Transistor Geometries and Cross-Sections

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IC Bipolar Junction Transistor Cross-Section with Buried Layer & Isolation

Cross-section:
- Emitter
- Base
- Collector
- n+ buried layer
- p-type substrate

Surface view:
An Assortment of Integrated Circuit Bipolar Junction Transistor Layouts
Additional Integrated Circuit Bipolar Junction Transistor Layouts

a) Base Collector

b) B E C

c) B E B C C
Discrete Bipolar Junction Transistor Cross-Section of Structure

Isolation is achieved by chip separation on wafer.

- **E**
- **B**
- **C**

- **p**-type diffused base layer
- **n**-type epitaxial layer
- **n+ wafer for low collector resistance**
Discrete Bipolar Junction Transistor Layouts

Photomicrograph of the 2N1613 – 1st Planar BJT sold commercially.

TO-18 transistor package
Discrete Power BJT on a TO-3 Header (Note copper connections to chip)

Still another BJT geometry
Discrete MOS Field-Effect Transistor

Photomicrograph of the FI 100, one of the first MOS transistors sold commercially.
Layout of four NAND Gates on a Single IC Die (TTL Logic)

Array of four NAND gates

https://en.wikipedia.org/wiki/NAND_gate
CMOS Inverter Gate – Circuit Schematic and Physical Layout

Physical Layout – Topography of devices and interconnects, made up of polygons that represent different layers of material.
CMOS Cross-Sectional View Showing NMOS and PMOS Transistors
CMOS NAND Gate Circuit Schematic and Layout

- **Input A** and **Input B**
- **Output Y**
- **VDD** and **GND** connections
- **p-MOS** and **n-MOS** transistors
- **CMOS NOR gate** schematic
Back to BJT Devices:

741 Op Amp IC Layout

- Differential amplifier
- Gain stage
- Output stage
- Inputs
- Capacitor
- Short-circuit protection
- Output
741 Op Amp IC Circuit Schematic Diagram