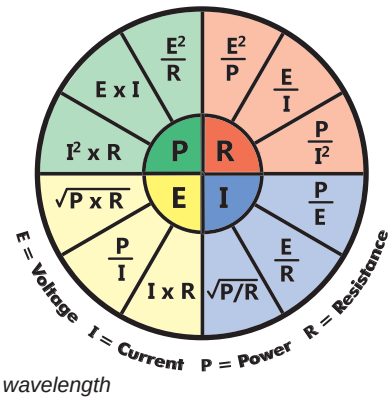
ETA® International Common Formulas

For use on all Basic Electronics Exams – Associate CET (CETa), Basic Systems Technician (BST), Electronics Modules (EM1-5), Student Electronics Technician (SET) as well as the General Communications Technician-Level 1 (GCT1) Exam

Conversion Factors

π (Pi) = 3.14	1 meter = 3.28 feet
2π = 6.28	1 inch = 2.54 centimeters
logπ = 0.497	1 radian = 57.3˚

Ohm's Law



Resistor Color Code Chart - '#' Band

Color	Digit Value	Decimal Multiplier	Tolerance	Temp. Coeff.
Black	0	1 Ω		250
Brown	1	10 Ω	± 1%	100
Red	2	100 Ω	± 2%	50
Orange	3	1 kΩ		15
Yellow	4	10 kΩ		25
Green	5	100 kΩ	± 0.5%	20
Blue	6	1 MΩ	± 0.25%	10
Violet	7	10 MΩ	± 0.10%	5
Gray	8	100 MΩ	± 0.05%	1
White	9	1 GΩ		
Gold		0.1 Ω	± 5%	
Silver		0.01 Ω	± 10%	
No Color			± 20%	(ppm)

Resonant Frequency Formulas

f *(kHz),* ***L*** *(Microhenries),* ***C*** *(Microfarads)*

$f_{kHz} = 159.2 / \sqrt{LC}$

f *(Hz),* ***L*** *(Henries),* ***C*** *(Farads)*

$$f_{resonant} = \frac{1}{2\pi\sqrt{LC}}$$

Frequency & Wavelength Formulas

f *= frequency,* ***λ*** *= wavelength*

0.5λ = 180˚ = half wave and 0.25λ = 90˚ = quarter wave

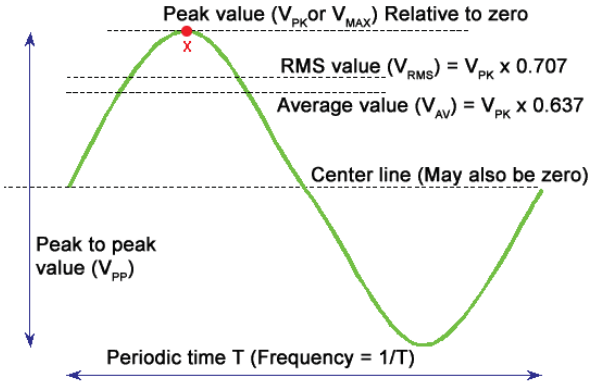
$f_{Hz} = (3 \times 10^8) / \lambda_{meters}$ or $f_{MHz} = 984 / \lambda_{feet}$

$\lambda_{meters} = (3 \times 10^8) / f_{Hz}$ or $\lambda_{feet} = 984 / f_{MHz}$

$c = f \times \lambda$ *where* ***c*** *is the speed of light*

Sine Wave Conversion

- Effective value (RMS) = 0.707 x Peak Value = 1.11 x Average Value
- Peak Value = 1.414 x Effective Value (RMS) = 1.57 x Average Value
- Average Value over positive half period = 0.637 x Peak Value = 0.9 x Effective Value (RMS)
- Identify: Waveform, Peak (amplitude), RMS, 1 cycle over time period (frequency), Peak to peak, and practical average



Voltage Gain In Decibels

Gain dB = $20\log_{10} (V_{out} / V_{in})$

Ratio Of 2 Power Levels In Decibels

Gain dB = $10\log_{10} (P_2 / P_1)$

Inverting Op-Amp

Gain (A_V) = (V_{OUT} / V_{IN}) = - (Rf / R_I)

Non-Inverting Op-Amp

Gain (A_V) = (V_{OUT} / V_{IN}) = 1 + (Rf / R_I)

Resistors In Series

$R = R_1 + R_2 + R_3$...

Resistors In Parallel

$1 / R = (1 / R_1) + (1 / R_2) + (1 / R_3)$...

Inductors Connected In Series

$L = L_1 + L_2 + L_3$...

Inductors Connected In Parallel

$1 / L = (1 / L_1) + (1 / L_2) + (1 / L_3)$...

Capacitors Connected In Parallel

$C = C_1 + C_2 + C_3$ +...

Capacitors Connected In Series

$1 / C = (1 / C_1) + (1 / C_2) + (1 / C_3)$ +...

Impedance For A Series Circuit

where **Z** is impedance

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

Impedance For R And X In Parallel

$$Z = \frac{RX}{\sqrt{R^2 + X^2}}$$

PEMDAS Rule

Parentheses, Exponents, Multiplication, Division, Add, Subtract

Time Constants

T *(Greek Tau),* ***R*** *(ohms),* ***C*** *(Farads),* ***L*** *(Henries)*

RL circuit: 1 T (sec) = L(H) / R(Ω)

RC circuit: 1 T (sec) = R(Ω) x C(F)

Compute Charge Or Quantity of Electricity & Energy Storage In A Capacitor

Q *(Coulombs),* ***W*** *(Joules),* ***C*** *(Farads),* ***V*** *(Volts)*

$Q = C \times V$ $W = ½ C \times V^2$

Capacitor Current Equations (storing energy in electric field)

I *(Amps),* ***Q*** *and* ***C*** *and* ***V*** *(as above),* ***d {delta Δ}*** *(Change),* ***t*** *(Time)*

$I = C(dV / dt)$ *from* $C*dV = dQ$ *and* $I = dQ/dt$

Inductor Voltage Equations

L *(Henries),* ***d****,* ***i****,* ***t****,* ***V****, and* ***W*** *(as above)*

$V = L(di / dt)$ $W = ½ L \times i^2$

Reactance Of Inductors

Reactance Of Capacitors

X_L & X_C *(Reactance),* ***C*** *and* ***L*** *(as above),* ***f*** *(Frequency)*

$X_L = 2\pi \times f \times L$ $X_C = 1 / (2\pi \times f \times C)$

Battery Internal Resistance

$V_{out} = EMF - (R_{int} \times I_{out})$

International System of Units (SI)

Prefix	Symbol	Multiplier	Power of Ten
tera	T	trillion	10^{12}
giga	G	billion	10^{9}
mega	M	million	10^{6}
kilo	k	thousand	10^{3}
none	none	1	10^{0}
milli	m	1/thousandth	10^{-3}
micro	μ	1/millionth	10^{-6}
nano	n	1/billionth	10^{-9}
pico	p	1/trillionth	10^{-12}

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