VoltCalc Electrical Formula Reference Sheet

Comprehensive DC, Single-Phase AC, Three-Phase AC, Voltage Drop, Motor, Transformer & Solar Formulas
Source: VoltCalc Engineering Resource Center - https://voltcalc.site/resources

1. Basic & DC Electrical Formulas (SI Units: V, A, Ohm, W, Wh, J)

Ohm's Law: V = I * R | I = V / R | R = V / I

DC Electrical Power: P (W) = V * I = I^2 * R = V^2 / R

Electrical Energy: E (Wh) = P (W) * t (h) | E (J) = P (W) * t (s) | 1 kWh = 3.6 * 10^6 J

Series Resistance: R_eq = R1 + R2 + ... + Rn | Parallel Resistance: 1/R_eq = 1/R1 + 1/R2 + ...

2. Single-Phase & Three-Phase AC Formulas (50 Hz / 60 Hz Sinusoidal Steady-State)

RMS & Peak (Pure Sine): V_rms = V_peak / sqrt(2) | I_rms = I_peak / sqrt(2) | f = 1 / T

Reactance & Impedance: X_L = 2*pi*f*L | X_C = 1 / (2*pi*f*C) | Z = sqrt(R^2 + (X_L - X_C)^2)

1-Phase AC Power: P (W) = V * I * PF | S (VA) = V * I | Q (var) = V * I * sin(phi) | PF = P / S

3-Phase Balanced Power: P (W) = sqrt(3) * V_LL * I_L * PF | S (VA) = sqrt(3) * V_LL * I_L

Wye (Star): V_LL = sqrt(3) * V_LN, I_L = I_phase | Delta: V_LL = V_phase, I_L = sqrt(3) * I_phase

3. Conductor Resistance & Voltage Drop Formulas

Conductor Resistance: R = rho * L / A | Temp Correction: R(T) = R_20 * [1 + alpha_20 * (T - 20 deg C)]

DC / 1-Phase Voltage Drop: V_drop = 2 * I * L * R_unit (or 2 * I * L * (R*cos(phi) + X*sin(phi)))

3-Phase Balanced Voltage Drop: V_drop = sqrt(3) * I * L * (R*cos(phi) + X*sin(phi))

Percentage Voltage Drop: %VD = (V_drop / V_nominal) * 100%

4. Motors, Transformers, Solar PV & Battery Storage

Motor Input & Efficiency: P_in = P_out / eta | 3-Phase Motor FLA = P_out / (sqrt(3) * V_LL * eta * PF)

Synchronous Speed: n_s (RPM) = (120 * f) / Poles | Transformer Ratio: V_p / V_s = N_p / N_s = I_s / I_p

Battery Energy & Runtime: E (Wh) = C (Ah) * V_nom | t (h) = (C_Ah * V_nom * DoD * eta_inv) / P_load

Solar Daily Energy: E_day (Wh) = P_array_STC * PSH * eta_sys | MPPT Current >= 1.25 * (P_array / V_bat)

Assumptions & Notice: Engineering planning reference only. Always verify against locally adopted NEC / IEC / BS 7671 code.