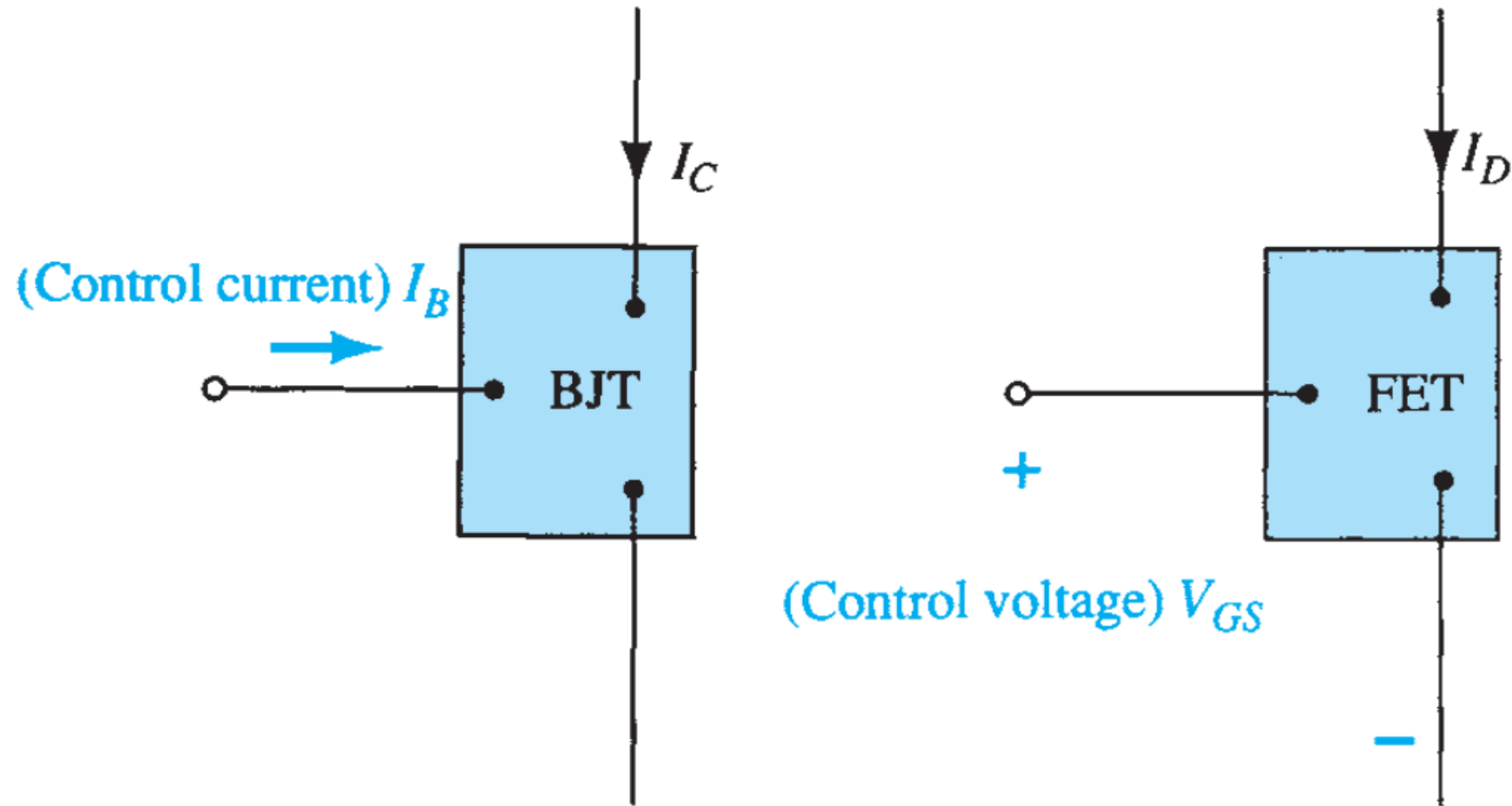


Field-effect transistor (FET)

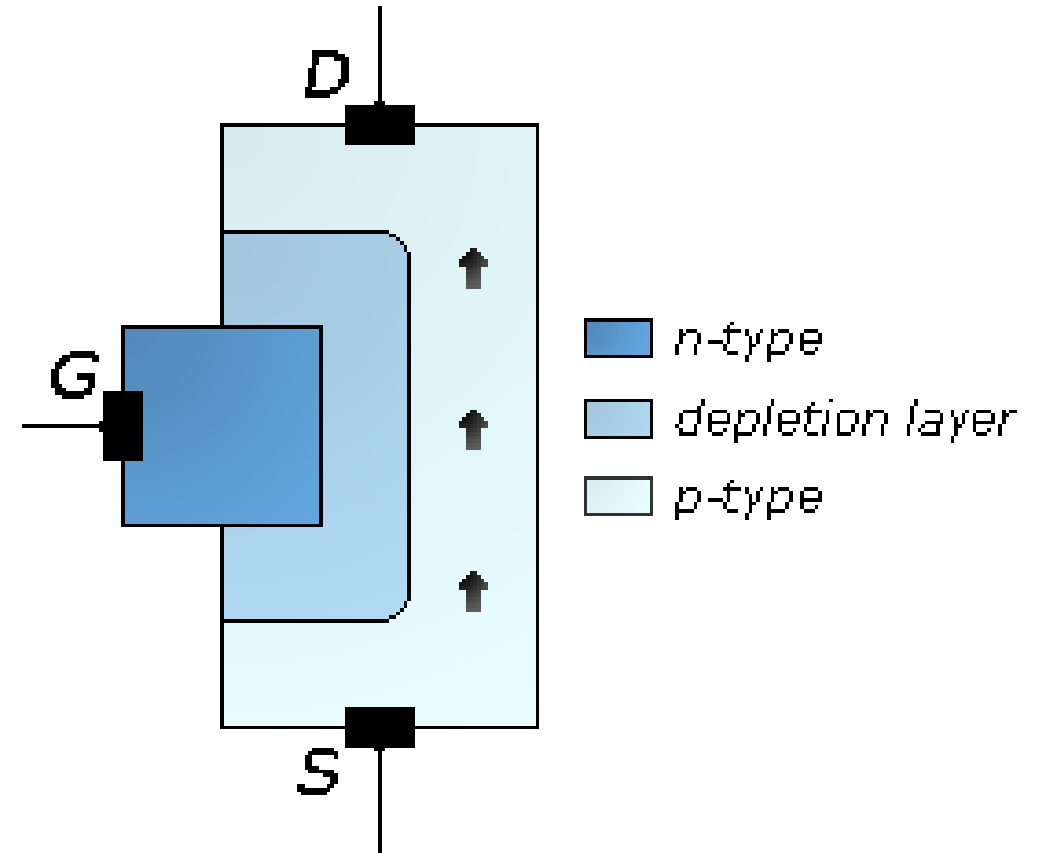
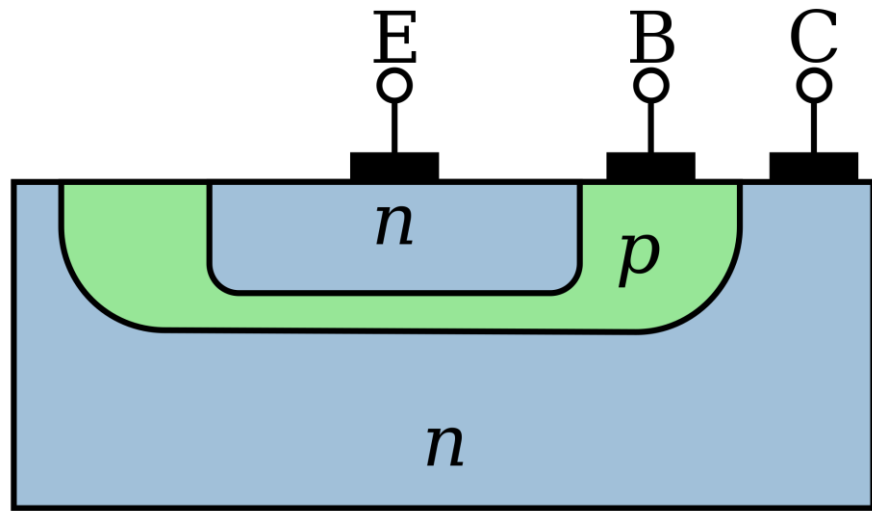
Dr Mohammad Abdur Rashid



BJT and FET



BJT and FET

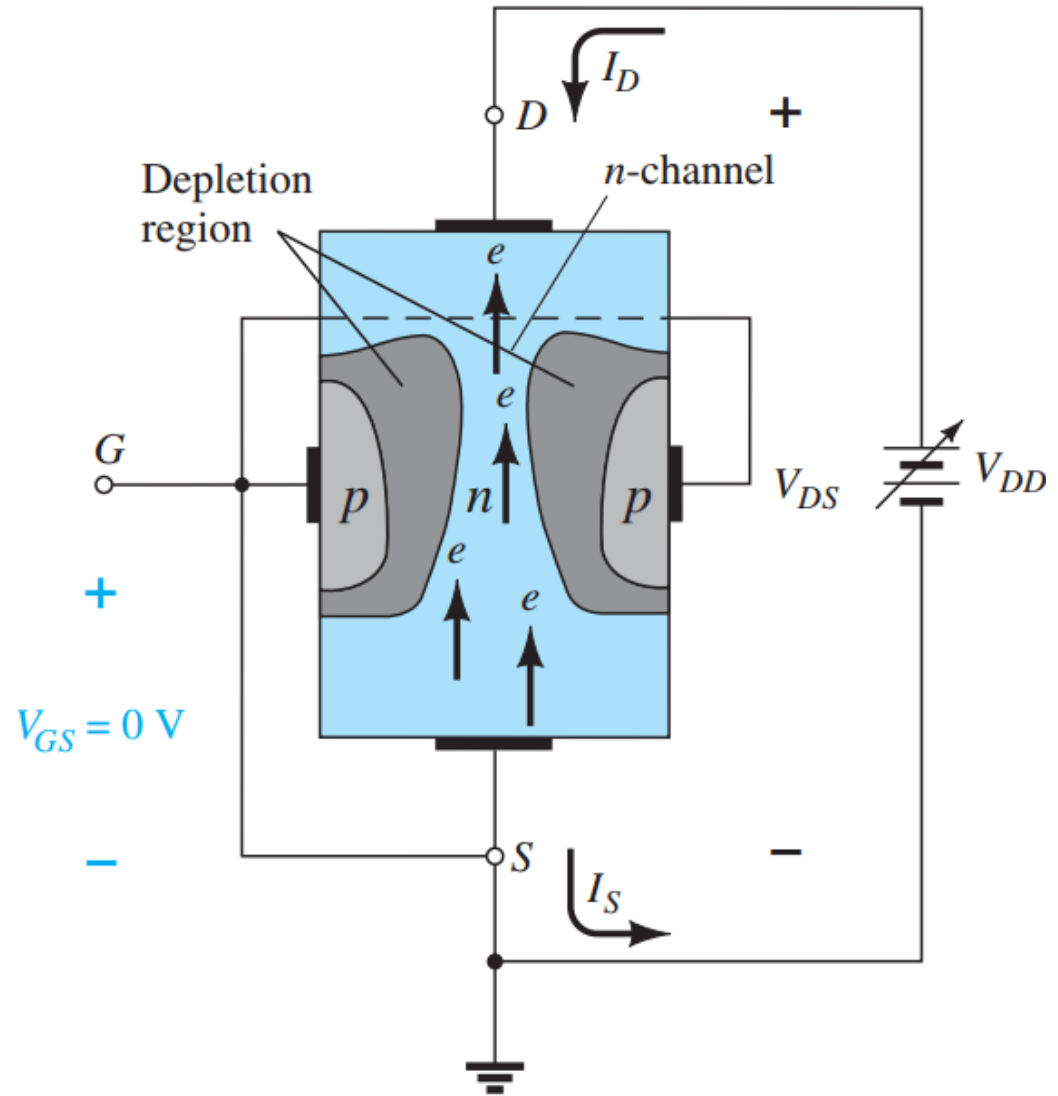


Flow of charge in JFET

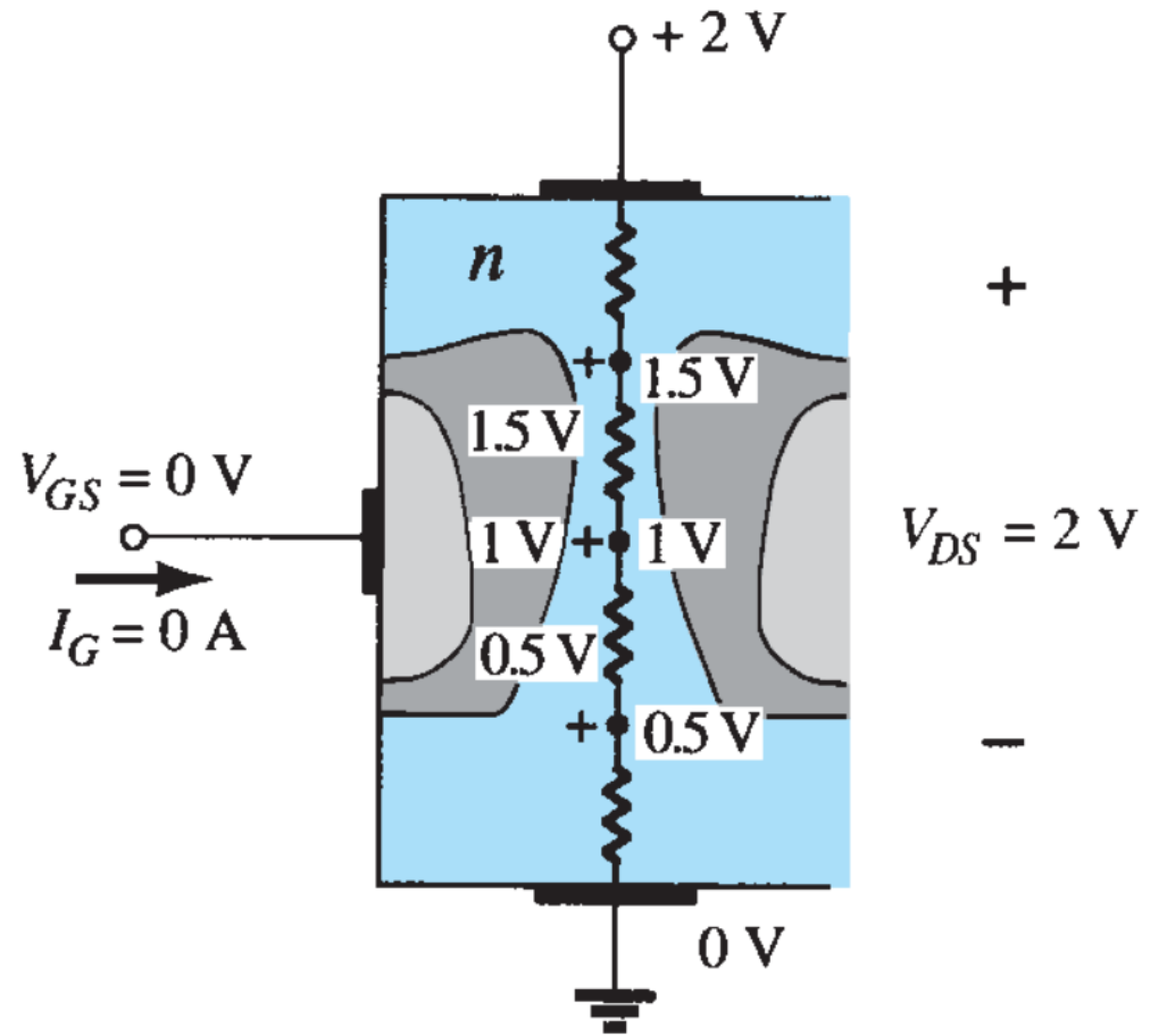
$$V_{GS} = 0 \text{ V}$$

&

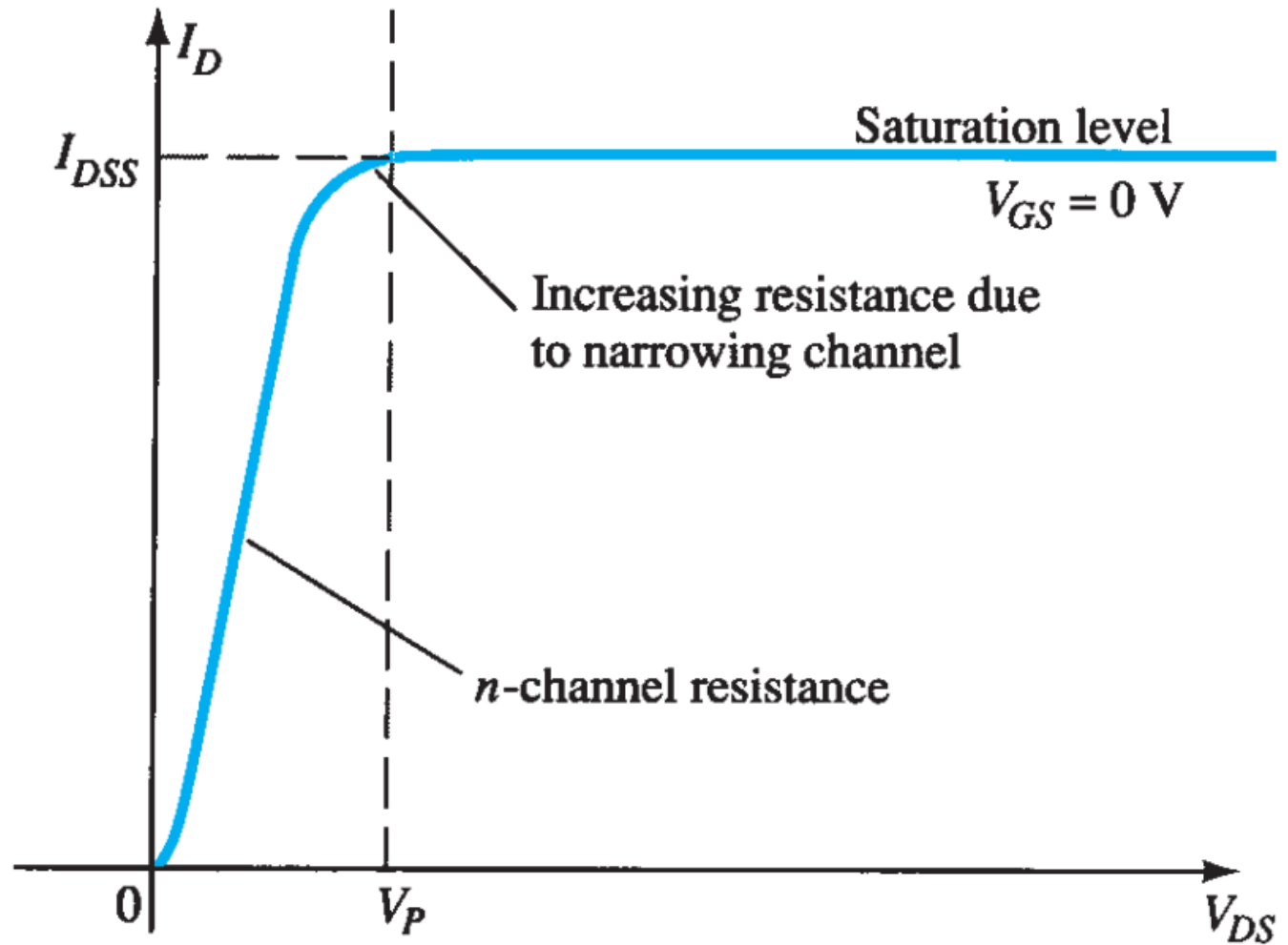
$$V_{DS} > 0 \text{ V}$$



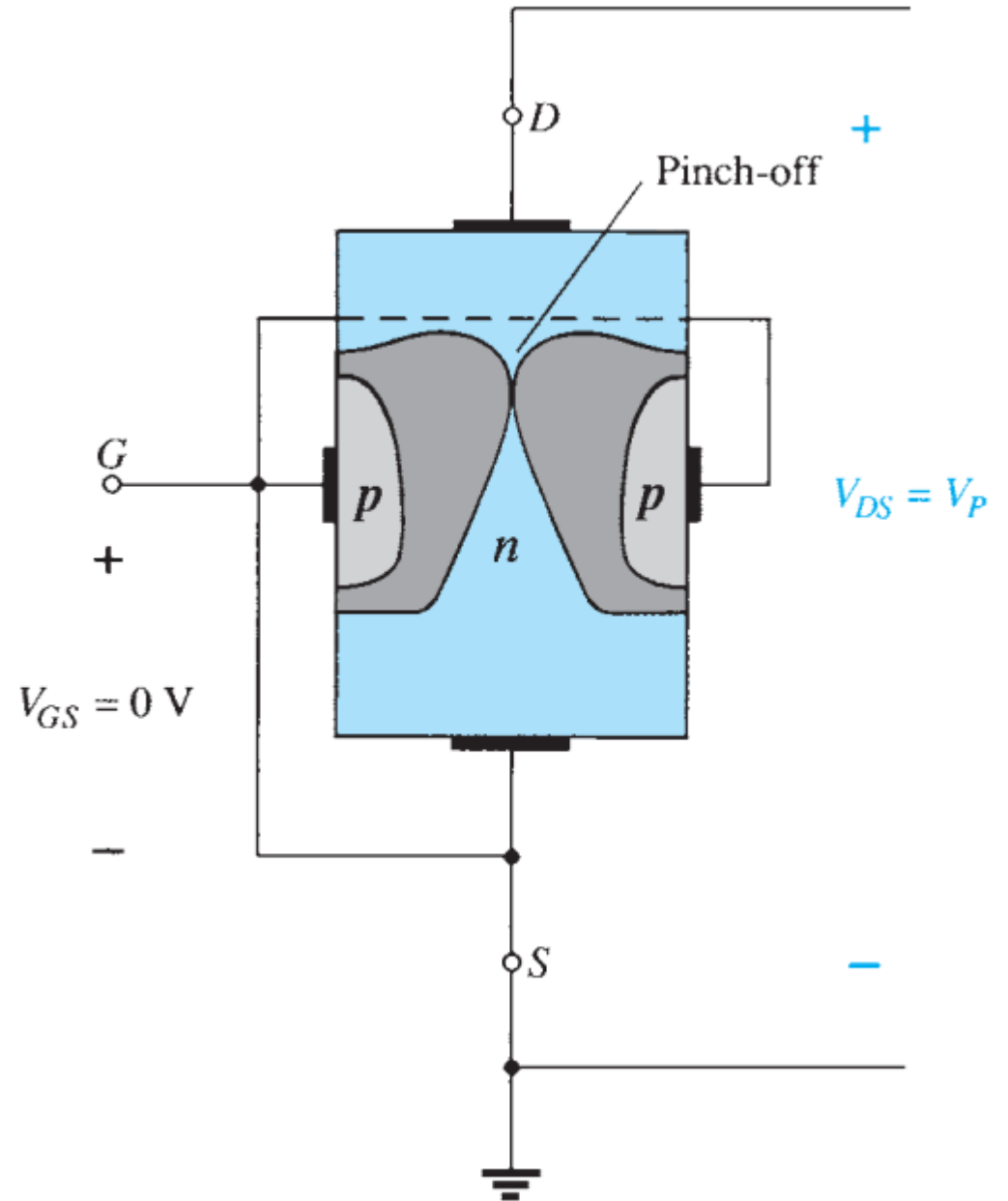
Varying reverse-bias potentials across the p–n junction of an n-channel JFET



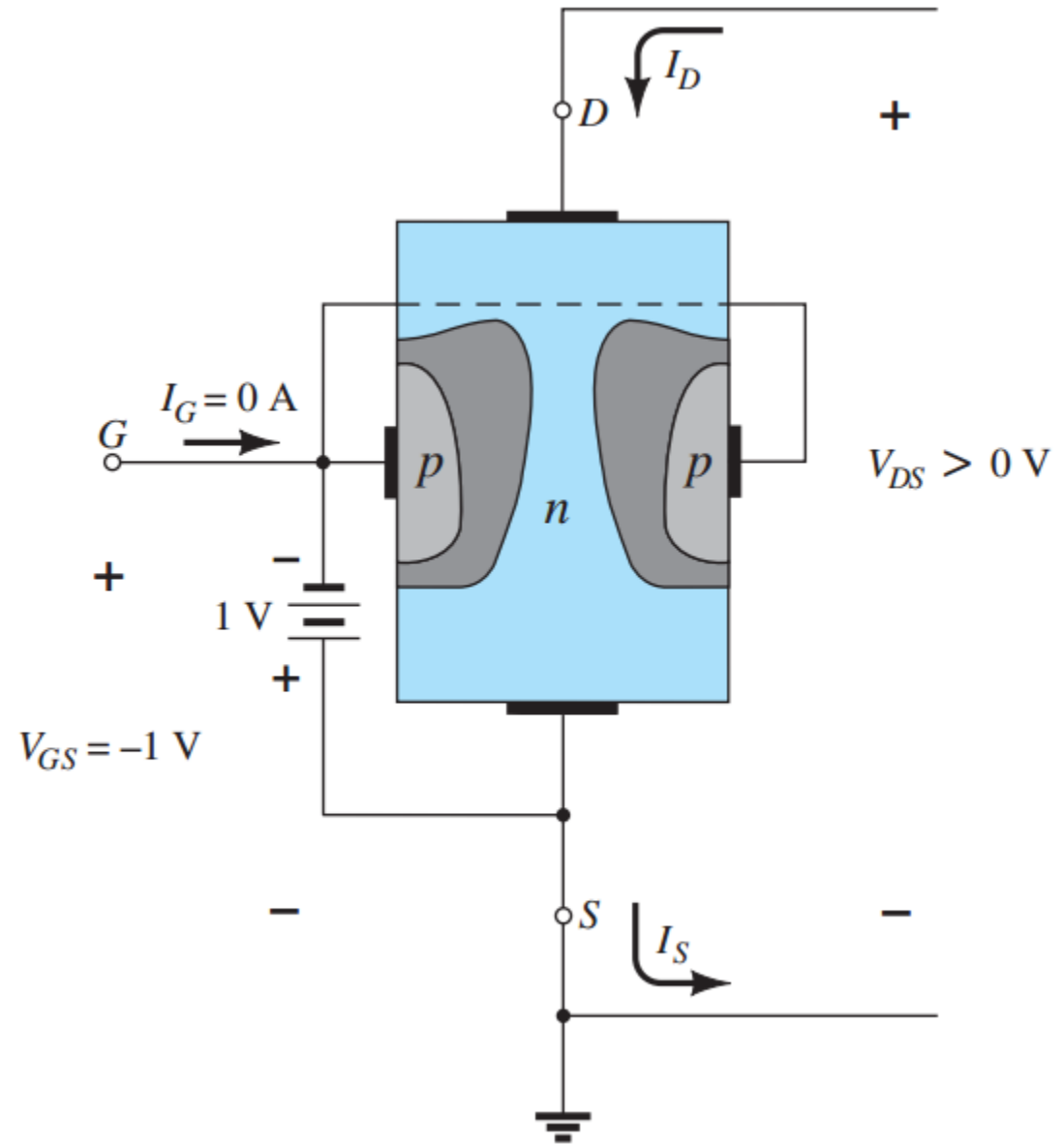
I_D versus V_{DS}
for
 $V_{GS} = 0\text{ V}$



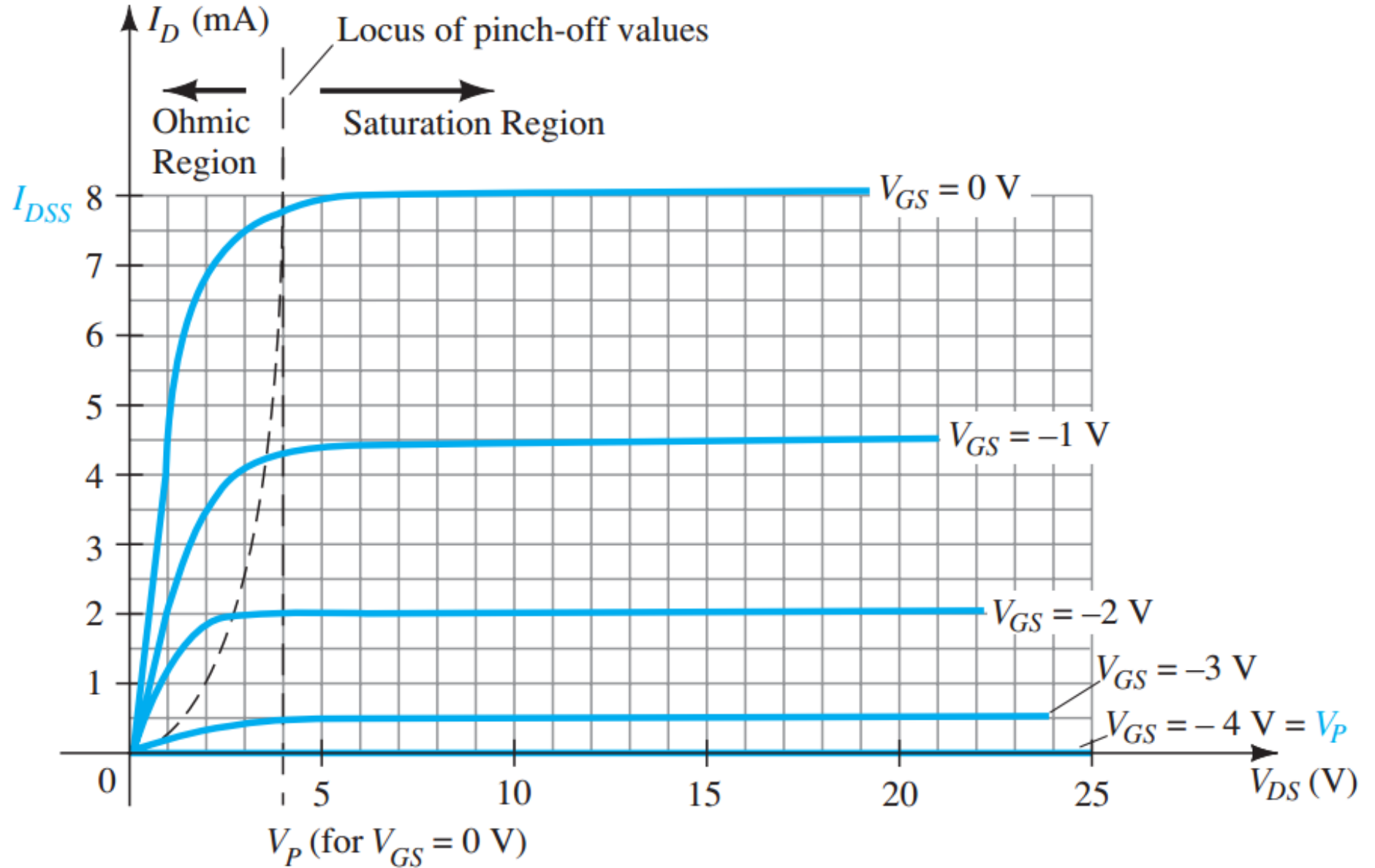
Pinch-off
($V_{GS} = 0 \text{ V}$, $V_{DS} = V_P$)



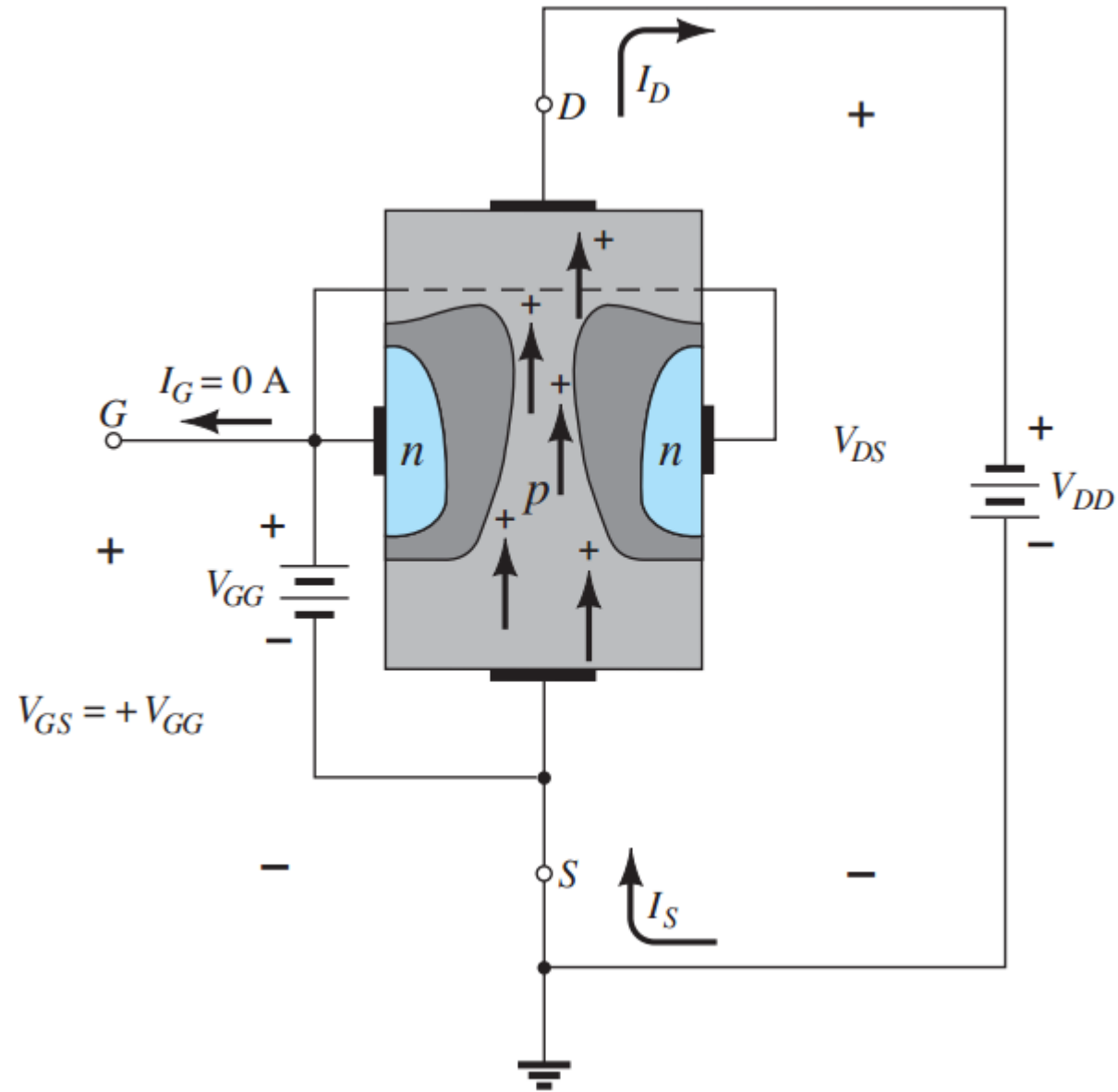
Application of a negative voltage to the gate of a JFET



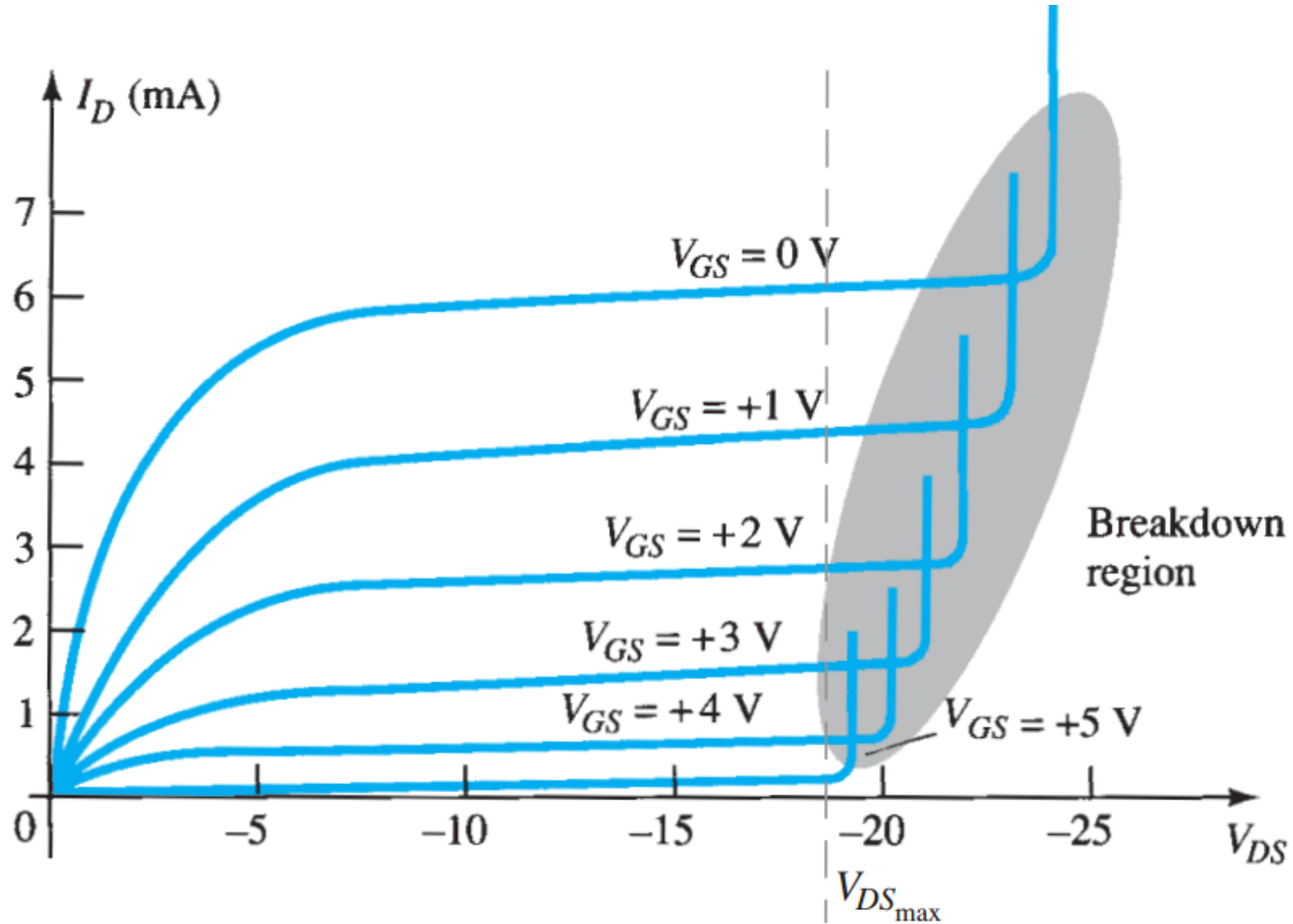
n -Channel JFET characteristics with $I_{DSS} = 8 \text{ mA}$ and $V_p = -4 \text{ V}$



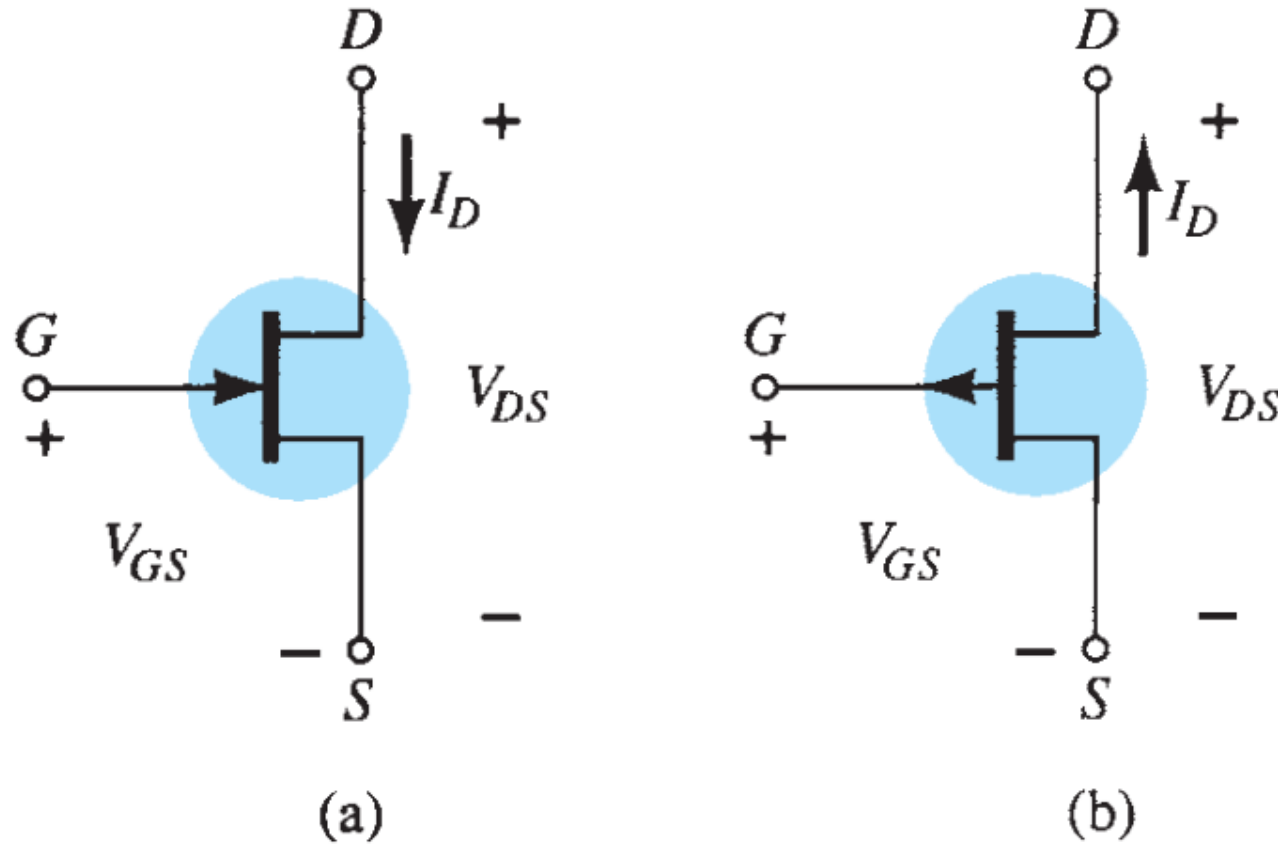
p -Channel JFET



p -Channel JFET characteristics with $I_{DSS} = 6 \text{ mA}$ and $V_p = +6 \text{ V}$



JFET symbols: (a) n -channel; (b) p -channel



Shockley's equation

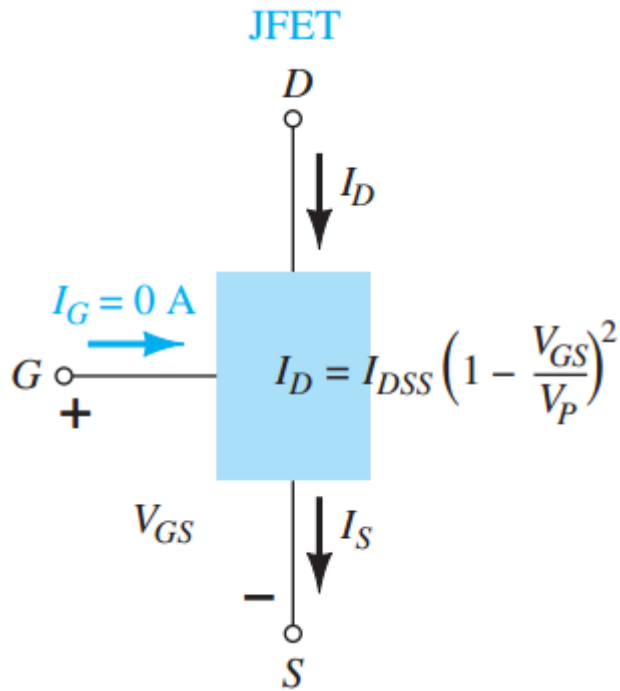
control variable

$$I_D = I_{DSS} \left(1 - \frac{V_{GS}}{V_P} \right)^2$$

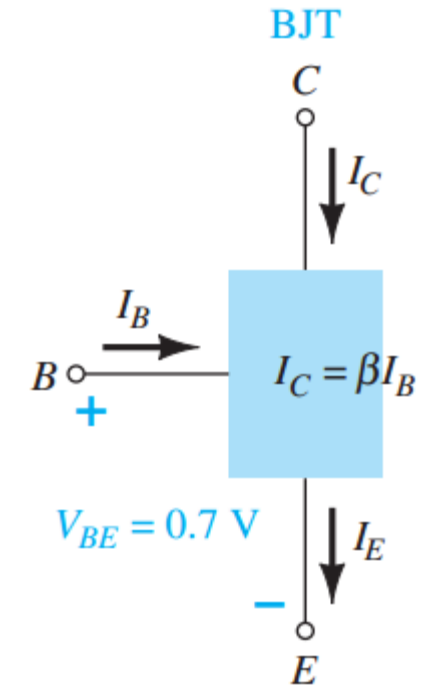
constants

$$r_d = \frac{r_o}{(1 - V_{GS}/V_P)^2}$$





<i>JFET</i>	\Leftrightarrow	<i>BJT</i>
$I_D = I_{DSS} \left(1 - \frac{V_{GS}}{V_P}\right)^2$		$I_C = \beta I_B$
$I_D = I_S$		$I_C \cong I_E$
$I_G \cong 0 \text{ A}$		$V_{BE} \cong 0.7 \text{ V}$

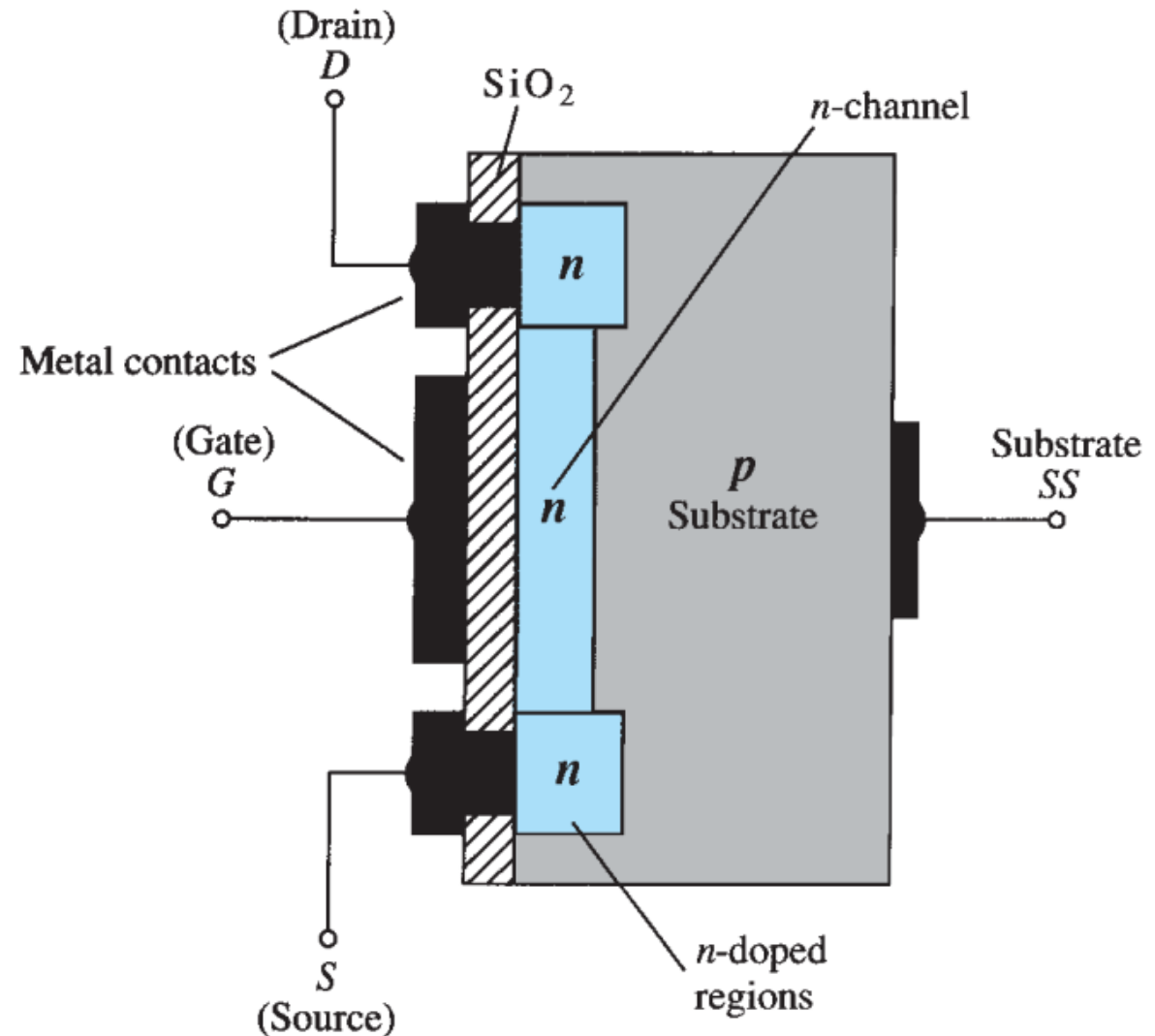


Metal-oxide-semiconductor field-effect transistor (MOSFET)

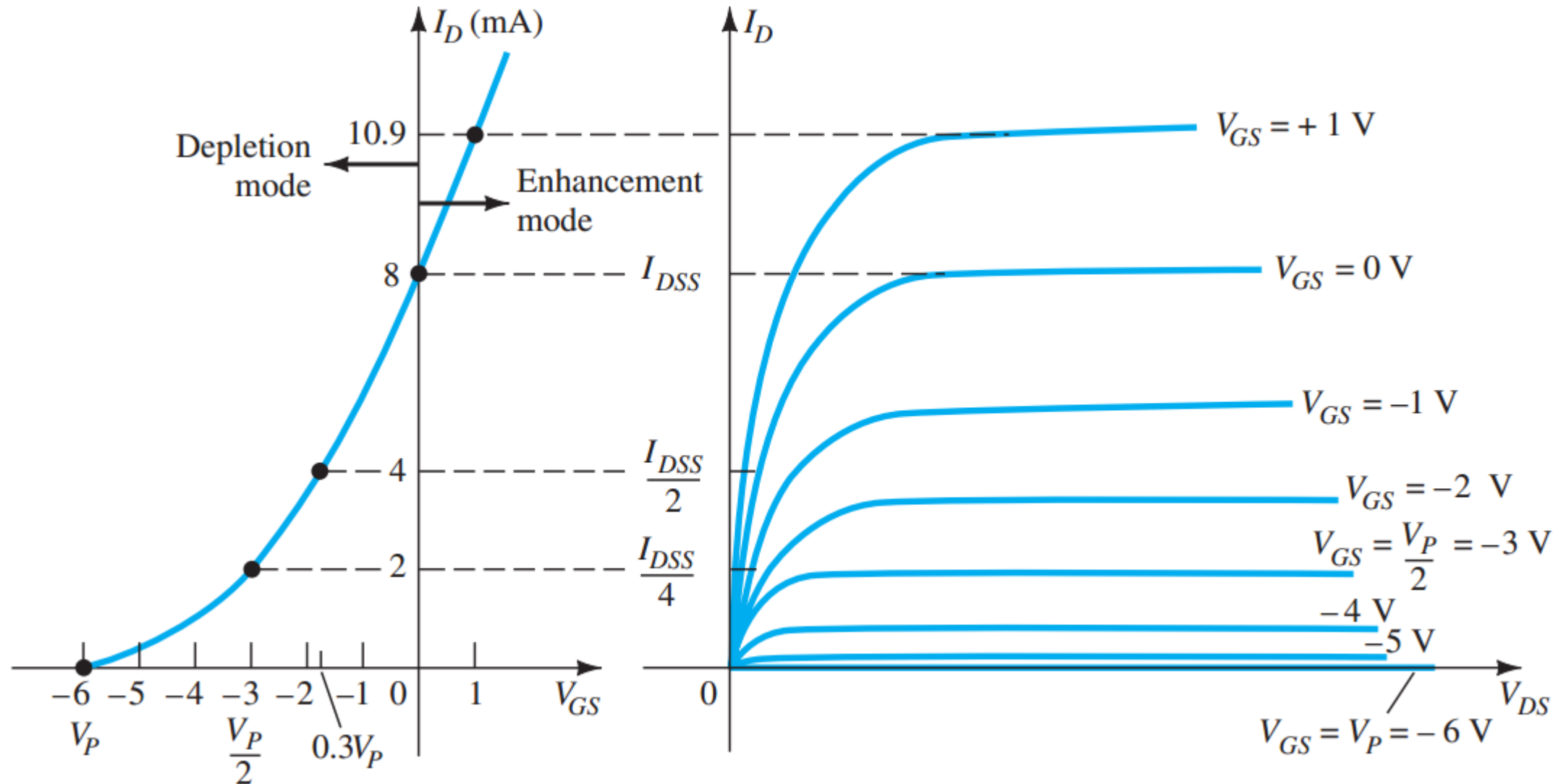
There is no direct electrical connection between the gate terminal and the channel of a MOSFET

depletion type MOSFET

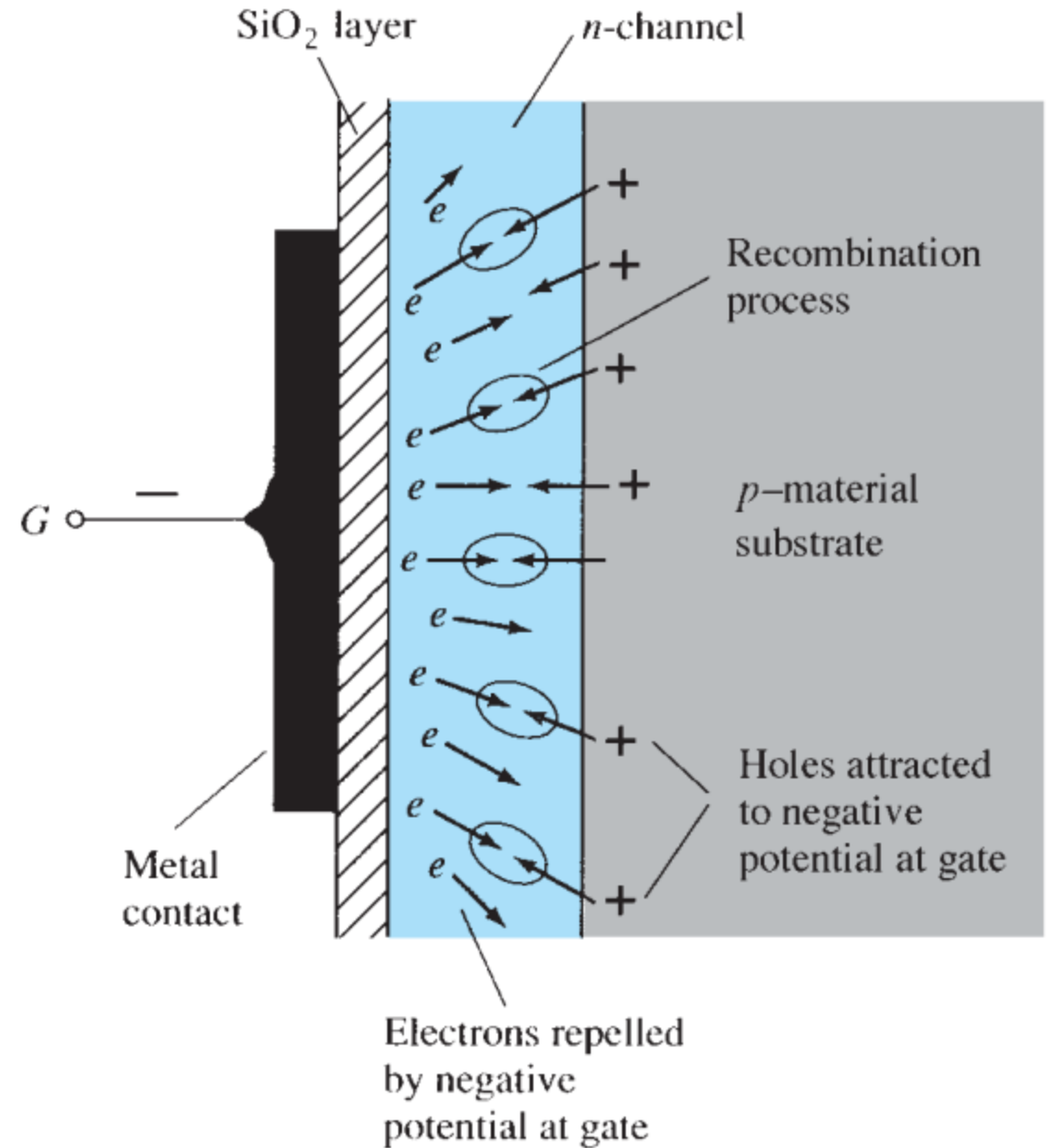
enhancement type MOSFET



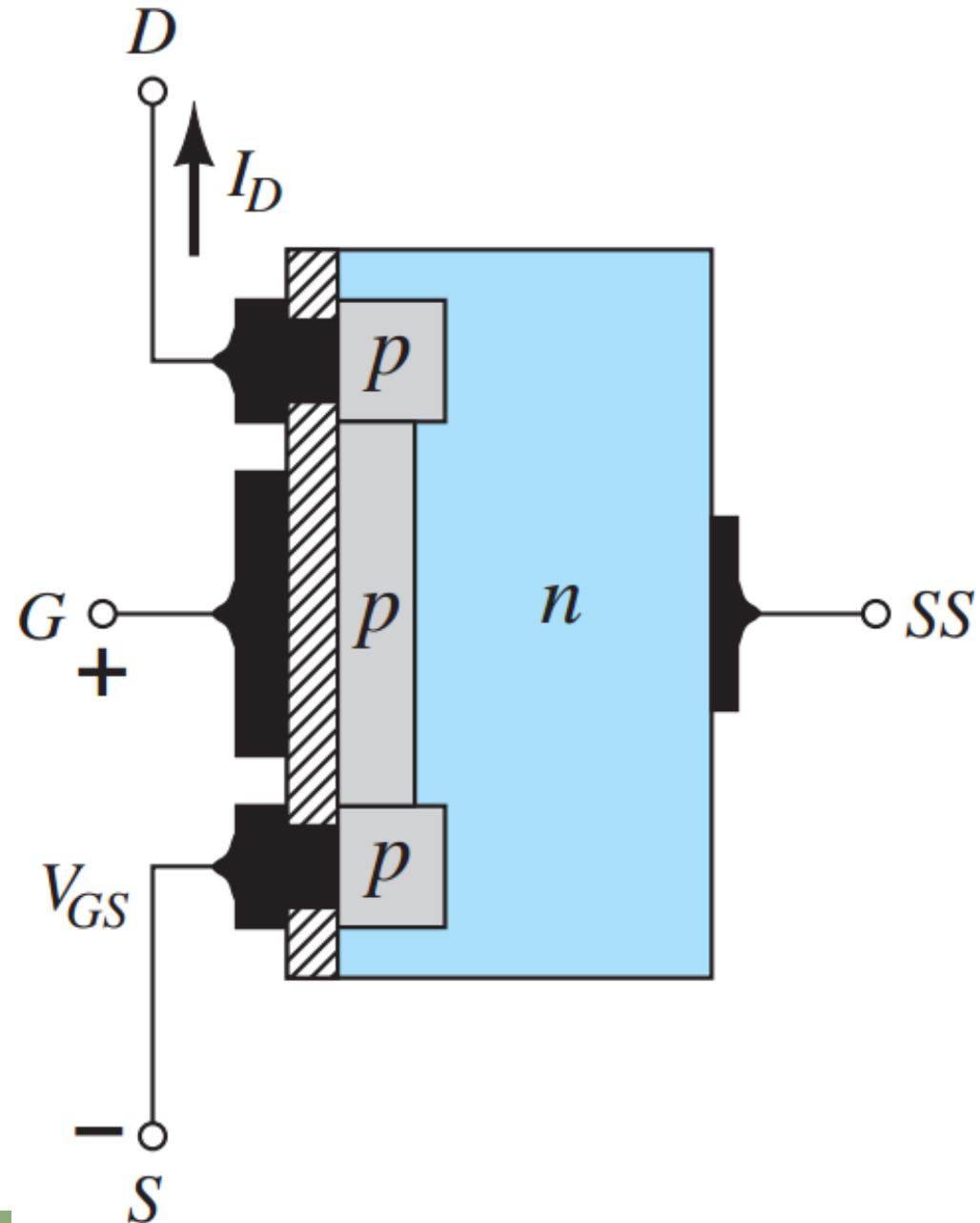
Drain and transfer characteristics for an n -channel depletion-type MOSFET



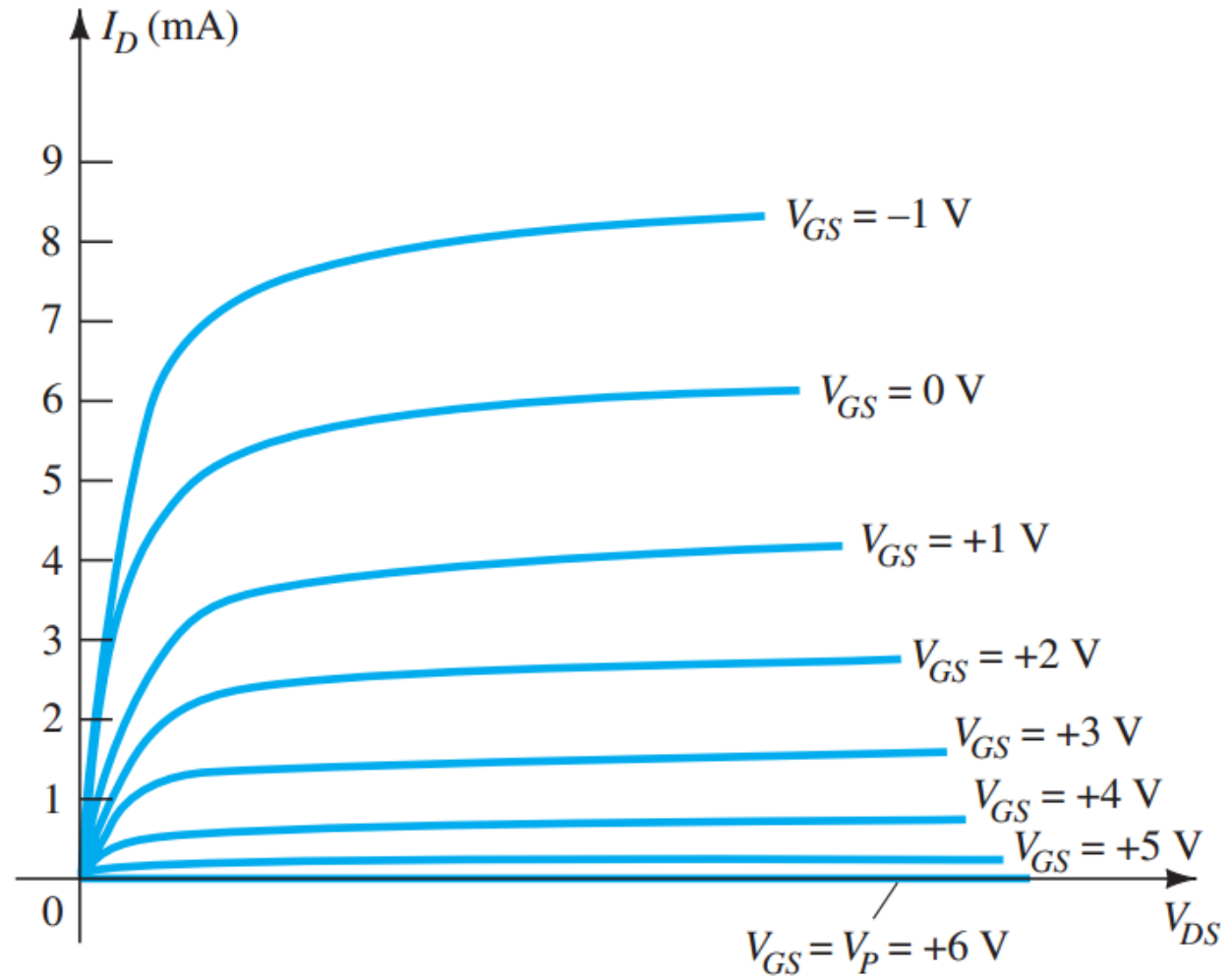
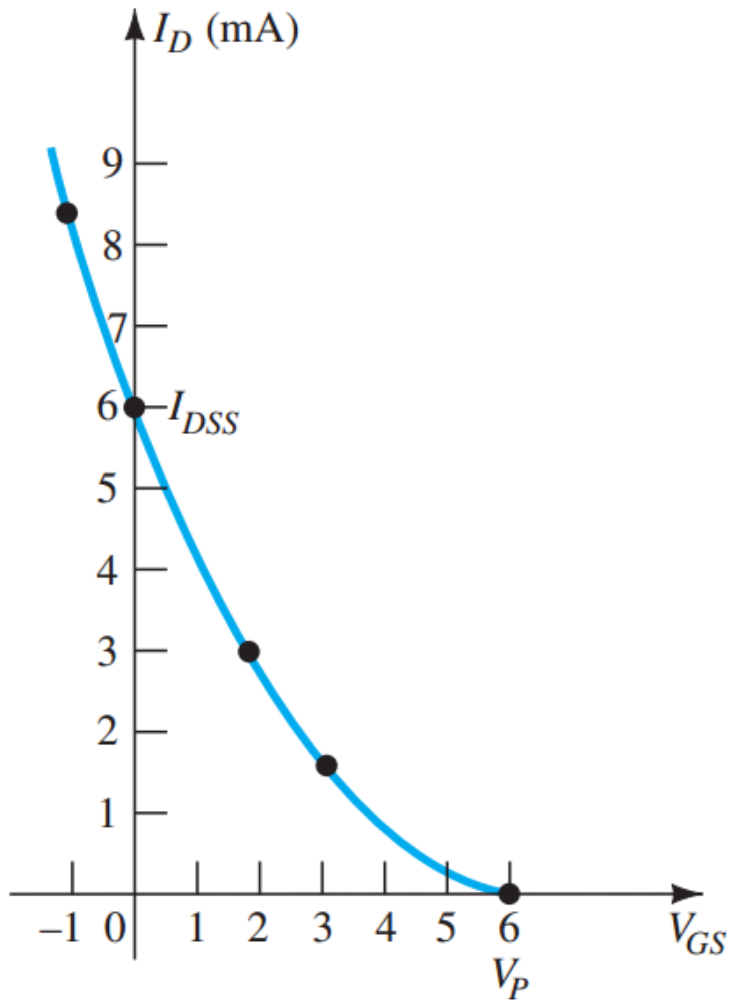
Reduction in free carriers
in a channel due to a
negative potential at the
gate terminal



p -channel
depletion-type
MOSFET

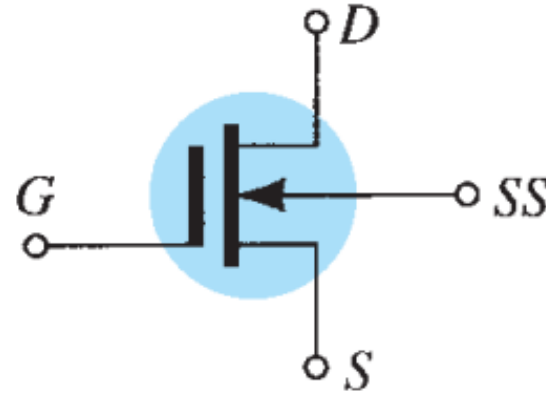


p -channel depletion-type MOSFET

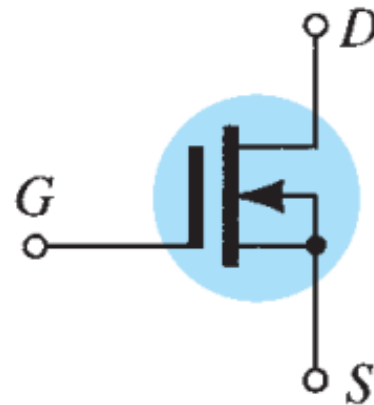
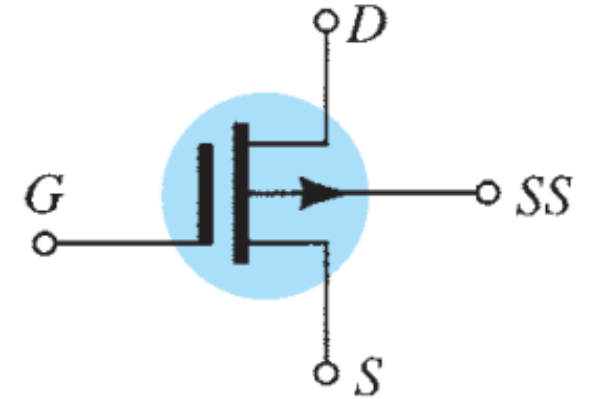


Graphic symbols for:
(a) n-channel depletion-type MOSFETs and
(b) p-channel depletion-type MOSFETs

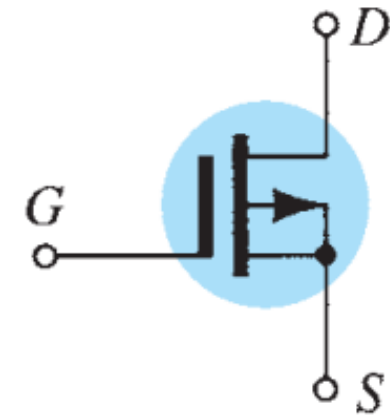
n-channel



p-channel



(a)

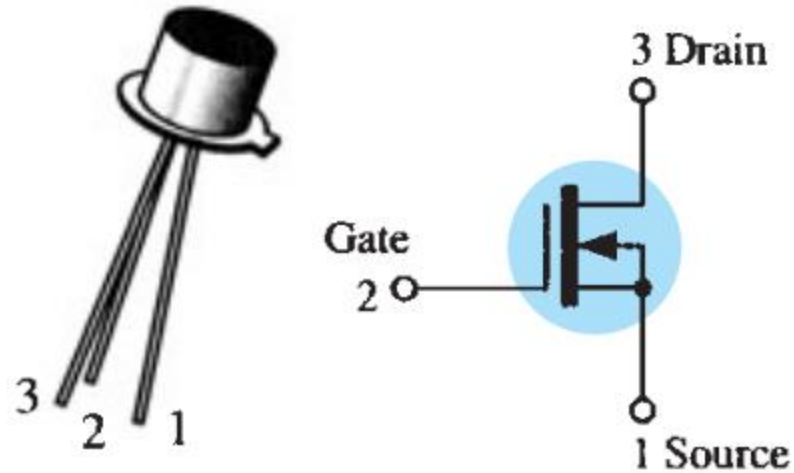


(b)



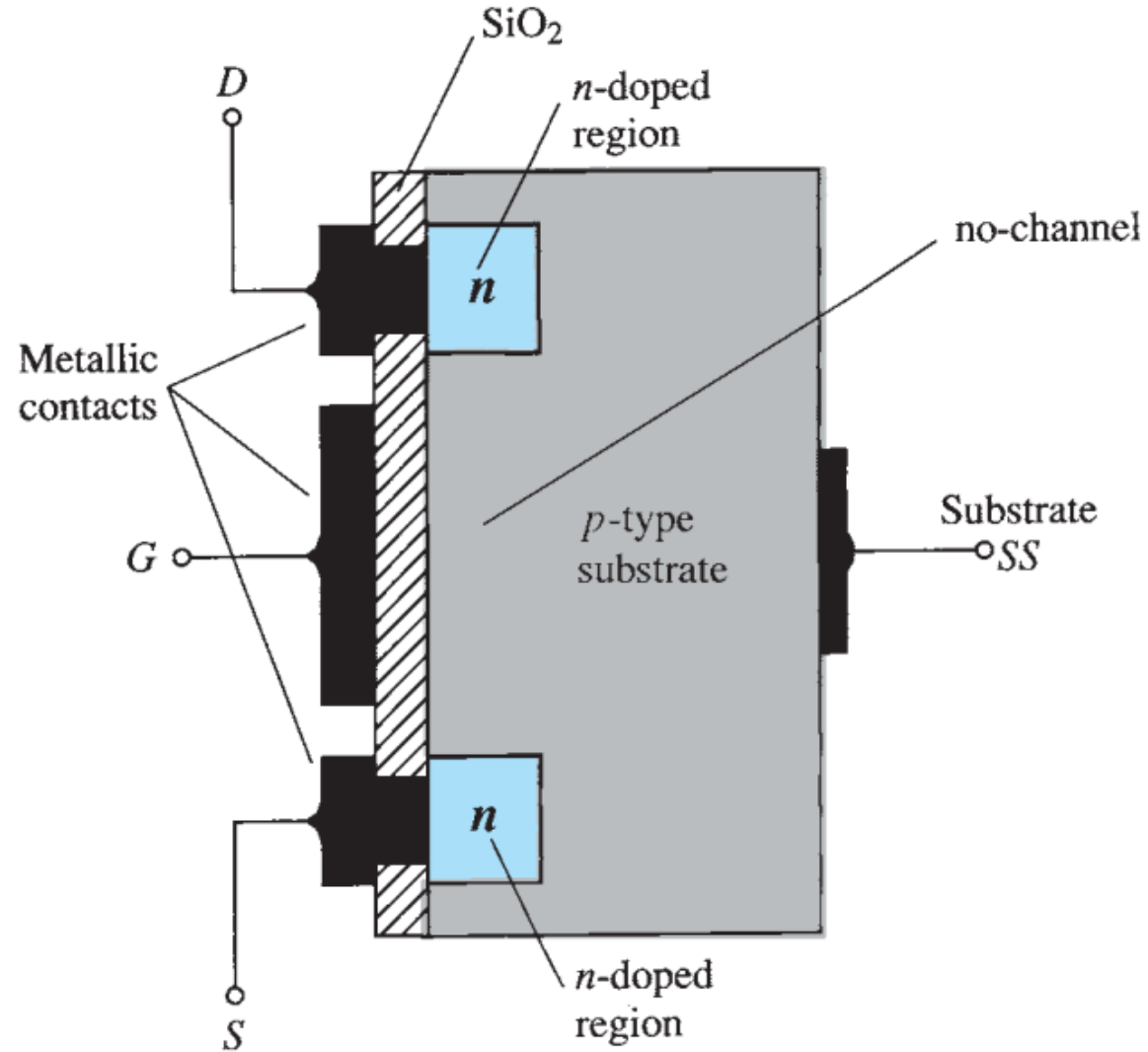
2N3797

**MOSFET
LOW-POWER AUDIO**

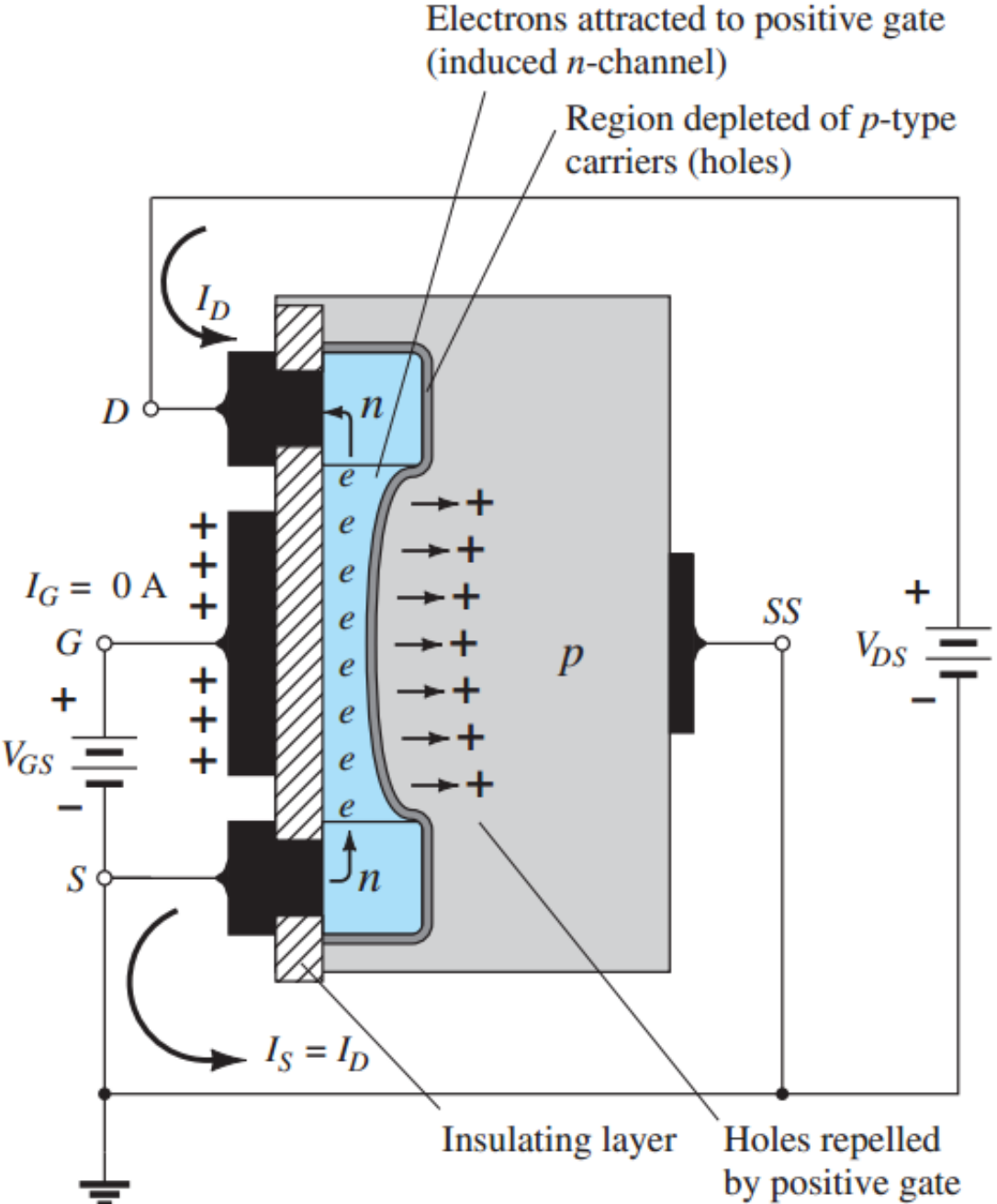


N-CHANNEL – DEPLETION

n-Channel enhancement-type MOSFET



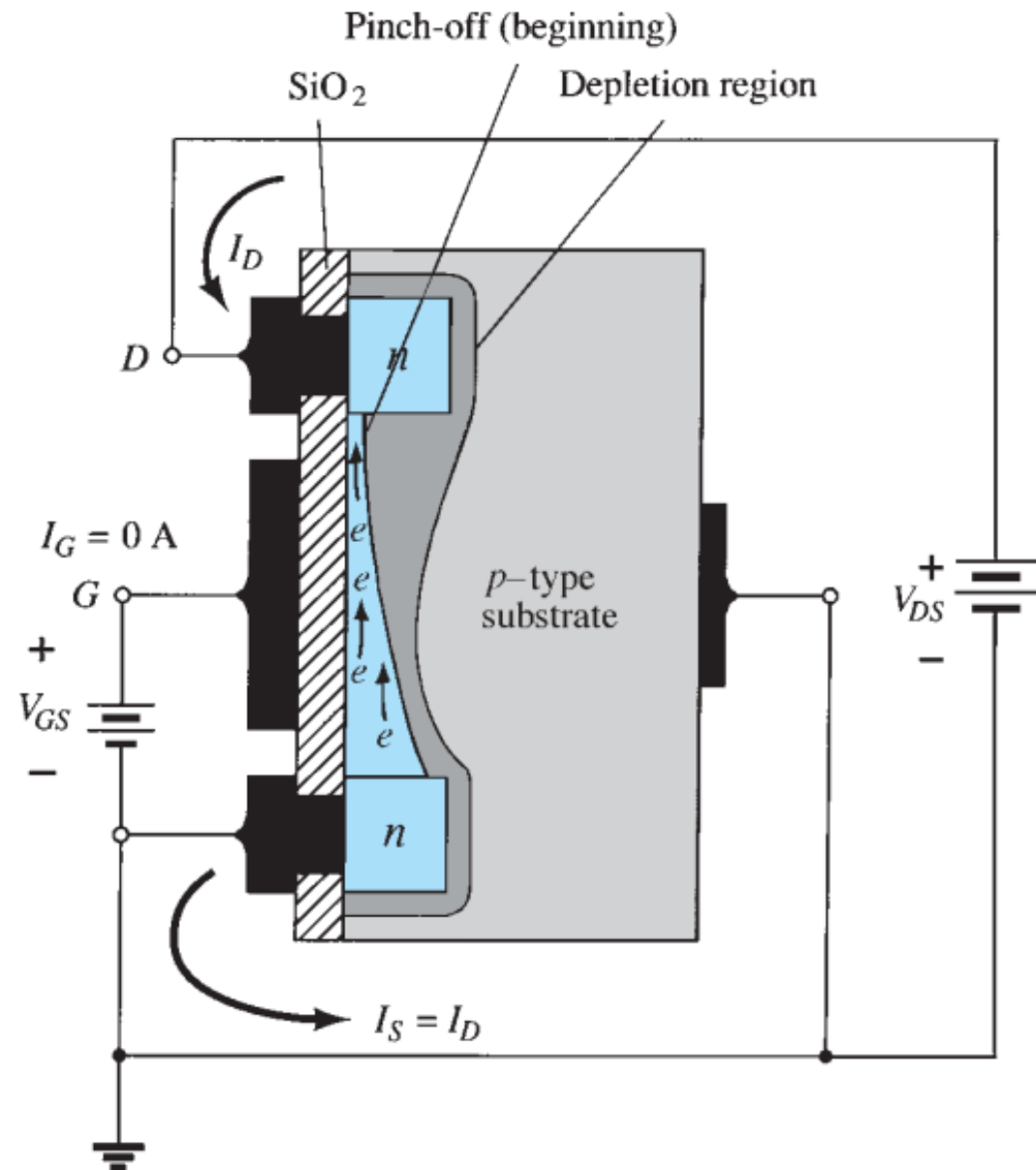
Channel formation in the n-channel enhancement-type MOSFET

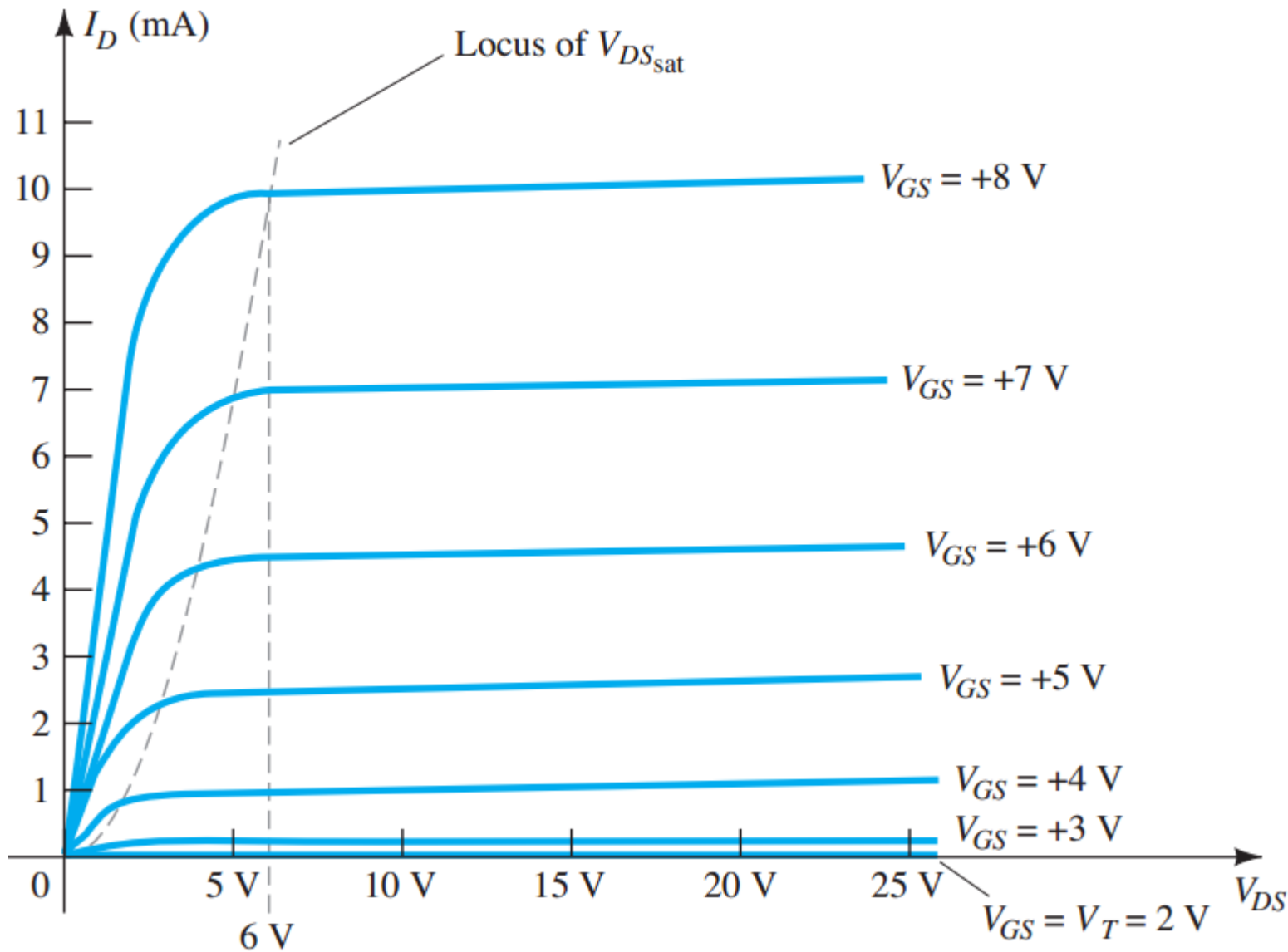


Change in channel and depletion region with increasing level of V_{DS} for a fixed value of V_{GS}

$$V_{DG} = V_{DS} - V_{GS}$$

$$V_{DS_{sat}} = V_{GS} - V_T$$





Drain characteristics of an n-channel enhancement-type MOSFET

$$k = 0.278 \times 10^{-3} \text{ A/V}^2$$

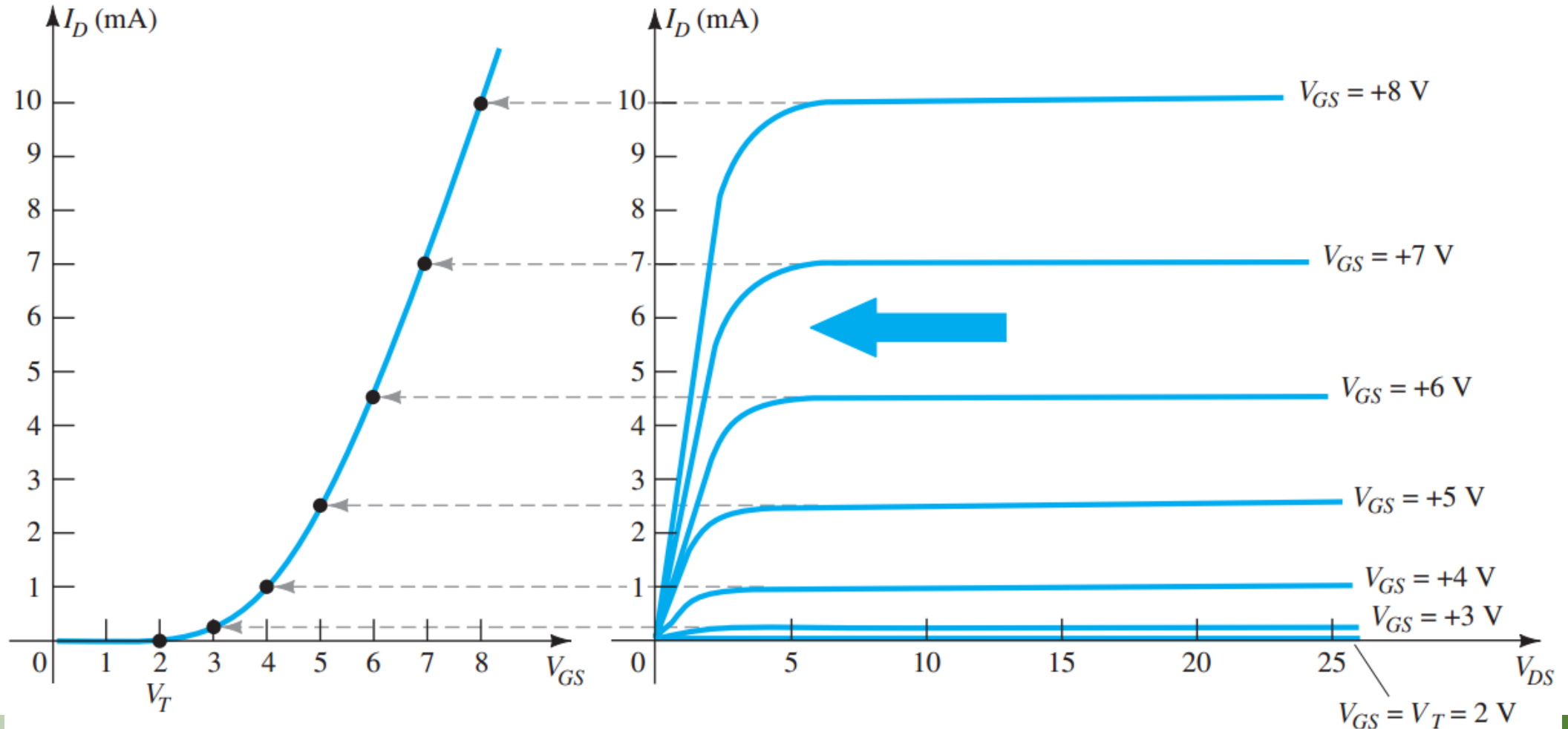


$$I_D = k(V_{GS} - V_T)^2$$

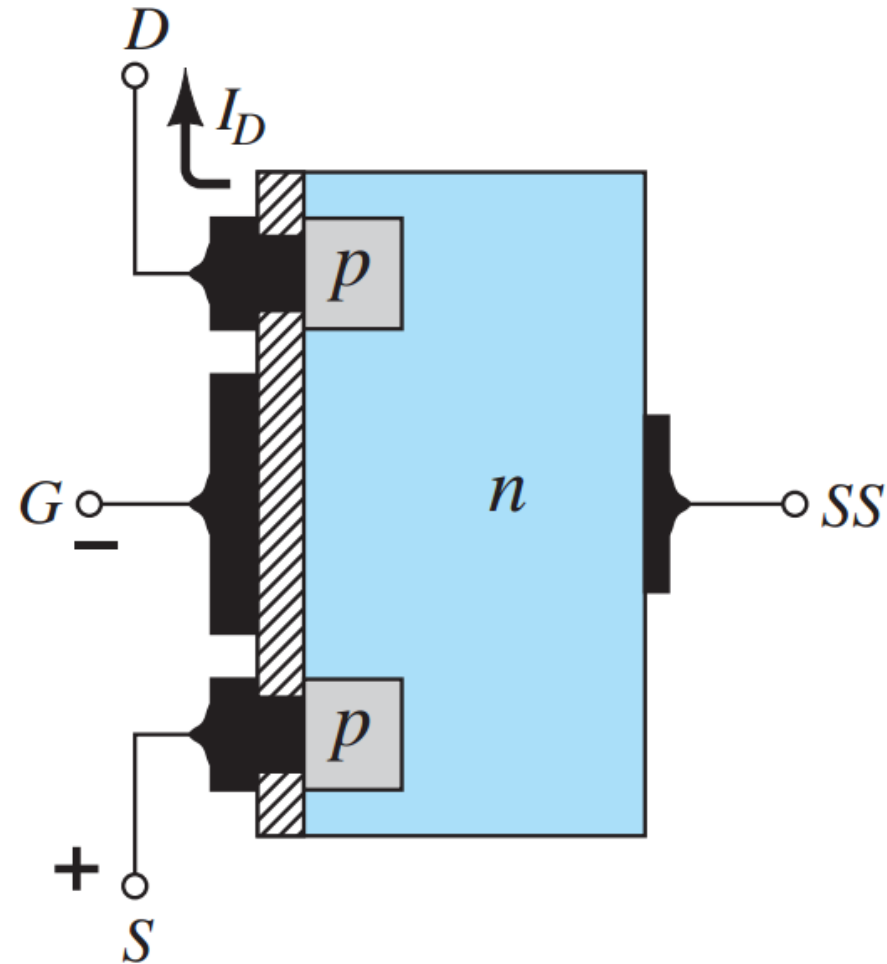
$$k = \frac{I_{D(\text{on})}}{(V_{GS(\text{on})} - V_T)^2}$$



Transfer characteristics for an n-channel enhancement-type MOSFET from the drain characteristics

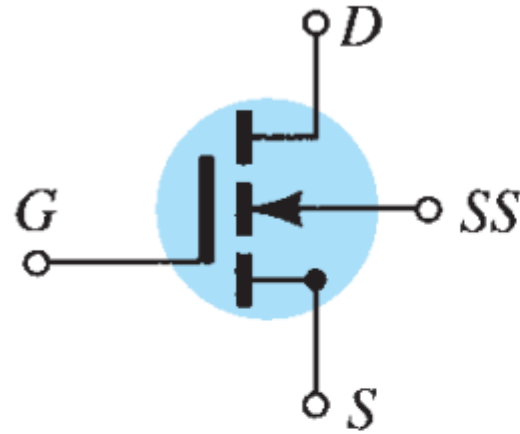


p -Channel enhancement-type MOSFET

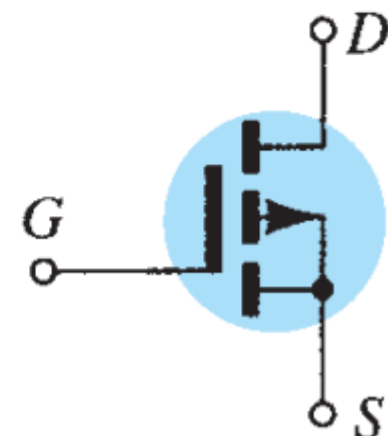
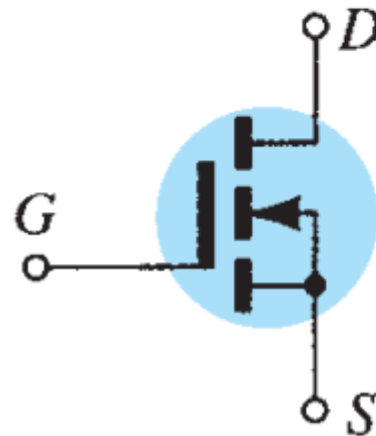
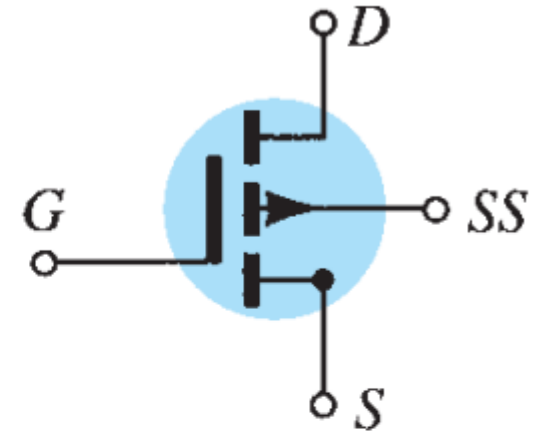


Symbols for:
(a) n-channel enhancement-type MOSFETs
and
(b) p-channel enhancement-type MOSFETs

n-channel



p-channel



Readings

Electronic Devices and Circuit Theory
– Boylestad, Nashelsky

Chapter 6: Field-Effect Transistors

