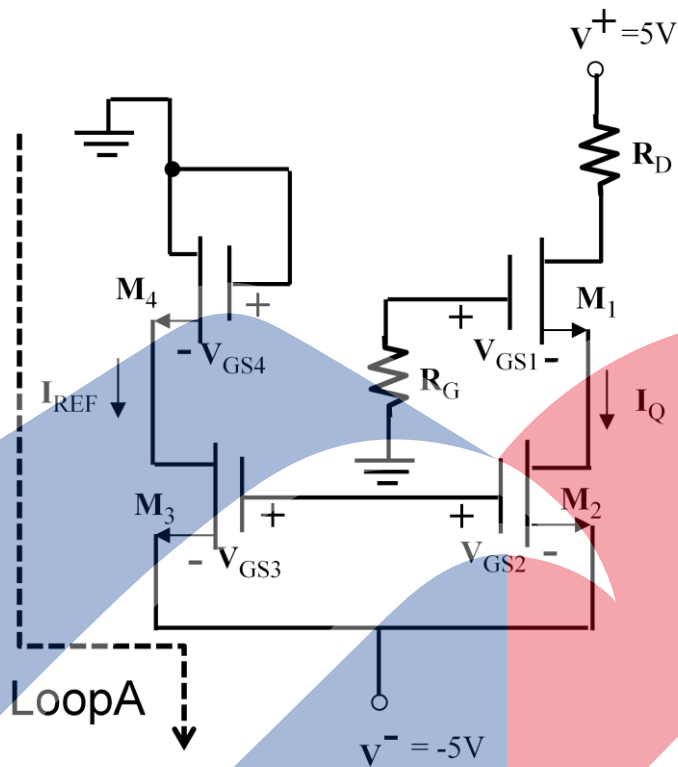


**Chapter 3**  
**場效電晶體(The**  
**Field-Effect Transistor)**

3.4 用於偏壓之固定電流源

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Southern Taiwan University

### 3.4 用於偏壓之固定電流源



$$\because V_{GS3} = V_{GS4}, V_{DS3} = V_{GS3}$$

$$\because V_{DS(SAT)} = V_{GS} - V_{TN}$$

$$\because V_{DS} > V_{DS(SAT)}$$

M3、M4 皆工作於 SAT

$$\text{故 } i_{D3} = k_{n3}(V_{GS3} - V_{TN3})^2 \text{ --- (1)}$$

$$i_{D4} = k_{n4}(V_{GS4} - V_{TN4})^2 \text{ --- (2)}$$

$$\text{(1) = (2)}$$

$$k_{n3}(V_{GS3} - V_{TN3})^2 = k_{n4}(V_{GS4} - V_{TN4})^2$$

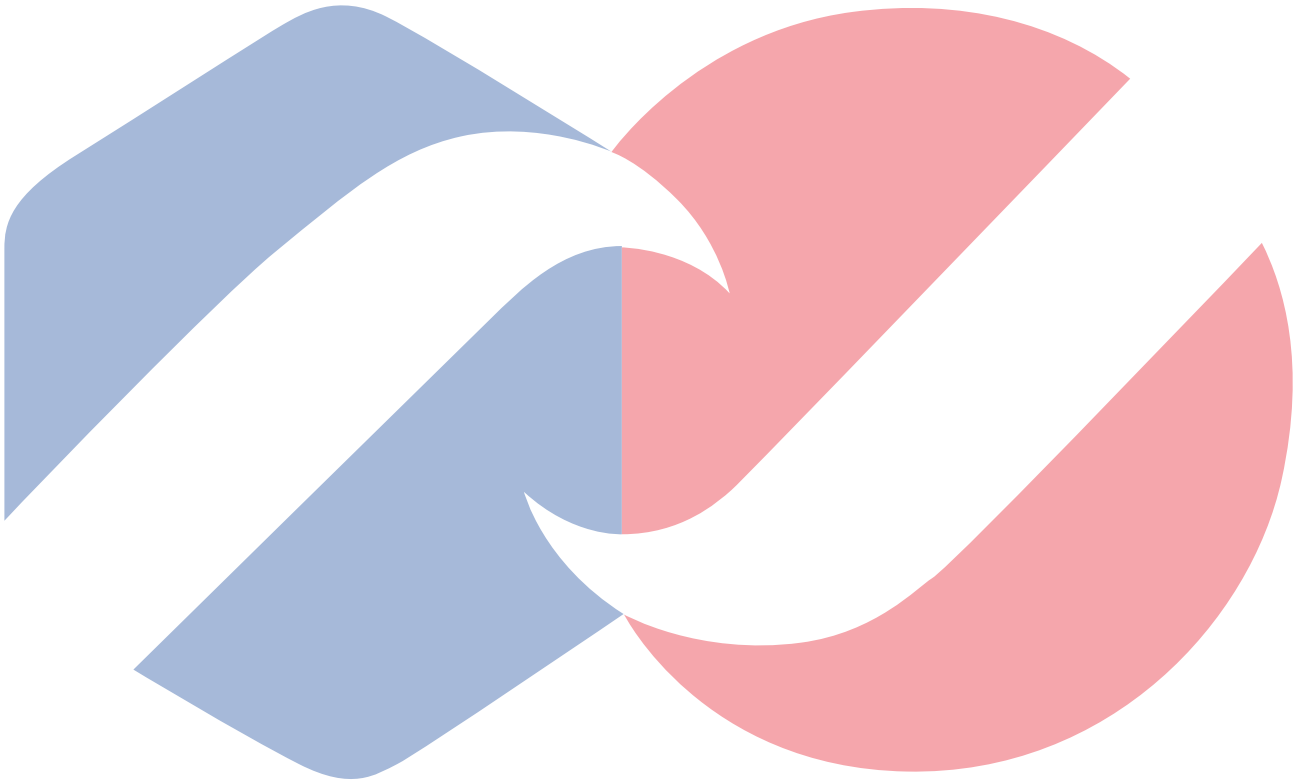
$$\sqrt{\frac{k_{n4}}{k_{n3}}}(V_{GS4} - V_{TN4}) = V_{GS3} - V_{TN3} \text{ --- (3)}$$

由 LoopA 可得:  $0 - V_{GS4} - V_{GS3} = V^-$

$$V_{GS4} + V_{GS3} = -V^- \text{ --- (4)}$$

由 (4) 代入 (3)

$$\sqrt{\frac{k_{n4}}{k_{n3}}}(-V^- - V_{GS3} - V_{TN4}) = V_{GS3} - V_{TN3}, \text{ 可得: } V_{GS3} = \frac{\sqrt{\frac{k_{n4}}{k_{n3}}}(-V^- - V_{TN4})}{\sqrt{\frac{k_{n4}}{k_{n3}} + 1}}$$



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