

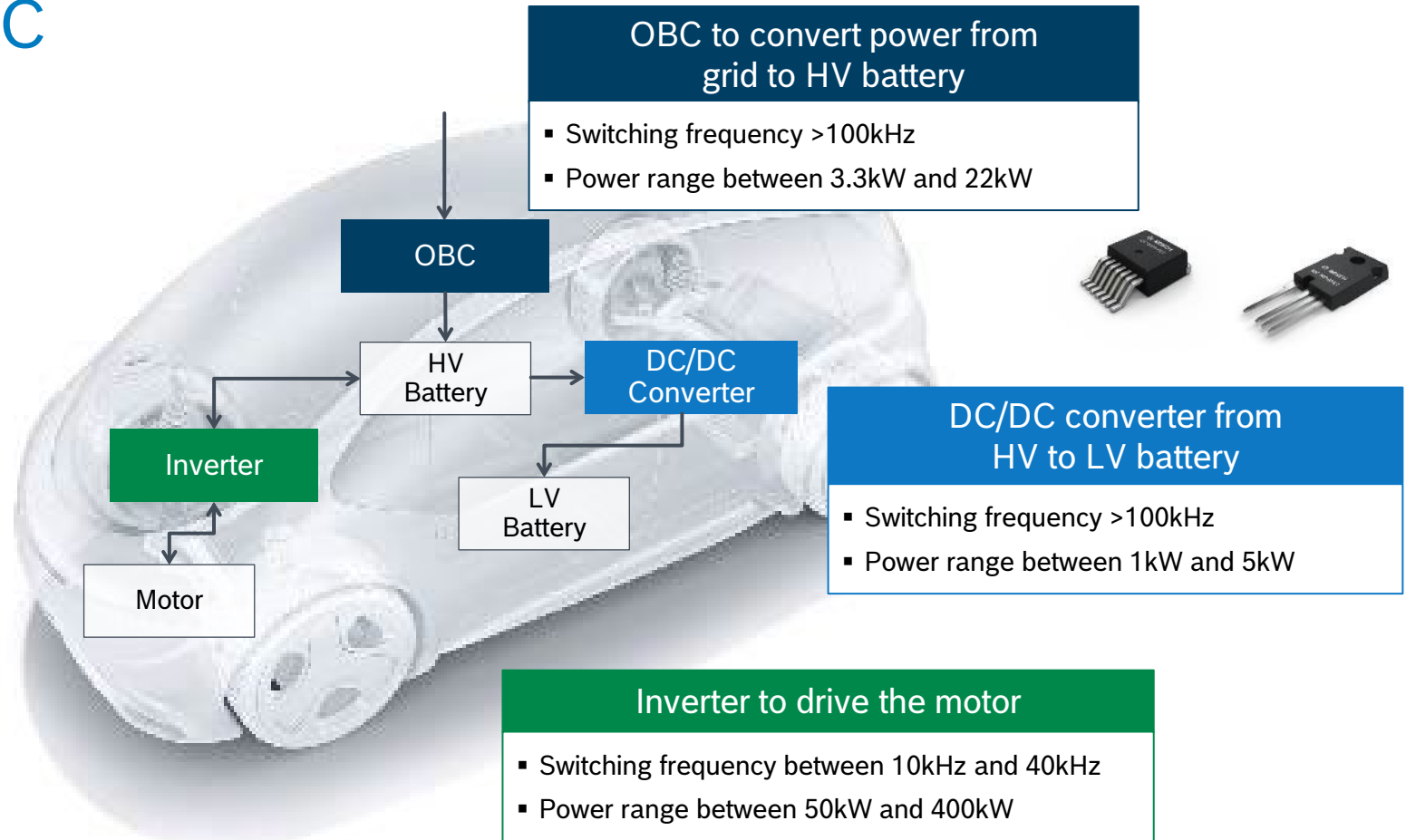
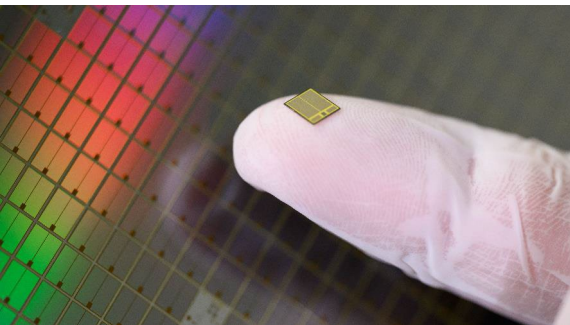
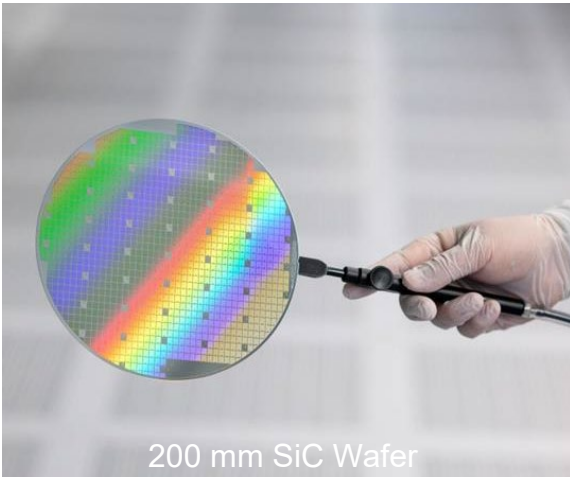
SiC Technology - Transfer to 200mm wafer size

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November 14, 2024

SiC Technology - Transfer to 200mm wafer size

Applications of SiC



SiC trench technology for automotive applications

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SiC in this decade

more than

21 Mio.

SiC MOSFETs delivered worldwide since 2021

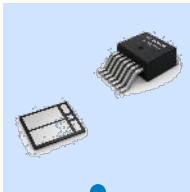


Installation SiC line Reutlingen



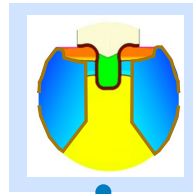
Reutlingen (DE)

SOP Gen1
6"/150mm



Reutlingen (DE)

SOP Gen 2
6"/150mm



Reutlingen (DE)

Samples Gen 2
8"/200mm

Extension
Reutlingen Fab



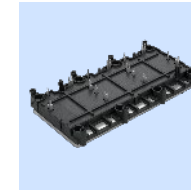
Reutlingen (DE)

Samples Gen 3
8"/200mm



Reutlingen (DE)

SOP Frame
module



Reutlingen (DE)

Samples Gen 2
8"/200mm



Roseville (U.S.)

2019

2021

2023

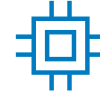
2024

2025

2026

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Expanding SiC manufacturing capacities in Germany and the U.S.



Bosch took up **high-volume production** of its first generation of SiC chips in Reutlingen, Germany, in **2021**.



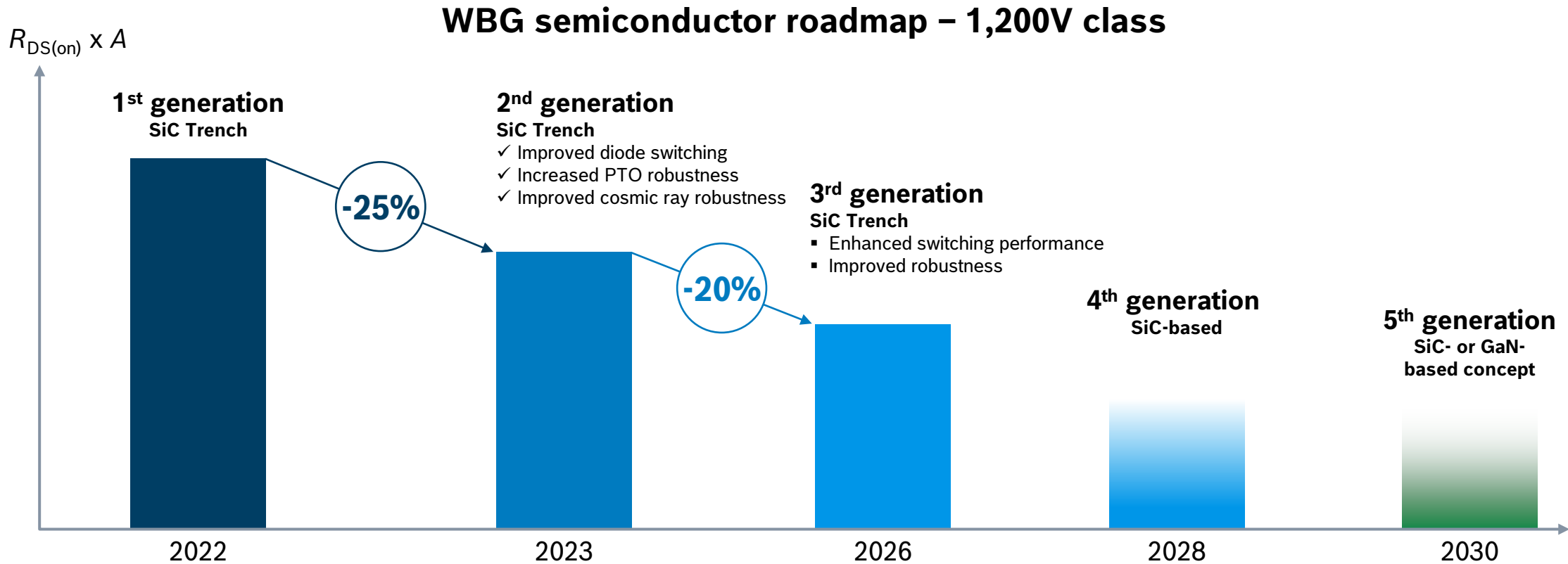
Bosch is **extending its SiC manufacturing capacities** in both Reutlingen and the new wafer fab in Roseville, California. This way, Bosch **makes supply chains more resilient** and **ensures a better supply of the local markets**.



In the coming years, Bosch will increase its delivery volume more than tenfold compared to today.

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Roadmap



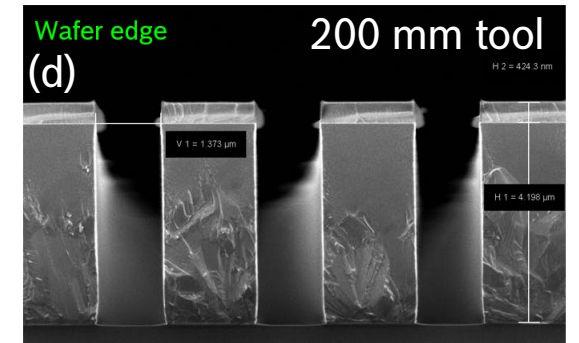
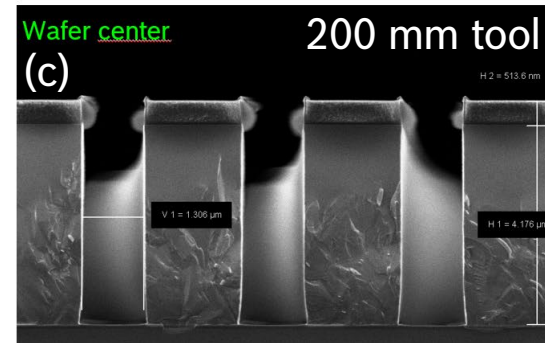
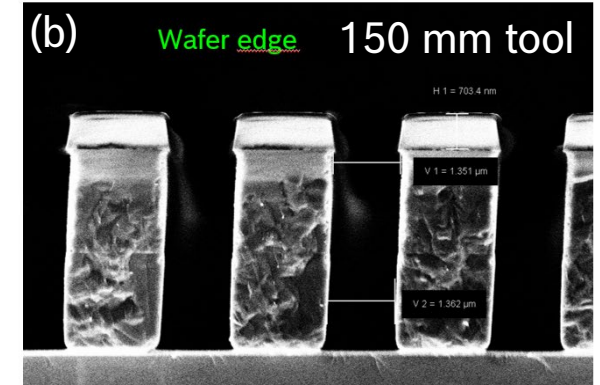
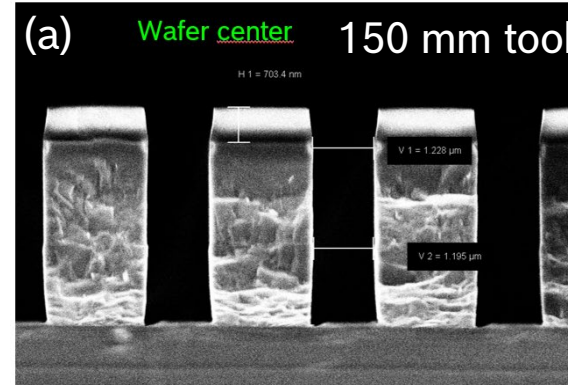
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Advantage of 200 mm

Single process development

More modern equipment designed for 200mm production enable better control of single processes

- Etching tools for SiC dry etching exhibit a higher center-to-edge uniformity
- Lithography tools allow a better alignment tolerance as well as smaller critical dimension
- Fully automated handling and transport



Structural investigation of hardmasks for fabricating implanted regions on a 150 mm tool (a,b) and on a 200 mm tool (c,d) indicating a much better uniformity over the wafer

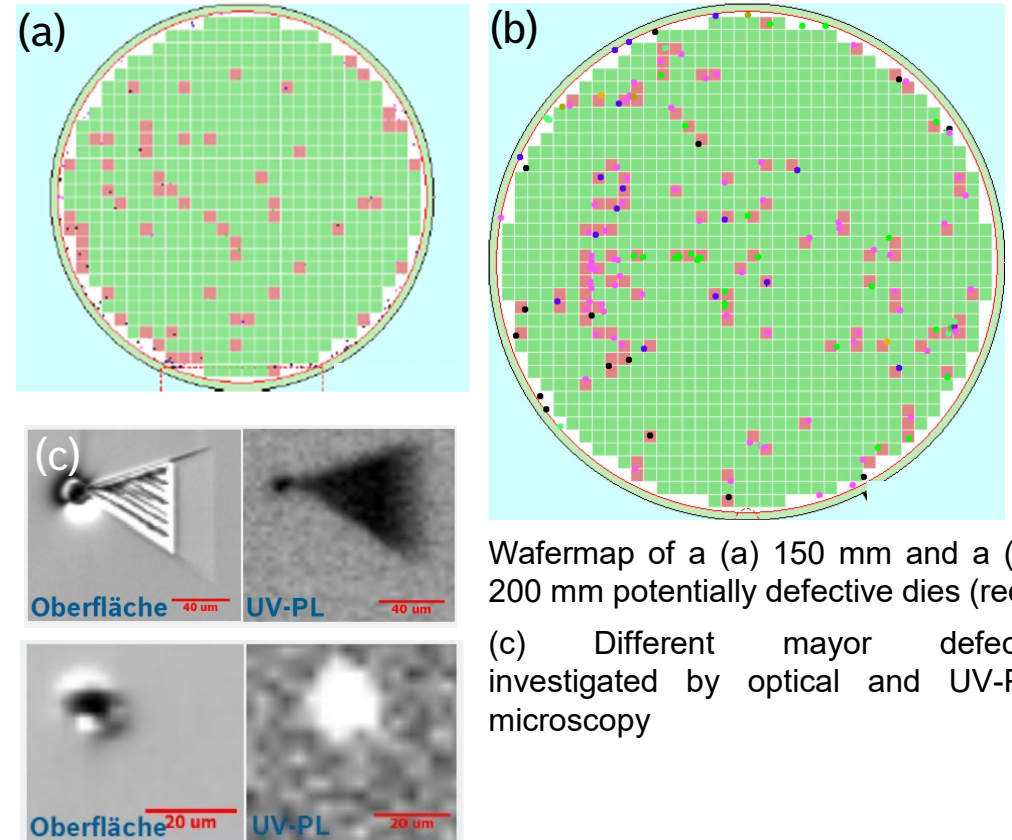
200mm tools bring SiC technology forward

SiC Technology - Transfer to 200mm wafer size

Advantage of 200 mm

Wafer material

- 2010s: 150 mm wafer became mature enough for high volume production
- 2020s: Decade of 200 mm wafer
 - Defect density reduction on 200 mm enables significant yield for high volume reduction
- Some obstacles have to be overcome
 - Exact matching with 150 mm process
 - Bow management



Wafermap of a (a) 150 mm and a (b) 200 mm potentially defective dies (red)

(c) Different mayor defects investigated by optical and UV-PL microscopy

Incoming SiC wafer material mature enough to ensure a successful transfer

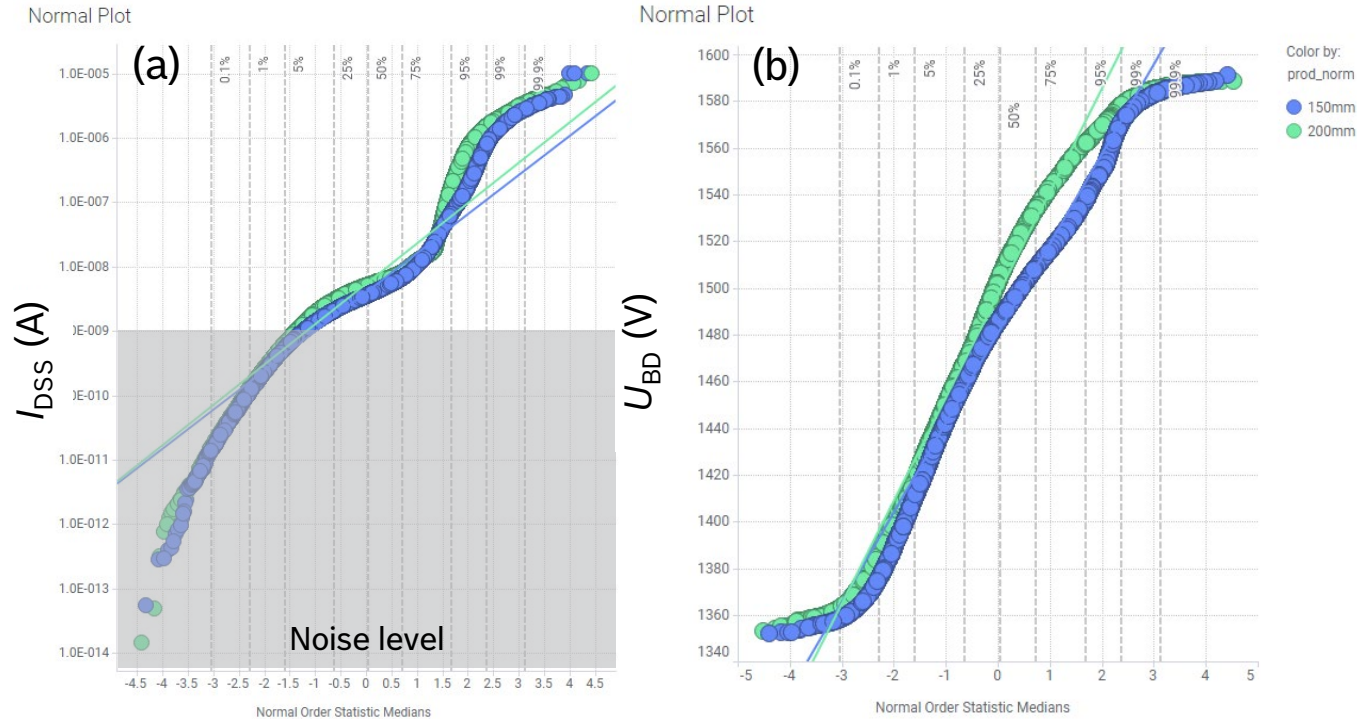
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Comparison 200mm vs 150 mm

Wafer level data of 200 mm production

Matching of 200 mm process to 150 mm necessary

- Matching of leakage current behavior displays similar defect density
- Matching of blocking behavior as one key parameter for a successful process transfer from 150 mm to 200 mm

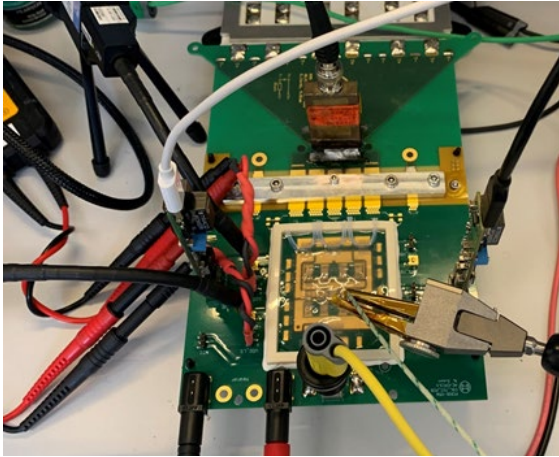


Normal probability plots of I_{DSS} ($U_{DS} = 1200V$) and U_{BD} ($I_{DS} = 1\text{ mA}$) of 150 mm and 200 mm devices.

Waferlevel data shows good matching between 150 mm and 200 mm

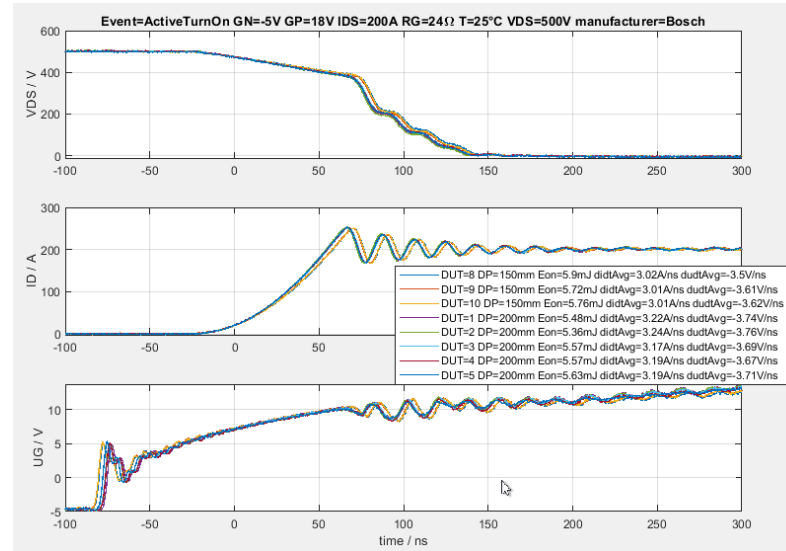
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Comparison 200mm vs 150 mm - Switching performance

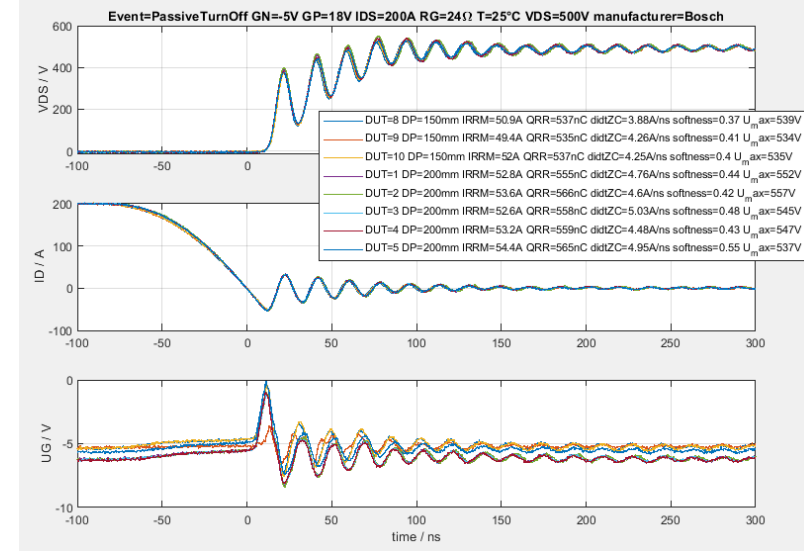


Test vehicle in setup in “application near” conditions. Half bridge configuration with one to four SiC chips in parallel.

Active On



Passive Off



Switching event of 2 SiC devices in half-bridge configuration. Similar switching curves for the active and passive devices achieved for different wafer sizes.

Switching under application conditions: Similar switching behavior of 150 mm and 200 mm devices

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Conclusion

- Transfer from 150 mm to 200 mm equipment allows higher production volumes
- 200 mm tools enable better technologies due to the more modern equipment
- 200 mm transfer is challenging
- Bosch's first 200mm Trench-MOS products are currently in qualification with scheduled finished by end of 2024

Bosch SiC technology: Ready to go for 200 mm

Thank You!



Supported by:



Federal Ministry
for Economic Affairs
and Climate Action

on the basis of a decision
by the German Bundestag



Bayerisches Staatsministerium für
Wirtschaft, Landesentwicklung und Energie

The IPCEI ME/CT project is supported by the Federal Ministry for Economic Affairs and Climate Action on the basis of a decision by the German Parliament, by the Ministry for Economic Affairs, Labor and Tourism of Baden-Württemberg based on a decision of the State Parliament of Baden-Württemberg, the Free State of Saxony on the basis of the budget adopted by the Saxon State Parliament, the Bavarian State Ministry for Economic Affairs, Regional Development and Energy, and funded by the European Union – NextGenerationEU.

Thank You



This project has received funding from the Key Digital Technologies Joint Undertaking (KDT JU) under Grant Agreement No 101007237. The JU receives support from the European Union's Horizon 2020 research and innovation programme and Germany, France, Italy, Sweden, Austria, Czech Republic, Spain.