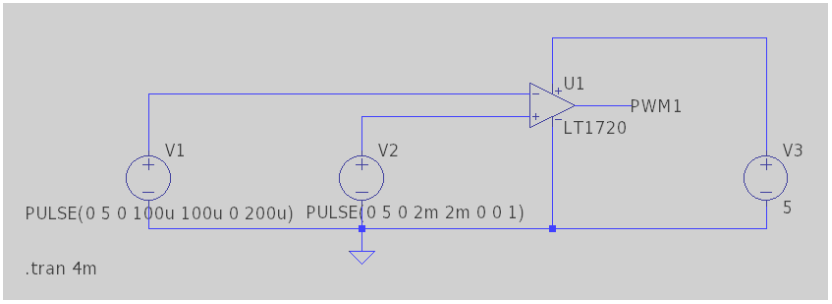
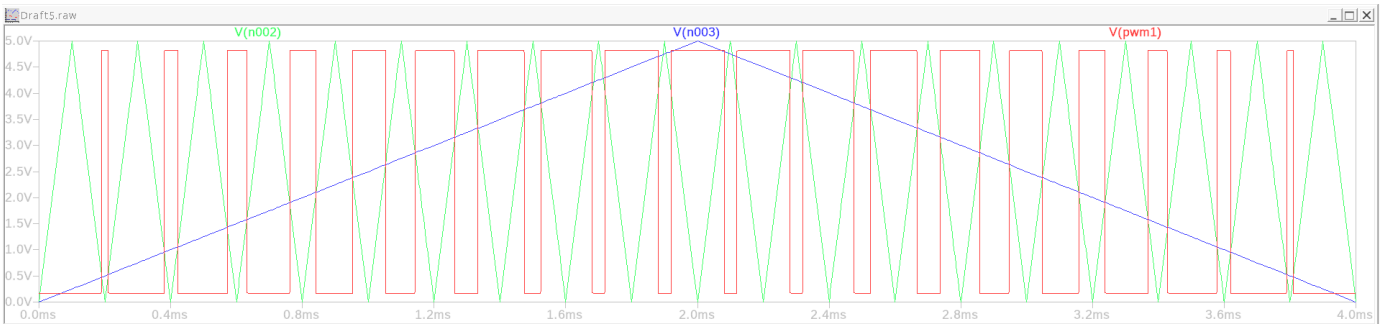
Assignment 5 - Bridge DC-DC converters

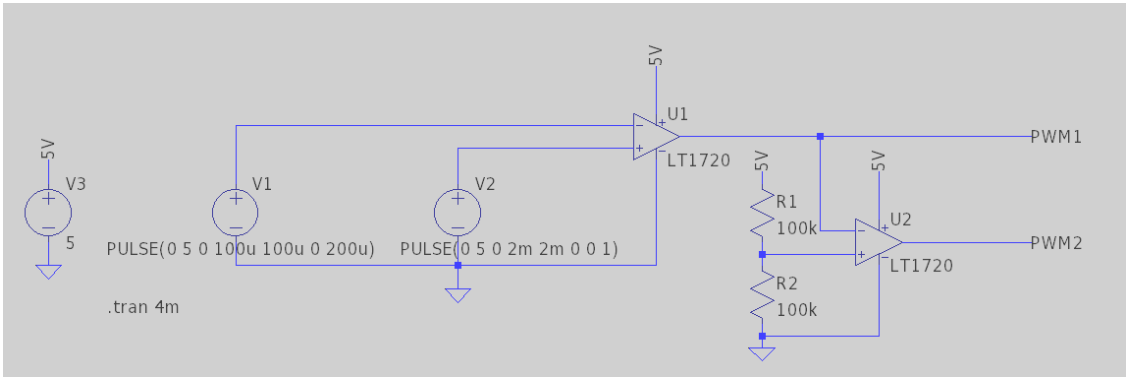
Forjanic Rémy (511448)

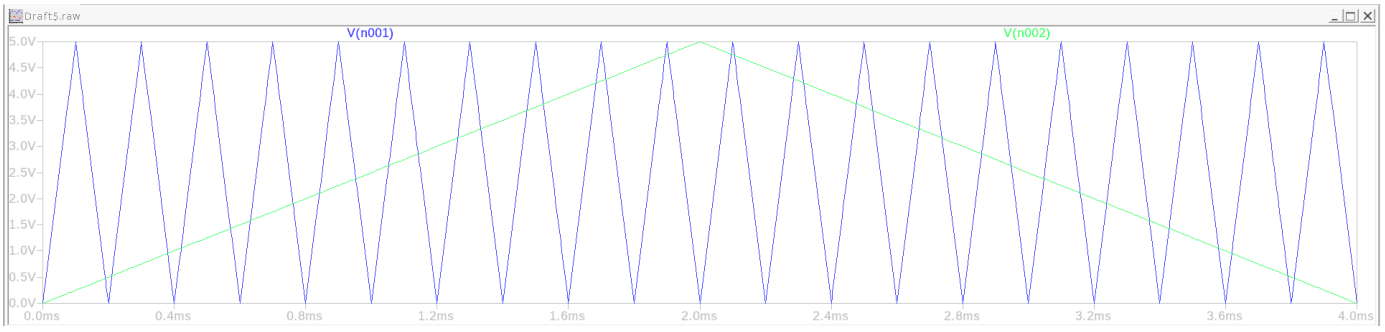
Question 1 - Control of DC-DC converters: Single PWM

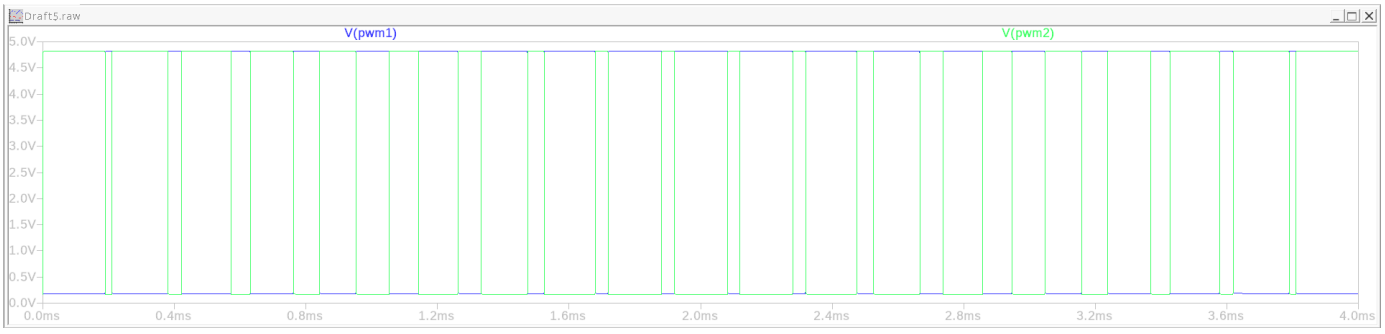




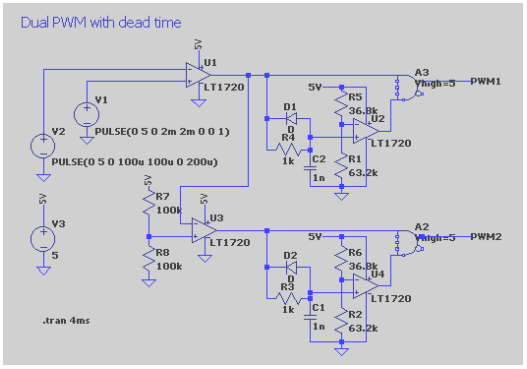
Question 2 - Control of DC-DC converters: Dual PWM

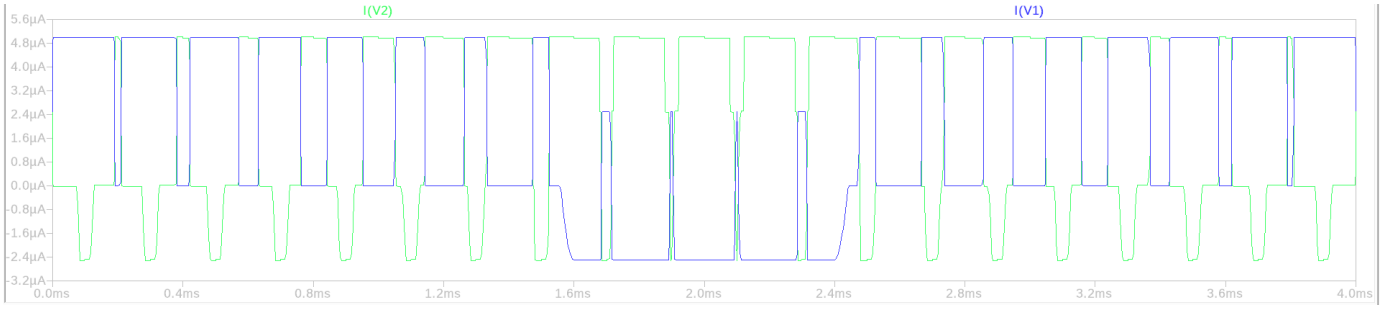


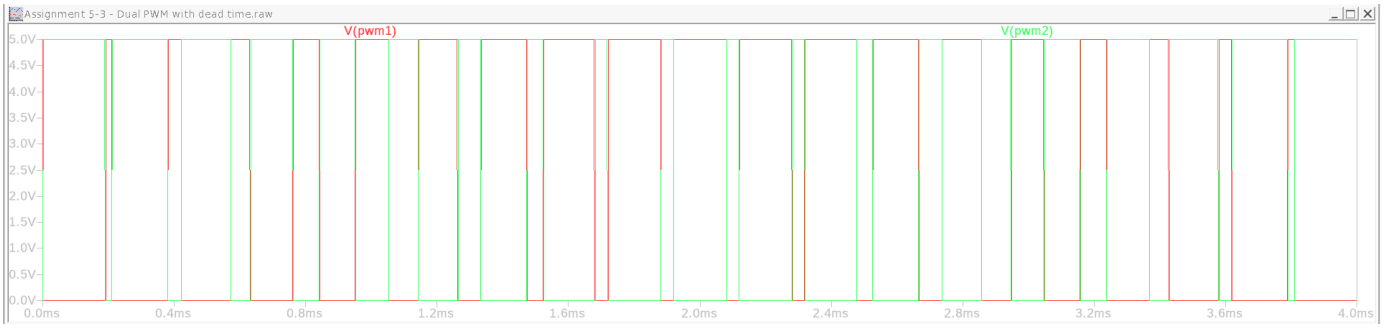




Question 3 - Control of DC-DC converters: Dual PWM with dead time



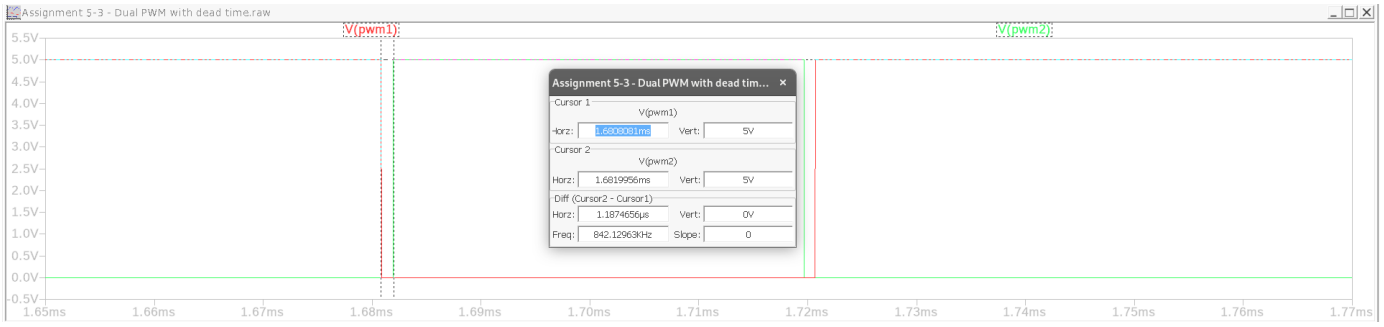




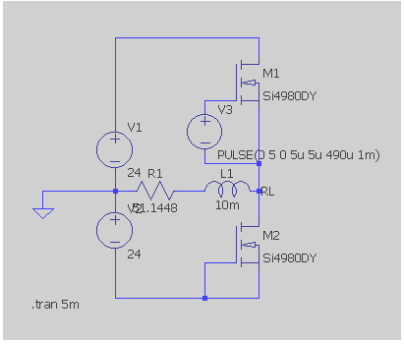
Calculate the dead time (the time between the turn off of PWM1 and turn on of PWM2).

Since $R_4 = R_3$ and $C_1 = C_2$: $t_\Delta = R_3 \times C_1 = 1k \times 1n = 1\mu s$

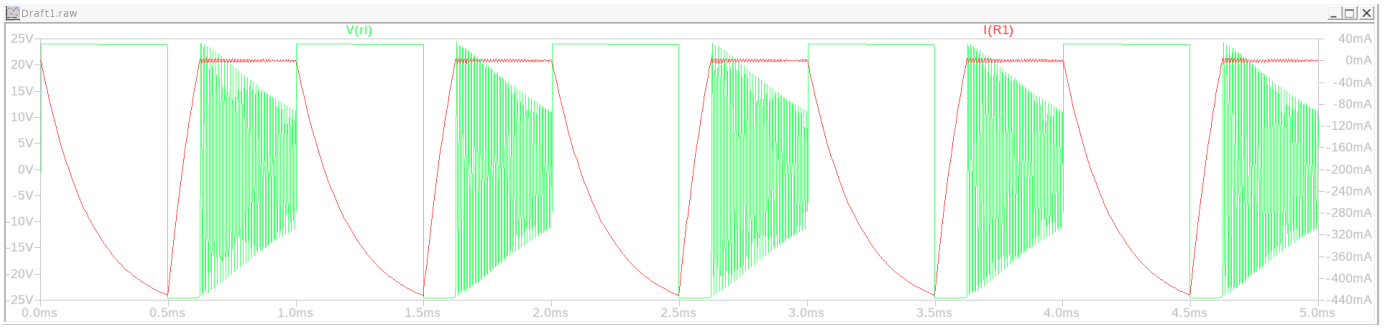
Verify the calculated dead time with the simulation results.



Question 4 - Half bridge: Unipolar switching

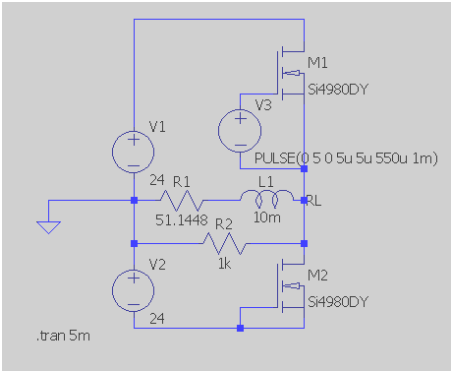


Show in a simulation the voltage across and current through the RL load.

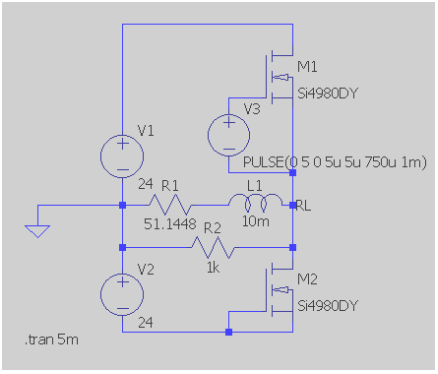


Question 5 - Unipolar switching of a RL load with bleeding resistor across the load

I don't understand why it's saying the duty cycle is 0.55 and not 0.5 even thought the period, the rise time, the on time and the fall time hasn't been changed.

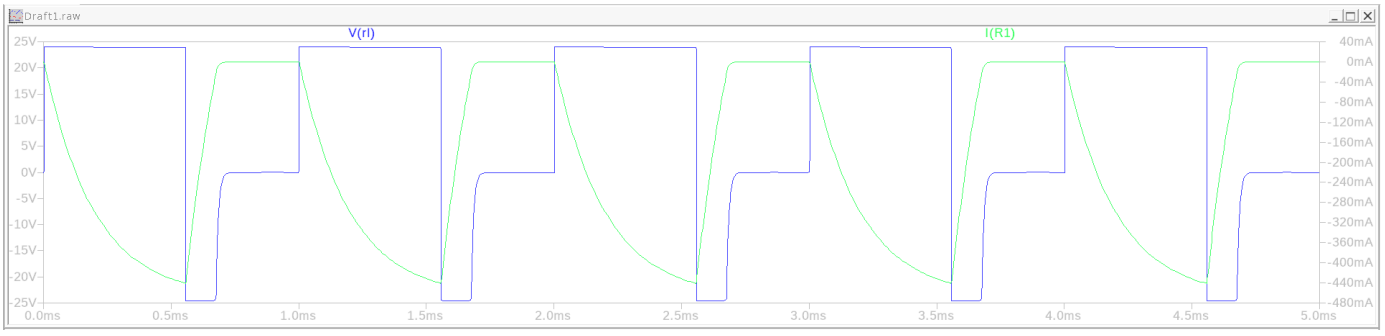


$D = 0.5$

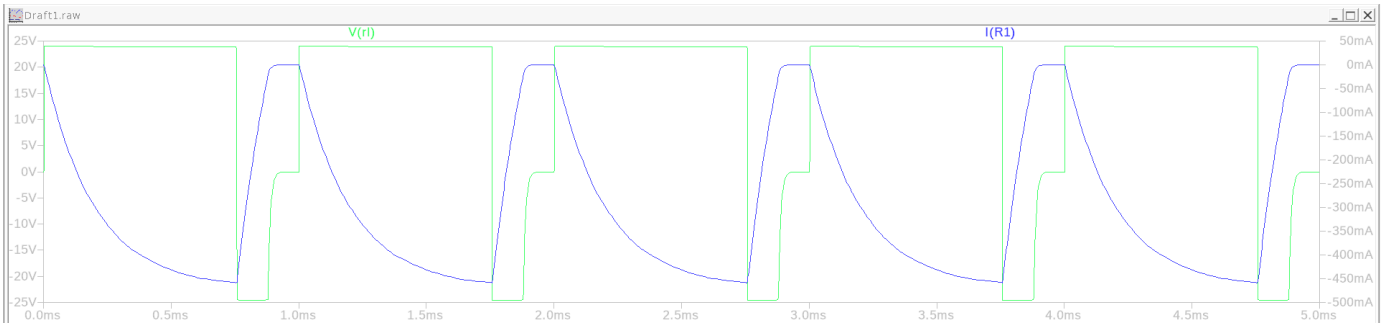


$D = 0.75$

Show in a simulation the voltage across and current through the RL load.

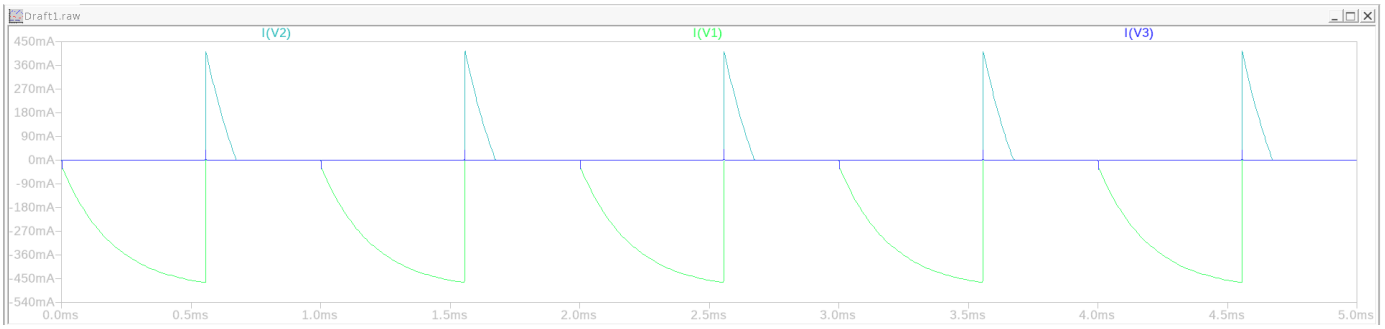


$D = 0.55$

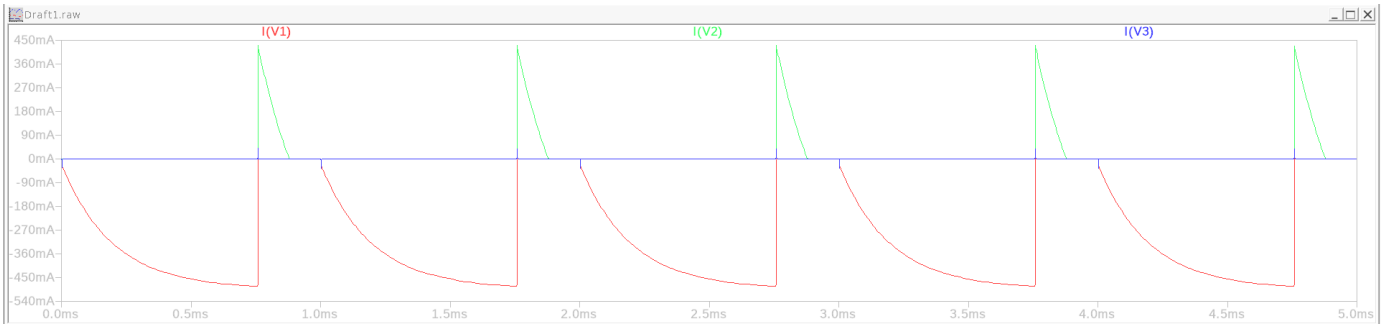


$D = 0.75$

Show in a simulation the source currents.

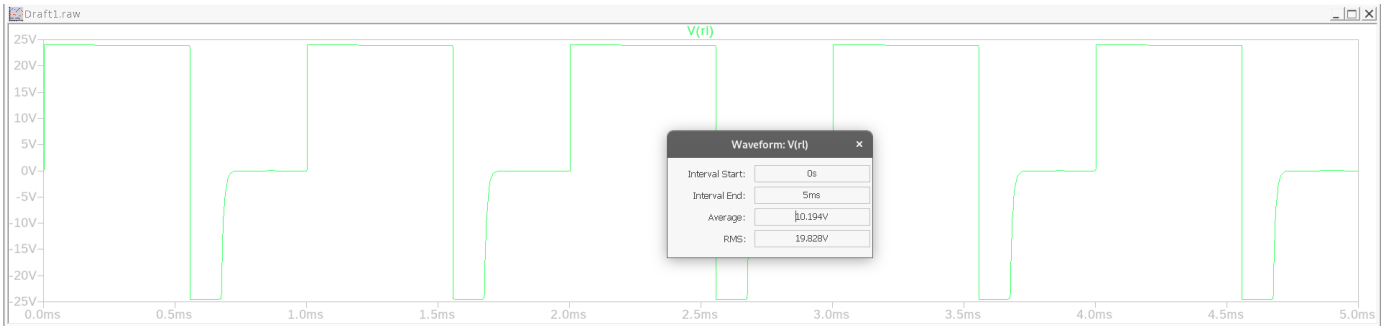


$D = 0.55$

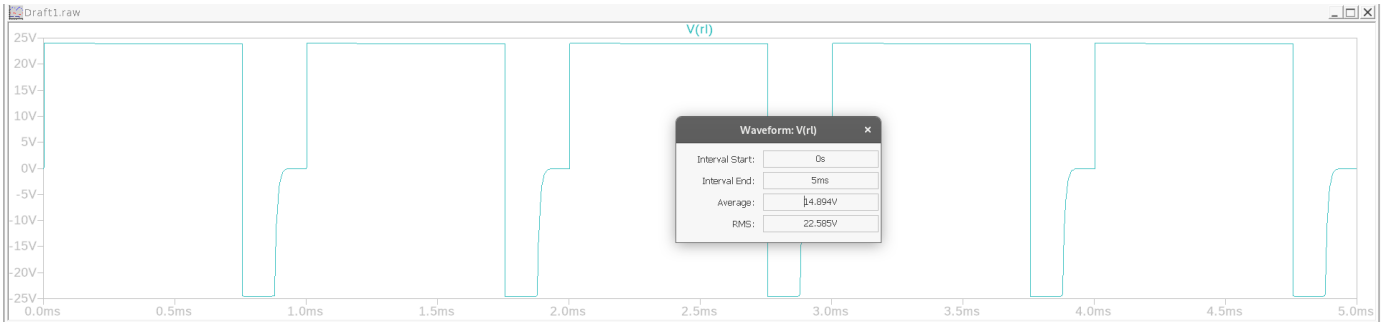


$D = 0.75$

What is the average voltage across the RL load?.



$D = 0.55$

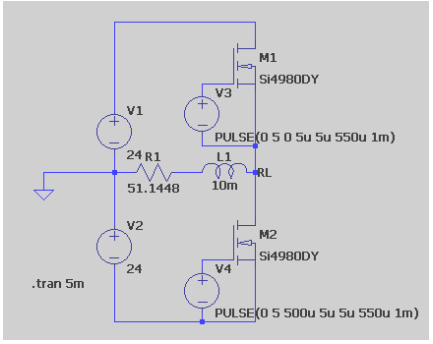


$D = 0.75$

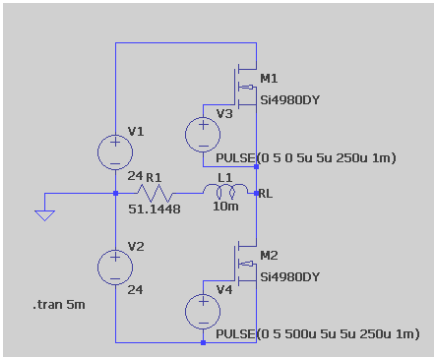
Question 6 - Bipolar switching RL load

$R1 = \frac{511448}{10000} = 51.1448\Omega$

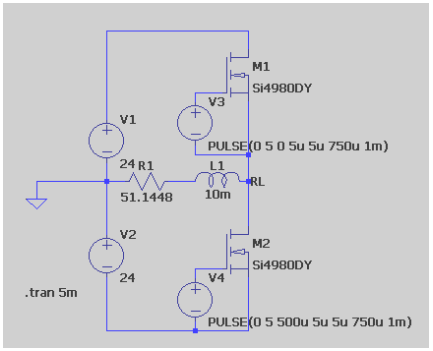
Simulation done with L = 10m instead of L = 5m, i compared my results with other people and there is not a big difference, the peaks are just more sharp.



$D = 0.55$

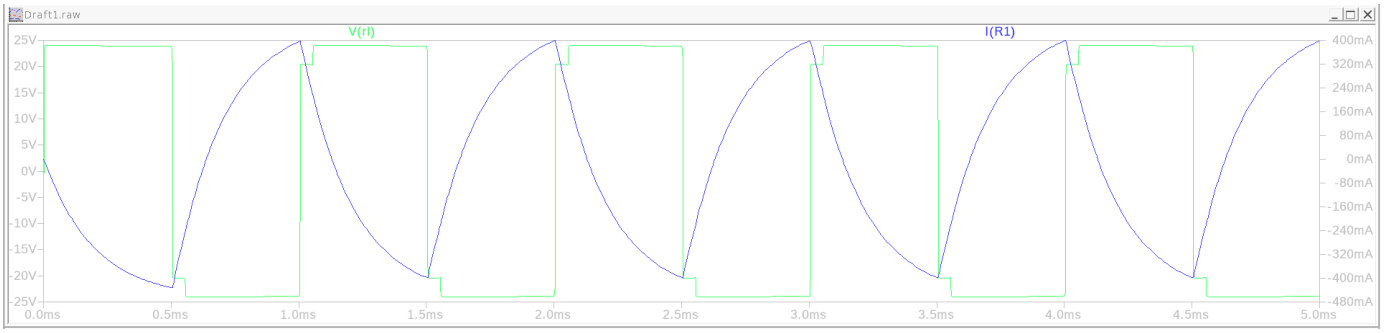


$D = 0.25$

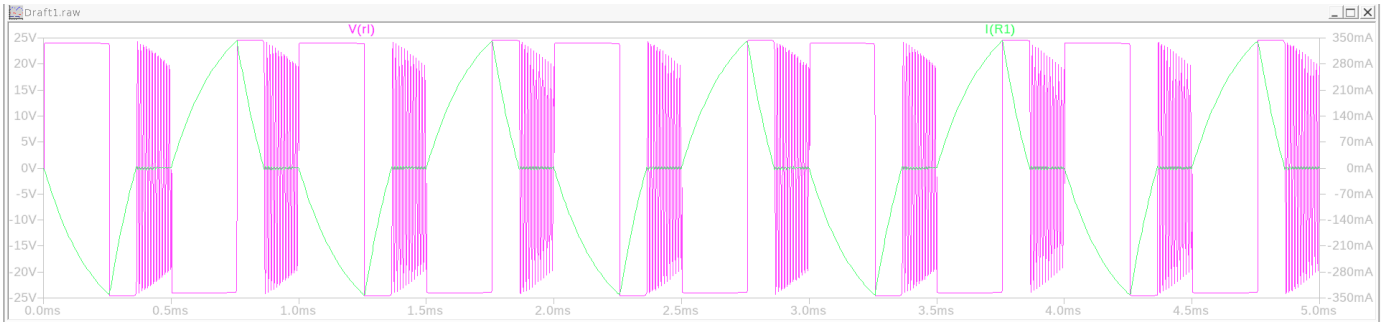


$D = 0.75$

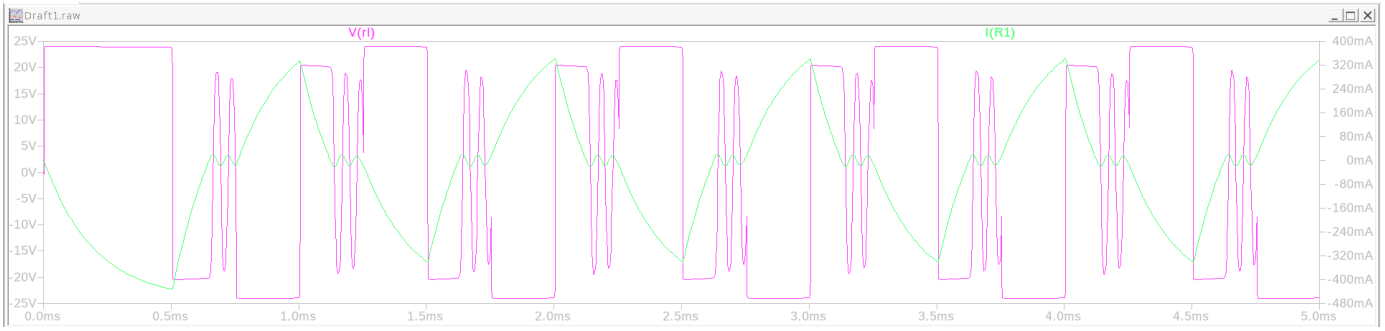
Show in a simulation the voltage across and current through the RL load.



$D = 0.55$

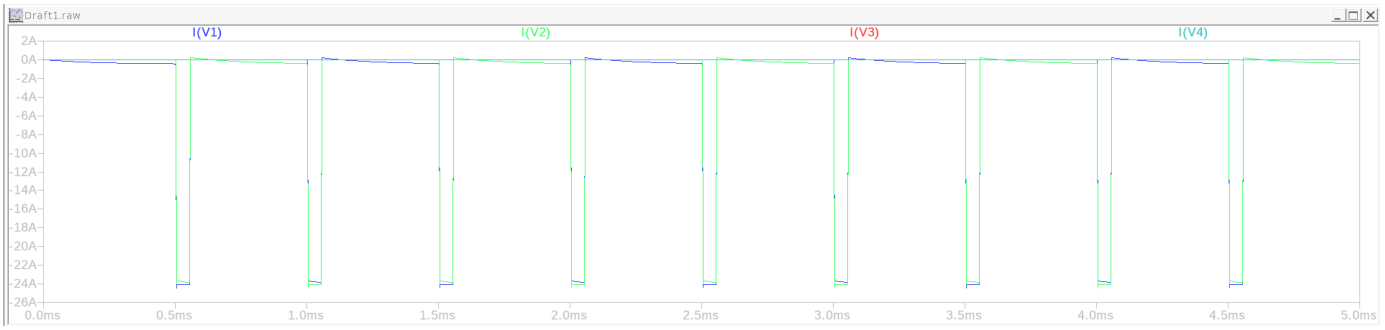


$D = 0.25$

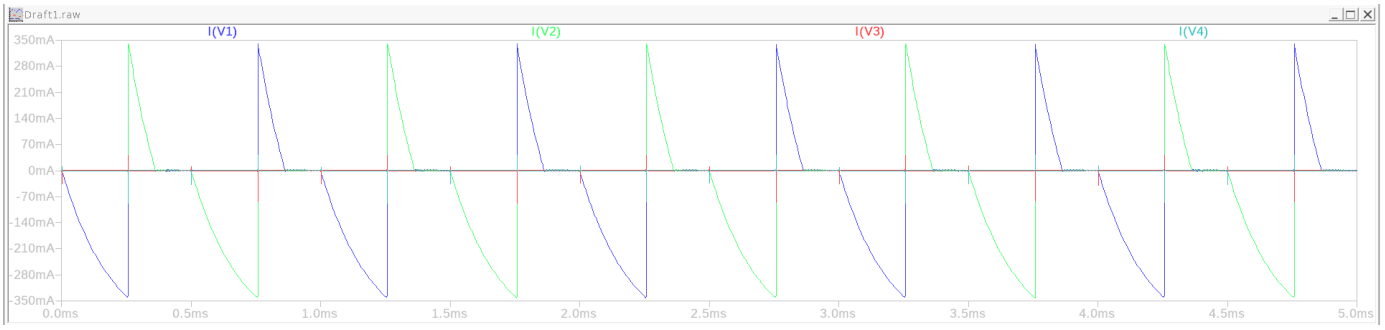


$D = 0.75$

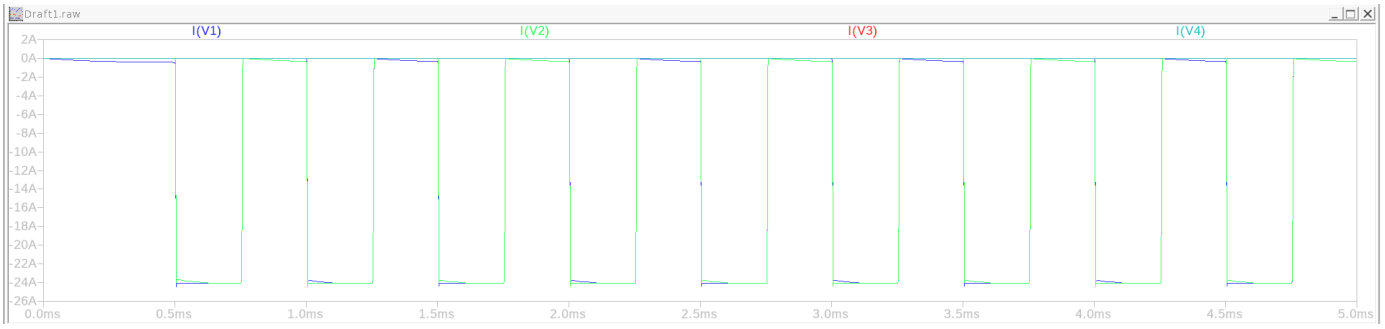
Show in a simulation the source currents.



$D = 0.55$

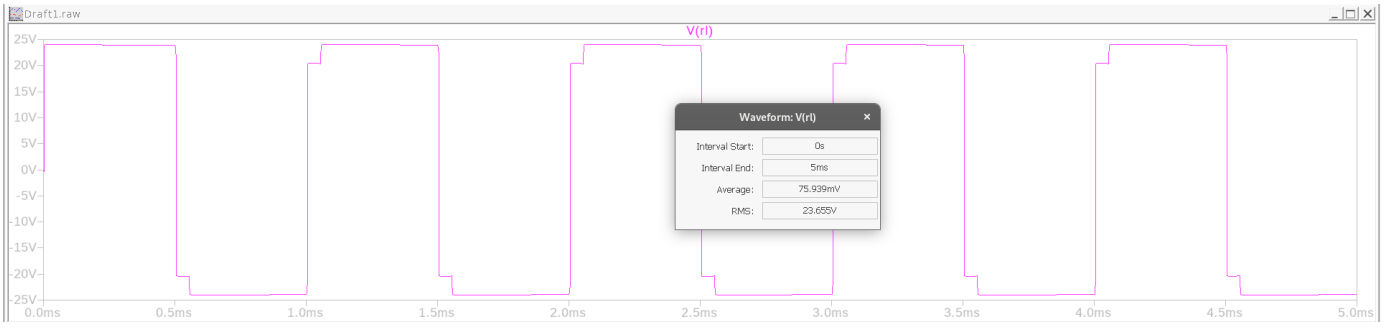


$D = 0.25$

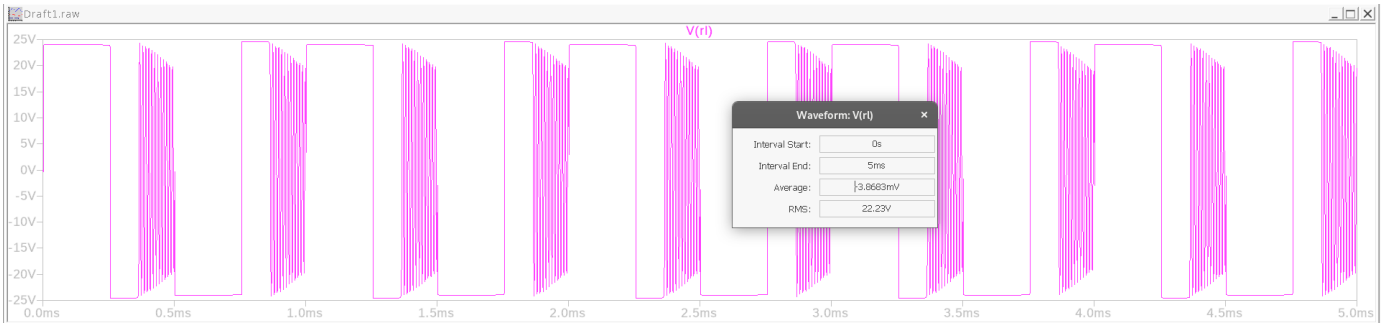


$D = 0.75$

What is the average voltage across the RL load?.



$D = 0.55$

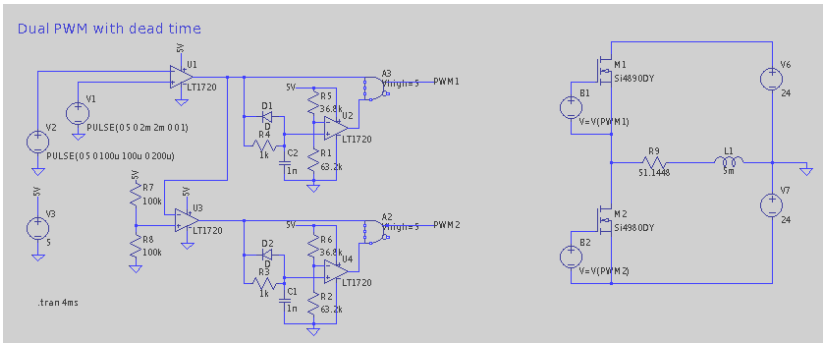


$D = 0.25$

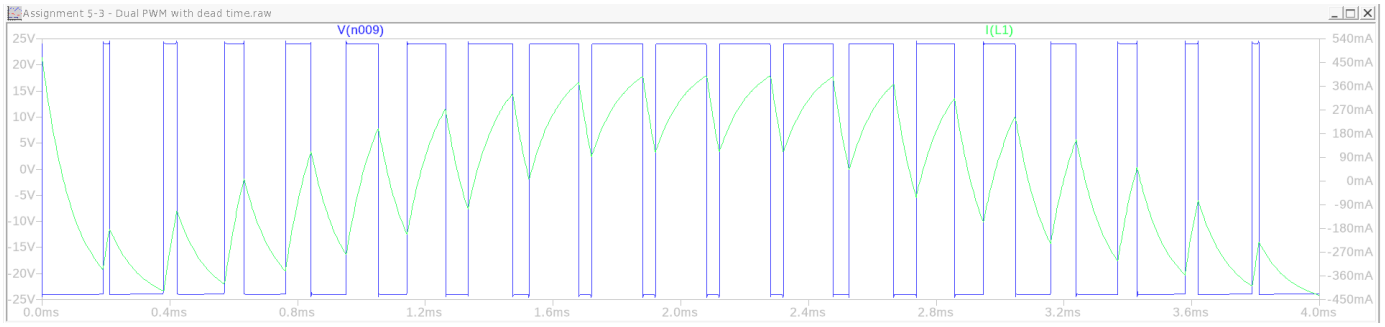
$D = 0.75$

Question 7 - PWM for half bridge

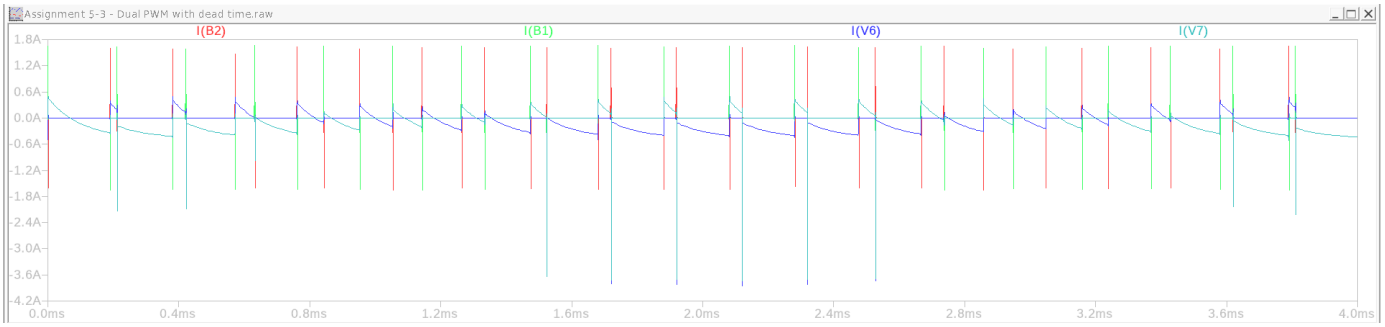
$R1 = \frac{511448}{10000} = 51.1448\Omega$

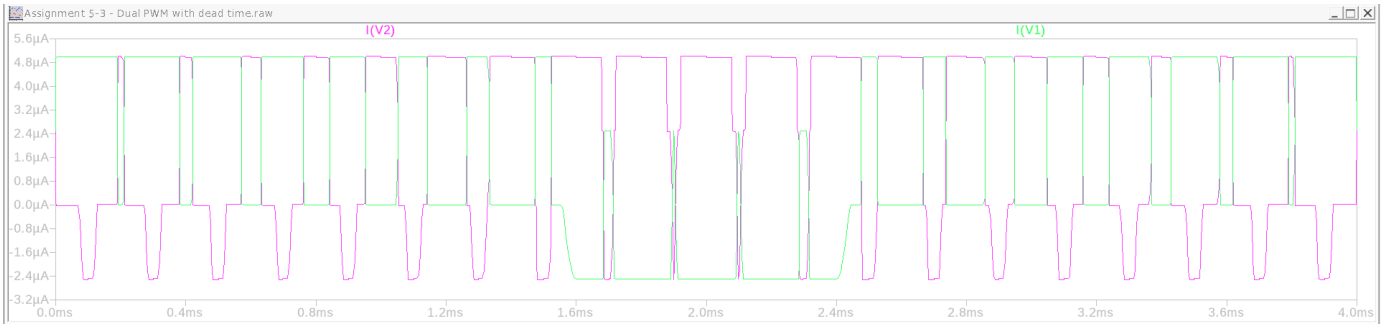


Show in a simulation the voltage across and current through the RL load.

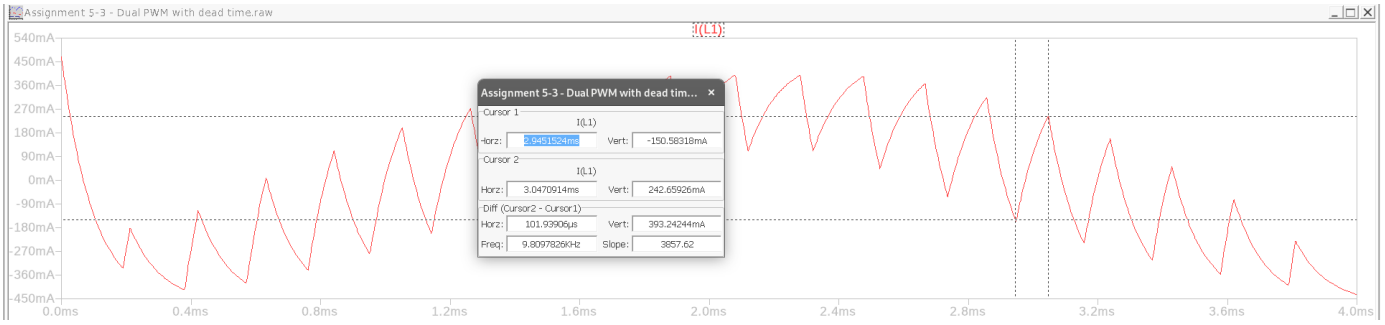


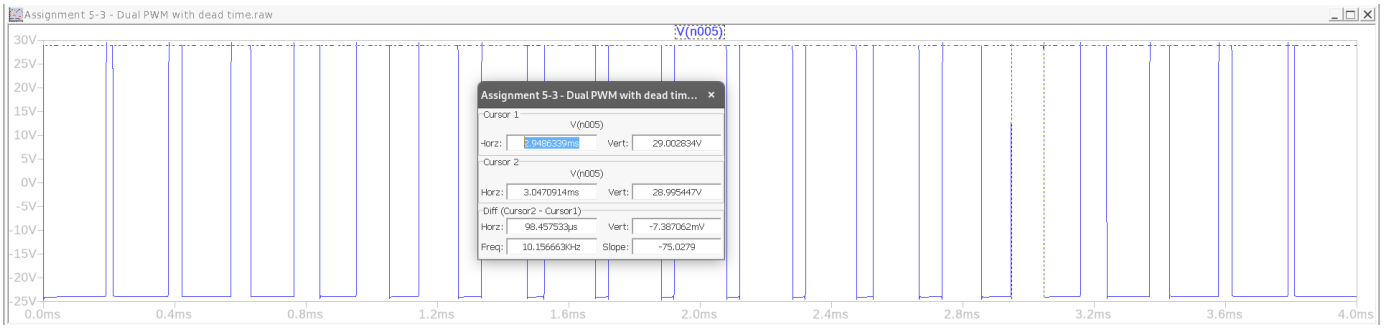
Show in a simulation the source currents.





For which duty cycle D there is the maximum ripple in the current?.





The ripple current is the biggest at $t = 2.9ms$.
Since the duty cycle changes linearly and at $t = 2ms$, $D = 0.8$ and at $t = 4ms$, $D = 0$:
$D = \frac{0.8}{(4-2)} \times (2.9 - 2) = 0.36$
The ripple current is the biggest when $D \approx 0.36$