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What is the relationship between speed and frequency

Topics: What is relation between frequency and voltage? on General Discussion What is relation between frequency and voltage? and how ...? Generally speaking, they are two unrelated topics which do get combined depending upon the requirements of the particular system under study. For example there are 120/240 volt systems that operate at 25, 50, 60, and 400 Hz in use around the world. The reasons for choosing a particular voltage and frequency pair, as well as voltage and current are related, and those relationships can be readily found in any text on electricity and/or Google. It is like asking "how was the universe made." They are only related in alternating current applications where the frequency is related to how often the voltage changes polarity. Frequency and Voltage are different things. Voltage is defined in basic electric principles (Physics: Mr. Voltaire) as the potential difference that pushes a current in Amperes through a Resistance in Ohms. This Voltage can be a steady value or a repetitive waveform (square wave, sinewave, triangular etc) Frequency is the number of cycles that a voltage waveform repeats itself per seconds. A voltage with 0 frequency in effect is steady at a certain value which is also known as DC voltage. Any other frequency means a voltage will change from 0 volts to a maximum positive value then back to 0 and over to the same maximum but negatively then back to 0, this process is ONE cycle and is a simplistic way of defining AC voltage. So 240V AC 50 Hz, means that the voltage waveform does the above cycle fifty time per second and swings between positive 240Volts and negative 240Volts. Hope this clarifies for you the ideas, I tried to keep it as simple as I could. They are basically completely unrelated. Voltage is an electrical physical quantity, while frequency is a measure of how often something occurs in a given unit of time. Gautam I guess your question is related to the most pure school theory for linear circuits and sin and cos functions in AC systems. However in the variable frequency drive field you can find that motor terminal voltage is a function of the frequency as $V = (Vp/fsys) \times f1$ Where $V =$ Motor terminal starting voltage $Vp =$ Rated Phase Voltage at Motor Teminal $fsys = 50$ or 60 HZ $f1 =$ Starting Frequency. All depends what are u asking. Regards If one imagines very hard there may be a very very distant relation between voltage and frequency under assumption that power factor of load is unity. Now power. P. Will be a function of frequency ie. P will vary as f. Again power P. Will vary as square of voltage so for a fixed power P we can establish a relation between voltage and frequency for unity pf load.. Looks too much theoretical? Umesh: Yes, that is definitely too theoretical, and incorrect, too. Only if we assume a lot of unmentioned circumstances, can we get anywhere near what you stated There is a relationship but it entails some theory which should be looked up in standard text books. Some of us may have forgotten the details. Aan attempted to show that relationship with the formula of Voltage as it relates frequency,flux and number of turns but he wasn't very sure.I think the right relationship is $V=4.44fN\phi$ (phi). Gautam you can do more research with the formula above, I am sure you will find the answer.Please give us update when you are through.Good luck. That relation depends on some given magnetic flux, so it is not an independent relationship. We could contrive a whole lot of other "relationships" if we go down that path; such as rotational speed of a generator, and many others, but we still need to assume some specific value of some other parameters, so we do not have any "pure" relationship between f and U. Relation between voltage and frequency only happen in source generator system. e.g frequency will affect the voltage made by generator, if generator accept full load or drop voltage then frequency will affect 5% from 50hz/60hz. Hi Ole, I appreciate your comments (which are quite judgmental !) on what I wrote. I will recommend reference ; Power System Stability By Kimbark . which deals with various aspects on frequency voltage and active power. The relationship between frequency and power is generally called as system inertia , which defines change in system MW per cycles /second. (This parameter is very important for setting Load frequency control relay which are used for islanded mode of system operation .) Second thing I wrote was about relation ship between Voltage and Power at unity power factor . Controlling of P is achieved by voltage control. It is called as Peak Shaving , wherein power purchase is controlled by controlling Voltage to avoid unscheduled interchange of energy at higher tariff. @Gautam , You have raised a very basic question form the System stability Point of View, You may explore further related topics ie Voltage Instability to develop better insight (without feeling least embarrassed by the responses from the group.) Relationships in simple terms are as follows; Voltage $\propto$ Magnetic flux and Frequency $\propto$ Speed. there is no relationship between voltage and frequency. this simple connectivity will why they are not. Interestingly, there seem to have been two view points in the discussion: - V, f as purely physical units - and yes, no connection there. (DC- Battery: no freq., but DC-voltage ; electromagnetic wave: freq, but no voltage) - V, f dependencies at a synchronous generator - as a clever device to produce AC. Yes, there is some artificial interdependency conjured by man and how the grid is operated (AVR, AGC etc). For generators, and large distribution systems, frequency movement is often the first warning of a under voltage, fault etc some where on the system. You have asked a simple question, you will not get a 1 paragraph answer here in linkedIn, but we will try. You need to expand on why you ask the question, what context for answers to be more specific. We don't know if you are doing school homework or have a 200 MW gen set becoming unstable. Agreed that physical relationship between voltage and frequency seems obscure when potential difference.frequency are considered in their simplest terms. However,the question is "what is the relationship...". This leaves us with 3 outstanding responses viz. 1.No relationship 2.Directly related 3. Indirectly related. Having said this, I believe Voltage is indirectly related to frequency when you consider machines(generators,transformers,motors) that make use of flux,speed,and turns of conductors. From my earlier comment, for a given capacity,if you reduce frequency and other parameters being constant,you will get a change in voltage and that's where the relationship as I conceive it comes in. In other words both are directly proportional to speed of the armature and indirectly related not proportional to each other due to AVR's and AG's Controller. $S=P+Q$. Frequency has no direct relationship with Voltage. However, a vary in frequency can effect P (Watt). That's why to increase a Generator's Watt for example, we increase the flow rate --> speed --> $N = 120F/P$. A vary in Voltage, can effect Q (Var). That's why in Power Plant's, among the ways to vary the Var is by playing around with the Generator Transformer Tap Changer (increase or decrease Voltage). Therefore, even though F has no relationship with V, But because F is related to P while V is related to Q, and $S=P+Q$, then should we say F is related to V or not? @Umesh, Thank you, I very much appreciate your point of view. What my comments were aimed at, was that most (if not all) the replies in this thread assume that we are discussing the relationship between frequency and voltage in some given system. But since there is no such system mentioned in the original post, we can vary the U/F relationship freely, by simply changing some other constant in that system. You are obviously correct in the inertia considerations, but again, that applies to a given system. Maybe my comment was a little too harsh and direct, but that would mostly be because I have seen so many other postings from you, that were direct to the point, and very correct. I have mostly worked in the the other areas of the industry from what you are in (Power Generation, and larger power installations in mining applications), so I have fortunately not had to be concerned with the inertia aspect in power distribution, except what I have been able to handle by simple load shedding of non-essential loads.. Voltage will either be Alternative or Direct. An alternating sinusoidal voltage will be in simple terms be considered as one which is from zero to its maximum positive value then drops down though zero to negative maximum value,the occurrence of this positive,zero negative zero action is observed in a seconds which is the Frequency.So when they say the frequency is 50 Hz,it means this particular voltage supply will under go -ve,zero, -ve zero 50 time in a second.Your bulb will brink off 50 time but you can not notice until you use an oscilloscope. In Direct voltage as from a battery,we usually say the frequency is Zero but it can be in positive maximum or negative maximum. Basically, Voltage Frequency relation will give you a clue of the kind of supply devise to use. There is no direct relationship between Voltage and frequency. Any voltage like 110 V,220, 400 V can be generated at one frequency e.g 50 Hz , or any other frequencies. It is the mechanical construction of; windings of Alternator and the rotational speed that result in yielding certain frequency.However in waveform generators and other laboratory instruments, the frequency is varied by changing the values of Capacitances (variable capacitors or adding stages by switching) , and than the output is amplified to raise the amplitude of waveform i.e Voltage level of waveform at desired level (which is limited to the scope and size of instrument.) i need more explanation-like i want to touch a wire connected to electricity source without getting a shock-my home current is 220v and 60H-if i make frequency 100H can i touch the wire-or i should change the voltage OP if question asked was in reference to mains or any form of ac voltage then Instantaneous voltage $V = \sin(\text{degree}) \times V_{\text{peak}}$. Hey, there is in fact a very useful connection between voltage and frequency, though not the one you are looking for. While not connected with "math"; pardon me there cause that's a half truth I am glossing over, there is a connection in mems design. When you use any IC core, you must choose an operating frequency, and lowering the frequency to drop the operating voltage is a common practice known as DVFS. I am really surprised at how the basic question got off to all different directions by so many answers. including "the two are not related at all" by many. Wrong!!!! Voltage is directly related to frequency, and students of Physics will find that in chapters of electriclity. It has been many decades since I studied Physics, so my recollection may be rusty in precision details, but the formula is like this: - E (Voltage) equals 2 times pie, times magnetic flux, times frequency, times number of turns in the electromagnetic coil. Pie here is the universal constant, roughly 22/7. Check it out in a Physics book under electriclity, or electromagnetic induction where they explain how amp-turns, flux and voltage are connected through the frequency. Seriously, i think atleast in case of generator it is $E=4.44*f*N*\phi$ (phi) Voltage and amperage must be related to frequency because both are measured using time. Just think about it in terms of an AC wave. Picture electrons moving back and forth completing an AC sin wave cycle. Now make them move back and forth 100 times faster. The sin wave would look the same provided it has the same amplitude, but would the electrons not have far more energy having moved back and forth 100 times faster in the same time frame? If a higher frequency with the same peak amplitude contains more energy then coincidentally voltage is a measure off energy. It's units are the Joule/Coulomb of charge. Joules are energy! also Current is a measure of Coulombs/second. That is a measure of time! Frequency is also a measure of time. Therefore Frequency, voltage and current are all interrelated. You cant refer to one without the other because when you break it down to there basic units its just different ways of stating gauging time and energy. According to me frequency and voltage are directly proportional. for example as the frequency increases the time period (which is essentially the delay) reduces. Now the delay is given as $t = R*C$, where R = Resistance and C = Capacitance. As the delay reduces the resistance decreases. Now the resistance can be given as $R = 1/k(Vdd-Vt)$, where k = product of mobility and oxide capacitance of a mosfet, $Vdd =$ operating voltage of a mosfet and $Vt =$ threshold voltage of a mosfet. Now as the resistance R decreases Voltage Vdd increases as they are inversely proportional which implies that frequency and voltage are directly proportional The synchronous speed is the speed of the revolution of the magnetic field in the stator winding of the motor. It is the speed at which the electromotive force is produced by the alternating machine. The Synchronous Speed is given by the relation shown below. The above equation (1) shows that the rotor speed N bears a constant relationship with the field poles and the frequency of the generated voltage in the armature winding. A machine that runs at synchronous speed is called a synchronous machine. Thus, an AC machine in which the rotor moved at a speed and built a constant relationship between the frequency of the voltage in the armature winding and the number of poles is called a Synchronous Machine. The table below gives the number of poles and synchronous speeds for a power frequency of 50 hertz. Number of PolesSynchronous Speed NS in r.p.m 23000 41500 61000 8750 10600 12500 Relationship between Speed and Frequency The frequency of the generated voltage depends upon the number of field poles and on the speed at which the field poles are rotated. One complete cycle of voltage is generated in an armature coil when a pair of field poles passes over the coil. Let, P be the total number of field poles, p is the pair of the field poles, N is the speed of the field in revolution per minute (r.p.m), n is the field poles in revolution per second (r.p.s), and f is the frequency of the generated voltage in hertz. As we know, In one revolution of the rotor, an armature coil is cut by P/2 north poles and P/2 south poles. Since one cycle is generated in an armature coil when a pair of field poles passes over the coil. The number of cycles generated by one revolution of the rotor. Will be equal to the number of pairs of poles. i.e., Number of cycles per revolution = p Number of revolutions per second = n Now, the frequency will be, Putting the value of n and p from the equation (2) and (3) in equation (4) we will get The above equation (3) and (5) gives the relationship between the number of poles, speed, and frequency.

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