Electronics Formulas Cheatsheet

OHMS LAW AND POWER

V = I * R Voltage equals Current times Resistance

P = V * I Power equals Voltage times Current

P = I^2 * R Power from Current and Resistance

P = V^2 / R Power from Voltage and Resistance

RESISTOR NETWORKS

Series: R_total = R1 + R2 + R3 + ...

Parallel: 1/R_total = 1/R1 + 1/R2 + 1/R3 + ...

Two in parallel: R_total = (R1 * R2) / (R1 + R2)

Voltage divider: V_out = V_in * R2 / (R1 + R2)

Current divider: I_R1 = I_total * R2 / (R1 + R2)

CAPACITOR NETWORKS

Series: 1/C_total = 1/C1 + 1/C2 + 1/C3 + ...

Parallel: C_total = C1 + C2 + C3 + ...

Stored charge: Q = C * V

Stored energy: E = 0.5 * C * V^2

RC CIRCUITS

Time constant: tau = R * C (in seconds)

Charging: V(t) = V_max * (1 - e^(-t/tau))

Discharging: V(t) = V_0 * e^(-t/tau)

5*tau equals 99.3 percent fully charged or discharged

Cutoff frequency (-3dB): f_c = 1 / (2*pi*R*C)

RL CIRCUITS

Time constant: tau = L / R

Current build-up: I(t) = I_max * (1 - e^(-t/tau))

Cutoff frequency: f_c = R / (2*pi*L)

OPERATIONAL AMPLIFIERS

Non-inverting gain: G = 1 + Rf / R1

Inverting gain: G = -Rf / R1

Differential: V_out = (Rf/R1) * (V2 - V1)

Summing: V_out = -Rf * (V1/R1 + V2/R2 + ...)

CMRR = 20 * log10(|Ad/Ac|) in dB

Gain-Bandwidth Product: GBW = Gain * BW (constant for a given op-amp)

FREQUENCY AND IMPEDANCE

Capacitive reactance: Xc = 1 / (2 * pi * f * C)

Inductive reactance: XL = 2 * pi * f * L

Resonant frequency: f_r = 1 / (2 * pi * sqrt(L*C))

Series Q factor: Q = (1/R) * sqrt(L/C)

Parallel Q factor: Q = R * sqrt(C/L)

dB CONVERSIONS

Power ratio: dB = 10 * log10(P2 / P1)

Voltage ratio: dB = 20 * log10(V2 / V1)

+3 dB = 2x power, 1.414x voltage

+6 dB = 4x power, 2x voltage

+10 dB = 10x power, 3.16x voltage

+20 dB = 100x power, 10x voltage

-3 dB = 0.5x power, 0.707x voltage

-10 dB = 0.1x power, 0.316x voltage

DC-DC CONVERTER BASICS

Buck (step-down): V_out = D * V_in (D = duty cycle, 0-100%)

Boost (step-up): V_out = V_in / (1 - D)

Buck-Boost (inverting): V_out = V_in * D / (1 - D)

Transformer: V_secondary / V_primary = N_secondary / N_primary

THERMAL MANAGEMENT

Junction temperature: T_j = T_a + P_diss * Theta_JA

Heatsink thermal path: Theta_JA = Theta_JC + Theta_CS + Theta_SA

Max power (no heatsink): P_max = (T_jmax - T_a) / Theta_JA

COMMON PREFIXES

pico (p) = 10^-12 nano (n) = 10^-9 micro (u) = 10^-6

milli (m) = 10^-3 kilo (k) = 10^3 mega (M) = 10^6

giga (G) = 10^9 tera (T) = 10^12