

LC Resonance with water based capacitors

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1. Abstract

A water fracturing device based on the works of Stanley Meyer consists of an LC circuit with water between the plates of the capacitor. The water is disassociated in hydrogen and oxygen by voltage potential instead of current. However, the presence of water in the capacitor changes the resonance properties of the LC circuit. This paper describes the effect of water as an electrolyte in the capacitor.

2. Introduction

In order for resonance to occur in an LC circuit, the resistance (R) and capacitance (C) should not be too big in relation to the inductance (L). The condition for resonance (under damping) to occur is depicted as:

$$C < 4L / R^2$$

Resonance is not hard to obtain in an LC circuit using a capacitor with an air gap. Even an LC circuit with a resistor instead of a capacitor will resonate due to the distributed capacitance of the coil. However water between the plates of the capacitor will dramatically increase the ESR (Equivalent Series Resistance) of the capacitor. This will have a large damping effect on the LC circuit. To counteract this, a larger coil is needed but this increases R as well because of the length of the wire. Therefore a coil with a large Q (relation of inductance versus resistance) is needed. To reduce the ESR, the plates of the capacitor have to be isolated from the water. This can be done using various methods such as adding a delrin insulator, using spray-on plastic, or epoxy. Another method is oxidizing the plates using an electrolytic process. This is done with commercial capacitors when the aluminium plates are oxidized forming a very thin insulating layer. Interestingly this effect is also observed with WFC (Water Fuel Cell) setups growing a thin layer of insulating white oxide over the course of many hours.

3. Setup

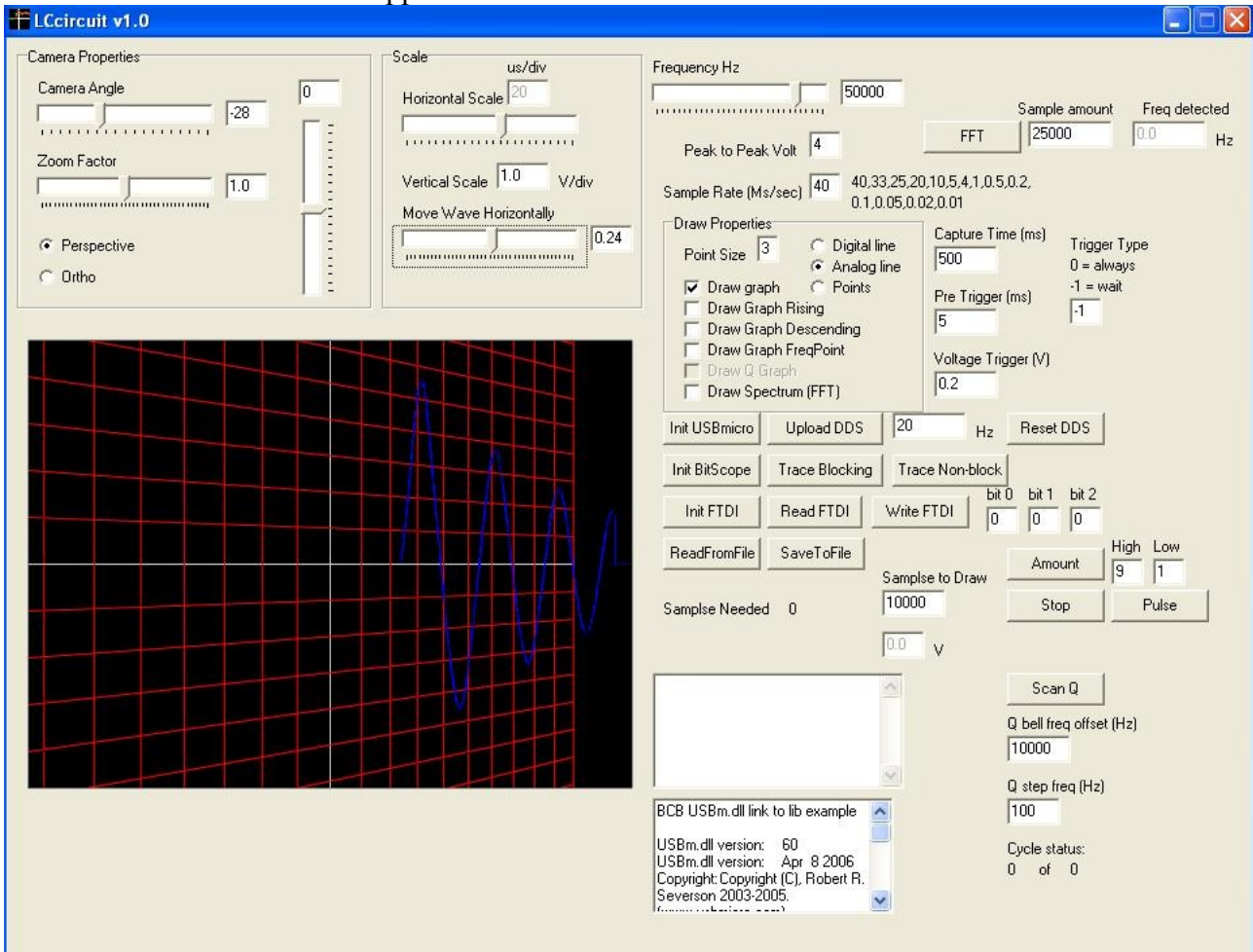
The frequency is generated by a DDS (Direct Digital Synthesizer). This IC (AD9851) can generate a frequency between 0 and 10Mhz with 0.01Hz step resolution in the current setup. Frequency control is done using a PC with a USB connection, communicating with a USB FIFO IC (FT245RL). An FPGA (Field Programmable Gate Array) IC is used for frequency gating. This IC (XC3S100E) enables the the DDS output to be split in a single pulse (with a programmable length), continuous frequency, single pulse train (for example do 5 pulses and then stop), or a continuous gated pulse train (for example do 5 pulses, stop for 3 pulses, then repeat). The FPGA is programmed in VHDL using Xilinx ISE 10.1 Webpack and the code is uploaded with a Digilent USB JTAG programmer.

The frequency output (generated by the DDS but modified by the FPGA) is send to a MOSFET driver (MC34151) which in turn switches a MOSFET (IRF3205) on and off. The MOSFET switches a primary coil which is magnetically coupled via a large toroidal core (T650-52) to a secondary coil. The secondary coil is completely isolated from the primary, so the grounds are not connected. Measurements are done using a normal LC setup (secondary coil in series with capacitor) and a Stanley Meyer setup (secondary coil -> choke 1 -> capacitor -> choke 2) is also used.

The output signal is measured with a differential oscilloscope probe (Pintek DP-25). The use of a differential probe instead of a normal probe is important because the system lacks a common ground. The differential probe is connected to a USB oscilloscope (Bitscope BS310). All measurements are done using a 20x attenuation on the probe unless otherwise noted. So in this case one vertical segment (block) on the probe scale equates to 20 volt. The scope data is read with the

factory supplied software and custom software as well, using and SDK, supplied by the manufacturer. This enables the incoming signal to be analysed using FFT (Fast Fourier Transform). This way the resonance frequency of the LC circuit can be measured instantly by applying a single pulse to the system and measuring the ringing effect. See the paper "A novel method of keeping a dynamic LC circuit in resonance" (by the same author) for more detail. The open source FFT SDK "FFTW" is used in this application.

Screenshot of the custom PC application:

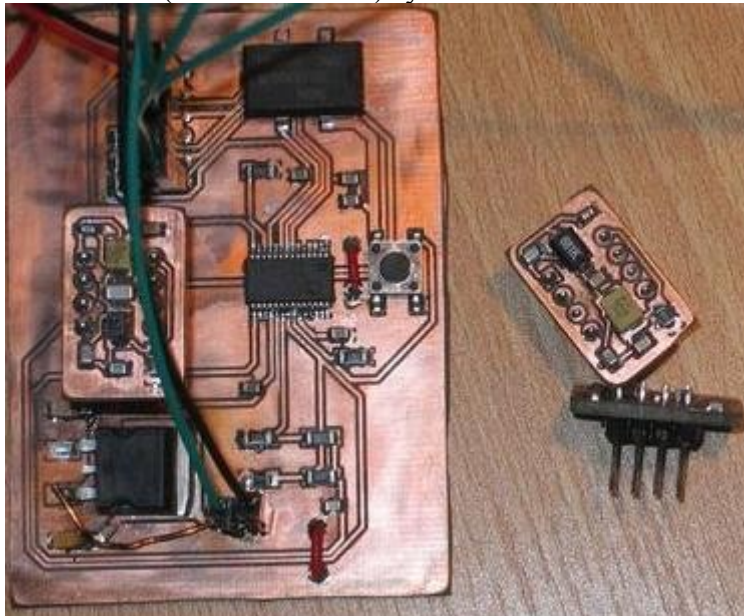


This program can read the oscilloscope data, display the result on a 3d display, do fast fourier transform on the result, and send a frequency or pulse to the LC circuit. The source is programmed in C++ and the scope window uses OpenGL graphics.

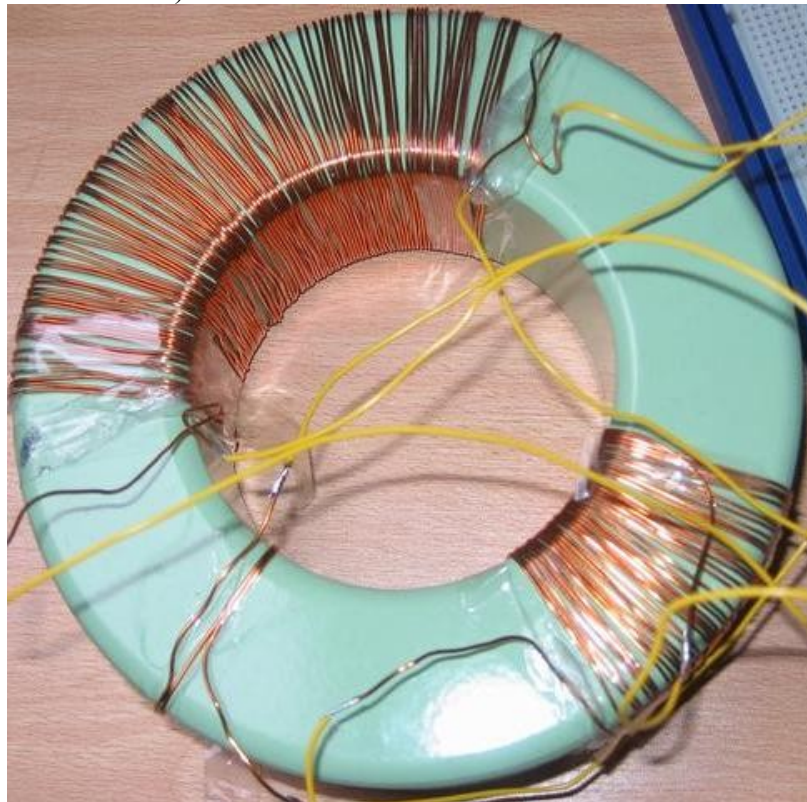
Here is an overview of the hardware used.
FPGA board:



DDS board with a modular LPF (Low Pass Filter) system:



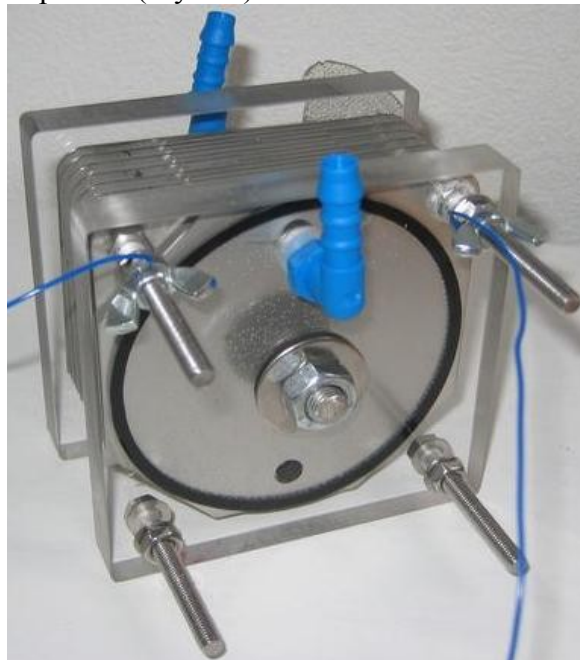
VIC (Voltage Intensifier Circuit):



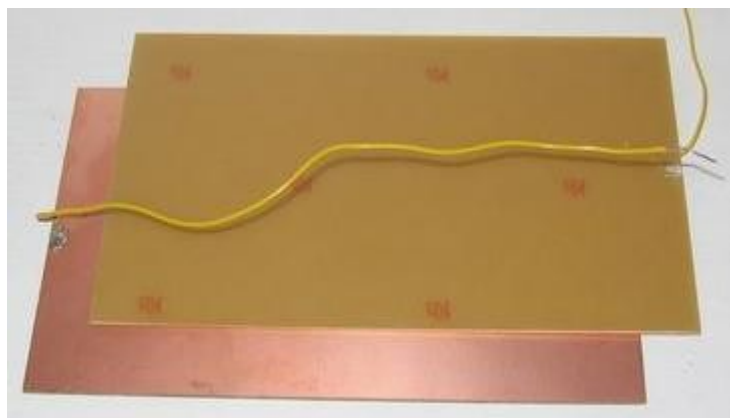
Stainless steel (316L) pipe capacitor (dry cell):



Stainless steel (316L) plate capacitor (dry cell):



PCB plate capacitor:



Variable capacitor:



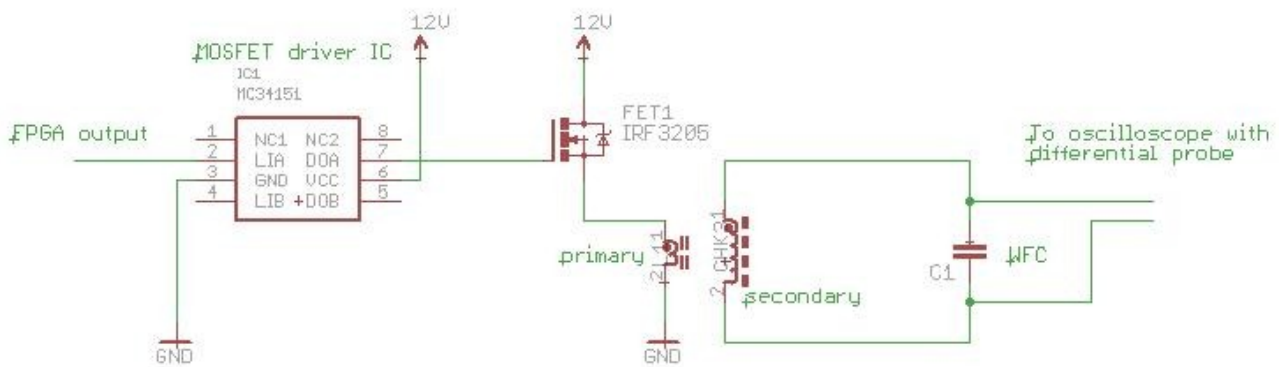
There are three different hardware setups used:

-LC circuit. This is one coil with a capacitor.

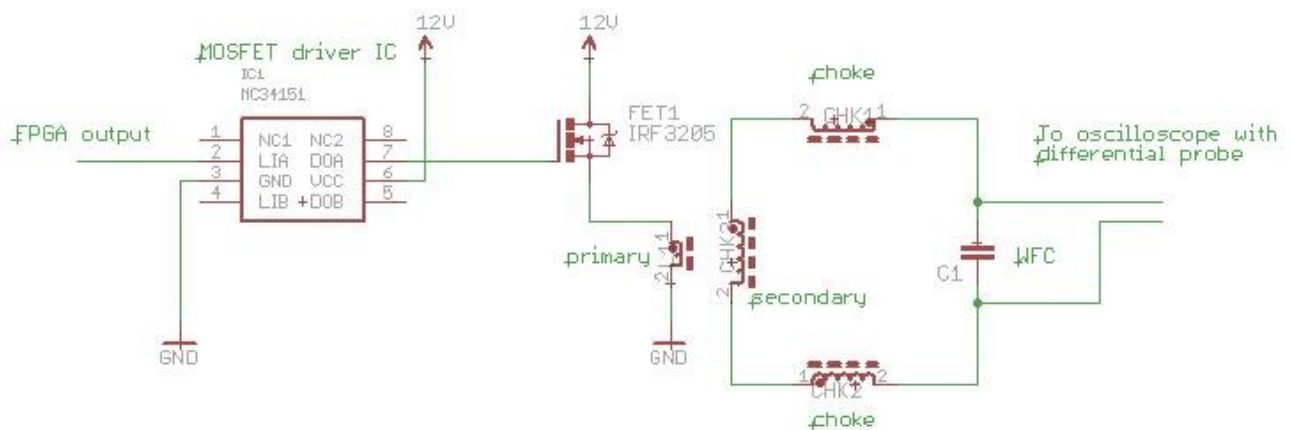
-VIC normal. This is one secondary coil, one capacitor and two chokes all connected in series.

-VIC reversed. This is the same as the VIC normal configuration except that one choke is connected in reverse.

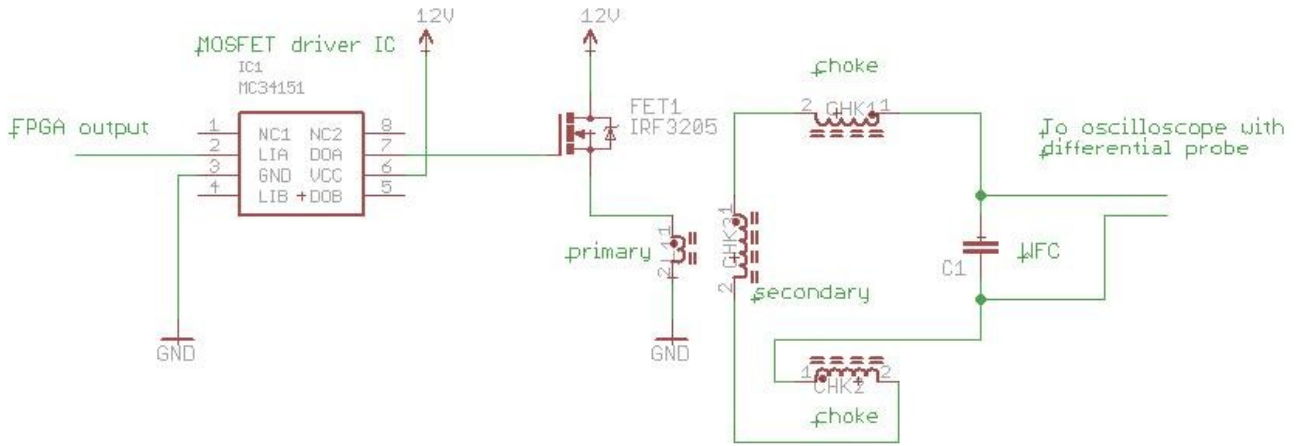
LC circuit:



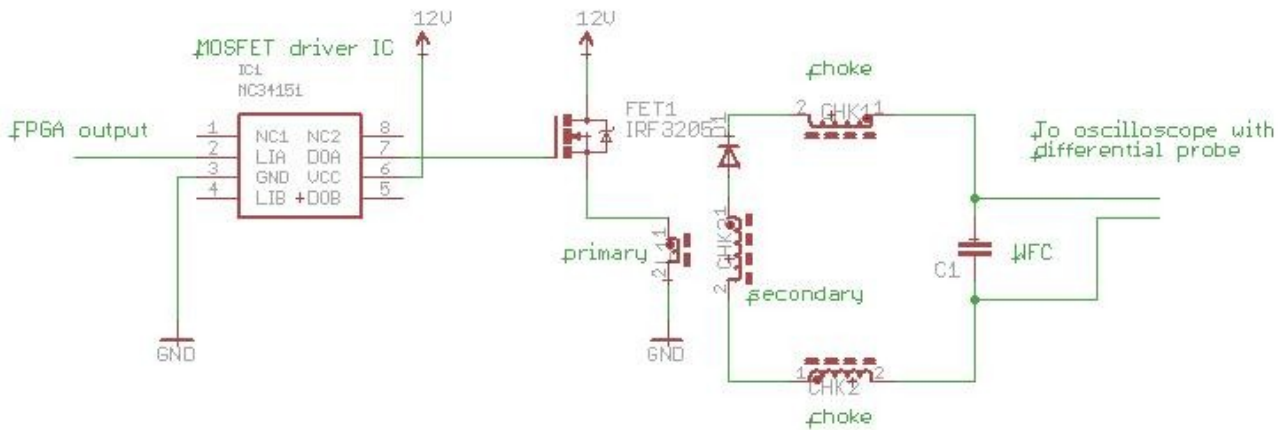
VIC normal configuration:



VIC reversed configuration:



VIC normal configuration but with blocking diode. The location of the diode is the same for the reversed VIC setup:



4. Measurements

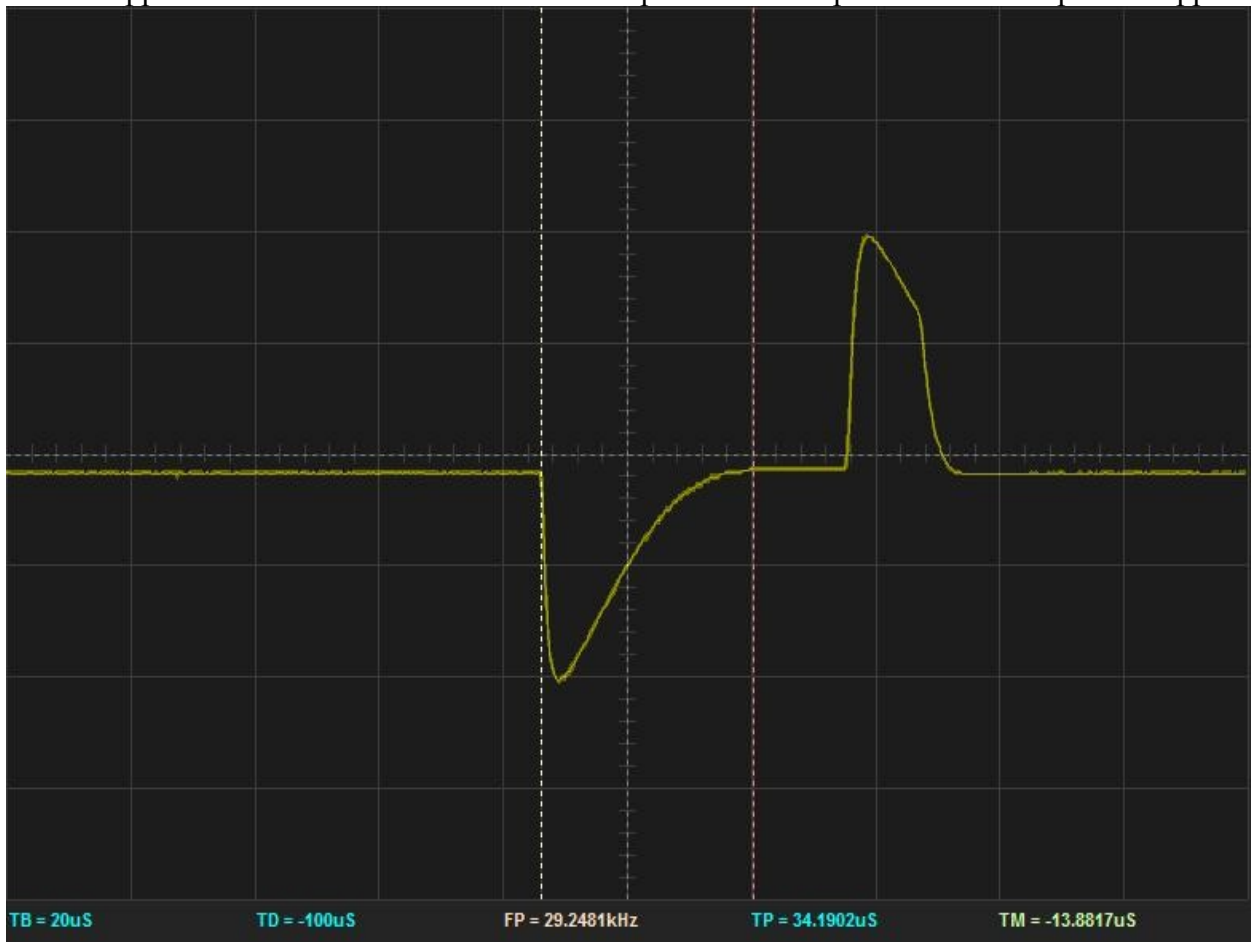
What follow is a series of screenshots from the USB oscilloscope under various conditions. In each screenshot you can see two vertical lines. These have been aligned with the peaks of the wave. Underneath you can read of the frequency of the wave, depicted by FP. All measurements which involves water is done using tap water. Input pulse duration is given as a frequency instead of time to make it easier to compare the input with the output (oscillating), as the output is given as a frequency as well. A 12v battery is used as a power supply for the primary coil.

Let's start with a classic configuration. This is a normal LC circuit with a variable capacitor set at maximum capacitance. A single pulse of 560Khz is applied and this is the result:



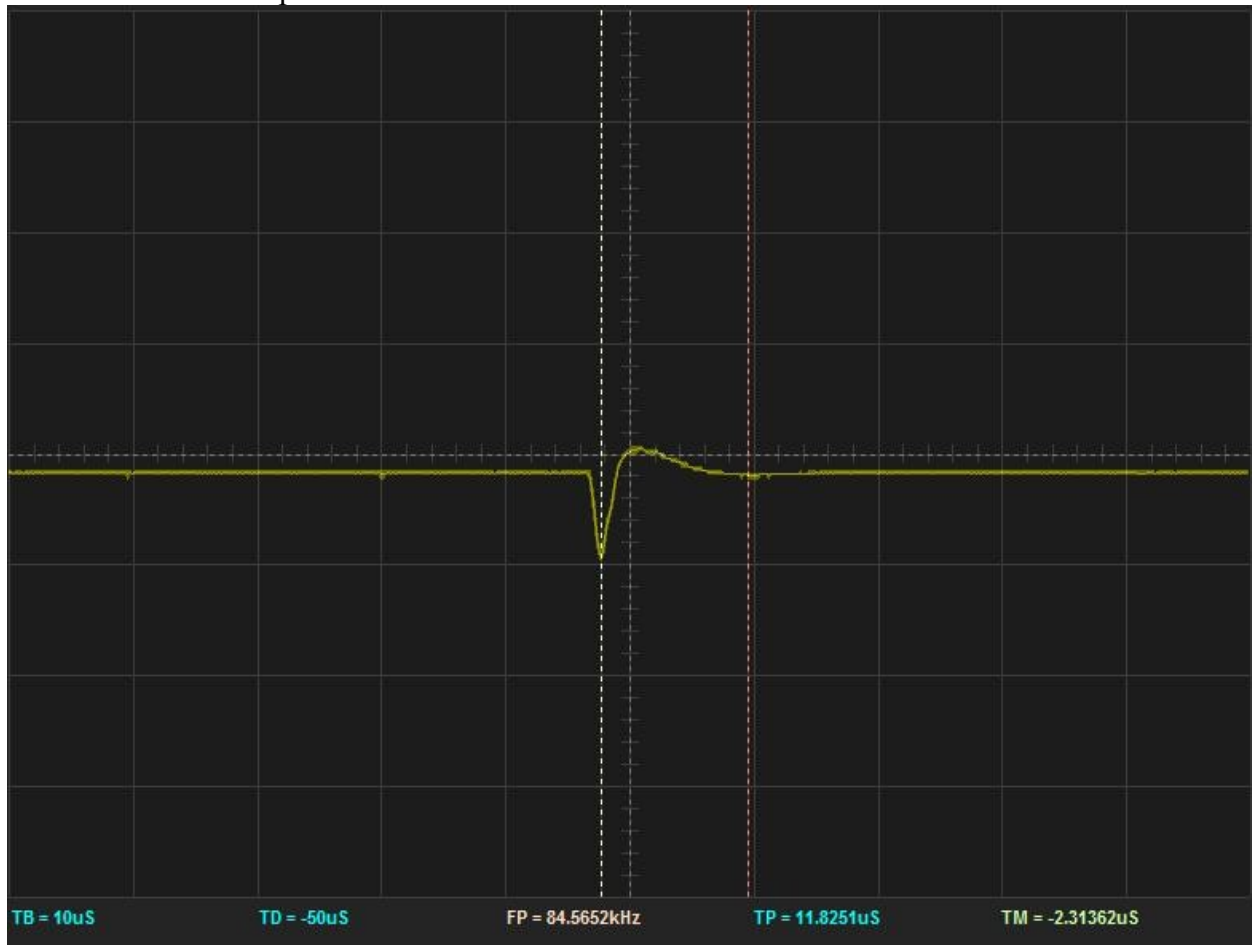
The ringing can clearly be seen.

But this happens when water is added between the plates of the capacitor. A 10Khz pulse is applied:



A charging and discharging capacitor can be seen, but no ringing.

This is with a 560Khz pulse:



The same effect can be seen with the pipe capacitor, the large parallel plate capacitor and two blank PCB's. The water has an over-damping effect and the ringing is stopped.

Note that the LC circuit will resonate again if one of the capacitor plates is disconnected or a series resistor is added. Both configurations will give the same result.



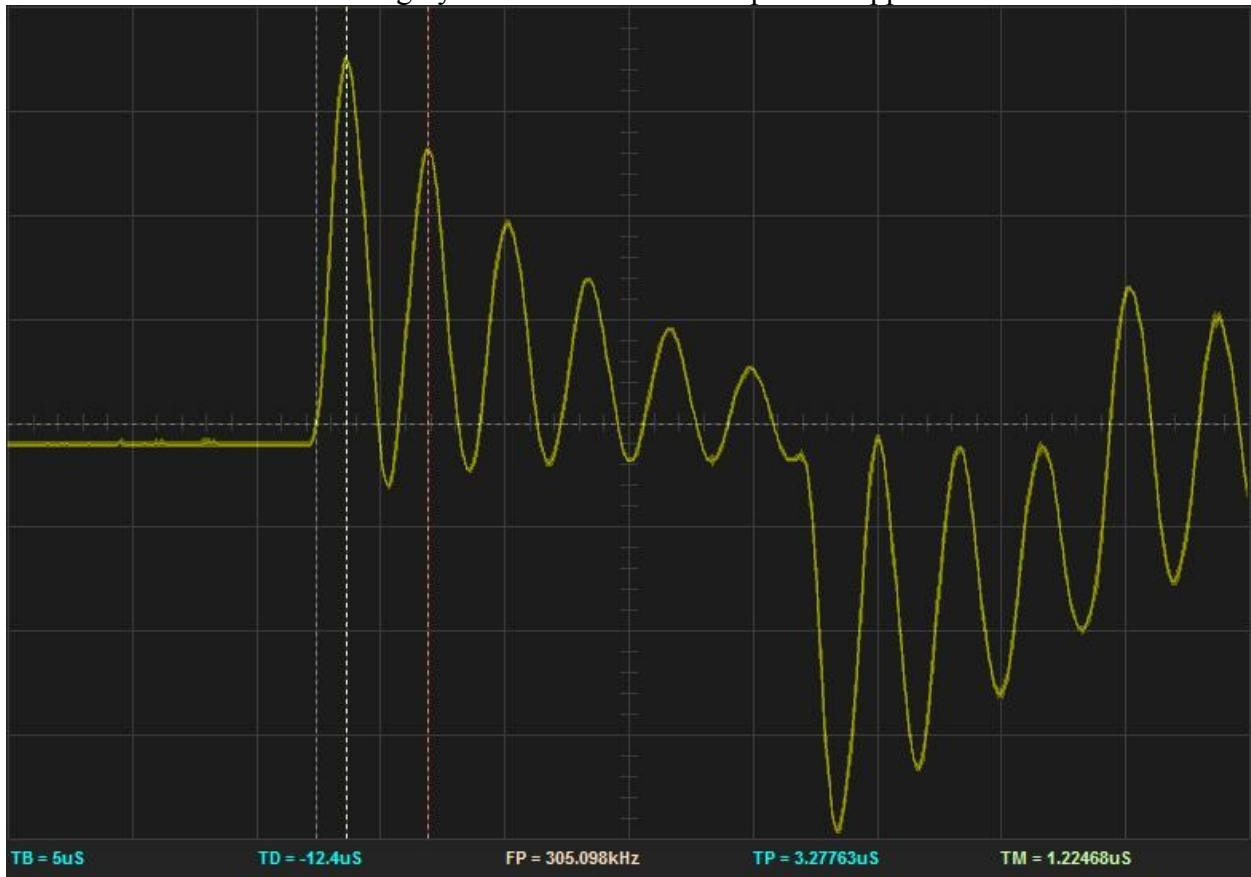
Note that the ringing is the self resonant frequency of the coil. This is evident because of a very high resonance frequency of 684Khz. The capacitor has no effect on the resonant frequency.

Let's see what happens if one of the plates of the PCB capacitor is insulated using PCB plastic spray. A very small amount of moist is added between the plates and a 50Khz pulse is applied:



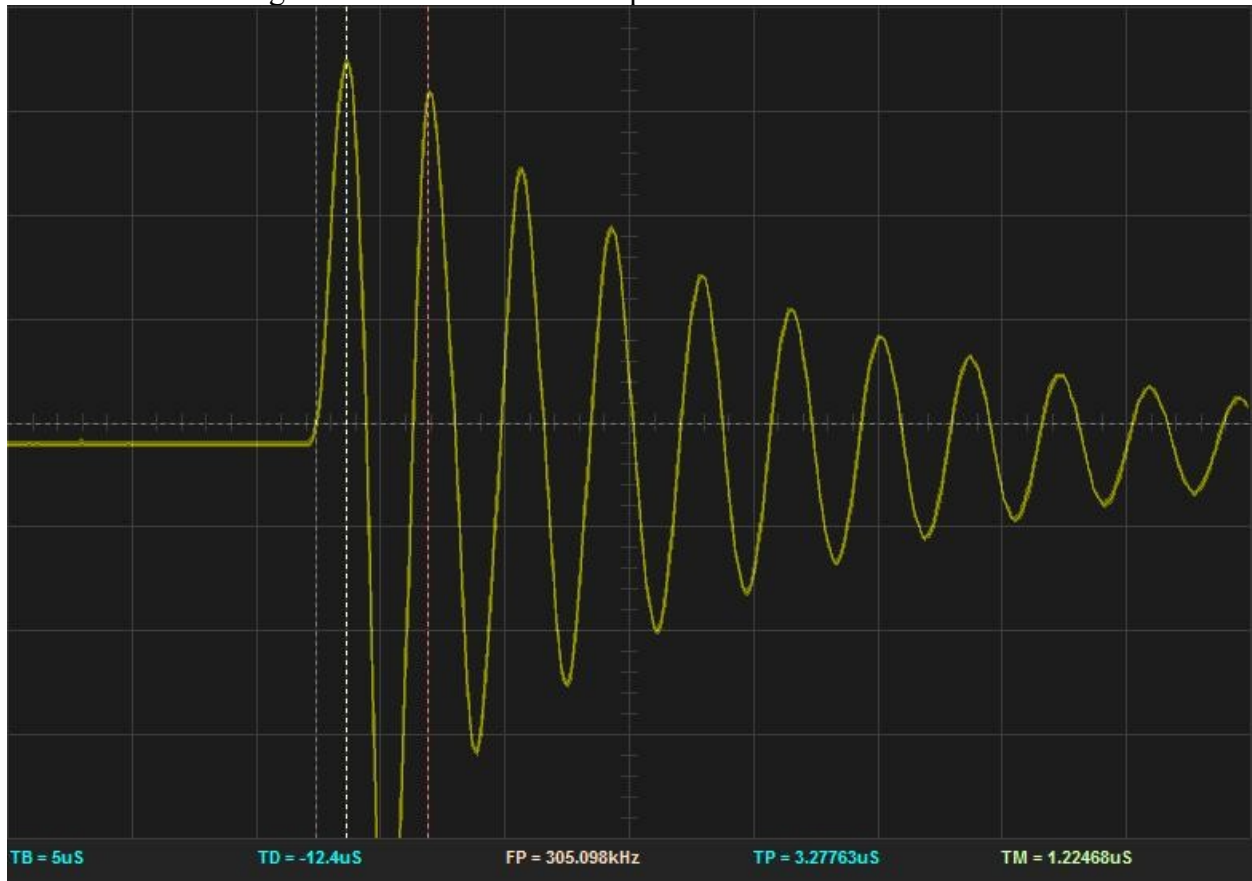
Note that there is barely evidence of ringing.

This time all the moist is thoroughly removed and a 50Khz pulse is applied:

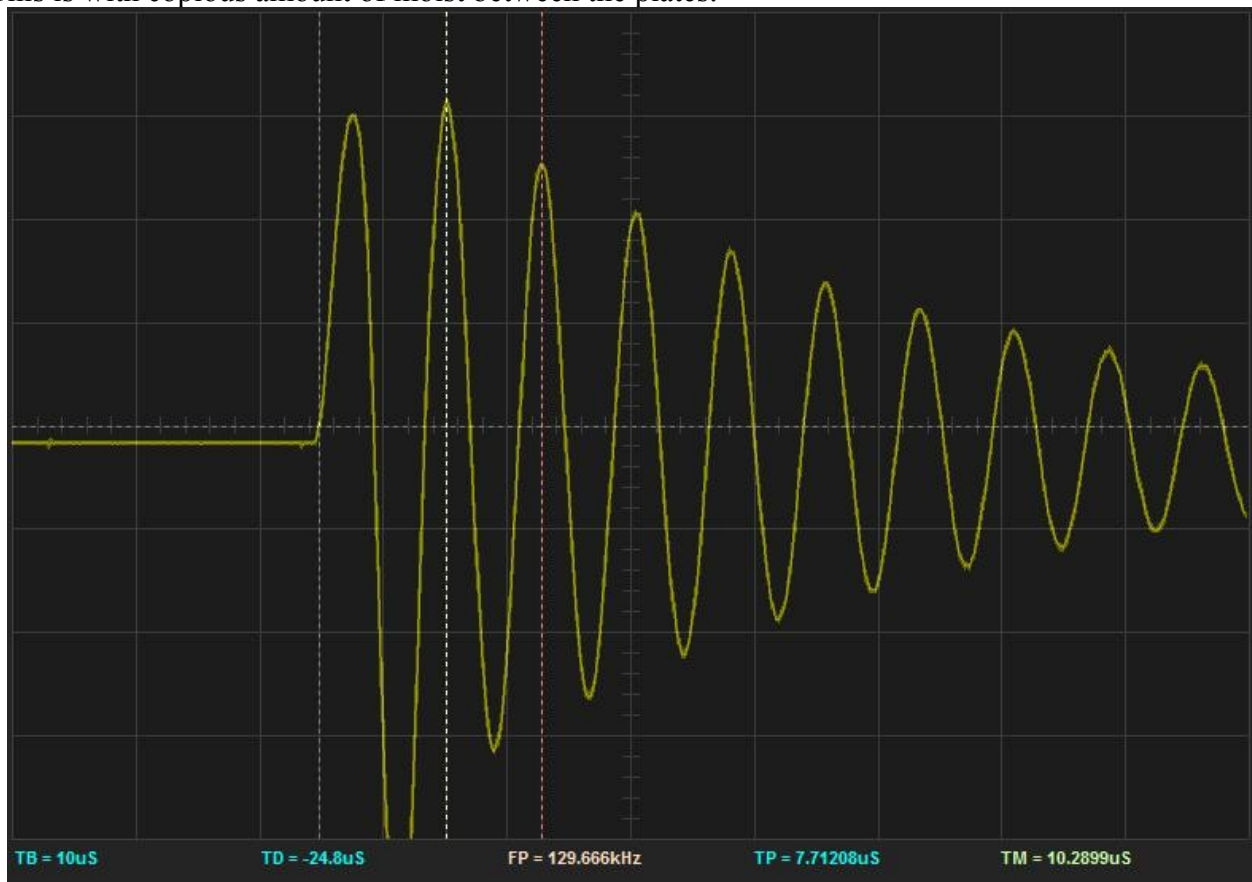


The ringing is very obvious now. Apparently the slightest amount of moist between the plates greatly reduces the ability for the LC circuit to resonate.

This is the same configuration but with a 305Khz pulse:



Now let's see what happens if both PCB plates are coated with a thin layer of PCB plastic spray. This is with copious amount of moist between the plates:



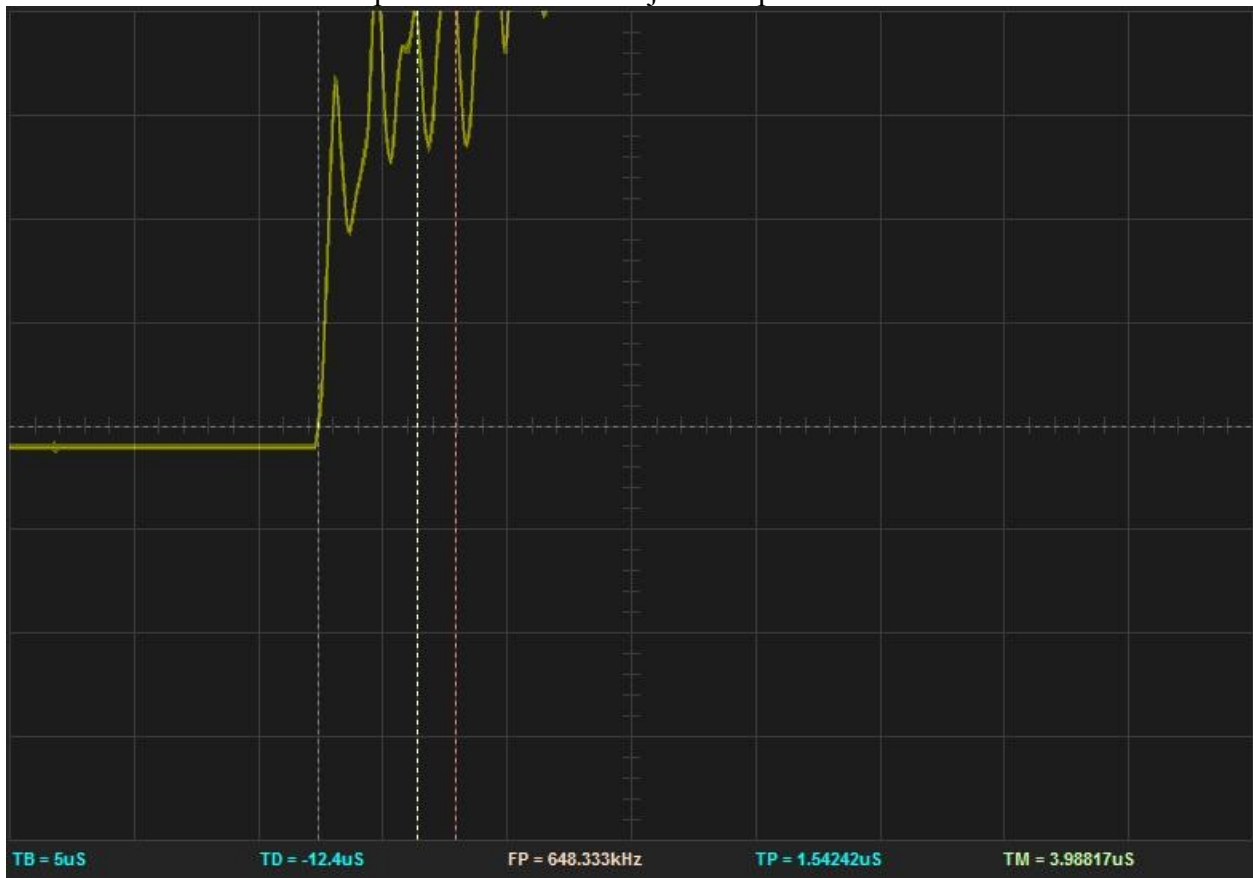
The ringing is very obvious. Also note the lower resonance frequency. It seems that insulating the plates from the water enables the setup to resonate again.

Now let's investigate the effect of a diode in the LC circuit. This is with a normal LC configuration and with a generic 1nf ceramic capacitor and a 20Khz pulse:



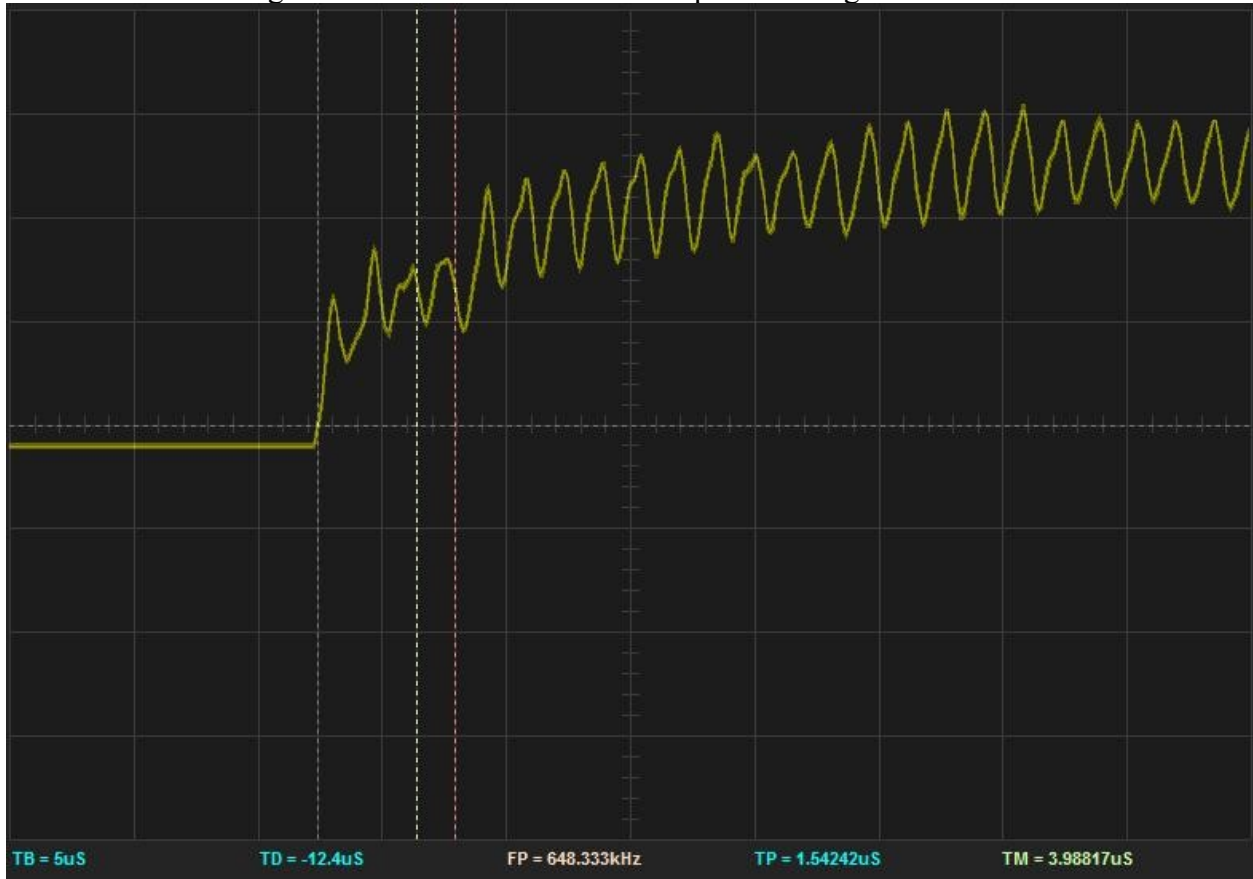
There is some evidence of ringing.

This is the result of a 648Khz pulse train instead of just one pulse:



A very high voltage is obtained.

This is the same configuration as above but with a 50x probe setting:

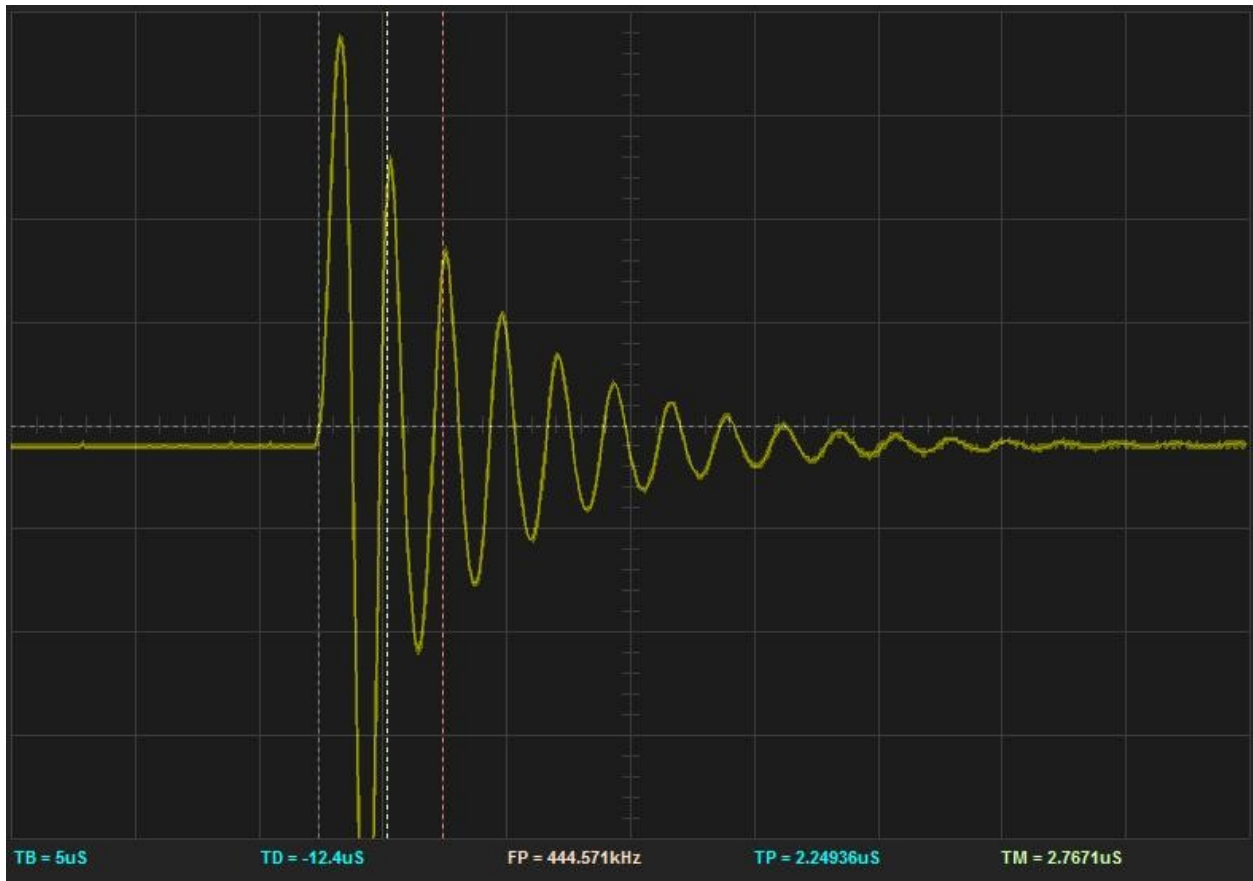


This is with a 200Khz pulse train and a 50x probe setting. The input frequency is out of resonance:



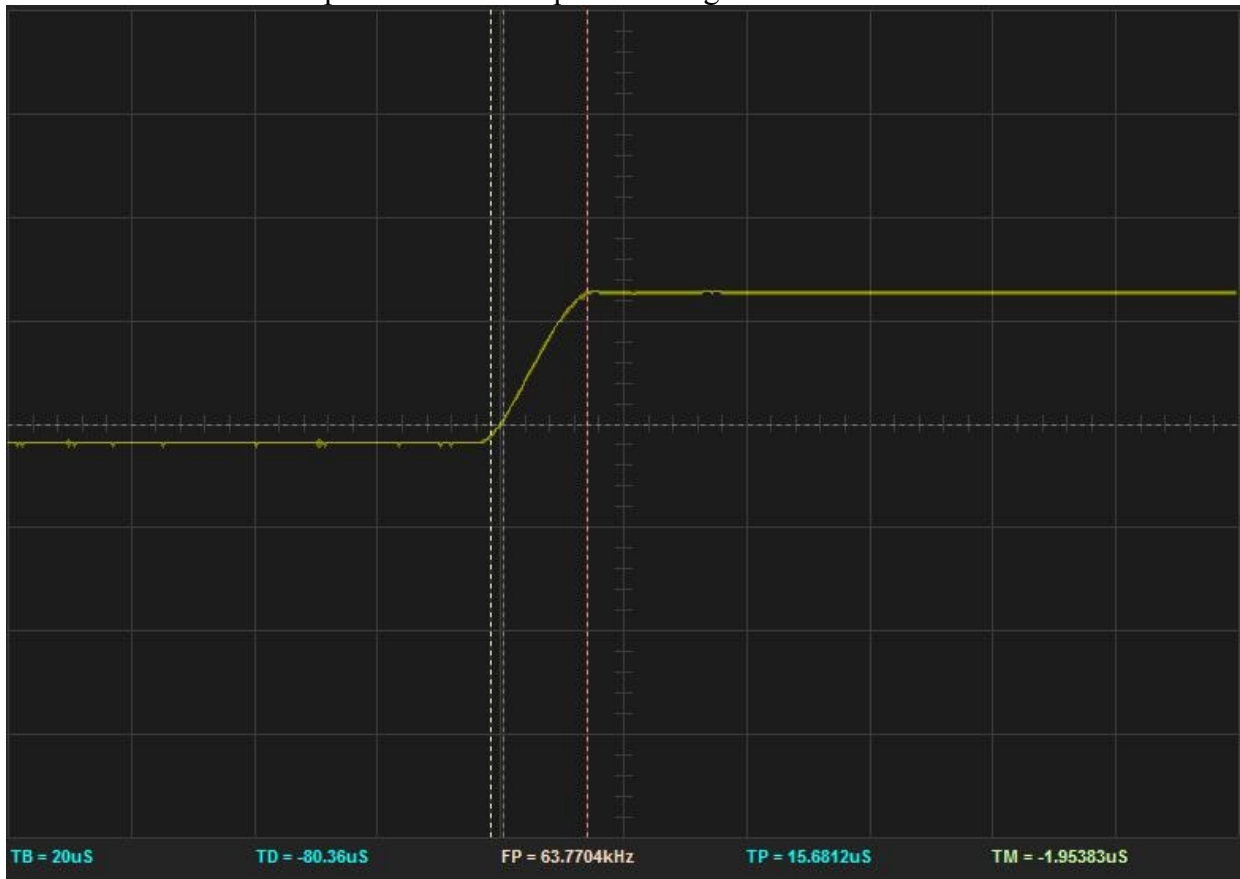
The voltage does not appear to build up as high if the input frequency is out of resonance. So even with a normal LC circuit and a diode, there seems to be a resonance effect. Even though the resonance frequency is much higher than without a diode.

This is without a diode:

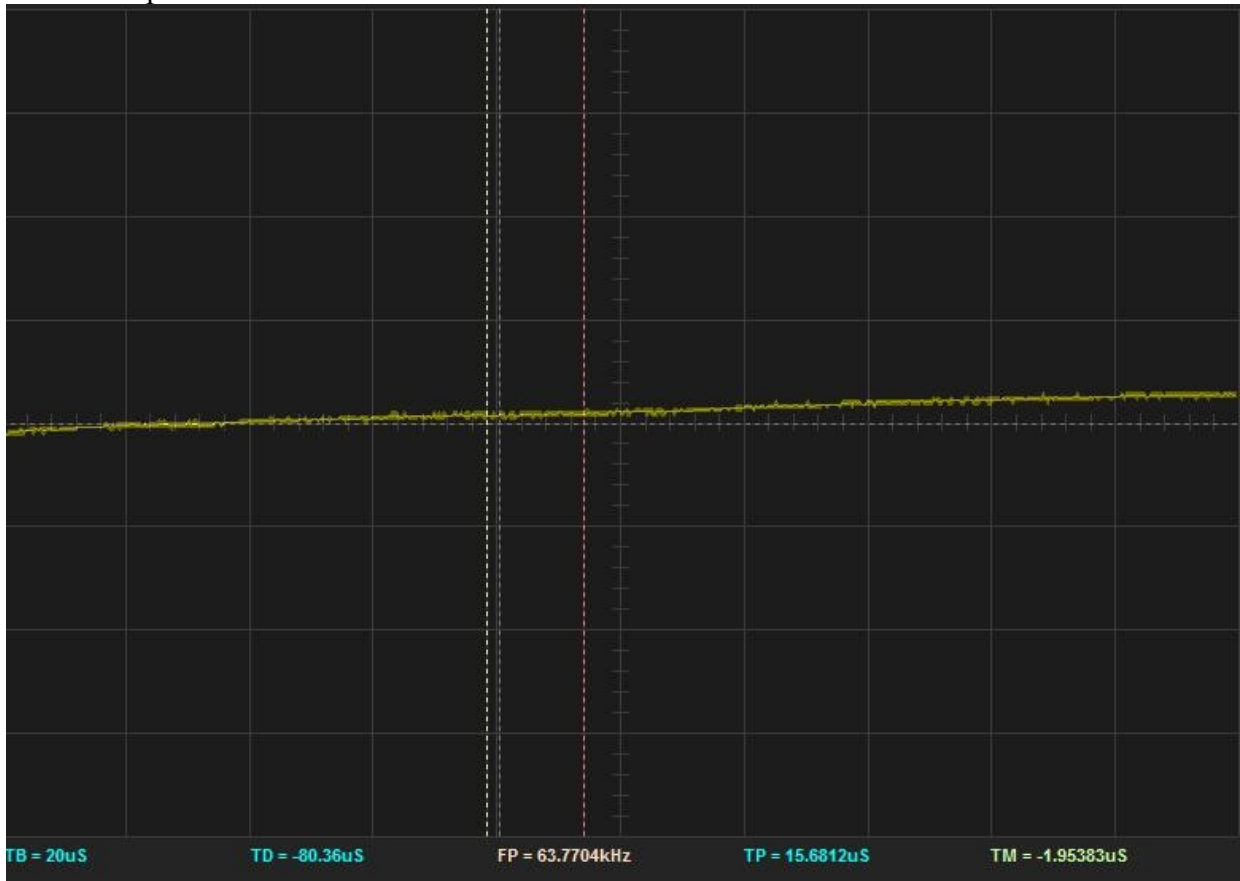


The resonance frequency is 440Khz instead of 640Khz.

Note that with a large capacitor, the LC circuit does not want to resonate if a diode is included. This is with a 100nF ceramic capacitor and a 20x probe setting:

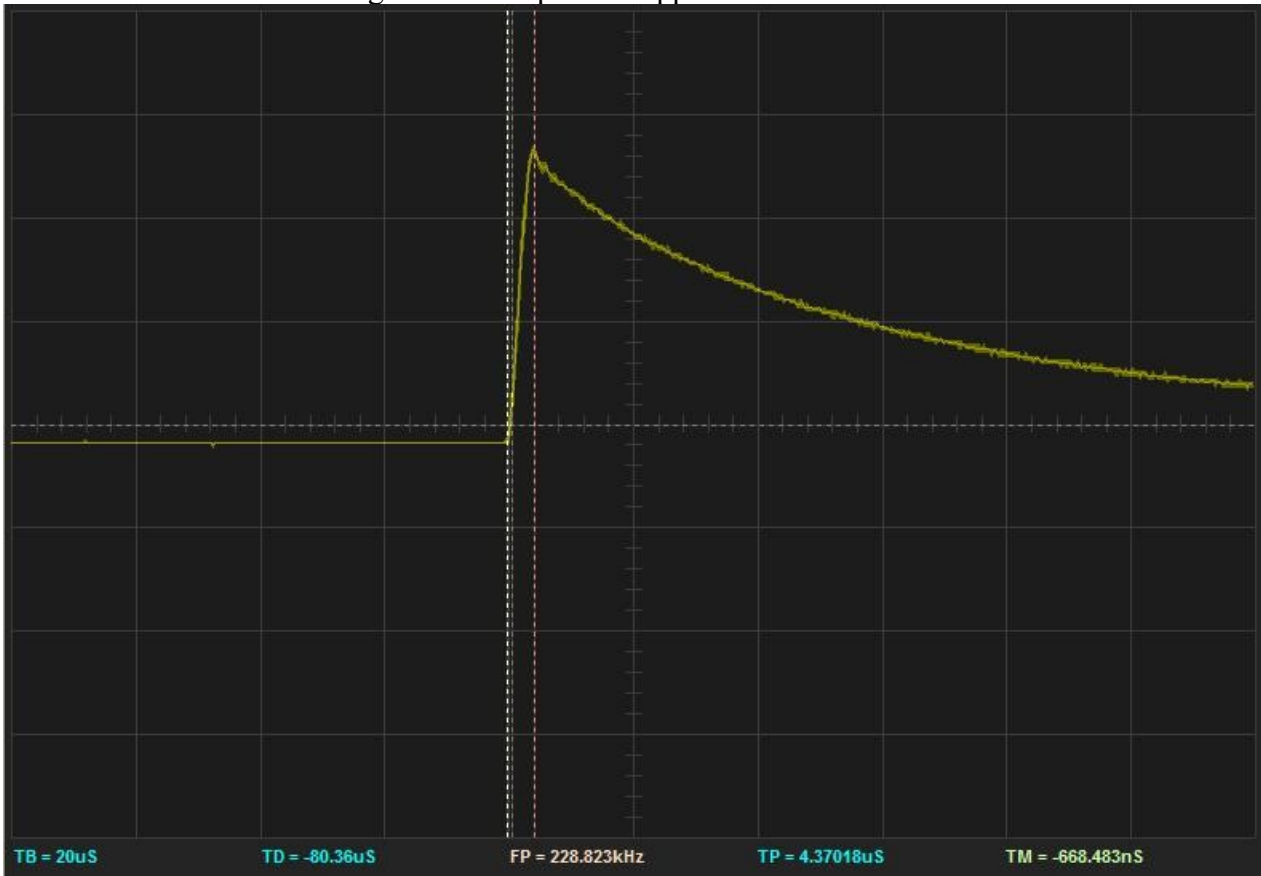


This is with a 100nf ceramic capacitor, a 500Khz pulse train, and a 50x probe setting to compare it to the 1nF capacitor at resonance with a diode:



The voltage is nowhere near as high. It seems that resonance does allow the voltage to increase to high levels if the system is in resonance.

This is a PCB capacitor with both side isolated and water added between the plates. A diode is added to the normal LC config. A 100Khz pulse is applied:



The voltage drops off much quicker then with the normal capacitor and there is only a very small ringing effect at the top of the peak.

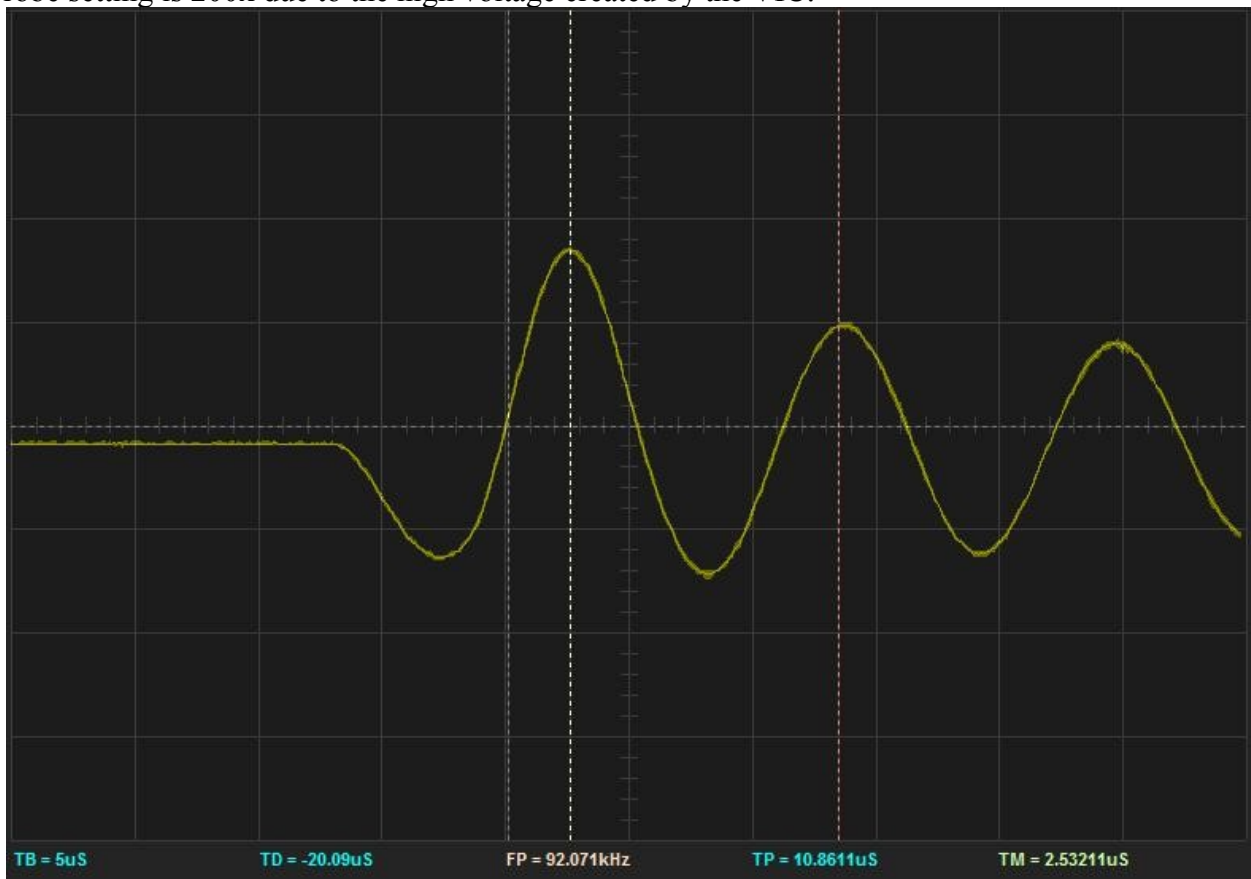
This is the same configuration but with a 600Khz pulse train and a 20x probe setting:



There is evidence of voltage build-up.

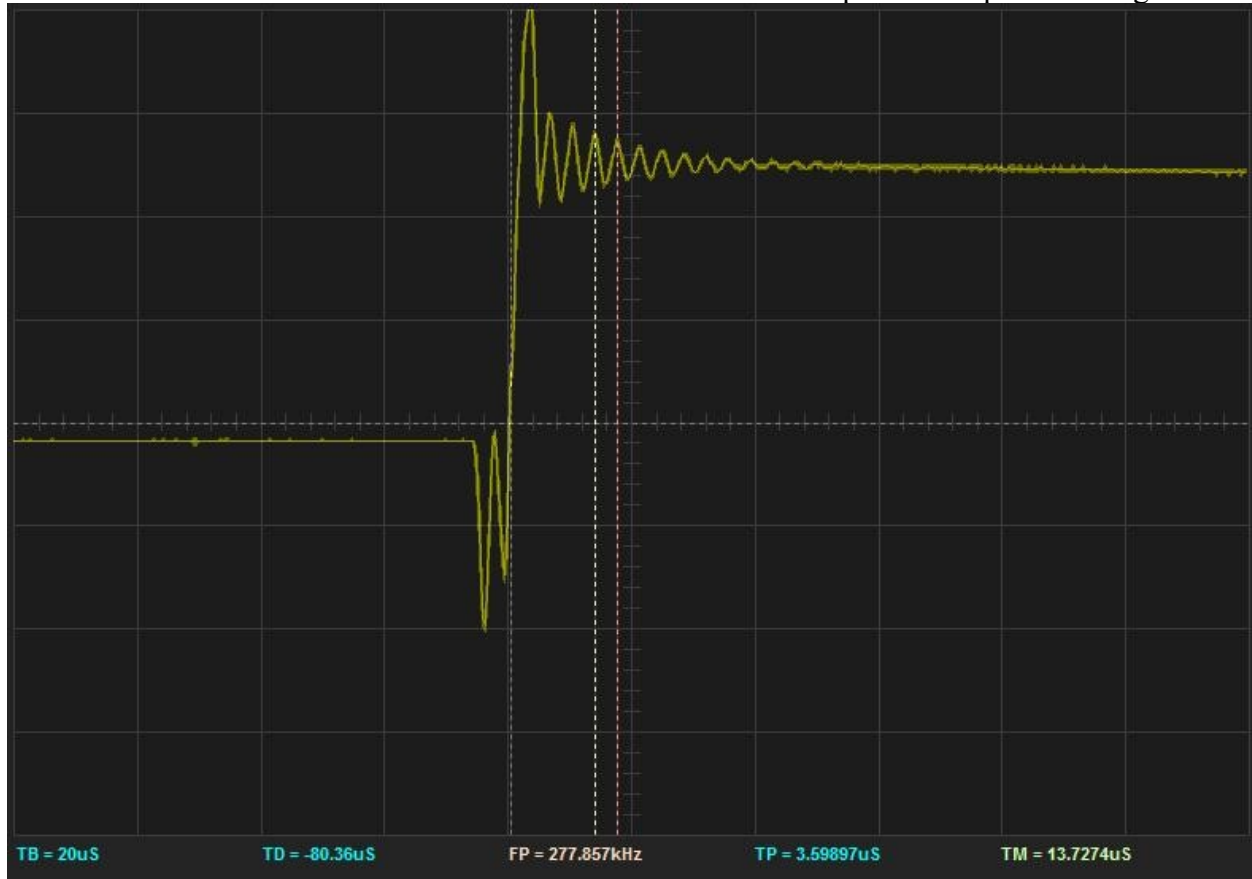
Now the effects of the VIC configuration will be explored.

This is a normal VIC configuration, no diode, a 1nF ceramic capacitor and a 92Khz pulse. The probe setting is 200x due to the high voltage created by the VIC:



Note that the resonance frequency is lower than with the LC config. This is due to the higher inductance of the VIC coils combined.

This the same situation but with a diode added and with a 200Khz pulse. The probe setting is 50x:

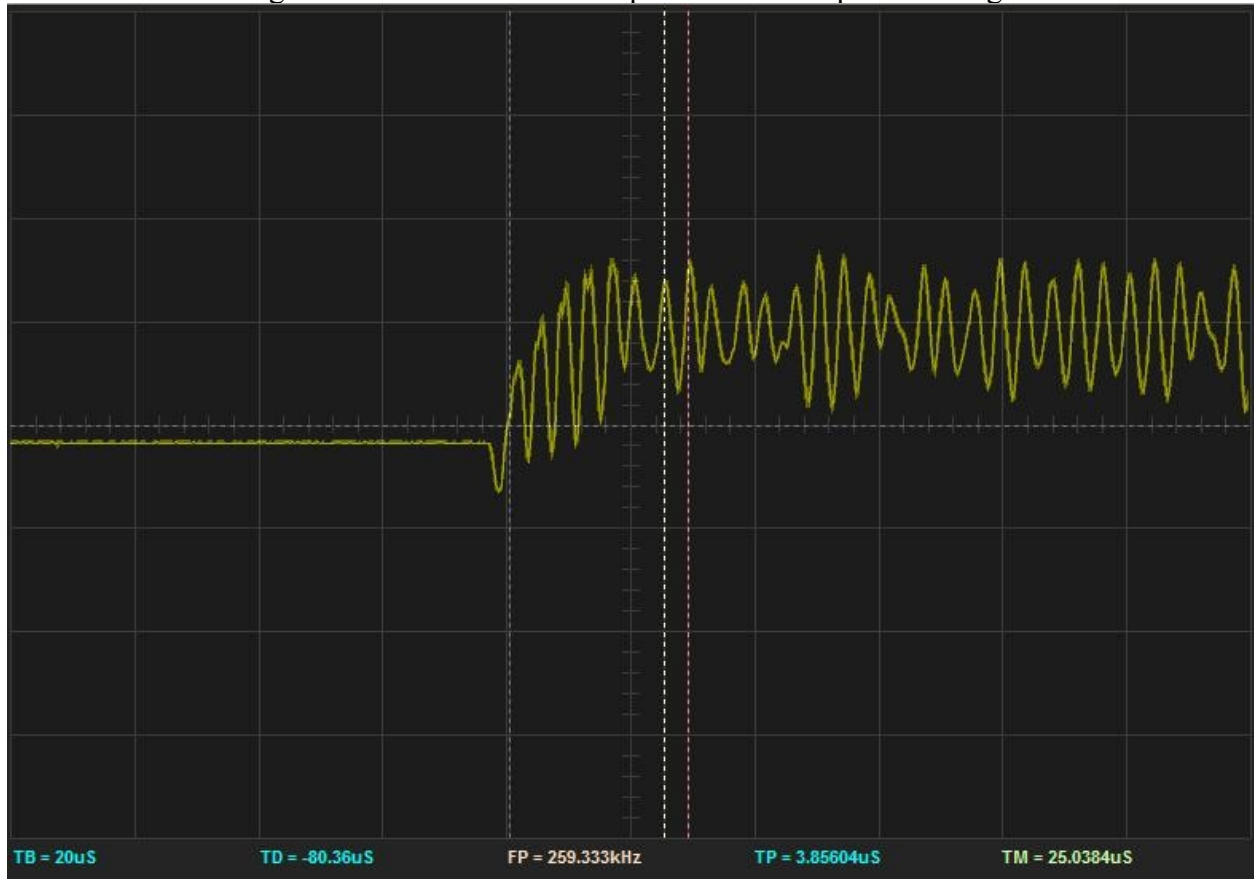


There is very clear evidence of ringing. The resonance frequency is much higher than without a diode though.

The effect becomes more pronounced with a 260Khz pulse, which is the resonance frequency:

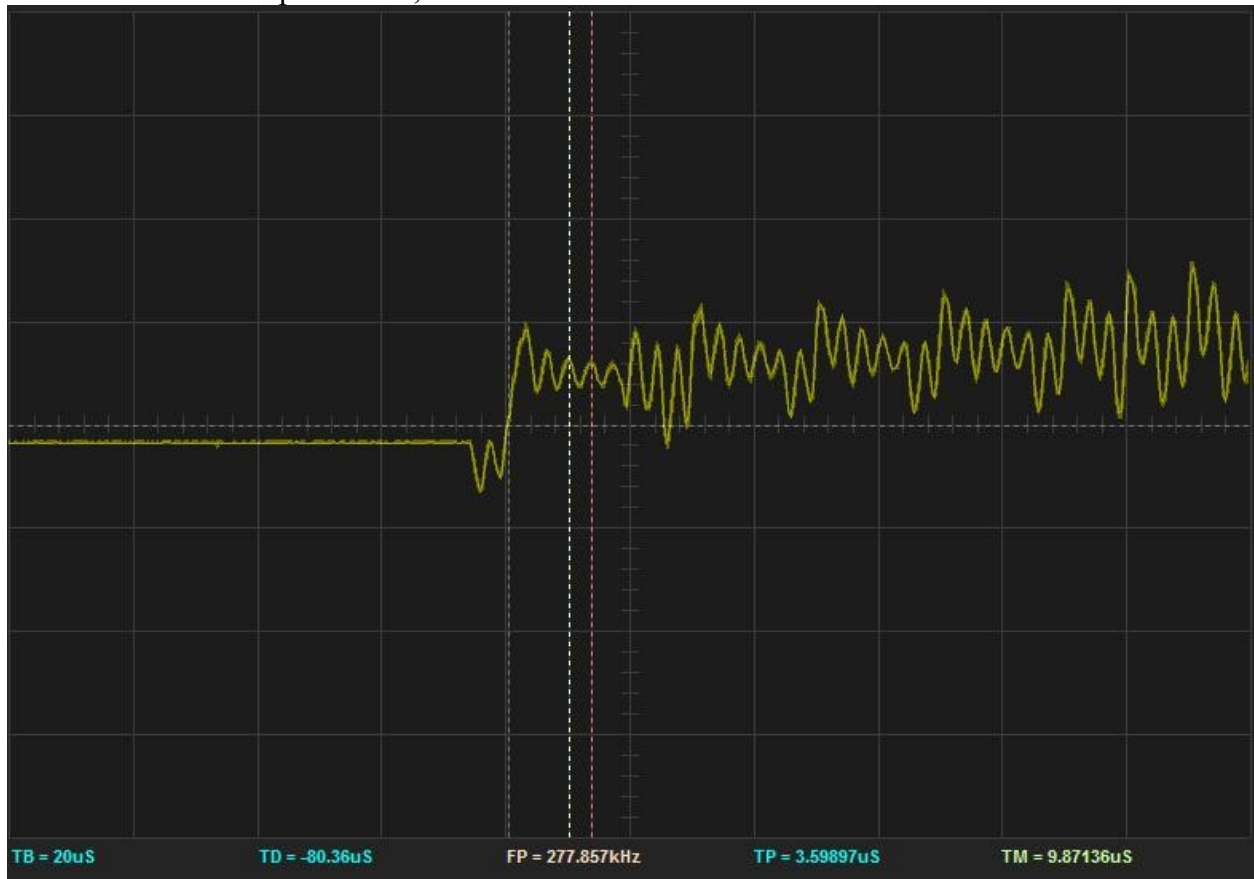


This is the same configuration but with a 260Khz pulse train. The probe setting is 200x:



A very high voltage is obtained and oscillations are still present.

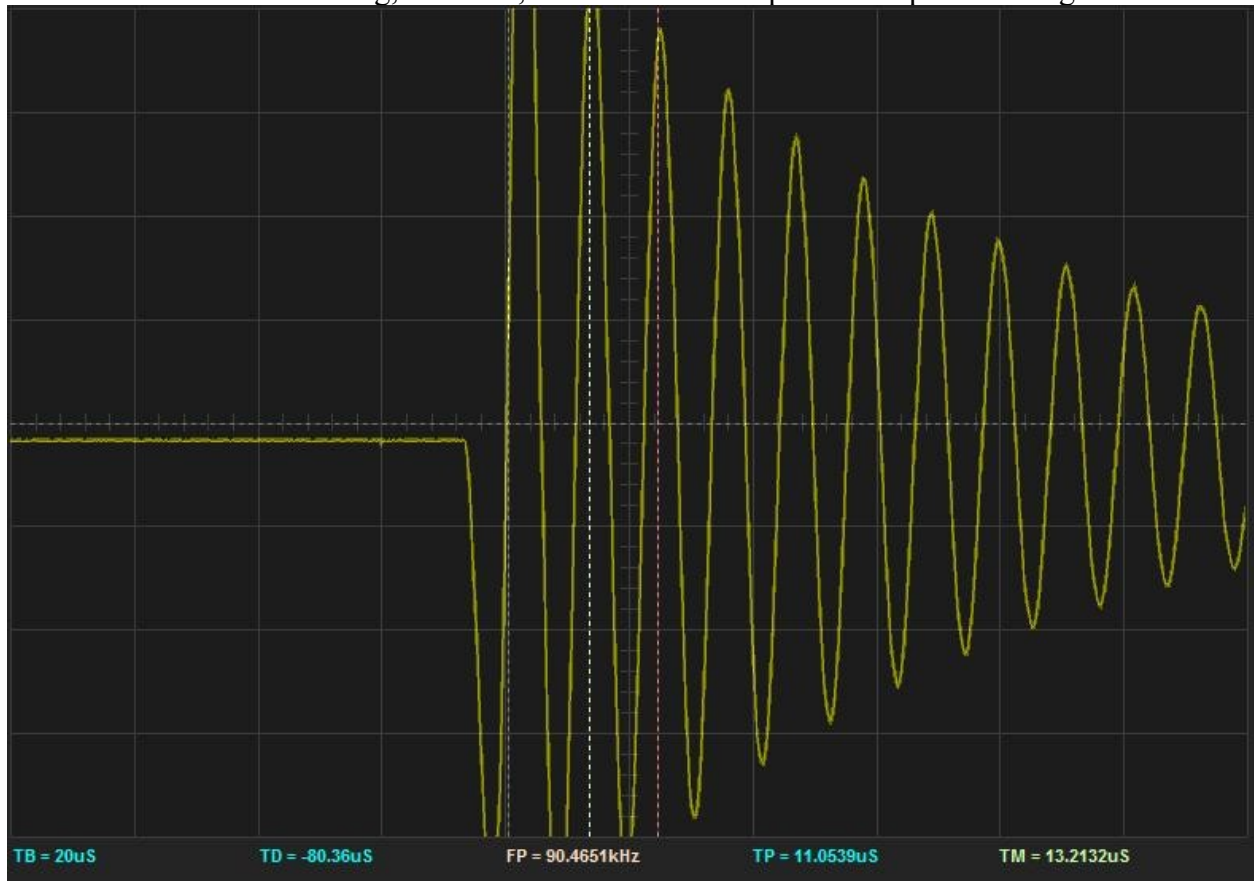
This is with a 100Khz pulse train, which is out of resonance:



The voltage is not as high as with an input frequency in resonance.

Here is a comparison between the VIC config (1nF diode) with no diode and a reversed VIC config with no diode.

This is the standard VIC config, no diode, and with a 90Khz pulse. The probe setting is 50x:



This is with a reversed VIC config, no diode, and a 204Khz pulse:



The voltage is lower and the resonance frequency higher.

5. Conclusion

Water has a significant damping effect on the resonance properties of an LC circuit or VIC configuration. The damping can be greatly reduced by insulating both plates of the capacitor. Even the slightest contact of water with either one of the capacitor plates (via the plate edge for example) has a significant impact on the resonance properties. Whether or not the insulation of both capacitor plates has an effect on gas production is to be investigated. This will be the subject of a later test.

Adding a diode in the LC or VIC configuration has the effect that the voltage will not be negative (depending on the orientation of the diode). The setup will still resonate with a diode present although this effect is more pronounced with the VIC configuration. The resonance frequency will be much higher than without a diode. When the input frequency matches the resonance frequency, the output voltage will be the highest.

6. Appendix

L - inductance, electromotive force which opposes the change in current.

C - capacitance, the amount of electric charge held.

R - resistance, the resistance to current.

Q - Q factor describes the damping of an oscillator.

Distributed capacitance - capacitance created by other components than a capacitor.

ESR - equivalent series resistance.

LC circuit - a circuit using a coil and capacitor, usually tuned in resonance.

AC - alternating current, current fluctuates regularly between positive AND negative.

DC - direct current, current stays either positive or negative.

Pulsed DC - current fluctuates regularly between positive OR negative and zero.

Disassociating water - splitting water into hydrogen and oxygen.

WFC - Water Fuel Cell, a capacitor with water between its plates.

Resonance - the frequency which generates the highest oscillation within its system.

Ringing - same as resonance.

VIC - Voltage Intensifier Coil.

IC - integrated circuit, chip.

FPGA - field programmable grid array, fast type of processor.

DDS - Direct Digital Synthesis, an IC or software program which creates a variable frequency.

Electrolyte - fluid which conducts electricity.

FIFO - first in first out data communication.

JTAG - communication system to program IC's.

MOSFET - high power transistor.

SDK - software development kit.

FFT - fast fourier transform, method to extract the base frequency from a signal.

FFTW - fastest fourier transform in the west, free open source FFT SDK.

OpenGL - software interface to hardware accelerated computer graphics system.

LPF - low pass filter, filters out unwanted high frequencies in signal.

7. References

The Birth Of New Technology - Stanly Meyer