Diploma of Audio Production Name________________

Analogue Fundamentals

Module 7

Resistors as components in a circuit (continued)

Topic 1: Power Dissipation in the Circuit.
Topic 2, Power Distribution
Topic 3, Measuring voltages around a circuit.

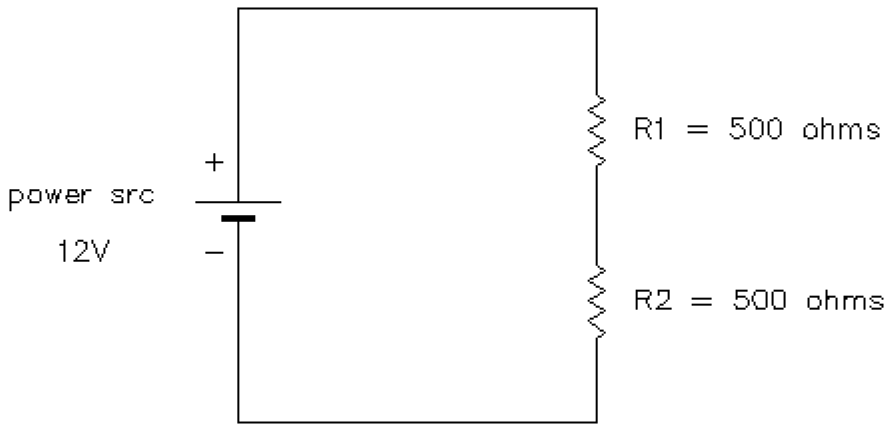
1. Distribution of Power.
2. Methods of determining "voltage drops" or how we measure the voltages around the circuit.
3. Voltage Dividers.

In previous lessons we discovered that the power dissipated in an electrical circuit is the **product** of the **applied voltage** and the **resulting current**.
And the current is proportional to the applied voltage and inversely propoRTional to the circuit resistance..

Lets look at the following: $\mathbf{R^{Total}}$ will be $\mathbf{R^1 + R^2}$ = 1000Ω

Proving I =V/R
= 12/ 1000
= 0.012 Amps or 12 milliamps.

So the power dissipation will be: Power(Watts) = 12V x 0.012A
= 0.144 Watts



Topic 2, Power Distribution

How much power is each resistor dissipating then?

To find this out we will need to determine the voltage across each resistor and using the common current we simply find the product of the resistor voltage and the current.

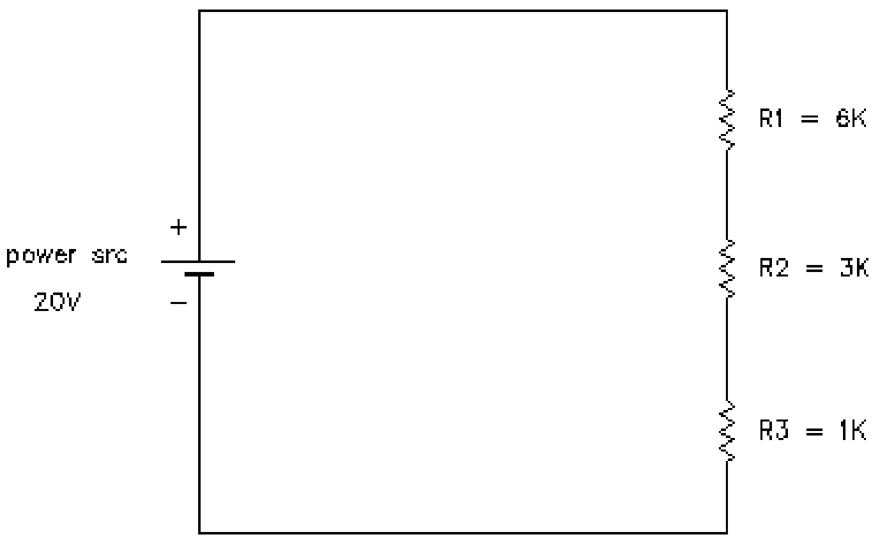
Because I = V/R and ∴V = IR, Volts across R1 & R2 = 500 x .144 which = 6V.

ie. Power resistor 1 = I circuit x Voltage R1(VR1)
= 0.012 x 6 volts
= 0.072 Watts (or 72 milliWatts)

From this we should deduce that if all resistors are the same value then we simply divide the total power by the number of resistors.

ie. $\frac{\text{144 milliWatts}}{2}$ which equals 72 milliWatts

Analyse the circuit below with 3 unequal resistors. Firstly determine the $\mathbf{R_{Total}}$ of the resistors. Then work out the series current through the circuit. The work out the power dissipated in each resistance.



Your predictions:

Total Resistance________________
Circuit Current ________________
Total Power dissipated ___________
Voltage across R1 ________________
Voltage across R2 ________________
Voltage across R3 ________________
Power dissipated by R1 ___________
Power dissipated by R2 ___________
Power dissipated by R3 ___________

Again some space for you calculations.

Important Observation..

So what have we discovered in a multi-resistor **series** circuit regarding individual power dissipations.
If you said that the highest value resistor has the highest power dissipation you are absolutely 100% correct..
Also the sum of the individual power dissipations equals the total power dissipated for the circuit.

ie. $P_{Total} = P_{R1} + P_{R2} + P_{R3}$ etc.

The **Ratio Method** of determining individual voltage drops around a series circuit.

As the current is the same through all resistors then the voltage developed across or dropped across each resistor only depends on their individual values as a fraction of the total resistance times the power supply voltage. The voltage drop over any resistance in a series circuit is exactly proportional to the amount of resistance.

eg. in our previous circuit we can find VR1 as follows:

$$VR_1 = \frac{R_1 \times Vs}{R_T}$$

Where Vs is the supply or applied voltage RT is the total resistance and R1 is the value of R1. This can also be expressed in a general formula as such:

$$VRx = Vin \times \frac{Rx}{Rtotal}$$

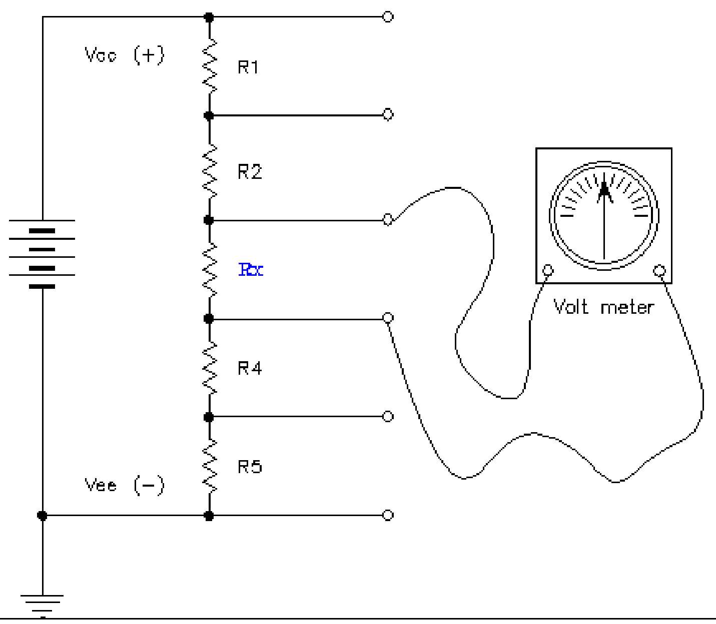
… where R_X is the resistance we are interested in and **Rtotal** (R_T) is the total of the series resistance of the circuit. On the next page, is a working through of ohms Law proving this formula to be correct.

We can show how this formula is ***true*** as follows:

Ohms Law states that:

$$I = \frac{V}{R}$$ which transposes to:

$$V = I \times R$$



Therefore the voltage over $\mathbf{V_{RX} = R^{X}.I^{cct}}$ (Ohms Law), where $\mathbf{R_X}$ is the "resistance of interest", and I^{cct} is the series current.

Also $\mathbf{I^{cct} = Vin/R_T}$ (Ohms Law again). So we can say that:

$$\mathbf{V_{Rx} = Rx \cdot \frac{V_{in}}{R_T}}$$

And this may be stated as:

$$\mathbf{V_{Rx} = V_{in} \cdot \frac{Rx}{R_T}}$$