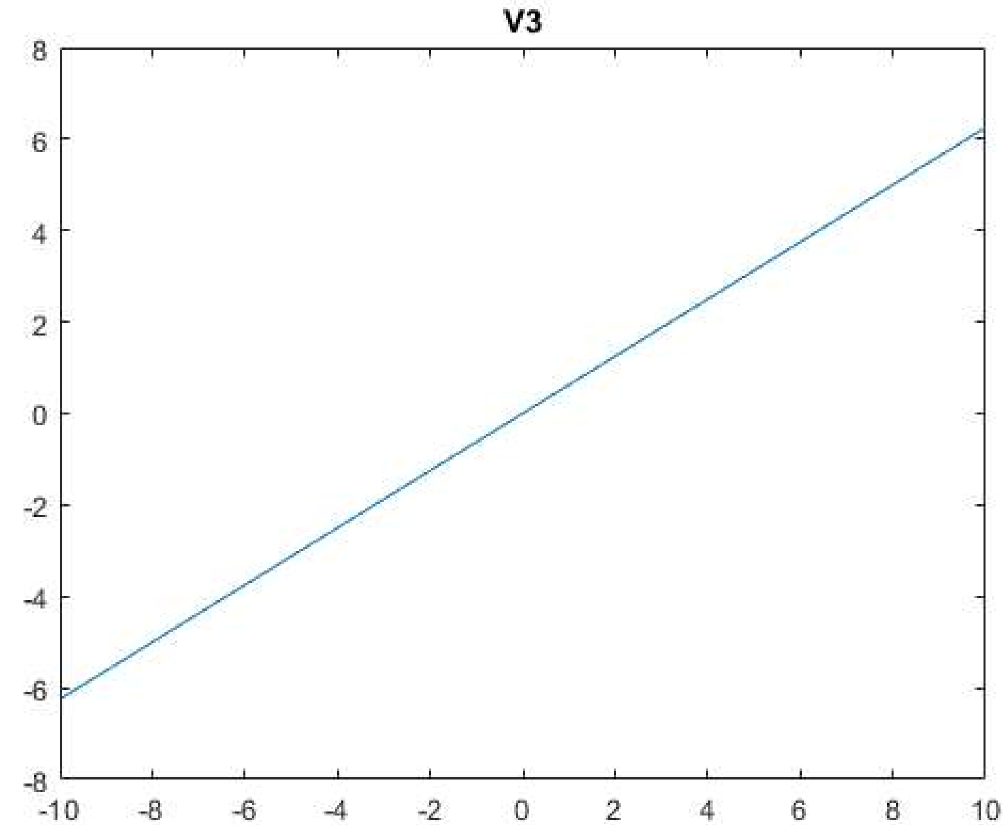
```
clear all
close all

R1 = 1;
C = 0.25;
R2 = 2;
L = 0.2;
R3 = 10;
a = 100;
R4 = 0.1;
Ro = 1000;
Y1 = 1/R1;
Y2 = 1/R2;
Y3 = 1/R3;
Y4 = 1/R4;

% V = [V1    V2             V3    V4     V5            i1   iL   i3];
G = [-1/R1  1/R1            0     0       0            1    0    0;
      1/R1 (-1/R1)-(1/R2)   0     0       0            0   -1    0;
      0      0             -1/R3  0       0             0    1    0;
      0      0             0   -1/R4  1/R4             0    0    1;
      0      0             0    1/R4  (-1/R4)-(1/Ro)   0   0    0;
      1      0             0     0        0            0    0    0;
      0      1             -1     0       0             0    0    0;
      0      0             a/R3  1        0            0    0    0]

% V = [V1 V2 V3 V4 V5 i1 iL i3];
Cm =   [-C   C 0   0   0   0   0   0;
        C -C 0   0   0   0   0   0;
        0   0 0   0   0   0   0   0;
        0   0 0   0   0   0   0   0;
        0   0 0   0   0   0   0   0;
        0   0 0   0   0   0   0   0;
        0   0 0   0   0   0  -L   0;
        0   0 0   0   0   0   0   0]
    %%%%%%%%%%%%%%%% Remember to output the matrices above %%%%%%%%%%%%%

 n = 0;
%  VinTest = -10:10;
for Vin = -10:10
    n = n + 1;
    F = [0 0 0 0 0 Vin 0 0];
    V = G\F';
    V3(n) = V(3);
    Vo(n) = V(5);
end

vin = -10:1:10;
figure(1)
plot(vin,V3)
title('V3')
figure(2)
plot(vin,Vo)
title('Vo')
```

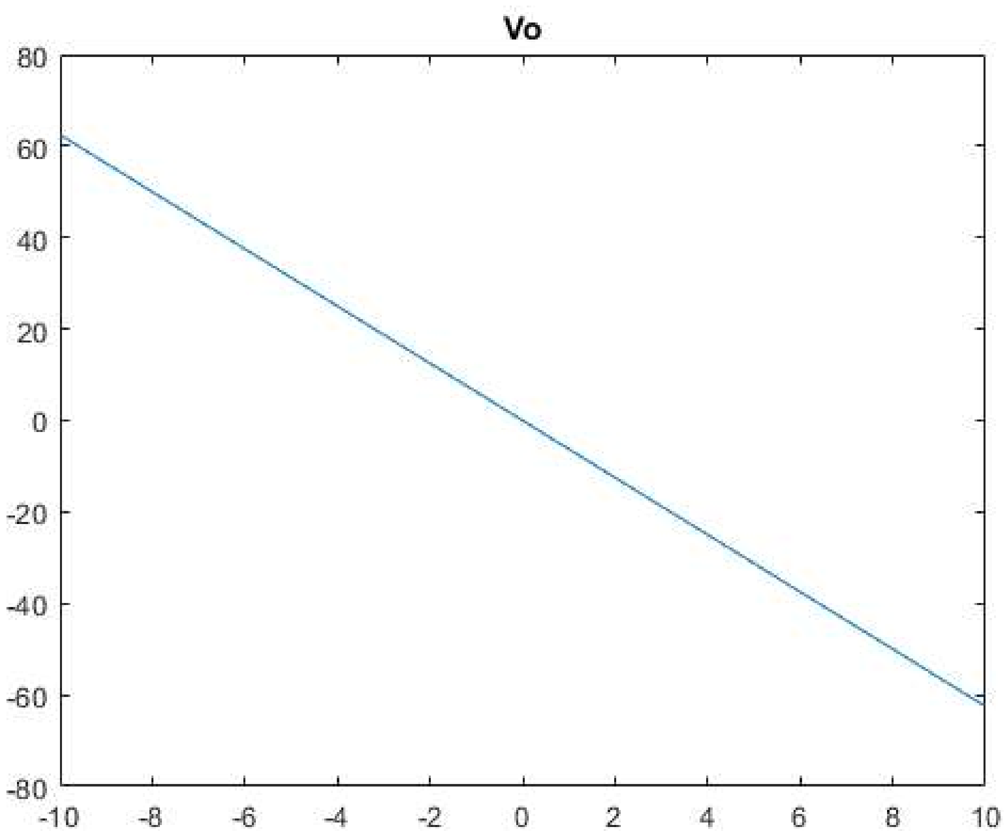
```
% w = linspace(1,1e6);
w = logspace(-3, 5, 100);
for n = 1:100
    F = [0 0 0 0 0 1 0 0];
    V = (G+(1i*w(n)*Cm))\F';
    Voii(n) = V(5);
    Adb(n) = 20*log10(Voii(n));
end

v1 = 1;
figure(3)
%%subplot(4,1,3)
semilogx(w,Voii)
title('Vo func of w')
grid on
figure(4)
semilogx(w,Adb)
title('Gain in dB')
grid on


figure(5)
Cnd = 0.25 + 0.05*randn(1,100);

for n = 1:100
    F = [0 0 0 0 0 1 0 0];
    Cmnd =   [-Cnd(n)  Cnd(n) 0  0  0  0  0  0;
        Cnd(n) -Cnd(n) 0  0  0  0  0  0;
        0  0 0  0  0  0  0  0;
        0  0 0  0  0  0  0  0;
        0  0 0  0  0  0  0  0;
        0  0 0  0  0  0  0  0;
        0  0 0  0  0  0  L  0;
        0  0 0  0  0  0  0  0];
    V = (G+(pi*Cmnd))\F';
    Voiii(n) = V(5);
end

hist(Voiii)
title('Hist of Gain')

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%Q2

V2 = zeros(8,1);
tstep = 0.001;
time =0;
Vin1 = 0;
deltat = 0.001;
w2 = 2*pi*(1/0.03);
figure(6);
clf;
figure(7);
clf;

for n = 1:1000 %each step represents a milisecond
```

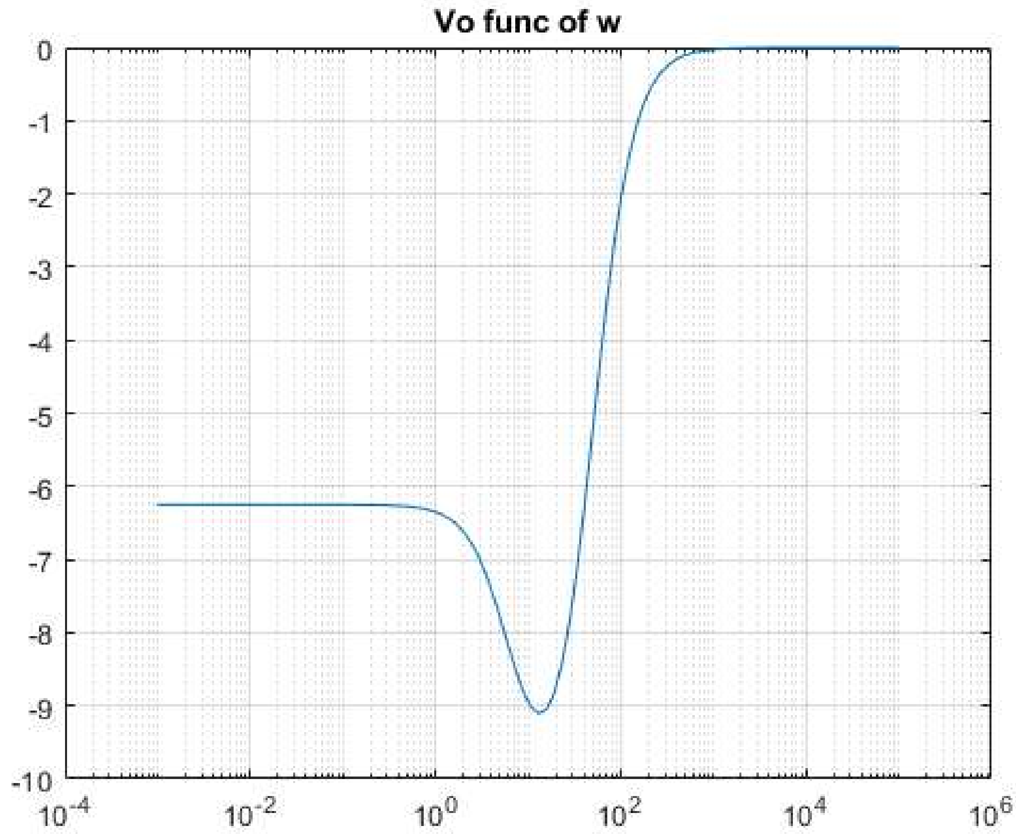
```
    if time == 0.03
        Vin1 = 1;
    end

%     Vin1 = sin(w2*time);

%      Vin1 = exp(-(time-0.06).^2/(2*(0.03)^2));

    F2 = [0 0 0 0 0 Vin1 0 0];
    A = G+(Cm/deltat);

%      V2 = A\(0*(V2/deltat)+F2.');
    V2 = A\(Cm*(V2/deltat)+F2.');

    time = tstep*n;
    figure(6);
    hold on
    scatter(time,Vin1,'r')
    title('input voltage')
    figure(7)
    hold on
    scatter(time,V2(5),'b')
    title('output voltage')

    Vin11(n,1) = Vin1;
    V2o(n,1) = V2(5);

end

figure(8)
Xin = fft(Vin11); %fft(Vin11,length(Vin11));
Xout = fft(V2o);
freq = 1./(deltat:deltat:time);
semilogx(freq,Xin,freq,Xout)
title('fft red-vin blue-vout')
grid on
figure(9)
Xshiftin = fftshift(Xin);
Xshiftout = fftshift(Xout);
semilogx(freq,Xshiftin,freq,Xshiftout)
grid on
title('fftshift red-vin blue-vout')

%%%%%%% It should be noted that as the time step increases the smoother the
%%%%%%% fourier transform plot becomes. Which would mean it is more
%%%%%%% precises.
```

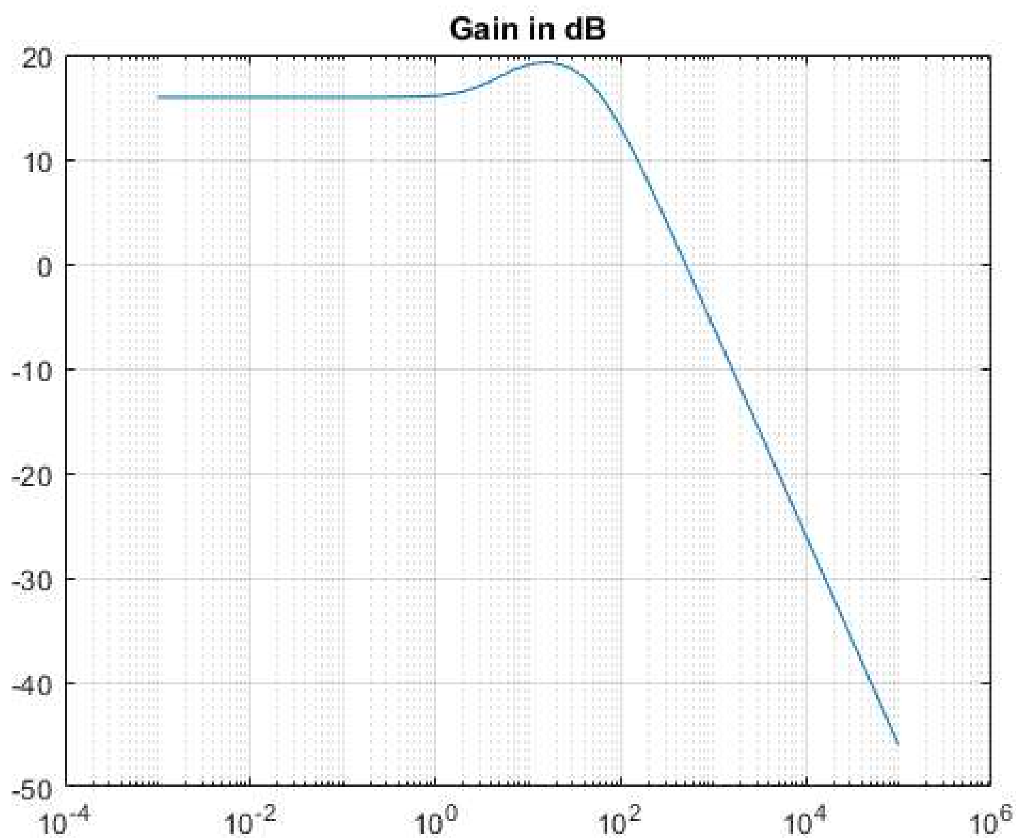
```
G =

  Columns 1 through 7

   -1.0000    1.0000         0         0         0    1.0000         0
    1.0000   -1.5000         0         0         0         0   -1.0000
         0         0   -0.1000         0         0         0    1.0000
         0         0         0  -10.0000   10.0000         0         0
```

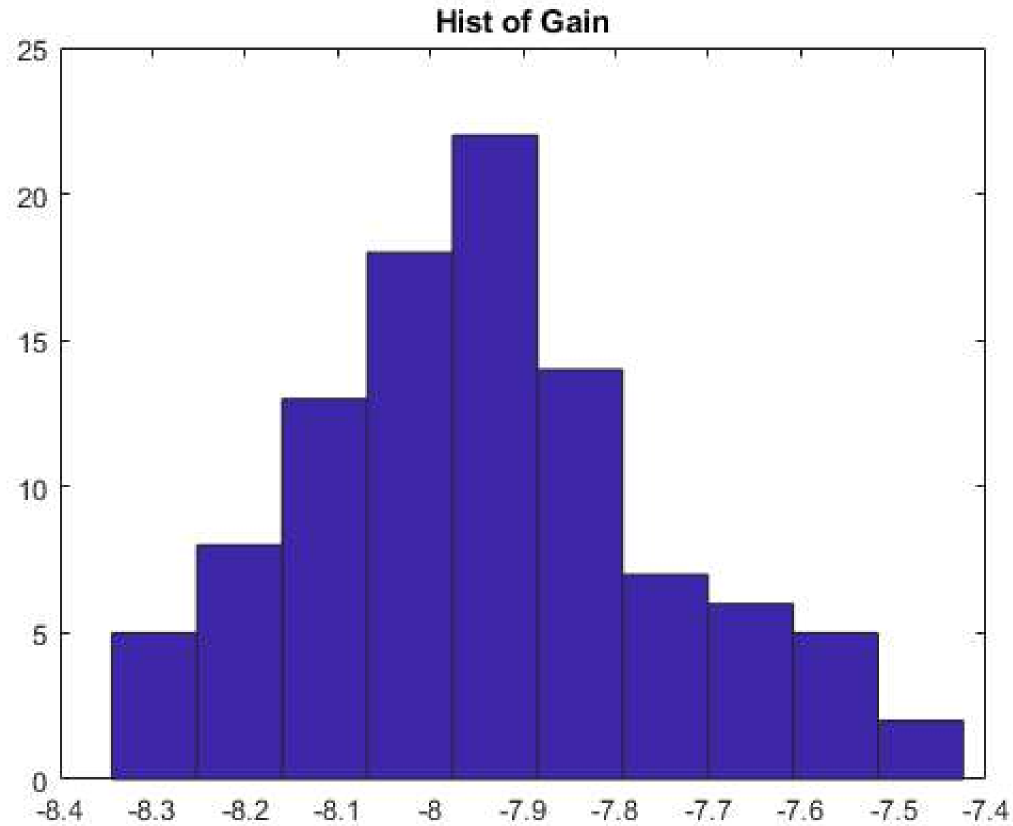
```
         0         0         0   10.0000  -10.0010         0         0
    1.0000         0         0         0         0         0         0
         0    1.0000   -1.0000         0         0         0         0
         0         0   10.0000    1.0000         0         0         0

  Column 8

         0
         0
         0
    1.0000
         0
         0
         0
         0


Cm =

  Columns 1 through 7

   -0.2500    0.2500         0         0         0         0         0
    0.2500   -0.2500         0         0         0         0         0
         0         0         0         0         0         0         0
         0         0         0         0         0         0         0
         0         0         0         0         0         0         0
         0         0         0         0         0         0         0
         0         0         0         0         0         0   -0.2000
         0         0         0         0         0         0         0

  Column 8

         0
         0
         0
         0
         0
         0
         0
         0

Warning: Imaginary parts of complex X and/or Y arguments ignored
Warning: Imaginary parts of complex X and/or Y arguments ignored
Warning: Imaginary parts of complex X and/or Y arguments ignored
Warning: Imaginary parts of complex X and/or Y arguments ignored
```

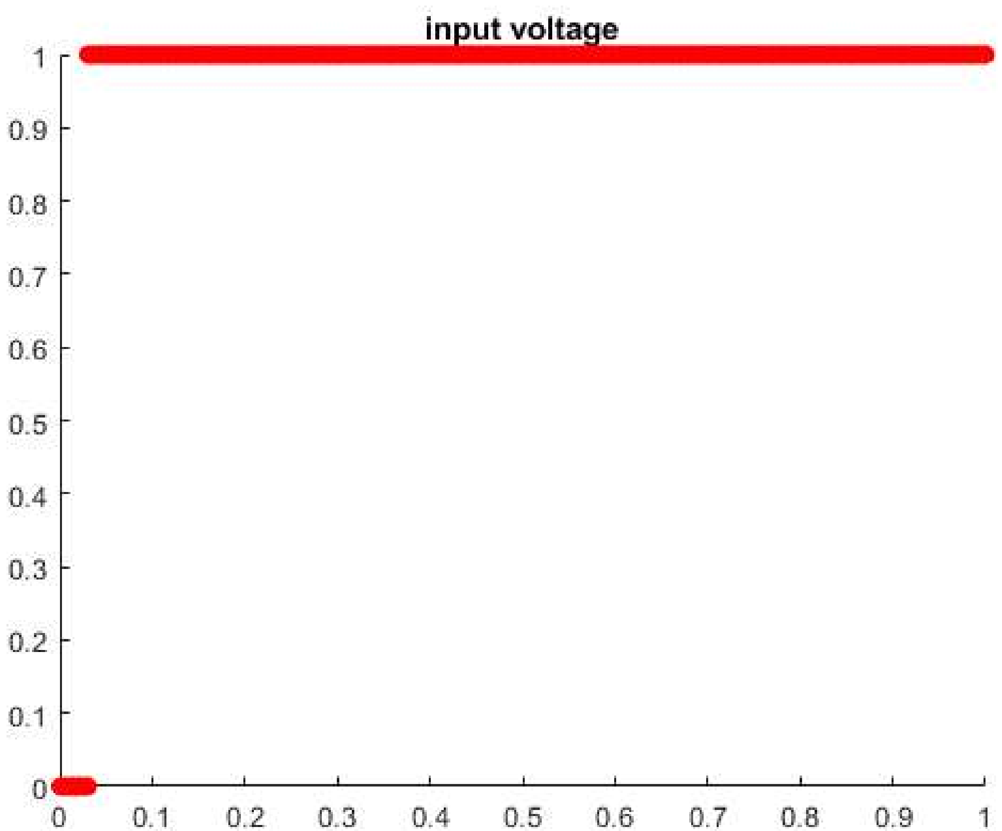

V3
8
6
4
2
0
-2
-4
-6
-8
-10
-8
-6
-4
-2
0
2
4
6
8
10

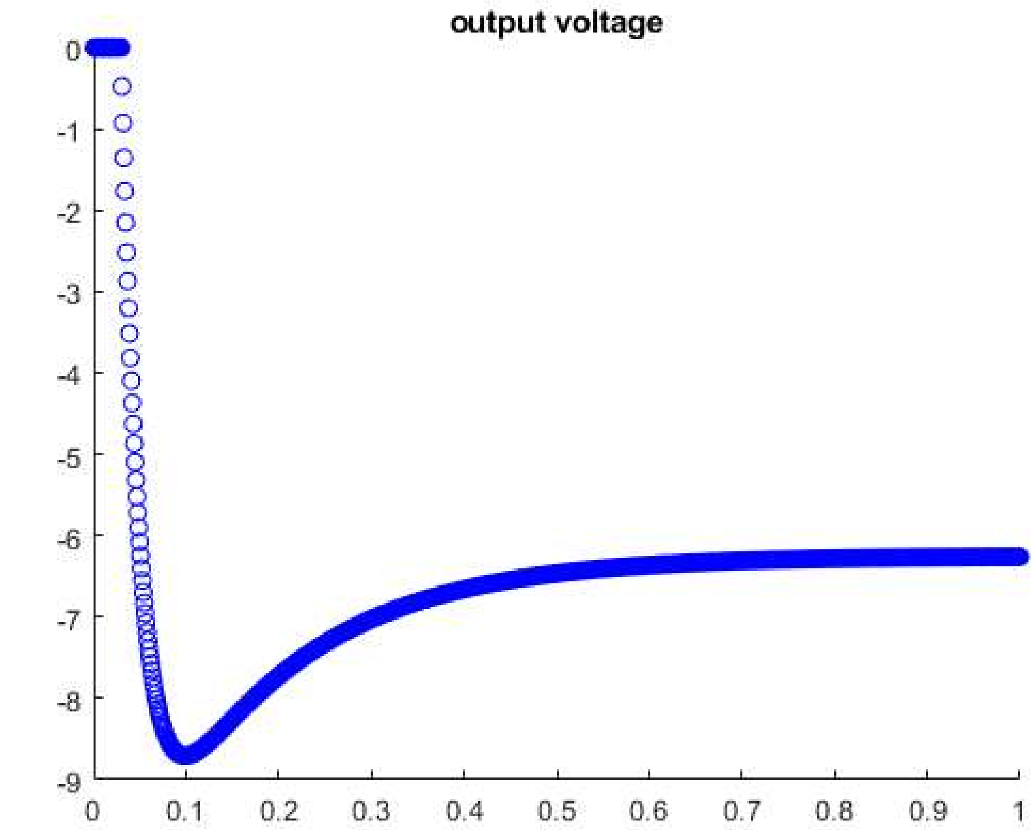

Vo
80
60
40
20
0
-20
-40
-60
-80
-10
-8
-6
-4
-2
0
2
4
6
8
10


Vo func of w
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
10^{-4}
10^{-2}
10^{0}
10^{2}
10^{4}
10^{6}

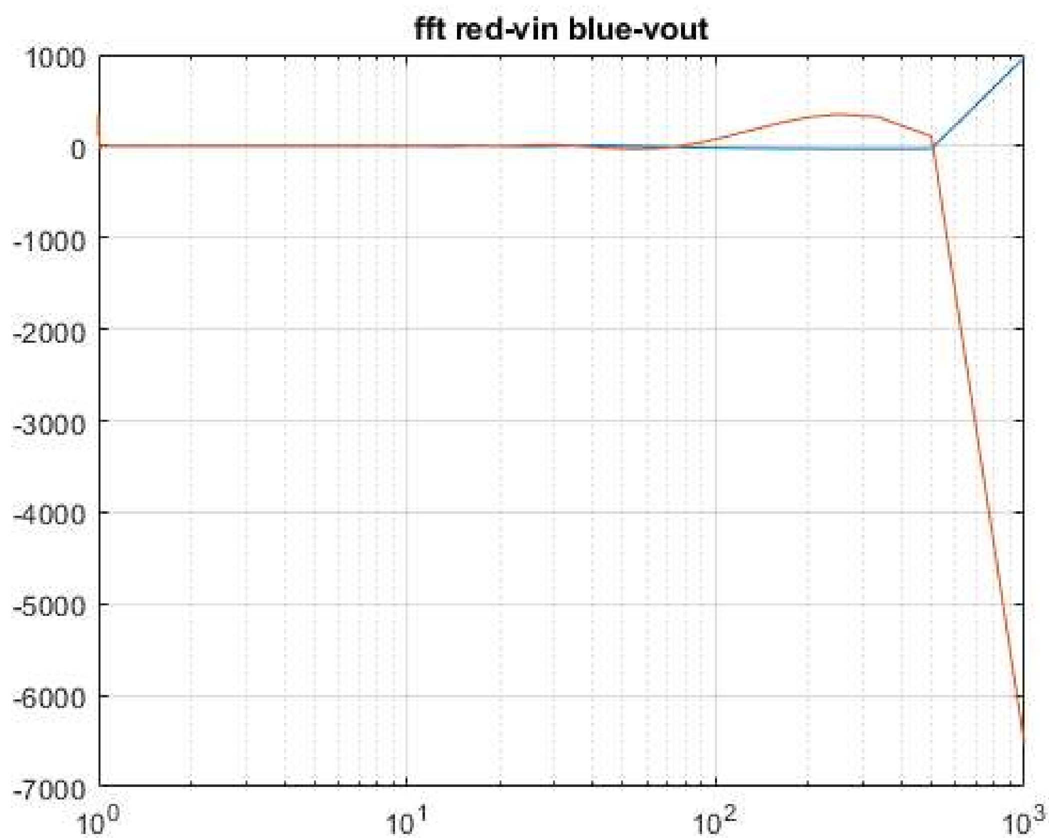

Gain in dB
20
10
0
-10
-20
-30
-40
-50
10^{-4}
10^{-2}
10^{0}
10^{2}
10^{4}
10^{6}


Hist of Gain
25
20
15
10
5
0
-8.4
-8.3
-8.2
-8.1
-8
-7.9
-7.8
-7.7
-7.6
-7.5
-7.4

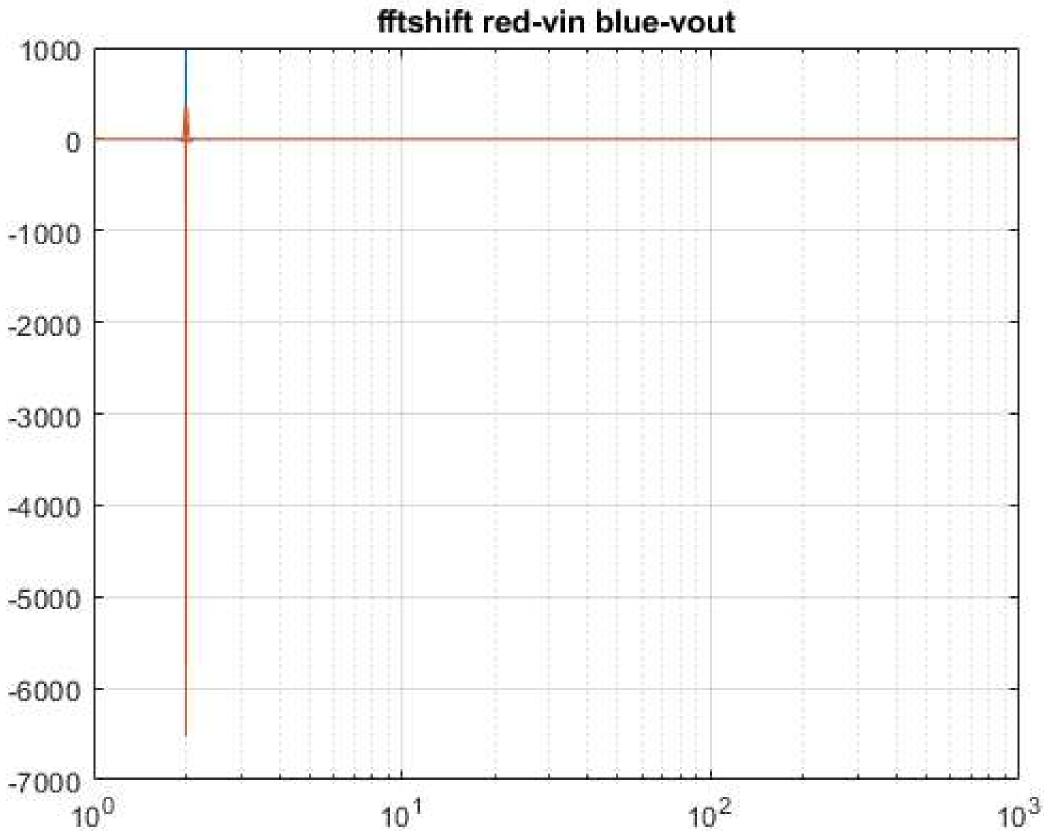

input voltage
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1



output voltage
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1



fft red-vin blue-vout
1000
0
-1000
-2000
-3000
-4000
-5000
-6000
-7000
10^0
10^1
10^2
10^3


fftshift red-vin blue-vout
1000
0
-1000
-2000
-3000
-4000
-5000
-6000
-7000
10^0
10^1
10^2
10^3