ANALOG ELECTRONICS LAB EC226

PROJECT REPORT ON “THE EFFECT OF NEGATIVE FEEDBACK ON GAIN AND BANDWIDTH OF THE AMPLIFIER”

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AIM: To study the effect of negative feedback on the gain and bandwidth of an amplifier.

THEORY:

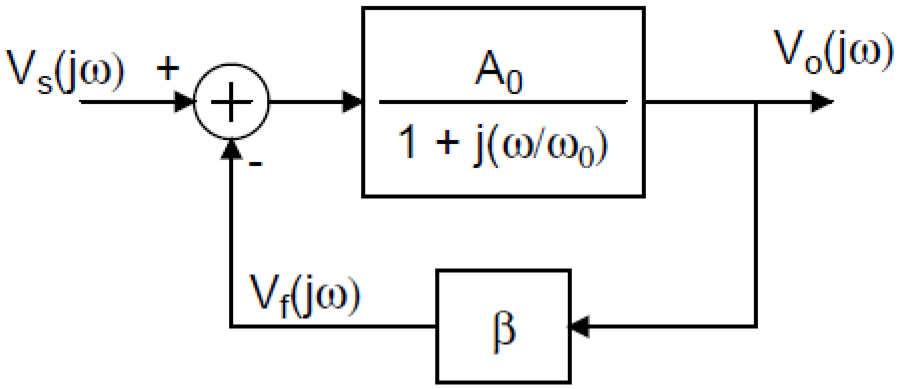
The forward gain of the amplifier A, is given by

$$A = \frac{A_0}{1 + j(\omega/\omega_0)}$$

Where A_0 = DC gain of the first order RC filter.

W_0= 3 dB bandwidth

Considering the block diagram of an amplifier we get

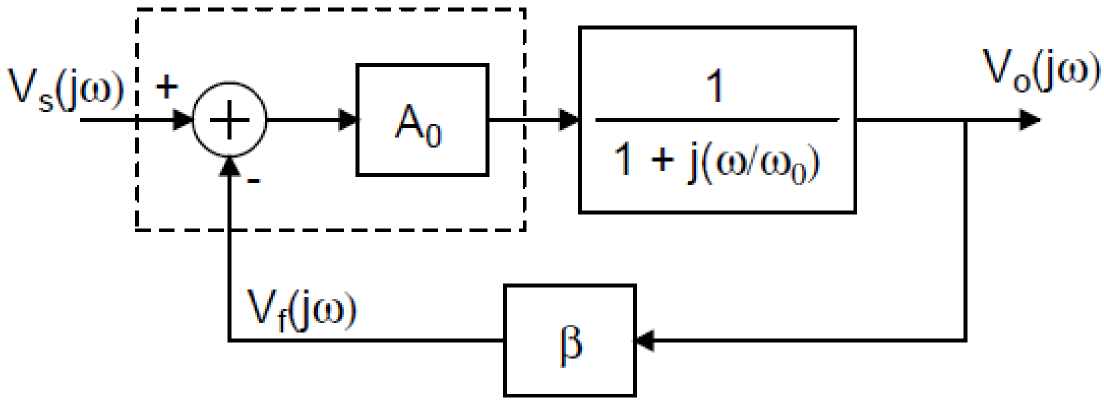


Where V_s is the input voltage

V_f is the feedback voltage

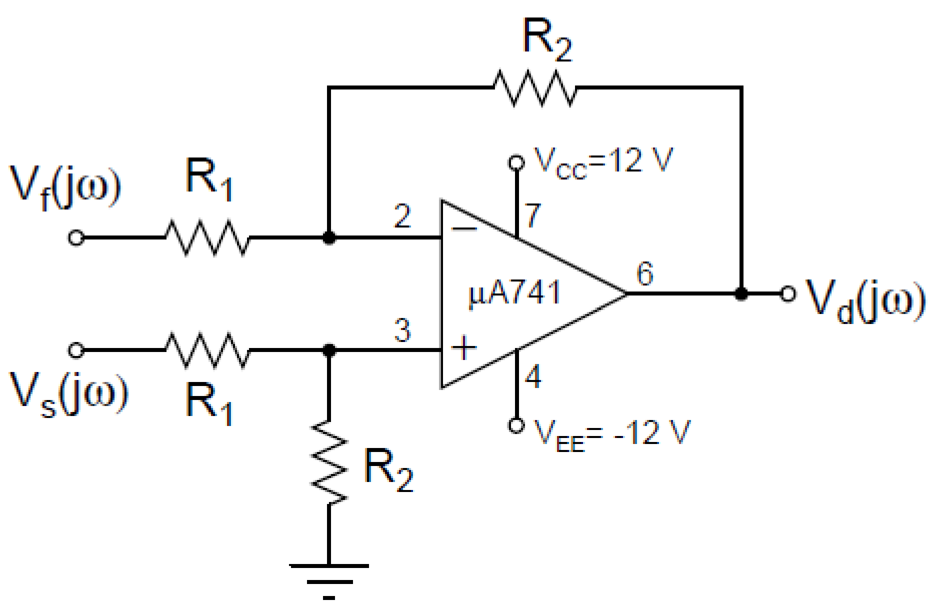
V_0 is the final output voltage

For our convenience we re-write the above block diagram in another way for easy implementation.



From the characteristics of op-amps we know that we can model the A_0 component of this block diagram.

For the other part of the forward gain involving *w* we can use a first order RC filter



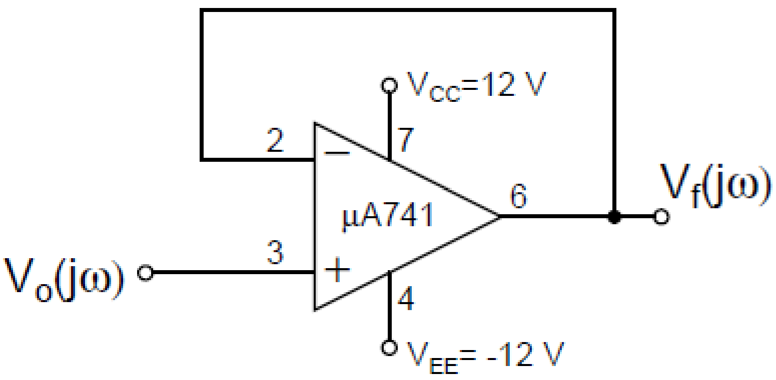
We know gain A_0 is given by,

$$A_0 = \frac{R_2}{R_1}$$

Based on this relation we can model our given circuit for any value of A_0.

For the feedback network we again use an op-amp. For this case we use the op-amp as a buffer with unity gain.

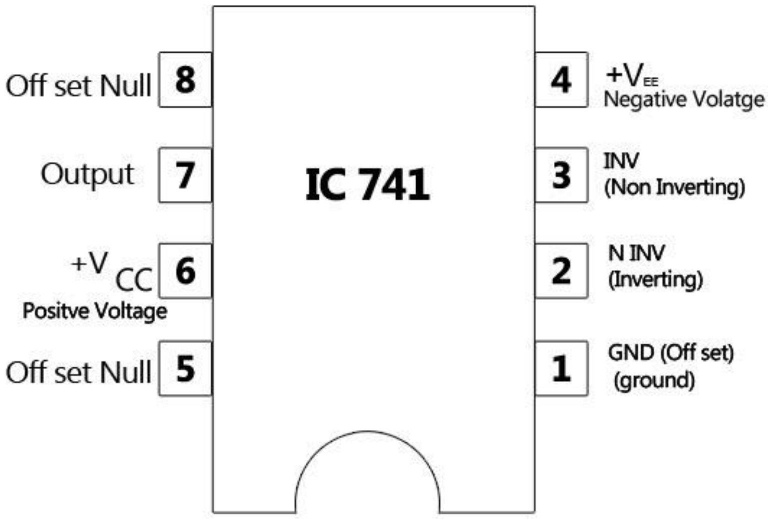
This is indicated in the diagram,



These block diagrams and circuit notations give us a clear idea on how to setup the experiment.

For all the op-amps in this experiment we are using μA741 IC.

The pin diagram for the IC is given below,



DESIGN OF CIRCUIT:

Given cut-off frequency for the RC filter is 200 Hz.

$$\frac{1}{2\pi RC} = f$$

$f_{cut\text{-}off} = 200 = \frac{1}{2\pi RC}$

$RC = \frac{1}{400\pi} = 7.95 \text{ X } 10^{-4}$

Taking R= 2.2 kΩ we get $C = \frac{1}{2\pi \ X\ 200\ X\ 2.2\ X\ 1000}$

$$C = 0.36\ \mu F$$

Approximate it to 0.33 µF.

This takes care of the first order RC filter portion of the circuit.

For the Amplifier $A_0 = 10$

$A_0 = \frac{R_2}{R_1}$ therefore $R_2 = 10k\Omega$ and $R_1 = 1k\Omega$

For approximated C=0.33μF the new cut-off frequency

$\frac{1}{2\pi RC} = f$ = $\frac{1000}{2\pi\ X\ 0.33\ X\ 2.2}$ = 219.22 Hz

COMPONENTS REQUIRED:

10 kΩ resistors (X2)

1 kΩ resistors (X2)

2.2 kΩ resistor (X1)

0.33 μF capacitor (X1)

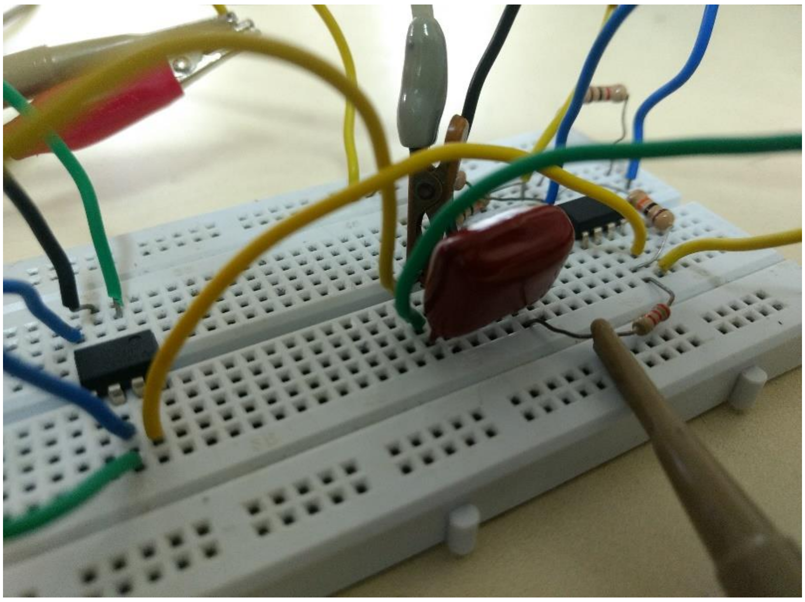
LM741 op-amp IC (X2)

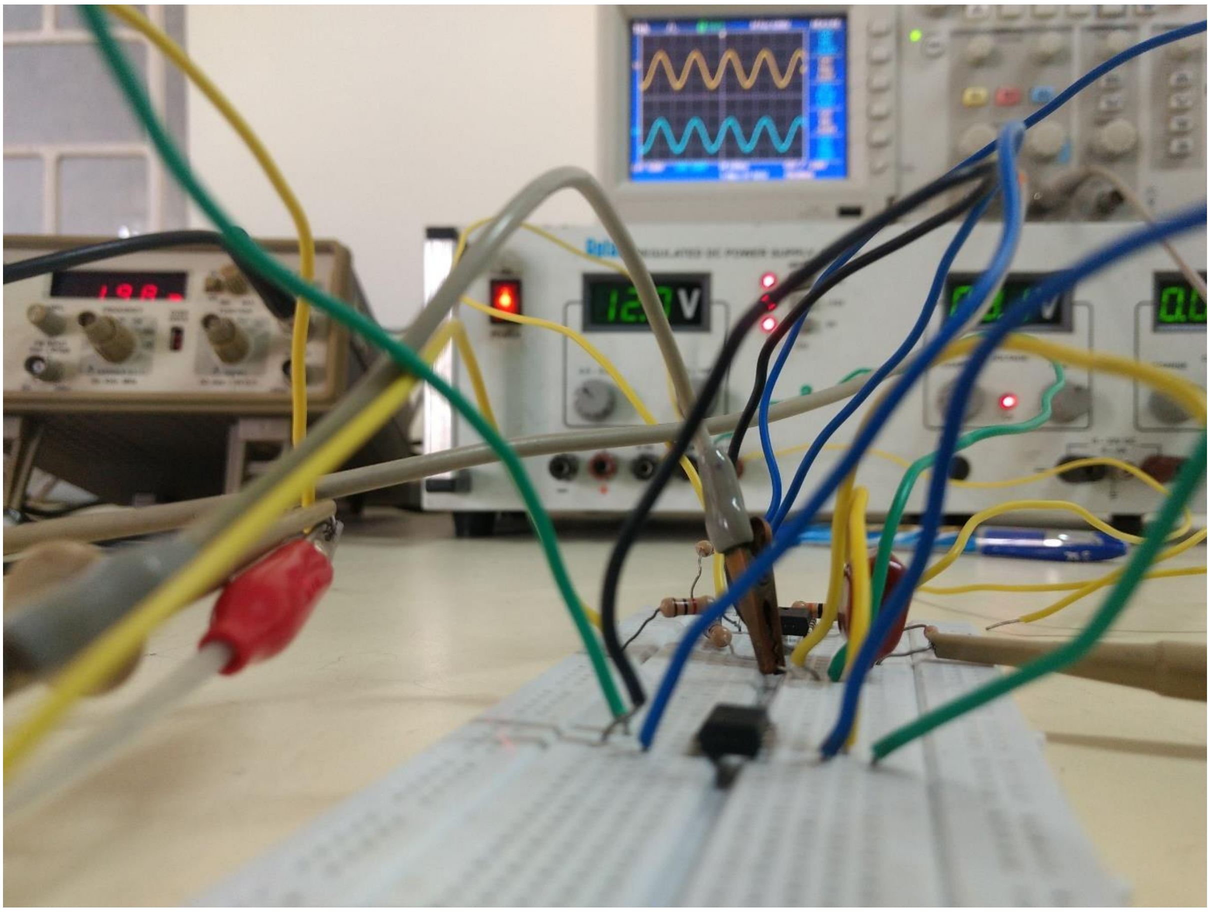
DC power supply of +12 and -12 V

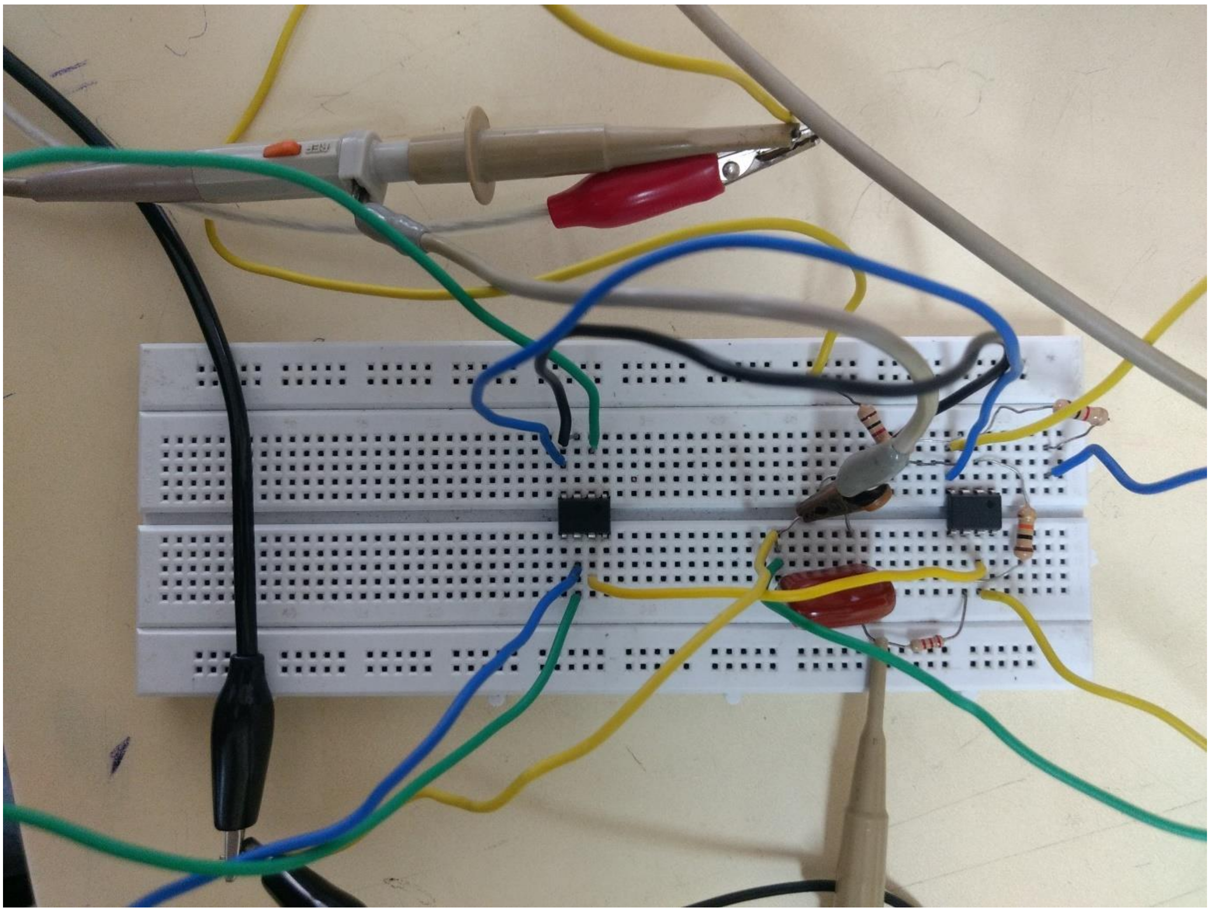
Function Generator

Digital Storage oscilloscope and probe wires

EXPERIMENTAL SETUP:







EXPERIMENTAL DATA RECORDED:

Without feedback data table:

Input Frequency	Gain (In dB)
10	20.172
30	20
50	19.82
80	19.645
100	19.465
120	19.08
150	18.689
180	18.276
190	18.06
200	17.841
210	17.616
220	17.38
230	17.38
260	16.65
300	15.847
500	12.86
800	9.54
1000	7.604
3000	-2.85
5000	-7.131
7000	-9.89
10000	-12.39
30000	-21.93

With feedback data table:

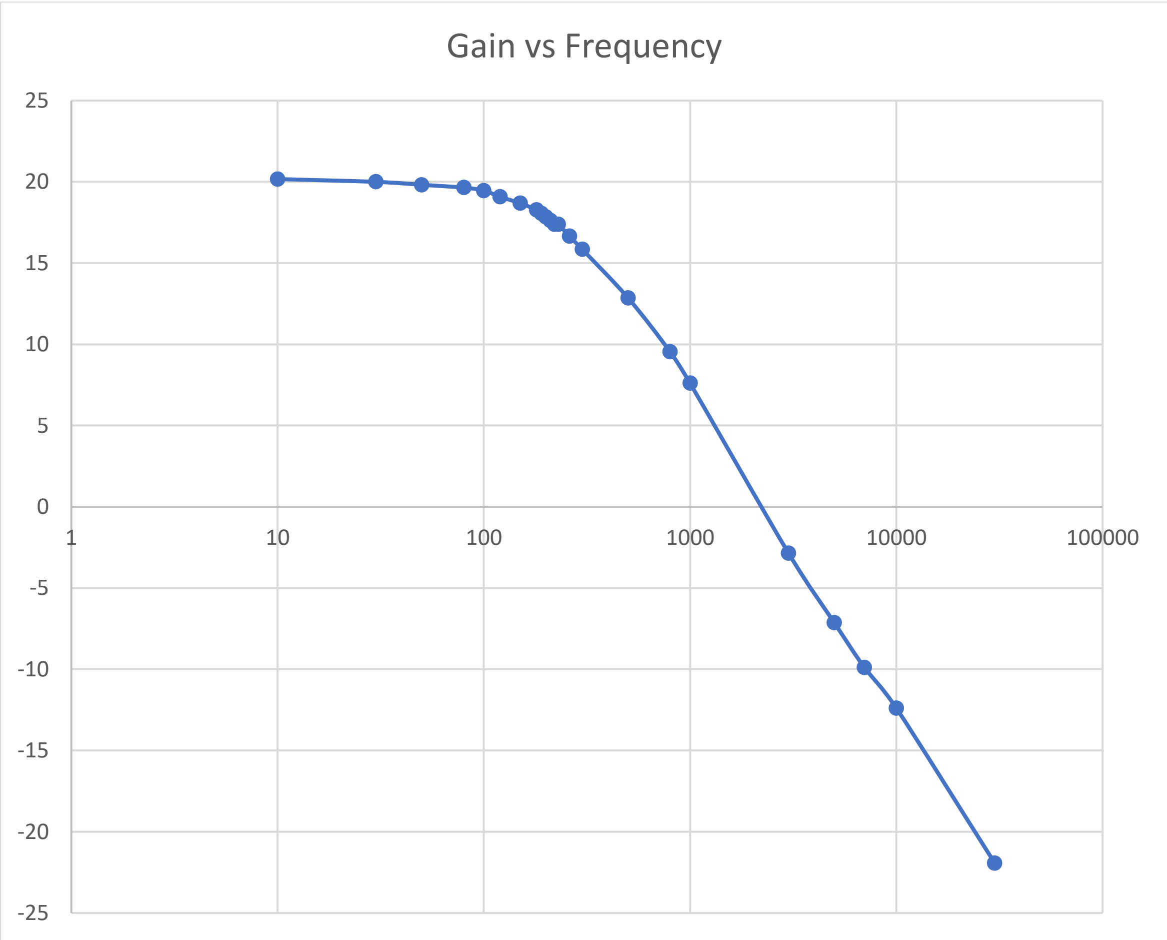
Input Frequency	Gain (In dB)
10	-0.72
50	-0.72
100	-0.72
500	-0.95
900	-1.68
1000	-1.85
1500	-2.71
1600	-3.05
1700	-3.35
1800	-3.56
1900	-3.77

2000	-3.98
2100	-4.15
2200	-4.44
2300	-4.55
2400	-4.79
2500	-5.04
3000	-6.52
5000	-9.89
7000	-12.69
10000	-15.49

GRAPHS OBTAINED:

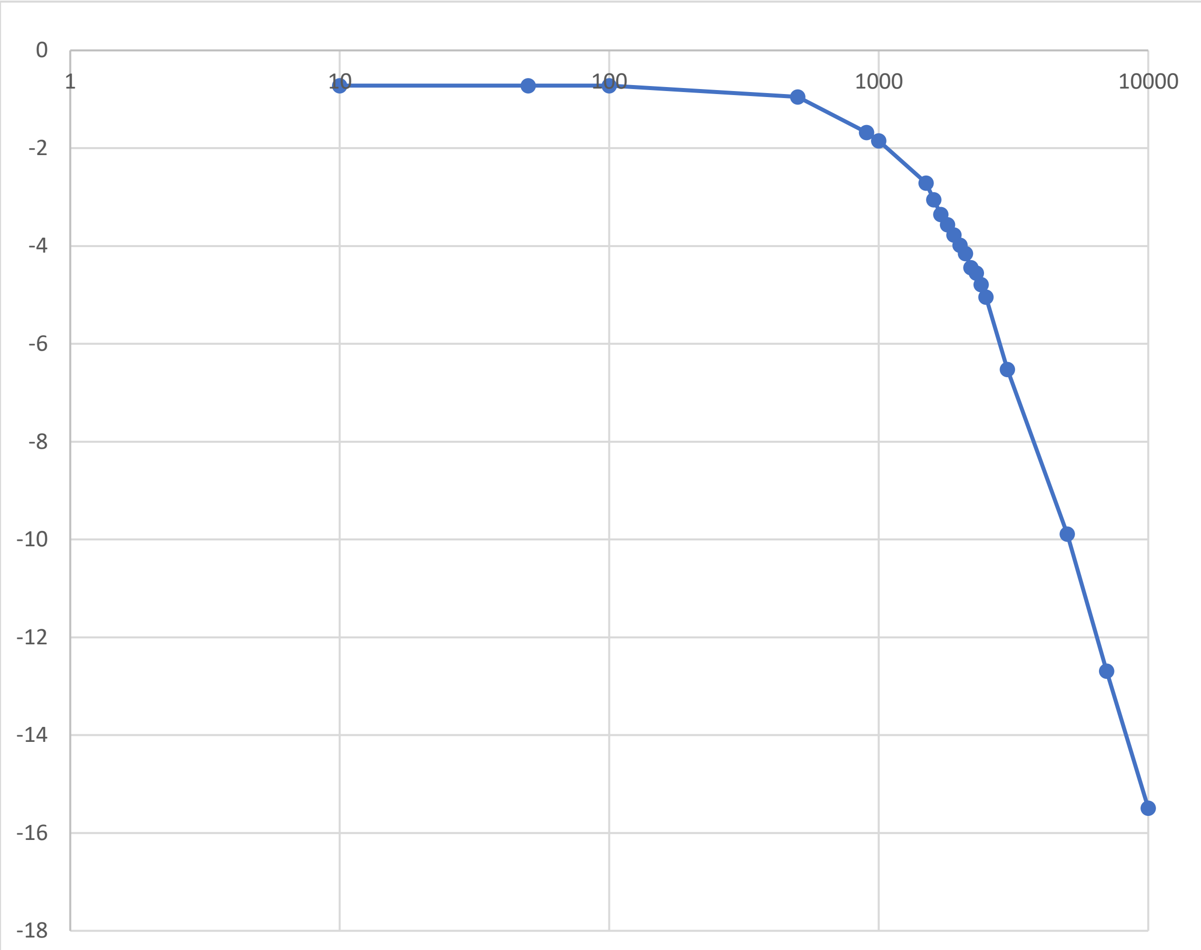
Without feedback:

Gain on X Axis and Frequency on Y Axis where Y axis is logarithmic.



With feedback:

Gain on X Axis and Frequency on Y Axis where Y axis is logarithmic



Result: By comparing the above two graphs we can clearly determine the effect feedback has on the gain for the same frequency.