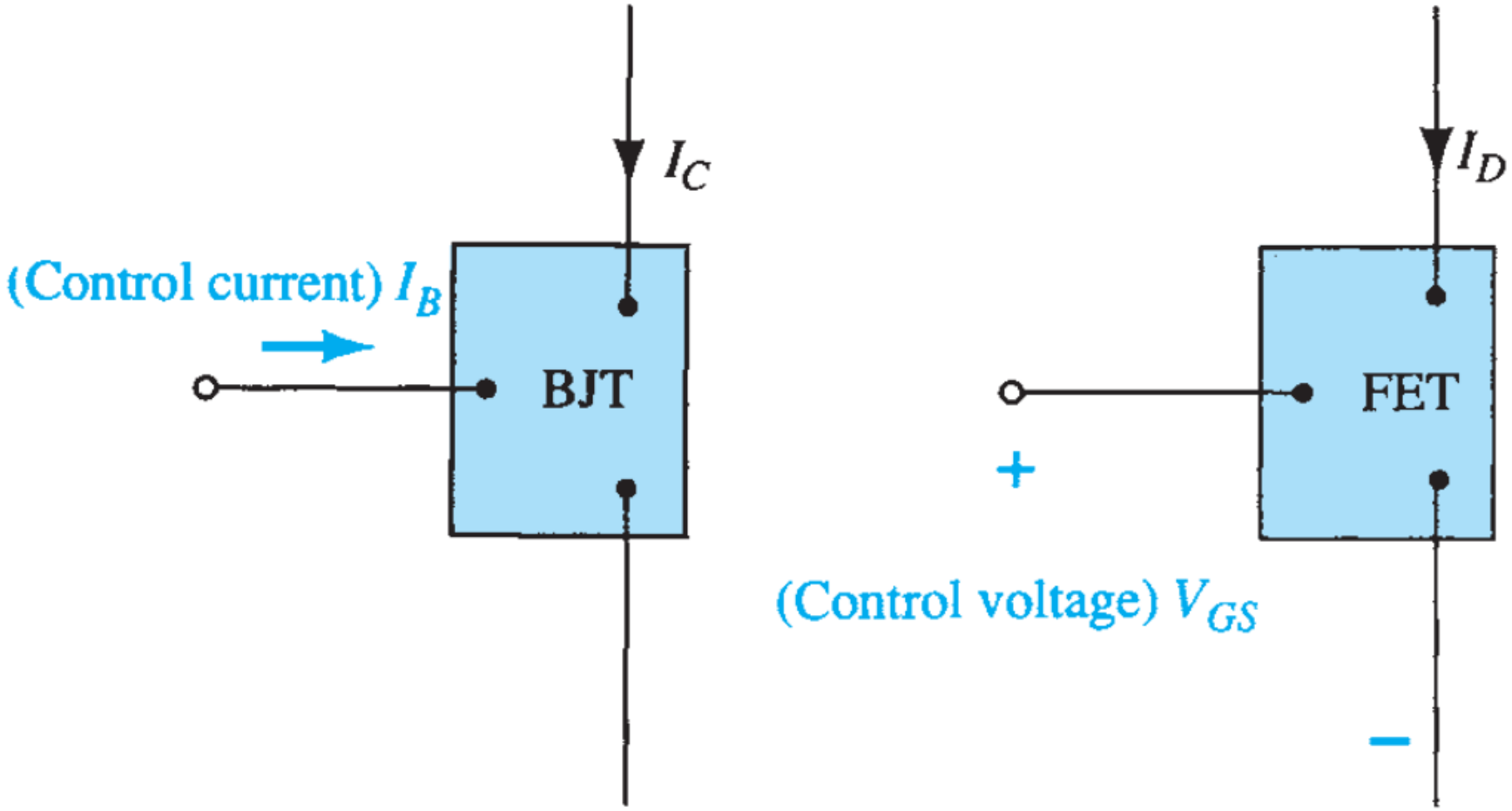
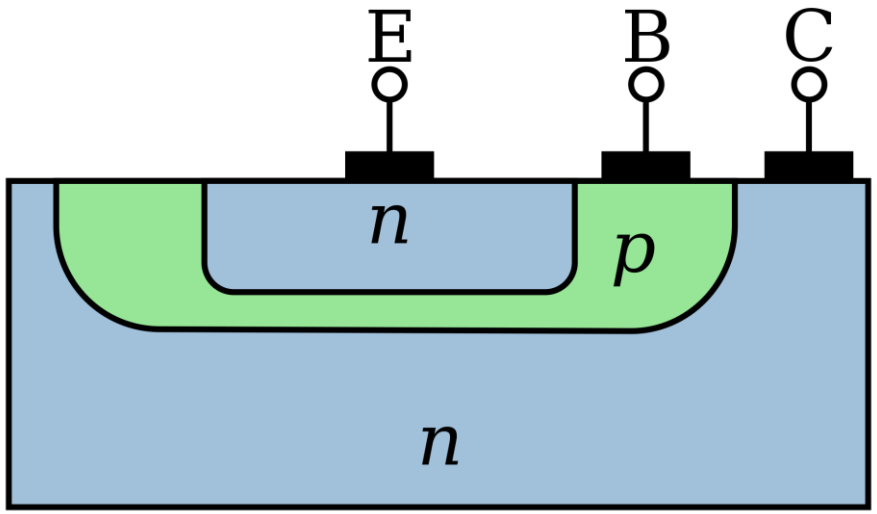
Field-effect transistor (FET)

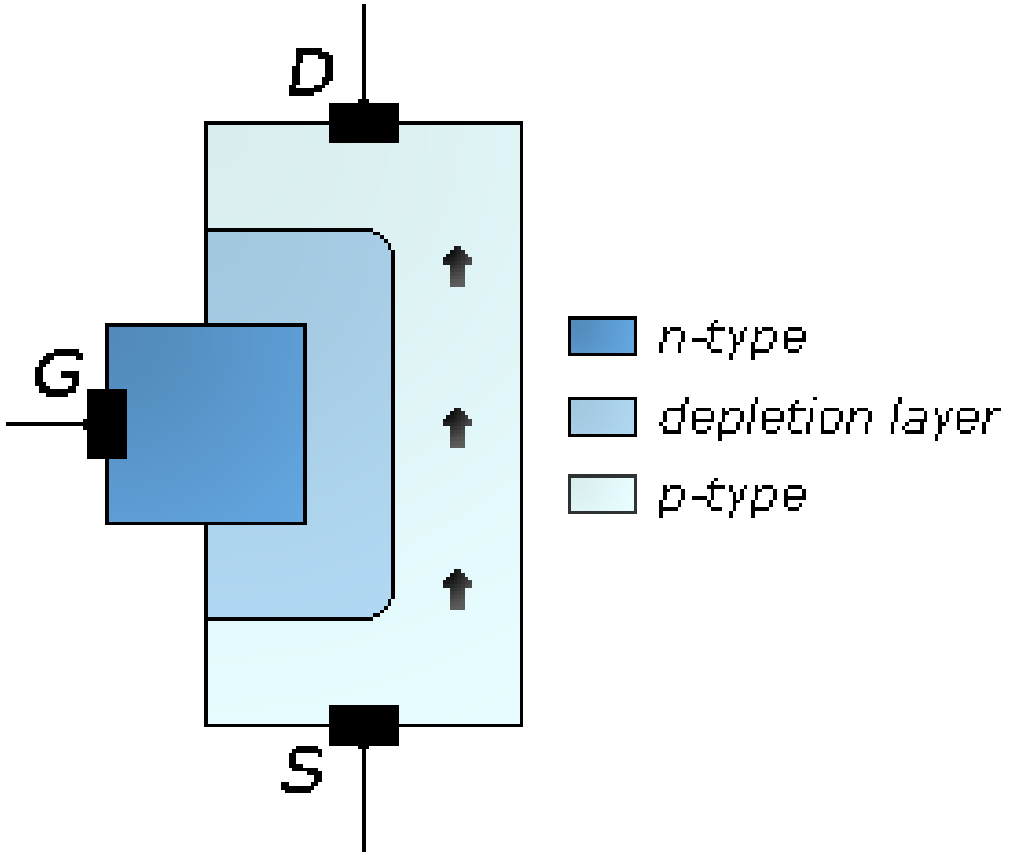
Dr Mohammad Abdur Rashid

BJT and FET

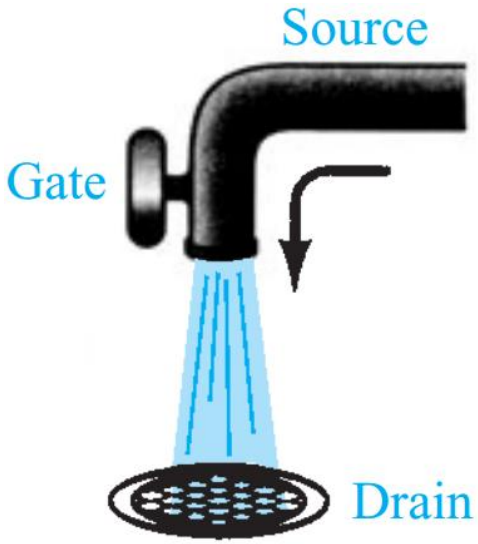


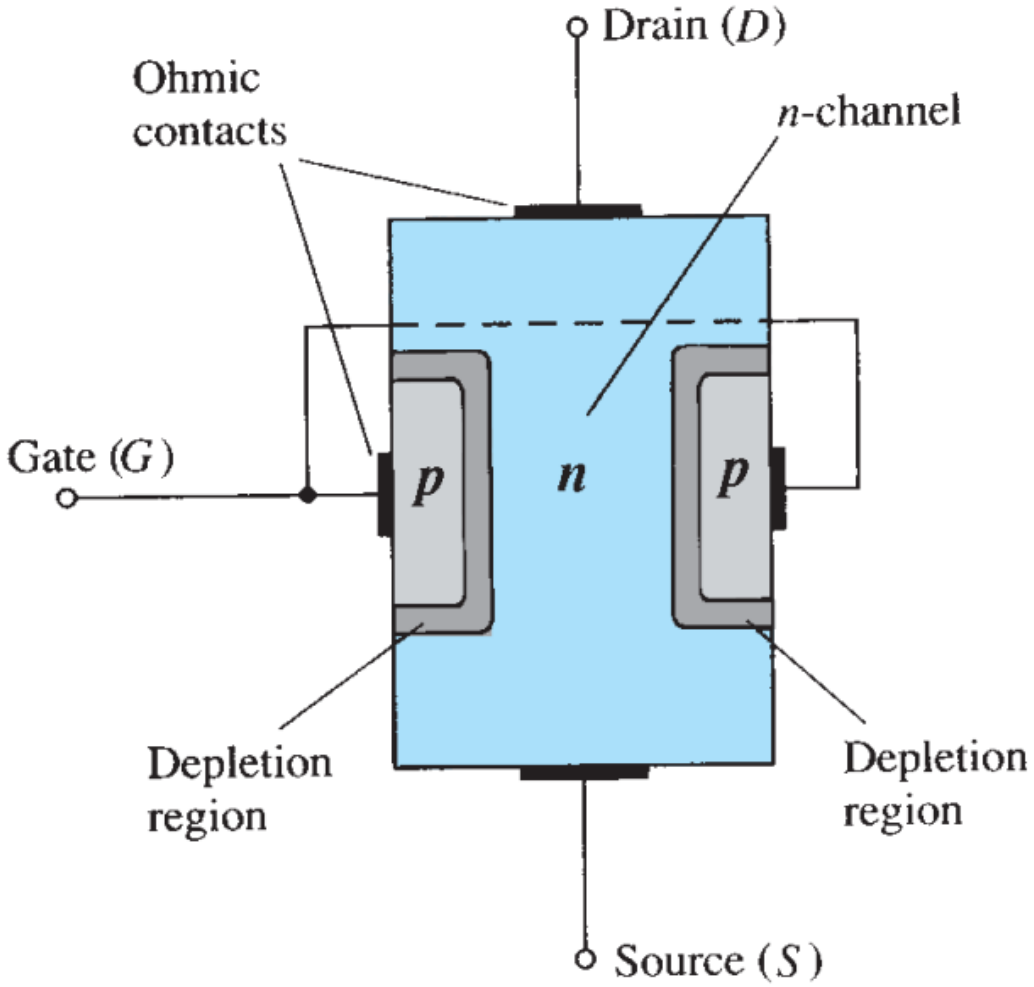
BJT and FET





Junction field-effect transistor (JFET)



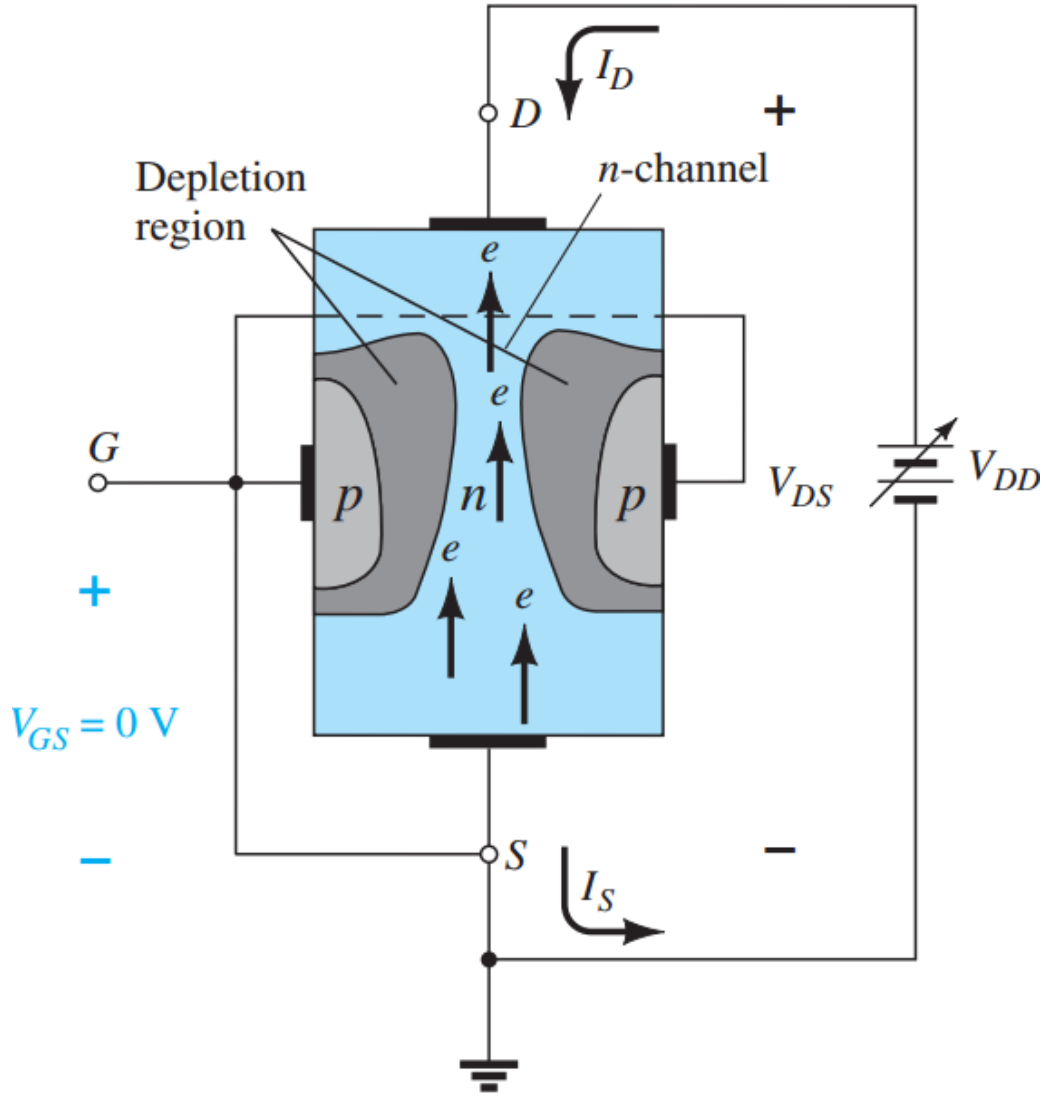


Flow of charge in JFET

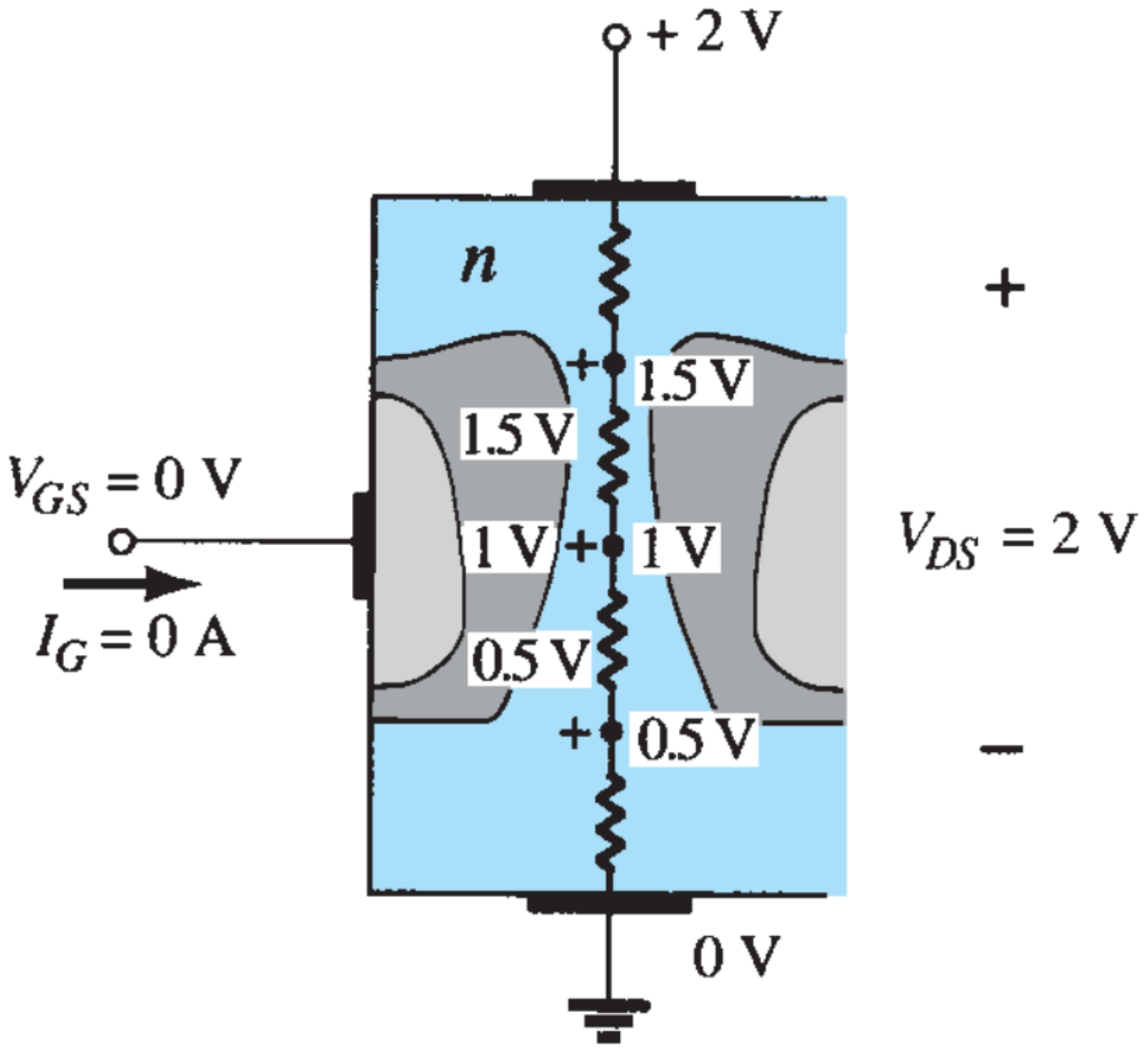
$V_{GS} = 0$ V

&

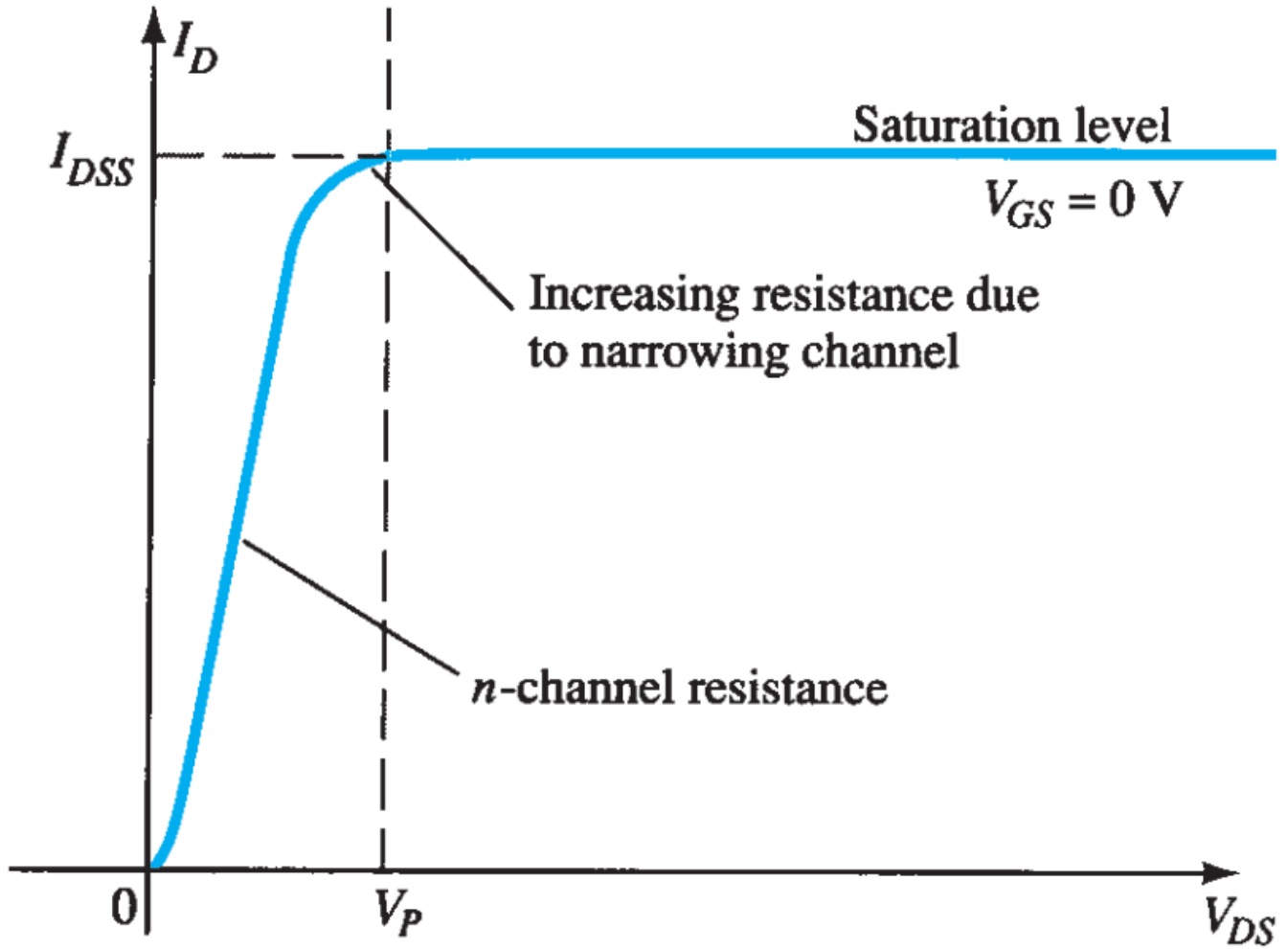
$V_{DS} > 0$ V



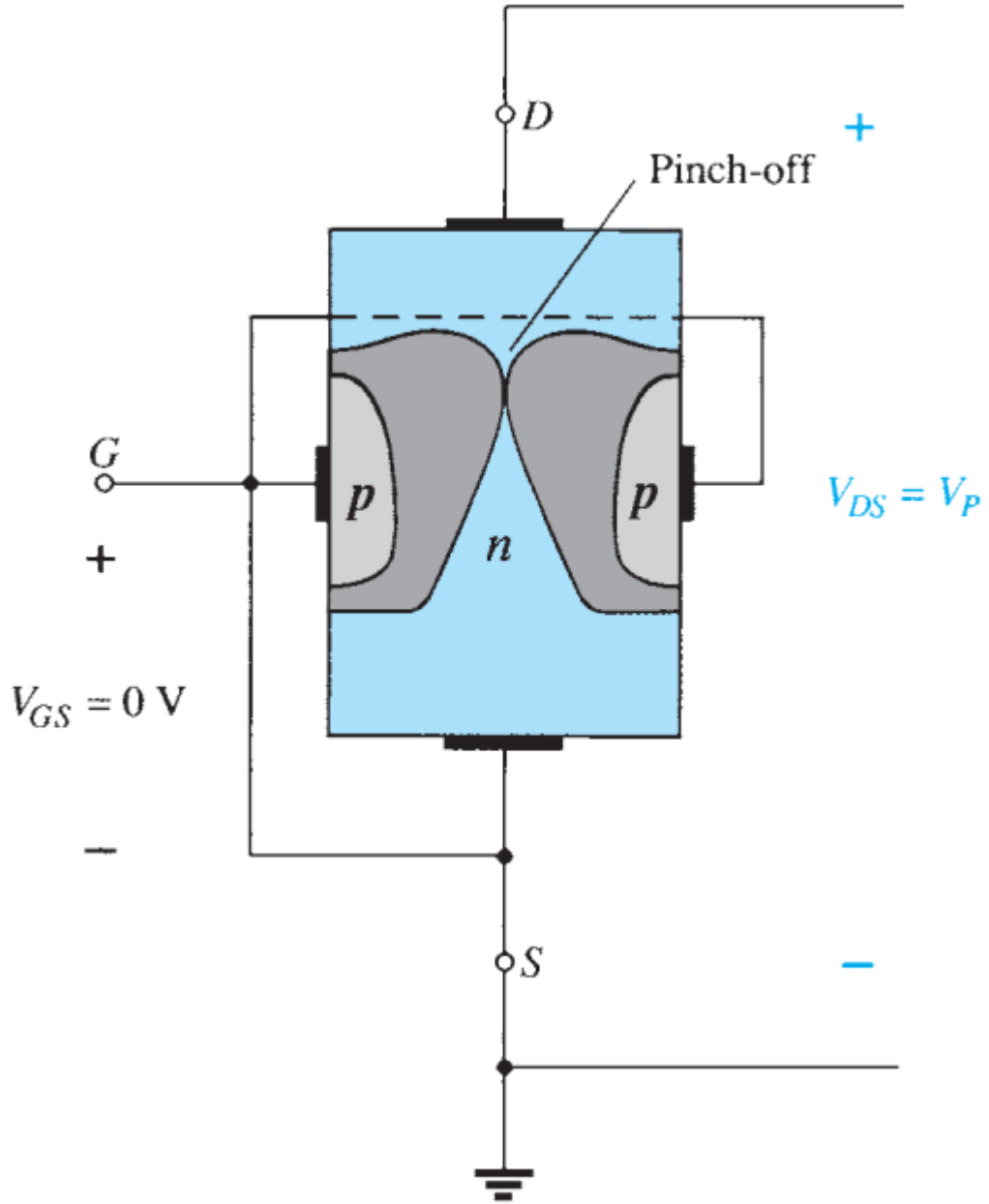
Varying reverse-bias potentials across the p–n junction of an n-channel JFET



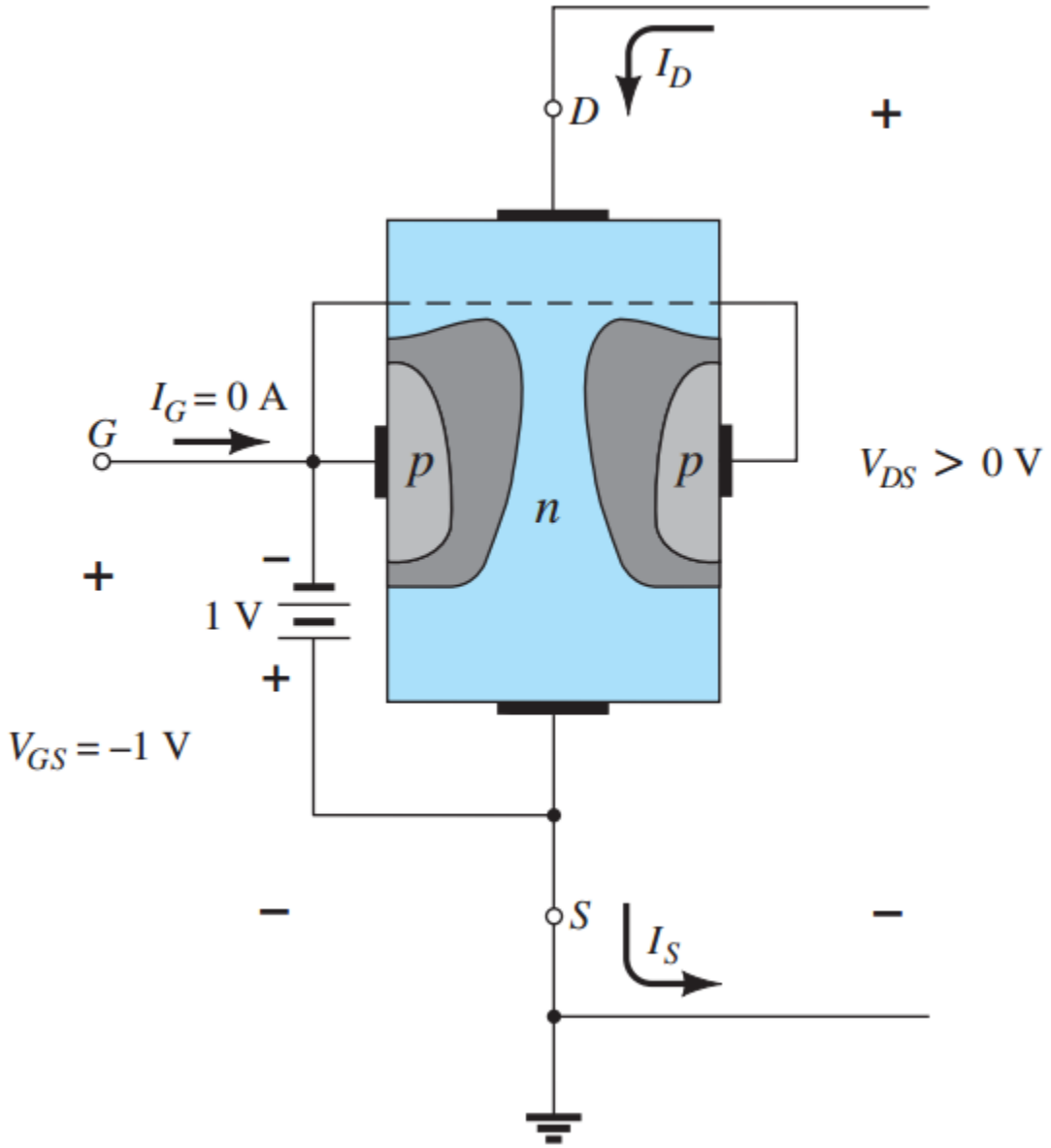
I_D versus V_{DS} for $V_{GS} = 0$ V



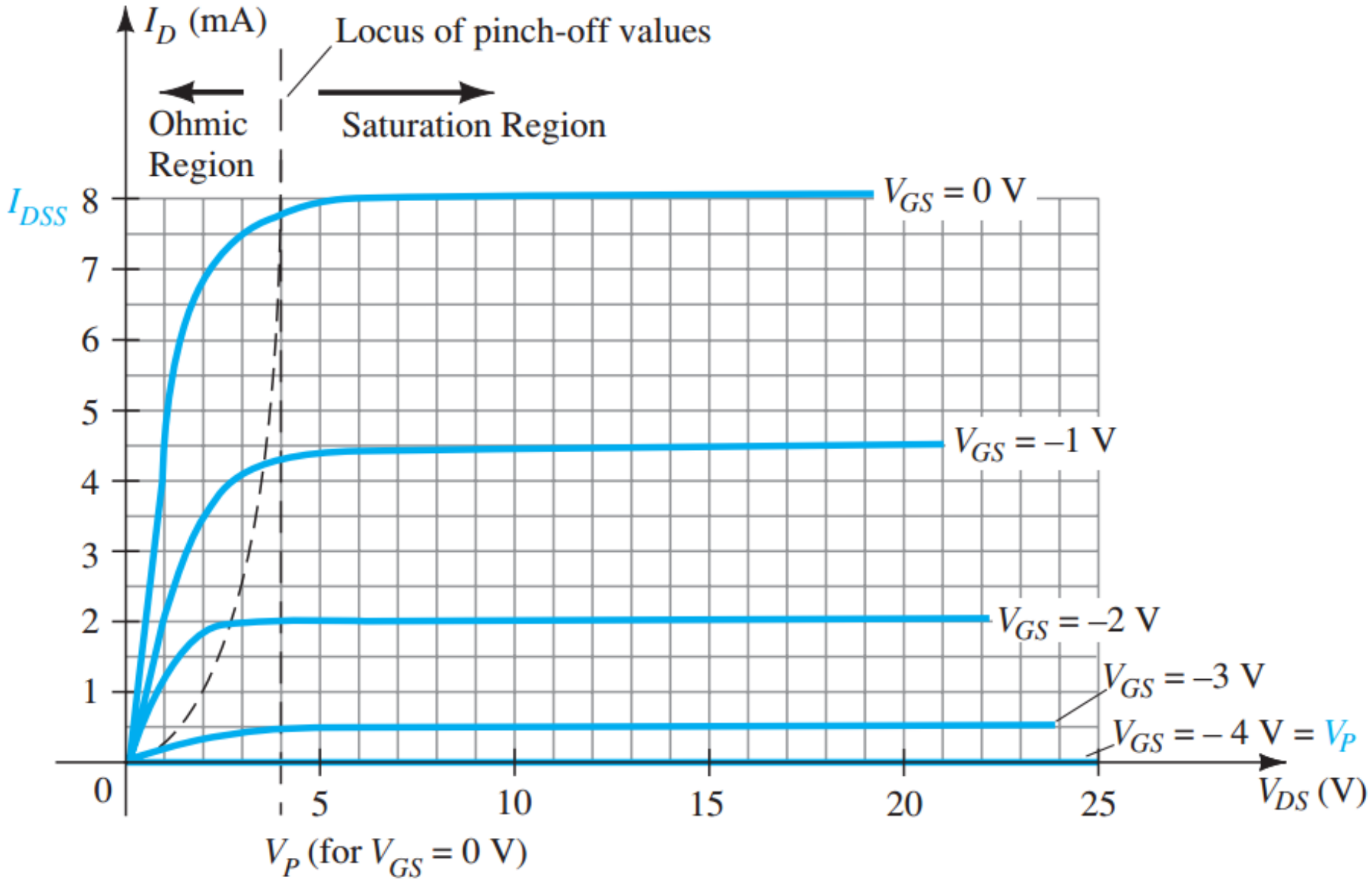
Pinch-off
(V_{GS} = 0 V, V_{DS} = V_P)



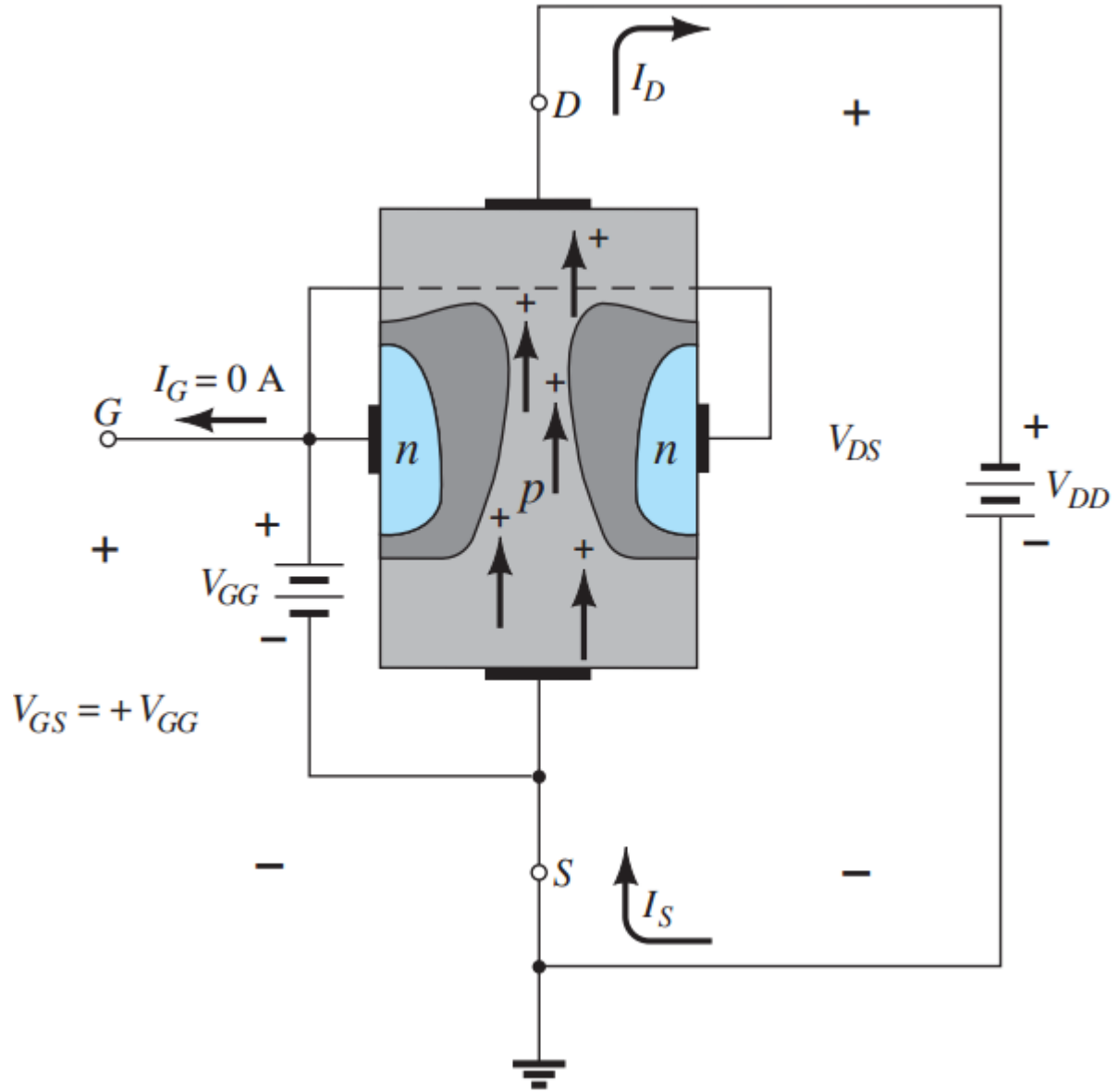
Application of a negative voltage to the gate of a JFET



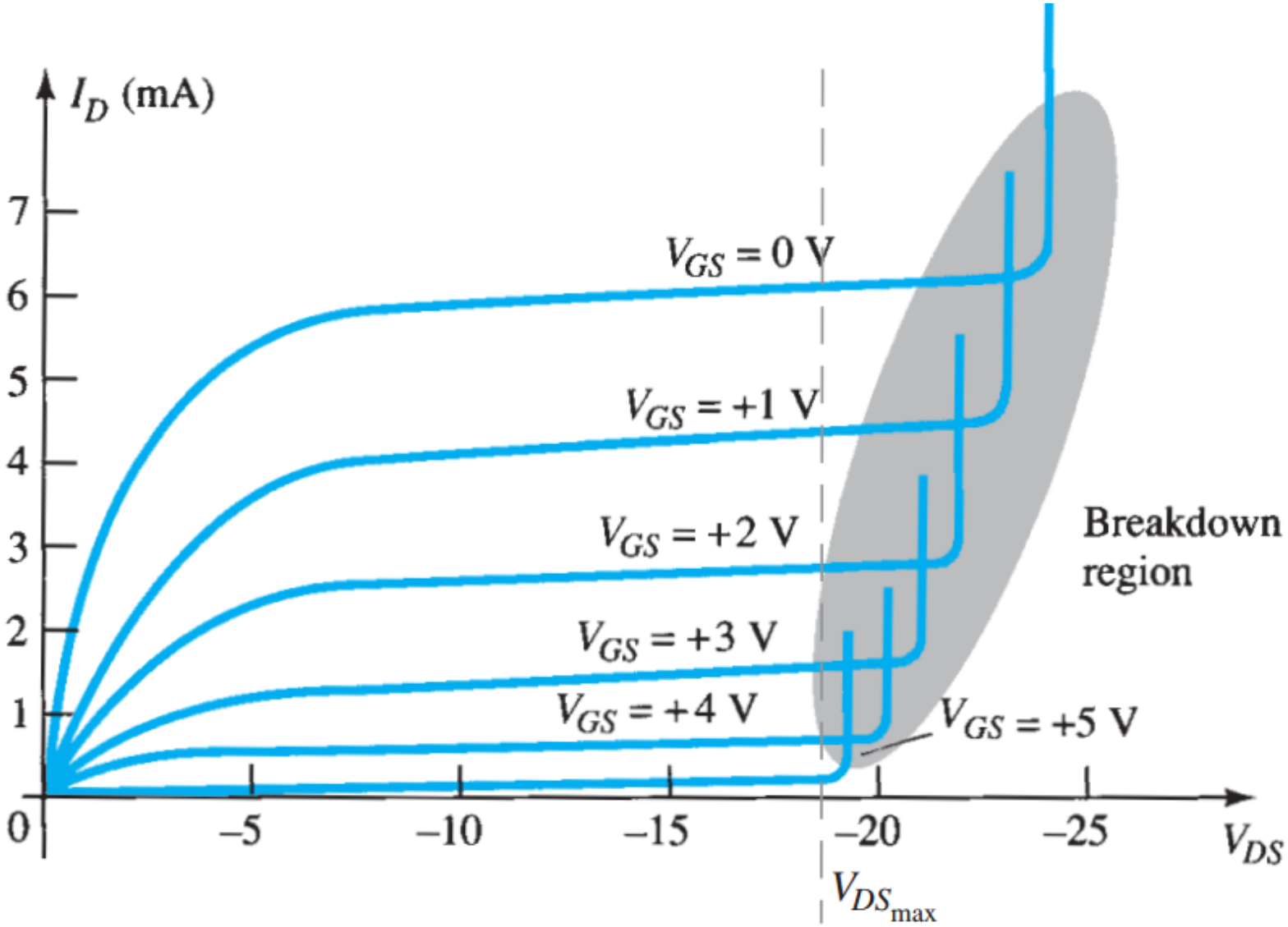
n-Channel JFET characteristics with I_{DSS} = 8 mA and V_P = -4 V



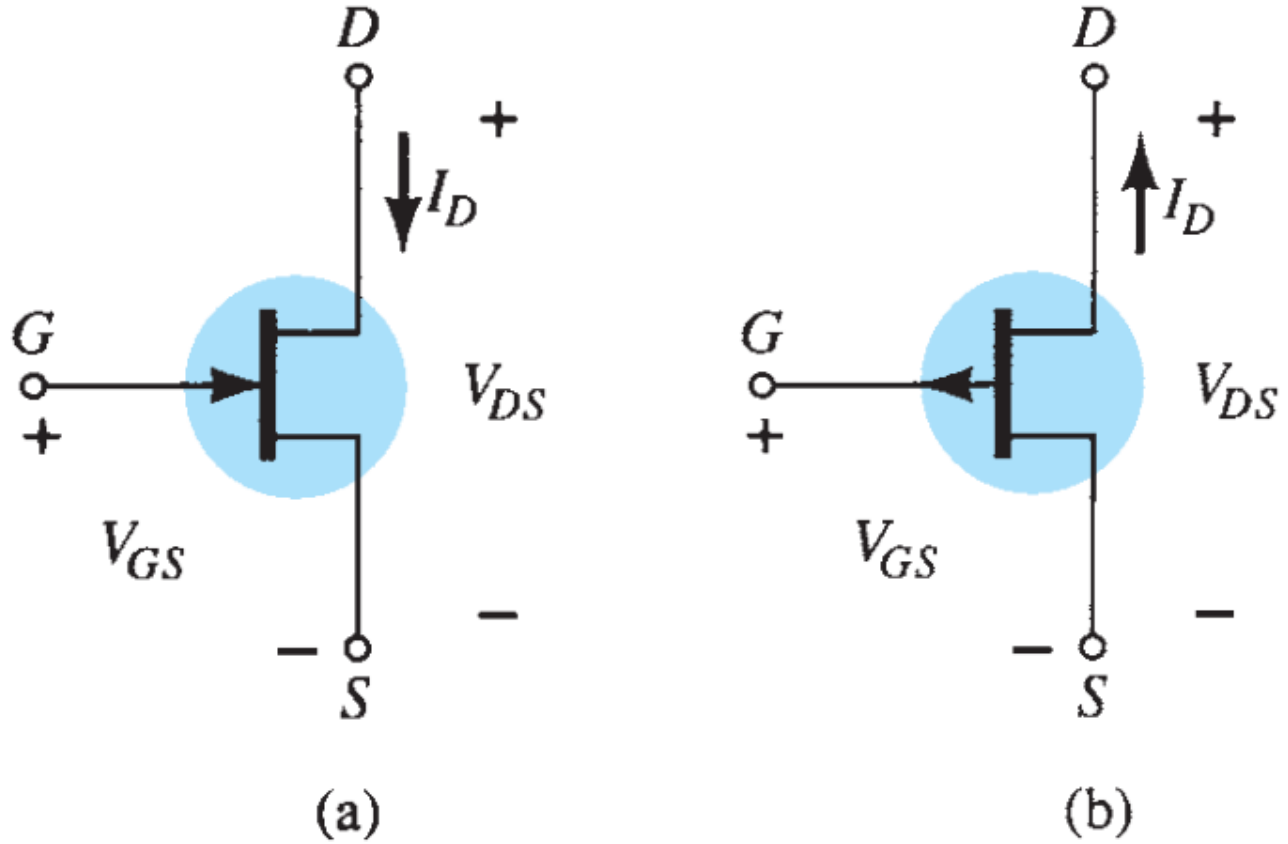
p-Channel JFET



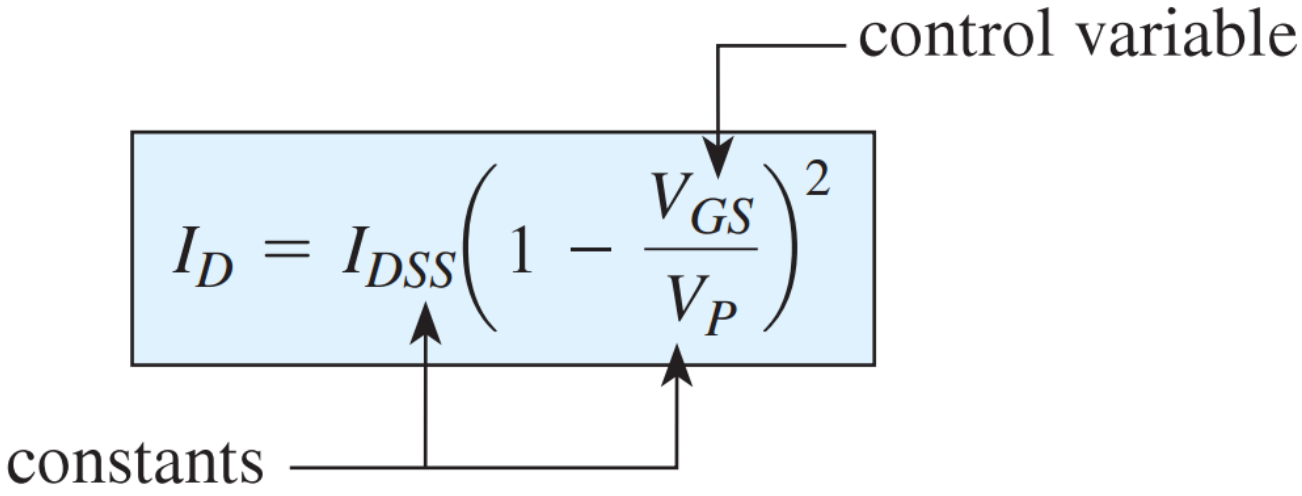
p-Channel JFET characteristics with I_{DSS} = 6 mA and V_P = +6 V



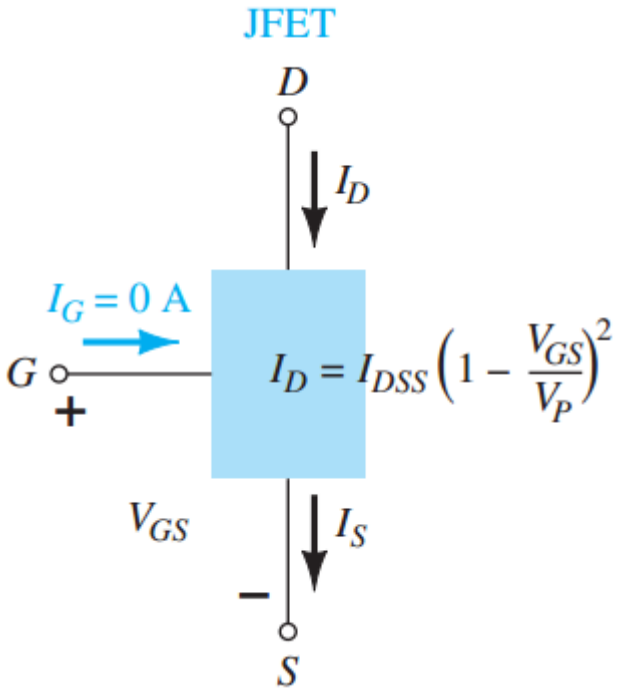
JFET symbols: (a) *n*-channel; (b) *p*-channel



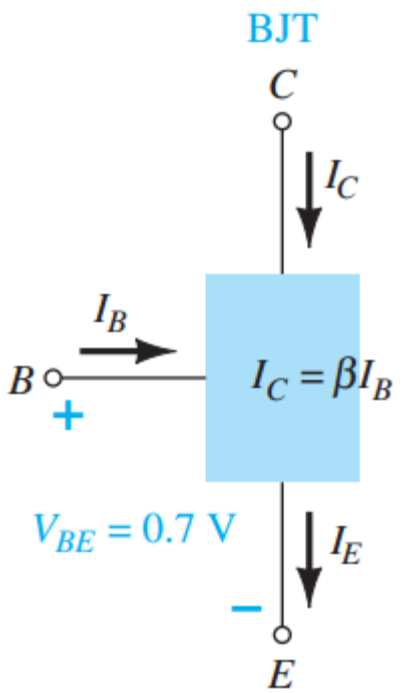
Shockley's equation



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

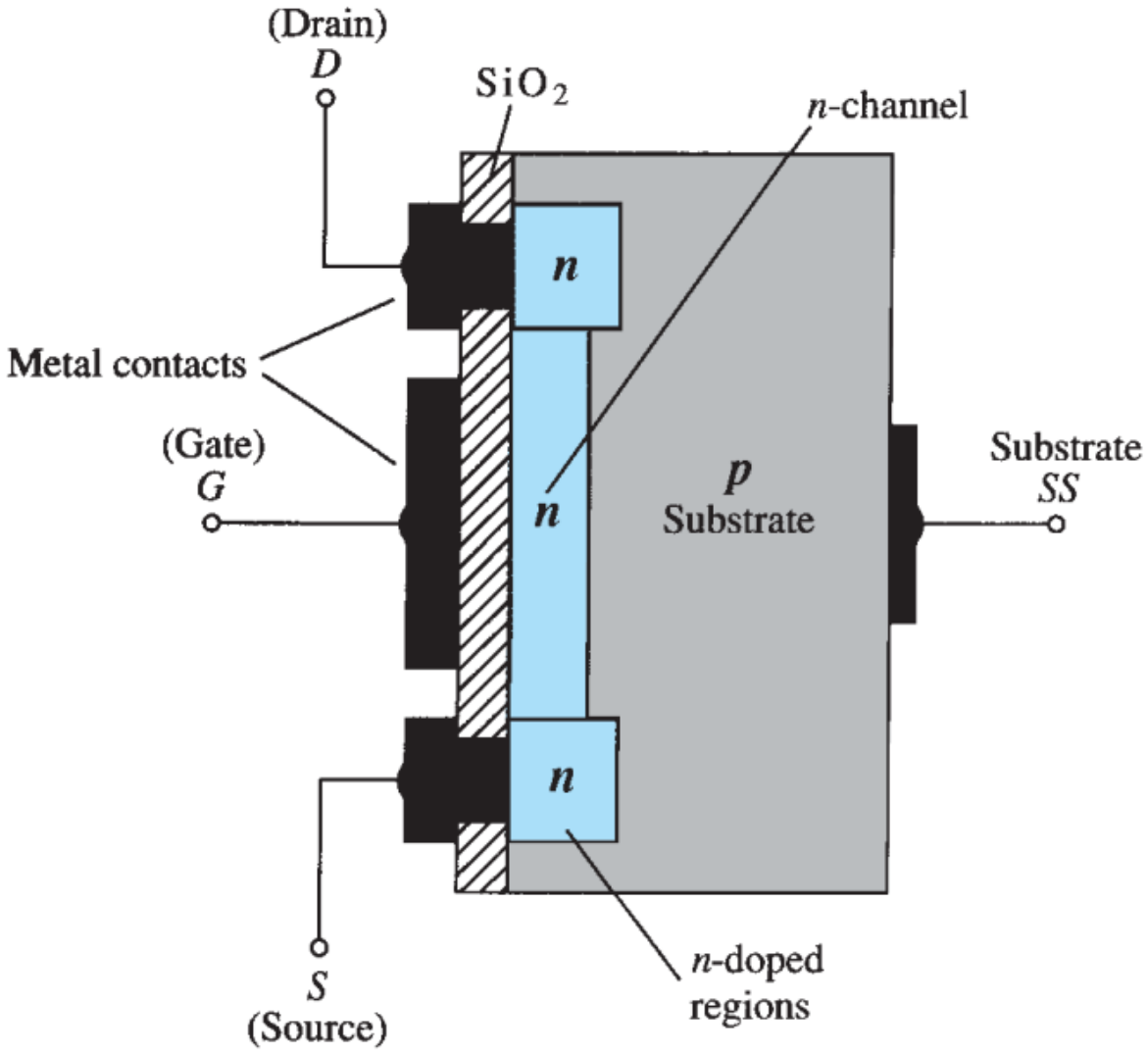


JFET		BJT
$I_D = I_{DSS}\left(1 - \frac{V_{GS}}{V_P}\right)^2$	$\Leftrightarrow$	$I_C = \beta I_B$
$I_D = I_S$	$\Leftrightarrow$	$I_C \cong I_E$
$I_G \cong 0$ A	$\Leftrightarrow$	$V_{BE} \cong 0.7$ V



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

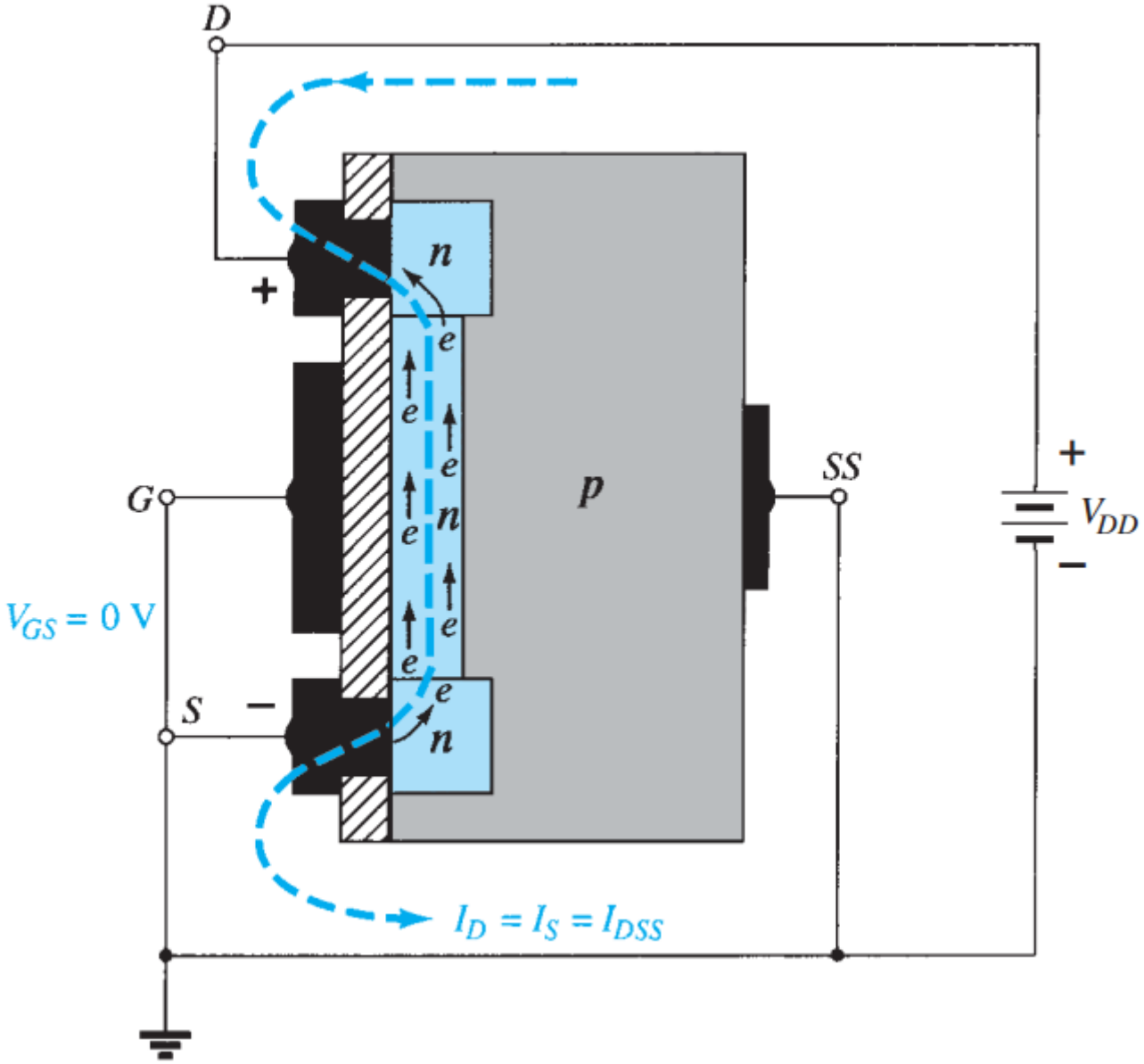
There is no direct electrical connection between the gate terminal and the channel of a MOSFET



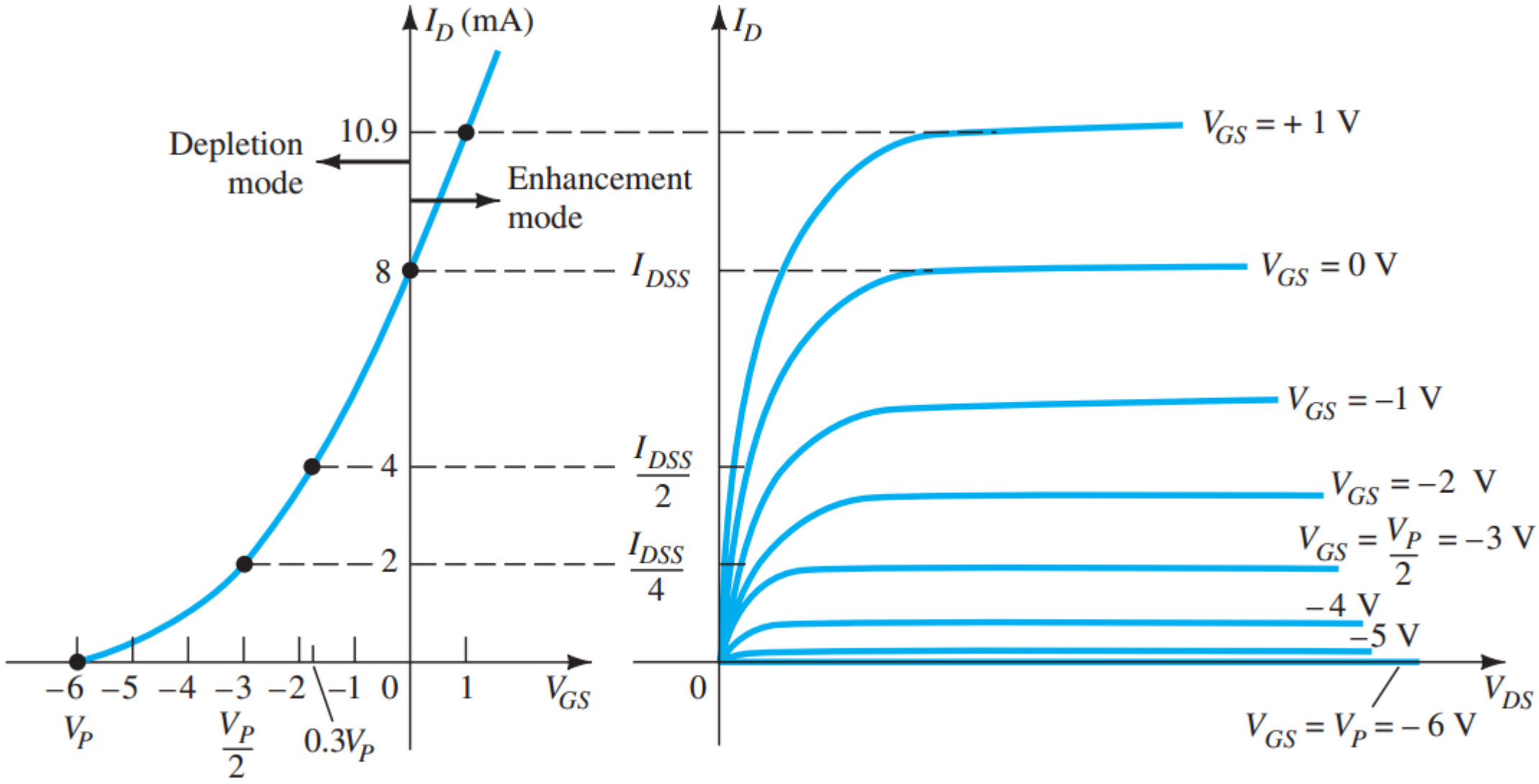
depletion type MOSFET

enhancement type MOSFET

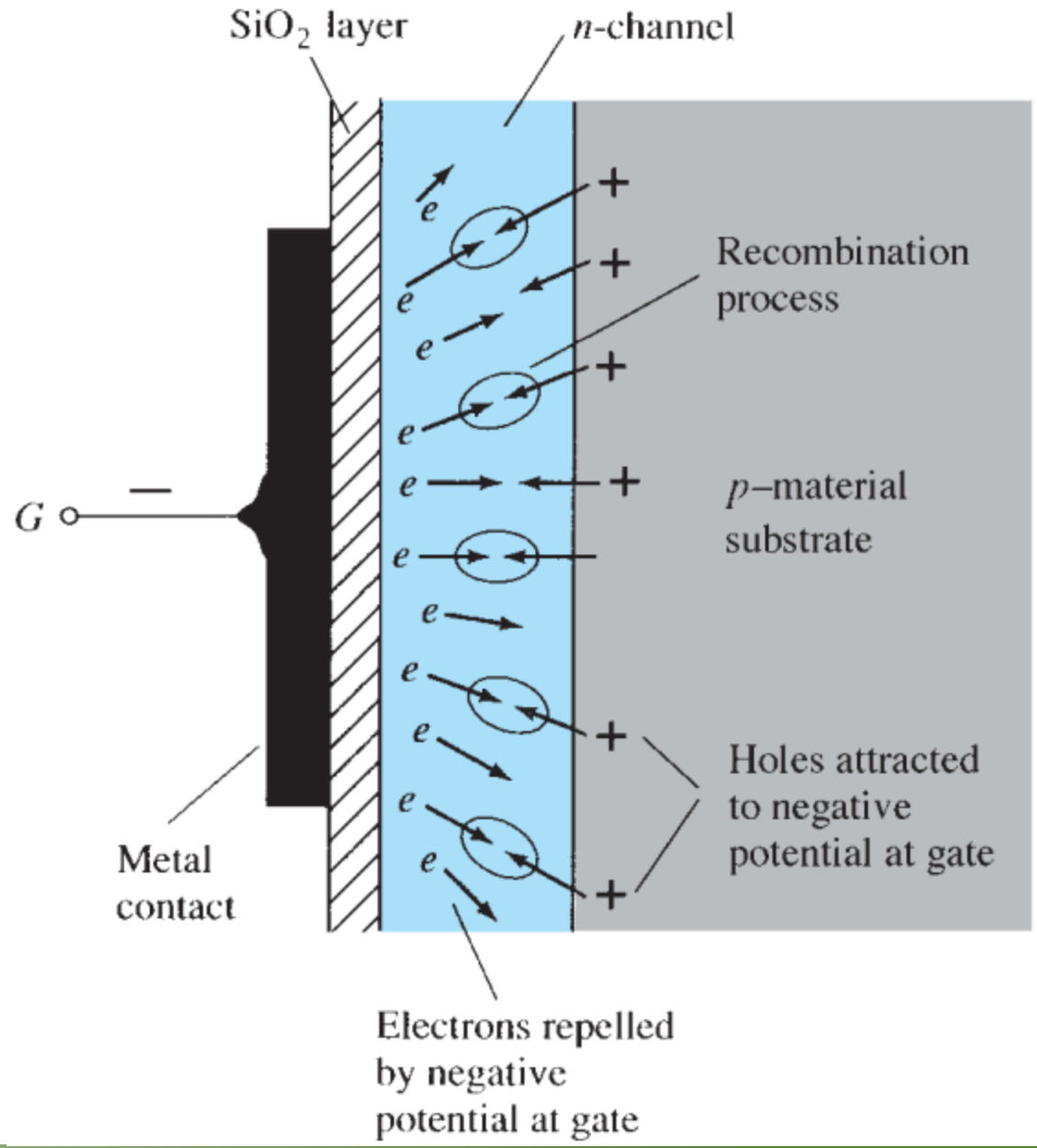
n-Channel depletion-type MOSFET with V_{GS} = 0 V and applied voltage V_{DD}



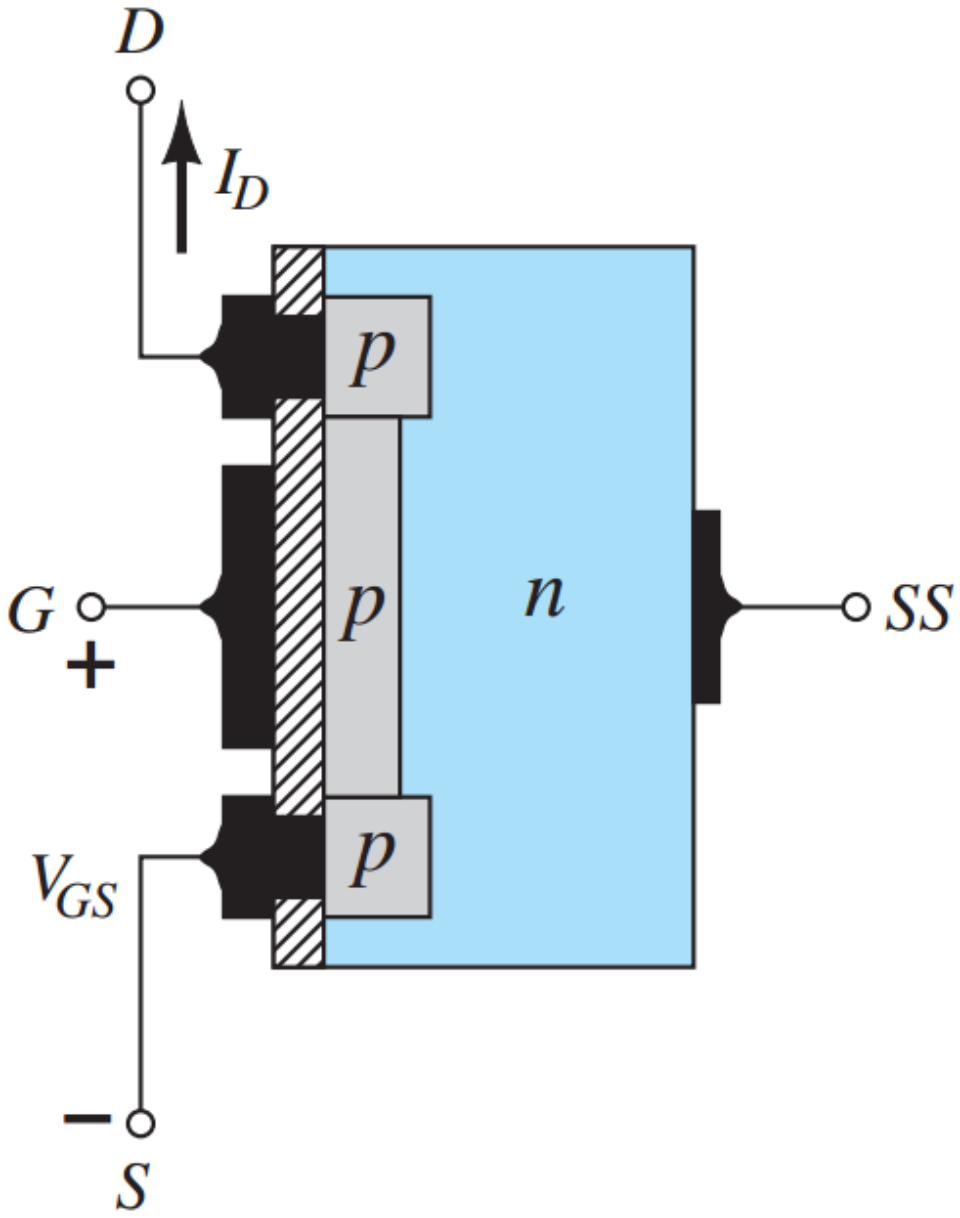
Drain and transfer characteristics for an *n*-channel depletion-type MOSFET



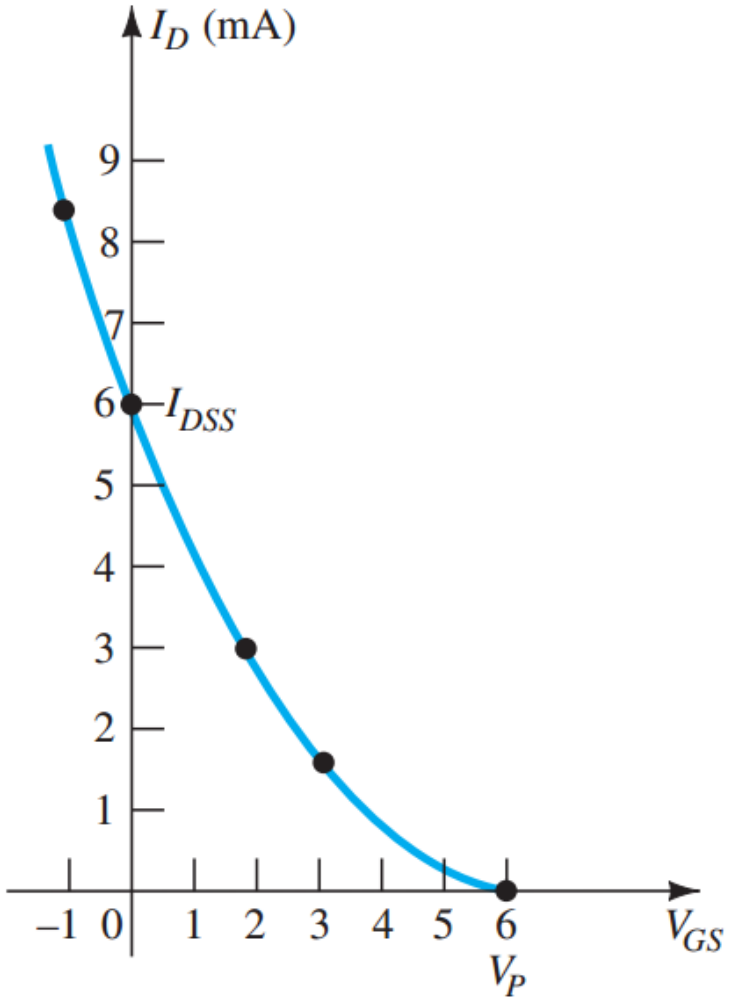
Reduction in free carriers in a channel due to a negative potential at the gate terminal

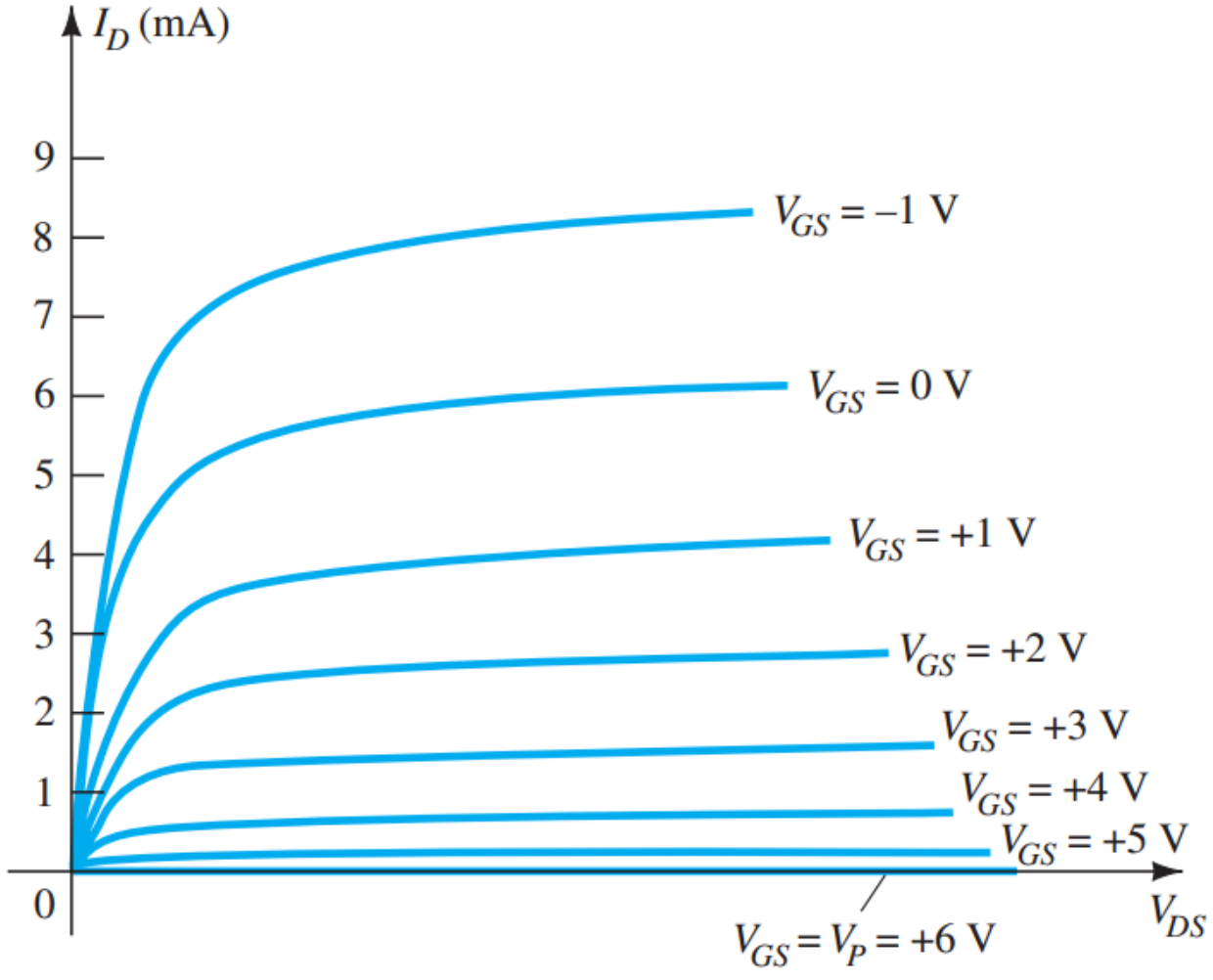


p-channel depletion-type MOSFET

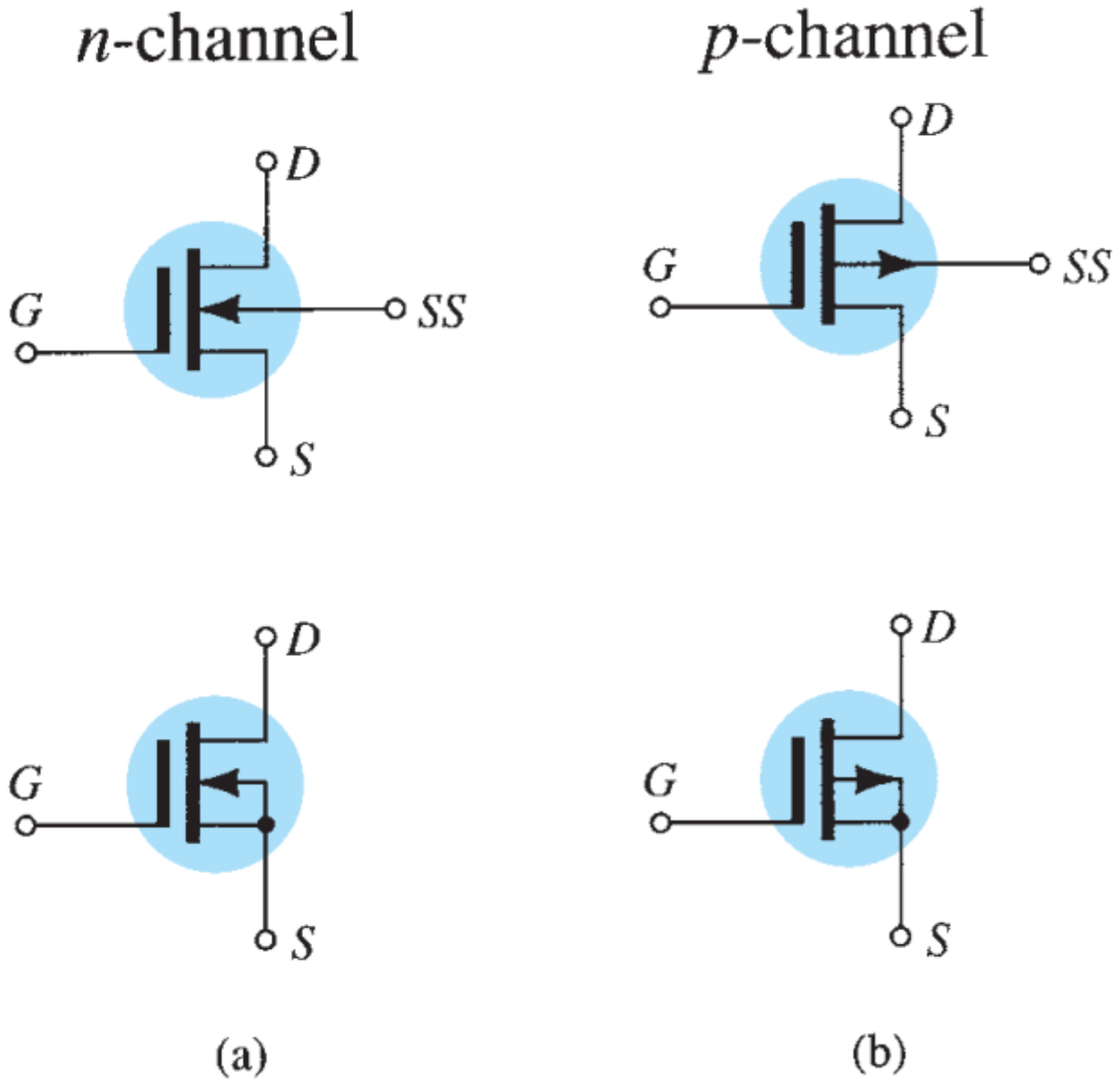


p-channel depletion-type MOSFET



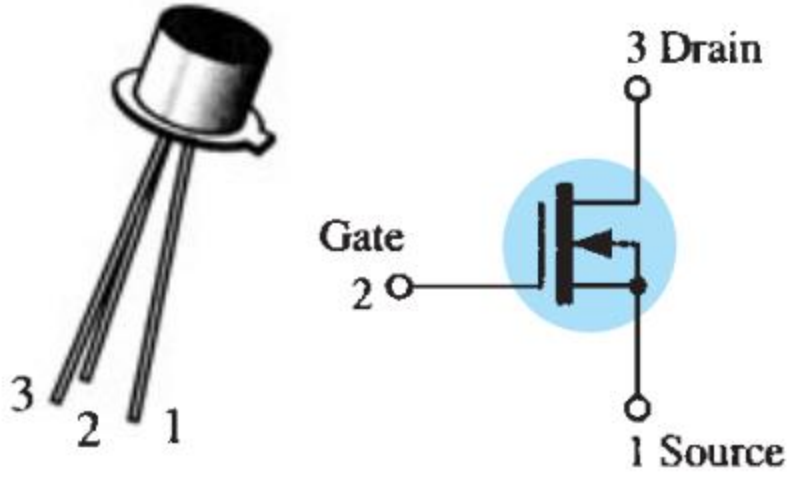


Graphic symbols for:
(a) n-channel depletion-type MOSFETs and
(b) p-channel depletion-type MOSFETs



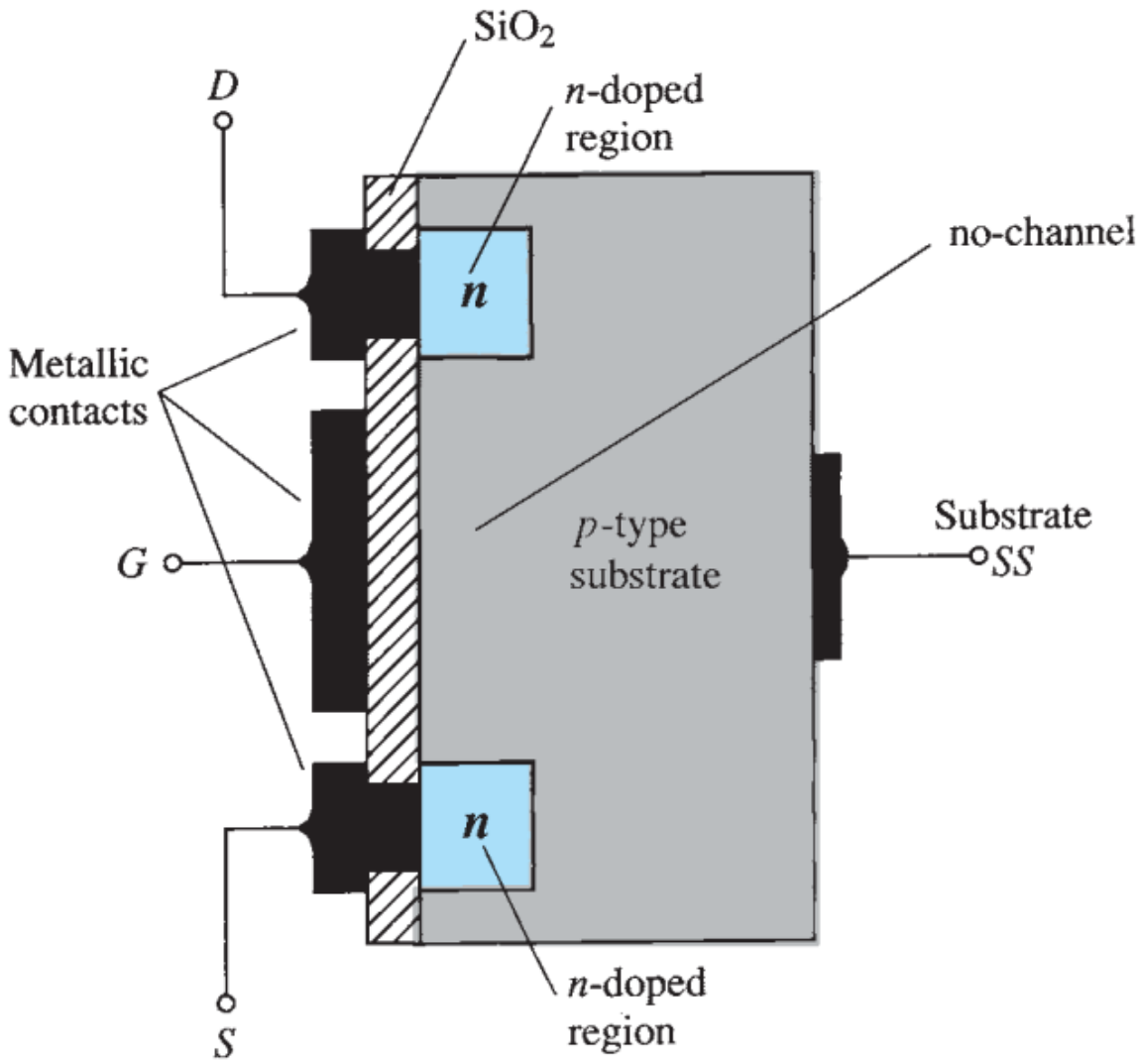
2N3797

MOSFET
LOW–POWER AUDIO

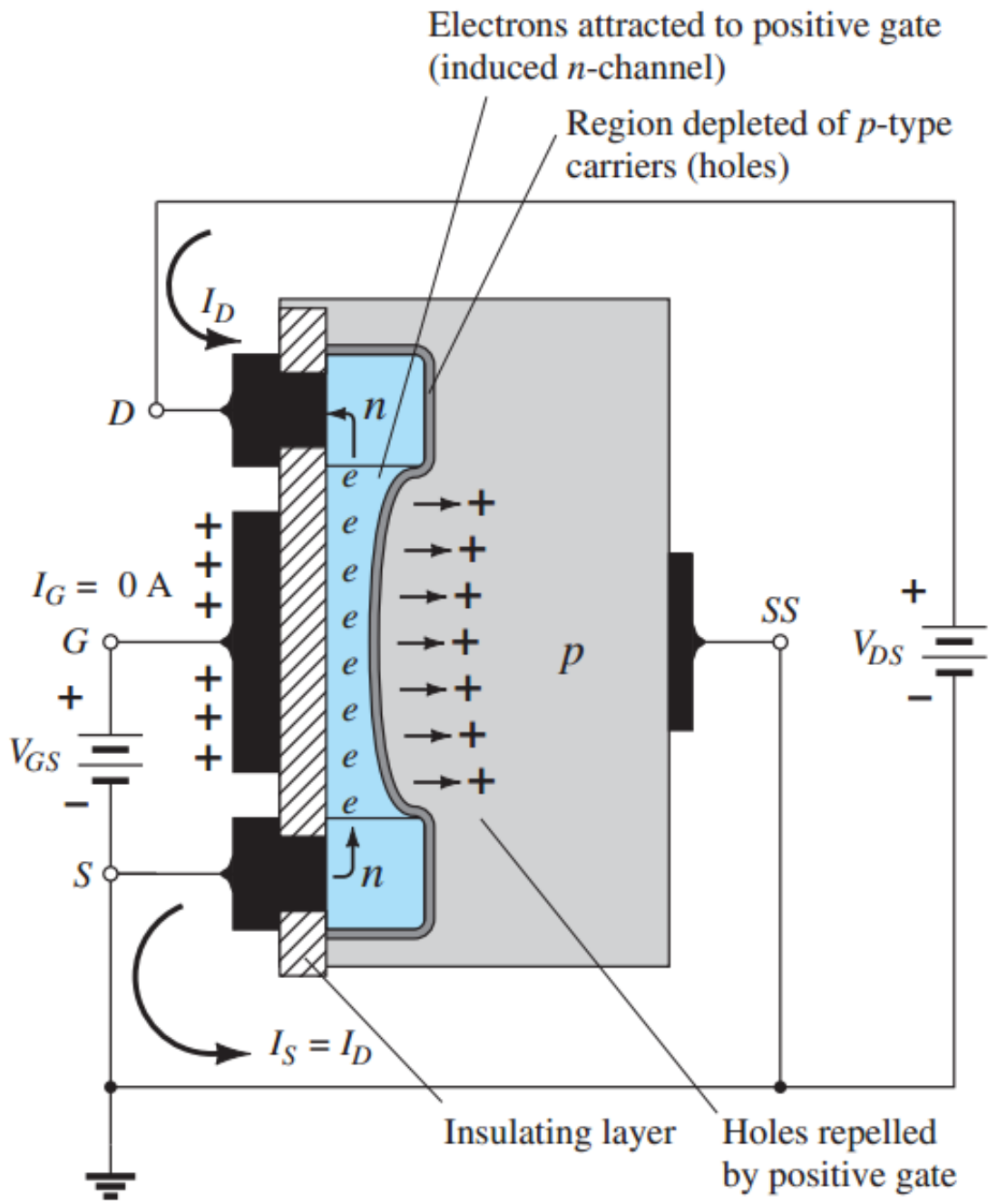


N-CHANNEL – DEPLETION

n-Channel enhancement-type MOSFET



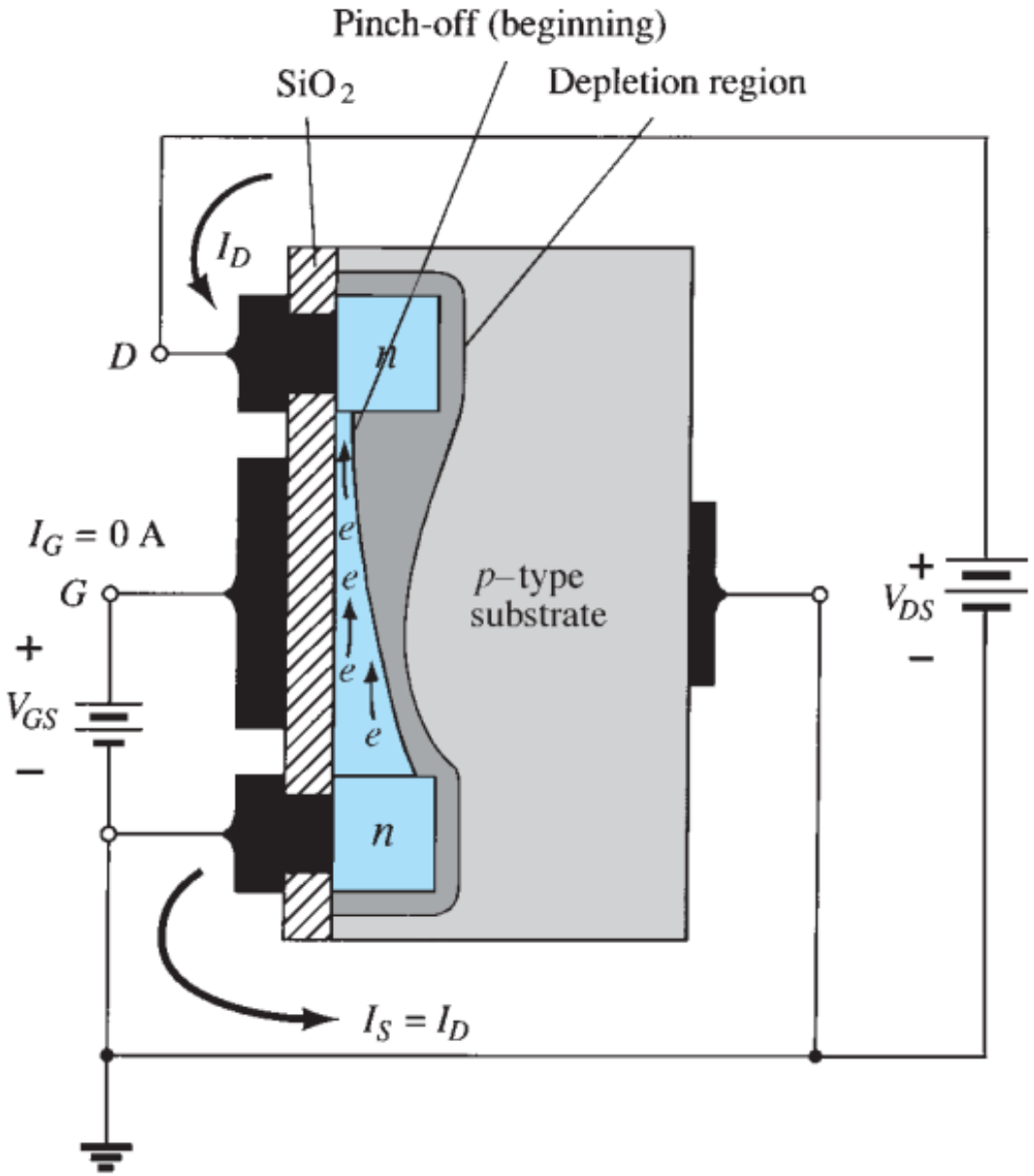
Channel formation in the n-channel enhancement-type MOSFET

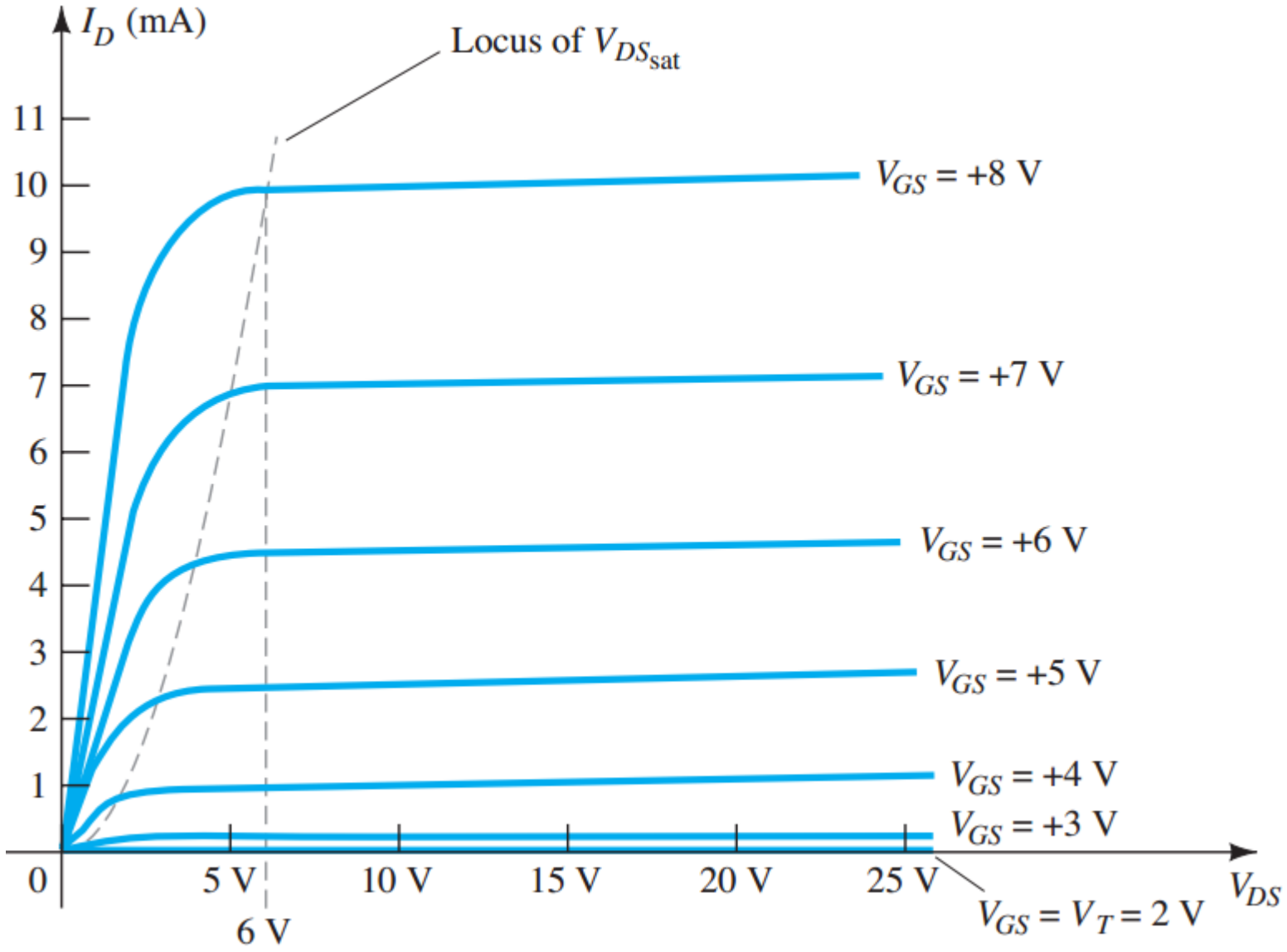


Change in channel and depletion region with increasing level of V_{DS} for a fixed value of V_{GS}

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

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





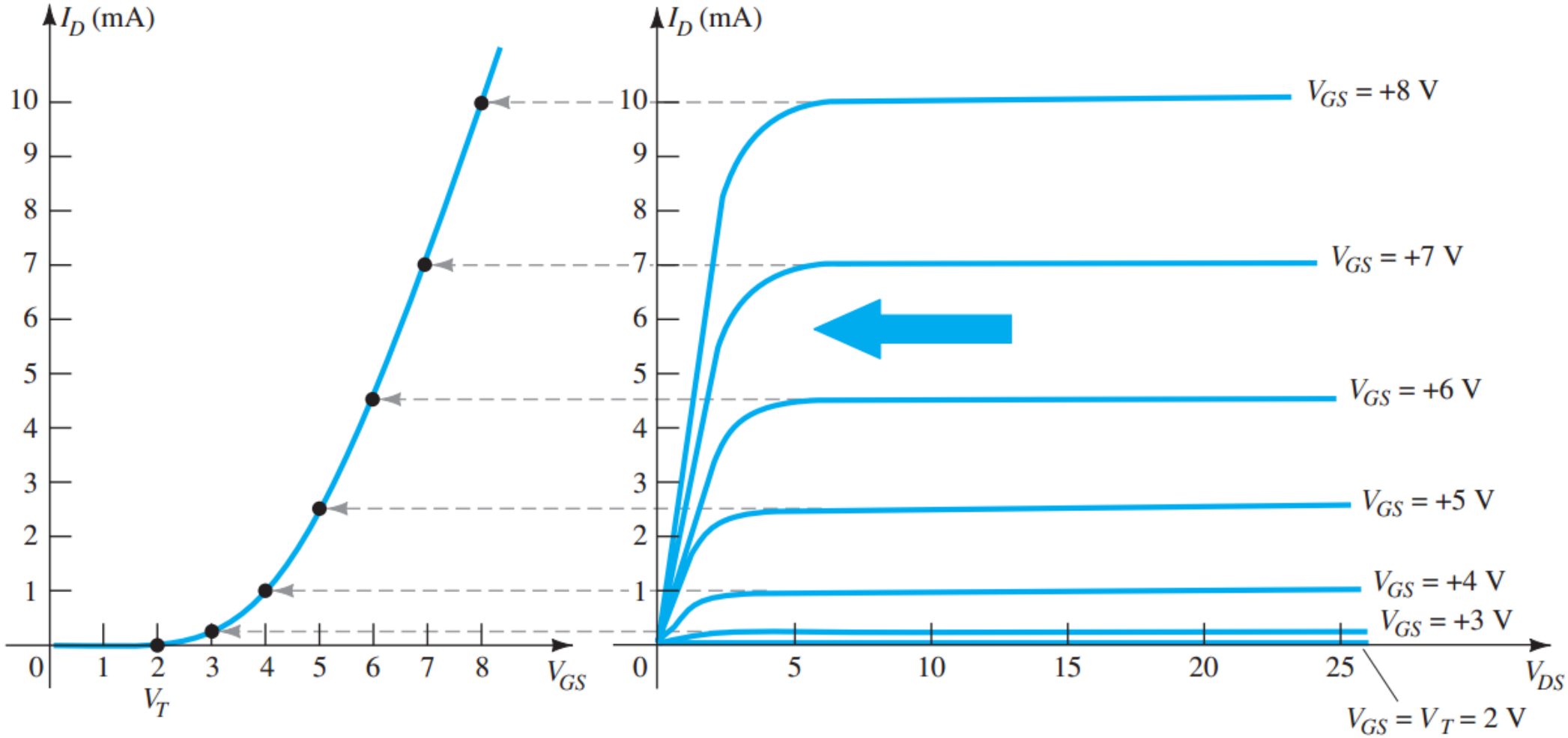
Drain characteristics of an n-channel enhancement-type MOSFET

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

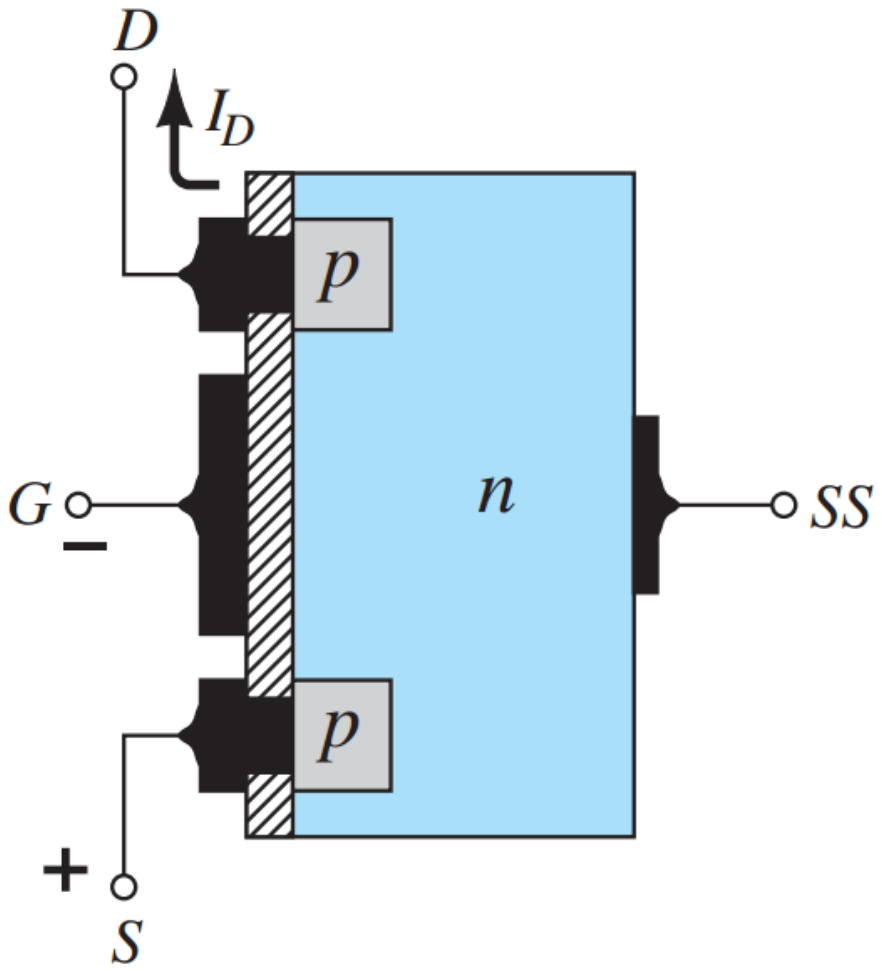
$$I_D = k(V_{GS} - V_T)^2$$

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

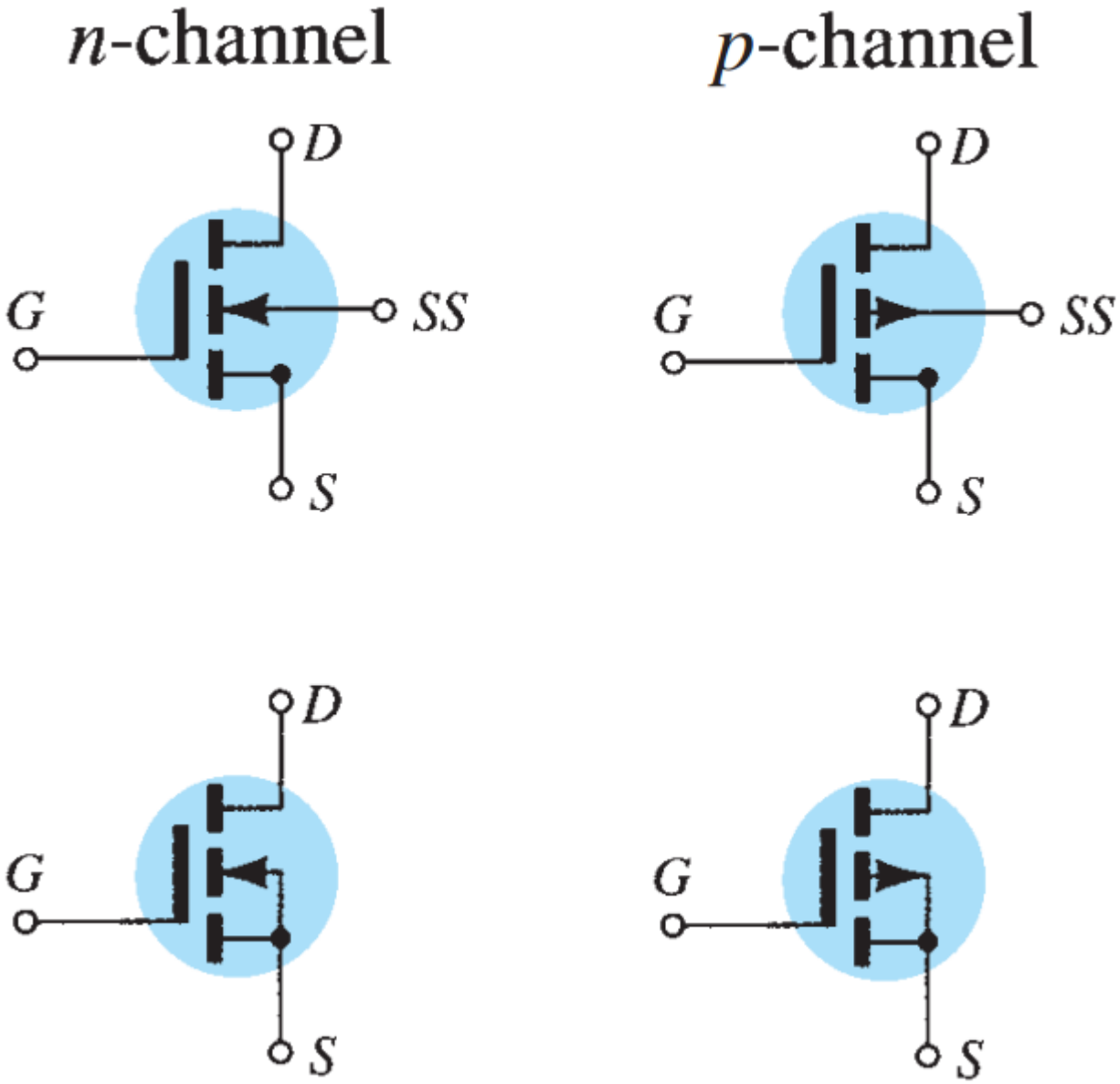
Transfer characteristics for an n-channel enhancement-type MOSFET from the drain characteristics



p-Channel enhancement-type MOSFET



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



Readings

Electronic Devices and Circuit Theory
– Boylestad, Nashelsky

Chapter 6: Field-Effect Transistors