Laboratory Application Assignment

In this lab application assignment you will examine how the inductive reactance, X_L, of an inductor increases when the frequency, f, increases. You will also see that more inductance, L, at a given frequency results in more inductive reactance, X_L. Finally, you will observe how X_L values combine in series and in parallel.

Equipment: Obtain the following items from your instructor.

- Function generator
- 33-mH and 100-mH inductors
- DMM

DC Resistance, r_i, of a Coil

With a DMM, measure and record the dc resistance of each inductor. Set the DMM to the lowest resistance range when measuring r_i.

r_i = _____ (33 mH)
r_i = _____ (100 mH)

Inductive Reactance, X_L

Refer to Fig. 20–17*a*. Calculate and record the value of X_L for each of the following frequencies listed below. Calculate X_L as $2\pi fL$.

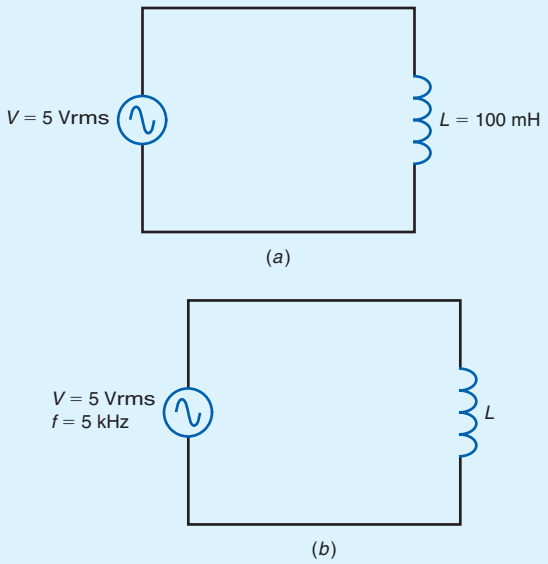
X_L = _____ @ f = 500 Hz
X_L = _____ @ f = 1 kHz
X_L = _____ @ f = 2 kHz

Connect the circuit in Fig. 20-17*a*. Set the voltage source to exactly 5 Vrms. For each of the following frequencies listed below, measure and record the current, I. (Use a DMM to measure I.) Next, calculate X_L as V/I.

I = _____ @ f = 500 Hz; X_L = _____
I = _____ @ f = 1 kHz; X_L = _____
I = _____ @ f = 2 kHz; X_L = _____

How do the experimental values of X_L compare to the calculated values? _____
Based on your experimental values, what happens to the value of X_L every time the frequency, f, doubles? _____
Is X_L proportional or inversely proportional to the frequency, f?
_____

Figure 20–17



Refer to Fig. 20–17*b*. With the frequency, f, set to 5 kHz, calculate and record the value of X_L for each of the following inductance values listed below. Calculate X_L as $2\pi fL$.

X_L = _____ when L = 33 mH
X_L = _____ when L = 100 mH

Connect the circuit in Fig. 20–17*b*. Adjust the frequency, f, of the function generator to exactly 5 kHz. For each inductance value listed below, measure and record the current, I. (Use a DMM to measure I.) Next, calculate X_L as V/I.

I = _____ when L = 33 mH; X_L = _____
I = _____ when L = 100 mH; X_L = _____

Is X_L proportional or inversely proportional to the value of inductance? _____

Did the dc resistance, r_i, of the inductors affect any of your measurements? _____
If so, explain. _____

Series Inductive Reactances

Refer to the circuit in Fig. 20–18*a*. Calculate and record the following values:

X_{L_1} = _____, X_{L_2} = _____, X_{L_T} = _____,
I = _____, V_{L_1} = _____, V_{L_2} = _____
Do V_{L_1} and V_{L_2} add to equal V_T? _____

Construct the circuit in Fig. 20–18*a*. Set the frequency of the function generator to exactly 5 kHz. Next, using a DMM, measure and record the following values:

I = _____, V_{L_1} = _____, V_{L_2} = _____
Using the measured values of voltage and current, calculate the following values:

X_{L_1} = _____, X_{L_2} = _____, X_{L_T} = _____

Are the experimental values calculated here close to those initially calculated? _____

Parallel Inductive Reactances

Refer to the circuit in Fig. 20–18*b*. Calculate and record the following values:

X_{L_1} = _____, X_{L_2} = _____, I_{L_1} = _____,
I_{L_2} = _____, I_T = _____, $X_{L_{EQ}}$ = _____
Do I_{L_1} and I_{L_2} add to equal I_T? _____

Construct the circuit in Fig. 20–18*b*. Set the frequency of the function generator to exactly 5 kHz. Next, using a DMM, measure and record the following values:

I_{L_1} = _____, I_{L_2} = _____, I_T = _____
Using the measured values of voltage and current, calculate the following values:

X_{L_1} = _____, X_{L_2} = _____, $X_{L_{EQ}}$ = _____
Are the experimental values calculated here similar to those initially calculated? _____

Figure 20–18