

# Design assignment

Uditya Raghav  
230102119

$$I_{ref} = 2.5 \mu$$

M8 assume  $V_{ov} = 0.150 \text{ mV}$

$$\frac{W}{L} \approx 1$$

let  $L = 900 \text{ n}$

$$W = 900 \text{ n}$$

$$I_D = \mu_n C_{ox} \frac{W}{L} (V_{ov})^2$$

$$\frac{W}{L} = \frac{2.5 \times 2}{230 \times 0.15^2}$$

$$\approx 1$$

$$V_{gs} - V_{th} = 0.143 \text{ mV}$$

$$g_m = 3.29 \times 10^{-5} \text{ S}$$

$$r_o = \frac{1}{2.58} \times 10^7 \Omega$$

from log files

M5

$$I = 10 \times I_{ref}$$

$$= 25 \mu$$

assume  $\frac{W}{L} = 10 \left( \frac{W}{L} \right)_8 = 10$

$$L = 900 \text{ n}$$

$$W = 9 \mu$$

but in lt spice more current in M5

reduce  $W = 7.8 \mu$

$$I = 25.1 \mu$$

$$V_{gs} - V_{th} = 0.16 \text{ mV}$$

$$g_m = 2.98 \times 10^{-4} \text{ S}$$

$$r_o = \frac{1}{3.23} \times 10^6 \Omega$$

from log files

M<sub>1</sub> and M<sub>2</sub>

assume  $V_{ov} = 0.09V$

$I = \frac{1}{2} \mu_n C_{ox} \frac{W}{L} (V_{ov})^2$

$\frac{W}{L} \approx 15$

$\frac{W}{L} = \frac{2 \times 12.5}{230 \times 0.09^2}$

at  $L = 1080n$

$= 15$

$W = 16.2\mu$

but not getting required  $V_{ov}$   
increase  $W$  slightly to  $18\mu$

$V_{gs} - V_{th} = 0.063V$

$G_m = 0.241mS$

$r_o = \frac{1}{1.46} \times 10^6 \Omega$

M<sub>3</sub> and M<sub>4</sub>

assume  $V_{ov} = 0.2V$

$\frac{W}{L} = \frac{2 \times 12.5}{100 \times 0.2^2}$

$\frac{W}{L} = 6.25$

$= 6.25$

at  $L = 1.08\mu$

$W = 6.25\mu$

$V_{ov} = 3.09 \times 10^{-1}V$

$G_m = 8.76 \times 10^{-5}S$

$r_o = \frac{1}{8.14} \times 10^7 \Omega$

gain of first stage

$G_{m1}(r_{o3} || r_{o2}) = 105.98$

$= 40.5dB$

for second stage

M<sub>6</sub> assume current in M<sub>6</sub> to be 9.6  $\mu$ A

$$\left(\frac{W}{L}\right)_6 = 4$$

$$\text{at } L = 180 \text{ nm}$$

$$W = 720 \text{ nm}$$

not getting required current at this

increase  $\frac{W}{L} = 6.5$  for high gain

$$W = 1.2 \mu$$

$$V_{ov} = 0.67 \text{ V}$$

$$g_m = 1.64 \times 10^{-4}$$

$$r_o = \frac{1}{4.76} \times 10^{-6} \Omega$$

M<sub>7</sub> assume  $V_{ov} = 0.2 \text{ V}$

$$\left(\frac{W}{L}\right)_7 = 5$$

$$\text{at } L = 180 \text{ nm } W = 900 \text{ nm}$$

not getting desired gain Increased

W to 1.2  $\mu$

$$\frac{W}{L} = \frac{1.2}{0.18} = 6.67$$

$$V_{ov} = 0.61 \text{ mV}$$

$$g_m = 1.06 \times 10^{-4} \text{ S}$$

$$r_o = \frac{1}{1.17} \times 10^6 \Omega$$

gain of second stage

$$= g_{m7} (r_{o6} \parallel r_{o7}) = 17.85$$
$$\approx 24.6 \text{ dB}$$

	$I_D$	$V_{ov}$	$G_m$	$r_o$	$\frac{W}{L}$	$ V_{th} $
$M_1$	$12.7 \mu A$	$0.062 V$	$0.241 mS$	$684 k\Omega$	$16.67$	$0.5 V$
$M_2$	$12.7 \mu A$	$0.062 V$	$0.241 mS$	$684 k\Omega$	$16.67$	$0.5 V$
$M_3$	$12.7 \mu A$	$0.31 V$	$8.76 \times 10^{-5} S$	$1230 k\Omega$	$5.78$	$0.37 V$
$M_4$	$12.7 \mu A$	$0.31 V$	$8.76 \times 10^{-5} S$	$1230 k\Omega$	$5.78$	$0.37 V$
$M_5$	$25.3 \mu A$	$0.16 V$	$0.306 mS$	$266 k\Omega$	$8.67$	$0.392 V$
$M_6$	$9.59 \mu A$	$0.067 V$	$0.164 mS$	$210 k\Omega$	$6.67$	$0.485$
$M_7$	$9.56 \mu A$	$0.68 V$	$1.06 \times 10^{-4} S$	$854 k\Omega$	$6.67$	$0.49 V$
$M_8$	$2.5 \mu$	$0.143$	$3.29 \times 10^{-5} S$	$3856 k\Omega$	$1$	$0.409 V$

gain of first stage =  $40.5 dB$

gain of 2nd stage =  $24.6 dB$

total gain =  $64.6 dB$

values from lt spice