

Experiment: TIA simple Z3 ZL

Filter 1

Invalid filter

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

$$H(s): \frac{R_3 R_L}{R_3 + R_L}$$

Filter 2

Invalid filter

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

$$H(s): \frac{R_3}{C_L R_3 s + 1}$$

Filter 3

Invalid filter

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

$$H(s): \frac{R_3 R_L}{C_L R_3 R_L s + R_3 + R_L}$$

Filter 4

Invalid filter

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

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

Filter 5

Filter Type: BS

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

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

$$\mathbf{Q}: \frac{L_L \sqrt{\sigma_L^2 L_L}}{C_L \sqrt{\frac{1}{R_3}}}$$

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

$$\text{Bandwidth: } \frac{R_3}{L_L}$$

Filter 6

Filter Type: BP

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

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

$$\mathbf{Q}: C_L R_3 \sqrt{\frac{1}{C_L L_L}}$$

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

$$\text{Bandwidth: } \frac{1}{C_L^2 R_3}$$

Filter 7

Filter Type: GE

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

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

$$\mathbf{Q}: \frac{L_L \sqrt{\frac{C_L L_L}{R_3 + R_L}}}{R_3 + R_L}$$

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

$$\text{Bandwidth: } \frac{R_3 + R_L}{L_L}$$

$$\mathbf{Qz}: \frac{L_L \sqrt{\sigma_L^2 L_L}}{R_L}$$

Filter 8

Filter Type: BP

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

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

$$\mathbf{Q}: \frac{C_L R_3 R_L \sqrt{\sigma_L^2 L_L}}{R_3 + R_L}$$

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

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

Filter 9

Filter Type: GE

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

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

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

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

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

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

Filter 10

Filter Type: BS

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

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

$$\mathbf{Q}: \frac{L_L \sqrt{\frac{1}{\sigma_L^2 L_L}} (R_3 + R_L)}{R_3 R_L}$$

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

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

Filter 11

Invalid filter

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

$$H(s): \frac{R_L}{C_3 R_L s + 1}$$

Filter 12

Invalid filter

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

$$H(s): \frac{1}{s (C_3 + C_L)}$$

Filter 13

Invalid filter

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

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

Filter 14

Invalid filter

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

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

Filter 15

Invalid filter

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

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

Filter 16

Invalid filter

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

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

Filter 17

Invalid filter

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

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

Filter 18**Filter Type:** BP

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

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

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

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

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

Filter 19

Invalid filter

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

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

Filter 20**Filter Type:** BS

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

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

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

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

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

Filter 21

Invalid filter

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

$$H(s): \frac{R_3 R_L}{C_3 R_3 R_L s + R_3 + R_L}$$

Filter 22

Invalid filter

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

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

Filter 23

Invalid filter

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

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

Filter 24**Filter Type:** Invalid011

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

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

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

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

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

Filter 25**Filter Type:** BS

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

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

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

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

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

Filter 26**Filter Type:** BP

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

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

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

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

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

Filter 27

Invalid filter

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

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

Filter 28**Filter Type:** BP

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

$$H(s): \frac{L_L R_3 R_4 s}{C_3 C_L R_3 R_L s^2 + C_L L_L R_3 R_L s^2 + L_L R_3 s + L_L R_L s + R_3 R_L}$$

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

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

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

Filter 29

Invalid filter

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

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

Filter 30**Filter Type:** BS

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

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

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

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

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

Filter 31

Invalid filter

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

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

Filter 32

Invalid filter

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

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

Filter 33**Filter Type:** Invalid011

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

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

$$\mathbf{Q}: \frac{C_3 C_L R_3 R_L \sqrt{C_3 C_L R_3 R_L}}{C_3 R_3 s + C_3 R_L s + C_L R_L}$$

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

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

Filter 34

Invalid filter

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

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

Filter 35

Invalid filter

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

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

Filter 36**Filter Type:** Invalid110

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

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

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

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

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

Filter 37

Invalid filter

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

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

Filter 38**Filter Type:** Invalid110

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

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

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

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

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

Filter 39

Invalid filter

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

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

Filter 40

Invalid filter

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

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

Filter 41**Filter Type:** BS

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

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

$$\mathbf{Q}: \frac{L_3 \sqrt{\frac{1}{C_3^2 L_3}}}{R_L}$$

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

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

Filter 42

Invalid filter

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

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

Filter 43**Filter Type:** BS

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

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

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

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

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

Filter 44

Invalid filter

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

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

Filter 45

Invalid filter

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

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

Filter 46

Invalid filter

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

$$H(s): \frac{L_L s (C_3 L_3 s^2 + 1)}{C_3 C_L L_3 L_L s^4 + C_3 L_3 s^2 + C_3 L_L s^2 + C_L L_L s^2 + 1}$$

Filter 47

Invalid filter

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

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

Filter 48

Invalid filter

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

$$H(s): \frac{L_L R_L s (C_3 L_3 s^2 + 1)}{C_3 C_L L_3 L_L R_L s^4 + C_3 L_3 L_L s^2 + C_3 L_3 R_L s^2 + C_3 L_L R_L s^2 + C_L R_L s^2 + L_L s + R_L}$$

Filter 49

Invalid filter

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

$$H(s): \frac{(C_3 L_3 s^2 + 1)(C_L L_L R_L s^2 + L_L s + R_L)}{C_3 C_L L_3 L_L s^4 + C_3 C_L L_L R_L s^2 + C_3 L_3 s^2 + C_3 L_L s^2 + C_3 R_L s + C_L L_L s^2 + 1}$$

Filter 50

Invalid filter

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

$$H(s): \frac{R_L (C_3 L_3 s^2 + 1)(C_L L_L s^2 + 1)}{C_3 C_L L_3 L_L s^4 + C_3 C_L L_3 R_L s^2 + C_3 C_L L_L R_L s^2 + C_3 L_3 s^2 + C_3 R_L s + C_L L_L s^2 + C_L R_L s + 1}$$

Filter 51**Filter Type:** BP

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

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

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

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

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

Filter 52

Invalid filter

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

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

Filter 53**Filter Type:** BP

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

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

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

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

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

Filter 54**Filter Type:** Invalid110

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

$$H(s): \frac{L_3 s (C_L R_L s^2 + C_3 L_3 s^2 + C_L R_L s + 1)}{C_3 C_L L_3 R_L s^4 + C_3 L_3 s^2 + C_L L_3 s^2 + C_L R_L s + 1}$$

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

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

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

Filter 55

Invalid filter

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

$$H(s): \frac{L_3 s (C_L L_L s^2 + 1)}{C_3 C_L L_3 L_L s^4 + C_3 L_3 s^2 + C_L L_3 s^2 + C_L L_L s^2 + 1}$$

Filter 56

Invalid filter

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

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

Filter 57

Invalid filter

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

$$H(s): \frac{L_3 s (C_L L_L s^2 + C_L R_L s + 1)}{C_3 C_L L_3 L_L s^4 + C_3 C_L L_3 R_L s^3 + C_3 L_3 L_3 s^2 + C_L L_3 s^2 + C_L L_L s^2 + C_L R_L s + 1}$$

Filter 58**Filter Type:** BP

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

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

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

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

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

Filter 59

Invalid filter

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

$$H(s): \frac{L_3 s (C_L L_L R_L s^2 + L_L s + R_L)}{C_3 C_L L_3 L_L R_L s^4 + C_3 L_3 L_3 s^2 + C_3 L_3 R_L s^2 + C_L L_3 L_3 s^2 + C_L L_L R_L s^2 + L_3 s + L_L s + R_L}$$

Filter 60

Invalid filter

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

$$H(s): \frac{L_3 R_L s (C_L L_L s^2 + 1)}{C_3 C_L L_3 L_L R_L s^4 + C_3 L_3 R_L s^2 + C_L L_3 L_3 s^2 + C_L L_3 R_L s^2 + C_L L_L R_L s^2 + L_3 s + R_L}$$

Filter 61**Filter Type:** GE

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

$$H(s): \frac{R_L (C_3 L_3 s^2 + C_3 R_3 s + 1)}{C_3 L_3 s^2 + C_3 R_3 s + C_3 R_3 s + 1}$$

$$\mathbf{Q}: \frac{L_3 \sqrt{C_3^2 R_3}}{R_3 + R_L}$$

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

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

$$\mathbf{Qz}: \frac{L_3 \sqrt{C_3^2 R_3}}{R_3}$$

Filter 62

Invalid filter

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

$$H(s): \frac{C_3 L_3 s^2 + C_3 R_3 s + 1}{s (C_3 C_L L_3 s^2 + C_3 C_L R_3 s + C_3 + C_3 + C_L)}$$

Filter 63

Invalid filter

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

$$H(s): \frac{R_L (C_3 L_3 s^2 + C_3 R_3 s + 1)}{C_3 C_L L_3 R_L s^3 + C_3 C_L R_3 R_L s^2 + C_3 L_3 s^2 + C_3 R_3 s + C_3 R_3 s + C_L R_L s + 1}$$

Filter 64

Invalid filter

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

$$H(s): \frac{(C_L R_L s + 1) (C_3 L_3 s^2 + C_3 R_3 s + 1)}{s (C_3 C_L L_3 s^2 + C_3 C_L R_3 s + C_3 C_L R_3 s + C_3 + C_3 + C_L)}$$

Filter 65

Invalid filter

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

$$H(s): \frac{(C_L L_L s^2 + 1) (C_3 L_3 s^2 + C_3 R_3 s + 1)}{s (C_3 C_L L_3 s^2 + C_3 C_L L_L R_3 s^2 + C_3 C_L R_3 s + C_3 + C_L)}$$

Filter 66

Invalid filter

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

$$H(s): \frac{L_L s (C_3 L_3 s^2 + C_3 R_3 s + 1)}{C_3 C_L L_3 L_L s^4 + C_3 C_L L_L R_3 s^3 + C_3 L_3 s^2 + C_3 L_L s^2 + C_3 R_3 s + C_L L_L s^2 + 1}$$

Filter 67

Invalid filter

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

$$H(s): \frac{(C_3 L_3 s^2 + C_3 R_3 s + 1) (C_L L_L s^2 + C_L R_L s + 1)}{s (C_3 C_L L_3 s^2 + C_3 C_L L_L R_3 s + C_3 C_L R_3 s + C_3 L_3 s^2 + C_3 L_L R_3 s + C_3 + C_L)}$$

Filter 68

Invalid filter

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

$$H(s): \frac{L_L R_L s (C_3 L_3 s^2 + C_3 R_3 s + 1)}{C_3 C_L L_3 L_L R_L s^4 + C_3 C_L L_L R_3 R_L s^3 + C_3 L_3 L_L s^2 + C_3 L_3 R_L s^2 + C_3 L_L R_3 s^2 + C_3 L_L R_L s^2 + C_3 R_3 R_L s + C_L L_L R_L s^2 + L_L s + R_L}$$

Filter 69

Invalid filter

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

$$H(s): \frac{(C_3 L_3 s^2 + C_3 R_3 s + 1) (C_L L_L R_L s^2 + L_L s + R_L)}{C_3 C_L L_3 L_L s^4 + C_3 C_L L_L R_3 s^3 + C_3 C_L L_L R_L s^2 + C_3 L_3 L_L s^2 + C_3 L_3 R_3 s + C_3 R_3 s + C_3 R_L s + C_L L_L s^2 + 1}$$

Filter 70

Invalid filter

$$Z(s): \left(\infty, \infty, L_3 s + R_3 + \frac{1}{C_3 s}, \infty, \infty, \frac{R_L \left(L_L s + \frac{1}{C_L s} \right)}{L_L s + R_L + \frac{1}{C_L s}} \right)$$
$$H(s): \frac{R_L \left(C_L L_L s^2 + 1 \right) \left(C_3 L_3 s^2 + C_3 R_3 s + 1 \right)}{C_3 C_L L_3 L_L s^4 + C_3 C_L L_3 R_3 s^3 + C_3 C_L L_L R_3 s^2 + C_3 C_L L_L R_3 s + C_3 C_L R_3 R_L s^2 + C_3 L_3 s^2 + C_3 R_3 s + C_L L_L s^2 + C_L R_L s + 1}$$

Filter 71

Filter Type: BP

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

$$H(s): \frac{L_3 R_3 R_L s}{C_3 L_3 R_3 R_L s^2 + L_3 R_3 s + L_3 R_L s + R_3 R_L}$$

$$\mathbf{Q}: \frac{C_3 R_3 R_L \sqrt{\frac{1}{C_3^2 L_3}}}{R_3 + R_L}$$

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

$$\textbf{Bandwidth: } \frac{R_3 + R_L}{C_3 R_3 R_L}$$

Filter 72

Filter Type: BP

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

$$H(s): \frac{L_3 R_3 s}{C_3 L_3 R_3 s^2 + C_L L_3 R_3 s^2 + L_3 s^2 + R_3}$$

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

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

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

Filter 73

Filter Type: BP

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

$$H(s): \frac{L_3 R_3 R_L s}{C_3 C_L R_3 R_L s^2 + C_L L_3 R_3 R_L s^2 + L_3 R_3 s + L_3 R_L s + R_3 R_L}$$

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

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

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

Filter 74

Filter Type: Invalid110

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

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

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

$$\omega_0: \sqrt{\frac{R_3}{L_3 (C_3 R_3 + C_L R_3 + C_L R_L)}}$$

$$\textbf{Bandwidth: } \frac{C_L R_3 R_L + L_3}{L_3 (C_3 R_3 + C_L R_3 + C_L R_L)}$$

Filter 75

Invalid filter

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

$$H(s): \frac{L_3 R_3 s \left(C_L L_L s^2 + 1 \right)}{C_3 C_L L_3 L_L R_3 s^4 + C_3 C_L R_3 s^2 + C_L L_3 L_L s^2 + C_L L_3 R_3 s^2 + C_L L_L R_3 s^2 + L_3 s + R_3}$$

Filter 76

Filter Type: BP

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

$$H(s): \frac{L_3 L_L R_3 s}{C_3 C_L L_L R_3 s^2 + C_L L_3 L_L R_3 s^2 + L_3 L_L s + L_3 R_3 + L_L R_3}$$

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

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

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

Filter 77

Invalid filter

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

$$H(s): \frac{L_3 R_3 s \left(C_L L_L s^2 + C_L R_L s + 1 \right)}{C_3 C_L L_3 L_L R_3 s^4 + C_3 C_L L_3 R_3 R_L s^3 + C_3 C_L R_3 R_L s^2 + C_3 L_3 R_3 s^2 + C_L L_3 L_L s^2 + C_L L_3 R_3 s^2 + C_L L_L R_3 s^2 + C_L L_L R_3 s^2 + C_L L_L R_3 s^2 + L_3 s + R_3}$$

Filter 78

Filter Type: BP

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

$$H(s): \frac{L_3 L_L R_3 R_L s}{C_3 C_L L_L R_3 R_L s^2 + C_L L_3 L_L R_3 R_L s^2 + L_3 L_L R_3 s + L_3 L_L s + L_3 R_3 R_L + L_L R_3 R_L}$$

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

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

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

Filter 79

Invalid filter

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

$$H(s): \frac{L_3 R_3 s \left(C_L L_L R_L s^2 + L_L s + R_L \right)}{C_3 C_L L_3 L_L R_3 R_L s^2 + C_3 C_L L_3 R_3 s^2 + C_3 L_3 R_3 R_L s^2 + C_L L_3 L_L R_3 s^2 + C_L L_3 R_3 s^2 + C_L L_L R_3 s^2 + C_L L_L R_3 s^2 + L_3 L_L s + L_3 R_3 s + L_3 R_L s + L_L R_3 s + R_3 R_L}$$

Filter 80

Invalid filter

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

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

Filter 81

Filter Type: GE

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

$$H(s): \frac{R_L \left(C_3 L_3 R_3 s^2 + L_3 s + R_3 \right)}{C_3 C_L R_3 s^2 + C_L L_3 R_3 s^2 + L_3 s + R_3 + R_L}$$

$$\mathbf{Q}: C_3 \sqrt{\frac{1}{C_3 L_3}} \left(R_3 + R_L \right)$$

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

$$\textbf{Bandwidth: } \frac{1}{C_3 (R_3 + R_L)}$$

$$\mathbf{Qz}: C_3 R_3 \sqrt{\frac{1}{C_3 L_3}}$$

Filter 82

Invalid filter

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

$$H(s): \frac{C_3 L_3 R_3 s^2 + L_3 s + R_3}{C_3 C_L L_3 R_3 s^3 + C_3 L_3 s^2 + C_L L_3 s^2 + C_L R_3 s + 1}$$

Filter 83

Invalid filter

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

$$H(s): \frac{R_L (C_3 L_3 R_3 s^2 + L_3 s + R_3)}{C_3 C_L L_3 R_3 R_L s^3 + C_3 L_3 R_3 s^2 + C_3 L_3 R_L s^2 + C_L L_3 R_L s^2 + C_L R_3 R_L s + L_3 s + R_3 + R_L}$$

Filter 84

Invalid filter

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

$$H(s): \frac{(C_L R_L s + 1)(C_3 L_3 R_3 s^2 + L_3 s + R_3)}{C_3 C_L L_3 R_3 s^3 + C_3 C_L L_3 R_L s^3 + C_3 L_3 s^3 + C_L L_3 s^2 + C_L R_3 s + C_L R_L s + 1}$$

Filter 85

Invalid filter

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

$$H(s): \frac{(C_L L_L s^2 + 1)(C_3 L_3 R_3 s^2 + L_3 s + R_3)}{C_3 C_L L_3 L_L s^4 + C_3 C_L L_3 R_3 s^3 + C_3 L_3 s^3 + C_L L_3 s^2 + C_L L_L s^2 + C_L R_3 s + 1}$$

Filter 86

Invalid filter

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

$$H(s): \frac{L_L s (C_3 L_3 R_3 s^2 + L_3 s + R_3)}{C_3 C_L L_3 L_L R_3 s^4 + C_3 L_3 L_L s^3 + C_3 L_3 L_3 R_3 s^2 + C_L L_3 L_3 s^2 + C_L L_L R_3 s^2 + L_3 s + L_L s + R_3}$$

Filter 87

Invalid filter

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

$$H(s): \frac{(C_L L_L s^2 + C_L R_L s + 1)(C_3 L_3 R_3 s^2 + L_3 s + R_3)}{C_3 C_L L_3 L_L L_L s^4 + C_3 C_L L_3 R_3 s^3 + C_3 C_L L_3 R_L s^3 + C_3 L_3 s^3 + C_3 L_3 s^2 + C_L L_L s^2 + C_L R_3 s + C_L R_L s + 1}$$

Filter 88

Invalid filter

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

$$H(s): \frac{L_L R_L s (C_3 L_3 R_3 s^2 + L_3 s + R_3)}{C_3 C_L L_3 L_L R_3 R_L s^4 + C_3 L_3 L_L R_3 s^3 + C_3 L_3 L_L R_L s^3 + C_3 L_3 R_3 R_L s^2 + C_L L_L R_L R_L s^2 + C_L L_L R_3 R_L s^2 + L_3 L_L s^2 + L_3 R_L s + L_L R_3 s + L_L R_L s + R_3 R_L}$$

Filter 89

Invalid filter

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

$$H(s): \frac{(C_3 L_3 R_3 s^2 + L_3 s + R_3)(C_L L_L R_L s^2 + L_L s + R_L)}{C_3 C_L L_3 L_L R_3 R_L s^4 + C_3 C_L L_3 L_L R_L s^3 + C_3 L_3 L_L R_L s^3 + C_3 L_3 R_3 s^2 + C_3 L_3 R_L s^2 + C_L L_L R_L s^2 + C_L L_L R_3 s^2 + L_3 s + L_L s + R_3 + R_L}$$

Filter 90

Invalid filter

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

$$H(s): \frac{R_L (C_L L_L s^2 + 1)(C_3 L_3 R_3 s^2 + L_3 s + R_3)}{C_3 C_L L_3 L_L R_3 R_L s^4 + C_3 C_L L_3 L_L R_L s^3 + C_3 C_L L_3 R_3 R_L s^3 + C_3 L_3 R_3 R_L s^2 + C_L L_L R_L R_L s^2 + C_L L_L R_3 R_L s^2 + L_3 L_L s^2 + L_3 R_L s + L_L R_3 s + L_L R_L s + R_3 + R_L}$$

Filter 91**Filter Type:** BS

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

$$H(s): \frac{R_3 R_L (C_3 L_3 s^2 + 1)}{C_3 L_3 R_3 s^2 + C_3 L_3 R_L s^2 + C_3 R_3 R_L s + R_3 + R_L}$$

$$\mathbf{Q}: \frac{L_3 \sqrt{\frac{1}{C_3^2 L_3}} (R_3 + R_L)}{R_L R_L}$$

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

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

Filter 92**Filter Type:** BS

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

$$H(s): \frac{R_3 (C_3 L_3 s^2 + 1)}{C_3 C_L L_3 R_3 R_L s^3 + C_3 L_3 s^2 + C_3 R_3 s + C_L R_3 s + 1}$$

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

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

$$\text{Bandwidth: } \frac{R_3 R_L (C_3 + C_L)}{C_3 L_3}$$

Filter 93**Filter Type:** BS

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

$$H(s): \frac{R_3 R_L (C_3 L_3 s^2 + 1)}{C_3 C_L L_3 R_3 R_L R_L s^3 + C_3 L_3 R_3 s^2 + C_3 L_3 R_L s^2 + C_3 R_3 R_L s + C_L R_3 R_L s + R_3 + R_L}$$

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

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

$$\text{Bandwidth: } \frac{R_3 R_L (C_3 + C_L)}{C_3 L_3 (R_3 + R_L)}$$

Filter 94

Invalid filter

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

$$H(s): \frac{R_3 (C_3 L_3 s^2 + 1)(C_L R_L s + 1)}{C_3 C_L L_3 R_3 s^3 + C_3 C_L L_3 R_L s^3 + C_3 C_L R_3 R_L s^2 + C_3 L_3 s^2 + C_3 R_3 s + C_L R_3 s + C_L R_L s + 1}$$

Filter 95

Invalid filter

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

$$H(s): \frac{R_3 (C_3 L_3 s^2 + 1)(C_L L_L s^2 + 1)}{C_3 C_L L_3 L_L s^4 + C_3 C_L L_3 R_3 s^3 + C_3 C_L L_3 R_L s^3 + C_3 L_3 s^3 + C_3 L_3 s^2 + C_3 R_3 s + C_L L_L s^2 + C_L R_3 s + 1}$$

Filter 96

Invalid filter

$$Z(s): \left(\infty, \infty, \frac{R_3 \left(L_3 s + \frac{1}{v_{32}^2} \right)}{L_3 s + R_3 + \frac{1}{v_{32}^2}}, \infty, \infty, \frac{L_L s}{C_L L_L s^2 + 1} \right)$$
$$H(s): \frac{L_L R_3 s (C_3 L_3 s^2 + 1)}{C_3 C_L L_3 L_L R_3 s^4 + C_3 L_3 L_L R_3 s^3 + C_3 L_3 R_3 s^2 + C_3 L_L R_3 s^2 + C_L L_L R_3 s^2 + L_L s + R_3}$$

Filter 97

Invalid filter

$$Z(s): \left(\infty, \infty, \frac{R_3 \left(L_3 s + \frac{1}{v_{32}^2} \right)}{L_3 s + R_3 + \frac{1}{v_{32}^2}}, \infty, \infty, L_L s + R_L + \frac{1}{C_L s} \right)$$
$$H(s): \frac{R_3 (C_3 L_3 s^2 + 1) (C_L L_L s^2 + C_L R_L s + 1)}{C_3 C_L L_3 L_L s^4 + C_3 C_L L_3 R_3 s^3 + C_3 C_L L_3 L_L R_3 s^3 + C_3 C_L L_L R_3 s^3 + C_3 C_L R_3 R_L s^2 + C_3 L_3 s^2 + C_3 R_3 s + C_L L_L s^2 + C_L R_3 s + C_L R_L s + 1}$$

Filter 98

Invalid filter

$$Z(s): \left(\infty, \infty, \frac{R_3 \left(L_3 s + \frac{1}{v_{32}^2} \right)}{L_3 s + R_3 + \frac{1}{v_{32}^2}}, \infty, \infty, \frac{1}{C_L s + \frac{1}{R_L} + \frac{1}{L_L s}} \right)$$
$$H(s): \frac{L_L R_3 R_L s (C_3 L_3 s^2 + 1)}{C_3 C_L L_3 L_L R_3 R_L s^4 + C_3 L_3 L_L R_3 s^3 + C_3 L_3 L_L R_3 s^3 + C_3 L_3 R_3 R_L s^3 + C_3 L_L R_3 R_L s^3 + C_3 L_L R_3 R_L s^2 + C_L L_L R_3 R_L s^2 + L_L R_3 s + L_L R_L s + R_3 R_L}$$

Filter 99

Invalid filter

$$Z(s): \left(\infty, \infty, \frac{R_3 \left(L_3 s + \frac{1}{v_{32}^2} \right)}{L_3 s + R_3 + \frac{1}{v_{32}^2}}, \infty, \infty, \frac{L_L s}{C_L L_L s^2 + 1} + R_L \right)$$
$$H(s): \frac{R_3 (C_3 L_3 s^2 + 1) (C_L L_L R_L s^2 + L_L s + R_L)}{C_3 C_L L_3 L_L R_3 s^4 + C_3 C_L L_3 L_L R_L s^4 + C_3 C_L L_L R_3 R_L s^3 + C_3 L_3 L_L R_3 R_L s^3 + C_3 L_3 L_L s^3 + C_3 L_3 R_3 s^2 + C_3 L_3 R_3 s^2 + C_3 L_L R_3 s^2 + C_3 R_3 R_L s + C_L L_L R_3 s^2 + C_L L_L R_L s^2 + L_L s + R_3 + R_L}$$

Filter 100

Invalid filter

$$Z(s): \left(\infty, \infty, \frac{R_3 \left(L_3 s + \frac{1}{v_{32}^2} \right)}{L_3 s + R_3 + \frac{1}{v_{32}^2}}, \infty, \infty, \frac{R_L \left(L_L s + \frac{1}{v_{L2}^2} \right)}{L_L s + R_L + \frac{1}{v_{L2}^2}} \right)$$
$$H(s): \frac{R_3 R_L (C_3 L_3 s^2 + 1) (C_L L_L s^2 + 1)}{C_3 C_L L_3 L_L R_3 s^4 + C_3 C_L L_3 L_L R_L s^4 + C_3 C_L L_3 R_3 R_L s^3 + C_3 C_L L_L R_3 R_L s^3 + C_3 L_3 R_3 s^2 + C_3 L_3 R_3 s^2 + C_3 L_3 R_L s^2 + C_3 R_3 R_L s + C_L L_L R_3 s^2 + C_L L_L R_L s^2 + C_L R_3 R_L s + R_3 + R_L}$$