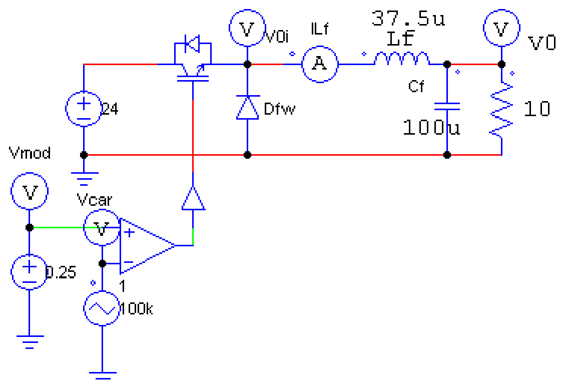
Consider a buck-dc-dc converter with the following specifications: fsw = 100 kHz, Vd= 24V, 6V<V0<9V and R = 10 ohms. Compute the value of L required for the converter to operate with CCM under all cases.

The ranges of load current and duty cycle are: 0.6A <Io<0.9A and 0.25<D<0.375.

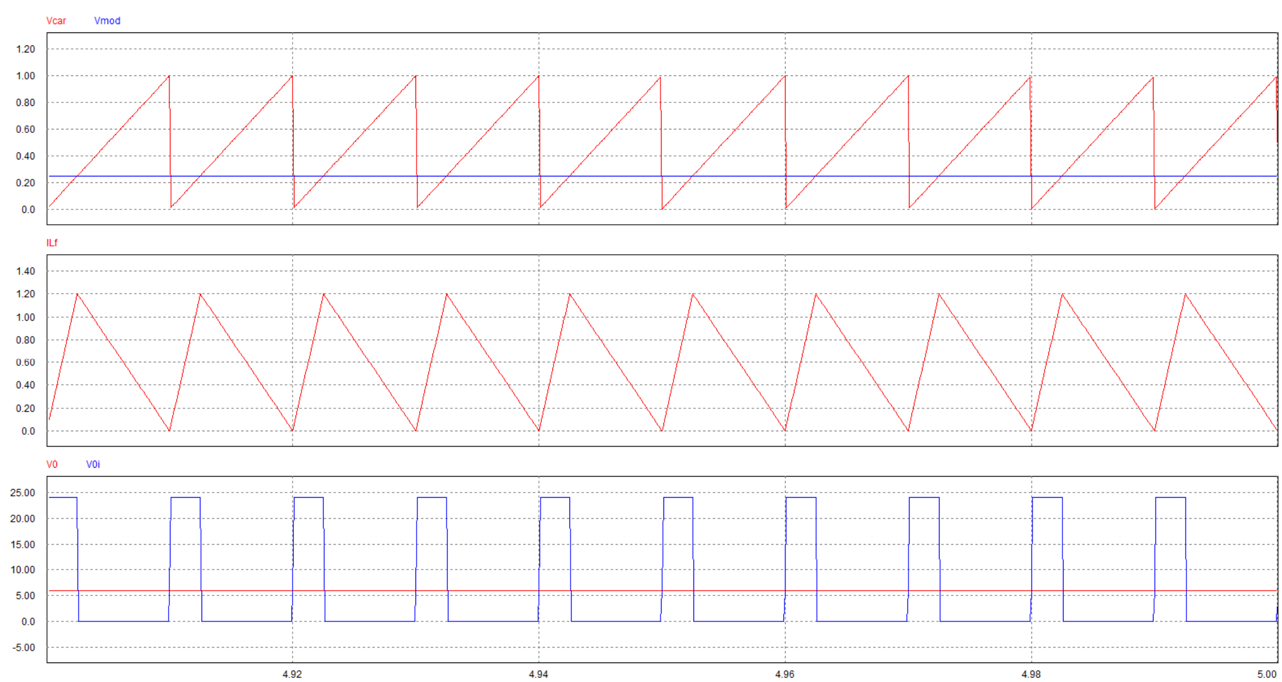
The converter operates with Vd constant and variable D, therefore one can use the graph shown in Fig. 7.6. To achieve CCM, the minimum load current (Iomin) has to be larger than the boundary current (IoB). Iomin = 0.6 A and occurs when D = 0.25.

In this case L>= 37.5 uH

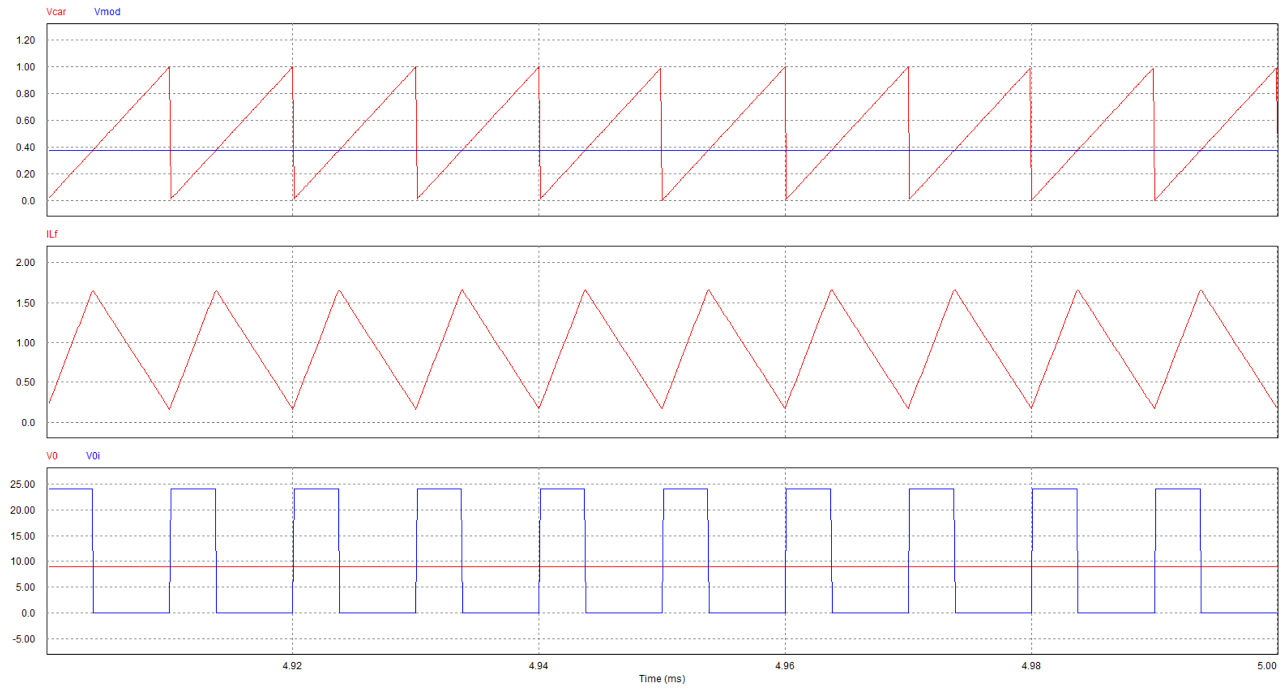
The PSIM simulation file, using a filter capacitor of 100 u and a time step of 0.1us, looks like:



Simulation results:

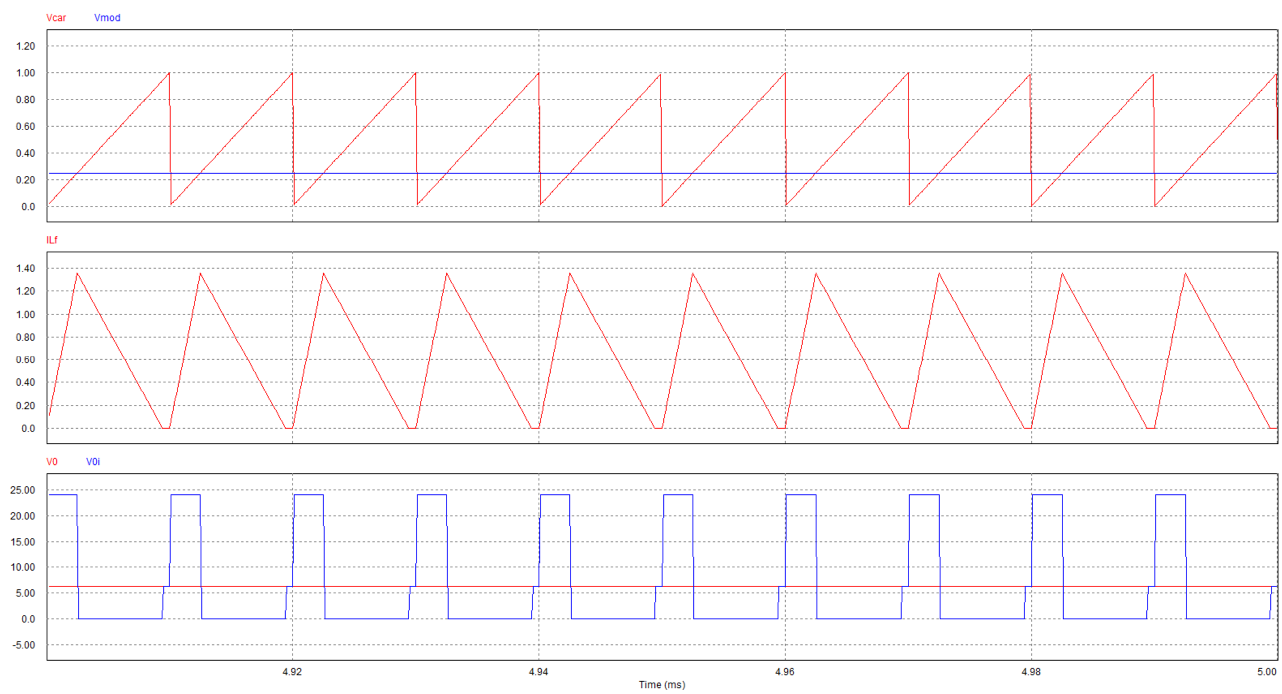


For the case one wishes to have an output voltage equal to 9V, the simulation results are:



Since this was not the critical case, the current is always above 0 A.

If a smaller inductor, say 32.5 uH had been used for the critical case (D = 0.25 and Io = 0.6 A), the simulation results would be:



There one sees that the system indeed operates with DCM and the output voltage of the converter (V0i) now presents 3 levels. It is equal to V0 while the inductor current is zero. The value of V0 is now 6.38 V, bigger than the 6V obtained with relation D Vd which is only valid for CCM.

Additional information in section 7-4-3 of the textbook, not discussed in this course.