

MOSFETs vs IGBTs: Which is Better?

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MOSFETs and IGBTs are being heavily utilized in most of today’s modern power electronics equipment and systems. With the present trend continuing, the future will see more use of these devices in more and more applications.

Both MOSFETs and IGBTs were developed in the late 1970’s early 1980’s. Yet, to many, they are still viewed as “*new technology*”. In terms of performance, MOSFETs and IGBTs are quite similar where both are voltage controlled devices as they can be turned on and off by controlling the voltage across their gate-source (emitter) junction; have high input impedances; are capable of switching at high speeds; and have high current carrying capacities. Although MOSFETs have relatively high forward drops and low breakdown voltages (<1200V) compared to IGBTs, IGBTs have a number of limitations including:

1. Lower switching speeds in comparison with MOSFETs, which is in part due to the tail current effect they exhibit during turn off (see Fig. 1).
2. Higher switching losses compared to MOSFETs, caused by the tail current effect (see Fig. 1).
3. Possibility of uncontrollable latch-up (stays-on) under overstress conditions (high dv/dt or di/dt)

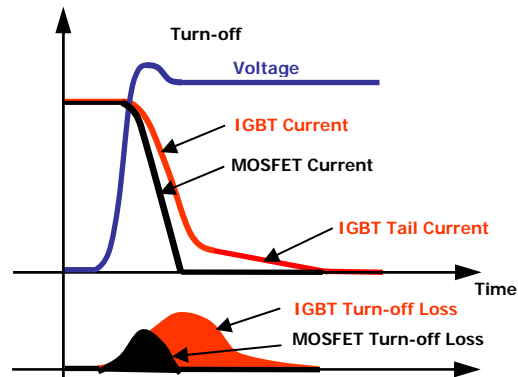
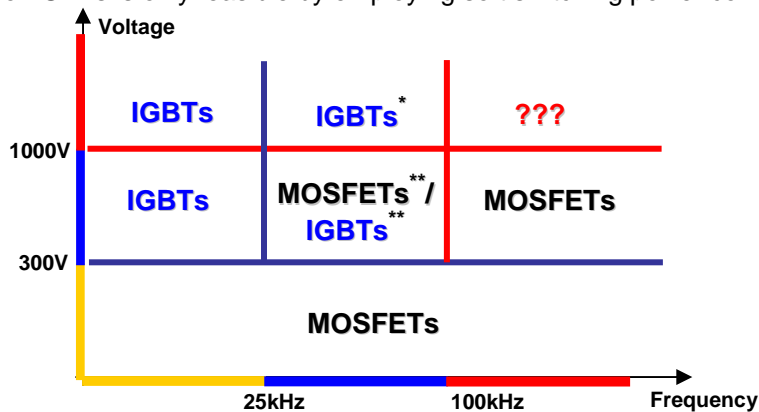


Fig. 1: MOSFET and IGBT turn-off behavior

One of the challenges presently facing designers is the question of which device is better. Well, the magic answer is: **IT DEPENDS**. The choice of a MOSFET versus an IGBT in a given application depends greatly on the application needs and requirements.

In developing a simple criteria to choose between MOSFETs and IGBTs in a given application, the switching frequency and the device’s voltage withstand requirement can be used. Figure 2 shows the application range of MOSFETs and IGBTs based on the above criteria. It is clear that MOSFETs are still the “*king of the hill*” in low voltage (<300V) and low to medium power applications (<10kW) at any switching frequency. As the voltage requirements increase, IGBTs become more appealing. However, at higher switching frequencies, MOSFETs are still superior due to their faster switching speeds. Higher frequency operation of IGBTs is only feasible by employing soft switching power conversion techniques.



* Switching frequencies above 25kHz only achievable with soft switching techniques
 ** The choice of MOSFETs vs IGBTs depends mainly on the application requirements

Fig. 1: MOSFETs and IGBTs Application Range

In summary, there has been euphoria and a push to claim IGBTs as a “*new*” technology while classifying MOSFETs as being a “*mature*” old technology. Many have been pushing the notion that IGBTs have significant performance improvements over MOSFETs and should be the device of choice in applications above 300V. This is far from true especially with continual innovations in MOSFET device and processing technologies that continue to push the limits of these devices into higher voltage and higher power applications.