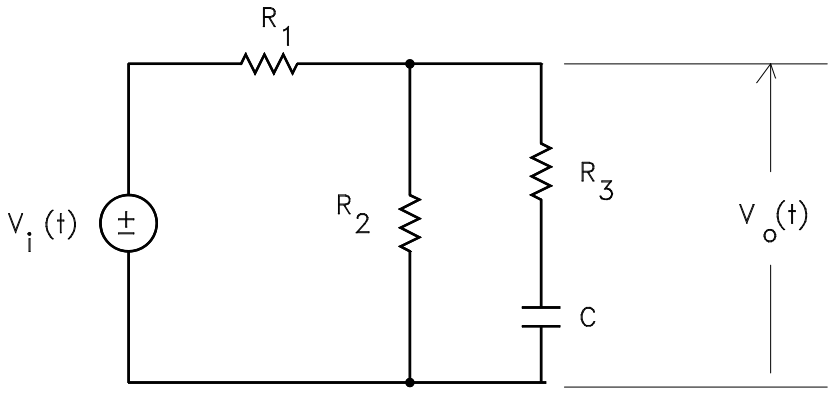
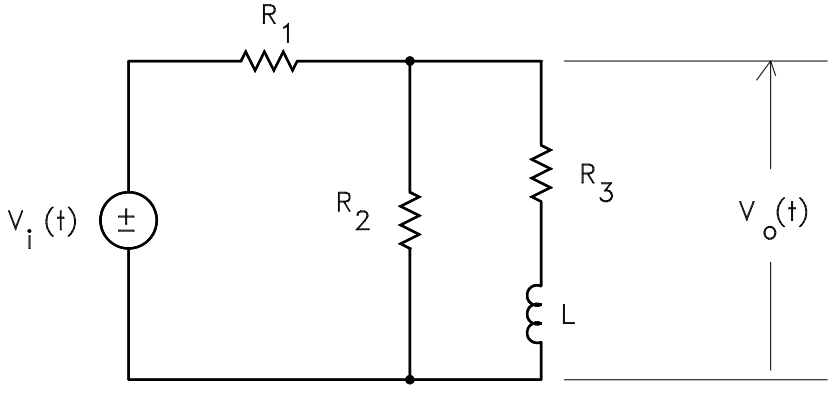
ECE 3043 Fall 2016
Homework Problem Set No 3 for Experiment No. 3

Due Week of September 12

1. The excitation for both circuits shown below is $e(t) = 10\,\mathrm{V}u(t)$. Plot the voltage $v_o(t)$, the reactive voltage and current (flowing through the reactive element from top to bottom) for the two circuits using Mathcad. Plot the circuit variables as t varies from 0 to two time constants for the circuits.. The values of the circuit components are $R_1 = 22\,\mathrm{k}\Omega$, $R_2 = 43\,\mathrm{k}\Omega$, $R_3 = 15\,\mathrm{k}\Omega$, $L = 3\,\mathrm{mH}$, and $C = 0.01\,\mu\mathrm{F}$.
2. Make the same plot as in Problem 2 using Matlab.
3. Make the same plot as in Problem 2 using National Instruments SPICE (Multisim).
4. Make the same plot as in Problem 2 using LTSpice (text editor input mode).



Circuit 1



Circuit 2

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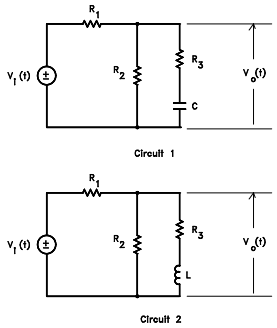
$N := 2000$

$R_1 := 22k\Omega \qquad R_2 := 43k\Omega \qquad R_3 := 15k\Omega$

$i := 0 .. N - 1 \qquad L := 3mH \qquad C := 0.01\mu F$



$$R_p(A,B) := \frac{A \cdot B}{A + B}$$

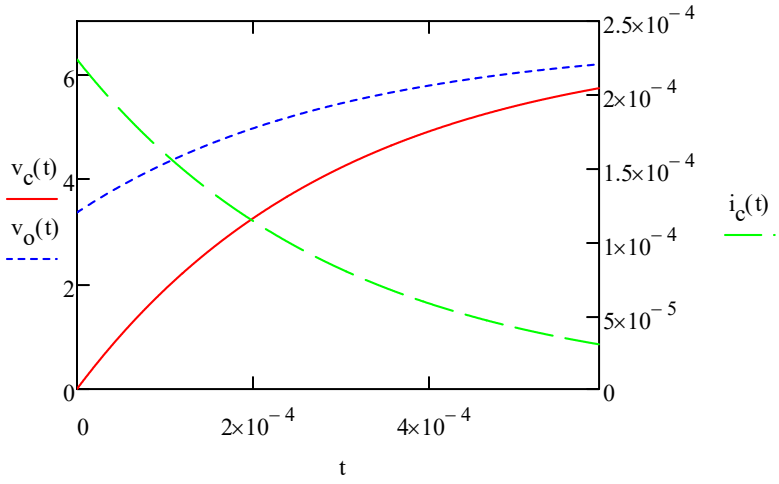
$E_o := 10V$

Circuit 1

$$\tau := \left(R_3 + R_p\left(R_1, R_2\right)\right) \cdot C = 295.538 \cdot \mu s$$

$$E := E_o \cdot \frac{R_2}{R_1 + R_2} = 6.615\ V \qquad R := \frac{\tau}{C} = 29.554 \cdot k\Omega$$

$$v_c(t) := E \cdot \left(1 - \exp\left(\frac{-t}{\tau}\right)\right) \qquad i_c(t) := \frac{E}{R} \cdot \exp\left(\frac{-t}{\tau}\right) \qquad v_o(t) := R_3 \cdot i_c(t) + v_c(t)$$



Circuit 2

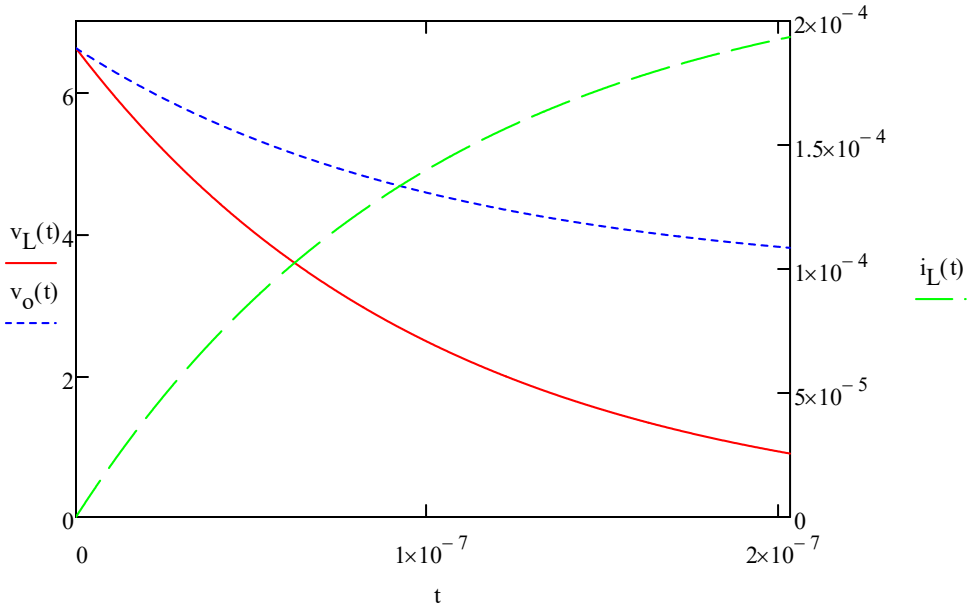
$$\tau := \frac{L}{R_3 + R_p\left(R_1, R_2\right)} = 0.102 \cdot \mu s \qquad G := \frac{1}{R} \qquad I := \frac{E}{R}$$

$$i_L(t) := I\cdot\left(1 - \exp\left(\frac{-t}{\tau}\right)\right) \qquad v_L(t) := \frac{I}{G}\cdot\exp\left(\frac{-t}{\tau}\right)$$

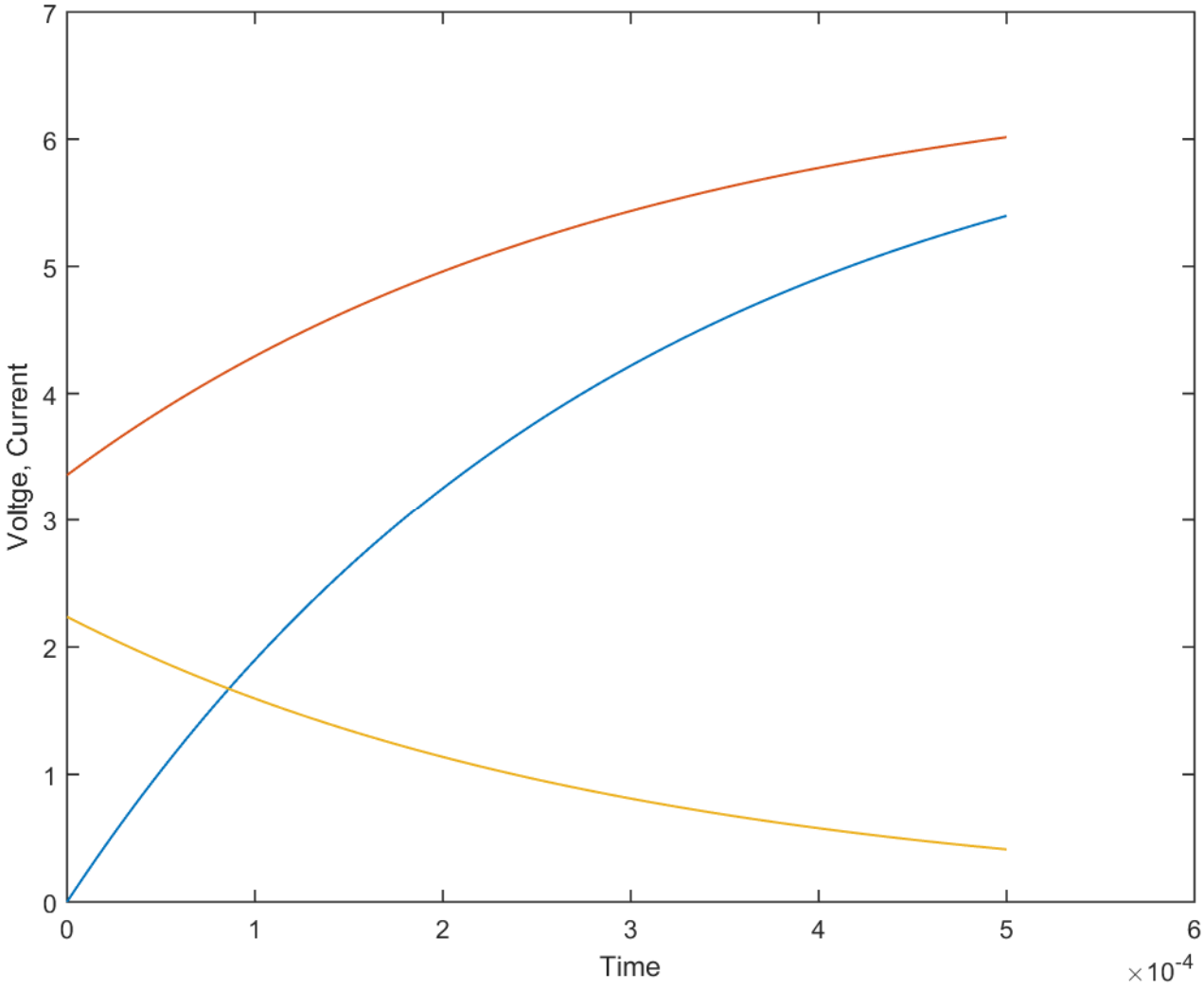
$$v_o(t) := R_3\cdot i_L(t) + v_L(t)$$

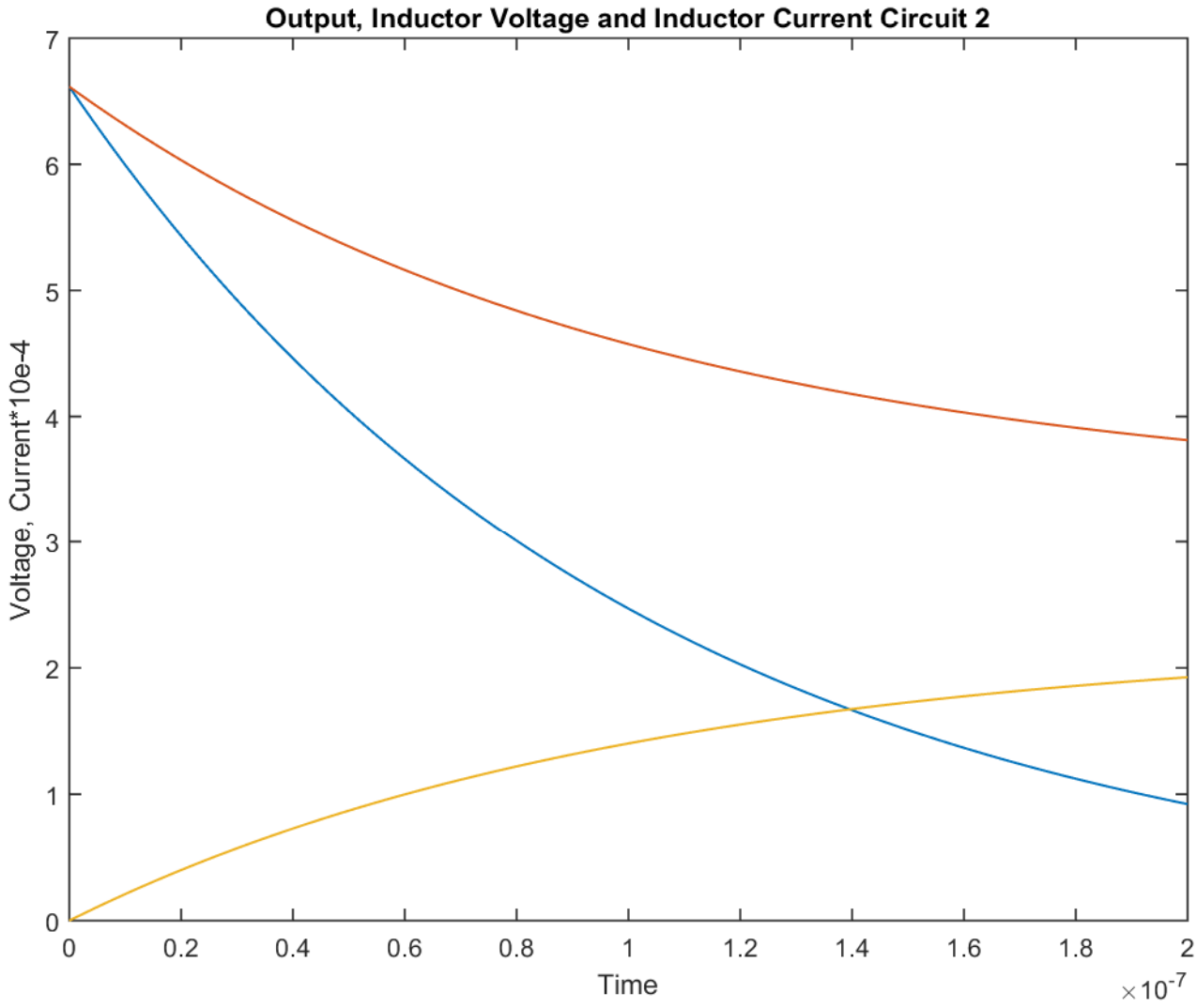
Thomas E. Brewer
Academic Factotum

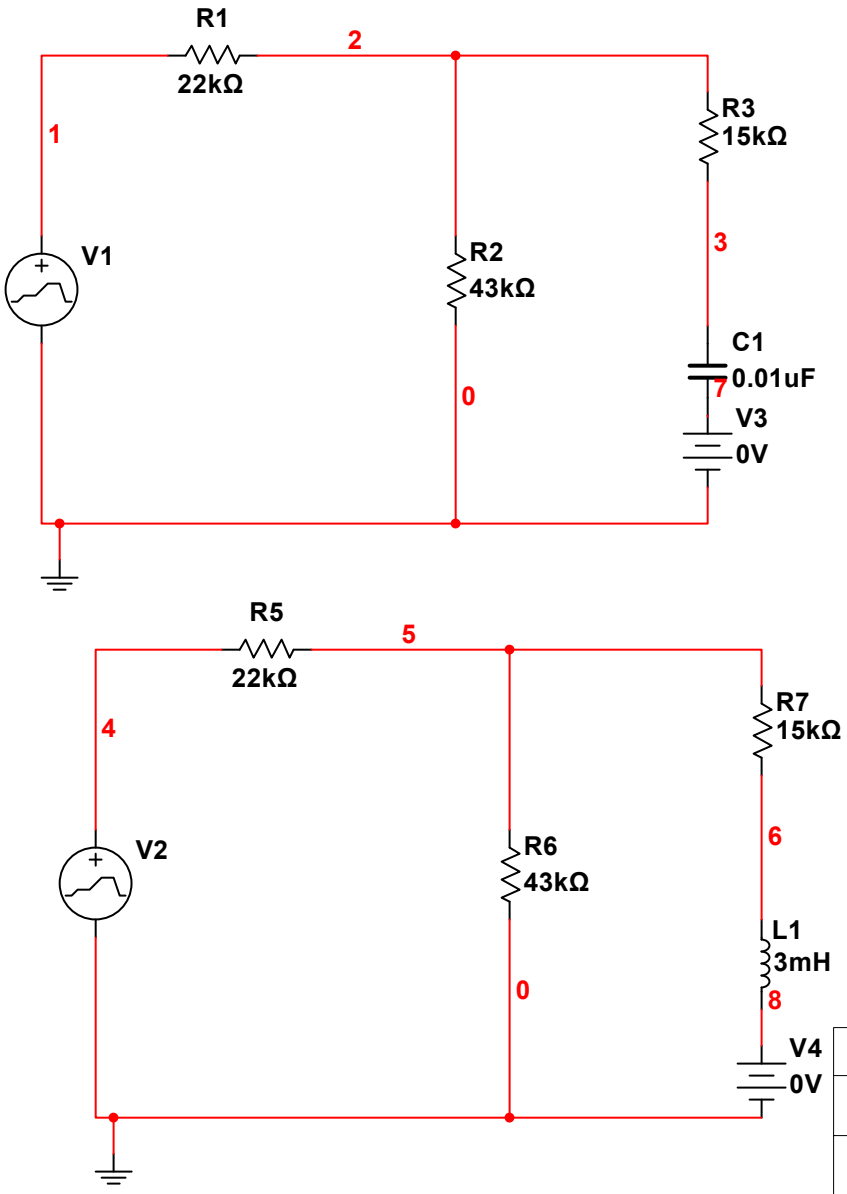
"brewmug.bmp"



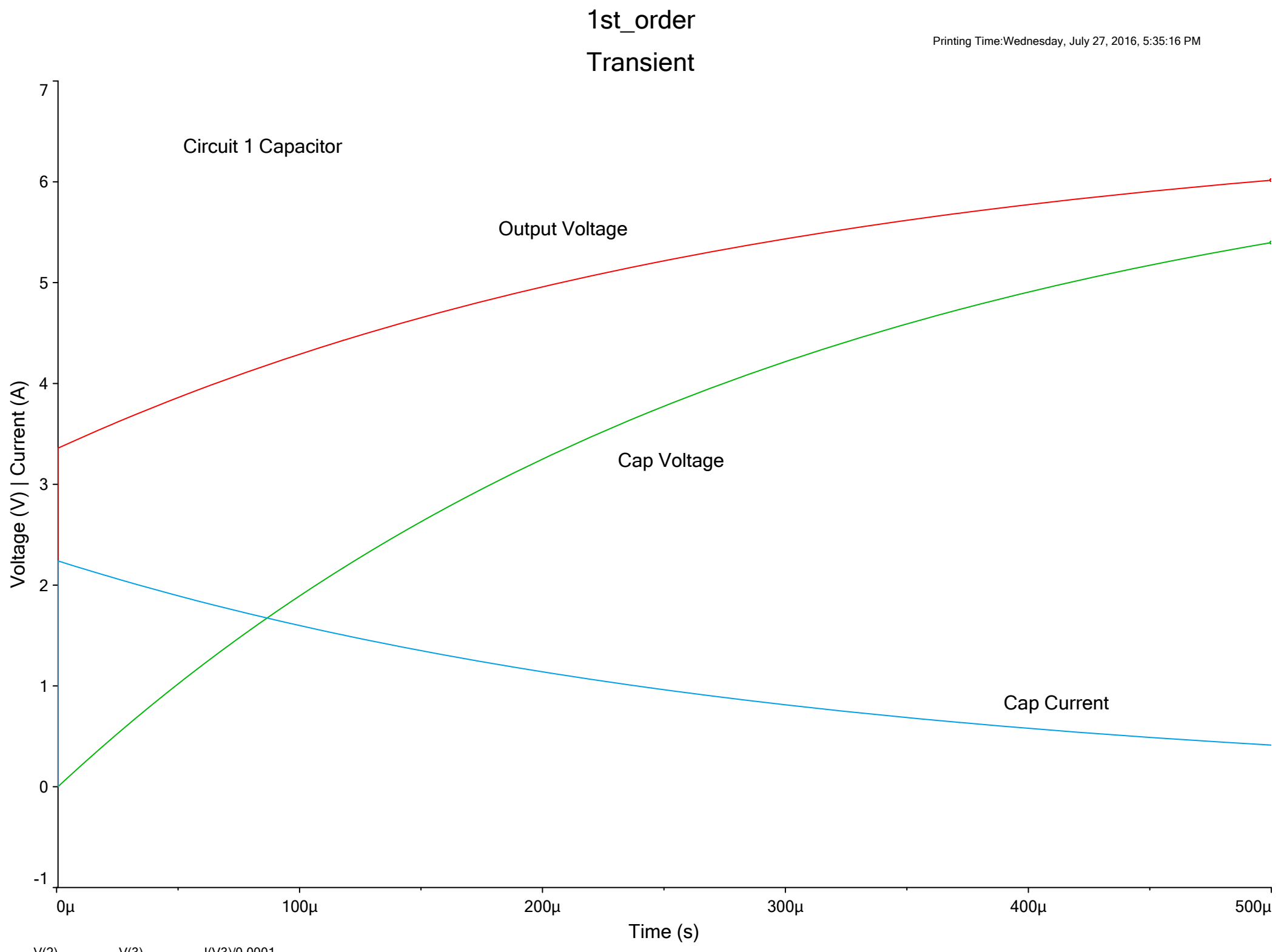
```
%Homework Prob 3 Fall 2016
%Circuit 1
%e0=10;r1=22e3;r2=43e3;r3=15e3;c=0.01e-6;
%e=e0*(r2)/(r1+r2);
%r=r3+r1*r2/(r1+r2);
%tau=r*c;
%t=linspace(0,5e-4,1000);
%vc=e*(1-exp(-t/tau));ic=(e/r)*exp(-t/tau);vo=vc+r3*ic;
%plot(t,vc,t,vo,t,ic/1e-4);
%Circuit 2
e0=10;r1=22e3;r2=43e3;r3=15e3;c=0.01e-6;
e=e0*(r2)/(r1+r2);
r=r3+r1*r2/(r1+r2);
G=1/r;I=e/r;l=3e-3;tau=l/r;
t=linspace(0,2e-7,1000);
il=I*(1-exp(-t/tau));vl=(I/G)*exp(-t/tau);
vo=vl+il*r3;
plot(t,vl,t,vo,t,il/1e-4);
```


7
6
5
4
3
2
1
0
Voltge, Current
0
1
2
3
4
5
6
Time
×10^-4


Output, Inductor Voltage and Inductor Current Circuit 2
Voltage, Current*10e-4
Time
×10^-7
0
1
2
3
4
5
6
7
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2



Title: Homework 3 for Experiment 3		
Size: A	Document N: 0001	Revision: 1.0
Date: 7/27/2016	Sheet 1 of 1	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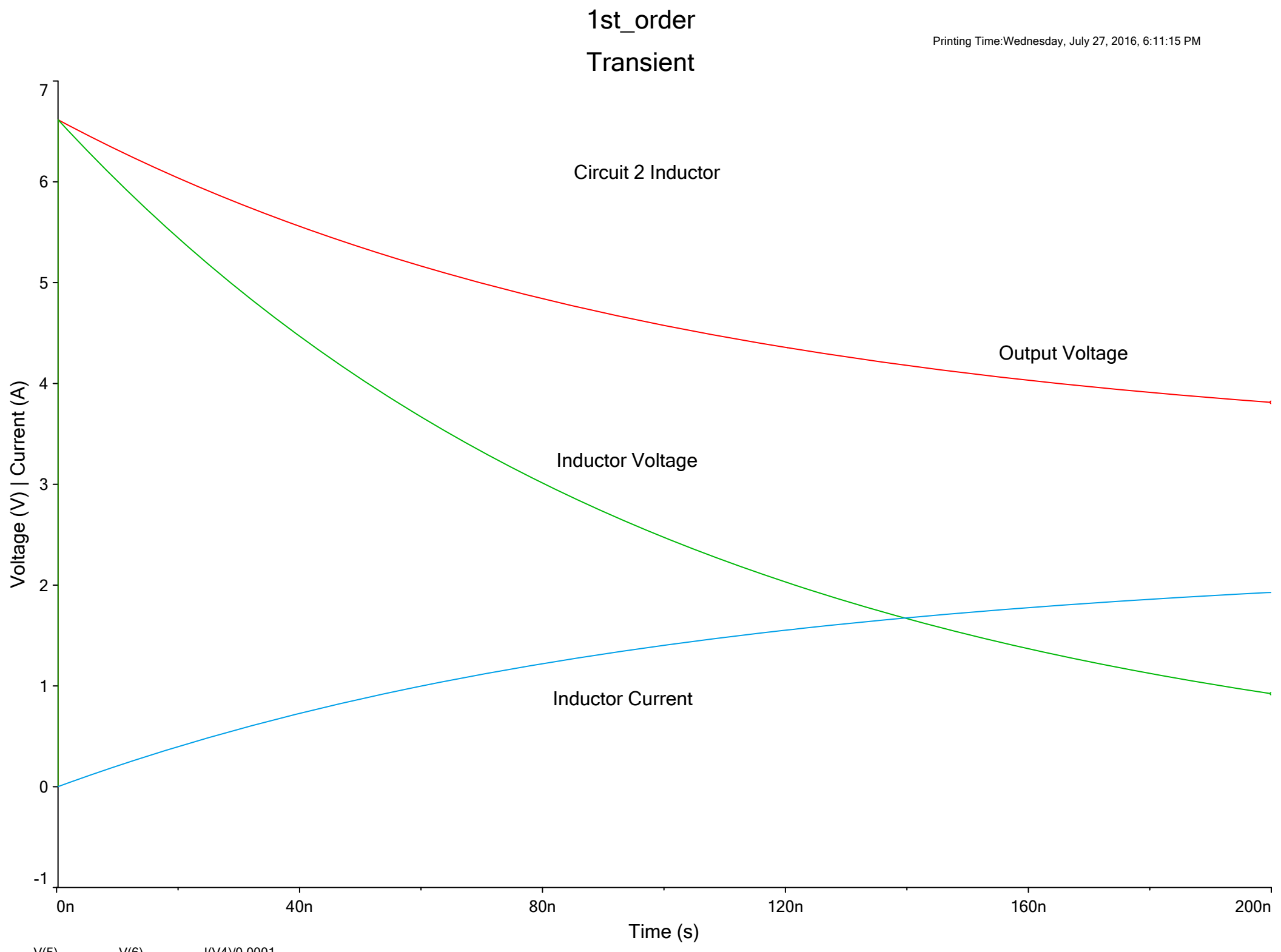
Transient
Printing Time:Wednesday, July 27, 2016, 5:35:16 PM
Circuit 1 Capacitor
Output Voltage
Cap Voltage
Cap Current
Voltage (V) | Current (A)
Time (s)
7
6
5
4
3
2
1
0
-1
0µ
100µ
200µ
300µ
400µ
500µ
V(2)
V(3)
I(V3)/0.0001


1st_order
Transient
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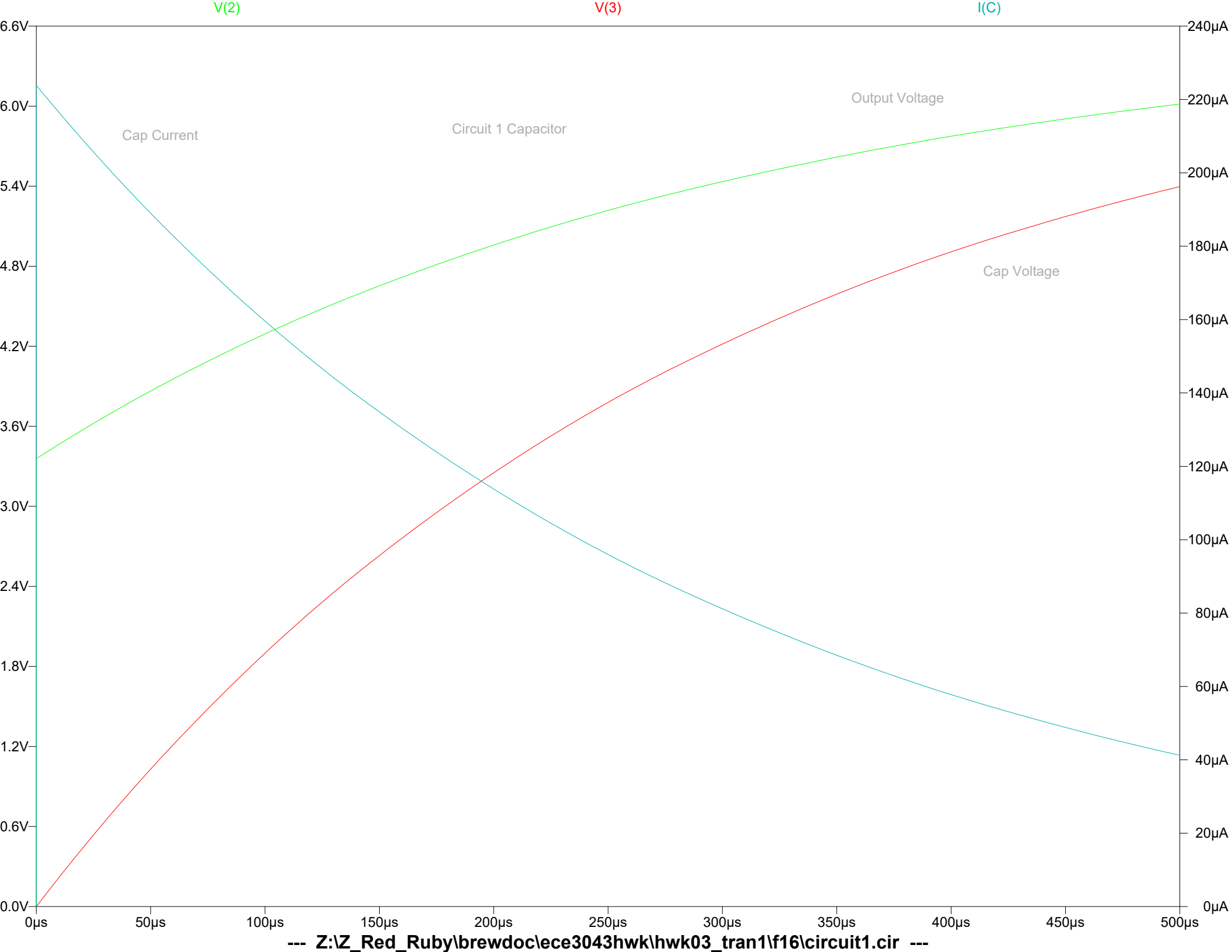
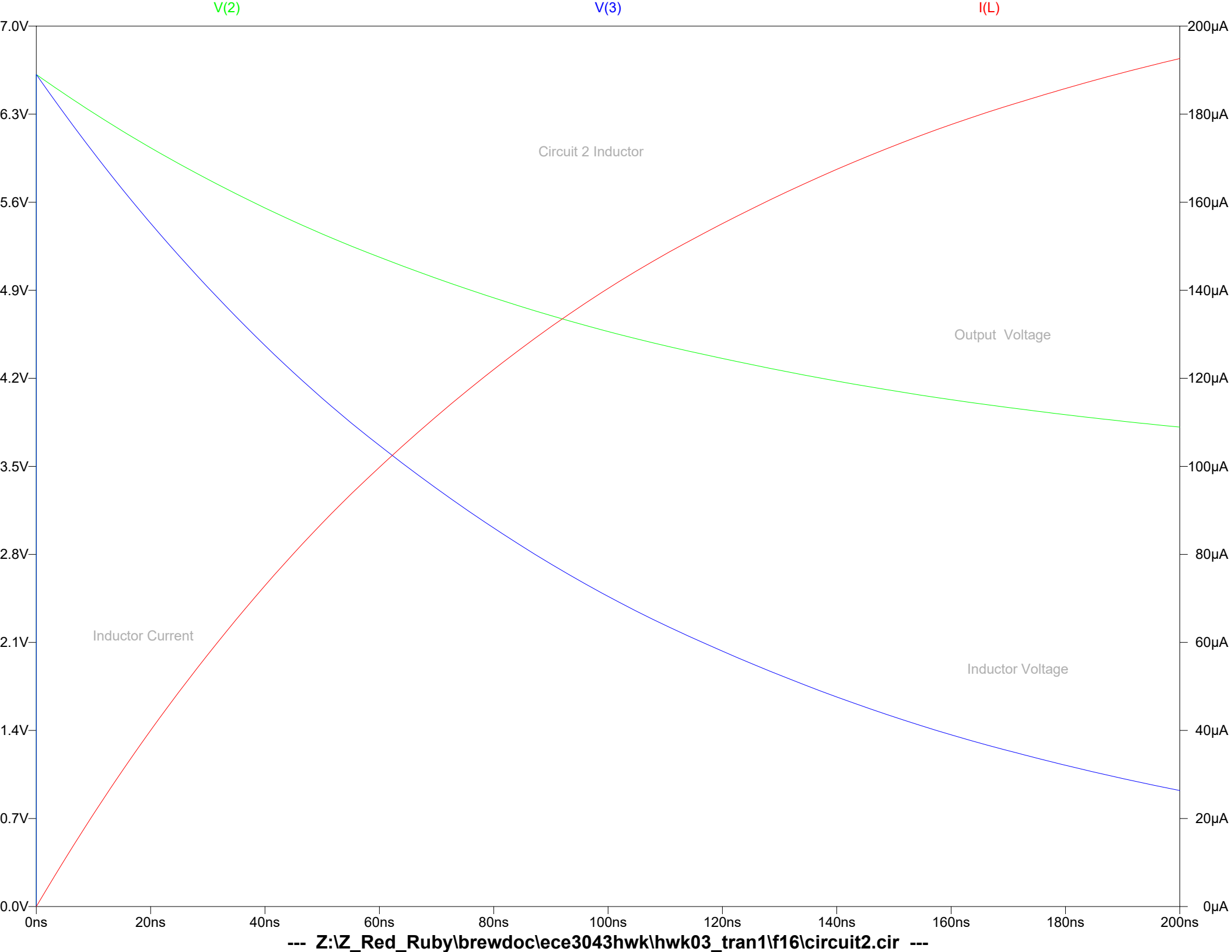
Circuit 2 Inductor
Output Voltage
Inductor Voltage
Inductor Current
Voltage (V) | Current (A)
Time (s)
7
6
5
4
3
2
1
0
-1
0n
40n
80n
120n
160n
200n
V(5)
V(6)
I(V4)/0.0001

```
Circuit 1 Capacitor
vi 1 0 pwl(0 10 0.8m 10)
r1 1 2 22k
r2 2 0 43k
r3 2 3 15k
c 3 0 0.01u ic=0
.tran 0 0.5mm uic
.end
```


V(2)
V(3)
I(C)
6.6V
6.0V
5.4V
4.8V
4.2V
3.6V
3.0V
2.4V
1.8V
1.2V
0.6V
0.0V
240µA
220µA
200µA
180µA
160µA
140µA
120µA
100µA
80µA
60µA
40µA
20µA
0µA
Cap Current
Circuit 1 Capacitor
Output Voltage
Cap Voltage
0µs
50µs
100µs
150µs
200µs
250µs
300µs
350µs
400µs
450µs
500µs
--- Z:\Z_Red_Ruby\brewdoc\ece3043hwk\hwk03_tran1\f16\circuit1.cir ---

```
Circuit 2 Inductor
vi 1 0 pwl(0 10 0.2u 10)
r1 1 2 22k
r2 2 0 43k
r3 2 3 15k
l 3 0 3m ic=0
.tran 0 0.2u uic
.end
```


V(2)
V(3)
I(L)
7.0V
6.3V
5.6V
4.9V
4.2V
3.5V
2.8V
2.1V
1.4V
0.7V
0.0V
200µA
180µA
160µA
140µA
120µA
100µA
80µA
60µA
40µA
20µA
0µA
0ns
20ns
40ns
60ns
80ns
100ns
120ns
140ns
160ns
180ns
200ns
Circuit 2 Inductor
Output Voltage
Inductor Current
Inductor Voltage
--- Z:\Z_Red_Ruby\brewdoc\ece3043hwk\hwk03_tran1\f16\circuit2.cir ---