# Possible Over-unity DC to DC or AC to DC Transformer

**©Cyril Smith**

## 1. Background

I have several books teaching electromagnetics, but they all omit one of the fundamental force laws of electrodynamics, that is the force on a small magnetic dipole within a non-uniform magnetic field. It is not because the force law is unknown, but maybe the omission was because it had no practical use. Perhaps this omission is the reason the ideas presented here have not been considered in the past. The missing formula will be found in texts dealing with atomic physics, regarding the Stern Gerlach experiment, and is given in the next section.

Electrons are small magnetic dipoles having a dipole moment, hence within a magnetic field they will endure an angular force trying to align the dipole with the local field and a linear force determined by the field gradient. Electrons under consideration here are the conduction electrons within magnetized Fe that become spin-polarised by the magnetization; hence some are already aligned with the field. The Fe has a tapered geometry that acts to concentrate the magnetic flux thus creating a non-uniform magnetic field with gradient in a fixed direction that imposes forces on the electrons. The Fe saturation field value of 1.7 Tesla limits the voltage that can be achieved from this magnetic force to tens of microvolts, hence it requires many flux concentrators in series to create useful voltage values, so this leads to microelectronics devices.

In this paper we describe a microelectronics device that produces DC voltage, either from a DC input or an AC input. It is a transformer that delivers DC output proportional to the input current, and the output is galvanically isolated from the input. Of interest is the fact that loading the DC output to extract power does not reflect onto the input in a meaningful way regarding conservation of energy.

## 2. The missing formula

The magnetic potential energy $W_m$ of a dipole having dipole-moment $\boldsymbol{\mu}$ in a magnetic field of flux density **B** (see Figure 1) is

$$W_m = -\mu B \cos\theta \qquad (1)$$

where $\theta$ is the angle between **B** and $\boldsymbol{\mu}$.

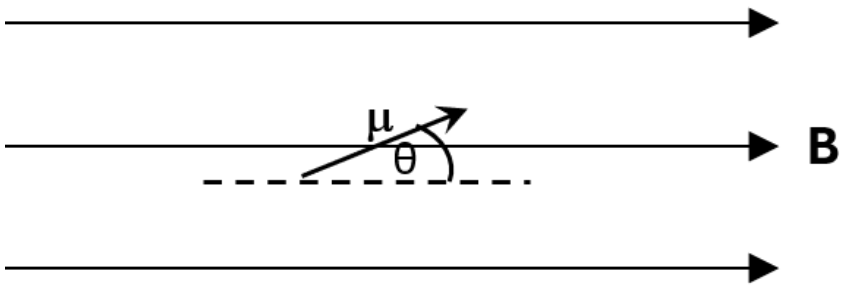



**Figure 1. Magnetic dipole in magnetic field**

The force is obtained by differentiation hence

$$F_x = \mu \cos\theta \ \frac{\partial B}{\partial x} \qquad (2)$$

and similar for the *y* and *z* indices. For θ less than 90° the force pulls the dipole towards the higher field region.

Electron spin gives the electron a magnetic dipole moment $\mu_B$ known as the Bohr magneton of value $9.273\times10^{-24}$ Am$^2$. Thus (2) applied to an electron is equivalent to that of an electric field **E** pointing in the direction of *x* having a magnitude given by

$$E_x = -\left(\frac{\mu_B}{e}\right) \cos\theta \ \frac{\partial B}{\partial x} \qquad (3)$$

(negative because the electron charge is negative). Integrating (3) along the x axis gives the voltage created by this magnetic force. The value of $\left(\frac{\mu_B}{e}\right)$ is 57.88 μV/Tesla.

### 3. Early computer core stores

Figure 2 illustrates early computer data storage using an array of square-loop ring cores where the data is stored magnetically, and the binary aspect is the CW or CCW direction of the field within each core.

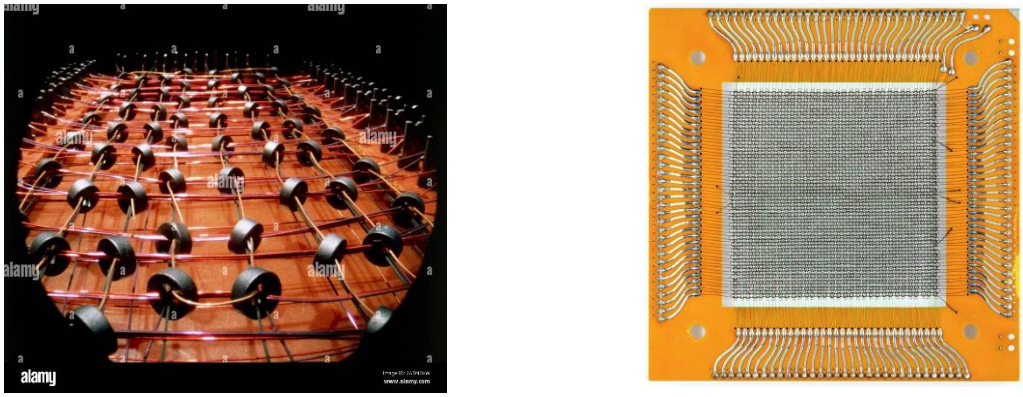


**Figure 2. Early Core Store and Microelectronic Version**

Now consider an array of Fe ring cores that are not square-loop but of linear BH characteristic as in transformers. They are electrically conductive and of asymmetric shape as shown in Figure 3. Unlike the cores in Figure 2 they have a single primary wire passing through all the cores.

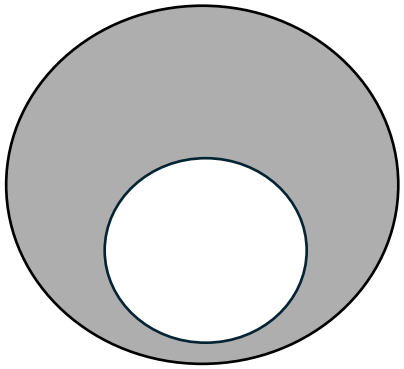


**Figure 3. Asymmetric Ring Core**

The next figure shows an FEMM plot of the field within the core from current in the wire (the orange circle) passing through the core. The flux (Webers) is constant around the core, but the flux density (Tesla) clearly shows significant flux compression. Within Fe the conduction electrons take on a spin polarisation proportional to the magnetization, thus there are more aligned along the field in a direction where they are pulled towards the stronger field than pulled the other way. This results in a non-uniform electron distribution, with the high field strength side having excess electrons and becoming negative, while the low field side has a deficiency and becomes positive. A voltmeter across there would register a potential difference. Reversing the current in the wire leads to the same polarity registered on the voltmeter, thus an alternating current yields an output waveform at twice the input frequency sitting on a DC level like full-wave rectification.

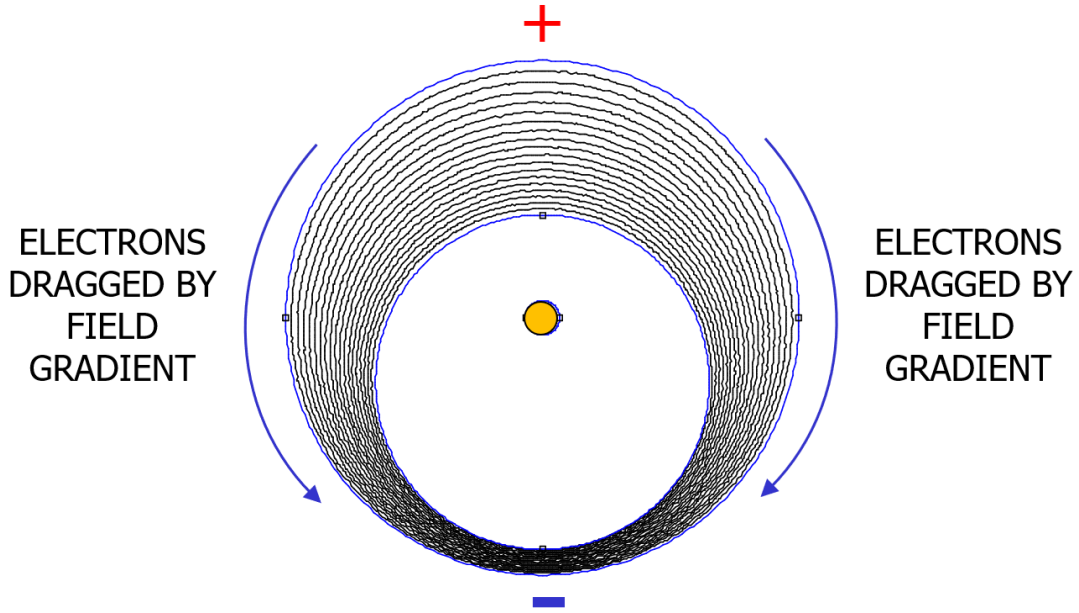



**Figure 4. Showing flux concentration.**

For 100% spin polarisation the voltage developed is 58μV for a 1T difference in flux density. 1T difference is easily achieved in Fe but the variation in spin polarization around the core has been shown to reduce the value to 20μV. A large array with all the voltages in series will produce practical values. Figure 5 shows such an array of just ten ring cores connected in series to provide the DC output, with the primary conductor interleaving all the cores.

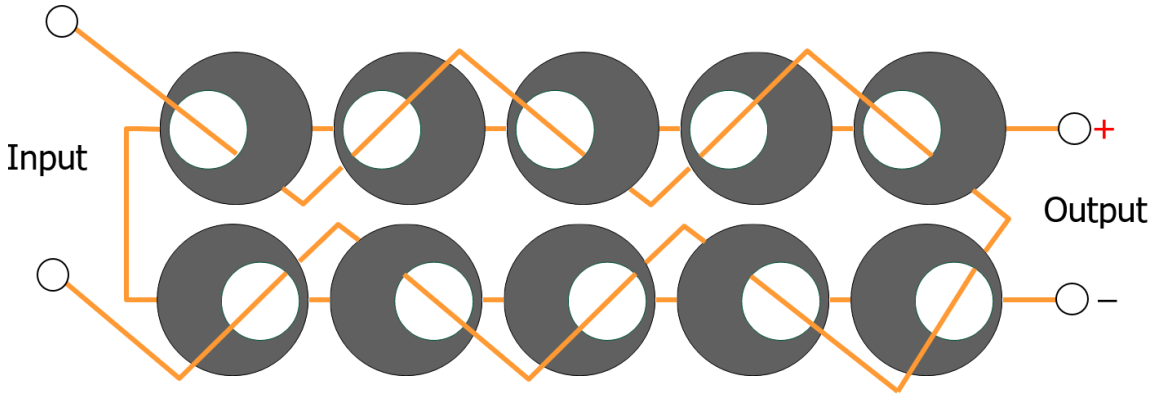



**Figure 5. Array of ring cores**

Figure 6 illustrates such a microelectronic device as a DC-to-DC transformer, a device that is presently considered impossible. It gives DC output voltage proportional to DC input current with galvanic isolation between output and input.

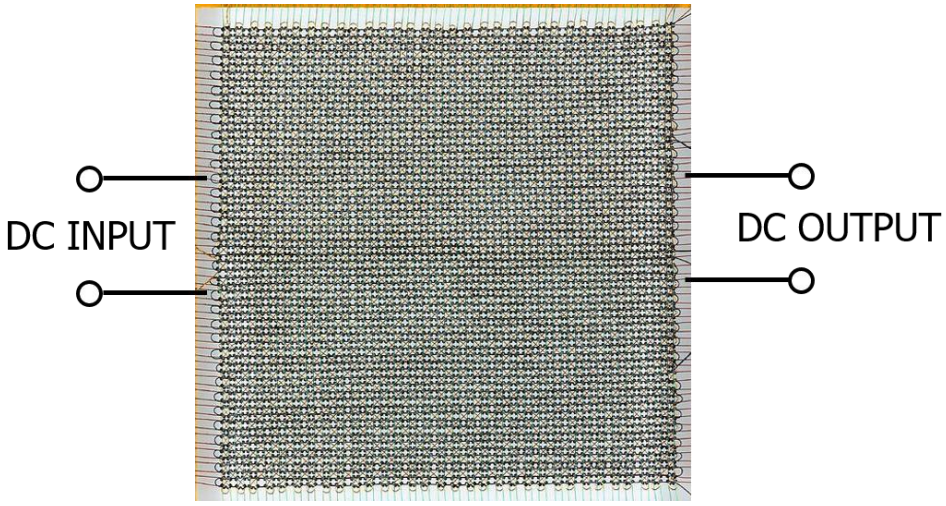



**Figure 6. Microelectronic version**

If the input wire is superconductive, apart from an inductive input energy pulse on application of the input current (the device is a series of inductors) it draws no power while supplying the DC output voltage. If the output connects to a load, DC current flowing within the Fe cores will introduce eddy field that causes the flux lines to spiral, thus reducing each input inductance value. That feeds back some inductive energy at the point of application of the load, but thereafter the input consumes zero power. Yes, the FE has a finite conductivity so that also consumes power and limits the power output, but it appears the system offers free energy, disobeying conservation of energy. Experiments are needed to verify or nullify this observation.

The device can also be run with AC input where the output becomes a waveform at twice the input frequency sitting on a DC level, providing full-wave rectification; it then requires smoothing to operate as a DC source.

## 4. Conclusion

A microelectronic array of special ring cores has been described. This appears to offer a continuous source of electrical power while consuming zero power. Experiments are needed to verify or nullify this observation.