

# How tall must a grounded aerial be to possess a voltage difference of 6V?

Bill Fogel's transistor, pt. 2



VINYASI

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Me:

How tall must a grounded aerial be to possess a voltage difference of 6V?

AI:

We can estimate the height of a vertical conductor (aerial) required to produce a voltage difference relative to the ground using **electric field concepts**.

## Step 1: Relate Voltage to Electric Field

The voltage difference  $V$  between a grounded point and a height  $h$  in a uniform electric field  $E$  is:

$$V = E \cdot h$$

where  $E$  is the vertical component of the **electric field** near the ground.

## Step 2: Use Typical Atmospheric Electric Field

Under fair weather conditions, the Earth's electric field is approximately:

$$E \approx 100 \text{ V/m}$$

This is a standard average; it can vary from 50 V/m to 150 V/m depending on local conditions.

### Step 3: Solve for Height $h$

Rewriting  $V = E \cdot h$  gives:

$$h = \frac{V}{E}$$

Given  $V = 6 \text{ V}$  and  $E \approx 100 \text{ V/m}$ :

$$h = \frac{6}{100} = 0.06 \text{ m} = 6 \text{ cm}$$

### Step 4: Consider Edge Cases

- If the local electric field is smaller, say  $E = 50 \text{ V/m}$ :

$$h = \frac{6}{50} = 0.12 \text{ m} = 12 \text{ cm}$$

- If the local field is stronger, say  $E = 150 \text{ V/m}$ :

$$h = \frac{6}{150} = 0.04 \text{ m} = 4 \text{ cm}$$

### Final Answer

For typical fair-weather conditions:

$$\boxed{h \approx 6 \text{ cm}}$$

This is the approximate height of a grounded aerial needed to produce a **6 V potential difference** relative to the Earth. Adjust proportionally if the local electric field differs.

Source(s):

1. [eCFR :: Appendix C to Subpart V of Part 1926, Title 29 -- Protection](#)

From Hazardous Differences in Electric Potential

2. 1910.269 App C - Protection From Hazardous Differences in Electric Potential | Occupational Safety and Health Administration

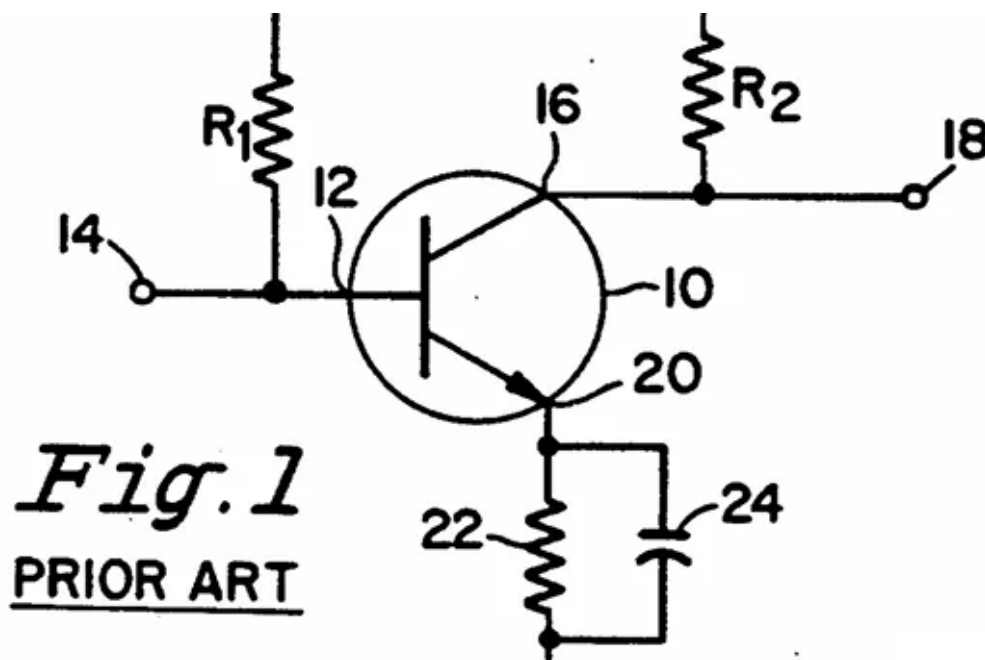
3. GO 95 Rules for Electric Overhead Line Construction Jan2020.pdf

4. ARTICLE 250 - GROUNDING AND BONDING

Considering the aforementioned dialogue with AI, it would appear to me that the simulation attempt of replicating Bill Fogel's transistor circuit in a previous post:

## **Bill Fogel may have figured out Gabriel Kron's Negative Resistor which may have originated with Nikola Tesla? - pt. 1**

VINYASI · MAY 3



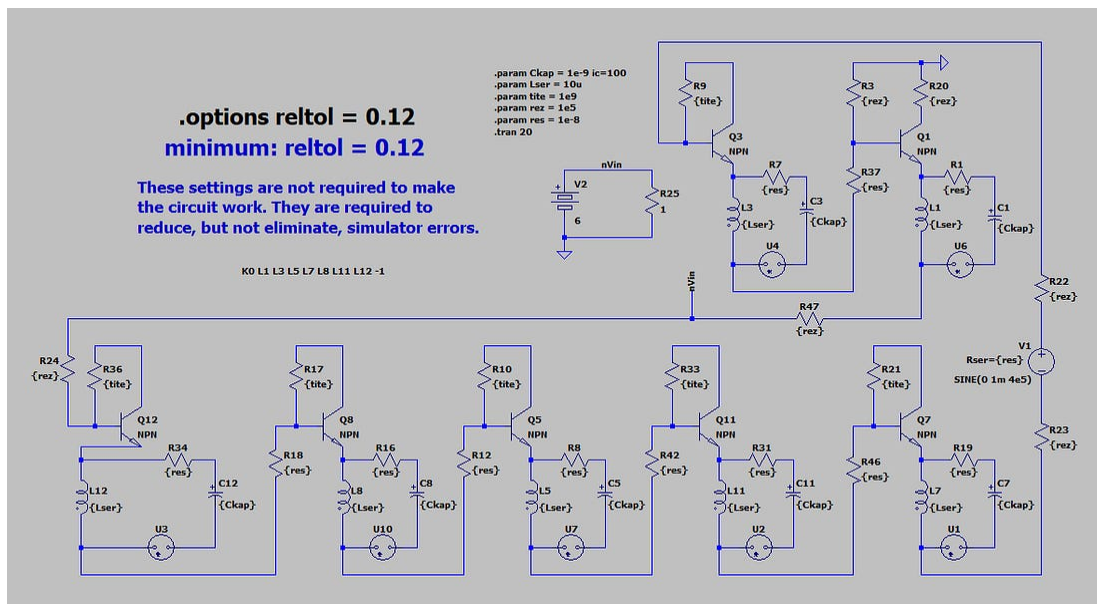
Gabriel Kron boasted that ...

[Read full story](#)

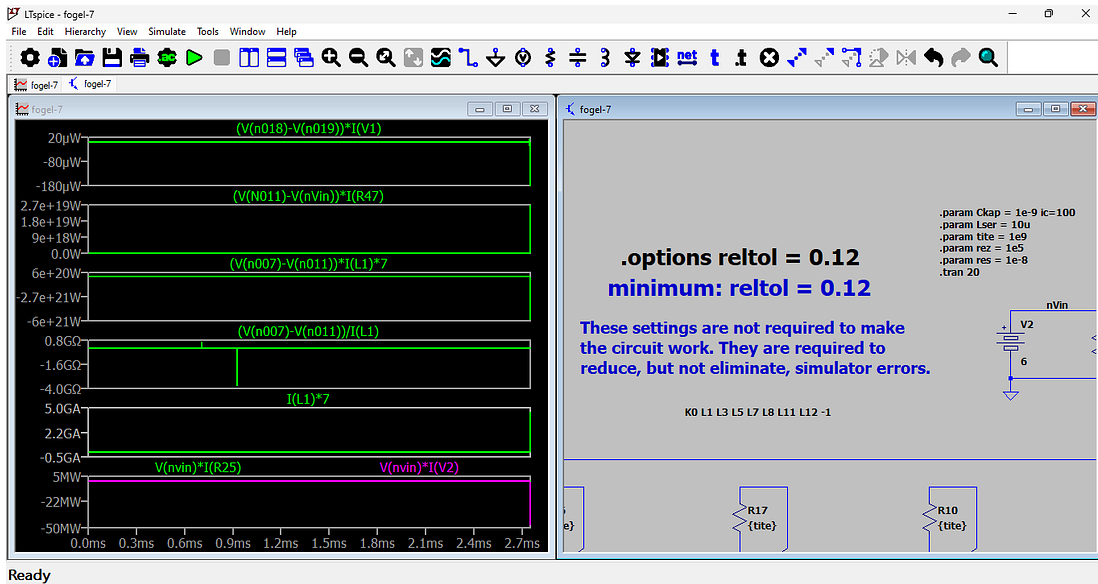
... could replace the 6V battery on the left side of the circuit with a grounded aerial to suck energy from out of the ground and produce St. Elmo's Fire!

This reminiscence comes courtesy of Byron Brubaker. But he used alternating layers of crushed aluminum cans, wood ash from campfire pits, and charcoal from the same place, and all of it wetted down with water to create a voltaic pile in a campground when the top is shorted with the ground, nearby, using battery cable.

Let's review yesterday's circuit and see whether it can be simplified:



So, it *can be* simplified to seven transistor modules. Here's the outcome:



Here's the log file:

LTspice 24.1.9 for Windows

Circuit: D:\Documents\Sims\LTSpice\2026\05 - May\04\mumu\fogel-7.net

Start Time: Mon May 4 18:20:32 2026

Options: reltol = 0.12

solver = Normal

Maximum thread count: 4

tnom = 27

temp = 27

method = trap

reltol = 0.12

Early termination of direct N-R iteration.

Direct Newton iteration failed to find .op point. (Use ".option noopiter"  
to skip.)

Starting Gmin stepping

Gmin = 10

Gmin = 1.07374

Gmin = 0.115292

Gmin = 0.0123794

Gmin = 0.00132923

Gmin = 0.000142725

Gmin = 1.5325e-05

Gmin = 1.6455e-06

Gmin = 1.76685e-07

Gmin = 1.89714e-08

Gmin = 2.03704e-09

Gmin = 2.18725e-10

Gmin = 2.34854e-11

Gmin = 2.52173e-12

Gmin = 2.70769e-13

Gmin = 0

Gmin stepping succeeded in finding the operating point.

Warning: Simulation tolerance relaxed to achieve convergence from  
2.7512703864337683e-03

Convergence Failure: Time step too small; time = 0.00275127, timestep  
= 1.25013e-18: trouble with instance "Q5"

Simulation Failed: Iteration limit reached

Total elapsed time: 16.854 seconds.

Files loaded:

D:\Documents\Sims\LTspice\2026\05 - May\04\mumu\fogel-7.net

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

C:\Users\vinya\AppData\Local\LTspice\lib\sub\neonbulb.sub

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Here's the netlist:

\* D:\Documents\Sims\LTspice\2026\05 - May\04\mumu\fogel-7.asc

\* Generated by LTspice 24.1.9 for Windows.

C1 N008 N012 {Ckap}

L1 N007 N011 {Lser} Rser={Lser}

R1 N008 N007 {res}

Q1 N003 N004 N007 0 NPN

R3 0 N004 {rez}

C3 N006 N010 {Ckap}

L3 N005 N009 {Lser} Rser={Lser}

R7 N006 N005 {res}

Q3 N002 N001 N005 0 NPN

R9 N002 N001 {tite}

C7 N034 N044 {Ckap}

L7 N033 N043 {Lser} Rser={Lser}

R19 N034 N033 {res}

Q7 N017 N024 N033 0 NPN

R21 N017 N024 {tite}

C11 N032 N042 {Ckap}

L11 N031 N041 {Lser} Rser={Lser}

R31 N032 N031 {res}

Q11 N016 N023 N031 0 NPN

R33 N016 N023 {tite}

C12 N026 N036 {Ckap}

L12 N025 N035 {Lser} Rser={Lser}

R34 N026 N025 {res}

Q12 N013 N020 N025 0 NPN

R36 N013 N020 {tite}

V1 N018 N019 SINE(0 1m 4e5) Rser={res}

R37 N009 N004 {res}

R42 N039 N023 {res}

R46 N041 N024 {res}

R47 N011 nVin {rez}

X§U1 N044 N043 neonbulb Vstrike=100 Vhold=50 Zon=2K Ihold=200u  
Tau=100u

X§U2 N042 N041 neonbulb Vstrike=100 Vhold=50 Zon=2K Ihold=200u  
Tau=100u

X§U3 N036 N035 neonbulb Vstrike=100 Vhold=50 Zon=2K Ihold=200u  
Tau=100u

X§U4 N010 N009 neonbulb Vstrike=100 Vhold=50 Zon=2K Ihold=200u  
Tau=100u

X§U6 N012 N011 neonbulb Vstrike=100 Vhold=50 Zon=2K Ihold=200u  
Tau=100u

C5 N030 N040 {Ckap}

L5 N029 N039 {Lser} Rser={Lser}

R8 N030 N029 {res}

Q5 N015 N022 N029 0 NPN

R10 N015 N022 {tite}

R12 N037 N022 {res}

X\$U7 N040 N039 neonbulb Vstrike=100 Vhold=50 Zon=2K Ihold=200u  
Tau=100u

C8 N028 N038 {Ckap}

L8 N027 N037 {Lser} Rser={Lser}

R16 N028 N027 {res}

Q8 N014 N021 N027 0 NPN

R17 N014 N021 {tite}

R18 N035 N021 {res}

X\$U10 N038 N037 neonbulb Vstrike=100 Vhold=50 Zon=2K Ihold=200u  
Tau=100u

R20 0 N003 {rez}

R22 N001 N018 {rez}

R23 N019 N043 {rez}

R24 N020 nVin {rez}

V2 nVin 0 6

R25 nVin 0 1

.model NPN NPN

.model PNP PNP

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

```
.param Ckap = 1e-9 ic=100
```

```
.param Lser = 10u
```

```
.param tite = 1e9
```

```
.param rez = 1e5
```

```
.param res = 1e-8
```

```
.tran 20
```

```
K0 L1 L3 L5 L7 L8 L11 L12 -1
```

```
.options reitot = 0.12
```

```
* minimum: reitot = 0.12
```

\* These settings are not required to make the circuit work. They are required to reduce, but not eliminate, simulator errors.

```
.lib neonbulb.sub
```

```
.backanno
```

```
.end
```

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[Download this circuit's simulation files.](#)

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