Chapter 6 Wk 2, Wed: Using the Scope to measure loop to loop cross talk

This lab will give you practice in using the scope and the function generator to set up and measure one of the most important noise problems with interconnects: loop to loop cross talk.

6.1 Purpose

Purpose of this lab is to measure the loop to loop cross talk between two loops and exercise your understanding of the principles of mutual inductance and what design features will reduce this common source of noise.

In order to start this lab you must first be an expert in using the scope and function generator. If you understand how to use the scope and function generator, you should be able to follow these simple directions and set up the scope and function generator appropriately.

These directions are WHA the instruments should be set up for. You should be able to figure out HOW to set up the instruments to meet these conditions based on what you have learned from the skill building videos.

6.1 Before you come to the lab

Review the SBW-7 about the 4024 scope. This covers the scope and function generator. View all the videos through SBW-7-11 the sync output of the function generator.

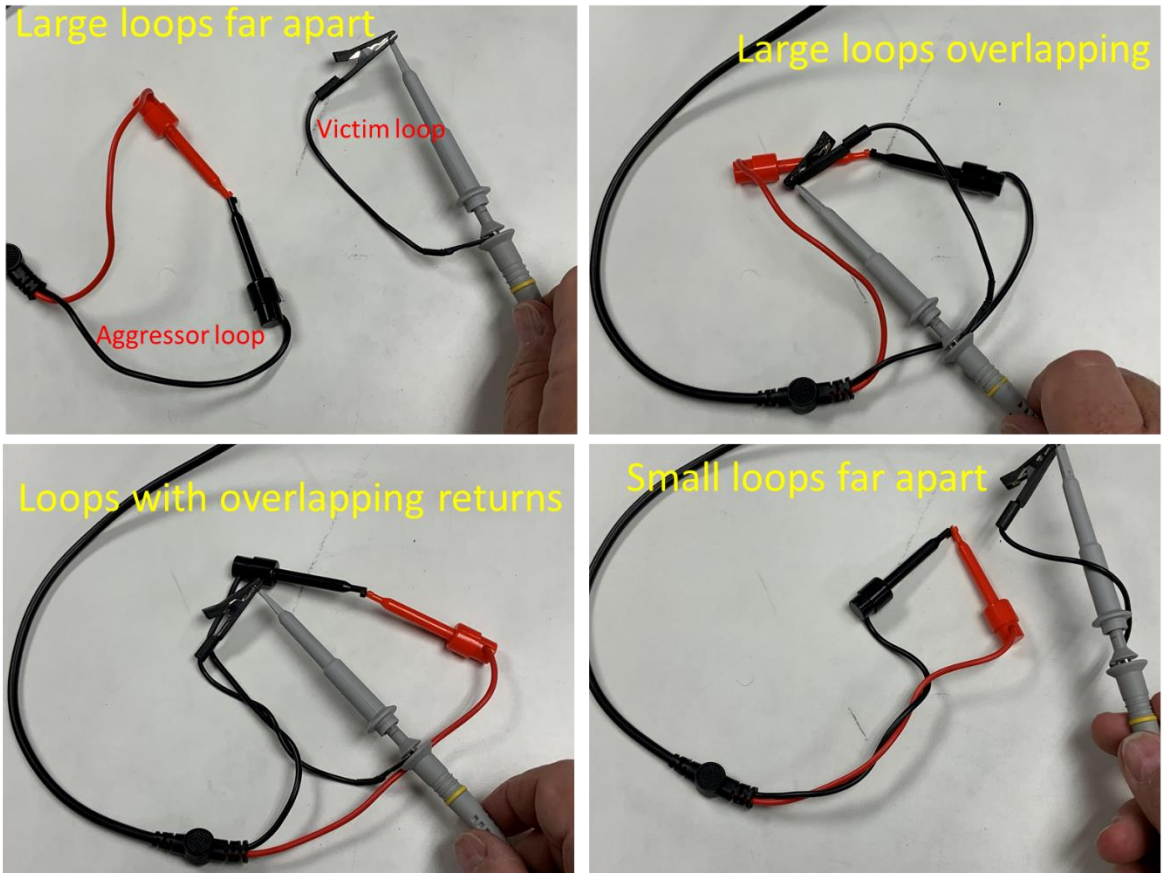
Review the chapters in the textbook on Thevenin models of voltage sources and how to measure them. This is sections: 6.5 and 6.6 of the textbook.

6.2 Setting up the scope and function generator

1. *Set up the scope to measure the output of the function generator, set for a 10 V p-p square wave of 10 kHz. Use the BNC to mini grabber on the function generator and the 10x probe in channel 1 of the scope.*
2. *Make sure the function generator is on High Z output.*
3. *Measure the sync out signal with the scope in channel 2. Trigger the scope on the sync signal. What is the output of the function generator doing when the scope is triggered by the sync signal?*
4. *What do you expect to see as the output signal? (rule #9). What do you actually measure?*
5. *What is the amplitude of the signal, the frequency of the signal and the rise and fall time of the signal you measure with the scope.*
6. *Measure the Thevenin output voltage and source resistance of the function generator by driving a known resistor load. You have just reverse-engineer an important property of this instrument.*
7. *Set the function generator output load to be 50 ohms. What is the Thevenin voltage and the Thevenin resistance?*

6.3 Set up the function generator as an aggressor loop

1. *Use the sync signal to trigger the scope and the function generator on the same square wave setting.*
2. *Short the ends of the function generator minigrabber cable. Knowing the internal Thevenin voltage and the Thevenin resistance of the function generator, what is the current in the minigrabber loop>*
3. *From your measurement of the rise time of the function generator signal, what is the dI/dt in the loop?*
4. *When the signal is rising (what is the sync signal doing on the rising edge of the function generator output?) what is the direction of circulation of the current in the mini grabber?*
5. *Use the 10x probe as the victim loop. Measure the voltage noise induced in the 10x probe synchronous with the function generator edge. How will you trigger the scope to measure the synchronous noise?*
6. *When the 10x probe loop is on top of the aggressor loop, what is the signature of the noise voltage? Why does it have the shape it has? From the magnitude, estimate the mutual inductance.*
7. *Flip the orientation. Of the loops. What happens to the signature of the noise? Why?*
8. *Explore the cases for the highest noise coupling and the lowest noise coupling.*
9. *Can you generalize from this experiment, design guidelines to reduce the amount of inductive cross talk between loops? In the figure below are four examples of loop to loop geometries you can explore.*



6.4 Check off by your TA

Before you complete the lab and to get credit for the lab, your TA will come around and ask you questions about what you are doing and will ask you to demonstrate some features of your measurements. You must get an OK to get credit for the lab.

You may be asked any of the questions above and to demonstrate any of measurements above or to explain any of your measurements.

6.5 The lab report:

Remember, your 1-2 page lab report will make a great example in your portfolio, demonstrating an important electrical effect of inductively coupled noise between an aggressor and a victim loop.

In your lab report, explain your measurement set up (a picture would help).

Show an example of the inductively coupled cross talk between the victim loop and aggressor loop and explain why it has the signature it does. Then show one other example of a different geometry and why it is either larger or smaller based on the geometry of the loops.

Your lab report is due on Canvas by Monday, 9 am.

6.6 Grading rubric:

2 points if you have a clean scope trace and articulate what you measured and what it means

1 point is you did not set up the scope correctly or if you are confused about the interpretation of the measurement

0 points if you do not have a clue or did not complete the lab