POWER (WATTS)

Power = **Current** x **Voltage**
(Watts) (Amps) (Volts)

P = I x V

Where: V = Volts, I = Amps
P = Power
This formula is used in many situations, from calculating the wattage of a resistor, to working out if an appliance will overload a particular power source.

A useful variation of this formula is :-
$P = I^2 \times R$

AC CURRENT

With AC (Alternating Current), the voltage swings from positive to negative generally in the shape of a sine wave. One reason AC is used in 240V sockets is that it is easily transformed to higher values. This allows the transmission of large amounts of power at low currents, reducing both the size of the conductors required and the losses experienced.

REACTANCE

Capacitors and inductors have the property known as reactance which is the property that opposes any *change* in the current flow. It therefore most commonly applies to AC. Inductive reactance increases with frequency and capacitive reactance decreases with frequency. When reactance is combined with resistance a new property known as impedance is formed, which is similar to DC resistance, except it has an associate phase angle, due to its reactive component.

Capacitive reactance is calculated as follows:-

$$X_C = \frac{1}{2.\pi.f.C}$$

Inductive reactance is calculated as follows :-

$$X_L = 2.\pi.f.L$$

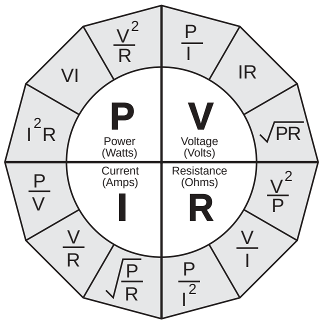
Where:

XC = Capacitive impedance in ohms
XL = Inductive impedance in ohms
C = Capacitance in farads
L = Inductance in henries
f = Frequency in hertz

The formula below will calculate the total impedance of a resistor in series with a reactive component.
Where:

Z = Complex impedance in ohms
X = Reactance
R = Resistance of the series resistor

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



FORMULA WHEEL

Using this formula wheel it is possible to calculate power, volts, amps or resistance for a given problem. ie. if you have two of the variables, for example power and volts, it is possible to find the amps in a circuit. This wheel expresses volts as V, however, if you are studying old text books, you may see volts shown as E.

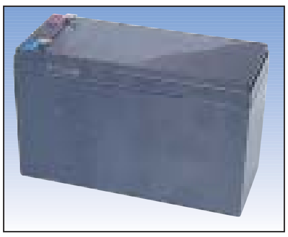
RMS VOLTAGE EQUIVALENTS

For a given AC voltage, the RMS equivalent will be the same as the DC voltage that gives the same heating effect as the AC voltage in question. Take note that the quantity Vp is the value from the zero crossing of the waveform to the peak, not from the negative peak to the positive peak.

$$V_{RMS}\text{ (Sine)} = VP / \sqrt{2} = VP \times 0.707$$
$$V_{RMS}\text{ (Triangle)} = VP \times 0.577$$

The RMS value of a square waveform is equal to its peak value, as the magnitude of a square wave remains constant over the half-period. (Assuming a 50% duty cycle)

TRICKLE CHARGING SLA BATTERIES



$$\text{Charge Current} = \frac{C}{10}$$

C = AH capacity of battery
AH = Current draw x total time
Use the formula above to calculate the required current to trickle charge a SLA battery. This formula is based on a charge time of approximately 14 hours. ie. a 7.5Ah battery should be charged at 750mA. The maximum charging rate for a SLA is usually no more than C/5. ie 7.5/5 = 1500mA. (if not connected in circuit). SLA batteries should not be discharged below 11V. Discharging below this will increase the internal resistance due to lead sulphate on the plates. This can lead to permanent damage.

ELECTRICAL MEASUREMENT DEFINITIONS

QUANTITY	NAME	DEFINITION
frequency	hertz(Hz)	1/s
force	newton (N)	$kg.m/s^2$
pressure	pascal (Pa)	$N/m^2=kg/m.s^2$
energy, work	joule (J)	$N.m=kg.m^2/s^2$
power	watt (W)	$J/s=kg.m^2/s^3$
electric charge	coulomb (C)	A.s
voltage	volt (V)	$W/A=kg.m^2/A.s^3$
capacitance	farad (F)	$C/V=A^2.s^4/kg.m^2$
inductance	henry (H)	$W/A=kg.m^2/A^2.s^2$
resistance	ohm (Ω)	$V/A=kg.m^2A^2.s^3$
conductance	siemens (S)	$A/V=A^2.s^3/kg.m^2$
magnetic flux	weber (Wb)	$V.s=kg.m^2/A.s^2$
flux density	tesla (T)	$Wb/m^2=kg/A.s^2$

DECIBELS

The decibel (dB) is not actually a unit of any particular quantity, but rather a dimensionless ratio between two quantities, such as power, voltage, current and acoustic pressure.
Many sensors, for instance the human ear, respond to inputs in a logarithmic fashion. Since the dB compares the logarithms of quantities, it agrees with our perceptive comparisons.
To calculate the ratio, in dB, of two power levels, P1 and P2, the formula is:

dB=10log(P1/P2)

If the quantities are voltages or currents, X1 and X2, the formula becomes:

dB=20log (X1/X2)

If the quantities, X1 and X2, are both measured using the same impedance, their dB ratio will be equal to the dB ratio of their respective powers. If their impedances, Z1 and Z2, are unequal, the dB ratio of their powers can be calculated using:

dB=20log (X1/X2) + 10log (Z2/Z1)

Negative dB values result when P1 (or X1) is less than P2 (or X2), while positive values indicate that P1 (or X1) is greater than P2 (or X2). Although the dB is not an absolute unit, certain absolute quantities using the dB scale have been devised. These include dBuV and dBm. dBuV is a logarithmic expression of a voltage compared to 1uV (microvolt). Thus , 76dBuV is equivalent to 6.31mV.
dBm is an expression of power level compared to 1mW (milliwatt). -20dBm is therefore equivalent to 10uW. Furthermore, because the unit dBm is specifically a measure of power, OdBm represents 775mV in a 600 ohm impedance but 224mV in a 50 ohm impedance.

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