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Multi-functional Chip Contribute to the Compact Design of Automotive SiC Power Module

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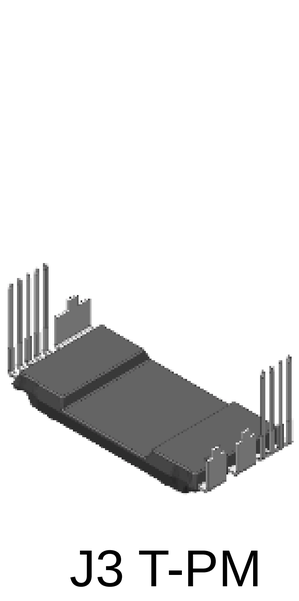
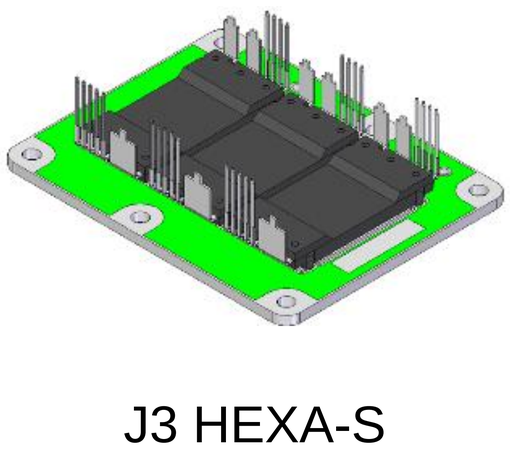
•Introduction

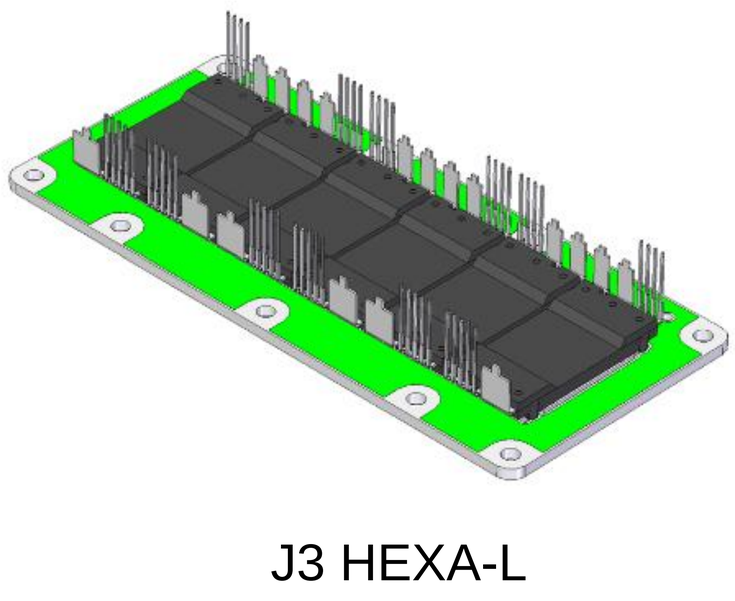
SiC power modules are already playing an important role in electric drive system of xEV and the size of power module has a large impact on the volume of electric drive system. Considering the design of electric drive systems is becoming more and more compact，it is necessary to reduce the size of SiC power module. Mitsubishi Electric has released a new generation of automotive SiC power modules, named J3 series, using an innovative multi-function chip for a more compact SiC power module design, including T-PM, HEXA-S and HEXA-L, which can contribute to the compact design of automotive electric drive system.



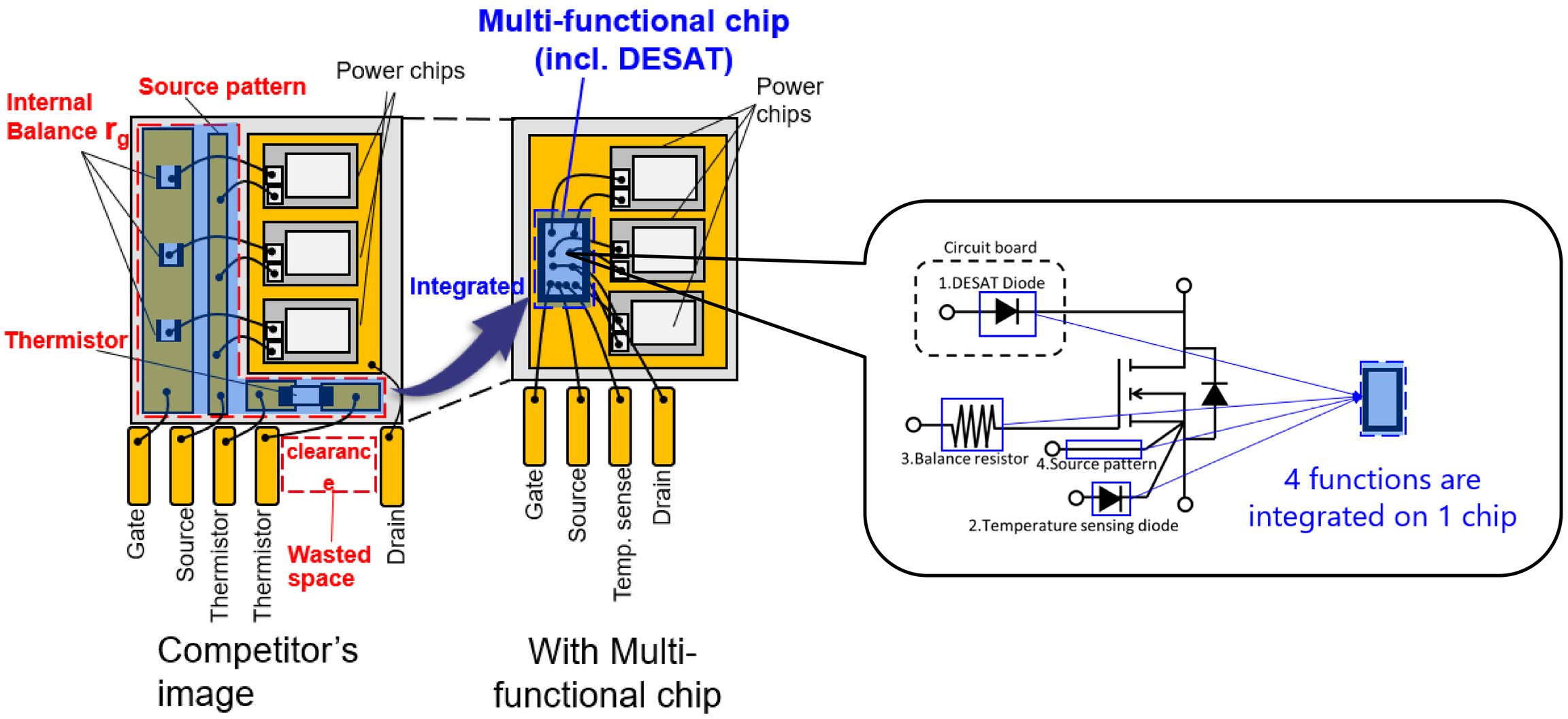
J3 T-PM



J3 HEXA-S



J3 HEXA-L



Competitor's image

With Multi-functional chip

- Mitsubishi Electric have successfully developed a new multi-functional Si chip that integrates the balance resistors, the temperature sensor, the source pattern, and the DESAT-Diode.
- Through using a multi-functional chip, the package size of SiC power module has been reduced by 15%, the L_s has been reduced 20% and the R_{th} has been improved 5%.

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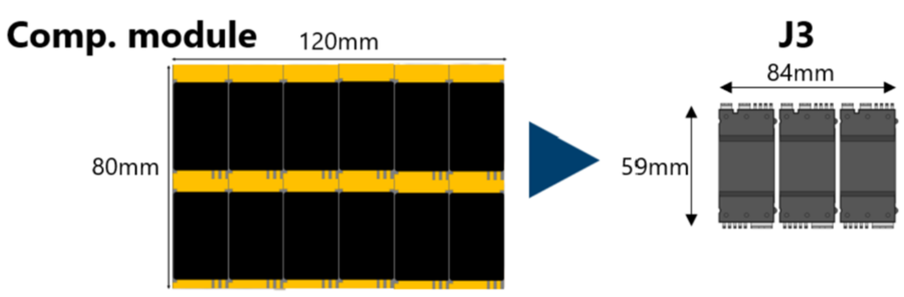
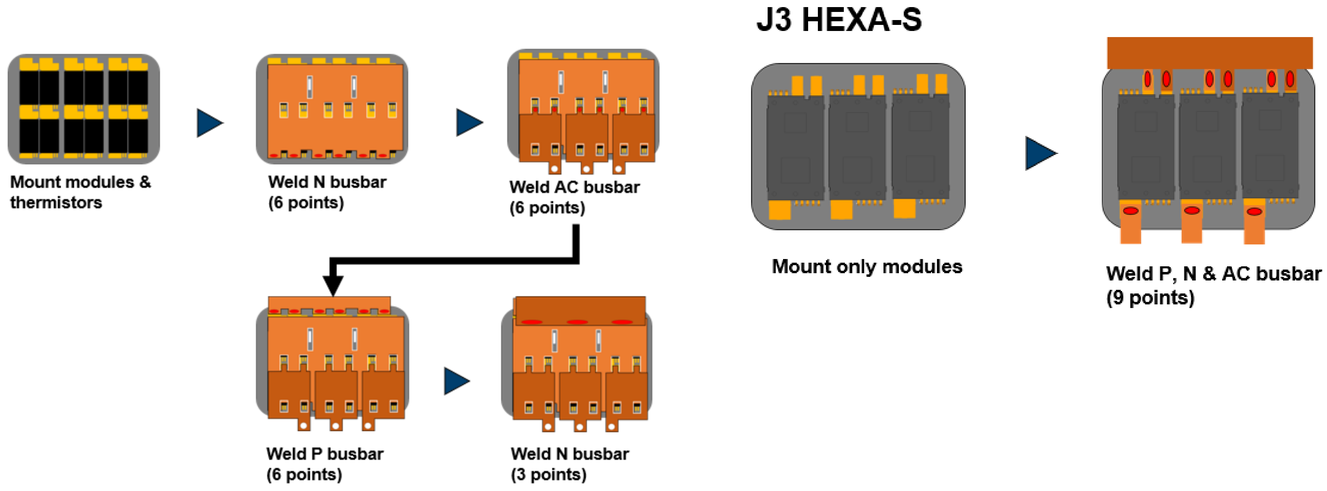
The application example of J3 T-PM



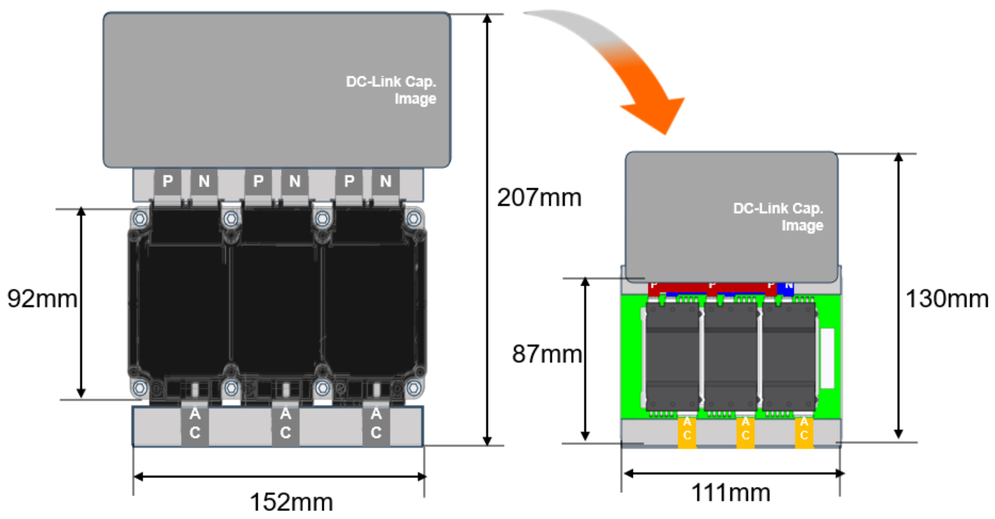
Comparison of size



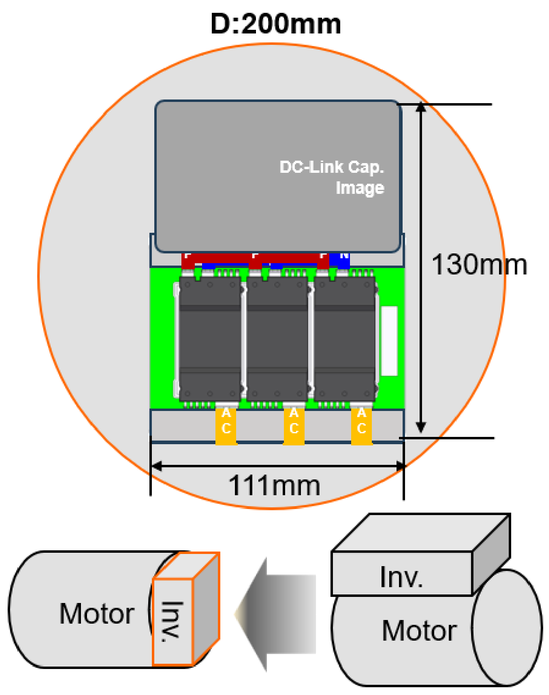
Comparison of assemble process

- In term of package size and design complexity, J3 T-PM, half-bridge power module, has advantages in replacing T-PAK parallel solution.
- For 2 pcs T-PAK parallel solution, 3 pcs T-PMs can replace 12 pcs T-PAK devices, in which the area can be reduced 48%.
- The assembly flow of T-PM is greatly simplified. The number of welding points can be reduced from 21 points to 9 points, the number of welding operations can be reduced from 4 to 1 and the number of busbars can be reduced, which can help to save material cost and improve the reliability.

The application example of J3 HEXA-S



Comparison of size



Layout example of invertor

- The size of J3 HEXA-S module is 8.7cmx11.1cm, which is less 50% than HPD module. The inverter volume can be reduced significantly by using HEXA-S module.
- In 150kW invertor design, the diameter of the motor is generally less than or equal to 200mm, the inverter using HEXA-S can be placed on the shaft side of the motor to further miniaturize e-Axle.

Conclusion

I. In the design of SiC power module, Mitsubishi Electric's original multi-functional chip does great help to decrease the size of power module.
II. J3 series SiC power module is the better choice for compact electric driver design in electric vehicle application and other applications with severe volume requirements, like eVTOL.