

Experiment: TIA simple Z1 ZL

Filter 1

Filter Type: GE

$$Z(s): \left(\infty, \infty, \frac{R_3}{C_3 R_3 s + 1}, \infty, \infty, \frac{L_L s}{C_L L_L s^2 + 1} + R_L \right)$$

$$H(s): \frac{g_m (C_L L_L R_L s^2 + L_L s + R_L)}{(C_1 s + g_m) (C_L L_L s^2 + 1)}$$

$$\mathbf{Q}: \frac{C_L L_L g_m \sqrt{C_1^2 L_L^2}}{C_1}$$

$$\omega_0: \sqrt{\frac{1}{C_L L_L}}$$

$$\text{Bandwidth: } \frac{C_1}{C_L L_L g_m}$$

$$\mathbf{Qz}: C_L R_L \sqrt{\frac{1}{C_1 L_L}}$$

Filter 2

Filter Type: GE

$$Z(s): \left(\infty, \infty, R_3 + \frac{1}{C_3 s}, \infty, \infty, \frac{L_L s}{C_L L_L s^2 + 1} + R_L \right)$$

$$H(s): \frac{R_L g_m (C_L L_L R_L s^2 + L_L s + R_L)}{(C_L L_L s^2 + 1) (C_1 R_1 s + R_1 g_m + 1)}$$

$$\mathbf{Q}: \frac{C_L L_L \sqrt{C_1^2 L_L^2} (R_L g_m + 1)}{C_1 R_1}$$

$$\omega_0: \sqrt{\frac{1}{C_L L_L}}$$

$$\text{Bandwidth: } \frac{C_1 R_1}{C_L L_L (R_1 g_m + 1)}$$

$$\mathbf{Qz}: C_L R_L \sqrt{\frac{1}{C_1 L_L}}$$

Filter 3

Filter Type: GE

$$Z(s): \left(\infty, \infty, \frac{1}{C_3 s + \frac{1}{R_3} + \frac{1}{L_3^2 s}}, \infty, \infty, R_L \right)$$

$$H(s): \frac{R_L g_m (C_1 L_1 s^2 + C_1 R_1 s + 1)}{C_1 L_1 g_m s^2 + C_1 R_1 g_m s + C_1 s + g_m}$$

$$\mathbf{Q}: \frac{L_1 g_m \sqrt{C_1^2 L_1^2}}{R_1 g_m + 1}$$

$$\omega_0: \sqrt{\frac{1}{C_1 L_1}}$$

$$\text{Bandwidth: } \frac{R_1 g_m + 1}{L_1 g_m}$$

$$\mathbf{Qz}: \frac{L_1 \sqrt{C_1^2 L_1^2}}{R_1}$$

Filter 4

Filter Type: GE

$$Z(s): \left(\infty, \infty, \frac{R_3 (L_3 s + \frac{1}{C_3})}{L_3 s + R_3 + \frac{1}{C_3 s}}, \infty, \infty, R_L \right)$$

$$H(s): \frac{R_L g_m (C_1 L_1 R_1 s^2 + L_1 s + R_1)}{C_1 L_1 R_1 g_m s^2 + C_1 L_1 s^2 + L_1 g_m s + R_1 g_m + 1}$$

$$\mathbf{Q}: \frac{C_1 \sqrt{C_1^2 L_1^2} (R_1 g_m + 1)}{g_m}$$

$$\omega_0: \sqrt{\frac{1}{C_1 L_1}}$$

$$\text{Bandwidth: } \frac{g_m}{C_1 (R_1 g_m + 1)}$$

$$\mathbf{Qz}: C_1 R_1 \sqrt{\frac{1}{C_1 L_1}}$$