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# Demands by Future Railway Converters and How They Change Power Semiconductor Modules

*The increase of competitiveness, robustness and efficiency of future railway converters has demanded new power semiconductor modules. Converter manufacturers particularly requested increasing power density and more flexibility for the converter design. This flexibility shall be achieved by simpler parallel connection of power semiconductor modules, which leads to scalability of output power. This article presents the main challenges for power semiconductors in future railway converters and Mitsubishi Electric's solution: power modules in the LV100 and HV100 package.*

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**Introduction**

In 2015, a consortium of train manufacturers and electric-equipment suppliers started discussions about the future of rolling stocks and radical innovations in the field of railway vehicles. The discussions, as part of the Horizon 2020 Project Roll2Rail, resulted also in technical requirements of tomorrow's power semiconductor modules. These shall provide:

- Higher power density,
- Multi-sourcing,
- Modularity and scalability,
- Readiness for SiC, and
- Ruggedness against environmental influences (temperature, humidity, vibration, …) [1].

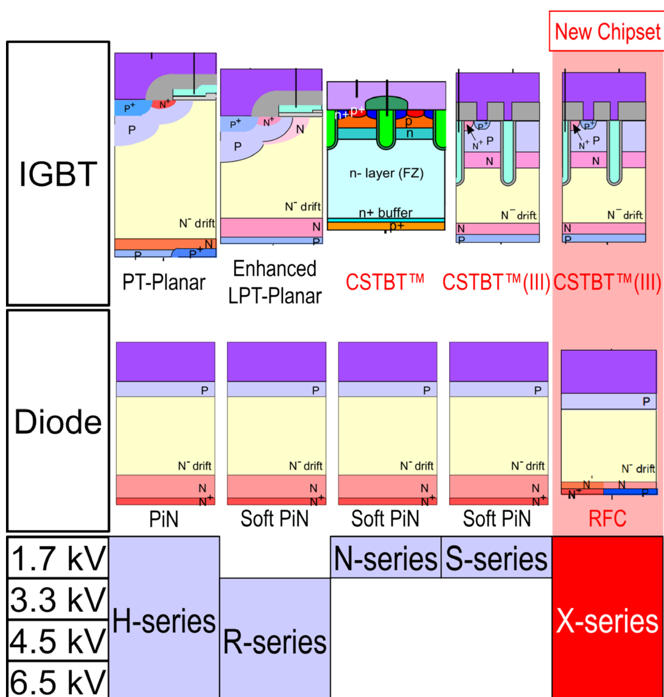


Figure 1: IGBT and diode chipset generations of MITSUBISHI ELECTRIC

Mitsubishi Electric's answer to the requirements from the Roll2Rail project are the packages LV100 and HV100. Today, power modules in the LV100 and HV100 package have become available for various voltage and current ratings.

The following article will introduce the silicon-based power modules of the LV100 and HV100 family. We will have a look at the advances in the chip and package technology, and measure the benefits in the application. A particular requirement of these power modules is the scalability of output power through the ability for parallel connection. The article will present a reference test setup for parallel connection and show the homogenous current distribution between paralleled modules for an optimal utilization of the silicon chip area.

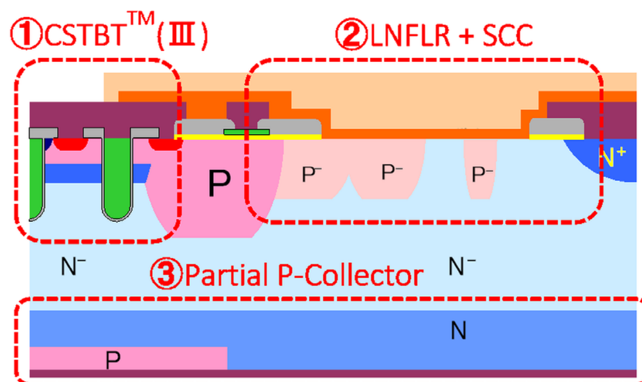


Figure 2: Structure of X-Series IGBT-chip

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