AMPLIFICATOR DE SEMNAL

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Cuprins

Introducere:

Amplificatorul este un circuit (bloc funcţional) care realizează creşterea puterii semnalului, păstrând informaţia din semnalul original. Creşterea puterii semnalului se face pe seama energiei absorbite de la sursa de alimentare. În general, la amplificarea unui semnal se doreşte ca acesta să nu se modifice ca şi formă, de unde rezultă că amplificatorul trebuie să lucreze liniar. Există totuşi situaţii în care amplificatorul lucrează liniar, dar forma semnalului este afectată de distorsiunile de amplitudine sau de fază. Un caz de acest gen se întâlneşte în domeniul circuitelor de impulsuri, unde forma semnalului poate fi uşor afectată, fără a se pierde informaţia.

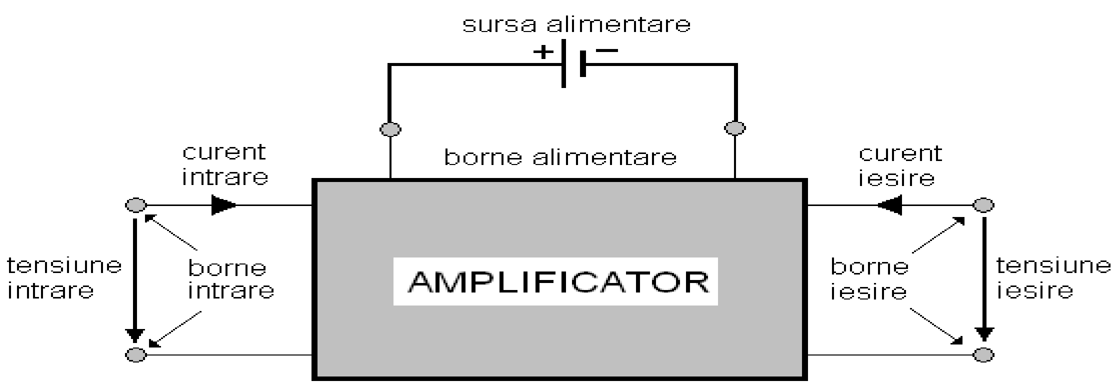
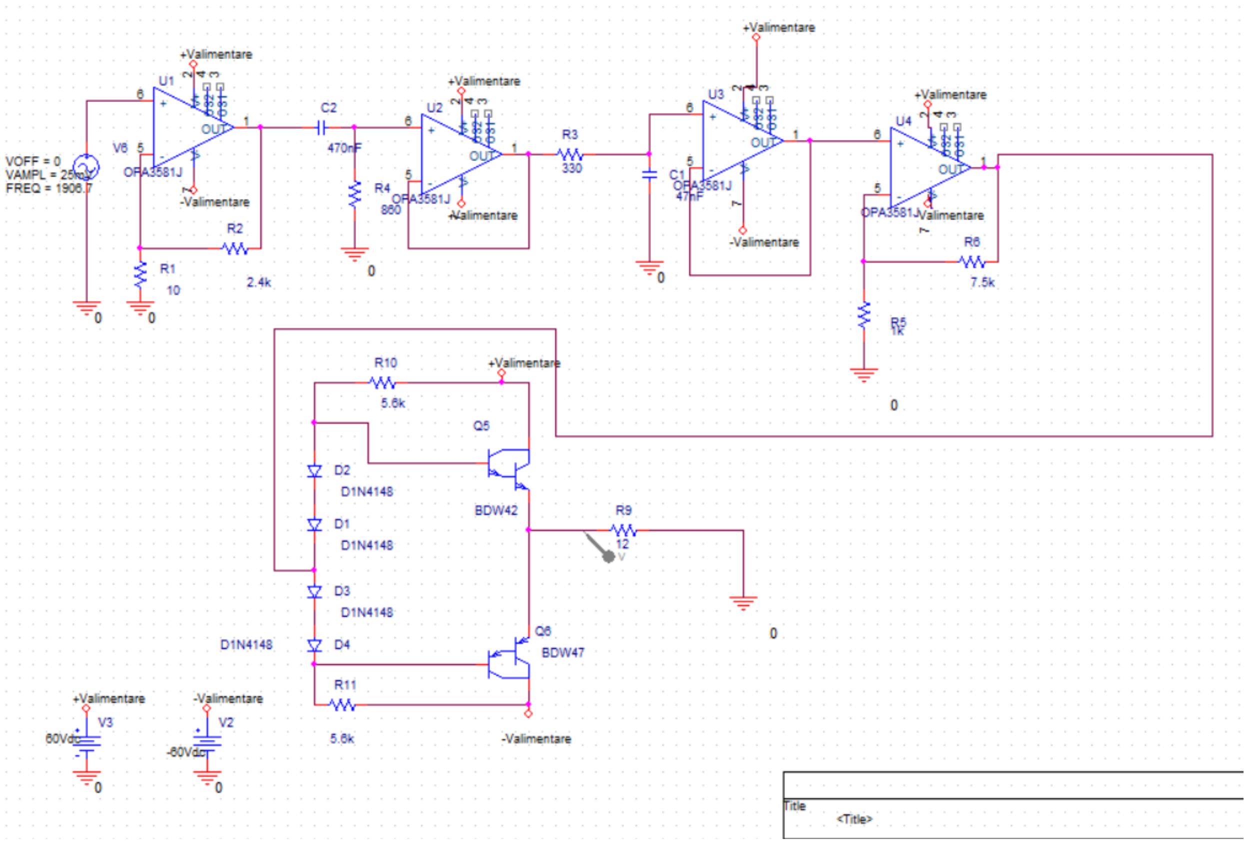


Figura 1. Schema de principiu a unui amplificator.

Datele proiectului:

Ain=25mV; Banda:[400Hz -10kHz]; Rout=12Ω; Aout=48V;

Prezentare Proiect(Schema)+Calcule:



Primul pas: se calculeaza amplificarea:A=$\frac{Aout}{Ain}$=$\frac{48V}{25mV}$=1920

A×B=GBW

A=$\frac{5MHz}{20k}$=250   =>   Amax=250

Calcule pentru dimensionarea primului Ao(U1):

RN=> V^{+}=V^{-} =>Vin=$\frac{R1}{R1+R2}$×V => $\frac{Vo}{Vin}$=$\frac{R1+R2}{R1}$

Av=$\frac{R1+R2}{R1}$=>250=1+$\frac{R2}{R1}$=>250=1+$\frac{R2}{R1}$

R1=10Ω => 249×10=R2 =>R2=2490 =>**R2=2.4KΩ**

Calcule pentru dimensionarea filtrului trece jos:

fo=$\frac{1}{2\pi R3C1}$ => $\frac{1}{2\pi R3C1}$=10kHz

C1=47nF => 10^9=47×10^4×2$\pi \times R3$ => R3=338.627=> **R3=330Ω**

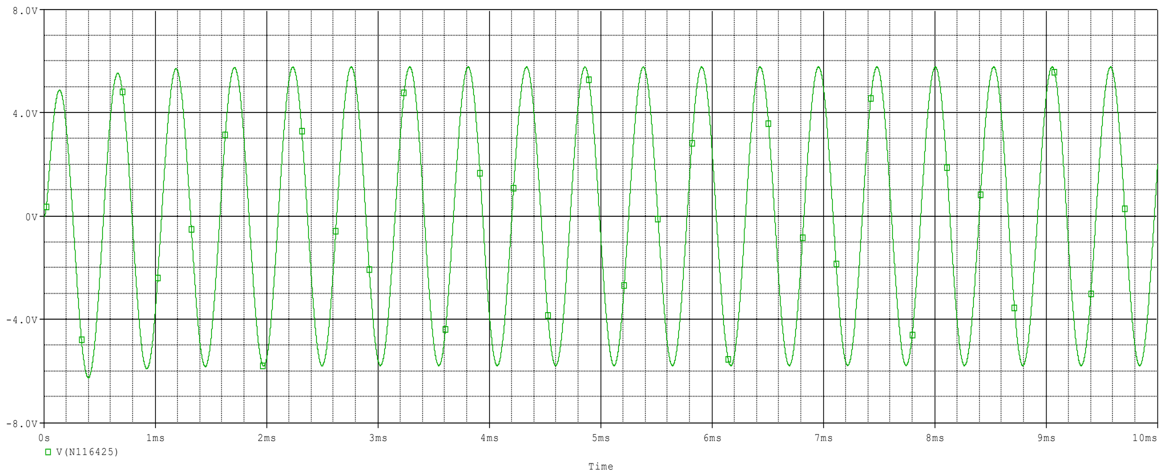
Calcule pentru dimensionarea filtrului trece sus:

fo=$\frac{1}{2\pi R3C2}$ => $\frac{1}{2\pi R3C2}$=400Hz

C2=470nF => 10^9=470×400×2$\pi \times R4$ => R4=846.568=> **R4=820Ω**

Calcule pentru dimensionarea celui de al 4-lea Ao(U4):

Din cauza filtrului tensiunea se modifica si atunci vom avea tensiunea de 5.77V ,aceasta tensiune este dedusa punand un marker la intrarea lui U4 si masurand tensiunea cu ajutorul unui cursor .



Probe Cursor

A1 =	2.2381m,	5.7704
A2 =	0.000,	-1.8570u
dif=	2.2381m,	5.7704

Vin= $\frac{R5+R6}{R5}$×V => $\frac{Vo}{Vin}=\frac{R5+R6}{R5}$ $\frac{Vo}{Vin}=\frac{48}{5.77}$ =>8.31=1+$\frac{R6}{R5}$=>**R5=1KΩ** =>

7.31×1000=R26 =>R6=7310 =>**R6=7.5KΩ**

Calcule pentru dimensionarea rezistentelor din etajul de amplificare:

La 10mA tensiunea este de 1V pe dioda => 60-2*1=58

Aplicam legea lui ohm: R=58/10mA=> R=5.8k

Valorile standard pentru rezistente,modelul E24 si capacitate si fisa cu specificatii pentru AO.

Standard Resistor Values (±5%)						
1.0	10	100	1.0K	10K	100K	1.0M
1.1	11	110	1.1K	11K	110K	1.1M
1.2	12	120	1.2K	12K	120K	1.2M
1.3	13	130	1.3K	13K	130K	1.3M
1.5	15	150	1.5K	15K	150K	1.5M
1.6	16	160	1.6K	16K	160K	1.6M
1.8	18	180	1.8K	18K	180K	1.8M
2.0	20	200	2.0K	20K	200K	2.0M
2.2	22	220	2.2K	22K	220K	2.2M
2.4	24	240	2.4K	24K	240K	2.4M
2.7	27	270	2.7K	27K	270K	2.7M
3.0	30	300	3.0K	30K	300K	3.0M
3.3	33	330	3.3K	33K	330K	3.3M
3.6	36	360	3.6K	36K	360K	3.6M
3.9	39	390	3.9K	39K	390K	3.9M
4.3	43	430	4.3K	43K	430K	4.3M
4.7	47	470	4.7K	47K	470K	4.7M
5.1	51	510	5.1K	51K	510K	5.1M
5.6	56	560	5.6K	56K	560K	5.6M
6.2	62	620	6.2K	62K	620K	6.2M
6.8	68	680	6.8K	68K	680K	6.8M
7.5	75	750	7.5K	75K	750K	7.5M
8.2	82	820	8.2K	82K	820K	8.2M
9.1	91	910	9.1K	91K	910K	9.1M

Standard Capacitor Values (±10%)						
10pF	100pF	1000pF	.010µF	.10µF	1.0µF	10µF
12pF	120pF	1200pF	.012µF	.12µF	1.2µF	
15pF	150pF	1500pF	.015µF	.15µF	1.5µF	
18pF	180pF	1800pF	.018µF	.18µF	1.8µF	
22pF	220pF	2200pF	.022µF	.22µF	2.2µF	22µF
27pF	270pF	2700pF	.027µF	.27µF	2.7µF	
33pF	330pF	3300pF	.033µF	.33µF	3.3µF	33µF
39pF	390pF	3900pF	.039µF	.39µF	3.9µF	
47pF	470pF	4700pF	.047µF	.47µF	4.7µF	47uF
56pF	560pF	5600pF	.056µF	.56µF	5.6µF	
68pF	680pF	6800pF	.068µF	.68µF	6.8µF	
82pF	820pF	8200pF	.082µF	.82µF	8.2µF	

SPECIFICATIONS

ELECTRICAL

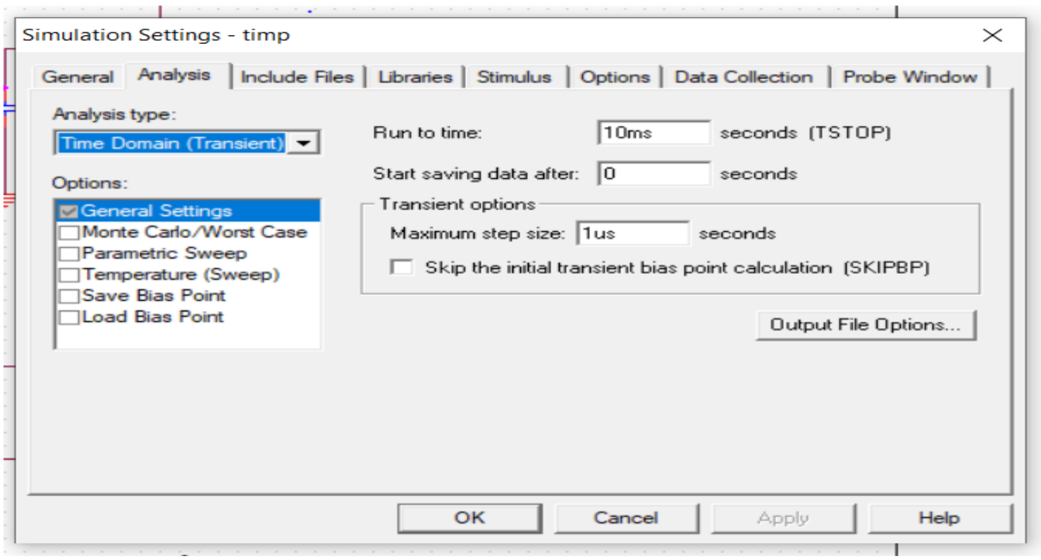
Typical at T_{CASE} = +25°C max unless otherwise noted.

MODELS	3580J	3581J	3582J
POWER SUPPLY			
Voltage, ±Vcc Quiescent Current, max	±15VDC to ±35VDC ±10mA	±32VDC to ±75VDC ±8mA	±70VDC to ±150VDC ±6.5mA
RATED OUTPUT			
Voltage, ±(Vcc) -5 VDC, min Current, min Current, Short Circuit Load Capacitance, max	±10VDC to ±30VDC ±60mA ±100mA	±27VDC to ±70VDC ±30mA ±50mA 10nF	±65VDC to ±145VDC ±15mA ±25mA
OPEN-LOOP GAIN			
No Load, DC Rated Load, DC, min	106dB 86dB	112dB 94dB	118dB 100dB
FREQUENCY RESPONSE			
Unity Gain Bandwidth, Small Signal Full Power Bandwidth Slew Rate Settling Time, 0.1%	100kHz 15V/µs	5MHz, min 60kHz 20V/µs 12µs	30kHz 20V/µs
INPUT OFFSET VOLTAGE			
Initial at T_{CASE} = +25°C, max Drift vs Temp, max Drift vs Supply Voltage Drift vs Time	±10mV ±30µV/°C 100µV/V 100µV/mo	±3mV ±25µV/°C 20µV/V 50µV/mo	±3mV ±25µV/°C 20µV/V 50µV/mo
INPUT BIAS CURRENT			
Initial at T_{CASE} = +25°C, max Drift vs Temp Drift vs Supply Voltage	-50pA 0.5pA/V	-20pA doubles every 10°C 0.2pA/V	-20pA 0.2pA/V
INPUT OFFSET CURRENT			
Initial at T_{CASE} = +25°C, max Drift vs Temp Drift vs Supply Voltage	0.5pA/V	±20pA doubles every 10°C 0.2pA/V	0.2pA/V
INPUT IMPEDANCE			
Differential Common-mode		$10^{11}\Omega$ · 10pF $10^{11}\Omega$	
INPUT NOISE			
Voltage 0.01Hz to 10Hz, p-p 10Hz to 1kHz, rms Current 0.01Hz to 10Hz, p-p	1µV 1pA	5µV 1.7µV 0.3pA	1.7µV 0.3pA
INPUT VOLTAGE RANGE			
Max Safe Differential Voltage(1) Max Safe Common-mode Voltage Common-mode Voltage, Linear Operation Common-mode Rejection	±(Vcc) -8 V 86dB	+Vcc + (-Vcc) +Vcc to -Vcc ±(Vcc) -10 V 110dB	±(Vcc) -10 V 110dB
TEMPERATURE Case			
Specification Operating Storage	0°C to 70°C -55°C to +125°C -55°C to +150°C		

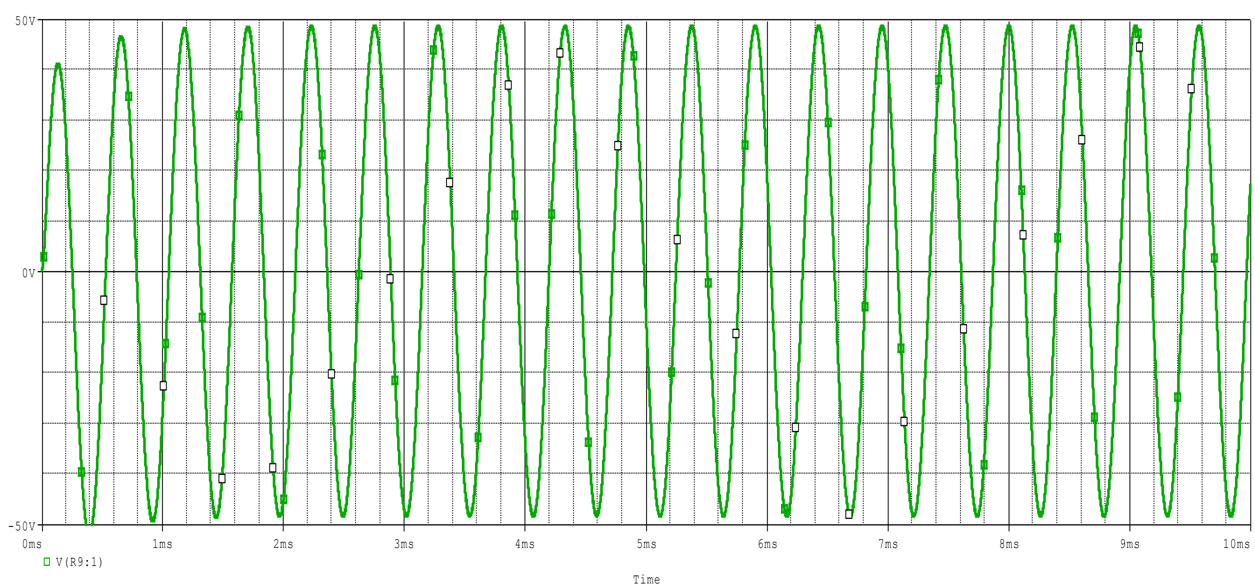
Analiza in timp(Time Domain(Transient)):

Pentru analiza in timp am folosit o sursa VSIN pentru a genera un semnal sinusoidal cu amplitudinea de 25mV.

Setari simulare:



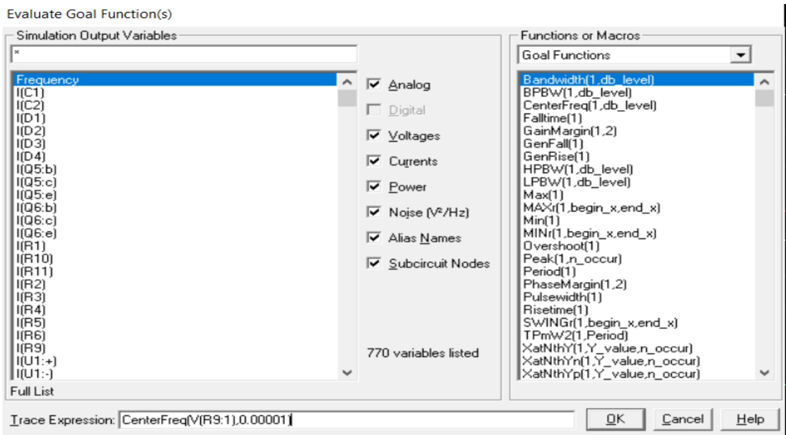
Forma semnal:

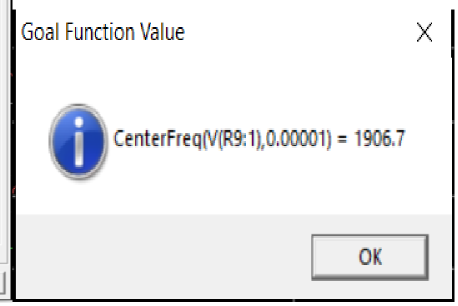


Analiza Fourier:

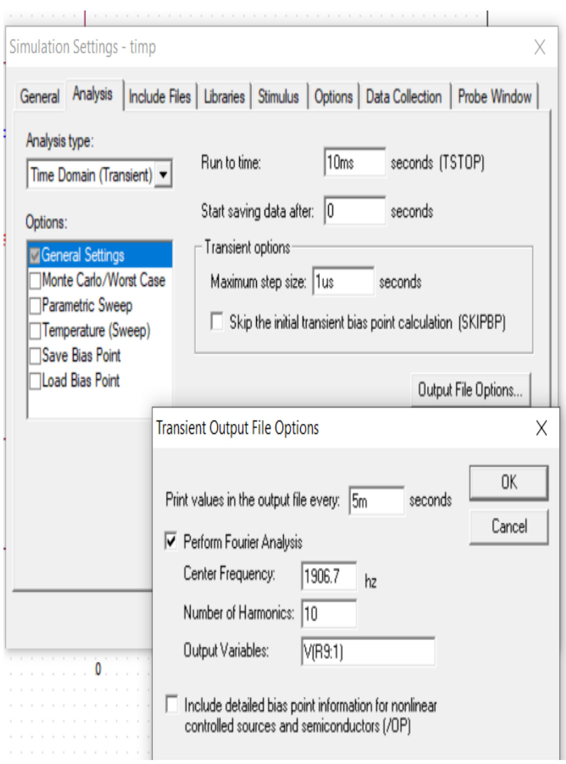
Aceasta analiza ne permite sa vedem cat este de distorsionat semnalul sinusoidal

Determinarea frecventei centrale:

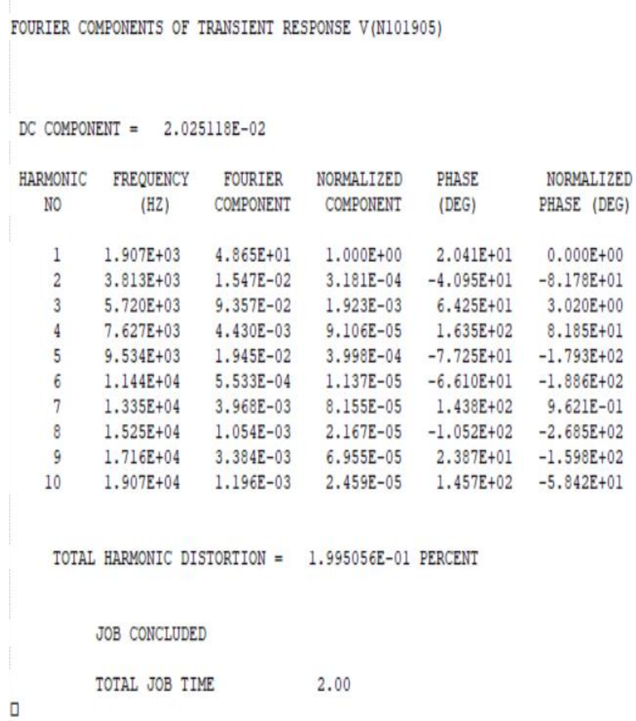




Setari simulare:



Output file:



FOURIER COMPONENTS OF TRANSIENT RESPONSE V(N101905)

DC COMPONENT = 2.025118E-02

HARMONIC NO	FREQUENCY (HZ)	FOURIER COMPONENT	NORMALIZED COMPONENT	PHASE (DEG)	NORMALIZED PHASE (DEG)
1	1.907E+03	4.865E+01	1.000E+00	2.041E+01	0.000E+00
2	3.813E+03	1.547E-02	3.181E-04	-4.095E+01	-8.178E+01
3	5.720E+03	9.357E-02	1.923E-03	6.425E+01	3.020E+00
4	7.627E+03	4.430E-03	9.106E-05	1.635E+02	8.185E+01
5	9.534E+03	1.945E-02	3.998E-04	-7.725E+01	-1.793E+02
6	1.144E+04	5.533E-04	1.137E-05	-6.610E+01	-1.886E+02
7	1.335E+04	3.968E-03	8.155E-05	1.438E+02	9.621E-01
8	1.525E+04	1.054E-03	2.167E-05	-1.052E+02	-2.685E+02
9	1.716E+04	3.384E-03	6.955E-05	2.387E+01	-1.598E+02
10	1.907E+04	1.196E-03	2.459E-05	1.457E+02	-5.842E+01

TOTAL HARMONIC DISTORTION = 1.995056E-01 PERCENT

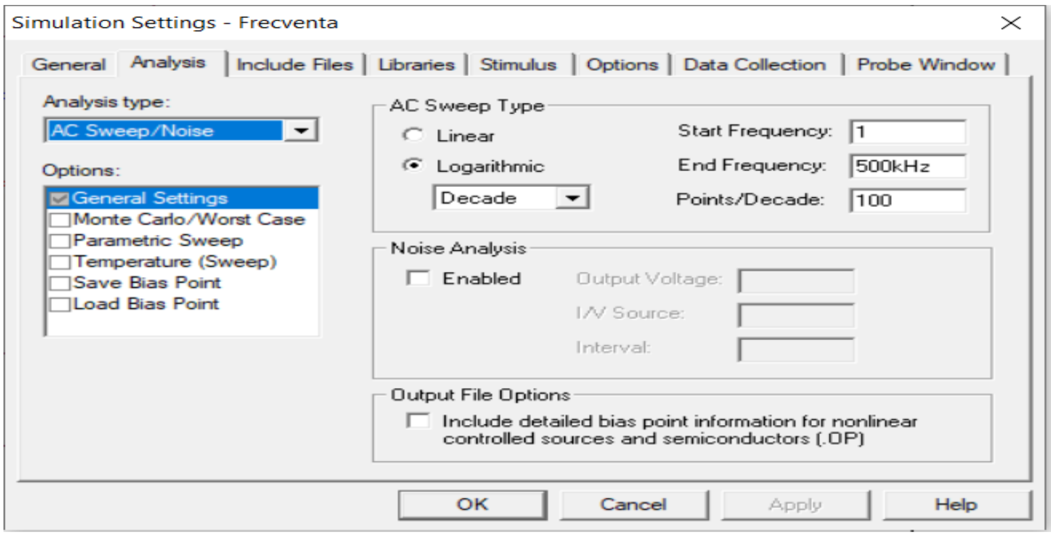
JOB CONCLUDED

TOTAL JOB TIME 2.00

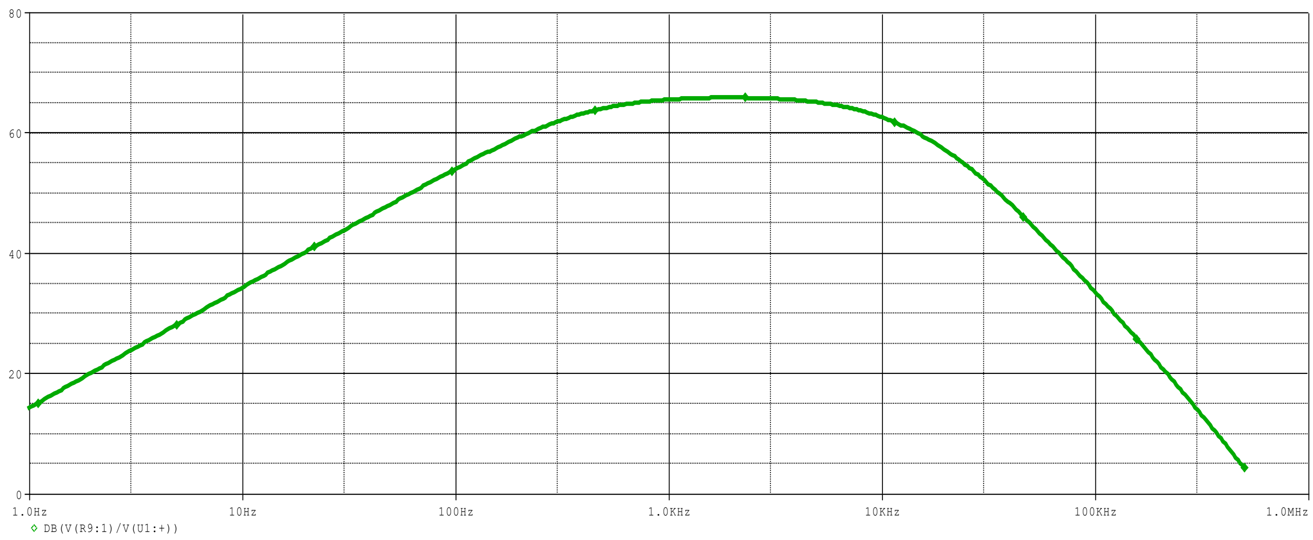
Analiza in frecventa(AC sweep):

Pentru aceasta simulare trebuie sa schimbam sursa VSIN cu o sursa VAC

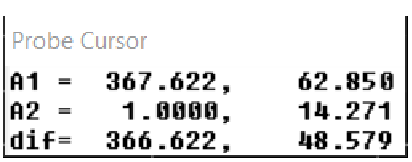
Setari simulare:



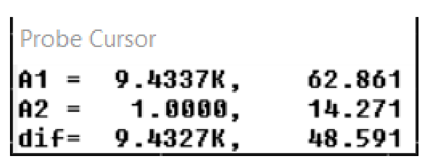
Caracteristica de frecventa a filtrului in urma simularii AC Sweep:



Plasand cursorul la -3dB obtinem:

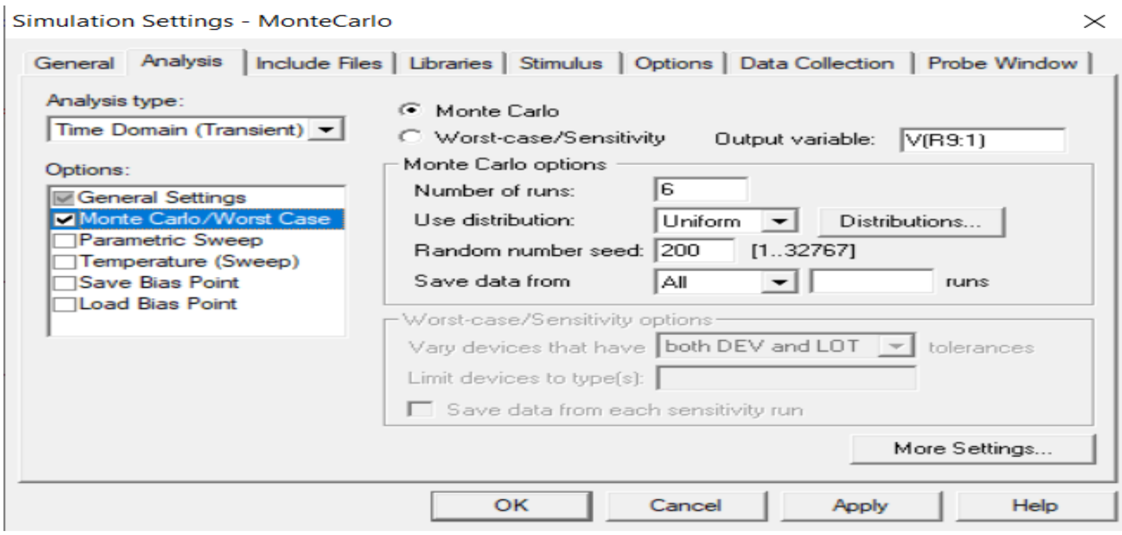


Plasand cursorul +3db obtinem:

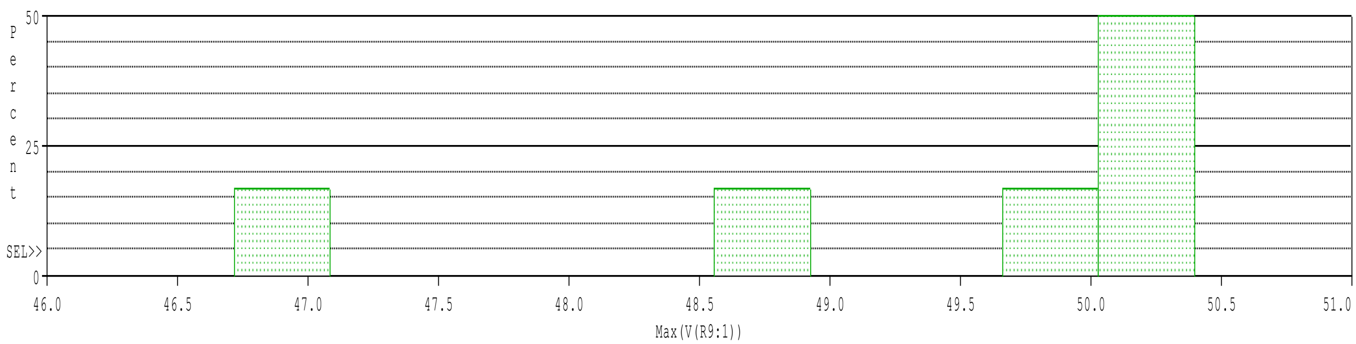


Analiza Monte Carlo:

Setari simulare:



Variatia semnalului de iesire in functie de tolerantele rezistentelor:



n samples = 6	mean = 49.3902	minimum = 46.7168	median = 50.0448	maximum = 50.3979
n divisions = 10	sigma = 1.45532	10th %ile = 46.7168	90th %ile = 50.3979