Model dimensionare Bandgap Kujik

STUDENT: POP CATALIN-CORNEL

Cuprins

1.Introducere

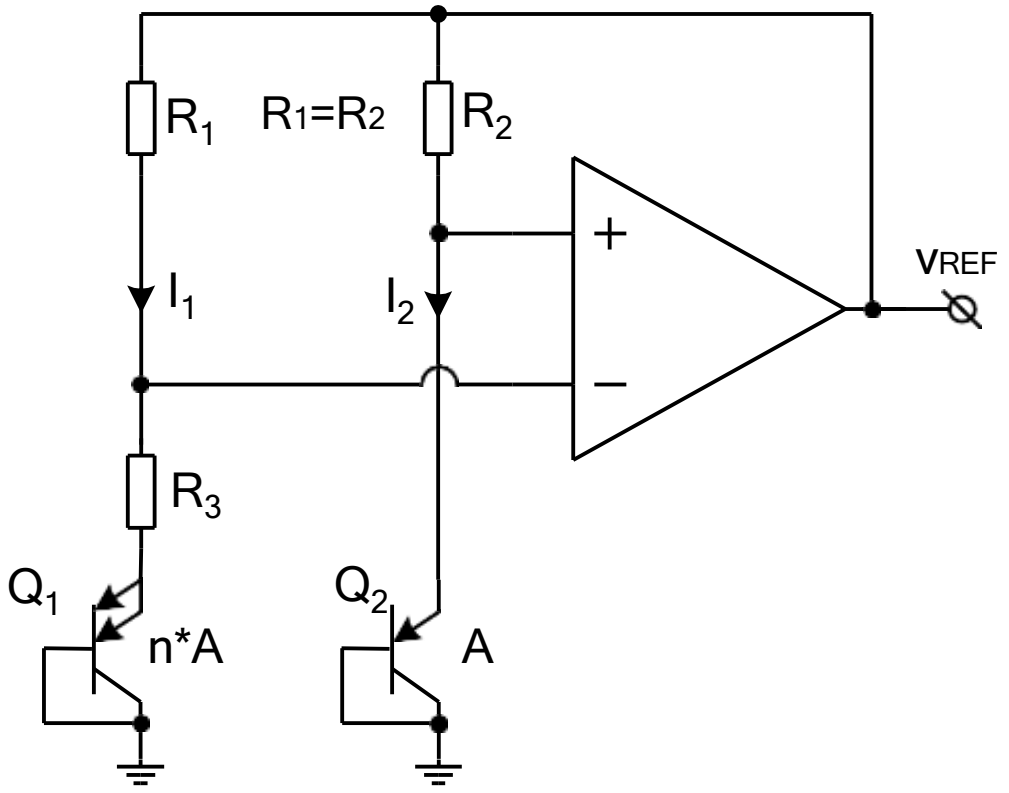
Ce sunt referințele de tensiune?

Referințele de tensiune sunt dispozitive electronice sau circuite care furnizează o tensiune stabilă și precisă, independentă de variațiile alimentării, temperaturii sau sarcinii.

2.Specificatii

Tip Bandgap	Tip OA_VV	ISS@25degC (µA)	Vout
Kujik	Miller	30µA	1.2V

3.Dimensionare Bandgap Kujik



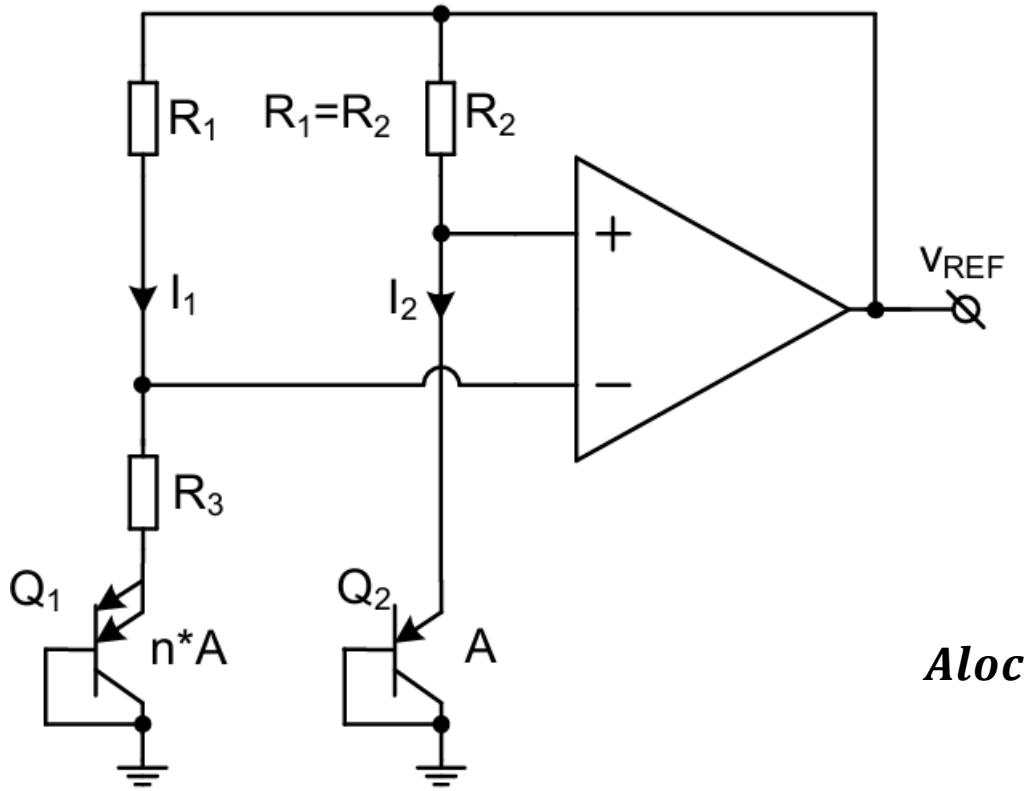
$$v_{BG} = v_{BE} + m \cdot V_T$$

$$\frac{\partial v_{BG}}{\partial Temp} = \frac{\partial v_{BE}}{\partial Temp} + m \cdot \frac{\partial V_T}{\partial Temp}$$

$$\frac{\partial v_{BG}}{\partial Temp} = 0 \Rightarrow m = -\left(\frac{\partial v_{BE}}{\partial Temp}\right) / \frac{\partial V_T}{\partial Temp}$$

$$m \cong \frac{2mV/^{o}C}{0.087mV/^{o}C} = 23; v_{BG} \cong 1.24V\,|_{Temp=300K}$$

3.Dimensionare Bandgap Kujik



$$v_{R_3} = v_{EB2} - v_{EB1} = V_T \ln n$$

$$I_{R3} = \frac{v_{R_3}}{R_3} = \frac{V_T}{R_3} \ln n \; ; I_{R3} = I_{R1} = I_{R2}$$

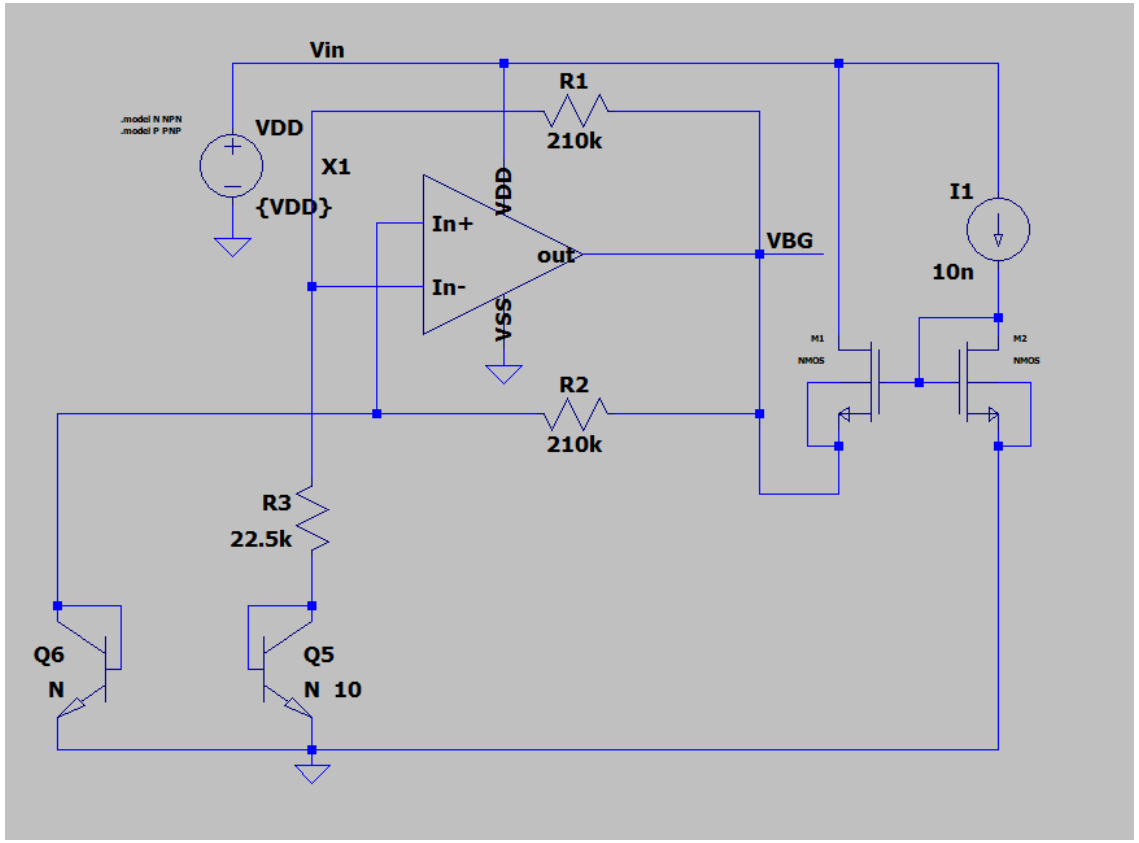
Tensiunea de referinta:

$$V_{REF} = v_{EB2} + R_2 \cdot I_{R2} = v_{EB2} + V_T \cdot \frac{R_2}{R_3} \ln n$$

$Aloc$ cate $4\mu A$ $pentru$ $R1$ si $R2$ si 20μA pentru Amplificator

$$R1 = R2 = 150k \qquad \frac{R2}{R3} = 10 \Rightarrow R3 = 15k$$

Prezentare circuit



Cu rezistentele R1=R2=150k si R3 = 15k, curentul imi depaseste limita impusa, de aceea am ajuns cu dimensionarea la R1=R2=210k si R3= 22.5k. Cu aceste valori insa VBG este aproximativ 1.17V, si nu 1.2V

4.Dimensionare amplificator operational

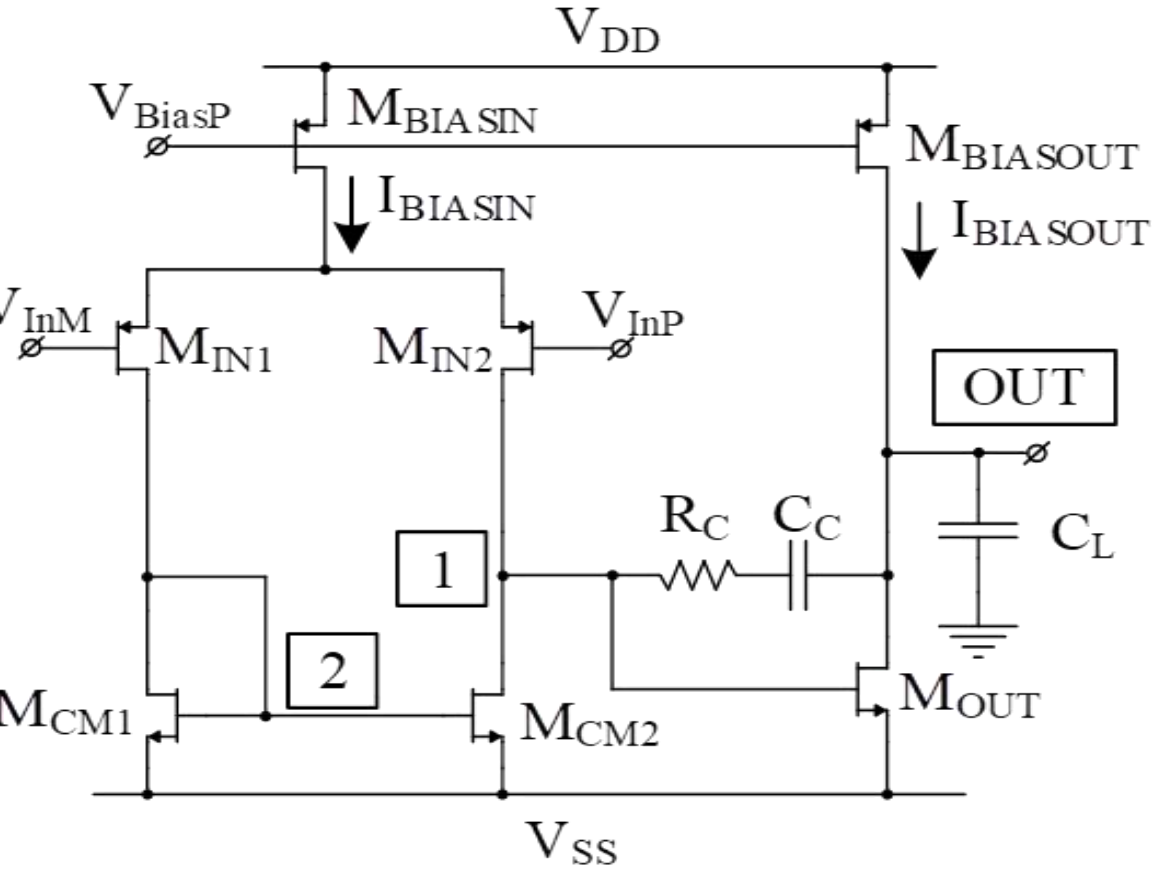
Set de referinta tranzistori

	MOS size					DCOP				small signal				
	L	W	W/L	Ad,As	Pd,Ps	|ID|	|Vdsat|	|Vth|	|Vgs|	gm [S]	gds [S]	rds [Ohm]	gmb [S]	VE
NMOS	1.80E-07	1.80E-06	10	6.48E-13	4.32E-06	5.00E-05	1.45E-01	0.487	0.683	5.26E-04	1.40E-05	7.14E+04	1.16E-04	1.98E+07
PMOS	1.80E-07	7.20E-06	40	2.59E-12	1.51E-05	5.00E-05	1.56E-01	0.52	0.682	5.50E-04	1.15E-05	8.70E+04	1.68E-04	2.42E+07

Set de referinta specificatii amplificator

Specificatii	
GBW(Hz)	6.00E+06
a0Min [dB]	6.00E+01
a0min [V/V]	1.00E+03
PM	6.00E+01
CL(F)	1.20E-11
SR(V/us)	9.00E-01
IDD_MAX(A)	2.00E-05
Vout_max_amplitude	1.20E+00
VDD	5.00E+00
VICM	2.50E+00

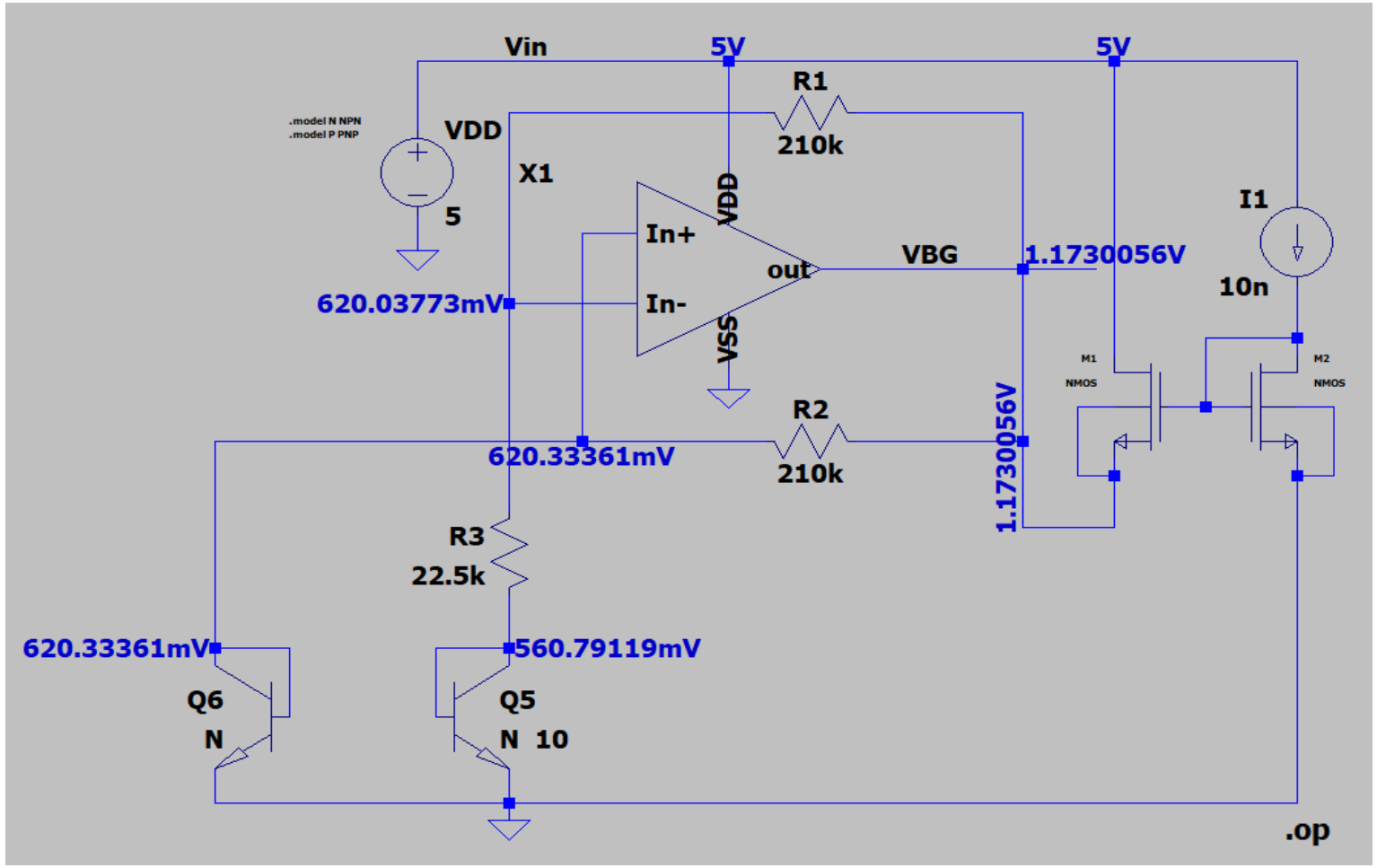
4.Dimensionare amplificator operational



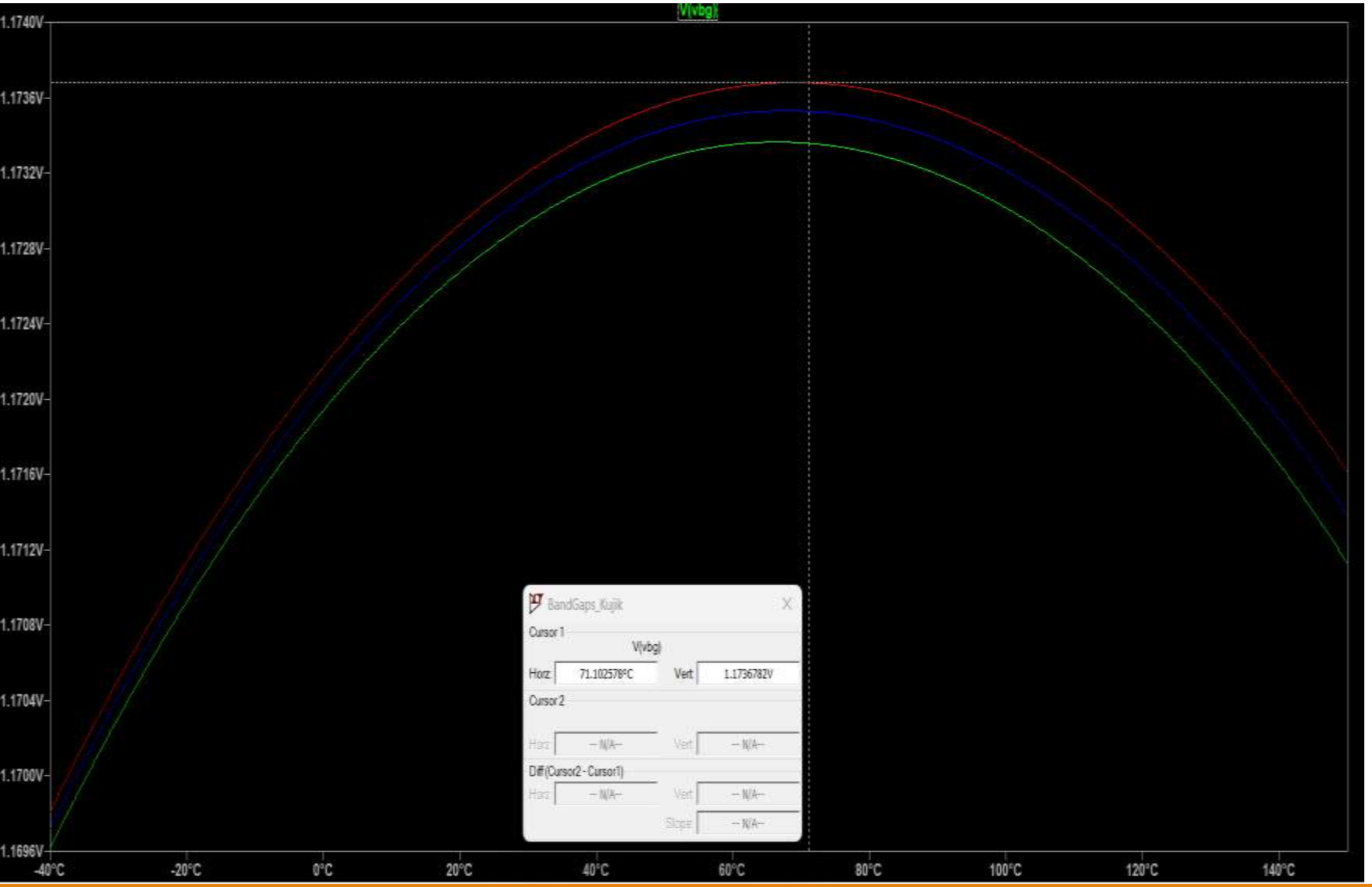
Tranzistorii din circuit							
MIN1,MIn2	Id(A)	Vdsat(V)	gm(S)	W(m)	L(m)	**Ad,As**	**Pd,Ps**
	2.26E-06	5.00E-02	9.05E-05	7.93E-06	4.50E-07	2.85E-12	1.66E-05
MCM1, MCM2	Id(A)	Vdsat(V)	gm(S)	W(m)	L(m)	**Ad,As**	**Pd,Ps**
	2.26E-06	5.00E-02	9.05E-05	1.71E-06	4.50E-07	6.16E-13	4.14E-06
MOUT	Id(A)	Vdsat(V)	gm(S)	W(m)	L(m)	**Ad,As**	**Pd,Ps**
	1.70E-05	5.00E-02	6.79E-04	5.14E-06	1.80E-07	1.85E-12	1.10E-05
MBiasIN	Id(A)	Vdsat(V)	gm(S)	W(m)	L(m)	**Ad,As**	**Pd,Ps**
	4.52E-06	0.1	9.05E-05	3.96E-06	4.50E-07	1.43E-12	8.65E-06
MBiasOUT	Id(A)	Vdsat(V)	gm(S)	W(m)	L(m)	**Ad,As**	**Pd,Ps**
	1.70E-05	0.1	3.39E-04	1.49E-05	4.50E-07	5.35E-12	3.04E-05
MDiode	Id(A)	Vdsat(V)	gm(S)	W(m)	L(m)	**Ad,As**	**Pd,Ps**
	1.00E-05	0.1	2.00E-04	8.76E-06	4.50E-07	3.15E-12	1.82E-05
Rc	1.47E+03						

5.Simulari

1)OP

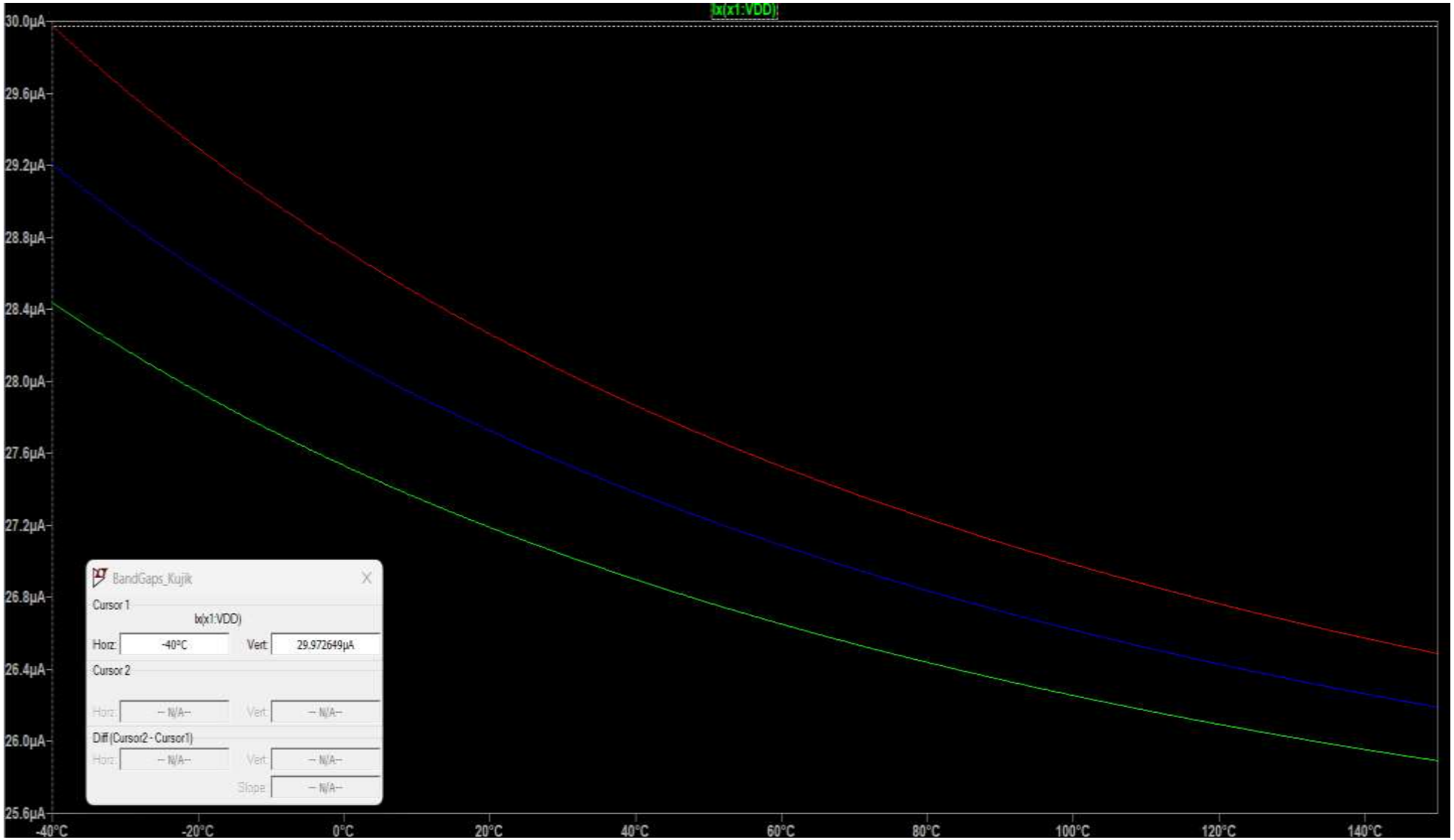


2)Variatia tensiunii in functie de temperatura

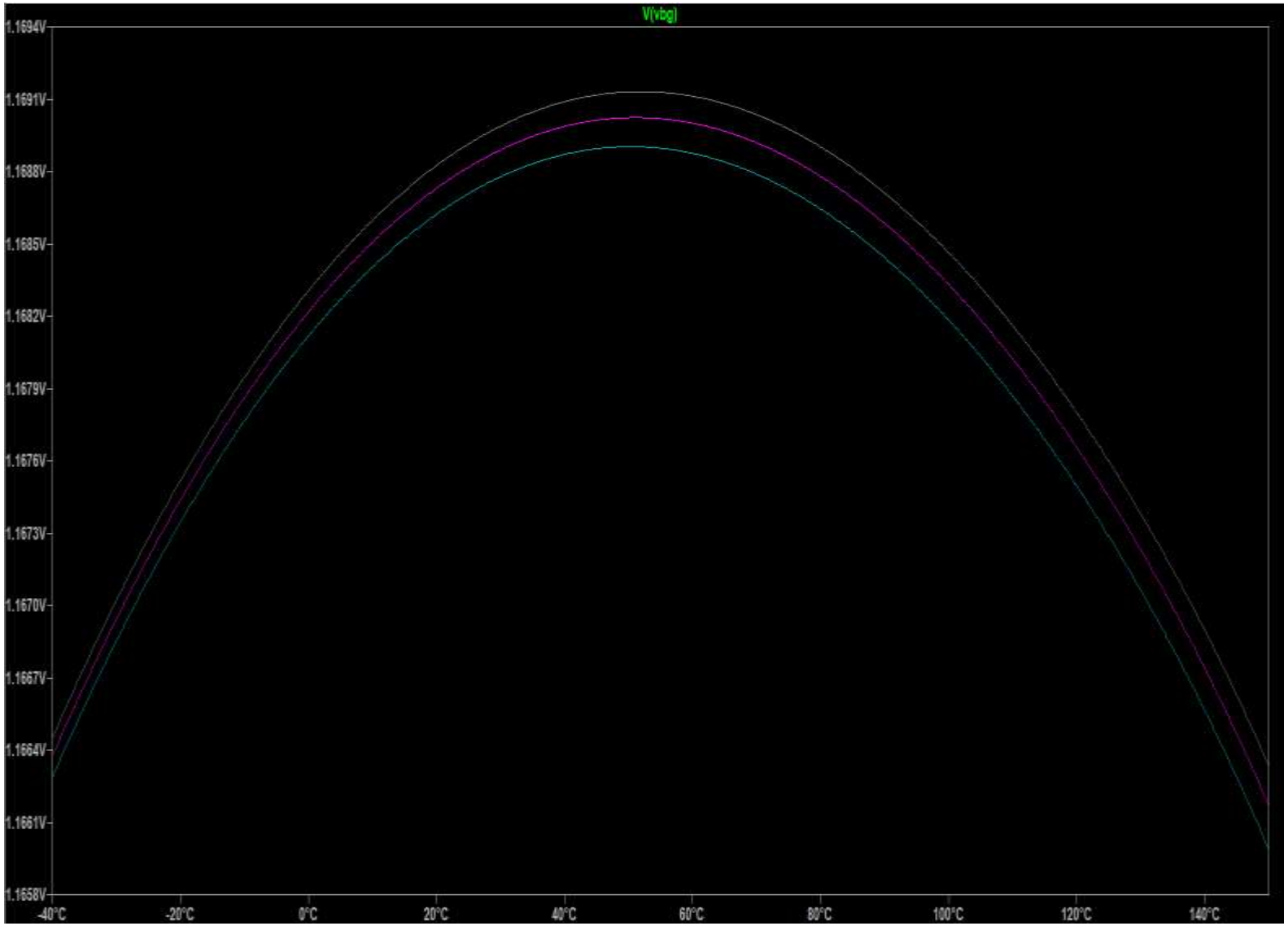


1.1736-1.1698 = 3.8mV => 0.3%

3)Curent consumat



4.1) Variatia rezistentelor cu +20%

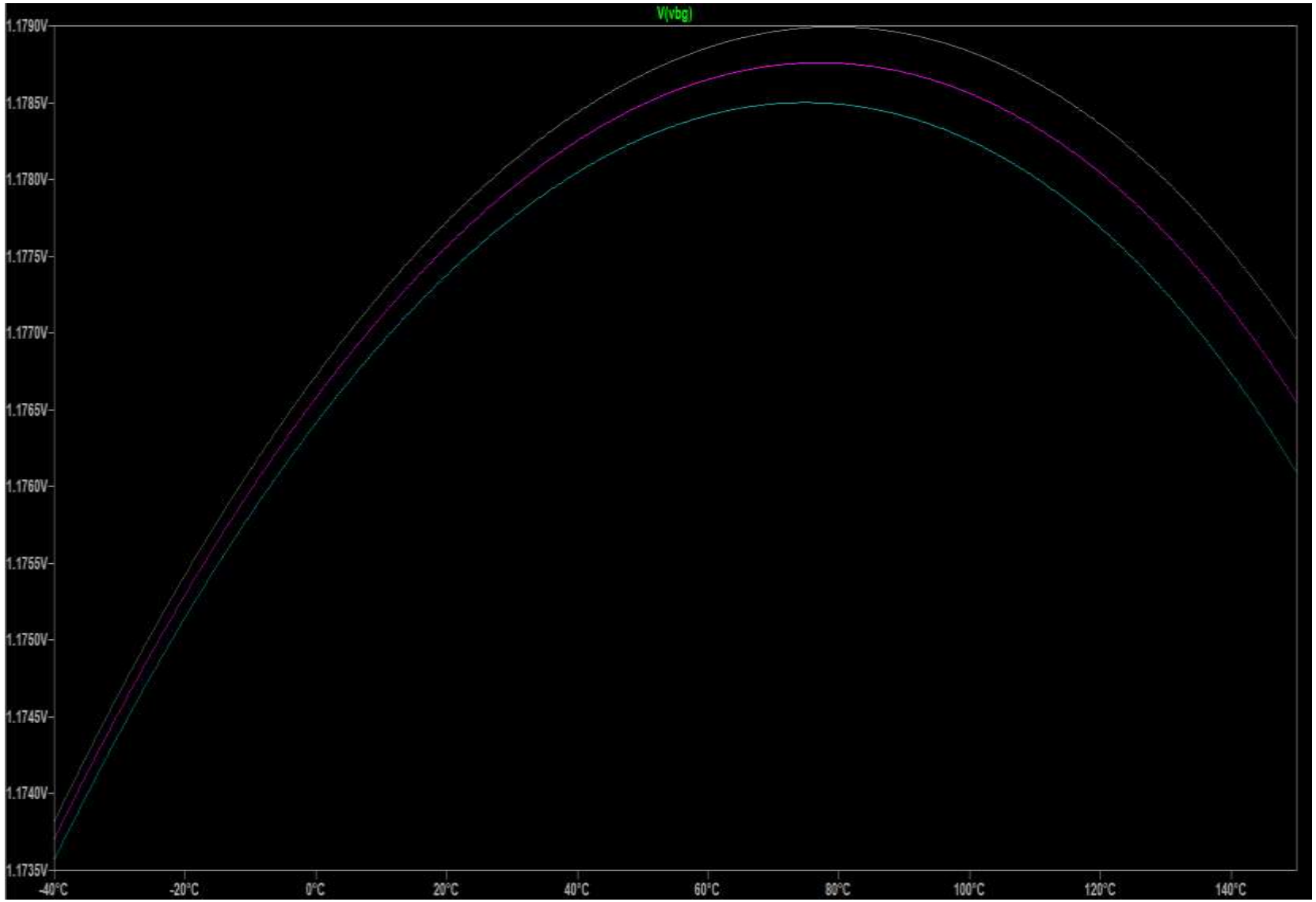


+20% => R2=R3=252k

+20% => R1=27k

Variatie de 4.5mV => $\sim 0,3\%$

4.2) Variatia rezistentelor cu -20%

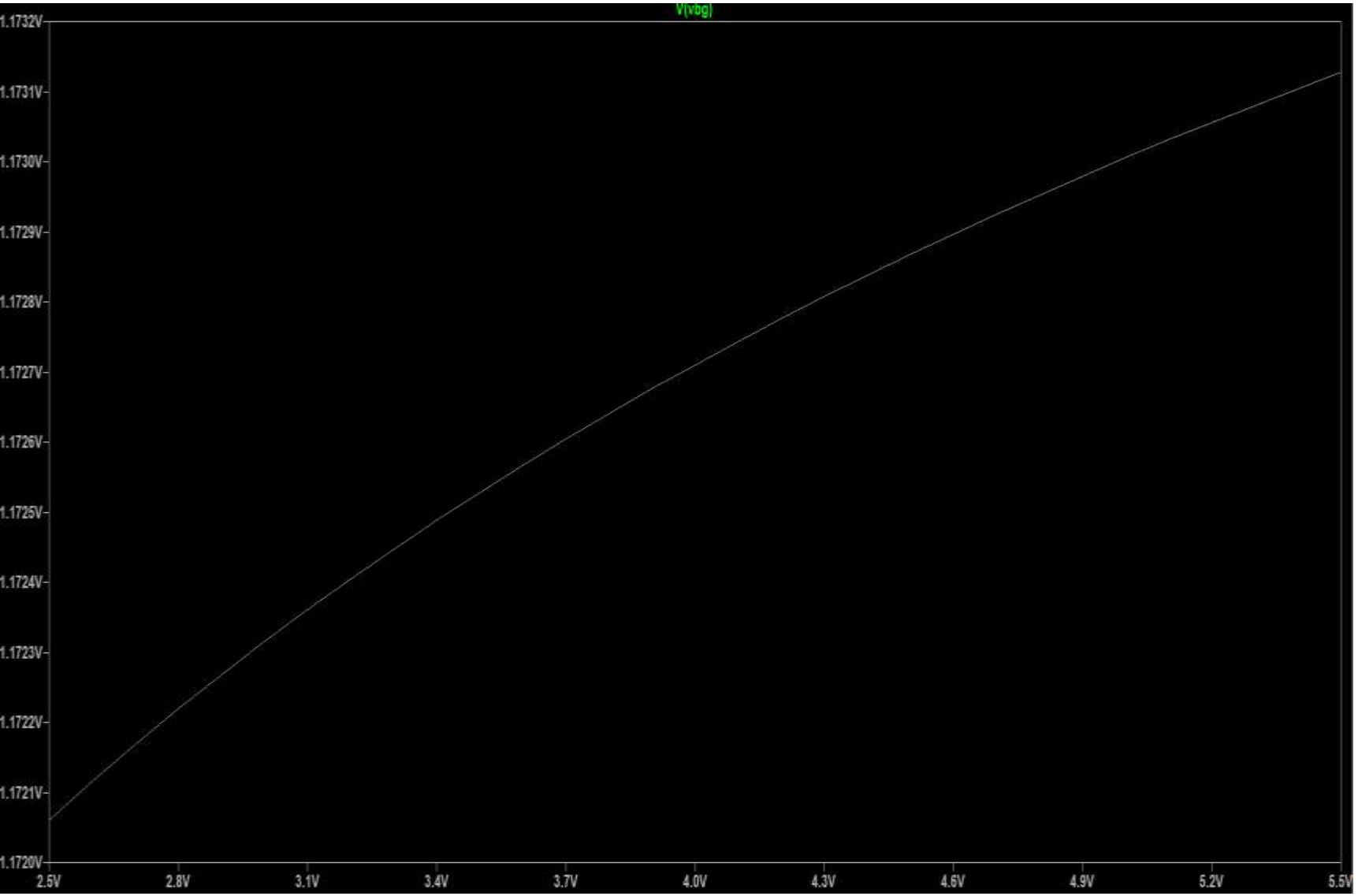


-20% => R1=R2=168k

-20% => R3=18k

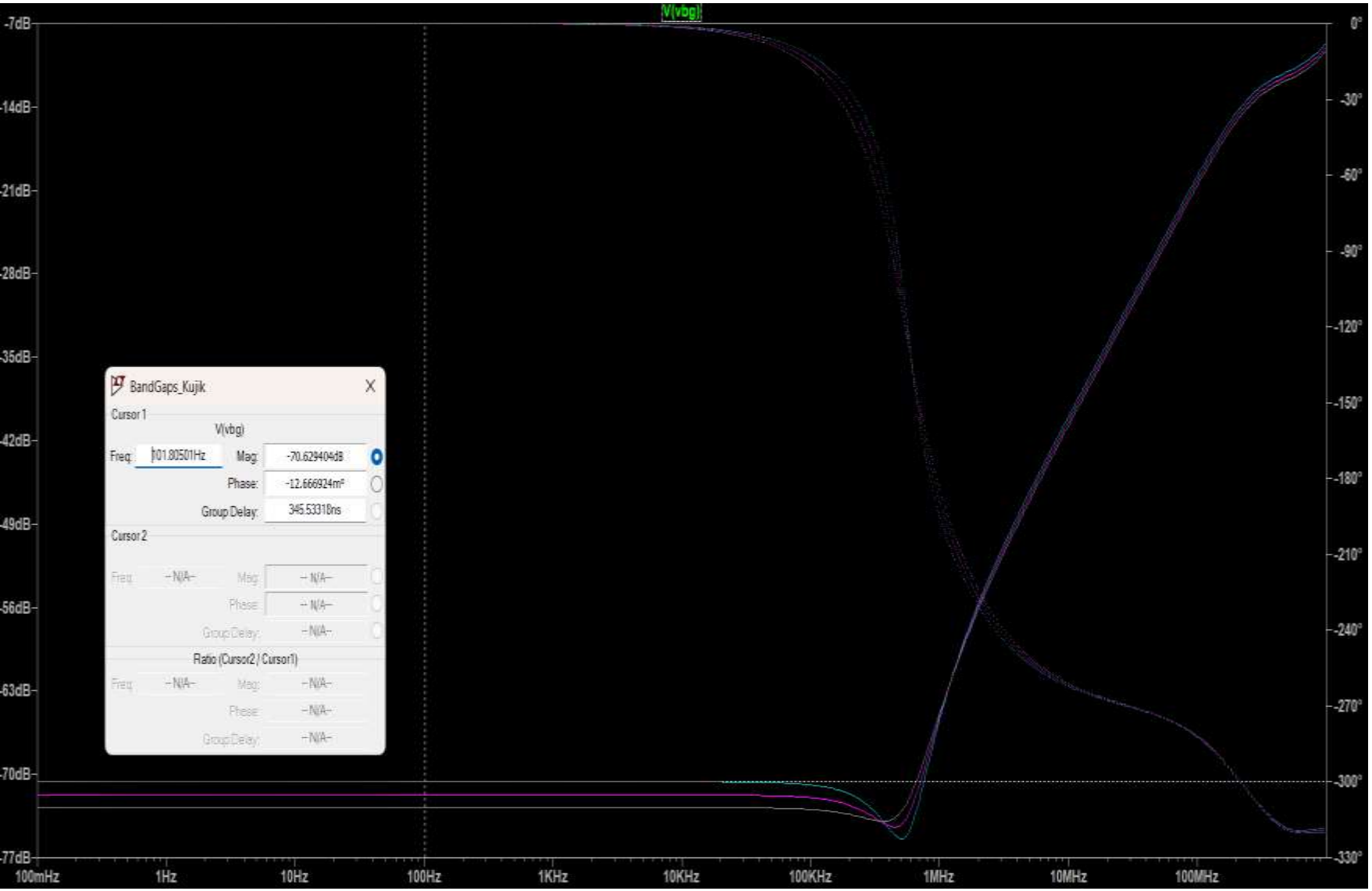
Variatie de 51.7mV => $\sim 4.5\%$

5)Variatia in functie de tensiunea de intrare



Variatie de 1.1mv => $\sim 0.1\%$

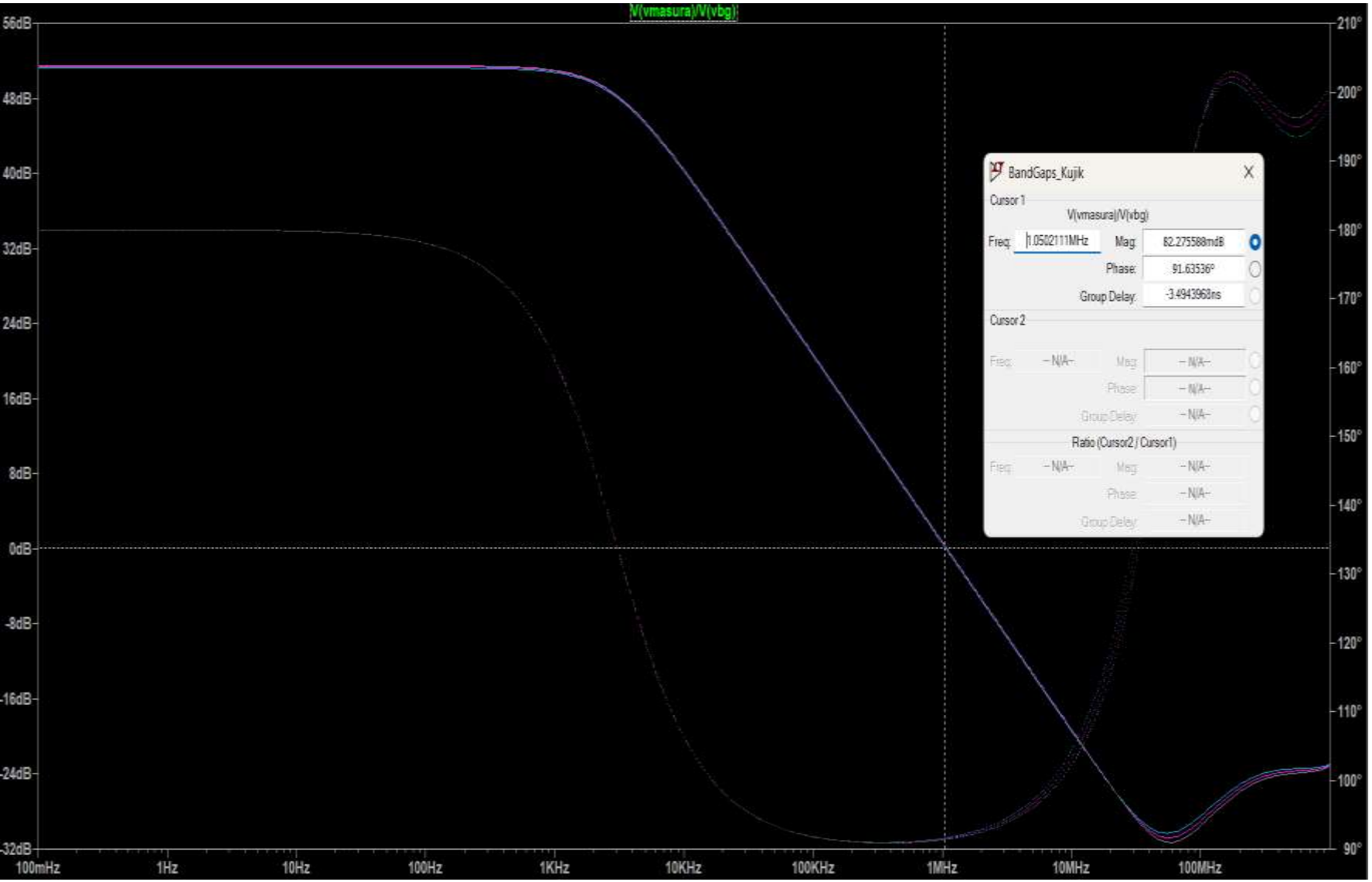
6)PSRR



$$PSRR^{dB} = 20\log\frac{a_{DIFF}}{a_{PS}}$$

PSRR de 70 dB reduce variațiile de tensiune de la intrare de 5 V la doar 1.5 mV la ieșire.

7)Stablitate

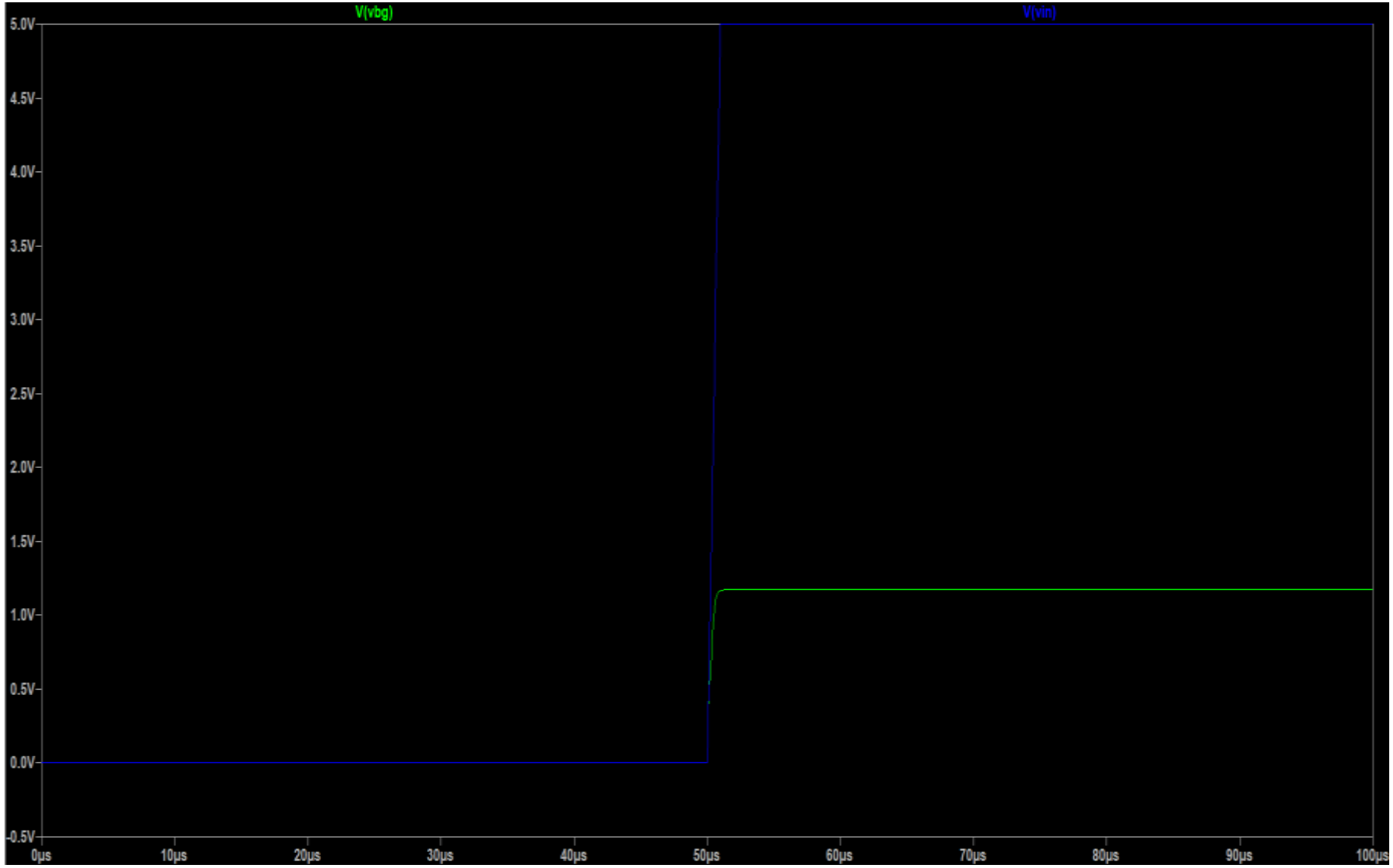


PM = 91°

GBW = 1MHz

A0 = 51dB

8)Transient - Start-up time



Start-up time ~ 1us

5.Concluzii

Parametru	Specificatii	Rezultat obtinut
VBG	1.2V	1.17V
ISS@25degC (µA)	30µA	29.9µA
Precizie	2%	5.2%