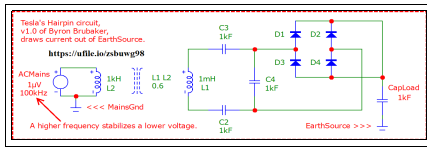


What is a Ground?¹

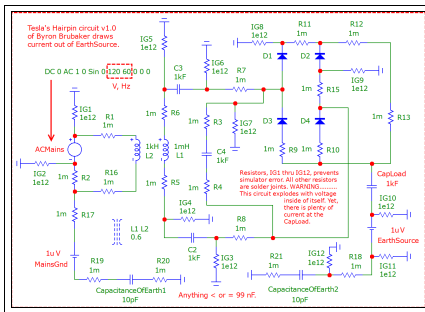


Schematic drawing of a simulation of Byron Brubaker's rendition of Tesla's Hairpin circuit.

But the study of Byron Brubaker's version, 1.0, of Tesla's Hairpin Circuit⁴ prompted me to finally understand these differences.

The ground components in both simulators are unique to each other due to how a referencing ground operates in each simulator.

In Paul Falstad's simulator, a referencing ground is already provided by the software. So, the user does not have to insert one anywhere since that has already been accomplished. The only purpose for the user to insert a ground (in Paul Falstad's simulator) is to act as a source for electronic flow of current. This presupposes that the Earth is a battery of around one microvolt whose amp-hour capacity is vast!



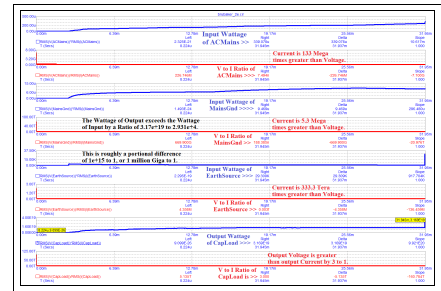
Raw schematic of an older version of a simulation of Byron Brubaker's rendition of Tesla's Hairpin circuit. Notice the complexity of this previous version versus the simplified drawing, up above? Don't build this version; build that one and *safely* play with modifying its parameters.

because that cannot sustain the *transient* (a momentary surge) which this simulation suddenly provokes and quickly dissipates to zero. So, a relatively large capacitive load could retain its charge and a series of switchings could clear these charges to zero by transferring these charges to the actual load that you wish to power and then restart this circuit from another cold start?

All of my capacitors possess 3 Ohms of equivalent series resistance. Both of my coils possess units of resistance equal to their units of inductance to approximate a wire gauge of 25 AWG.

The rate at which over-reactance exhibits overunity is determined by the smallness of the two capacitors, labeled: *CapacitanceOfEarth1* and *CapacitanceOfEarth2*. Although the Earth's capacitance is assumed to be ~711 micro Farads, this does not produce overunity within a reasonable length of time. Or else, it may possibly fail to produce overunity at all. I don't know. I didn't have the patience to wait long

Up until now, I did not understand how a Berkeley SPICE² ground component operates. Nor did I understand its difference from how a ground operates in Paul Falstad's simulator.³

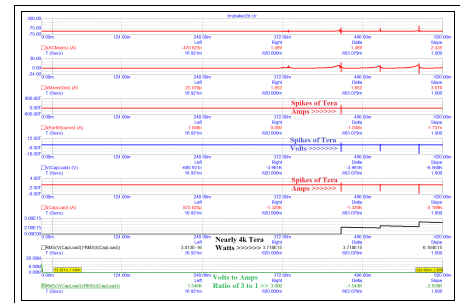


Output of the simulated drawing.

A referencing ground is not provided in the Berkeley SPICE family of simulators, to which Micro-Cap⁵ and LTSPICE⁶ are members. So, this is the only function which a ground represents in these simulators.

If you want to represent anything else, such as what a user-inserted ground would represent in Paul Falstad's simulator, then you have to

insert a micro volt battery in between a ground and your circuit. You will also have to add a low-level capacitor behind the battery. I have labeled these, *CapacitanceOfEarth1* and *CapacitanceOfEarth2*. Between this battery and the circuit, you may position your load. Mine, here, is a capacitive load, labeled: *CapLoad*. It is *not* a resistive load



Output of the older, simulated version of Byron's Hairpin.

¹The ground plane is not merely a zero reference.

²The SPICE Page

³Paul Falstad's electronic simulator

⁴My discussion of Byron's Hairpin Circuit on Quora

⁵Micro-Cap 12 electronic simulator

⁶LTspice – Fast • Free • Unlimited

enough to find out! So, to speed things up a bit, I chose to use values which are less than 100 nano Farads, such as: 99nF or 10pF or 100 femto Farads.

- BTW, one micro volt is the atmospheric voltage at ground level which is enough to power a crystal radio set from the 1920s.
- *ACMains* amperage is the amperage which is being drawn from the utility grid.
- *MainsGnd* is the amperage which enters the circuit from the ground adjacent to the *ACMains*.
- *EarthSource* is the amperage which the Earth is providing free of charge!
- *CapLoad* voltage dominates *CapLoad* amperage by a factor of 3 to 1 due to this component's equivalent series resistance is set to 3 Ohms.
- BTW, if you choose to build either of these simulations, you may want to (somehow) engineer the prevention of their tendency towards exploding, suddenly, with an excessive amount of power rather than allow this circuit to fry itself (or throw shrapnel in all directions).

How much Energy Does it Take to Operate Reactance (also known as Reactive Power)?

Answer ...

It takes an indeterminate quantity of energy to operate reactance. It takes some energy, but the actual required amount may vary or be irrelevant due to the parametric property of certain types of reactance.

But just because the quantity of reactance may not matter does not make it possible to do away with it altogether unless we make up the difference with an unlimited supply of energy (and money to pay for that energy) to operate a non-reactive, or semi-reactive, appliance.

If we make an analogy between energetic water flowing within a reactive medium such as through a conduit (pipe) representing current flowing through a conductor (possessing inductance), then either an infinite amount of time or an infinitely large pipe will single-handedly be capable of conducting an unlimited quantity of water through that pipe.

And, since time is regulated by the frequency of oscillations and also regulates the phase relations between voltage and current, time is another factor of reactance besides capacitance and inductance. Thus, we have four factors to regulate the pumping of energy *against* a gradient of impedance – not by fighting that gradient, but – by effortlessly reversing current under certain conditions.

And, since the size of a pipe can be enlarged, its equivalency of inductance within a conductive medium may also be enlarged to any size desired, to accommodate any quantity of water which is carried within a pipe or any quantity of current within a conductor in any shortness of transit-time.

Think of a heat pump. It pumps water against a gradient of greater heat to increase that heat. Thus, it should (theoretically at least) get harder and harder to pump against an ever-increasing gradient of escalating heat, yes?

That's what happens if we ignore the power of reactance and focus all of our effort upon energetically pumping energy against a gradient, namely: against impedance.

But with the reversal of current, the opposite happens. It gets easier and easier to reactively pump energy against an ever-increasing voltage due to the constant acceleration of pumping action brought about by escalating reactances.

There are four reactances that we may manipulate to achieve these results. They are: mutual inductance, self-inductance, mutual capacitance and self-capacitance.

The mutual varieties of inductance and capacitance are an interesting pair of reactances, for they are inverses of each other. In other words, whenever mutual inductance is high, mutual capacitance is low. And, whenever mutual capacitance is high, mutual inductance is low.

If mutual reactances appear at all (and they, usually, always do), then they always appear together at the same time. They are never capable of entirely excluding each other. It is impossible for a circuit to possess mutual inductance without also possessing mutual capacitance.

In other words, ...

An elevated magnetic coupling will possess an elevated mutual inductance while, at the same time, (it may be inferred that) a depressed mutual capacitance is also taking place. Likewise, whenever a very weak coupling among inductors takes place, mutual capacitance becomes elevated. Since the interactions among inductors is complex, it is an over-simplification to ignore their mutual capacitances varying over time along with variations of their mutual inductances. And it is impossible for mutual reactance to have no impact upon self-reactance. So, the mutuality of reactance guides the outcome of self-reactance.

This is analogous to how messenger RNA can affect the outcome of gene expression despite the physicality of the DNA due to an endless list of factors, not the least of which are: stress, the weather, poor nutrition, lack of sleep, etc.

These two properties of mutual reactance trump the self-referral versions in that, for some uncanny reason, mutual reactance may escalate, or diminish, over time even though self-reactance cannot. Mutual reactances are, thus: parametric.

Go, figure!