7^{th} Gen. IGBT and Diode Chipset Enabling Highest Performance Power Modules

Various application fields of power electronics require semiconductors with low losses, high reliability and good controllability. The 7^{th} gen. IGBT which is based on the carrier stored trench bipolar transistor CSTBT™ technology is developed to address these requirements in the blocking voltage classes of 650V, 1200V and 1700V. A new corresponding freewheel diode is developed based on the new relaxed field of cathode technology.

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Introduction

Industrial IGBT Modules are used in a various field of applications. All this applications require semiconductors with low losses to develop modules and systems which have higher efficiency and higher power density. On the other hand a wide SOA (safe operation area) and good controllability of switching behavior are requested to achieve high reliability and cover the EMI conditions. The trade-off of these contrary requirements for the chip design are improved and optimized with the 7th gen. IGBT.

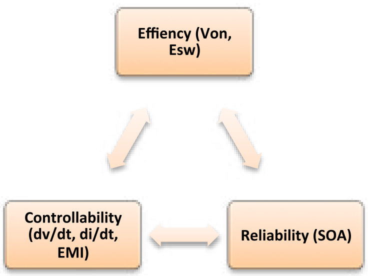

Figure 1: Trade-off of IGBT chip design requirements

IGBT chip design

The IGBT chip design of the 7th gen. IGBT is based on the CSTBTTM technology. This structure is also applied for the 6th gen. IGBT. The result of an additional carrier store layer is higher and homogeneous concentration of carrier's thrown the IGBT chip which provides lower on state voltage drop. Further optimizing of the cells, reduction of wafer thickness and advanced processes offer further improvements of the total IGBT performance.

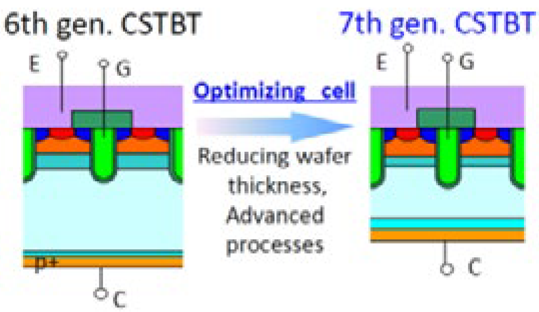

Figure 2: Evolution of IGBT Chip structures

The IGBT chip is divided in active and passive area. The passive area at the termination of the chip is used to expand the electrical field. This passive area does not contribute by the actual current conduction. To minimize the passive area new termination structure is introduced. By this method the IGBT chip size can be reduced without reduction of the active area. Therefore electrical performance of the IGBT is not influenced by this passive edge termination reduction. On the other hand the active IGBT chip area can be enlarged if the total chips size is kept. The result of the enlarged active area is a further reduction of the on state voltage drop. So enlarging active area enables either the reduction of the on state voltage drop or the compact package design with high current density As conclusion the new termination structure enable to design a more compact IGBT chips with higher efficiency.

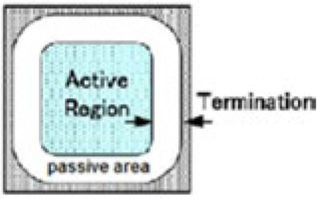

Figure 3: IGBT chip areas

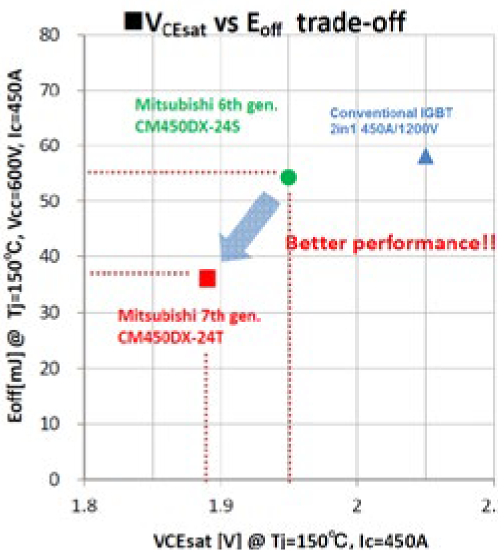

Figure 4: VCE(sat)- Eoff tradeoff of 1200V/450A Modules