# 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: $\frac{Z_1 Z_L(g_m r_o+1)}{Z_1 g_m r_o+Z_1+Z_L+r_o}$

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

# 2 HP

# 3 BP

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

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

**Parameters:**

Q: $C_L \sqrt{\frac{1}{C_L L_L}} \left(R_1 g_m r_o + R_1 + r_o\right)$
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: $R_1 \left(g_m r_o + 1\right)$
Qz: 0
Wz: None

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

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

**Parameters:**

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

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

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

**Parameters:**

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

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

### 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:**

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

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

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

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

**Parameters:**

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

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

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

**Parameters:**

Q: $\frac{C_1 C_L R_1 R_L r_o \sqrt{\frac{R_1 g_m r_o+R_1+R_L+r_o}{C_1 C_L R_1 R_L r_o}}}{C_1 R_1 R_L+C_1 R_1 r_o+C_L R_1 R_L g_m r_o+C_L R_1 R_L+C_L R_L r_o}$
wo: $\sqrt{\frac{R_1 g_m r_o+R_1+R_L+r_o}{C_1 C_L R_1 R_L r_o}}$
bandwidth: $\frac{C_1 R_1 R_L+C_1 R_1 r_o+C_L R_1 R_L g_m r_o+C_L R_1 R_L+C_L R_L r_o}{C_1 C_L R_1 R_L r_o}$

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: 0
K-BP: 0
Qz: None
Wz: None

# 5 BS

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

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

**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: $R_1 \left(g_m r_o + 1\right)$
K-HP: $R_1 \left(g_m r_o + 1\right)$
K-BP: 0
Qz: None
Wz: $\sqrt{\frac{1}{C_L L_L}}$

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

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

**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: $\frac{R_L (R_1 g_m r_o+R_1+r_o)}{L_L (R_1 g_m r_o+R_1+R_L+r_o)}$
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 $Z(s) = \left(L_1 s + \frac{1}{C_1 s},\ \infty,\ \infty,\ \infty,\ \infty,\ R_L\right)$

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

**Parameters:**

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

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

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

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

**Parameters:**

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

## 6 GE

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

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

**Parameters:**

Q: $\frac{L_L\sqrt{\frac{1}{C_L L_L}}}{R_1 g_m r_o+R_1+R_L+r_o}$
wo: $\sqrt{\frac{1}{C_L L_L}}$
bandwidth: $\frac{R_1 g_m r_o+R_1+R_L+r_o}{L_L}$
K-LP: $R_1\left(g_m r_o+1\right)$
K-HP: $R_1\left(g_m r_o+1\right)$
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: $\frac{L_L\sqrt{\frac{1}{C_L L_L}}}{R_L}$
Wz: $\sqrt{\frac{1}{C_L L_L}}$

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

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

**Parameters:**

Q: $C_L\sqrt{\frac{1}{C_L L_L}}\left(R_1 g_m r_o + R_1 + R_L + r_o\right)$
wo: $\sqrt{\frac{1}{C_L L_L}}$
bandwidth: $\frac{1}{C_L(R_1 g_m r_o + R_1 + R_L + r_o)}$
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: $R_1\left(g_m r_o + 1\right)$
Qz: $C_L R_L\sqrt{\frac{1}{C_L L_L}}$
Wz: $\sqrt{\frac{1}{C_L L_L}}$

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

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

**Parameters:**

Q: $\frac{L_1\sqrt{\frac{1}{C_1 L_1}}(g_m r_o+1)}{R_1 g_m r_o + R_1 + R_L + r_o}$
wo: $\sqrt{\frac{1}{C_1 L_1}}$
bandwidth: $\frac{R_1 g_m r_o + R_1 + R_L + r_o}{L_1(g_m r_o+1)}$
K-LP: $R_L$
K-HP: $R_L$
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: $\frac{L_1\sqrt{\frac{1}{C_1 L_1}}}{R_1}$
Wz: $\sqrt{\frac{1}{C_1 L_1}}$

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

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

**Parameters:**

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

# 7 AP

# 8 INVALID-NUMER

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

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

**Parameters:**

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

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

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

**Parameters:**

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: $R_1 \left(g_m r_o + 1\right)$
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: None

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

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

**Parameters:**

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: None

# 9 INVALID-WZ

# 10 INVALID-ORDER

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

**10.25 INVALID-ORDER-25** $Z(s) = \left(\frac{R_1}{C_1R_1s+1},\ \infty,\ \infty,\ \infty,\ \infty,\ \frac{1}{C_Ls+\frac{1}{R_L}+\frac{1}{L_Ls}}\right)$

$$H(s) = \frac{L_LR_1R_Ls\left(g_mr_o+1\right)}{C_1C_LL_LR_1R_Lr_os^3+C_1L_LR_1R_Ls^2+C_1L_LR_1r_os^2+C_1R_1R_Lr_os+C_LL_LR_1R_Lg_mr_os^2+C_LL_LR_1R_Ls^2+C_LL_LR_Lr_os^2+L_LR_1g_mr_os+L_LR_1s+L_LR_Ls+L_Lr_os+R_1R_Lg_mr_o+R_1R_L+R_Lr_o}$$

**10.26 INVALID-ORDER-26** $Z(s) = \left(\frac{R_1}{C_1R_1s+1},\ \infty,\ \infty,\ \infty,\ \infty,\ \frac{L_Ls}{C_LL_Ls^2+1}+R_L\right)$

$$H(s) = \frac{R_1\left(g_mr_o+1\right)\left(C_LL_LR_Ls^2+L_Ls+R_L\right)}{C_1C_LL_LR_1R_Ls^3+C_1C_LL_LR_1r_os^3+C_1L_LR_1s^2+C_1R_1R_Ls+C_1R_1r_os+C_LL_LR_1g_mr_os^2+C_LL_LR_1s^2+C_LL_LR_Ls^2+C_LL_Lr_os^2+L_Ls+R_1g_mr_o+R_1+R_L+r_o}$$

**10.27 INVALID-ORDER-27** $Z(s) = \left(\frac{R_1}{C_1R_1s+1},\ \infty,\ \infty,\ \infty,\ \infty,\ \frac{R_L\left(L_Ls+\frac{1}{C_Ls}\right)}{L_Ls+R_L+\frac{1}{C_Ls}}\right)$

$$H(s) = \frac{R_1R_L\left(g_mr_o+1\right)\left(C_LL_Ls^2+1\right)}{C_1C_LL_LR_1R_Ls^3+C_1C_LL_LR_1r_os^3+C_1C_LR_1R_Lr_os^2+C_1R_1R_Ls+C_1R_1r_os+C_LL_LR_1g_mr_os^2+C_LL_LR_1s^2+C_LL_LR_Ls^2+C_LL_Lr_os^2+C_LR_1R_Lg_mr_os+C_LR_1R_Ls+C_LR_Lr_os+R_1g_mr_o+R_1+R_L+r_o}$$

**10.28 INVALID-ORDER-28** $Z(s) = \left(R_1+\frac{1}{C_1s},\ \infty,\ \infty,\ \infty,\ \infty,\ R_L\right)$

$$H(s) = \frac{R_L\left(g_mr_o+1\right)\left(C_1R_1s+1\right)}{C_1R_1g_mr_os+C_1R_1s+C_1R_Ls+C_1r_os+g_mr_o+1}$$

**10.29 INVALID-ORDER-29** $Z(s) = \left(R_1+\frac{1}{C_1s},\ \infty,\ \infty,\ \infty,\ \infty,\ \frac{1}{C_Ls}\right)$

$$H(s) = \frac{\left(g_mr_o+1\right)\left(C_1R_1s+1\right)}{s\left(C_1C_LR_1g_mr_os+C_1C_LR_1s+C_1C_Lr_os+C_1+C_Lg_mr_o+C_L\right)}$$

**10.30 INVALID-ORDER-30** $Z(s) = \left(R_1+\frac{1}{C_1s},\ \infty,\ \infty,\ \infty,\ \infty,\ R_L+\frac{1}{C_Ls}\right)$

$$H(s) = \frac{\left(g_mr_o+1\right)\left(C_1R_1s+1\right)\left(C_LR_Ls+1\right)}{s\left(C_1C_LR_1g_mr_os+C_1C_LR_1s+C_1C_LR_Ls+C_1C_Lr_os+C_1+C_Lg_mr_o+C_L\right)}$$

**10.31 INVALID-ORDER-31** $Z(s) = \left(R_1+\frac{1}{C_1s},\ \infty,\ \infty,\ \infty,\ \infty,\ L_Ls+\frac{1}{C_Ls}\right)$

$$H(s) = \frac{\left(g_mr_o+1\right)\left(C_1R_1s+1\right)\left(C_LL_Ls^2+1\right)}{s\left(C_1C_LL_Ls^2+C_1C_LR_1g_mr_os+C_1C_LR_1s+C_1C_Lr_os+C_1+C_Lg_mr_o+C_L\right)}$$

**10.32 INVALID-ORDER-32** $Z(s) = \left(R_1+\frac{1}{C_1s},\ \infty,\ \infty,\ \infty,\ \infty,\ \frac{L_Ls}{C_LL_Ls^2+1}\right)$

$$H(s) = \frac{L_Ls\left(g_mr_o+1\right)\left(C_1R_1s+1\right)}{C_1C_LL_LR_1g_mr_os^3+C_1C_LL_LR_1s^3+C_1C_LL_Lr_os^3+C_1L_Ls^2+C_1R_1g_mr_os+C_1R_1s+C_1r_os+C_LL_Lg_mr_os^2+C_LL_Ls^2+g_mr_o+1}$$

**10.33 INVALID-ORDER-33** $Z(s) = \left(R_1+\frac{1}{C_1s},\ \infty,\ \infty,\ \infty,\ \infty,\ L_Ls+R_L+\frac{1}{C_Ls}\right)$

$$H(s) = \frac{\left(g_mr_o+1\right)\left(C_1R_1s+1\right)\left(C_LL_Ls^2+C_LR_Ls+1\right)}{s\left(C_1C_LL_Ls^2+C_1C_LR_1g_mr_os+C_1C_LR_1s+C_1C_LR_Ls+C_1C_Lr_os+C_1+C_Lg_mr_o+C_L\right)}$$

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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