

## Lab D10: Investigating a Genecon

**Goal:** To learn as much as possible about the inner workings of a Genecon without taking it apart.

**Prelab:** Read Cutnell & Johnson 22.7 and the boxed-in portions of the attached page.

**Method:**

Genecons	capacitors
6 volt bulbs in holders	connecting wires
analog multimeters	various batteries, battery holders
oscilloscope	

### CAUTION

*The Genecons are fragile instruments. Dropping a Genecon can permanently damage it. Cranking the handle too fast can strip the gears and render the Genecon permanently useless.*

*On the other hand, the Genecon is also a powerful instrument. If it is cranked too rapidly, the Genecon can generate sufficient voltage to burn out a light bulb or to blow the fuse on the analog multimeter.*

*Please **DO NOT USE THE GENECONS or THE ANALOG MULTIMETERS** until the instructor has taught you how to use the analog multimeter properly and to read the scale.*

- 1) The working of an analog multimeter is similar to the working of a galvanometer. The instructor will help you understand which ports the red and black leads should be plugged into and also how to read the scale(s) which is a bit tricky. Please make sure that you understand how to read the scale, depending on which dial the multimeter is set to in this lab. In this lab you should only be measuring voltage differences (*never* current) with the multimeter.
- 2) Spend a few minutes in general investigation of the Genecon connected to (in turn) a multimeter, a light bulb, a battery, a capacitor (can you charge it? How do you know it's charged?), another Genecon, and even your own two hands (no other body parts, please). Record all your observations in your lab book (of course). Throughout, take care not to crank the Genecon too fast. Also, keep in mind that this is a *physics* experiment. Be thinking about what you observe and how it ties into what you already know or learned from the book. If there is something you don't understand, please ask.
- 3) Is the Genecon a generator or a motor? Explain.

## Part II: Investigations with an oscilloscope

1. Turn on your oscilloscope and set controls as follows:

Both red-top knobs turned to CAL'D position.

Knob at far upper right pushed in.

DC/AC on DC (left side)

Volts/Div on 2 (left side)

Time/Div on 2 ms (right side)

Push GND (left side under AC/DC) in. This grounds the vertical deflection plates so that the electron beam scans across the screen at  $V=0$ . This will be your time axis. Use the vertical control (far upper left) to move the time axis so that it splits the screen horizontally. Once this is done, push GND again so that the button comes out.

2. In a previous lab, you learned how to use an oscilloscope. As review, what do the vertical and horizontal scales on the oscilloscope screen measure?
3. Connect the leads of the Genecon to the oscilloscope. While turning at a steady rate of about 1 turn per second, measure the period of the voltage (a period is twice the time from one peak to the next). If you have trouble getting a steady pattern, try a time scale of 5 or 10 ms/div. Sketch the screen as a graph (half page) with voltage and time axes. Label and number the axes.
4. Calculate the frequency of the voltage in units of  $s^{-1}$ . Compare this to the frequency of turning. Examine the inner workings of the Genecon as best you can and then try to explain why the voltage frequency is so much greater than the rotation frequency of the crank.
5. Connect the leads of the Genecon to a  $10\text{-}\Omega$  resistor. Turn very slowly and then increase gradually. Avoid turning extremely fast, as this may strip the gears. How does the mechanical opposition to turning change? Touch the resistor. What do you feel? What can you conclude?
6. Do an experiment to see how the mechanical opposition to turning depends on the electrical resistance (load) between the leads of the Genecon. Tell what you keep constant in your experiment. Use resistors of 0, 10, 100, 1000, and infinite ohms. Tell how you get 0 and infinite resistance. Record your data in an understandable way. Formulate a conclusion in a sentence.
7. Measure the electrical resistance of a light bulb by feel. That is, connect the bulb to a Genecon and turn at the same rate as in #6. Estimate the electrical resistance by the amount of mechanical opposition that you feel. Does this change with brightness about the same way as when you measured the resistance of a light bulb several weeks ago?

**Now answer the following questions. Good answers require a thorough familiarity with the reading material.**

8. The voltage waveform from the Genecon is periodic, but it's not sinusoidal. What does this tell you about the inner construction of the device?
9. The voltage from the Genecon is always greater than 0 while you are turning. What does this tell you about the inner construction of the device?
10. Why does the mechanical opposition to turning increase with decreasing load? You will need to consider such things as: i) how current depends on resistance, ii) the influence of the induced magnetic field, iii) Lenz' Law and conservation of energy.