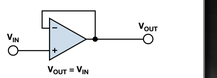
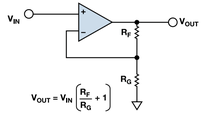
# 助您节省时间的放大器设计参考指南

### 电压跟随器



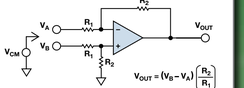

缓冲高阻抗信号源和低阻性负载

### 同相运算放大器



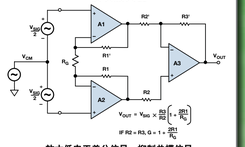

同相信号放大

### 电压减法器/差动放大器



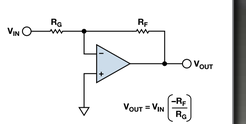

放大两个电压之差、抑制共模电压

### 仪表放大器



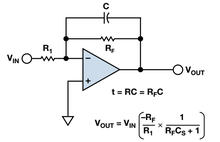

放大低电平差分信号、抑制共模信号

### 反相运算放大器



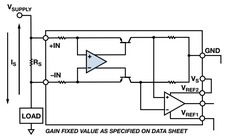

放大并反转输入

### 低通滤波器/积分器



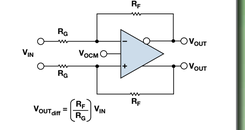

限制信号带宽

### 电流检测放大器



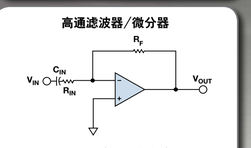

放大$R_S$上的电压、抑制$V_{SUPPLY}$

### 差分放大器



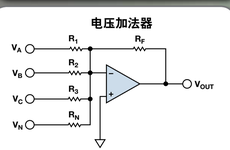

从差分或单端信号源驱动差分输入ADC

### 高通滤波器/微分器



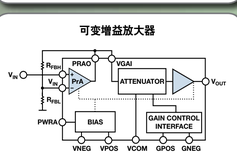

隔直、放大交流信号

### 电压加法器



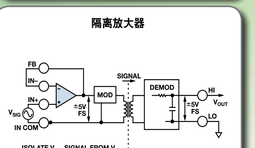

多个电压求和

### 可变增益放大器



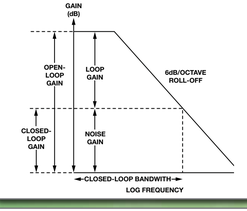

将输入信号放大1至1000倍，
0dB至60dB，由$V_{GAIN}$设置

### 隔离放大器

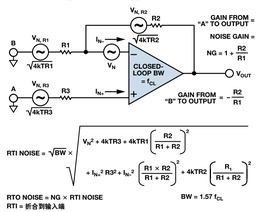



$V_{OUT} = V_{IN}$

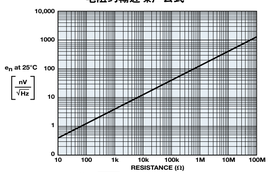
### 电压反馈型放大器的闭环频率响应




### 单极系统的运算放大器噪声




### 电阻约翰逊噪声公式




$V_R = \sqrt{4kTRB}$

总和：

$V_R$ = 电阻约翰逊噪声频谱密度

k = 波尔兹曼常数 ($1.38 \times 10^{-23}$ J/K)

T = 开尔文绝对温度

R = 电阻值(Ohms)

B = 带宽(Hz)

25°C时，$4kT = 1.65 \times 10^{-20}$ W/Hz，因此，$V_R = \sqrt{1.65 \times 10^{-20} RB}$

### 串联电阻

$$R_{TOTAL} = R_1 + R_2 + R_3 + \ldots$$

### 并联电阻

$$R_{TOTAL} = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots}$$

### 两个电阻并联

$$R_{TOTAL} = \frac{R_1 R_2}{R_1 + R_2}$$

### 等值电阻并联

$R_{TOTAL} = \frac{R}{N}$ 其中R为等值电阻之一的阻值，N为等值电阻的数量

### 分贝(dB)公式(等值阻抗)

$$db = 10 \text{ Log } \frac{P_{OUT}}{P_{IN}} = 20 \text{ Log } \frac{V_{OUT}}{V_{IN}}$$

$$= 20 \text{ Log } \frac{I_{OUT}}{I_{IN}} \quad \text{(Gain)}$$

$$db = 10 \text{ Log } \frac{P_{IN}}{P_{OUT}} = 20 \text{ Log } \frac{V_{IN}}{V_{OUT}}$$

$$= 20 \text{ Log } \frac{I_{IN}}{I_{OUT}} \quad \text{(Gain)}$$

### 正弦电压和电流

RMS = 均方根 = 有效值

$V_{RMS} = 0.707\ V_{PEAK}$

$V_{AVE.} = 0.637\ V_{PEAK}$

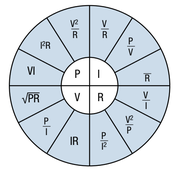
$V_{PEAK} = 1.414\ V_{EFF.}$

$V_{EFF.} = 1.11\ V_{AVE.}$

$V_{PEAK} = 1.57\ V_{AVE.}$

$V_{AVE.} = 0.9\ V_{EFF.}$

### 欧姆定律(直流电路)




### 电抗公式

$$X_C = \frac{1}{2\pi fC}$$

$$X_L = 2\pi fL$$

### 变压器(升压或降压比)

$$\frac{N_P}{N_S} = \frac{E_P}{E_S} = \frac{I_S}{I_P} = \sqrt{\frac{Z_P}{Z_S}}$$

### 阻抗公式(串联)

$Z = \sqrt{R^2 + X_L^2}$ (RL串联)

$Z = \sqrt{R^2 + X_C^2}$ (RC串联)

$Z = X_L - X_C$ (LC串联)

$Z = \sqrt{R^2 + (X_L - X_C)^2}$ (RLC串联)

$Z = \frac{V_A}{I}$

### 电压和阻抗公式(并联)

$Z = \frac{RX_L}{\sqrt{R^2 + X_L^2}}$ (RL) $Z = \frac{V_A}{I_{LINE}}$

$Z = \frac{RX_C}{\sqrt{R^2 + X_C^2}}$ (RC) $V_A = V_L = V_C = V_R$

$Z = \frac{X_L X_C}{X_L - X_C}$ (LC) $V_A = I_{LINE} Z$

$Z = \frac{RX}{\sqrt{R^2 + X^2}}$ (RLC)

## 常用1%电阻值

1%精度的电阻阻值范围为10.0到1.00M(另也有1.10 M、1.20 M、1.30 M、1.50 M、1.60 M、1.80 M、2.00 M和2.20 M)。

下表列出了最常用容差(1%)的标准基本电阻值，以及可用的典型阻值范围。要确定基本值以外的其它电阻值，请将其乘以10、100、1000或10,000。

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 10.0 | 10.2 | 10.5 | 10.7 | 11.0 | 11.3 | 11.5 | 11.8 | 12.1 | 12.4 | 12.7 | 13.0 |
| 13.3 | 13.7 | 14.0 | 14.3 | 14.7 | 15.0 | 15.4 | 15.8 | 16.2 | 16.5 | 16.9 | 17.4 |
| 17.8 | 18.2 | 18.7 | 19.1 | 19.6 | 20.0 | 20.5 | 21.0 | 21.5 | 22.1 | 22.6 | 23.2 |
| 23.7 | 24.3 | 24.9 | 25.5 | 26.1 | 26.7 | 27.4 | 29.0 | 28.7 | 29.4 | 30.1 | 30.9 |
| 31.6 | 32.4 | 33.2 | 34.0 | 34.8 | 35.7 | 36.5 | 37.4 | 38.3 | 39.2 | 40.2 | 41.2 |
| 42.2 | 43.2 | 44.2 | 45.3 | 46.4 | 47.5 | 48.7 | 49.9 | 51.1 | 52.3 | 53.6 | 54.9 |
| 56.2 | 57.6 | 59.0 | 60.4 | 61.9 | 63.4 | 64.9 | 66.5 | 68.1 | 69.8 | 71.5 | 73.2 |
| 75.0 | 76.8 | 78.7 | 80.6 | 82.5 | 84.5 | 86.6 | 88.7 | 90.9 | 93.1 | 95.3 | 97.6 |

## 常用电容值

| pF | pF | pF | pF | µF | µF | µF | µF | µF | µF | µF |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.0 | 10 | 100 | 1000 | 0.01 | 0.1 | 1.0 | 10 | 100 | 1000 | 10,000 |
| 1.1 | 11 | 110 | 1100 | | | | | | | |
| 1.2 | 12 | 120 | 1200 | | | | | | | |
| 1.3 | 13 | 130 | 1300 | | | | | | | |
| 1.5 | 15 | 150 | 1500 | 0.015 | 0.15 | 1.5 | 15 | 150 | 1500 | |
| 1.6 | 16 | 160 | 1600 | | | | | | | |
| 1.8 | 18 | 180 | 1800 | | | | | | | |
| 2.0 | 20 | 200 | 2000 | | | | | | | |
| 2.2 | 22 | 220 | 2200 | 0.022 | 0.22 | 2.2 | 22 | 220 | 2200 | |
| 2.4 | 24 | 240 | 2400 | | | | | | | |
| 2.7 | 27 | 270 | 2700 | | | | | | | |
| 3.0 | 30 | 300 | 3000 | | | | | | | |
| 3.3 | 33 | 330 | 3300 | 0.033 | 0.33 | 3.3 | 33 | 330 | 3300 | |
| 3.6 | 36 | 360 | 3600 | | | | | | | |
| 3.9 | 39 | 390 | 3900 | | | | | | | |
| 4.3 | 43 | 430 | 4300 | | | | | | | |
| 4.7 | 47 | 470 | 4700 | 0.047 | 0.47 | 4.7 | 47 | 470 | 4700 | |
| 5.1 | 51 | 510 | 5100 | | | | | | | |
| 5.6 | 56 | 560 | 5600 | | | | | | | |
| 6.2 | 62 | 620 | 6200 | | | | | | | |
| 6.8 | 68 | 680 | 6800 | 0.068 | 0.68 | 6.8 | 68 | 680 | 6800 | |
| 7.5 | 75 | 750 | 7500 | | | | | | | |
| 8.2 | 82 | 820 | 8200 | | | | | | | |
| 9.1 | 91 | 910 | 9100 | | | | | | | |

www.analog.com/zh/amplifiers

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