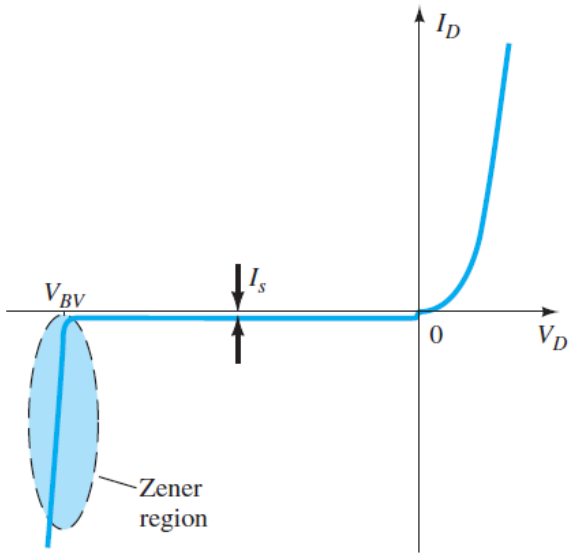
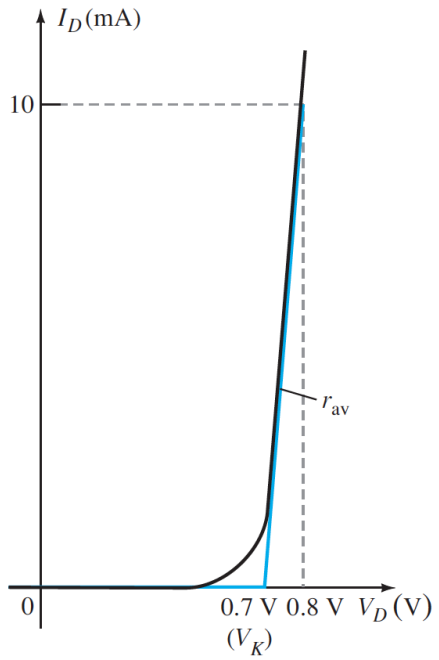
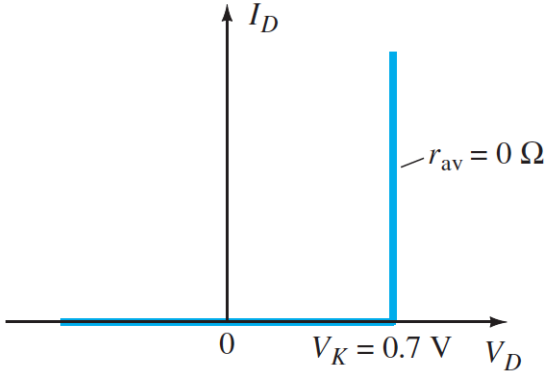
Fundamentals of Electronics

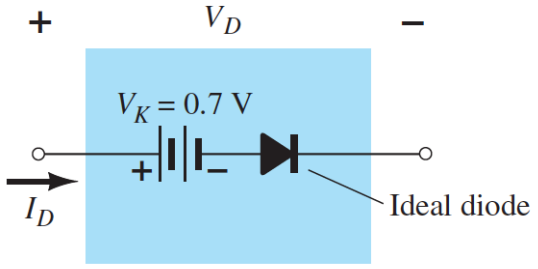
ECE 101

Summary

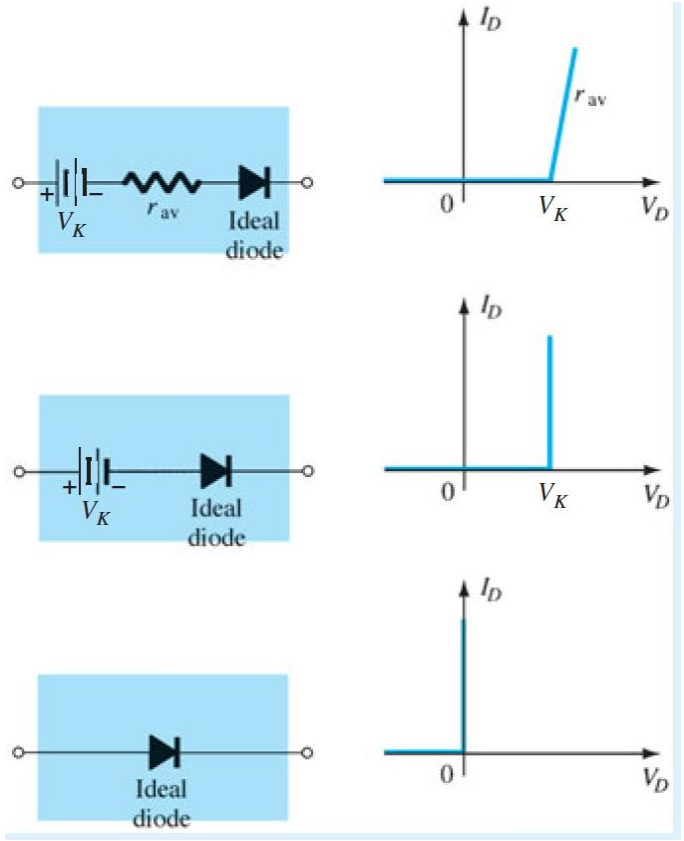

I_D
V_{BV}
I_s
0
V_D
Zener region

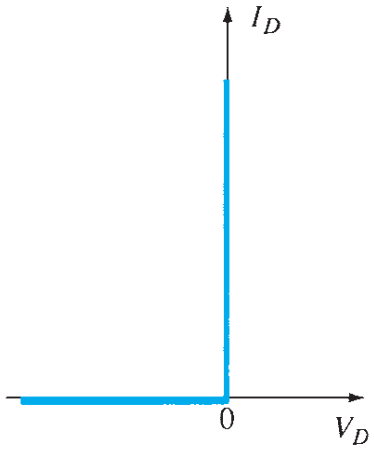

I_D(mA)
10
r_{av}
0
0.7 V 0.8 V V_D(V)
(V_K)

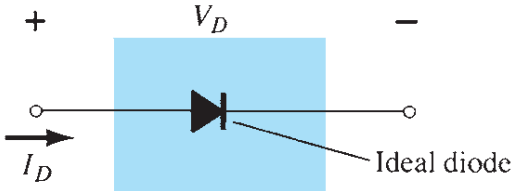

I_D
$r_{av} = 0\ \Omega$
0
$V_K = 0.7$ V
V_D


+
V_D
−
$V_K = 0.7$ V
+
−
I_D
Ideal diode

Si

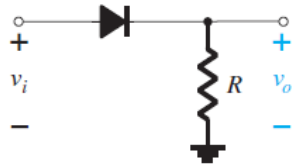

I_D
r_{av}
0
V_K
V_D
+
−
V_K
r_{av}
Ideal diode
I_D
0
V_K
V_D
+
−
V_K
Ideal diode
I_D
0
V_D
Ideal diode

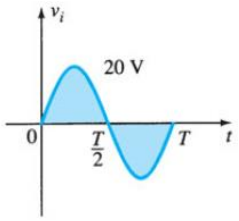

I_D
0
V_D

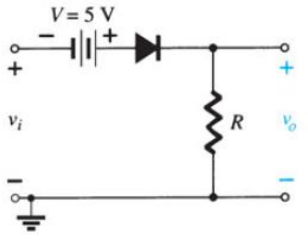

+
V_D
−
I_D
Ideal diode

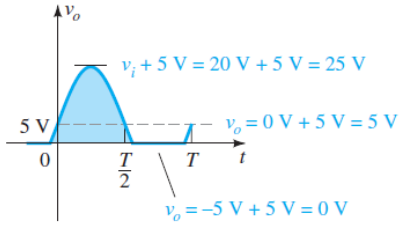
Diode as clipper

In series

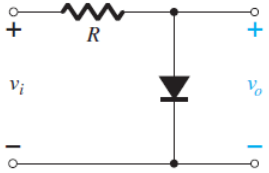


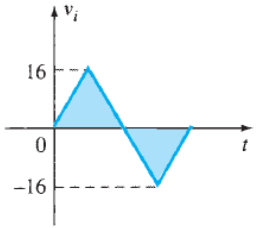


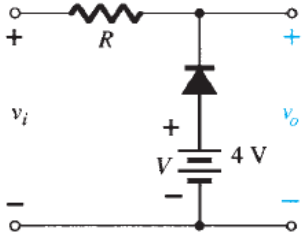


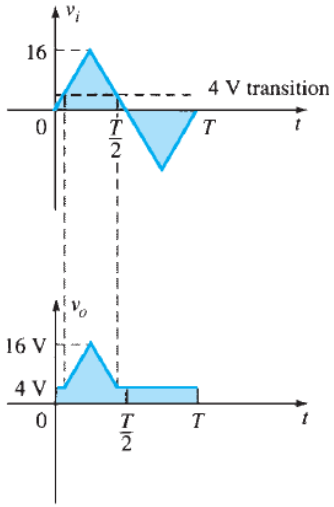


In parallel



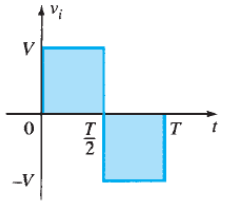


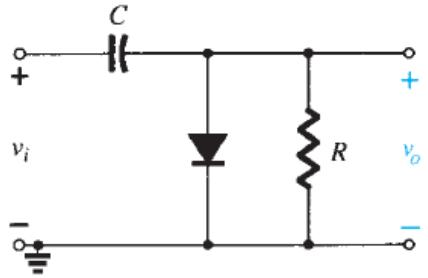


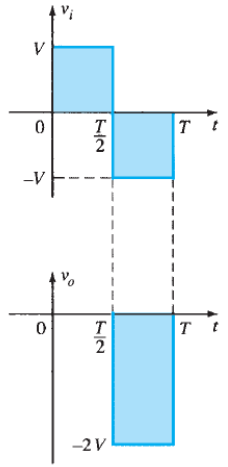


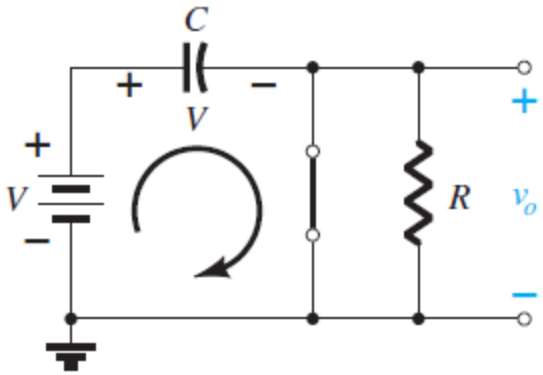
Diode as clamper

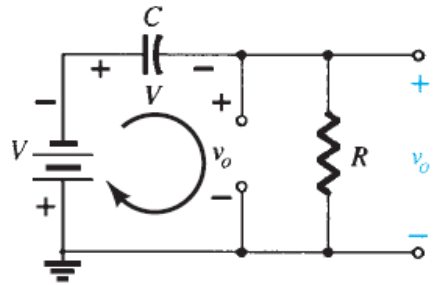
Clamper is a circuit that changes the dc level of a waveform without changing its appearance.



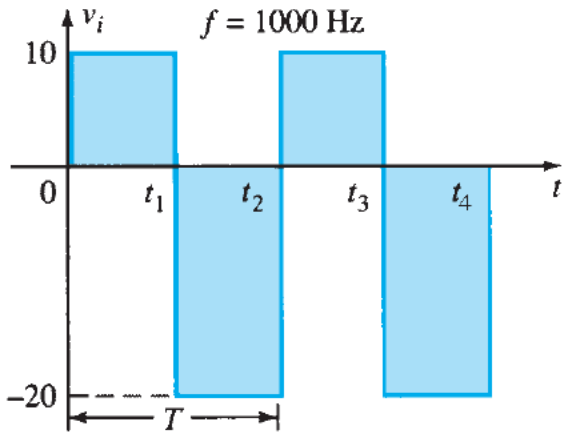


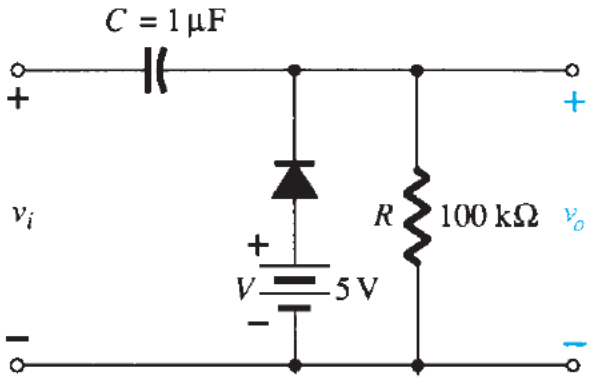




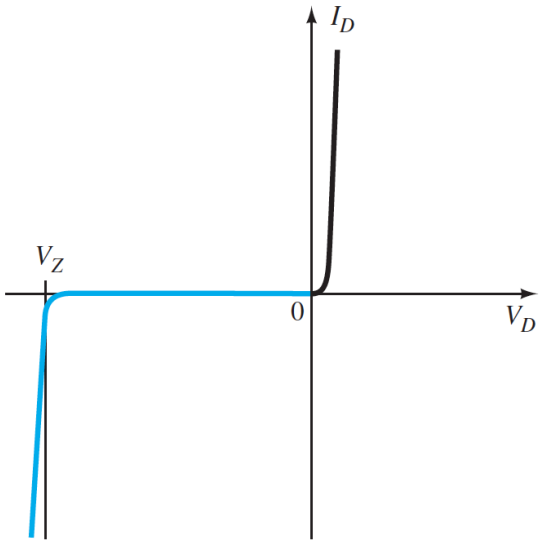


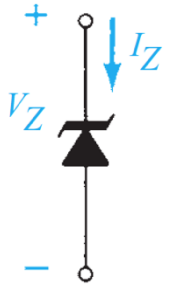
Determine the output voltage

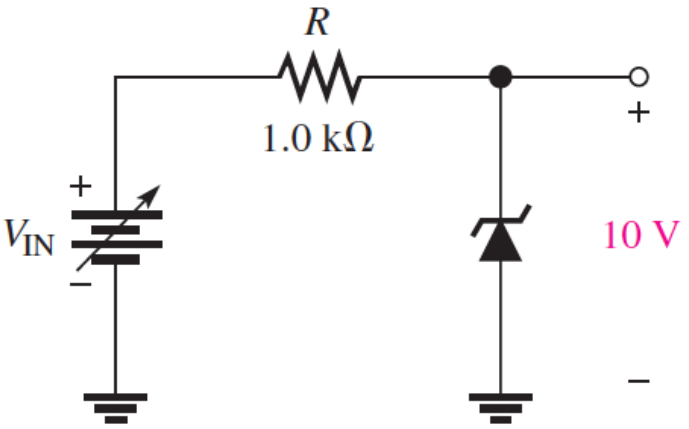


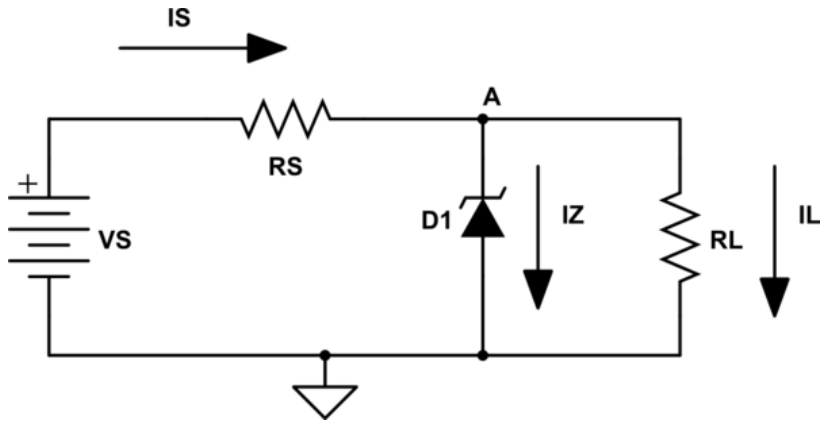


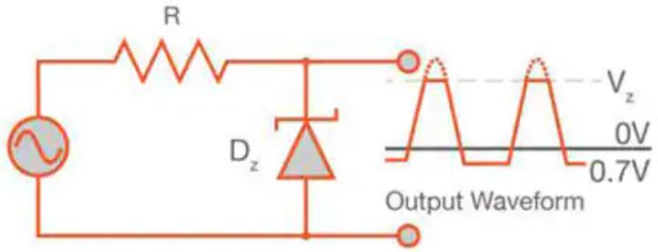
Zener Voltage Regulation





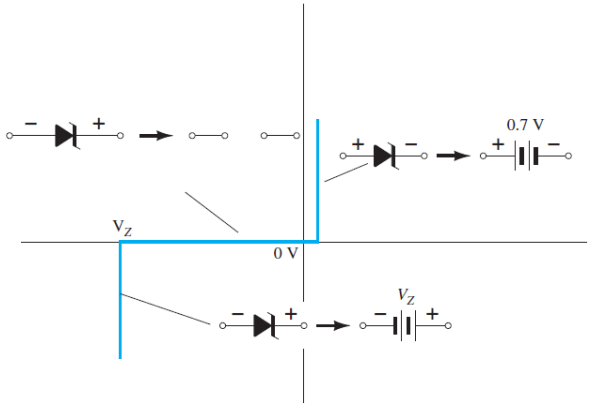


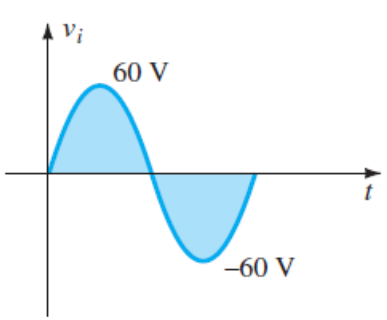


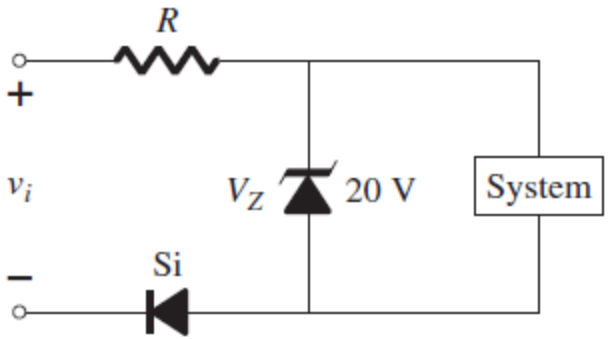


Zener regulation

Voltage regulator







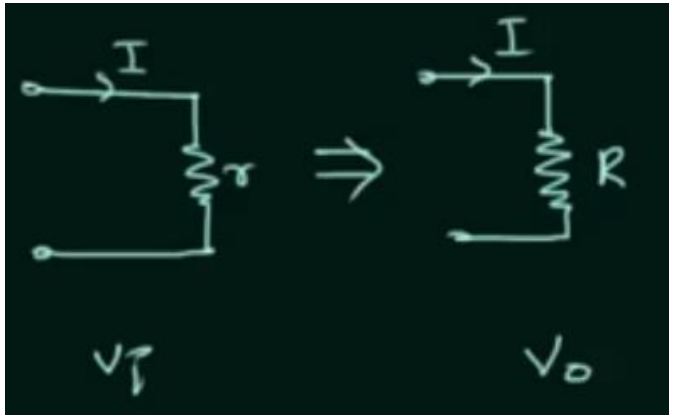
The Transistor

Amplification and switching

Transistor

- Key characteristic:
  - The transistor is a three-terminal device with the feature that the current through two terminals can be controlled by small changes we make in the current or voltage at the third terminal.
  - This control feature allows us to amplify small ac signals or to switch the device from an *on* state to an *off* state and back.
  - These two operations, *amplification* and *switching*, are the basis of a host of electronic functions.
  - This forms the basis for both bipolar junction transistors (BJT) and field effect transistors (FET).

The transistor action - 1



$V_i = I \times r$ $\quad V_o = I \times R$

$V_i < V_o$ (amplification)

Active mode

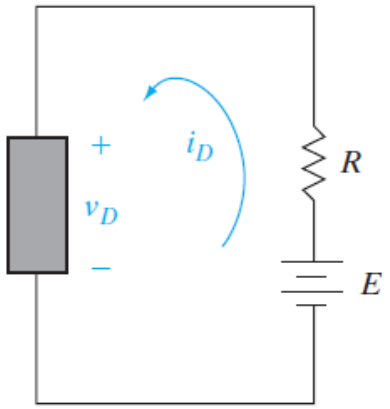
$J_1 \rightarrow$ f.b. $\quad$ Res = 0

$J_2 \rightarrow$ r.b. $\quad$ Res = ∞

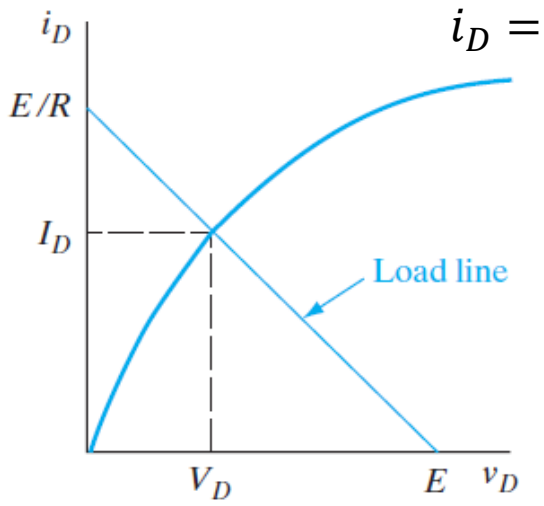
BJT

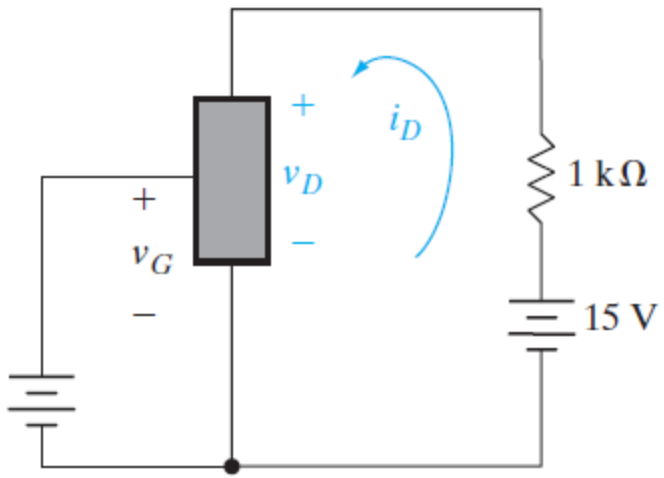
The transistor action - 2

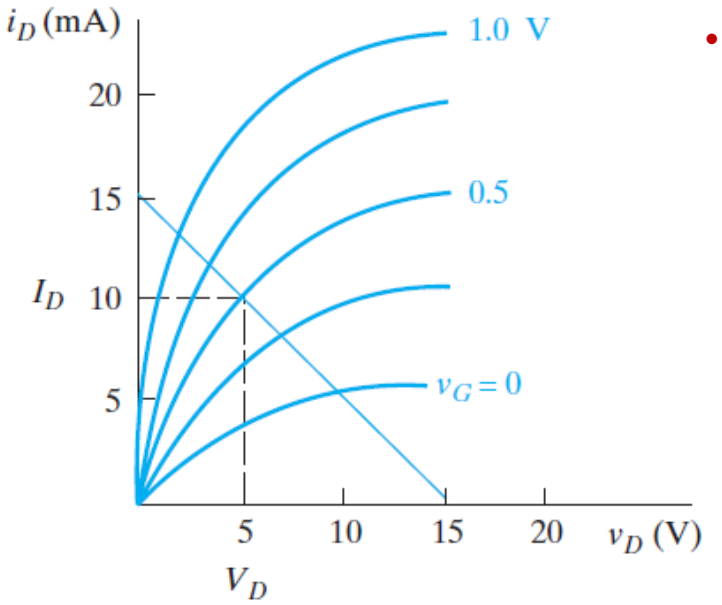
Load line $E = i_D R + v_D$



$i_D = f(V_D)$







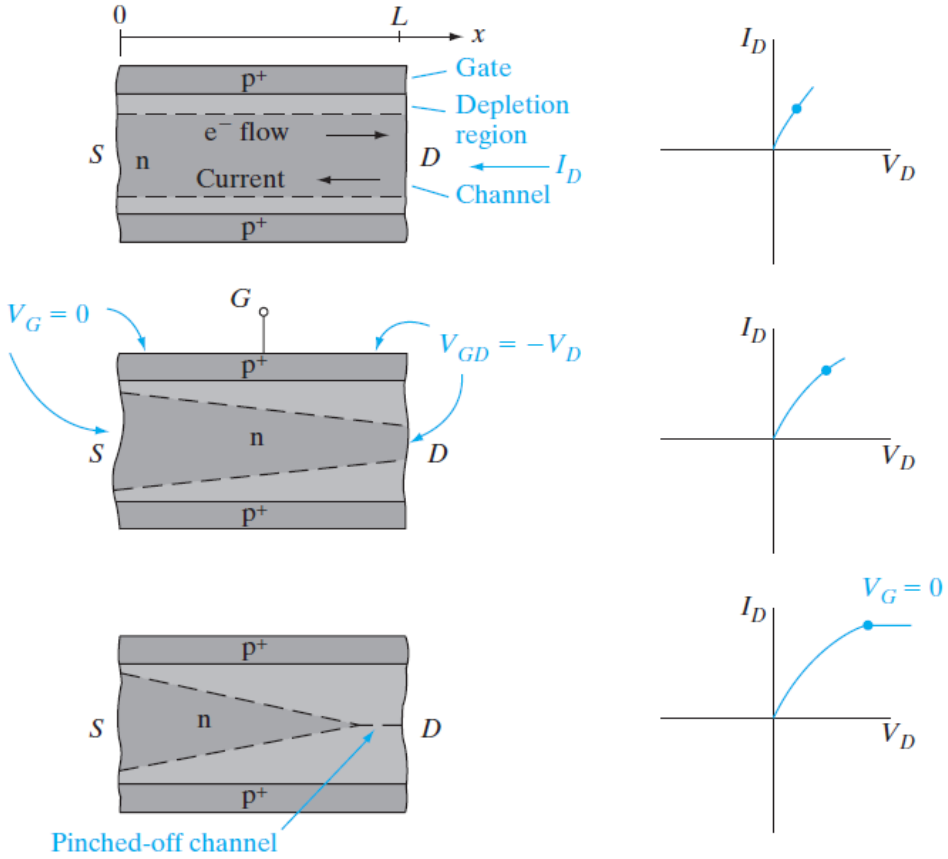
- If an ac source is added to the control voltage
  - We can achieve large variations in *iD* by making small changes in V*G*
  - For example if V*G* changes by value of 0.25V, *Vd* varies about its dc 2V.
  - Thus the amplification of the ac signal is 2/0.25 = 8.
  - we can switch from the bottom of the load line to almost the top by appropriate changes in V_G.

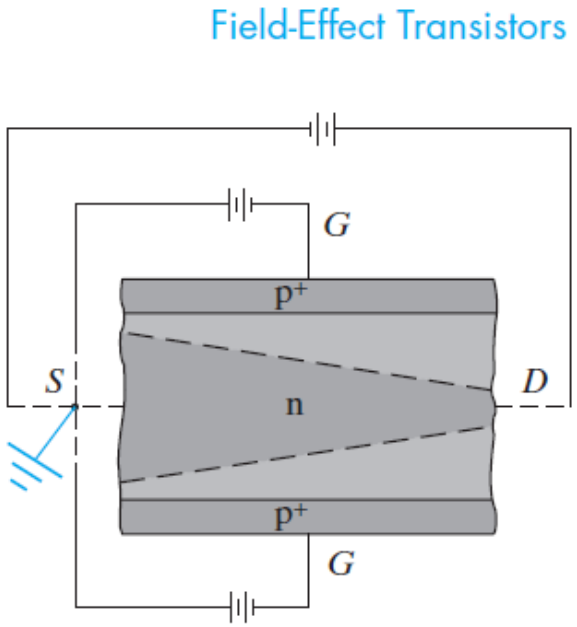
For BJTs, this kind of control is achieved by current control.

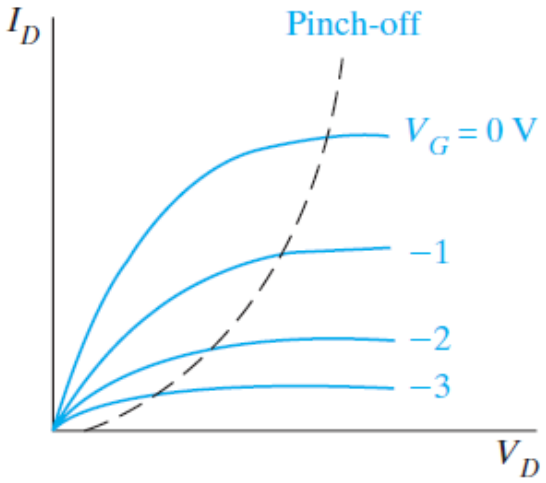
Field Effect Transistors

The idea

Junction Field Effect Transistor: JFETs







Gate control

Thank you