ECE 320 & ECE 329

ENERGY SYSTEMS I

BACKGROUND STUDY IN ENERGY SYSTEMS

SESSION no. 35

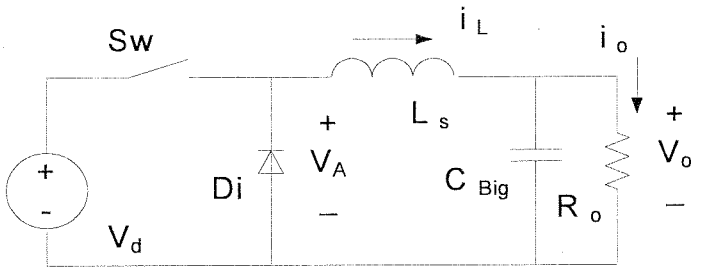
ECE 320 NAME _____

Quiz 8 13 April 2012

Power Electronics

1. (8 points) A buck converter operates at 500kHz at a duty cycle of 0.35. It provides an output voltage of 2.5 Volts DC to a 20 Ohm load. The inductor is 10μH. Assume an ideal transistor switch and diode; Assume negligible voltage ripple on the output voltage.

   a. (2 points) Draw a circuit diagram for this buck converter. Label currents and voltages that you use in this problem.



b. (3 points) Find and sketch the diode voltage waveform. Label its maximum voltage, its minimum voltage, and the times that switching occurs during at least one switching cycle.

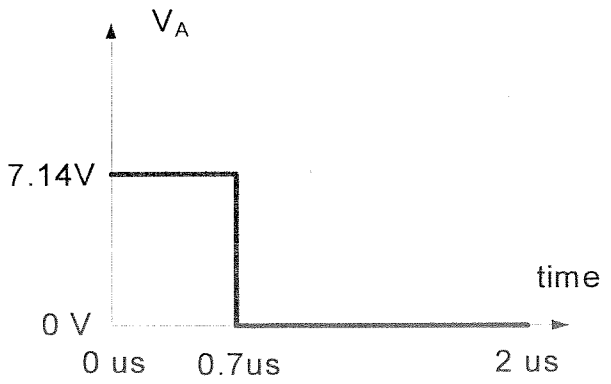
Restate the given.

$f_s := 500 \cdot kHz$ $D := 0.35$ $V_o := 2.5 \cdot V$ $R_o := 20 \cdot \Omega$ $L_s := 100 \cdot \mu H$

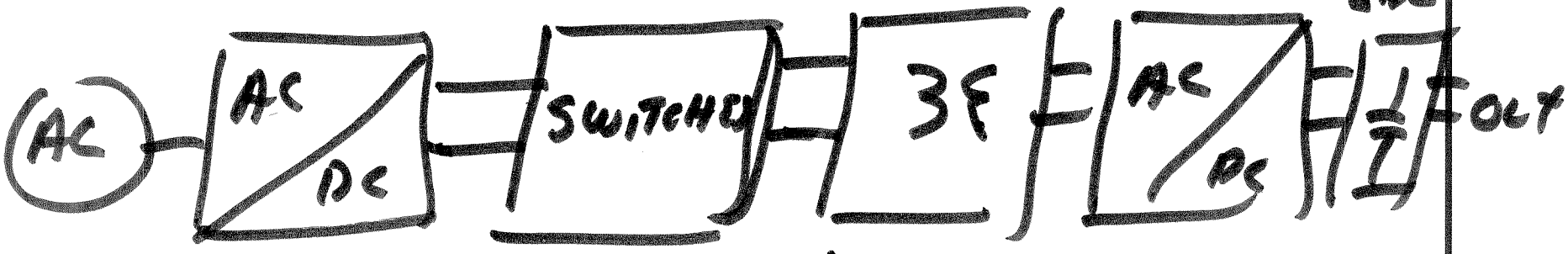
Rearrange the voltage formula to find the input voltage. The time period is the reciprocal of the switching frequency.

$$V_d := \frac{V_o}{D} = 7.143\,V \qquad T_s := \frac{1}{f_s} = 2\,\mu s \qquad D \cdot T_s = 0.7\,\mu s$$

Graph the waveform.



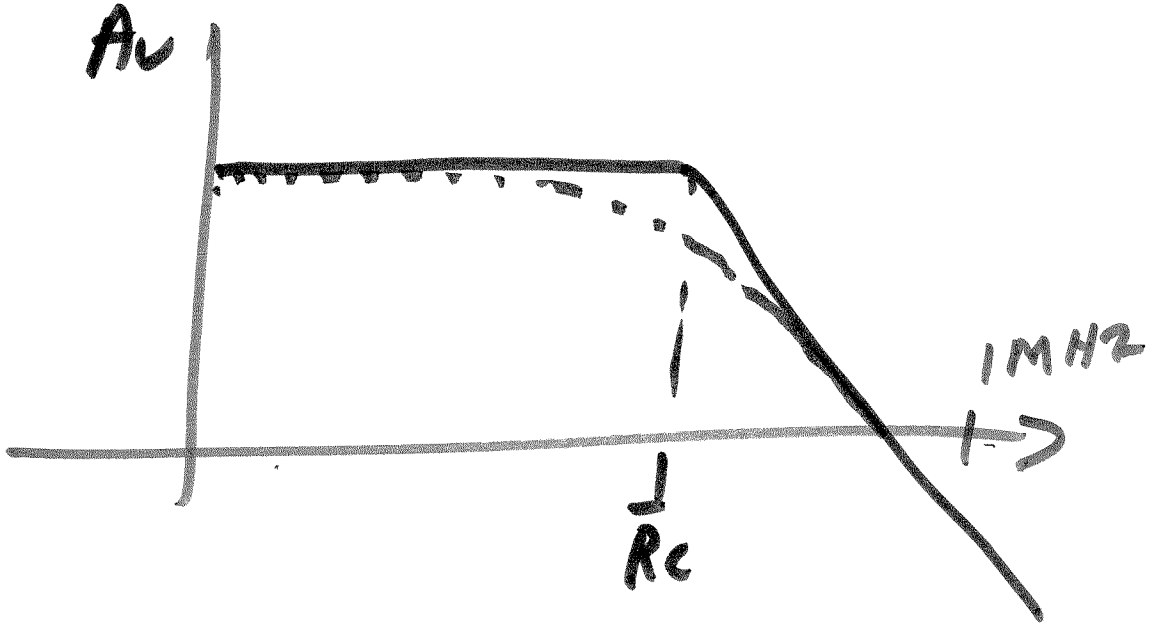
ISOLATED CONVERTER

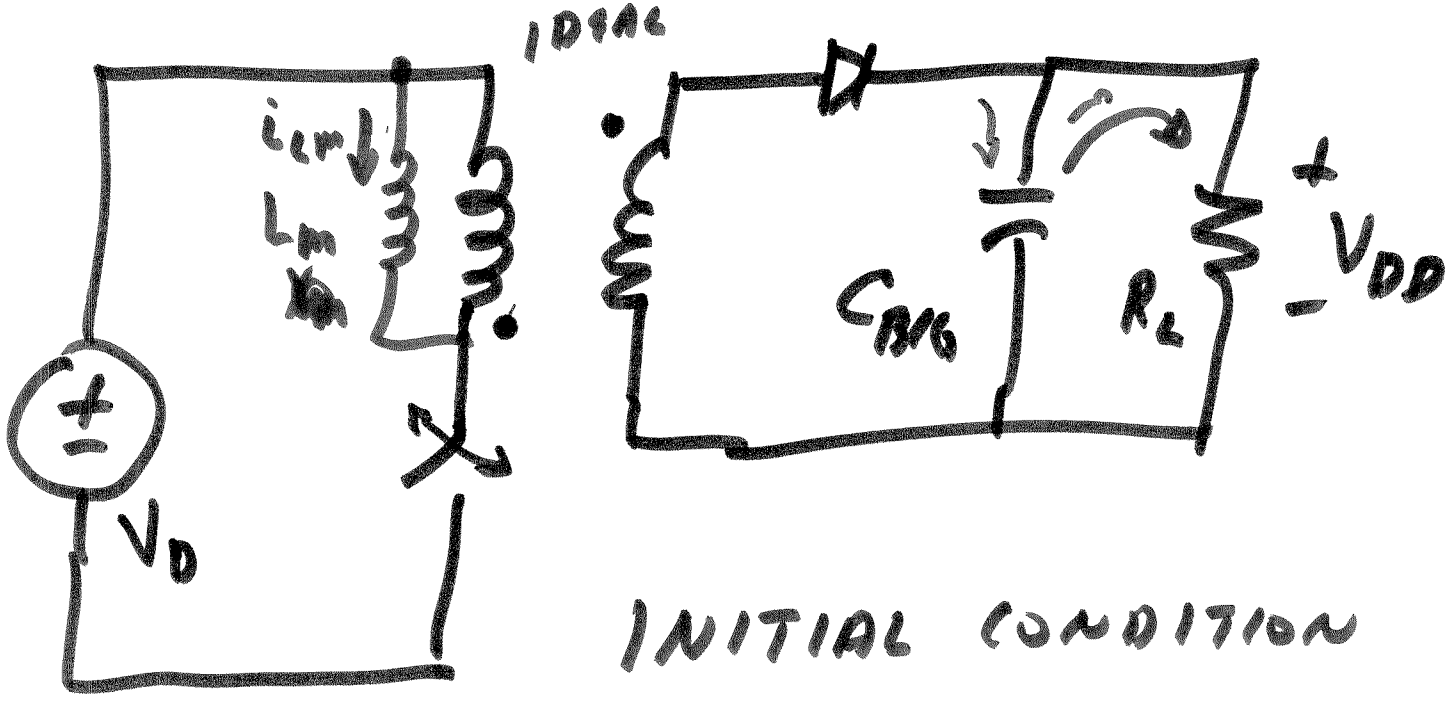


$$V = \omega N B A$$

$$\frac{1}{\sqrt{LC}}$$

$$\omega_b = \frac{1}{RC}$$





INITIAL CONDITION

- SWITCH OPEN.
- $i_{Lm} = 0$
- CAPACITOR SUPPLY POWER TO LOAD
- CLOSE SWITCH
- i_{Lm} RAMPS UP; CURRENT OUT BLOCKED

OPEN SWITCH

- i_L CONTINUOUS
- CURRENT IN $T(M1)$
- CURRENT IN $T(M2)$
- CURRENT THROUGH DIODE TO LOAD
- CHARGE PUMP

ECE 320 / ECE 329

Energy Systems I

Lesson 35

Quiz

DC / DC Converters

Flyback Converter

Isolated DC/DC converters: flyback, forward, push-pull, half bridge and full bridge

They contain a transformer.

Why an isolated power supply?

*Filtering is easier at high freq. (Save money on components.)

*Isolation…no dc path…tends to have a degree of better safety

*Arbitrary grounding of output

*Size and weight; a much smaller circuit for the same amount of power

*Big steps down or up: turns ratio

*Efficiency tends to be higher with a flyback than with a buck

*Low Total Harmonic Distortion on the output dc; easier to filter

*We can control the power factor on the AC side