

Lab 0: Introduction to Micromagic

1.1 Objective

The purpose of this lab is to get you familiar with the software we use in the labs. The specific software we use is the SUE design manager and MAX layout environment tools from Micromagic Inc. (www.micromagic.com).

In this lab, we will use SUE to do schematic entry and simulations. The lab also gives a brief introduction of how to use MAX for doing full-custom layout, which will be further explored in Lab 2. At the end of this lab, you should become familiar with the tools as well as the design methodology for the labs.

1.2 Preparation

1.2.1 Software Setup

The Micromagic software is accessible from all eecg machines. To setup, simply append these lines to the end of the .cshrc file in your home directory, then logout and re-login:

```
#ece334 Micromagic setup
if ( ! $?ECE451 ) then
source /cad2/ece451/SOURCEME
setenv ECE451 1
```

Now you should be able to start SUE and MAX by the following commands from the terminal:

```
sue (to start SUE)
max (to start MAX)
```

If you run into any problems using either SUE or MAX (for example, a command does not do what it is supposed to do), always look at the terminal. The terminal acts as a log file and prints out the any warnings or error messages. Generally, these are descriptive enough for you to find out the cause if a problem arises.

1.3 Lab Work

1.3.1 L1 - SUE Tutorial

SUE is the schematic environment of the Micromagic tool set. In this environment, you can place components (resistors, capacitors, transistors, logic gates, etc.) and simulate them to see results. All laboratory experiments involve theoretical calculations of circuits learned in the classroom, and simulations using SUE to compare results.

To get familiar with the SUE environment, we will go through the software's tutorial.

1. Start SUE by typing "sue" in the command line.
2. Download the SUE tutorial from the Help menu, select SUE tutorial.
3. **Start the tutorial on page 9 of the PDF** (which is page 1 of the tutorial).
4. Follow the instructions and complete the tutorial with the following notes:

- **Page 2: skip the whole page.**

- Page 14 (step 4): after changing the transistor size to 8/4, change it back to 2/1.

- **Skip pages 43-58 of the PDF.**

1.3.2 Sizing Transistors

- **Use "lp_min" (PMOS) and "ln_min" (NMOS)** when sizing transistor lengths. "lp_min" (PMOS) and "ln_min" (NMOS) are the minimum lengths of each transistor and in digital you almost always make use of minimum length sizes.
- If you want to put a numerical number for the length size, you must proceed it with a "u" indicating that it is micrometers
- When sizing the width of the transistor, you DO NOT proceed it with a u. This is because the software is configured to automatically assume all width values are in micrometers (but confusingly, no assumptions are made on the length size as note above).

1.3.3 L2 - MAX Tutorial

MAX is the layout environment of the Micromagic tool set. Layout environments are used to draw or layout the components that you have placed in your schematic. Digital circuits studied in the course have very standard good-practise layout techniques that you will study and practice in one of the laboratories.

For now, we will simply use some basic commands of the layout environment to get you familiar with the too.

1. Start MAX by typing “max”.
2. Draw a box.
3. Resize it and move it around using the middle mouse button.
4. Paint it to form a Poly layer. You can do this by hovering your mouse over the poly layer on the left-hand side and pressing “p”.
5. Now try moving it around again and try stretching it in both directions using the “Edit edge” command in the “Edit” menu, or simply type “a”.
6. In case you want to undo any change, you can simply press “u”. It is possible to undo several commands by pressing “u” several times.
7. Draw a piece of wire in metal1. To do that you can type “w” and use the mouse to draw the metal wire. Whenever you need to bend the wire, left click and move the mouse to the new direction. To end the wire, click the middle button of the mouse.
8. Experiment around with the MAX environment.

1.3.4 Configuring Layers in Max

In the MAX environment, the layers available are listed on the side panel. By clicking on the layers, you can at anytime have the layers in one of the following configurations:

- Visible: In this state the layer is visible and can be modified.
- Lock: In this state you can see the layers, but you cannot modify them (move, resize, delete, etc). This is useful if you are trying to work with one layer (for example metal1) but don’t want to inadvertently change another layer (ex metal2)
- Hide: In this state, the layer is invisible. This is useful if you want to visualize one of the layers. For example, if you use metal1 for routing, then by hiding the other layers, you can see how you have done the routing.