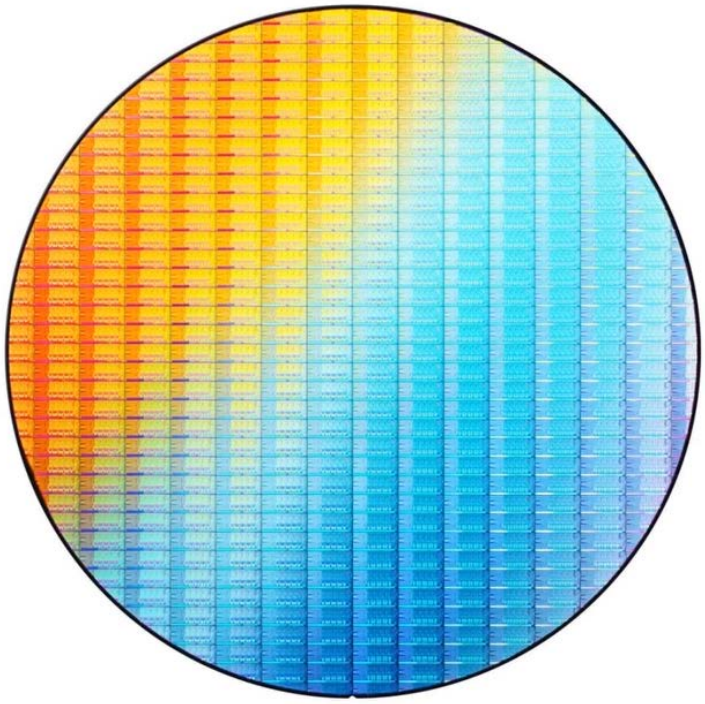
How Metal Oxide Field Effect Transistors Work

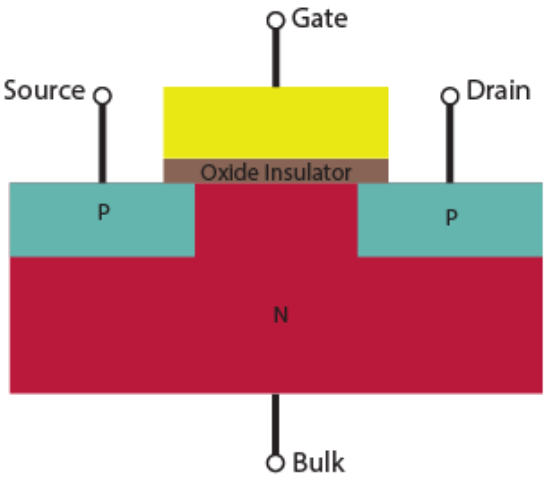
The metal-oxide-semiconductor field-effect transistor (MOSFET for short) is a commonly used transistor used for switching and amplification.

MOSFETS have four regions known as a gate (G), a source (S), a drain (D), and a body or bulk (B). Each of these regions is connected to a terminal. The bulk and drain are often connected together so only three terminals, the Source, Gate, and Drain are shown in electrical diagrams. MOSFETs are usually created on silicon substrate.

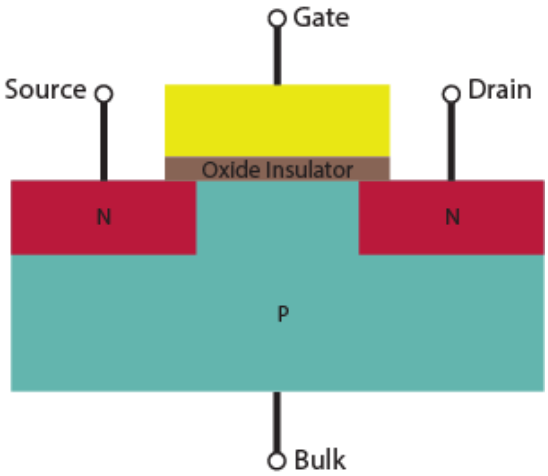


Silicon Wafer Substrate

MOSFETs can be either p-channel or n-channel transistors. The substrate of an p-channel transistor will be n-type silicon. N-type silicon is silicon that has been doped to have more free electrons. For n-channel transistors, a p-type silicon substrate is used. P-type silicon is silicon that has been doped to have more electron holes. The source and drain regions are created by doping the silicon to the opposite polarity of the substrate. P-channel and n-channel transistors are also referred to as pMOS and nMOS respectively.

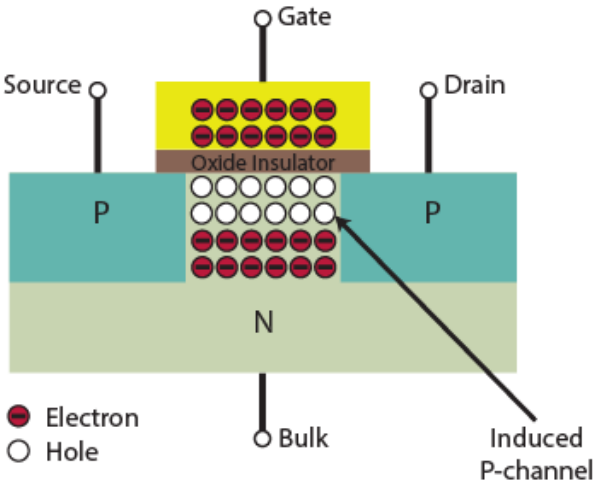


pMOS transistor

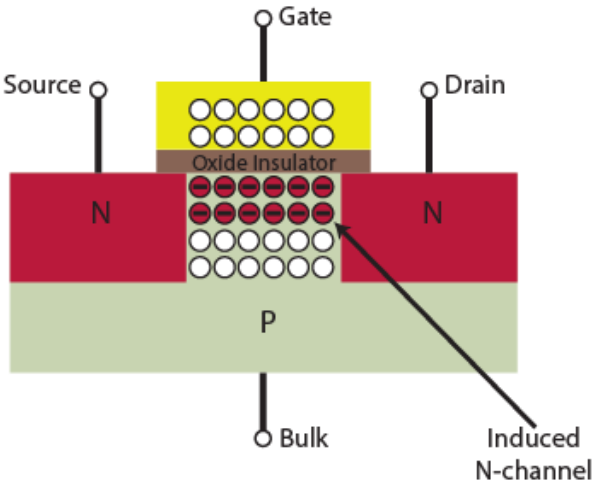


nMOS transistor

The flow of current through a MOSFET is controlled by the gate. If there is no voltage potential at the gate, there will be no flow of current between the source and drain. When a voltage is applied to the region under the gate, an electrical field will be created that creates a channel between the source and the drain. This channel allows current to flow from the source to the drain.



pMOS transistor



nMOS transistor

When a negative voltage is applied to the gate of an pMOS transistor, electrons are repulsed from the region under the gate, forming a p-channel that allows current to flow. When a positive voltage is applied to the gate of an nMOS transistor, electrons are attracted to the region under the gate, forming a negatively charged region known as an n-channel that allows current to flow.