

Electronics Data Sheet

Constants

Constant	Code	Value	Unit
Speed of light in a vacuum	c	3×10^8	m s^{-1}
Permeability of free space	μ_0	$4\pi \times 10^{-7}$	H m^{-1}
Permittivity of free space	ϵ_0	8.85×10^{-12}	F m^{-1}
Charge of an electron	e	-1.602×10^{-19}	C
Charge of a proton	e	$+1.602 \times 10^{-19}$	C
Mass of an electron	m_e	9.11×10^{-31}	kg

Simple Circuits

Series resistors $R_T = R_1 + R_2 + \dots$

Parallel resistors $\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \dots$

Voltage divider $V_{\text{out}} = V_{\text{in}} \left(\frac{R_2}{R_1 + R_2} \right)$

Kirchhoff I $I_T = I_1 + I_2 + \dots$

Kirchhoff II $\mathcal{E} = V_1 + V_2 + \dots$

Energy $E = VIt = VQ$

Internal Resistance $\mathcal{E} = I(R + r)$

AC Theory (Sinusoidal Waves)

Peak Voltage	$V_0 = \frac{V_{pk\ to\ pk}}{2}$	Angular velocity	$\omega = 2\pi f$
RMS voltage	$V_{RMS} = \frac{V_0}{\sqrt{2}}$	Average value	$0.637 \times \text{max value}$
RMS value	$0.707 \times \text{max value}$		

AC Theory (Reactive Circuits)

Reactance of a capacitor	$X_C = \frac{1}{2\pi f C}$	Power factor	$\cos \phi = \frac{R}{Z}$
Reactance of an inductor	$X_L = 2\pi f L$	Apparent power	$S = VI$
Reactance	$X = \frac{V}{I}$	True power	$P = VI \cos \phi$
Impedance	$Z = \frac{V}{I}$	Reactive power	$Q = VI \sin \phi$
Series Impedance	$Z^2 = X^2 + R^2$		

AC Theory (Resonance)

Resonant frequency	$f = \frac{1}{2\pi\sqrt{LC}}$	Impedance (series circuit)	$Z = R$
Q factor	$Q = \frac{V_L}{V}$	Q factor	$Q = \frac{1}{2\pi f CR}$
Q factor	$Q = \frac{1}{R} \sqrt{\left(\frac{L}{C}\right)}$	Q factor	$Q = \frac{2\pi f L}{R}$

Operational Amplifiers

Gain	$\text{Gain} = \frac{V_{\text{out}}}{V_{\text{in}}}$	Output voltage	$V_{\text{out}} = A_{\text{OL}}[(V+) - (V-)]$
Inverting	$\frac{V_{\text{out}}}{V_{\text{in}}} = -\frac{R_f}{R_a}$	Non-inverting	$\frac{V_{\text{out}}}{V_{\text{in}}} = 1 + \frac{R_f}{R_a}$
Difference	$V_{\text{out}} = (V_2 - V_1) \left(\frac{R_f}{R_1} \right)$	Summing	$V_{\text{out}} = -R_f \left(\frac{V_1}{R_1} + \frac{V_2}{R_2} + \dots + \frac{V_n}{R_n} \right)$