Experiment 8:
Op-Amp Circuits

Post-Lab Report

A.

Prove theoretically that for an ideal op-amp

$$V_o = -\frac{R_2}{R_1} V_I$$

For an ideal operational amplifier:
Vp=Vn=0 in this case [P is grounded]
I n = I p = 0 A
I1 + I2 = I n = 0 A
Then I1 = - I2 , but I1 = V1 / R1 , and I2 = (V0 - 0) / R2 = -I1 ,
V0 = - I1 * R2 = -V1 (R2/R1)

Can you find a relationship between the low -frequency gain and bandwidth?

The bandwidth in this case is equal to the frequency at which the magnitude of the gain Vo/VI drops to 1/•ã2 of its low frequency =R2/R1 The absolute value of the gain: |A|= Vo/V1 = R2/R 1. To find a relation between the low-frequency gain and bandwidth, we refer to our experimental results:
For gain = 10, bandwidth = 91 KHz
For gain = 4.54, bandwidth = 95 Hz
Thus we can conclude when the gain increases the bandwidth decreases.
Thus the bandwidth is inversely proportional to the low-frequency gain.

B.

Prove theoretically that for an ideal op-amp

$$V_o = \left(1 + \frac{R_2}{R_1}\right) V_I$$

Vn = Vp = V1
I n = I p = 0 A
I1 + I2 = 0 A , then I1 = - I2
I1 = - Vn / R1 = -V1/R1 , I2 = (Vo - V1)/R2
Then Vo - V1 = I2*R2 = -I1 * R2 = V1 (R2/R1)
Therefore, Vo = V1 (1 + R2/R1)

C.

How does this bandwidth compare with that of the non-inverting amplifier?

The bandwidth of the non-inverting op-amp is equal to the frequency at which the magnitude of the gain drops to of its low frequency value (which, theoretically, is 1+R2/R1.)

E.

Prove theoretically that for an ideal op-amp

$$V_o = -\frac{1}{RC}\int V_I dt$$

To verify experimentally, you should prove that the peak to -peak output voltage is equal, in absolute value, to the area enclosed under the square wave (for 0 < t < T/2 or for T/2 < t < T) divided by the product RC.

V1-Ri=0 i=V1/R 0-Vcapacitor=Vo -i=CdVo/dt dVo/dt=-i/C=-V1/RC Vo=-V1/RCdt Vo=-1/RC•çV1dt

F.

Prove theoretically that for an ideal op-amp

$$V_o = -RC\frac{dv_I}{dt}$$

To prove experimentally, you should prove that the output voltage level is equal, in absolute value, to the product RC multiplied by the slope of the triangular input signal.

Vo=R icapacitor
Icapacitor=-Cdv/dt
Vo=-RCdV1/dt