Lab. 11

CHARACTERIZATION OF DIFFERENTIAL AMPLIFIER

1. DC bias and input range
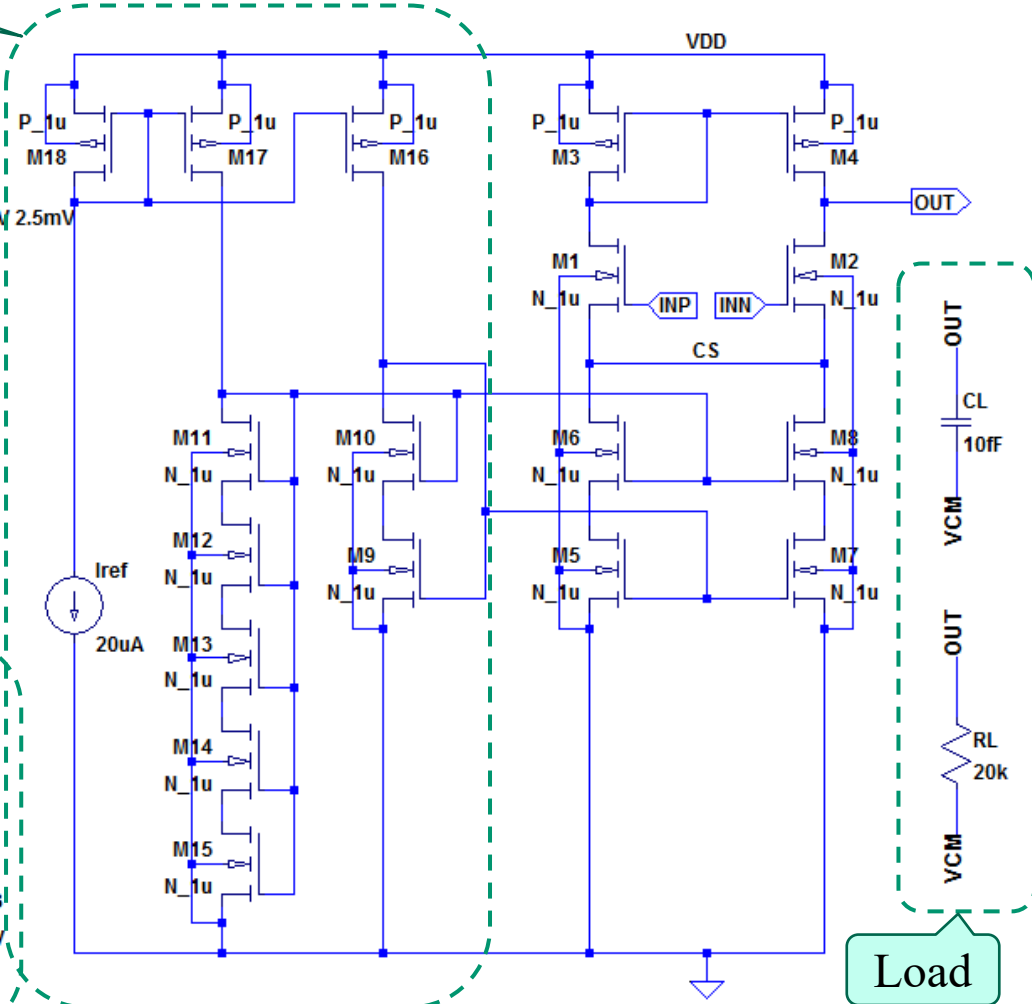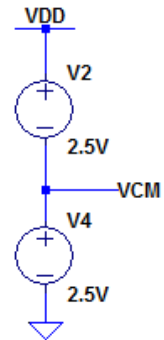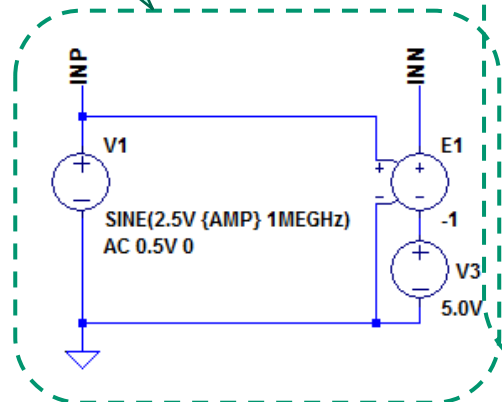
- Carry out the analysis of the differential amplifier shown in the next slide. In the DC analysis, use 20 kΩ load resistor (RL) to sink and source the output current.

- Check the output voltage, the input voltage, the drain current of M1 and M2, the common source voltage V(MC).

  - Note: The input and output signal is biased by the common mode voltage VCM. Then the load resistor must be connected to VCM node.

Schematic

Parameters

MOSFET	L(m)	W(m)	M	AD, AS(m^2)	PD, PS(m)	W/L
M1, M2	2u	20u	1	60p	26u	10
M3, M4	2u	20u	1	60p	26u	10
M5-M15	2u	10u	1	30p	16u	5
M16-M18	2u	10u	3	30p	16u	15

Differential signal source

2. AC analysis

- Carry out the AC analysis of the differential amplifier shown in the previous page. In the AC and TRAN analysis, use the 10fF capacitive load.

- Measure the differential gain, the cut-off frequency, the unity gain frequency, and the phase margin.

  – Remove the load resistor RL or set the RL to 1TΩ, because the voltage gain is degraded by RL.

  – Set the AC magnitude of the signal source = 0.5V, that is, the amplitude of the differential signal is given at 1.0V. In an AC analysis, the distortion cannot be considered, because the analysis is carried out for the linearized small-signal equivalent circuit. Therefore, the amplitude of signal source is usually set at 1.0V for convenience to obtain the sensitivity to the input amplitude.

3. TRAN analysis

- Carry out the TRAN analysis of the differential amplifier shown in the previous page.

  – The amplitude of the input signal is stepped by .step param directive.

- Show the output waveform and FFT results.

  – FFT requires the large number of point in the waveform. The automatic data deletion must be suppressed by the .option directive.

  – .options plotwinsize=0

  – FFT can be applied to the 2^N data. Here the number of data is set to the default value ($262144 = 2^{18}$). Please see the comment on the FFT setting in http://jaco.ec.t.kanazawa-u.ac.jp/edu/ec2/ltspice/26.html

Parameter of transient analysis