

Re: Newbie – Current, Voltage, Resistance, Power and Transformer theory

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- *From:* PeteS <peter.smith8380@xxxxxxxxxxxxx>
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Peter Bennett wrote:

On 16 Oct 2006 09:28:23 –0700, "hdjim69" <hdjim69@xxxxxxxxxxxxx> wrote:

I'm just starting the section on AC and the book is explaining why we (homes and industry) use AC instead of DC and the use of transformers. Now, the books says the reason we use AC is to minimize power loss. That homes and industry need a lot of current and if we were using DC we'd need to push a huge amount of current through the transmission lines and the higher the current the more we'd lose in heat loss. OK fine. But now let's see what happens in AC. Rather than pushing a huge amount of current we have a very high voltage say 200,000 to 600,000 volts and a low amount of amps (current). But how can we have this HUGE amount of "pressure" (the typical explanation of what voltage is) and hardly any current ? I've been reading that voltage and current are proportional – the more voltage the more current. Ahh... but this isn't the case really since current is a variable value. It depends on the amount of resistance. So getting back to the transmission lines, if we have HIGH voltage and LOW current then resistance MUST be high. $E = I * R$ that is, if I is low R must be high to get a high value of E. And resistance is what cause heat which causes power loss. So how can we have low current + low resistance = high voltage ?

The Power company is delivering Power to us, and power is voltage times current. So, to deliver a given power, a higher voltage will permit a lower current.

Power is lost in the transmission lines due to resistance in the wires – that power is sometimes called "I squared R loss" since power may be calculated from I^2/R .

I think the OP is hung up on this:

<It depends on the amount of resistance. So getting back to the transmission lines, if we have HIGH voltage and LOW current then resistance MUST be high>

Not at all.

We provide a high voltage so the current will be *relatively* low. The actual resistance is the parallel addition of the loads (ignoring reactive effects for now) plus the resistance of the cable.

So the current becomes $I = V/R$ (or more properly in this case $I = E/R$ but that's another discussion....) where V is the source EMF and R is the effective load.

As others have noted, for a given load, a higher voltage means a lower current which leads to lower power losses (copper loss).

As the load gets heavier (higher current) then we get larger losses, of course. By making the source EMF *very high* the current is still low enough *at this point in the power delivery system* to keep power losses at a reasonable level.

Before we get to the plant/house/trailer/bar the voltage is transformed to <some national standard> of 110V – 240V (RMS). That lower voltage is suitable for consumer (and industrial) equipment and the power loss within a house (for example) at 110V (again, for example) is negligible [unless you are running lots of lamps for some interesting recreational drugs, of course].

Anyway, your hangup point – 'there's high voltage for low current so it must have been high resistance' is mistaken; we know there is a certain power load, so we raise the voltage *in the transmission system* such that the energy can actually be successfully transferred, whatever the load provided it is within the spec range.

Cheers

PeteS

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