Faraday's Law, How many windings do your coils need.

Faraday's Law

It's Faraday's Law that you need to employ when trying to determine how big your coil needs to be for a certain voltage from your Alternator / Generator.

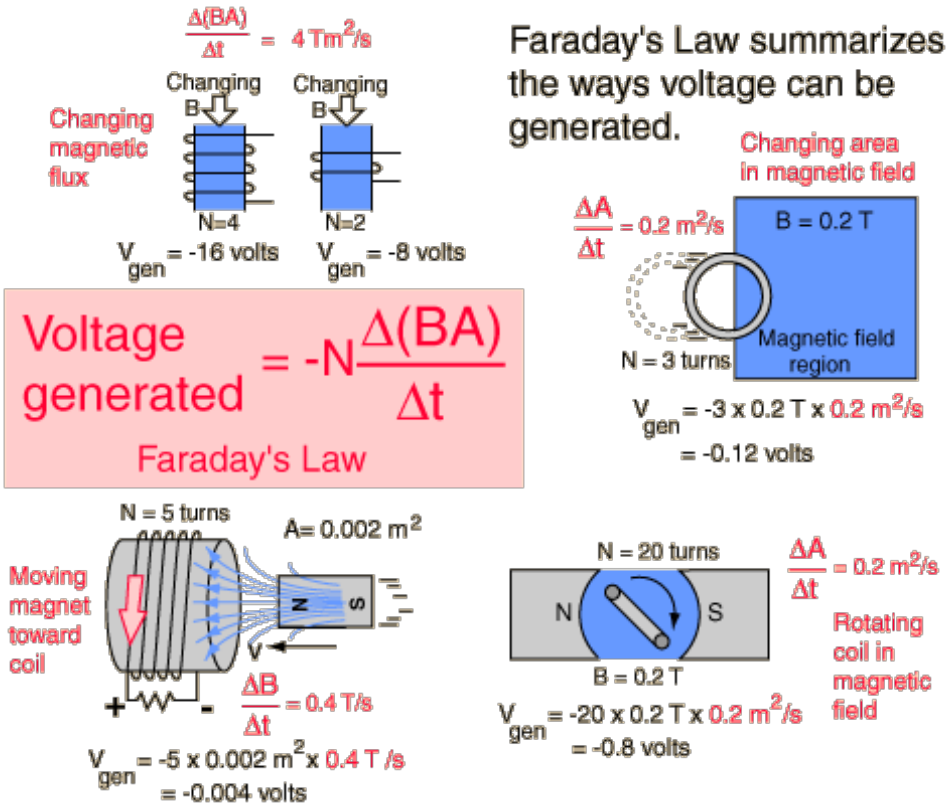
I have found it a common question, how big does my coil need to be. Faraday's Law will answer that question, but you will soon find that getting the data needed for Faraday to answer your question will be very difficult because getting exact numbers will be next to impossible. At most I've found is that you can get a ball park figure. The biggest part of inventing is trial and error. But a ball park figure will cut that down a bit.

Formula for Output of a Coil

In the forums there is a common question, asking how many turns does my coil need to produce X amount of output. That depends on your design, how close your coils are to the magnets, how strong your magnets are, what size of wire your using, and how fast your coils are cutting the magnetic flux. A question not easily answered. You really have to experiment to find what works best for you(The way Thomas Alva Edison did it.). I can tell you this, the higher the RPM's of your alternator the less the number of turns needed there by allowing a heaver gage of wire that can be used giving higher Amperage output.

Or we can do it the way Tesla would do it, and that was with mathematics. The Formula for output is below:

Faraday's Law



V = -N * change in ((tesla * area meters squared)/ seconds)

I use the TI-89 Graphing Calculator for all my calculations which has symbolic manipulation ability.

Lets change this formula so we can use it to determine the number of turns we need for our coil. We know we are going to need around 14 volts to charge 12 volt batteries. We will change the 14 volts to a negative 14 volts to account for Lenz's law.

So with the use of a little algebra we get.

N = -1 * (-V/ change in ((tesla * area meters squared)/ seconds))

Now lets plug in the numbers.

V = 14.

Now lets figure the tesla. You will need to know how much Gauss or tesla you permanent magnet is rated for. This will give you something to work with because each winding will have a distance from the magnet that will determine the gauss or tesla that, that winding will be cutting through. The shape of the magnet plus the design of your coil and what your using to draw the flux through the coil will all determine the average gauss or tesla you will use in this formula.

I have a rare earth magnet rated for 6325 Gauss so I'm going to cut that in half and use the number 3162 Gauss just to get an idea of how many windings I'm going to need to get my 14 volts. I'm cutting this value in half because the 6325 Gauss figure is taken very close to the magnet, the windings of my coil will, on average, be farther from the coil.

10,000 gauss = 1 tesla
3162/10000 = .3162 tesla

Tesla = .3162

Now lets figure the meters squared. My magnet is 2" by 1". So I need to convert meters square to inches square. One square meter is 1,550.0031 inches square. My magnet is 2 inches square.

1,550.0031 = one meter square
2/1,550.0031 = .00129 meters squared (more or less)

Meters squared = .00129

Lets figure 5 turns per second, that gives us 300 RPM. If we do a good blade design we might be able to get 300 RPM in 3 to 5 mile winds.

5 turns per second gives us one turn every .2 seconds
seconds = .2

This gives us the formula

N = -1 * (-14/ ((.3162 * .00129)/ .2))
N = -1 * (-14/(.000407898/.2))
N = -1 * (-14/.00203949)
N = -1 * - 6864.5
N = 6864.5

We get 6864.5 windings we need for our generator to give us 14 volts.

Of course with that many windings we are going to have to lower our estimated value of tesla we have, because with that many windings we are going to have to in crease the average distance the windings are from the magnet, which will mean that we need even more windings. To make this thing work we are going to have to increase the RPM's or the number of magnets.

You will probably have more then one magnet in your design and more then one coil. So this number divided up between a number of coils and magnets can become more manageable.

Magnets and there shapes and Magnetization Direction.
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