Faculty Of Engineering and Technology

Electrical and Computer Engineering Department

CIRCUITS AND ELECTRONICS LABORATORY

ENEE 2103

Experiment #: 3

First and Second Order Circuit

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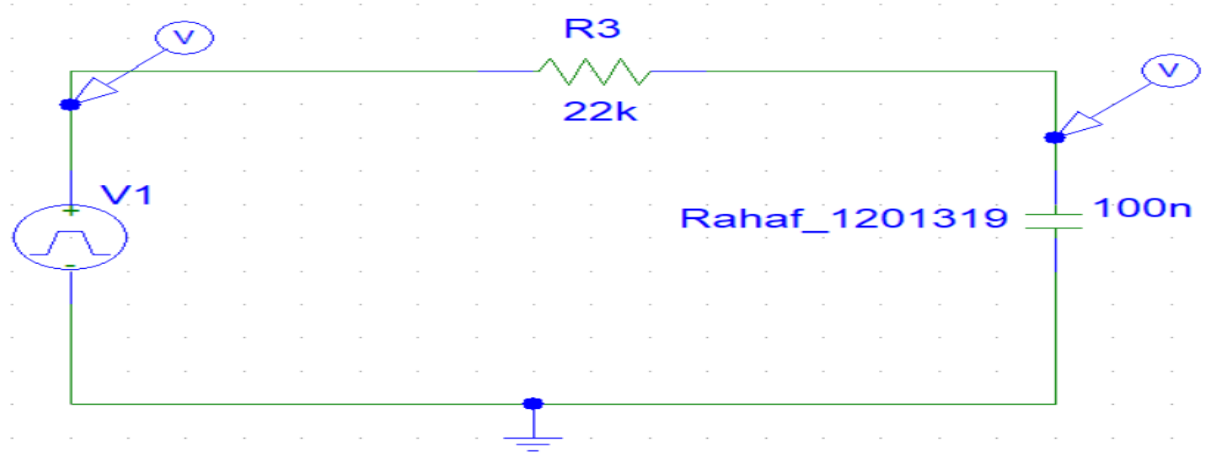
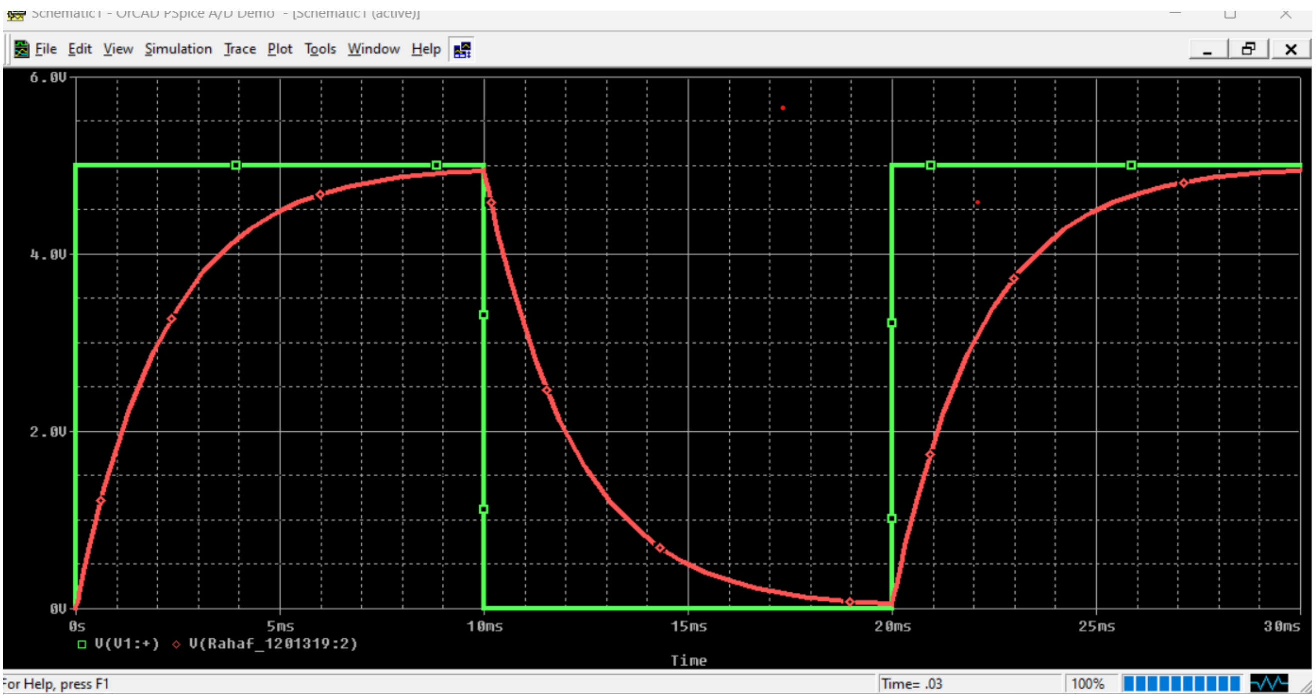
Circuit using Pspice->

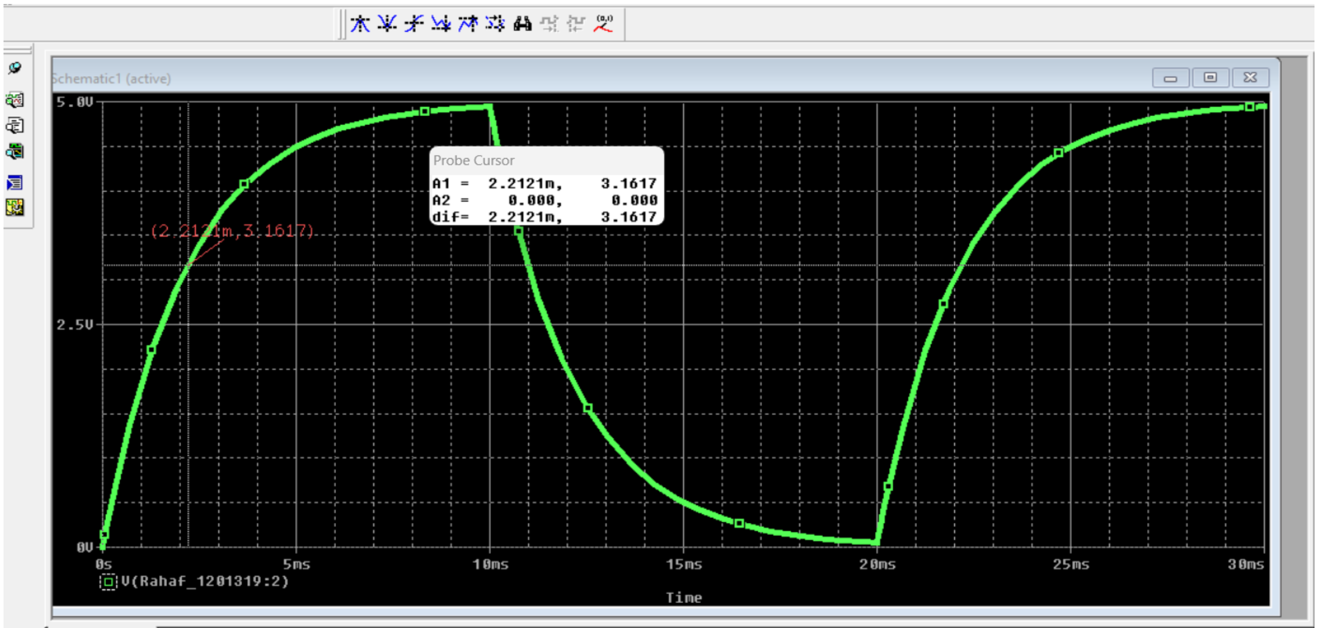


Fig(1.1)

Result->



Fig(1.2)



Fig(1.3)

To find T :

First we find that Vmax (experimentally) = 4.9454 v

0.63*4.9454=3.1v

at v = 3.1v -> t = 2.2 ms

so T =2.212ms

To find the time constant theoretically, we have R=22kΩ, and C=100nF

➔ T (theoretically) = RC = 22 ∗ 103∗ 100 ∗ 10−9 = 2.2 ms

▪ Steady state voltage value on the capacitor:

The capacitor voltage reaches its steady state value at Vc(0), C appears as an open circuit.

➔ Vc steady state = 5 v

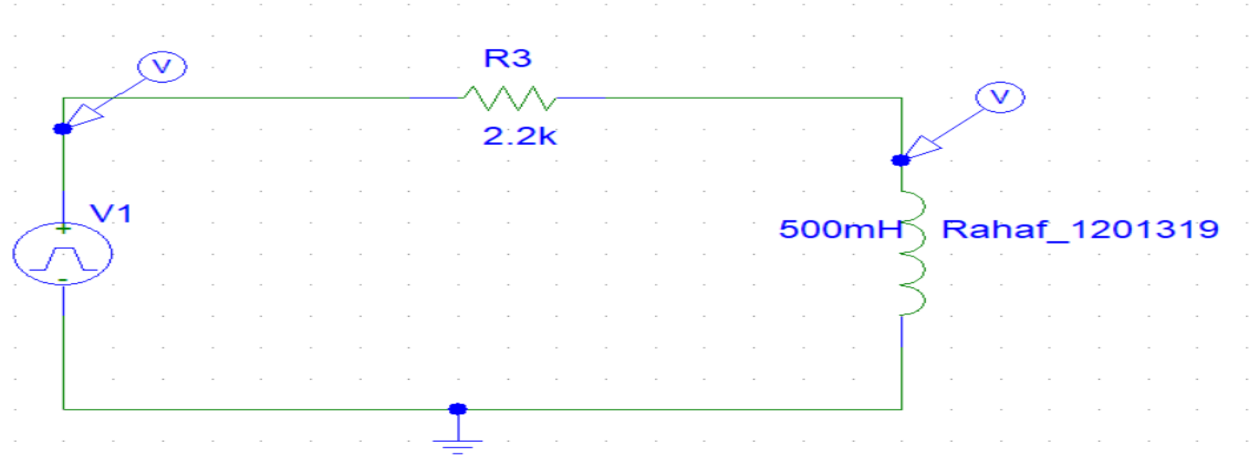
▪ The value of the capacitor:

o C(experimentally) =T(experimentally)/R=2.5814 ms/ 22K= 117.3nF

o C(theoretically) = 100nF

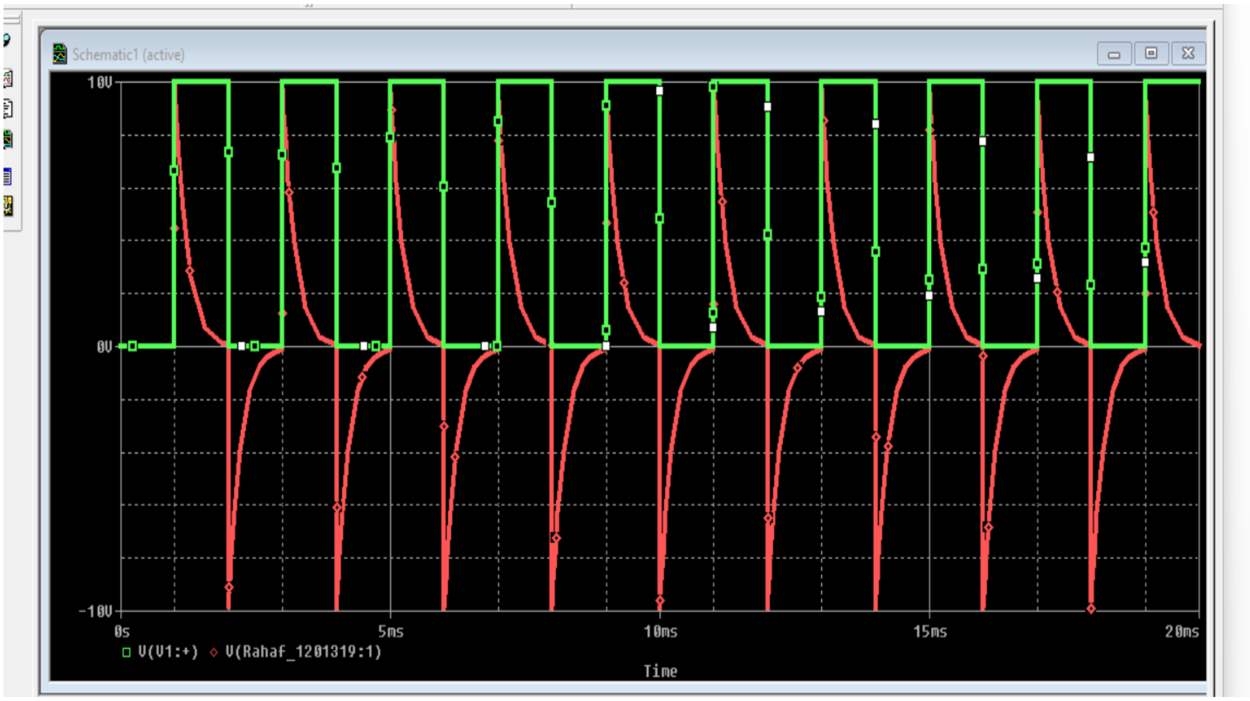
2.RL Circuit

Circuit using Pspice->

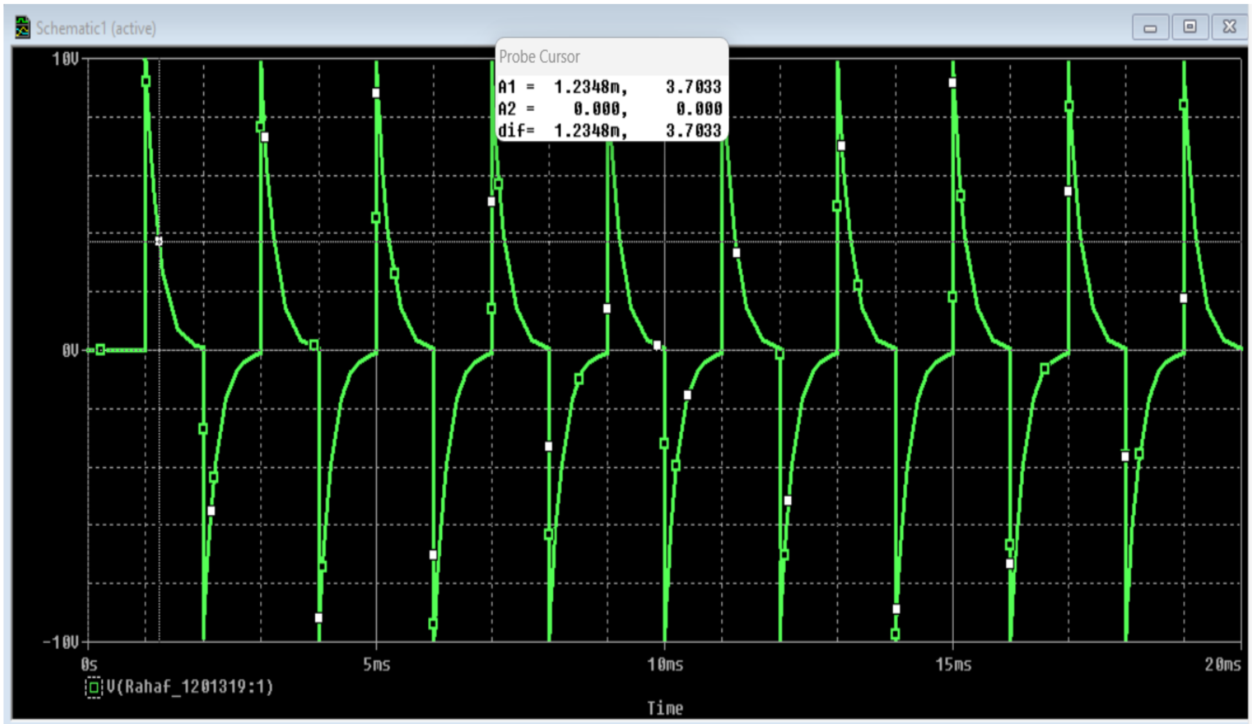


Fig(2.1)

Result->



Fig(2.2)



Fig(2.3)

Vmax = 9.879v

V(t) discharging = 0.37 Vmax ➔ V(t) = 0.37 ∗ 9.87= 3.5619v

t when v =3.6519 = 1.2348ms

so ,T = 1.2348ms -1ms = 0.2348ms

To find the time constant theoretically, we have R=2.2kΩ, and L=500mH

so ➔ T (theoretically) =L/R=500m/2.2k = 0.227ms

Steady state voltage value on the inductor:

The capacitor voltage reaches its steady state value VL(0), C appears as a short circuit.

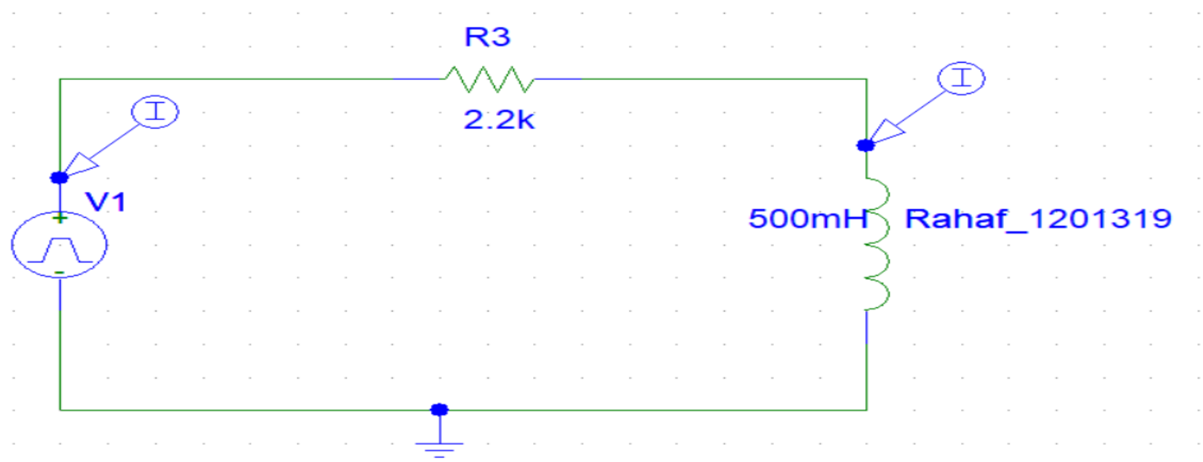
➔ VL steady state = 10 v

▪ The value of the inductor:

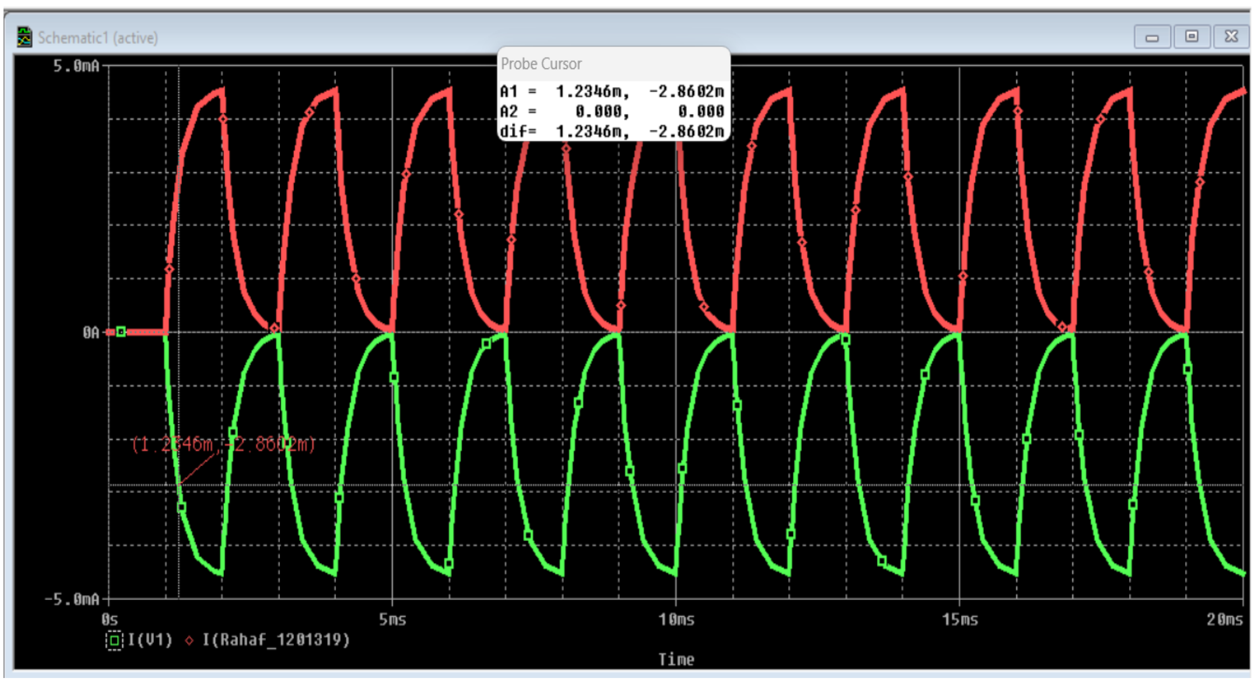
o L(experimentally) = T (experimentally) * R = 0.2268ms *2.2K =498.96 mH

o L(theoretically) = 500mH

Current response:



Fig(2.4)



Fig(2.5)

Imax (experimentally) = 4.4897A

• Time constant:

▪ To find the time constant experimentally, we find the time at charging

I(t)charging = 0.63 Imax ➔ I(t) = 0.63 ∗ 4.4897= 2.8285mA

t (at I = 2.8285mA) =1.2230ms

so , T (experimentally) = 1.2230ms -1ms = 0.2230ms

▪ Steady state current value on the inductor:

The inductor current reaches its steady state value at VL(0), L appears as a short circuit..

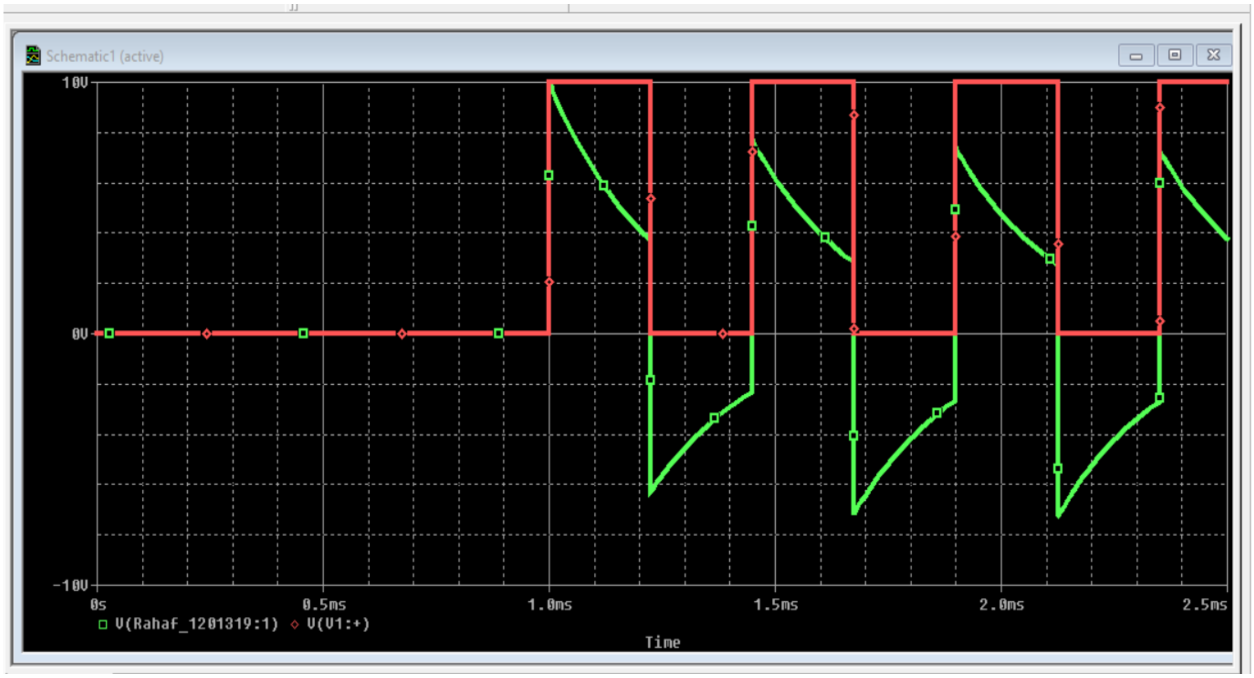
➔ IL steady state =10/2.2k= 4.545 mA

RL circuit after change the period of the periodic square wave to T=2* time constant of inductor:

T = 2 ∗L/R=500m/2.2k = 0.454ms

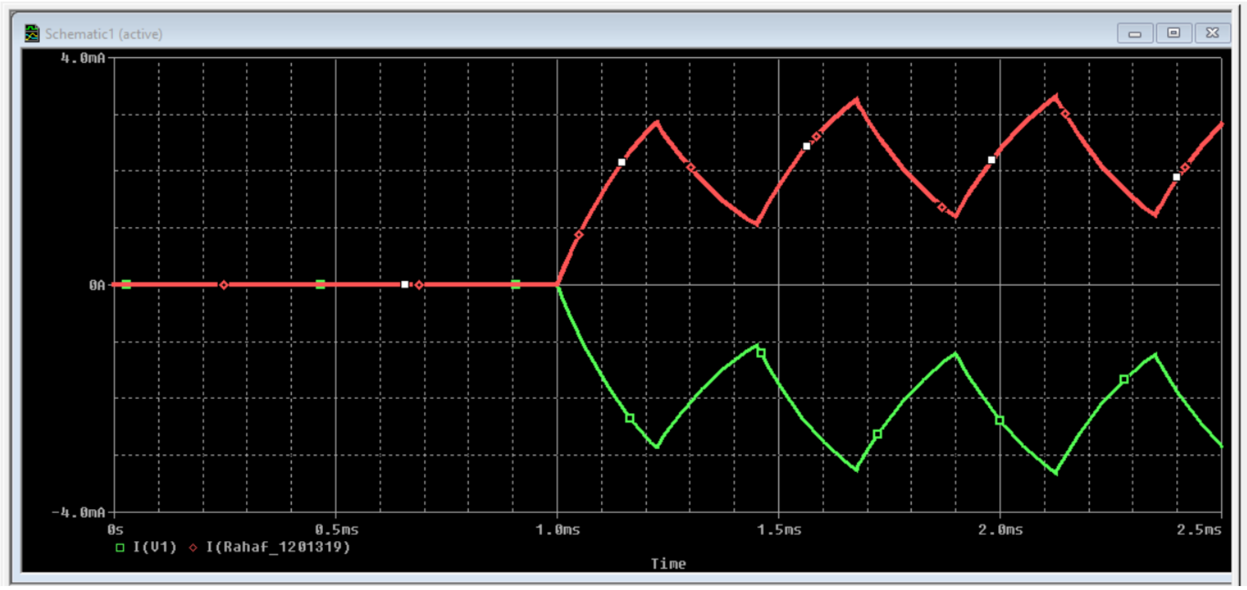
F = 1/T= 2.2 KHz.

Voltage response->



Fig(2.6)

Current response->



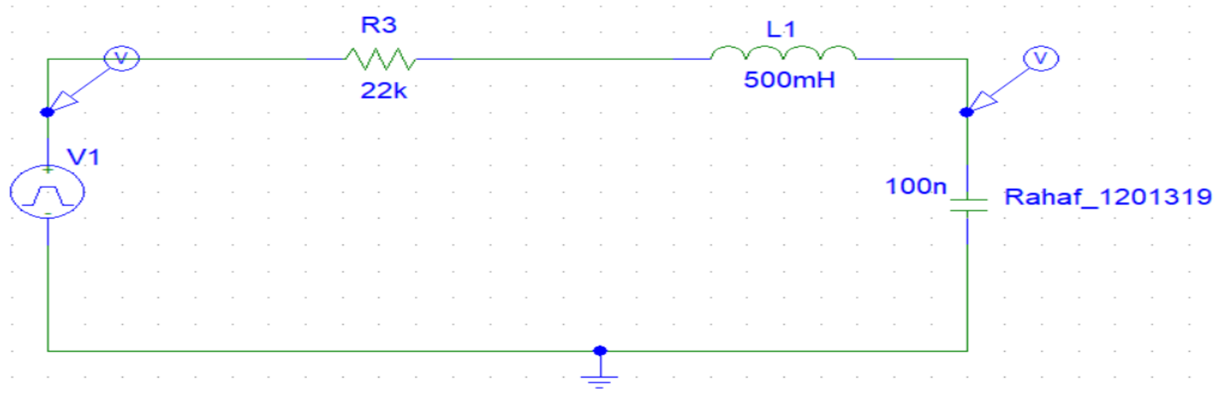
Fig(2.7)

3.RLC Circuits

3.1.Response type

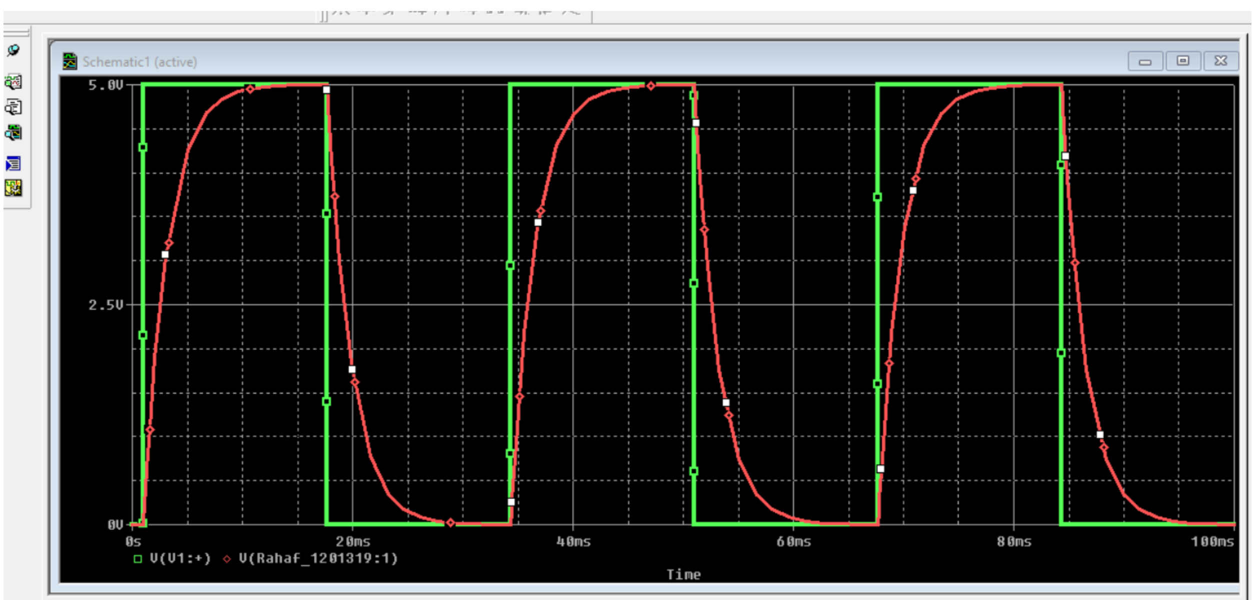
3.1.1.over damped response

Circuit using Pspice->



Fig(3.1.1.1)

Result->



Fig(3.1.1.2)

The response is over damped since we have α > w

α =R/2L=22K/2∗500m= 22000 rad/s

w =1/(LC)^0.5=1/(500m∗100n)^0.5= 4472.13 rad/s

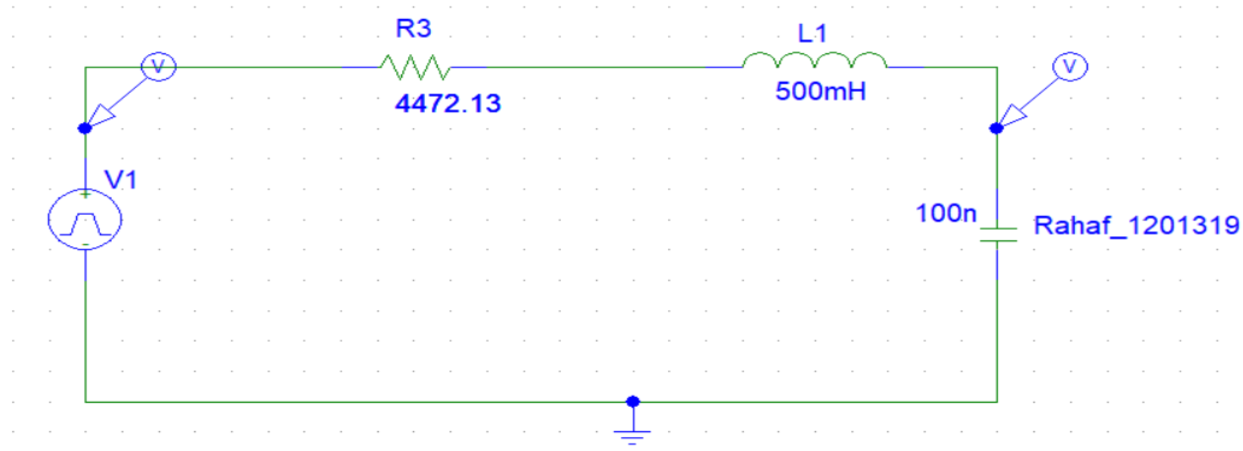
3.1.2. critical damped response

To get critically damped response we have α = w.

Therefore, the value of the resistance to give critically damped response will be:

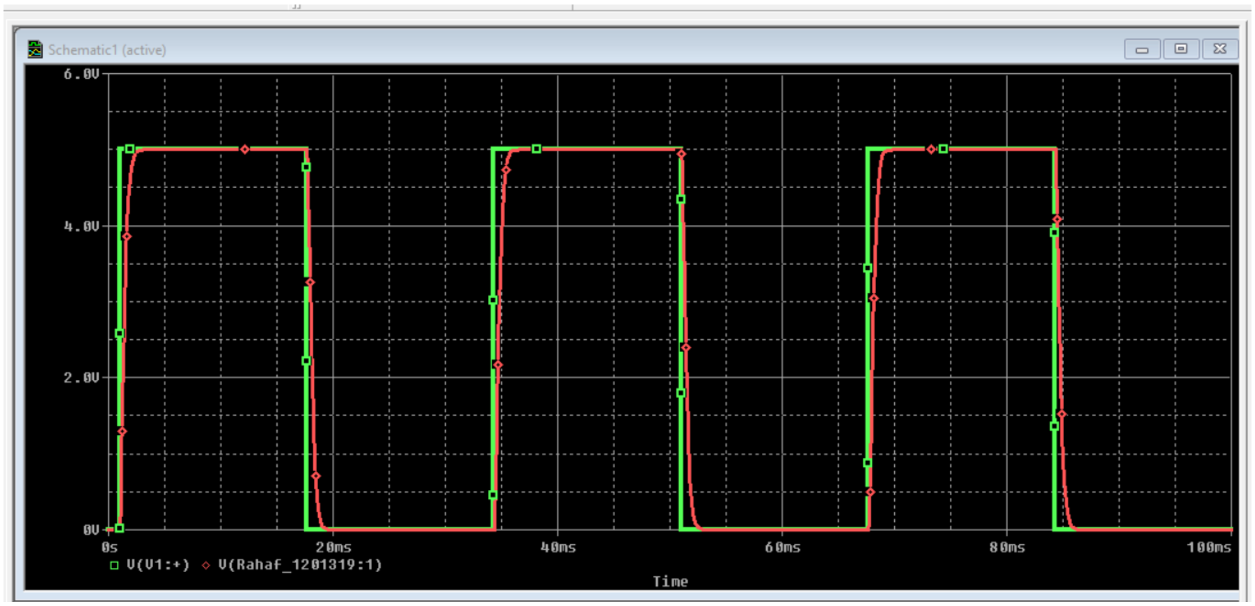
R/2L=1/(L*C)^0.5➔R/(2∗500m)=1/(500m∗100n)^0.5➔ R= 4472.13

Circuit using Pspice->



Fig(3.1.2.1)

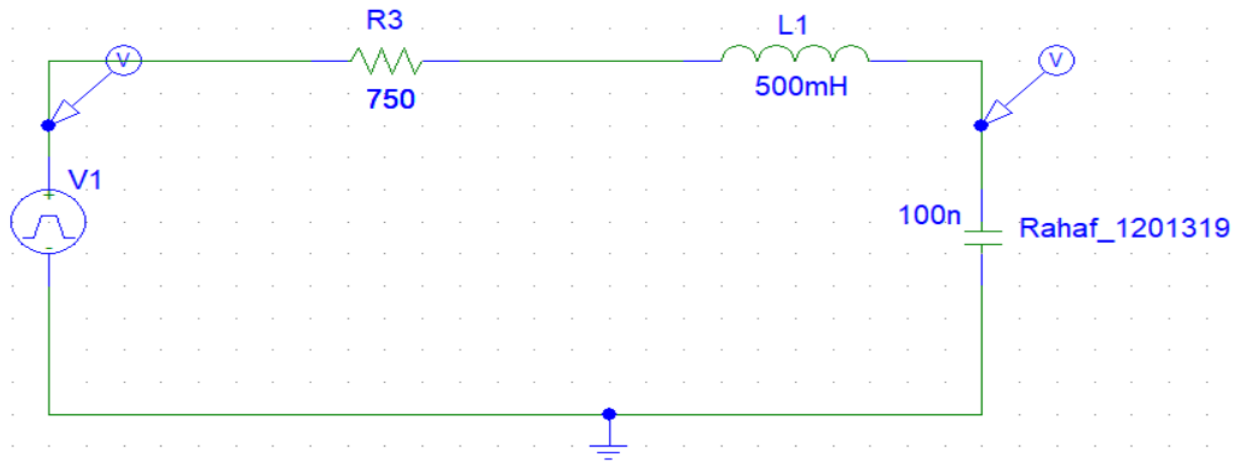
Result->



Fig(3.1.2.2)

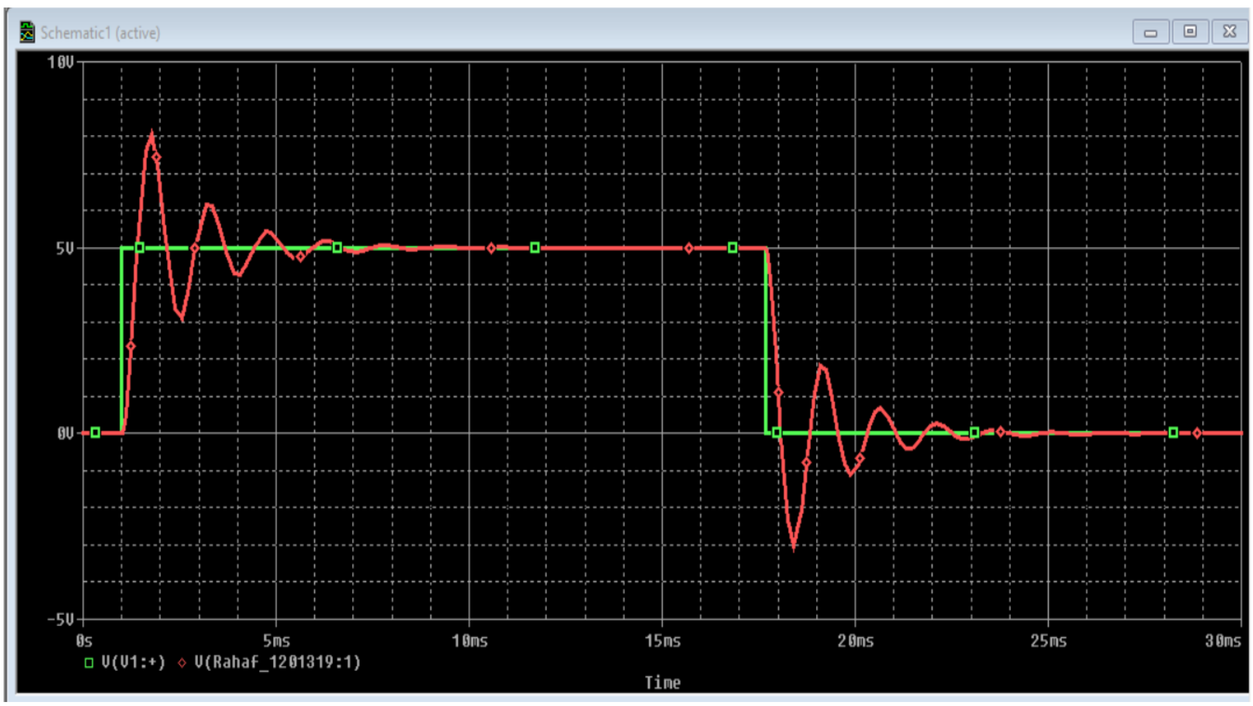
3.1.3 under damped response:

➔ Circuit using PSpice:



Fig(3.1.3.1)

Result->



Fig(3.1.3.2)

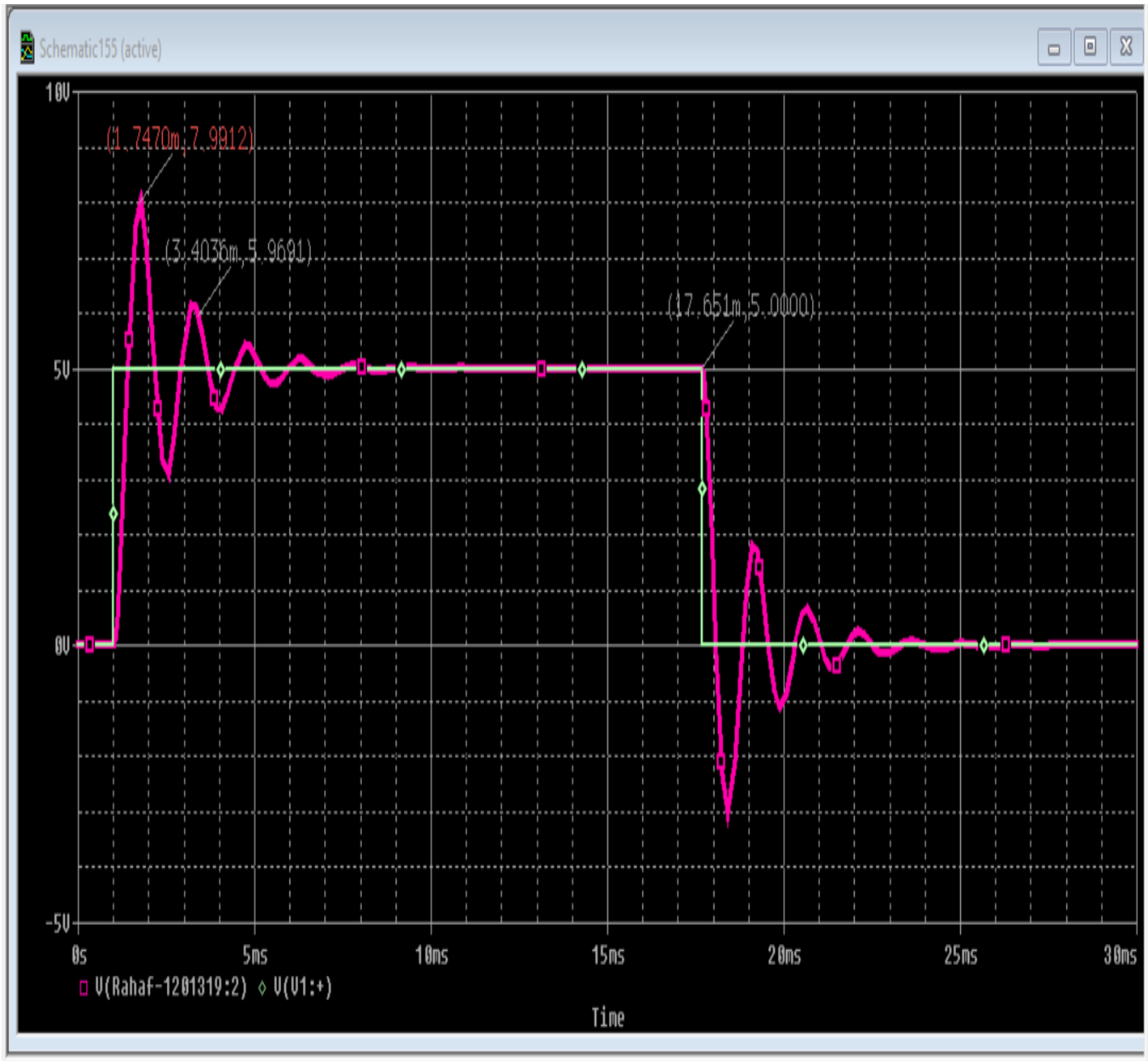
The response is under damped since we have $\alpha < w$

α =R/2L=750Ω/2∗500m= 750 rad/s

w =1/(LC)^0.5=1/(500m∗100n)^0.5= 4472.13 rad/s

3.2.Response Parameters

Circuit using Pspice->



Fig(3.2.1)

$t_a = 1,747$ ms

$t_b = 3,4036$ ms

$V_a = 7,9912$ V

$V_b = 5,969$ V

$V_o(\infty) = 5,0$ V

$$T = \frac{t_b - t_a}{\ln\left(\frac{V_a - V_o(\infty)}{V_b - V_o(\infty)}\right)} = \frac{3,4036 - 1,747}{\ln\left(\frac{7,9912 - 5,0}{5,969 - 5,0}\right)} = 1,2496 \text{ ms}$$

damping coefficient $\alpha = \frac{1}{T} = 0,8 \text{ Krad/sec.}$

damped radian frequency $w_d = \frac{2\pi}{t_b - t_a} = \frac{2\pi}{3,4036 - 1,747} = 3,8 \text{ Krad/sec}$

damped radian frequency (theoretically):

$$w_d = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{500m * 100n}} = 4,47213 \text{ Krad/s}$$