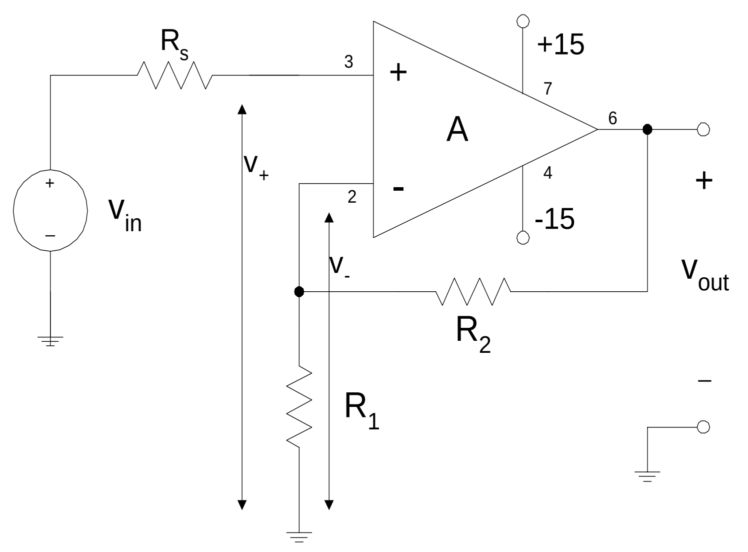
NON-INVERTING AMPLIFIER GAIN ANALYSIS

using FINITE OPEN LOOP GAIN examples

Refer to Figure 7 of the Motorola MC 1741C spec: Open-Loop Frequency Response



$$Let\ R_s = 0;\ Therefore\ v_+ = v_{in}$$

$$v_- = \frac{R_1}{R_1 + R_2} \times v_{out;} \qquad but\ v_+ = v_-$$

$$so\ v_{in} = \frac{R_1}{R_1 + R_2} \times v_{out;}$$

$$\frac{v_{out}}{v_{in}} = \frac{R_1 + R_2}{R_1}$$

$$or\ A_v = 1 + \frac{R_2}{R_1}$$

FINITE OPEN-LOOP GAIN ANALYSIS:

Examples at 1 Hz, 1000 Hz, and 10kHz

Voltage gain A_v=40dB = 100; R_2= 100kΩ, R_1= 1kΩ; [OK 101 = 40.1dB!]

1. At 1 Hz, A_{vol} = 100 dB = 1 x 10^5 = 100,000. [From the gain-bandwidth curve for the device.]

$$A_v = \frac{A}{1 + A\beta} = \frac{10^5}{1 + 10^5 \times .01} = \frac{10^5}{10^3} = 100 = 40\,dB$$

Note: Aβ = 10^3 = 60 dB; 60 dB loop gain + 40 dB closed loop gain = 100 dB total gain

2. At 1000 Hz, A_{vol} = 60 dB = 10^3 = 1000.

$$A_v = \frac{A}{1 + A\beta} = \frac{10^3}{1 + 10^3 \times .01} = \frac{10^3}{1 + 10} = \frac{1000}{11} = 90.9 = 39.2\,dB$$

Note: Aβ = 10^1 = 20 dB; 20 dB loop gain + 40 dB closed loop gain = 60 dB total gain

3. At 10 kHz, A_{vol} = 42 dB = 1.26 x 10^2 = 126.

$$A_v = \frac{A}{1 + A\beta} = \frac{126}{1 + 126 \times .01} = \frac{126}{1 + 1.26} = \frac{126}{2.26} = 55.8 = 34.9\,dB$$

Note: $A\beta$ = 1.26 = 2.0 dB; 2 dB loop gain + 40 dB closed loop gain = 42 dB total gain