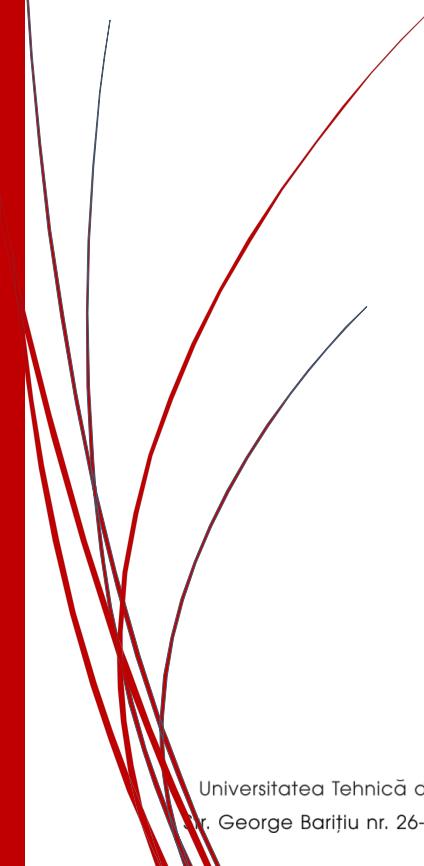


# Proiect SCIA



Nume: Muresan Adina-Stefania

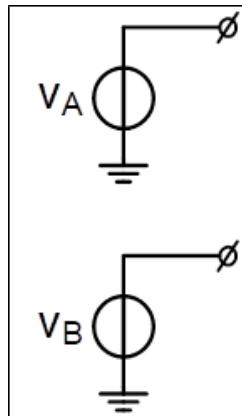
Profesori coordonatori: Conf. dr. ing. Marius Neag,  
Gheorghe Eduard Vladu

## Cuprins

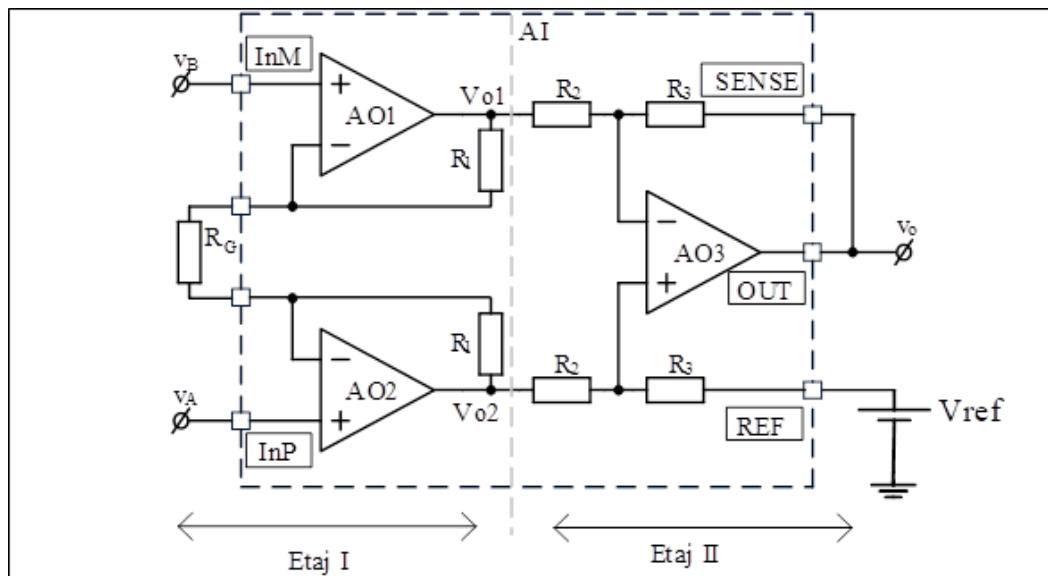
1.	Tematica proiectului .....	2
2.	Dimensionare.....	5
2.1.	Etajul 1 – Amplificator de instrumentație cu 3 AO-uri .....	5
2.2.	Etajul 2 – Filtru LOW Pass, KHN.....	6
2.3.	Etajul 3 - PGA cu switch-uri in afara căii de semnal, inversor .....	8
2.4.	Etajul 4 – Redresor dublu-alternanță.....	10
3.	Caracterizarea etajelor .....	13
3.1.	Etajul 1 .....	13
3.2.	Etajul 2 .....	18
3.3.	Etajul 3 .....	21
3.4.	Etajul 4 .....	28
4.	Verificarea si caracterizarea interfetei analogice .....	31
5.	Concluzii .....	34
5.1.	Etajul 1 .....	34
5.2.	Etajul 2 .....	35
5.3.	Etajul 3 .....	36
5.4	Etajul 4 .....	37

## 1. Tematica proiectului

Sursa de semnal: differential



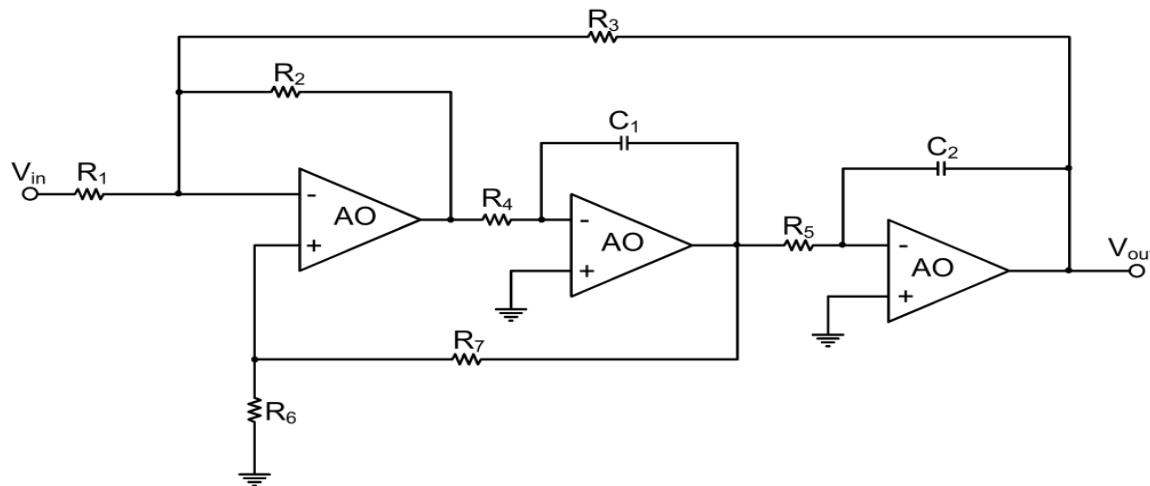
Etajul 1 – amplificator: Amplificator de instrumentație cu 3 AO-uri



Amplitudine minima (pt. câștig maxim PGA)	Amplitudine maxima (pt. câștig minim PGA)	Câștig  etaj 1 (liniar)
4.45e-02	1.12e-01	16

AO folosit: LT6018

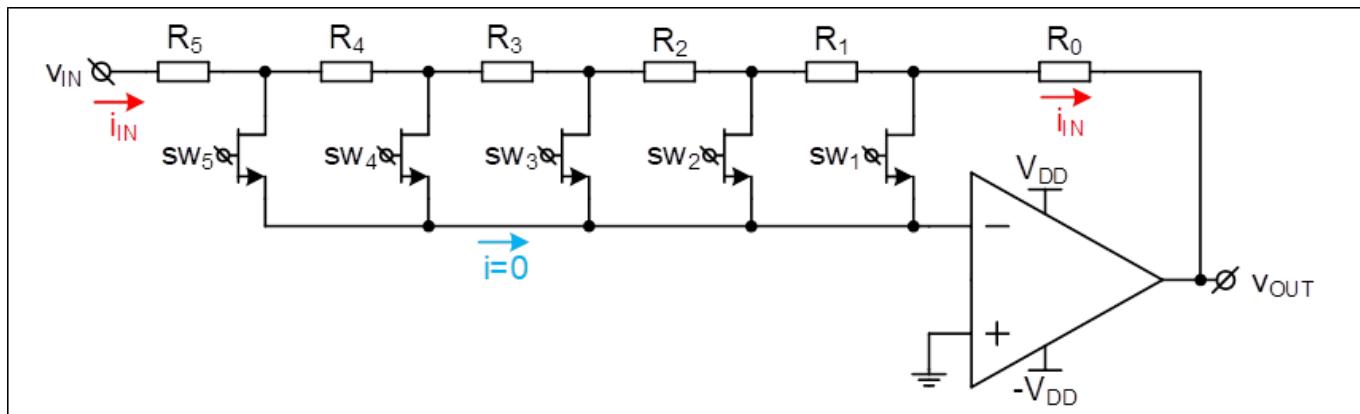
Etajul 2 – filtru: Filtru KHN(Kerwin-Hueslsman-Newcomb), Low Pass



H0  câștig liniar în banda de trecere	Rintrare minim	Banda	Q
1	2kΩ	5kHz	1

AO folosit: AD8030

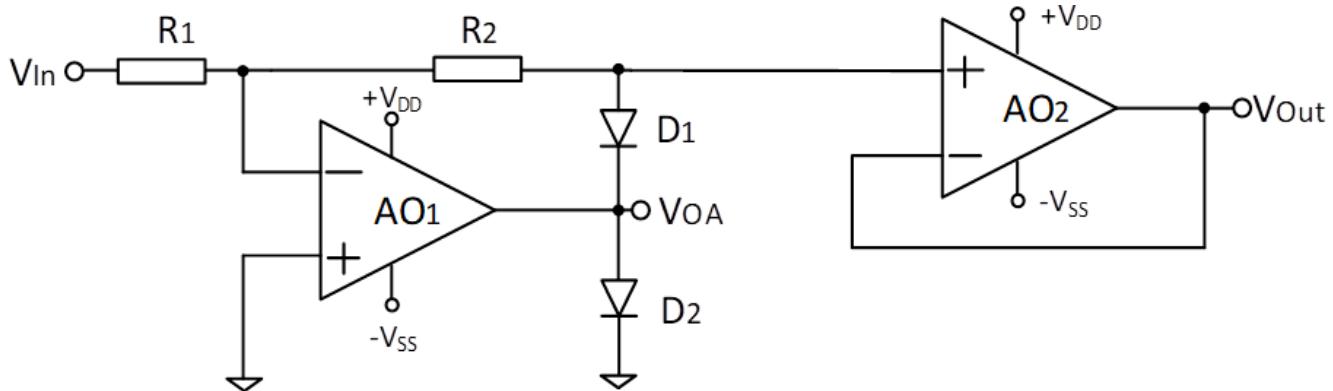
Etaj 3 – PGA(Amplificator cu Câștig Programabil) – Configurație inversoare cu switch-uri în afara căii de semnal



Câștig minim[dB]	Rezoluție(pas minim) [dB]	Nr. pași	Câștig maxim[dB]	Rintrare minim
7	2	5	15	2kΩ

AO folosit: LT6018

Etaj 4 – Redresor – Redresor bi-alternanță cu 2 AO-uri

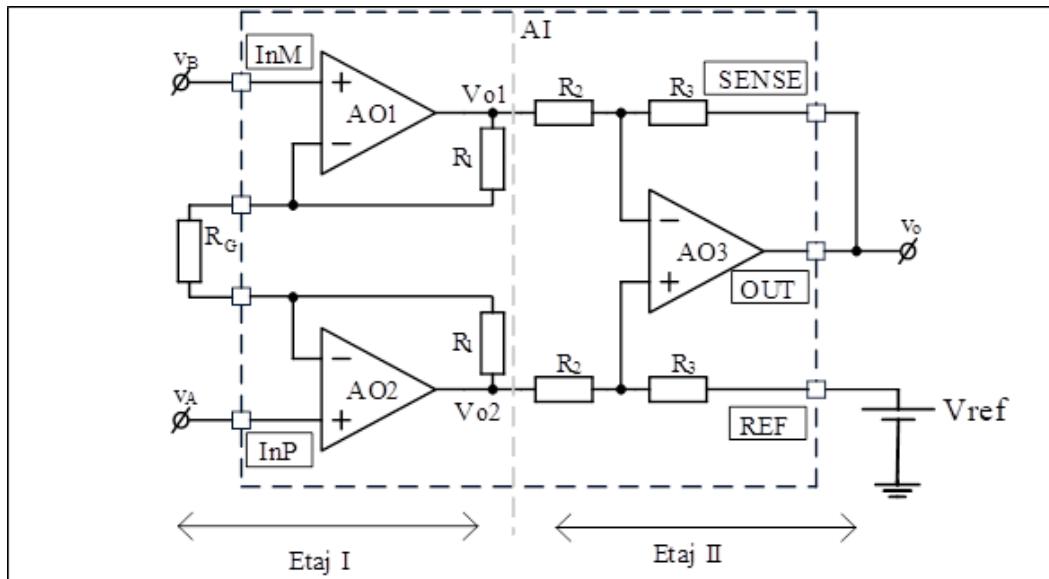


Câștig  (liniar)
1

AO folosite: pt. AO1 – AD820, iar pt. AO2 – AD8030

## 2. Dimensionare

### 2.1. Etajul I – Amplificator de instrumentație cu 3 AO-uri



Amplificarea diferențială data în specificații este  $A_D=16$ . Amplificatorul de instrumentație din figură are intrare diferențială și ieșire diferențială.

$$V_{out} = A_D V_{in} \quad (1)$$

$$V_{in} = V_A - V_B \quad (2)$$

$$\text{Pentru etajul I: } A_{DI} = \frac{V_{o2} - V_{o1}}{V_A - V_B} = \left(1 + \frac{2R_1}{R_G}\right) \quad (3), \text{ iar pentru etajul II: } A_{DII} = \frac{V_{out}}{V_{o2} - V_{o1}} = \frac{R_3}{R_2} \quad (4)$$

Din (3)  $\rightarrow V_{out} = (V_{o2} - V_{o1}) \cdot \frac{R_3}{R_2}$ . Înlocuim  $V_{o2} - V_{o1}$  din expresia (4) și rezultă:

$$V_{out} = (V_A - V_B) \left(1 + \frac{2R_1}{R_G}\right) \frac{R_3}{R_2} \quad (5)$$

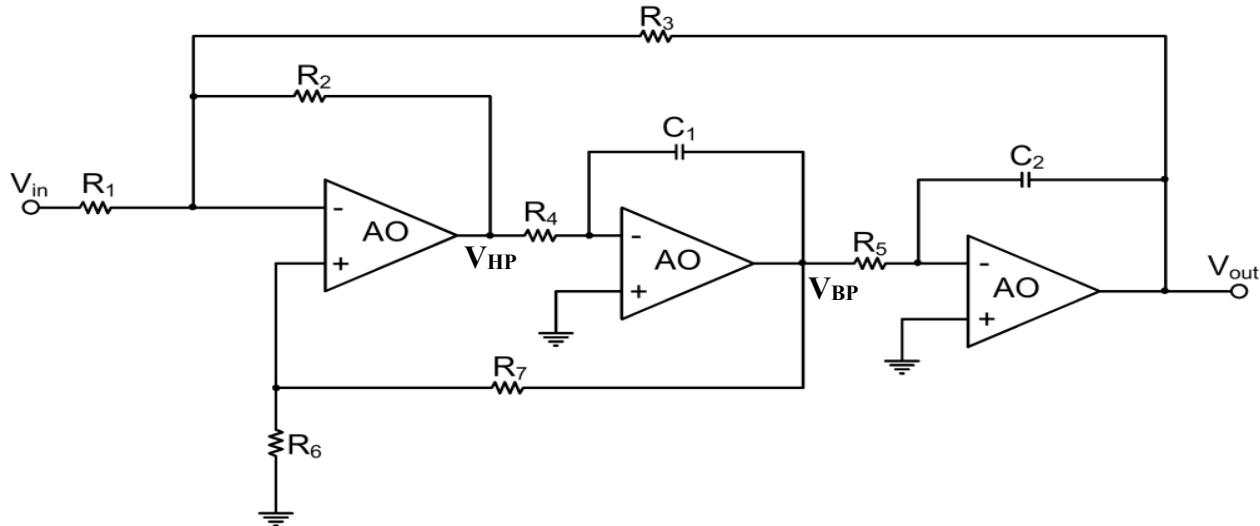
$$\text{Din (1)} \rightarrow A_D = V_{out}/V_{in} \quad (6)$$

$$\text{Înlocuind (5) și (2) în (6) obținem că } A_D = \left(1 + \frac{2R_1}{R_G}\right) \frac{R_3}{R_2}.$$

$$\text{Din specificații } A_D=16, \text{ deci } \left(1 + \frac{2R_1}{R_G}\right) \frac{R_3}{R_2} = 16.$$

Aleg  $R_1=50\text{k}\Omega$  și  $R_G=100\text{k}\Omega$ . Rezultă că  $8=\frac{R_3}{R_2}$ , adică  $8R_2=R_3$ . Aleg  $R_2=10\text{k}\Omega$   $\Rightarrow$   $R_3=80\text{k}\Omega$ .

## 2.2. Etajul 2 – Filtru LOW Pass, KHN



Filtrul/bicuad-ul din figura de mai sus este un filtru de ordinul 2 deoarece există două componente reactive(2 condensatoare).

Forma canonica a funcției de transfer a unui filtru de ordinul 2 este:

$$H(s) = H_0 \frac{\omega_0^2}{s^2 + \frac{\omega_0}{Q}s + \omega_0^2} \quad (7)$$

Funcția de transfer a filtrului KHN este:

$$H(s) = \frac{-\frac{1}{R_1 R_2 C_1 C_2}}{s^2 + \frac{3R_6}{R_6 + R_7} \cdot \frac{1}{R_1 C_1} s + \frac{1}{R_1 R_2 C_1 C_2}} \quad (8)$$

Identific termenii din (8) termenii din (7).

$$H_0 = -1$$

$$\omega_0^2 = \frac{1}{R_1 R_2 C_1 C_2} \quad (9)$$

$$\frac{\omega_0}{Q} = 3 \frac{R_6}{R_6 + R_7} \cdot \frac{1}{R_1 C_1} \quad (10)$$

Aleg  $R_1=R_2=R_3=R_4=R_5$  și  $C_1=C_2$ . Atunci rezultă că:

$$\omega_0^2 = \frac{1}{{R_1}^2 {C_1}^2} \quad (11)$$

Deci:

$$(12) \omega_0 = \frac{1}{{R_1} {C_1}} \text{ și } Q = \frac{3 \cdot R_3}{{R_3} + {R_4}}. \quad (13)$$

Cum  $f_0=5\text{kHz}$ , atunci  $\omega_0 = 2 \cdot \pi \cdot f_0 = 2 \cdot 3,14 \cdot 5 \cdot 10^3 \cong 3,14 \cdot 10^4$  (14)

Deci egalând (12) cu (14) obțin  $\omega_0 = \frac{1}{{R_1} {C_1}} = 3,14 \cdot 10^4$ . Aleg  $C_1=C_2=10\text{nF}$ , atunci rezultă că

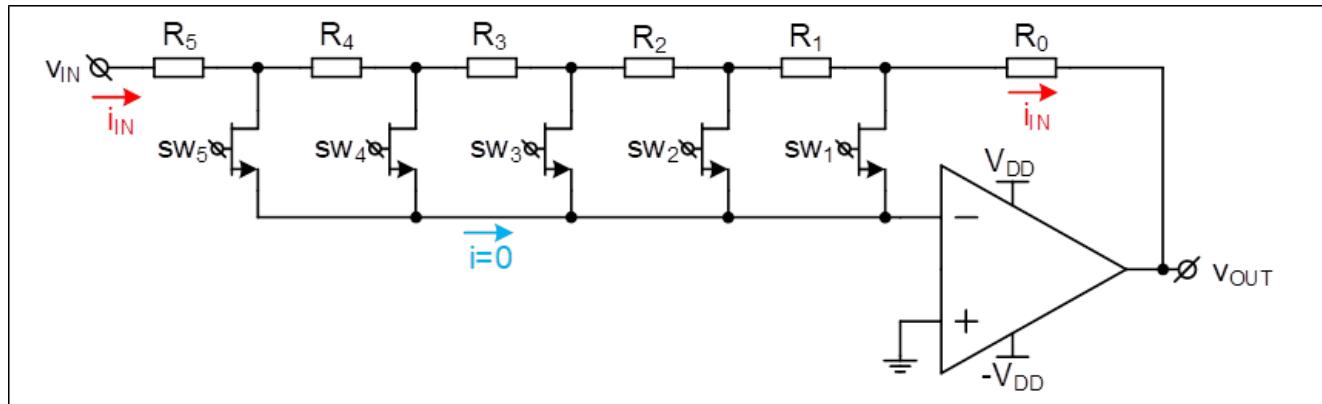
$$R_1 = \frac{1}{10 \cdot 10^{-9} \cdot 3,14 \cdot 10^4} = 0,318 \cdot 10^4 = 3,18\text{k}\Omega. \quad \underline{R_1=R_2=R_3=R_4=R_5=3,18\text{k}\Omega}.$$

Din specificații,  $Q=1$  (15). Egalând ecuația (13) cu (15) rezultă:

$$1 = \frac{3 \cdot R_6}{R_6 + R_7} \leftrightarrow R_6 + R_7 = 3R_6 \rightarrow 2R_6 = R_7$$

Aleg  $R_6=10\text{k}\Omega$ , atunci  $R_7=20\text{k}\Omega$ .

### 2.3. Etajul 3 - PGA cu switch-uri în afara căii de semnal, inversor



$A_{\min}=7\text{dB}$ ,  $A_{\max}=15\text{dB}$ , număr de pași=5, rezoluție=2dB,  $R_{in\_min}=2\text{k}\Omega$ .

	A[dB]	A[liniar]
	7	2.23
	9	2.81
	11	3.54
	13	4.46
	15	5.62

SW <sub>5</sub>	SW <sub>4</sub>	SW <sub>3</sub>	SW <sub>2</sub>	SW <sub>1</sub>	R <sub>F</sub>	R <sub>G</sub>	A <sub>v</sub> dat
on	-	-	-	-	$R_0 + R_1 + R_2 + R_3 + R_4$	$R_5$	5.62
-	on	-	-	-	$R_0 + R_1 + R_2 + R_3$	$R_5 + R_4$	4.46
-	-	on	-	-	$R_0 + R_1 + R_2$	$R_5 + R_4 + R_3$	3.54
--	-	-	on		$R_0 + R_1$	$R_5 + R_4 + R_3 + R_2$	2.81
	-	-	-	on	$R_0$	$R_5 + R_4 + R_3 + R_2 + R_1$	2.23

$$A_v = -\frac{R_F}{R_G}, \text{ deci } |A_v| = \frac{R_F}{R_G}$$

Când SW<sub>5</sub> e activ, atunci o să avem câștig maxim, iar când SW<sub>1</sub> este activ, o să avem câștig minim.

$$R_0 + R_1 + R_2 + R_3 + R_4 = 5.62R_5 \quad (16)$$

$$R_0 + R_1 + R_2 + R_3 = 4.46(R_5 + R_4) \quad (17)$$

$$R_0 + R_1 + R_2 = 3.54(R_5 + R_4 + R_3) \quad (18)$$

$$R_0 + R_1 = 2.81(R_5 + R_4 + R_3 + R_2) \quad (19)$$

$$R_0 = 2.81(R_5 + R_4 + R_3 + R_2 + R_1) \quad (20)$$

Aleg  $R_5=R_{in\_min}=2k\Omega$ .

Înlocuind (17) în (16), rezultă că  $R_4 = 0.21R_5 = 0.42k\Omega$ .

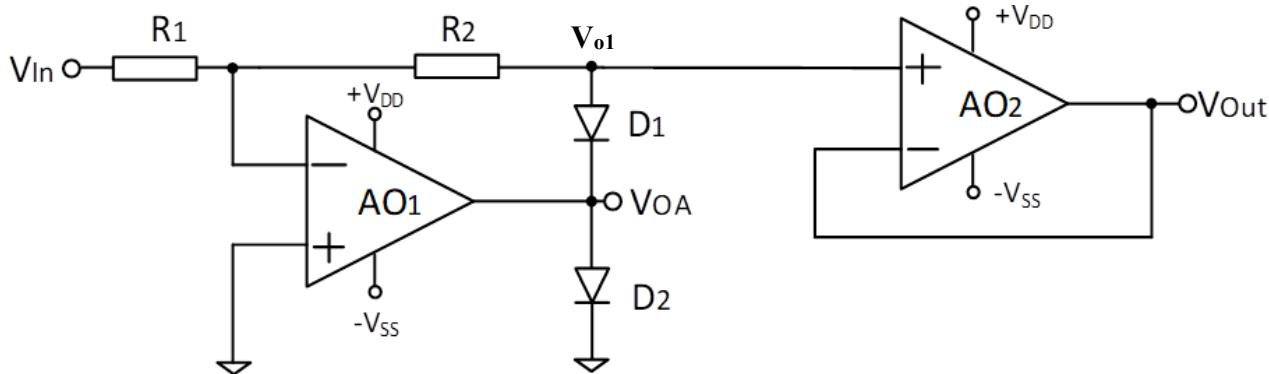
Înlocuind (18) în (17), rezultă că  $R_3 = 0.2(R_5 + R_4) = 0.484k\Omega$

Înlocuind (19) în (18), rezultă că  $R_2 = 0.19(R_5 + R_4 + R_3) = 0.55k\Omega$

Înlocuind (20) în (19), rezultă că  $R_1 = 0.18(R_5 + R_4 + R_3 + R_2) = 0.621k\Omega$

Din (20) rezultă că  $R_0 = 2.81(R_5 + R_4 + R_3 + R_2 + R_1) = 9.08 k\Omega$

#### 2.4. Etajul 4 – Redresor dublu-alternanță



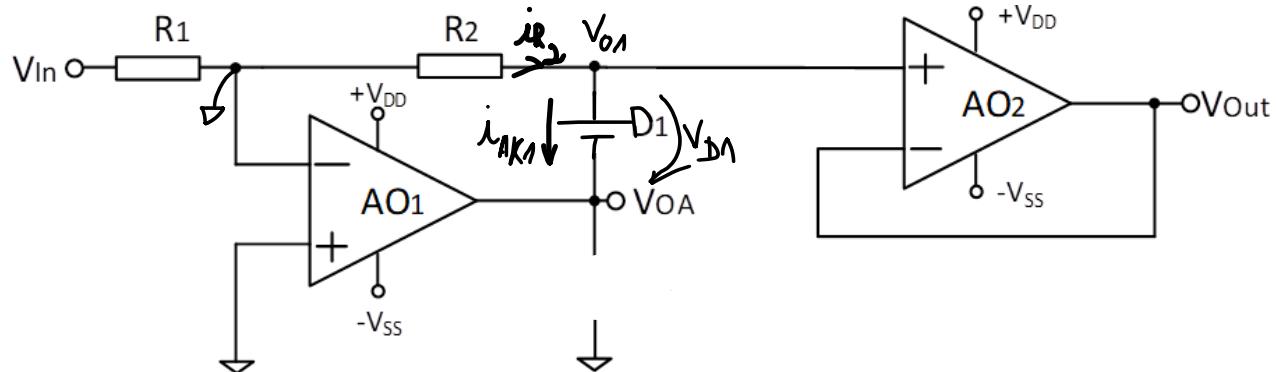
Trebuie să se calculeze funcția de transfer a circuitului, adică cât este ieșirea în funcție de intrare.

Cazul I:  $V_{in}$  tinde la  $+V_{DD}$ .

Presupunem că  $D_1$  și  $D_2$  sunt blocate.

$$v_1^+ = 0 \text{ și } v_1^- > 0 \quad v_1^- > v_1^+ \Rightarrow V_{AO1} \rightarrow -V_{SS}$$

$V_{AK1} > 0$ , atunci  $D_1$  o să fie on, iar  $V_{AK2} < 0$  și  $D_2$  o să fie off.



Există reacție negativă pt. AO1 prin  $D_1$  și  $R_2$ . Deci:

$$v_1^+ = v_1^- = 0$$

AO2 este un repotor de tensiune, deci  $V_{out} = V_{o1}$ , unde  $V_{o1} = -\frac{R_2}{R_1} V_{in}$ , deci  $V_{out} = -\frac{R_2}{R_1} V_{in}$  pentru  $V_{in} > 0$ .

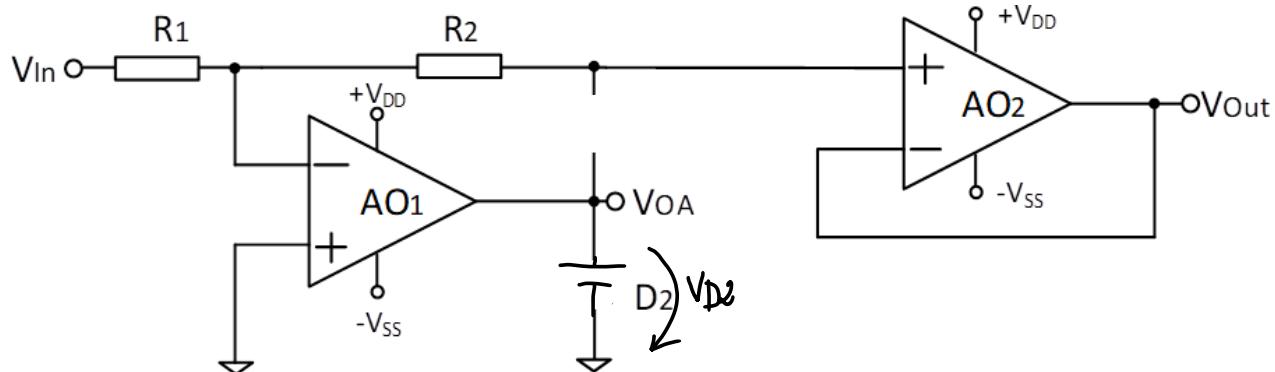
Aflăm domeniul pentru  $V_{in}$ , adică aflăm curentul prin  $D_1$ .  $I_{AK1} \geq 0$ .

$$i_{AK1} = i_{R_2} = \frac{V_{R_2}}{R_2} = \frac{0 - V_{o1}}{R_2} = \frac{1}{R_2} \cdot (-1) \cdot \left( -\frac{R_2}{R_1} \right) V_{in} = \frac{1}{R_1} V_{in}, \text{ pt. } V_{in} > 0$$

Cazul II:  $V_{in}$  tinde la  $-V_{SS}$ . Presupunem că  $D_1$  și  $D_2$  sunt blocate.

$$v_1^+ = 0 \text{ și } v_1^- < 0 \quad v_1^- < v_1^+ \Rightarrow V_{AO1} \rightarrow +V_{DD}$$

$V_{AK1} < 0$ , atunci  $D_1$  o să fie off, iar  $V_{AK2} > 0$  și  $D_2$  o să fie on.



Există reacție negativă în jurul lui AO2.  $v_2^+ = v_2^- = v_1^-$

$$v_1^- = v_1^+ = 0$$

AO2 este un repotor de tensiune, deci  $V_{out} = V_{in}$ , pt.  $V_{in} < 0$

$$V_{out} = -\frac{R_2}{R_1} V_{in}, \text{ pt. } V_{in} > 0 \quad \text{și} \quad V_{out} = V_{in}, \text{ pt. } V_{in} < 0$$

$$V_{out} = \begin{cases} -\frac{R_2}{R_1} \cdot V_{in}, & V_{in} > 0 \\ V_{in}, & V_{in} < 0 \end{cases}$$

$A_v = 1$ , deci  $R_2/R_1 = 1$ , atunci  $R_1 = R_2 = 2k\Omega$

Output Voltage Swing:  $V_{OA1} \in [-V_s + 0.22; +V_s - 0.22] = [-4.78V; 4.78V]$

$$\text{Pt. } V_{in} > 0 \Rightarrow V_{AO1} = -\frac{R_2}{R_1} V_{in} - V_{D1}$$

$$\text{Pt. } V_{in} < 0 \Rightarrow V_{AO1} = -V_{D2}$$

Domeniul liniar al tensiunii de intrare:

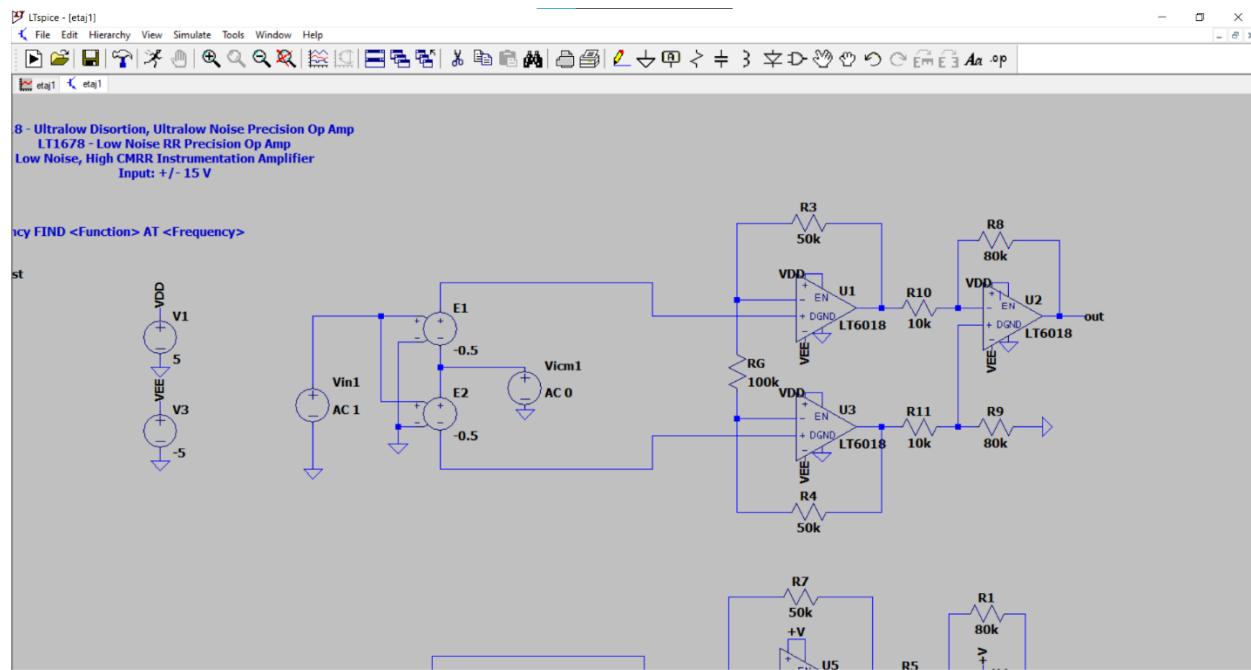
$$R_1 = R_2, V_{d1} = 0.62V$$

$$V_{in} = - (R_1/R_2)(V_{AO1} + V_{d1}) = - (V_{AO1} + V_{d1})$$

$$V_{inmax} = - (-4.78 + 0.62) = 4.16 \text{ V și } V_{inmin} = -4.16 \text{ V.}$$

### 3. Caracterizarea etajelor

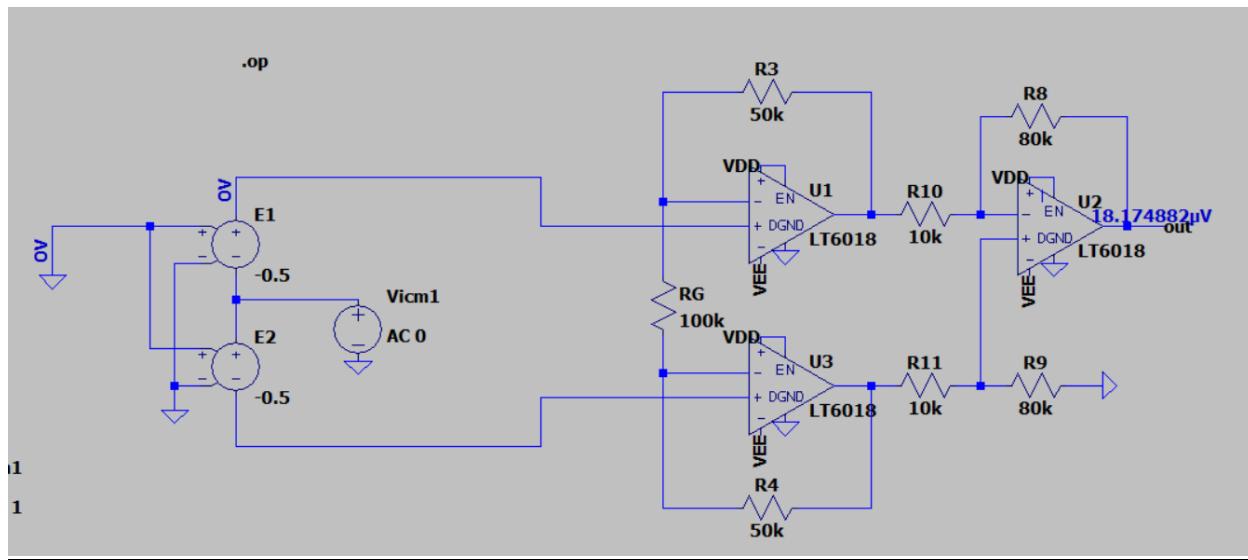
#### 3.1. Etajul 1



#### Punct static de funcționare

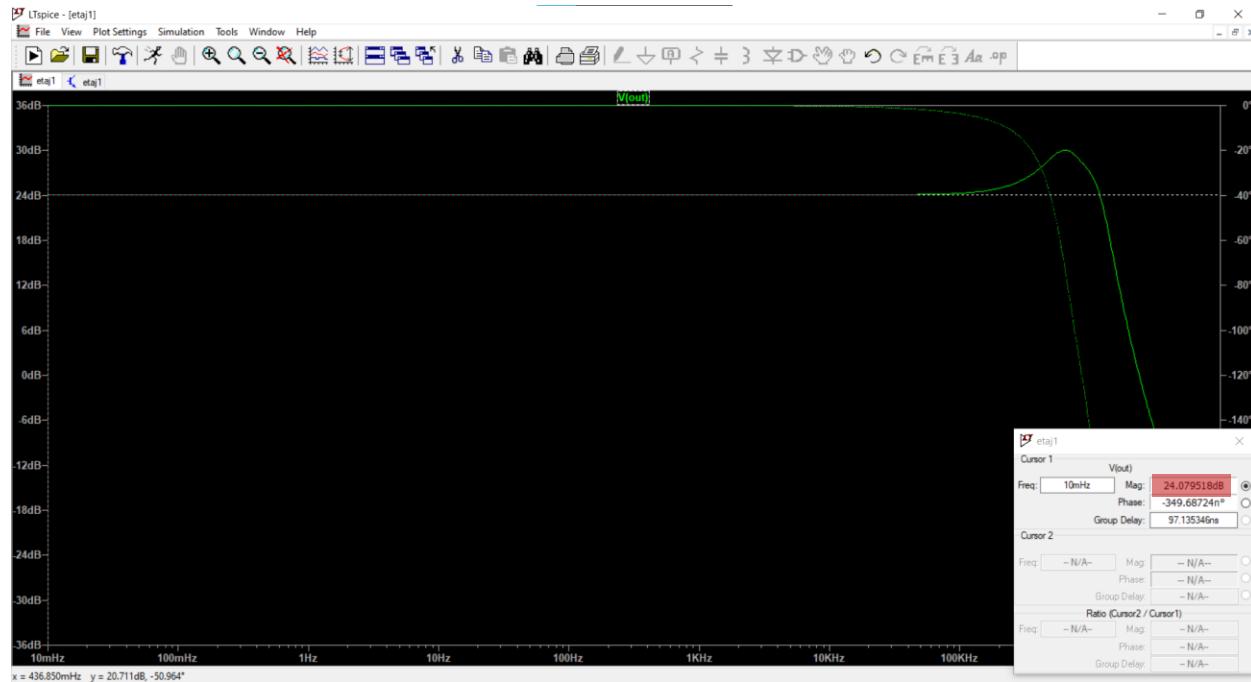
--- Operating Point ---		
V(vdd):	5	voltage
V(vee):	-5	voltage
V(out):	1.81749e-05	voltage
V(n003):	-0.021172	voltage
V(n007):	-0.021172	voltage
V(n002):	-0.0298768	voltage
V(n010):	-0.0298768	voltage
V(n001):	3.42323e-09	voltage
V(n009):	3.42323e-09	voltage
V(n006):	0	voltage
V(n004):	0	voltage
V(n008):	0	voltage
V(n011):	0	voltage
V(n014):	3.70313	voltage
V(n017):	2.97175	voltage
V(+v):	3.85491	voltage
V(-v):	3.87908	voltage
V(outcm):	3.85686	voltage
V(n013):	3.68585	voltage
V(n020):	3.33932	voltage
V(n012):	3.59938	voltage
V(n019):	3.42622	voltage
V(n015):	0	voltage
V(n021):	0	voltage
V(n016):	0	voltage
V(n018):	0	voltage
V(n022):	12.9224	voltage
V(n027):	12.4861	voltage
V(+v_ps):	15	voltage
V(outps):	3.92667	voltage
V(n024):	14.0469	voltage
V(n030):	14.0469	voltage
V(n023):	6.63195	voltage
V(n029):	6.63195	voltage
V(n025):	0	voltage
V(n031):	0	voltage
V(n026):	0	voltage
V(n028):	0	voltage

## Compensare DC



Nu e nevoie de compensare pentru că având masă la intrare, la ieșire se obține o tensiune de ordinul  $\mu$ V.

Amplificare diferențială de 24dB, adică 16 în liniar



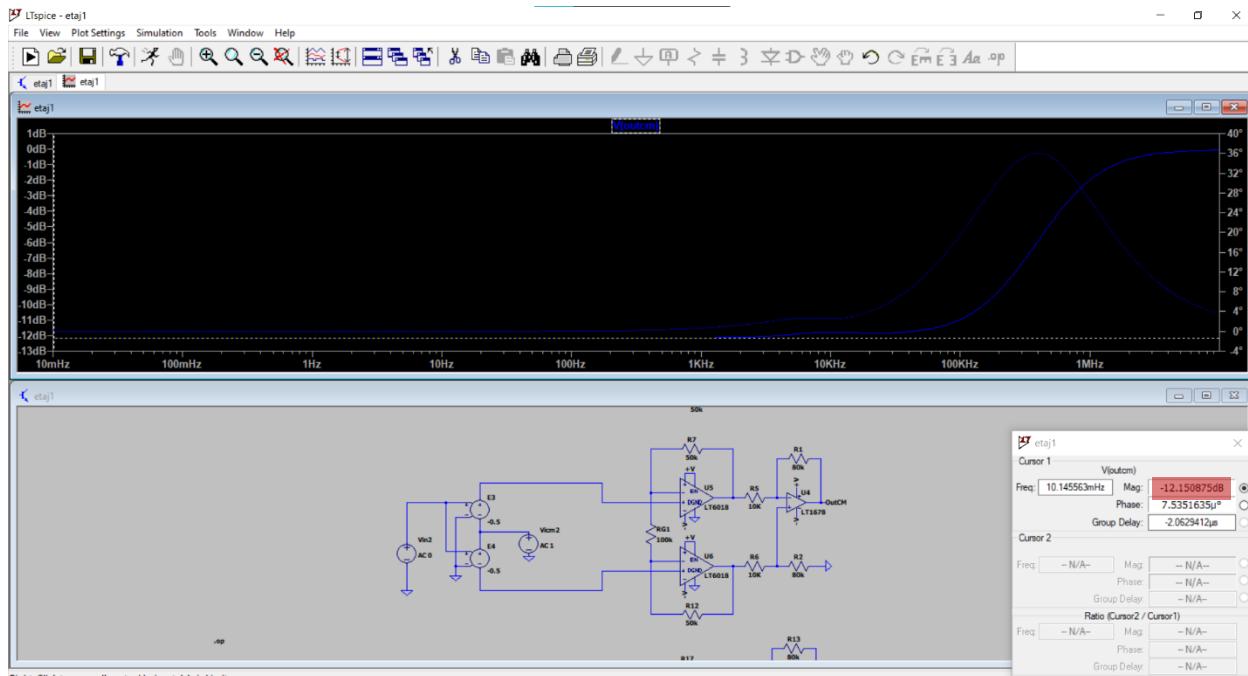
Banda la -3dB



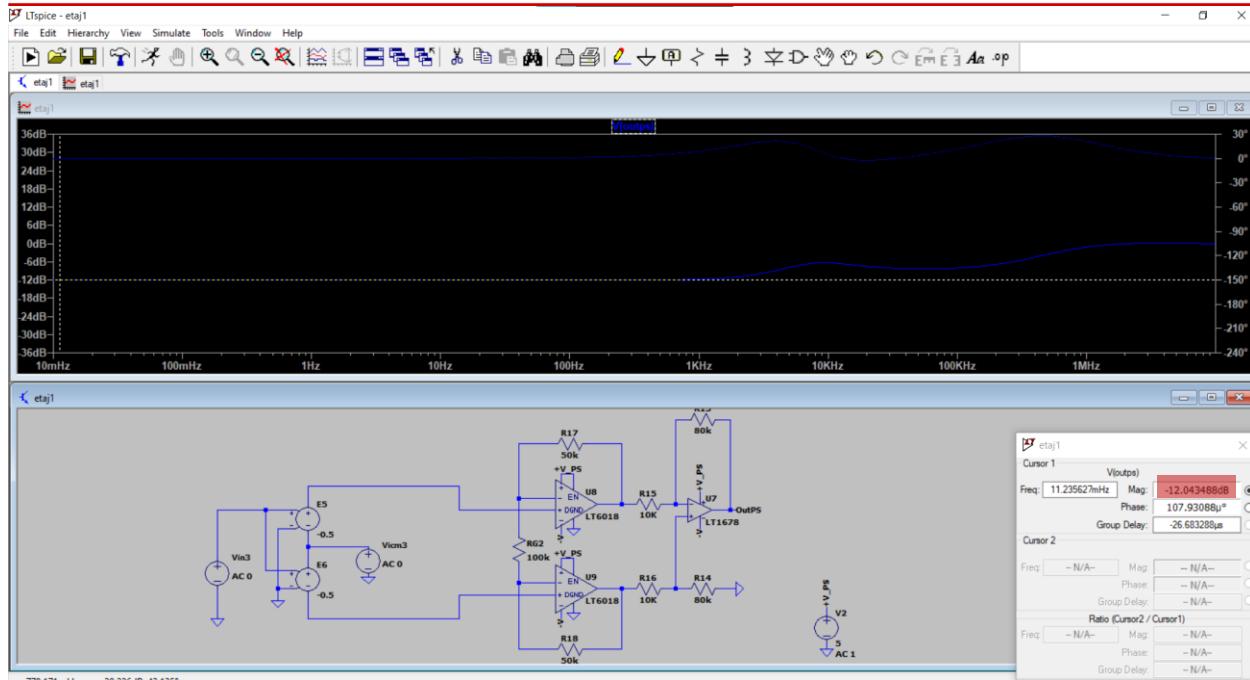
Banda este mai mare decât banda filtrului(5kHz)

Câstigul poate fi modificat prin intermediul rezistenței  $R_G$ .

Câstigul de mod comun – am nevoie de el pentru a calcula  $CMRR = A_D - A_{CM}$

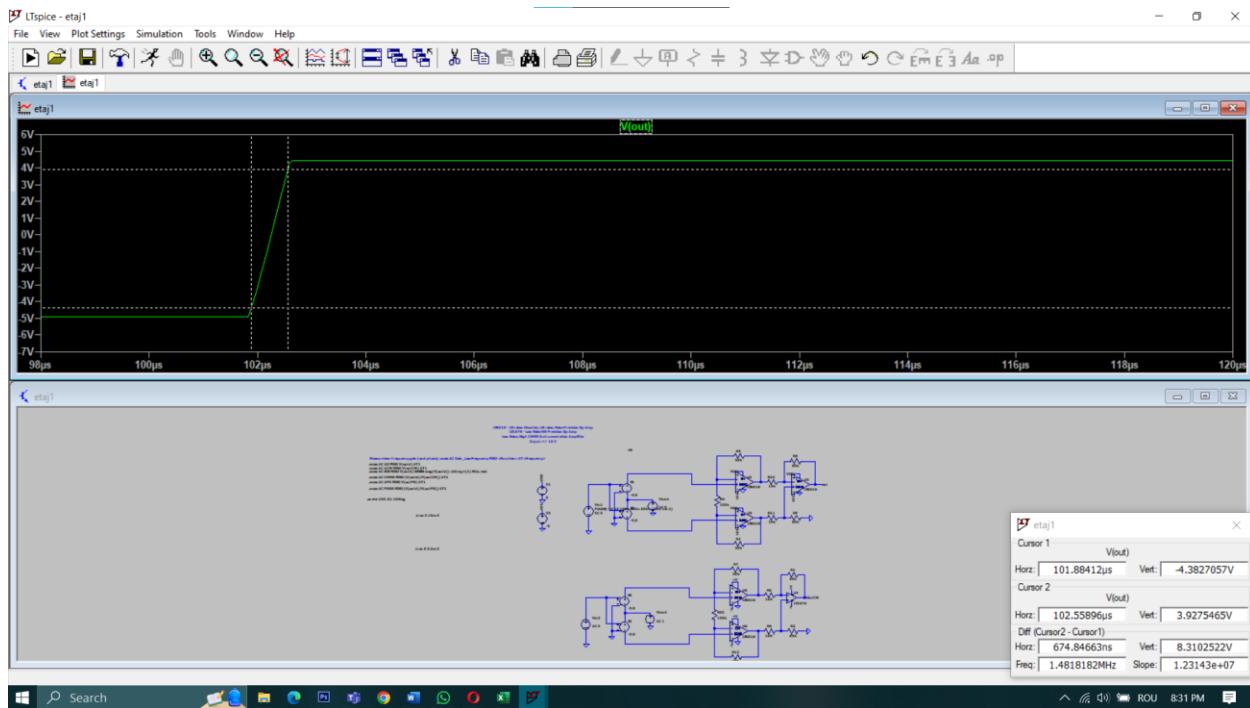


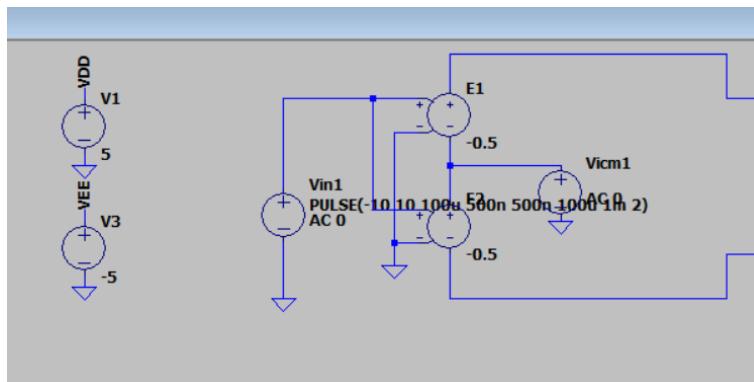
A<sub>PS</sub>



Avem nevoie pe  $A_{PS}$  pentru a calcula  $PSRR = A_D - A_{PS}$

### Slew Rate(SR)



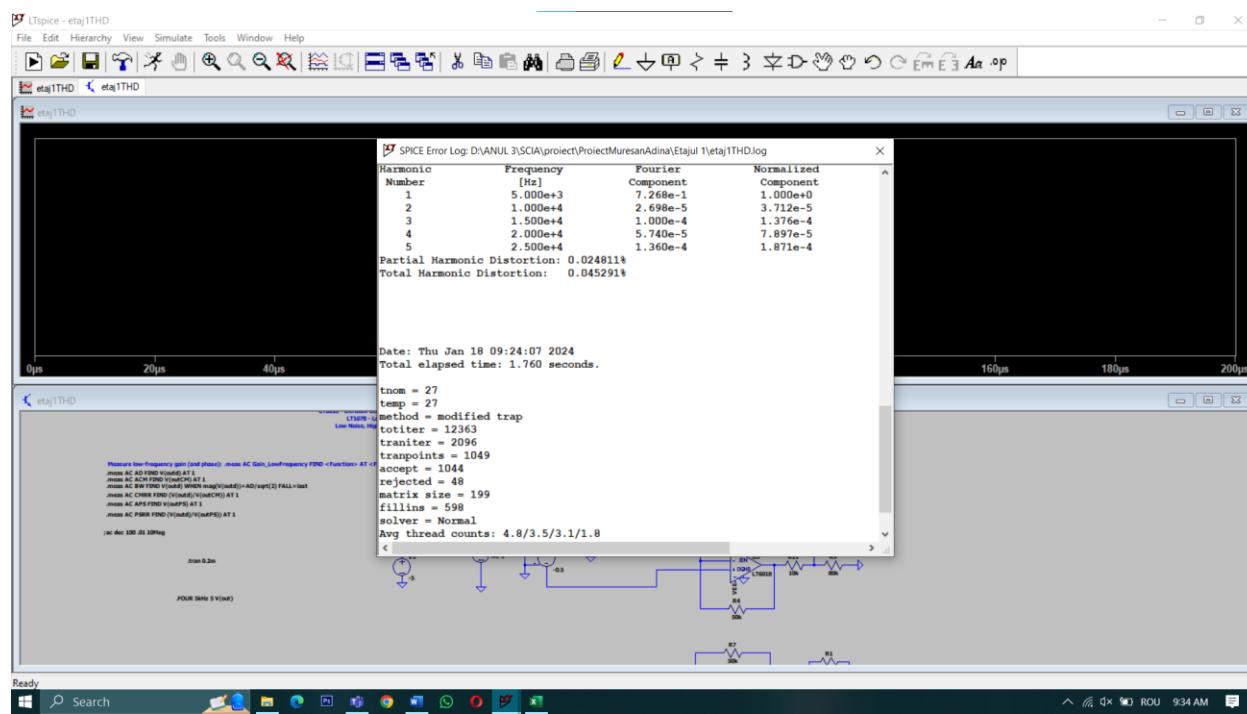


-cu analiza transient și o sursă de tip PULSE la intrarea circuitului

.tran 0 0.3m 0

$SR = 8.31V / 0.675\mu s = 12.311V/\mu s < SR$  din data sheet

## THD



# LT6018

33V, Ultralow Noise, Precision C

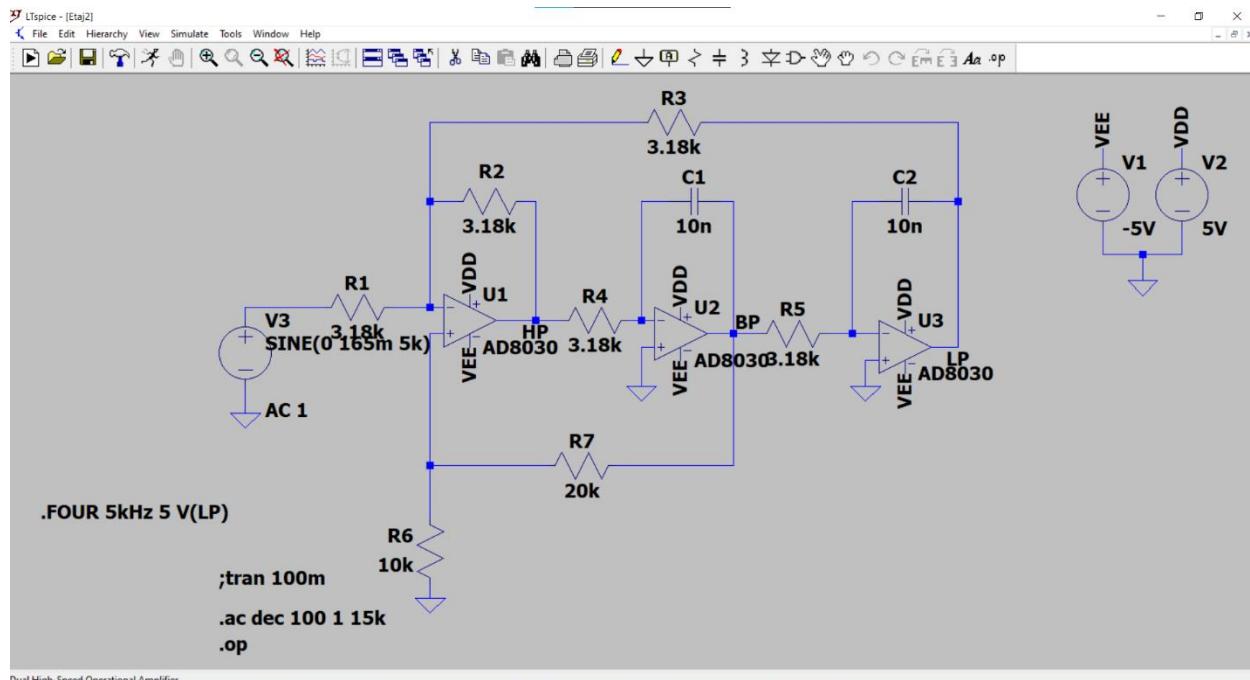
Overview Documentation & Resources Tools & Simulations

## Overview

### Features and Benefits | Product I

- Ultralow Voltage Noise
  - 30nV<sub>P,P</sub> Noise: 0.1Hz to 10Hz
  - 1.2nV/ $\sqrt{\text{Hz}}$  Typical at 1kHz
- Maximum Offset Voltage: 50 $\mu$ V
- Maximum Offset Voltage Drift: 0.5 $\mu$ V/ $^{\circ}$ C
- CMRR: 124dB (Minimum)
- A<sub>VOL</sub>: 132dB (Minimum)
- Slew Rate: 30V/ $\mu$ s
- Gain-Bandwidth Product: 15MHz
- Wide Supply Range: 8V to 33V
- Ultralow THD: -115dB at 1kHz
- Unity Gain Stable
- Low Power Shutdown: 6.2 $\mu$ A
- SOIC-8E and 4mm × 3mm 12-Lead DFN Packages
- 4.5kV HBM and 2kV CDM Tolerant

### 3.2. Etajul 2



Dual High-Speed Operational Amplifier

### Punct Static de Funcționare

```

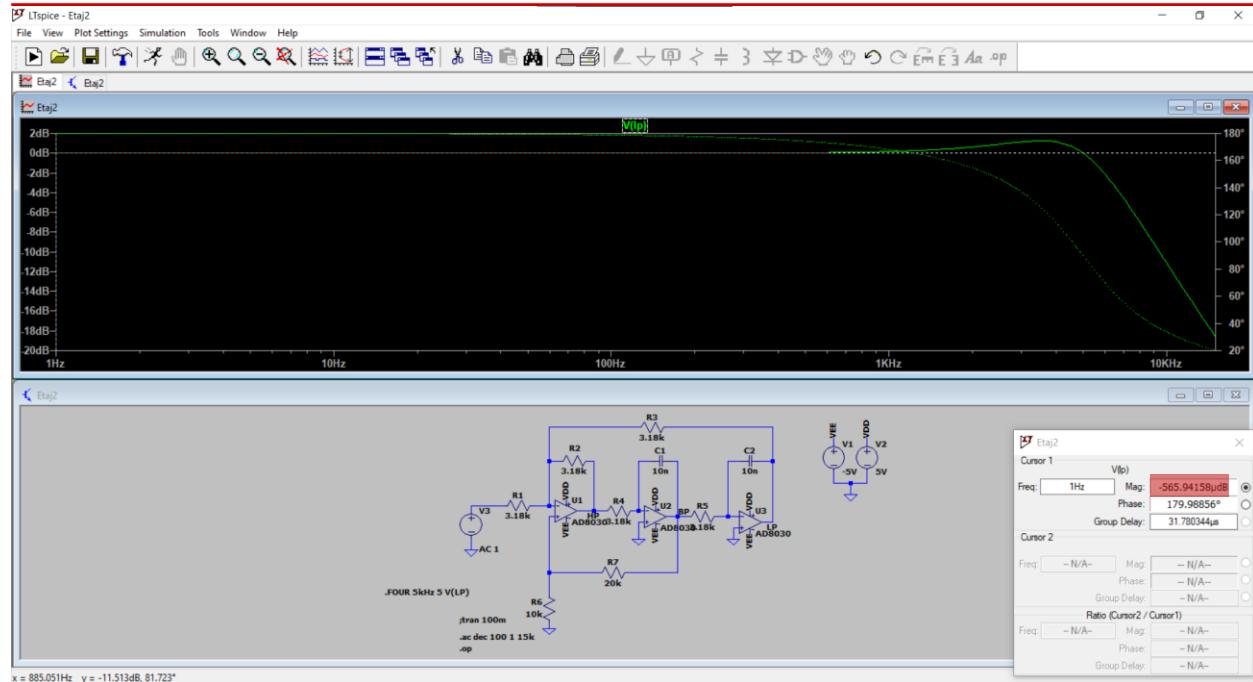
> D:\ANUL 3\SCIA\project\Etaj2\Etaj2.asc
---- Operating Point ---

```

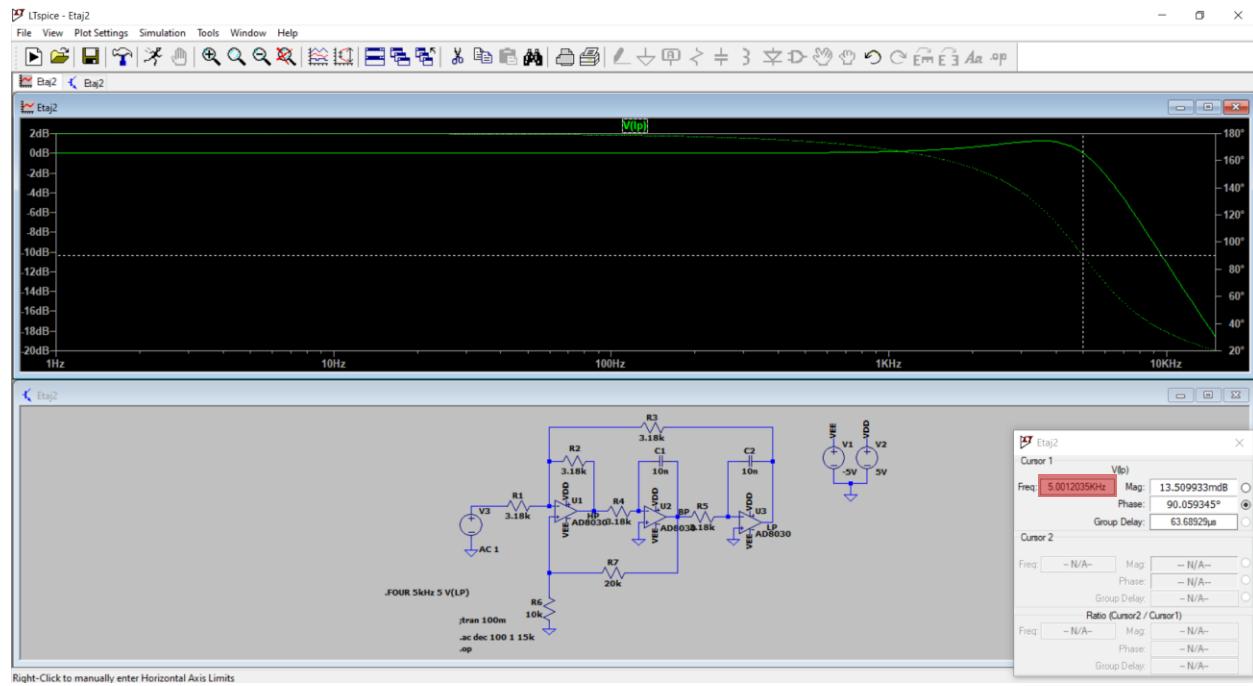
V(n001):	0.0095216	voltage
V(n004):	0	voltage
V(hp):	-0.0054055	voltage
V(lp):	0.0285694	voltage
V(n005):	0.00952033	voltage
V(bp):	-0.00540729	voltage
V(n003):	-1.28318e-06	voltage
V(vdd):	5	voltage
V(vee):	-5	voltage
V(n002):	5.00606e-07	voltage
I(C1):	-5.40779e-23	device_current
I(C2):	2.85706e-22	device_current
I(R1):	2.99421e-06	device_current
I(R2):	-4.69406e-06	device_current
I(R3):	5.98986e-06	device_current
I(R6):	-9.52033e-07	device_current
I(R7):	7.46381e-07	device_current
I(R5):	-1.7e-06	device_current
I(R4):	1.7e-06	device_current
I(V1):	0.00391174	device_current
I(V2):	-0.00391909	device_current
I(V3):	2.99421e-06	device_current
Ix(u1:1):	-1.69841e-06	subckt_current
Ix(u1:2):	-1.69841e-06	subckt_current
Ix(u1:3):	0.00130429	subckt_current
Ix(u1:4):	-0.00130728	subckt_current
Ix(u1:5):	6.39406e-06	subckt_current
Ix(u2:1):	-1.7e-06	subckt_current
Ix(u2:2):	-1.7e-06	subckt_current
Ix(u2:3):	0.00130429	subckt_current
Ix(u2:4):	-0.00130333	subckt_current
Ix(u2:5):	2.44638e-06	subckt_current
Ix(u3:1):	-1.7e-06	subckt_current
Ix(u3:2):	-1.7e-06	subckt_current
Ix(u3:3):	0.00131051	subckt_current
Ix(u3:4):	-0.00130112	subckt_current
Ix(u3:5):	-5.98986e-06	subckt_current

### Câștig în banda de trecere

$H_0 \approx 0 \text{ dB} = 1 \text{ liniar}$

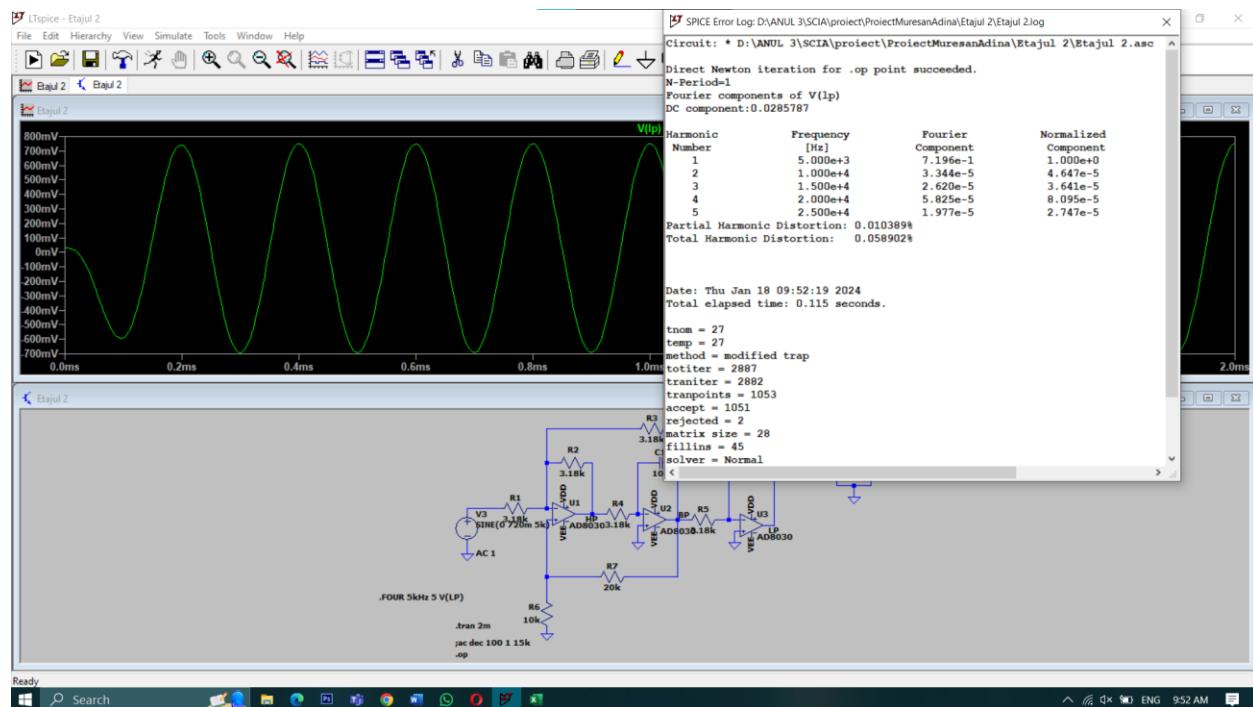


Banda filtrului, măsurată la o fază de 90 de grade



Tot aici se poate observa și factorul de calitate, Q, care este aproximativ 0dB, adică 1 în linear, exact cum este dat în specificații.

## THD <1% prin modificarea amplitudinii semnalului sinusoidal de la intrare



### 3.3. Etajul 3

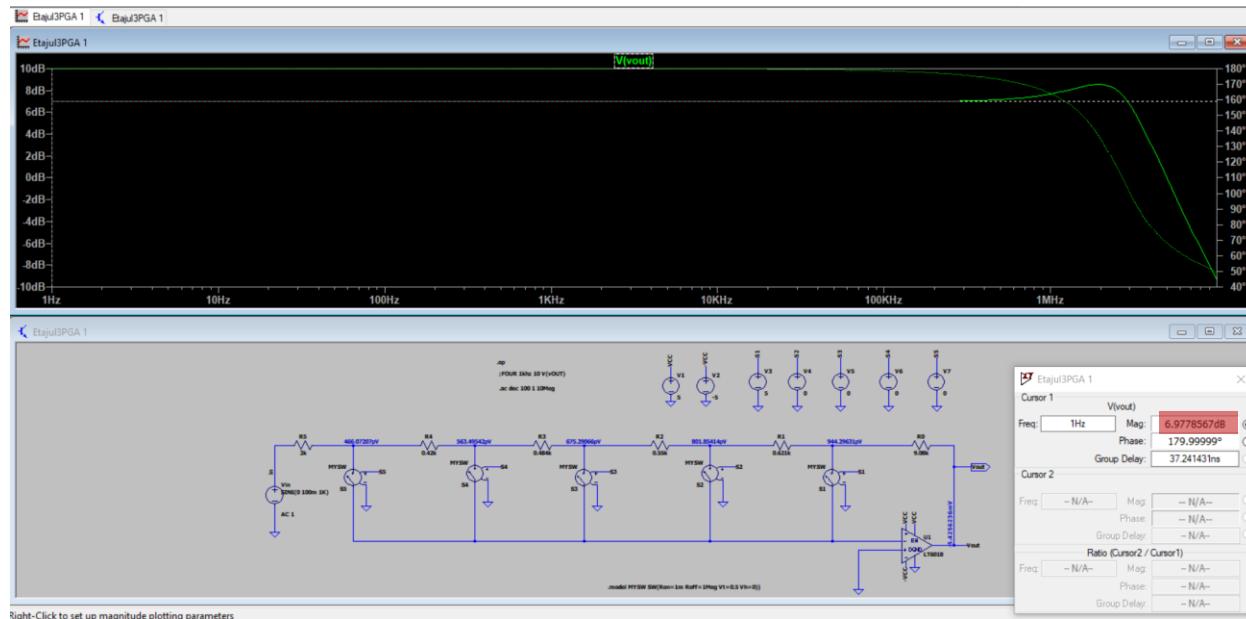
PSF

\* D:\ANUL 3\SCIA\proiect\Etaj3\Etajul3PGA 1.asc

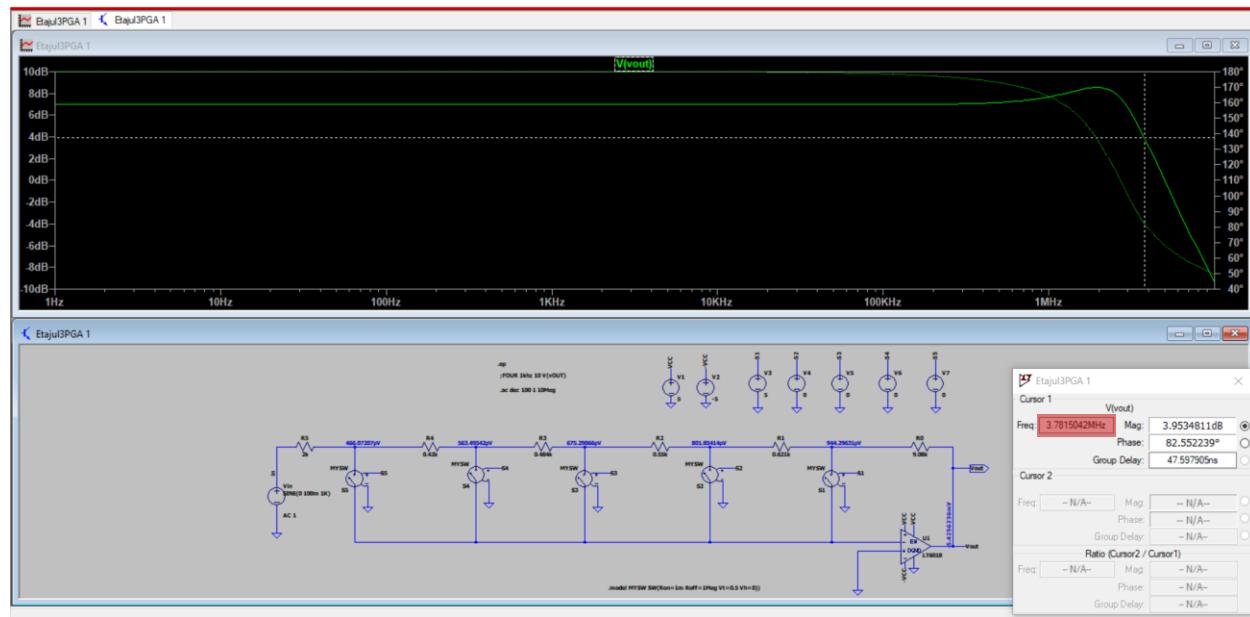
--- Operating Point ---

```
V(vcc) :      5          voltage
V(-vcc) :    -5          voltage
V(vout) :  -0.00666109  voltage
V(n006) :  1.63689e-09  voltage
V(in) :       0          voltage
V(n005) : -0.00123547  voltage
V(n004) : -0.00086517  voltage
V(n003) : -0.000537681 voltage
V(n002) : -0.000249751 voltage
V(n001) : 1.04224e-09  voltage
V(s1) :       0          voltage
V(s2) :       0          voltage
V(s3) :       0          voltage
V(s4) :       0          voltage
V(s5) :       5          voltage
I(R1) : -5.963e-07   device_current
I(R2) : -5.95435e-07 device_current
I(R3) : -5.94897e-07 device_current
I(R4) : -5.94647e-07 device_current
I(R5) : 5.21121e-13  device_current
I(R0) : -5.97535e-07 device_current
I(S2) : -8.65173e-10 device_current
I(S3) : -5.37683e-10 device_current
I(S4) : -2.49753e-10 device_current
I(S5) : -5.94648e-07 device_current
I(S1) : -1.23548e-09 device_current
I(V1) : -0.0103284 device_current
I(V2) : 0.0103271 device_current
I(Vin) : 5.21121e-13 device_current
I(V3) : 0          device_current
I(V4) : 0          device_current
I(V5) : 0          device_current
I(V6) : 0          device_current
I(V7) : 0          device_current
Ix(u1:1) : -5.97763e-07 subckt_current
Ix(u1:2) : -5.97536e-07 subckt_current
Ix(u1:3) : 0.0103284 subckt_current
Ix(u1:4) : -0.0103271 subckt_current
Ix(u1:5) : 5.97535e-07 subckt_current
Ix(u1:6) : 4.16677e-10 subckt_current
Ix(u1:7) : -7.01e-07 subckt_current
```

Treapta 1, SW<sub>1</sub>=ON, restul OFF

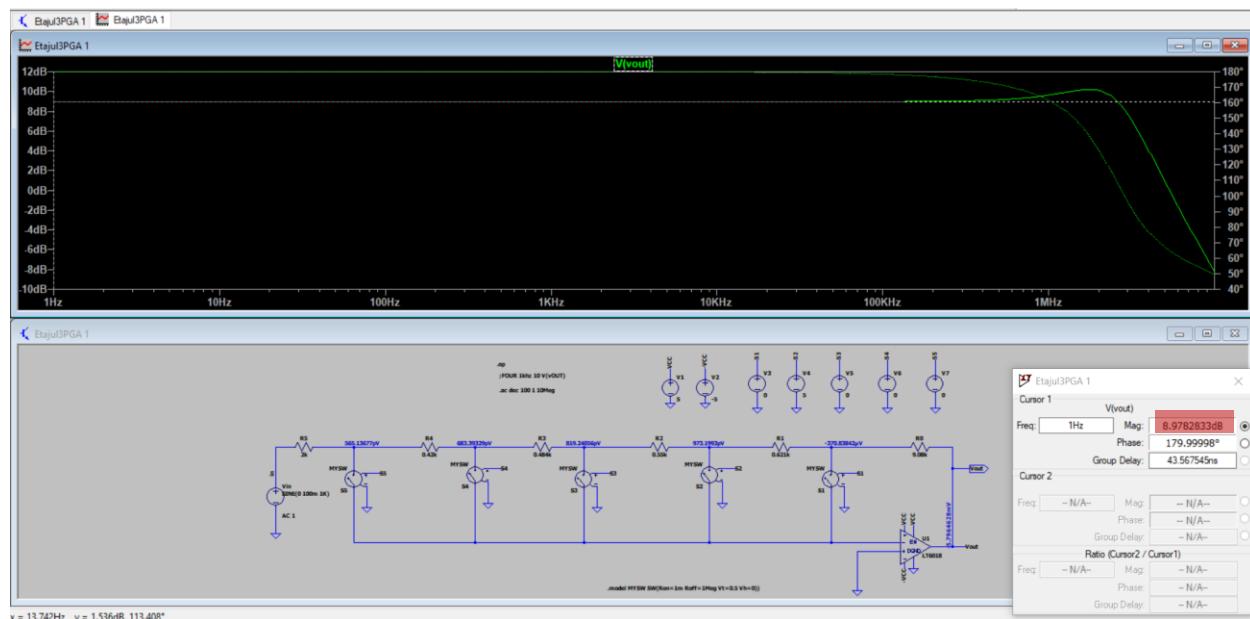


$$A_{v1}=6.97 \text{ dB}$$



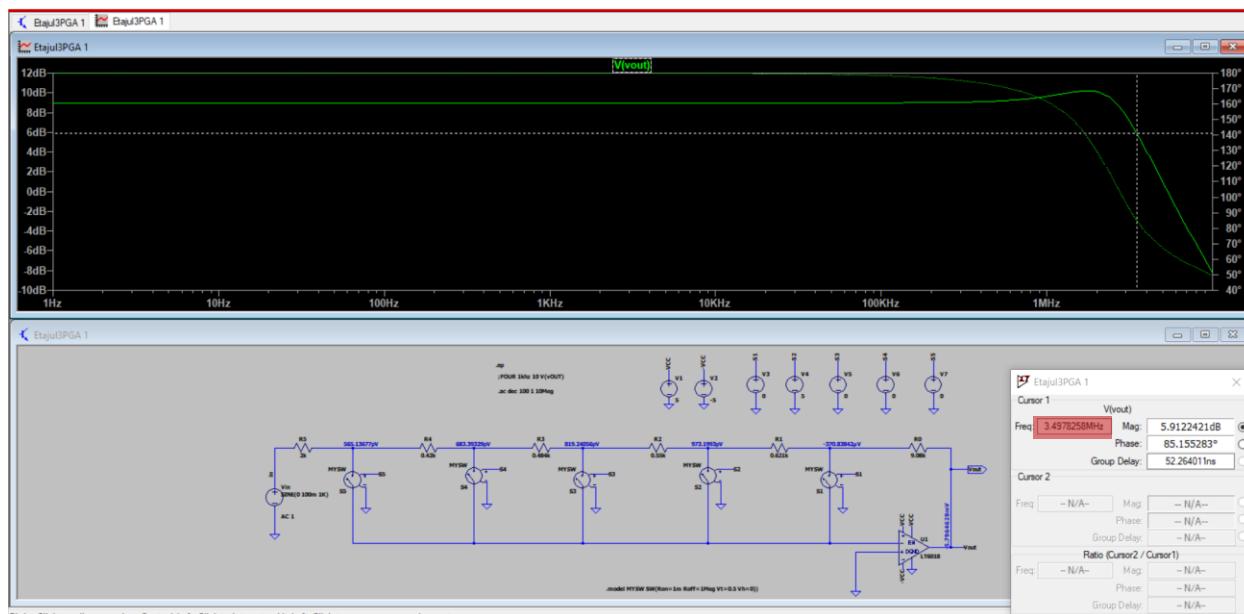
$BW_1 = 3.78 \text{ MHz} > 5 \text{ kHz}$  (banda filtrului)

Treapta 2, SW<sub>2</sub>=ON, restul OFF

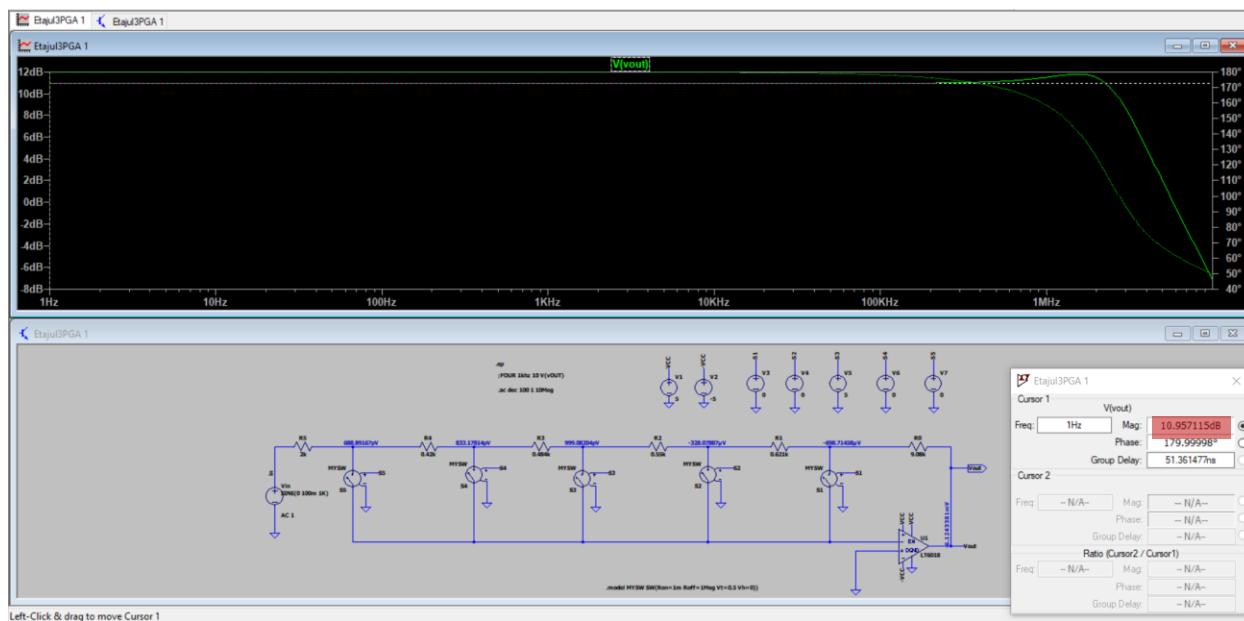


A<sub>v2</sub>=8.97dB

$\text{BW}_2 = 3.43 \text{ MHz} > 5 \text{ kHz}$  (banda filtrului)

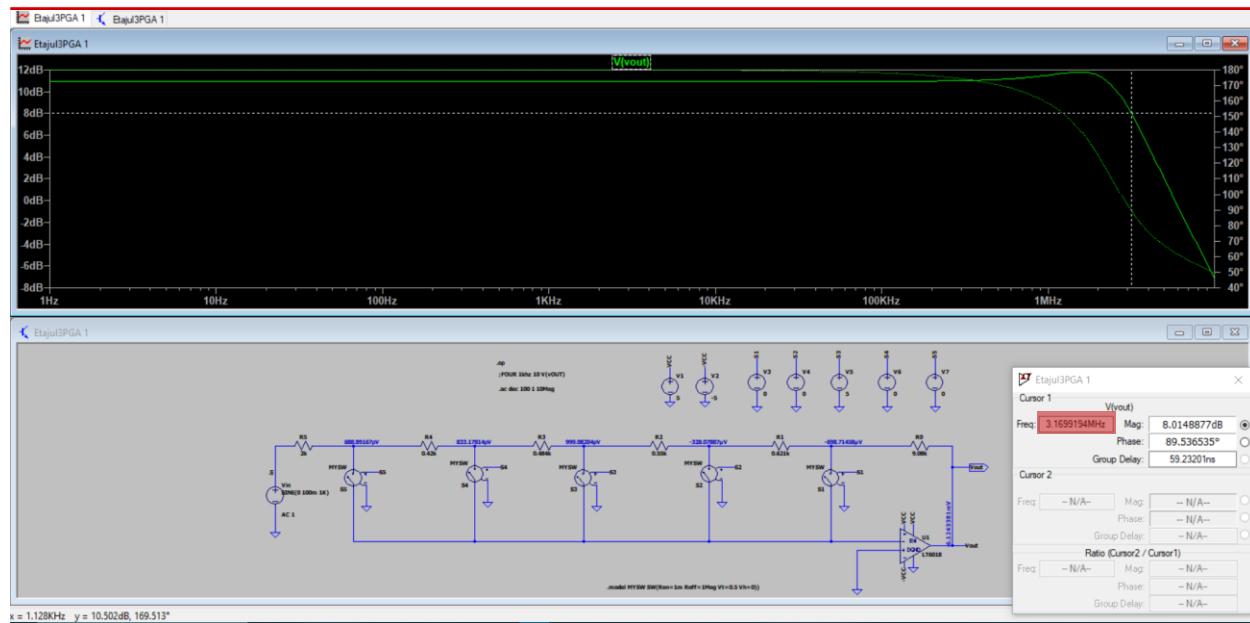


Treapta 3,  $SW_3=ON$ , restul OFF

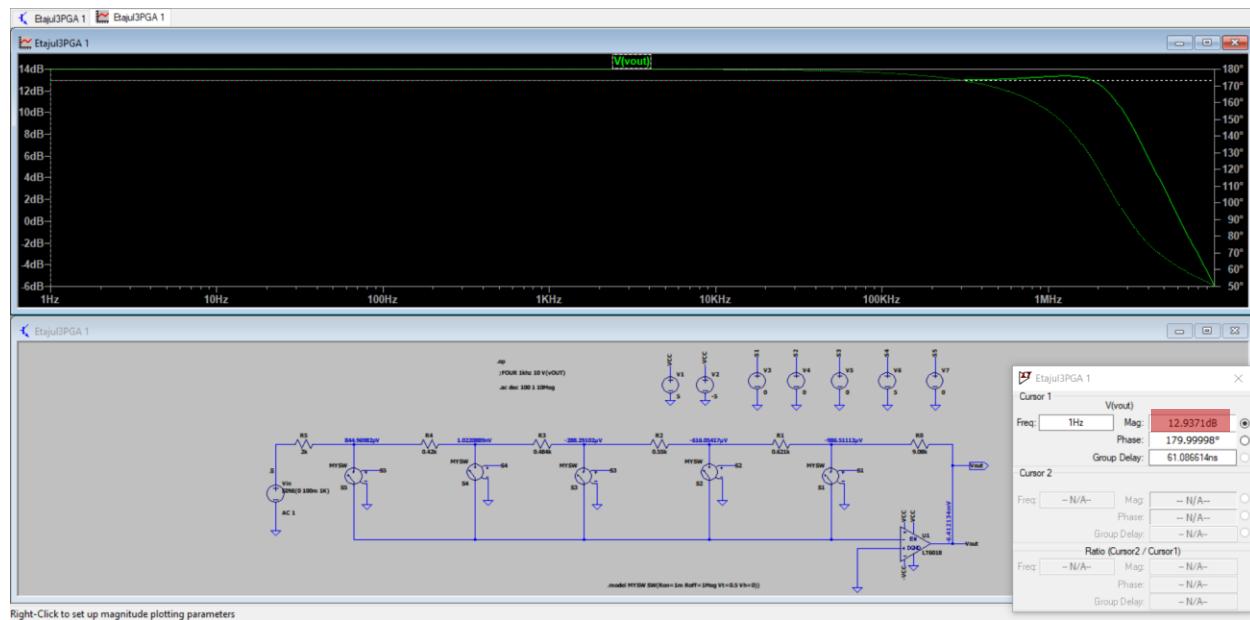


$$A_{v3}=10.95\text{dB}$$

$$BW_3=3.17\text{MHz}$$

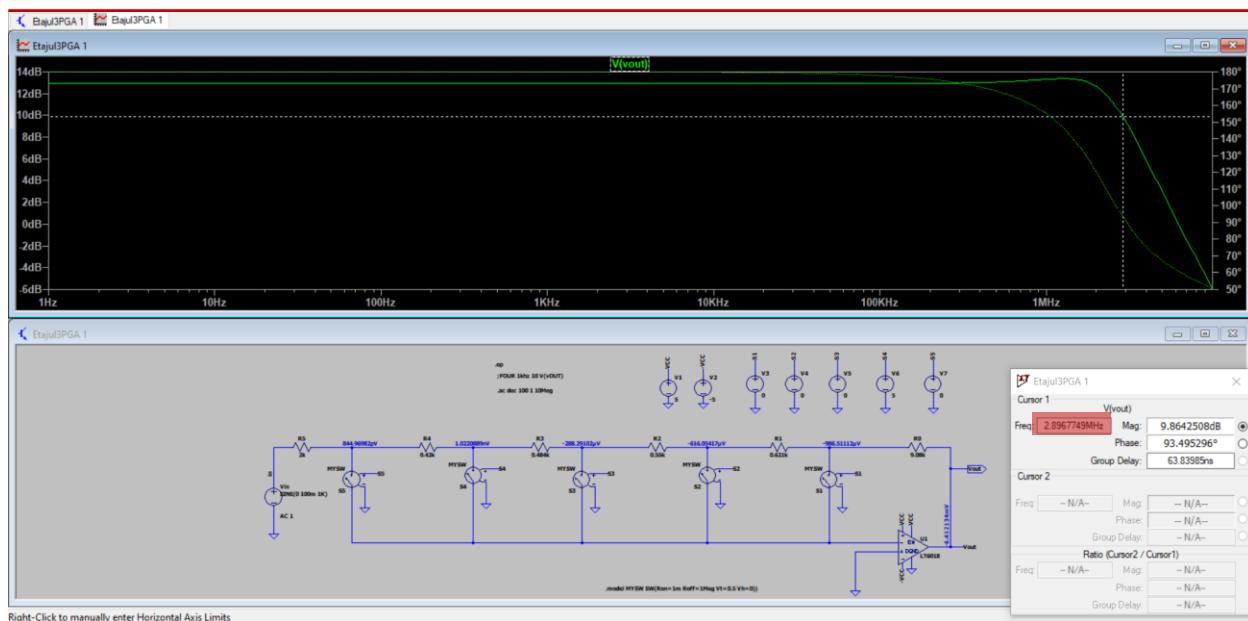


Treapta 4, SW<sub>4</sub>=ON, restul OFF

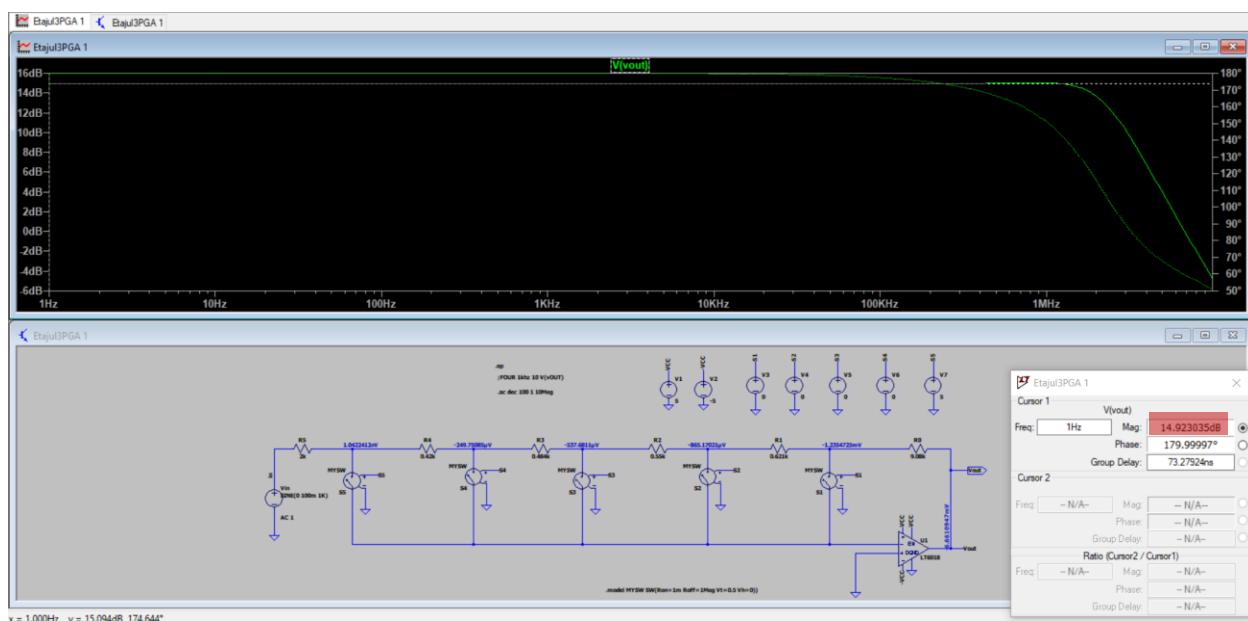


$$A_{v4} = 12.93 \text{ dB}$$

$$BW_4 = 2.89 \text{ MHz}$$

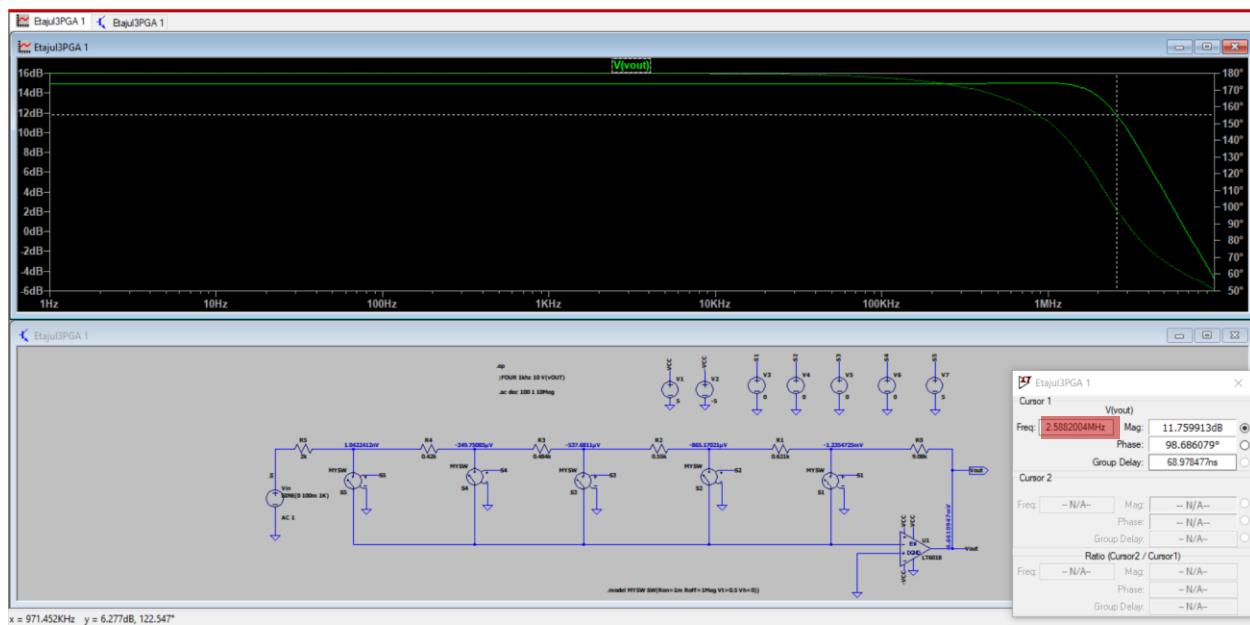


Treapta 5,  $SW_5=ON$ , restul OFF



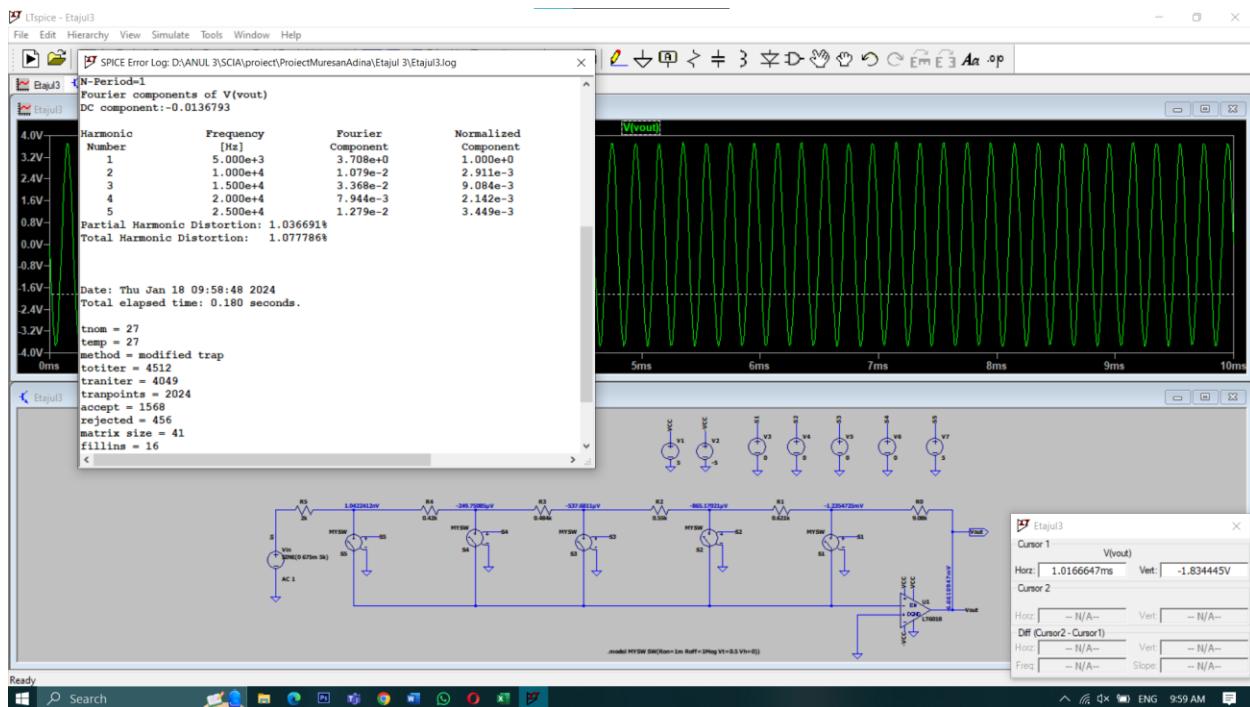
$A_{v5}=14.92\text{dB}$

$\text{BW}_5=2.58\text{MHz}$

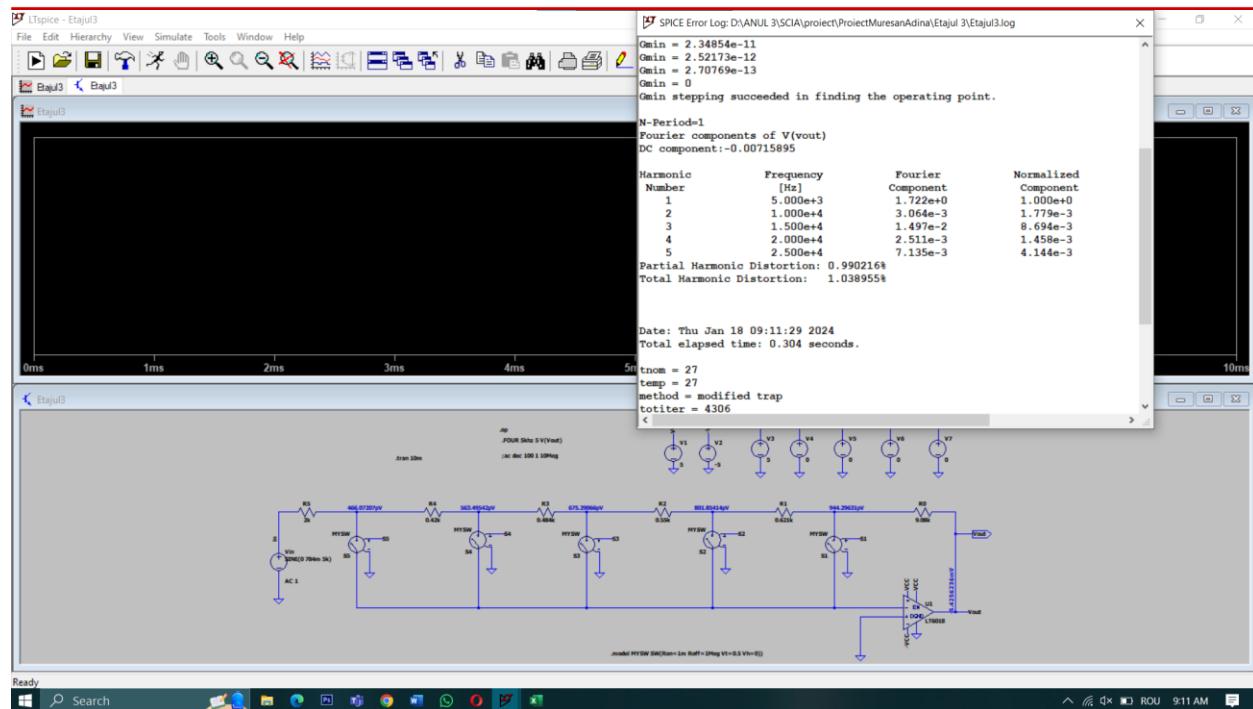


## THD

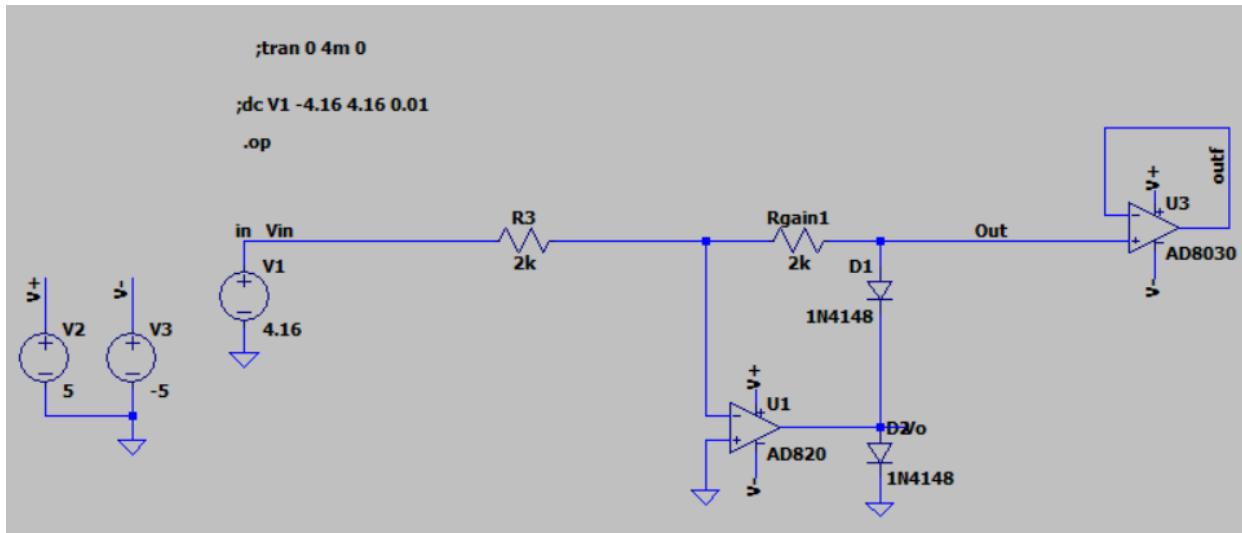
SW5 activ - Amplitudine maxima: 15x0.045



SW1 activ - Amplitudine minima: 7x0.112



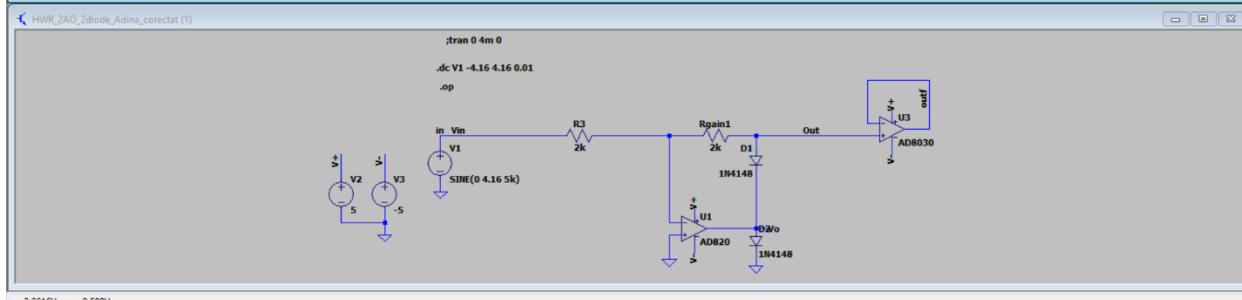
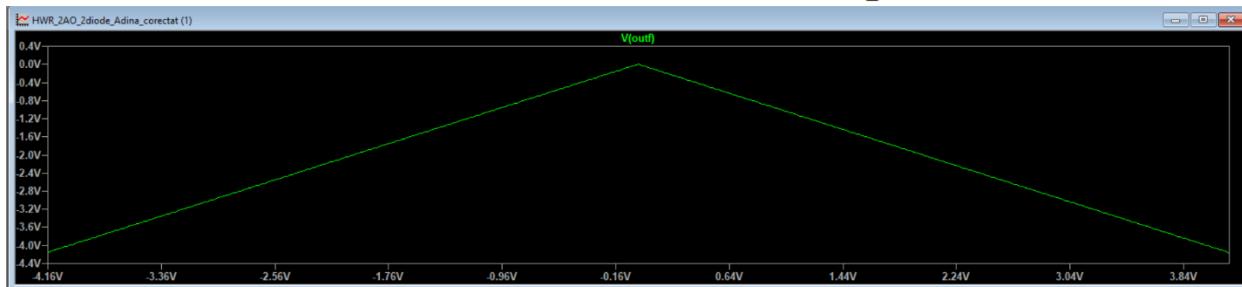
### 3.4. Etajul 4



--- Operating Point ---

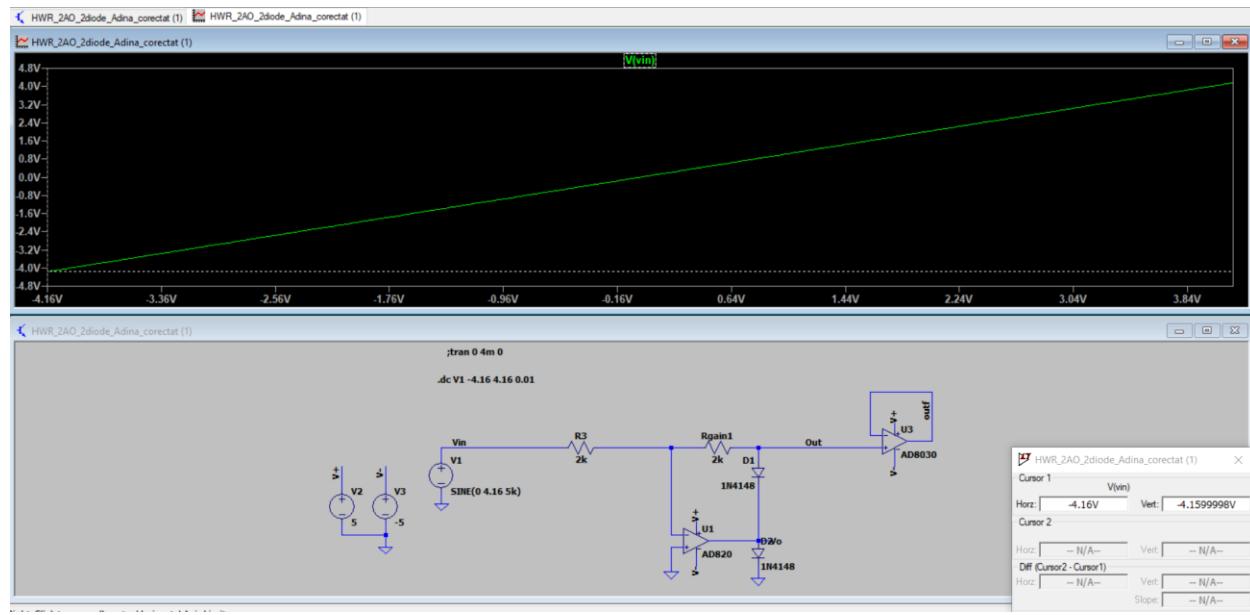
PSF

V(in) :	4.16	voltage
V(v+) :	5	voltage
V(v-) :	-5	voltage
V(n001) :	1.31189e-05	voltage
V(out) :	-4.15997	voltage
V(vo) :	-4.77857	voltage
V(outf) :	-4.15996	voltage
I(D1) :	0.00208239	device_current
I(D2) :	-2.52478e-09	device_current
I(R3) :	-0.00207999	device_current
I(Rgain1) :	-0.00207999	device_current
I(V1) :	-0.00207999	device_current
I(V2) :	-0.00170586	device_current
I(V3) :	0.00378586	device_current
Ix(u3:1) :	-2.39333e-06	subckt_current
Ix(u3:2) :	-2.39333e-06	subckt_current
Ix(u3:3) :	0.00134653	subckt_current
Ix(u3:4) :	-0.00134413	subckt_current
Ix(u3:5) :	2.39333e-06	subckt_current
Ix(u1:1) :	-1.91833e-12	subckt_current
Ix(u1:2) :	-1.91833e-12	subckt_current
Ix(u1:3) :	0.000359333	subckt_current
Ix(u1:4) :	-0.00244172	subckt_current
Ix(u1:5) :	0.00208239	subckt_current

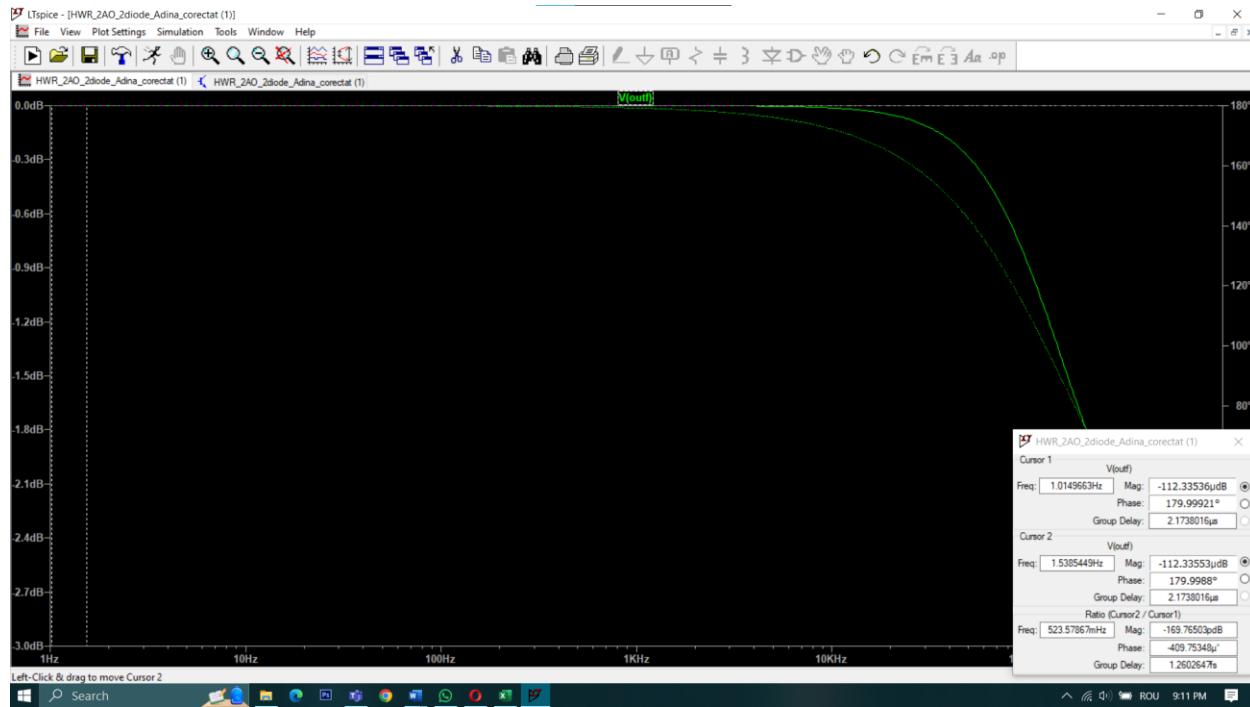


x = 3.2616V v = 0.580V

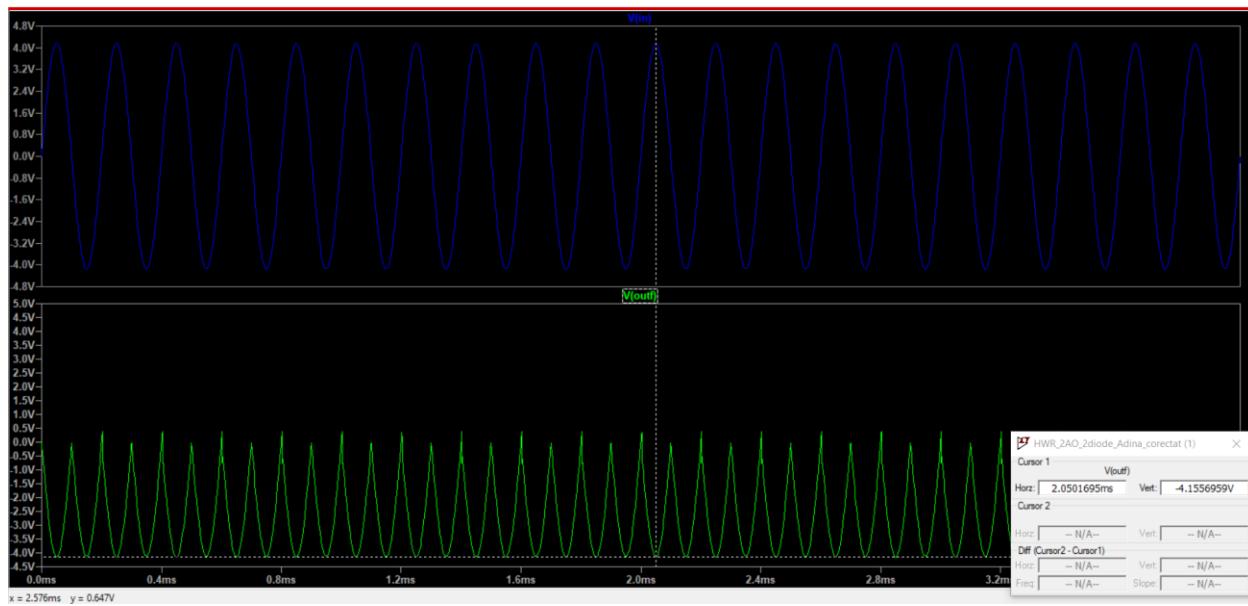
### Domeniul tensiunii de intrare



Căștig – analiză AC cu o sursă AC cu amplitudinea 1

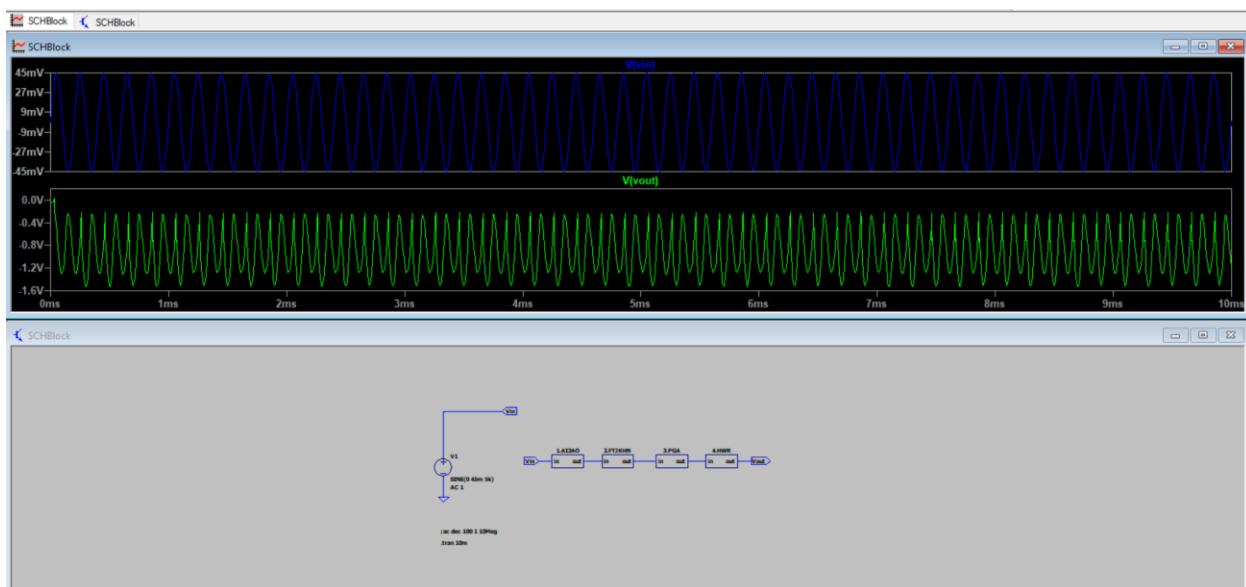
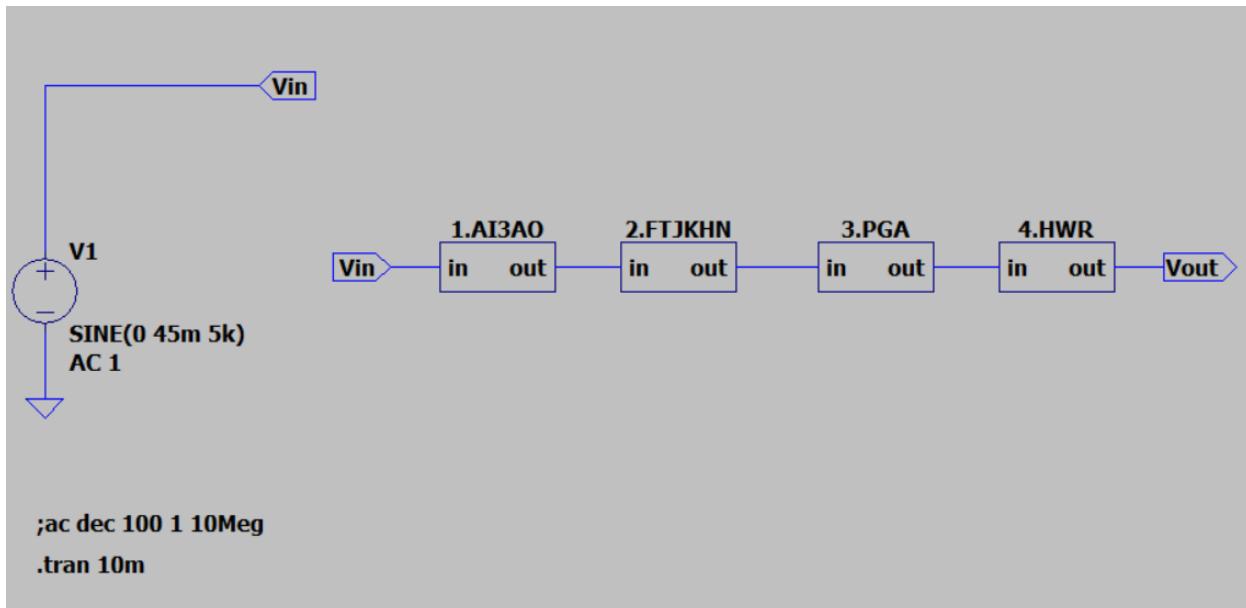


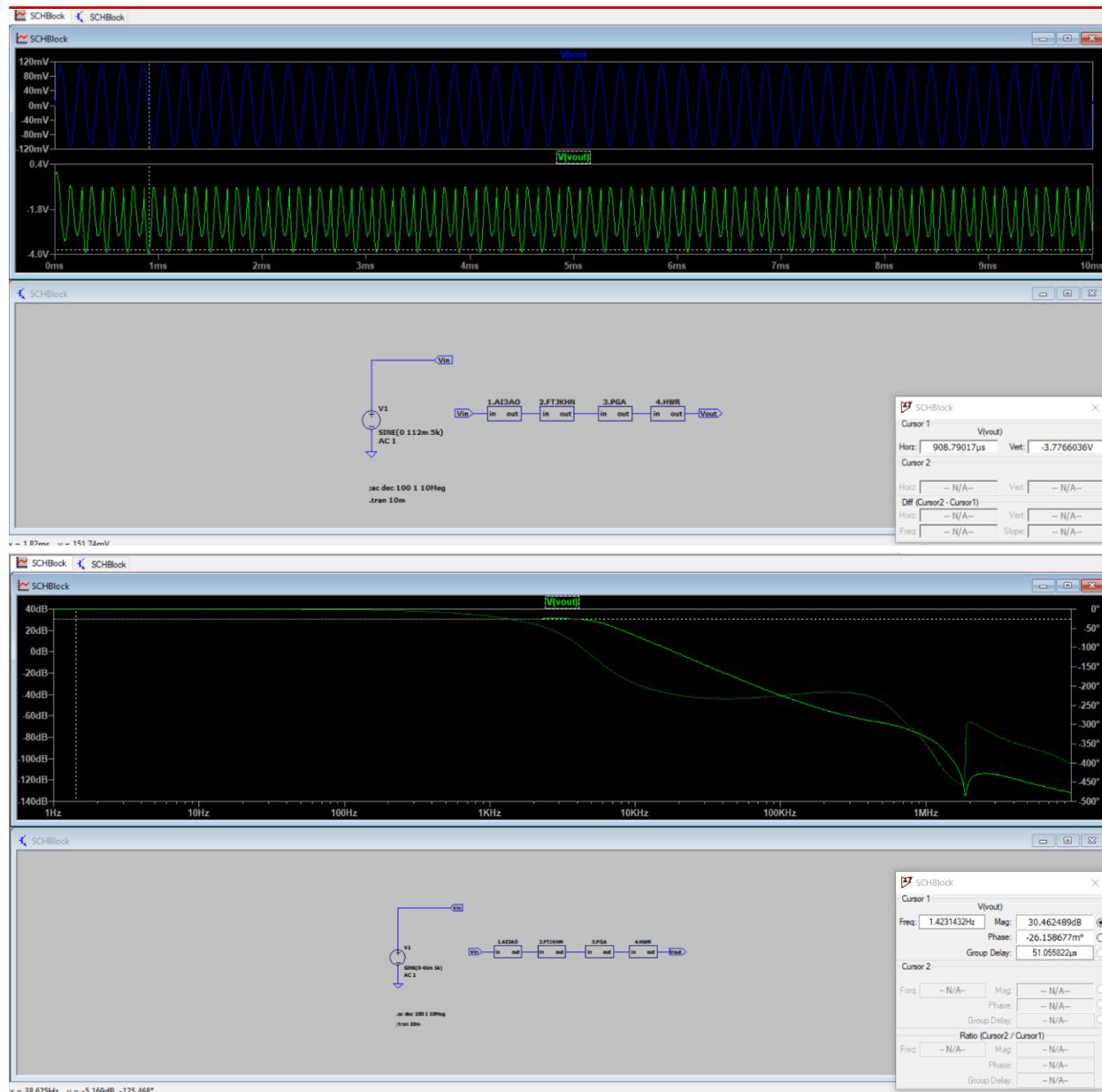
Implementare functie de circuit, circuitul este un redresor dublu-alternantă

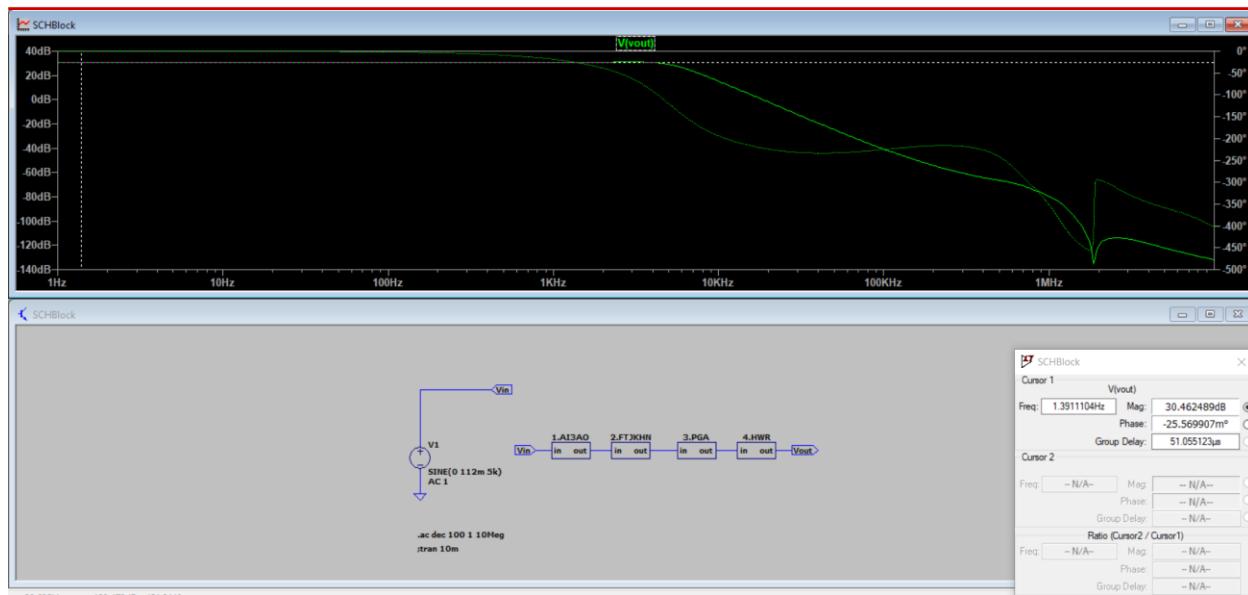


## 4. Verificarea si caracterizarea interfetei analogice

Schema bloc







## 5. Concluzii

### 5.1. Etajul 1

CMRR_AO [dB]	GBW_AO [Hz]	R1	R2	R3	Rg
133	1.50E+07	5.00E+04	1.00E+04	8.00E+04	1.00E+05
CMRR_AO linear					
4466835.922					
<b>Estimari Teoretice ( Calculate)</b>					
AD liniar	AD dB	CMRR [dB]	Banda la - 3dB [Hz]		
1.60E+01	2.41E+01	1.39E+02	1.63E+06		
<b>Masuratori</b>					
AD low freq[dB]	AC low freq[dB]	CMRR [dB]	APS [dB]	PSRR [dB]	Banda la - 3dB
24.16	-12.15	36.31	-12.04	36.2	1.32E+06
<b>Diferente intre estimari si masuratori [%]</b>					
AD dB	CMRR [dB]	Banda la - 3dB			
-3.22E-01	7.39E+01	1.89E+01			

## 5.2. Etajul 2

GBW AO	R1	R2	R3	R4	R5	R6	R7	C1	C2
1.25E+08	3.18E+03	3.18E+03	3.18E+03	3.18E+03	3.18E+03	1.00E+04	2.00E+04	1.00E-08	1.00E-08
Valori estimate/calculate									
f0[Hz]	H0 linear	H0[dB]	Q						
5.00E+03	1	0	1.00E+00						
Valori masurate					Erori				
H0[dB]	BW[Hz]	ainPeak[dB]			H0[dB]	BW[%]			
-5.65E-04	5.01E+03	1.30E-02			5.65E-04	1.42E-01			

### 5.3. Etajul 3

GBW AO	R0	R1	R2	R3	R4	R5		
1.50E+07	9.03E+03	6.21E+02	5.50E+02	4.84E+02	4.20E+02	2.00E+03		
S1[V]	S2[V]	S3[V]	S4[V]	S5[V]	Av  [dB]	Av  linear	Rin[ohmi]	BW[Hz]
5	0	0	0	0	7.00E+00	2.24E+00	4.08E+03	4.63E+06
0	5	0	0	0	9.00E+00	2.82E+00	3.45E+03	3.93E+06
0	0	5	0	0	1.10E+01	3.55E+00	2.90E+03	3.30E+06
0	0	0	5	0	1.30E+01	4.47E+00	2.42E+03	2.74E+06
0	0	0	0	0	1.50E+01	5.62E+00	2.00E+03	2.26E+06
Valori estimate/calculete								
Valori masurate			Erori					
Av[dB]	BW[Hz]		Av[dB]	BW[%]				
6.97E+00	3.78E+06		3.00E-02	-1.84E+01				
8.97E+00	3.43E+06		3.00E-02	-1.27E+01				
1.10E+01	3.17E+06		5.00E-02	-3.88E+00				
1.29E+01	2.89E+06		7.00E-02	5.33E+00				
1.49E+01	2.58E+06		8.00E-02	1.39E+01				

#### 5.4 Etajul 4

R1[ohmi]	R2[ohmi]	Av[dB]	Av[linear]						
2.00E+03	2.00E+03	0	1.00E+00						
Valori masurate									
Av[dB]	Vomin[V]	Vomax[V]	Vinmin[V]	Vinmax[V]					
0	-4.13	-7.60E-01	-4.159	4.159					