

Next Generation 1200V IGBT and Diode Technology for Automotive Drivetrain Applications

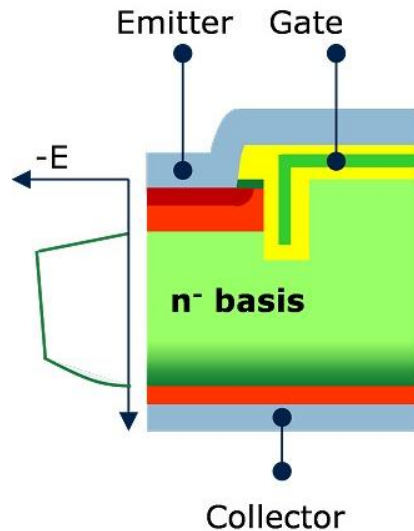
Jiong Wu, Infineon Technologies AG

EDT3 / RC-IGBT 1200V

New Generation 1200V IGBT and Diode Technology

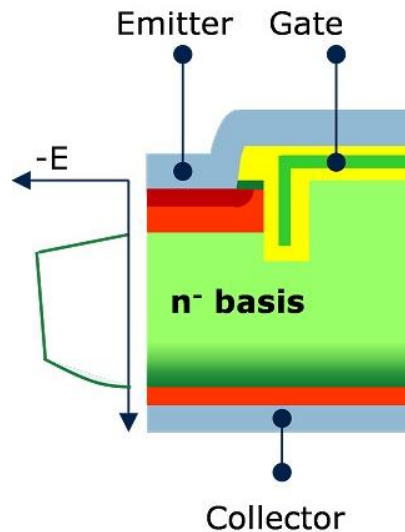
IGBT4

Trench Field-Stop
2012



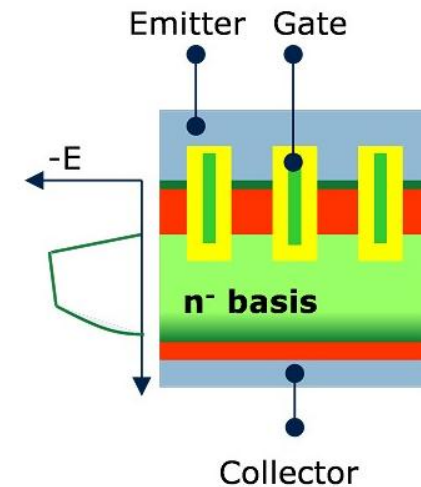
EDT 1200V

Trench Field-Stop
2020



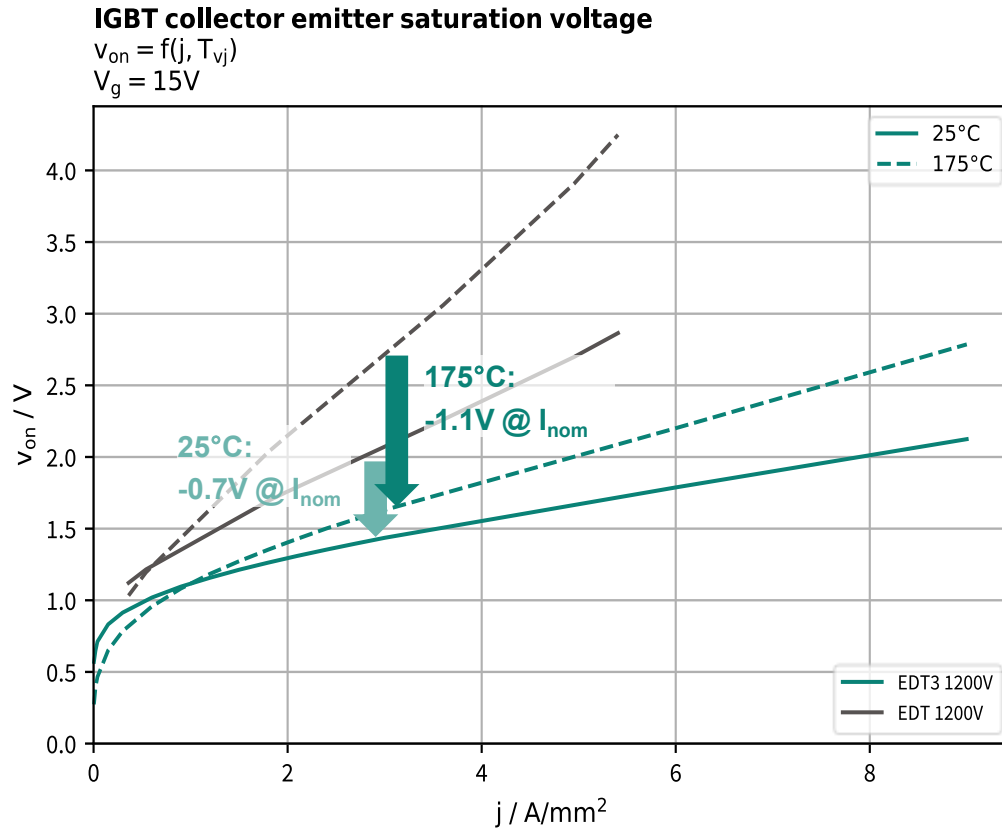
EDT3 1200V

RC-IGBT 1200V
Micro Pattern Trench
2025

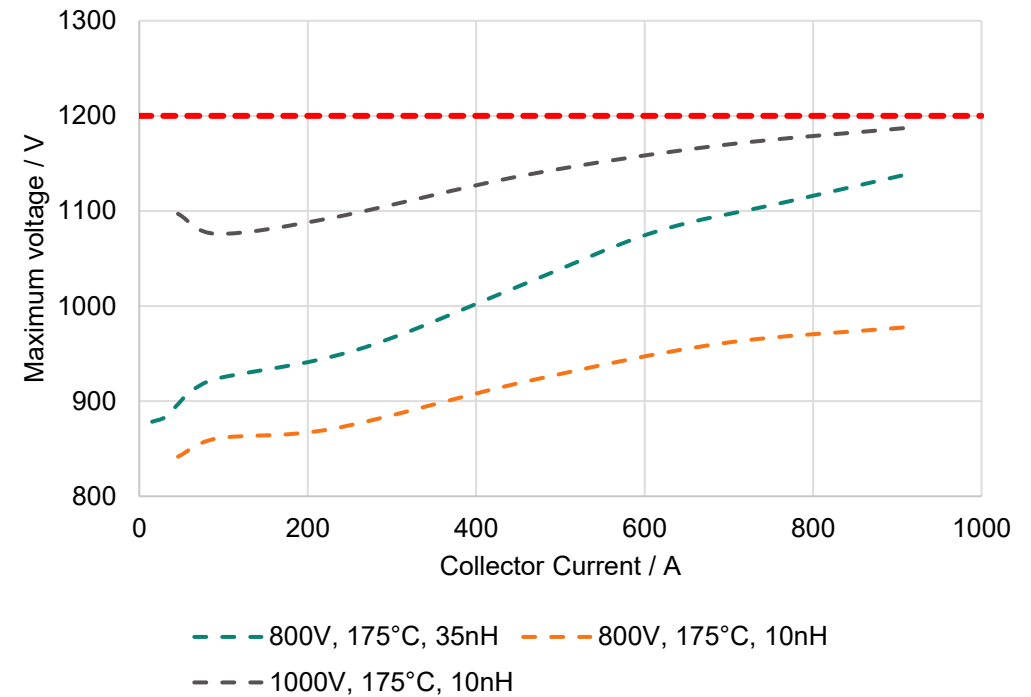


EDT3 1200V IGBT Performance

- Significant improvement of conduction loss compared to the previous generation

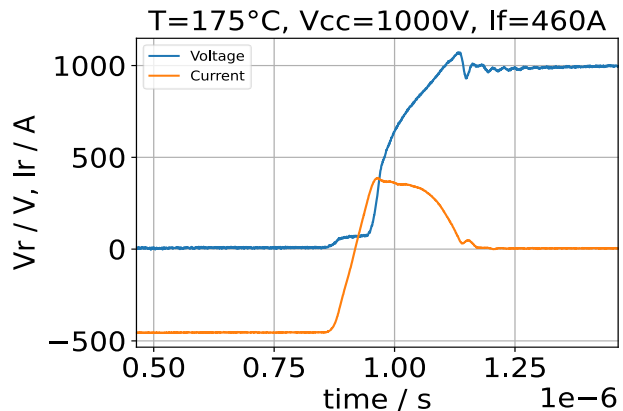
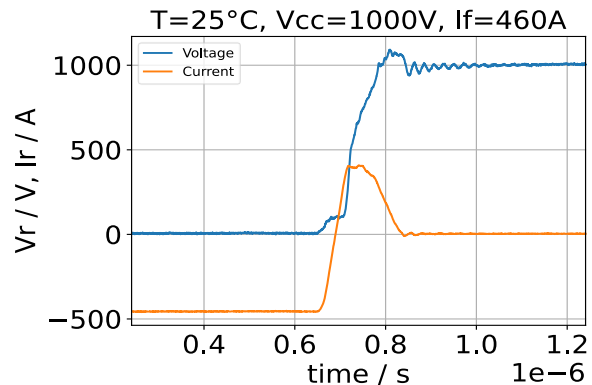
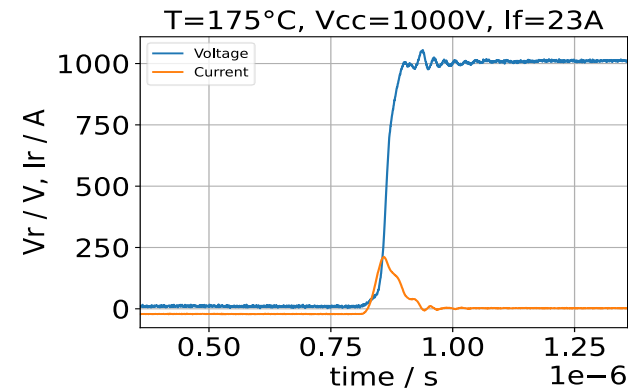
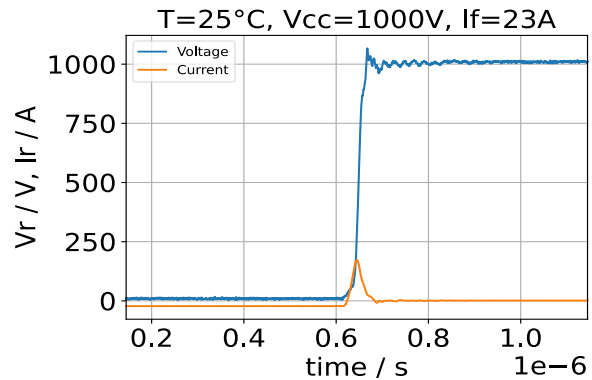


- Low overvoltage during switch-off
 - Self-controlled switching is usable
 - Enabling operation at DC link voltage up to 1000V



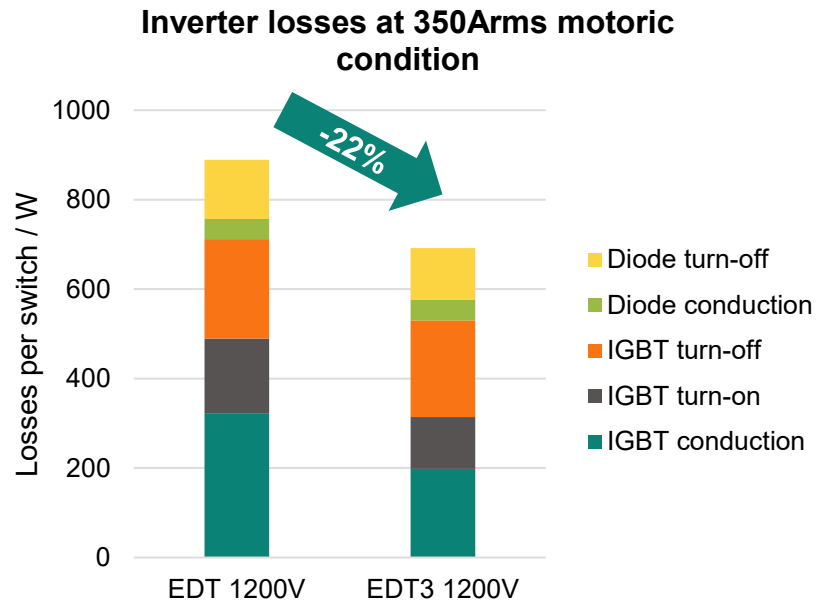
EDT3 1200V Diode Performance

- The EDT3 1200V diode is specifically designed to complement the EDT3 IGBT.
- Soft diode reverse recovery performance enables faster switching, resulting to lower IGBT turn-on losses.

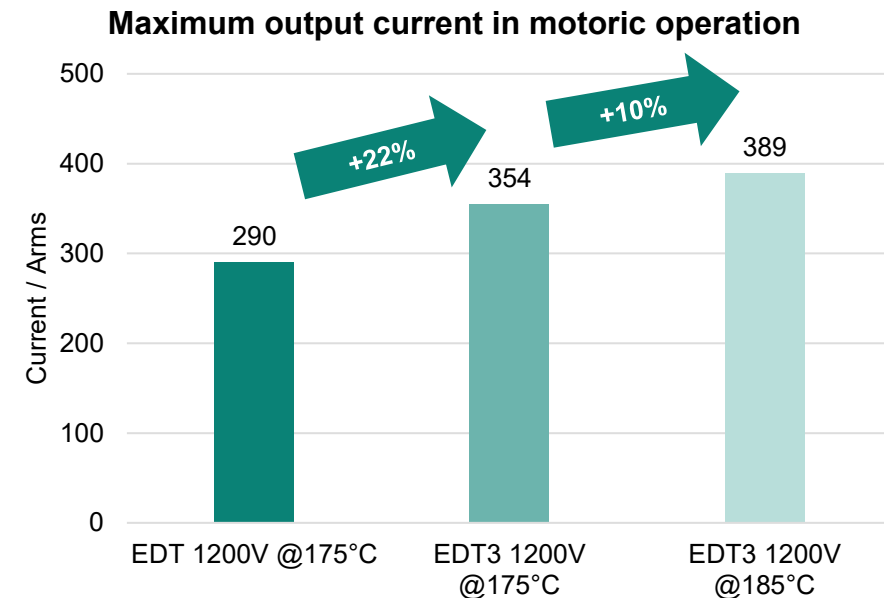


Benefit of EDT3 1200V in Inverter Application

- EDT3 1200V technology achieves 22% reduction of total inverter losses, under high load motoric conditions.
- EDT3 1200V delivers a 22% increase in output current from the same chip area, maintaining $T_{vj,max}$ at 175°C.
- A total increase of 34% can be achieved compared to the previous generation, utilizing the increase of $T_{vj,max}$ to 185°C.



Simulated inverter losses in motoric operation
(350Arms, $V_{DC}=800V$, $\cos(\varphi)=0.85$, $M=1$, $f_{sw}=10kHz$, $T_{ref}=65^{\circ}C$).



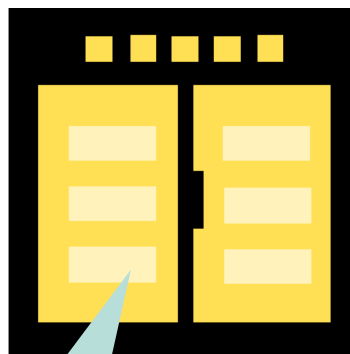
Simulated output current in motoric operation
($V_{DC}=800V$, $\cos(\varphi)=0.85$, $M=1$, $f_{sw}=10kHz$, $T_{ref}=65^{\circ}C$)

RC-IGBT 1200V

IGBT + Diode



RC-IGBT



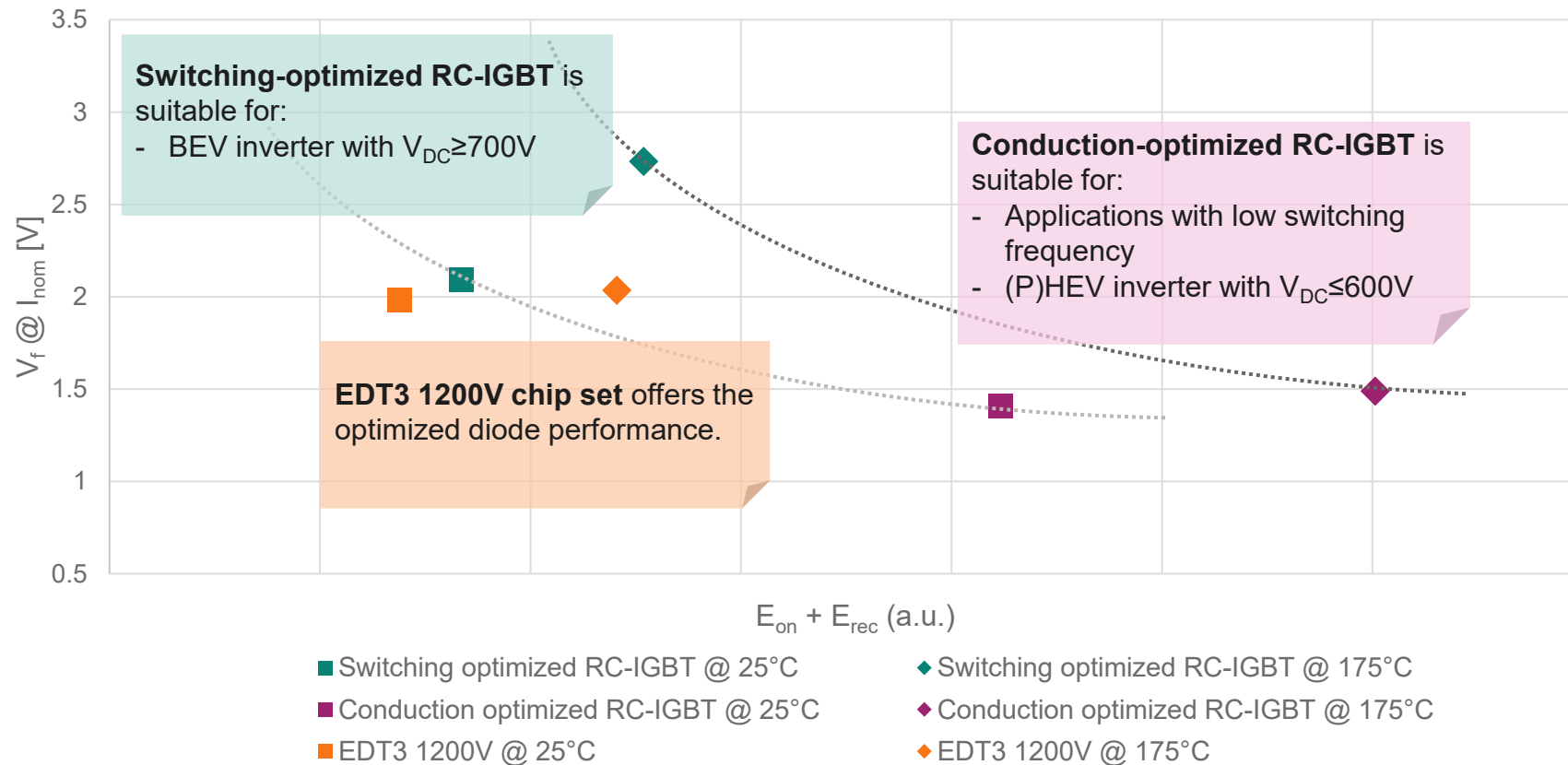
The freewheeling diode
is integrated on the
same die of the IGBT

Advantages of RC-IGBT

- Approx. 20% thermal resistance reduction of IGBT enhances the IGBT's performance in motoric operation.
- Reduced temperature ripple increases power cycling lifetime of the power module.
- Increased chip active area within the same module footprint, thanks to reduced edge termination structures and the elimination of gaps between the IGBT and diode.
- Simplified module assembly with fewer parts.

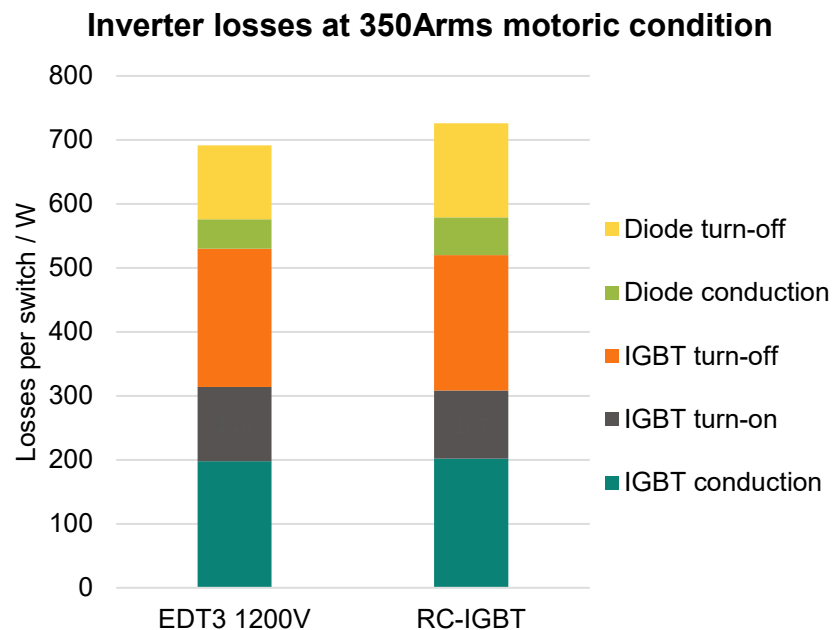
RC-IGBT 1200V Flavors

- The 2 flavors of RC-IGBT technology together with the EDT3 1200V compose the new generation of Infineon's 1200V IGBT / diode portfolio for automotive drivetrain applications

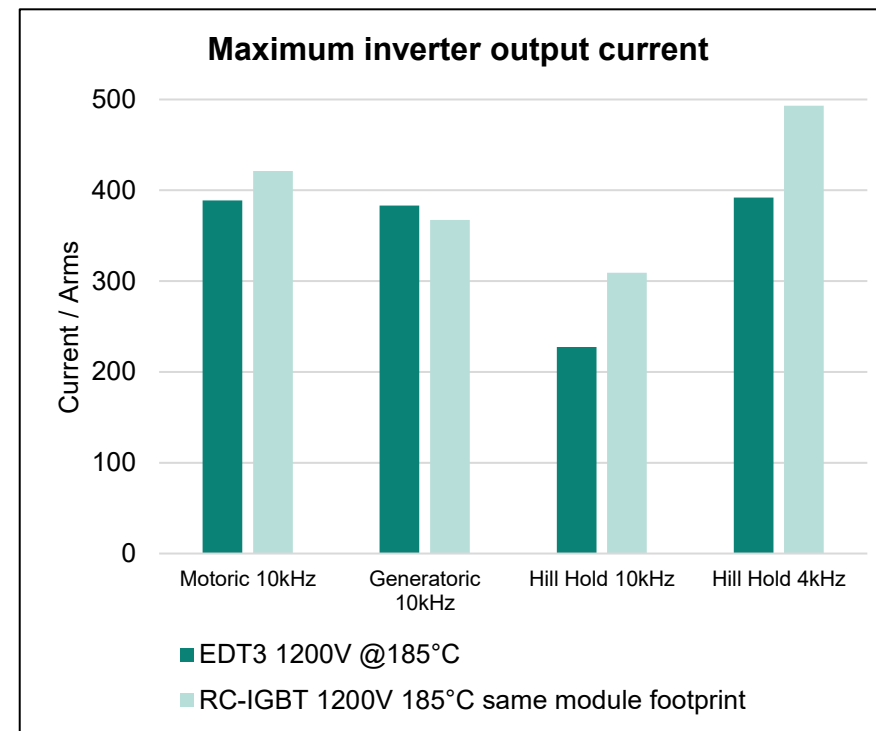


Comparison EDT3 1200V Chipset vs. RC-IGBT *)

*) Switching-optimized flavor



- IGBT losses are almost identical
- RC-IGBT's diode losses are slightly higher



- RC-IGBT yields higher inverter output current in motoric and hill hold operations

Summary

- Infineon's new EDT3 1200V IGBT + Diode technology exhibits a 22% reduction in losses in motoric operation.
- This loss reduction, combined with the increased maximum junction temperature of 185°C, enables a 34% increase in output current compared to the previous generation.
- Infineon also offers reverse conducting (RC-)IGBT in two different trade-offs: The switching optimized RC-IGBT and the conduction optimized RC-IGBT.
- The availability of both, IGBT + diode as well as RC-IGBT provides module designers the flexibility to choose the best match for their specific requirements, enabling the development of more efficient and compact power conversion systems.

Thank you for your attention!

Any Questions?