

by A. Marzuki

**Voltage Source:**

Equivalent circuit model of voltage source:

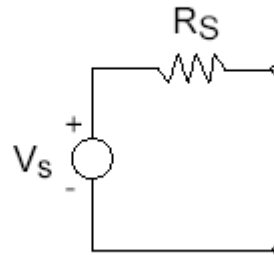
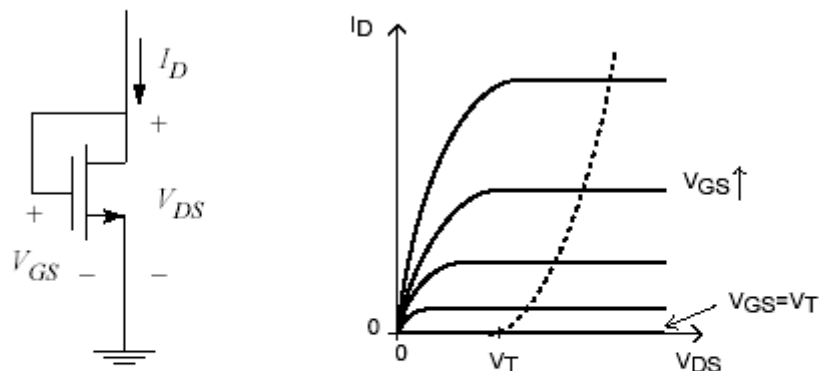


Fig.1

□ Consider MOSFET in "diode configuration":



I-V characteristics:

$$I_D = \frac{W}{2L} \mu C_{ox} (V_{GS} - V_T)^2 = \frac{W}{2L} \mu C_{ox} (V_{DS} - V_T)^2$$

Fig. 2

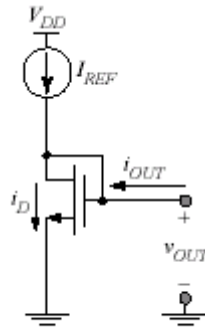


Fig. 3

$V_{GS} = V_{DS}$  takes value needed to sink current:

$$I_D = I_{REF} + i_{OUT} = \frac{W}{2L} \mu C_{ox} (v_{OUT} - V_T)^2$$

1. From above equation, determines  $V_{out}$ . What is relationship of  $V_{out}$  vs  $I_{REF}$  and  $W/L$ ?
2. By employing Silterra Transistors, design  $V_{out}$  of 0.9 V using circuit similar to Fig. 3.

## Current Source:

Equivalent circuit model of current source:

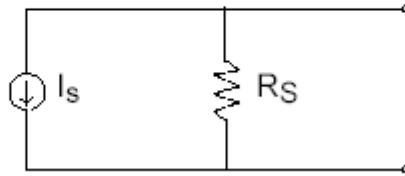


Fig. 4

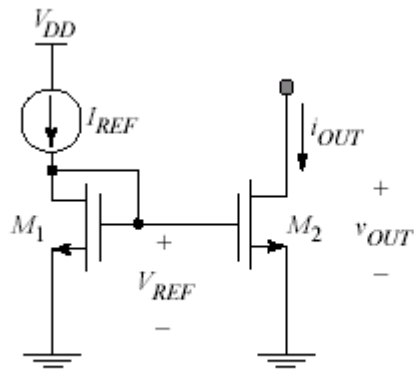


Fig. 5

1. What is relationship of  $i_{out}$  vs  $I_{REF}$  and  $W/L$ ?
2. Design  $i_{out}$  of  $20 \mu A$  using Silterra Transistor. Note down  $V_{DD}$  value.