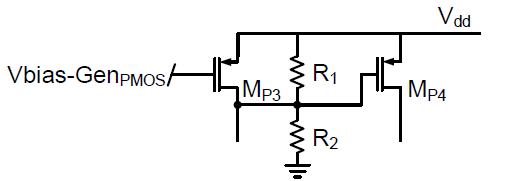
|  |  |  |  |
| --- | --- | --- | --- |
| Node | Time Constant | Assumptions/Simplifications | Simplified Time Constant |
| 1 - Input |  | * Cin >> Cgs2 |  |
| 2 - Vx |  | * R2/R1 < 4 |  |
| 3 - Vy |  | * R3/R4 < 4 |  |
| 4 - Vz |  |  |  |
| 5 - Vout |  |  |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Stage | Gain | R in terms of gain | Equals | Simplified Time Constant |
| 1 - CG |  | R2 = 4R1  = gain  => = = gain  => R1 = 5/4\* gain | 5000 |  |
| 2 – Cascode |  | R3 = 4R4  = 5  => = 5  => = 5  => R4 = | 5 |  |
| 3 – CS |  |  | 1.2 |  |
| 4 – CD |  |  | 1 |  |
|  |  |  |  |  |

# First resistive divider

Calculating bounds on the ratio of R2/R1:



Assume that the current through Mp3 is matched with the current through Mn2, such that no current flows between the R1/R2 resistive divider and into the transistor stack. Assume that there is no body effect on Vt. In order to keep Mp4 in saturation, we must have the following condition:

In other words

Then R1||R2 = <ratio>/(<1+ratio>R1) = Gain\_CG

R1 = 5/4 Gain\_CG

# First Cgs4

# Second resistor divider

Use same values as first divider, since GBW product will be less affected by gain since there is a gm factor in this stage.

# third xtor stack

Gain = gm7/gm8

# fourth xtor stack

Script overview

Choose current allocations -> Calculate gm’s -> Calculate Vov’s -> Calculate sizings

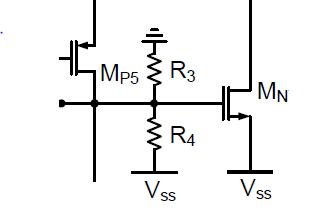
1. Find gain equation at each of the 4 stages
   1. Ignore ro, assume ro >> R1-4
2. Find RC time constaint at each node
   1. Ignore Cgd b/c Cgd = Cov << Cgs = 2/3WLCox + Cov
   2. Ignore bulk terminal caps b/c hard to estimate
3. Power ≤ 2mW, Vdd - Vss = 5V→ Ids\_tot ≤ = 400A
4. Pick Vov = typical 0.3; L = 0.2um
5. Sweep over Ids distribution over 4 branches and 4 stage gains allocation
   1. 4 branches of Ids sum up to Ids\_tot
   2. Product of 4 stages’ gain equal to our target gain of 30k
6. During each iteration, calculate:
   1. gm and W for each xtor
   2. R1-R4
   3. tau for the 5 major nodes (in, x, y, z, out)
   4. from tau calculate f-3db see if it meets our spec of 90MHz

First pass design strategy

1. Find gain equation at each of the 4 stages
   1. Ignore ro, assume ro >> R1-4
2. Find RC time constaint at each node
   1. Ignore Cgd b/c Cgd = Cov << Cgs = 2/3WLCox + Cov
   2. Ignore bulk terminal caps b/c hard to estimate
3. Product of the 4 gains >= 30k. Allocate a percentage of 30k for each stage
4. 1/(sum of all nodes’ time constants) >= 90MHz. Allocate a percentage of 1/90Mhz for each node.
5. At this point, we have each stage’s gain in function of gm, R; each node’s time constant as a function of gm, R, C. We can correlate the 2 equations to assign values to gm, C, R variables.
6. From gm, we can find W.
7. After all xtors are sized, we will calculate Ids of the xtors connected to Vbias-Gen to determine the biasing voltage.

|  |  |  |  |
| --- | --- | --- | --- |
| Assumptions | Independent Variables | Derived quantities | Performance Characteristics |
| * Vov[1..10] * Length[1..10] | * I\_branch[1...4] * Gain\_stage[1..4] * R[1..4] | * Width[1..10] * Cgs[1..10] * Miller Gain (Mn10) * Gm[1..10] | * DC Gain * 3db Bandwidth * Power |

Similarly for R3/R4:



In other words