

**FORMULA SHEET****RLC**

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

$$X_L = 2\pi fL$$

$$f_r = \frac{1}{2\pi\sqrt{LC}}$$

**Series**

$$I_T = \frac{V_T}{Z}$$

$$V_L = I X_L$$

$$V_C = I X_C$$

$$V_T = I Z$$

$$Q = \frac{X_L}{Z} = \frac{X_C}{Z} = \frac{V_L}{V_S} = \frac{V_C}{V_S} = \frac{1}{R} \sqrt{\frac{L}{C}}$$

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

$$V_T = \sqrt{V_R^2 + (V_L - V_C)^2}$$

$$\cos\theta = \frac{R}{Z}$$

$$\cos\theta = \frac{V_R}{V_T}$$

**Parallel**

$$\cos\theta = \frac{I_R}{I_T}$$

$$I_T = \sqrt{I_R^2 + (I_L - I_C)^2}$$

$$I_R = \frac{V_R}{R}$$

$$I_C = \frac{V_C}{X_C}$$

$$I_L = \frac{V_L}{X_L}$$

$$Q = \frac{X_L}{Z} = \frac{X_C}{Z} = \frac{I_L}{I_S} = \frac{I_C}{I_S} = \frac{1}{R} \sqrt{\frac{L}{C}}$$

$$BW = \frac{f_r}{Q}$$

**SEMICONDUCTOR DEVICES**

$$\text{Gain } A_V = \frac{V_{out}}{V_{in}} = -\left(\frac{R_f}{R_{in}}\right)$$

$$V_{out} = V_{in} \times \left(-\frac{R_F}{R_{in}}\right)$$

$$V_{OUT} = V_{IN} \times \left(1 + \frac{R_F}{R_{in}}\right)$$

**SWITCHING CIRCUITS**

$$V_{out} = V_{in} 1 \times \left(-\frac{R_F}{R_1}\right) + V_{in} 2 \times \left(-\frac{R_F}{R_2}\right) + \dots V_{in} N \times \left(-\frac{R_F}{R_N}\right)$$

$$V_{out} = -(V_1 + V_2 + V_3 + \dots V_N)$$

$$(\text{Time constant } 1) \tau = 0.693RC$$

$$T_{ON} = 0.693(R_1 + R_2)C_1 \quad T_{OFF} = 0.693(R_2)C_1$$

**AMPLIFIERS**

$$I_C = \frac{V_C}{R_C}$$

$$I_B = \frac{V_{CC} - V_{BE}}{R_B}$$

$$V_{CC} = V_{CE} + I_C R_C$$

$$A = \beta_1 \times \beta_2$$

$$A_i = 20 \log \frac{I_o}{I_i}$$

$$A_v = 20 \log \frac{V_o}{V_i}$$

$$P_o = I^2 \times Z_o$$

$$A_p = 10 \log \frac{P_o}{P_i}$$

$$A_{v(dB)} = 20 \log A_v$$

$$\text{Gain } A_V = \frac{V_{out}}{V_{in}} = -\left(\frac{R_F}{R_{in}}\right)$$

$$f_o = \frac{1}{2\pi\sqrt{L_T C}}$$

Hartley oscillator

$$f_o = \frac{1}{2\pi\sqrt{L C_T}}$$

Colpitts oscillator

$$f_o = \frac{1}{2\pi\sqrt{6RC}}$$

RC phase-shift oscillator