PROIECT SCIA

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SPECIFICATII

Etaj 1						Etaj 2				
Sursa semnal	amplitudine minima (pt castig maxim PGA)	amplitudine maxima (pt castig minim PGA)	unitate masura	Tip Etaj 1	|Castig| etaj 1 (liniar)	tip Etaj 2	|H0| castig liniar in banda de trecere	Rintrare minim	Banda	Q
4	8.42E-06	6.68E-05	A (differential)	6	10000	7	depinde de Q	2.00E+03	3.00E+03	1.73
2	6.00E-02	1.51E-01	V (differential)	5	10	10	1	2.00E+03	1.00E+04	1.41
1	2.26E-02	5.69E-02	V (single ended)	1	7	8	depinde de Q	2.00E+03	7.00E+03	1.41
1	1.77E-01	4.46E-01	V (single ended)	1	10	10	1	2.00E+03	1.00E+04	1.73
2	2.81E-02	7.05E-02	V (differential)	4	10	10	1	2.00E+03	9.00E+03	1.41
4	2.81E-05	7.05E-05	A (differential)	6	10000	3	1	2.00E+03	1.00E+04	1
2	5.61E-02	1.41E-01	V (differential)	5	10	1	1	2.00E+03	1.00E+04	1.41
1	1.02E-01	2.55E-01	V (single ended)	1	7	1	1	2.00E+03	7.00E+03	1.41
2	1.20E-01	4.77E-01	V (differential)	10	10	9	1	2.00E+03	5.00E+03	1.73
1	6.25E-03	4.96E-02	V (single ended)	1	20	7	depinde de Q	2.00E+03	2.00E+03	1.73

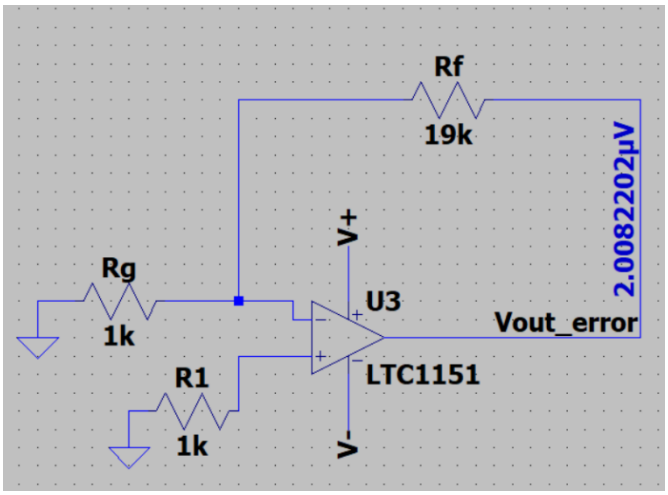
Etaj 3						Etaj 4		AO
tip Etaj 3	castig minim [dB]	rezolutie (pas minim) [dB]	nr pasi	castig maxim [dB]	Rintrare minim	tip Etaj 4	|Castig| etaj 4 (liniar)	Tip AO
2	1	6	4	19	2.00E+03	10	2	7
4	12	2	5	20		14	1	14
1	8	2	5	16	4.00E+03	7	1	10
1	1	2	5	9.00E+00	2.00E+03	8	1	8
4	11	2	5	19		6	2	7
1	11	2	5	19	4.00E+03	2	2	15
5	11	2	5	19		7	1	6
2	7	2	5	15	4.00E+03	2	1	15
3	2	3	5	14	2.00E+03	9	1	2
2	2	6	4	20	2.00E+03	18	1	15

OP-AMP LTC1151 - from Datasheet : GBW = 1.5 MHz;

SwAIC2122

DIMENSIONARE

ETAJ 1:



Amp(min) = 0.00625 V = 6.25mV;

Amp(max) = 0.0496455146702676 = 49.64mV;

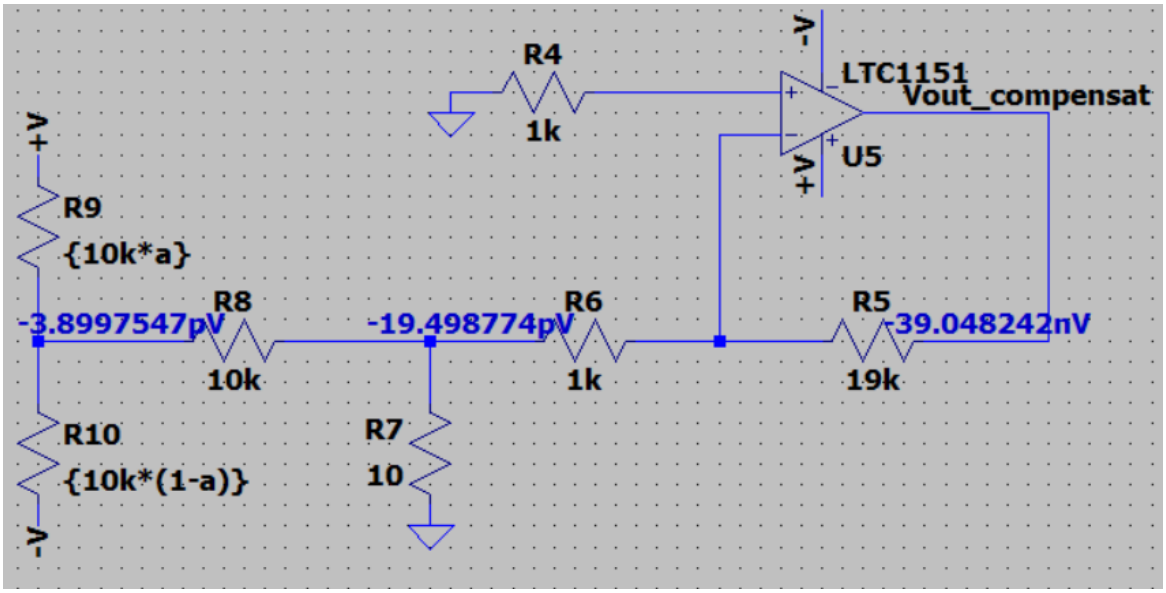
Av = 1+ Rf/Rg = 20; => Rf = 19k si Rg = 1k;

Vout(ideal) = Amp(max);

Cu sursele pasivizate, obtin o tensiune la iesire de

2.00822 uV, inseamna ca avem nevoie sa o compensam cu -2.00822 uV;

Pentru a minimiza eroarea, adaugam o sursa de compensare cu divizor rezistiv la borna inversoare:



Vcomp. = (Vcc/R9 – Vcc/R10) / (1/R9 + 1/R10) ;
Vrc = Vcomp. * R7/(R7+R8) ;

Vrc trebuie sa aiba valoarea 2.00822 uV ;

Vrc = Vcomp. * 10/(10 + 10000) ;

Vrc = 150/10010 * (R9 – R10)/(R9 + R10) ;

$2.00822*10^{-6}$ V / (150/10010) = $1.3406*10^{-4}$;

R9 * (1 + 1.3406*10^{-4}) = R10 * (1 - 1.3406*10^{-4}) ;

R9 * 1.00013406 = R10 * 0.99986594 ;

R9/R10 = 0.99973 ;

R9 = Rp*K ;

R10 = Rp*(1-K) ;

K/(1 – K) = 0.99973 ;

K = 0.99973 – 0.99973 * K ;

K *(1 + 0.99973) = 0.99973 ;

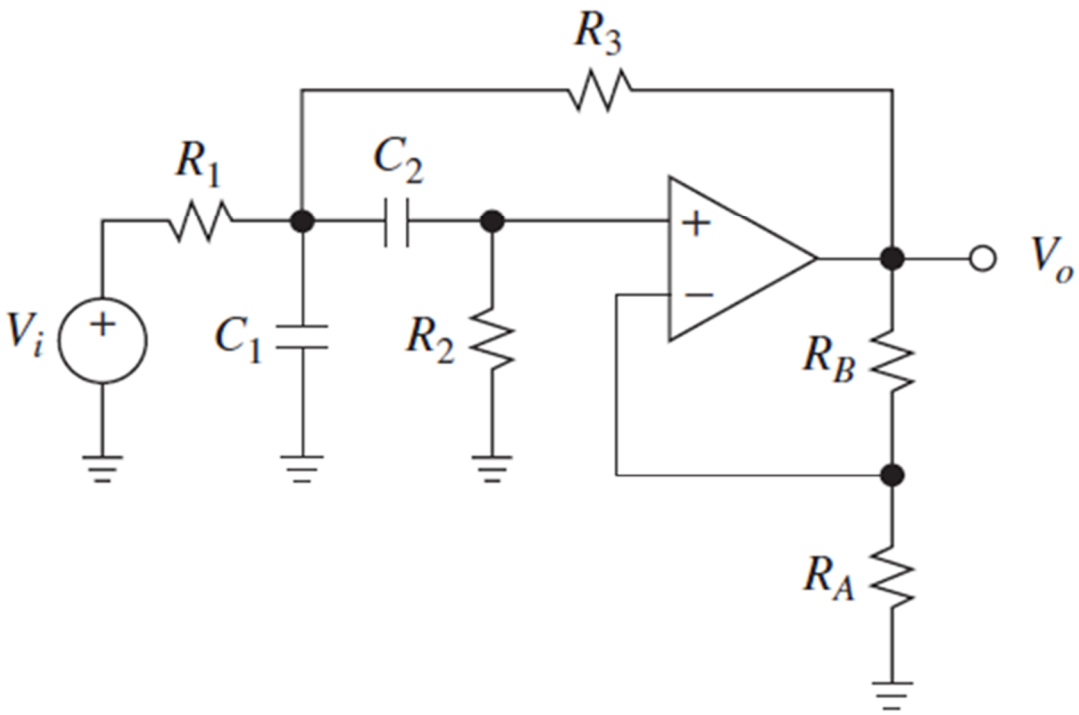
K * 1.99973 = 0.99973 ;

K = 0.49993249 ;

K = 49.99% ;

ETAJ 2:

Bicuad Sallen-Key trece banda :



BW(0dB) = 2 kHz; Rin = 2 kHz; Q = 1.73;

We again note that one can vary R_1 to tune ω_0 and R_B to adjust Q.
If $Q > \sqrt{2}/3$, a convenient choice is $R_1 = R_2 = R_3 = R$ and $C_1 = C_2 = C$, in which case the above expressions reduce to

$$H_{0BP} = \frac{K}{4-K} \qquad \omega_0 = \frac{\sqrt{2}}{RC} \qquad Q = \frac{\sqrt{2}}{4-K}$$

The corresponding design equations are

$$RC = \sqrt{2}/\omega_0 \qquad K = 4 - \sqrt{2}/Q \qquad R_B = (K-1)R_A$$

Q = 1.73; Q > $\sqrt{2}$/3 =>

1.73 = $\sqrt{2}$/(4-K) ;

4-K = 0.81;

K = 3.18;

Aleg Ra = 2k , Rb = (3.18 -1) * 2k , Rb = 4.36 k;

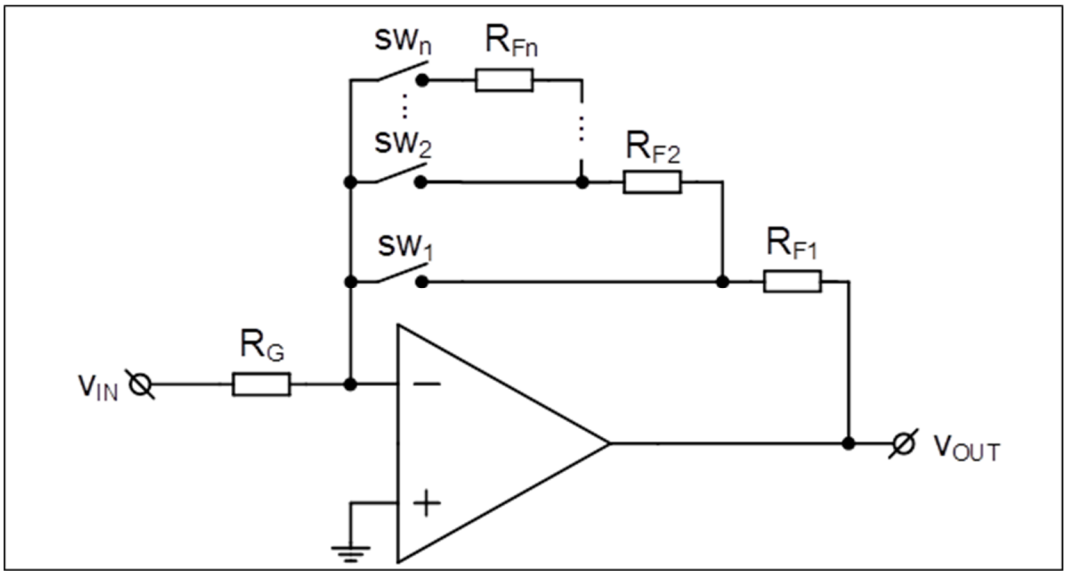
$$H_{0BP} = \frac{K}{1 + (1-K)R_1/R_3 + (1 + C_1/C_2)R_1/R_2} \qquad \omega_0 = \frac{\sqrt{1 + R_1/R_3}}{\sqrt{R_1 C_1 R_2 C_2}}$$

Aleg R1 = R2 = R3 = 2k; C1 = C2 = C3 = 50uF;

H(0BP) = 3.18/0.82 = 3.87;

Wo = $\sqrt{2}$/0.001 = 14 142 rad/s;

ETAJ 3: PGA:



Av min. = 1 dB;

Pas minim = 6 dB ;

Av max. = 20 dB;

Nr pasi: 4

Rin = 2k = Rg;

Av = -Rf/Rg;

Av = { 1 dB, 7 dB, 13 dB, 19 dB }, transformam in linear :

1. Pentru $\text{Câștig (dB)} = 1$:
   $\text{Câștig linear} = 10^{\left(\frac{1}{20}\right)} \approx 1.12$
2. Pentru $\text{Câștig (dB)} = 7$:
   $\text{Câștig linear} = 10^{\left(\frac{7}{20}\right)} \approx 2.24$
3. Pentru $\text{Câștig (dB)} = 13$:
   $\text{Câștig linear} = 10^{\left(\frac{13}{20}\right)} \approx 4.47$
4. Pentru $\text{Câștig (dB)} = 19$:
   $\text{Câștig linear} = 10^{\left(\frac{19}{20}\right)} \approx 8.91$

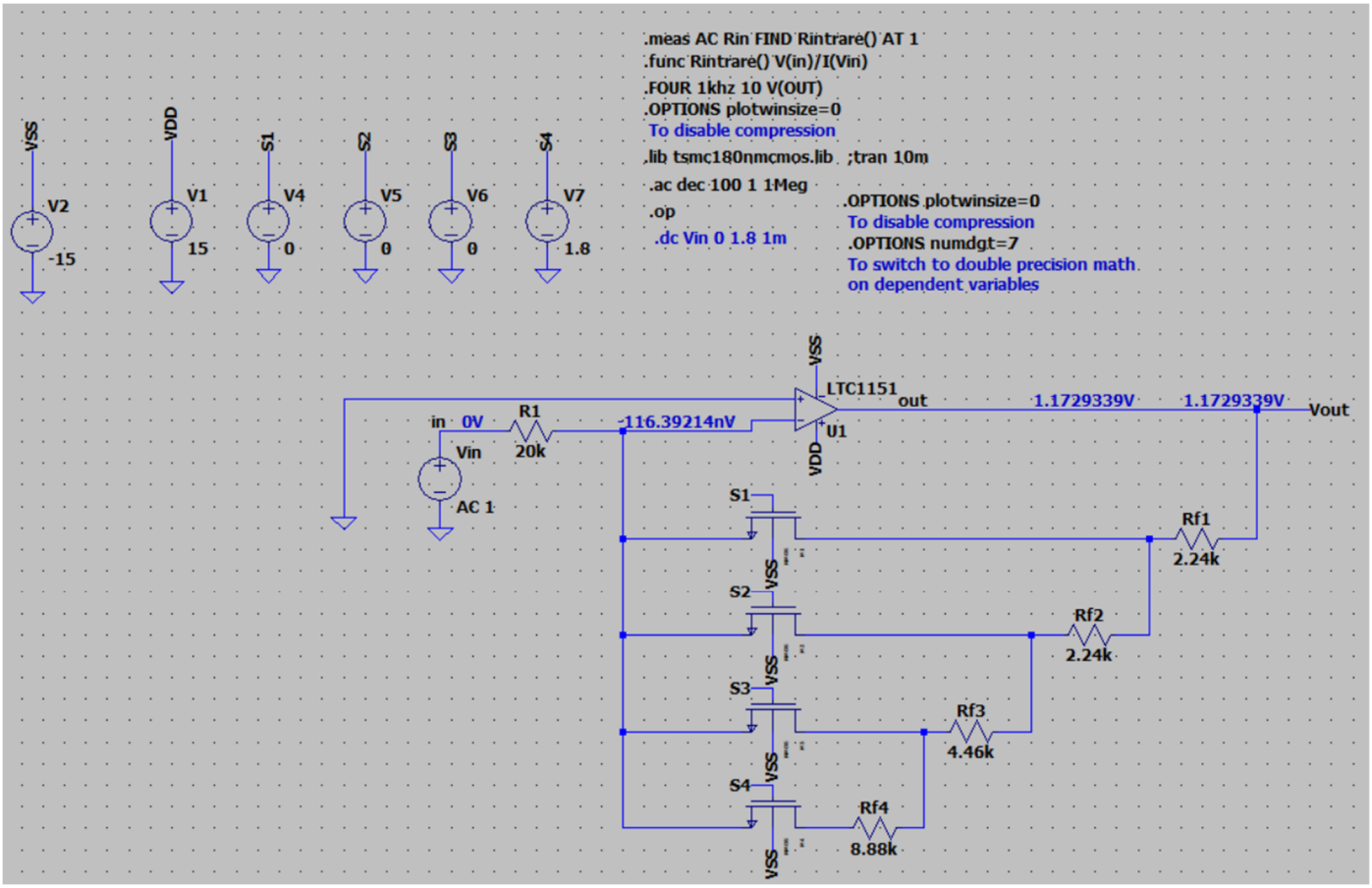
Rf1 = 2.24 k;

Rf2 = 2.24 k;

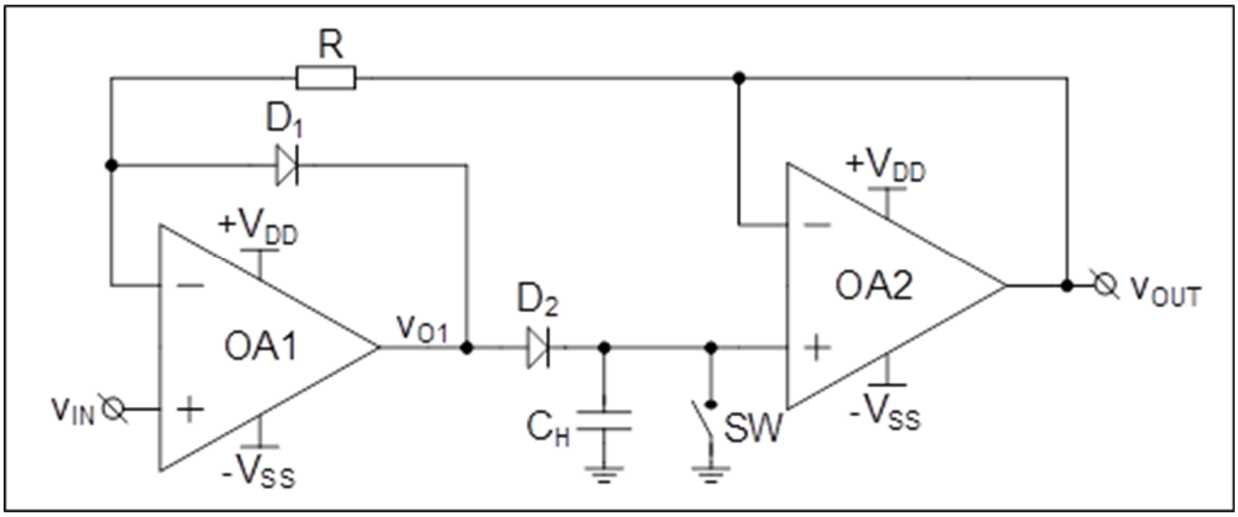
Rf3 = 4.46 k;

Rf4 = 8.88 k;

BW = GBW(oa) / (1 + Av) ;



ETAJ 4 : Positive peak detect:

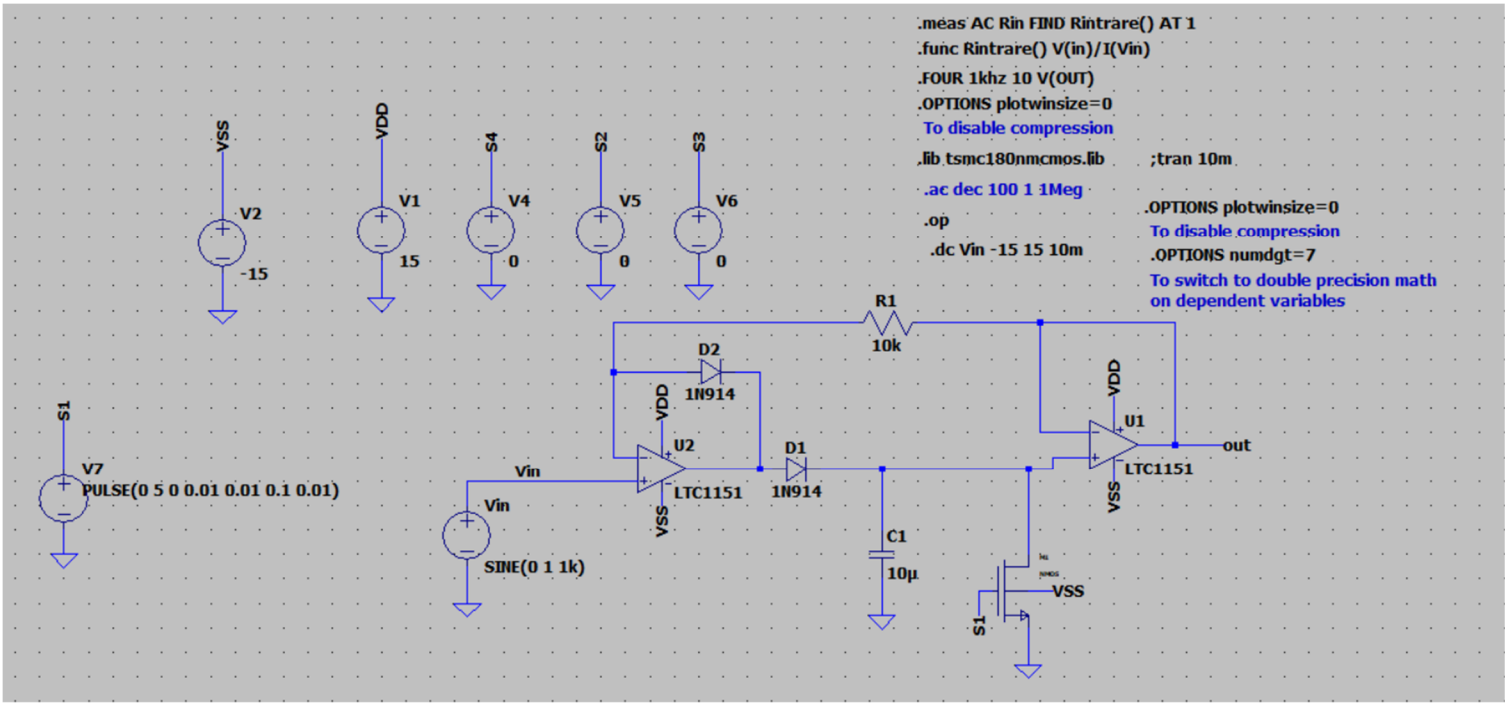


Castig linear : Av = 1; OP-AMP LTC1151;

Aleg:

$R = 10k$ **și** $C = 10\mu F$**:**

- $t_{\text{descărcare}} = R \cdot C = 10k \cdot 10\mu F = 0.1$ secunde.



Ideea implementarii Switch-ului este urmatoare,

folosind tranzistorul CMOS tsmc180 dinCircuitul cu PGA,

putem simula cu ajutorul unei surse de tip PULSE, deoarece stim perioada de descarcare a condesatorului si :

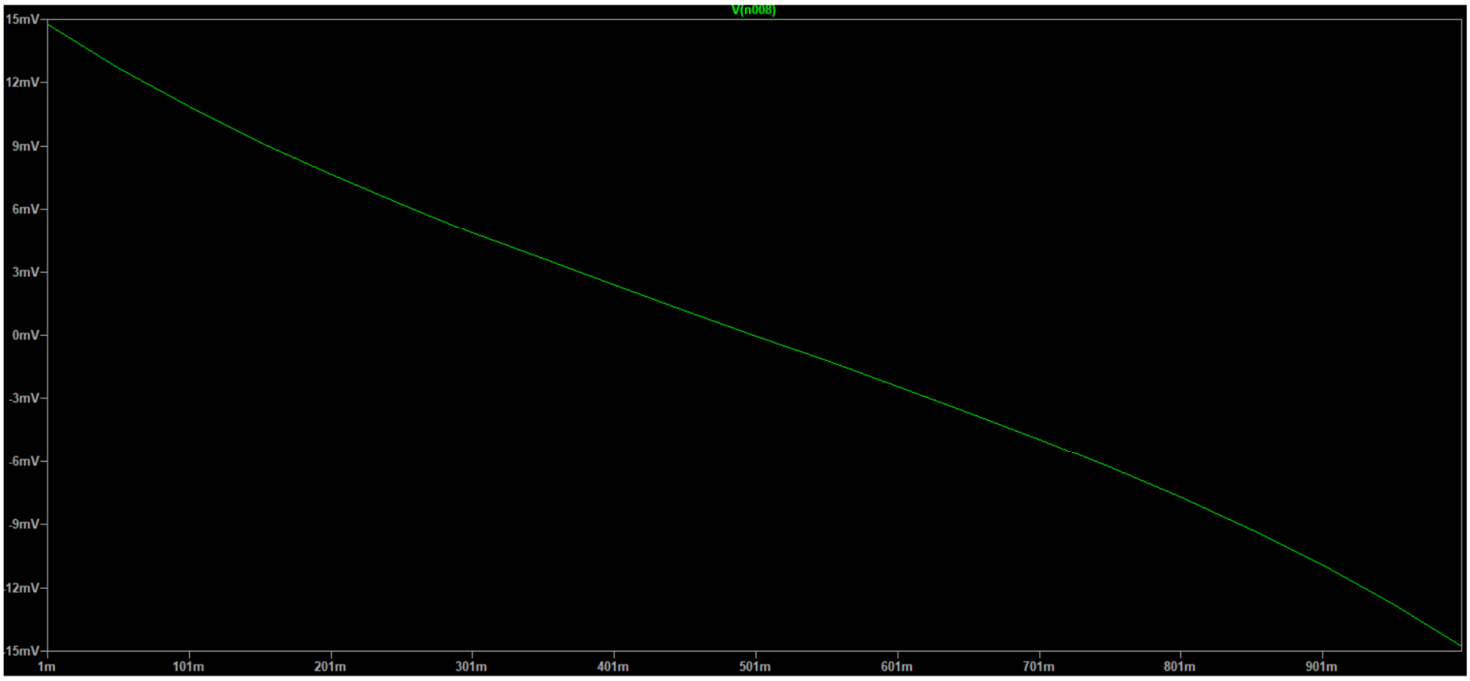
$$T \approx t_{\text{descărcare}}$$

Unde T este perioada de comutare a tranzistorului.

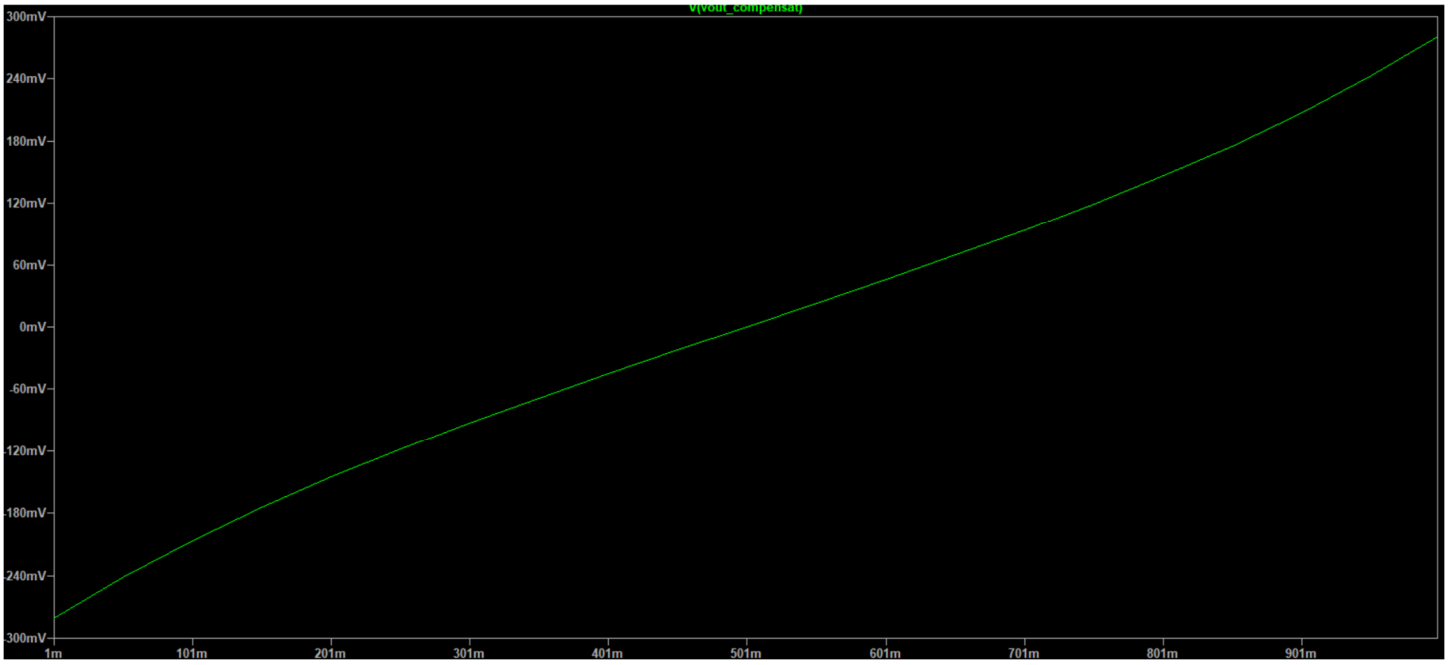
SIMULARI

ETAJ 1 :

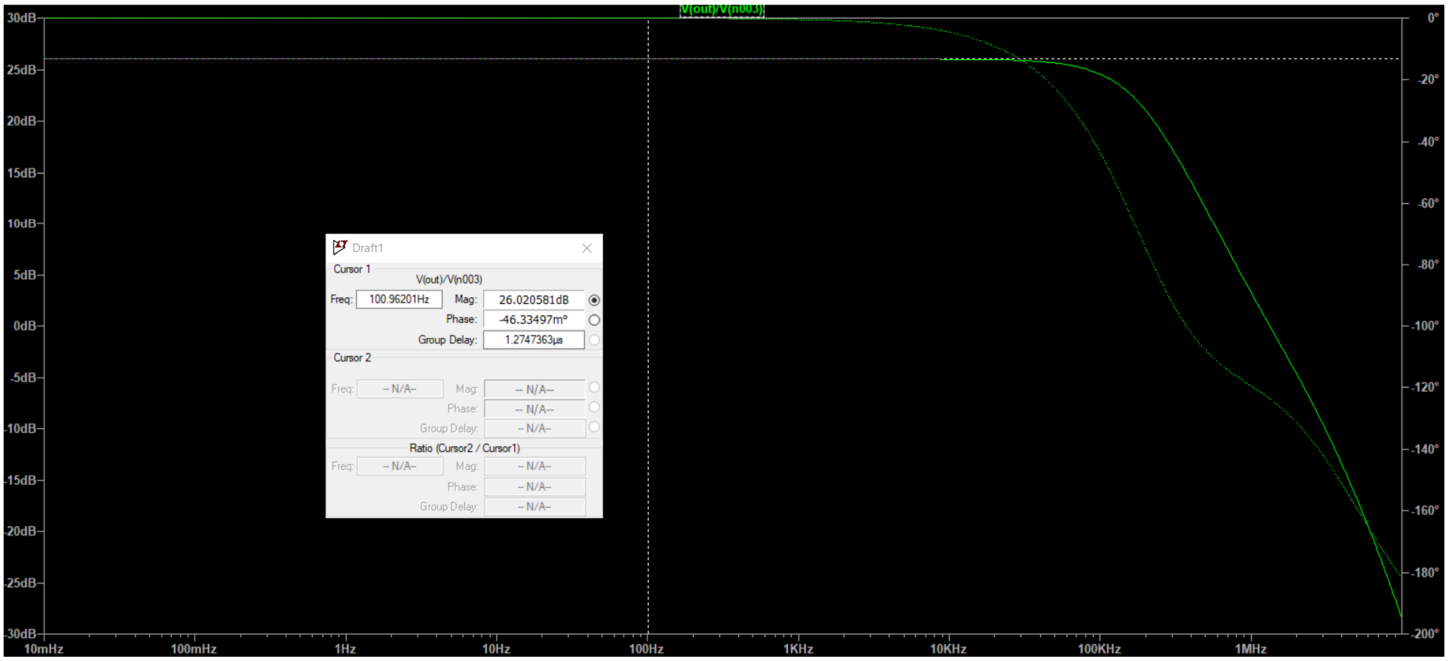
V compensare in functie de potentiometru:



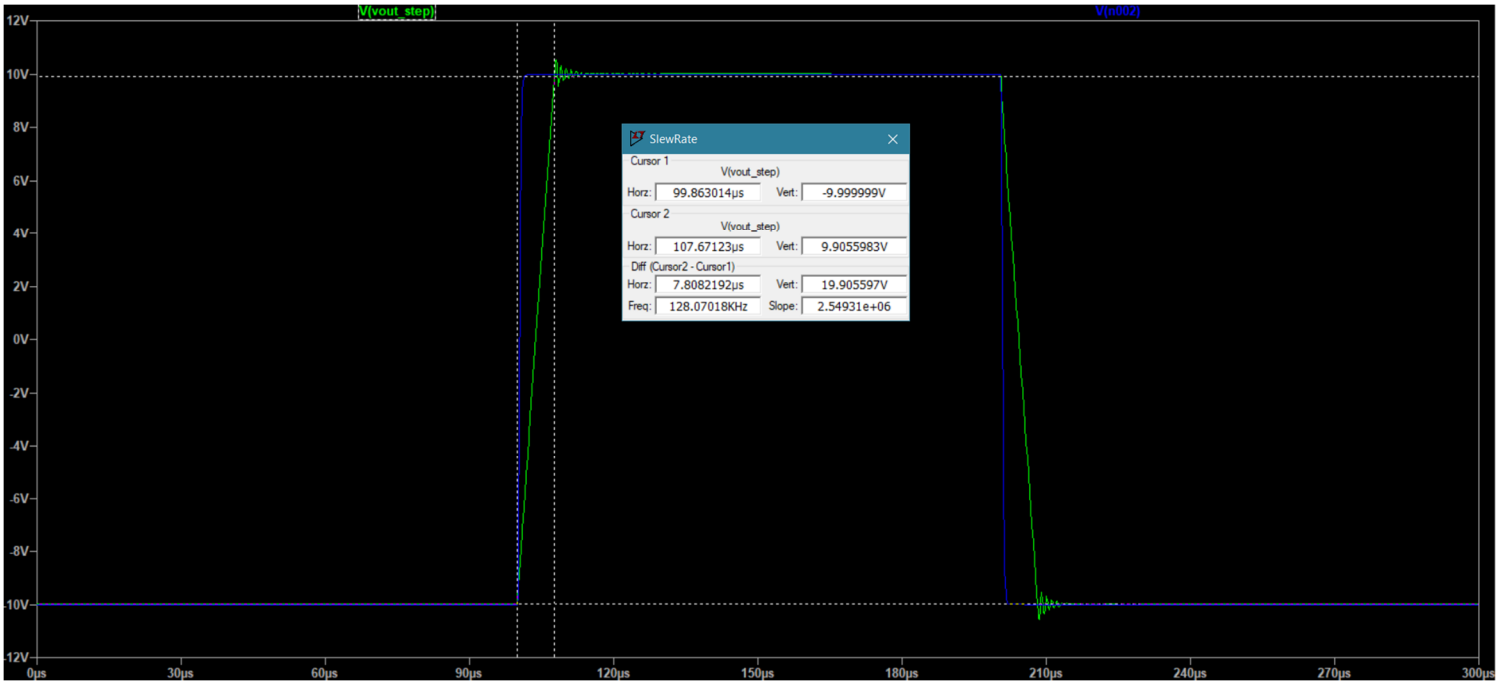
Vout DC Sweep full range: (max value 280 mV)



Castigul la joasa frecventa (AC Sweep):

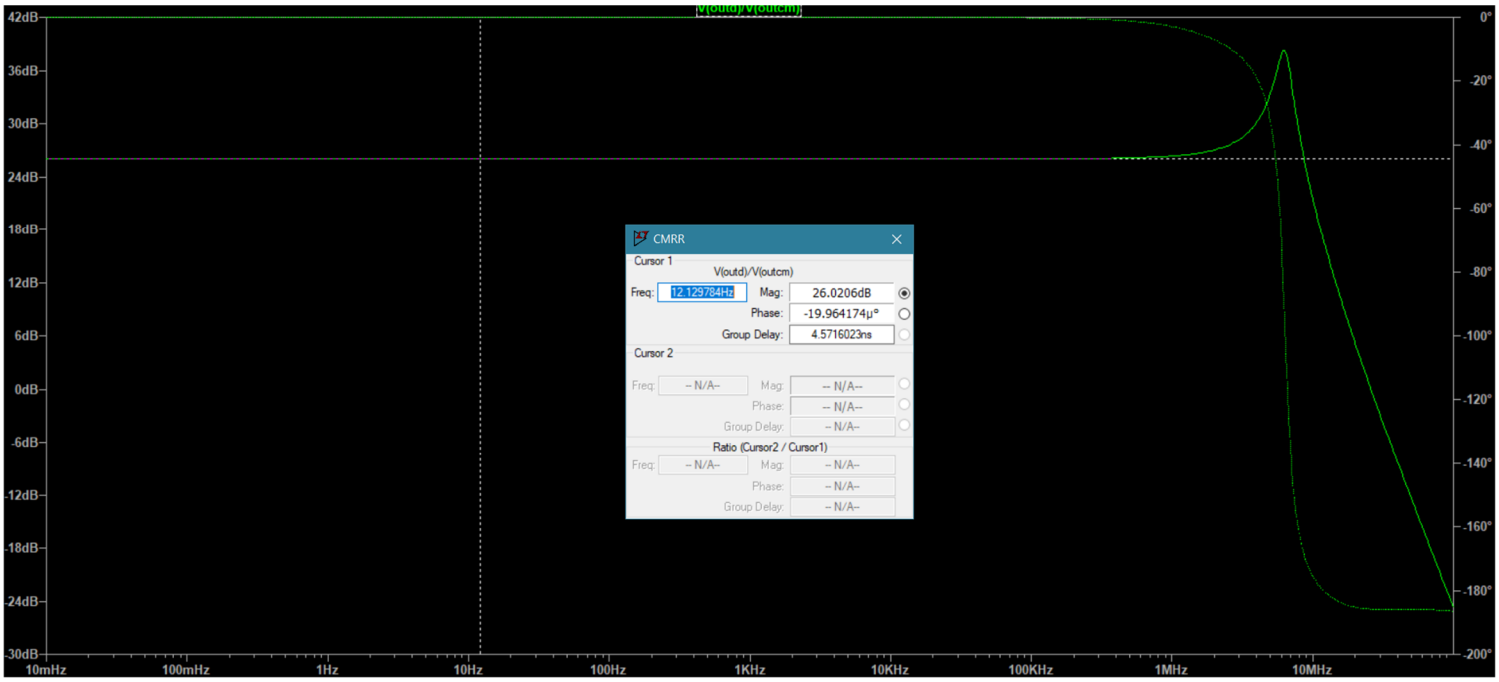


Slew Rate:



SR = 25.4 V/us;

CMMR(raport intre iesirea diferenteala si cea comuna)

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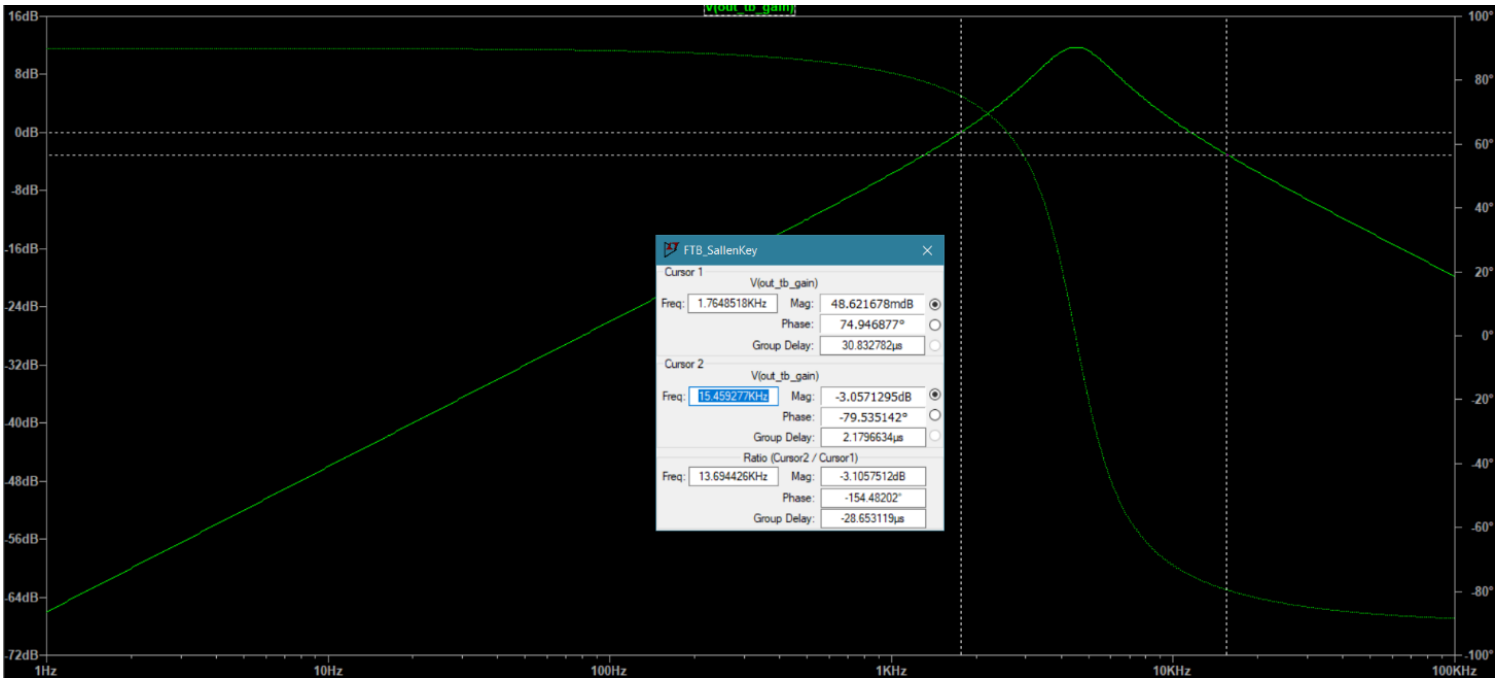
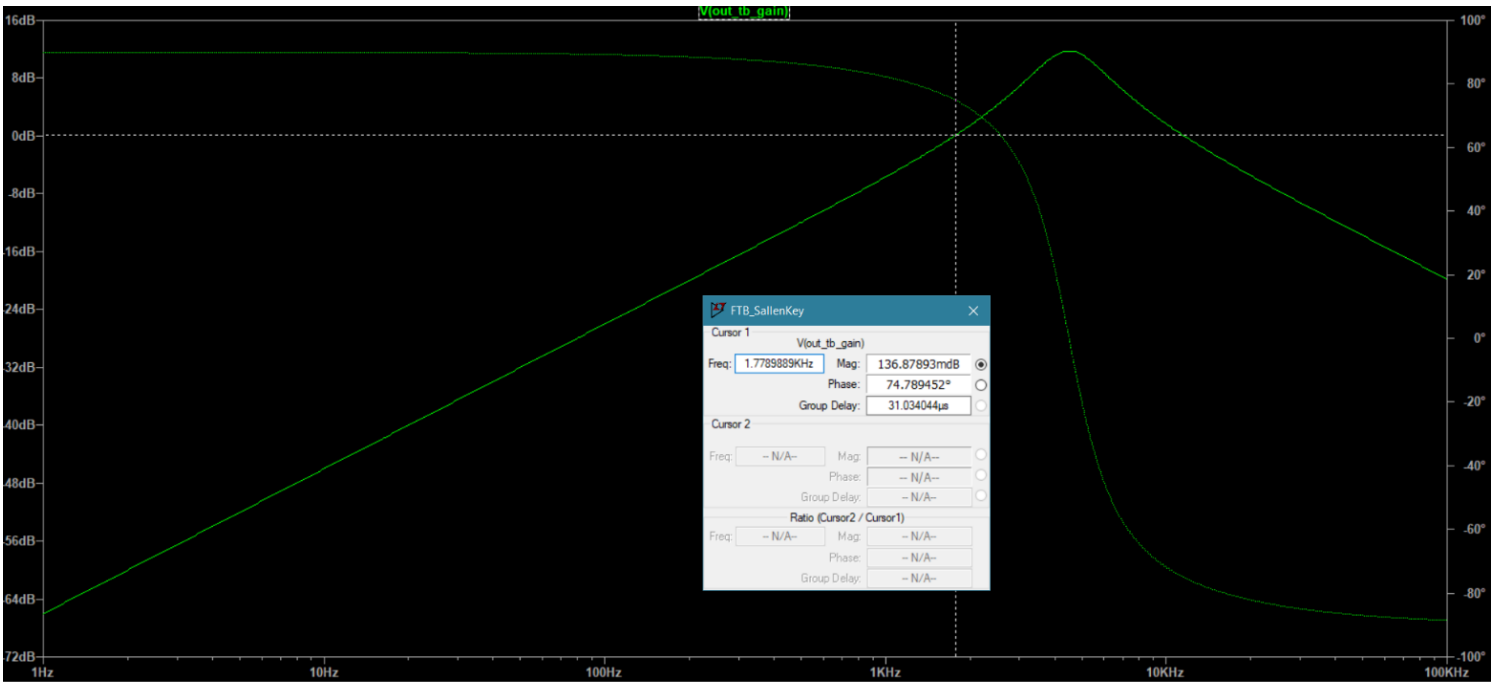
Measurement: common_mode_rejection_ratio
  step             cmrr()                  at
     1             (26.0206dB,-1.64553e-06°)          1
     2             (26.0206dB,-1.64553e-06°)          1
```

ETAJ 2:

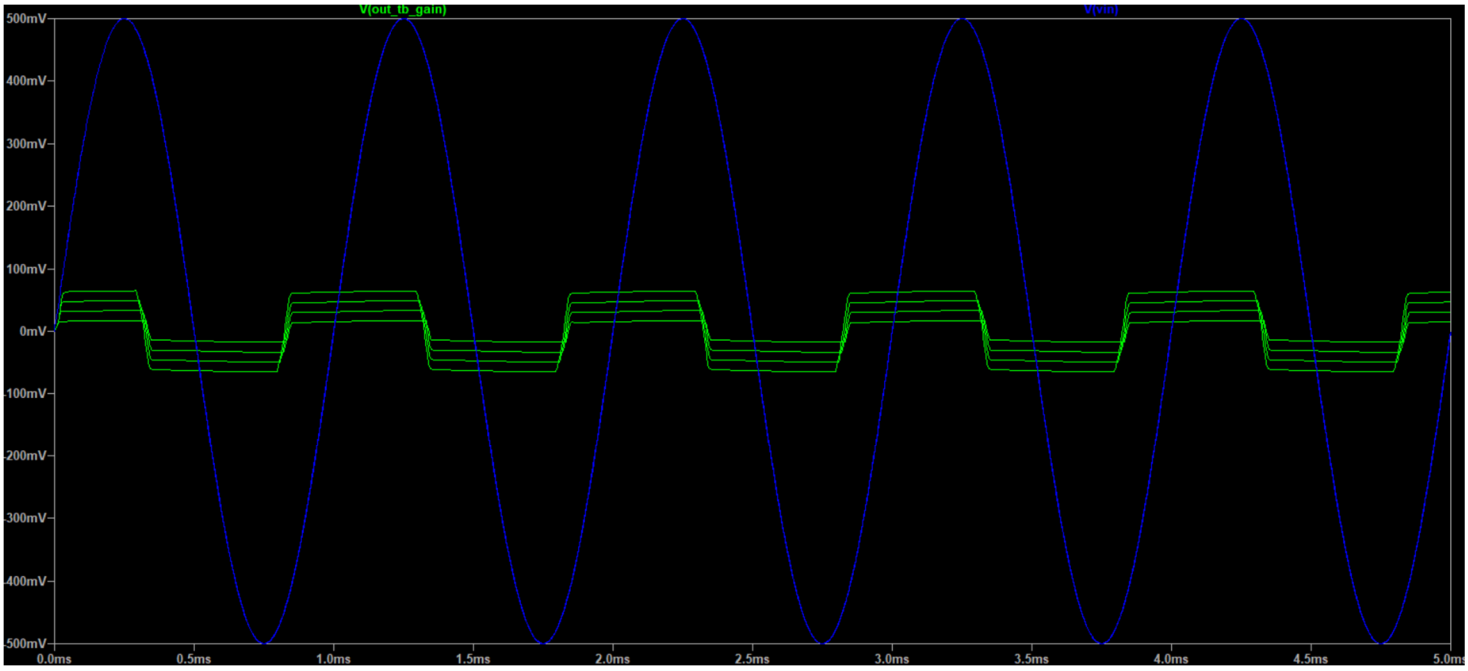
Banda la -3 dB :

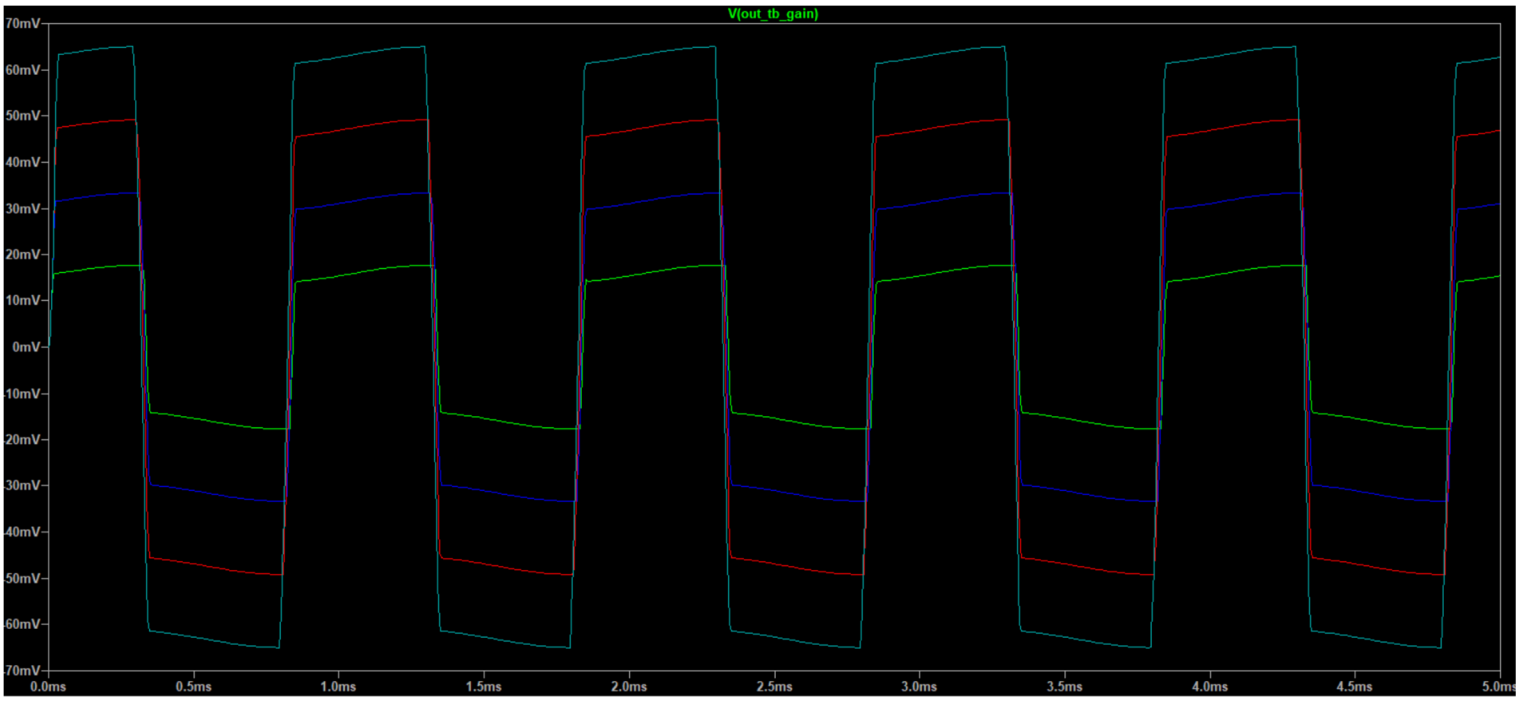


Banda la 0 dB este de 1.78 kHz, conform specificatiilor:



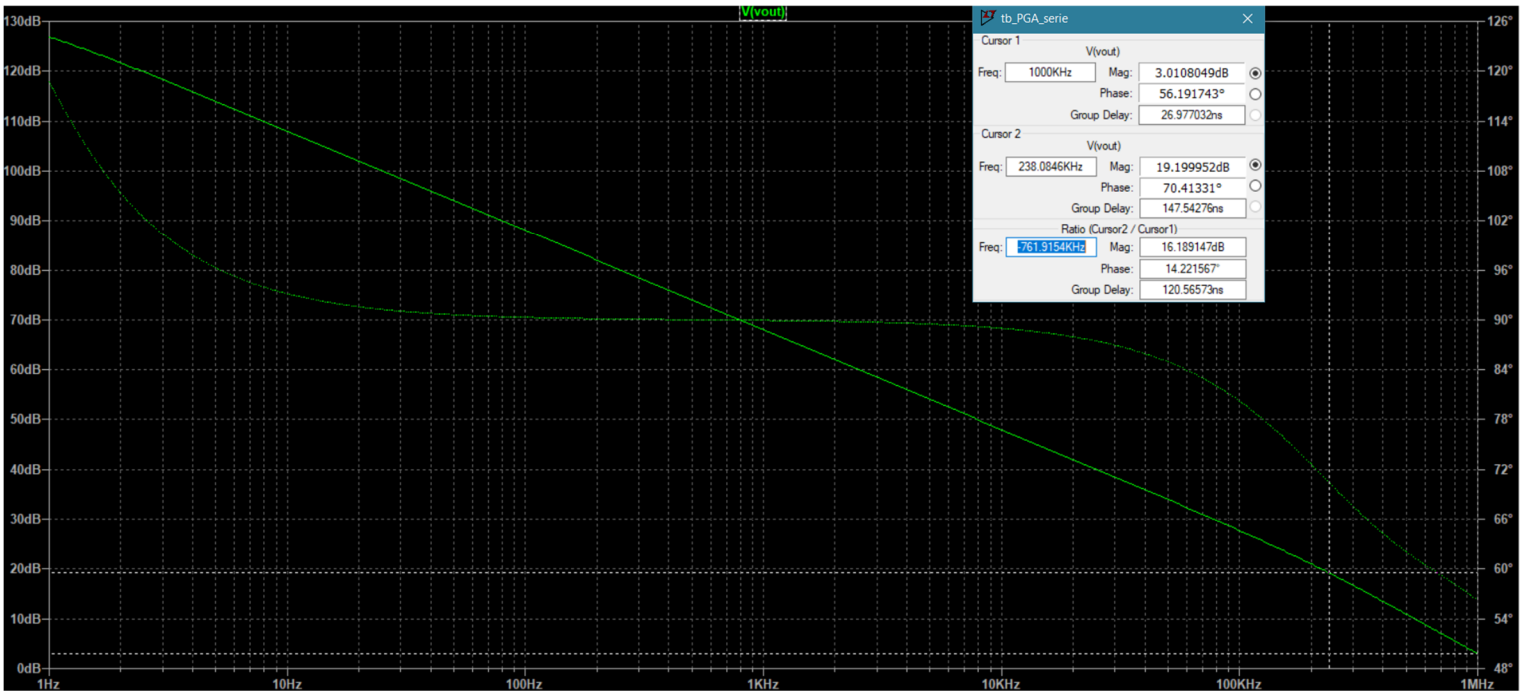
Simulare transient cu lista parametrilor SR setata:



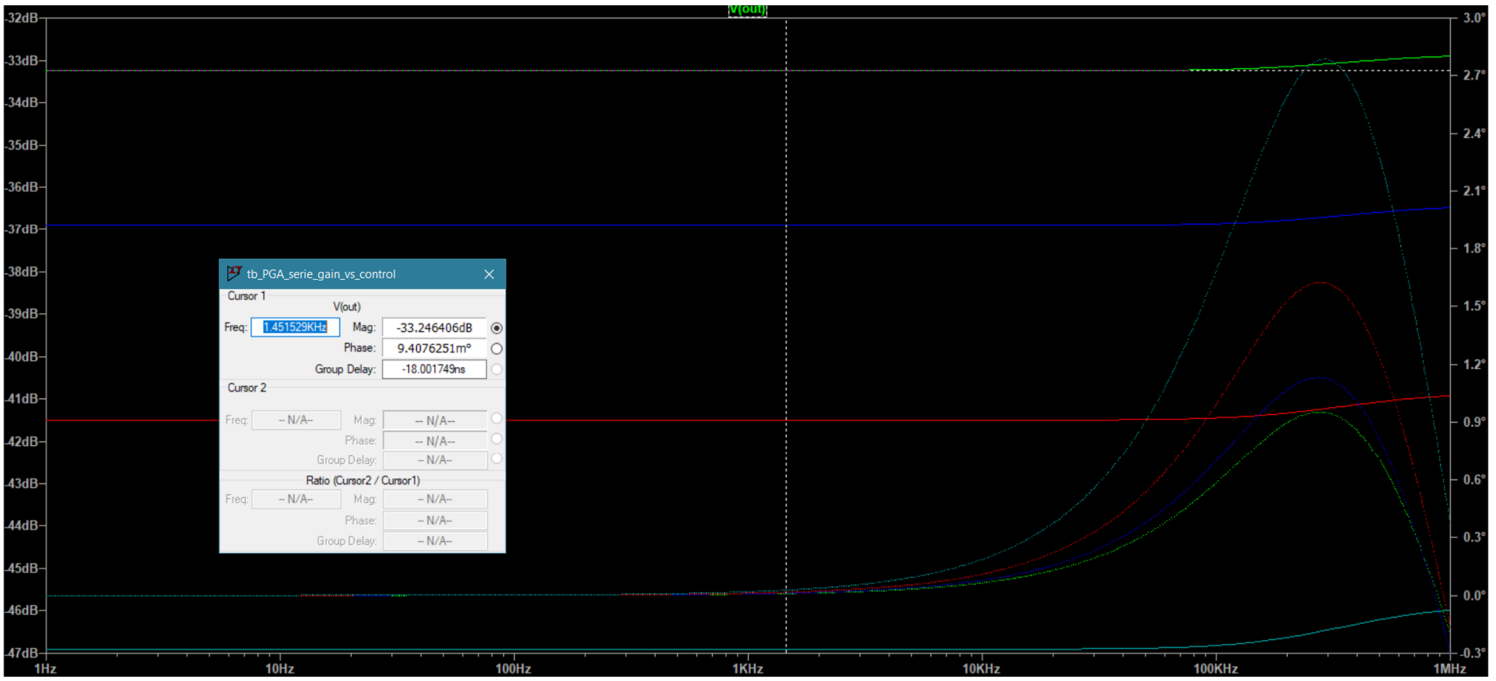


ETAJ 3:

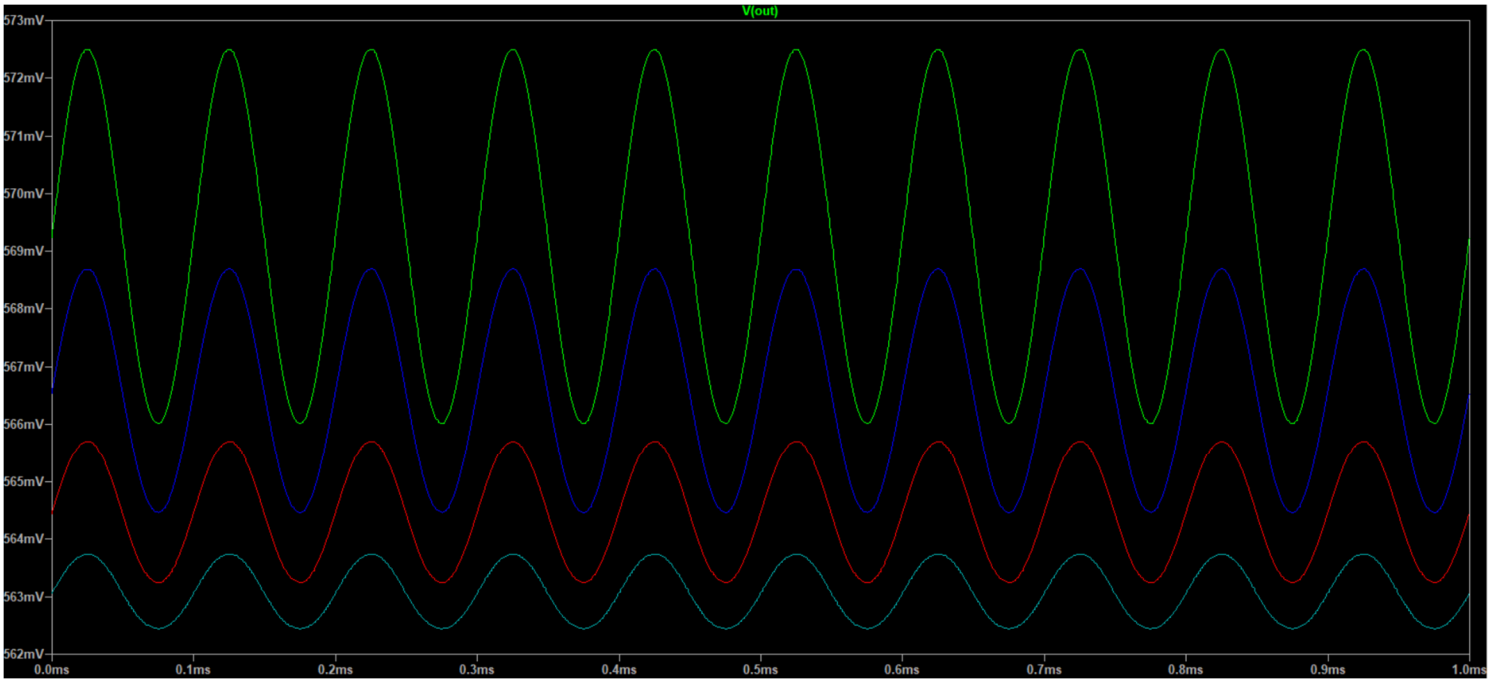
Caracteristica in frecventa (comutatorul S4 activ):



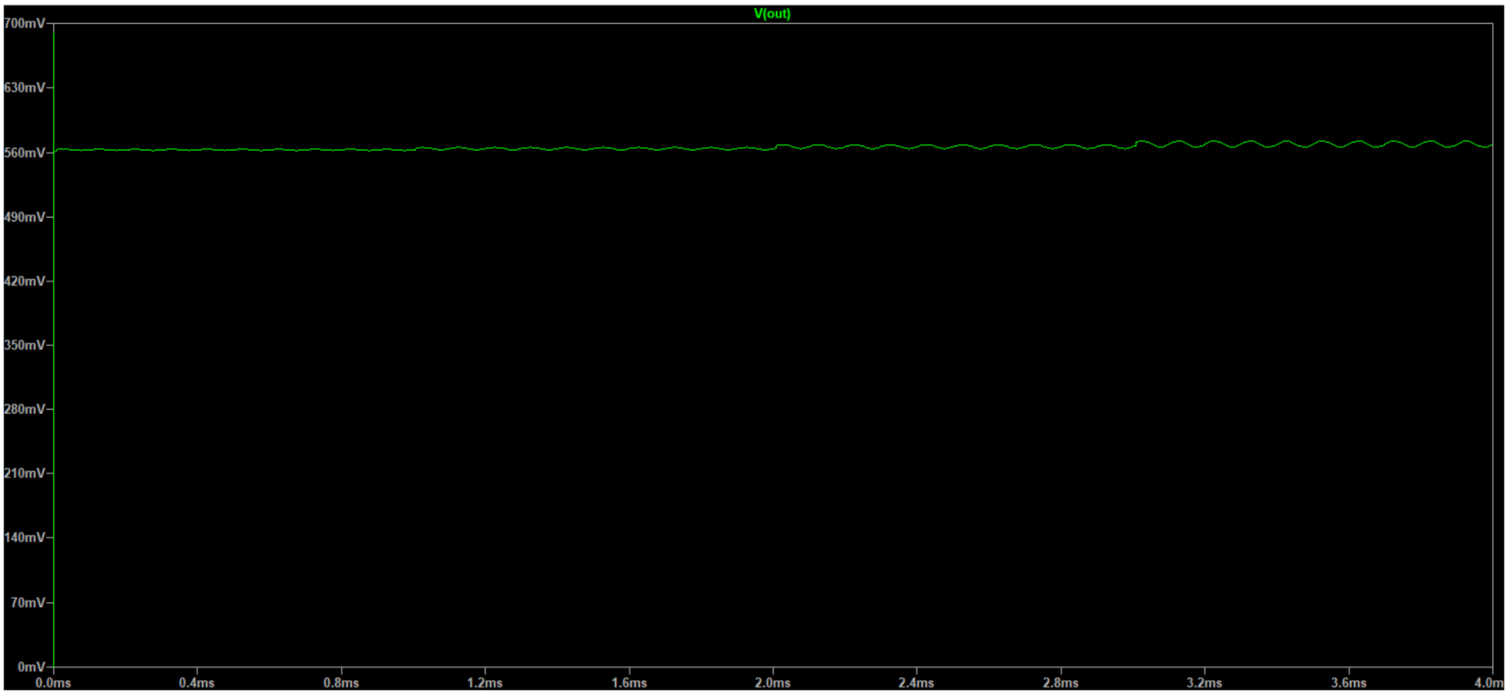
Caracteristica “gain_vs_control” in frecventa:



Simulare tranzitorie “gain_vs_control” :



Simulare tranzitorie “serie_gain_step” :



ETAJ 4 :

Tensiunea de intrare si iesire a detectorului de varf (Voutmax = 14.63 V) :