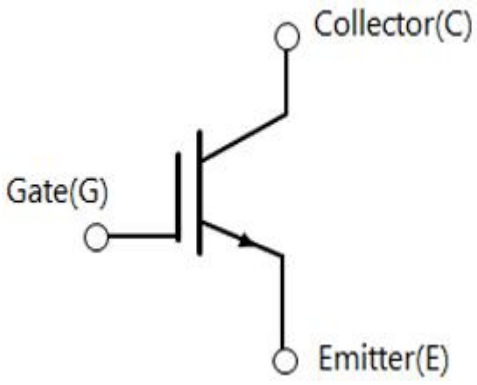
# IGBT

## What is IGBT ?

IGBT stands for Insulated Gate Bipolar Transistor

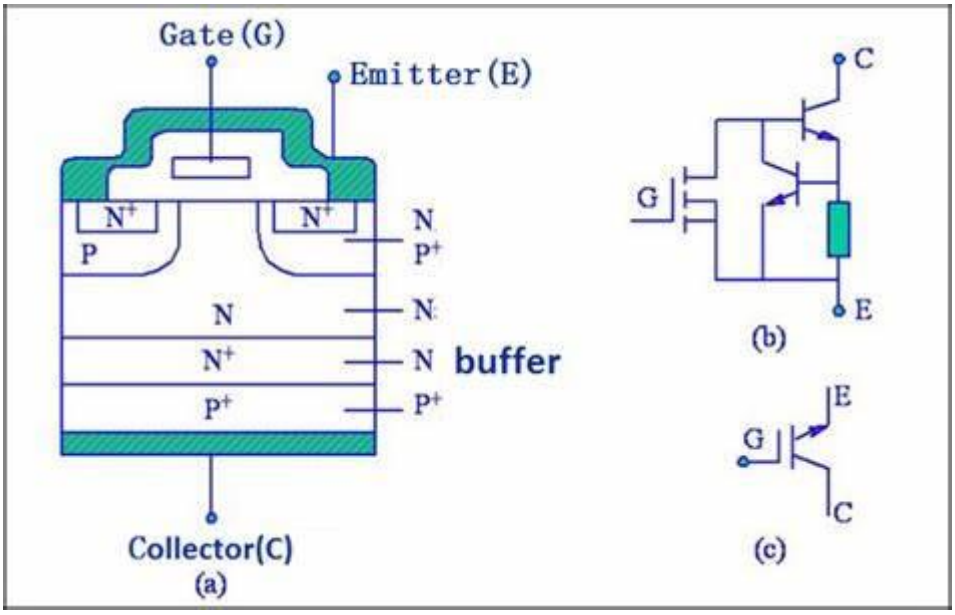
It is a three-terminal semiconductor switching device that can be used for fast switching with high efficiency in many types of electronic devices. These devices are mostly used in amplifiers for switching/processing complex wave patters with pulse width modulation (PWM).




IGBT can be considered as a mix of BJT and MOSFET as it have the same input characteristics as the BJT and has the same output characteristics as the MOSFET which is very useful in a lot of applications

## Construction:

IGBT has three terminals attached to three different metal layers, the metal layer of the gate terminal is insulated from the semiconductors by a layer of silicon dioxide (SIO2). IGBT is constructed with 4 layers of semiconductor sandwiched together. The layer closer to the collector is the **p+ substrate layer** above that is the **n- layer**, another p layer is kept closer to the emitter and inside the p layer, we have the **n+ layers**. The junction between the p+ layer and n- layer as seen in the following image




To understand the **working of the IGBT**, consider a voltage source $V_G$ connected positively to the Gate terminal with respect to the Emitter. Consider other voltage source $V_{CC}$ connected across The Emitter and the Collector, where Collector is kept positive with respect to the Emitter. Due to the voltage source $V_{CC}$ the junction J1 will be forward-biased whereas the junction J2 will be reverse biased. Since J2 is in reverse bias there will not be any current flow inside the IGBT(from collector to emitter).

## Types of IGBT:

The IGBT is classified as two types based on the n+ buffer layer, the IGBTs that are having the n+ buffer layer is called the **Punch through IGBT (PT-IGBT)**, the IGBTs that does not have an n+ buffer layer are called the **Non-Punch Through- IGBT (NPT- IGBT).**

## Operation regions:

**cutoff region:** when the gate voltage equal zero

**active region: when the Vge is increased beyond the threshold voltage**

**saturation region: when Vge increased but still less than the threshold voltage**

**this diagram shows the three regions better**