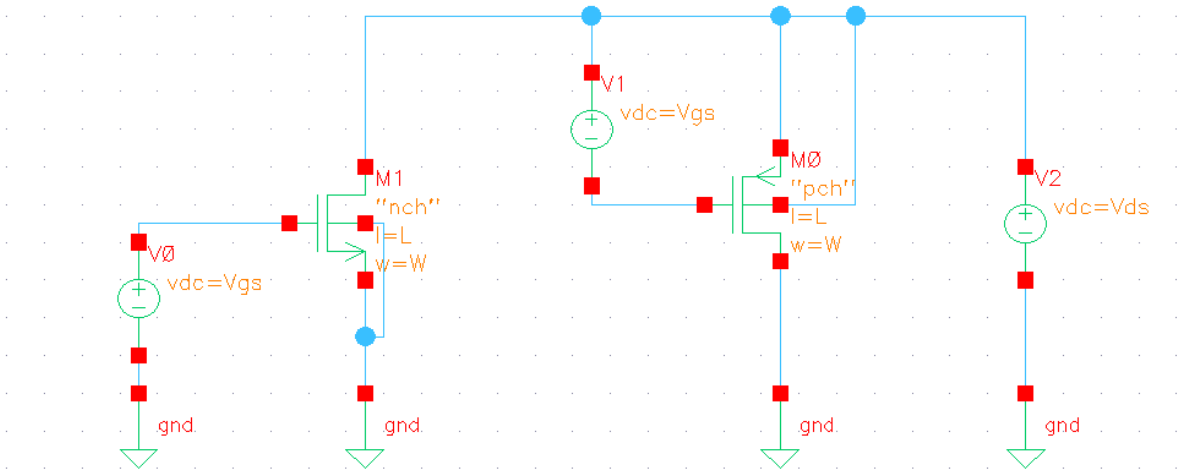
Lab 05

Simple Vs Low Compliance Cascode Current Mirror

Part 1: Sizing Chart

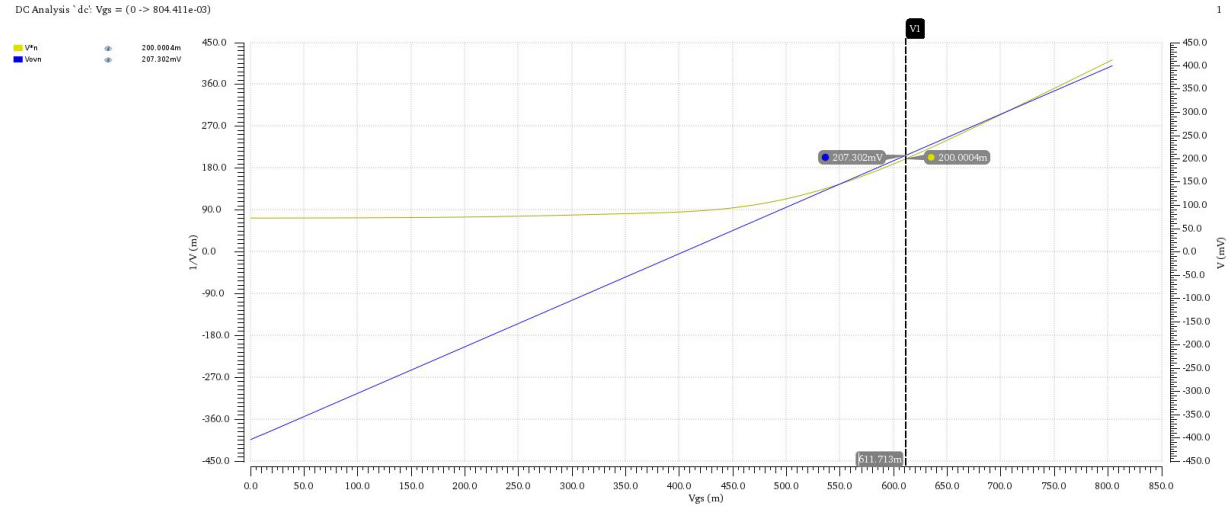
- Given Parameters in this Lab:

MOSFET Length L	1um
Supply Voltage V_{ds}	1.8V
Drain Current I_D	20uA
Real MOSFET Overdrive Voltage V^*	0.2V



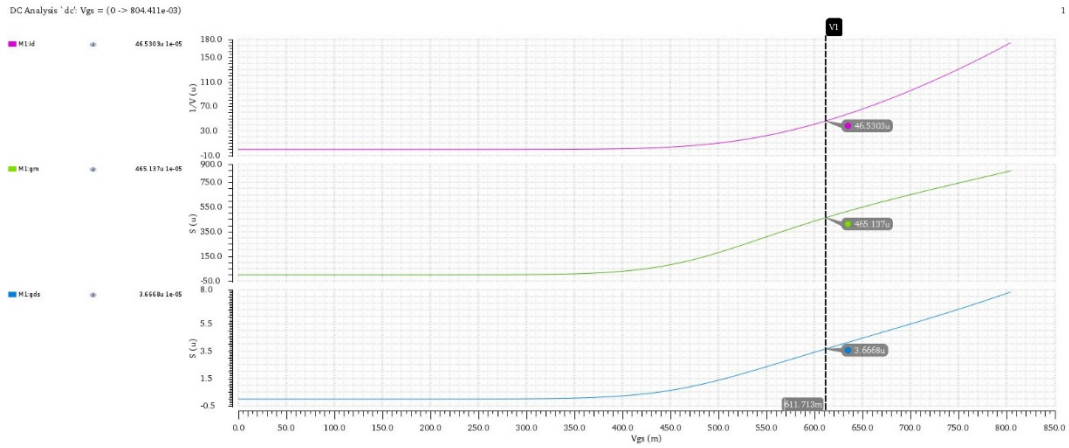
Schematic used in sizing

- Determine NMOS Width Value (Wn):



Vov & V* versus Vgs sweep

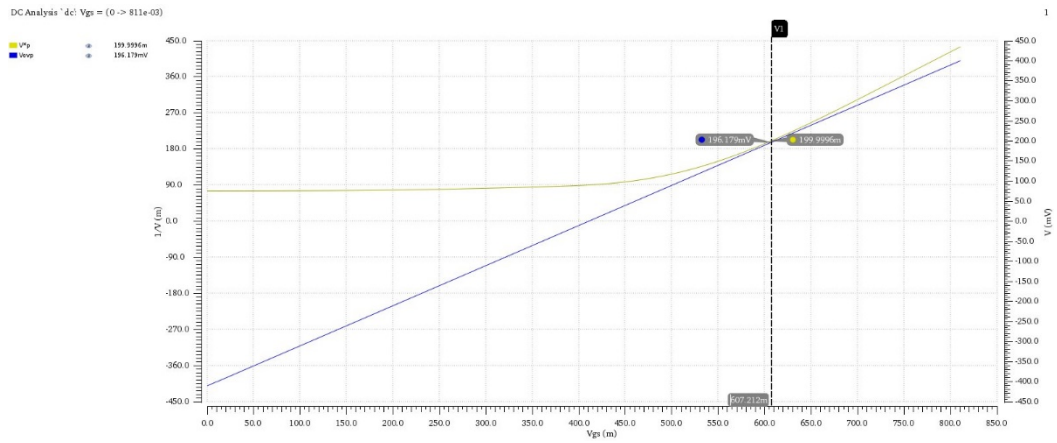
From previous graphs we find at $V_Q^* = 200mV \rightarrow V_{gsQ} = 611.713mV$ *and* $V_{ovQ} = 207.3102mV$.



I_D, g_m *and* g_{ds}versus V_{gs}

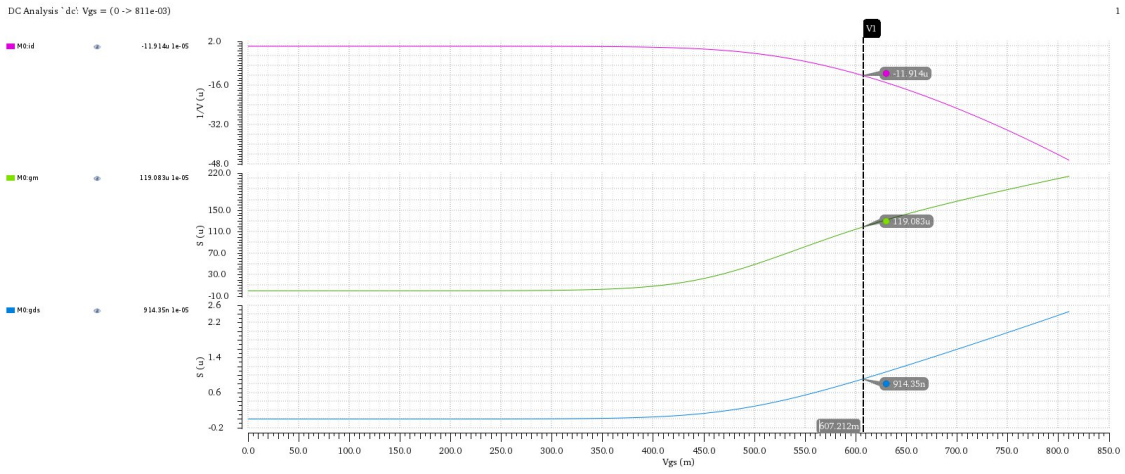
From previous graph at $V_{gs} = 611.713mV$, we have $I_{dX} = 46.5303uA, g_{mX} = 465.137uS$ *and* $g_{dsX} = 3.6668uS$.
Using cross multiplication as $I_d \propto W$, we find that W=4.23um.
Also $g_m = 196.7529uS, and\ g_{ds} = 1.551nS$ @ W=4.23um.

- Determine PMOS Width Value (Wp):



Vov & V* versus Vgs sweep

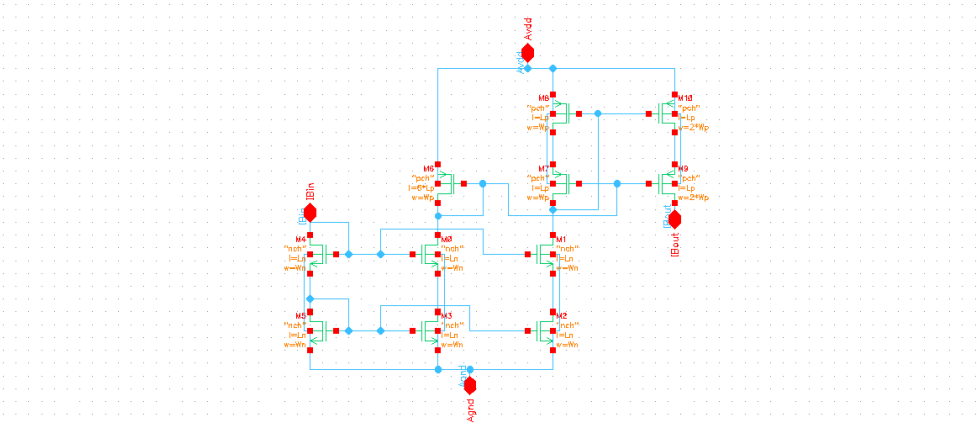
From previous graphs we find at $V_Q^* = 200mV \rightarrow V_{gsQ} = 607.2124mV\ and\ V_{ovQ} = 196.18mV$.



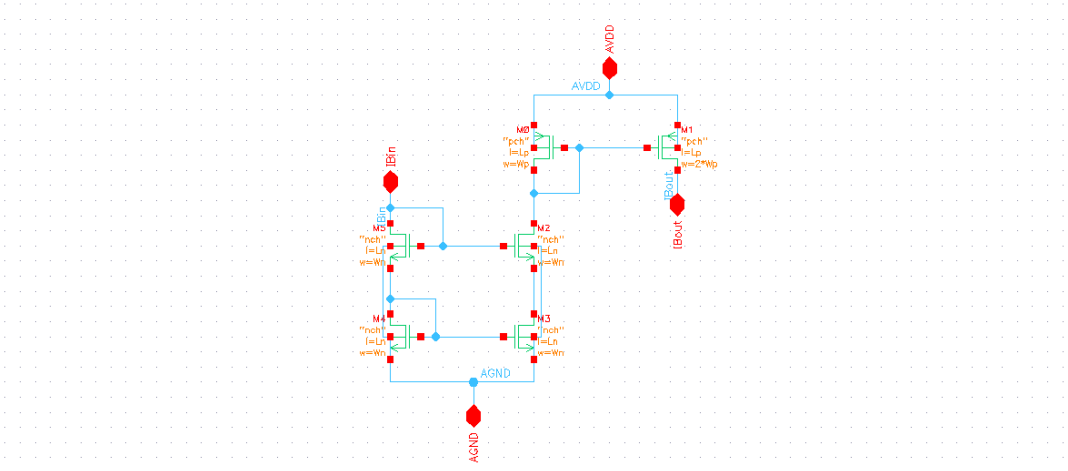
I_D, g_m *and* g_{ds}versus V_{gs}

From previous graph at $V_{gs} = 607.2124mV$, we have $I_{dX} = 11.914uA, g_{mX} = 119.083uS\ and\ g_{dsX} = 914.35nS$.
Using cross multiplication as $I_d \propto W$, we find that W=16.787um.
Also $g_m = 200uS, and\ g_{ds} = 1.535uS$ @ W=16.787um.

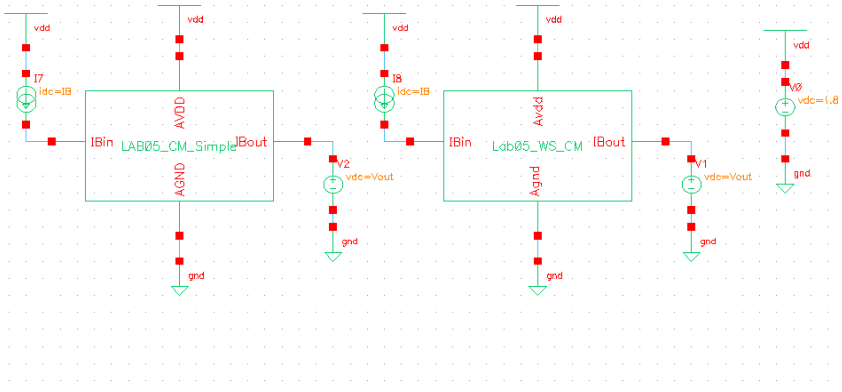
Part 2: Current Mirror



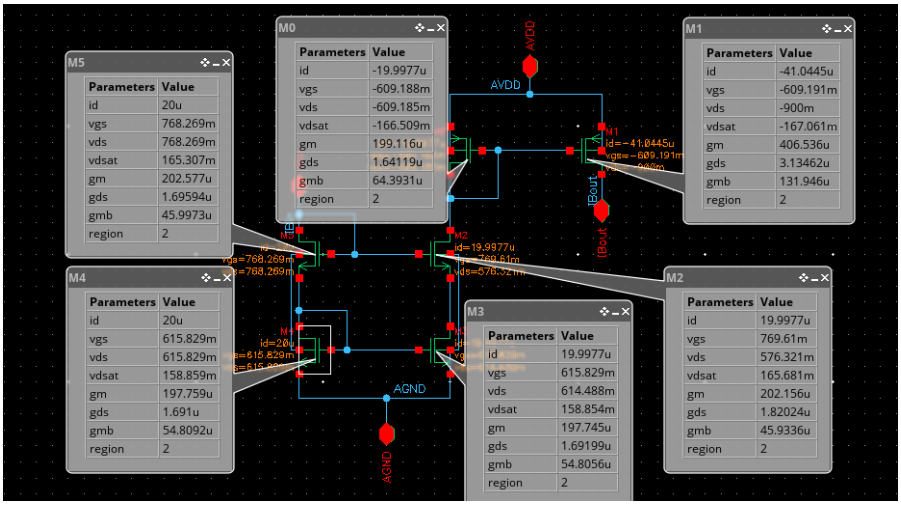
Wide sense current mirror schematic on cadence



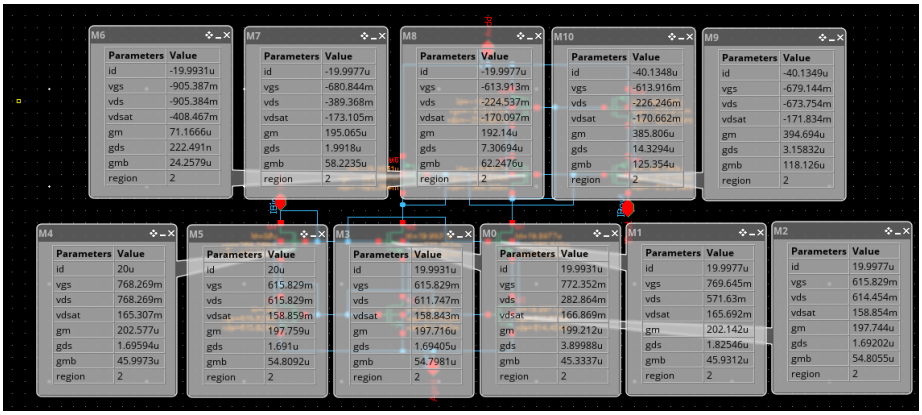
Simple cascode current mirror schematic on cadence



WS & simple current mirrors symbols for testbench

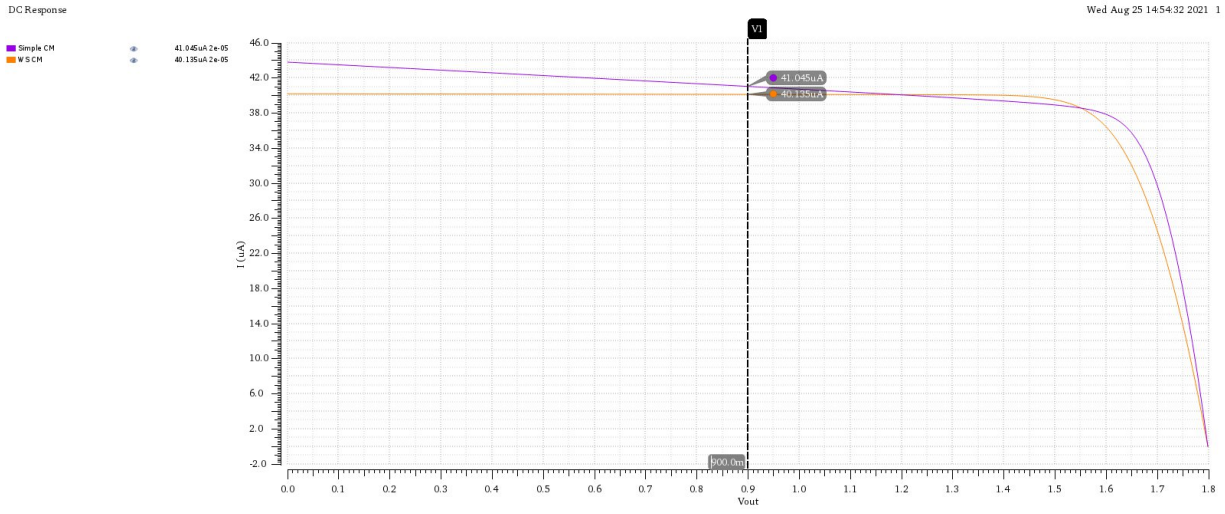


Simple cascode current mirror Mosfets OP parameters



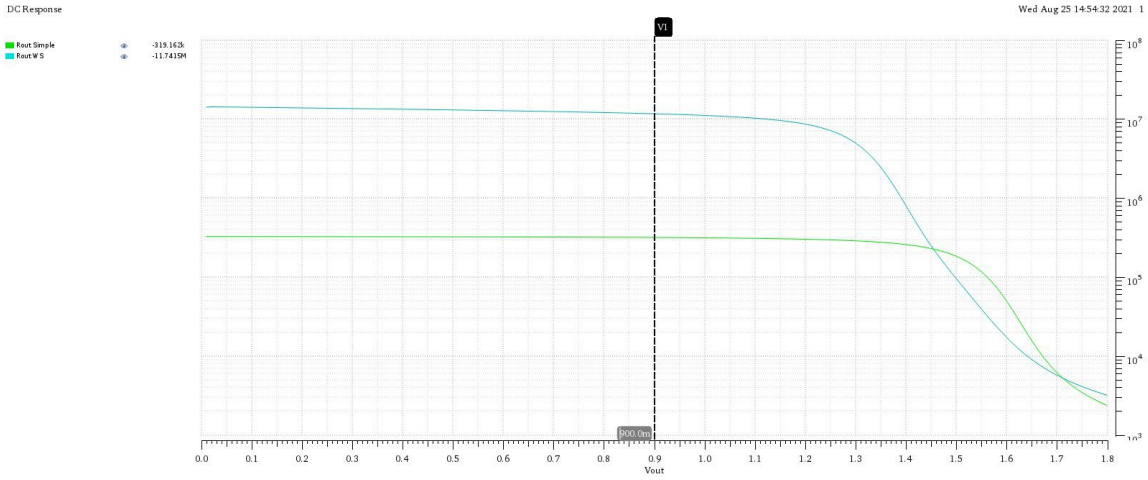
Wide sense cascode current mirror MOSFETs OP parameters

- As shown in previous figures that all MOSFETs region equal 2 which mean that it operates in saturation region.
- From OP parameters shown in previous figures it's clear that results of Vgs, gm and gds are nearly to values calculated in part1.



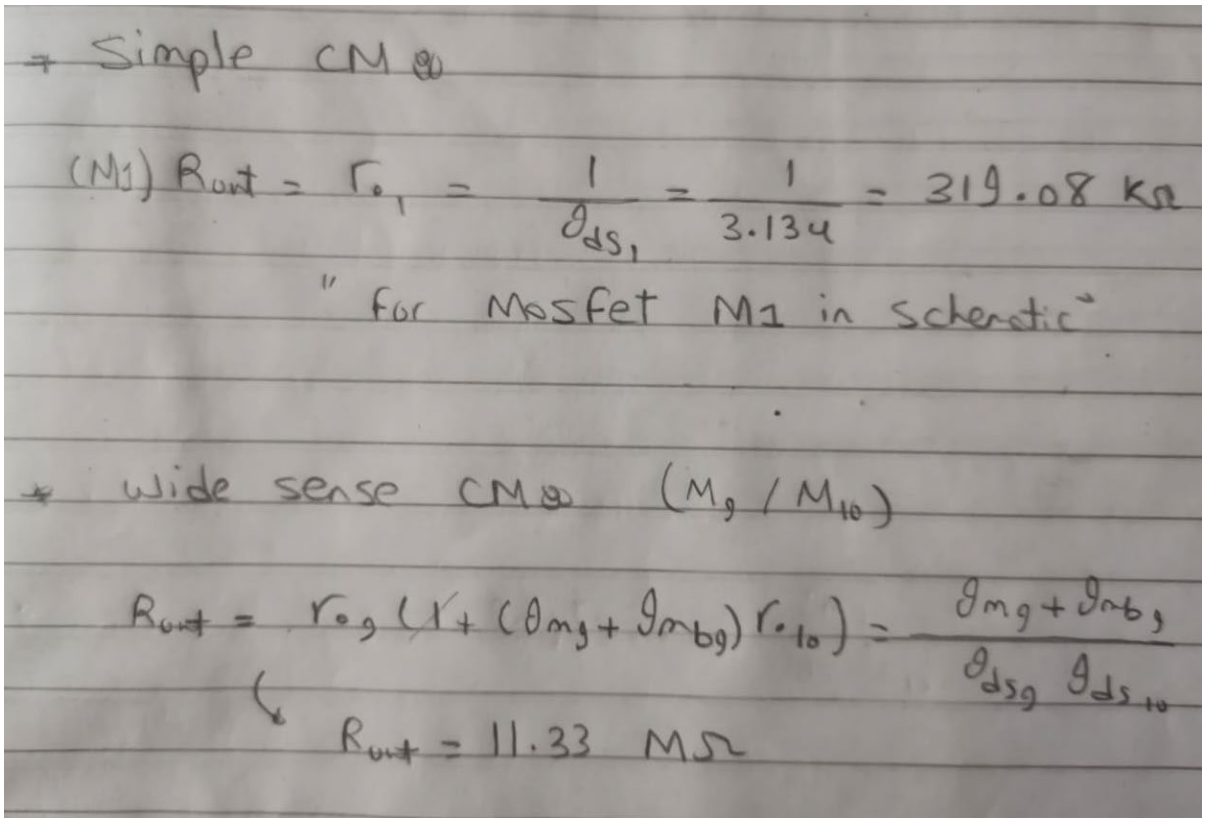
output current versus Vout sweep for WS & simple current mirrors

- As shown from previous analysis that wide sense current mirror is more stable (constant current value) with voltage variations despite simple current mirror which changed with Vout variations.
- Because at this certain point voltage difference between Vdd and Vout provides the same Vds to MOSFET as VDS of magic battery which give perfect mirroring.



Output resistance versus VOUT of WS & simple CMs

- Rout of wide sense CM is more than that of simple CM because output of wide sense CM is cascaded which give high impedance while simple CM is only a single transistor so its output impedance not boosted.
- No, Rout doesn't changed with VOUT given that MOSFET operates in saturation, and Rout in this case is function in channel length which is constant value.



Analytical calculations for Rout simple & WS CMs