Transistors and Transistor Circuits

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1. Introduction

- A transistor is a three-terminal semiconductor device used to amplify or switch electronic signals.
- The two main families are the bipolar junction transistor (BJT) and the field-effect transistor (FET).

2. BJT Structure and Types

- **NPN and PNP:** BJTs have three regions called emitter, base, and collector formed from doped semiconductor.
- Current flows from collector to emitter when a small base current is supplied, giving current control.
- **Current gain (?):** the ratio of collector current to base current, often 50 to 300.

3. Field-Effect Transistors

- **JFET and MOSFET:** FETs are voltage-controlled, using gate voltage to control current between drain and source.
- MOSFETs dominate digital circuits because of high input impedance and low power use.

4. Operating Regions

- **Cut-off:** transistor is off and conducts no current, acting as an open switch.
- **Saturation:** transistor is fully on, acting as a closed switch.
- **Active region:** used for linear amplification of signals.

5. Common Circuits

- Common-emitter amplifiers provide voltage and current gain for audio and signal stages.
- Transistors act as switches in logic gates, relays, and motor drivers.

6. Summary

- Transistors amplify and switch signals; BJTs are current-controlled and FETs are voltage-controlled, with biasing setting the operating region.