EE155/255 F17 Lab 6
Transformer Experiments

Assigned 10/31/17
Due Week of 11/6/17

Step 1: Characterize Your Core

Wind 5 turns of wire on a bobbin for a PQ32/20 core and insert the bobbin on the core. Connect your 'inductor' as illustrated in the Figure 1 below. We measure the integral of the voltage applied to the inductor and the instantaneous current through the inductor.

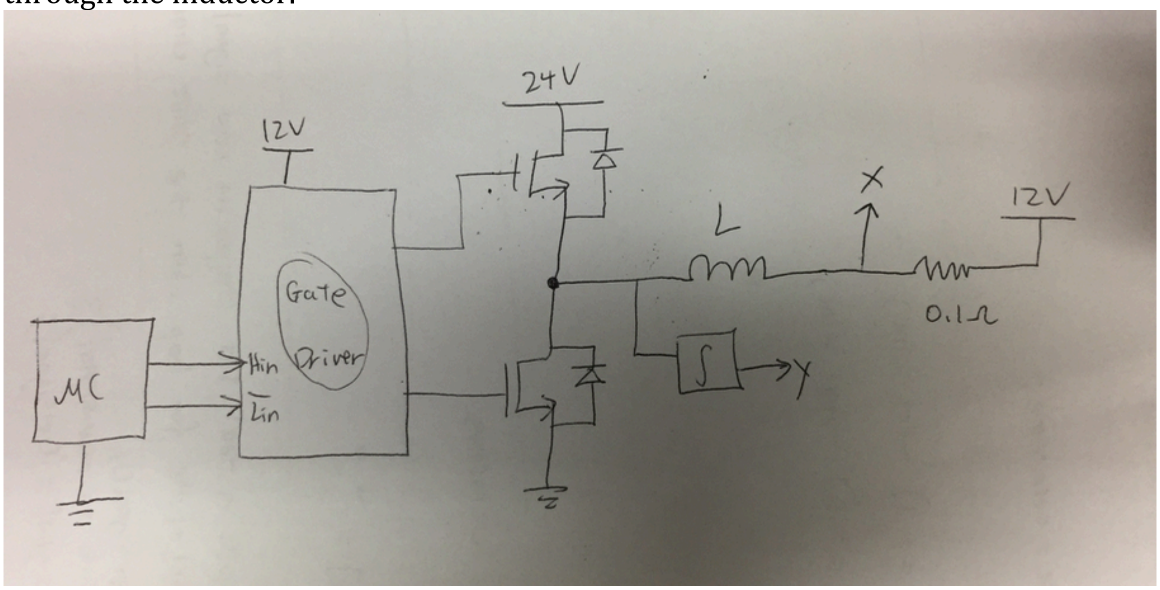

Figure 1: Test Setup for Core Evaluation

To "integrate" voltage you can just use a resistor and capacitor. If the time constant is around 10x the width of your pulses the approximation is reasonable.

Write a program on the microcontroller to apply the following stimulus (shown in Figure 2 below).

1. Turn on the top FET for a programmed time, *x*.
2. Turn on the bottom FET for time 2*x.*
3. Turn both FETs off to apply no stimulus to the inductor for programmed time *y*.
4. Repeat steps 1-3 in an infinite loop

A good set of parameters to start with is x = 25μs and y = 100x.

It is important that the duty factor of the transformer be kept low (i.e. that $y >> x$). When you drive the core into saturation the current will get very high. Also, when you operate with high B-fields the core losses will be very high. It is important that the average current and average core loss be kept low to avoid overheating.

From Chapter 23 of the class notes we know that the voltage across each turn is $d\phi/dt$, so the integral of voltage is ϕ, and since $B = \phi/A$, the output of the integrator represents the B field applied to the core – scaled by N/A, where in this case N is the number of turns. (For the PQ32/20 A = 167mm^2).

Also from Chapter 23, we know that $H = Ni/l$, so our current measurement of current gives us the H field in the core – scaled by l/N. (For the PQ32/20 l = 74.7mm)

Plot the inductor current and the integral voltage measurement in the time domain. Call a CA to get checked off on this part.

Put your oscilloscope in x-y mode. Connect your integral voltage measurement BN/A to the x-channel and your current measurement Hl/N to the y-channel. Do not use differential probes. Remember that both of your probe grounds must be at the same potential or you may kill the oscilloscope. Plot the BH curve. Varying your timing parameters x, y, and the number of turns N as necessary, answer the following questions?

1. What is the permeability μ_r of your core?
2. What is the saturation B-field of your core?
3. How much energy is lost during one cycle where B oscillates between +0.1T and -0.1T?

Call a CA to get checked off on this part.

Step 2: Characterize your Transformer

Wind a second, 10-turn winding on your transformer. Measure the magnetizing inductance and the leakage inductance of the resulting transformer.

Connect a 10-Ohm resistor across the secondary of your transformer and apply your pulse sequence from step 1 to the primary. Sketch the voltage waveform across the resistor. Explain the waveform you see.

Call a CA to get checked off on this part.