This note brings together a number of equations and conversion factors that are useful when applying a power supply.

### General

**Voltage & Current**

<table>
<thead>
<tr>
<th>Equation</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_P$</td>
<td>$(\frac{1}{0.707}) \times V_{RMS}$</td>
</tr>
<tr>
<td>$V_{PP}$</td>
<td>$\sqrt{2} V_{RMS} = 1.414 V_{RMS}$</td>
</tr>
<tr>
<td>$V_{RMS}$</td>
<td>$\sqrt{0.5} V_{P} \approx 0.707 V_{P}$</td>
</tr>
<tr>
<td>$V_{AVG}$</td>
<td>$(\frac{2}{\pi}) \times V_{P} \approx 0.637 V_{P}$</td>
</tr>
<tr>
<td>$I_P$</td>
<td>$\sqrt{2} I_{RMS} \approx 1.414 I_{RMS}$</td>
</tr>
<tr>
<td>$I_{PP}$</td>
<td>$2 I_{P}$</td>
</tr>
<tr>
<td>$I_{RMS}$</td>
<td>$\sqrt{0.5} I_{P} \approx 0.707 I_{P}$</td>
</tr>
<tr>
<td>$I_{AVG}$</td>
<td>$(\frac{2}{\pi}) \times I_{P} \approx 0.637 I_{P}$</td>
</tr>
</tbody>
</table>

Where:
- $V_P$ = Peak Voltage
- $V_{PP}$ = Peak to Peak Voltage
- $V_{AVG}$ = Average Voltage
- $V_{RMS}$ = RMS (root mean square) Voltage
- $I_P$ = Peak Current
- $I_{PP}$ = Peak to Peak Current
- $I_{RMS}$ = RMS (root mean square) Current
- $I_{AVG}$ = Average Current

**Frequency & Time**

<table>
<thead>
<tr>
<th>Equation</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$F$</td>
<td>$(\frac{1}{T})$</td>
</tr>
<tr>
<td>$T$</td>
<td>$(\frac{1}{F})$</td>
</tr>
</tbody>
</table>

Duty Cycle: The ratio of “on” time to “off” time of the semiconductor switch (in PWM systems) or clock signal.

<table>
<thead>
<tr>
<th>Duty Cycle</th>
<th>Calculation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duty Cycle</td>
<td>$= \left(\frac{\text{Pulse Width}}{\text{Cycle Time}}\right) \times 100$</td>
</tr>
</tbody>
</table>

Where:
- $F$ = Frequency
- $T$ = Time

### Reactance

- $X_C = \left(\frac{1}{2\pi F C}\right)$
- $X_L = 2\pi F L$

Where:
- $X_C$ = Reactance, in ohms, of a capacitance
- $X_L$ = Reactance, in ohms, of an inductance
- $F$ = Frequency in Hertz
- $C$ = Capacitance in Farads
- $L$ = Inductance in Henrys

### Decibel

**Decibel (dB):** A decibel (dB) is the fundamental measurement unit used in EMI measurements.

<table>
<thead>
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<tr>
<td>dB</td>
<td>$10 \log_{10} \left(\frac{P_{OUT}}{P_{IN}}\right)$</td>
</tr>
<tr>
<td>dB</td>
<td>$20 \log_{10} \left(\frac{V_{OUT}}{V_{IN}}\right)$</td>
</tr>
<tr>
<td>PR</td>
<td>$10 (\text{dB/10})$</td>
</tr>
<tr>
<td>VR</td>
<td>$10 (\text{dB/20})$</td>
</tr>
</tbody>
</table>

Where:
- $P_{OUT}$ = Output Power
- $P_{IN}$ = Input Power
- $V_{OUT}$ = Output Voltage
- $V_{IN}$ = Input Voltage
- PR = Power Ratio
- VR = Voltage Ratio (Current ratio is the same)
Power Supplies in the industry.

Features include:
- A wide selection of models and low cost.
- A variety of low cost standard AC/DC and DC/DC converters. These units offer many high performance features including:
  - 30W Output Power
  - 2:1 Input Range
  - Standard Pin-Outs
  - Single/Dual Outputs
  - Lowest Cost

AC/DC Power Supplies! MPD offers a full line of enclosed & open frame AC/DC power supplies. Ranging from 10W to 300W, these compact supplies meet international standards while offering a wide selection of models and low cost. Features include:
- 10W to 300W
- Universal AC Input
- Meet EN60950
- Compact Size
- Low Cost

B300ERW! 30W in 1” x 2” Case MPD offers a wide variety of low cost standard DC/DC converters. These units offer many high performance features including:
- 30W Output Power
- 2:1 Input
- 1” x 2” x 0.4” Case
- 1.5 kV I/O Isolation
- RoHS Compliant
- Meet EN60950
- Industry Standard Pin-Outs

MPD offers one of the widest selections of standard AC/DC and DC/DC power supplies in the industry. All are offered at the lowest cost possible.

See Us On The WEB!!

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### Specifications

#### Efficiency

Efficiency (η): The ratio of total output power to input power. Typically expressed as a percentage, efficiency is derived by the equation:

\[
\eta = \frac{P_{\text{OUT}}}{P_{\text{IN}}} \times 100
\]

Where:
- \( P_{\text{OUT}} \) = Output Power
- \( P_{\text{IN}} \) = Input Power

#### Power

Average Power: In an ac circuit, the average value of ac power. For resistive circuits, this equals the square of the rms current times the circuit resistance, as given by:

\[
P_A = (I_{\text{RMS}})^2R
\]

Where:
- \( I_{\text{RMS}} \) = rms value of the circuit current
- \( R \) = Circuit resistance in ohms

True Power: The actual power consumed by an ac circuit. It is given by:

\[
P_T = V_{\text{RMS}} \times I_{\text{RMS}} \cos(\phi)
\]

Where:
- \( I_{\text{RMS}} \) = rms value of the circuit current
- \( V_{\text{RMS}} \) = rms value of the circuit voltage

Power Factor: For an ac input power supply, the ratio of true input power to apparent input power.

\[
PF = \cos(\phi)
\]

\[
PF = \left( \frac{P_T}{P_{\text{App}}} \right)
\]

#### Thermal

Internal Power Dissipation: Power dissipated as heat within the power supply during normal operation.

\[
P_D = \frac{P_{\text{IN}} \times P_{\text{OUT}}}{\eta}
\]

Where:
- \( P_D \) = Internal power dissipated
- \( P_{\text{IN}} \) = Input Power
- \( P_{\text{OUT}} \) = Output Power
- \( \eta \) = Efficiency

---

### Power Equations

**Thermal Resistance:** \( \theta \) A measure of the opposition a material will have to the flow of heat. Used to calculate the temperature drop that occurs when power flows through a material or across the junction of two materials.

\[
\theta (^\circ C/W) = \frac{L}{K \cdot A}
\]

Where:
- \( L \) = Length of material
- \( K \) = Thermal conductivity of material
- \( A \) = Cross sectional area of material
- \( \Delta T \) = Temp drop across material
- \( P_D \) = Power flowing through material

**Line Regulation:**

\[
\text{Line Regulation} (%) = \left( \frac{V_{\text{L, \Delta}}}{V_{\text{IN, \Delta}}} \right) \times 100
\]

Where:
- \( V_{\text{L, \Delta}} \) = Load Voltage
- \( V_{\text{IN, \Delta}} \) = Input Voltage (Line)

**Load Regulation:**

\[
\text{Load Regulation} (%) = \left( \frac{\text{NLV}_{\text{OUT}} - \text{FLV}_{\text{OUT}}}{\text{FLV}_{\text{OUT}}} \right) \times 100
\]

Where:
- \( \text{NLV}_{\text{OUT}} \) = Load Voltage @ No Load
- \( \text{FLV}_{\text{OUT}} \) = Load Voltage @ Full Load

### Conversion Factors

Common Conversions

- LFM = CFM / Area
- CFM = Area x LFM
- °C = °F - 32
- °F = 1.8 x °C + 32
- °K = °F + 459.67
- °K = °C + 273.15
- 1 Inch = 25.4 mm
- 1 mm = 0.03937 Inches
- 1 m = 39.7 Inches
- 1 Ampere-Hour = 3,600 Coulombs
- 1 IB = 453.4924 Grams
- 1 Ounce = 28.3495 Grams
- 1 Gram = 0.0357 Ounces
- 1 kGram = 2.205 Pounds
- 1 Pound = 0.4523 kgrams
- 1 Watt = 1 Joule/Second
- 1 BTU/Sec = 1.054.8 Joules/Sec
- 1 Joule = 0.000948 BTU