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PROBLEMS

32.1 A 1.5V AAA battery has a capacity of 1000 mAh. How much energy does a full-capacity AAA battery store? How low long can this battery supply energy to a 10kΩ resistor? When the battery is supplying energy to the resistor what is the instantaneous power supplied? What is the average power supplied? How are these related? Why?

32.2 Suppose that a digital chip uses a *VDD* of 1V. Further suppose that an the output of this digital system drives a 10 pF load (this capacitance is used to model what is connected to the chip). What is the energy needed to send a bit from the digital chip to the load? How much energy does it take to send 100Mbits? What is the instantaneous power when sending this information at 1Gb/s and 10Mb/s? What dissipates power (where does the energy go) in this system?

32.3 Show, using simulations, how to measure the on resistance of MD in Fig. 32.8.

32.4 Redesign the driver in Fig. 32.8 to better ensure that MU and MD are never on at the same time. Verify your design, and comments, with simulations.

32.5 Show how a snubber circuit can reduce the oscillations in Fig. 32.15. Comment on your design and verify your design and comments with simulations.

32.6 Redesign the buck SPS in Ex. 32.5 using a PMOS for MU. Verify the operation of your design and your comments.

32.7 Repeat Ex. 32.6 using a Schottky diode. Comment on your simulation results.

32.8 What are the benefits and drawbacks of increasing the frequency used in the boost SPS in Ex. 32.7? Use simulations to verify your comments.

32.9 Show, using simulations, that using a lower capacitance diode improves the performance of the boost SPS in Ex. 32.7.

32.10 For the circuit seen in Fig. 32.53 assume the primary's inductance is 10 mH, the secondary's inductance is 100 μH, and that the resistance of the 0.001 Ω resistor is negligible (it's included so a voltage source doesn't directly drive an inductance in the simulations). Using hand calculations find all voltages and currents in the circuit. Verify your hand calculations using simulations.

32.11 For the buck SPS control loop example show, using simulations, that increasing the location of the crossover frequency, f_{un}, causes the loop to be less stable but react faster.

32.12 Repeat problem 32.11 for the boost SPS control loop example in this chapter.

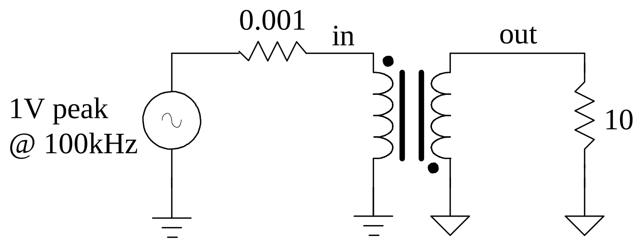

Figure 32.53 Circuit for problem 32.10.

32.13 Repeat problem 32.11 for the flyback SPS control loop example in this chapter.

32.14 For the example buck HPS discussed in this chapter discuss how selection of the inductor influences the operation. Use simulations to support your discussion. Please be clear on the trade-offs involved.

32.15 Repeat problem 32.14 for the example boost HPS discussed in this chapter but, in addition to how the selection of the inductor influences operation, also discuss how the oscillator frequency influences operation.

32.16 Redesign the flyback HPS example of this chapter to operate using a 1 MHz oscillator. What are the benefits and drawbacks of increasing the oscillator's frequency? Can the filter capacitor's value be changed? Why or why not? Use simulations to support your answers.