ECE 320 & ECE 329

ENERGY SYSTEMS I

BACKGROUND STUDY IN ENERGY SYSTEMS

SESSION no. 38

ECE 320 / ECE 329 NAME _____
Quiz 10
Engineering Expo

(20 points) Attend the Engineering Expo on Friday morning. Observe the exhibits and ask questions of at least three exhibitors. Complete the report below and submit it in class on the same day.

27 April 2012

SUBJECT: Report of Quiz 10

Professor Herb Hess
Department of Electrical Engineering
University of Idaho

Professor Hess:

I went to the Engineering Expo on the morning of 27 April 2012. I observed the exhibits and asked technical questions (plural) of each of at least three exhibitors.

_____
Electrical Engineer

ECE 320 / ECE 329
Quiz 8
Power Electronics
Flyback Converter

NAME _____

23 April 2012

1. (4 points) A flyback converter in continuous conduction mode takes 160V DC and converts to 3.3V DC. If the duty cycle is 0.40, calculate the turns ratio of the transformer. Assume an ideal switch and diode.

2. (3 points) The same flyback converter has a transformer magnetizing inductance of 40μH. It switches at 1.0 MHz. For continuous conduction mode, calculate the change in input current, as the text handout calls Δi_{Lm}.

There is more on the other side of this page

ECE 320 / ECE 329
Quiz 8
Power Electronics
Flyback Converter

NAME _____
23 April 2012

3. (3 points) Calculate and plot the transistor switch voltage of the same flyback converter in continuous conduction mode.

There is more on the other side of this page

ECE 320 / ECE 329 NAME _____

Quiz 9 23 April 2012

Power Electronics

Flyback Converter

1. (4 points) A flyback converter in continuous conduction mode takes 160V DC and converts to 3.3V DC. If the duty cycle is 0.40, calculate the turns ratio of the transformer. Assume an ideal switch and diode.

$V_d := 160 \cdot V \quad V_o := 3.3 \cdot V \quad D := 0.4$

Calculate the ratio of output to input DC voltage. This is the voltage gain.

$$A_v := \frac{3.3 \cdot V}{160 \cdot V} = 0.021$$

Use the voltage gain formula, rearranging it, to find the turns ratio.

$$A_v = \frac{D}{1 - D} \cdot N_{12} \qquad N_{12} := A_v \cdot \frac{(1 - D)}{D} = 0.031 \qquad \frac{1}{N_{12}} = 32.323$$

2. (3 points) The same flyback converter has a transformer magnetizing inductance of 40µH. It switches at 1.0 MHz. For continuous conduction mode, calculate the change in input current, as the text handout calls Δi_{Lm}.

40

$L_m := 50 \cdot \mu H \qquad f_s := 1.0 \cdot MHz \qquad T_s := \frac{1}{f_s} = 1 \times 10^{-6}\, s$

1.60A

$$\Delta i_{Lm} := \frac{1}{L_m} \cdot (160 \cdot V) \cdot (D \cdot T_s) = 1.28\, A$$

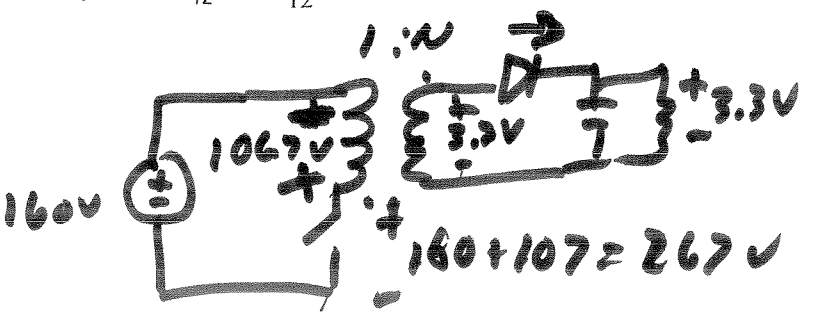
3. (3 points) Calculate and plot the transistor switch voltage of the same flyback converter in continuous conduction mode.

While the switch conducts, its voltage is zero.

Using a loop equation, we find that, when the switch blocks, its voltage is the sum of the input voltage V_d and the reflected output voltage, which we will call V_{N1}.

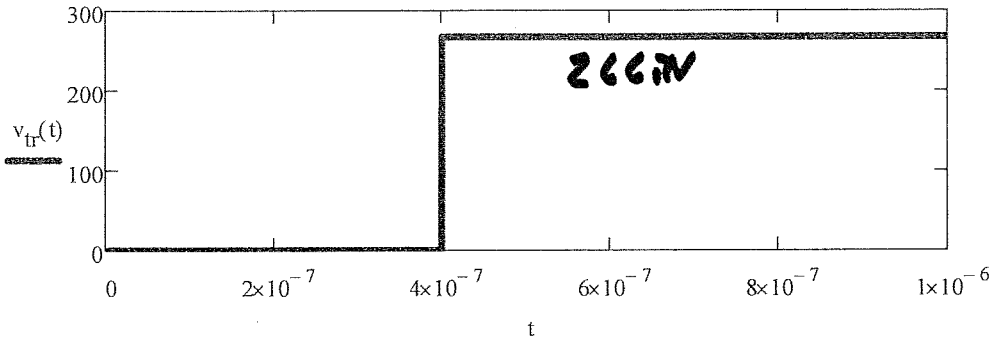
$V_d = 160\, V$ We already found N_{12}: $N_{12} = 0.031$

$$V_{N1} := \frac{V_o}{N_{12}} = 106.667\, V$$



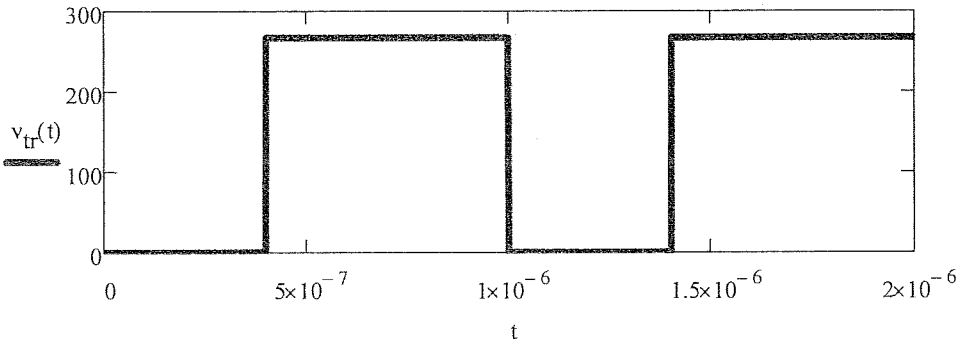
Plot the result: One cycle

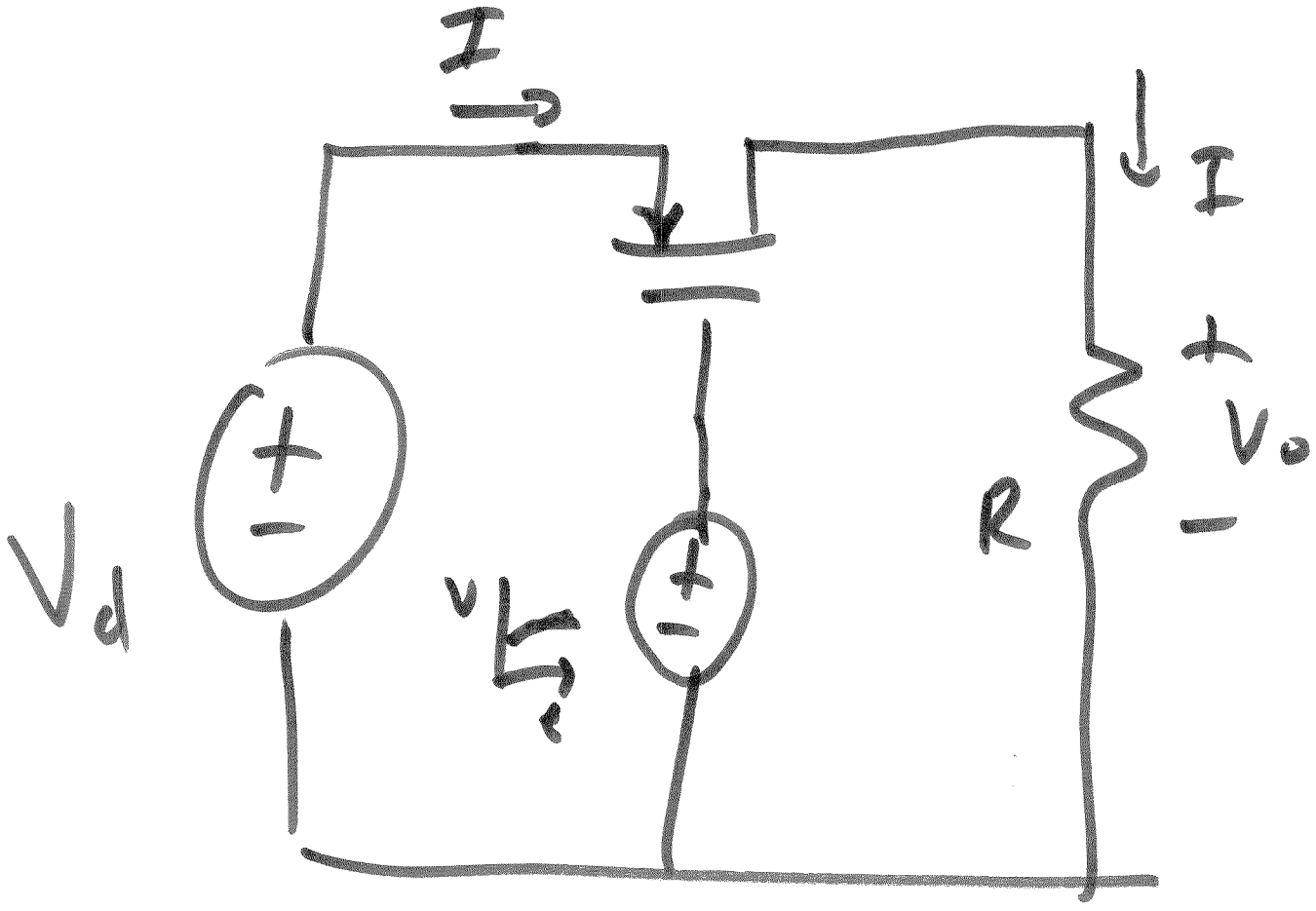
$$v_{tr}(t) := \begin{cases} 0 \cdot V & \text{if } 0 \le t \le D \cdot T_s \\ \left(V_d + V_{N1}\right) & \text{if } D \cdot T_s < t \le T_s \end{cases}$$



Plot the result: Two cycles

$$v_{tr}(t) := \begin{cases} 0 \cdot V & \text{if } 0 \le t \le D \cdot T_s \\ \left(V_d + V_{N1}\right) & \text{if } D \cdot T_s < t \le T_s \\ 0 \cdot V & \text{if } T_s \le t \le T_s + D \cdot T_s \\ \left(V_d + V_{N1}\right) & \text{if } T_s + D \cdot T_s < t \le 2 \cdot T_s \end{cases}$$




I
I
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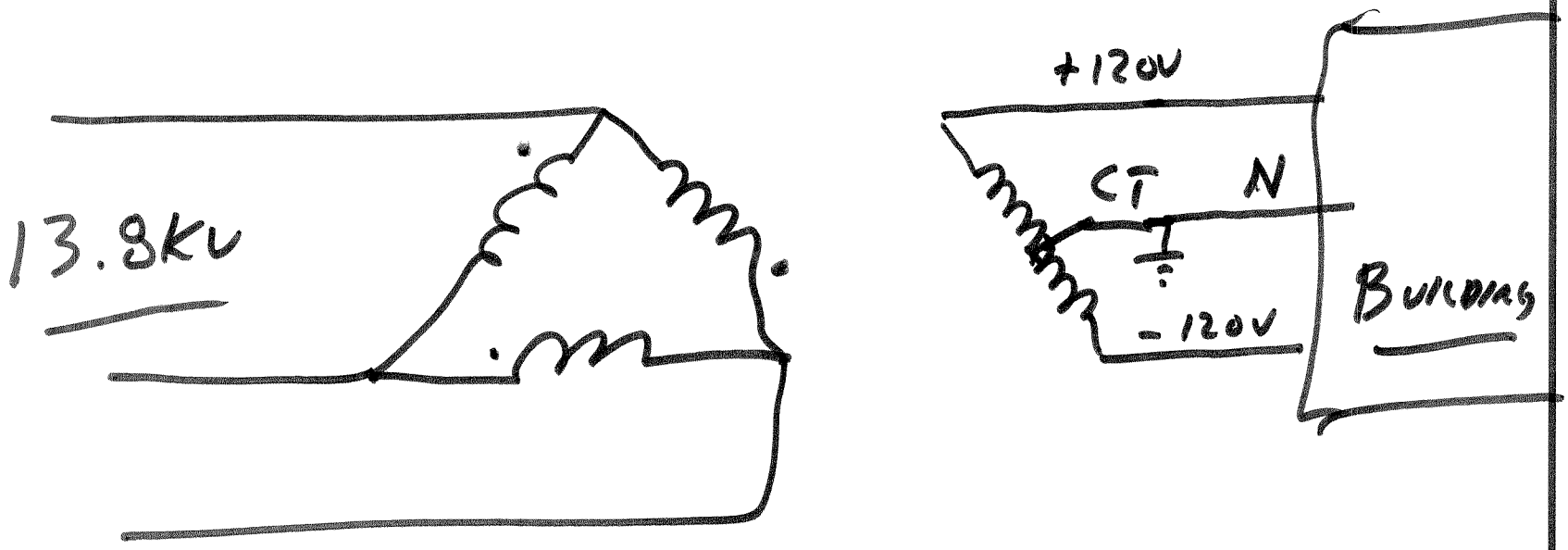

COLOR CODE

N = WHITE

GND = GREEN (GREEN/Yellow)

HOT = ANY COLOR EXCEPT WHITE, GREEN, VIOLET

ECE 320 / ECE 329

Energy Systems I

Lesson 38

Exam next lesson

50 minutes, write for your life

Power electronics

1. Linear regulator
2. Buck
3. Boost
4. Flyback
5. Derivations...

Wiring practices

National electrical code, updated every 3 years.

National Fire Protection Association is the publisher.

The code is to prevent fires.