eSubnet Fragment Article

Electricity Primer

Prior to my networking career and the launch of eSubnet, I worked as a electrician. In this treatise, I'm going to discuss one of the other really important wires commonly found in data centres; the power cord. Depending upon your location you are provided different kinds of AC electricity for your data centre. Over the years I have been asked so many times about the differences in electrical sources, so here you go. I am only going to discuss voltages that you typically find in use in a data centre.

By now you may have an odd look on your face because I mentioned that there are "kinds of AC electricity" and you probably assumed we have only one. Well, the two kinds in common use in data centers are: single-phase and 3-phase. The difference between them is the number of degrees which separate the individual peaks and valleys in the sine waves of each of the voltages. For single phase it is 180° and for 3-phase it is 120°.

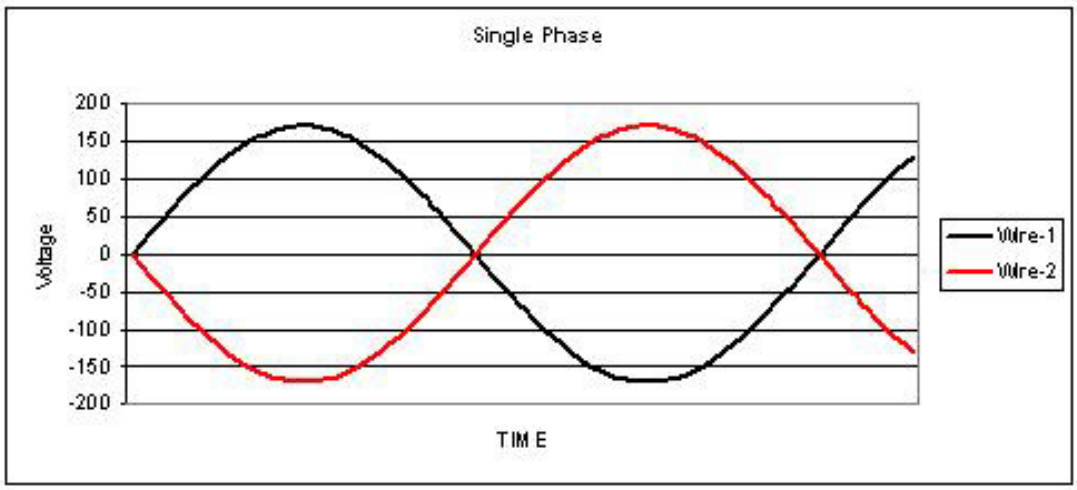
For the rest of this article I'll need you to think back to your early classes in physics and math, and I'll assist you with a quick refresher on electricity.

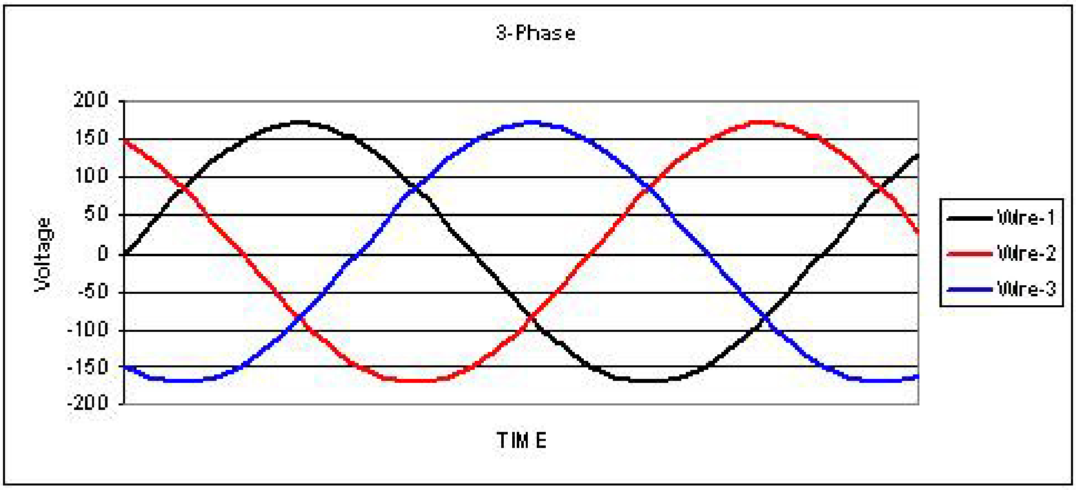
Simple Facts about Electricity

- Electricity is generated as either Alternating Current (AC) or Direct Current (DC)
- AC is delivered in a sine wave pattern with the resulting nominal voltage being lower then the peak voltage.
- Any material through which electricity flows is a conductor.
- Any material which impedes the flow of electricity is a resistor.
- Electricity is the result of moving a conductor through a magnetic field.
- When electricity flows through a conductor it generates a magnetic field.
- Anything that consumes electricity is called a load.
- Volts are the push that moves electrical current through a conductor.
- Amperage or Amp is the rate or intensity of electric flow through a conductor.
- We buy electricity by consumption measured in kilowatts / hour.
- A kilowatt is 1000 watts, not 1024 watts.
- A single watt is equal to 1 volt-amp which is calculated by multiplying 1 volt x 1 amp.
- A load of 100 watts will use half the amps if the voltage is doubled. Or twice the amps if the voltage is halved
- Electricity flows in a loop. We receive electricity via a wire and use the earth to complete the loop to the generating station. Inside the building the neutral wire is part of the return path.
- Electricity is deadly and humans, who consist of roughly 60% water, make great conductors, so it behooves you to treat it with respect.

How Electricity works.

Looking at the two graphs below, we can see how AC has a sine wave form. This applies to both voltage and amperage. Electrical power is available when the sine wave is not at the midpoint or 0 on the graph.





Understanding Electrical Power

Single Phase Voltages

[illegible]

than 0, twice, or for 1/30th of a second. All of this momentary change in power results in a nominal value of 120 volts. This is the simple explanation. The more complex explanation deals with the root mean square of the curve.

3-Phase Voltages

3-phase voltage works with the same combination or conductor to neutral and conductor to conductor voltages. But, in this case due to the 120O separation between the waves the end result is 120/208V.

Here is the formula for those who are really into math.

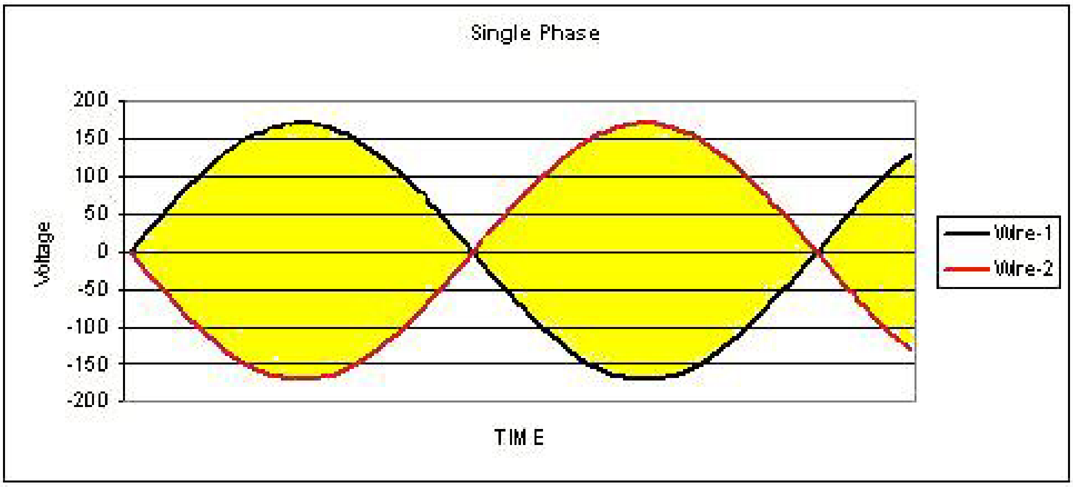
Root Mean Squared Voltage for a cosine waveform.

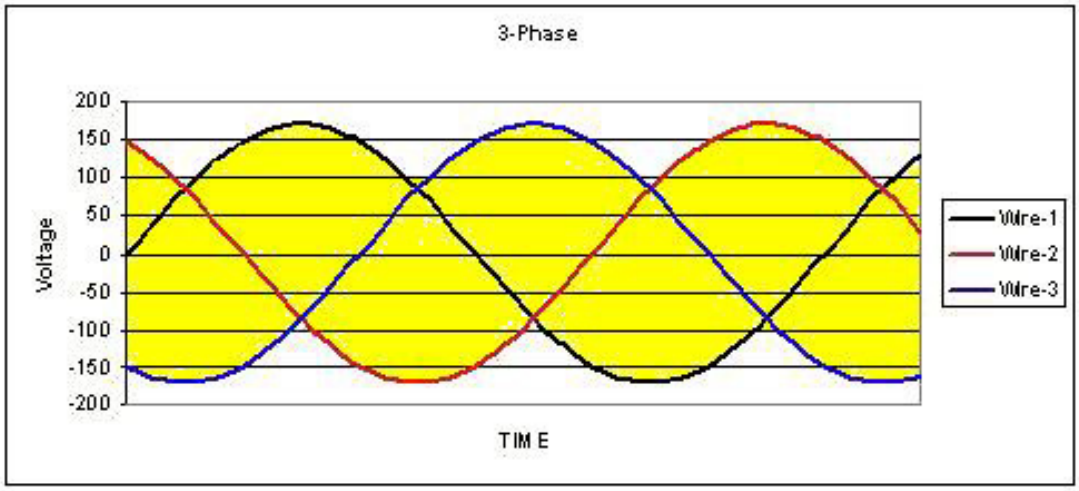
Other Volt Values

Office towers often have an additional voltage: 347V. This is the conductor to neutral voltage, while the conductor to conductor voltage is 600V. 347V is commonly used in lighting. At such a high voltage each fixture draws very few amps. This results in more fixtures being placed on a single breaker. This reduces the installation costs as smaller electrical panels can be deployed.

Why is 3-Phase Better?

The easiest way to demonstrate this is to fill in the areas inside the curve, as shown below:





As you can see in the graphs above, 3-Phase has a greater volume between the curves. , It more efficiently delivers a more constant 'push' over single phase.

Conclusion

Now that you are better informed on the electricity in your data centre you can better understand why some devices such as workstation computers and monitors are 120v, and why your UPS is 208v. You should also be able to see why changing from 120v to 208v or 240v in your data center will not save money on your hydro bill. Volts X Amps = Watts.

Simplified - Amps dictate the size of the wire, Volts dictate the amount of insulation required and you are billed by consumption (the watts).

Originally published OCT, 2009

About the Author

Richard Danielli is the founder and President of eSubnet Enterprises. He has broad expertise in the fields of networking and data security. Based in Toronto, eSubnet provides superior customized solutions for networking and data security. Additional articles are available at http://www.esubnet.com/fragment.html.

Reprints

1. Commercial use: Commercial newspapers, magazines and websites that wish to reprint an article should contact eSubnet for permission.
2. Non-Commercial use: Any reproduction of content (excerpt or full text) by nonprofit organizations or companies wishing to share information with their members or clients requires that you notify us, whether for print or online usage.

Regarding reprints, contact Mr. Danielli at rdanielli(at)esubnet.com or at (416) 203-1223.