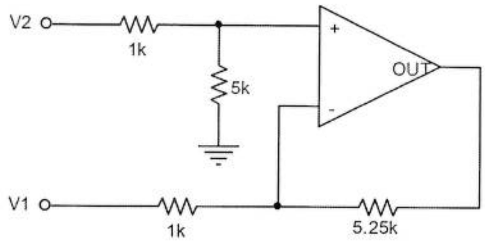
ELEC 401 Chapter 9 Quiz, Fall 2014 Name: Key

1. For the difference amplifier shown below, determine the CMRR in dB.



By superposition: $v_o = \left(\frac{5}{6}\right)\left(1+\frac{5.25}{1}\right)V_2 + \left(\frac{-5.25}{1}\right)V_1$

$= \left(\frac{5}{6}\right)\left(\frac{6.25}{1}\right)V_2 - \left(\frac{5.25}{1}\right)V_1$

$= 5.208V_2 - 5.25V_1$

$$\left.\begin{aligned} V_{cm} &= \frac{V_2+V_1}{2} \\ V_d &= V_2 - V_1 \end{aligned}\right\} \quad \begin{aligned} V_{cm} &= \frac{V_2}{2} + \frac{V_1}{2} \\ \frac{V_d}{2} &= \frac{V_2}{2} - \frac{V_1}{2} \end{aligned} \quad \left\} \begin{aligned} &\text{By Addition}: V_{cm} + \frac{V_d}{2} = V_2 \\ &\text{By Subtract}: V_{cm} - \frac{V_d}{2} = V_1 \end{aligned}\right.$$

$v_o = 5.208\left(V_{cm} + \frac{1}{2}V_d\right) - 5.25\left(V_{cm} - \frac{1}{2}V_D\right)$

$= -0.0417\,V_{cm} + 5.23\,V_D$

$\therefore |A_{cm}| = 0.0417 \;;\; |A_d| = 5.23$

$\therefore \text{CMRR} = 20\log\left(\frac{5.23}{.0417}\right) = \underline{\underline{42\,dB}}$

2. Design an inverting amplifier to provide a nominal closed-loop voltage gain of A_V=100 with no more than a 0.5% variance in the gain. The voltage source has an output resistance of 10kΩ±10%. If the rail voltages are ±10V, determine the range of acceptable input voltages.

$$A_V = \frac{-R_2}{R_1 + R_S}$$

$R_S = 10k\Omega \pm 10\%$

10% of 10kΩ = 100Ω

$\therefore 9.9k < R_S < 10.1k$

Max gain with $R_S = 9.9k\Omega$

0.5% of 100 = 0.5 => $99.5 < A_V < 100.5$

$$100.5 = \frac{R_2}{R_1 + 9.9} \quad ; \quad 99.5 = \frac{R_2}{R_1 + 10.1}$$

$100.5(R_1 + 9.9) = 99.5(R_1 + 10.1) \Rightarrow R_1 = \underline{10k\Omega}$

$\therefore \underline{R_2 = 2M\Omega}$

For $V_{o,max} = 10V$ @ largest gain (100.5)

$V_{i,max} = 99.5mV$

$\therefore \underline{-99.5mV < V_{i,max} < 99.5mV}$