What's Watt

To the beginner in the audio world there is nothing more confusing than the definition of a 'watt'. You do not have to read too many magazine articles or talk to many audio salesman before you realize that there are many types of 'watts' output and that each commercial group quotes the highest numerical 'watt' value which suits their aims. Let's see: there is Peak Music Power, Total Music Power, average power, RMS power, etc. Let's see if we can make some sense from all this!

Power is defined as the rate of doing work and is measured in *watts*. Electrical power can also be defined as the rate at which electrical energy is transformed into other forms of energy (heat, sound, etc).

To measure electrical power (P), the voltage (E) and current (I) must be known. Power is then calculated by the following formula:

$$P = E \text{ x } I$$

Using Ohm's Law, we know that $E = I \text{ x } R$. By substituting this equation in to the formula above, we can also caluclate power by:

$$P = I^2 \text{ x } R \quad \text{and} \quad P = E^2 / R$$

These three power formulas apply to both direct current (DC) and alternating current (AC) circuits. However, during each cycle, an AC voltage (or current) passes through a large range of values from zero to maximum. Therefore, there are three values generally associated with measuring AC voltages and currents.

1. **Peak or Maximum Value.** This is the maximum instantaneous value occurring during one cycle. The peak value is not used as an indication of the effectiveness of an AC waveform because this value occurs at only two instants during each cycle.

   The difference between the peaks of positive and negative values is called the peak-to-peak value. This is twice the peak value.

2. **Effective or RMS Value.** This is the value which produces the same heating effect as a continuous (DC) current of the same amount. An AC current of 10 amps (RMS) has the same heating effect as 10 amps DC.

   The RMS value is the one usually used to express AC voltages and currents. Most measuring instruments are calibrated to read this value.

   For a sine wave,
   Peak Value = 1.414 x RMS Value
   RMS Value = 0.707 Peak Value

3. **Average Value.** The average value is the average of all the instantaneous values of an AC waveform for one half cycle.

   For a sine wave,
   Average Value = 0.637 Peak Value

The following table can be used to convert sinusoidal voltage (or current) from one value to another.

From	To:	RMS	Average	Peak	Peak-to-Peak
			(Multiply by)		
RMS		1.0	0.9	1.414	2.828
Average		1.11	1.0	1.1.57	3.14
Peak		0.707	0.637	1.0	2.0
Peak-to-Peak		0.3535	0.3185	0.5	1.0

As we said before, there are many methods of expressing the power rating of audio amplifiers. The only meaningful one is "RMS power per channel". This gives the EFFECTIVE power rating on a per channel basis. The load value should also be known.

For example: "10 watts RMS per channel into 8 ohms" means that the amplifier is capable of delivering 10 watts of effective (RMS) power into an 8 ohm load, usually speakers.

The other methods of measuring power are usually used to make amplifier specifications appear better than they really are!