FORMULA SHEET

RLC

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

$$X_L = 2\pi fL$$

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

Series

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

$$V_L = I\,X_L$$

$$V_C = I\,X_C$$

$$V_T = I\,Z$$

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

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

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

$$\text{Cos }\theta = \frac{R}{Z}$$

$$\text{Cos }\theta = \frac{V_R}{V_T}$$

Parallel

$$\text{Cos }\theta = \frac{I_R}{I_T}$$

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

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

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

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

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

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

SEMICONDUCTOR DEVICES

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

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

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

SWITCHING CIRCUITS

$$V_{out} = V_{in}1 \times \left(-\frac{R_F}{R1}\right) + V_{in}2 \times \left(-\frac{R_F}{R2}\right) + \ldots V_{in}N \times \left(-\frac{R_F}{RN}\right)$$

$$V_{out} = -\left(V_1 + V_2 + V_3 + \ldots V_N\right)$$

AMPLIFIERS

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

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

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

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

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

$$P_O = I^2 \times Z_O$$

$$A_P = 10\log\frac{P_O}{P_i}$$

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

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

$$f_O = \frac{1}{2\pi\sqrt{L_T C}} \qquad \text{Hartley oscillator}$$

$$f_O = \frac{1}{2\pi\sqrt{LC_T}} \qquad \text{Colpitts oscillator}$$

$$f_O = \frac{1}{2\pi\sqrt{6RC}} \qquad \text{RC phase-shifting oscillator}$$