What is supply frequency

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Recently I was thinking about a generator project and realized that is beyond my current understanding of AC power. I have been doing some research since but I am really having a hard time understanding the frequency part of AC power sources. From what I understand the frequency of an AC signal is the number of full +/- voltage cycles in a signal.

To make discussion simpler lets consider an A/C generator that is driven by a constant 1500 RPM. If that generator has has 4 poles this would result in 50 Hz, since there are 6000 magnet switches every minute, which is 3000 full voltage changes a minute which is 50 changes a second.

Now lets assume I have the same sort of generator (size, etc) but it has 12 poles like an usual car alternator, it will produce 150Hz AC power. At this point I am really wondering why any appliance would care. If you consider it within a full second nothing really changes, there is the same amount of time in positive voltage and negative voltage as if it would be running with 50Hz. It just switches three times more often.

Why exactly do A/C appliances care how often the voltage inverts with A/C power sources?

So an induction motor designed to run on 60Hz will run slower on 50Hz. This isn"t usually a problem as this essentially de-rates the motor. On the other hand, running a 50Hz motor on 60Hz might be a problem as the motor can deliver more power than it"s designed for.

Universal motors won"t care.

Appliances that internally convert AC to DC (including home computers and other electronics) won"t care, mostly. Power supplies that support 50Hz need more input capacitance than 60Hz ones.

IT gear power supplies have largely migrated to designs that support all worldwide line voltages and frequencies, so they"re designed specifically to not care. Specifically, they have bigger capacitance rated at higher voltage to accommodate both 50Hz and 230/240V as they are rectified to DC.

Magnetic iron cores are rarely efficient at spanning over a decade or maybe 2 of frequency unless ferrite. So automotive alternators are not as efficient as fixed f types. Eddy current losses tend to increase exponentially with frequency and Z also increases with f until self winding parallel resonance (LC).

200 to 400 Hz magnetics in iron cores have thinner laminates and ferrites also change composition with RF frequency with lower mu and more conductive particles. So the big torroids once used in audio power amps or SMPS are high mu until they start to exceed a certain f.

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Web: https://www.kary.com.pl/contact-us/
Email: energystorage2000@gmail.com
WhatsApp: 8613816583346