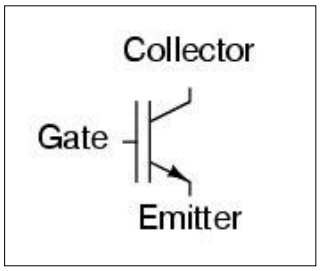
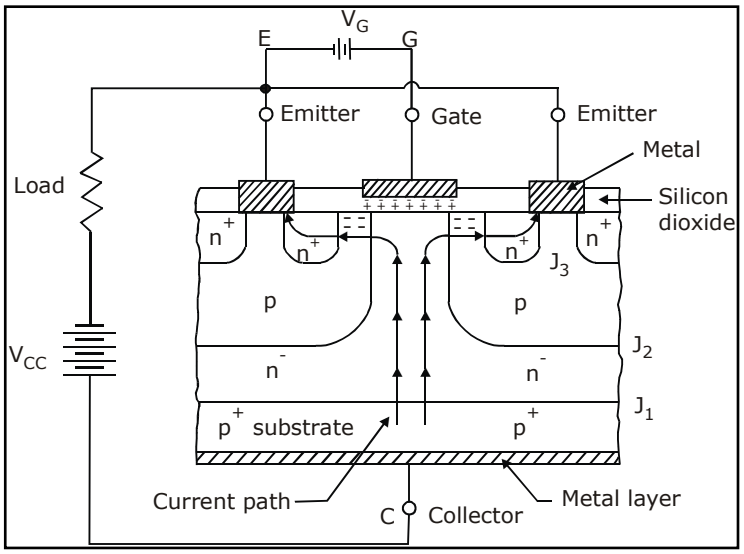
IGBT

The metal oxide semiconductor insulated gate transistor or IGBT combines the advantages of BJT's and MOSFET's. Therefore an IGBT has high input impedance like a MOSFET and low-on state power loss as in a BJT. Further IGBT is free from second breakdown problem present in BJT.



2.7.1 IGBT Basic Structure and Working

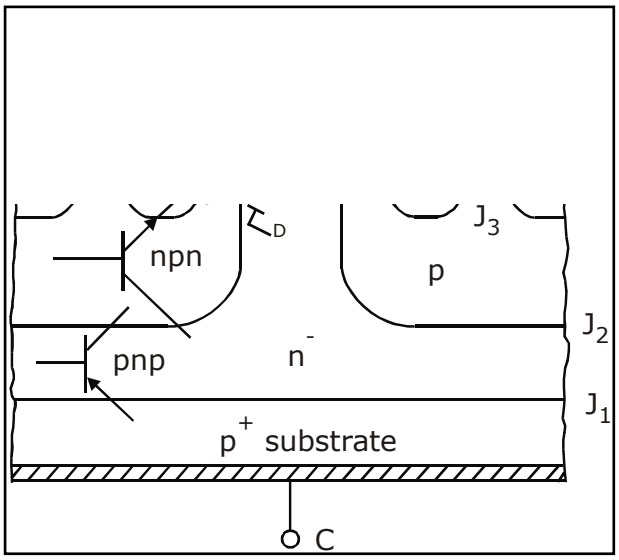


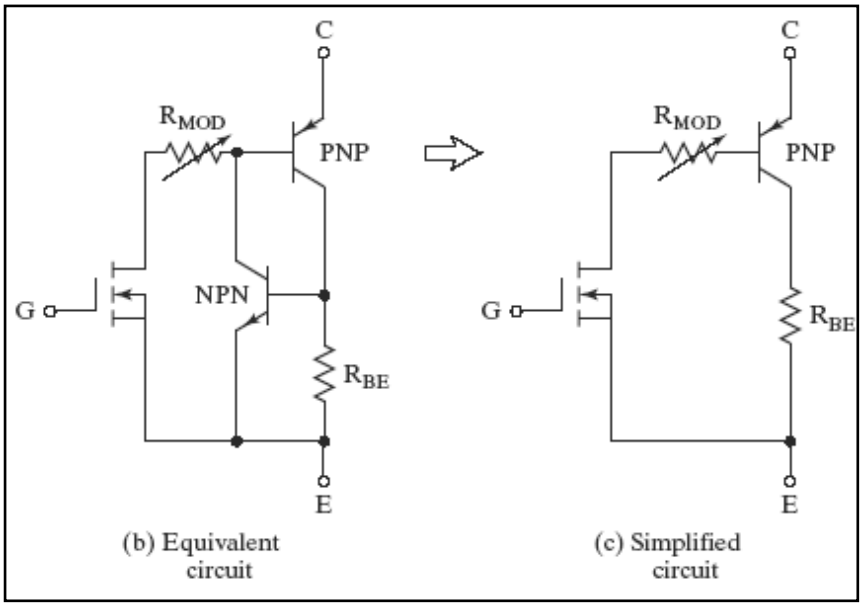
It is constructed virtually in the same manner as a power MOSFET. However, the substrate is now a p^+ layer called the collector.

When gate is positive with respect to positive with respect to emitter and with gate emitter voltage greater than V_{GSTH}, an n channel is formed as in case of power MOSFET. This channel short circuits the region with n^+ emitter regions.

An electron movement in the channel in turn causes substantial hole injection from p^+ substrate layer into the epitaxially layer. Eventually a forward current is established.

The three layers p^+, and constitute a pnp transistor with p^+ as emitter, as base and as collector. Also , and n^+ layers constitute a npn transistor. The MOSFET is formed with input gate, emitter as source and n^- region as drain. Equivalent circuit is as shown below.





Also p serves as collector for pnp device and also as base for npn transistor. The two pnp and npn is formed as shown.

When gate is applied $V_{GS} > V_{GSth}$ MOSFET turns on. This gives the base drive to . Therefore starts conducting. The collector of is base of T_2. Therefore regenerative action takes place and large number of carriers are injected into the n^- drift region. This reduces the ON-state loss of IGBT just like BJT.

When gate drive is removed IGBT is turn-off. When gate is removed the induced channel will vanish and internal MOSFET will turn-off. Therefore will turn-off it T_2 turns off. Structure of IGBT is such that R_1 is very small. If R_1 small T_1 will not conduct therefore IGBT's are different from MOSFET's since resistance of drift region reduces when gate drive is applied due to p^+ injecting region. Therefore ON state IGBT is very small.