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

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>π (Pi)</td>
<td>3.14</td>
</tr>
<tr>
<td>2π</td>
<td>6.28</td>
</tr>
<tr>
<td>logπ</td>
<td>0.497</td>
</tr>
</tbody>
</table>

1 meter = 3.28 feet
1 inch = 2.54 centimeters
1 radian = 57.3°

Resonant Frequency Formulas

Where \( f \) is in kHz, \( L \) is in microhenries, \( C \) is in microfarads

\[
\text{f}_{\text{res}} = \frac{159.2}{\sqrt{LC}}
\]

Where \( f \) is in Hz, \( L \) is in Henries, \( C \) is in Farads

\[
\text{f}_{\text{res}} = \frac{1}{2\pi\sqrt{LC}}
\]

Ohm’s Law

\[
E = I \times R
\]

\[
P = EI
\]

\[
I = \frac{P}{E}
\]

\[
E = \frac{P}{I}
\]

\[
I^2 = \frac{P}{R}
\]

\[
E^2 = \frac{P}{R}
\]

\[
R = \frac{P}{I}
\]

\[
P = IR
\]

\[
E = \sqrt{P^2 - I^2}
\]

International System of Units (SI)

<table>
<thead>
<tr>
<th>Prefix</th>
<th>Symbol</th>
<th>Multiplier</th>
<th>Power of Ten</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terra</td>
<td>T</td>
<td>trillion</td>
<td>10^12</td>
</tr>
<tr>
<td>Giga</td>
<td>G</td>
<td>billion</td>
<td>10^9</td>
</tr>
<tr>
<td>Mega</td>
<td>M</td>
<td>million</td>
<td>10^6</td>
</tr>
<tr>
<td>Kilo</td>
<td>k</td>
<td>thousand</td>
<td>10^3</td>
</tr>
<tr>
<td>None</td>
<td></td>
<td>1</td>
<td>10^0</td>
</tr>
<tr>
<td>Milli</td>
<td>m</td>
<td>1/thousandth</td>
<td>10^-3</td>
</tr>
<tr>
<td>Micro</td>
<td>μ</td>
<td>1/millionth</td>
<td>10^-6</td>
</tr>
<tr>
<td>Nano</td>
<td>n</td>
<td>1/billionth</td>
<td>10^-9</td>
</tr>
<tr>
<td>Pico</td>
<td>p</td>
<td>1/trillionth</td>
<td>10^-12</td>
</tr>
</tbody>
</table>

PEMDAS Rule

Parentheses, Exponents, Multiplication, Division, Add, Subtract

Reactance Of Inductors

Where \( X_L \) is reactance, \( f \) is frequency, and \( L \) is inductance

\[
X_L = 2\pi f L
\]

Time Constants

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

RL circuit: \( T = L/R \)

RC circuit: \( T = R/C \)

Compute Charge Or Quantity of Electricity

where \( Q \) is the charge (in Coulombs), \( C \) is the capacitance (in Farads), and \( V \) is the potential difference (in Volts)

\[
Q = CV
\]

Energy Storage In A Capacitor

where \( W \) is the energy (in Joules), \( C \) is the capacitance (in Farads), and \( V \) is the potential difference (in Volts)

\[
W = \frac{1}{2} CV^2
\]

Capacitors Connected In Parallel

\[
C = C_1 + C_2 + C_3 + \ldots
\]

1 \(/ C = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + \ldots
\]

Capacitors Connected In Series

\[
C = C_1 \times C_2 \times C_3 \times \ldots
\]

1 \(/ C = \frac{1}{C_1} \times \frac{1}{C_2} \times \frac{1}{C_3} \times \ldots
\]

Reactance Of Capacitors

\[
X_C = \frac{1}{2\pi f C}
\]

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

\[
RX
\]

\[
Z = \sqrt{R^2 + X^2}
\]

Battery Internal Resistance

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

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 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 \( (V_{out} / V_{in}) \)

Ratio Of 2 Power Levels In Decibels

Gain dB = 10 log \( (P_{out} / P_{in}) \)

Resistors In Series

\[
R = R_1 + R_2 + R_3 + \ldots
\]

Resistors In Parallel

\[
1 / R = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots
\]

Inductors Connected In Series

\[
L = L_1 + L_2 + L_3 + \ldots
\]

Inductors Connected In Parallel

\[
1 / L = \frac{1}{L_1} + \frac{1}{L_2} + \frac{1}{L_3} + \ldots
\]