Power Electronics Education
Electronic Book

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Tutorial 2: Power Switches

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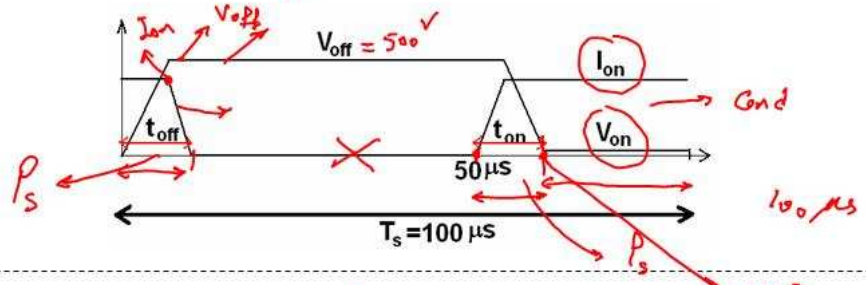
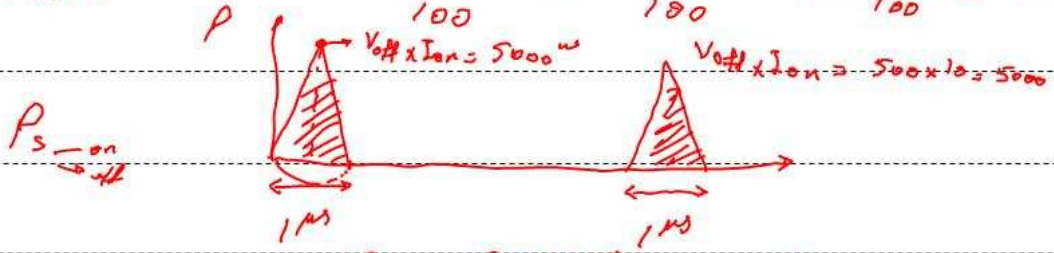
Q1: Determine the switching and conduction losses of a power switch whose voltage and current waveforms are as below:

$t_{on}=1\mu s$, $t_{off}=1\mu s$, $I_{off}=0$, $V_{on}=2$ V, $V_{off}=500$ V, $I_{on}=10$A



$$P_{cond} = \frac{V_{on} \times I_{on} \times (100-51)}{100} = \frac{2 \times 10 \times 49}{100} = \frac{98 \times 10}{100} = 9.8 \text{ watts}$$



$$P_{s\_on} = \frac{5000 \times 1\mu s}{2 \times 100\ \mu s} = \frac{50}{2} = 25 \text{ watts}$$

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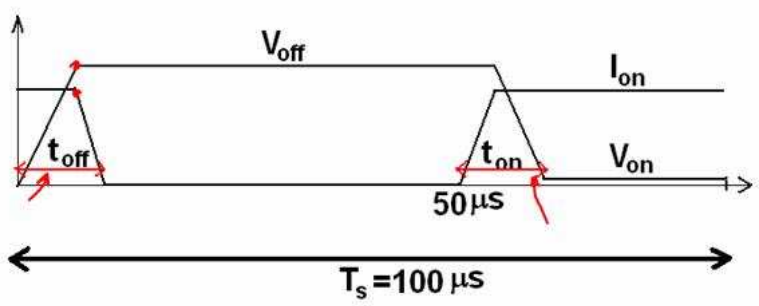


$P_{s\_off} = P_{s\_on} = 2.5$ watts

$P_s = P_{s\_off} + P_{s\_on} = 25 + 25 = 50$ watts

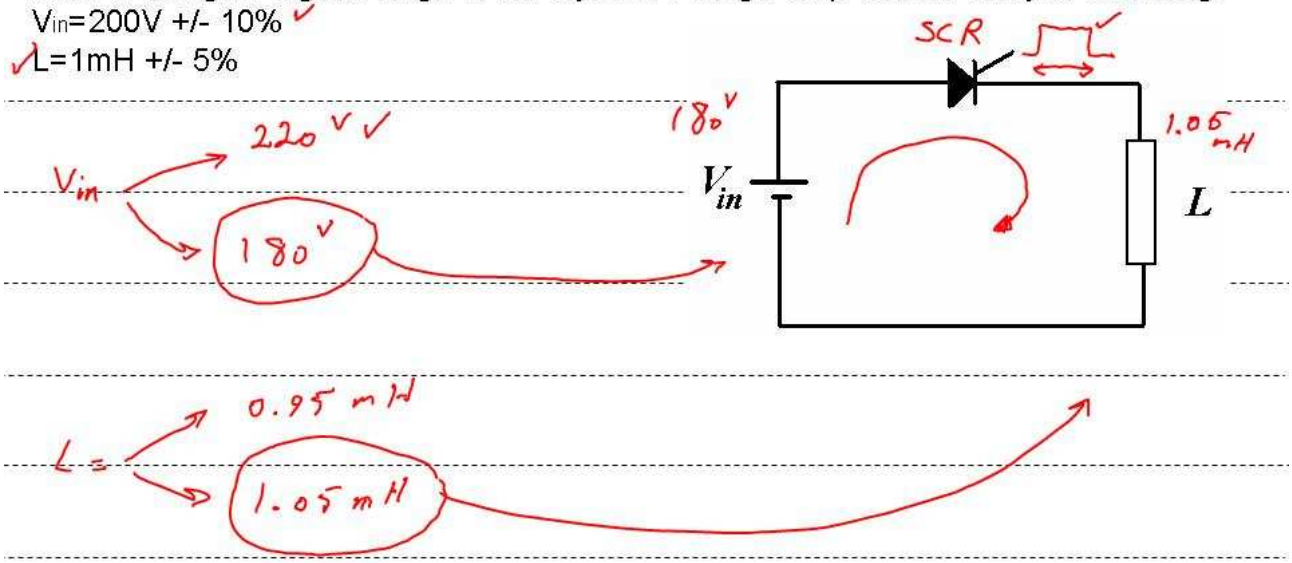
$P_{cond} = 9.8$ watts

$P_{loss} = 59.8$ watts

Q2: In the following circuit, the thyristor has a latching current level of 50mA and to turn on it, a pulse voltage is applied to a gate terminal of the switch. What is a minimum pulse width for the gate signal to keep the switch in the on state when we remove the gate signal. Neglect the thyristor voltage drop and no delay in switching.

V_{in}=200V +/- 10%

L=1mH +/- 5%



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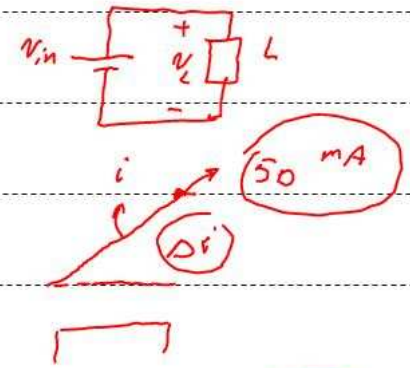
$$180 = V_L = L\frac{di}{dt} = 1.05\times10^{-3} \times \frac{\Delta i}{\Delta t}$$



$$\Delta t = \frac{1.05\times10^{-3}}{180} \times \Delta i$$

$$\Delta t = \frac{1.05}{180}\times10^{-3}\times50\times10^{-3} = \frac{1.05\times50}{180}\times10^{-6} = \frac{5.25}{18}\ \mu s$$

Pulse width for a gate signal $> \frac{5.25}{18}\ \mu s$