

Physics of Electronics:

8. Field Effect Devices

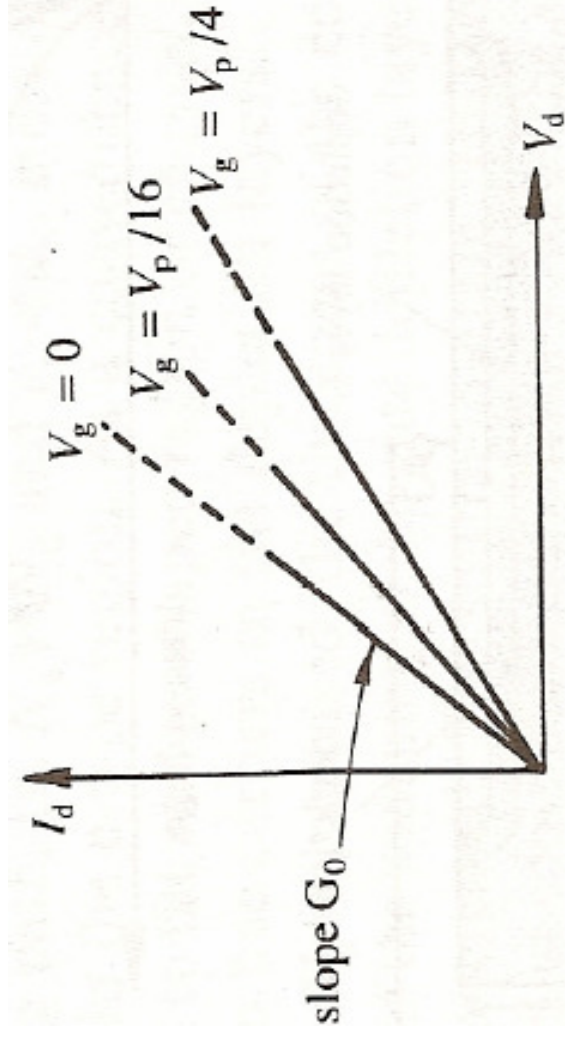
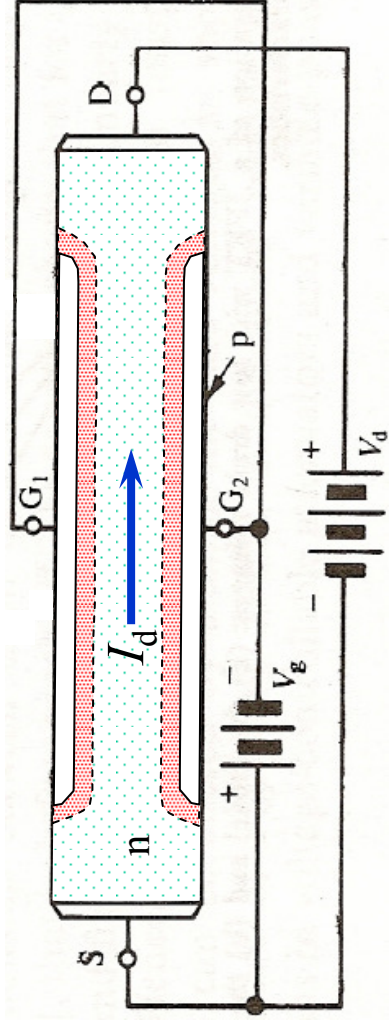
July – December 2008

Contents overview

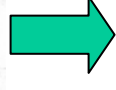
- General properties and types of FETs.
- The JFET - phenomenology.
- Drain and transfer characteristics of JFETs.
- The MOSFETs

Drain and transfer in JFET

- Linear Operation
 - When V_d small ($\sim$ conduction channel uniform)



$$d_n = \left(\frac{2\epsilon V_0 N_a}{e N_d (N_a + N_d)} \right)^{1/2} \quad [\text{chap. 7}]$$



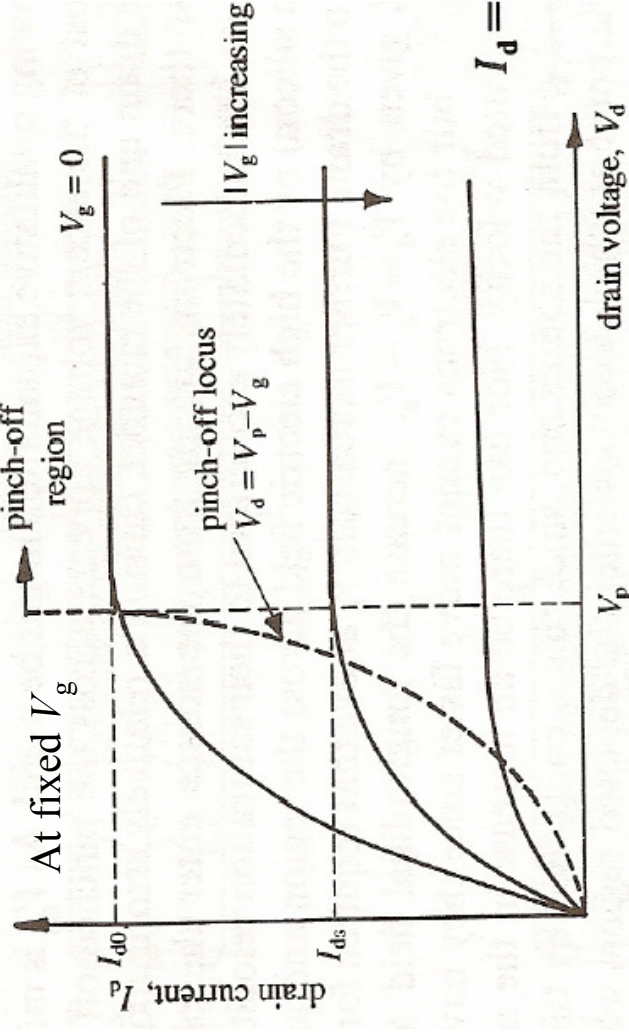
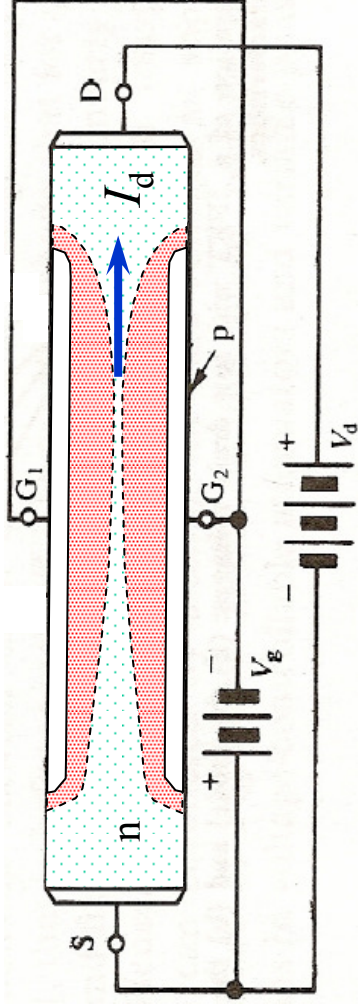
$$I_d \simeq G_0 [1 - (V_g/V_p)^{1/2}] V_d$$

Voltage-controlled resistor!!!!

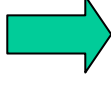
Drain and transfer in JFET

- Operation as far as pinch-off

– Large V_d & $V_d + V_g \leq V_p$:



$$I_d = G_0 \left[1 - \left(\frac{V_0 + V_g}{V_0 + V_p} \right)^{1/2} \right] V_d$$

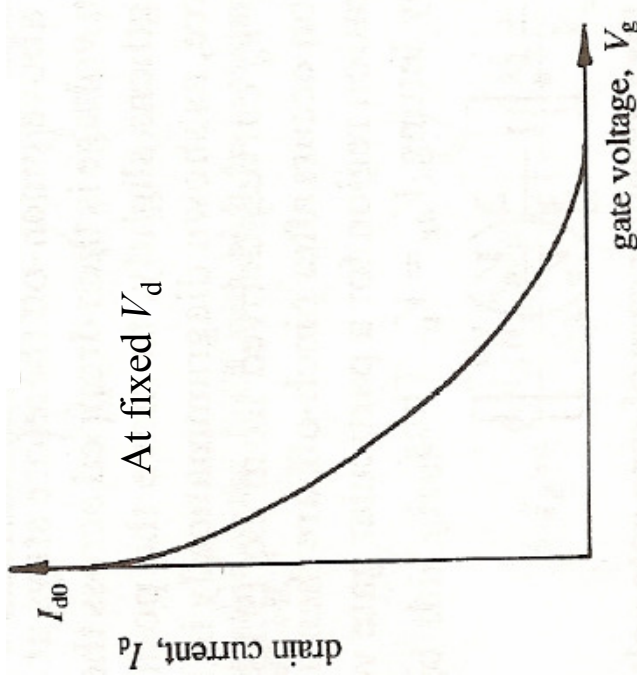
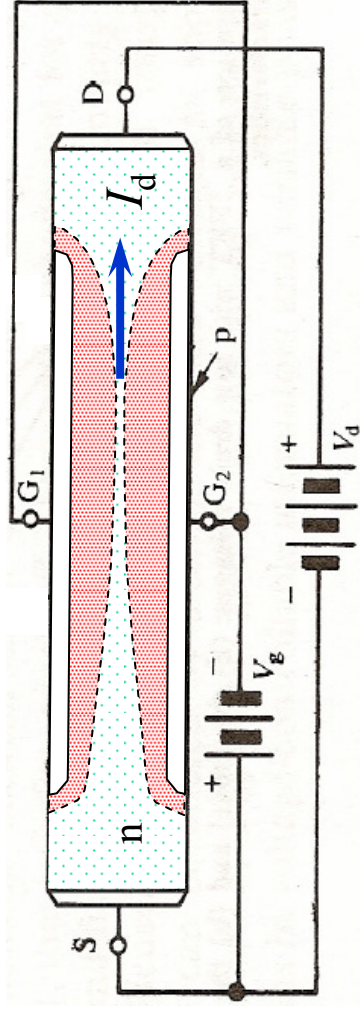


$$I_d = G_0 \left\{ V_{dg} \left[1 - \frac{2}{3} \left(\frac{V_{dg}}{V_p} \right)^{1/2} \right] - V_g \left[1 - \frac{2}{3} \left(\frac{V_g}{V_p} \right)^{1/2} \right] \right\}$$

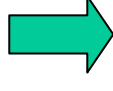
Drain and transfer in JFET

- Operation as far as pinch-off

– Large V_d & $V_d + V_g \leq V_p$:



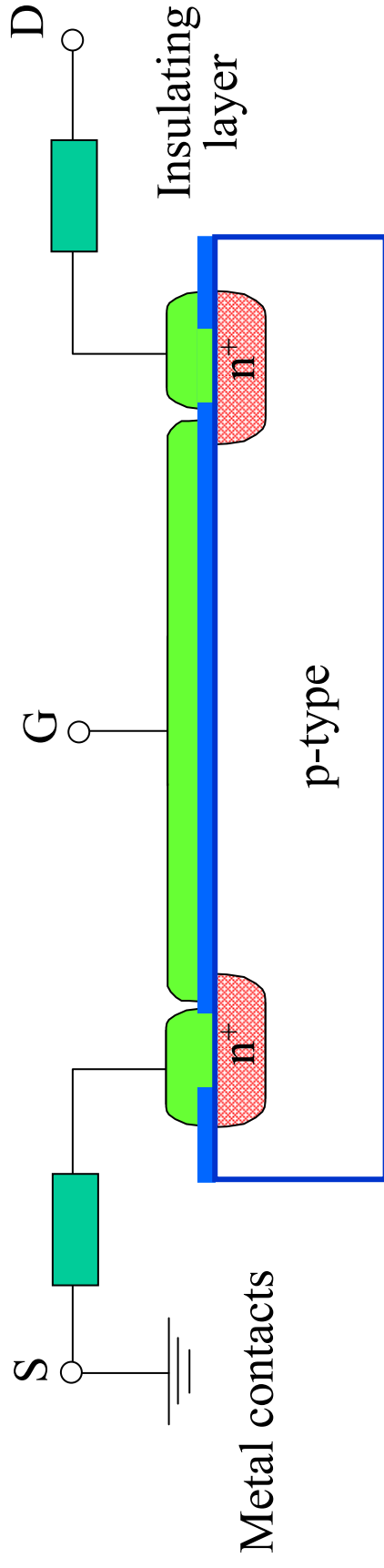
$$I_d = G_0 \left[1 - \left(\frac{V_0 + V_g}{V_0 + V_p} \right)^{1/2} \right] V_d$$



$$I_d = G_0 \left\{ V_{dg} \left[1 - \frac{2}{3} \left(\frac{V_{dg}}{V_p} \right)^{1/2} \right] - V_g \left[1 - \frac{2}{3} \left(\frac{V_g}{V_p} \right)^{1/2} \right] \right\}$$

MOSFET

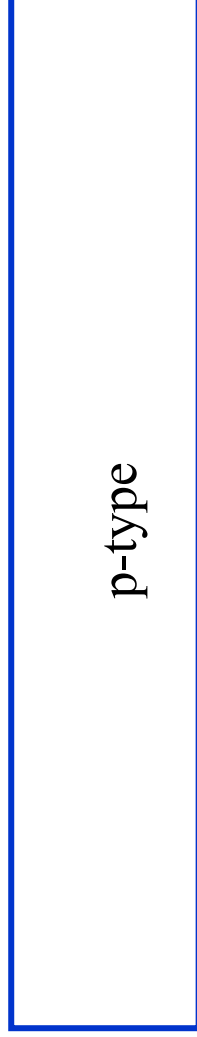
- Induced channel MOSFET
 - Structure & fabrication:



MOSFET

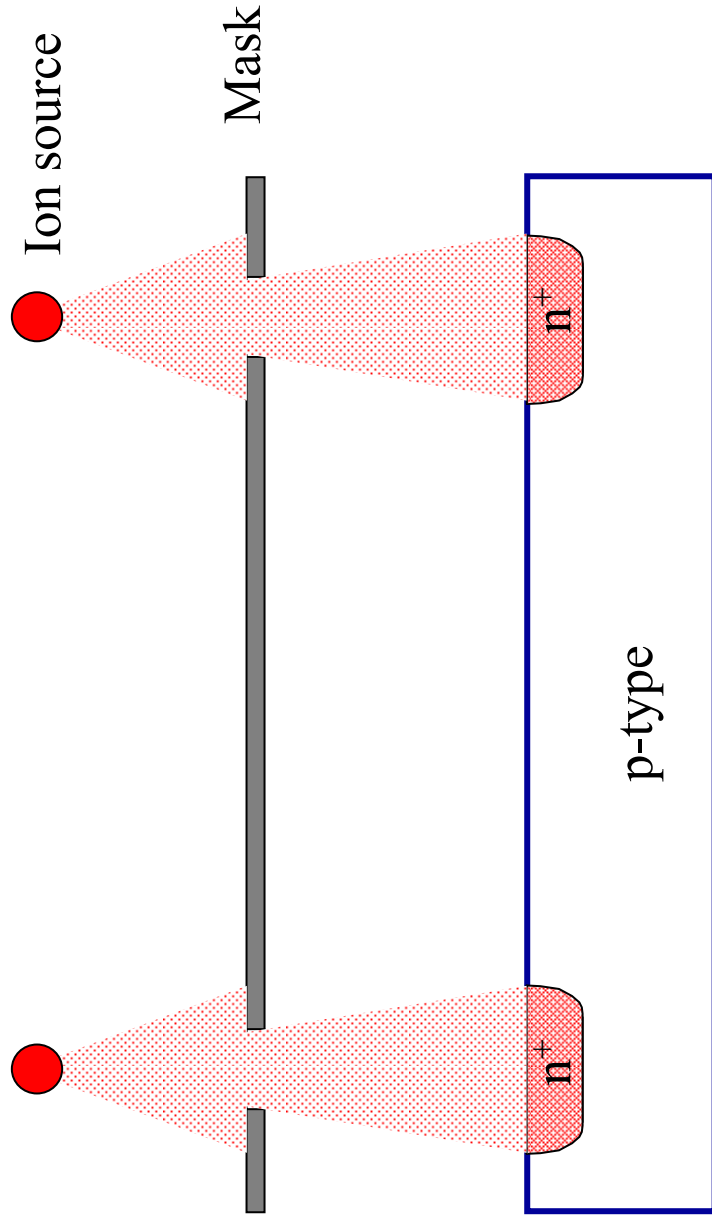
- Induced channel MOSFET
 - Structure & fabrication:

Mask



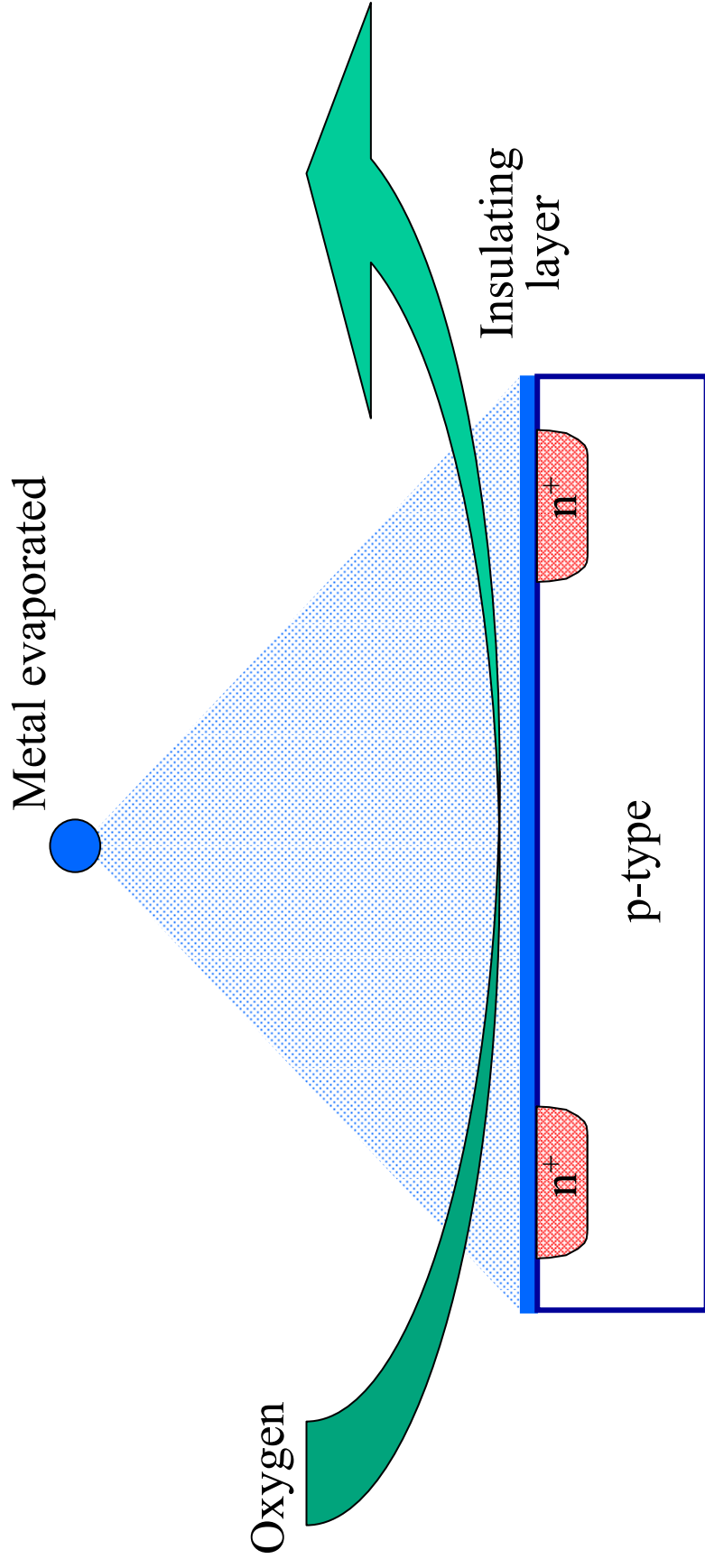
MOSFET

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 - Structure & fabrication:



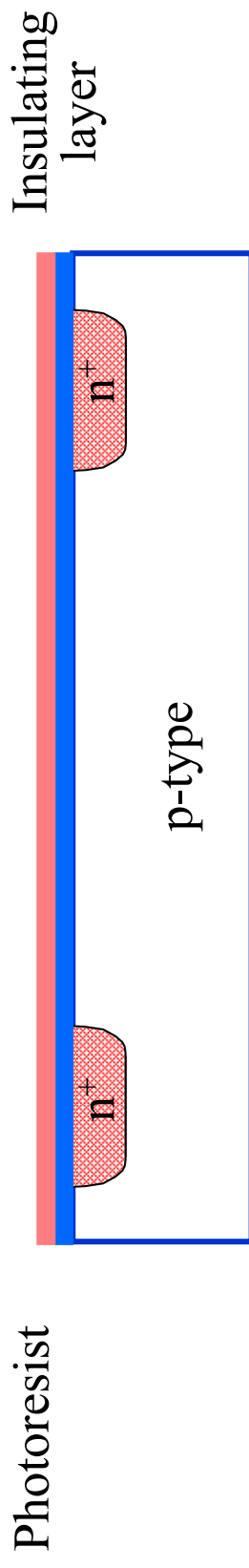
MOSFET

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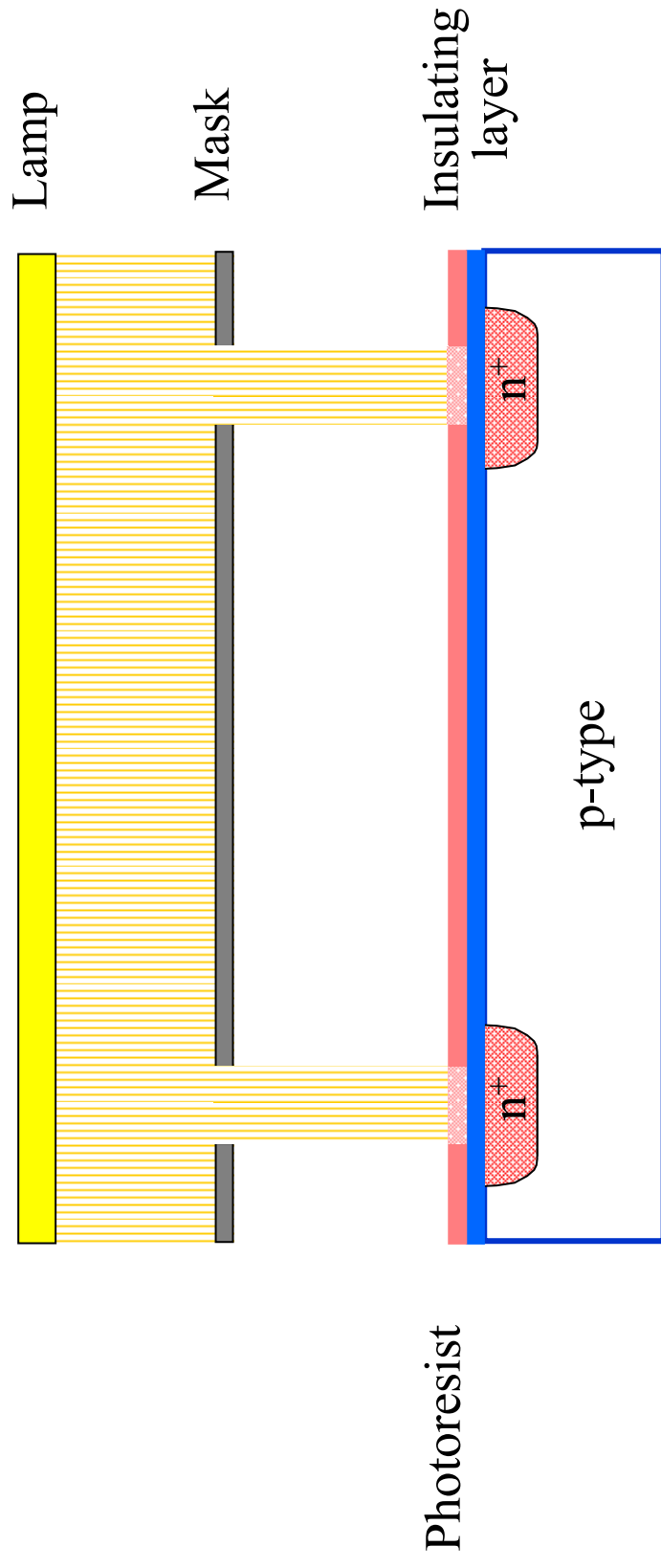
MOSFET

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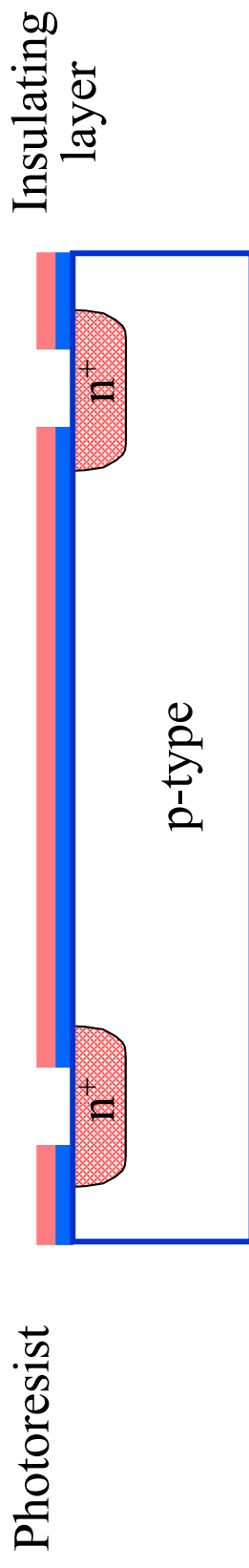
MOSFET

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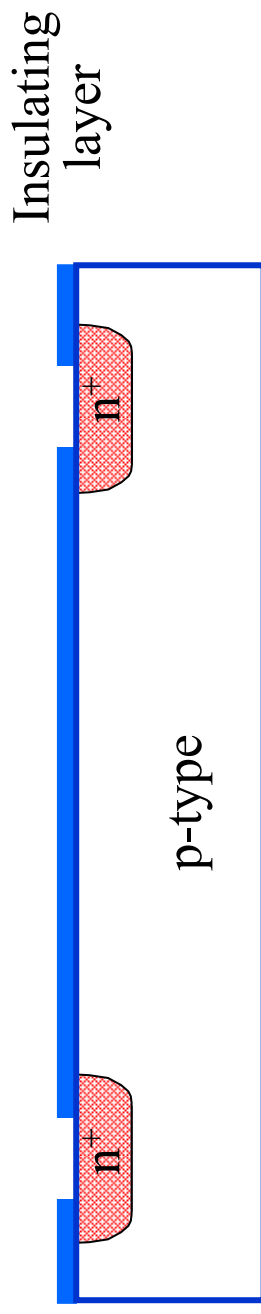
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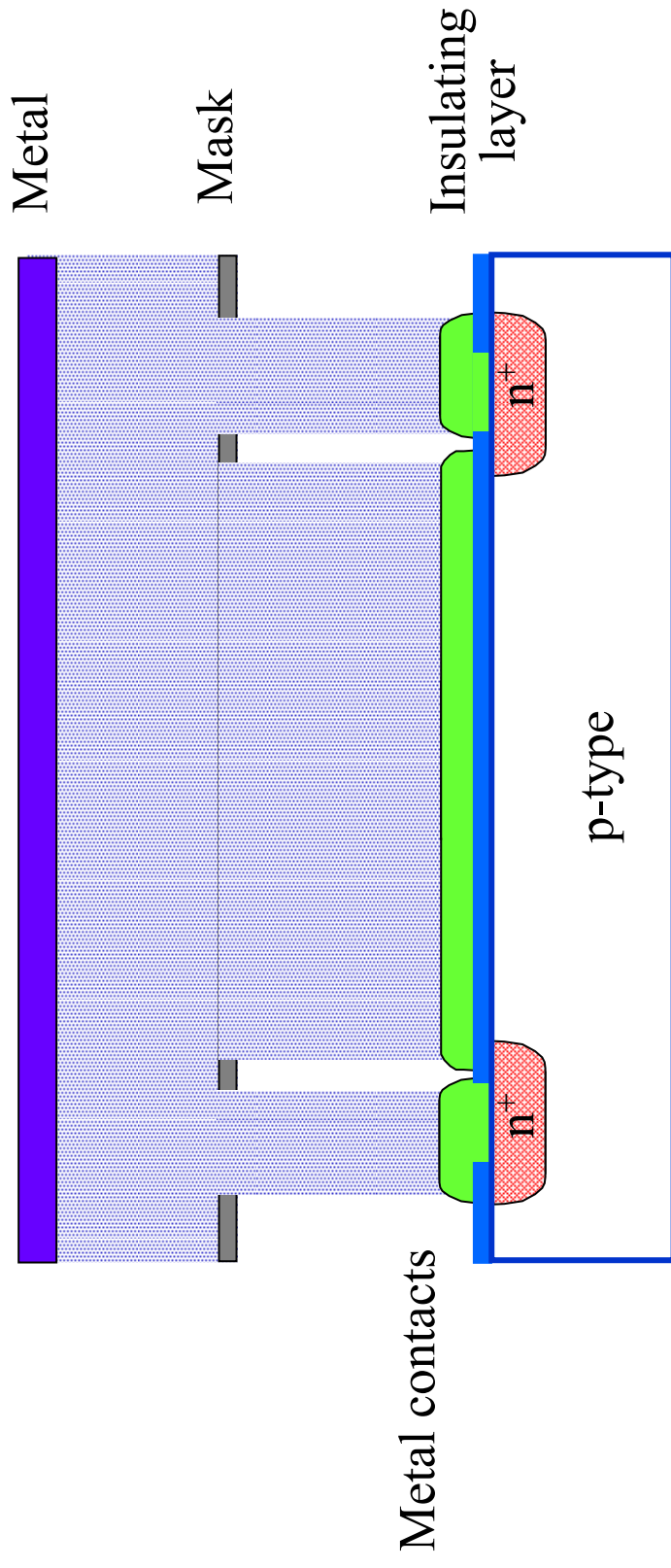
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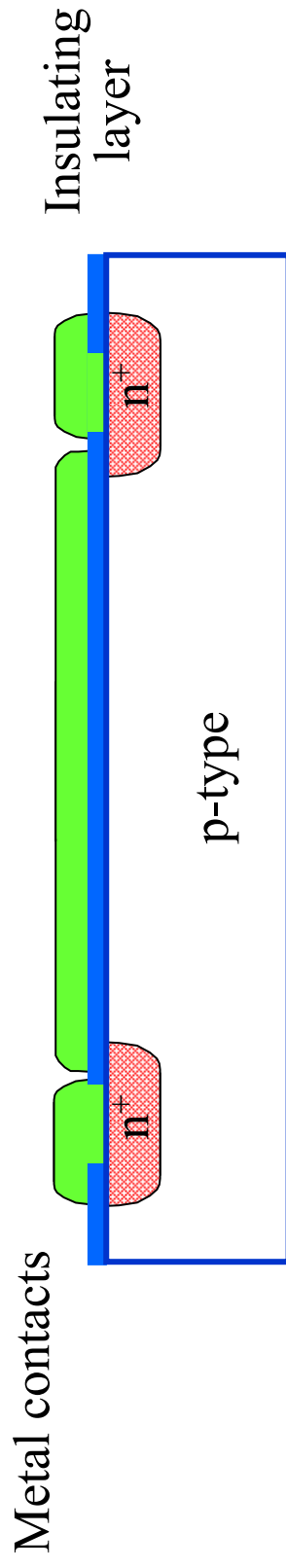
MOSFET

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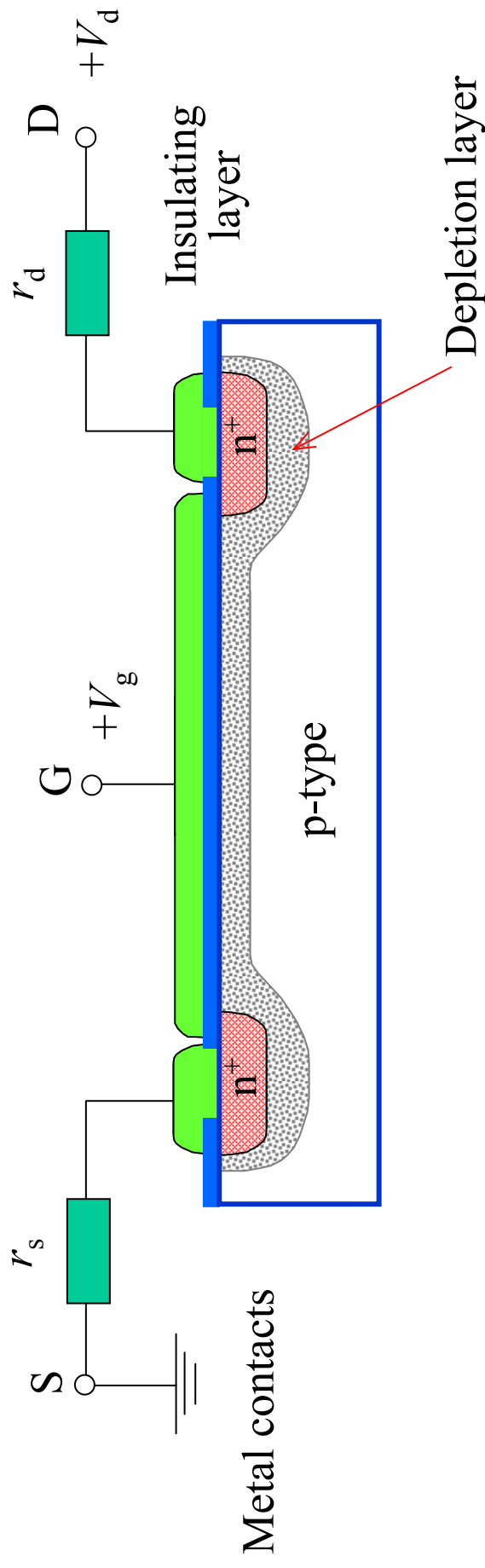
MOSFET

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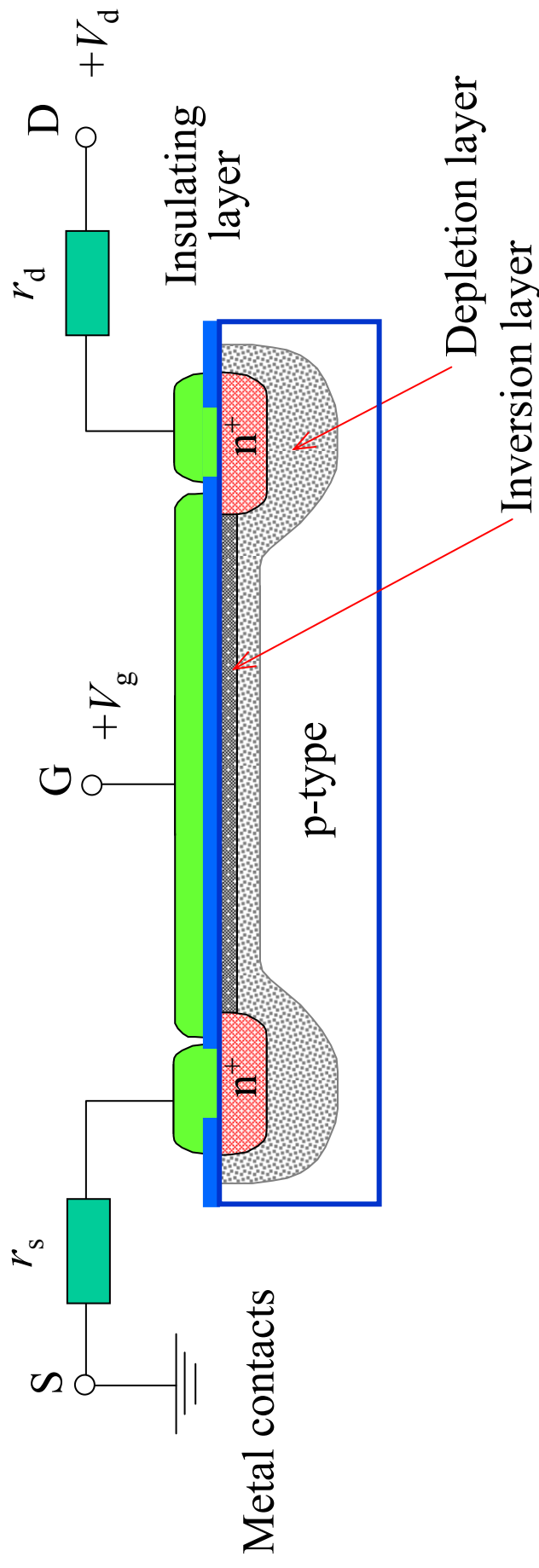
MOSFET

- Induced channel MOSFET
 - Working principle:



MOSFET

- Induced channel MOSFET
 - Working principle:



MOSFET

- Induced channel MOSFET
 - Structure:

