Mirrored Symmetric Circuit Simulation in LTSpice. Postulating Phase Conjugate Response. pt. 6



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VINYASI · SEP 24

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Read full story

Quotable quote:

> “Headbutting may be an electrical analogue of conjugate feedback, in which the opposing response is not simply cancellation but participates in generating the state of the following half-cycle.” — AI

This turned out to be an incorrect prognosis on the part of both AI and myself.

Instead, the correct analysis of the anomalous energy appearing in this circuit is that we take a semi-large coil of 10 Henrys and we get it to

store lots of voltage, and very little current, as if it were semi-mocking a capacitor by maintaining a zero voltage of difference between the two terminals of this slightly large coil. So, each nodal voltage (of each of its two terminals) equals each other and is very large and continues to climb towards infinity as the difference between them continues to remain at zero volts. Meanwhile, there's very little accumulation of current within this type of coil behavior since the voltage across this coil remains at zero. The only reason why it exhibits *any current at all* is probably due to the adjacent voltages of the components, nearby, which surround it.

That's weird. *But, that's innovation!*

Actually, that's not weird since we're taking advantage of the largess of this coil, L1, so as to capitalize upon its momentum.

Coils are like mass: their inductance encapsulates the momentum of a comparable object whose mass is set into motion. So, whereas a coil's inductance relates to the mass of an object, the force which propels a mass is comparable to the watts of an analogous coil. The combination of these two factors: mass and force versus inductance and watts, gives the whole picture of how much impact can an object or a coil have.

So, you could call this a partial application of the principle of phase conjugation in as much as the voltage which enters into the two terminals of this semi-large coil are entering it through its two terminals, simultaneously and inversely. But only the voltage is doing this. The current is not.

So, the current ***is not*** phase conjugated within this coil, L1, while its voltage IS phase conjugated producing zero voltage difference across its two terminals plus a residual buildup of current (not much to speak of).

> Phase conjugation hides the accumulation of some parameter or another of energy or of matter, etc. This reduces stress since a phase conjugated parameter has zero net value. You won't even know that it's there unless you alter your perspective.

Thus, my analysis is complete with this sixth post (in this series).

Link to this dialogue.

What I call "headbutting" may be phase conjugation?

https://www.rexresearch1.com/BeardenLibrary/BeardenAIDSBiologicalwarfare.pdf

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Possibly as an analogy, yes—but I would not call what you've been calling "headbutting" phase conjugation yet. There is a very specific feature of phase conjugation that makes your idea interesting, but there are also important differences.

I looked at the Bearden material you linked and related Bearden material. Bearden explicitly describes phase-conjugate systems in terms of a wave and its **phase-conjugate replica**, with the replica retracing the original wave's path; he also describes repeated interaction/pumping between phase-conjugate elements as producing amplification. Bill St. Clair & this.

Where your "headbutting" idea resembles it

Your coupled-inductor situation has something unusually close to the *geometry* of that concept:

$$V_{L3} = L_3\dot{I}_3 + M\dot{I}_5 + R_3 I_3$$

$$V_{L5} = L_5\dot{I}_5 + M\dot{I}_3 + R_5 I_5$$

With your values,

$$L_3 = L_5 = 2H, \qquad M = 1.98H$$

So the inductive matrix is

$$\begin{bmatrix} 2 & 1.98 \\ 1.98 & 2 \end{bmatrix}$$

That has eigenvalues

$$3.98H, \qquad 0.02H$$

The 0.02H mode is the interesting one: it is the **difference mode**, where the self and mutual contributions almost cancel.

That's very much in the spirit of what you've been calling **headbutting**:

$$2\dot{I}_3 \quad \text{against} \quad 1.98\dot{I}_5$$

and vice versa.

We've actually measured this in your simulations. In the earlier K=.99 experiment, those terms were almost perfectly anti-correlated, while their sums became tiny. That is a real mathematical property of your coupled-inductor system, not terminology we've imposed on it.

But here's the crucial distinction

180° opposition is not by itself phase conjugation.

For a sinusoid,

$$x(t) = A\cos(\omega t + \phi)$$

its complex phase conjugate is associated with

$$A^* e^{-j\phi}$$

rather than merely

$$-Ae^{j\phi}$$

And a physical phase-conjugate wave involves reversal of the wave's propagation/wavefront evolution—not merely two circuit quantities having opposite signs. Conventional phase conjugation is produced by a nonlinear process such as four-wave mixing or parametric interaction. Wikipedia

So:

$$\boxed{\text{headbutting} \neq \text{phase conjugation merely because the phases oppose}}$$

But your system has another feature that makes the question much more interesting.

The thing I'd investigate is conjugate feedback

Bearden's description isn't simply "two things are 180° apart."

The important mechanism is:

> a signal encounters a nonlinear medium → a conjugate replica is generated → that replica returns along the signal's previous path → the interaction can be iterated/pumped. Bill St. Clair and this.

Now compare that conceptually with what you've been observing:

$$\boxed{L3 \leftrightarrow L5 \rightarrow \text{near-opposing inductive response} \rightarrow MON \rightarrow \text{state-dependent GDT} \rightarrow L3/L5}$$

That's **feedback involving an opposing response**.

And your particularly interesting observation is that the opposition isn't exact:

$$2H \quad \text{versus} \quad 1.98H$$

So instead of:

$$+1.00 - 1.00 = 0$$

you have something like:

$$+1.00 - 0.99 = +0.01$$

That residual is precisely the sort of thing that, in your "headbutting" picture, **doesn't disappear but becomes the next state of the system.**

That's considerably more interesting than simply saying "the currents are 180° out of phase."

There's another reason I wouldn't dismiss your terminology too quickly

Bearden himself uses **"phase conjugate"** in a broader conceptual framework involving counterpropagating wave pairs and standing structures. His writings explicitly describe pairs that propagate in opposite directions and interact iteratively; he calls the resulting process "ping-ponging" and discusses amplification through repeated phase-conjugate interactions. Eternal Keys and this.

That is quite close to the **"headbutting"** mental picture you've been developing.

However, we shouldn't jump from:

> “these two circuit terms oppose each other”

to:

> “therefore the circuit is phase-conjugating.”

We need an experimental signature that distinguishes the two.

I think we can actually test that in your simulation.

Instead of asking whether

$$I_3 \approx -I_5$$

I’d ask whether the **state generated by one half-cycle is the phase-conjugate of the preceding half-cycle**.

Because you’ve already pointed out that the circuit’s half-cycle duration isn’t constant, we should use its own events as the clock.

For successive extrema t_n, t_{n+1}, construct something like:

$$X_n = \begin{bmatrix} I_3(t_n) \\ I_5(t_n) \\ V_{MON}(t_n) \end{bmatrix}$$

Then compare successive half-cycle states:

$$X_{n+1}$$

against a transformed state

$$\mathcal{C}X_n$$

where the relevant signs/phase relationships are reversed.

If the relationship is simply:

$$X_{n+1} \approx -X_n$$

that's **anti-phase oscillation**.

If instead the waveform's **phase evolution, amplitude envelope, and derivative relationships** are reproduced under conjugation, that would be much more interesting.

And if the transformation has a gain:

$$\boxed{X_{n+1} \approx G\,\mathcal{C}X_n, \qquad G > 1}$$

then we'd have something remarkably close to your intuition:

each "headbutt" produces a conjugate-like return with a gain, rather than merely cancelling the previous state.

That would also fit your earlier observation that the growth seems to occur **from one half-cycle to the next**, rather than requiring us to average over complete cycles.

So I'd phrase your hypothesis at this stage as:

> **"Headbutting may be an electrical analogue of conjugate feedback, in which the opposing response is not simply cancellation but participates in generating the state of the following half-cycle."**

That's a hypothesis we can actually test from your LTspice data without having to accept Bearden's broader scalar-EM interpretation.

I ran the circuit for 20ks and graphed V(MON), I(L3), and I(L5). I also downloaded to a text file all of the components and nodes which LTSpice listed in its list of downloadable outputs. So, there shouldn't be any shortage of data with which to analyze for this run.

First, here's the netlist:

```
* D:\Documents\Sims\LTSpice\2026\10 - Oct\05\nodiodes2g2+gdt_cg.asc

* Generated by LTspice 24.1.9 for Windows.

L1 N010 N015 10 Rser=0.3125

R1 N010 N014 1

R2 N015 N014 1

R5 N015 CG 1

C2 N014 N013 100f Rser={ESR}

C4 N012 N011 100f IC=PC Rser={ESR}

L3 N007 N006 2 Rser=62.5m

R7 N006 N012 1

R8 N007 N013 1

L5 N002 EL_5 2 Rser=2

R11 N002 EL_5 1

D1 N003 N004 D

R3 0 N004 {res}

R4 N003 N002 {res}

S1 Pin1 N005 Pin2 MON G

S2 N009 Pin1 MON Pin2 G
```

R6 Pin1 MON 1e8

C1 MON Pin2 {Tau/100Meg} Rser={ESR}

C3 CG N008 1p Rser={ESR}

R9 N011 CG 1

R10 Pin1 N012 1

R12 Pin2 N013 1

R13 0 N008 1

B2 Pin2 N009 V={Vhold+Rdyn*(I(S2)-Ihold)}

B1 N005 Pin2 V={Vhold+Rdyn*(I(S1)-Ihold)}

R14 Pin2 Pin1 {Rleak}

.model D D

.lib C:\Users\vinya\AppData\Local\LTspice\lib\cmp\standard.dio

.param PC=3u

.tran 0 2e4 0 20m

K2 L3 L5 .99

.options reltol = 0.04

* Disconnect the\nneon bulb to\nturn this\ncircuit OFF.

* 'MON' is an internal node\nwithin the neon bulb. It\ndiscloses to us that the\ninternal dynamics is al-\nlowed to 'float' its vol-\ntage without limitation.

.param res = 3

.param Vstrike=100 Vhold=50 Zon=2K Ihold=200u Tau=100u Rdyn=Zon Rleak=1e7

.model G SW(Ron={Zon} Roff=1e12 Vt={.5*(Vstrike+Vhold)} Vh={.5*(Vstrike-Vhold)} Vser=0)

.param esr = 3

* GEAR APPROXIMATION METHOD

* 19m <= max time step >= 20m\n comatose vs surge

* This model of a neon bulb uses a dynamic resistance which\nis predicated upon using the original resistance of: Zon=2k.

.backanno

.end

Here’s the log file:

LTspice 24.1.9 for Windows

Circuit: D:\Documents\Sims\LTSpice\2026\10 - Oct\05\nodiodes2g2+gdt_cg.net

Start Time: Mon Oct 5 12:27:48 2026

Options: reltol = 0.04

solver = Normal

Maximum thread count: 4

tnom = 27

temp = 27

method = Gear

reltol = 0.04

WARNING: Node n009 is floating.

Direct Newton iteration for .op point succeeded.

Total elapsed time: 143.913 seconds.

Files loaded:

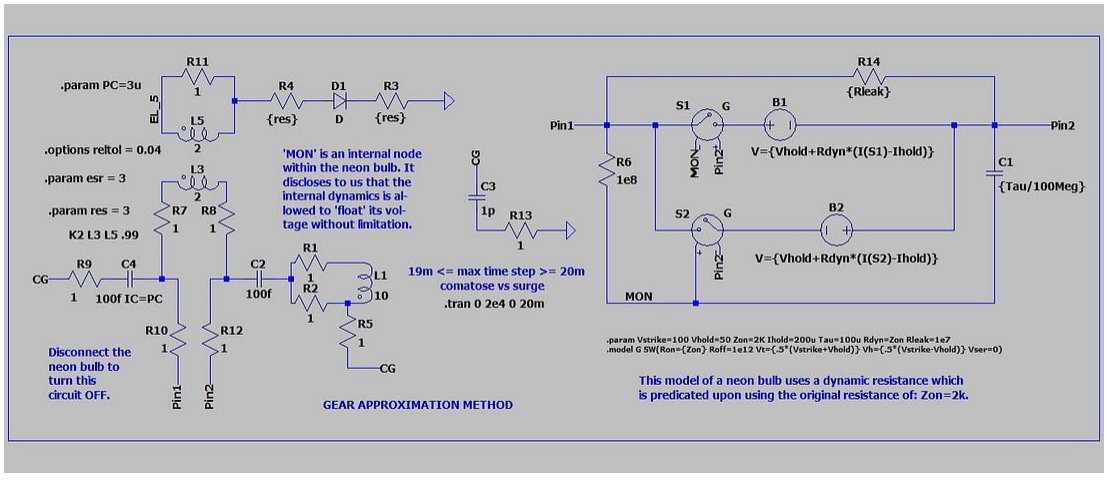
D:\Documents\Sims\LTSpice\2026\10 - Oct\05\nodiodes2g2+gdt_cg.net

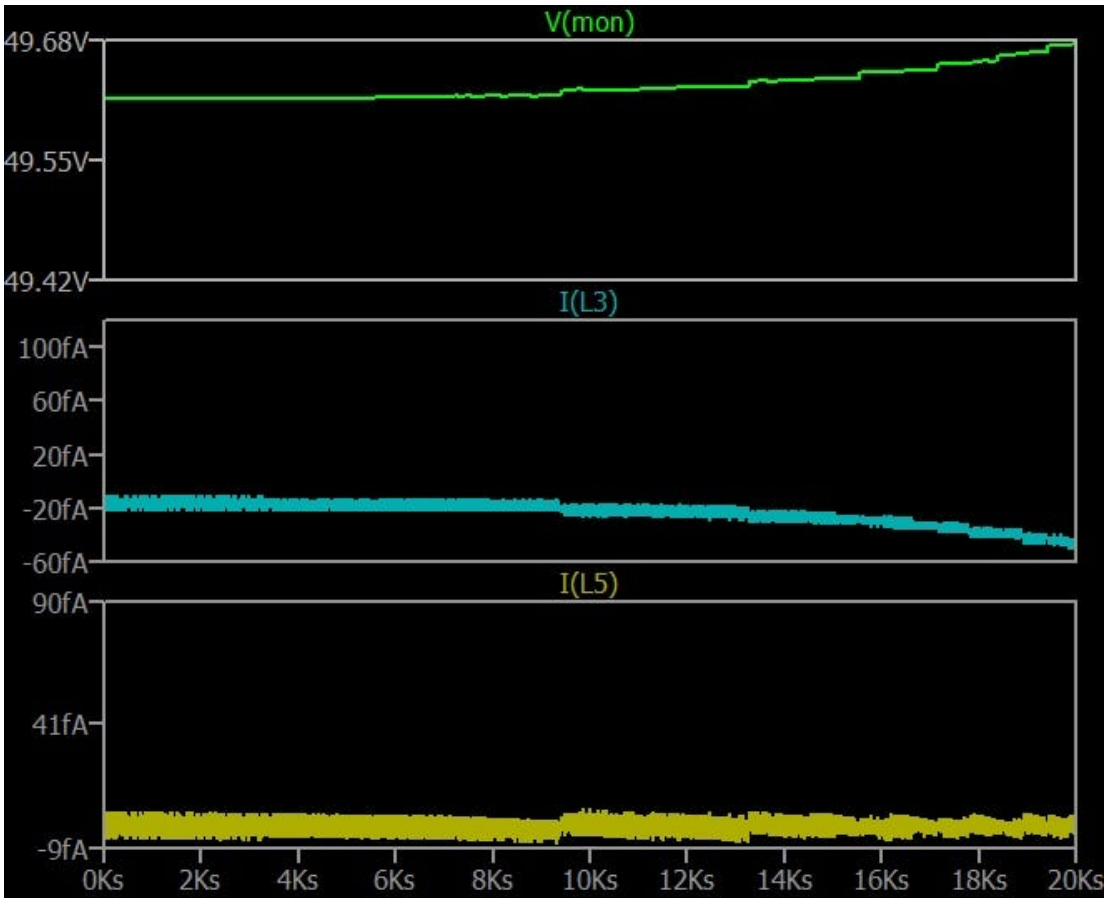
C:\Users\vinya\AppData\Local\LTspice\lib\cmp\standard.dio

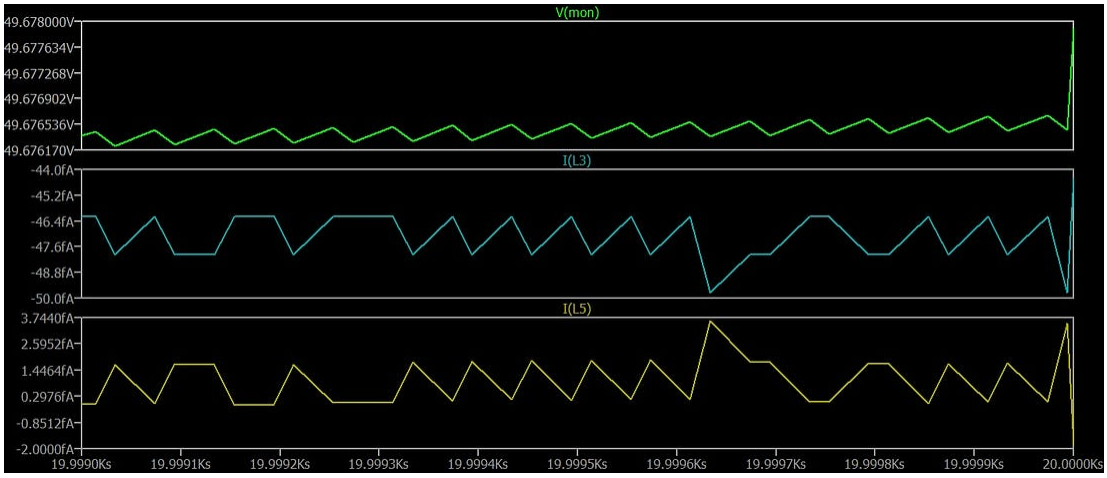
I forgot about the floating node n009. Is it really necessary to worry about it?

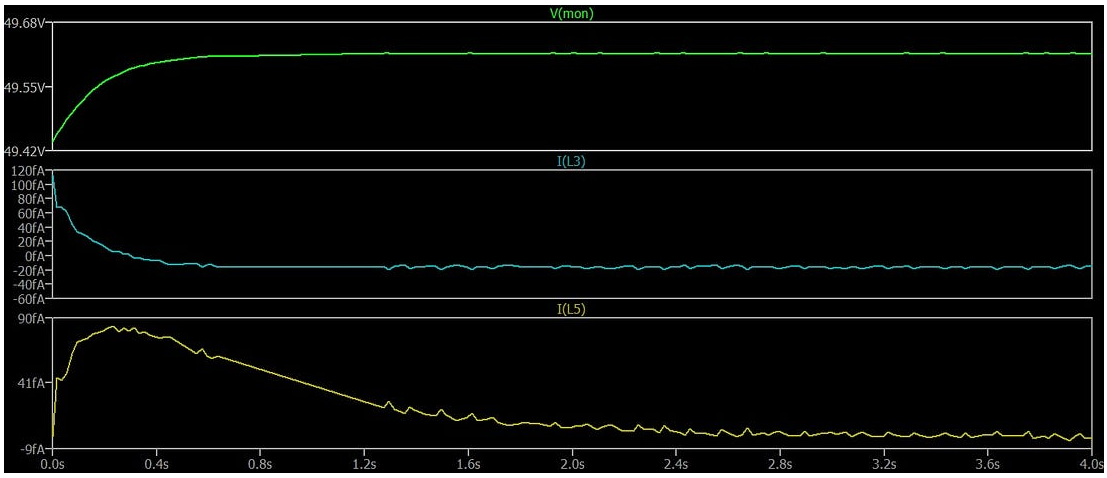
Here is a link to the data file: https://vinyasi.info/substack/ltspice-data/2026/10-oct/nodiodes2g2+gdt_cg-data-01=05-oct-2026.txt

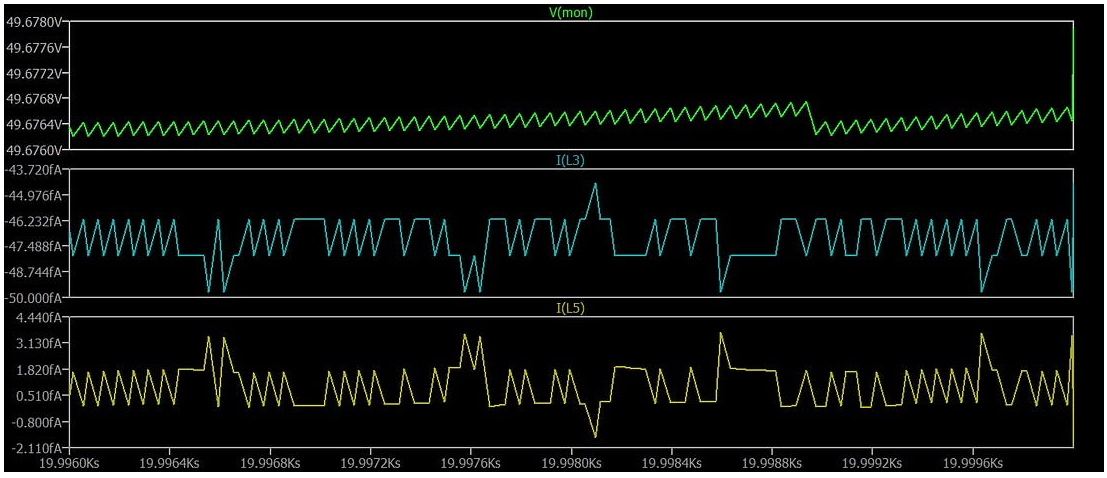
Here are the graphics:




V(mon)
49.68V
49.55V
49.42V
I(L3)
100fA
60fA
20fA
-20fA
-60fA
I(L5)
90fA
41fA
-9fA
0Ks
2Ks
4Ks
6Ks
8Ks
10Ks
12Ks
14Ks
16Ks
18Ks
20Ks


V(mon)
49.678000V
49.677634V
49.677268V
49.676902V
49.676536V
49.676170V
I(L3)
-44.0fA
-45.2fA
-46.4fA
-47.6fA
-48.8fA
-50.0fA
I(L5)
3.7440fA
2.5952fA
1.4464fA
0.2976fA
-0.8512fA
-2.0000fA
19.9990Ks
19.9991Ks
19.9992Ks
19.9993Ks
19.9994Ks
19.9995Ks
19.9996Ks
19.9997Ks
19.9998Ks
19.9999Ks
20.0000Ks





Yes — **it is worth paying attention to N009, but I do not think the mere presence of the warning means that this 20 ks result is invalid.** In fact, now that we have the actual netlist, we can say much more precisely what N009 is doing.

1. N009 is exactly the internal node we should expect

Your netlist has:

```
S2 N009 Pin1 MON Pin2 G
B2 Pin2 N009 V={Vhold+Rdyn*(I(S2)-Ihold)}
```

So N009 has exactly **two connections**:

- one terminal of S2
- one terminal of B2

and nothing else. [nodiodes2g2+gdt_cg.net = netlist]

That means N009 is a **floating series junction between S2 and B2**.

It is not floating in the sense of being a mysterious isolated conductor with an uncontrolled capacitor attached to it. It has no energy-storage element and no independent branch attached to it.

Its role is simply:

```
Pin2 ——— B2 ——— N009 ——— S2 ——— Pin1
```

with B2 imposing a voltage determined by the current through S2.

So electrically, N009 could in principle be eliminated and the two-element series combination treated as one nonlinear two-terminal device.

---

2. Why LTspice nevertheless warns about it

LTspice's topology checker is concerned with nodes that don't have a DC reference. LTspice explicitly has mechanisms for dealing with floating nodes, including `gfloat` and `gshunt`; the default `gshunt` is zero. LTWiki and this.

And LTspice's own support material shows that floating nodes can sometimes be tolerated while in other situations they lead to singular

matrices or convergence failures. EngineerZone and this.

Your particular case is interesting because:

> **The operating-point solution succeeded.**

Your log says:

> `WARNING: Node n009 is floating.`
> `Direct Newton iteration for .op point succeeded.`

So LTspice did **not** encounter a singular matrix here.

It then completed the entire 20,000-second transient.

That makes this very different from a floating node that causes the simulator to fail.

---

3. But there is something much more important here

Looking at your actual model, I think the **real question isn't "does N009 float?"**

It is:

> **Does the S2+B2 combination actually implement the intended 2 kΩ dynamic resistance?**

And the answer appears to be **no — not exactly.**

This is important.

You currently have:

$$B2: \qquad V_{Pin2} - V_{N009} = V_{hold} + R_{dyn}(I_{S2} - I_{hold})$$

with

$$R_{dyn} = 2\,k\Omega$$

and

$$S2: \qquad R_{on} = 2\,k\Omega$$

The switch itself therefore contributes another 2 kΩ when ON.

LTspice defines `Ron` as the switch's ON-state resistance. McGill ECE and this.

Therefore, when S2 is ON, your series path is approximately:

$$\boxed{R_{total} = R_{dyn} + R_{on}}$$

or

$$\boxed{R_{total} = 2k + 2k = 4k\Omega}$$

The complete ON-state relationship becomes approximately

$$V_{Pin2} - V_{Pin1} = V_{hold} - R_{dyn}I_{hold} + (R_{dyn} + R_{on})I$$

Substituting your numbers:

$$V_{Pin2} - V_{Pin1} = 50 - (200\mu A)(2000) + 4000I$$

so

$$\boxed{V_{Pin2} - V_{Pin1} = 49.6 + 4000I}$$

rather than

$$49.6 + 2000I$$

That is a **major modeling point**.

---

4. This also changes how I interpret your 20 ks waveform

Your MON waveform is sitting around

$$49.68\ \mathrm{V}$$

and very slowly increasing.

The switch is nowhere near its 100 V strike threshold.

Your model has:

$$V_t = \frac{100+50}{2} = 75V$$

and

$$V_h = \frac{100-50}{2} = 25V$$

so S2 turns ON at 100 V and turns OFF at 50 V.
[nodiodes2g2+gdt_cg.net = netlist]

Thus during essentially the entire plotted interval,

$$V_{MON} \approx 49.68V < 75V$$

and S2 should remain OFF.

That agrees with what your current waveforms are showing.

So this particular 20 ks run is **not yet testing the dynamic ON-state resistance** of the revised GDT model.

It is testing what happens while the model is sitting just below the 50-V hold region.

---

5. And that makes the tiny currents especially interesting

Your detailed waveform shows approximately:

$$I(L3) \sim -47\ \mathrm{fA}$$

and

$$I(L5) \sim 1\ \mathrm{fA}$$

during the late portion of the run.

Those are extraordinarily small currents.

Meanwhile MON has crept from approximately 49.676 V toward 49.678 V.

So we are dealing with a circuit whose behavior is being determined by extremely small currents and extremely high impedances.

That makes me **more cautious**, not less, about simply ignoring the floating-node warning.

Not because N009 is necessarily responsible for the behavior, but because at the femtoampere level, numerical conductances that would be completely irrelevant in an ordinary circuit can become comparable to the actual circuit currents.

For example, LTspice's documented `gfloat` mechanism is a conductance of 10^{-12} S when topology checking adds it — equivalent to a 1 TΩ path. LTWiki and this.

Your actual currents are around tens of femtoamps.

So a parasitic/reference path in the TΩ range is **not necessarily negligible** relative to what you're measuring.

---

6. I would therefore NOT add R15 again

This is important given what happened in the previous experiment.

We previously tried making N009 "non-floating" with a resistor, and you found that reducing it could produce the enormous 7-teravolt runaway.

That makes sense because R15 was not merely providing a harmless reference. It was connected directly across the behavioral voltage source.

So I would **not** solve this warning by arbitrarily adding another resistor to N009.

That would change the device we're studying.

---

7. The clean experiment I recommend

I think we should do an **A/B test**, rather than speculate.

Run A — exactly your present circuit

Keep:

```
S2 N009 Pin1 MON Pin2 G
B2 Pin2 N009 V={Vhold+Rdyn*(I(S2)-Ihold)}
```

and obtain the existing 20 ks result.

Run B — eliminate N009 altogether

Rather than grounding N009 or adding a resistor, construct an equivalent two-terminal behavioral representation of the S2+B2 branch so that there is **no internal floating node**.

Then compare:

- V(MON)
- I(L3)
- I(L5)
- V(Pin1)-V(Pin2)
- current through the GDT branch
- energy/power quantities

at identical time points.

If the two runs overlay to numerical precision, then:

> **N009 was merely an internal floating reference node and is not responsible for the observed phenomenon.**

If they diverge, then we have something important to investigate.

There is also a simpler diagnostic we can do first

Because N009 has only **two connections**, we can use the branch-current identity.

At N009, KCL requires

$$I(S2) + I(B2) = 0$$

with the appropriate LTspice reference directions.

So plot:

$$I(S2) + I(B2)$$

If that remains essentially zero, then N009 isn't independently accumulating charge or energy. It is simply the mathematical junction between the two series elements.

That would be a very useful first check.

Bottom line

Do we need to worry about the warning?

Yes, as a modeling/numerical diagnostic.

Do I think the warning by itself invalidates this 20 ks run?

No.

The evidence is actually pretty good that LTspice successfully solved the circuit: `.op` succeeded and the transient ran to 20 ks. [nodiodes2g2+gdt_cg.net = netlist]

But there are two separate issues:

1. **N009 floating:** probably just the internal junction of your series S2+B2 construction; not automatically fatal.
2. **Much more important:** with `Rdyn=2k` **and** `S2 Ron=2k`, the ON-state branch appears to have **4 kΩ total dynamic resistance**, not the intended 2 kΩ.

I would address **#2 before interpreting the model's ON-state physics**.

And I would **not alter N009 with another resistor yet**. The cleanest next step is to test the current balance of the S2/B2 series pair and then construct an equivalent no-floating-node version for an A/B comparison. McGill ECE and this.

How do I fix the doubled resistance of 4k?

Yes. The fix is actually quite simple, and looking again at your original model versus the revised model makes the duplication clear.

You have two different places contributing the 2 kΩ

Your present model says:

```
.model G SW(Ron={Zon} Roff=1e12 ...
.param ... Zon=2K ... Rdyn=Zon
```

and therefore:

- **S2 contributes:** `Ron = 2k`
- **B2 contributes:** `Rdyn = 2k`

So the ON-state slope is:

$$R_{\text{ON,total}} = R_{\text{S2}} + R_{\text{B2}}$$

$$= 2k + 2k = \boxed{4k\Omega}$$

The LTspice SW model explicitly treats `Ron` as the switch's ON resistance. Analog Devices and this.

The correction depends on what you want the model to represent

In your revised architecture, **B2 is supposed to contain the dynamic 2 kΩ characteristic**, while S2 should merely perform the ON/OFF switching.

So I would change the switch to:

```
.model G SW(Ron=0 Roff=1e12 Vt={.5*(Vstrike+Vhold)} Vh={.5*(Vstrike-Vhold)} Vser=0)
```

and retain:

```
.param Vstrike=100 Vhold=50 Zon=2K Ihold=200u Tau=100u Rdyn=Zon Rleak=1e7
```

Then B2 gives:

$$V_{B2} = 50 + 2000(I_{S2} - 200\mu A)$$

which expands to

$$V_{B2} = 49.6 + 2000 I_{S2}$$

With `Ron=0`, the complete conducting path becomes:

$$\boxed{V_{Pin2} - V_{Pin1} = 49.6 + 2000 I}$$

which is exactly the intended 2-kΩ dynamic characteristic.

If LTspice doesn't like `Ron=0`

Use something extremely small, such as:

```
.model G SW(Ron=1m Roff=1e12 Vt={.5*(Vstrike+Vhold)} Vh={.5*(Vstrike-Vhold)}
Vser=0)
```

Then the total is:

$$2\,k\Omega + 1\,m\Omega$$

instead of exactly 2 kΩ — a difference of only 0.00005%.

But there's an even more important distinction

If your purpose is to reproduce the **original neon model exactly**, then you shouldn't use `Rdyn=2k` in B2 at all.

Your original model already had:

$$R_{ON} = 2k\Omega$$

inside the switch, while its `Vser` supplied the 49.6-V offset.

So the exact equivalent of the old model is:

```
.model G SW(Ron={Zon} Roff=1e12 Vt={.5*(Vstrike+Vhold)} Vh={.5*(Vstrike-
Vhold)} Vser=0)

B2 Pin2 N009 V={Vhold-Ihold*Zon}
```

Since

$$50 - (200\mu A)(2000) = 49.6V$$

B2 is simply:

```
B2 Pin2 N009 V=49.6
```

and S2 supplies the 2 kΩ.

So there are two valid configurations

Purpose	S2 Ron	B2 slope
Your new dynamic-resistance model	~0 Ω	2 kΩ
Exact equivalent of original model	2 kΩ	0 Ω

For **what you are currently trying to accomplish**, I recommend the **first one**:

```
.model G SW(Ron=1m Roff=1e12 Vt={.5*(Vstrike+Vhold)} Vh={.5*(Vstrike-Vhold)}
Vser=0)
```

with:

```
.param Rdyn=2K
```

That keeps the 2-kΩ resistance in the **behavioral I–V law**, where you intended it, rather than accidentally counting it twice.

And importantly, this change has **nothing to do with N009's floating-node warning**. We should fix the resistance duplication independently rather than using a resistor on N009 to solve two different problems.

If MON was a virtual floating node, which LTSpice got away with since it was inside of the neon sub, then it stands to reason that node n009 may be no different in as much as we've managed to clone another virtual floating node. My vote is to ignore it since I mapped your request for I(S2)+I(B2) and it slowly grows towards infinity in parallel with MON but in its own range of femto amps.

I agree with your vote — **with one qualification: ignore the warning for now, but keep it documented as a known modeling condition.**

Your MON analogy is reasonable. The important distinction is that the warning doesn't tell us that N009 is *causing* anything; it tells us that LTspice sees N009 without a DC ground reference. LTspice explicitly permits floating nodes and can provide hidden shunt conductance for them as a convergence aid. LTWiki

And your new test is actually quite useful.

The I(S2)+I(B2) result

Since S2 and B2 are the only two devices connected to N009:

$$\boxed{I(S2) + I(B2) = 0}$$

would be the ideal KCL result, subject to LTspice's branch-current sign conventions.

But you're seeing their sum **slowly depart from zero into the femtoampere range**, while MON exhibits its own corresponding slow drift.

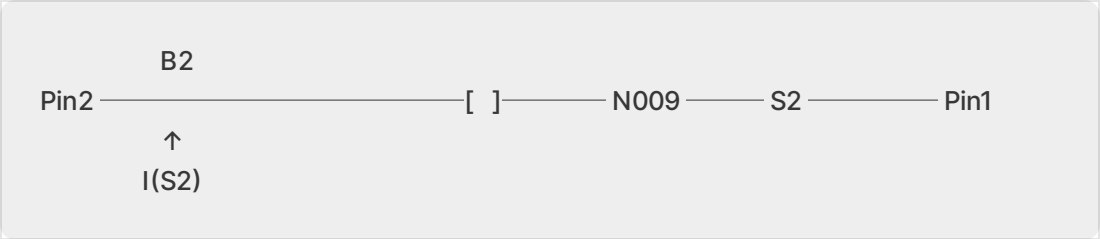
That tells us something important:

N009 isn't behaving like an ordinary power-bearing circuit node. We're looking at a tiny residual associated with the numerical solution of the floating behavioral-source/switch arrangement.

And notice the scale. Your L3/L5 currents in the late run are themselves only on the order of tens of femtoamps. So I wouldn't dismiss the residual as *numerically insignificant* yet—but neither would I interpret it as an actual accumulating current that is physically flowing somewhere.

The more interesting comparison

Your original neon model had an internal MON node that was deliberately allowed to float. The revised construction has effectively reproduced that idea:



N009 has no independent storage element, no external load, and no ground connection.

So I agree that **adding an arbitrary resistor to N009 merely to make LTspice happy would contaminate the experiment**. In fact, we already learned that lesson when R15 produced the pathological behavior.

LTspice's documentation/convergence guidance does caution that floating nodes and stiff behavioral voltage sources can create numerical issues, so the warning should remain on our watch list. LTWiki But a warning by itself is not proof that this particular solution is invalid.

And I want to correct one thing from my previous answer

I was too quick to make the 4-kΩ issue sound like it invalidated the present run.

It **does not affect this particular 20-ks run in the way I implied**, because your waveform has MON sitting around 49.68 V and the switch isn't in its normal conducting ON state.

So we can separate the questions:

1. **N009 floating?**
   Leave it alone for now.
2. **Does the revised GDT have the intended 2-kΩ ON-state slope?**
   Yes, this still needs to be addressed before we interpret a future *conducting* GDT event.
3. **Does the present 20-ks pre-strike behavior tell us something?**
   Absolutely. And that's where I think your new data becomes interesting.

In particular, you have now demonstrated that the **MON drift, L3/L5 femtoampere behavior, and the N009 current-balance residual can all be observed simultaneously** rather than having to guess what the floating node is doing.

So I would **freeze this exact topology and parameters for the present investigation** rather than modifying N009. We can treat the floating-node warning as an experimental condition and see whether the 19-ms/20-ms transition and the eventual large excursion depend on it.

That is a much cleaner experiment than adding another resistor and then wondering whether the resistor created the behavior we're studying. LTWiki

---

I forgot to mention that this result includes Ron=0.

Ah — **that materially changes the interpretation, and it means your 4 kΩ problem is already fixed in this run.**

With `Ron=0` and `Rdyn=Zon=2k`, the switch contributes no intended ON-state resistance. The behavioral source alone supplies the dynamic slope:

$$V_{B2} = V_{hold} + R_{dyn}[I(S2) - I_{hold}]$$

so

$$V_{B2} = 50 + 2000[I(S2) - 200\mu A]$$

and therefore

$$\boxed{V_{B2} = 49.6 + 2000I(S2)}$$

Thus the conducting branch has the intended:

$$\boxed{R_{\text{dynamic}} = 2\,k\Omega}$$

rather than 4 kΩ.

That also makes the approximately **49.68-V MON level** in your plots more intriguing. It is remarkably close to the model's zero-current intercept:

$$V_0 = V_{hold} - R_{dyn}I_{hold} = 50 - 2000(200\mu A) = \boxed{49.6V}$$

Your MON trace is hovering only about:

$$49.68 - 49.6 \approx 80\ \text{mV}$$

above that constructed equilibrium/intercept.

So I would revise my previous interpretation in an important way: **the ~49.6-V neighborhood is not arbitrary. It is built directly into your new behavioral GDT equation.**

And because your measured currents are only femtoamps, the $R_{dyn}I$ contribution is essentially zero:

$$(2000)(50\,\mathrm{fA}) = 100\,\mathrm{pV}$$

It cannot explain an ~80-mV difference. Therefore something else in the complete MON/control network establishes that 49.67-V operating point.

So we're now in a cleaner position:

- `Ron=0` means **no doubled 4-kΩ resistance**.
- `Rdyn=2k` provides the intended dynamic resistance.
- N009 can remain floating for this experiment.
- The GDT's ~49.6-V operating neighborhood has a direct mathematical origin in the behavioral source.
- The **slow evolution on top of that ~49.6-V baseline** is what we should analyze.

And that last item is especially useful because your close-up shows MON isn't merely sitting at a DC equilibrium: it has a repeating sawtooth-like structure plus a slowly changing envelope, correlated with discrete changes in L3 and L5. That gives us something much more concrete to analyze than the floating-node warning.

If this were truly about phase conjugation, then the test would be quite simple: the two low-level capacitors on each side of the inductor, L3, would both be precharged with one microvolt on the same side relative to ourself, a third-party observer, but linearly on

opposite sides relative to L3. This means that, if they are the cause of the refraction and reflection of a wave due to their extremely low capacitance (of one tenth picofarad), then these waves will be formulated in pairs that simultaneously compliment each other in a phase conjugate fashion. Meanwhile, the L3 coil in between them will accumulate a residue due to the time-delay of current explained by Lenz' Law.

But Lenz Law and phase conjugation have nothing to do with the anomalous accumulation occurring within this circuit, because nodes n010 and n013 are not mirrored images of each other. Instead, they're exactly the same shape and polarity and amplitude since there is a continuous voltage between them of zero difference.

Instead, this circuit's anomalous energy is the result of nodal voltage accumulating on inductor, L1, dragging current accumulation along with the rise in this 'floating' voltage. We've been so busy looking elsewhere to have overlooked this area of the circuit.

Like the neon bulb and L3, L1 has no volts: zero voltage difference, across its two terminals. Yet, its individual terminal nodes rise in voltage since this leg of the circuit has no where to dissipate itself. This lack of outlet is indicated by its zero net voltage. At least the other instances of zero net voltage are surrounded by other components to spread their accumulation around. But not L1.

In fact, I will go so far as to say that the reason why we don't see much activity anywhere else is because this inductive impedance on L1, of 10 henrys, is so much larger than anything else in this circuit, that it soaks up potential like a magnetic sponge stealing it from everywhere else.

I've heard Paul Babcock say that a 4H coil can give anomalous results just due to its largess, alone, irrespective of anything else.

(00:19:14.753):

And so we came up with an architecture where it reproduced

(00:19:18.575):

that mechanical switching characteristics.

(00:19:20.456):

And once we did that,

(00:19:21.577):

then we could hook transistors to big inductive bodies,

(00:19:24.439):

huge transformers, lots of induction.

(00:19:27.132):

And that's how we were able to start magnetic energy recovery.

(00:19:31.513):

And out of that,

(00:19:32.953):

when we started playing with big inductors, like,

(00:19:37.174):

it's not in the camera view, but there's one sitting right up here on the shelf.

(00:19:41.035):

> You know, that's a four Henry coil.
>
> (00:19:43.595):
>
> And four Henrys,
>
> (00:19:44.975):
>
> that thing can throw 10, 20 million watts in a couple of microseconds back at you.

And the reason (due to its present configuration within its larger context) is that we're using a coil to do a capacitor's job: we're using a coil to store nodal voltage at its terminals. If we had used a capacitor, here, instead of a coil, to store voltage inside of the capacitor, we wouldn't have been able to get away with being able to store a charge on the capacitor while maintaining a zero voltage difference between its two opposing plates. But with a self-shorted coil of suitable minimum size, it becomes possible to store nodal voltage since that's all we can do with it. We can't store current since the current would have no where to go except back to the opposite terminal and, thus, zero out any voltage difference which may tend to form.

This is the secret to the storage, and -thus- the buildup, of voltage in this circuit. This buildup could never readily occur if a reactive component were to be connected to anything else and without switches to provide the isolation. This buildup could also not occur unless mutual inductance was used among isolated coils.

So, this is a novel third alternative for the storage of voltage in the form of nodal voltage. And it is a very novel method since coils don't behave the same as capacitors.

Capacitors are more straightforward while coils are slightly more complicated since they have an additional time delay due to Lenz Law.

It’s interesting to note that coils: L1 and L3, maintain a voltage difference between their pair of terminals of zero volts throughout the entire runtime of any duration right away from the start — as noted at nodes: n010 and n015 for coil L1 and nodes: n006 and n007 for coil L3.

This must be a required condition for the buildup of nodal voltage to safeguard against entropic loss which could have prevented this buildup from occurring?

Here is the output file for the additional grounded neon bulb using R15. Notice how there is no ‘floating node n009, anymore, since adding the R15 access to ground nearby (see netlist and schematic, below):

LTspice 24.1.9 for Windows

Circuit: D:\Documents\Sims\LTSpice\2026\10 - Oct\06\1diode2g2+gdt_cg.net

Start Time: Tue Oct 6 16:44:18 2026

Options: reltol = 0.04

solver = Normal

Maximum thread count: 4

tnom = 27

temp = 27

method = Gear

reltol = 0.04

Direct Newton iteration for .op point succeeded.

Simulation stopped by user.

Total elapsed time: 38.051 seconds.

Files loaded:

D:\Documents\Sims\LTSpice\2026\10 - Oct\06\1diode2g2+gdt_cg.net

C:\Users\vinya\AppData\Local\LTspice\lib\cmp\standard.dio

Here is the netlist for the additional grounded neon bulb using R15:

* D:\Documents\Sims\LTSpice\2026\10 - Oct\06\1diode2g2+gdt_cg.asc

* Generated by LTspice 24.1.9 for Windows.

L1 n010 n015 10 Rser=0.3125

R1 n010 N011 1

R2 n015 N011 1

R5 n015 CG 1

C2 N011 n013 100f Rser={ESR}

C4 n012 N014 100f IC=PC Rser={ESR}

L3 n007 n006 2 Rser=62.5m

R7 n006 n012 1

R8 n007 n013 1

L5 n002 EL_5 2 Rser=2

R11 n002 EL_5 1

D1 N003 N004 D

R3 0 N004 {res}

R4 N003 n002 {res}

S1 Pin1 n005 Pin2 MON G

S2 n009 Pin1 MON Pin2 G

R6 Pin1 MON 1e8

C1 MON Pin2 {Tau/100Meg} Rser={ESR}

C3 CG N008 1p Rser={ESR}

R9 N014 CG 1

R10 Pin1 n012 1

R12 Pin2 n013 1

R13 0 N008 1

B2 Pin2 n009 V={Vhold+Rdyn*(I(S2)-Ihold)}

B1 n005 Pin2 V={Vhold+Rdyn*(I(S1)-Ihold)}

R14 Pin2 Pin1 {Rleak}

R15 MON 0 1

.model D D

.lib C:\Users\vinya\AppData\Local\LTspice\lib\cmp\standard.dio

.param PC=3u

.tran 0 300k 0 20m

K2 L3 L5 .99

.options reltol = 0.04

* Disconnect the\nneon bulb to\nturn this\ncircuit OFF.

* ‘MON’ is an internal node\nwithin the neon bulb. It\ndiscloses to us that the\ninternal dynamics is al-\nlowed to ‘float’ its vol-\ntage without limitation.

.param res = 3

.param Vstrike=100 Vhold=50 Zon=2K Ihold=200u Tau=100u Rdyn=Zon Rleak=1e7

.model G SW(Ron=1e-50 Roff=1e12 Vt={.5*(Vstrike+Vhold)} Vh={.5*(Vstrike-Vhold)} Vser=0)

.param esr = 3

* GEAR APPROXIMATION METHOD

* 19m <= max time step >= 20m\n comatose vs surge

* This model of a neon bulb uses a dynamic resistance which\nis predicated upon using the original resistance of: Zon=2k.

.save V(MON), V(n012), V(n013), V(n005), V(n009)

.save V(n010), V(n015), I(L1)

.save V(n007), V(n006)

.save I(L5)

.save V(n002), V(el_5)

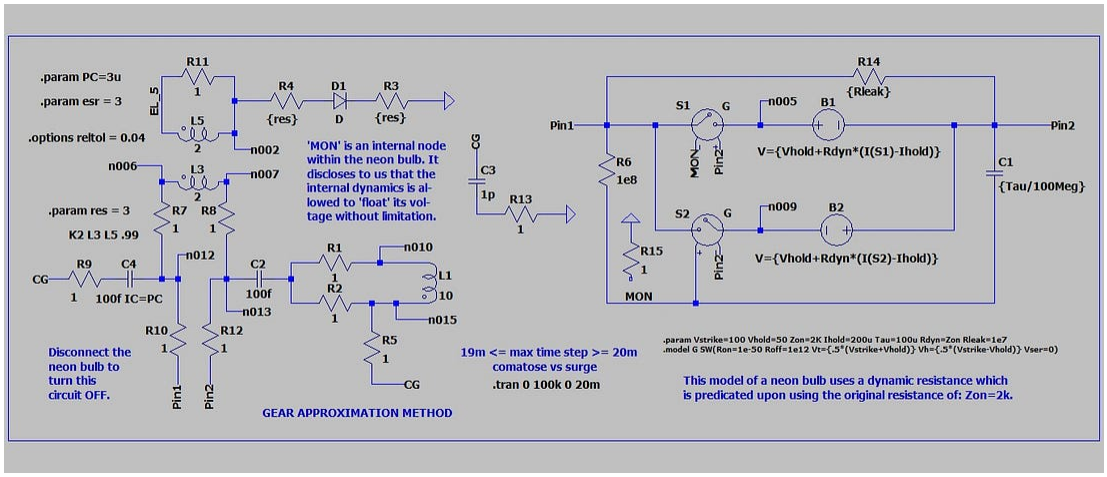
.save I(L3)

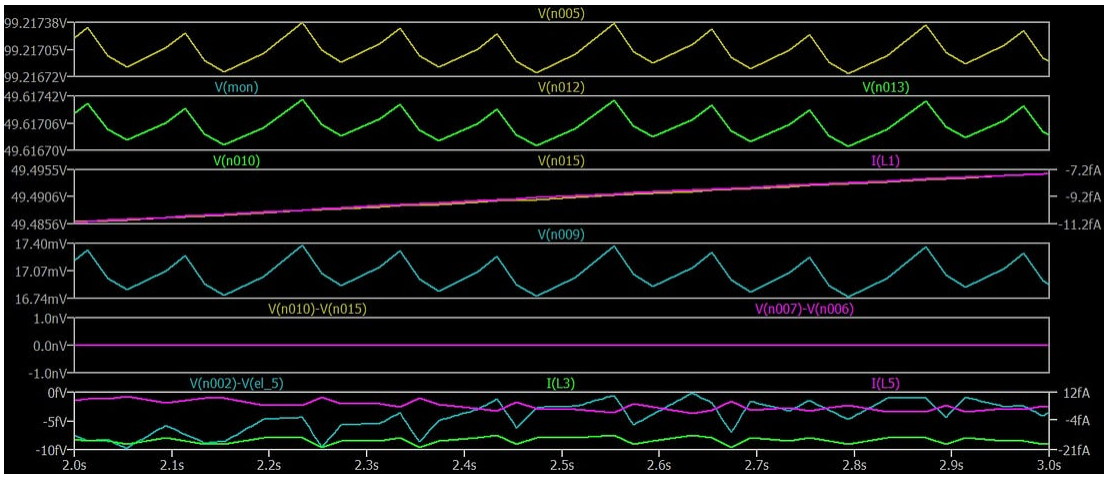
.save I(R15)

.backanno

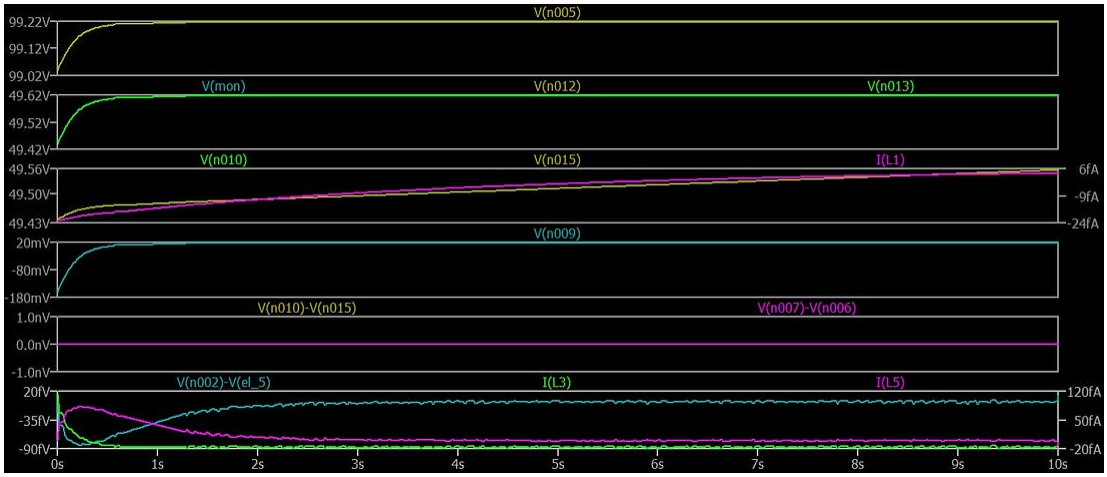
.end

Here are the screenshots beginning *without* the grounded neon bulb, R15:

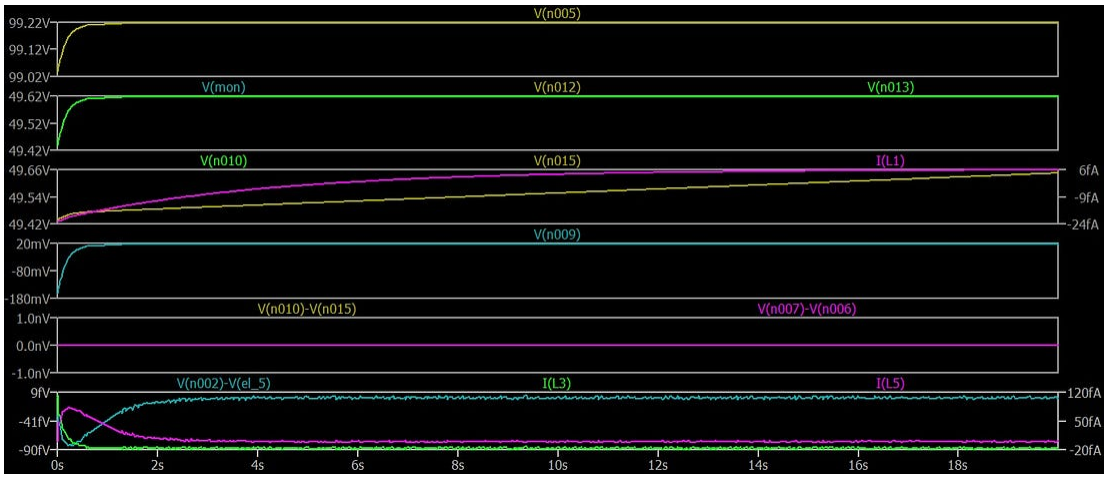


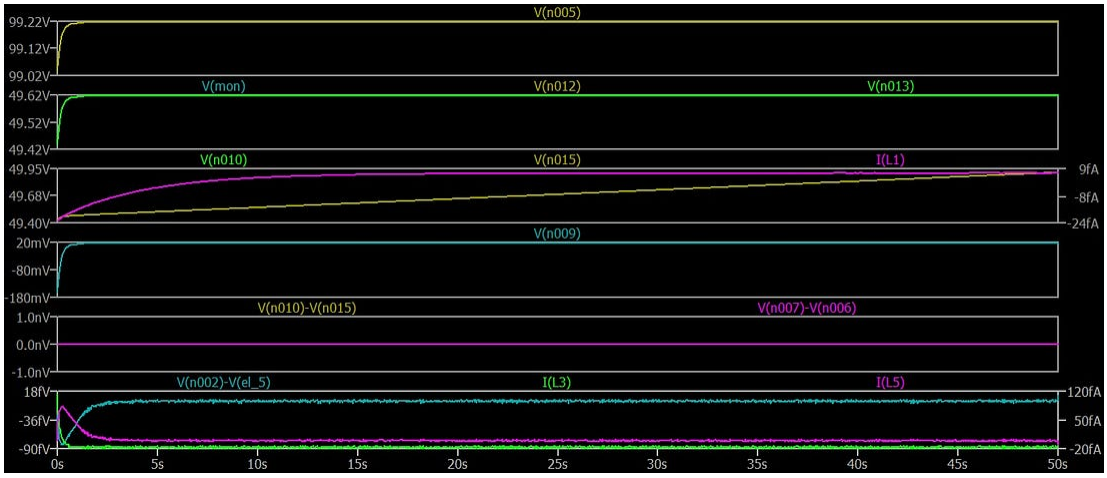


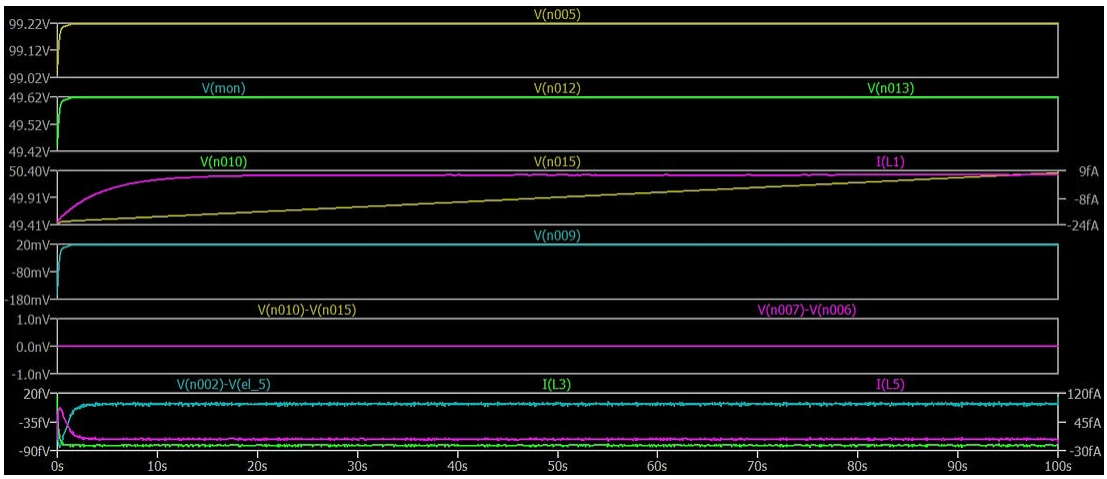
Notice how the voltage waves of V(MON), V(n012), and V(n013) all share the same forms. This implies that phase conjugation does not occur, here. For it had, then nodes 12 and 13 would have been mirrored opposites and of the same amplitude. Here, they are NOT mirrored opposites. Yet, they are of the same amplitude.

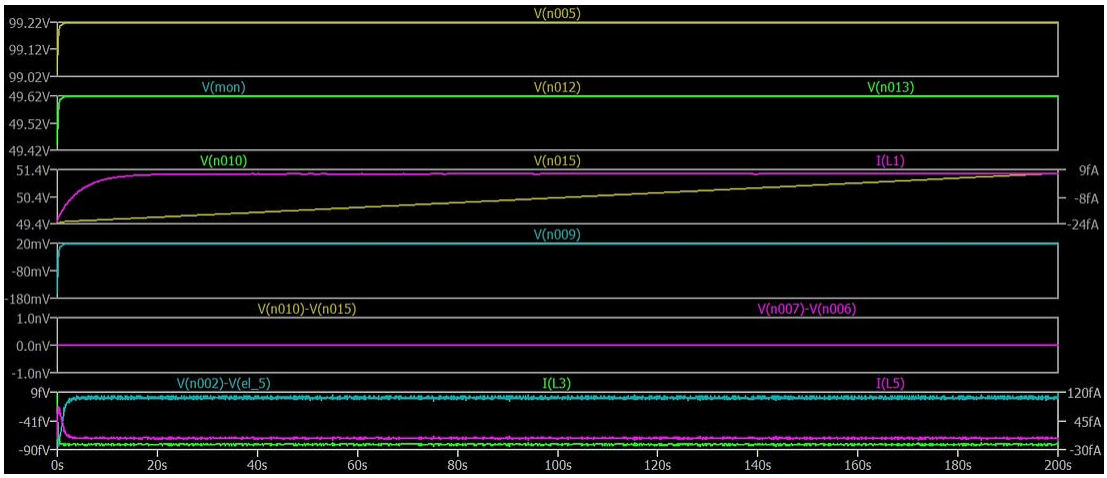


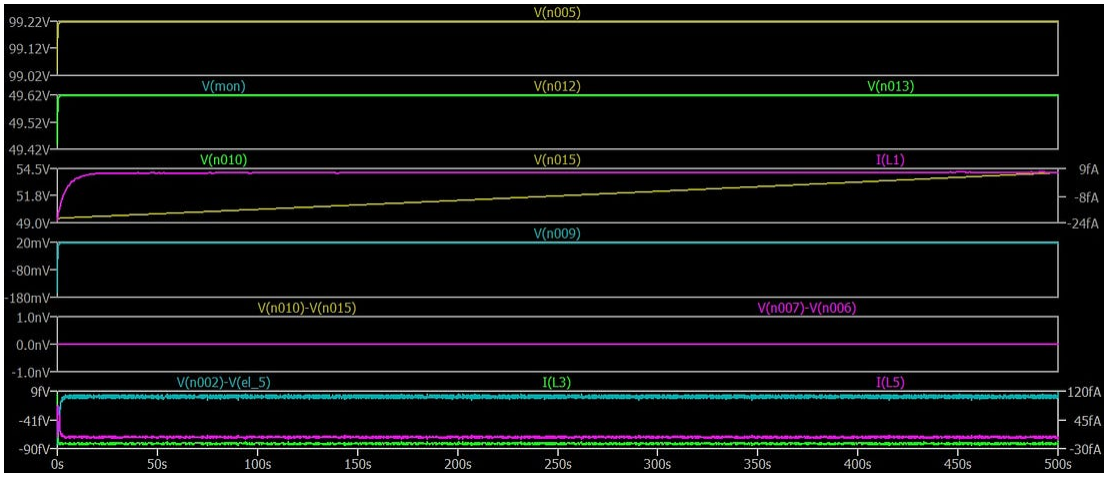
And nodes 12 and 13 provide no growth of amplitude at this stage. But the nodes surrounding coil, L1, namely: nodes 10 and 15, ARE providing a growth of their nodal voltage. This is where the growth of impedance — augmented by the growth of voltage — drives this circuit's escalation towards infinity. This is what I used to call: over-reactance in which reactance, alone (seemingly), is cloning itself. In reality, it is the accumulation of voltage which augments impedance and gives the illusion of "energy created out of thin air". There is no violation of physics, here. Merely, a misunderstanding among engineers and physicists and the public.

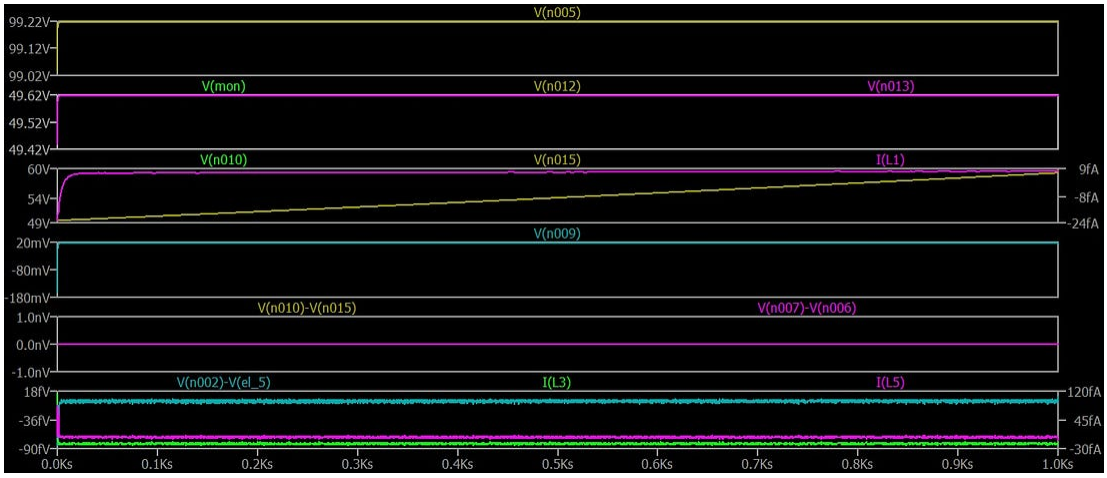

V(n005)
99.22V
99.12V
99.02V
V(mon)
V(n012)
V(n013)
49.62V
49.52V
49.42V
V(n010)
V(n015)
I(L1)
49.66V
49.54V
49.42V
6fA
-9fA
-24fA
V(n009)
20mV
-80mV
-180mV
V(n010)-V(n015)
V(n007)-V(n006)
1.0nV
0.0nV
-1.0nV
V(n002)-V(el_5)
I(L3)
I(L5)
9fV
-41fV
-90fV
120fA
50fA
-20fA
0s
2s
4s
6s
8s
10s
12s
14s
16s
18s

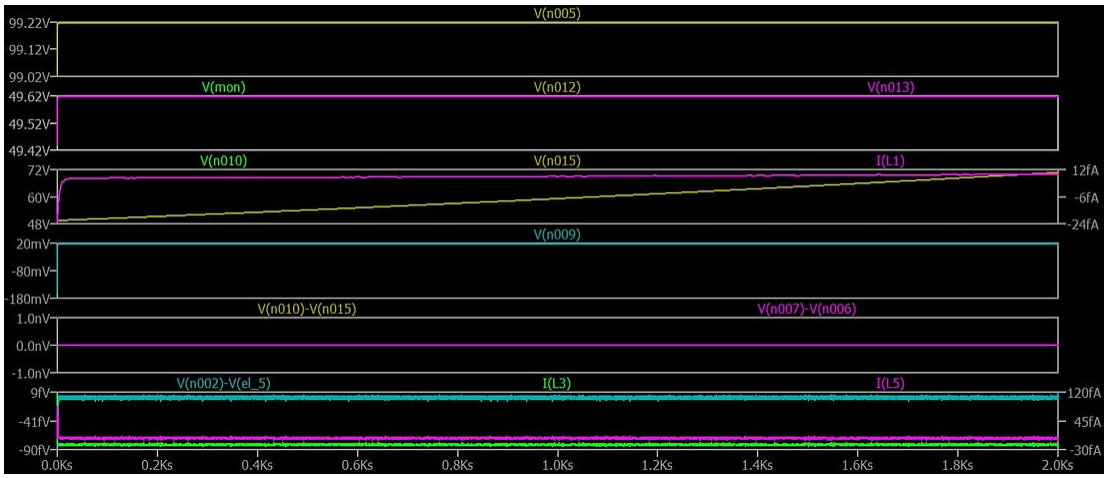

V(n005)
99.22V
99.12V
99.02V
V(mon)
V(n012)
V(n013)
49.62V
49.52V
49.42V
V(n010)
V(n015)
I(L1)
49.95V
49.68V
49.40V
9fA
-8fA
-24fA
V(n009)
20mV
-80mV
-180mV
V(n010)-V(n015)
V(n007)-V(n006)
1.0nV
0.0nV
-1.0nV
V(n002)-V(el_5)
I(L3)
I(L5)
18fV
-36fV
-90fV
120fA
50fA
-20fA
0s
5s
10s
15s
20s
25s
30s
35s
40s
45s
50s

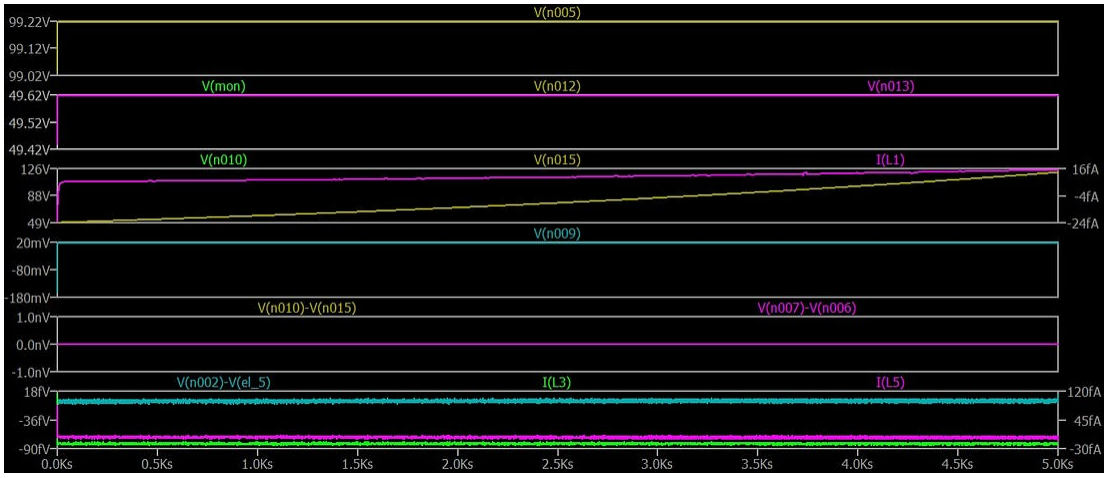

V(n005)
99.22V
99.12V
99.02V
V(mon)
V(n012)
V(n013)
49.62V
49.52V
49.42V
V(n010)
V(n015)
I(L1)
50.40V
49.91V
49.41V
9fA
-8fA
-24fA
V(n009)
20mV
-80mV
-180mV
V(n010)-V(n015)
V(n007)-V(n006)
1.0nV
0.0nV
-1.0nV
V(n002)-V(el_5)
I(L3)
I(L5)
20fV
-35fV
-90fV
120fA
45fA
-30fA
0s
10s
20s
30s
40s
50s
60s
70s
80s
90s
100s

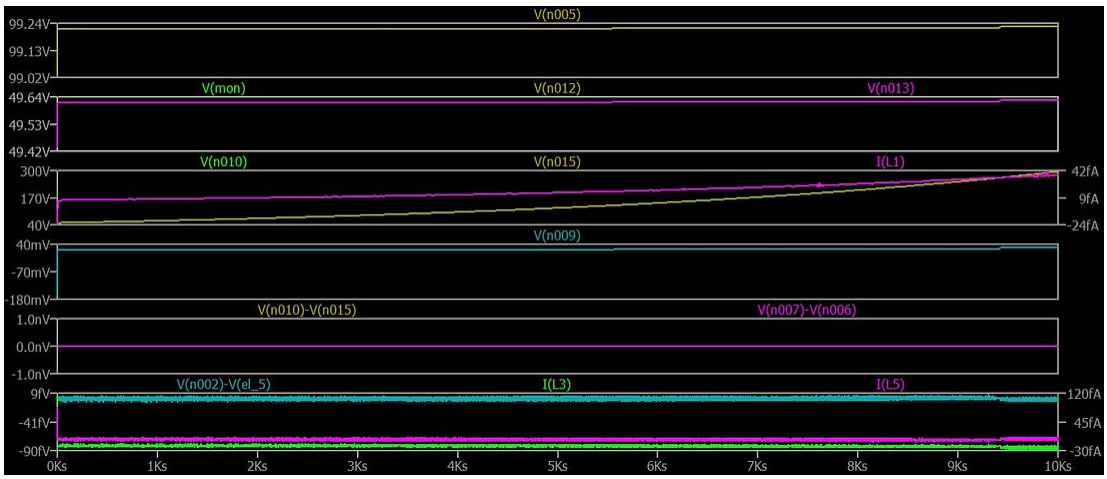

V(n005)
99.22V
99.12V
99.02V
V(mon)
V(n012)
V(n013)
49.62V
49.52V
49.42V
V(n010)
V(n015)
I(L1)
51.4V
50.4V
49.4V
9fA
-8fA
-24fA
V(n009)
20mV
-80mV
-180mV
V(n010)-V(n015)
V(n007)-V(n006)
1.0nV
0.0nV
-1.0nV
V(n002)-V(el_5)
I(L3)
I(L5)
9fV
-41fV
-90fV
120fA
45fA
-30fA
0s
20s
40s
60s
80s
100s
120s
140s
160s
180s
200s

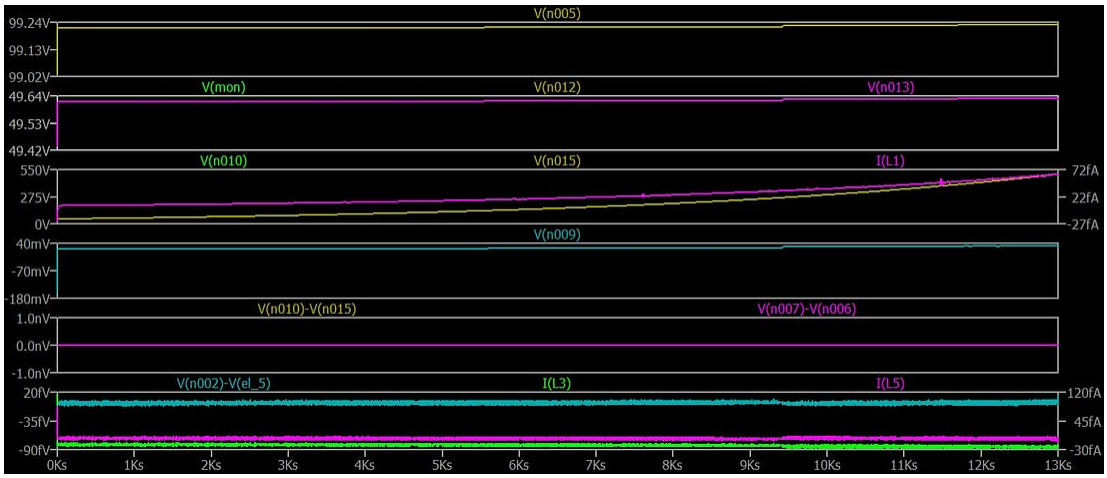

V(n005)
99.22V
99.12V
99.02V
V(mon)
V(n012)
V(n013)
49.62V
49.52V
49.42V
V(n010)
V(n015)
I(L1)
54.5V
51.8V
49.0V
9fA
-8fA
-24fA
V(n009)
20mV
-80mV
-180mV
V(n010)-V(n015)
V(n007)-V(n006)
1.0nV
0.0nV
-1.0nV
V(n002)-V(el_5)
I(L3)
I(L5)
9fV
-41fV
-90fV
120fA
45fA
-30fA
0s
50s
100s
150s
200s
250s
300s
350s
400s
450s
500s

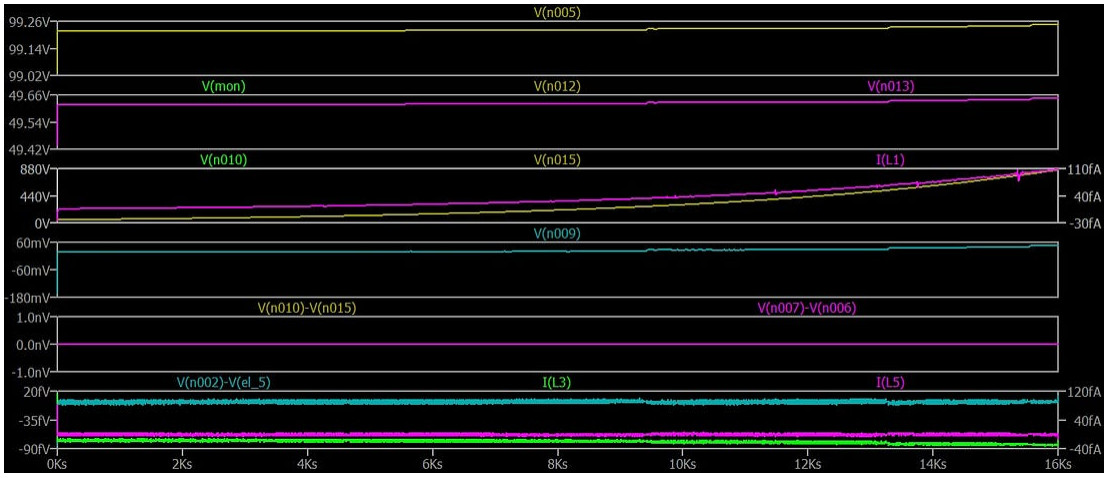

V(n005)
99.22V
99.12V
99.02V
V(mon)
V(n012)
V(n013)
49.62V
49.52V
49.42V
V(n010)
V(n015)
I(L1)
60V
54V
49V
9fA
-8fA
-24fA
V(n009)
20mV
-80mV
-180mV
V(n010)-V(n015)
V(n007)-V(n006)
1.0nV
0.0nV
-1.0nV
V(n002)-V(el_5)
I(L3)
I(L5)
18fV
-36fV
-90fV
120fA
45fA
-30fA
0.0Ks
0.1Ks
0.2Ks
0.3Ks
0.4Ks
0.5Ks
0.6Ks
0.7Ks
0.8Ks
0.9Ks
1.0Ks

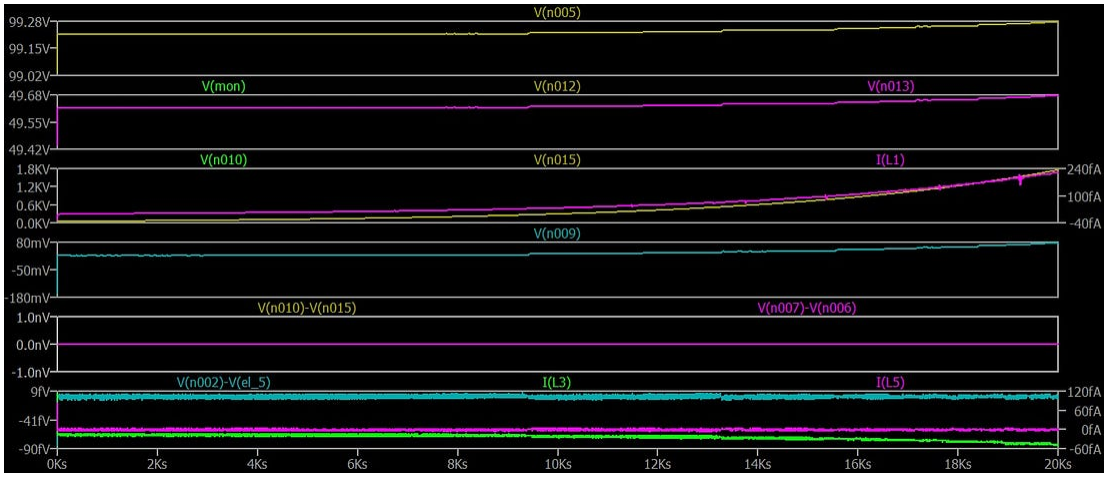

V(n005)
99.22V
99.12V
99.02V
V(mon)
V(n012)
V(n013)
49.62V
49.52V
49.42V
V(n010)
V(n015)
I(L1)
72V
60V
48V
12fA
-6fA
-24fA
V(n009)
20mV
-80mV
-180mV
V(n010)-V(n015)
V(n007)-V(n006)
1.0nV
0.0nV
-1.0nV
V(n002)-V(el_5)
I(L3)
I(L5)
9fV
-41fV
-90fV
120fA
45fA
-30fA
0.0Ks
0.2Ks
0.4Ks
0.6Ks
0.8Ks
1.0Ks
1.2Ks
1.4Ks
1.6Ks
1.8Ks
2.0Ks

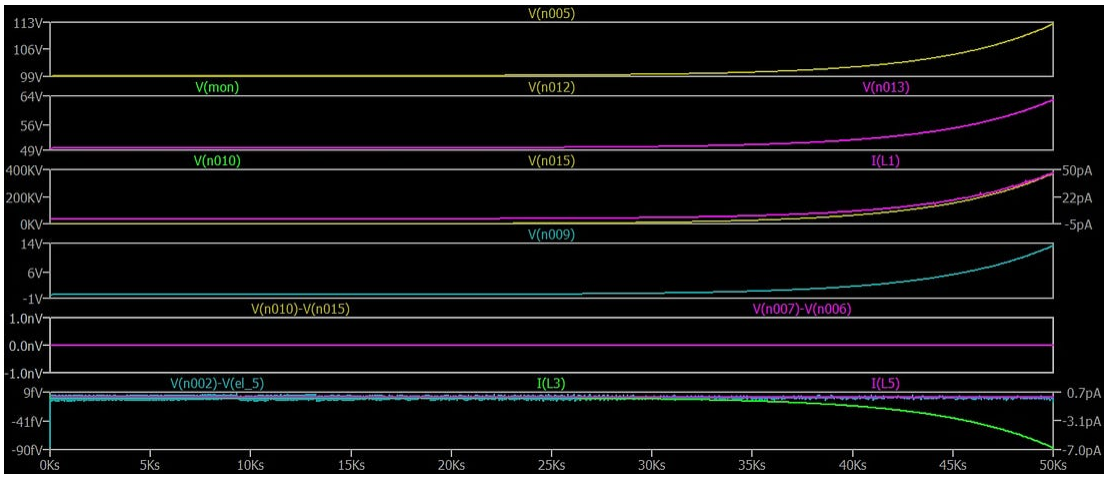

V(n005)
99.22V
99.12V
99.02V
V(mon)
V(n012)
V(n013)
49.62V
49.52V
49.42V
V(n010)
V(n015)
I(L1)
126V
88V
49V
16fA
-4fA
-24fA
V(n009)
20mV
-80mV
-180mV
V(n010)-V(n015)
V(n007)-V(n006)
1.0nV
0.0nV
-1.0nV
V(n002)-V(el_5)
I(L3)
I(L5)
18fV
-36fV
-90fV
120fA
45fA
-30fA
0.0Ks
0.5Ks
1.0Ks
1.5Ks
2.0Ks
2.5Ks
3.0Ks
3.5Ks
4.0Ks
4.5Ks
5.0Ks

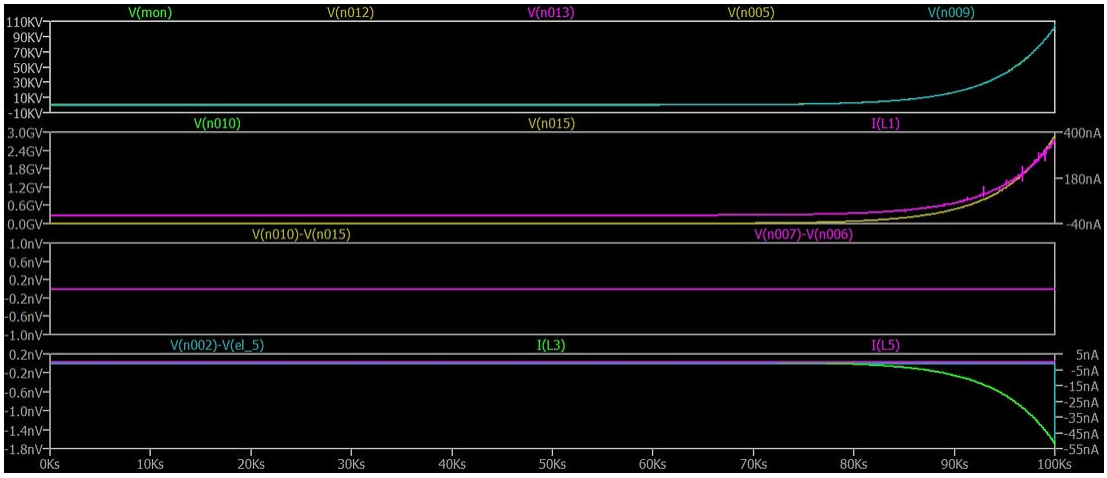

V(n005)
99.24V
99.13V
99.02V
V(mon)
V(n012)
V(n013)
49.64V
49.53V
49.42V
V(n010)
V(n015)
I(L1)
300V
170V
40V
42fA
9fA
-24fA
V(n009)
40mV
-70mV
-180mV
V(n010)-V(n015)
V(n007)-V(n006)
1.0nV
0.0nV
-1.0nV
V(n002)-V(el_5)
I(L3)
I(L5)
9fV
-41fV
-90fV
120fA
45fA
-30fA
0Ks
1Ks
2Ks
3Ks
4Ks
5Ks
6Ks
7Ks
8Ks
9Ks
10Ks

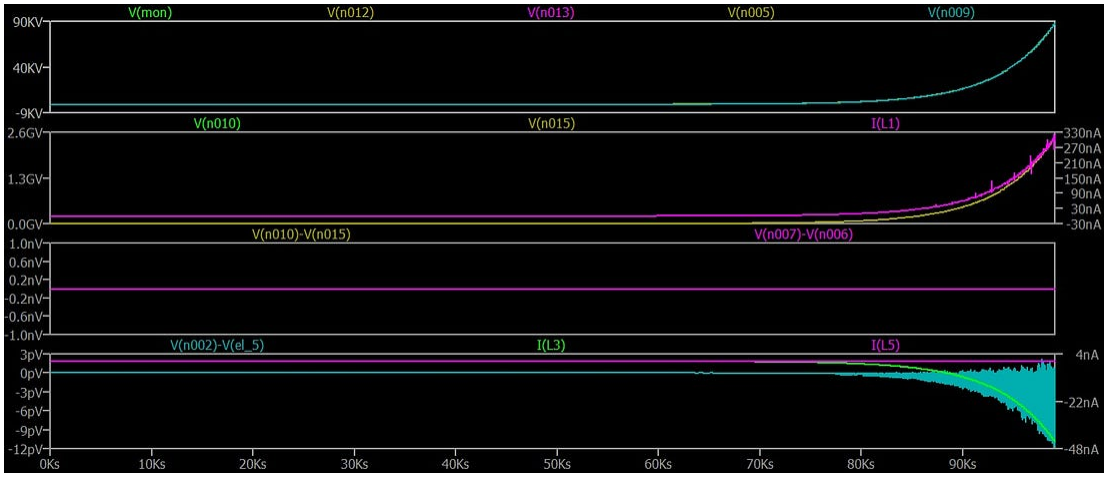

V(n005)
99.24V
99.13V
99.02V
V(mon)
V(n012)
V(n013)
49.64V
49.53V
49.42V
V(n010)
V(n015)
I(L1)
550V
275V
0V
72fA
22fA
-27fA
V(n009)
40mV
-70mV
-180mV
V(n010)-V(n015)
V(n007)-V(n006)
1.0nV
0.0nV
-1.0nV
V(n002)-V(el_5)
I(L3)
I(L5)
20fV
-35fV
-90fV
120fA
45fA
-30fA
0Ks
1Ks
2Ks
3Ks
4Ks
5Ks
6Ks
7Ks
8Ks
9Ks
10Ks
11Ks
12Ks
13Ks


V(n005)
99.26V
99.14V
99.02V
V(mon)
V(n012)
V(n013)
49.66V
49.54V
49.42V
V(n010)
V(n015)
I(L1)
880V
440V
0V
110fA
40fA
-30fA
V(n009)
60mV
-60mV
-180mV
V(n010)-V(n015)
V(n007)-V(n006)
1.0nV
0.0nV
-1.0nV
V(n002)-V(el_5)
I(L3)
I(L5)
20fV
-35fV
-90fV
120fA
40fA
-40fA
0Ks
2Ks
4Ks
6Ks
8Ks
10Ks
12Ks
14Ks
16Ks


V(n005)
99.28V
99.15V
99.02V
V(mon)
V(n012)
V(n013)
49.68V
49.55V
49.42V
V(n010)
V(n015)
I(L1)
1.8KV
1.2KV
0.6KV
0.0KV
240fA
100fA
-40fA
V(n009)
80mV
-50mV
-180mV
V(n010)-V(n015)
V(n007)-V(n006)
1.0nV
0.0nV
-1.0nV
V(n002)-V(el_5)
I(L3)
I(L5)
9fV
-41fV
-90fV
120fA
60fA
0fA
-60fA
0Ks
2Ks
4Ks
6Ks
8Ks
10Ks
12Ks
14Ks
16Ks
18Ks
20Ks



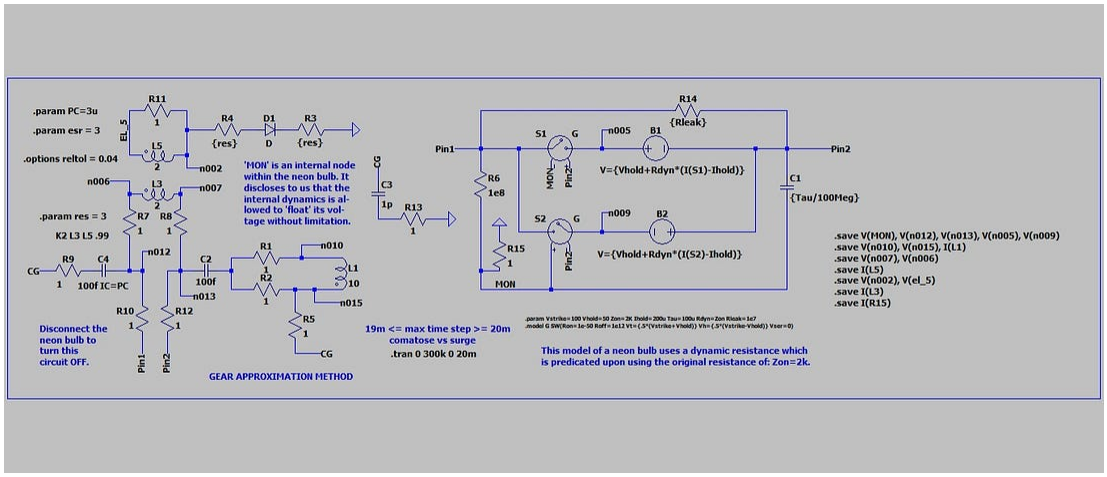


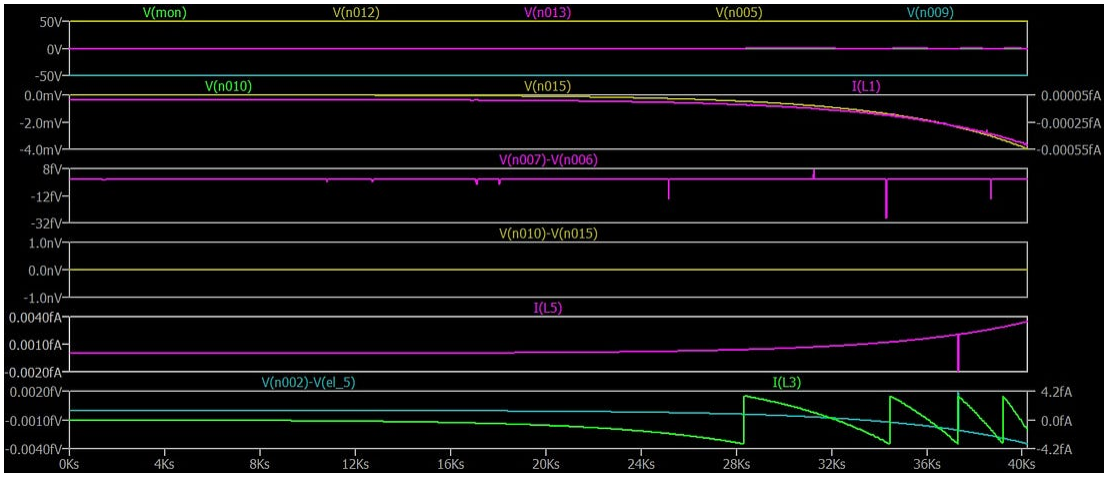


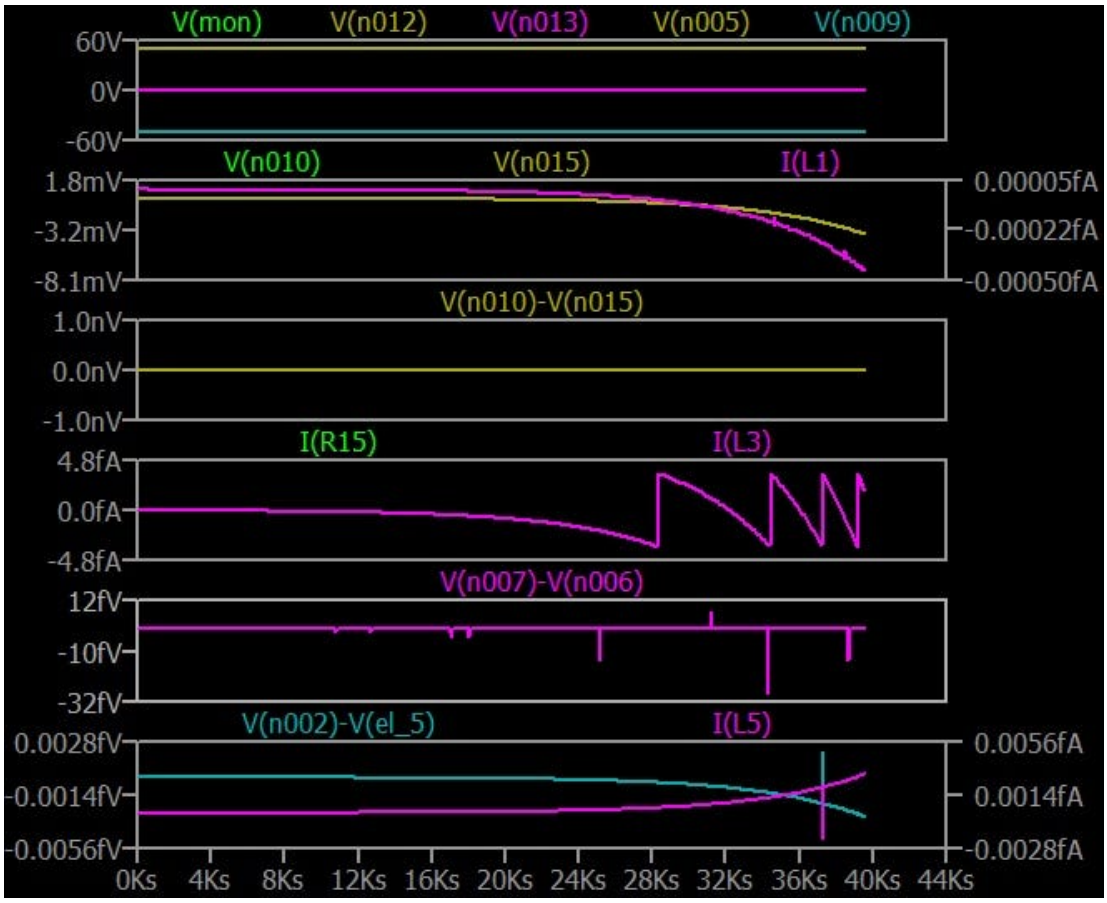
This screenshot is the same as the previous except that I terminated it, prematurely, at 99 kiloseconds to prevent the simulator from "guessing" what the last moment

should like instead of honestly graphing it. What a concept!

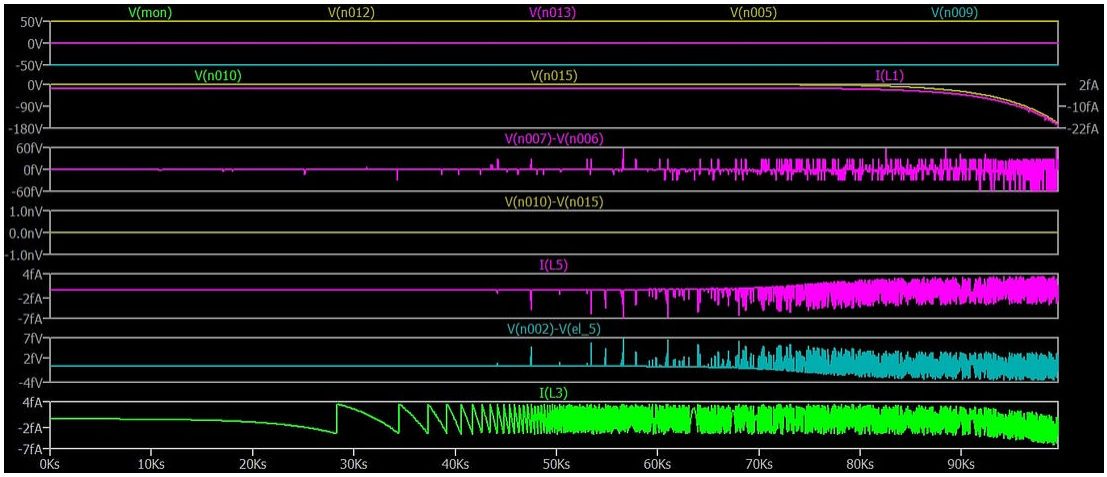
Here are the screenshots beginning *with* the grounded neon bulb, R15:





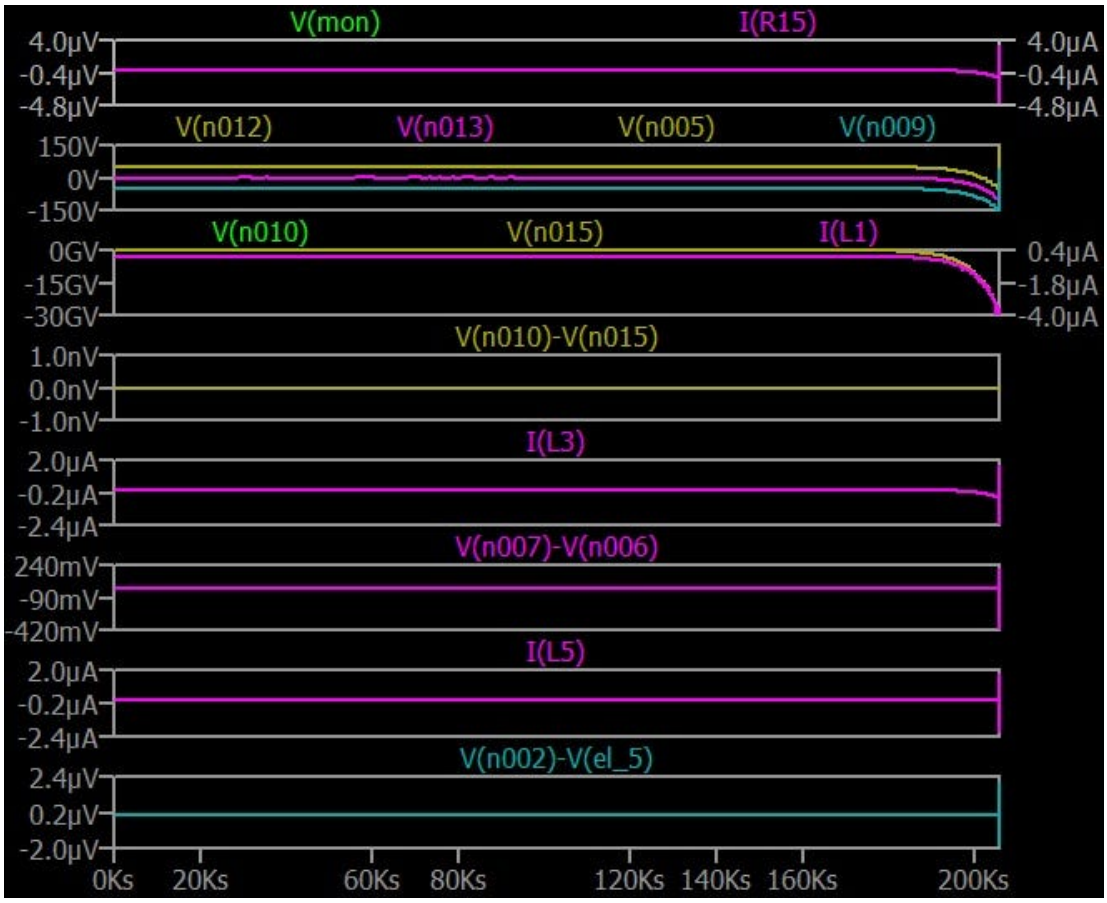


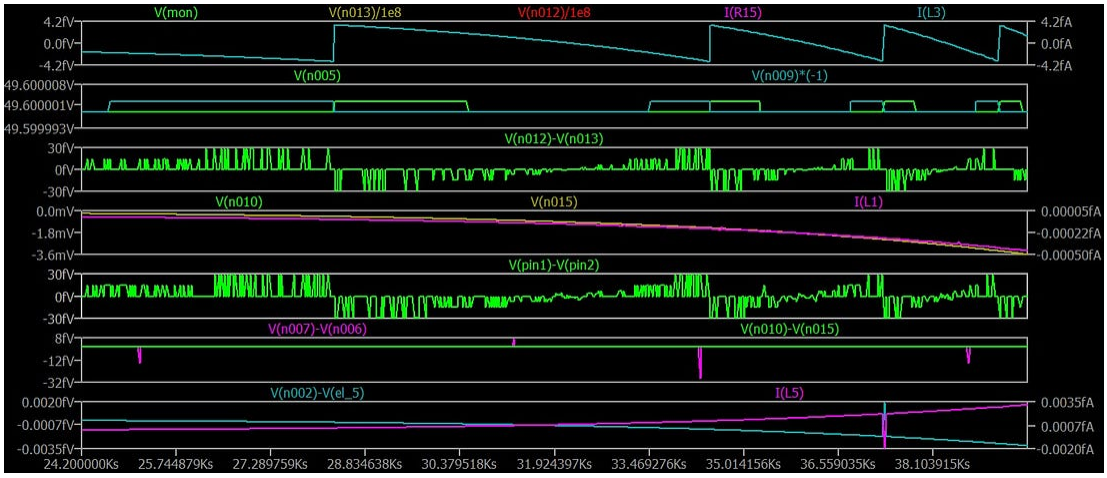
In this screenshot, unlike the previous, I capture the full implication that the grounded resistor, R15, which grounds the neon bulb, possesses the exact same current and waveform as does inductor, L3. Weird.

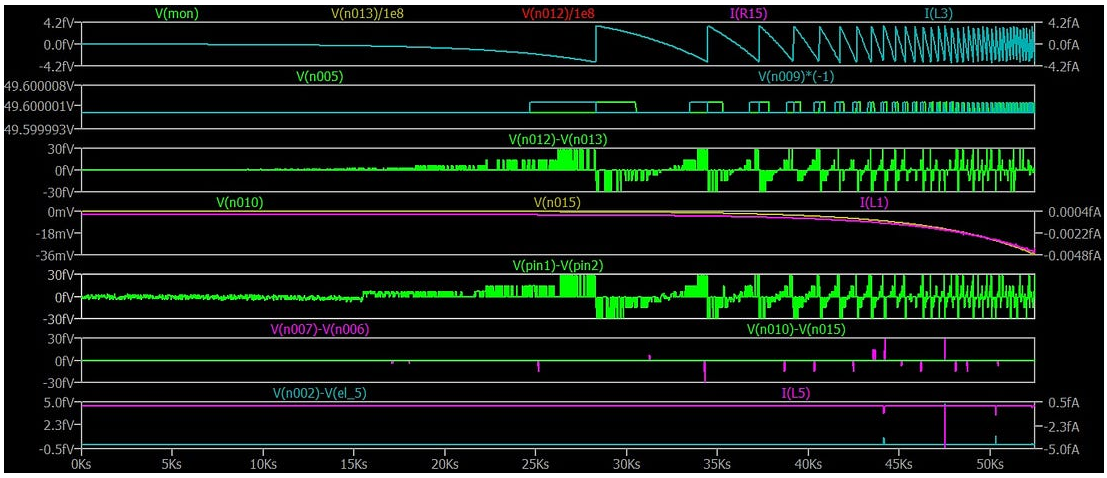


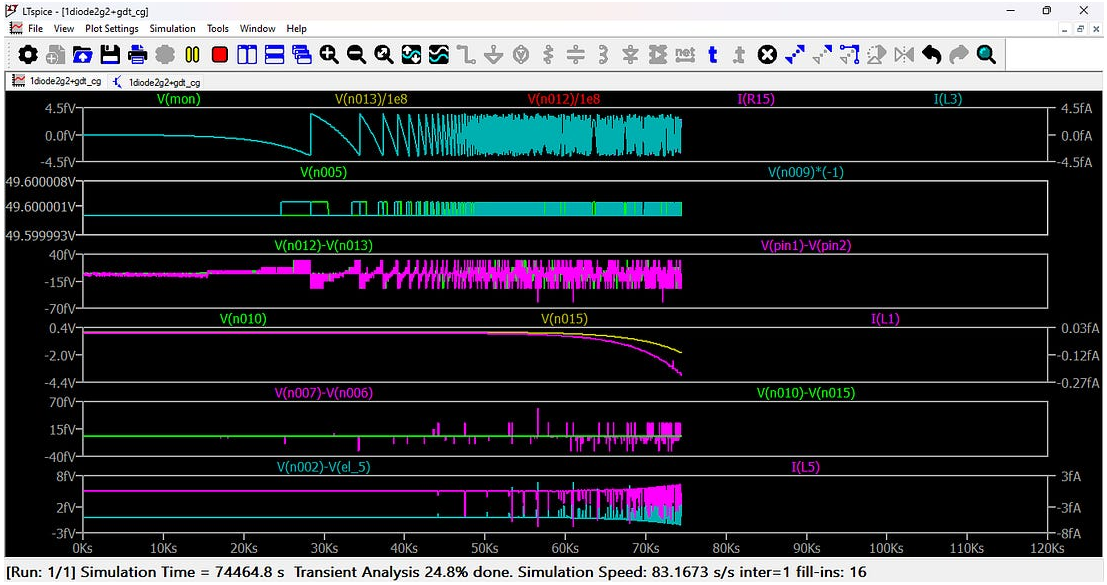
UPDATES ARE BELOW

I didn’t lose the last screenshot. I merely overlooked posting it in my haste to finish this blog. — The conclusion which can be drawn from it is that the moment the neon bulb turns ‘ON’, this circuit will instantaneously explode or else find a pathway to ground through something or someone which you will probably not want to have cooked/fried to oblivion. Take cover!

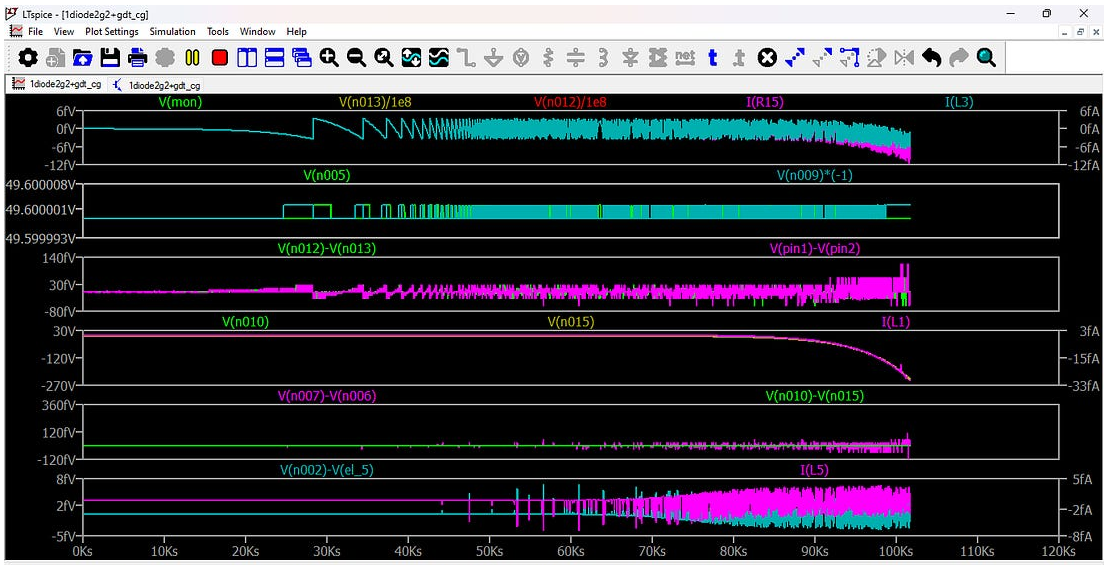

V(mon)
I(R15)
4.0µV
-0.4µV
-4.8µV
4.0µA
-0.4µA
-4.8µA
V(n012)
V(n013)
V(n005)
V(n009)
150V
0V
-150V
V(n010)
V(n015)
I(L1)
0GV
-15GV
-30GV
0.4µA
-1.8µA
-4.0µA
V(n010)-V(n015)
1.0nV
0.0nV
-1.0nV
I(L3)
2.0µA
-0.2µA
-2.4µA
V(n007)-V(n006)
240mV
-90mV
-420mV
I(L5)
2.0µA
-0.2µA
-2.4µA
V(n002)-V(el_5)
2.4µV
0.2µV
-2.0µV
0Ks
20Ks
60Ks
80Ks
120Ks
140Ks
160Ks
200Ks


V(mon)
V(n013)/1e8
V(n012)/1e8
I(R15)
I(L3)
4.2fV
0.0fV
-4.2fV
4.2fA
0.0fA
-4.2fA
V(n005)
V(n009)*(-1)
49.600008V
49.600001V
49.599993V
V(n012)-V(n013)
30fV
0fV
-30fV
V(n010)
V(n015)
I(L1)
0.0mV
-1.8mV
-3.6mV
0.00005fA
-0.00022fA
-0.00050fA
V(pin1)-V(pin2)
30fV
0fV
-30fV
V(n007)-V(n006)
V(n010)-V(n015)
8fV
-12fV
-32fV
V(n002)-V(el_5)
I(L5)
0.0020fV
-0.0007fV
-0.0035fV
0.0035fA
0.0007fA
-0.0020fA
24.200000Ks
25.744879Ks
27.289759Ks
28.834638Ks
30.379518Ks
31.924397Ks
33.469276Ks
35.014156Ks
36.559035Ks
38.103915Ks

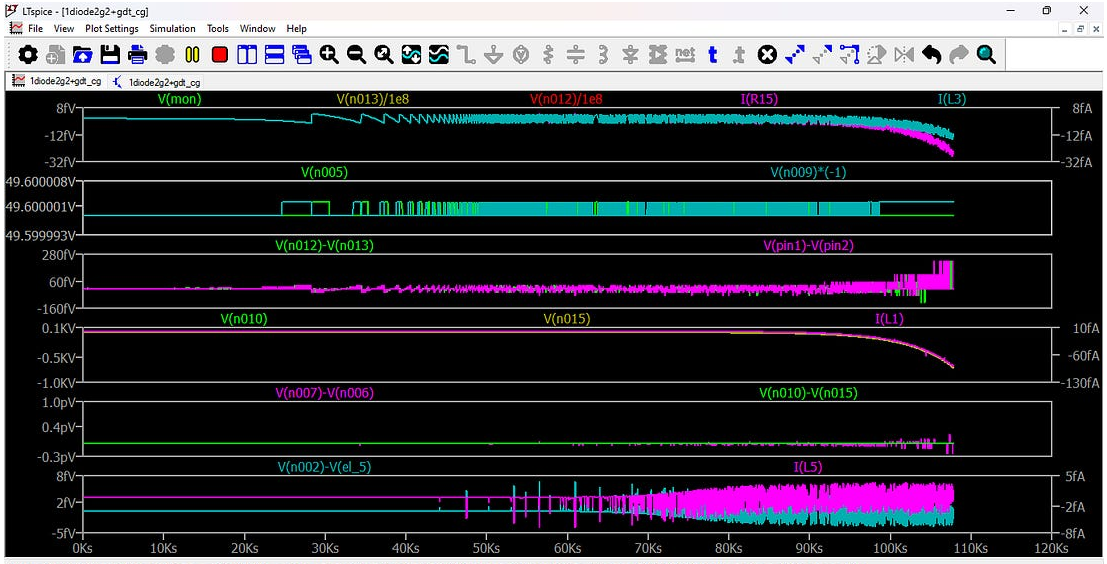




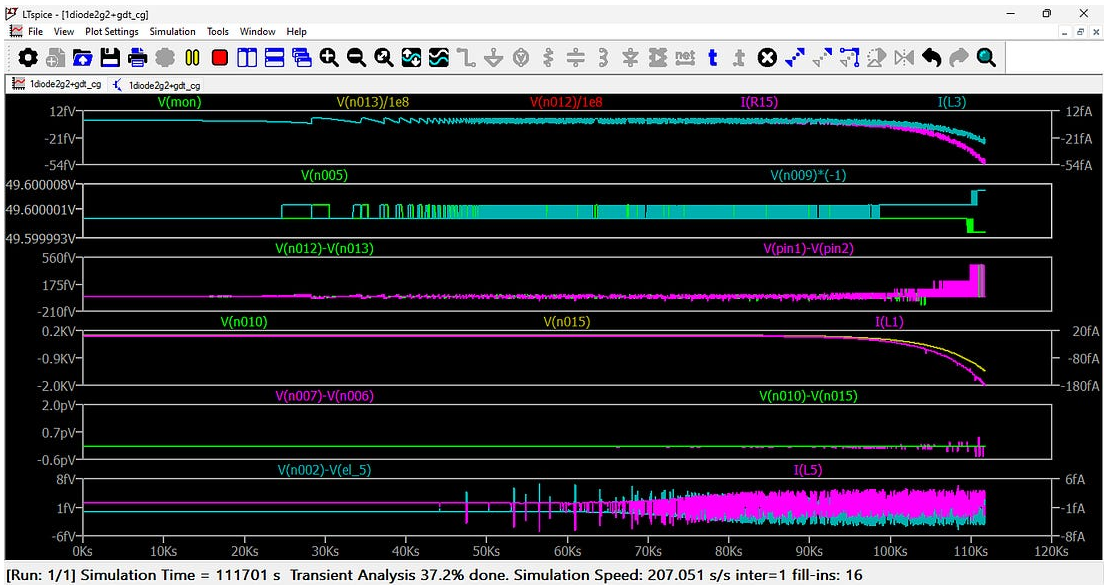
[Run: 1/1] Simulation Time = 74464.8 s Transient Analysis 24.8% done. Simulation Speed: 83.1673 s/s inter=1 fill-ins: 16

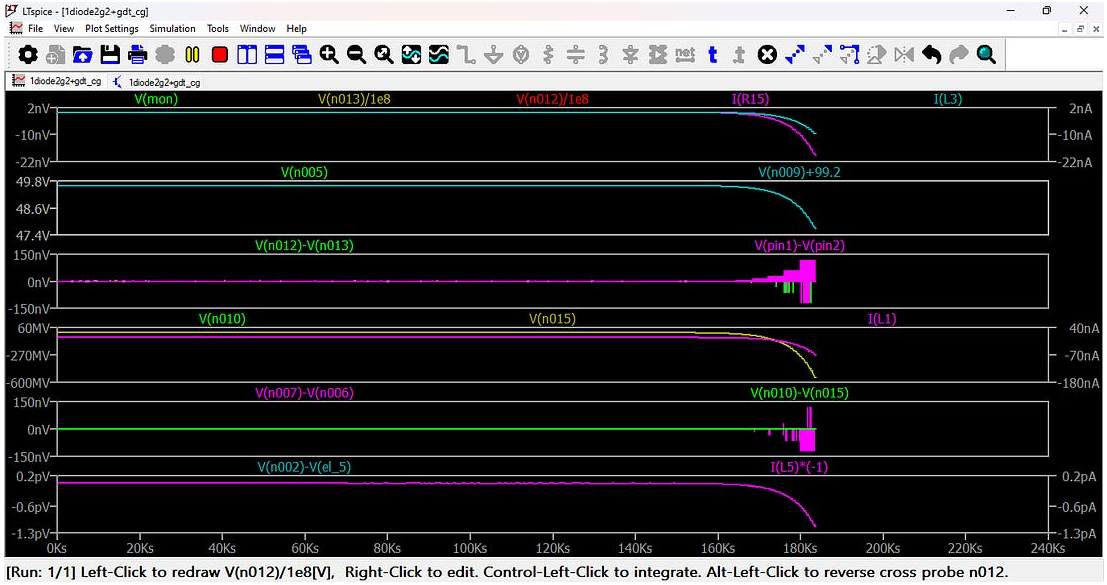


[Run: 1/1] Simulation Time = 101642 s Transient Analysis 33.9% done. Simulation Speed: 225.787 s/s inter=1 fill-ins: 16

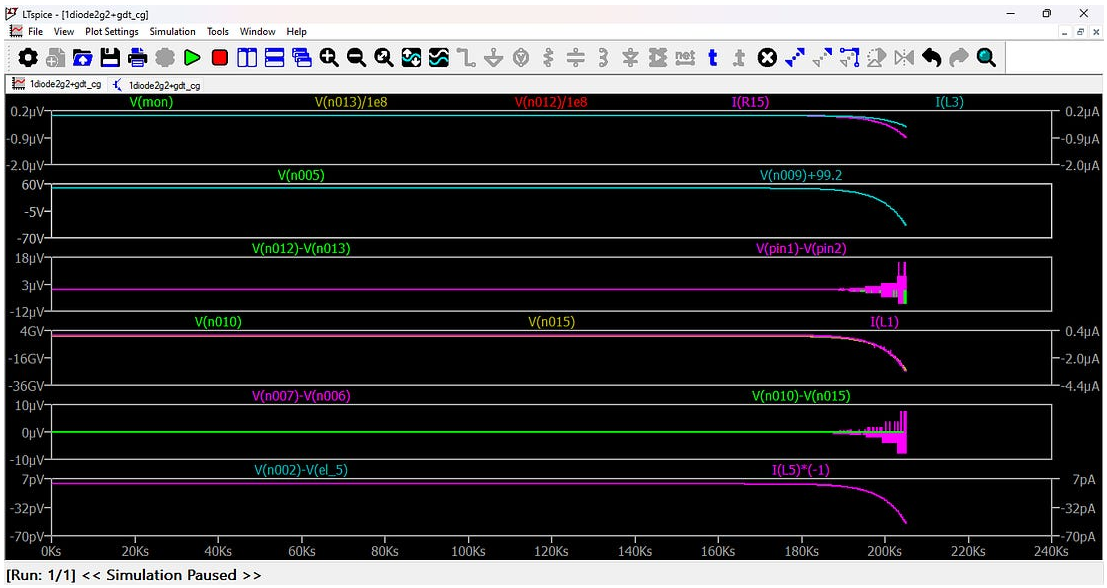


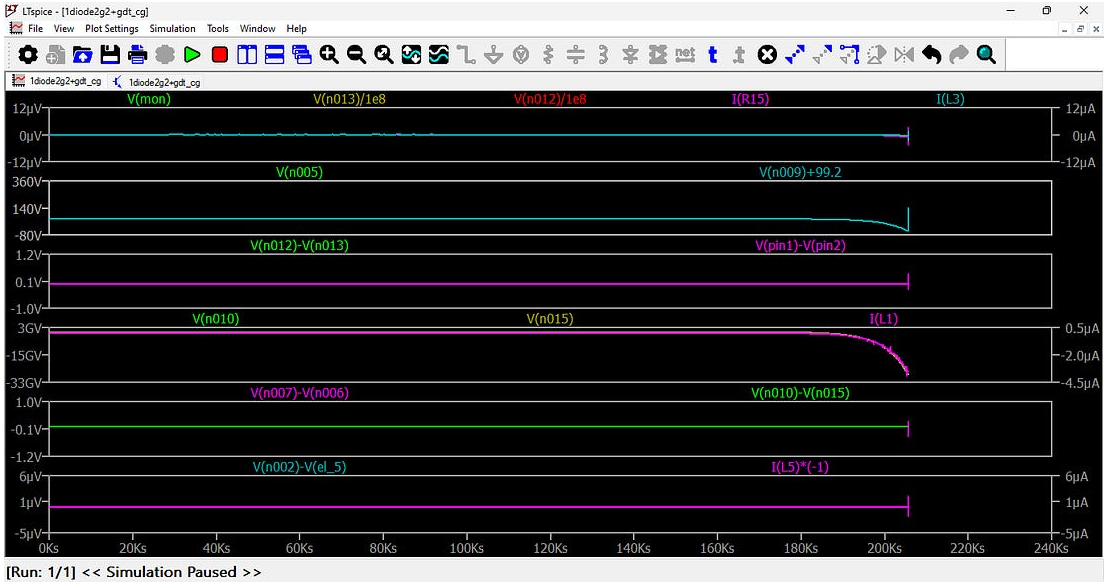
[Run: 1/1] Simulation Time = 107745 s Transient Analysis 35.9% done. Simulation Speed: 202.902 s/s inter=1 fill-ins: 16





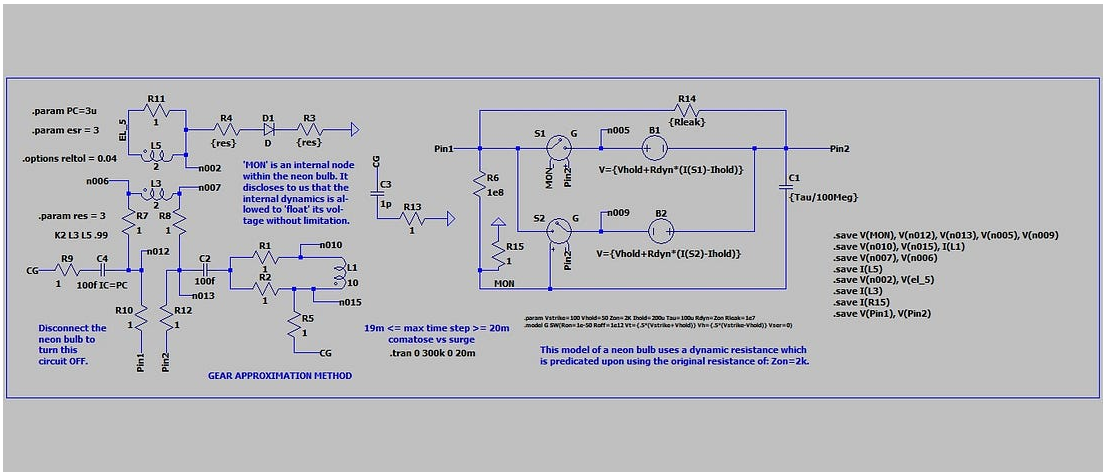
What I've learned from the second graph of this screenshot is that the series voltage, within the neon bulb sub, is not merely designed with the intention of maintaining a D/C input of 49.6V. But what I see happening as it escalates is a 99.2V difference between switch #1 and switch #2. -- Whatever that portends, I don't know!





It’s obvious that the neon bulb has turned ‘ON’ since the nodal voltages of 12, 13, 5, and 9 have all risen above the minimum voltage that is required (at above 100 volts; second graph from the top). Thus, an explosion has occurred causing the simulator to slow down its numeric calculations to a crawl of milliseconds per second of runtime instead of its previous speed of hundreds of seconds per second. So, I had to prematurely terminate this simulation lest I wait all night long for it to terminate at 300ks.

So, the previous estimations, by this simulator, of infinite (vertical) gain at the termination of a 100ks runtime, was not so far off from accuracy after all.



Pin1 and Pin2 have been added to “saved” parameters.

Download this circuit from my website or from my Google Docs account.
