VLSI Design Tutorial

Magic Guide

- MAGIC: Manhattan Artwork Generator for Integrated Circuits
- Circuit used to design VLSI Layouts.
- Recommended to use a Mouse for the operation.

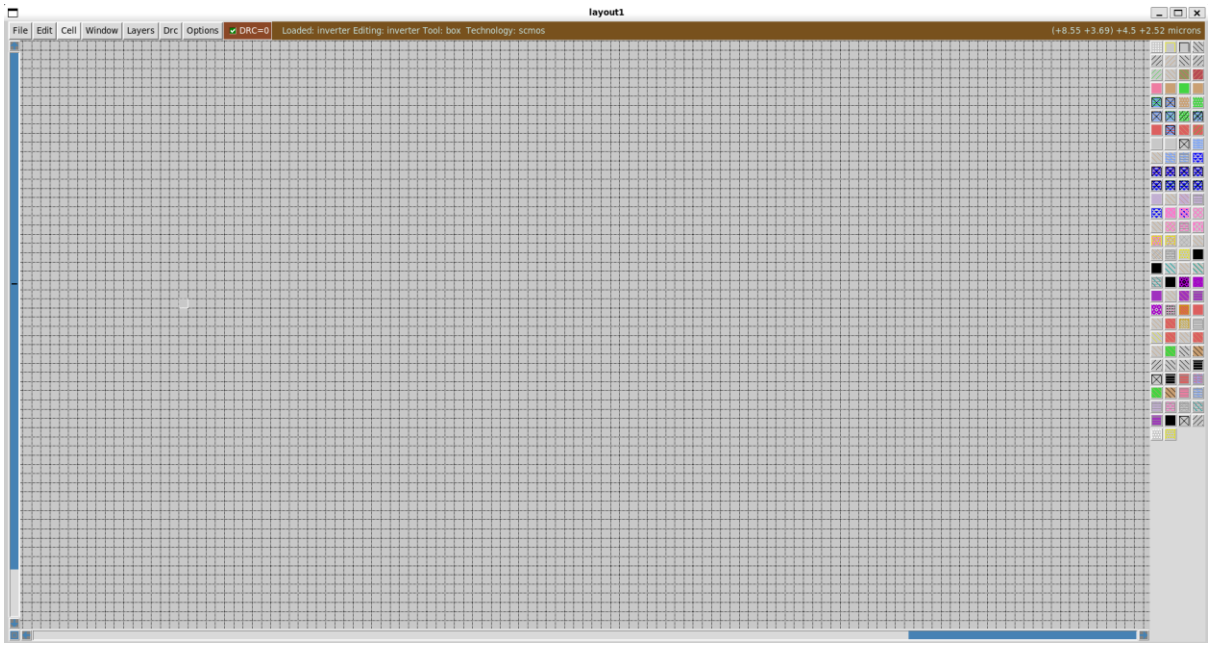
Installation and Opening:

- Before the installation process make sure you have *SCN6M_DEEP.09.tech27* in the same directory.
- It is recommended to use Linux for installation of MAGIC. Please follow the following steps.
  1. Download by executing the following bash command: –
     sudo apt-get install magic
  2. Run the tool by the following command: -
     magic -T SCN6M_DEEP.09.tech27 inverter.mag
- In case of using a Windows device, do as follows
  1. Install WSLG or WSL with display portal support.
  2. Please follow the following video.
     (46) Magic VLSI Tutorial (part 1), Installation and Technology Files - YouTube
- In case of using a MAC, install a virtual machine with Linux for installing magic.

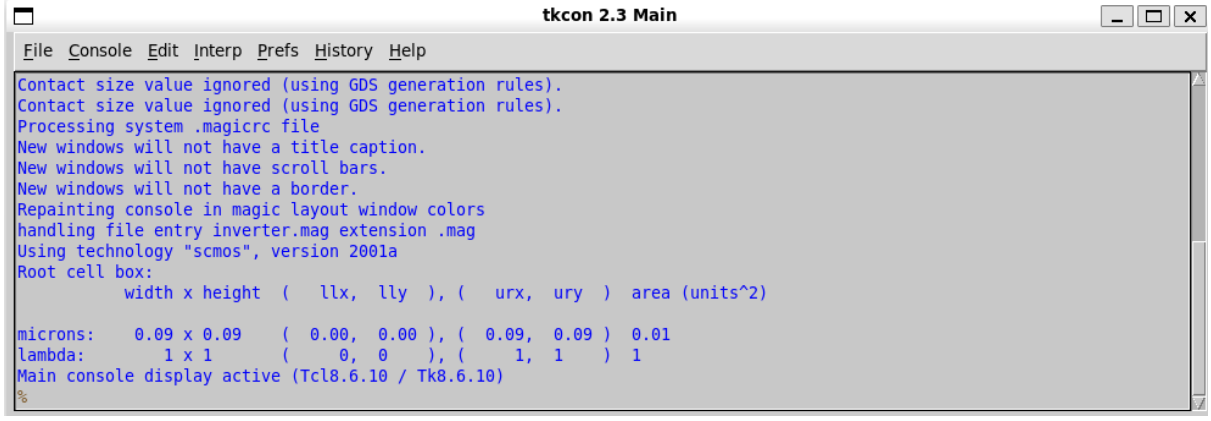
Layout Design:

- Magic contains two windows: Layout window and Console window.
- A layout window is the window where you will be making the layout.
  1. It is by default assumed that the whole of the area is a pwell.
  2. To select a square in MAGIC, use the left-mouse click to select the bottom left vertex and right-mouse click at the diagonally opposite vertex of the required cell block to select it.
  3. To paint an area inside the square, select the box and from the toolbar select the material to fill in the box by clicking on the Scroll-wheel on the mouse.
  4. To erase an area inside the square, select the box and click on the scroll wheel pointing towards an empty area.
  5. To view the grid when making the layout press ‘g’.
  6. The smallest square in the grid is set to lambda = 90nm. Lambda is a scale factor used to define the minimum technology geometry.

7. Minimum permissible dimensions are defined in terms of lambda as follows.
    - N-well = 12λ
    - pdiffusion = 3λ
    - ndiffusion = 3λ
    - Channel Length = 2λ
    - Width NMOS = 4λ
    - Width PMOS = 8λ
    - Width of Source and Drain of MOS = 5λ
    - Contact = 4λ



Layout Window

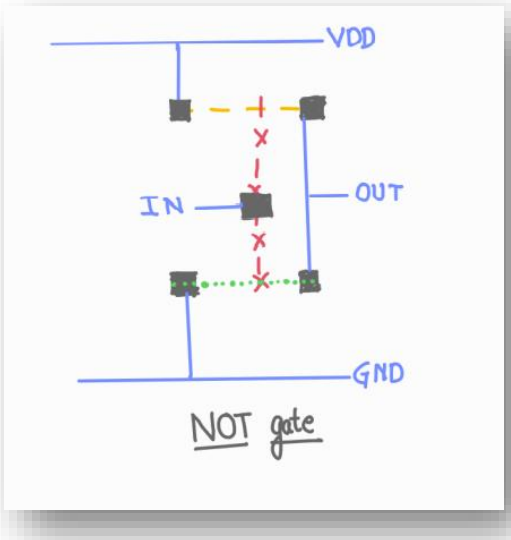


Console Window

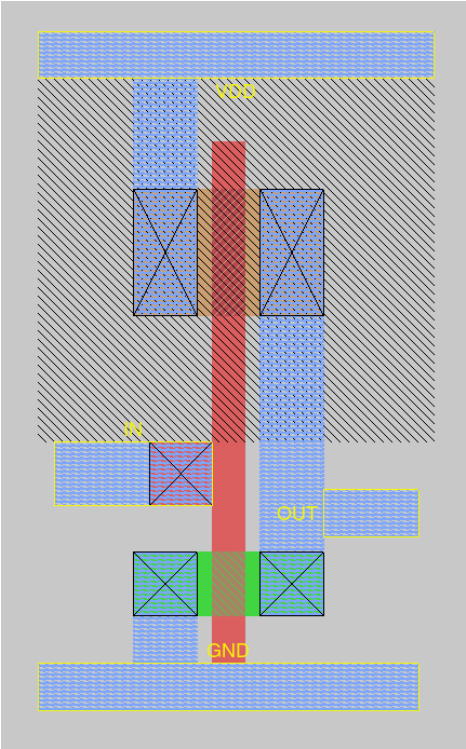
8. Some Important Shortcuts
    - g: Show/ Unshow Grid
    - Scroll-Wheel button: Fills clicked material in the Selected box.
    - z: ZOOM IN
    - Shift + z: ZOOM OUT
    - u: UNDO
    - r: REDO
    - a: Will select everything in the chosen box.
    - Shift + a: Will select everything in the chosen box + Keep previously selected material.
    - y: Same as DRC why
    - c: Select the box (area) you want to COPY, then place your cursor where you want to COPY, then press c.
    - d: Select a box you want to DELETE and press d.
    - Keypad 2,4,6,8: Move selected material in the direction of Arrows.
    - x: Make an imported circuit visible.
    - Space: Gives different cursor options.

9. Some commands for the console window.
    - paint: Use paint to paint a part of the layout.
    - erase: Use erase to erase a part of the layout.
    - label: Use the label to label a part of the layout.
    - save: Use save to save the layout.
    - extract all: Creates a Magic-compatible netlist in .ext format.
    - ext2spice: Converts .ext net-list into Spice compatible .spice /.sp net-list.
    - drc: Design rule checker
    - drc check: gives the location where there is issue.

10. Inverter Stick diagram.



11. Inverter Layout



12. Extracting the file to spice
    - In the Console Window To Save, Type save .mag e.g. save inverter.mag
    - To extract netlist, Type extract all. This gives .ext format netlist.
    - To convert into a spice netlist, Type ext2spice -c .ext
    - The values above the minimum Capacitance value will be shown in the netlist. e.g. ext2spice -c 1fF inverter.ext
    - You can also type or leave the field blank to get all capacitance values in the netlist. e.g. ext2spice -c cmin inverter.ext or ext2spice -c inverter.ext

13. You can also extract a circuit to make a cell. This will make importing one design into another easier.
    - Use the command getcell to import a design into another design.
    - This design is not editable from the current file, because it's just a copy of the imported design. (It is just a reference)
    - If you change the parent layout, the layout in the current file will also change.
    - Select an imported layout and press x to make the layout visible.