

Experiment: TIA Z3 ZL

Filter 1

Invalid filter  
 $Z(s)$ :  $(\infty, \infty, R_3, \infty, \infty, R_L)$

Filter 2

Invalid filter  
 $Z(s)$ :  $(\infty, \infty, R_3, \infty, \infty, \frac{1}{C_L s})$

Filter 3

Invalid filter  
 $Z(s)$ :  $(\infty, \infty, R_3, \infty, \infty, \frac{R_3}{C_L R_L s + 1})$

Filter 4

Invalid filter  
 $Z(s)$ :  $(\infty, \infty, R_3, \infty, \infty, R_L + \frac{1}{C_L s})$

Filter 5

Filter Type: BS  
 $Z(s)$ :  $(\infty, \infty, R_3, \infty, \infty, L_L s + \frac{1}{C_L s})$   
 $H(s)$ :  $\frac{R_3(C_L L_L s^2 + 1)}{C_L L_L s^2 + C_L R_3 s + 1}$   
**Q**:  $\frac{L_L \sqrt{\frac{1}{C_L L_L}}}{R_3}$   
 $\omega_0$ :  $\sqrt{\frac{1}{C_L L_L}}$   
**Bandwidth**:  $\frac{R_3}{L_L}$

Filter 6

Filter Type: BP  
 $Z(s)$ :  $(\infty, \infty, R_3, \infty, \infty, \frac{L_L s}{C_L L_L s^2 + 1})$   
 $H(s)$ :  $\frac{L_L R_3 s}{C_L L_L R_3 s^2 + L_L s + R_3}$   
**Q**:  $C_L R_3 \sqrt{\frac{1}{C_L L_L}}$   
 $\omega_0$ :  $\sqrt{\frac{1}{C_L L_L}}$   
**Bandwidth**:  $\frac{1}{C_L R_3}$

Filter 7

Filter Type: GE  
 $Z(s)$ :  $(\infty, \infty, R_3, \infty, \infty, L_L s + R_L + \frac{1}{C_L s})$   
 $H(s)$ :  $\frac{R_3(C_L L_L s^2 + C_L R_L s + 1)}{C_L L_L s^2 + C_L R_3 s + C_L R_L s + 1}$   
**Q**:  $\frac{L_L \sqrt{\frac{1}{C_L L_L}}}{R_3 + R_L}$   
 $\omega_0$ :  $\sqrt{\frac{1}{C_L L_L}}$   
**Bandwidth**:  $\frac{R_3 + R_L}{L_L}$   
**Qz**:  $\frac{L_L \sqrt{\frac{1}{C_L L_L}}}{R_L}$

Filter 8

Filter Type: BP  
 $Z(s)$ :  $(\infty, \infty, R_3, \infty, \infty, \frac{1}{R_L + \frac{1}{C_L s}})$   
 $H(s)$ :  $\frac{L_L R_3 R_L s}{C_L L_L R_3 R_L s^2 + L_L R_3 s + L_L R_L s + R_3 R_L}$   
**Q**:  $\frac{C_L R_3 R_L \sqrt{\frac{1}{C_L L_L}}}{R_3 + R_L}$   
 $\omega_0$ :  $\sqrt{\frac{1}{C_L L_L}}$   
**Bandwidth**:  $\frac{R_3 + R_L}{C_L R_3 R_L}$

Filter 9

Filter Type: GE  
 $Z(s)$ :  $(\infty, \infty, R_3, \infty, \infty, \frac{L_L s}{C_L L_L s^2 + 1} + R_L)$   
 $H(s)$ :  $\frac{R_3(C_L L_L R_L s^2 + L_L s + R_L)}{C_L L_L R_3 s^2 + C_L L_L R_L s^2 + L_L s + R_3 + R_L}$   
**Q**:  $C_L \sqrt{\frac{1}{C_L L_L}} (R_3 + R_L)$   
 $\omega_0$ :  $\sqrt{\frac{1}{C_L L_L}}$   
**Bandwidth**:  $\frac{1}{C_L (R_3 + R_L)}$   
**Qz**:  $C_L R_L \sqrt{\frac{1}{C_L L_L}}$

Filter 10

Filter Type: BS  
 $Z(s)$ :  $(\infty, \infty, R_3, \infty, \infty, \frac{R_L (L_L s + \frac{1}{C_L s})}{L_L s + R_L + \frac{1}{C_L s}})$   
 $H(s)$ :  $\frac{R_3 R_L (C_L L_L s^2 + 1)}{C_L L_L R_3 s^2 + C_L L_L R_L s^2 + C_L R_3 R_L s + R_3 + R_L}$   
**Q**:  $\frac{L_L \sqrt{\frac{1}{C_L L_L}} (R_3 + R_L)}{R_3 R_L}$   
 $\omega_0$ :  $\sqrt{\frac{1}{C_L L_L}}$   
**Bandwidth**:  $\frac{R_3 R_L}{L_L (R_3 + R_L)}$

Filter 11

Invalid filter  
 $Z(s)$ :  $(\infty, \infty, \frac{1}{C_3 s}, \infty, \infty, R_L)$

Filter 12

Invalid filter  
 $Z(s)$ :  $(\infty, \infty, \frac{1}{C_3 s}, \infty, \infty, \frac{1}{C_L s})$

Filter 13

Invalid filter  
 $Z(s)$ :  $(\infty, \infty, \frac{1}{C_3 s}, \infty, \infty, \frac{R_3}{C_L R_L s + 1})$

Filter 14

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

**Filter 15**

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

**Filter 16**

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

**Filter 17**

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

**Filter 18**

**Filter Type:** BP

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

$H(s)$ :  $\frac{L_L R_L s}{C_3 L_L R_L s^2 + C_L L_L R_L s^2 + L_L s + R_L}$

**Q:**  $R_L \sqrt{\frac{1}{L_L (C_3 + C_L)}} (C_3 + C_L)$

$\omega_0$ :  $\sqrt{\frac{1}{L_L (C_3 + C_L)}}$

**Bandwidth:**  $\frac{1}{R_L (C_3 + C_L)}$

**Filter 19**

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

**Filter 20**

**Filter Type:** BS

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

$H(s)$ :  $\frac{R_L (C_L L_L s^2 + 1)}{C_3 C_L R_L R_L s^2 + C_3 R_L s + C_L L_L s^2 + C_L R_L s + 1}$

**Q:**  $\frac{C_L L_L \sqrt{\frac{1}{C_L^2 L_L}}}{R_L (C_3 + C_L)}$

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

**Bandwidth:**  $\frac{R_L (C_3 + C_L)}{C_L L_L}$

**Filter 21**

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

**Filter 22**

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

**Filter 23**

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

**Filter 24**

**Filter Type:** Invalid011

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

$H(s)$ :  $\frac{R_3 (C_L R_L s + 1)}{C_3 C_L R_3 R_3 s^2 + C_3 R_3 s + C_L R_3 s^2 + C_L R_3 s + 1}$

**Q:**  $\frac{C_3 C_L R_3 R_L \sqrt{\frac{1}{C_3^2 C_L^2 R_3 R_L}}}{C_3 R_3 + C_L R_3 + C_L R_L}$

$\omega_0$ :  $\sqrt{\frac{1}{C_3 C_L R_3 R_L}}$

**Bandwidth:**  $\frac{C_3 R_3 + C_L R_3 + C_L R_L}{C_3 C_L R_3 R_L}$

**Filter 25**

**Filter Type:** BS

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

$H(s)$ :  $\frac{R_3 (C_L L_L s^2 + 1)}{C_3 C_L R_3 R_3 s^2 + C_3 R_3 s + C_L L_L s^2 + C_L R_3 s + 1}$

**Q:**  $\frac{C_L L_L \sqrt{\frac{1}{C_L^2 L_L}}}{R_3 (C_3 + C_L)}$

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

**Bandwidth:**  $\frac{R_3 (C_3 + C_L)}{C_L L_L}$

**Filter 26**

**Filter Type:** BP

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

$H(s)$ :  $\frac{L_L R_3 s}{C_3 L_L R_3 s^2 + C_L L_L R_3 s^2 + L_L s + R_3}$

**Q:**  $R_3 \sqrt{\frac{1}{L_L (C_3 + C_L)}} (C_3 + C_L)$

$\omega_0$ :  $\sqrt{\frac{1}{L_L (C_3 + C_L)}}$

**Bandwidth:**  $\frac{1}{R_3 (C_3 + C_L)}$

**Filter 27**

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

**Filter 28**

**Filter Type:** BP

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

$H(s)$ :  $\frac{L_L R_3 R_L s}{C_3 L_L R_3 R_L s^2 + C_L L_L R_3 R_L s^2 + L_L R_3 s + L_L R_L s + R_3 R_L}$

**Q:**  $\frac{R_3 R_L \sqrt{\frac{1}{L_L (C_3 + C_L)}}}{R_3 + R_L} (C_3 + C_L)$

$\omega_0$ :  $\sqrt{\frac{1}{L_L (C_3 + C_L)}}$

**Bandwidth:**  $\frac{R_3 + R_L}{R_3 R_L (C_3 + C_L)}$

**Filter 29**

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

**Filter 30****Filter Type:** BS

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

$$H(s): \frac{R_3 R_L (C_L L_L s^2 + 1)}{C_3 C_L L_L R_3 R_L s^3 + C_3 R_3 R_L s + C_L L_L R_3 s^2 + C_L L_L R_L s^2 + C_L R_3 R_L s + R_3 + R_L}$$

$$Q: \frac{C_L L_L \sqrt{C_L^2 L_L^2 (R_3 + R_L)}}{R_3 R_L (C_3 + C_L)}$$

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

$$\text{Bandwidth: } \frac{R_3 R_L (C_3 + C_L)}{C_L L_L (R_3 + R_L)}$$

**Filter 31**

Invalid filter

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

**Filter 32**

Invalid filter

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

**Filter 33****Filter Type:** Invalid011

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

$$H(s): \frac{R_L (C_3 R_3 s + 1)}{C_3 C_L R_3 R_L s^2 + C_3 R_3 + C_3 R_L s + C_L R_L s + 1}$$

$$Q: \frac{C_3 C_L R_3 R_L \sqrt{C_3^2 C_L^2 R_3 R_L}}{C_3 R_3 + C_3 R_L + C_L R_L}$$

$$\omega_0: \sqrt{\frac{1}{C_3 C_L R_3 R_L}}$$

$$\text{Bandwidth: } \frac{C_3 R_3 + C_3 R_L + C_L R_L}{C_3 C_L R_3 R_L}$$

**Filter 34**

Invalid filter

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

**Filter 35**

Invalid filter

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

**Filter 36****Filter Type:** Invalid110

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

$$H(s): \frac{L_L s (C_3 R_3 s + 1)}{C_3 C_L L_L R_3 s^2 + C_3 L_L R_3 s^2 + C_3 R_3 s + C_L L_L s^2 + 1}$$

$$Q: \frac{L_L \sqrt{C_3^2 (C_3 + C_L)} (C_3 + C_L)}{C_3 R_3}$$

$$\omega_0: \sqrt{\frac{1}{L_L (C_3 + C_L)}}$$

$$\text{Bandwidth: } \frac{C_3 R_3}{L_L (C_3 + C_L)}$$

**Filter 37**

Invalid filter

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

**Filter 38****Filter Type:** Invalid110

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

$$H(s): \frac{L_L R_L s (C_L R_3 s + 1)}{C_3 C_L L_L R_3 R_L s^3 + C_3 L_L R_3 s^3 + C_3 L_L R_L R_L s^3 + C_3 R_3 R_L s + C_L L_L R_L s^3 + L_L s^3 + R_L}$$

$$Q: \frac{L_L \sqrt{\frac{R_3}{L_L (C_3 R_3 + C_3 R_L + C_L R_L)}} (C_3 R_3 + C_3 R_L + C_L R_L)}{C_3 R_3 R_L + L_L}$$

$$\omega_0: \sqrt{\frac{R_L}{L_L (C_3 R_3 + C_3 R_L + C_L R_L)}}$$

$$\text{Bandwidth: } \frac{C_3 R_3 R_L + L_L}{L_L (C_3 R_3 + C_3 R_L + C_L R_L)}$$

**Filter 39**

Invalid filter

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

**Filter 40**

Invalid filter

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

**Filter 41****Filter Type:** BS

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

$$H(s): \frac{R_L (C_3 L_3 s^2 + 1)}{C_3 C_L L_3 R_L s^2 + C_3 L_3 s^2 + C_3 R_L s + C_L R_L s + 1}$$

$$Q: \frac{L_3 \sqrt{C_3^2 L_3^2}}{R_L}$$

$$\omega_0: \sqrt{\frac{1}{C_3 L_3}}$$

$$\text{Bandwidth: } \frac{R_L}{L_3}$$

**Filter 42**

Invalid filter

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

**Filter 43****Filter Type:** BS

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

$$H(s): \frac{R_L (C_3 L_3 s^2 + 1)}{C_3 C_L L_3 R_L s^2 + C_3 L_3 s^2 + C_3 R_L s + C_L R_L s + 1}$$

$$Q: \frac{C_3 L_3 \sqrt{\frac{1}{C_3^2 L_3^2}}}{R_L (C_3 + C_L)}$$

$$\omega_0: \sqrt{\frac{1}{C_3 L_3}}$$

$$\text{Bandwidth: } \frac{R_L (C_3 + C_L)}{C_3 L_3}$$

**Filter 44**

Invalid filter

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

**Filter 45**

Invalid filter  
 $Z(s)$ :  $\left(\infty, \infty, L_3 s + \frac{1}{C_3 s}, \infty, \infty, L_L s + \frac{1}{C_L s}\right)$

**Filter 46**

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

**Filter 47**

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

**Filter 48**

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

**Filter 49**

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

**Filter 50**

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

**Filter 51**

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

$H(s)$ :  $\frac{L_3 R_L s}{C_3 L_3 R_L s^2 + L_3 s + R_L}$

**Q:**  $C_3 R_L \sqrt{\frac{1}{C_3 L_3}}$

$\omega_0$ :  $\sqrt{\frac{1}{C_3 L_3}}$

**Bandwidth:**  $\frac{1}{C_3 R_L}$

**Filter 52**

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

**Filter 53**

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

$H(s)$ :  $\frac{L_3 R_L s}{C_3 L_3 R_L s^2 + C_L^2 R_L s^2 + L_3 s + R_L}$

**Q:**  $R_L \sqrt{\frac{1}{L_3 (C_3 + C_L)}} (C_3 + C_L)$

$\omega_0$ :  $\sqrt{\frac{1}{L_3 (C_3 + C_L)}}$

**Bandwidth:**  $\frac{1}{R_L (C_3 + C_L)}$

**Filter 54**

**Filter Type:** Invalid110  
 $Z(s)$ :  $\left(\infty, \infty, \frac{L_3 s}{C_3 L_3 s^2 + 1}, \infty, \infty, R_L + \frac{1}{C_L s}\right)$

$H(s)$ :  $\frac{L_3 s (C_L R_L s + 1)}{C_3 C_L L_3 R_L s^3 + C_3 L_3 s^2 + C_L L_3 s^2 + C_L R_L s + 1}$

**Q:**  $\frac{L_3 \sqrt{\frac{1}{L_3 (C_3 + C_L)}} (C_3 + C_L)}{C_L R_L}$

$\omega_0$ :  $\sqrt{\frac{1}{L_3 (C_3 + C_L)}}$

**Bandwidth:**  $\frac{C_L R_L}{L_3 (C_3 + C_L)}$

**Filter 55**

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

**Filter 56**

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

**Filter 57**

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

**Filter 58**

**Filter Type:** BP  
 $Z(s)$ :  $\left(\infty, \infty, \frac{L_3 s}{C_3 L_3 s^2 + 1}, \infty, \infty, \frac{1}{C_L s + \frac{1}{R_L} + \frac{1}{L_L s}}\right)$

$H(s)$ :  $\frac{L_3 L_L R_L s}{C_3 L_3 L_L R_L s^2 + C_L^2 L_3 L_L R_L s^2 + L_3 L_L s + L_3 R_L + L_L R_L}$

**Q:**  $R_L \sqrt{\frac{L_3 + L_L}{L_3 L_L (C_3 + C_L)}} (C_3 + C_L)$

$\omega_0$ :  $\sqrt{\frac{L_3 + L_L}{L_3 L_L (C_3 + C_L)}}$

**Bandwidth:**  $\frac{1}{R_L (C_3 + C_L)}$

**Filter 59**

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

**Filter 60**

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

**Filter 61**

**Filter Type:** GE

$$Z(s)\text{:}\left(\infty,\infty,L_3s+R_3+\frac{1}{C_3s},\infty,\infty,R_L\right)$$

$$H(s)\text{:}\frac{R_L\left(C_3L_3s^2+C_3R_3s+1\right)}{C_3L_3s^2+C_3R_3s+C_3R_LR_Ls+1}$$

$$\mathbf{Q}\text{:}\frac{L_3\sqrt{\frac{C_3L_3}{R_3+R_L}}}{R_3+R_L}$$

$$\omega_0\text{:}\sqrt{\frac{1}{C_3L_3}}$$

$$\mathbf{Bandwidth}\text{:}\frac{R_3+R_L}{L_3}$$

$$\mathbf{Qz}\text{:}\frac{L_3\sqrt{\frac{C_3L_3}{R_3}}}{R_3}$$

**Filter 62**

Invalid filter

$$Z(s)\text{:}\left(\infty,\infty,L_3s+R_3+\frac{1}{C_3s},\infty,\infty,\frac{1}{C_Ls}\right)$$

**Filter 63**

Invalid filter

$$Z(s)\text{:}\left(\infty,\infty,L_3s+R_3+\frac{1}{C_3s},\infty,\infty,\frac{R_LR_L}{C_LR_Ls^2+1}\right)$$

**Filter 64**

Invalid filter

$$Z(s)\text{:}\left(\infty,\infty,L_3s+R_3+\frac{1}{C_3s},\infty,\infty,R_L+\frac{1}{C_Ls}\right)$$

**Filter 65**

Invalid filter

$$Z(s)\text{:}\left(\infty,\infty,L_3s+R_3+\frac{1}{C_3s},\infty,\infty,L_Ls+\frac{1}{C_Ls}\right)$$

**Filter 66**

Invalid filter

$$Z(s)\text{:}\left(\infty,\infty,L_3s+R_3+\frac{1}{C_3s},\infty,\infty,\frac{L_Ls}{C_LL_Ls^2+1}\right)$$

**Filter 67**

Invalid filter

$$Z(s)\text{:}\left(\infty,\infty,L_3s+R_3+\frac{1}{C_3s},\infty,\infty,L_Ls+R_L+\frac{1}{C_Ls}\right)$$

**Filter 68**

Invalid filter

$$Z(s)\text{:}\left(\infty,\infty,L_3s+R_3+\frac{1}{C_3s},\infty,\infty,\frac{1}{C_Ls+\frac{1}{R_L+\frac{1}{L_Ls}}}\right)$$

**Filter 69**

Invalid filter

$$Z(s)\text{:}\left(\infty,\infty,L_3s+R_3+\frac{1}{C_3s},\infty,\infty,\frac{-L_Ls}{C_LL_Ls^2+1}+R_L\right)$$

**Filter 70**

Invalid filter

$$Z(s)\text{:}\left(\infty,\infty,L_3s+R_3+\frac{1}{C_3s},\infty,\infty,\frac{R_L\left(L_Ls+\frac{1}{C_L}\right)}{L_Ls+R_L+\frac{1}{C_Ls}}\right)$$

**Filter 71**

**Filter Type:** BP

$$Z(s)\text{:}\left(\infty,\infty,\frac{1}{C_3s+\frac{1}{R_3}+\frac{1}{L_3s}},\infty,\infty,R_L\right)$$

$$H(s)\text{:}\frac{L_3R_3R_Ls}{C_3L_3R_3R_LR_Ls^2+L_3R_3s+L_3R_Ls+R_3R_L}$$

$$\mathbf{Q}\text{:}\frac{C_3R_3R_L\sqrt{\frac{C_3L_3}{R_3+R_L}}}{R_3+R_L}$$

$$\omega_0\text{:}\sqrt{\frac{1}{C_3L_3}}$$

$$\mathbf{Bandwidth}\text{:}\frac{R_3+R_L}{C_3R_3R_L}$$

**Filter 72**

**Filter Type:** BP

$$Z(s)\text{:}\left(\infty,\infty,\frac{1}{C_3s+\frac{1}{R_3}+\frac{1}{L_3s}},\infty,\infty,\frac{1}{C_Ls}\right)$$

$$H(s)\text{:}\frac{L_3R_3s}{C_3L_3R_3s^2+C_LL_3R_3s^2+L_3s+R_3}$$

$$\mathbf{Q}\text{:}R_3\sqrt{\frac{1}{L_3(C_3+C_L)}}(C_3+C_L)$$

$$\omega_0\text{:}\sqrt{\frac{1}{L_3(C_3+C_L)}}$$

$$\mathbf{Bandwidth}\text{:}\frac{1}{R_3(C_3+C_L)}$$

**Filter 73**

**Filter Type:** BP

$$Z(s)\text{:}\left(\infty,\infty,\frac{1}{C_3s+\frac{1}{R_3}+\frac{1}{L_3s}},\infty,\infty,\frac{R_L}{C_LR_Ls+1}\right)$$

$$H(s)\text{:}\frac{L_3R_3R_Ls}{C_3C_LL_3R_3R_LR_Ls^2+C_LL_3R_3R_LR_Ls^2+L_3R_3s+L_3R_LR_Ls+R_3R_L}$$

$$\mathbf{Q}\text{:}\frac{R_3R_L\sqrt{\frac{1}{L_3(C_3+C_L)}}(C_3+C_L)}{R_3+R_L}$$

$$\omega_0\text{:}\sqrt{\frac{1}{L_3(C_3+C_L)}}$$

$$\mathbf{Bandwidth}\text{:}\frac{R_3+R_L}{R_3R_L(C_3+C_L)}$$

**Filter 74**

**Filter Type:** Invalid110

$$Z(s)\text{:}\left(\infty,\infty,\frac{1}{C_3s+\frac{1}{R_3}+\frac{1}{L_3s}},\infty,\infty,R_L+\frac{1}{C_Ls}\right)$$

$$H(s)\text{:}\frac{L_3R_3s(C_LR_Ls+1)}{C_3C_LL_3R_3R_LR_Ls^2+C_3L_3R_3s^2+C_LL_3R_3s^2+C_LL_3R_LR_Ls^2+C_LR_3R_LR_Ls+L_3s+R_3}$$

$$\mathbf{Q}\text{:}\frac{L_3\sqrt{\frac{R_3}{L_3(C_3R_3+C_LR_3s+C_LR_L)}}(C_3R_3+C_LR_3+C_LR_L)}{C_LR_3R_LR_L+L_3}$$

$$\omega_0\text{:}\sqrt{\frac{1}{L_3(C_3R_3+C_LR_3s+C_LR_L)}}$$

$$\mathbf{Bandwidth}\text{:}\frac{C_LR_3R_LR_L+L_3}{L_3(C_3R_3+C_LR_3s+C_LR_L)}$$

**Filter 75**

Invalid filter

$$Z(s)\text{:}\left(\infty,\infty,\frac{1}{C_3s+\frac{1}{R_3}+\frac{1}{L_3s}},\infty,\infty,L_Ls+\frac{1}{C_Ls}\right)$$

**Filter 76****Filter Type:** BP

$$Z(s): \left( \infty, \infty, \frac{1}{C_3s+\frac{1}{R_3}+\frac{1}{L_3s}}, \infty, \infty, \frac{L_Ls}{C_L L_Ls^2+1} \right)$$

$$H(s): \frac{C_3L_3L_LR_3s^2+C_3L_3L_LR_3R_Ls+L_3L_LR_3R_LR_3}{C_3L_3L_LR_3s^2+C_3L_3L_LR_3R_Ls+L_3L_LR_3+L_3R_3+L_LR_3}$$

$$\mathbf{Q}: R_3\sqrt{\frac{L_3+L_L}{L_3L_L(C_3+C_L)}}(C_3+C_L)$$

$$\omega_0: \sqrt{\frac{L_3+L_L}{L_3L_L(C_3+C_L)}}$$

$$\mathbf{Bandwidth:} \frac{1}{R_3(C_3+C_L)}$$

**Filter 77**

Invalid filter

$$Z(s): \left( \infty, \infty, \frac{1}{C_3s+\frac{1}{R_3}+\frac{1}{L_3s}}, \infty, \infty, L_Ls+R_L+\frac{1}{C_Ls} \right)$$

**Filter 78****Filter Type:** BP

$$Z(s): \left( \infty, \infty, \frac{1}{C_3s+\frac{1}{R_3}+\frac{1}{L_3s}}, \infty, \infty, \frac{1}{C_Ls+\frac{1}{R_L}+\frac{1}{L_Ls}} \right)$$

$$H(s): \frac{L_3L_LR_3R_Ls}{C_3L_3L_LR_3R_Ls^2+C_3L_3L_LR_3R_LR_3+L_3L_LR_3R_Ls+L_3L_LR_3R_Ls+L_3R_3R_L+L_LR_3R_L}$$

$$\mathbf{Q}: R_3R_L\sqrt{\frac{L_3+L_L}{L_3L_L(C_3+C_L)}}(C_3+C_L)$$

$$\omega_0: \sqrt{\frac{L_3+L_L}{L_3L_L(C_3+C_L)}}$$

$$\mathbf{Bandwidth:} \frac{R_3+R_L}{R_3R_L(C_3+C_L)}$$

**Filter 79**

Invalid filter

$$Z(s): \left( \infty, \infty, \frac{1}{C_3s+\frac{1}{R_3}+\frac{1}{L_3s}}, \infty, \infty, \frac{L_Ls}{C_L L_Ls^2+1}+R_L \right)$$

**Filter 80**

Invalid filter

$$Z(s): \left( \infty, \infty, \frac{1}{C_3s+\frac{1}{R_3}+\frac{1}{L_3s}}, \infty, \infty, \frac{R_L\left(L_Ls+\frac{1}{C_Ls}\right)}{L_Ls+R_L+C_Ls} \right)$$

**Filter 81****Filter Type:** GE

$$Z(s): \left( \infty, \infty, \frac{L_3s}{C_3L_3s^2+1}+R_3, \infty, \infty, R_L \right)$$

$$H(s): \frac{R_L\left(C_3L_3R_3s^2+L_3s+R_3\right)}{C_3L_3R_3s^2+C_3L_3R_Ls^2+L_3s+R_3+R_L}$$

$$\mathbf{Q}: C_3\sqrt{\frac{1}{C_3L_3}}\left(R_3+R_L\right)$$

$$\omega_0: \sqrt{\frac{1}{C_3L_3}}$$

$$\mathbf{Bandwidth:} \frac{1}{C_3\left(R_3+R_L\right)}$$

$$\mathbf{Qz:} C_3R_3\sqrt{\frac{1}{C_3L_3}}$$

**Filter 82**

Invalid filter

$$Z(s): \left( \infty, \infty, \frac{L_3s}{C_3L_3s^2+1}+R_3, \infty, \infty, \frac{1}{C_Ls} \right)$$

**Filter 83**

Invalid filter

$$Z(s): \left( \infty, \infty, \frac{L_3s}{C_3L_3s^2+1}+R_3, \infty, \infty, \frac{R_L}{C_LR_Ls+1} \right)$$

**Filter 84**

Invalid filter

$$Z(s): \left( \infty, \infty, \frac{L_3s}{C_3L_3s^2+1}+R_3, \infty, \infty, R_L+\frac{1}{C_Ls} \right)$$

**Filter 85**

Invalid filter

$$Z(s): \left( \infty, \infty, \frac{L_3s}{C_3L_3s^2+1}+R_3, \infty, \infty, L_Ls+\frac{1}{C_Ls} \right)$$

**Filter 86**

Invalid filter

$$Z(s): \left( \infty, \infty, \frac{L_3s}{C_3L_3s^2+1}+R_3, \infty, \infty, \frac{L_Ls}{C_L L_Ls^2+1} \right)$$

**Filter 87**

Invalid filter

$$Z(s): \left( \infty, \infty, \frac{L_3s}{C_3L_3s^2+1}+R_3, \infty, \infty, L_Ls+R_L+\frac{1}{C_Ls} \right)$$

**Filter 88**

Invalid filter

$$Z(s): \left( \infty, \infty, \frac{L_3s}{C_3L_3s^2+1}+R_3, \infty, \infty, \frac{1}{C_Ls+\frac{1}{R_L}+\frac{1}{L_Ls}} \right)$$

**Filter 89**

Invalid filter

$$Z(s): \left( \infty, \infty, \frac{L_3s}{C_3L_3s^2+1}+R_3, \infty, \infty, \frac{L_Ls}{C_L L_Ls^2+1}+R_L \right)$$

**Filter 90**

Invalid filter

$$Z(s): \left( \infty, \infty, \frac{L_3s}{C_3L_3s^2+1}+R_3, \infty, \infty, \frac{R_L\left(L_Ls+\frac{1}{C_Ls}\right)}{L_Ls+R_L+C_Ls} \right)$$

**Filter 91****Filter Type:** BS

$$Z(s): \left( \infty, \infty, \frac{R_3\left(L_3s+\frac{1}{C_Ls}\right)}{L_3s+R_3+\frac{1}{C_Ls}}, \infty, \infty, R_L \right)$$

$$H(s): \frac{R_3R_L\left(C_3L_3s^2+1\right)}{C_3L_3R_3s^2+C_3L_3R_LR_Ls^2+C_3R_3R_Ls+R_3+R_L}$$

$$\mathbf{Q}: \frac{L_3\sqrt{\frac{1}{C_3R_3}}\left(R_3+R_L\right)}{R_3R_L}$$

$$\omega_0: \sqrt{\frac{1}{C_3L_3}}$$

$$\mathbf{Bandwidth:} \frac{R_3R_L}{L_3\left(R_3+R_L\right)}$$

**Filter 92**

**Filter Type:** BS

$$Z(s)\colon \left(\infty,\infty,\frac{R_3\left(L_3s+\frac{1}{C_3^2}\right)}{L_3s+R_3+\frac{1}{C_3^2}},\infty,\infty,\frac{1}{C_Ls}\right)$$

$$H(s)\colon \frac{R_2\left(C_3L_3s^2+1\right)}{C_3C_LL_3R_3s^3+C_3L_3s^2+C_3R_3+C_LR_3+1}$$

$$\mathbf{Q}\colon \frac{C_3L_3\sqrt{\frac{1}{C_3^2L_3}}}{R_3(C_3+C_L)}$$

$$\omega_0\colon \sqrt{\frac{1}{C_3L_3}}$$

$$\textbf{Bandwidth}\colon \frac{R_3(C_3+C_L)}{C_3L_3}$$

**Filter 93**

**Filter Type:** BS

$$Z(s)\colon \left(\infty,\infty,\frac{R_3\left(L_3s+\frac{1}{C_3^2}\right)}{L_3s+R_3+\frac{1}{C_3^2}},\infty,\infty,\frac{R_L}{C_LR_Ls+1}\right)$$

$$H(s)\colon \frac{R_2R_L\left(C_3L_3s^2+1\right)}{C_3C_LL_3R_3R_LR_Ls^3+C_3L_3R_3s^2+C_3L_3R_Ls^2+C_3R_3R_Ls+C_LR_3R_Ls+R_3+R_L}$$

$$\mathbf{Q}\colon \frac{C_3L_3\sqrt{\frac{1}{C_3^2L_3}}(R_3+R_L)}{R_3R_L(C_3+C_L)}$$

$$\omega_0\colon \sqrt{\frac{1}{C_3L_3}}$$

$$\textbf{Bandwidth}\colon \frac{R_2R_L(C_3+C_L)}{C_3L_3(R_3+R_L)}$$

**Filter 94**

Invalid filter

$$Z(s)\colon \left(\infty,\infty,\frac{R_3\left(L_3s+\frac{1}{C_3^2}\right)}{L_3s+R_3+\frac{1}{C_3^2}},\infty,\infty,R_L+\frac{1}{C_Ls}\right)$$

**Filter 95**

Invalid filter

$$Z(s)\colon \left(\infty,\infty,\frac{R_3\left(L_3s+\frac{1}{C_3^2}\right)}{L_3s+R_3+\frac{1}{C_3^2}},\infty,\infty,L_Ls+\frac{1}{C_Ls}\right)$$

**Filter 96**

Invalid filter

$$Z(s)\colon \left(\infty,\infty,\frac{R_3\left(L_3s+\frac{1}{C_3^2}\right)}{L_3s+R_3+\frac{1}{C_3^2}},\infty,\infty,\frac{L_Ls}{C_LL_Ls^2+1}\right)$$

**Filter 97**

Invalid filter

$$Z(s)\colon \left(\infty,\infty,\frac{R_3\left(L_3s+\frac{1}{C_3^2}\right)}{L_3s+R_3+\frac{1}{C_3^2}},\infty,\infty,L_Ls+R_L+\frac{1}{C_Ls}\right)$$

**Filter 98**

Invalid filter

$$Z(s)\colon \left(\infty,\infty,\frac{R_3\left(L_3s+\frac{1}{C_3^2}\right)}{L_3s+R_3+\frac{1}{C_3^2}},\infty,\infty,\frac{1}{C_Ls+\frac{1}{R_L}+\frac{1}{L_Ls}}\right)$$

**Filter 99**

Invalid filter

$$Z(s)\colon \left(\infty,\infty,\frac{R_3\left(L_3s+\frac{1}{C_3^2}\right)}{L_3s+R_3+\frac{1}{C_3^2}},\infty,\infty,\frac{L_Ls}{C_LL_Ls^2+1}+R_L\right)$$

**Filter 100**

Invalid filter

$$Z(s)\colon \left(\infty,\infty,\frac{R_3\left(L_3s+\frac{1}{C_3^2}\right)}{L_3s+R_3+\frac{1}{C_3^2}},\infty,\infty,\frac{R_L\left(L_Ls+\frac{1}{C_L^2}\right)}{L_Ls+R_L+\frac{1}{C_L^2}}\right)$$