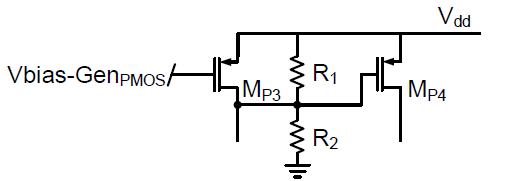
|  |  |  |  |
| --- | --- | --- | --- |
| Node | Time Constant | Assumptions/Simplifications | Simplified Time Constant |
| 1 - Input |  | * Cin >> Cgs2 |  |
| 2 - Vx |  | * R2/R1 < 4 |  |
| 3 - Vy |  | * R3/R4 < 4 |  |
| 4 - Vz |  |  |  |
| 5 - Vout |  |  |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 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 |  |
|  |  |  |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| Assumptions | Independent Variables | Derived quantities | Performance Characteristics |
| * Length[1..10] | * I\_branch[1...4]   Random for now   * Gain\_stage[1..4]   CG, cascade  CS,CD ~ 1 always   * $R3 = x\*$R2;   10-10k, increment of 1k   * All gm’s except (4, 7, 8, 10):   0.0000005-0.003 | * Width[1..10] * Cgs[1..10] * Miller Gain (Mn10) * Gm[1..10] * Vov[1..10] | * DC Gain * 3db Bandwidth * Power |

# 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

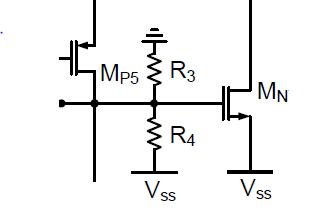
Then R1||R2 = <ratio>/(<1+ratio>R1) = Gain\_CG

R1 = 5/4 Gain\_CG

# First Cgs4

# Second resistor divider

Similarly for R3/R4:



In other words

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 constant 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→ Itot ≤ = 400uA
4. Allocate gain per stage
5. Find R1/R2 ratio = 4
6. Assume R3/R4 = 3
7. Calculate gm from gain and R’s
8. Find power dissipated by the R’s to figure out how much left for xtor stacks
9. Allocate current through 4 stacks based on #5
10. For each xtor,
    1. calculate Vov from its Ids and gm
    2. calculate W from Ids, Vov
    3. calculate Cgs
11. Calculate time constants at each stage. 1/sum must meet our target bandwidth