SNS COLLEGE OF TECHNOLOGY

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Coimbatore-35

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DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

19ECB201-ANALOG ELECTRONIC CIRCUITS

II YEAR/ III SEMESTER

UNIT 5 – IC MOSFET AMPLIFIERS

TOPIC – MOSFET current sources

MOSFET Current Sources

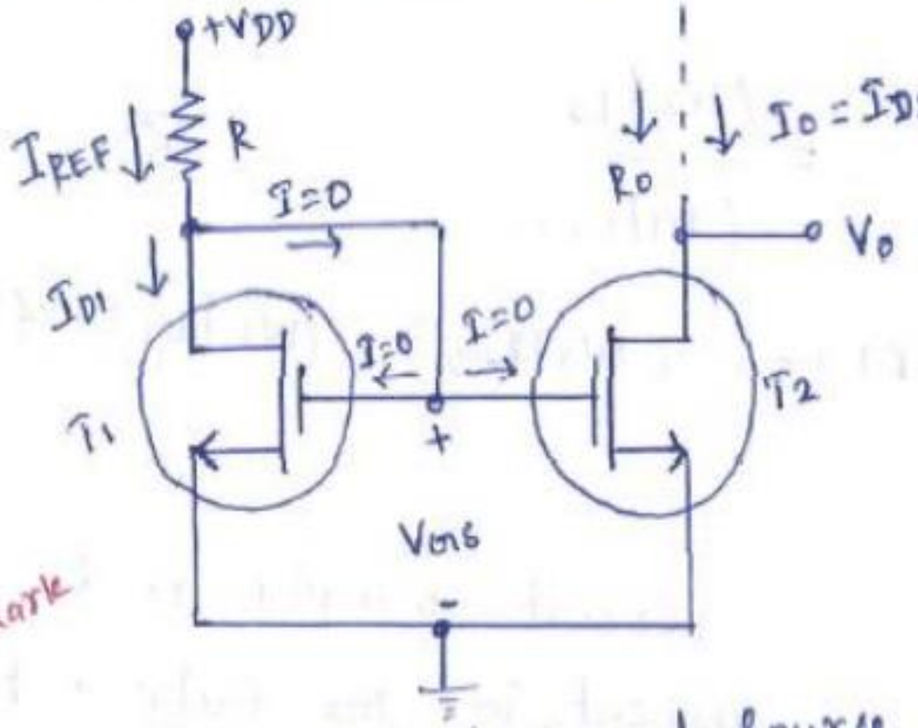

Fig: Constant Current Source Using MOSFET

* The circuit uses 2 MOSFETs T1 & T2.
* The drain & gate of MOSFET T1 is shorted, it's operated in satural region.
* Neglecting channel leng modulation ($\lambda = 0$) The drai

Current of T_1 is given by

$$I_{REF} = I_{D1}$$

$$= \frac{1}{2} k_n' \left(\frac{W_1}{L_1}\right)(V_{GS} - V_{T1})^2 \quad — (1)$$

$$I_{REF} = K_{n1}(V_{GS} - V_{T1})^2 \Rightarrow \frac{I_{REF}}{K_{n1}} = (V_{GS} - V_T)^2$$

$$V_{GS} = V_{T1} + \sqrt{\frac{I_{REF}}{K_{n1}}} \quad — (2)$$

W. K. T

$$I_{REF} = I_{D1} \Rightarrow$$

$$I_{REF} = \frac{V_{DD} - V_{GS}}{R} \quad — (3)$$

* The MOSFET T_2 has the same V_{GS} at T_1 : Thus if we assume that it's operating in saturation we have

$$I_O = I_{D2} = \frac{1}{2} k_n' \left(\frac{W_2}{L_2}\right) (V_{GS} - V_{T2})^2 \quad -(1)$$

$$= k_{n2} (V_{GS} - V_{T2})^2$$

* $V_{GS1} = V_{GS2}$ & substituting value of V_{GS} from

eqn ② we have

$$I_O = K_{n2}\left(V_{T1} + \sqrt{\frac{I_{REF}}{K_{n1}}} - V_{T2}\right)^2 .$$

* Here also we can neglect the channel length modulation ($\lambda = 0$).

* Taking the ratio of eqns ① & ④ we get

$$\frac{I_O}{I_{REF}} = \frac{I_{D2}}{I_{D1}} = \frac{(W_2/L_2)}{(W_1/L_1)} \quad \text{— ⑤}$$

* For identical MOSFETs, $(W_2/L_2) = (W_1/L_1)$ & hence

$I_O = I_{REF}$.

* In such situation the circuit simply replicates (or) mirrors the reference current in the output terminal.

* For the reason, when 2 MOSFETs are identical, the circuit shown in above fig is known as current mirror circuit.

Effect of V_o on I_o

* To operated in saturation,

$$V_o \geq V_{GS} - V_T \quad \text{——} \quad (6)$$

(or)

$$V_o \geq V_{ov} \quad \text{——} \quad (7)$$

where

V_{ov} - overrride voltage

2Mark

*In initial analysis we have neglected the effect of channel length modulation. However, it has significant effect on the operation of the current source circuit.

THANK YOU