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| ELEC 402 – October 24, 2021 |
| Project 3 Report |
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Diagram, schematic

Description automatically generated



1. Resistive load inverter

At one extreme, V­in is high, transistor is off and no current flows because MOS is in cut-off region, VOH = VDD. At the other extreme, Vin = VOH = VDD substituted into IOUT = Iload g IR = I­DS(lin), and the transistor operates in linear region. Using the useful formula for linear current:

Now we can also just straight up plug-in everything (taken from question):

* Vin = VGS = VOH = VDD = 1.2 V
* VDS = Vout = VOL = 0.1 V
* L = 0.1 µm
* RL = 10 kΩ
* µn = 270 cm2V-1s-1
* Cox = 1.0E-6 F/cm2
* EC = 6 V/µm
* VT = 0.4 V

Equating for W and throwing into wolfram:

1. Saturated-enhancement-load inverter

With this layout, we know the top pull-up transistor is the load and bottom pull-down transistor is the inverter. We know the load is always in saturation and the inverter should be linear because we want Vout = VOL = 0.1 V. Using the useful formula for linear (left) and saturated (right) current, we can equate the two and get:

Using the following substitutions (inverter):

* Vin = VGS = VOH = VDD = 1.2 V
* VDS = Vout = VOL = 0.1 V
* L = 0.1 µm
* µn = 270 cm2V-1s-1
* Cox = 1.0E-6 F/cm2
* EC = 6 V/µm
* VT = 0.4 V

Using the following substitutions (load):

* Vin = VOH = VDD = 1.2 V
* VGS = 1.2 – 0.1 = 1.1 V
* vsat = 8E6 cm/s
* Wload = 0.1 µm
* L = 0.1 µm
* Cox = 1.0E-6 F/cm2
* EC = 6 V/µm
* VT = 0.4 V

Note that although the left side units cancel out nicely due to the cm2/cm2, we need to convert the right side units from cm (1E-2) to µm (1E-6) after the Coxvsat cancellation as there is still a cm unit left, done by multiplying the right side with 1E-4.

Equating for Winverter and throwing into wolfram:

1. less (?) saturated enhancement load inverter

Diagram, schematic

Description automatically generated

Diagram

Description automatically generated

Graphical user interface, text, application

Description automatically generated

Text

Description automatically generated