

# Filter Summary Report: TIA,some,parasitic,Z1,ZL

Generated by MacAnalog-Symbolix

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## Contents

**1 Examined  $H(z)$  for TIA some parasitic Z1 ZL:**  $\frac{Z_1 Z_L (g_m r_o + 1)}{Z_1 g_m r_o + Z_1 + Z_L + r_o}$

$$H(z) = \frac{Z_1 Z_L (g_m r_o + 1)}{Z_1 g_m r_o + Z_1 + Z_L + r_o}$$

**2 HP**

**3 BP**

**3.1 BP-1**  $Z(s) = \left( R_1, \infty, \infty, \infty, \infty, \frac{L_L s}{C_L L_L s^2 + 1} \right)$

$$H(s) = \frac{L_L R_1 s (g_m r_o + 1)}{C_L L_L R_1 g_m r_o s^2 + C_L L_L R_1 s^2 + C_L L_L r_o s^2 + L_L s + R_1 g_m r_o + R_1 + r_o}$$

**Parameters:**

Q:  $C_L \sqrt{\frac{1}{C_L L_L}} (R_1 g_m r_o + R_1 + r_o)$

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

bandwidth:  $\frac{1}{C_L (R_1 g_m r_o + R_1 + r_o)}$

K-LP: 0

K-HP: 0

K-BP:  $R_1 (g_m r_o + 1)$

Qz: 0

Wz: None

**3.2 BP-2**  $Z(s) = \left( R_1, \infty, \infty, \infty, \infty, \frac{1}{C_L s + \frac{1}{R_L} + \frac{1}{L_L s}} \right)$

$$H(s) = \frac{L_L R_1 R_L s (g_m r_o + 1)}{C_L L_L R_1 R_L g_m r_o s^2 + C_L L_L R_1 R_L s^2 + C_L L_L R_L r_o s^2 + L_L R_1 g_m r_o s + L_L R_1 s + L_L R_L s + L_L r_o s + R_1 R_L g_m r_o + R_1 R_L + R_L r_o}$$

**Parameters:**

$$\begin{aligned}
\text{Q: } & \frac{C_L R_L \sqrt{\frac{1}{C_L L_L}} (R_1 g_m r_o + R_1 + r_o)}{R_1 g_m r_o + R_1 + R_L + r_o} \\
\text{wo: } & \sqrt{\frac{1}{C_L L_L}} \\
\text{bandwidth: } & \frac{R_1 g_m r_o + R_1 + R_L + r_o}{C_L R_L (R_1 g_m r_o + R_1 + r_o)} \\
\text{K-LP: } & 0 \\
\text{K-HP: } & 0 \\
\text{K-BP: } & \frac{R_1 R_L (g_m r_o + 1)}{R_1 g_m r_o + R_1 + R_L + r_o} \\
\text{QZ: } & 0 \\
\text{Wz: } & \text{None}
\end{aligned}$$

**3.3 BP-3**  $Z(s) = \left( L_1 s, \infty, \infty, \infty, \infty, \frac{1}{C_L s} \right)$

$$H(s) = \frac{L_1 s (g_m r_o + 1)}{C_L L_1 g_m r_o s^2 + C_L L_1 s^2 + C_L r_o s + 1}$$

**Parameters:**

$$\begin{aligned}
\text{Q: } & \frac{L_1 \sqrt{\frac{1}{C_L L_1 (g_m r_o + 1)}} (g_m r_o + 1)}{r_o} \\
\text{wo: } & \sqrt{\frac{1}{C_L L_1 (g_m r_o + 1)}} \\
\text{bandwidth: } & \frac{r_o}{L_1 (g_m r_o + 1)} \\
\text{K-LP: } & 0 \\
\text{K-HP: } & 0 \\
\text{K-BP: } & \frac{L_1 (g_m r_o + 1)}{C_L r_o} \\
\text{QZ: } & 0 \\
\text{Wz: } & \text{None}
\end{aligned}$$

**3.4 BP-4**  $Z(s) = \left( L_1 s, \infty, \infty, \infty, \infty, \frac{R_L}{C_L R_L s + 1} \right)$

$$H(s) = \frac{L_1 R_L s (g_m r_o + 1)}{C_L L_1 R_L g_m r_o s^2 + C_L L_1 R_L s^2 + C_L R_L r_o s + L_1 g_m r_o s + L_1 s + R_L + r_o}$$

**Parameters:**

$$\text{Q: } \frac{C_L L_1 R_L \sqrt{\frac{R_L + r_o}{C_L L_1 R_L (g_m r_o + 1)}} (g_m r_o + 1)}{C_L R_L r_o + L_1 g_m r_o + L_1}$$

wo:  $\sqrt{\frac{R_L+r_o}{C_L L_1 R_L (g_m r_o + 1)}}$   
 bandwidth:  $\frac{C_L R_L r_o + L_1 g_m r_o + L_1}{C_L L_1 R_L (g_m r_o + 1)}$   
 K-LP: 0  
 K-HP: 0  
 K-BP:  $\frac{L_1 R_L (g_m r_o + 1)}{C_L R_L r_o + L_1 g_m r_o + L_1}$   
 QZ: 0  
 Wz: None

**3.5 BP-5**  $Z(s) = \left( \frac{L_1 s}{C_1 L_1 s^2 + 1}, \infty, \infty, \infty, \infty, R_L \right)$

$$H(s) = \frac{L_1 R_L s (g_m r_o + 1)}{C_1 L_1 R_L s^2 + C_1 L_1 r_o s^2 + L_1 g_m r_o s + L_1 s + R_L + r_o}$$

**Parameters:**

Q:  $\frac{C_1 \sqrt{\frac{1}{C_1 L_1}} (R_L + r_o)}{g_m r_o + 1}$   
 wo:  $\sqrt{\frac{1}{C_1 L_1}}$   
 bandwidth:  $\frac{g_m r_o + 1}{C_1 (R_L + r_o)}$   
 K-LP: 0  
 K-HP: 0  
 K-BP:  $R_L$   
 QZ: 0  
 Wz: None

**3.6 BP-6**  $Z(s) = \left( \frac{1}{C_1 s + \frac{1}{R_1} + \frac{1}{L_1 s}}, \infty, \infty, \infty, \infty, R_L \right)$

$$H(s) = \frac{L_1 R_1 R_L s (g_m r_o + 1)}{C_1 L_1 R_1 R_L s^2 + C_1 L_1 R_1 r_o s^2 + L_1 R_1 g_m r_o s + L_1 R_1 s + L_1 R_L s + L_1 r_o s + R_1 R_L + R_1 r_o}$$

**Parameters:**

Q:  $\frac{C_1 R_1 \sqrt{\frac{1}{C_1 L_1}} (R_L + r_o)}{R_1 g_m r_o + R_1 + R_L + r_o}$

wo:  $\sqrt{\frac{1}{C_1 L_1}}$   
 bandwidth:  $\frac{R_1 g_m r_o + R_1 + R_L + r_o}{C_1 R_1 (R_L + r_o)}$   
 K-LP: 0  
 K-HP: 0  
 K-BP:  $\frac{R_1 R_L (g_m r_o + 1)}{R_1 g_m r_o + R_1 + R_L + r_o}$   
 QZ: 0  
 Wz: None

## 4 LP

**4.1 LP-1**  $Z(s) = \left( \frac{1}{C_1 s}, \infty, \infty, \infty, \infty, \frac{R_L}{C_L R_L s + 1} \right)$

$$H(s) = \frac{R_L (g_m r_o + 1)}{C_1 C_L R_L r_o s^2 + C_1 R_L s + C_1 r_o s + C_L R_L g_m r_o s + C_L R_L s + g_m r_o + 1}$$

**Parameters:**

Q:  $\frac{C_1 C_L R_L r_o \sqrt{\frac{g_m r_o + 1}{C_1 C_L R_L r_o}}}{C_1 R_L + C_1 r_o + C_L R_L g_m r_o + C_L R_L}$   
 wo:  $\sqrt{\frac{g_m r_o + 1}{C_1 C_L R_L r_o}}$   
 bandwidth:  $\frac{C_1 R_L + C_1 r_o + C_L R_L g_m r_o + C_L R_L}{C_1 C_L R_L r_o}$   
 K-LP:  $R_L$   
 K-HP: 0  
 K-BP: 0  
 QZ: None  
 Wz: None

**4.2 LP-2**  $Z(s) = \left( \frac{R_1}{C_1 R_1 s + 1}, \infty, \infty, \infty, \infty, \frac{1}{C_L s} \right)$

$$H(s) = \frac{R_1 (g_m r_o + 1)}{C_1 C_L R_1 r_o s^2 + C_1 R_1 s + C_L R_1 g_m r_o s + C_L R_1 s + C_L r_o s + 1}$$

**Parameters:**

$$\begin{aligned} \text{Q: } & \frac{C_1 C_L R_1 r_o \sqrt{\frac{1}{C_1 C_L R_1 r_o}}}{C_1 R_1 + C_L R_1 g_m r_o + C_L R_1 + C_L r_o} \\ \text{wo: } & \sqrt{\frac{1}{C_1 C_L R_1 r_o}} \\ \text{bandwidth: } & \frac{C_1 R_1 + C_L R_1 g_m r_o + C_L R_1 + C_L r_o}{C_1 C_L R_1 r_o} \\ \text{K-LP: } & R_1 (g_m r_o + 1) \\ \text{K-HP: } & 0 \\ \text{K-BP: } & 0 \\ \text{Qz: } & \text{None} \\ \text{Wz: } & \text{None} \end{aligned}$$

**4.3 LP-3**  $Z(s) = \left( \frac{R_1}{C_1 R_1 s + 1}, \infty, \infty, \infty, \infty, \frac{R_L}{C_L R_L s + 1} \right)$

$$H(s) = \frac{R_1 R_L (g_m r_o + 1)}{C_1 C_L R_1 R_L r_o s^2 + C_1 R_1 R_L s + C_1 R_1 r_o s + C_L R_1 R_L g_m r_o s + C_L R_1 R_L s + C_L R_L r_o s + R_1 g_m r_o + R_1 + R_L + r_o}$$

**Parameters:**

$$\begin{aligned} \text{Q: } & \frac{C_1 C_L R_1 R_L r_o \sqrt{\frac{R_1 g_m r_o + R_1 + R_L + r_o}{C_1 C_L R_1 R_L r_o}}}{C_1 R_1 R_L + C_1 R_1 r_o + C_L R_1 R_L g_m r_o + C_L R_1 R_L + C_L R_L r_o} \\ \text{wo: } & \sqrt{\frac{R_1 g_m r_o + R_1 + R_L + r_o}{C_1 C_L R_1 R_L r_o}} \\ \text{bandwidth: } & \frac{C_1 R_1 R_L + C_1 R_1 r_o + C_L R_1 R_L g_m r_o + C_L R_1 R_L + C_L R_L r_o}{C_1 C_L R_1 R_L r_o} \\ \text{K-LP: } & \frac{R_1 R_L (g_m r_o + 1)}{R_1 g_m r_o + R_1 + R_L + r_o} \\ \text{K-HP: } & 0 \\ \text{K-BP: } & 0 \\ \text{Qz: } & \text{None} \\ \text{Wz: } & \text{None} \end{aligned}$$

## 5 BS

**5.1 BS-1**  $Z(s) = \left( R_1, \infty, \infty, \infty, \infty, L_L s + \frac{1}{C_L s} \right)$

$$H(s) = \frac{R_1 (g_m r_o + 1) (C_L L_L s^2 + 1)}{C_L L_L s^2 + C_L R_1 g_m r_o s + C_L R_1 s + C_L r_o s + 1}$$

**Parameters:**

Q:  $\frac{L_L \sqrt{\frac{1}{C_L L_L}}}{R_1 g_m r_o + R_1 + r_o}$   
 wo:  $\sqrt{\frac{1}{C_L L_L}}$   
 bandwidth:  $\frac{R_1 g_m r_o + R_1 + r_o}{L_L}$   
 K-LP:  $R_1 (g_m r_o + 1)$   
 K-HP:  $R_1 (g_m r_o + 1)$   
 K-BP: 0  
 QZ: None  
 WZ:  $\sqrt{\frac{1}{C_L L_L}}$

**5.2 BS-2**  $Z(s) = \left( R_1, \infty, \infty, \infty, \infty, \frac{R_L (L_L s + \frac{1}{C_L s})}{L_L s + R_L + \frac{1}{C_L s}} \right)$

$$H(s) = \frac{R_1 R_L (g_m r_o + 1) (C_L L_L s^2 + 1)}{C_L L_L R_1 g_m r_o s^2 + C_L L_L R_1 s^2 + C_L L_L R_L s^2 + C_L L_L r_o s^2 + C_L R_1 R_L g_m r_o s + C_L R_1 R_L s + C_L R_L r_o s + R_1 g_m r_o + R_1 + R_L + r_o}$$

**Parameters:**

Q:  $\frac{L_L \sqrt{\frac{1}{C_L L_L}} (R_1 g_m r_o + R_1 + R_L + r_o)}{R_L (R_1 g_m r_o + R_1 + r_o)}$   
 wo:  $\sqrt{\frac{1}{C_L L_L}}$   
 bandwidth:  $\frac{R_L (R_1 g_m r_o + R_1 + R_L + r_o)}{L_L (R_1 g_m r_o + R_1 + R_L + r_o)}$   
 K-LP:  $\frac{R_1 R_L (g_m r_o + 1)}{R_1 g_m r_o + R_1 + R_L + r_o}$   
 K-HP:  $\frac{R_1 R_L (g_m r_o + 1)}{R_1 g_m r_o + R_1 + R_L + r_o}$   
 K-BP: 0  
 QZ: None  
 WZ:  $\sqrt{\frac{1}{C_L L_L}}$

**5.3 BS-3**  $Z(s) = \left( L_1 s + \frac{1}{C_1 s}, \infty, \infty, \infty, \infty, R_L \right)$

$$H(s) = \frac{R_L (g_m r_o + 1) (C_1 L_1 s^2 + 1)}{C_1 L_1 g_m r_o s^2 + C_1 L_1 s^2 + C_1 R_L s + C_1 r_o s + g_m r_o + 1}$$

**Parameters:**

$$\begin{aligned} \text{Q: } & \frac{L_1 \sqrt{\frac{1}{C_1 L_1}} (g_m r_o + 1)}{R_L + r_o} \\ \text{wo: } & \sqrt{\frac{1}{C_1 L_1}} \\ \text{bandwidth: } & \frac{R_L + r_o}{L_1 (g_m r_o + 1)} \\ \text{K-LP: } & R_L \\ \text{K-HP: } & R_L \\ \text{K-BP: } & 0 \\ \text{Qz: } & \text{None} \\ \text{Wz: } & \sqrt{\frac{1}{C_1 L_1}} \end{aligned}$$

**5.4 BS-4**  $Z(s) = \left( \frac{R_1 (L_1 s + \frac{1}{C_1 s})}{L_1 s + R_1 + \frac{1}{C_1 s}}, \infty, \infty, \infty, \infty, R_L \right)$

$$H(s) = \frac{R_1 R_L (g_m r_o + 1) (C_1 L_1 s^2 + 1)}{C_1 L_1 R_1 g_m r_o s^2 + C_1 L_1 R_1 s^2 + C_1 L_1 R_L s^2 + C_1 L_1 r_o s^2 + C_1 R_1 R_L s + C_1 R_1 r_o s + R_1 g_m r_o + R_1 + R_L + r_o}$$

**Parameters:**

$$\begin{aligned} \text{Q: } & \frac{L_1 \sqrt{\frac{1}{C_1 L_1}} (R_1 g_m r_o + R_1 + R_L + r_o)}{R_1 (R_L + r_o)} \\ \text{wo: } & \sqrt{\frac{1}{C_1 L_1}} \\ \text{bandwidth: } & \frac{R_1 (R_L + r_o)}{L_1 (R_1 g_m r_o + R_1 + R_L + r_o)} \\ \text{K-LP: } & \frac{R_1 R_L (g_m r_o + 1)}{R_1 g_m r_o + R_1 + R_L + r_o} \\ \text{K-HP: } & \frac{R_1 R_L (g_m r_o + 1)}{R_1 g_m r_o + R_1 + R_L + r_o} \\ \text{K-BP: } & 0 \\ \text{Qz: } & \text{None} \\ \text{Wz: } & \sqrt{\frac{1}{C_1 L_1}} \end{aligned}$$



## 6 GE

**6.1 GE-1**  $Z(s) = \left( R_1, \infty, \infty, \infty, \infty, L_L s + R_L + \frac{1}{C_L s} \right)$

$$H(s) = \frac{R_1 (g_m r_o + 1) (C_L L_L s^2 + C_L R_L s + 1)}{C_L L_L s^2 + C_L R_1 g_m r_o s + C_L R_1 s + C_L R_L s + C_L r_o s + 1}$$

**Parameters:**

$$\begin{aligned} \text{Q: } & \frac{L_L \sqrt{\frac{1}{C_L L_L}}}{R_1 g_m r_o + R_1 + R_L + r_o} \\ \text{wo: } & \sqrt{\frac{1}{C_L L_L}} \\ \text{bandwidth: } & \frac{R_1 g_m r_o + R_1 + R_L + r_o}{L_L} \\ \text{K-LP: } & R_1 (g_m r_o + 1) \\ \text{K-HP: } & R_1 (g_m r_o + 1) \\ \text{K-BP: } & \frac{R_1 R_L (g_m r_o + 1)}{R_1 g_m r_o + R_1 + R_L + r_o} \\ \text{QZ: } & \frac{L_L \sqrt{\frac{1}{C_L L_L}}}{R_L} \\ \text{WZ: } & \sqrt{\frac{1}{C_L L_L}} \end{aligned}$$

**6.2 GE-2**  $Z(s) = \left( R_1, \infty, \infty, \infty, \infty, \frac{L_L s}{C_L L_L s^2 + 1} + R_L \right)$

$$H(s) = \frac{R_1 (g_m r_o + 1) (C_L L_L R_L s^2 + L_L s + R_L)}{C_L L_L R_1 g_m r_o s^2 + C_L L_L R_1 s^2 + C_L L_L R_L s^2 + C_L L_L r_o s^2 + L_L s + R_1 g_m r_o + R_1 + R_L + r_o}$$

**Parameters:**

$$\begin{aligned} \text{Q: } & C_L \sqrt{\frac{1}{C_L L_L}} (R_1 g_m r_o + R_1 + R_L + r_o) \\ \text{wo: } & \sqrt{\frac{1}{C_L L_L}} \\ \text{bandwidth: } & \frac{1}{C_L (R_1 g_m r_o + R_1 + R_L + r_o)} \\ \text{K-LP: } & \frac{R_1 R_L (g_m r_o + 1)}{R_1 g_m r_o + R_1 + R_L + r_o} \\ \text{K-HP: } & \frac{R_1 R_L (g_m r_o + 1)}{R_1 g_m r_o + R_1 + R_L + r_o} \\ \text{K-BP: } & R_1 (g_m r_o + 1) \end{aligned}$$

$$\text{QZ: } C_L R_L \sqrt{\frac{1}{C_L L_L}}$$

$$\text{WZ: } \sqrt{\frac{1}{C_L L_L}}$$

**6.3 GE-3**  $Z(s) = \left( L_1 s + R_1 + \frac{1}{C_1 s}, \infty, \infty, \infty, \infty, R_L \right)$

$$H(s) = \frac{R_L (g_m r_o + 1) (C_1 L_1 s^2 + C_1 R_1 s + 1)}{C_1 L_1 g_m r_o s^2 + C_1 L_1 s^2 + C_1 R_1 g_m r_o s + C_1 R_1 s + C_1 R_L s + C_1 r_o s + g_m r_o + 1}$$

**Parameters:**

$$\text{Q: } \frac{L_1 \sqrt{\frac{1}{C_1 L_1}} (g_m r_o + 1)}{R_1 g_m r_o + R_1 + R_L + r_o}$$

$$\text{wO: } \sqrt{\frac{1}{C_1 L_1}}$$

$$\text{bandwidth: } \frac{R_1 g_m r_o + R_1 + R_L + r_o}{L_1 (g_m r_o + 1)}$$

$$\text{K-LP: } R_L$$

$$\text{K-HP: } R_L$$

$$\text{K-BP: } \frac{R_1 R_L (g_m r_o + 1)}{R_1 g_m r_o + R_1 + R_L + r_o}$$

$$\text{QZ: } \frac{L_1 \sqrt{\frac{1}{C_1 L_1}}}{R_1}$$

$$\text{WZ: } \sqrt{\frac{1}{C_1 L_1}}$$

**6.4 GE-4**  $Z(s) = \left( \frac{L_1 s}{C_1 L_1 s^2 + 1} + R_1, \infty, \infty, \infty, \infty, R_L \right)$

$$H(s) = \frac{R_L (g_m r_o + 1) (C_1 L_1 R_1 s^2 + L_1 s + R_1)}{C_1 L_1 R_1 g_m r_o s^2 + C_1 L_1 R_1 s^2 + C_1 L_1 R_L s^2 + C_1 L_1 r_o s^2 + L_1 g_m r_o s + L_1 s + R_1 g_m r_o + R_1 + R_L + r_o}$$

**Parameters:**

$$\text{Q: } \frac{C_1 \sqrt{\frac{1}{C_1 L_1}} (R_1 g_m r_o + R_1 + R_L + r_o)}{g_m r_o + 1}$$

$$\text{wO: } \sqrt{\frac{1}{C_1 L_1}}$$

$$\text{bandwidth: } \frac{g_m r_o + 1}{C_1 (R_1 g_m r_o + R_1 + R_L + r_o)}$$

$$\text{K-LP: } \frac{R_1 R_L (g_m r_o + 1)}{R_1 g_m r_o + R_1 + R_L + r_o}$$

$$\begin{aligned} \text{K-HP: } & \frac{R_1 R_L (g_m r_o + 1)}{R_1 g_m r_o + R_1 + R_L + r_o} \\ \text{K-BP: } & R_L \\ \text{QZ: } & C_1 R_1 \sqrt{\frac{1}{C_1 L_1}} \\ \text{WZ: } & \sqrt{\frac{1}{C_1 L_1}} \end{aligned}$$

## 7 AP

## 8 INVALID-NUMER

**8.1 INVALID-NUMER-1**  $Z(s) = \left( L_1 s, \infty, \infty, \infty, \infty, R_L + \frac{1}{C_L s} \right)$

$$H(s) = \frac{L_1 s (g_m r_o + 1) (C_L R_L s + 1)}{C_L L_1 g_m r_o s^2 + C_L L_1 s^2 + C_L R_L s + C_L r_o s + 1}$$

**Parameters:**

$$\begin{aligned} \text{Q: } & \frac{L_1 \sqrt{\frac{1}{C_L L_1 (g_m r_o + 1)}} (g_m r_o + 1)}{R_L + r_o} \\ \text{wo: } & \sqrt{\frac{1}{C_L L_1 (g_m r_o + 1)}} \\ \text{bandwidth: } & \frac{R_L + r_o}{L_1 (g_m r_o + 1)} \\ \text{K-LP: } & 0 \\ \text{K-HP: } & R_L \\ \text{K-BP: } & \frac{L_1 (g_m r_o + 1)}{C_L (R_L + r_o)} \\ \text{QZ: } & C_L R_L \sqrt{\frac{1}{C_L L_1 (g_m r_o + 1)}} \\ \text{WZ: } & \text{None} \end{aligned}$$

**8.2 INVALID-NUMER-2**  $Z(s) = \left( \frac{R_1}{C_1 R_1 s + 1}, \infty, \infty, \infty, \infty, R_L + \frac{1}{C_L s} \right)$

$$H(s) = \frac{R_1 (g_m r_o + 1) (C_L R_L s + 1)}{C_1 C_L R_1 R_L s^2 + C_1 C_L R_1 r_o s^2 + C_1 R_1 s + C_L R_1 g_m r_o s + C_L R_1 s + C_L R_L s + C_L r_o s + 1}$$

**Parameters:**

$$\begin{aligned}
Q: & \frac{C_1 C_L R_1 \sqrt{\frac{1}{C_1 C_L R_1 (R_L + r_o)}} (R_L + r_o)}{C_1 R_1 + C_L R_1 g_m r_o + C_L R_1 + C_L R_L + C_L r_o} \\
wo: & \sqrt{\frac{1}{C_1 C_L R_1 (R_L + r_o)}} \\
bandwidth: & \frac{C_1 R_1 + C_L R_1 g_m r_o + C_L R_1 + C_L R_L + C_L r_o}{C_1 C_L R_1 (R_L + r_o)} \\
K-LP: & R_1 (g_m r_o + 1) \\
K-HP: & 0 \\
K-BP: & \frac{C_L R_1 R_L (g_m r_o + 1)}{C_1 R_1 + C_L R_1 g_m r_o + C_L R_1 + C_L R_L + C_L r_o} \\
Qz: & 0 \\
Wz: & \text{None}
\end{aligned}$$

### 8.3 INVALID-NUMER-3 $Z(s) = \left( R_1 + \frac{1}{C_1 s}, \infty, \infty, \infty, \infty, \frac{R_L}{C_L R_L s + 1} \right)$

$$H(s) = \frac{R_L (g_m r_o + 1) (C_1 R_1 s + 1)}{C_1 C_L R_1 R_L g_m r_o s^2 + C_1 C_L R_1 R_L s^2 + C_1 C_L R_L r_o s^2 + C_1 R_1 g_m r_o s + C_1 R_1 s + C_1 R_L s + C_1 r_o s + C_L R_L g_m r_o s + C_L R_L s + g_m r_o + 1}$$

**Parameters:**

$$\begin{aligned}
Q: & \frac{C_1 C_L R_L \sqrt{\frac{g_m r_o + 1}{C_1 C_L R_L (R_1 g_m r_o + R_1 + r_o)}} (R_1 g_m r_o + R_1 + r_o)}{C_1 R_1 g_m r_o + C_1 R_1 + C_1 R_L + C_1 r_o + C_L R_L g_m r_o + C_L R_L} \\
wo: & \sqrt{\frac{g_m r_o + 1}{C_1 C_L R_L (R_1 g_m r_o + R_1 + r_o)}} \\
bandwidth: & \frac{C_1 R_1 g_m r_o + C_1 R_1 + C_1 R_L + C_1 r_o + C_L R_L g_m r_o + C_L R_L}{C_1 C_L R_L (R_1 g_m r_o + R_1 + r_o)} \\
K-LP: & R_L \\
K-HP: & 0 \\
K-BP: & \frac{C_1 R_1 R_L (g_m r_o + 1)}{C_1 R_1 g_m r_o + C_1 R_1 + C_1 R_L + C_1 r_o + C_L R_L g_m r_o + C_L R_L} \\
Qz: & 0 \\
Wz: & \text{None}
\end{aligned}$$

## 9 INVALID-WZ

## 10 INVALID-ORDER

**10.1 INVALID-ORDER-1**  $Z(s) = (R_1, \infty, \infty, \infty, \infty, R_L)$

$$H(s) = \frac{R_1 R_L (g_m r_o + 1)}{R_1 g_m r_o + R_1 + R_L + r_o}$$

**10.2 INVALID-ORDER-2**  $Z(s) = \left( R_1, \infty, \infty, \infty, \infty, \frac{1}{C_L s} \right)$

$$H(s) = \frac{R_1 (g_m r_o + 1)}{C_L R_1 g_m r_o s + C_L R_1 s + C_L r_o s + 1}$$

**10.3 INVALID-ORDER-3**  $Z(s) = \left( R_1, \infty, \infty, \infty, \infty, \frac{R_L}{C_L R_L s + 1} \right)$

$$H(s) = \frac{R_1 R_L (g_m r_o + 1)}{C_L R_1 R_L g_m r_o s + C_L R_1 R_L s + C_L R_L r_o s + R_1 g_m r_o + R_1 + R_L + r_o}$$

**10.4 INVALID-ORDER-4**  $Z(s) = \left( R_1, \infty, \infty, \infty, \infty, R_L + \frac{1}{C_L s} \right)$

$$H(s) = \frac{R_1 (g_m r_o + 1) (C_L R_L s + 1)}{C_L R_1 g_m r_o s + C_L R_1 s + C_L R_L s + C_L r_o s + 1}$$

**10.5 INVALID-ORDER-5**  $Z(s) = (L_1 s, \infty, \infty, \infty, \infty, R_L)$

$$H(s) = \frac{L_1 R_L s (g_m r_o + 1)}{L_1 g_m r_o s + L_1 s + R_L + r_o}$$

**10.6 INVALID-ORDER-6**  $Z(s) = \left( L_1 s, \infty, \infty, \infty, \infty, L_L s + \frac{1}{C_L s} \right)$

$$H(s) = \frac{L_1 s (g_m r_o + 1) (C_L L_L s^2 + 1)}{C_L L_1 g_m r_o s^2 + C_L L_1 s^2 + C_L L_L s^2 + C_L r_o s + 1}$$

**10.7 INVALID-ORDER-7**  $Z(s) = \left( L_1 s, \infty, \infty, \infty, \infty, \frac{L_L s}{C_L L_L s^2 + 1} \right)$

$$H(s) = \frac{L_1 L_L s^2 (g_m r_o + 1)}{C_L L_1 L_L g_m r_o s^3 + C_L L_1 L_L s^3 + C_L L_L r_o s^2 + L_1 g_m r_o s + L_1 s + L_L s + r_o}$$

**10.8 INVALID-ORDER-8**  $Z(s) = \left( L_1 s, \infty, \infty, \infty, \infty, L_L s + R_L + \frac{1}{C_L s} \right)$

$$H(s) = \frac{L_1 s (g_m r_o + 1) (C_L L_L s^2 + C_L R_L s + 1)}{C_L L_1 g_m r_o s^2 + C_L L_1 s^2 + C_L L_L s^2 + C_L R_L s + C_L r_o s + 1}$$

**10.9 INVALID-ORDER-9**  $Z(s) = \left( L_1 s, \infty, \infty, \infty, \infty, \frac{1}{C_L s + \frac{1}{R_L} + \frac{1}{L_L s}} \right)$

$$H(s) = \frac{L_1 L_L R_L s^2 (g_m r_o + 1)}{C_L L_1 L_L R_L g_m r_o s^3 + C_L L_1 L_L R_L s^3 + C_L L_L R_L r_o s^2 + L_1 L_L g_m r_o s^2 + L_1 L_L s^2 + L_1 R_L g_m r_o s + L_1 R_L s + L_L R_L s + L_L r_o s + R_L r_o}$$

**10.10 INVALID-ORDER-10**  $Z(s) = \left( L_1 s, \infty, \infty, \infty, \infty, \frac{L_L s}{C_L L_L s^2 + 1} + R_L \right)$

$$H(s) = \frac{L_1 s (g_m r_o + 1) (C_L L_L R_L s^2 + L_L s + R_L)}{C_L L_1 L_L g_m r_o s^3 + C_L L_1 L_L s^3 + C_L L_L R_L s^2 + C_L L_L r_o s^2 + L_1 g_m r_o s + L_1 s + L_L s + R_L + r_o}$$

**10.11 INVALID-ORDER-11**  $Z(s) = \left( L_1 s, \infty, \infty, \infty, \infty, \frac{R_L \left( L_L s + \frac{1}{C_L s} \right)}{L_L s + R_L + \frac{1}{C_L s}} \right)$

$$H(s) = \frac{L_1 R_L s (g_m r_o + 1) (C_L L_L s^2 + 1)}{C_L L_1 L_L g_m r_o s^3 + C_L L_1 L_L s^3 + C_L L_1 R_L g_m r_o s^2 + C_L L_1 R_L s^2 + C_L L_L R_L s^2 + C_L L_L r_o s^2 + C_L R_L r_o s + L_1 g_m r_o s + L_1 s + R_L + r_o}$$

**10.12 INVALID-ORDER-12**  $Z(s) = \left( \frac{1}{C_1 s}, \infty, \infty, \infty, \infty, R_L \right)$

$$H(s) = \frac{R_L (g_m r_o + 1)}{C_1 R_L s + C_1 r_o s + g_m r_o + 1}$$

**10.13 INVALID-ORDER-13**  $Z(s) = \left( \frac{1}{C_1 s}, \infty, \infty, \infty, \infty, \frac{1}{C_L s} \right)$

$$H(s) = \frac{g_m r_o + 1}{s (C_1 C_L r_o s + C_1 + C_L g_m r_o + C_L)}$$

**10.14 INVALID-ORDER-14**  $Z(s) = \left( \frac{1}{C_1 s}, \infty, \infty, \infty, \infty, R_L + \frac{1}{C_L s} \right)$

$$H(s) = \frac{(g_m r_o + 1) (C_L R_L s + 1)}{s (C_1 C_L R_L s + C_1 C_L r_o s + C_1 + C_L g_m r_o + C_L)}$$

**10.15 INVALID-ORDER-15**  $Z(s) = \left( \frac{1}{C_1 s}, \infty, \infty, \infty, \infty, L_L s + \frac{1}{C_L s} \right)$

$$H(s) = \frac{(g_m r_o + 1) (C_L L_L s^2 + 1)}{s (C_1 C_L L_L s^2 + C_1 C_L r_o s + C_1 + C_L g_m r_o + C_L)}$$

**10.16 INVALID-ORDER-16**  $Z(s) = \left( \frac{1}{C_1 s}, \infty, \infty, \infty, \infty, \frac{L_L s}{C_L L_L s^2 + 1} \right)$

$$H(s) = \frac{L_L s (g_m r_o + 1)}{C_1 C_L L_L r_o s^3 + C_1 L_L s^2 + C_1 r_o s + C_L L_L g_m r_o s^2 + C_L L_L s^2 + g_m r_o + 1}$$

**10.17 INVALID-ORDER-17**  $Z(s) = \left( \frac{1}{C_1 s}, \infty, \infty, \infty, \infty, L_L s + R_L + \frac{1}{C_L s} \right)$

$$H(s) = \frac{(g_m r_o + 1) (C_L L_L s^2 + C_L R_L s + 1)}{s (C_1 C_L L_L s^2 + C_1 C_L R_L s + C_1 C_L r_o s + C_1 + C_L g_m r_o + C_L)}$$

**10.18 INVALID-ORDER-18**  $Z(s) = \left( \frac{1}{C_1 s}, \infty, \infty, \infty, \infty, \frac{1}{C_L s + \frac{1}{R_L} + \frac{1}{L_L s}} \right)$

$$H(s) = \frac{L_L R_L s (g_m r_o + 1)}{C_1 C_L L_L R_L r_o s^3 + C_1 L_L R_L s^2 + C_1 L_L r_o s^2 + C_1 R_L r_o s + C_L L_L R_L g_m r_o s^2 + C_L L_L R_L s^2 + L_L g_m r_o s + L_L s + R_L g_m r_o + R_L}$$

**10.19 INVALID-ORDER-19**  $Z(s) = \left( \frac{1}{C_1 s}, \infty, \infty, \infty, \infty, \frac{L_L s}{C_L L_L s^2 + 1} + R_L \right)$

$$H(s) = \frac{(g_m r_o + 1) (C_L L_L R_L s^2 + L_L s + R_L)}{C_1 C_L L_L R_L s^3 + C_1 C_L L_L r_o s^3 + C_1 L_L s^2 + C_1 R_L s + C_1 r_o s + C_L L_L g_m r_o s^2 + C_L L_L s^2 + g_m r_o + 1}$$

**10.20 INVALID-ORDER-20**  $Z(s) = \left( \frac{1}{C_1 s}, \infty, \infty, \infty, \infty, \frac{R_L (L_L s + \frac{1}{C_L s})}{L_L s + R_L + \frac{1}{C_L s}} \right)$

$$H(s) = \frac{R_L (g_m r_o + 1) (C_L L_L s^2 + 1)}{C_1 C_L L_L R_L s^3 + C_1 C_L L_L r_o s^3 + C_1 C_L R_L r_o s^2 + C_1 R_L s + C_1 r_o s + C_L L_L g_m r_o s^2 + C_L L_L s^2 + C_L R_L g_m r_o s + C_L R_L s + g_m r_o + 1}$$

**10.21 INVALID-ORDER-21**  $Z(s) = \left( \frac{R_1}{C_1 R_1 s + 1}, \infty, \infty, \infty, \infty, R_L \right)$

$$H(s) = \frac{R_1 R_L (g_m r_o + 1)}{C_1 R_1 R_L s + C_1 R_1 r_o s + R_1 g_m r_o + R_1 + R_L + r_o}$$

**10.22 INVALID-ORDER-22**  $Z(s) = \left( \frac{R_1}{C_1 R_1 s + 1}, \infty, \infty, \infty, \infty, L_L s + \frac{1}{C_L s} \right)$

$$H(s) = \frac{R_1 (g_m r_o + 1) (C_L L_L s^2 + 1)}{C_1 C_L L_L R_1 s^3 + C_1 C_L R_1 r_o s^2 + C_1 R_1 s + C_L L_L s^2 + C_L R_1 g_m r_o s + C_L R_1 s + C_L r_o s + 1}$$



**10.23 INVALID-ORDER-23**  $Z(s) = \left( \frac{R_1}{C_1 R_1 s + 1}, \infty, \infty, \infty, \infty, \frac{L_L s}{C_L L_L s^2 + 1} \right)$

$$H(s) = \frac{L_L R_1 s (g_m r_o + 1)}{C_1 C_L L_L R_1 r_o s^3 + C_1 L_L R_1 s^2 + C_1 R_1 r_o s + C_L L_L R_1 g_m r_o s^2 + C_L L_L R_1 s^2 + C_L L_L r_o s^2 + L_L s + R_1 g_m r_o + R_1 + r_o}$$

**10.24 INVALID-ORDER-24**  $Z(s) = \left( \frac{R_1}{C_1 R_1 s + 1}, \infty, \infty, \infty, \infty, L_L s + R_L + \frac{1}{C_L s} \right)$

$$H(s) = \frac{R_1 (g_m r_o + 1) (C_L L_L s^2 + C_L R_L s + 1)}{C_1 C_L L_L R_1 s^3 + C_1 C_L R_1 R_L s^2 + C_1 C_L R_1 r_o s^2 + C_1 R_1 s + C_L L_L s^2 + C_L R_1 g_m r_o s + C_L R_1 s + C_L R_L s + C_L r_o s + 1}$$

**10.25 INVALID-ORDER-25**  $Z(s) = \left( \frac{R_1}{C_1 R_1 s + 1}, \infty, \infty, \infty, \infty, \frac{1}{C_L s + \frac{1}{R_L} + \frac{1}{L_L s}} \right)$

$$H(s) = \frac{L_L R_1 R_L s (g_m r_o + 1)}{C_1 C_L L_L R_1 R_L r_o s^3 + C_1 L_L R_1 R_L s^2 + C_1 L_L R_1 r_o s^2 + C_1 R_1 R_L r_o s + C_L L_L R_1 R_L g_m r_o s^2 + C_L L_L R_1 R_L s^2 + C_L L_L R_L r_o s^2 + L_L R_1 g_m r_o s + L_L R_1 s + L_L R_L s + L_L r_o s + R_1 R_L}$$

**10.26 INVALID-ORDER-26**  $Z(s) = \left( \frac{R_1}{C_1 R_1 s + 1}, \infty, \infty, \infty, \infty, \frac{L_L s}{C_L L_L s^2 + 1} + R_L \right)$

$$H(s) = \frac{R_1 (g_m r_o + 1) (C_L L_L R_L s^2 + L_L s + R_L)}{C_1 C_L L_L R_1 R_L s^3 + C_1 C_L L_L R_1 r_o s^3 + C_1 L_L R_1 s^2 + C_1 R_1 R_L s + C_1 R_1 r_o s + C_L L_L R_1 g_m r_o s^2 + C_L L_L R_1 s^2 + C_L L_L R_L s^2 + C_L L_L r_o s^2 + L_L s + R_1 g_m r_o + R_1 + R_L + r_o}$$

**10.27 INVALID-ORDER-27**  $Z(s) = \left( \frac{R_1}{C_1 R_1 s + 1}, \infty, \infty, \infty, \infty, \frac{R_L (L_L s + \frac{1}{C_L s})}{L_L s + R_L + \frac{1}{C_L s}} \right)$

$$H(s) = \frac{R_1 R_L (g_m r_o + 1) (C_L L_L s^2 + 1)}{C_1 C_L L_L R_1 R_L s^3 + C_1 C_L L_L R_1 r_o s^3 + C_1 C_L R_1 R_L r_o s^2 + C_1 R_1 R_L s + C_1 R_1 r_o s + C_L L_L R_1 g_m r_o s^2 + C_L L_L R_1 s^2 + C_L L_L R_L s^2 + C_L L_L r_o s^2 + C_L R_1 R_L g_m r_o s + C_L R_1 R_L s +}$$

**10.28 INVALID-ORDER-28**  $Z(s) = \left( R_1 + \frac{1}{C_1 s}, \infty, \infty, \infty, \infty, R_L \right)$

$$H(s) = \frac{R_L (g_m r_o + 1) (C_1 R_1 s + 1)}{C_1 R_1 g_m r_o s + C_1 R_1 s + C_1 R_L s + C_1 r_o s + g_m r_o + 1}$$

**10.29 INVALID-ORDER-29**  $Z(s) = \left( R_1 + \frac{1}{C_1 s}, \infty, \infty, \infty, \infty, \frac{1}{C_L s} \right)$

$$H(s) = \frac{(g_m r_o + 1) (C_1 R_1 s + 1)}{s (C_1 C_L R_1 g_m r_o s + C_1 C_L R_1 s + C_1 C_L r_o s + C_1 + C_L g_m r_o + C_L)}$$

**10.30 INVALID-ORDER-30**  $Z(s) = \left( R_1 + \frac{1}{C_1 s}, \infty, \infty, \infty, \infty, R_L + \frac{1}{C_L s} \right)$

$$H(s) = \frac{(g_m r_o + 1) (C_1 R_1 s + 1) (C_L R_L s + 1)}{s (C_1 C_L R_1 g_m r_o s + C_1 C_L R_1 s + C_1 C_L R_L s + C_1 C_L r_o s + C_1 + C_L g_m r_o + C_L)}$$

**10.31 INVALID-ORDER-31**  $Z(s) = \left( R_1 + \frac{1}{C_1 s}, \infty, \infty, \infty, \infty, L_L s + \frac{1}{C_L s} \right)$

$$H(s) = \frac{(g_m r_o + 1) (C_1 R_1 s + 1) (C_L L_L s^2 + 1)}{s (C_1 C_L L_L s^2 + C_1 C_L R_1 g_m r_o s + C_1 C_L R_1 s + C_1 C_L r_o s + C_1 + C_L g_m r_o + C_L)}$$

**10.32 INVALID-ORDER-32**  $Z(s) = \left( R_1 + \frac{1}{C_1 s}, \infty, \infty, \infty, \infty, \frac{L_L s}{C_L L_L s^2 + 1} \right)$

$$H(s) = \frac{L_L s (g_m r_o + 1) (C_1 R_1 s + 1)}{C_1 C_L L_L R_1 g_m r_o s^3 + C_1 C_L L_L R_1 s^3 + C_1 C_L L_L r_o s^3 + C_1 L_L s^2 + C_1 R_1 g_m r_o s + C_1 R_1 s + C_1 r_o s + C_L L_L g_m r_o s^2 + C_L L_L s^2 + g_m r_o + 1}$$

**10.33 INVALID-ORDER-33**  $Z(s) = \left( R_1 + \frac{1}{C_1 s}, \infty, \infty, \infty, \infty, L_L s + R_L + \frac{1}{C_L s} \right)$

$$H(s) = \frac{(g_m r_o + 1) (C_1 R_1 s + 1) (C_L L_L s^2 + C_L R_L s + 1)}{s (C_1 C_L L_L s^2 + C_1 C_L R_1 g_m r_o s + C_1 C_L R_1 s + C_1 C_L R_L s + C_1 C_L r_o s + C_1 + C_L g_m r_o + C_L)}$$

$$10.34 \quad \text{INVALID-ORDER-34} \quad Z(s) = \left( R_1 + \frac{1}{C_1 s}, \infty, \infty, \infty, \infty, \frac{1}{C_L s + \frac{1}{R_L} + \frac{1}{L_L s}} \right)$$

$$H(s) = \frac{L_L R_L s (g_m r_o + 1) (C_1 R_1 s + 1)}{C_1 C_L L_L R_1 R_L g_m r_o s^3 + C_1 C_L L_L R_1 R_L s^3 + C_1 C_L L_L R_L r_o s^3 + C_1 L_L R_1 g_m r_o s^2 + C_1 L_L R_1 s^2 + C_1 L_L R_L s^2 + C_1 L_L r_o s^2 + C_1 R_1 R_L g_m r_o s + C_1 R_1 R_L s + C_1 R_L r_o s + C_L L_L R_1 s^2 + C_L L_L R_L s^2 + C_L L_L r_o s^2 + C_L L_L s^2 + g_m r_o + 1}$$

$$10.35 \quad \text{INVALID-ORDER-35} \quad Z(s) = \left( R_1 + \frac{1}{C_1 s}, \infty, \infty, \infty, \infty, \frac{L_L s}{C_L L_L s^2 + 1} + R_L \right)$$

$$H(s) = \frac{(g_m r_o + 1) (C_1 R_1 s + 1) (C_L L_L R_L s^2 + L_L s + R_L)}{C_1 C_L L_L R_1 g_m r_o s^3 + C_1 C_L L_L R_1 s^3 + C_1 C_L L_L R_L s^3 + C_1 C_L L_L r_o s^3 + C_1 L_L s^2 + C_1 R_1 g_m r_o s + C_1 R_1 s + C_1 R_L s + C_1 r_o s + C_L L_L g_m r_o s^2 + C_L L_L s^2 + g_m r_o + 1}$$

$$10.36 \quad \text{INVALID-ORDER-36} \quad Z(s) = \left( R_1 + \frac{1}{C_1 s}, \infty, \infty, \infty, \infty, \frac{R_L (L_L s + \frac{1}{C_L s})}{L_L s + R_L + \frac{1}{C_L s}} \right)$$

$$H(s) = \frac{R_L (g_m r_o + 1) (C_1 R_1 s + 1) (C_L L_L s^2 + 1)}{C_1 C_L L_L R_1 g_m r_o s^3 + C_1 C_L L_L R_1 s^3 + C_1 C_L L_L R_L s^3 + C_1 C_L L_L r_o s^3 + C_1 C_L R_1 R_L g_m r_o s^2 + C_1 C_L R_1 R_L s^2 + C_1 C_L R_L r_o s^2 + C_1 R_1 g_m r_o s + C_1 R_1 s + C_1 R_L s + C_1 r_o s + C_L L_L R_1 s^2 + C_L L_L R_L s^2 + C_L L_L r_o s^2 + C_L L_L s^2 + g_m r_o + 1}$$

$$10.37 \quad \text{INVALID-ORDER-37} \quad Z(s) = \left( L_1 s + \frac{1}{C_1 s}, \infty, \infty, \infty, \infty, \frac{1}{C_L s} \right)$$

$$H(s) = \frac{(g_m r_o + 1) (C_1 L_1 s^2 + 1)}{s (C_1 C_L L_1 g_m r_o s^2 + C_1 C_L L_1 s^2 + C_1 C_L r_o s + C_1 + C_L g_m r_o + C_L)}$$

$$10.38 \quad \text{INVALID-ORDER-38} \quad Z(s) = \left( L_1 s + \frac{1}{C_1 s}, \infty, \infty, \infty, \infty, \frac{R_L}{C_L R_L s + 1} \right)$$

$$H(s) = \frac{R_L (g_m r_o + 1) (C_1 L_1 s^2 + 1)}{C_1 C_L L_1 R_L g_m r_o s^3 + C_1 C_L L_1 R_L s^3 + C_1 C_L R_L r_o s^2 + C_1 L_1 g_m r_o s^2 + C_1 L_1 s^2 + C_1 R_L s + C_1 r_o s + C_L R_L g_m r_o s + C_L R_L s + g_m r_o + 1}$$

**10.39 INVALID-ORDER-39**  $Z(s) = \left( L_1 s + \frac{1}{C_1 s}, \infty, \infty, \infty, \infty, R_L + \frac{1}{C_L s} \right)$

$$H(s) = \frac{(g_m r_o + 1) (C_1 L_1 s^2 + 1) (C_L R_L s + 1)}{s (C_1 C_L L_1 g_m r_o s^2 + C_1 C_L L_1 s^2 + C_1 C_L R_L s + C_1 C_L r_o s + C_1 + C_L g_m r_o + C_L)}$$

**10.40 INVALID-ORDER-40**  $Z(s) = \left( L_1 s + \frac{1}{C_1 s}, \infty, \infty, \infty, \infty, L_L s + \frac{1}{C_L s} \right)$

$$H(s) = \frac{(g_m r_o + 1) (C_1 L_1 s^2 + 1) (C_L L_L s^2 + 1)}{s (C_1 C_L L_1 g_m r_o s^2 + C_1 C_L L_1 s^2 + C_1 C_L L_L s^2 + C_1 C_L r_o s + C_1 + C_L g_m r_o + C_L)}$$

**10.41 INVALID-ORDER-41**  $Z(s) = \left( L_1 s + \frac{1}{C_1 s}, \infty, \infty, \infty, \infty, \frac{L_L s}{C_L L_L s^2 + 1} \right)$

$$H(s) = \frac{L_L s (g_m r_o + 1) (C_1 L_1 s^2 + 1)}{C_1 C_L L_1 L_L g_m r_o s^4 + C_1 C_L L_1 L_L s^4 + C_1 C_L L_L r_o s^3 + C_1 L_1 g_m r_o s^2 + C_1 L_1 s^2 + C_1 L_L s^2 + C_1 r_o s + C_L L_L g_m r_o s^2 + C_L L_L s^2 + g_m r_o + 1}$$

**10.42 INVALID-ORDER-42**  $Z(s) = \left( L_1 s + \frac{1}{C_1 s}, \infty, \infty, \infty, \infty, L_L s + R_L + \frac{1}{C_L s} \right)$

$$H(s) = \frac{(g_m r_o + 1) (C_1 L_1 s^2 + 1) (C_L L_L s^2 + C_L R_L s + 1)}{s (C_1 C_L L_1 g_m r_o s^2 + C_1 C_L L_1 s^2 + C_1 C_L L_L s^2 + C_1 C_L R_L s + C_1 C_L r_o s + C_1 + C_L g_m r_o + C_L)}$$

**10.43 INVALID-ORDER-43**  $Z(s) = \left( L_1 s + \frac{1}{C_1 s}, \infty, \infty, \infty, \infty, \frac{1}{C_L s + \frac{1}{R_L} + \frac{1}{L_L s}} \right)$

$$H(s) = \frac{L_L R_L s (g_m r_o + 1) (C_1 L_1 s^2 + 1)}{C_1 C_L L_1 L_L R_L g_m r_o s^4 + C_1 C_L L_1 L_L R_L s^4 + C_1 C_L L_L R_L r_o s^3 + C_1 L_1 L_L g_m r_o s^3 + C_1 L_1 L_L s^3 + C_1 L_1 R_L g_m r_o s^2 + C_1 L_1 R_L s^2 + C_1 L_L R_L s^2 + C_1 L_L r_o s^2 + C_1 R_L r_o s + C_L L_L}$$

**10.44 INVALID-ORDER-44**  $Z(s) = \left( L_1 s + \frac{1}{C_1 s}, \infty, \infty, \infty, \infty, \frac{L_L s}{C_L L_L s^2 + 1} + R_L \right)$

$$H(s) = \frac{(g_m r_o + 1)(C_1 L_1 s^2 + 1)(C_L L_L R_L s^2 + L_L s + R_L)}{C_1 C_L L_1 L_L g_m r_o s^4 + C_1 C_L L_1 L_L s^4 + C_1 C_L L_L R_L s^3 + C_1 C_L L_L r_o s^3 + C_1 L_1 g_m r_o s^2 + C_1 L_1 s^2 + C_1 L_L s^2 + C_1 R_L s + C_1 r_o s + C_L L_L g_m r_o s^2 + C_L L_L s^2 + g_m r_o + 1}$$

**10.45 INVALID-ORDER-45**  $Z(s) = \left( L_1 s + \frac{1}{C_1 s}, \infty, \infty, \infty, \infty, \frac{R_L \left( L_L s + \frac{1}{C_L s} \right)}{L_L s + R_L + \frac{1}{C_L s}} \right)$

$$H(s) = \frac{R_L (g_m r_o + 1)(C_1 L_1 s^2 + 1)(C_L L_L s^2 + 1)}{C_1 C_L L_1 L_L g_m r_o s^4 + C_1 C_L L_1 L_L s^4 + C_1 C_L L_1 R_L g_m r_o s^3 + C_1 C_L L_1 R_L s^3 + C_1 C_L L_L R_L s^3 + C_1 C_L L_L r_o s^3 + C_1 C_L R_L r_o s^2 + C_1 L_1 g_m r_o s^2 + C_1 L_1 s^2 + C_1 R_L s + C_1 r_o s + C_L}$$

**10.46 INVALID-ORDER-46**  $Z(s) = \left( \frac{L_1 s}{C_1 L_1 s^2 + 1}, \infty, \infty, \infty, \infty, \frac{1}{C_L s} \right)$

$$H(s) = \frac{L_1 s (g_m r_o + 1)}{C_1 C_L L_1 r_o s^3 + C_1 L_1 s^2 + C_L L_1 g_m r_o s^2 + C_L L_1 s^2 + C_L r_o s + 1}$$

**10.47 INVALID-ORDER-47**  $Z(s) = \left( \frac{L_1 s}{C_1 L_1 s^2 + 1}, \infty, \infty, \infty, \infty, \frac{R_L}{C_L R_L s + 1} \right)$

$$H(s) = \frac{L_1 R_L s (g_m r_o + 1)}{C_1 C_L L_1 R_L r_o s^3 + C_1 L_1 R_L s^2 + C_1 L_1 r_o s^2 + C_L L_1 R_L g_m r_o s^2 + C_L L_1 R_L s^2 + C_L R_L r_o s + L_1 g_m r_o s + L_1 s + R_L + r_o}$$

**10.48 INVALID-ORDER-48**  $Z(s) = \left( \frac{L_1 s}{C_1 L_1 s^2 + 1}, \infty, \infty, \infty, \infty, R_L + \frac{1}{C_L s} \right)$

$$H(s) = \frac{L_1 s (g_m r_o + 1)(C_L R_L s + 1)}{C_1 C_L L_1 R_L s^3 + C_1 C_L L_1 r_o s^3 + C_1 L_1 s^2 + C_L L_1 g_m r_o s^2 + C_L L_1 s^2 + C_L R_L s + C_L r_o s + 1}$$

**10.49 INVALID-ORDER-49**  $Z(s) = \left( \frac{L_1 s}{C_1 L_1 s^2 + 1}, \infty, \infty, \infty, \infty, L_L s + \frac{1}{C_L s} \right)$

$$H(s) = \frac{L_1 s (g_m r_o + 1)(C_L L_L s^2 + 1)}{C_1 C_L L_1 L_L s^4 + C_1 C_L L_1 r_o s^3 + C_1 L_1 s^2 + C_L L_1 g_m r_o s^2 + C_L L_1 s^2 + C_L L_L s^2 + C_L r_o s + 1}$$

**10.50 INVALID-ORDER-50**  $Z(s) = \left( \frac{L_1 s}{C_1 L_1 s^2 + 1}, \infty, \infty, \infty, \infty, \frac{L_L s}{C_L L_L s^2 + 1} \right)$

$$H(s) = \frac{L_1 L_L s^2 (g_m r_o + 1)}{C_1 C_L L_1 L_L r_o s^4 + C_1 L_1 L_L s^3 + C_1 L_1 r_o s^2 + C_L L_1 L_L g_m r_o s^3 + C_L L_1 L_L s^3 + C_L L_L r_o s^2 + L_1 g_m r_o s + L_1 s + L_L s + r_o}$$

**10.51 INVALID-ORDER-51**  $Z(s) = \left( \frac{L_1 s}{C_1 L_1 s^2 + 1}, \infty, \infty, \infty, \infty, L_L s + R_L + \frac{1}{C_L s} \right)$

$$H(s) = \frac{L_1 s (g_m r_o + 1) (C_L L_L s^2 + C_L R_L s + 1)}{C_1 C_L L_1 L_L s^4 + C_1 C_L L_1 R_L s^3 + C_1 C_L L_1 r_o s^3 + C_1 L_1 s^2 + C_L L_1 g_m r_o s^2 + C_L L_1 s^2 + C_L L_L s^2 + C_L R_L s + C_L r_o s + 1}$$

**10.52 INVALID-ORDER-52**  $Z(s) = \left( \frac{L_1 s}{C_1 L_1 s^2 + 1}, \infty, \infty, \infty, \infty, \frac{1}{C_L s + \frac{1}{R_L} + \frac{1}{L_L s}} \right)$

$$H(s) = \frac{L_1 L_L R_L s^2 (g_m r_o + 1)}{C_1 C_L L_1 L_L R_L r_o s^4 + C_1 L_1 L_L R_L s^3 + C_1 L_1 L_L r_o s^3 + C_1 L_1 R_L r_o s^2 + C_L L_1 L_L R_L g_m r_o s^3 + C_L L_1 L_L R_L s^3 + C_L L_L R_L r_o s^2 + L_1 L_L g_m r_o s^2 + L_1 L_L s^2 + L_1 R_L g_m r_o s + L_1 R_L s}$$

**10.53 INVALID-ORDER-53**  $Z(s) = \left( \frac{L_1 s}{C_1 L_1 s^2 + 1}, \infty, \infty, \infty, \infty, \frac{L_L s}{C_L L_L s^2 + 1} + R_L \right)$

$$H(s) = \frac{L_1 s (g_m r_o + 1) (C_L L_L R_L s^2 + L_L s + R_L)}{C_1 C_L L_1 L_L R_L s^4 + C_1 C_L L_1 L_L r_o s^4 + C_1 L_1 L_L s^3 + C_1 L_1 R_L s^2 + C_1 L_1 r_o s^2 + C_L L_1 L_L g_m r_o s^3 + C_L L_1 L_L s^3 + C_L L_L R_L s^2 + C_L L_L r_o s^2 + L_1 g_m r_o s + L_1 s + L_L s + R_L + r_o}$$

**10.54 INVALID-ORDER-54**  $Z(s) = \left( \frac{L_1 s}{C_1 L_1 s^2 + 1}, \infty, \infty, \infty, \infty, \frac{R_L \left( L_L s + \frac{1}{C_L s} \right)}{L_L s + R_L + \frac{1}{C_L s}} \right)$

$$H(s) = \frac{L_1 R_L s (g_m r_o + 1) (C_L L_L s^2 + 1)}{C_1 C_L L_1 L_L R_L s^4 + C_1 C_L L_1 L_L r_o s^4 + C_1 C_L L_1 R_L r_o s^3 + C_1 L_1 R_L s^2 + C_1 L_1 r_o s^2 + C_L L_1 L_L g_m r_o s^3 + C_L L_1 L_L s^3 + C_L L_1 R_L g_m r_o s^2 + C_L L_1 R_L s^2 + C_L L_L R_L s^2 + C_L L_L r_o s^2}$$

**10.55 INVALID-ORDER-55**  $Z(s) = \left( L_1 s + R_1 + \frac{1}{C_1 s}, \infty, \infty, \infty, \infty, \frac{1}{C_L s} \right)$

$$H(s) = \frac{(g_m r_o + 1) (C_1 L_1 s^2 + C_1 R_1 s + 1)}{s (C_1 C_L L_1 g_m r_o s^2 + C_1 C_L L_1 s^2 + C_1 C_L R_1 g_m r_o s + C_1 C_L R_1 s + C_1 C_L r_o s + C_1 + C_L g_m r_o + C_L)}$$

**10.56 INVALID-ORDER-56**  $Z(s) = \left( L_1 s + R_1 + \frac{1}{C_1 s}, \infty, \infty, \infty, \infty, \frac{R_L}{C_L R_L s + 1} \right)$

$$H(s) = \frac{R_L (g_m r_o + 1) (C_1 L_1 s^2 + C_1 R_1 s + 1)}{C_1 C_L L_1 R_L g_m r_o s^3 + C_1 C_L L_1 R_L s^3 + C_1 C_L R_1 R_L g_m r_o s^2 + C_1 C_L R_1 R_L s^2 + C_1 C_L R_L r_o s^2 + C_1 L_1 g_m r_o s^2 + C_1 L_1 s^2 + C_1 R_1 g_m r_o s + C_1 R_1 s + C_1 R_L s + C_1 r_o s + C_L R_L g_m r_o}$$

**10.57 INVALID-ORDER-57**  $Z(s) = \left( L_1 s + R_1 + \frac{1}{C_1 s}, \infty, \infty, \infty, \infty, R_L + \frac{1}{C_L s} \right)$

$$H(s) = \frac{(g_m r_o + 1) (C_L R_L s + 1) (C_1 L_1 s^2 + C_1 R_1 s + 1)}{s (C_1 C_L L_1 g_m r_o s^2 + C_1 C_L L_1 s^2 + C_1 C_L R_1 g_m r_o s + C_1 C_L R_1 s + C_1 C_L R_L s + C_1 C_L r_o s + C_1 + C_L g_m r_o + C_L)}$$

**10.58 INVALID-ORDER-58**  $Z(s) = \left( L_1 s + R_1 + \frac{1}{C_1 s}, \infty, \infty, \infty, \infty, L_L s + \frac{1}{C_L s} \right)$

$$H(s) = \frac{(g_m r_o + 1) (C_L L_L s^2 + 1) (C_1 L_1 s^2 + C_1 R_1 s + 1)}{s (C_1 C_L L_1 g_m r_o s^2 + C_1 C_L L_1 s^2 + C_1 C_L L_L s^2 + C_1 C_L R_1 g_m r_o s + C_1 C_L R_1 s + C_1 C_L r_o s + C_1 + C_L g_m r_o + C_L)}$$

**10.59 INVALID-ORDER-59**  $Z(s) = \left( L_1 s + R_1 + \frac{1}{C_1 s}, \infty, \infty, \infty, \infty, \frac{L_L s}{C_L L_L s^2 + 1} \right)$

$$H(s) = \frac{L_L s (g_m r_o + 1) (C_1 L_1 s^2 + C_1 R_1 s + 1)}{C_1 C_L L_1 L_L g_m r_o s^4 + C_1 C_L L_1 L_L s^4 + C_1 C_L L_L R_1 g_m r_o s^3 + C_1 C_L L_L R_1 s^3 + C_1 C_L L_L r_o s^3 + C_1 L_1 g_m r_o s^2 + C_1 L_1 s^2 + C_1 L_L s^2 + C_1 R_1 g_m r_o s + C_1 R_1 s + C_1 r_o s + C_L L_L g_m r_o}$$

**10.60 INVALID-ORDER-60**  $Z(s) = \left( L_1 s + R_1 + \frac{1}{C_1 s}, \infty, \infty, \infty, \infty, L_L s + R_L + \frac{1}{C_L s} \right)$

$$H(s) = \frac{(g_m r_o + 1) (C_1 L_1 s^2 + C_1 R_1 s + 1) (C_L L_L s^2 + C_L R_L s + 1)}{s (C_1 C_L L_1 g_m r_o s^2 + C_1 C_L L_1 s^2 + C_1 C_L L_L s^2 + C_1 C_L R_1 g_m r_o s + C_1 C_L R_1 s + C_1 C_L R_L s + C_1 C_L r_o s + C_1 + C_L g_m r_o + C_L)}$$

**10.61 INVALID-ORDER-61**  $Z(s) = \left( L_1 s + R_1 + \frac{1}{C_1 s}, \infty, \infty, \infty, \infty, \frac{1}{C_L s + \frac{1}{R_L} + \frac{1}{L_L s}} \right)$

$$H(s) = \frac{L_L R_L s (g_m r_o + 1) (C_1 L_L R_L s^2 + C_1 L_L R_L s + C_1 L_L R_L)}{C_1 C_L L_1 L_L R_L g_m r_o s^4 + C_1 C_L L_1 L_L R_L s^4 + C_1 C_L L_L R_1 R_L g_m r_o s^3 + C_1 C_L L_L R_1 R_L s^3 + C_1 C_L L_L R_L r_o s^3 + C_1 L_1 L_L g_m r_o s^3 + C_1 L_1 L_L s^3 + C_1 L_1 R_L g_m r_o s^2 + C_1 L_1 R_L s^2 + C_1 L_1 R_L}$$

**10.62 INVALID-ORDER-62**  $Z(s) = \left( L_1 s + R_1 + \frac{1}{C_1 s}, \infty, \infty, \infty, \infty, \frac{L_L s}{C_L L_L s^2 + 1} + R_L \right)$

$$H(s) = \frac{(g_m r_o + 1) (C_1 L_1 s^2 + C_1 R_1 s + 1) (C_L L_L R_L s^2 + L_L s + R_L)}{C_1 C_L L_1 L_L g_m r_o s^4 + C_1 C_L L_1 L_L s^4 + C_1 C_L L_L R_1 g_m r_o s^3 + C_1 C_L L_L R_1 s^3 + C_1 C_L L_L R_L s^3 + C_1 C_L L_L R_o s^3 + C_1 L_1 g_m r_o s^2 + C_1 L_1 s^2 + C_1 L_L s^2 + C_1 R_1 g_m r_o s + C_1 R_1 s + C_1}.$$

**10.63 INVALID-ORDER-63**  $Z(s) = \left( L_1 s + R_1 + \frac{1}{C_1 s}, \infty, \infty, \infty, \infty, \frac{R_L \left( L_L s + \frac{1}{C_L s} \right)}{L_L s + R_L + \frac{1}{C_L s}} \right)$

$$H(s) = \frac{R_L (g_m r_o + 1) (C_L L_L s^2 + 1) (C_1 L_L s + 1)}{C_1 C_L L_1 L_L g_m r_o s^4 + C_1 C_L L_1 L_L s^4 + C_1 C_L L_1 R_L g_m r_o s^3 + C_1 C_L L_1 R_L s^3 + C_1 C_L L_L R_1 g_m r_o s^3 + C_1 C_L L_L R_1 s^3 + C_1 C_L L_L R_L s^3 + C_1 C_L L_L R_o s^3 + C_1 C_L R_1 R_L g_m r_o s^2 + C_1 C_L R_1 R_L s^2 + C_1 C_L R_1 R_o s^2 + C_1 C_L R_1 s^2 + C_1 C_L R_o s^2 + C_1 C_L s^2 + C_1 C_L}.$$

**10.64 INVALID-ORDER-64**  $Z(s) = \left( \frac{1}{C_1 s + \frac{1}{R_1} + \frac{1}{L_1 s}}, \infty, \infty, \infty, \infty, \frac{1}{C_L s} \right)$

$$H(s) = \frac{L_1 R_1 s (g_m r_o + 1)}{C_1 C_L L_1 R_1 r_o s^3 + C_1 L_1 R_1 s^2 + C_L L_1 R_1 g_m r_o s^2 + C_L L_1 R_1 s^2 + C_L L_1 r_o s^2 + C_L R_1 r_o s + L_1 s + R_1}$$

**10.65 INVALID-ORDER-65**  $Z(s) = \left( \frac{1}{C_1 s + \frac{1}{R_1} + \frac{1}{L_1 s}}, \infty, \infty, \infty, \infty, \frac{R_L}{C_L R_L s + 1} \right)$

$$H(s) = \frac{L_1 R_1 R_L s (g_m r_o + 1)}{C_1 C_L L_1 R_1 R_L r_o s^3 + C_1 L_1 R_1 R_L s^2 + C_1 L_1 R_1 r_o s^2 + C_L L_1 R_1 R_L g_m r_o s^2 + C_L L_1 R_1 R_L s^2 + C_L L_1 R_L r_o s^2 + C_L R_1 R_L r_o s + L_1 R_1 g_m r_o s + L_1 R_1 s + L_1 R_L s + L_1 r_o s + R_1 R_L}$$



$$10.66 \quad \text{INVALID-ORDER-66} \quad Z(s) = \left( \frac{1}{C_1 s + \frac{1}{R_1} + \frac{1}{L_1 s}}, \infty, \infty, \infty, \infty, R_L + \frac{1}{C_L s} \right)$$

$$H(s) = \frac{L_1 R_1 s (g_m r_o + 1) (C_L R_L s + 1)}{C_1 C_L L_1 R_1 R_L s^3 + C_1 C_L L_1 R_1 r_o s^3 + C_1 L_1 R_1 s^2 + C_L L_1 R_1 g_m r_o s^2 + C_L L_1 R_1 s^2 + C_L L_1 R_L s^2 + C_L L_1 r_o s^2 + C_L R_1 R_L s + C_L R_1 r_o s + L_1 s + R_1}$$

$$10.67 \quad \text{INVALID-ORDER-67} \quad Z(s) = \left( \frac{1}{C_1 s + \frac{1}{R_1} + \frac{1}{L_1 s}}, \infty, \infty, \infty, \infty, L_L s + \frac{1}{C_L s} \right)$$

$$H(s) = \frac{L_1 R_1 s (g_m r_o + 1) (C_L L_L s^2 + 1)}{C_1 C_L L_1 L_L R_1 s^4 + C_1 C_L L_1 R_1 r_o s^3 + C_1 L_1 R_1 s^2 + C_L L_1 L_L s^3 + C_L L_1 R_1 g_m r_o s^2 + C_L L_1 R_1 s^2 + C_L L_1 r_o s^2 + C_L L_L R_1 s^2 + C_L R_1 r_o s + L_1 s + R_1}$$

$$10.68 \quad \text{INVALID-ORDER-68} \quad Z(s) = \left( \frac{1}{C_1 s + \frac{1}{R_1} + \frac{1}{L_1 s}}, \infty, \infty, \infty, \infty, \frac{L_L s}{C_L L_L s^2 + 1} \right)$$

$$H(s) = \frac{L_1 L_L R_1 s^2 (g_m r_o + 1)}{C_1 C_L L_1 L_L R_1 r_o s^4 + C_1 L_1 L_L R_1 s^3 + C_1 L_1 R_1 r_o s^2 + C_L L_1 L_L R_1 g_m r_o s^3 + C_L L_1 L_L R_1 s^3 + C_L L_1 L_L r_o s^3 + C_L L_L R_1 r_o s^2 + L_1 L_L s^2 + L_1 R_1 g_m r_o s + L_1 R_1 s + L_1 r_o s + L_L R_1 s}$$

$$10.69 \quad \text{INVALID-ORDER-69} \quad Z(s) = \left( \frac{1}{C_1 s + \frac{1}{R_1} + \frac{1}{L_1 s}}, \infty, \infty, \infty, \infty, L_L s + R_L + \frac{1}{C_L s} \right)$$

$$H(s) = \frac{L_1 R_1 s (g_m r_o + 1) (C_L L_L s^2 + C_L R_L s + 1)}{C_1 C_L L_1 L_L R_1 s^4 + C_1 C_L L_1 R_1 R_L s^3 + C_1 C_L L_1 R_1 r_o s^3 + C_1 L_1 R_1 s^2 + C_L L_1 L_L s^3 + C_L L_1 R_1 g_m r_o s^2 + C_L L_1 R_1 s^2 + C_L L_1 R_L s^2 + C_L L_1 r_o s^2 + C_L L_L R_1 s^2 + C_L R_1 R_L s + C_L R_1 r_o s + L_1 s + R_1}$$

$$10.70 \quad \text{INVALID-ORDER-70} \quad Z(s) = \left( \frac{1}{C_1 s + \frac{1}{R_1} + \frac{1}{L_1 s}}, \infty, \infty, \infty, \infty, \frac{1}{C_L s + \frac{1}{R_L} + \frac{1}{L_L s}} \right)$$

$$H(s) = \frac{L_1 L_L R_1 R_L s^2 (g_m r_o + 1)}{C_1 C_L L_1 L_L R_1 R_L r_o s^4 + C_1 L_1 L_L R_1 R_L s^3 + C_1 L_1 L_L R_1 r_o s^3 + C_1 L_1 R_1 R_L r_o s^2 + C_L L_1 L_L R_1 R_L g_m r_o s^3 + C_L L_1 L_L R_1 R_L s^3 + C_L L_1 L_L R_L r_o s^3 + C_L L_L R_1 R_L r_o s^2 + L_1 L_L R_1 s^2 + L_1 R_1 R_L s + L_1 R_1 r_o s + L_1 r_o s + R_L s + R_L}$$

**10.71 INVALID-ORDER-71**  $Z(s) = \left( \frac{1}{C_1 s + \frac{1}{R_1} + \frac{1}{L_1 s}}, \infty, \infty, \infty, \infty, \frac{L_L s}{C_L L_L s^2 + 1} + R_L \right)$

$$H(s) = \frac{L_1 R_1 s (g_m r_o + 1) (C_L L_L R_L s^2 + L_L s + R_L)}{C_1 C_L L_1 L_L R_1 R_L s^4 + C_1 C_L L_1 L_L R_1 r_o s^4 + C_1 L_1 L_L R_1 s^3 + C_1 L_1 R_1 R_L s^2 + C_1 L_1 R_1 r_o s^2 + C_L L_1 L_L R_1 g_m r_o s^3 + C_L L_1 L_L R_1 s^3 + C_L L_1 L_L R_L s^3 + C_L L_1 L_L r_o s^3 + C_L L_L R_1 s^2}$$

**10.72 INVALID-ORDER-72**  $Z(s) = \left( \frac{1}{C_1 s + \frac{1}{R_1} + \frac{1}{L_1 s}}, \infty, \infty, \infty, \infty, \frac{R_L \left( L_L s + \frac{1}{C_L s} \right)}{L_L s + R_L + \frac{1}{C_L s}} \right)$

$$H(s) = \frac{L_1 R_1 R_L s (g_m r_o + 1) (C_L L}{C_1 C_L L_1 L_L R_1 R_L s^4 + C_1 C_L L_1 L_L R_1 r_o s^4 + C_1 C_L L_1 R_1 R_L r_o s^3 + C_1 L_1 R_1 R_L s^2 + C_1 L_1 R_1 r_o s^2 + C_L L_1 L_L R_1 g_m r_o s^3 + C_L L_1 L_L R_1 s^3 + C_L L_1 L_L R_L s^3 + C_L L_1 L_L r_o s^3 + C_L L}$$

**10.73 INVALID-ORDER-73**  $Z(s) = \left( \frac{L_1 s}{C_1 L_1 s^2 + 1} + R_1, \infty, \infty, \infty, \infty, \frac{1}{C_L s} \right)$

$$H(s) = \frac{(g_m r_o + 1)(C_1 L_1 R_1 s^2 + L_1 s + R_1)}{C_1 C_L L_1 R_1 g_m r_o s^3 + C_1 C_L L_1 R_1 s^3 + C_1 C_L L_1 r_o s^3 + C_1 L_1 s^2 + C_L L_1 g_m r_o s^2 + C_L L_1 s^2 + C_L R_1 g_m r_o s + C_L R_1 s + C_L r_o s + 1}$$

**10.74 INVALID-ORDER-74**  $Z(s) = \left( \frac{L_1 s}{C_1 L_1 s^2 + 1} + R_1, \infty, \infty, \infty, \infty, \frac{R_L}{C_L R_L s + 1} \right)$

$$H(s) = \frac{R_L (g_m r_o + 1) (C_1 L_1 R_1 s^2 + L_1 s + R_1)}{C_1 C_L L_1 R_1 R_L g_m r_o s^3 + C_1 C_L L_1 R_1 R_L s^3 + C_1 C_L L_1 R_L r_o s^3 + C_1 L_1 R_1 g_m r_o s^2 + C_1 L_1 R_1 s^2 + C_1 L_1 R_L s^2 + C_1 L_1 r_o s^2 + C_L L_1 R_L g_m r_o s^2 + C_L L_1 R_L s^2 + C_L R_1 R_L g_m r_o s + C}$$

**10.75 INVALID-ORDER-75**  $Z(s) = \left( \frac{L_1 s}{C_1 L_1 s^2 + 1} + R_1, \infty, \infty, \infty, \infty, R_L + \frac{1}{C_L s} \right)$

$$H(s) = \frac{(g_m r_o + 1)(C_L R_L s + 1)(C_1 L_1 R_1 s^2 + L_1 s + R_1)}{C_1 C_L L_1 R_1 g_m r_o s^3 + C_1 C_L L_1 R_1 s^3 + C_1 C_L L_1 R_L s^3 + C_1 C_L L_1 r_o s^3 + C_1 L_1 s^2 + C_L L_1 g_m r_o s^2 + C_L L_1 s^2 + C_L R_1 g_m r_o s + C_L R_1 s + C_L R_L s + C_L r_o s + 1}$$

**10.76 INVALID-ORDER-76**  $Z(s) = \left( \frac{L_1 s}{C_1 L_1 s^2 + 1} + R_1, \infty, \infty, \infty, \infty, L_L s + \frac{1}{C_L s} \right)$

$$H(s) = \frac{(g_m r_o + 1)(C_L L_L s^2 + 1)(C_1 L_1 R_1 s^2 + L_1 s + R_1)}{C_1 C_L L_1 L_L s^4 + C_1 C_L L_1 R_1 g_m r_o s^3 + C_1 C_L L_1 R_1 s^3 + C_1 C_L L_1 r_o s^3 + C_1 L_1 s^2 + C_L L_1 g_m r_o s^2 + C_L L_1 s^2 + C_L L_L s^2 + C_L R_1 g_m r_o s + C_L R_1 s + C_L r_o s + 1}$$

**10.77 INVALID-ORDER-77**  $Z(s) = \left( \frac{L_1 s}{C_1 L_1 s^2 + 1} + R_1, \infty, \infty, \infty, \infty, \frac{L_L s}{C_L L_L s^2 + 1} \right)$

$$H(s) = \frac{L_L s (g_m r_o + 1)(C_1 L_1 R_1 s^2 + L_1 s + R_1)}{C_1 C_L L_1 L_L R_1 g_m r_o s^4 + C_1 C_L L_1 L_L R_1 s^4 + C_1 C_L L_1 L_L r_o s^4 + C_1 L_1 L_L s^3 + C_1 L_1 R_1 g_m r_o s^2 + C_1 L_1 R_1 s^2 + C_1 L_1 r_o s^2 + C_L L_1 L_L g_m r_o s^3 + C_L L_1 L_L s^3 + C_L L_L R_1 g_m r_o s^2 + C_L L_L R_1 s^2 + C_L L_L r_o s^2 + C_L R_1 g_m r_o s + C_L R_1 s + C_L r_o s + 1}$$

**10.78 INVALID-ORDER-78**  $Z(s) = \left( \frac{L_1 s}{C_1 L_1 s^2 + 1} + R_1, \infty, \infty, \infty, \infty, L_L s + R_L + \frac{1}{C_L s} \right)$

$$H(s) = \frac{(g_m r_o + 1)(C_L L_L s^2 + C_L R_L s + 1)(C_1 L_1 R_1 s^2 + L_1 s + R_1)}{C_1 C_L L_1 L_L s^4 + C_1 C_L L_1 R_1 g_m r_o s^3 + C_1 C_L L_1 R_1 s^3 + C_1 C_L L_1 R_L s^3 + C_1 C_L L_1 r_o s^3 + C_1 L_1 s^2 + C_L L_1 g_m r_o s^2 + C_L L_1 s^2 + C_L L_L s^2 + C_L R_1 g_m r_o s + C_L R_1 s + C_L R_L s + C_L r_o s + 1}$$

**10.79 INVALID-ORDER-79**  $Z(s) = \left( \frac{L_1 s}{C_1 L_1 s^2 + 1} + R_1, \infty, \infty, \infty, \infty, \frac{1}{C_L s + \frac{1}{R_L} + \frac{1}{L_L s}} \right)$

$$H(s) = \frac{(g_m r_o + 1)(C_L L_L s^2 + C_L R_L s + 1)(C_1 L_1 R_1 s^2 + L_1 s + R_1)}{C_1 C_L L_1 L_L R_1 g_m r_o s^4 + C_1 C_L L_1 L_L R_1 R_L s^4 + C_1 C_L L_1 L_L R_L r_o s^4 + C_1 L_1 L_L R_1 g_m r_o s^3 + C_1 L_1 L_L R_1 s^3 + C_1 L_1 L_L R_L s^3 + C_1 L_1 L_L r_o s^3 + C_1 L_1 R_1 R_L g_m r_o s^2 + C_1 L_1 R_1 R_L s^2 + C_1 L_1 R_1 r_o s^2 + C_1 L_1 R_L g_m r_o s + C_1 L_1 R_L s + C_1 L_1 r_o s + 1}$$

**10.80 INVALID-ORDER-80**  $Z(s) = \left( \frac{L_1 s}{C_1 L_1 s^2 + 1} + R_1, \infty, \infty, \infty, \infty, \frac{L_L s}{C_L L_L s^2 + 1} + R_L \right)$

$$H(s) = \frac{(g_m r_o + 1)(C_1 L_1 R_1 s^2 + L_1 s + R_1)(C_L L_L R_L s^2 + L_L s + R_L)}{C_1 C_L L_1 L_L R_1 g_m r_o s^4 + C_1 C_L L_1 L_L R_1 s^4 + C_1 C_L L_1 L_L R_L s^4 + C_1 C_L L_1 L_L r_o s^4 + C_1 L_1 L_L s^3 + C_1 L_1 R_1 g_m r_o s^2 + C_1 L_1 R_1 s^2 + C_1 L_1 R_L s^2 + C_1 L_1 r_o s^2 + C_L L_1 L_L g_m r_o s^3 + C_L L_1 L_L s^3 + C_L L_L R_1 g_m r_o s^2 + C_L L_L R_1 s^2 + C_L L_L r_o s^2 + C_L R_1 g_m r_o s + C_L R_1 s + C_L R_L s + C_L r_o s + 1}$$

$$10.81 \quad \text{INVALID-ORDER-81} \quad Z(s) = \left( \frac{L_1 s}{C_1 L_1 s^2 + 1} + R_1, \infty, \infty, \infty, \infty, \frac{R_L \left( L_L s + \frac{1}{C_L s} \right)}{L_L s + R_L + \frac{1}{C_L s}} \right)$$

$$H(s) = \frac{C_1 C_L L_1 L_L R_1 g_m r_o s^4 + C_1 C_L L_1 L_L R_1 s^4 + C_1 C_L L_1 L_L R_L s^4 + C_1 C_L L_1 L_L r_o s^4 + C_1 C_L L_1 R_1 R_L g_m r_o s^3 + C_1 C_L L_1 R_1 R_L s^3 + C_1 C_L L_1 R_L r_o s^3 + C_1 L_1 R_1 g_m r_o s^2 + C_1 L_1 R_1 s^2}{C_1 C_L L_1 R_1 g_m r_o s^3 + C_1 C_L L_1 R_1 s^3 + C_1 C_L L_1 R_L r_o s^3 + C_1 C_L R_1 r_o s^2 + C_1 L_1 s^2 + C_1 R_1 s + C_L R_1 g_m r_o s + C_L R_1 s + C_L r_o s + 1}$$

$$10.82 \quad \text{INVALID-ORDER-82} \quad Z(s) = \left( \frac{R_1 \left( L_1 s + \frac{1}{C_1 s} \right)}{L_1 s + R_1 + \frac{1}{C_1 s}}, \infty, \infty, \infty, \infty, \frac{1}{C_L s} \right)$$

$$H(s) = \frac{R_1 (g_m r_o + 1) (C_1 L_1 s^2 + 1)}{C_1 C_L L_1 R_1 g_m r_o s^3 + C_1 C_L L_1 R_1 s^3 + C_1 C_L L_1 R_L r_o s^3 + C_1 C_L R_1 r_o s^2 + C_1 L_1 s^2 + C_1 R_1 s + C_L R_1 g_m r_o s + C_L R_1 s + C_L r_o s + 1}$$

$$10.83 \quad \text{INVALID-ORDER-83} \quad Z(s) = \left( \frac{R_1 \left( L_1 s + \frac{1}{C_1 s} \right)}{L_1 s + R_1 + \frac{1}{C_1 s}}, \infty, \infty, \infty, \infty, \frac{R_L}{C_L R_L s + 1} \right)$$

$$H(s) = \frac{R_1 R_L (g_m r_o + 1) (C_1 L_1 s^2 + 1)}{C_1 C_L L_1 R_1 R_L g_m r_o s^3 + C_1 C_L L_1 R_1 R_L s^3 + C_1 C_L L_1 R_L r_o s^3 + C_1 C_L R_1 R_L r_o s^2 + C_1 L_1 R_1 g_m r_o s^2 + C_1 L_1 R_1 s^2 + C_1 L_1 R_L s^2 + C_1 L_1 r_o s^2 + C_1 R_1 R_L s + C_1 R_1 r_o s + C_L R_1 R_L}$$

$$10.84 \quad \text{INVALID-ORDER-84} \quad Z(s) = \left( \frac{R_1 \left( L_1 s + \frac{1}{C_1 s} \right)}{L_1 s + R_1 + \frac{1}{C_1 s}}, \infty, \infty, \infty, \infty, R_L + \frac{1}{C_L s} \right)$$

$$H(s) = \frac{R_1 (g_m r_o + 1) (C_1 L_1 s^2 + 1) (C_L R_L s + 1)}{C_1 C_L L_1 R_1 g_m r_o s^3 + C_1 C_L L_1 R_1 s^3 + C_1 C_L L_1 R_L s^3 + C_1 C_L L_1 r_o s^3 + C_1 C_L R_1 R_L s^2 + C_1 C_L R_1 r_o s^2 + C_1 L_1 s^2 + C_1 R_1 s + C_L R_1 g_m r_o s + C_L R_1 s + C_L R_L s + C_L r_o s + 1}$$

$$10.85 \quad \text{INVALID-ORDER-85} \quad Z(s) = \left( \frac{R_1 \left( L_1 s + \frac{1}{C_1 s} \right)}{L_1 s + R_1 + \frac{1}{C_1 s}}, \infty, \infty, \infty, \infty, L_L s + \frac{1}{C_L s} \right)$$

$$H(s) = \frac{R_1 (g_m r_o + 1) (C_1 L_1 s^2 + 1) (C_L L_L s^2 + 1)}{C_1 C_L L_1 L_L s^4 + C_1 C_L L_1 R_1 g_m r_o s^3 + C_1 C_L L_1 R_1 s^3 + C_1 C_L L_1 r_o s^3 + C_1 C_L L_L R_1 s^3 + C_1 C_L R_1 r_o s^2 + C_1 L_1 s^2 + C_1 R_1 s + C_L L_L s^2 + C_L R_1 g_m r_o s + C_L R_1 s + C_L r_o s + 1}$$

$$10.86 \quad \text{INVALID-ORDER-86} \quad Z(s) = \left( \frac{R_1 \left( L_1 s + \frac{1}{C_1 s} \right)}{L_1 s + R_1 + \frac{1}{C_1 s}}, \infty, \infty, \infty, \infty, \frac{L_L s}{C_L L_L s^2 + 1} \right)$$

$$H(s) = \frac{L_L R_1 s (g_m r_o + 1) (C_1 L_1 s^2 + 1)}{C_1 C_L L_1 L_L R_1 g_m r_o s^4 + C_1 C_L L_1 L_L R_1 s^4 + C_1 C_L L_1 L_L R_o s^4 + C_1 C_L L_L R_1 r_o s^3 + C_1 L_1 L_L s^3 + C_1 L_1 R_1 g_m r_o s^2 + C_1 L_1 R_1 s^2 + C_1 L_1 r_o s^2 + C_1 L_L R_1 s^2 + C_1 R_1 r_o s + C_L L_L R_1 s}$$

$$10.87 \quad \text{INVALID-ORDER-87} \quad Z(s) = \left( \frac{R_1 \left( L_1 s + \frac{1}{C_1 s} \right)}{L_1 s + R_1 + \frac{1}{C_1 s}}, \infty, \infty, \infty, \infty, L_L s + R_L + \frac{1}{C_L s} \right)$$

$$H(s) = \frac{R_1 (g_m r_o + 1) (C_1 L_1 s^2 + 1) (C_L L_L s^2 + C_L R_L s + 1)}{C_1 C_L L_1 L_L s^4 + C_1 C_L L_1 R_1 g_m r_o s^3 + C_1 C_L L_1 R_1 s^3 + C_1 C_L L_1 R_L s^3 + C_1 C_L L_1 r_o s^3 + C_1 C_L L_L R_1 s^3 + C_1 C_L R_1 R_L s^2 + C_1 C_L R_1 r_o s^2 + C_1 L_1 s^2 + C_1 R_1 s + C_L L_L s^2 + C_L R_1 s}$$

$$10.88 \quad \text{INVALID-ORDER-88} \quad Z(s) = \left( \frac{R_1 \left( L_1 s + \frac{1}{C_1 s} \right)}{L_1 s + R_1 + \frac{1}{C_1 s}}, \infty, \infty, \infty, \infty, \frac{1}{C_L s + \frac{1}{R_L} + \frac{1}{L_L s}} \right)$$

$$H(s) = \frac{R_1 (g_m r_o + 1) (C_1 L_1 s^2 + 1) (C_L L_L R_L s^2 + C_L R_L s + 1)}{C_1 C_L L_1 L_L R_1 R_L g_m r_o s^4 + C_1 C_L L_1 L_L R_1 R_L s^4 + C_1 C_L L_1 L_L R_L r_o s^4 + C_1 C_L L_L R_1 R_L r_o s^3 + C_1 L_1 L_L R_1 g_m r_o s^3 + C_1 L_1 L_L R_1 s^3 + C_1 L_1 L_L R_L s^3 + C_1 L_1 L_L r_o s^3 + C_1 L_1 R_1 s^3}$$

$$10.89 \quad \text{INVALID-ORDER-89} \quad Z(s) = \left( \frac{R_1 \left( L_1 s + \frac{1}{C_1 s} \right)}{L_1 s + R_1 + \frac{1}{C_1 s}}, \infty, \infty, \infty, \infty, \frac{L_L s}{C_L L_L s^2 + 1} + R_L \right)$$

$$H(s) = \frac{R_1 (g_m r_o + 1) (C_1 L_1 s^2 + 1) (C_L L_L R_L s^2 + C_L R_L s + 1)}{C_1 C_L L_1 L_L R_1 g_m r_o s^4 + C_1 C_L L_1 L_L R_1 s^4 + C_1 C_L L_1 L_L R_L s^4 + C_1 C_L L_1 L_L r_o s^4 + C_1 C_L L_L R_1 R_L s^3 + C_1 C_L L_L R_1 r_o s^3 + C_1 L_1 L_L s^3 + C_1 L_1 R_1 g_m r_o s^2 + C_1 L_1 R_1 s^2 + C_1 L_1 R_L s^2}$$

$$10.90 \quad \text{INVALID-ORDER-90} \quad Z(s) = \left( \frac{R_1 \left( L_1 s + \frac{1}{C_1 s} \right)}{L_1 s + R_1 + \frac{1}{C_1 s}}, \infty, \infty, \infty, \infty, \frac{R_L \left( L_L s + \frac{1}{C_L s} \right)}{L_L s + R_L + \frac{1}{C_L s}} \right)$$

$$H(s) = \frac{R_L (g_m r_o + 1) (C_1 L_1 s^2 + 1) (C_L L_L R_L s^2 + C_L R_L s + 1)}{C_1 C_L L_1 L_L R_1 g_m r_o s^4 + C_1 C_L L_1 L_L R_1 s^4 + C_1 C_L L_1 L_L R_L s^4 + C_1 C_L L_1 L_L r_o s^4 + C_1 C_L L_1 R_1 R_L g_m r_o s^3 + C_1 C_L L_1 R_1 R_L s^3 + C_1 C_L L_1 R_L r_o s^3 + C_1 C_L L_L R_1 R_L s^3 + C_1 C_L L_L R_1 s^3}$$