Experiment: TIA simple Z5 ZL

Filter 1

Filter Type: GE
$Z(s)$: $\left(\infty,\ \infty,\ R_3,\ \infty,\ \infty,\ L_L s + R_L + \frac{1}{C_L s}\right)$
$H(s)$: $\frac{(R_4 g_m - 1)\left(C_L L_L s^2 + C_L R_L s + 1\right)}{2C_L L_L g_m s^2 + C_L R_4 g_m s + 2C_L R_L g_m s + C_L s + 2g_m}$
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 2

Filter Type: GE
$Z(s)$: $\left(\infty,\ \infty,\ R_3,\ \infty,\ \infty,\ \frac{L_L s}{C_L L_L s^2 + 1} + R_L\right)$
$H(s)$: $\frac{(R_4 g_m - 1)\left(C_L L_L R_L s^2 + L_L s + R_L\right)}{C_L L_L R_4 g_m s^2 + 2C_L L_L R_L g_m s^2 + C_L L_L s^2 + 2L_L g_m s + R_4 g_m + 2R_L g_m + 1}$
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 3

Filter Type: GE
$Z(s)$: $\left(\infty,\ \infty,\ L_3 s + \frac{1}{C_3 s},\ \infty,\ \infty,\ R_L\right)$
$H(s)$: $\frac{R_L\left(C_4 L_4 g_m s^2 - C_4 s + g_m\right)}{C_4 L_4 g_m s^2 + 2C_4 R_L g_m s + C_4 s + g_m}$
Q: $\frac{L_4 g_m \sqrt{\frac{1}{C_4 L_4}}}{2R_L g_m + 1}$
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 4

Filter Type: GE
$Z(s)$: $\left(\infty,\ \infty,\ \frac{L_3 s}{C_3 L_3 s^2 + 1},\ \infty,\ \infty,\ R_L\right)$
$H(s)$: $\frac{R_L\left(-C_4 L_4 s^2 + L_4 g_m s - 1\right)}{2C_4 L_4 R_L g_m s^2 + C_4 L_4 s^2 + L_4 g_m s + 2R_L g_m + 1}$
Q: $\frac{C_4 \sqrt{\frac{1}{C_4 L_4}} (2R_L g_m + 1)}{g_m}$
ω_0: $\sqrt{\frac{1}{C_4 L_4}}$
Bandwidth: $\frac{g_m}{C_4 (2R_L g_m + 1)}$
Qz: $-\frac{C_4 \sqrt{\frac{1}{C_4 L_4}}}{g_m}$

Filter 5

Filter Type: GE
$Z(s)$: $\left(\infty,\ \infty,\ L_3 s + R_3 + \frac{1}{C_3 s},\ \infty,\ \infty,\ R_L\right)$
$H(s)$: $\frac{R_L\left(C_4 L_4 g_m s^2 + C_4 R_4 g_m s - C_4 s + g_m\right)}{C_4 L_4 g_m s^2 + C_4 R_4 g_m s + 2C_4 R_L g_m s + C_4 s + g_m}$
Q: $\frac{L_4 g_m \sqrt{\frac{1}{C_4 L_4}}}{R_4 g_m + 2R_L g_m + 1}$
ω_0: $\sqrt{\frac{1}{C_4 L_4}}$
Bandwidth: $\frac{R_4 g_m + 2R_L g_m + 1}{L_4 g_m}$
Qz: $\frac{L_4 g_m \sqrt{\frac{1}{C_4 L_4}}}{R_4 g_m - 1}$

Filter 6

Filter Type: GE
$Z(s)$: $\left(\infty,\ \infty,\ \frac{1}{C_3 s + \frac{1}{R_3} + \frac{1}{L_3 s}},\ \infty,\ \infty,\ R_L\right)$
$H(s)$: $\frac{R_L\left(-C_4 L_4 R_4 s^2 + L_4 R_4 g_m s - L_4 s - R_4\right)}{2C_4 L_4 R_4 R_L g_m s^2 + C_4 L_4 R_4 s^2 + L_4 R_4 g_m s + 2L_4 R_L g_m s + L_4 s + 2R_4 R_L g_m + R_4}$
Q: $\frac{C_4 R_4 \sqrt{\frac{1}{C_4 L_4}} (2R_L g_m + 1)}{R_4 g_m + 2R_L g_m + 1}$
ω_0: $\sqrt{\frac{1}{C_4 L_4}}$
Bandwidth: $\frac{R_4 g_m + 2R_L g_m + 1}{C_4 R_4 (2R_L g_m + 1)}$
Qz: $-\frac{C_4 R_4 \sqrt{\frac{1}{C_4 L_4}}}{R_4 g_m - 1}$

Filter 7

Filter Type: GE
$Z(s)$: $\left(\infty,\ \infty,\ \frac{L_3 s}{C_3 L_3 s^2 + 1} + R_3,\ \infty,\ \infty,\ R_L\right)$
$H(s)$: $\frac{R_L\left(C_4 L_4 R_4 g_m s^2 - C_4 L_4 s^2 + L_4 g_m s + R_4 g_m - 1\right)}{C_4 L_4 R_4 g_m s^2 + 2C_4 L_4 R_L g_m s^2 + C_4 L_4 s^2 + L_4 g_m s + R_4 g_m + 2R_L g_m + 1}$
Q: $\frac{C_4 \sqrt{\frac{1}{C_4 L_4}} (R_4 g_m + 2R_L g_m + 1)}{g_m}$
ω_0: $\sqrt{\frac{1}{C_4 L_4}}$
Bandwidth: $\frac{g_m}{C_4 (R_4 g_m + 2R_L g_m + 1)}$
Qz: $\frac{C_4 \sqrt{\frac{1}{C_4 L_4}} (R_4 g_m - 1)}{g_m}$

Filter 8

Filter Type: GE
$Z(s)$: $\left(\infty,\ \infty,\ \frac{R_3\left(L_3 s + \frac{1}{C_3 s}\right)}{L_3 s + R_3 + \frac{1}{C_3 s}},\ \infty,\ \infty,\ R_L\right)$
$H(s)$: $\frac{R_L\left(C_4 L_4 R_4 g_m s^2 - C_4 L_4 s^2 - C_4 R_4 s + R_4 g_m - 1\right)}{C_4 L_4 R_4 g_m s^2 + 2C_4 L_4 R_L g_m s^2 + C_4 L_4 s^2 + 2C_4 R_4 R_L g_m s + C_4 R_4 s + R_4 g_m + 2R_L g_m + 1}$
Q: $\frac{L_4 \sqrt{\frac{1}{C_4 L_4}} (R_4 g_m + 2R_L g_m + 1)}{R_4 (2R_L g_m + 1)}$
ω_0: $\sqrt{\frac{1}{C_4 L_4}}$
Bandwidth: $\frac{R_4 (2R_L g_m + 1)}{L_4 (R_4 g_m + 2R_L g_m + 1)}$
Qz: $\frac{L_4 \sqrt{\frac{1}{C_4 L_4}} (-R_4 g_m + 1)}{R_4}$