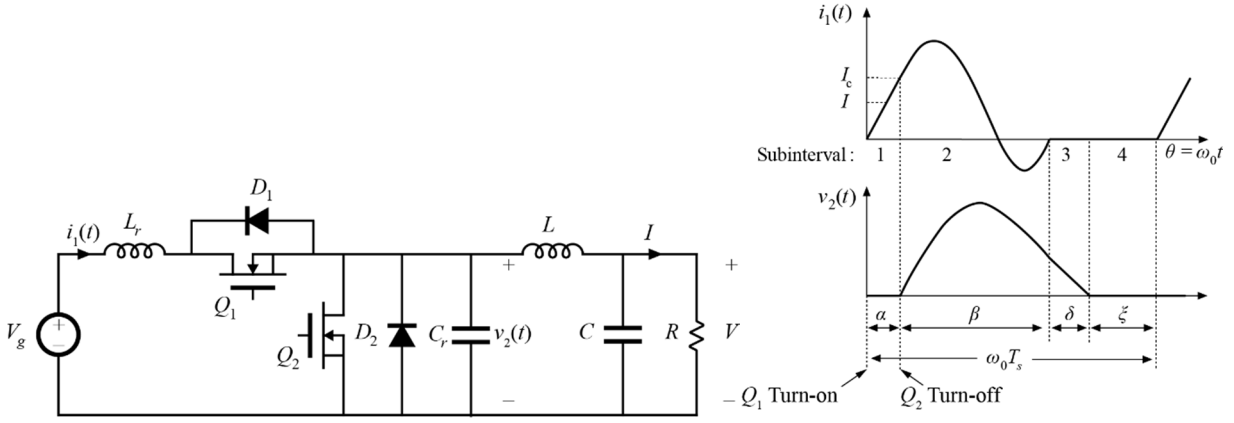
Resonant Switch Converter with Synchronous Rectifier

Fig. 1(a) shows a resonant switch converter employing a synchronous rectifier (Q_2). Transistor Q_2 is on whenever D_2 would normally conduct. In addition, Q2 can be held on to extend the length of subinterval 1 beyond what is possible in the non-synchronous case. For all parts of the problem, assume the converter is controlled such that the waveforms in Fig. 1(b) describe circuit operation. The converter is controlled such that the current at the end of subinterval 1 is $I_c \geq I$.



(a) (b)

Figure 1: Resonant switch converter under study (a) and representative waveforms for the given mode of operation (b).

a) What type of resonant switch is employed? What is the parent PWM converter? (Note: You may neglect Q_2 in answering this question)
b) Sketch and label the normalized i_1-v_2 state plane corresponding to the waveforms of Fig. 1(b).
c) Solve to find an expression for the conversion ratio M, as a function of the normalized load current J, switching frequency F, and control current J_c.
d) Solve for the zero soft switching boundary for this mode of operation.