A Negative Resistance Oscillator

BY RICHARD GRAY

Have you ever wanted to know the frequency of a resonant circuit or I.F. can? Are you a High Fidelity nut, and would like to know the self-resonant frequency of a transformer? Would you like to know if a coupling coil in a radio is working, and how well? Figure 1 shows an easy circuit for use with your oscilloscope and counter that will answer these questions and a lot more.

The circuit consists of a high speed Op-Amp and a few discrete parts. The circuit reflects the positive feedback resistor to the load as a negative resistance. When the negative resistance is greater than the (positive) resistance of the parallel resonant circuit, the losses are canceled and the circuit oscillates. The Bi-Color LED and buffer transistor acts as an indicator. It will glow orange when oscillation takes place (red plus green). The pot should only be advanced to the point where oscillation begins. Further advancing the pot will saturate the circuit and give a false reading of a lower frequency.

The circuit can also be used to evaluate the quality of a tuned circuit and the mutual inductance. If a calibrated knob is used, the dial reading will give the resistance of the circuit at resonance (after a few calculations). The pot should be advanced fully, and backed off to the point where oscillations just cease. Unfortunately, most knobs are not calibrated to have zero at full clockwise rotation.

When using the unit, the sensing leads should be as short as possible to reduce stray capacitance. Also the output cable should be short and connect to the high impedance input of a counter or oscilloscope to avoid loading down the indicator circuit. If the unit is connected across the grid circuit of a tube, the frequency will be lower than expected due to capacitive loading. If the unit is used in the plate circuit (B+ to plate), the frequency will read appreciably higher and very close to what is indicated on the radio dial.

When the unit is not connected to a circuit, the LED will either light red or green. This can also be used to indicate an open coil winding. The same effect may also happen if an iron core transformer is shorted. As the pot is advanced, the LED will tum red or green, instead of orange, indicating oscillations are not taking place, and the transformer is probably shorted

Unfortunately, no one value of "Gain resistor" is best for all measurements. For High "Q" circuits, K=2, (R_K =I0K) is a good choice. As circuits get "lossy", more gain is useful. This is especially true when using inductive coupling. Sometimes it is necessary to advance the pot to the point where oscillations begin, and back off slightly. This is true if the circuit under test has very little capacitive loading. The "Q" of the test circuit can be reduced by shunting with a resistor.

Have fun with this new "toy" and let me know of new uses. By the way, if you are a purist, I have a vacuum tube circuit that also checks tuned circuits

Excerpted & Augmented from the:
Southern California Antique Radio Society "Gazette"
Volume: 22, Number 2 May 1997

NOTES:

The LM318 was something I had in my Junk Box
Any High Speed Op-Amp should also work fine!

Use a Potentiometer with a Plastic Body and Shaft to minimize stray Capacitance

I suggest using two, 9 Volt, Lithium Batteries.
These batteries have a Rated shelf Life of 20 Years, and supposedly never leak!

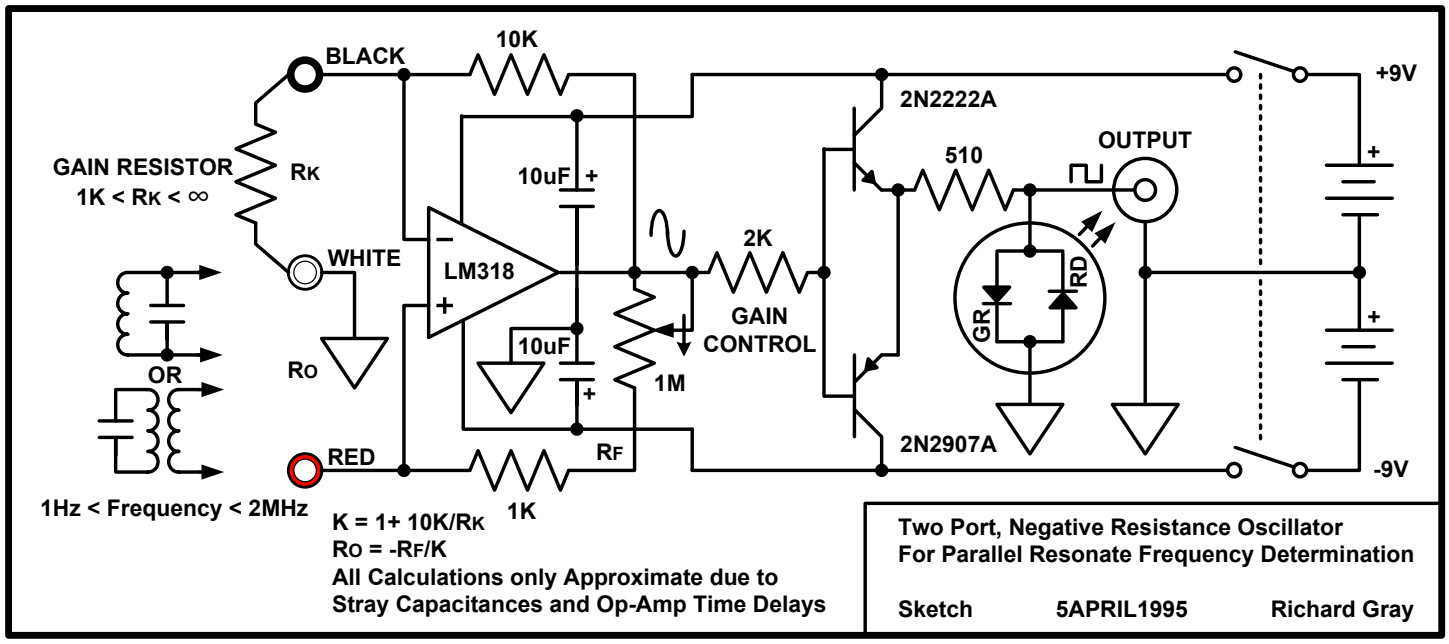
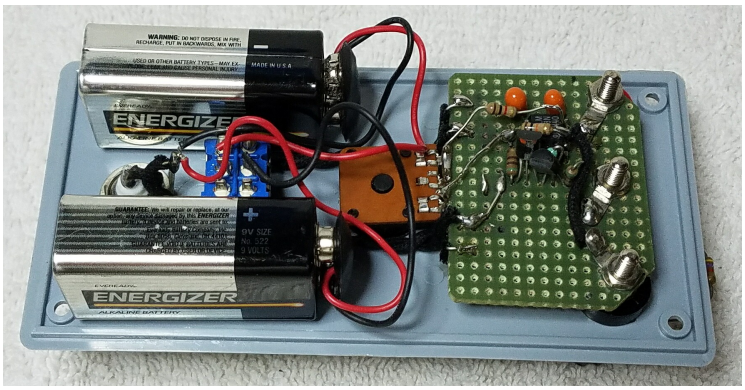


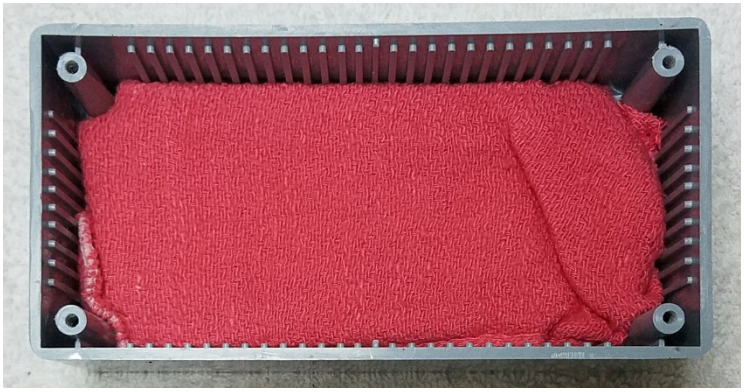
FIGURE 1, SCHEMATIC OF THE NEGATIVE RESISTANCE OSCILLATOR

Top View of Assembled Unit



Circuitry Mounted to the Lid

View Showing the Banana Plug Alligator Clips



View showing the inside of the Box, will cloth to support the Batteries