAZIONE QUANDO

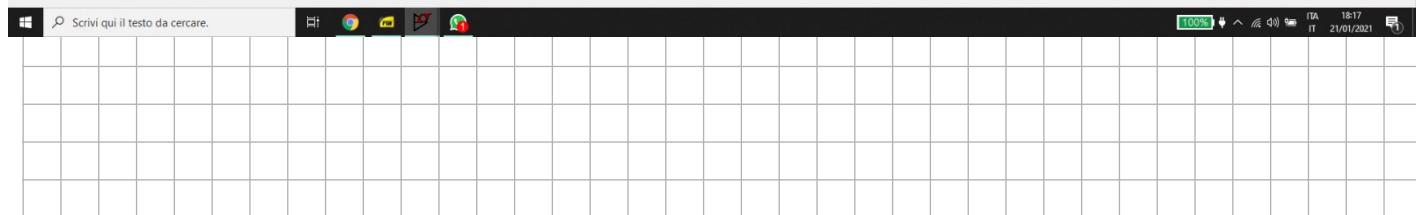
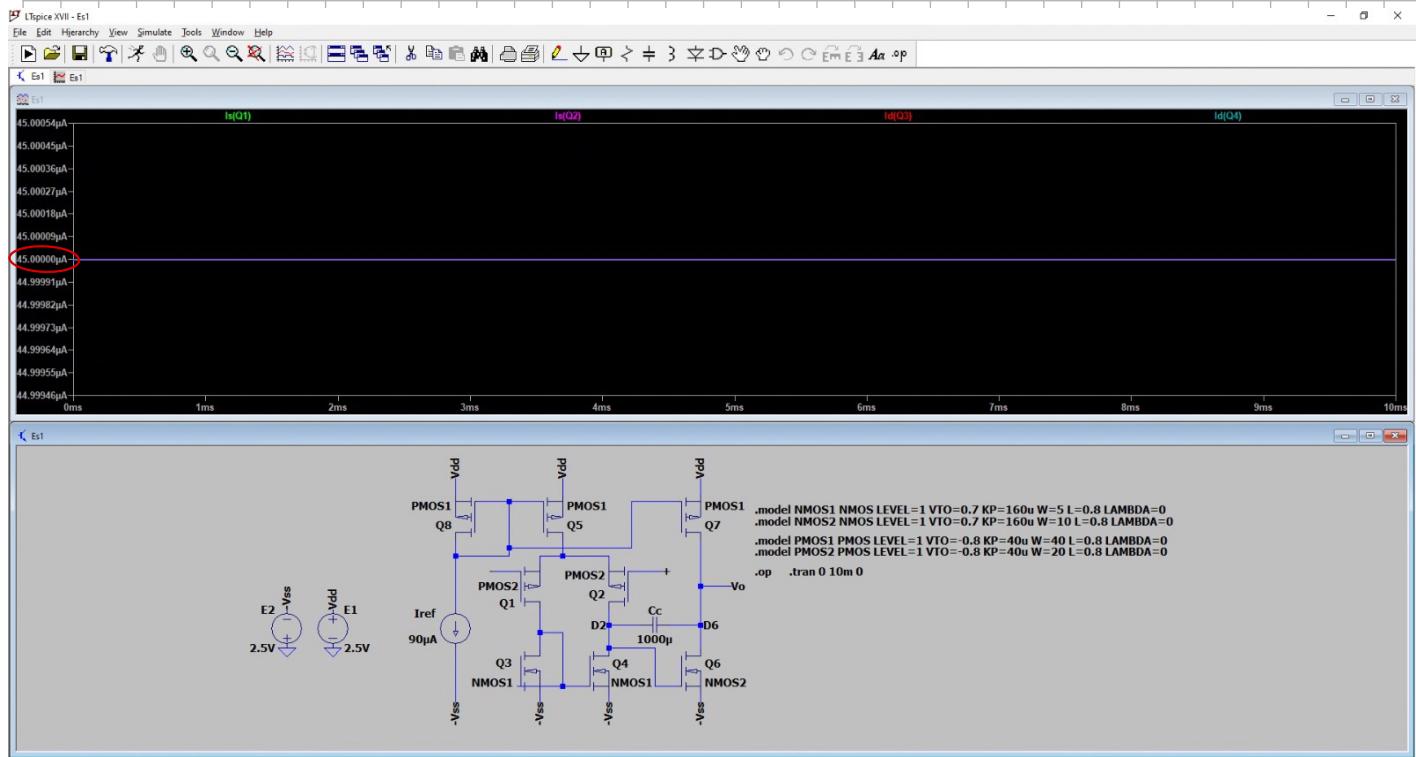
$$V_{DS} < V_{ov} \quad V_{DS} < 0,3 \text{ V}$$

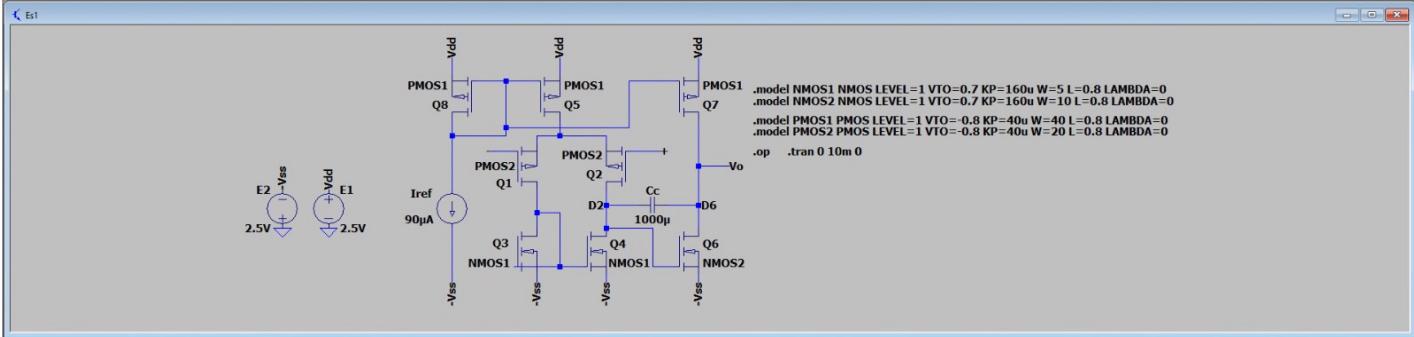
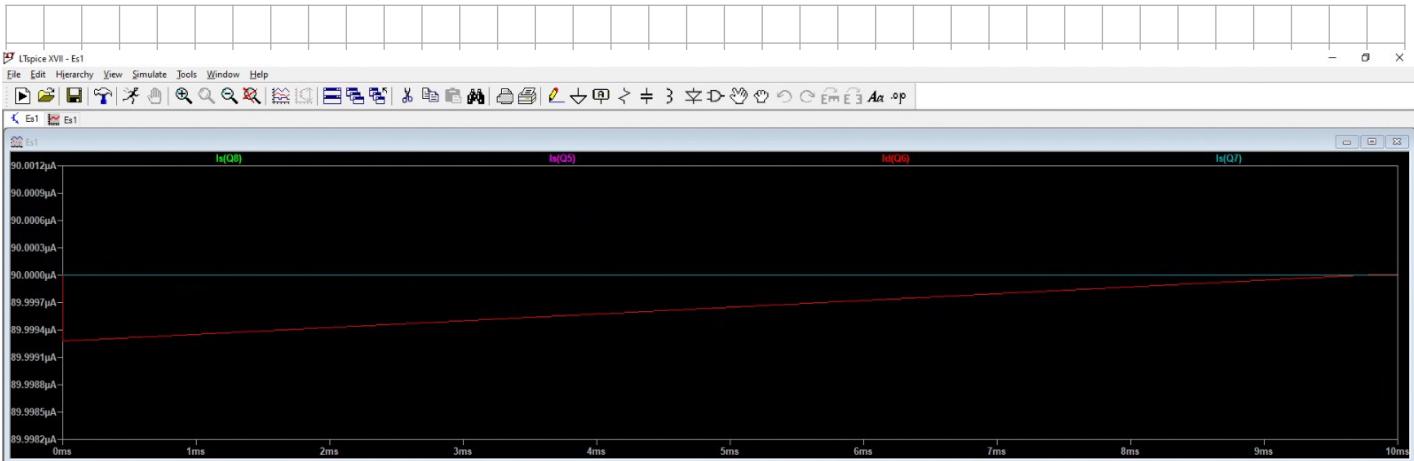
$$\text{INOLTRE } V_{DS} = V_o + 2,5 \text{ V}$$

$$V_o + 2,5 < 0,3 \quad V_o < -2,2 \text{ V}$$

## 1.5

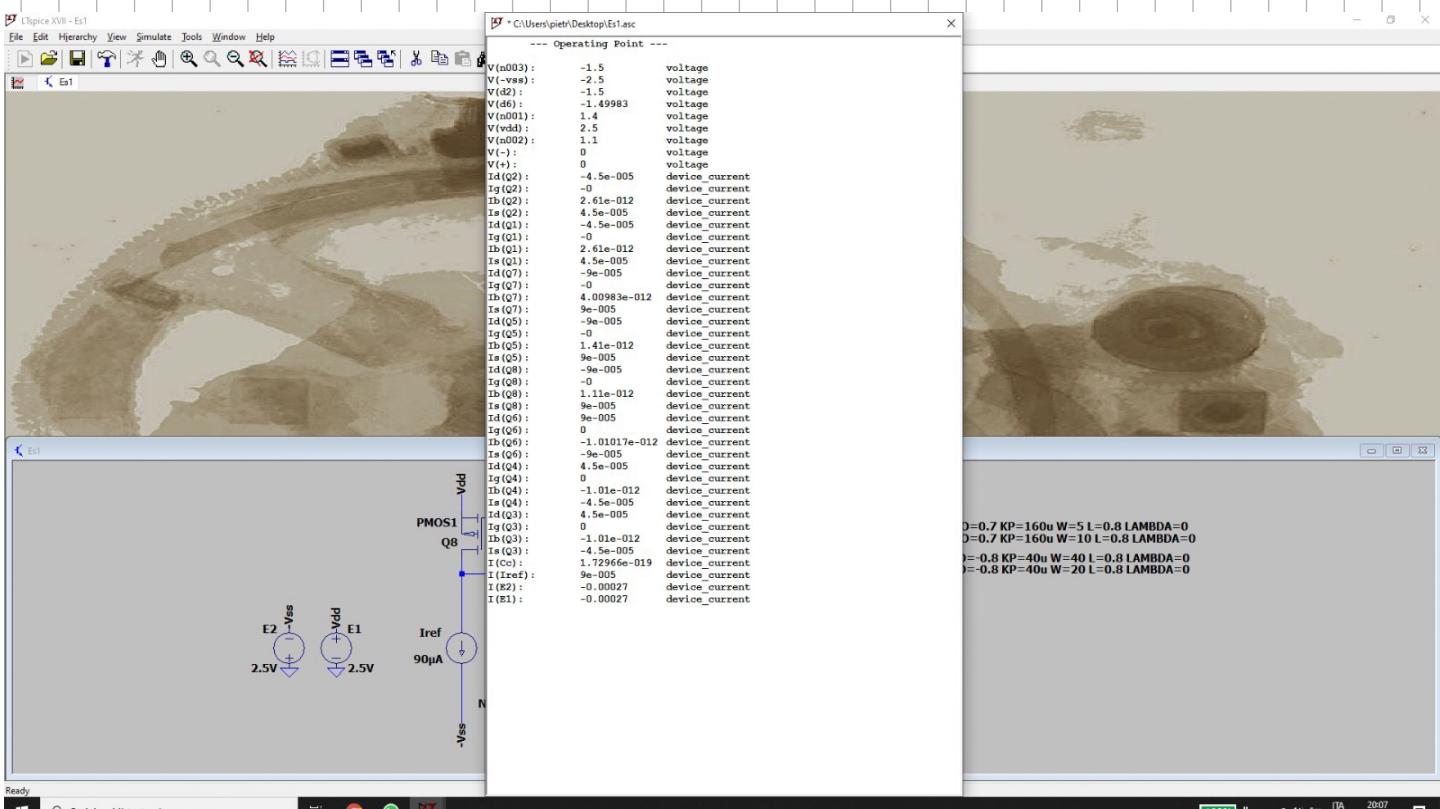
PER QUANTO RIGUARDA LE CORREZIONI, SI VERIFICA CHE





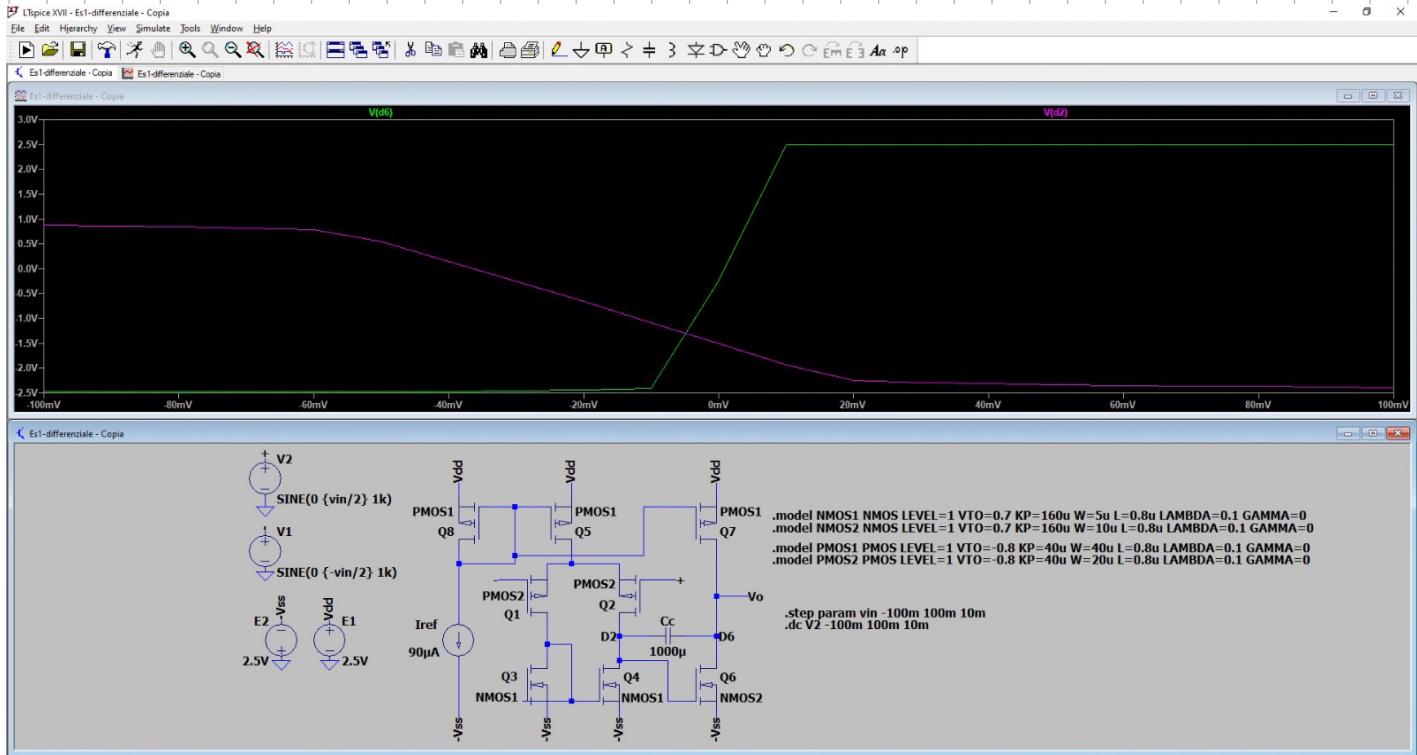
Scrivi qui il testo da cercare.

ALLO STESSO MODO SI VERIFICA CHE I VALORI TROVATI NEL PUNTO 1.1 I PUNTI DI POLARIZZAZIONE DEI TRANSISTOR SONO CORRETTI

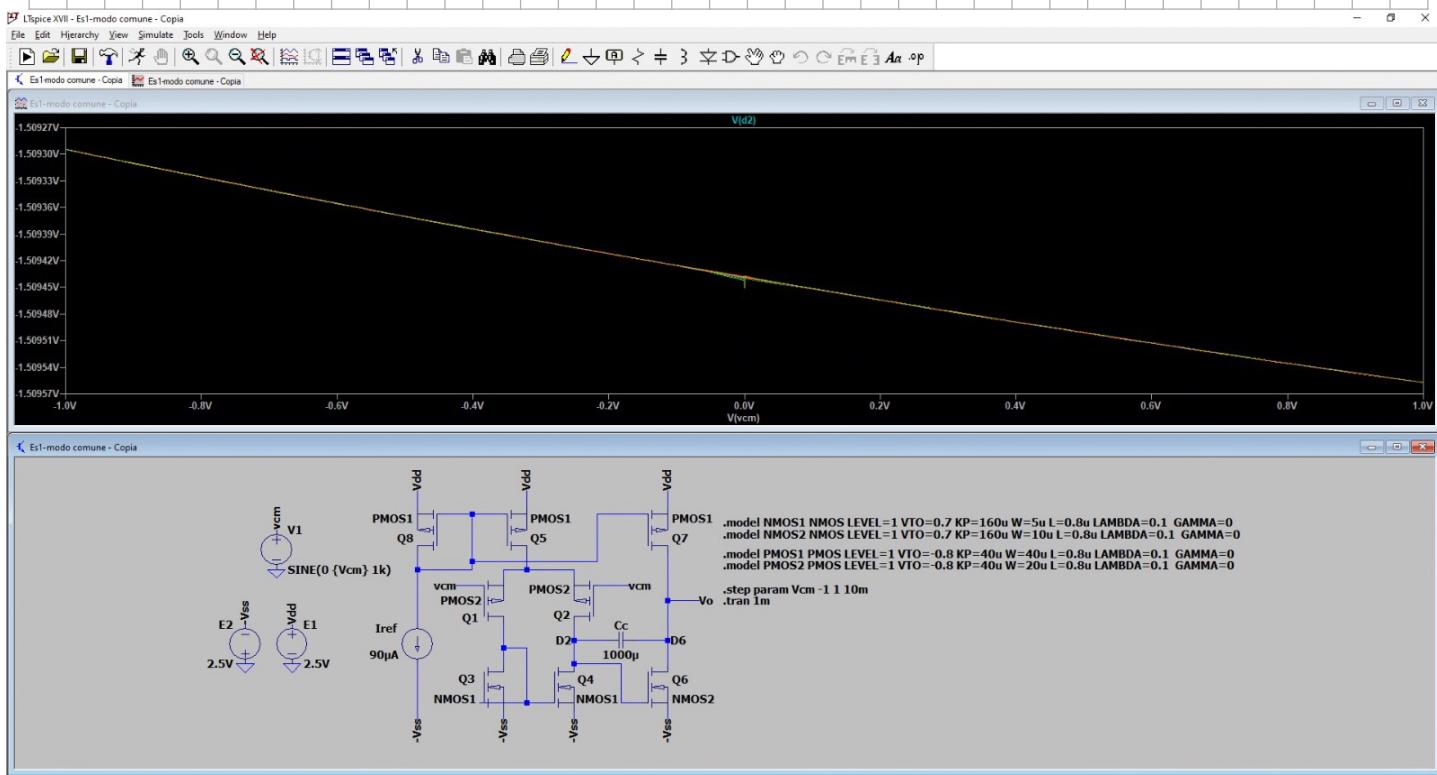


Scrivi qui il testo da cercare.

## GRAFICO:

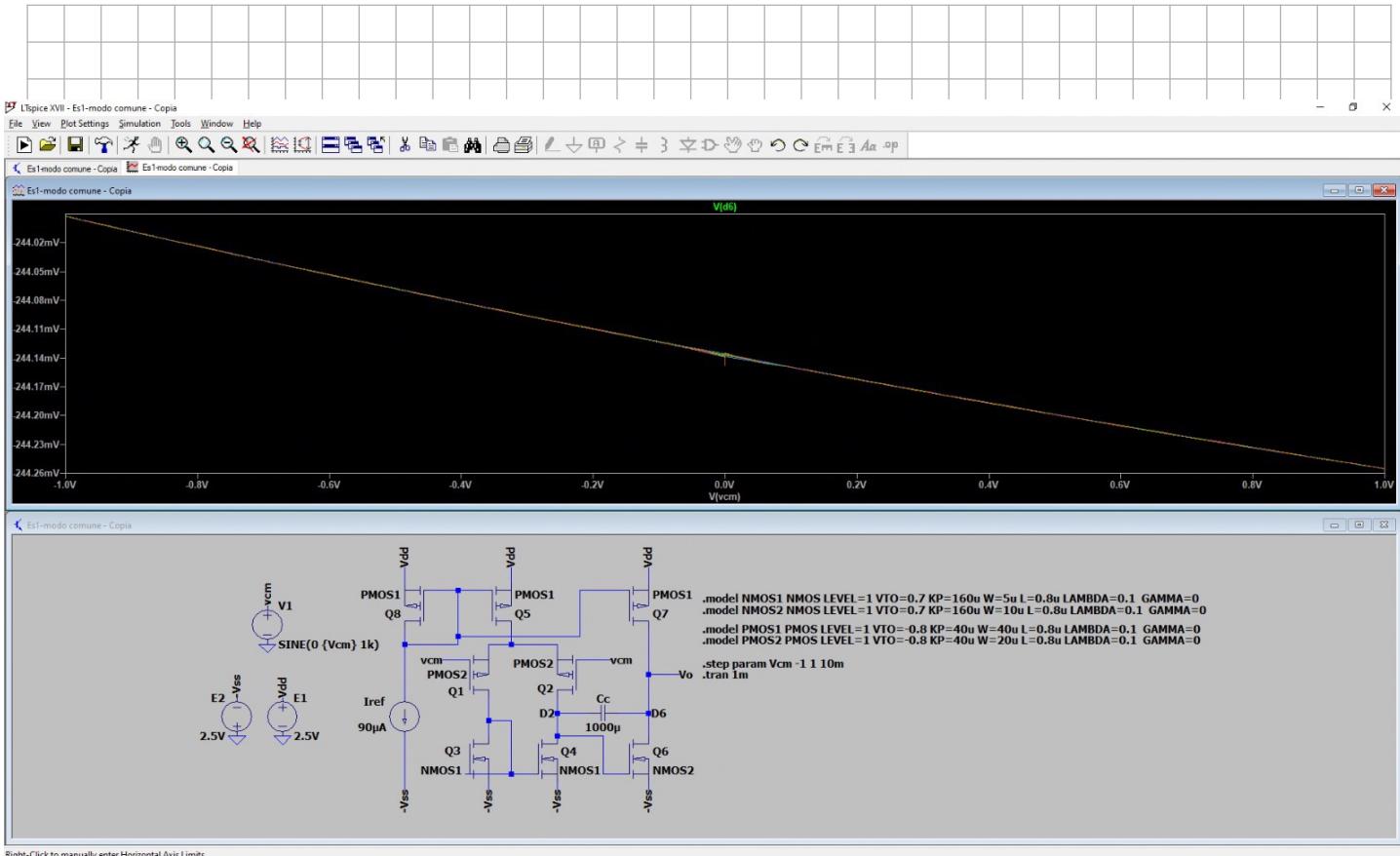


1.6



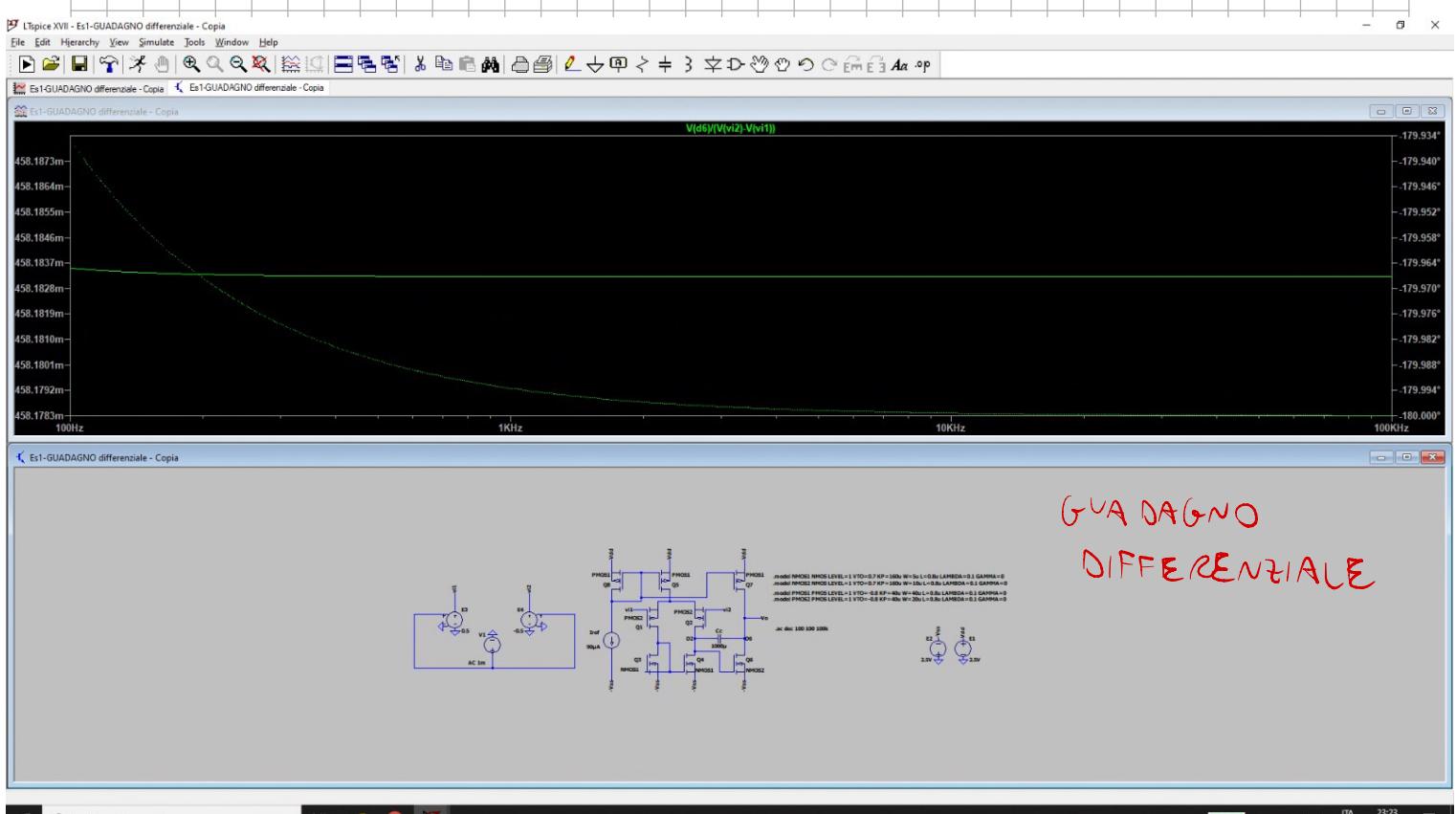
x = 0.797V y = -1.5094785V



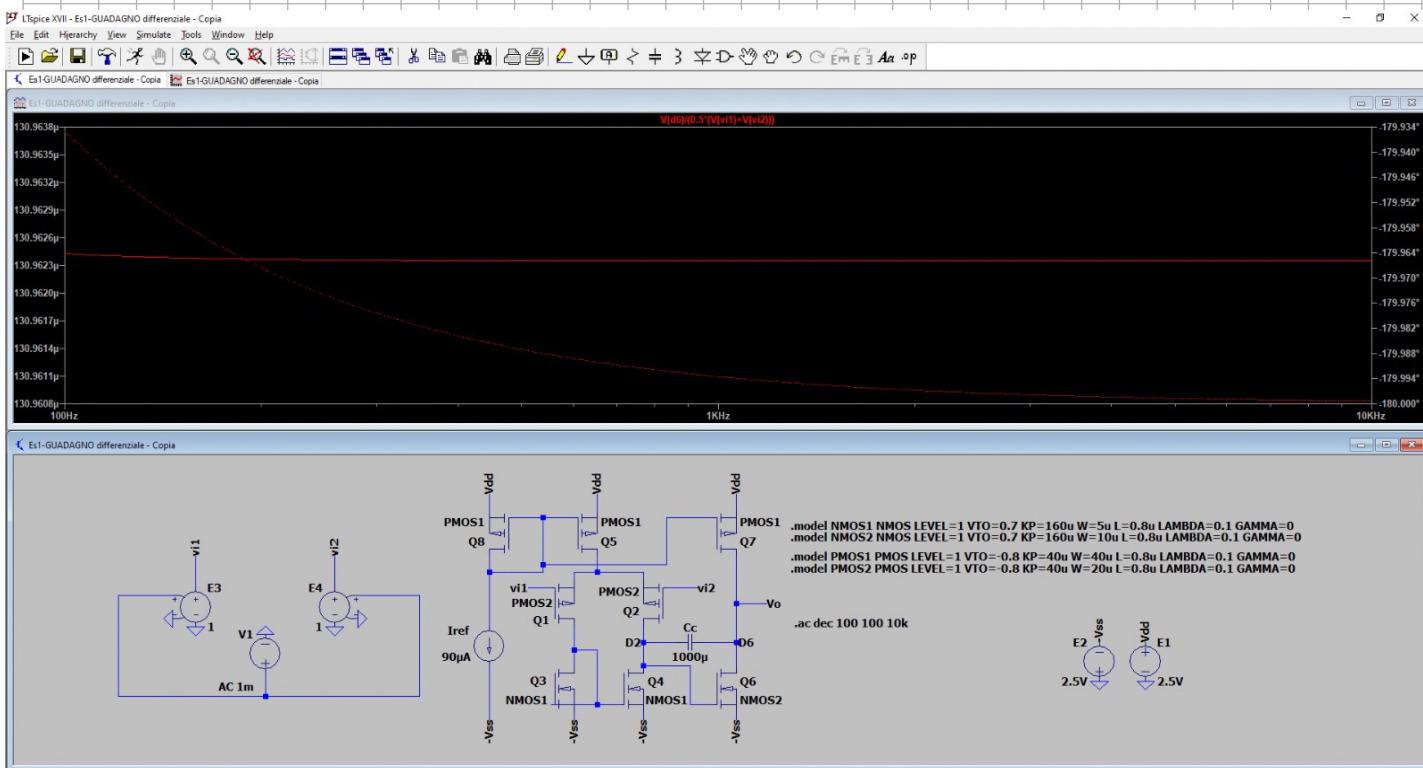


1.7

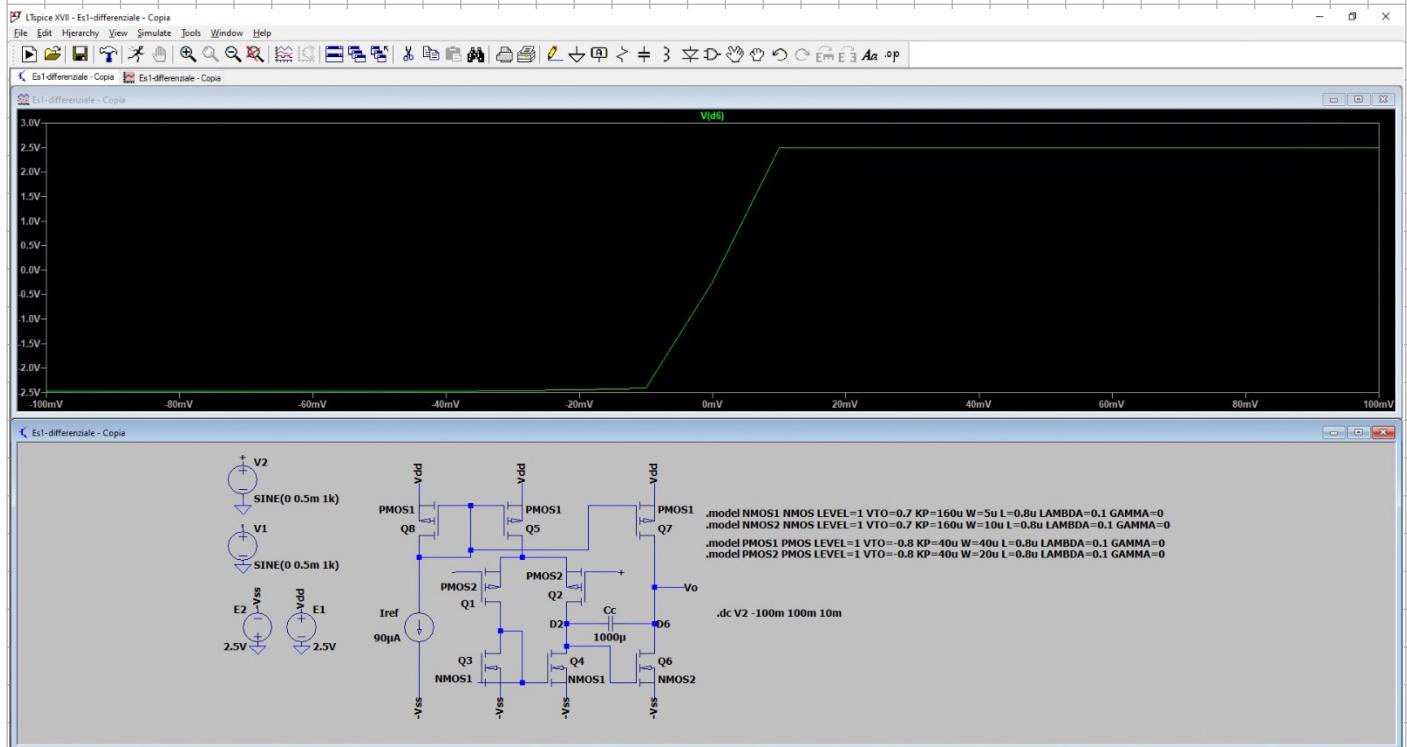
SEGUENDO IL PROCEDIMENTO SVOLTO PER LA  
RISOLVIMENTO DEL TECNO COMPTINO TROVO:

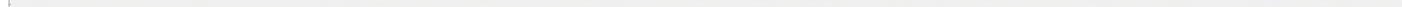


PER IL GUADAGNO DI MODO COMUNE INVECE;

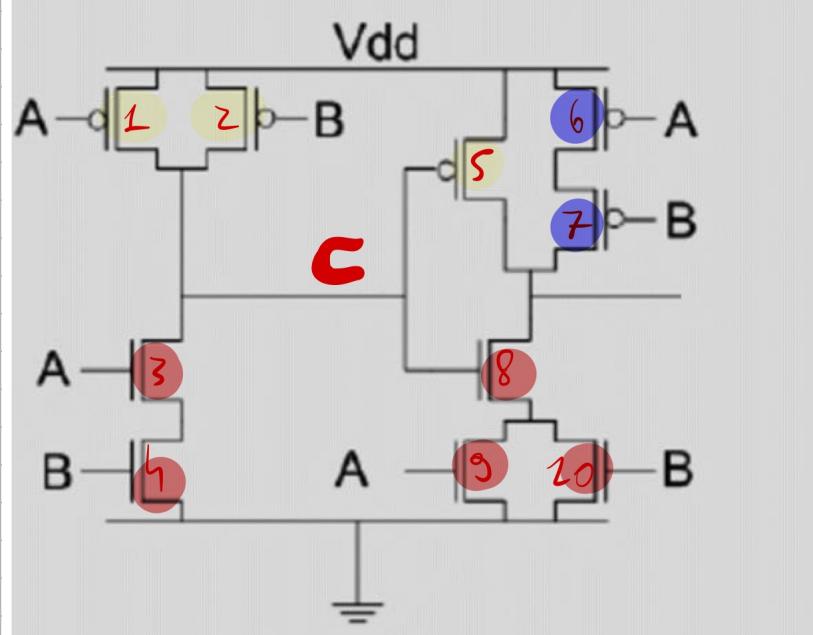


1.8



A standard Windows taskbar at the bottom of the screen. From left to right, it includes: the Windows logo, a search bar with placeholder text "Scrivi qui il testo da cercare.", pinned icons for File Explorer, Google Chrome, WhatsApp, and Microsoft Edge, and a system tray with battery level (100%), volume, network, and date/time (ITA 23/01/2021).

2.



2.1

LA PORTA DI SINISTRA GENERA IL PRODOTTO NEGATO DELL'OPERAZIONE DI SOMMA, INFATTI:

$$C = \overline{A \cdot B}$$

A	B	$\overline{A \cdot B}$
0	0	1
0	1	1
1	0	1
1	1	0

LA PORTA DI DESTRA INVECE GENERA LA SOMMA DI A, B NEGATA, INFATTI:

L'USCITA DEL CIRCUITO RISULTA ESSERE

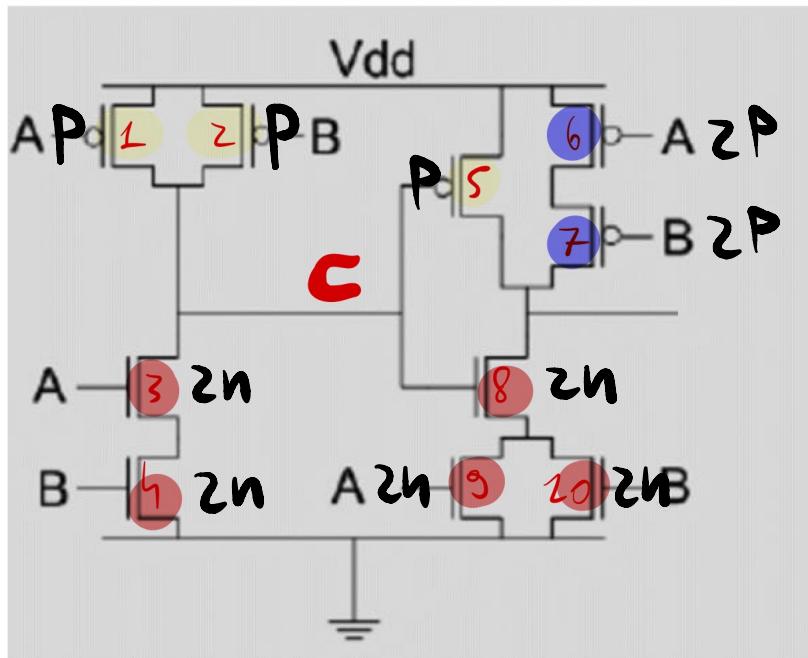
$$Y = \overline{(A + B)} \cdot \overline{A \cdot B}$$

LA CUI TABELLA DI VERITÀ È:

A	B	Y
0	0	1
0	1	0
1	0	0
1	1	1

DATO CHE  $k_n = 4k_p$ , PER BILANCiare IL CIRCUITO SCEGLIO:

$$n = 1, 5 \longrightarrow p = 6$$



$$W_1 = W_2 = p \cdot L = 4.8 \mu m$$

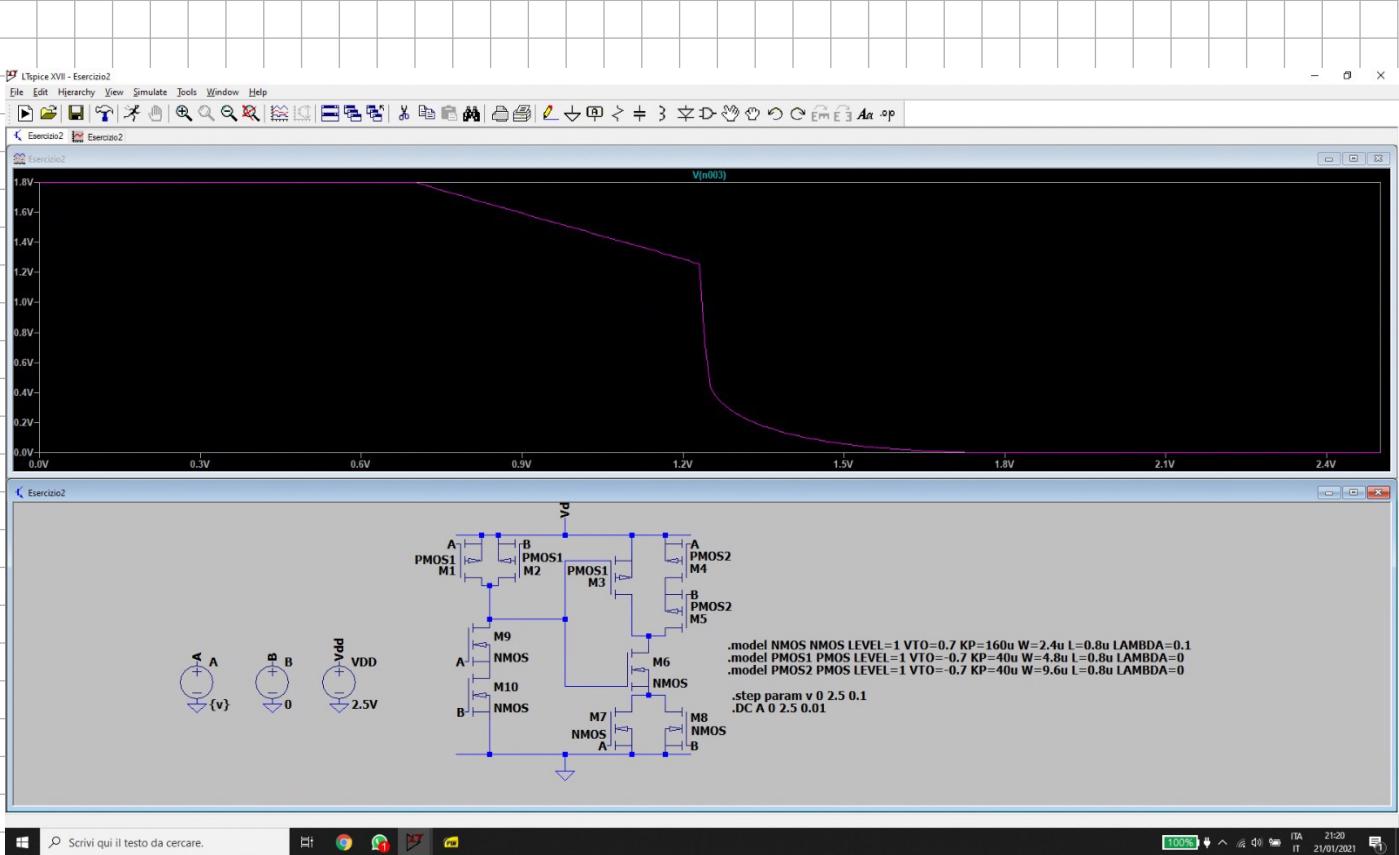
$$W_3 = W_4 = 2n \cdot L = 2.4 \mu m$$

$$W_8 = W_9 = W_{10} = 2n \cdot L = 2.4 \mu m$$

$$L = 0.8 \mu m$$

$$W_6 = W_7 = 2p \cdot L = 9.6 \mu m$$

$$W_5 = p \cdot L = 4.8 \mu m$$



2.2

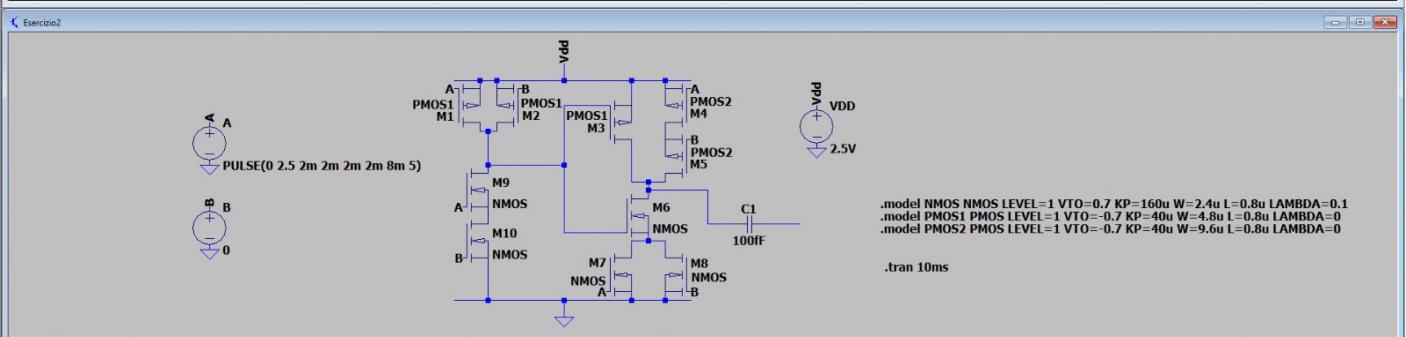
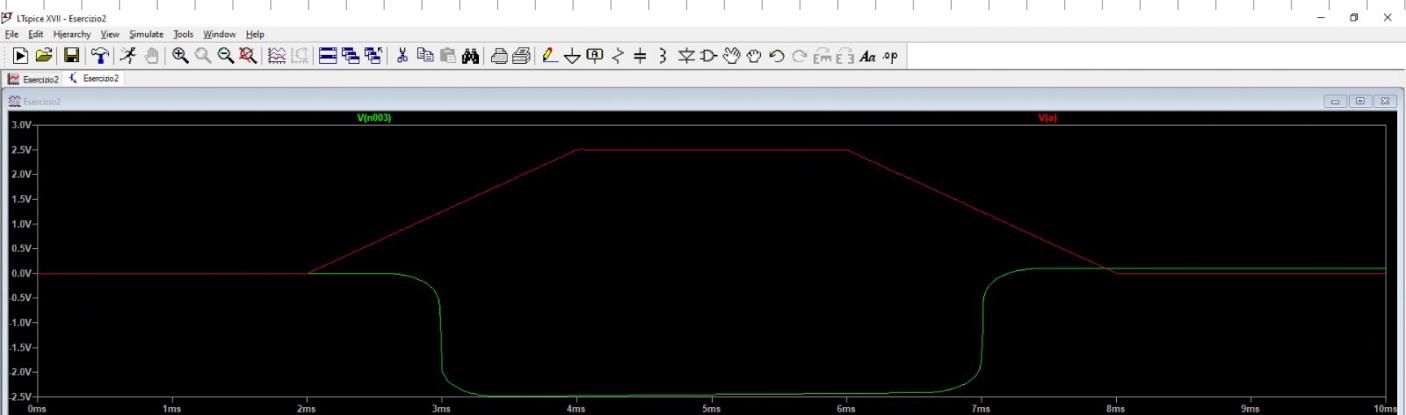
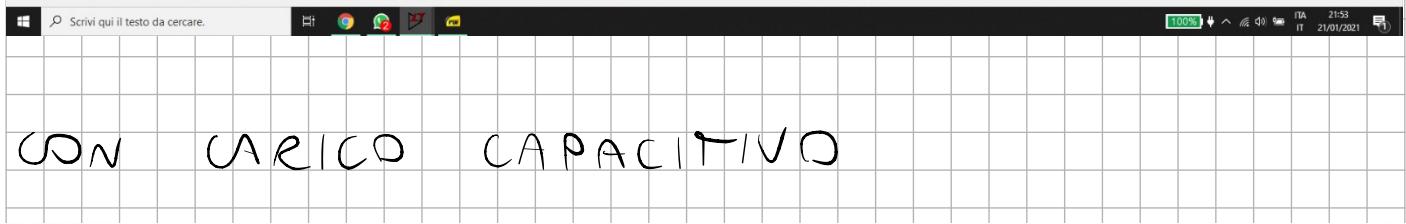
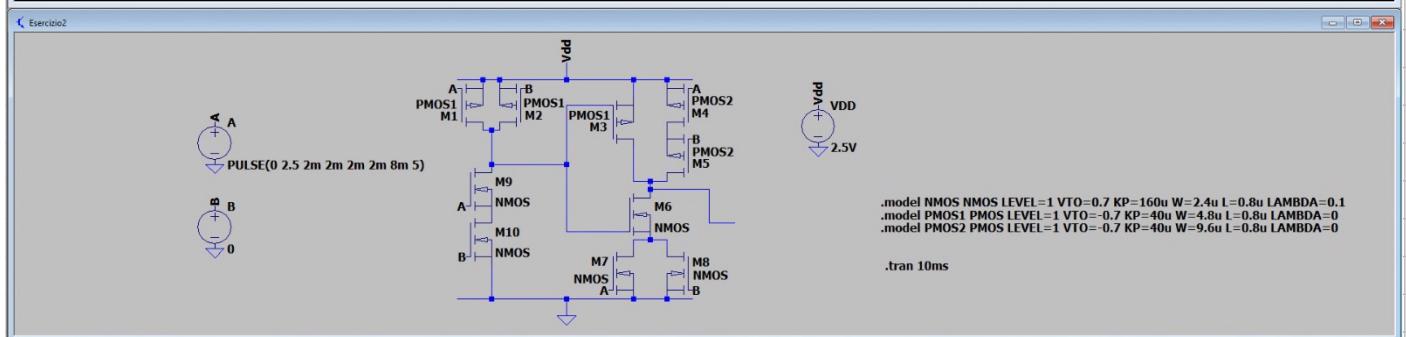
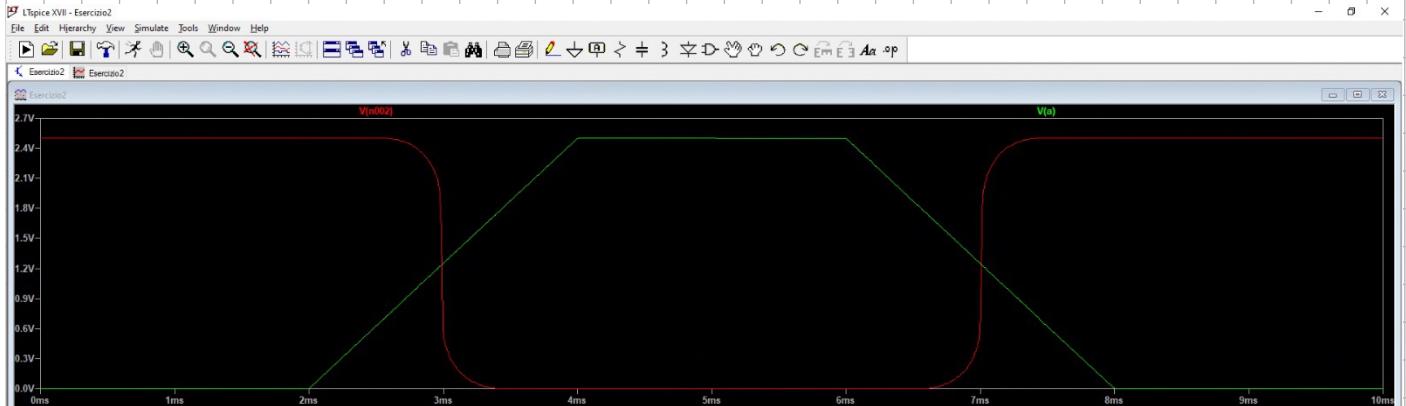
LA POTENZA DINAMICA DISSIPATA SI CALCOLA  
COME:

$$P_{dyn} = C_L V_{DD}^2 f_{0 \rightarrow 1} = 7.427 \cdot 10^{-7} W$$

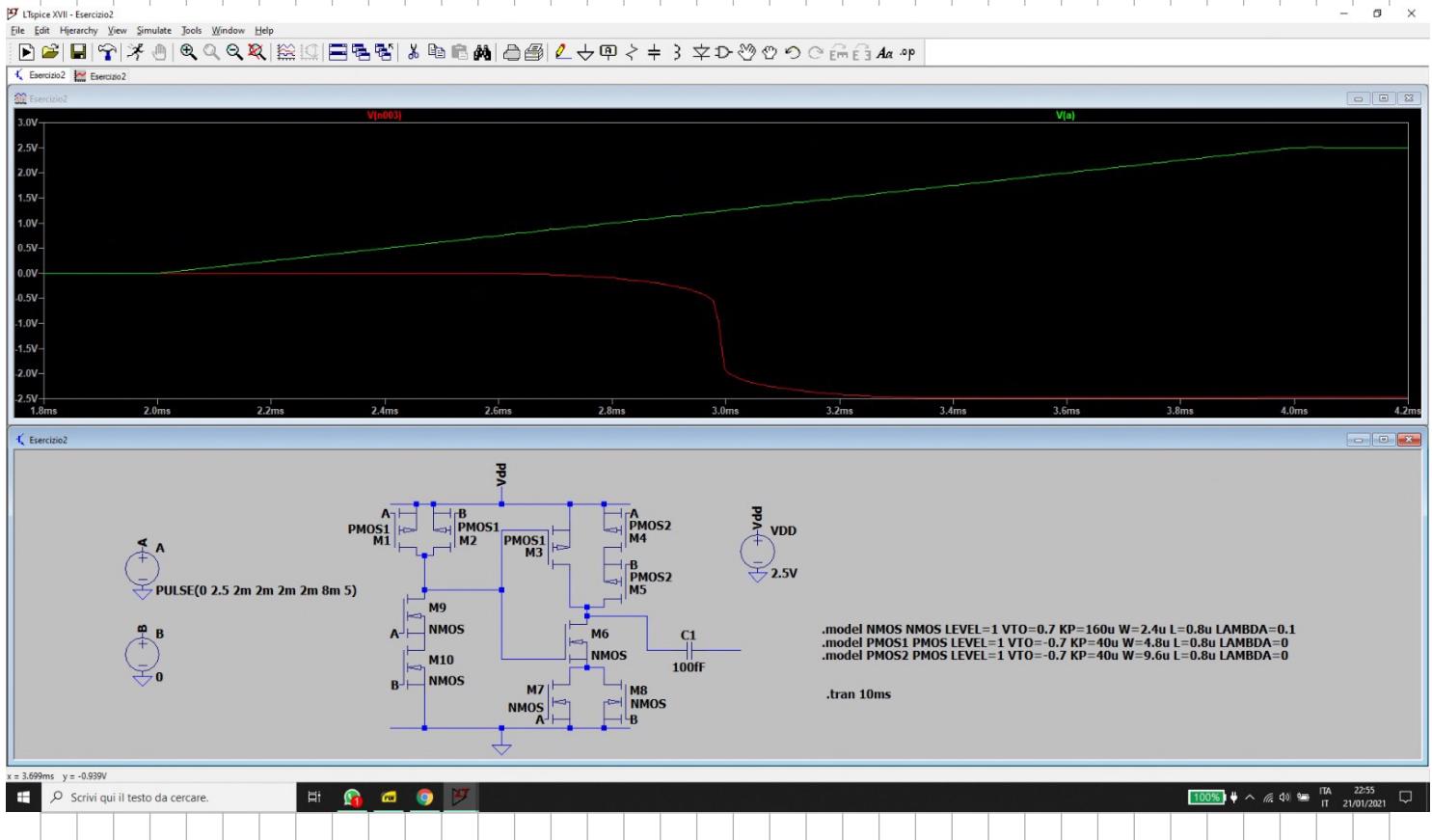
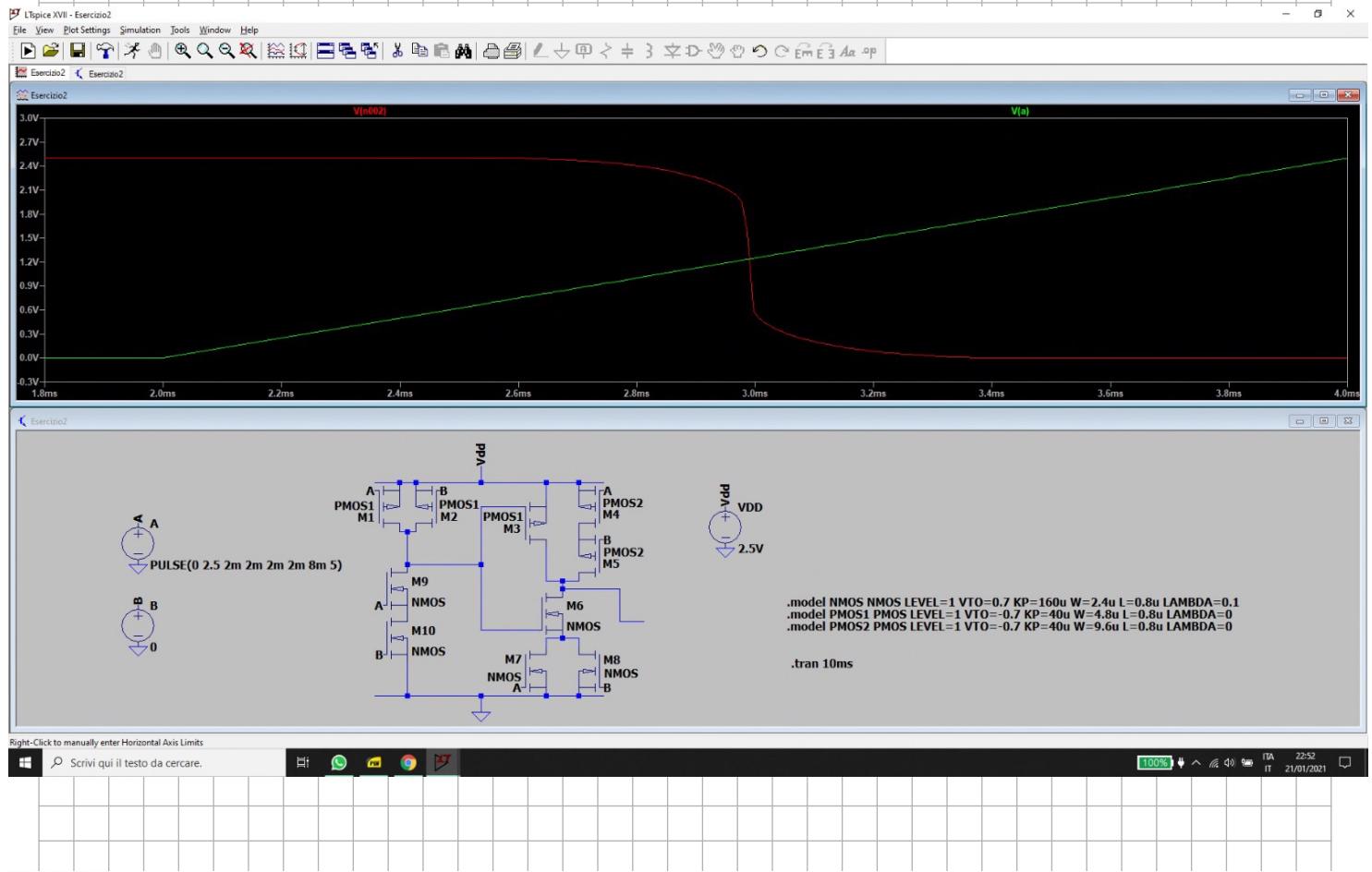
$$f_{0 \rightarrow 1} = 1188356 \text{ Hz}$$

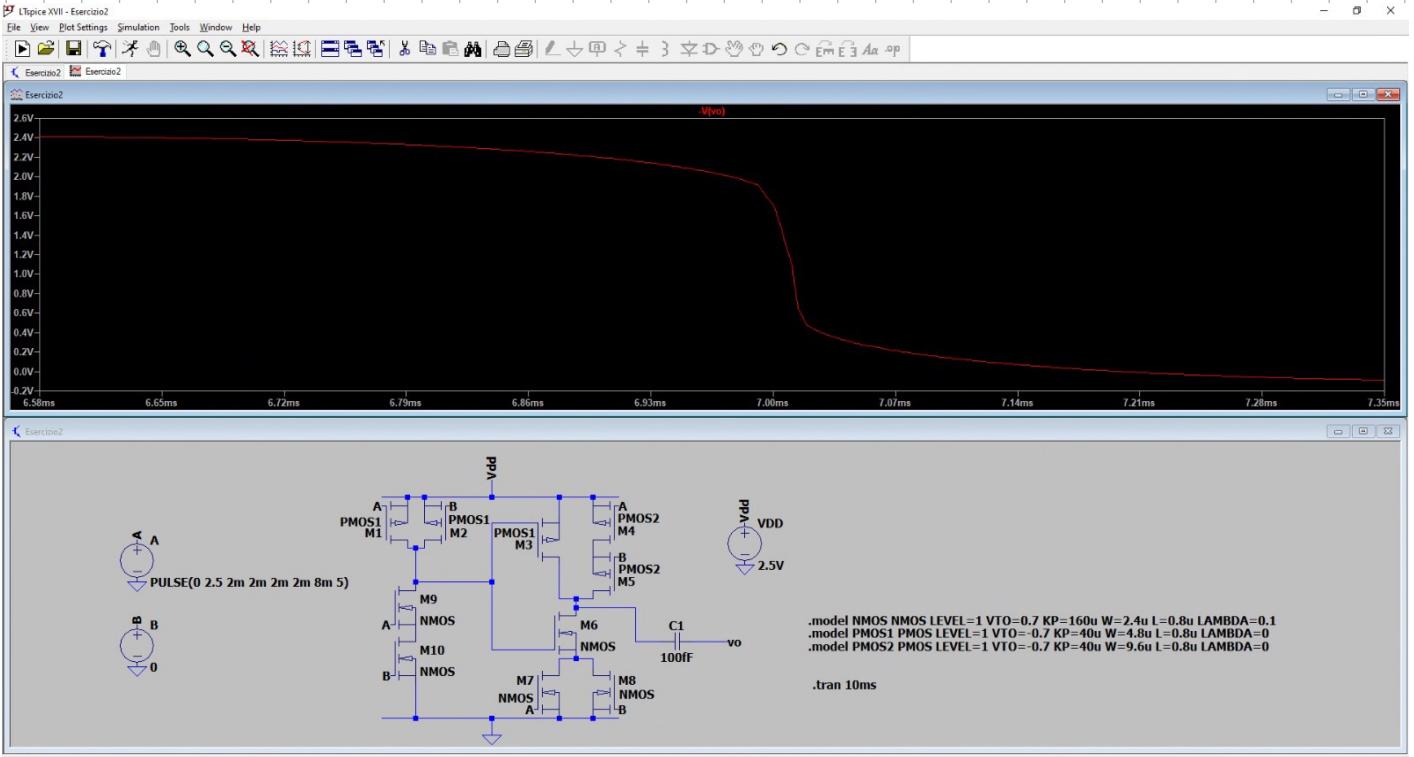
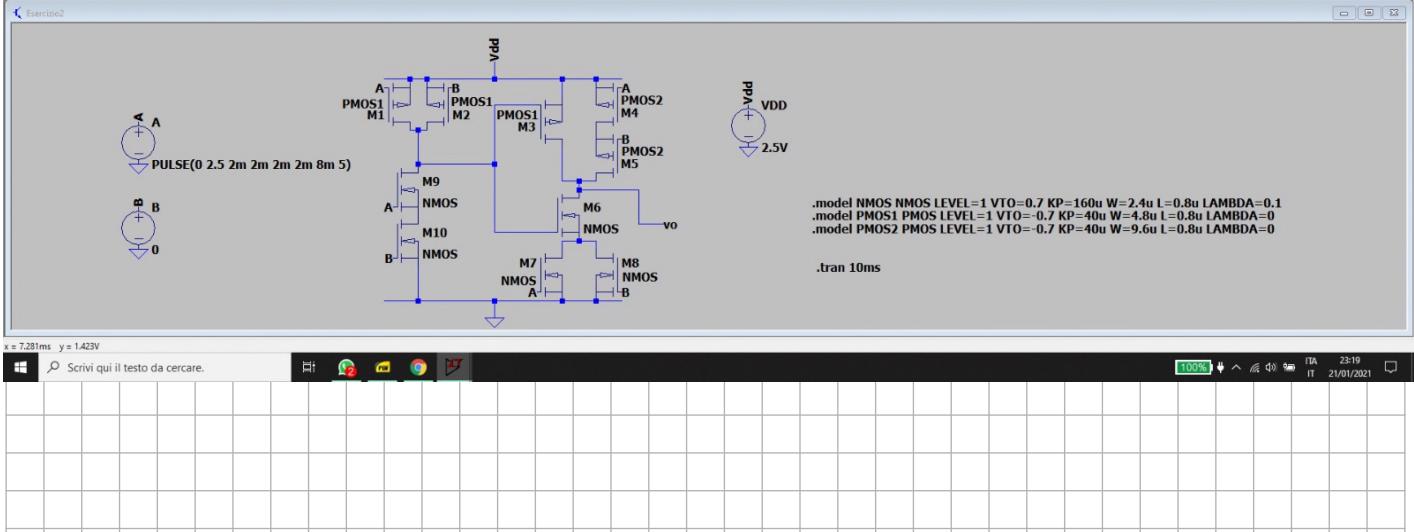
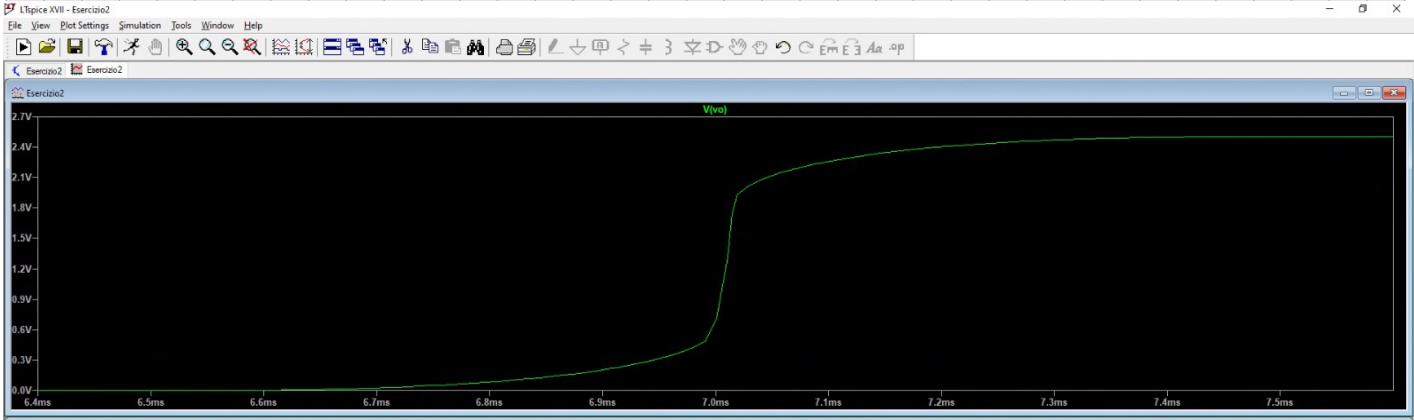
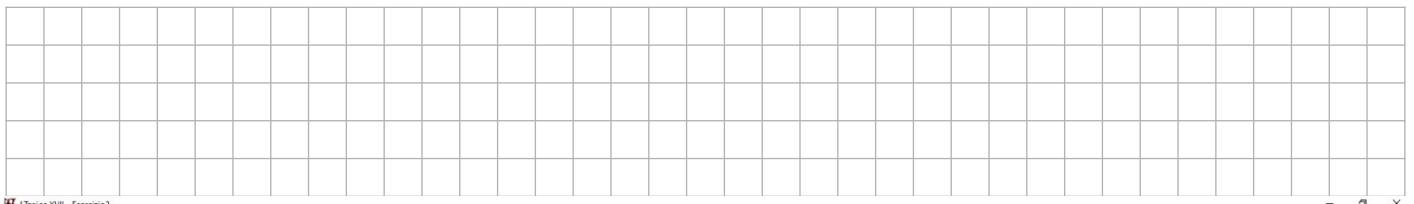
2.3

## SENZA CARICO CAPACITIVO

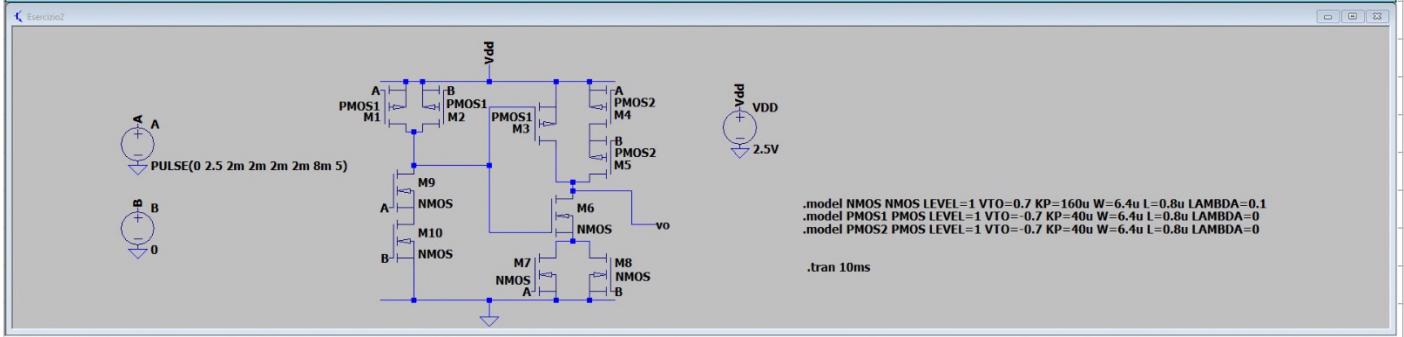
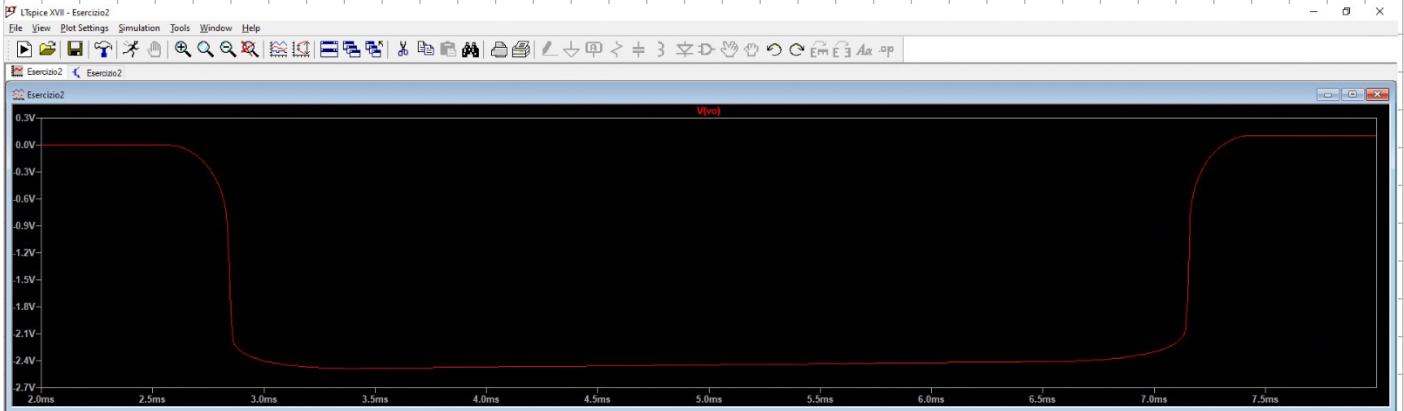


QUELLO CHE SI PUÒ NOTARE È CHE CON L'AGGIUNTA DI UN CONDENSATORE, LA CARICA È SCARICA DI QUESTO PORTA AD UN RALLENTAMENTO NEL PASSAGGIO DA 0 A 1 E VICEVERSA





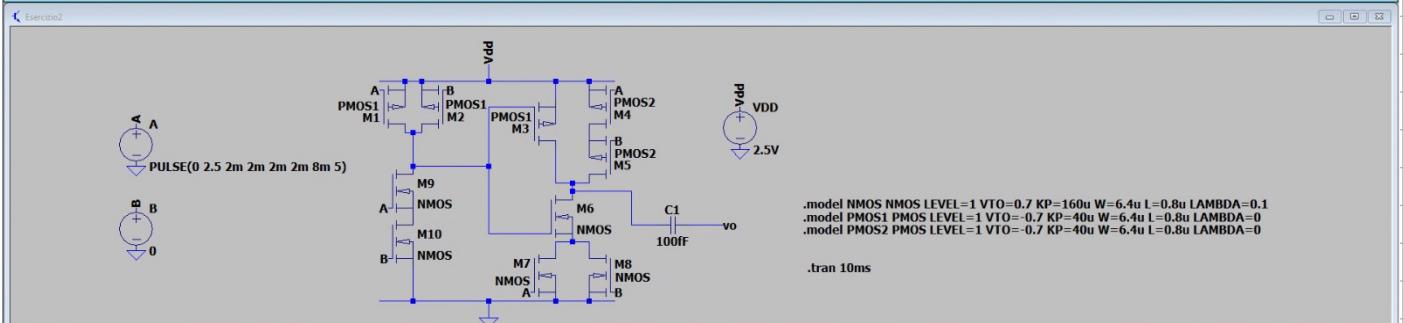
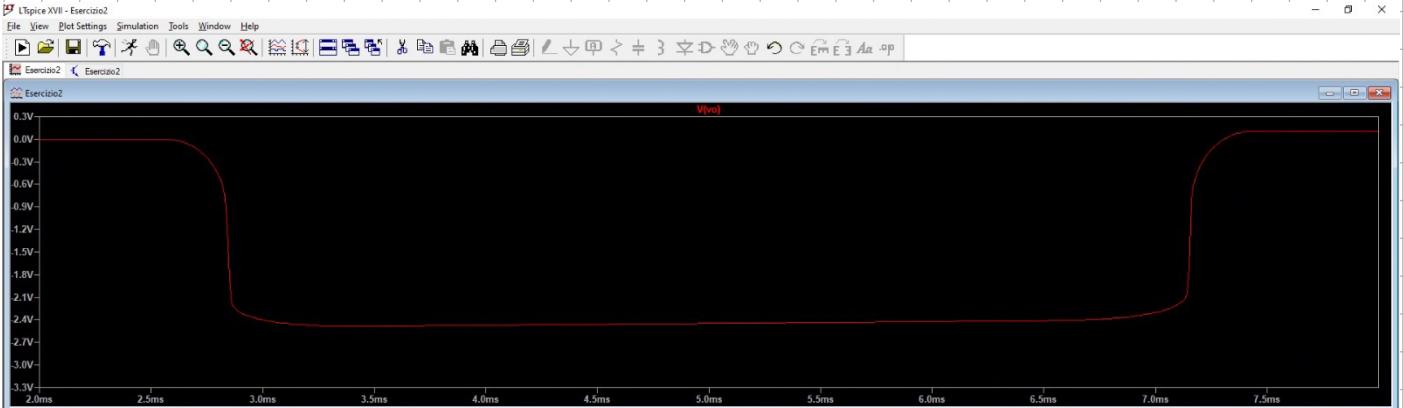
2.4



x = 7.439ms y = -1.143V

Scrivi qui il testo da cercare.

100% ITA IT 23/16 21/01/2021



x = 7.713ms y = -2.395V

Scrivi qui il testo da cercare.

100% ITA IT 23/15 21/01/2021