10 June 2020

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| Date: | 10June 2020 | Name: | Srinidhi J C |
| Course: | VLSI | USN: | 4al16ec078 |
| Topic: | MOS Transistor Basics ii & iii | Semester & Section: | 8th & b |
| Github Repository: | SrinidhiJC078 |  |  |

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| FORENOON SESSION DETAILS |
| Image of session  A picture containing aircraft, airplane  Description automatically generatedA screenshot of a cell phone  Description automatically generatedA screenshot of a cell phone  Description automatically generatedA map with text  Description automatically generatedA screenshot of a cell phone  Description automatically generated |
| Report –  a NMOS enhancement mode MOSFET, enhancement mode  then I will have a threshold voltage VTH of approximately at equal to 0.5 volts which means that  after 0.5 volts only a channel will be formed between source and drain right the problem we have  ovhoweverer here is that you will not only give a gate voltage just equals to threshold voltage but  you will like to give a gate voltage slightly larger than that right.  And why and how we will see in subsequent slide but if you give gate voltage greater than  threshold voltage right out of that extra voltage which is available to you some of it falls on the  gate voltage I give some of the example let us suppose the gate value of 1 volt and your  threshold voltage gives the 0.5 volt and out of the 1 volt given by the gate 0.5 volt is just utilized  to form the the channel right.  So how much extra voltage is available at the silicon-silicon dioxide as interface it is  approximately equals to 0.5. So we define the VGS-VTH right which is this one as the available  gate voltage to the channel that means a charge carrier or once the inversion has been formed  electrons assuming it to be an N channel enhancement mode MOSFET electrons will actually see  a voltage of VGS-VTH and therefore the inversion charge will be actually proportional to this  potential right.  Just like in a simple parallel plate capacitor therefore we can define Q that is the charge per unit  area right is equal to the charge this is actually charge per unit length this is charge per unit  length right is equal to width, width of the device is along this direction. So this is W this is your  L between this point and this point so W into Cox C into V Q is equal to CV so this is basically  C into V this is charge per unit area so this is charge per unit area right into voltage. What is the  W value?  W value is in meters so this meters cancels with meters Q into V equal to Q sorry C into V. C  into V is equal to your charge and therefore charge per unit meter is basically the amount of  charge which is available to you. So Q equal to this value is basically VGS - VTH.  Q=WC (V -V )  VGS-VTH is also refer to as over drive right it is also refer to over drive now let us consider that  I have a applied voltage now. Now till this much time there is no drain voltage now I apply a  drain voltage keeping my source to be equal to grounded and gate voltage of the threshold. So  above threshold my channel is already formed. Now when I apply a drain voltage a positive  drain voltage.  Please understand this n+p region right can be replaced by a diode which is something like this  this is n n+p region this is p region right I can replace this by a diode. So if I apply a positive  voltage here I am basically reverse biasing in the diode which effectively means that there will  be depletion region on this side which was initially like this for you did not apply a bias now  because something like this. So when you applied the gate voltage when you apply a drain  voltage which is very high the depletion region starts to eat away into to the channel.  V will be given as Miu into E when Miu is defined as a mobility of the charge carrier right  mobility of the charge carrier from basic device equations. E is given as – DV by DX right why -  DVDX because you see very well that if the voltage is increasing in this direction right is  increasing in this direction which means that I have a low voltage on this side and high voltage  on this side electrons will be actually moving in the opposite direction why because electrons has  been negative sign to it.  Voltage is increasing in this direction but the electrons will be moving in the opposite direction  as electric field therefore equals to -DV time DX which is- of DVDX right it is for electrons.  Therefore if I therefore this multiple this so if I put this is what I am saying Miu into - DVDX so  that minus and minus sign will get cancel out each other I do what I do replace this velocity by  what this velocity by Miu into E and this E by-DVDX.  Once I do that I get this final expression for ID with W is width Coxide Cox is the oxide  capacitance per unit area this is the effective potential energy this the mobility of charge carrier  in this case electronic and this DVDX which is this is nothing but the electric field. Now as you  very know you have apply a boundary condition because this is primarily as a differential  equation which I need to be solved what are the boundary conditions?  That at that X = 0 as I can assume that source is grounded it is a very valid assumption at this  stage but since source is grounded right is grounded I will have obviously V (0) = 0 and my V(L)  will be equals to VDS why VL = VDS because of that is the amount of voltage upon the drain  side. Just put those values here that means you will have X = 0 to L X = when you integrate from  0 to L you also integrate from 0 to VDS.  So at L the voltage was equals to VDS at X = 0 source side Voltage = 0. Integrate this point  assuming that the current is constant obviously the current continuity has to be maintained I get  an expression which is something like this quite interesting expression in front of you which is  ID = Miu NW / L Cox VG – VTH which is the over drive multiplied by (VDS – VDS square / 2)  right. Also please refer to this point that W /L is also referred to as to as aspect ratio of a device  right.  2  DS  D n OX GS TH DS  W V  I =μ C [(V -V )V - ]  This is p type,  this is n +, n +. So if you give VB much larger than but less than 0, you are actually  increasing the depletion thickness here, as well as here, right. So what will happen this  depletion thickness which some become something like this will increase, right. So you are  therefore still maintaining the reverse bias condition between source and bulk and drain and  bulk body.  So the condition was that I have to sustain or have to have reverse bias between source and  bulk and drain and bulk and this will be maintained if you simply give VB less than 0. If you  make VB greater than 0, then you are in a problem that then this will forward bias this  junction as well as this junction. And there will be heavy current flow through the device, it  will burn out the device, right. So just to give you an idea about what us talking about  therefore to keep the source and drain junction always in reverse bias, we make VB less than  0.  Now, let us see what happens? The we will look at the expression first and then we go to the  physical discussion. VT is given as VTH + gamma times 2 times Phi F + VSB – 2 Phi F. 2  Phi F is a constant which is given again by the previous discussion the KT by 2 times K T by  Q is the value of Phi F which you see Fermi level between. So this is basically you are, sorry,  Phi ms metal semiconductor function difference which you see.  T TH F SB F V =V +γ( 2Φ +V - 2Φ )  If you look very carefully this gamma is defined as the body coefficient factor and VSB is the  source to body voltage. Now, if you, as I discussed with you in the previous just now  discussion that if I make it therefore VSB if I make it more and more negative, right. Then  this depletion region becomes larger and larger, agreed? As the depletion thickness becomes  larger and larger on this side, I have to apply a larger gate voltage in order to break this  channel.  Because depletion thickness is large, in order to make it smaller by gate voltage has to  become larger and larger, this is threshold voltage will become higher and higher. With this  basic knowledge what I am going to show tell you therefore is, if you make a therefore VSB  large, high VSB. This expression will give you a larger value and therefore your threshold  voltage will increase.  VTH 0, this is VTH which is threshold voltage, old voltage, right, at VSB = 0. When you V  SB = 0, this 0 becomes like this, this equation vanishes and VT goes to VTH. So at VSB = 0,  the whole quantity is = 0 and these two quantities become equal, as VFB become more and so  VSB is what? VS – VB, right. So if you are bulk, you are making it negatively large, you are  making VSB more positive, right.  And therefore as you make it more and more positive, this quantity which is VSB starts to  increase and therefore threshold voltage increases. This is what is known as a body effect,  right. So in body effect, in an n channel enhancement mode MOSFET, if you go on rising the  value of the, if you go and making it more and more negative, you actually end up having a  larger threshold voltage available to you at the end of the day this is the first. |

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| Date: | 10 June 2020 | Name: | Srinidhi J C | |
| Course: | IOT in Python with Rosberry Pi | USN: | 4al16ec078 | |
| Topic: |  | Semester & Section: | 8th & b | |
| AFTERNOON SESSION DETAILS | | | |
| Image of session  [A Thing](https://www.raspberrypi.org/wp-content/uploads/2015/05/thing1.png)[PIR connected to Pi](https://www.raspberrypi.org/wp-content/uploads/2015/05/pir-pi.jpg)  [node-red and thingbox](https://www.raspberrypi.org/wp-content/uploads/2015/05/flowget.png) | | | |

The Internet of Things had been around for a while ([since 1982](https://www.cs.cmu.edu/~coke/) apparently) but it’s still a bit of a mystery to many. The concept of hooking up physical devices and letting them talk to each other is great, but how do you get started? How do you get useful data from them?

I’ve been playing around with IoT this week and came across this great starter IoT project for the Pi, a [people counting project](http://blog.ubidots.com/building-a-people-counter-with-raspberry-pi-and-ubidots) by [Agustin Pelaez](http://blog.ubidots.com/author/agustin-pelaez). It’s an oldie but goodie and worth a mention because it’s as simple as it gets in terms of IoT—a sensor sends data to a server, which then presents the data in a nice, human-friendly form.

It’s also as cheap as chips—apart from a Pi you only need a passive infra-red sensor (PIR) as used in [several of our resources](https://www.raspberrypi.org/resources/). We love PIRs: they cost a couple of quid, connect directly to the Pi GPIO pins and they can be used for all sorts of useful and/or mad projects. The basic [Ubidots](http://www.ubidots.com) account that stores and analyses the data is free. So this is an ideal IoT beginners’ project— cheap, straightforward and can be adapted to other projects. (Note that there is a bug in the code, *peopleev = 0* should read *peoplecount = 0*.)

If you want to dig further without too much pain, the [ThingBox](http://thethingbox.io/) has an SD card image for the Pi that allows you to “Install Internet of Things technologies on a Raspberry Pi without any technical knowledge” and has a number of [basic projects](http://thethingbox.io/docs/index.html) to get you started. It works with Ubidots out of the box and has a [number of tutorials](http://ubidots.com/docs/devices/nodered.html) that will help you learn common IoT tools like [Node-RED](http://www.nodered.org) on the Pi (including a PIR counter project which is a nice compare-and-contrast  to the Python based one above.)

The ThingBox a lot. It lowers the activation energy needed to get started with IoT on the Pi (actually, it makes it easy) and it allows all Pi owners access to what appears at first glance to be an arcane … Thing. The Internet of Things is fun, useful and empowering, and a natural extension to physical computing using the GPIO pins on the Pi. Hook up some Things today and have play. Raspberry Pi serial port consists of two signals (a 'transmit' signal, TxD and a 'receive' signal RxD) made available on the [GPIO header](https://elinux.org/RPi_Low-level_peripherals). To connect to another serial device, you connect the 'transmit' of one to the 'receive' of the other, and vice versa. You will also need to connect the Ground pins of the two devices together.

The Broadcom chip at the heart of the Raspberry Pi has low power serial ports with limitations of voltage and protocol compatibility. The ports use 0V and 3.3 V logic levels, not 0 & +5V TTL levels or the +/-12 V used by [RS-232](http://en.wikipedia.org/wiki/RS-232) serial ports found on some older PCs. If you wish to connect one of these, you need a board or adapter to convert the signal levels. See [this tutorial](http://codeandlife.com/2012/07/01/raspberry-pi-serial-console-with-max3232cpe/) for one example on how to build a 3.3 V to RS-232 level converter with a breadboard, a MAX3232CPE IC and five 0.1 µF capacitors. If your Raspberry Pi has bluetooth/wireless capability, then the on-chip UART connected to the header pins is the less capable mini-UART with no break detection, no framing errors detection, no parity bit, no receive timeout interrupt and no DCD, DSR, DTR or RI signals (See [RPi UART info](https://www.raspberrypi.org/documentation/configuration/uart.md) for more details.) To connect your Raspberry Pi to a PC with a USB port, the simplest option is to use a USB-to-serial cable which uses 3.3 V logic levels (e.g. the [Adafruit 954](http://www.adafruit.com/products/954) cable, the [FTDI TTL-232R-RPI](http://www.ftdichip.com/Products/Cables/RPi.htm) cable, or the [Debug Buddy](http://www.mysticengineering.com/debug.buddy/pi.usage.html) ultimate serial port). These can be simply plugged in directly to the GPIO header. To connect to a peripheral which has 0/5 V signals, you should ideally have a circuit to convert between the voltage levels. See [this tutorial](http://www.element14.com/community/groups/raspberry-pi/blog/2012/07/18/look-ma-no-display-using-the-raspberry-pi-serial-console) for an example using a ready-made level shifter module. Other circuits for level shifting are shown at [RPi\_GPIO\_Interface\_Circuits#Level\_Shifters](https://elinux.org/RPi_GPIO_Interface_Circuits#Level_Shifters). The [Debug Buddy](http://www.mysticengineering.com/debug.buddy) ultimate serial port can also be configured for 0/5 V signals.