

EE-202 Electronics-I-

Chapter 10

Field-Effect Transistors

JFET

FET

FET (Field-Effect Transistors) - BJTs (Bipolar Junction Transistors).

Similarities:

- **Amplifiers**
- **Switching devices**
- **Impedance matching circuits**

Differences:

- **FETs are voltage controlled devices, BJTs are current controlled devices.**
- **FETs have a higher input impedance, BJTs have higher gains.**
- **FETs are less sensitive to temperature variations and they are more easily integrated on ICs.**
- **FETs are generally more sensitive to static than BJTs.**

FET Types

- **JFET** — Junction Field-Effect Transistor
- **MOSFET** — Metal-Oxide Field-Effect Transistor
 - **D-MOSFET** — Depletion MOSFET
 - **E-MOSFET** — Enhancement MOSFET

JFET Construction

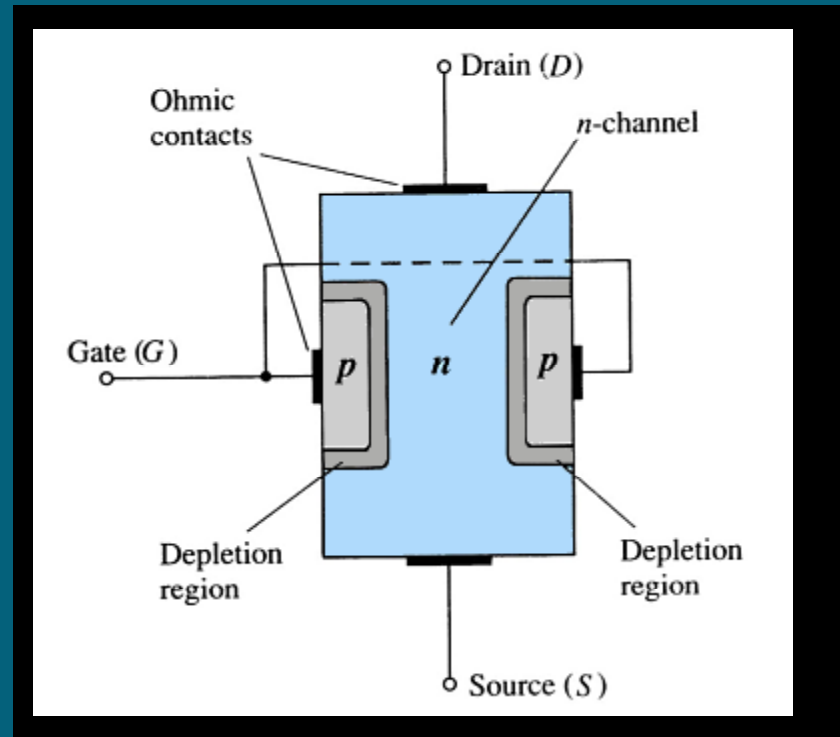
There are two types of JFETs

- *n*-channel
- *p*-channel

The *n*-channel is more widely used.

There are three terminals.

- **Drain (D)** and **source (S)** are connected to the *n*-channel
- **Gate (G)** is connected to the *p*-type material



JFET Operating Characteristics

Three basic operating conditions for a JFET:

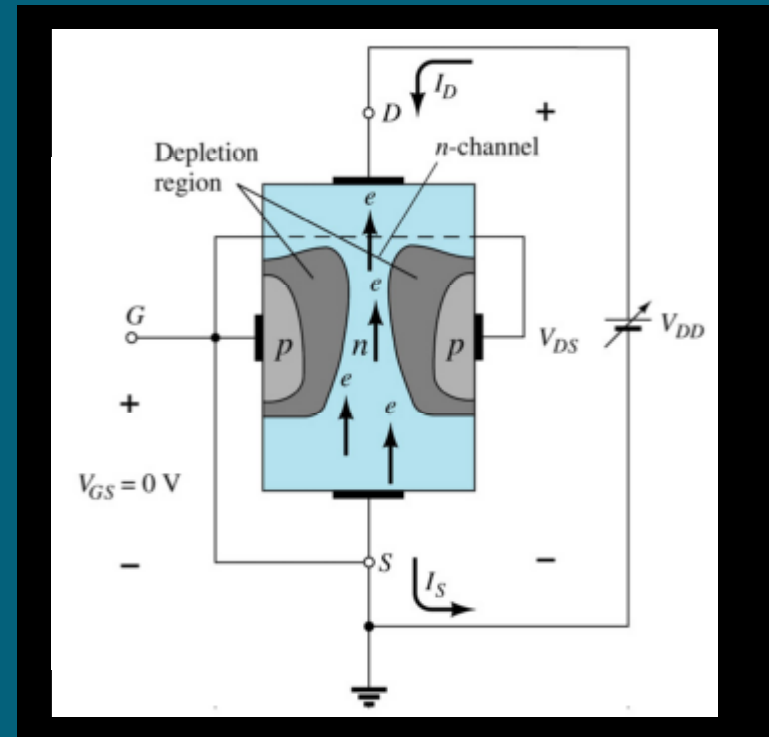
- $V_{GS} = 0$, V_{DS} increasing to some positive value
- $V_{GS} < 0$, V_{DS} at some positive value
- **Voltage-controlled resistor**

JFET Operating Characteristics

$V_{GS} = 0$, V_{DS} increasing to some positive value

When $V_{GS} = 0$ and V_{DS} is increased from 0 to a more positive voltage;

- The depletion region between p-gate and n-channel increases
- Increasing the depletion region, decreases the size of the n-channel
- Increasing in the n-channel resistance, the I_D current increases.



JFET Operating Characteristics

$V_{GS} = 0$, V_{DS} increasing to some positive value: Pinch Off

$V_{GS} = 0$ and V_{DS} is increased to a more positive voltage, the depletion zone gets so large that it **pinches off** the n-channel.

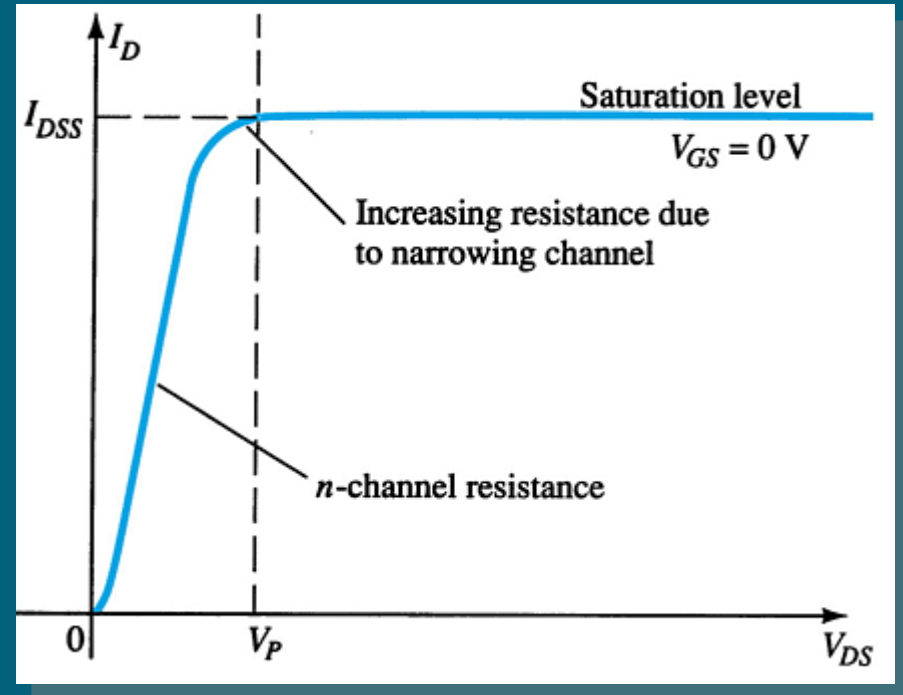
The current in the n-channel (I_D) would drop to 0 A, but it does just the opposite—as V_{DS} increases, so does I_D .

JFET Operating Characteristics

$V_{GS} = 0$, V_{DS} increasing to some positive value: Saturation

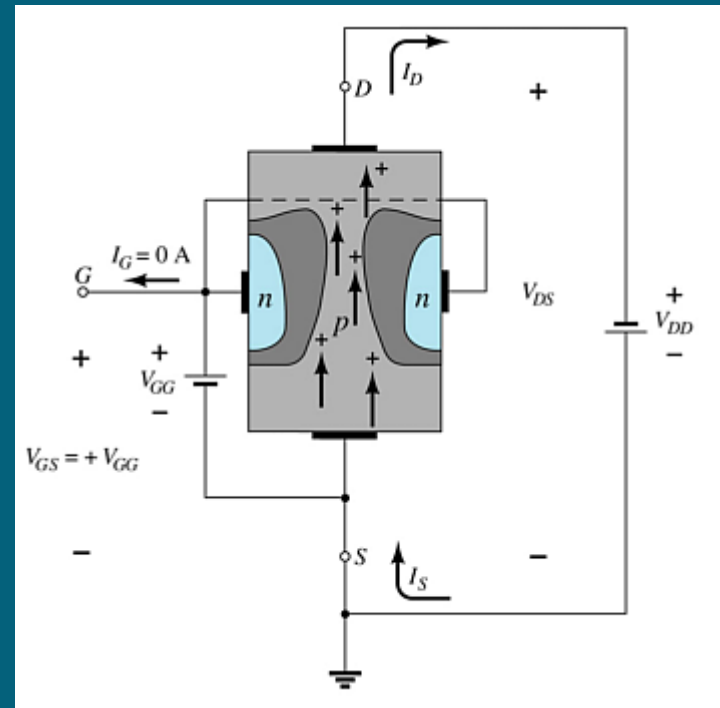
At the pinch-off point:

- Increasing in V_{GS} does not produce any increasing in I_D .
- V_{GS} at pinch-off is denoted as V_p .
- I_D is at saturation or maximum. It is referred to as I_{DSS} .
- The ohmic value of the channel is maximum.

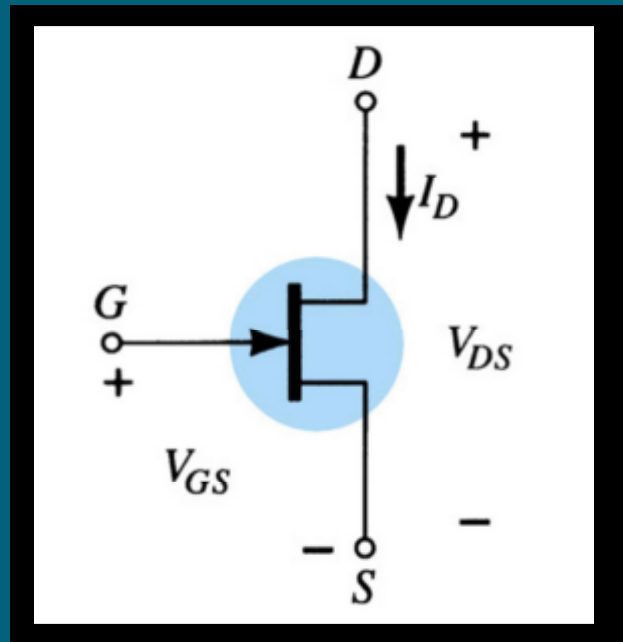


p-Channel JFETs

The *p*-channel JFET is similar to the *n*-channel JFET, except the polarities and currents are reversed.



JFET Symbol



JFET Transfer Curve

This graph shows the value of I_D for a given value of V_{GS} .

