

Experiment: TIA Z5 ZL

Filter 1

Invalid filter
 $Z(s)$: $(\infty, \infty, \infty, \infty, \infty, R_4, R_L)$

Filter 2

Invalid filter
 $Z(s)$: $(\infty, \infty, \infty, \infty, \infty, R_4, \frac{1}{C_L s})$

Filter 3

Invalid filter
 $Z(s)$: $(\infty, \infty, \infty, \infty, \infty, R_4, \frac{R_L}{C_L R_L s + 1})$

Filter 4

Invalid filter
 $Z(s)$: $(\infty, \infty, \infty, \infty, \infty, R_4, R_L + \frac{1}{C_L s})$

Filter 5

Filter Type: BS
 $Z(s)$: $(\infty, \infty, \infty, \infty, \infty, R_4, L_L s + \frac{1}{C_L s})$
 $H(s)$: $\frac{(R_4 g_m - 1)(C_L L_L s^2 + 1)}{2C_L L_L g_m s^2 + C_L R_4 g_m s + C_L s + 2g_m}$
Q: $\frac{2L_L g_m \sqrt{\frac{1}{C_L L_L}}}{R_4 g_m + 1}$
 ω_0 : $\sqrt{\frac{1}{C_L L_L}}$
Bandwidth: $\frac{R_4 g_m + 1}{2L_L g_m}$

Filter 6

Filter Type: BP
 $Z(s)$: $(\infty, \infty, \infty, \infty, \infty, R_4, \frac{L_L s}{C_L L_L s^2 + 1})$
 $H(s)$: $\frac{L_L s(R_4 g_m - 1)}{C_L L_L R_4 g_m s^2 + C_L L_L s^2 + 2L_L g_m s + R_4 g_m + 1}$
Q: $\frac{C_L \sqrt{\frac{1}{C_L L_L}}(R_4 g_m + 1)}{2g_m}$
 ω_0 : $\sqrt{\frac{1}{C_L L_L}}$
Bandwidth: $\frac{2g_m}{C_L(R_4 g_m + 1)}$

Filter 7

Filter Type: GE
 $Z(s)$: $(\infty, \infty, \infty, \infty, \infty, R_4, L_L s + R_L + \frac{1}{C_L s})$
 $H(s)$: $\frac{(R_4 g_m - 1)(C_L L_L s^2 + C_L R_L s + 1)}{2C_L L_L g_m s^2 + C_L R_4 g_m s + 2C_L R_L g_m s + C_L s + 2g_m}$
Q: $\frac{2L_L g_m \sqrt{\frac{1}{C_L L_L}}}{R_4 g_m + 2R_L g_m + 1}$
 ω_0 : $\sqrt{\frac{1}{C_L L_L}}$
Bandwidth: $\frac{R_4 g_m + 2R_L g_m + 1}{2L_L g_m}$
Qz: $\frac{L_L \sqrt{\frac{1}{C_L L_L}}}{R_L}$

Filter 8

Filter Type: BP
 $Z(s)$: $(\infty, \infty, \infty, \infty, \infty, R_4, \frac{1}{C_L s + \frac{1}{R_L} + \frac{1}{L_L s}})$
 $H(s)$: $\frac{L_L R_L s(R_4 g_m - 1)}{C_L L_L R_L R_L g_m s^2 + C_L L_L R_L s^2 + L_L R_4 g_m s + 2L_L R_L g_m s + L_L s + R_L R_L g_m + R_L}$
Q: $\frac{C_L R_L \sqrt{\frac{1}{C_L L_L}}(R_4 g_m + 1)}{R_4 g_m + 2R_L g_m + 1}$
 ω_0 : $\sqrt{\frac{1}{C_L L_L}}$
Bandwidth: $\frac{R_4 g_m + 2R_L g_m + 1}{C_L R_L(R_4 g_m + 1)}$

Filter 9

Filter Type: GE
 $Z(s)$: $(\infty, \infty, \infty, \infty, \infty, R_4, \frac{L_L s}{C_L L_L s^2 + 1} + R_L)$
 $H(s)$: $\frac{C_L L_L R_4 g_m s^2 + 2C_L L_L R_L g_m s^2 + C_L L_L R_L s^2 + L_L s + R_L}{C_L L_L R_4 g_m s^2 + 2C_L L_L R_L g_m s^2 + C_L L_L s^2 + 2L_L g_m s + R_4 g_m + 2R_L g_m + 1}$
Q: $\frac{C_L \sqrt{\frac{1}{C_L L_L}}(R_4 g_m + 2R_L g_m + 1)}{2g_m}$
 ω_0 : $\sqrt{\frac{1}{C_L L_L}}$
Bandwidth: $\frac{2g_m}{C_L(R_4 g_m + 2R_L g_m + 1)}$
Qz: $C_L R_L \sqrt{\frac{1}{C_L L_L}}$

Filter 10

Filter Type: BS
 $Z(s)$: $(\infty, \infty, \infty, \infty, \infty, R_4, \frac{R_L(L_L s + \frac{1}{C_L s})}{L_L s + R_L + \frac{1}{C_L s}})$
 $H(s)$: $\frac{R_L(R_4 g_m - 1)(C_L L_L s^2 + 1)}{C_L L_L R_L R_L g_m s^2 + 2C_L L_L R_L g_m s^2 + C_L L_L s^2 + C_L R_L R_L g_m s + C_L R_L s + R_4 g_m + 2R_L g_m + 1}$
Q: $\frac{L_L \sqrt{\frac{1}{C_L L_L}}(R_4 g_m + 2R_L g_m + 1)}{R_L(R_4 g_m + 1)}$
 ω_0 : $\sqrt{\frac{1}{C_L L_L}}$
Bandwidth: $\frac{R_L(R_4 g_m + 1)}{L_L(R_4 g_m + 2R_L g_m + 1)}$

Filter 11

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

Filter 12

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

Filter 13

Filter Type: Invalid011
 $Z(s)$: $(\infty, \infty, \infty, \infty, \infty, \frac{1}{C_L s}, \frac{R_L}{C_L R_L s + 1})$
 $H(s)$: $\frac{R_L(-C_L s + g_m)}{C_L C_L R_L s^2 + 2C_L R_L g_m s + C_L s + C_L R_L g_m s + g_m}$
Q: $\frac{C_L C_L R_L \sqrt{\frac{1}{C_L C_L R_L}}}{2C_L R_L g_m + C_L + C_L R_L g_m}$
 ω_0 : $\sqrt{\frac{g_m}{C_L C_L R_L}}$
Bandwidth: $\frac{2C_L R_L g_m + C_L + C_L R_L g_m}{C_L C_L R_L}$

Filter 14

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

Filter 15

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

Filter 16

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

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

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

$$\omega_0: \sqrt{\frac{1}{L_L (2C_L + C_L)}}$$

Bandwidth: $\frac{C_L}{L_L g_m (2C_L + C_L)}$

Filter 17

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

Filter 18

Filter Type: Invalid110
$$Z(s): \left(\infty, \infty, \infty, \infty, \infty, \frac{1}{C_L s}, \frac{1}{C_L s + \frac{1}{R_L} + \frac{1}{L_L s}} \right)$$

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

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

$$\omega_0: \sqrt{\frac{R_L g_m}{L_L (2C_L R_L g_m + C_L + C_L R_L g_m)}}$$

Bandwidth: $\frac{C_L R_L + L_L g_m}{L_L (2C_L R_L g_m + C_L + C_L R_L g_m)}$

Filter 19

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

Filter 20

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

Filter 21

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

Filter 22

Filter Type: Invalid011
$$Z(s): \left(\infty, \infty, \infty, \infty, \infty, \frac{R_L}{C_L R_{k+1}}, \frac{1}{C_L s} \right)$$

$$H(s): \frac{-C_L R_{k+1} g_m - 1}{C_L C_L L_L R_L s^3 + 2C_L L_L R_L g_m s^2 + C_L R_L s + C_L s + 2g_m}$$

$$\mathbf{Q}: \frac{\sqrt{2C_L C_L R_L} \sqrt{\frac{R_L g_m}{C_L C_L R_L}}}{2C_L R_{k+1} g_m + C_L R_{k+1} g_m + C_L}$$

$$\omega_0: \sqrt{2 \sqrt{\frac{R_L g_m}{C_L C_L R_L}}}$$

Bandwidth: $\frac{2C_L R_{k+1} g_m + C_L R_{k+1} g_m + C_L}{C_L C_L R_L}$

Filter 23

Filter Type: Invalid011
$$Z(s): \left(\infty, \infty, \infty, \infty, \infty, \frac{R_L}{C_L R_{k+1}}, \frac{R_L}{C_L R_{k+1}} \right)$$

$$H(s): \frac{R_L (-C_L R_{k+1} + R_{k+1} g_m - 1)}{C_L C_L L_L R_L s^3 + 2C_L L_L R_L g_m s^2 + C_L R_L s + C_L R_L s + R_{k+1} g_m + 2R_L g_m + 1}$$

$$\mathbf{Q}: \frac{C_L C_L R_L R_L \sqrt{\frac{R_{k+1} g_m + 1}{C_L C_L R_L R_L}}}{2C_L R_L R_L g_m + C_L R_L + C_L R_L R_L g_m + C_L R_L}$$

$$\omega_0: \sqrt{\frac{R_{k+1} g_m + 1}{C_L C_L R_L R_L}}$$

Bandwidth: $\frac{2C_L R_L R_L g_m + C_L R_L + C_L R_L R_L g_m + C_L R_L}{C_L C_L R_L R_L}$

Filter 24

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

Filter 25

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

Filter 26

Filter Type: Invalid110
$$Z(s): \left(\infty, \infty, \infty, \infty, \infty, \frac{R_L}{C_L R_{k+1}}, \frac{L_L s}{C_L L_L s^2 + 1} \right)$$

$$H(s): \frac{L_L s(-C_L R_{k+1} + R_{k+1} g_m - 1)}{C_L C_L L_L R_L s^3 + 2C_L L_L R_L g_m s^2 + C_L R_L s + C_L L_L R_L s^2 + 2L_L R_L g_m s + R_L g_m + 1}$$

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

$$\omega_0: \sqrt{\frac{R_L g_m + 1}{L_L (2C_L R_L g_m + C_L R_L + C_L R_L g_m + C_L)}}$$

Bandwidth: $\frac{C_L R_L + 2L_L g_m}{L_L (2C_L R_L g_m + C_L R_L g_m + C_L)}$

Filter 27

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

Filter 28

Filter Type: Invalid110
$$Z(s): \left(\infty, \infty, \infty, \infty, \infty, \frac{R_L}{C_L R_{k+1}}, \frac{1}{C_L s + \frac{1}{R_L} + \frac{1}{L_L s}} \right)$$

$$H(s): \frac{L_L R_L s(-C_L R_{k+1} + R_{k+1} g_m - 1)}{C_L C_L L_L R_L R_L s^3 + 2C_L L_L R_L R_L g_m s^2 + C_L L_L R_L s^3 + C_L R_L R_L s + C_L L_L R_L s^2 + L_L R_L g_m s + L_L s + R_L R_L g_m + R_L}$$

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

$$\omega_0: \sqrt{\frac{R_L (R_L g_m + 1)}{L_L (2C_L R_L R_L g_m + C_L R_L + C_L R_L R_L g_m + C_L R_L)}}$$

Bandwidth: $\frac{C_L R_L R_L + L_L R_L g_m + 2L_L R_L g_m + L_L}{L_L (2C_L R_L R_L g_m + C_L R_L + C_L R_L R_L g_m + C_L R_L)}$

Filter 29

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, \infty, \frac{R_4}{C_4 R_{Ls}+1}, \frac{L_L s}{C_L L_L s^2+1}+R_L\right)$

Filter 30

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, \infty, \frac{R_4}{C_4 R_{Ls}+1}, \frac{R_L\left(L_L s+\frac{1}{C_L s}\right)}{L_L s+R_L+\frac{1}{C_L s}}\right)$

Filter 31

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, R_4+\frac{1}{C_4 s}, R_L\right)$

Filter 32

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, R_4+\frac{1}{C_4 s}, \frac{1}{C_L s}\right)$

Filter 33

Filter Type: Invalid011
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, \infty, R_4+\frac{1}{C_4 s}, \frac{R_L}{C_L R_{Ls}+1}\right)$
 $H(s)$: $\frac{R_L(C_4 R_4 g_m s-C_4 s+g_m)}{C_4 C_L R_L R_L g_m s^2+C_4 C_L R_L s^2+C_4 R_4 g_m s+2C_4 R_L g_m s+C_4 s+C_L R_L g_m s+g_m}$
Q: $\frac{C_4 C_L R_L \sqrt{2C_4 R_L g_m+1}}{C_4 R_4 g_m+2C_4 R_L g_m+C_4+C_L R_L g_m}$
 ω_0 : $\sqrt{\frac{R_L}{C_4 C_L R_L(R_4 g_m+1)}}$
Bandwidth: $\frac{C_4 R_4 g_m+2C_4 R_L g_m+C_4+C_L R_4 g_m}{C_4 C_L R_L(R_4 g_m+1)}$

Filter 34

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, \infty, R_4+\frac{1}{C_4 s}, R_L+\frac{1}{C_L s}\right)$

Filter 35

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, \infty, R_4+\frac{1}{C_4 s}, L_L s+\frac{1}{C_L s}\right)$

Filter 36

Filter Type: Invalid110
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, \infty, R_4+\frac{1}{C_4 s}, \frac{L_L s}{C_L L_L s^2+1}\right)$
 $H(s)$: $\frac{L_L s(C_4 R_4 g_m s-C_4 s+g_m)}{C_4 C_L L_L R_4 g_m s^2+C_4 C_L L_L s^2+2C_4 L_L g_m s^2+C_4 R_4 g_m s+C_4 s+C_L L_L g_m s^2+g_m}$
Q: $\frac{L_L g_m \sqrt{\frac{1}{L_L(2C_4+C_L)}}}{C_4(R_4 g_m+1)}$
 ω_0 : $\sqrt{\frac{1}{L_L(2C_4+C_L)}}$
Bandwidth: $\frac{C_4(R_4 g_m+1)}{L_L g_m(2C_4+C_L)}$

Filter 37

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, \infty, R_4+\frac{1}{C_4 s}, L_L s+R_L+\frac{1}{C_L s}\right)$

Filter 38

Filter Type: Invalid110
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, \infty, R_4+\frac{1}{C_4 s}, \frac{1}{C_L s+\frac{1}{R_L}+\frac{1}{L_L s}}\right)$
 $H(s)$: $\frac{L_L R_L s(C_4 R_4 g_m s-C_4 s+g_m)}{C_4 C_L L_L R_L R_L g_m s^2+C_4 C_L L_L R_L s^2+C_4 L_L R_4 g_m s^2+C_4 L_L s^2+C_4 R_L R_L g_m s+C_4 R_L s+C_L L_L R_L g_m s^2+L_L g_m s+R_L g_m}$
Q: $\frac{L_L \sqrt{\frac{R_L g_m}{L_L(C_4 R_4 g_m+2C_4 R_L g_m+C_4+C_L R_L g_m)}}}{C_4 R_4 g_m+2C_4 R_L g_m+C_4+C_L R_L g_m}$
 ω_0 : $\sqrt{\frac{R_L g_m}{L_L(C_4 R_4 g_m+2C_4 R_L g_m+C_4+C_L R_L g_m)}}$
Bandwidth: $\frac{C_4 R_L R_L g_m+C_4 R_L+L_L g_m}{L_L(C_4 R_4 g_m+2C_4 R_L g_m+C_4+C_L R_L g_m)}$

Filter 39

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, \infty, R_4+\frac{1}{C_4 s}, \frac{L_L s}{C_L L_L s^2+1}+R_L\right)$

Filter 40

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, \infty, R_4+\frac{1}{C_4 s}, \frac{R_L(L_L s+\frac{1}{C_L s})}{L_L s+R_L+\frac{1}{C_L s}}\right)$

Filter 41

Filter Type: GE
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, \infty, L_4 s+\frac{1}{C_4 s}, R_L\right)$

$H(s)$: $\frac{R_L(C_4 L_4 g_m s^2-C_4 s+g_m)}{C_4 L_4 g_m s^2+2C_4 R_L g_m s+C_4 s+g_m}$

Q: $\frac{L_4 g_m \sqrt{2C_4 L_4}}{2R_L g_m+1}$

ω_0 : $\sqrt{\frac{1}{C_4 L_4}}$

Bandwidth: $\frac{2R_L g_m+1}{L_4 g_m}$

Qz: $-L_4 g_m \sqrt{\frac{1}{C_4 L_4}}$

Filter 42

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, \infty, L_4 s+\frac{1}{C_4 s}, \frac{1}{C_L s}\right)$

Filter 43

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, \infty, L_4 s+\frac{1}{C_4 s}, \frac{R_L}{C_L R_{Ls}+1}\right)$

Filter 44

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, \infty, L_4 s+\frac{1}{C_4 s}, R_L+\frac{1}{C_L s}\right)$

Filter 45

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, \infty, L_4 s+\frac{1}{C_4 s}, L_L s+\frac{1}{C_L s}\right)$

Filter 46

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, \infty, L_4s + \frac{1}{C_4s}, \frac{L_4s}{C_L L_4 s^2 + 1}\right)$

Filter 47

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, \infty, L_4s + \frac{1}{C_4s}, L_Ls + R_L + \frac{1}{C_Ls}\right)$

Filter 48

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, \infty, L_4s + \frac{1}{C_4s}, \frac{1}{C_Ls + \frac{1}{R_L} + \frac{1}{L_Ls}}\right)$

Filter 49

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, \infty, L_4s + \frac{1}{C_4s}, \frac{L_4s}{C_L L_4 s^2 + 1} + R_L\right)$

Filter 50

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, \infty, L_4s + \frac{1}{C_4s}, \frac{R_L\left(L_Ls + \frac{1}{C_L}\right)}{L_Ls + R_L + \frac{1}{C_Ls}}\right)$

Filter 51

Filter Type: GE
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, \infty, \frac{L_4s}{C_4 L_4 s^2 + 1}, R_L\right)$
 $H(s)$: $\frac{R_L\left(-C_4 L_4 s^2 + L_4 g_m s - 1\right)}{2 C_4 L_4 R_L g_m s^2 + C_4 L_4 s^2 + L_4 g_m s + 2 R_L g_m + 1}$
Q: $\frac{C_4 \sqrt{\frac{1}{C_4^2 L_4^2}}\left(2 R_L g_m + 1\right)}{g_m}$
 ω_0 : $\sqrt{\frac{1}{C_4 L_4}}$
Bandwidth: $\frac{g_m}{C_4\left(2 R_L g_m + 1\right)}$
Qz: $-\frac{C_4 \sqrt{\frac{1}{C_4^2 L_4^2}}}{g_m}$

Filter 52

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, \infty, \frac{L_4s}{C_4 L_4 s^2 + 1}, \frac{1}{C_Ls}\right)$

Filter 53

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, \infty, \frac{L_4s}{C_L L_4 s^2 + 1}, \frac{R_L}{C_L R_L s + 1}\right)$

Filter 54

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, \infty, \frac{L_4s}{C_4 L_4 s^2 + 1}, R_L + \frac{1}{C_Ls}\right)$

Filter 55

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, \infty, \frac{L_4s}{C_L L_4 s^2 + 1}, L_Ls + \frac{1}{C_Ls}\right)$

Filter 56

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, \infty, \frac{L_4s}{C_4 L_4 s^2 + 1}, \frac{L_Ls}{C_L L_4 s^2 + 1}\right)$

Filter 57

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, \infty, \frac{L_4s}{C_L L_4 s^2 + 1}, L_Ls + R_L + \frac{1}{C_Ls}\right)$

Filter 58

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, \infty, \frac{L_4s}{C_4 L_4 s^2 + 1}, \frac{1}{C_Ls + \frac{1}{R_L} + \frac{1}{L_Ls}}\right)$

Filter 59

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, \infty, \frac{L_4s}{C_4 L_4 s^2 + 1}, \frac{L_Ls}{C_L L_4 s^2 + 1} + R_L\right)$

Filter 60

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, \infty, \frac{L_4s}{C_L L_4 s^2 + 1}, \frac{R_L\left(L_Ls + \frac{1}{C_L}\right)}{L_Ls + R_L + \frac{1}{C_Ls}}\right)$

Filter 61

Filter Type: GE
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, \infty, L_4s + R_4 + \frac{1}{C_4s}, R_L\right)$
 $H(s)$: $\frac{R_L\left(C_4 L_4 g_m s^2 + C_4 R_4 g_m s - C_4 s + g_m\right)}{C_4 L_4 g_m s^2 + C_4 R_4 g_m s + 2 C_4 R_L g_m s + C_4 s + g_m}$
Q: $\frac{L_4 g_m \sqrt{\frac{1}{C_4^2 L_4^2}}}{R_4 g_m + 2 R_L g_m + 1}$
 ω_0 : $\sqrt{\frac{1}{C_4 L_4}}$
Bandwidth: $\frac{R_4 g_m + 2 R_L g_m + 1}{L_4 g_m}$
Qz: $\frac{L_4 g_m \sqrt{\frac{1}{C_4^2 L_4^2}}}{R_4 g_m + 1}$

Filter 62

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, \infty, L_4s + R_4 + \frac{1}{C_4s}, \frac{1}{C_Ls}\right)$

Filter 63

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, \infty, L_4s + R_4 + \frac{1}{C_4s}, \frac{R_L}{C_L R_L s + 1}\right)$

Filter 64

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, \infty, L_4s + R_4 + \frac{1}{C_4s}, R_L + \frac{1}{C_Ls}\right)$

Filter 65

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, L_4 s + R_4 + \frac{1}{C_4 s}, L_L s + \frac{1}{C_L s}\right)$

Filter 66

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, L_4 s + R_4 + \frac{1}{C_4 s}, \frac{L_L s}{C_L L_L s^2 + 1}\right)$

Filter 67

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, L_4 s + R_4 + \frac{1}{C_4 s}, L_L s + R_L + \frac{1}{C_L s}\right)$

Filter 68

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, L_4 s + R_4 + \frac{1}{C_4 s}, \frac{1}{C_L s + \frac{1}{R_L + \frac{1}{C_L s}}}\right)$

Filter 69

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, L_4 s + R_4 + \frac{1}{C_4 s}, \frac{L_L s}{C_L L_L s^2 + 1} + R_L\right)$

Filter 70

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, L_4 s + R_4 + \frac{1}{C_4 s}, \frac{R_L \left(L_L s + \frac{1}{C_L s}\right)}{L_L s + R_L + \frac{1}{C_L s}}\right)$

Filter 71

Filter Type: GE

$Z(s)$: $\left(\infty, \infty, \infty, \infty, \frac{1}{C_4 s + \frac{1}{R_4 + \frac{1}{L_4 s}}}, R_L\right)$
 $H(s)$: $\frac{R_L \left(-C_4 L_4 R_4 s^2 + L_4 R_4 g_m s - L_4 s - R_4\right)}{2 C_4 L_4 R_L R_L g_m s^2 + C_4 L_4 R_L s^2 + L_4 R_4 g_m s + 2 L_4 L_L g_m s + L_4 s + 2 R_L R_L g_m + R_L}$
Q: $\frac{C_4 R_4 \sqrt{\frac{C_4 L_4}{C_L L_L}} (2 R_L g_m + 1)}{R_4 g_m + 2 R_L g_m + 1}$
 ω_0 : $\sqrt{\frac{1}{C_4 L_4}}$
Bandwidth: $\frac{R_4 g_m + 2 R_L g_m + 1}{C_4 R_L (2 R_L g_m + 1)}$
Qz: $-\frac{C_4 R_4 \sqrt{\frac{C_4 L_4}{C_L L_L}}}{R_4 g_m + 1}$

Filter 72

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, \frac{1}{C_4 s + \frac{1}{R_4 + \frac{1}{L_4 s}}}, \frac{1}{C_L s}\right)$

Filter 73

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, \frac{1}{C_4 s + \frac{1}{R_4 + \frac{1}{L_4 s}}}, \frac{R_L}{C_L R_L s + 1}\right)$

Filter 74

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, \frac{1}{C_4 s + \frac{1}{R_4 + \frac{1}{L_4 s}}}, R_L + \frac{1}{C_L s}\right)$

Filter 75

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, \frac{1}{C_4 s + \frac{1}{R_4 + \frac{1}{L_4 s}}}, L_L s + \frac{1}{C_L s}\right)$

Filter 76

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, \frac{1}{C_4 s + \frac{1}{R_4 + \frac{1}{L_4 s}}}, \frac{L_L s}{C_L L_L s^2 + 1}\right)$

Filter 77

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, \frac{1}{C_4 s + \frac{1}{R_4 + \frac{1}{L_4 s}}}, L_L s + R_L + \frac{1}{C_L s}\right)$

Filter 78

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, \frac{1}{C_4 s + \frac{1}{R_4 + \frac{1}{L_4 s}}}, \frac{1}{C_L s + \frac{1}{R_L + \frac{1}{C_L s}}}\right)$

Filter 79

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, \frac{1}{C_4 s + \frac{1}{R_4 + \frac{1}{L_4 s}}}, \frac{L_L s}{C_L L_L s^2 + 1} + R_L\right)$

Filter 80

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, \frac{1}{C_4 s + \frac{1}{R_4 + \frac{1}{L_4 s}}}, \frac{R_L \left(L_L s + \frac{1}{C_L s}\right)}{L_L s + R_L + \frac{1}{C_L s}}\right)$

Filter 81

Filter Type: GE

$Z(s)$: $\left(\infty, \infty, \infty, \infty, \frac{L_L s}{C_L L_L s^2 + 1} + R_4, R_L\right)$
 $H(s)$: $\frac{R_L \left(C_4 L_4 R_4 g_m s^2 - C_4 L_4 s^2 + L_4 g_m s + R_4 g_m - 1\right)}{C_4 L_4 R_4 g_m s^2 + 2 C_4 L_4 R_L g_m s^2 + C_4 L_4 s^2 + L_4 g_m s + R_4 g_m + 2 R_L g_m + 1}$
Q: $\frac{C_4 \sqrt{\frac{C_4 L_4}{C_L L_L}} (R_4 g_m + 2 R_L g_m + 1)}{g_m}$
 ω_0 : $\sqrt{\frac{1}{C_4 L_4}}$
Bandwidth: $\frac{g_m}{C_4 (R_4 g_m + 2 R_L g_m + 1)}$
Qz: $\frac{C_4 \sqrt{\frac{C_4 L_4}{C_L L_L}} (R_4 g_m - 1)}{g_m}$

Filter 82

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, \frac{L_L s}{C_L L_L s^2 + 1} + R_4, \frac{1}{C_L s}\right)$

Filter 83

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, \infty, \frac{L_4 s}{C_4 L_4 s^2 + 1} + R_4, \frac{R_L}{C_L R_L s + 1} \right)$

Filter 84

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, \infty, \frac{L_4 s}{C_4 L_4 s^2 + 1} + R_4, R_L + \frac{1}{C_L s} \right)$

Filter 85

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, \infty, \frac{L_4 s}{C_4 L_4 s^2 + 1} + R_4, L_L s + \frac{1}{C_L s} \right)$

Filter 86

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, \infty, \frac{L_4 s}{C_4 L_4 s^2 + 1} + R_4, \frac{L_L s}{C_L L_L s^2 + 1} \right)$

Filter 87

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, \infty, \frac{L_4 s}{C_4 L_4 s^2 + 1} + R_4, L_L s + R_L + \frac{1}{C_L s} \right)$

Filter 88

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, \infty, \frac{L_L s}{C_4 L_4 s^2 + 1} + R_4, \frac{1}{C_L s + \frac{1}{R_L + \frac{1}{L_L s}}} \right)$

Filter 89

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, \infty, \frac{L_4 s}{C_4 L_4 s^2 + 1} + R_4, \frac{L_L s}{C_L L_L s^2 + 1} + R_L \right)$

Filter 90

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, \infty, \frac{L_4 s}{C_4 L_4 s^2 + 1} + R_4, \frac{R_L \left(L_L s + \frac{1}{C_L s} \right)}{L_L s + R_L + \frac{1}{C_L s}} \right)$

Filter 91

Filter Type: GE

$Z(s)$: $\left(\infty, \infty, \infty, \infty, \infty, \frac{R_4 \left(L_L s + \frac{1}{C_L s} \right)}{L_L s + R_4 + \frac{1}{C_L s}}, R_L \right)$
 $H(s)$: $\frac{R_L \left(C_4 L_4 R_4 g_m s^2 - C_4 L_4 s^2 - C_4 R_4 s + R_4 g_m - 1 \right)}{C_4 L_4 R_4 g_m s^2 + 2 C_4 L_4 R_L g_m s + C_4 L_4 s^2 + 2 C_4 R_L R_L g_m s + C_4 R_L s + R_4 g_m + 2 R_L g_m + 1}$
Q: $\frac{L_4 \sqrt{\frac{C_4^2 L_4^2}{R_4^2} (R_4 g_m + 2 R_L g_m + 1)}}{R_4 (2 R_L g_m + 1)}$
 ω_0 : $\sqrt{\frac{1}{C_4 L_4}}$
Bandwidth: $\frac{R_4 (2 R_L g_m + 1)}{L_4 (R_4 g_m + 2 R_L g_m + 1)}$
Qz: $\frac{L_4 \sqrt{\frac{1}{C_4^2 L_4^2} (-R_4 g_m + 1)}}{R_4}$

Filter 92

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, \infty, \frac{R_4 \left(L_L s + \frac{1}{C_L s} \right)}{L_L s + R_4 + \frac{1}{C_L s}}, \frac{1}{C_L s} \right)$

Filter 93

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, \infty, \frac{R_4 \left(L_L s + \frac{1}{C_L s} \right)}{L_L s + R_4 + \frac{1}{C_L s}}, \frac{R_L}{C_L R_L s + 1} \right)$

Filter 94

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, \infty, \frac{R_4 \left(L_L s + \frac{1}{C_L s} \right)}{L_L s + R_4 + \frac{1}{C_L s}}, R_L + \frac{1}{C_L s} \right)$

Filter 95

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, \infty, \frac{R_4 \left(L_L s + \frac{1}{C_L s} \right)}{L_L s + R_4 + \frac{1}{C_L s}}, L_L s + \frac{1}{C_L s} \right)$

Filter 96

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, \infty, \frac{R_4 \left(L_L s + \frac{1}{C_L s} \right)}{L_L s + R_4 + \frac{1}{C_L s}}, \frac{L_L s}{C_L L_L s^2 + 1} \right)$

Filter 97

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, \infty, \frac{R_4 \left(L_L s + \frac{1}{C_L s} \right)}{L_L s + R_4 + \frac{1}{C_L s}}, L_L s + R_L + \frac{1}{C_L s} \right)$

Filter 98

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, \infty, \frac{R_4 \left(L_L s + \frac{1}{C_L s} \right)}{L_L s + R_4 + \frac{1}{C_L s}}, \frac{1}{C_L s + \frac{1}{R_L + \frac{1}{L_L s}}} \right)$

Filter 99

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, \infty, \frac{R_4 \left(L_L s + \frac{1}{C_L s} \right)}{L_L s + R_4 + \frac{1}{C_L s}}, \frac{L_L s}{C_L L_L s^2 + 1} + R_L \right)$

Filter 100

Invalid filter
 $Z(s)$: $\left(\infty, \infty, \infty, \infty, \infty, \frac{R_4 \left(L_L s + \frac{1}{C_L s} \right)}{L_L s + R_4 + \frac{1}{C_L s}}, \frac{R_L \left(L_L s + \frac{1}{C_L s} \right)}{L_L s + R_L + \frac{1}{C_L s}} \right)$