

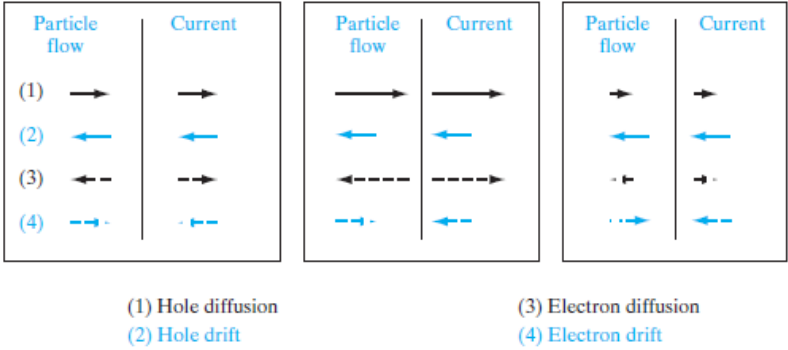
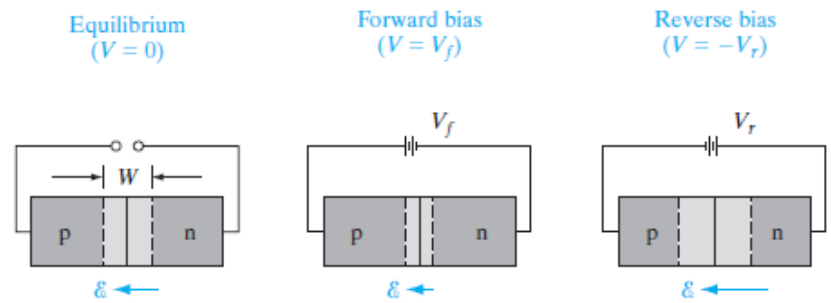
ECN 101

Introduction to Electronics and Communication Engineering

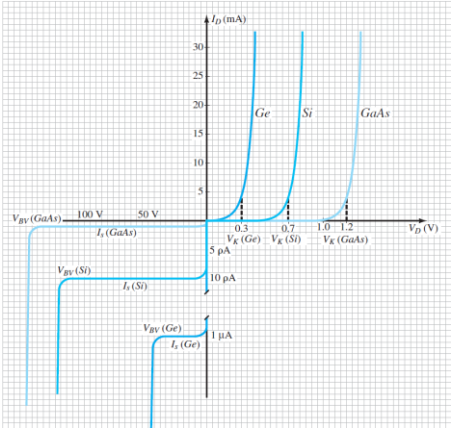
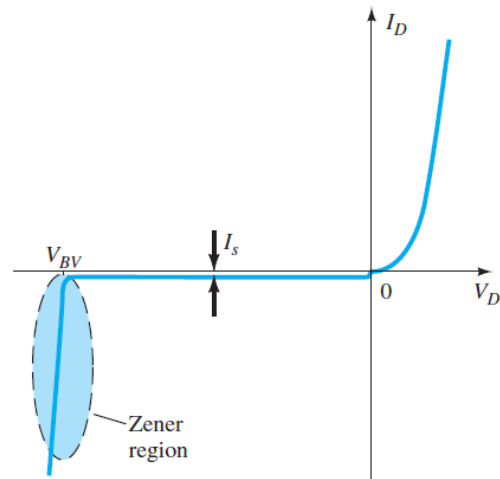
Important info

- Groups
- Project
- Teaching assistant
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Review



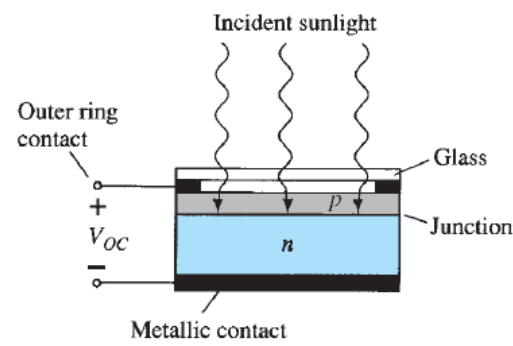
$$I_D = I_S(e^{V_D/nV_T} - 1)$$



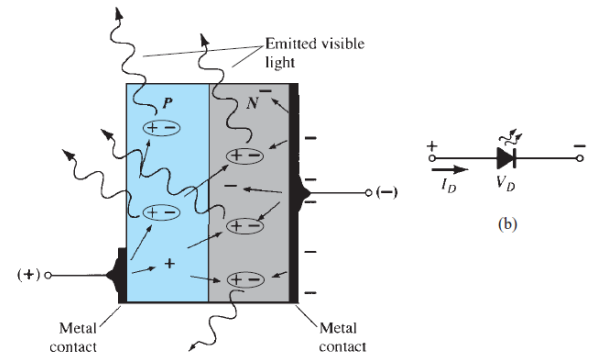
Bandgap

Free carriers

Solar Cells



LEDs



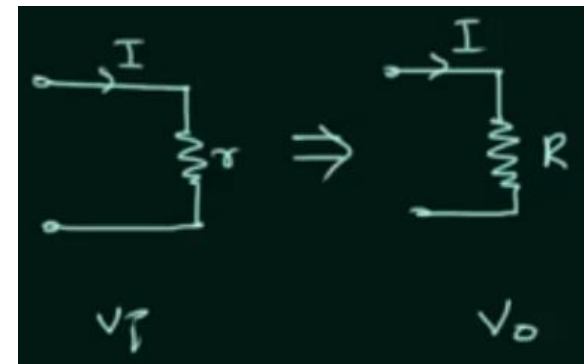
The transistor

Transistor

Amplification and switching

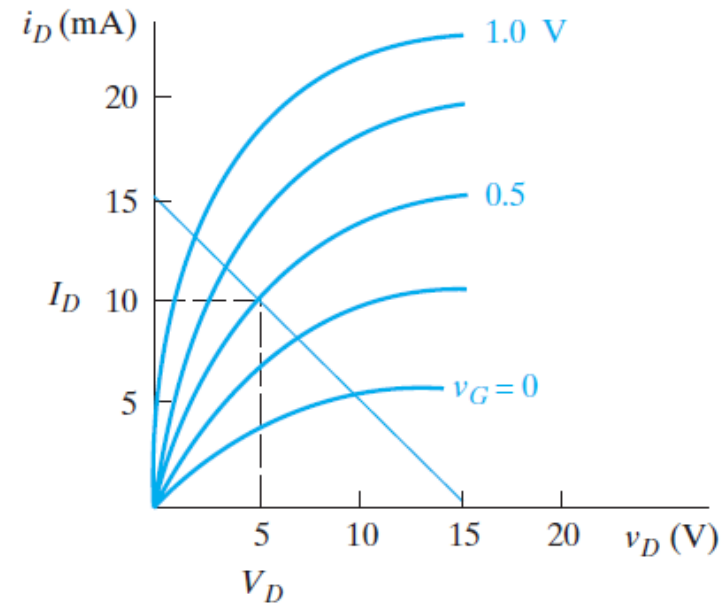
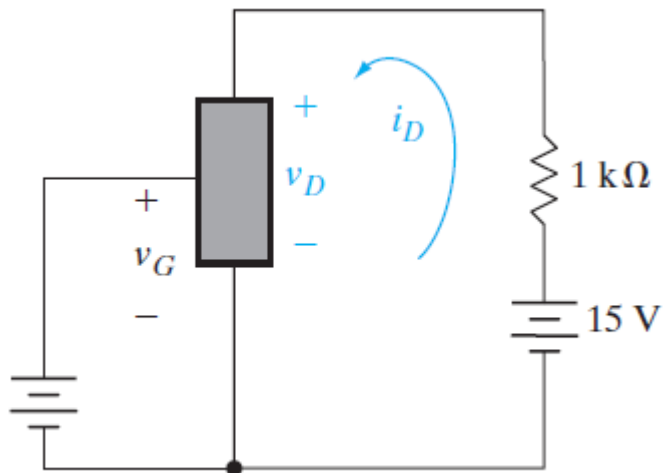
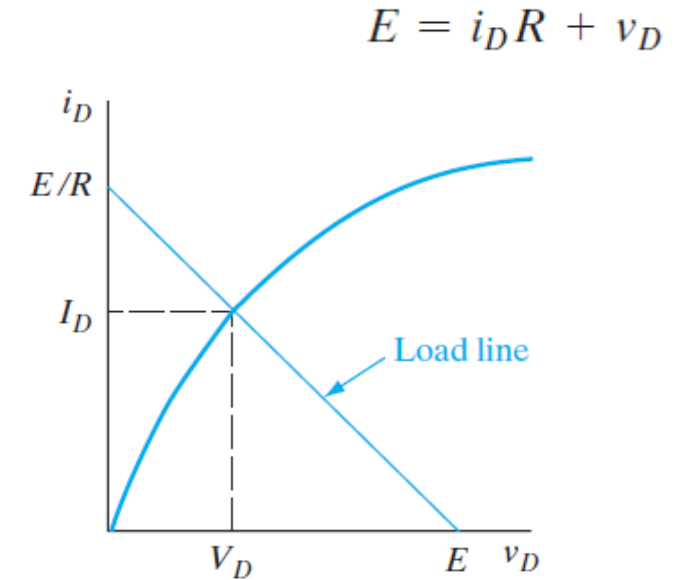
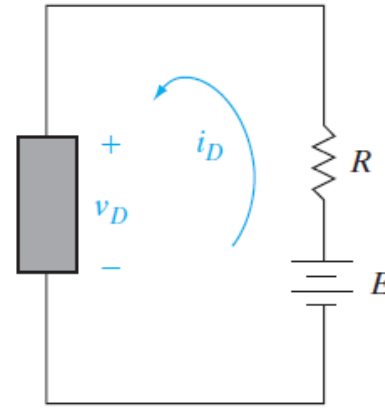
- Key characteristic:
 - The transistor is a three-terminal device with the feature that the current through two terminals can be controlled by small changes we make in the current or voltage at the third terminal.
 - This control feature allows us to amplify small ac signals or to switch the device 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 and field effect transistors.

Active mode
 $J_1 \rightarrow f-b$ $R_{es} = 0$
 $J_2 \rightarrow r-b$ $R_{es} = \infty$



$$V_i = I \times r \quad V_o = I \times R$$
$$V_i < V_o \quad (\text{amplification})$$

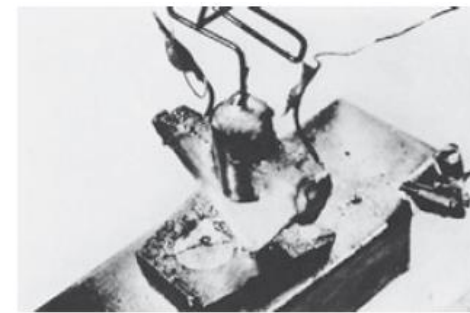
The transistor action



- If an ac source is added to the control voltage
 - We can achieve large variations in i_D by making small changes in V_G
 - For example if V_G changes by value of 0.25V, V_d 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 .

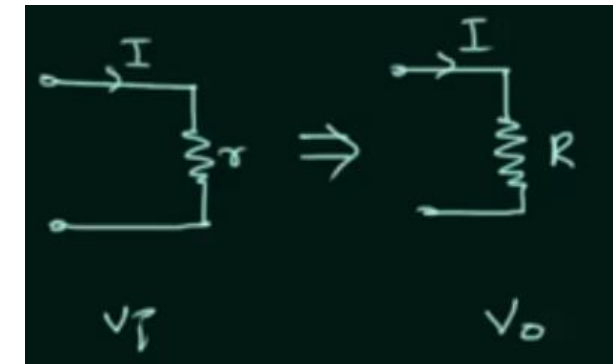
For BJTs, this kind of control is achieved by current control.

Transistors: BJT



The first transistor

Active mode
 $J_1 \rightarrow f \cdot b \cdot R_{es} = 0$
 $J_2 \rightarrow r \cdot b \cdot R_{es} = \infty$

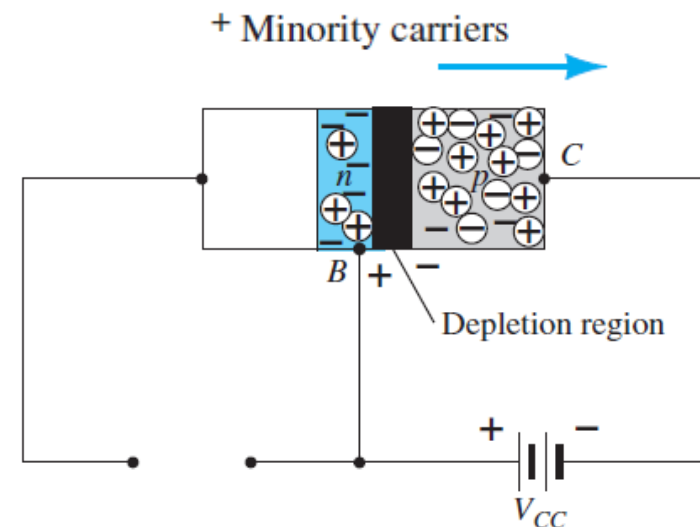
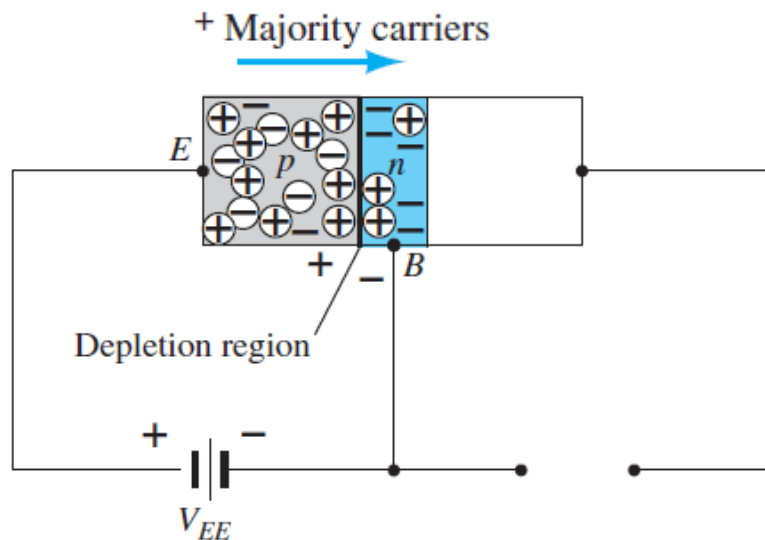


$$V_i = I \times r \quad V_o = I \times R$$

$$V_i < V_o \quad (\text{amplification})$$

One p-n junction is forward biased, the other one is reverse biased.

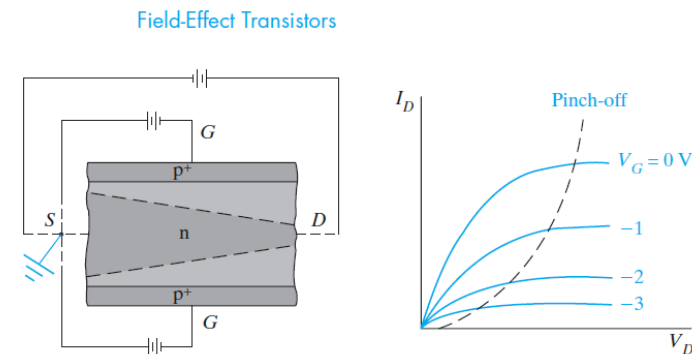
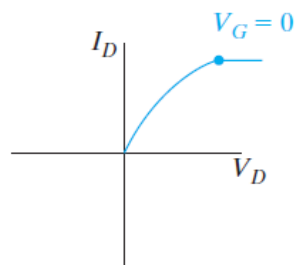
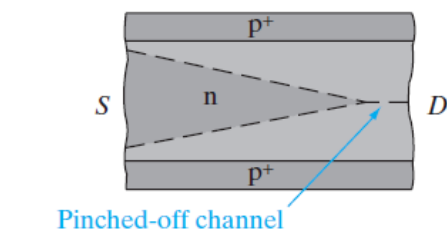
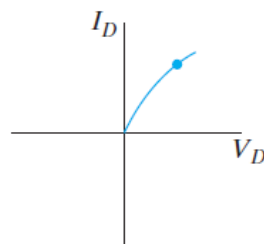
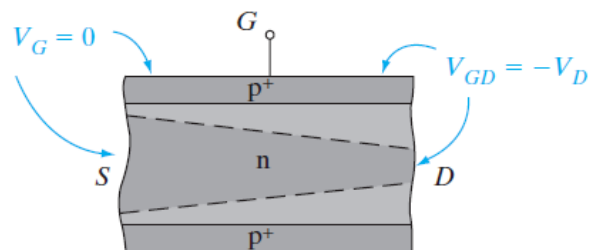
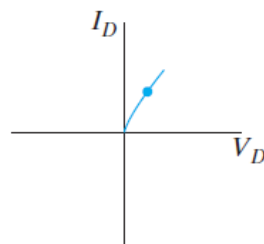
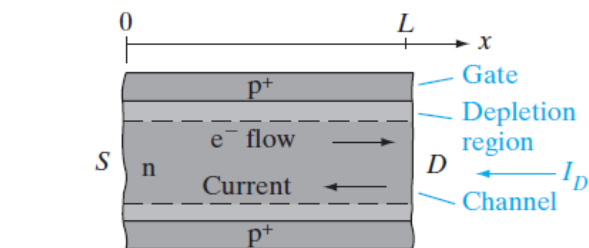
Basic mechanism



Field Effect Transistors

The idea

Junction Field Effect Transistor: JFETs



Gate control

Field Effect Transistors

MOSFETs

Different regimes as V_D is varied.

