

Experiment: TIA simple Z1 ZL

Filter 1

Filter Type: BP

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

$$H(s): \frac{L_L R_3 R_L g_m s}{(R_L g_m + 1)(C_L L_L R_L s^2 + L_L s + R_L)}$$

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

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

$$\text{Bandwidth: } \frac{1}{C_L R_L}$$

Filter 2

Filter Type: BP

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

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

$$\mathbf{Q}: \frac{C_L L_L R_L g_m \sqrt{\frac{1}{C_L L_L R_L g_m}}}{C_L R_L + L_L g_m}$$

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

$$\text{Bandwidth: } \frac{C_L R_L + L_L g_m}{C_L L_L R_L g_m}$$

Filter 3

Filter Type: BP

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

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

$$\mathbf{Q}: \frac{C_L L_L g_m \sqrt{\frac{1}{C_L^2 L_L}}}{C_L}$$

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

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

Filter 4

Filter Type: BP

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

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

$$\mathbf{Q}: \frac{L_L \sqrt{\frac{R_L g_m}{L_L (C_L + C_L R_L g_m)}} (C_L + C_L R_L g_m)}{C_L R_L + L_L g_m}$$

$$\omega_0: \sqrt{\frac{R_L g_m}{L_L (C_L + C_L R_L g_m)}}$$

$$\text{Bandwidth: } \frac{C_L R_L + L_L g_m}{L_L (C_L + C_L R_L g_m)}$$

Filter 5

Filter Type: BP

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

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

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

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

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

Filter 6

Filter Type: BP

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

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

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

$$\omega_0: \sqrt{\frac{R_L (R_L g_m + 1)}{L_L (C_L R_L + C_L R_L R_L g_m + C_L R_L)}}$$

$$\text{Bandwidth: } \frac{C_L R_L R_L + L_L R_L g_m + L_L}{L_L (C_L R_L + C_L R_L R_L g_m + C_L R_L)}$$

Filter 7

Filter Type: BP

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

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

$$\mathbf{Q}: \frac{C_L \sqrt{\frac{1}{C_L^2 L_L}}}{g_m}$$

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

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

Filter 8

Filter Type: BP

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

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

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

$$\omega_0: \sqrt{\frac{1}{L_L (C_L + C_L R_L g_m)}}$$

$$\text{Bandwidth: } \frac{C_L R_L + L_L g_m}{L_L (C_L + C_L R_L g_m)}$$

Filter 9

Filter Type: BP

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

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

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

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

$$\text{Bandwidth: } \frac{R_L g_m + 1}{C_L R_L}$$

Filter 10

Filter Type: BP

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

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

$$\mathbf{Q}: \frac{L_L \sqrt{\frac{R_L}{L_L (C_L R_L + C_L R_L R_L g_m + C_L R_L)}} (C_L R_L + C_L R_L R_L g_m + C_L R_L)}{C_L R_L R_L + L_L R_L g_m + L_L}$$

$$\omega_0: \sqrt{\frac{R_L}{L_L (C_L R_L + C_L R_L R_L g_m + C_L R_L)}}$$

$$\text{Bandwidth: } \frac{C_L R_L R_L + L_L R_L g_m + L_L}{L_L (C_L R_L + C_L R_L R_L g_m + C_L R_L)}$$