

INSTRUMENTATION

Analog IC Design : 2022-23 Lecture 6 Differential Amplifiers Part-3 By Dr. Sanjay Vidhyadharan

ELECTRICAL ELECTRONICS COM

COMMUNICATION

Basic MOS Differential Pair



8/27/2022

ELECTRICAL

COMMUNICATION

INSTRUMENTATION

MOS Differential Pair



COMMUNICATION

8/27/2022

ELECTRICAL

ELECTRONICS

INSTRUMENTATION

MOS Differential Pair



8/27/2022

ELECTRICAL

ELECTRONICS

Active Loads



For passive resistance load Diff Amp we need a larger drain resistor to achieve higher gain, but more drain resistance means a lower DC bias voltage at the output node. Passive resistance need large silicon area and has large parasitic capacitance

8/27/2022

ELECTRONICS

ELECTRICAL



COMMUNICATION

8/27/2022

ELECTRONICS

ELECTRICAL



8/27/2022

COMMUNICATION



With Diode Load: $V_{SS} + V_{ov-M5} + V_{Thn-M1} + V_{ov-M1} \le V_{CM} \le V_{DD} - |V_{Thp-M3}| + V_{THn-M1}$

8/27/2022

ELECTRICAL ELECTRONICS



COMMUNICATION

ELECTRICAL

ELECTRONICS

INSTRUMENTATION

Problems with Current-Source MOS Loads



In sub-micron technologies it's hard to obtain differential gains higher than 10-20. Trade-off among output voltage swing, voltage gain , and CM input range

8/27/2022

Problems with Current-Source MOS Loads



 $A_{V,diff} \approx g_{m1}[(g_{m3}r_{o3}r_{o1}) \| (g_{m5}r_{o5}r_{o7})]$

COMMUNICATION

8/27/2022

ELECTRICAL

ELECTRONICS

INSTRUMENTATION

8/27/2022

8/27/2022

COMMUNICATION

STEP 1—Find Max and Min DC Bias current from Slew Rate

Slew rate is the rate of change of output voltage of the amplifier due to a step change in input voltage. It occurs in the extreme case of a branch being open circuited (say MOSFETs 2 and 4).

Step In and entire current available in one branch

8/27/2022

ELECTRICAL

ELECTRONICS

COMMUNICATION

INSTRUMENTATION

STEP 2 — To find aspect ratios(W/L) of M_3 and M_4 from Input Common Mode Range

ELECTRICAL

COMMUNICATION

STEP 3 — To find aspect ratios(W/L) of M_1 and M_2 from Gain and Bandwidth

8/27/2022

ELECTRONICS

COMMUNICATION

8/27/2022

ELECTRICAL

ELECTRONICS

COMMUNICATION

INSTRUMENTATION

8/27/2022

Gilbert Cell

8/27/2022

ELECTRONICS CO

COMMUNICATION

Gilbert Cell

COMMUNICATION

8/27/2022

ELECTRICAL

ELECTRONICS

8/27/2022

COMMUNICATION