# Integrated gate-commutated thyristor wikipedia

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A power semiconductor device is a semiconductor device used as a switch or rectifier in power electronics (for example in a switch-mode power supply). Such a device is also called a power device or, when used in an integrated circuit, a power IC.

A power semiconductor device is usually used in "commutation mode" (i.e., it is either on or off), and therefore has a design optimized for such usage; it should usually not be used in linear operation. Linear power circuits are widespread as voltage regulators, audio amplifiers, and radio frequency amplifiers.

The first electronic device used in power circuits was the electrolytic rectifier - an early version was described by a French experimenter, A. Nodon, in 1904. These were briefly popular with early radio experimenters as they could be improvised from aluminum sheets, and household chemicals. They had low withstand voltages and limited efficiency.[1]

The first solid-state power semiconductor devices were copper oxide rectifiers, used in early battery chargers and power supplies for radio equipment, announced in 1927 by L.O. Grundahl and P. H. Geiger.[2]

The first germanium power semiconductor device appeared in 1952 with the introduction of the power diode by R.N. Hall. It had a reverse voltage blocking capability of 200 V and a current rating of 35 A.

The Insulated-gate bipolar transistor (IGBT) was developed in the 1980s, and became widely available in the 1990s. This component has the power handling capability of the bipolar transistor and the advantages of the isolated gate drive of the power MOSFET.

Some common power devices are the power MOSFET, power diode, thyristor, and IGBT. The power diode and power MOSFET operate on similar principles to their low-power counterparts, but are able to carry a larger amount of current and are typically able to withstand a larger reverse-bias voltage in the off-state.

Switching times range from tens of nanoseconds to a few hundred microseconds. Nominal voltages for MOSFET switching devices range from a few volts to a little over 1000 V, with currents up to about 100 A or so, though MOSFETs can be paralleled to increase switching current. MOSFET devices are not bi-directional, nor are they reverse voltage blocking.[20]

An example of this new device from ABB shows how this device improves on GTO technology for switching high voltage and high current in power electronics applications. According to ABB, the IGCT devices are capable of switching in excess of 5000 VAC and 5000 A at very high frequencies, something not possible to do efficiently with GTO devices.[22]

In reality, the design of a diode is a trade-off between performance in on-state, off-state, and commutation. Indeed, the same area of the device must sustain the blocking voltage in the off-state and allow current flow in the on-state; as the requirements for the two states are completely opposite, a diode has to be either optimised for one of them, or time must be allowed to switch from one state to the other (i.e., the commutation speed must be reduced).

These trade-offs are the same for all power devices; for instance, a Schottky diode has excellent switching speed and on-state performance, but a high level of leakage current in the off-state. On the other hand, a PIN diode is commercially available in different commutation speeds (what are called "fast" and "ultrafast" rectifiers), but any increase in speed is necessarily associated with a lower performance in the on-state.