Low cost 1200 V G2S Pin Diodes to upgrade Silicon Diodes to SIC characteristica for modul production

2026

G2S™ Basics

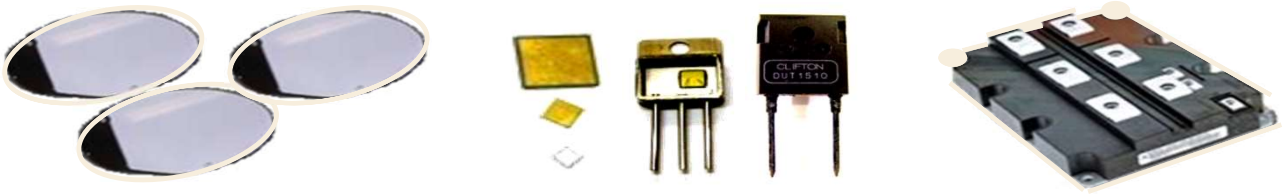
G2S™ in Power Moduls

G2S™

3-5 Power Electronics GmbH

Profile 3-5 Power Electronics GmbH

Company:	3-5 Power Electronics GmbH, founded 2016
Office:	Technologie Zentrum Dresden-Süd
Employees:	10
Business purpose:	Development, production (Fab-lite) and marketing of GaAs semi-finished products, chips and modules for power electronics
Target markets:	Industrial products, industrial plant construction, inverters for EV and renewable energies (solar and wind), EV battery charging stations, data centers, and industrial motor drives
Products:	Fast pn diodes, Schottky diodes and power transistors based on the GaAs semiconductor material
Invested:	€17.4 Million (€ 15,1 mm from Investors and € 2.3 mm in Grants from Germany, new Grants decisions €2.4 mm)
Shareholders:	Dr. Volker Dudek (founder, CTO), Dr. Gerhard Bolenz (founder, CFO), Richard J. Kulle (founder, adviser), Sturm Family Office (founder ebm-pabst, Germany)
Business model:	Development and production using proprietary GaAs technology based on a Fab-Lite model, according to which product design and proprietary manufacturing processes are carried out in-house and standard manufacturing processes are outsourced (Azurspace, Heilbronn)



GaAs High Voltage Basics

UnitedSiC

50A -1200V SiC Schottky Diode

3-5PE
1200V 60A pin Diode

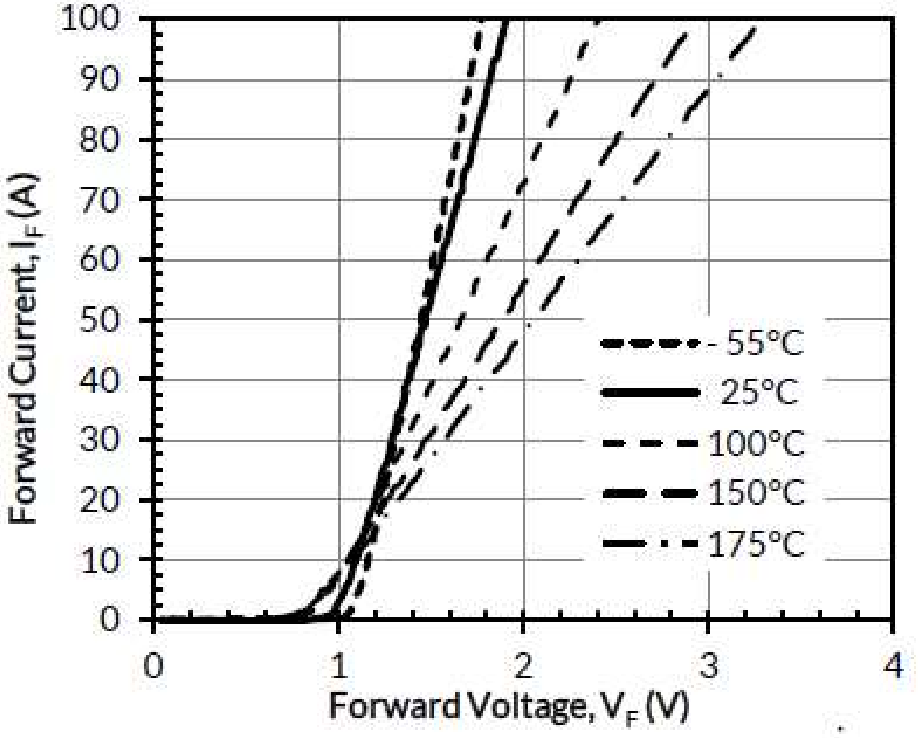


Figure 1. Typical forward characteristics

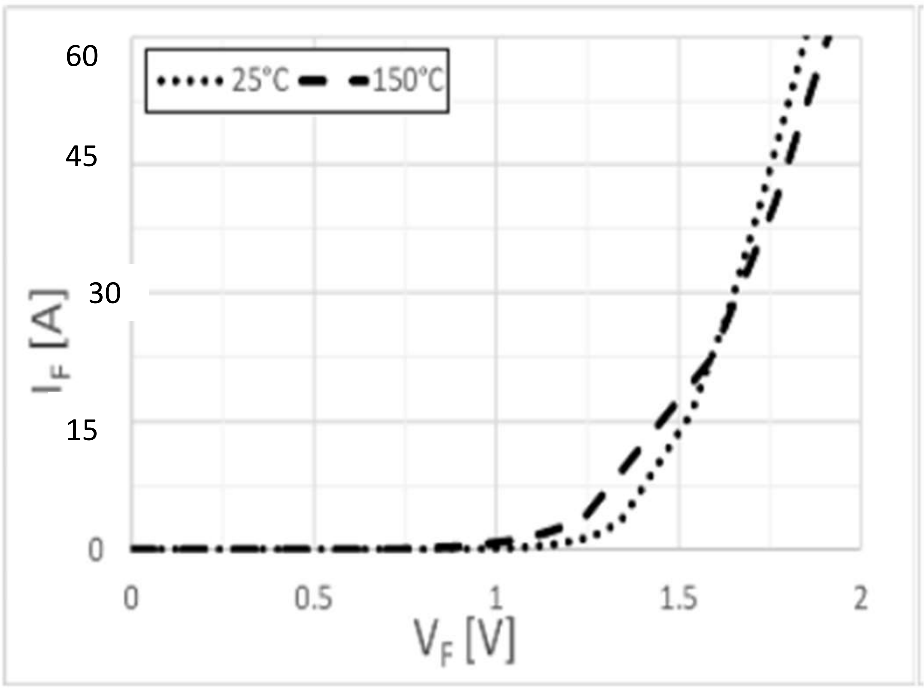
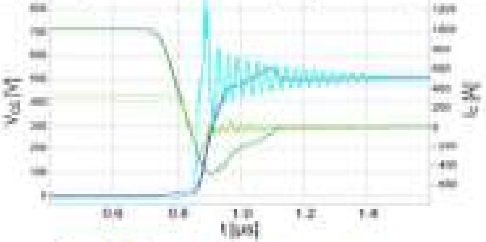
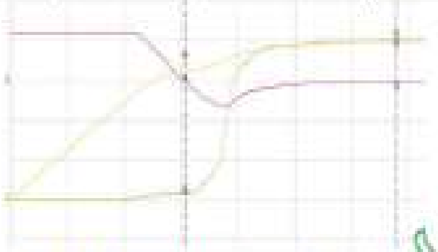
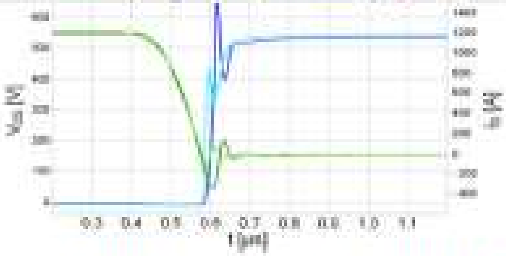


Fig. 1: Forward Characteristics

Comparing general performance and dynamic behaviour

	Si	**G2S**	**SiC**
Common Power Diode Types	(Schottky* <600V), **pin**	(Schottky* <600V), **pin**	**Schottky*, Body****
Operating Current density [A/cm²] (for 1200V devices)	↓ 200-300 👎	↑ 600-800 👍	↓ 150-200 👎
Junction capacitance $\left(C_j = \frac{\varepsilon A}{d}\right)$	→ (moderate area, higher w_B) 👍	↓ (small area, moderate w_B) 👍	↑ (large area, thin w_B) 👎
Dynamic Losses	 ➔ QRR very temperature dependent 👎	 ➔ QRR is temperature stable over wide range due to temp. dependent mobility 👍	 ➔ Temperature dependent QRR in bipolar mode and for body diodes 👎
EMI higher at	More EMI and lower switching speed at low temperatures → **cold start drawback** [1,2]	More EMI and lower switching speed at low temperatures → **cold start drawback**	More EMI and lower switching speed at higher temperatures → **max performance drawback** [1,2]
Total Switching losses	↑ highest and temperature dependent Qrr, moderate Qj 👎	↓ moderate and almost temperature independent Qrr, lowest Qj 👍	↓ small, temperature dependent Qrr, very high Qj 👍

* **Schottky** = MPS (merged pin Schottky) p-Islands inject holes (bipolar mode) at high currents (accelerated at elevated temperature)

** **Body-diodes** = PN (bipolar) diodes

[1] O. Siwak et al. „SiC MOSFET im Antriebsumrichter für E-Fahrzeuge –eine eierlegende Wollmilchsau??“ Proceedings Halbleiterkolloquium Freiburg 2024
[2] A. Maitra et al. „Body-Diode Robustness in SiC MOSFETs“ Proceedings Halbleiterkolloquium Freiburg 2024

Comparing general performance and dynamic behaviour

		SiC		GaAs	
1	**High Breakdown Voltage (critical electrical Field)**	**10 time better as Si**	🟢 🟢	**2 time better as Si**	🟢
2	**Carrier Mobility**	**0,7 time of Si**	🔵	**6 time better Si**	🟢 🟢
3	**High Temperature robustness**	**Theoretical Up to 800 ° C, Si up to 200 °** **(But Package Limit 200° in the future 300°)**	🟢	**300 ° C, Si up to 200 °**	🟢
4	**Switch off Power Loss**	**1/20 of Si**	🟢 🟢	**1/7 of Si**	🟢 🟢
5	**Switching Frequency**	**20 times faster than Si**	🟢	**7 times faster than Si**	🟢
6	**EMI Noise generation**	**higher than Si**	🔵	**Comparable to Si**	🟢 🟢
7	**Production efforts**	**much higher than Si**	🔵	**Defect level comparable to Si**	🟢

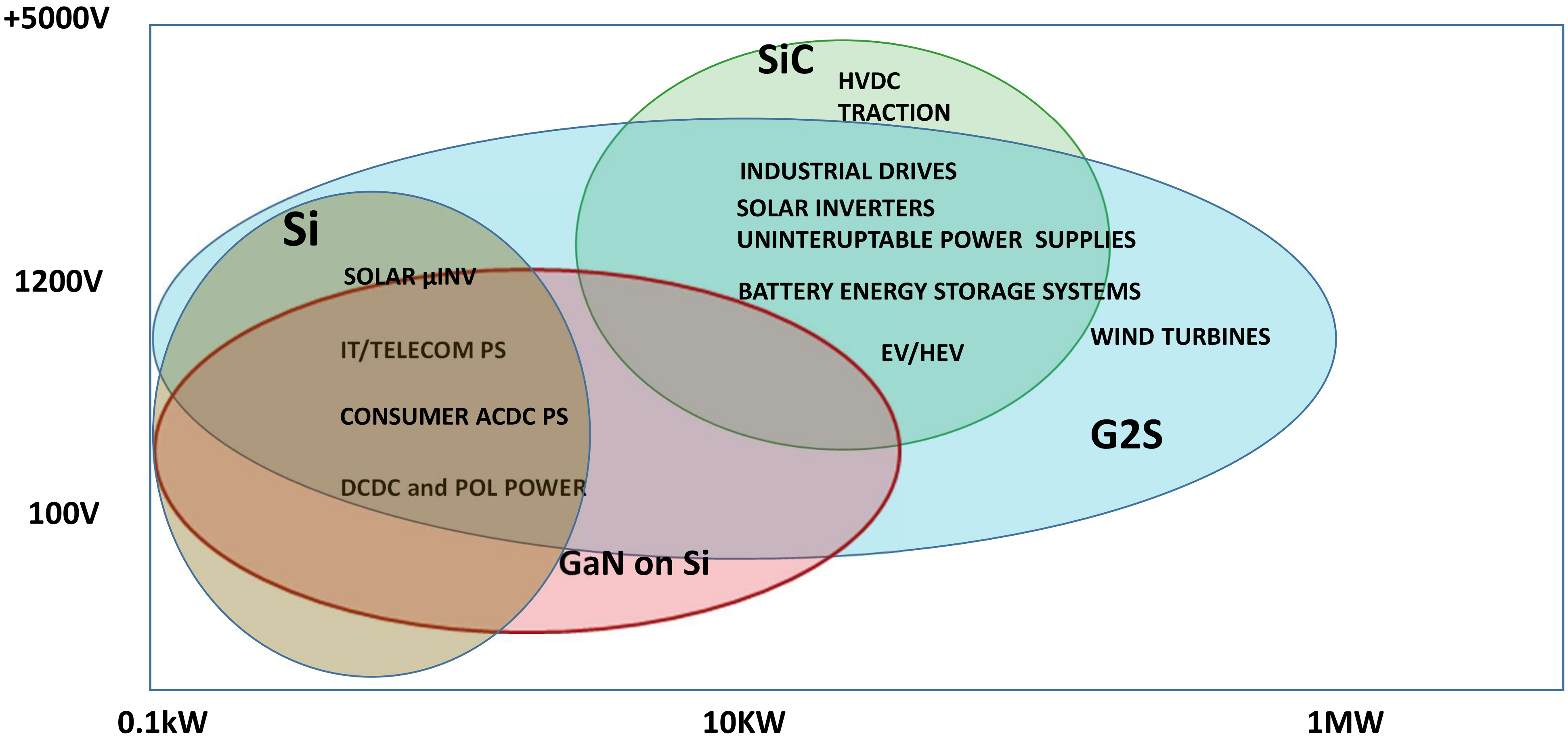
The use of LOW COST GaAs will lead to reduced power losses and a reduction of passive devices, reduction of device size and cooling systems leading to WEIGHT and VOLUME REDUCTION of High Power Products

Source: University of Tennessee, Michigan State Uni. Oak Ridge Institute
Prof. Lutz, University of Chemnitz

G2S Diodes

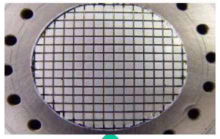
- 35PE has developed a new technology G2Sfor power semiconductors based on GaAs substrates
- This technology enables G2S PIN diodes with high breakdown voltage and high current density while also offering fast switching speeds comparable to Schottky diodes
- G2S PIN diodes perform better than Si PIN diodes and SiC Schottky diodes across a wide temperature range and voltage
- Manufacturing costs are approximately one-third lower, and in addition the chip size is a factor 2 smaller compared to SiC diodes
- G2S PIN diodes can be offered at Si prices even at high voltages (1200 V).
- High performance G2S PIN diodes including chip size reduction also allows for smaller module sizes, thereby reducing module costs and weight.
- G2S PIN diodes outperform comparable Si diodes at the same price.

35PE’s Product Positioning

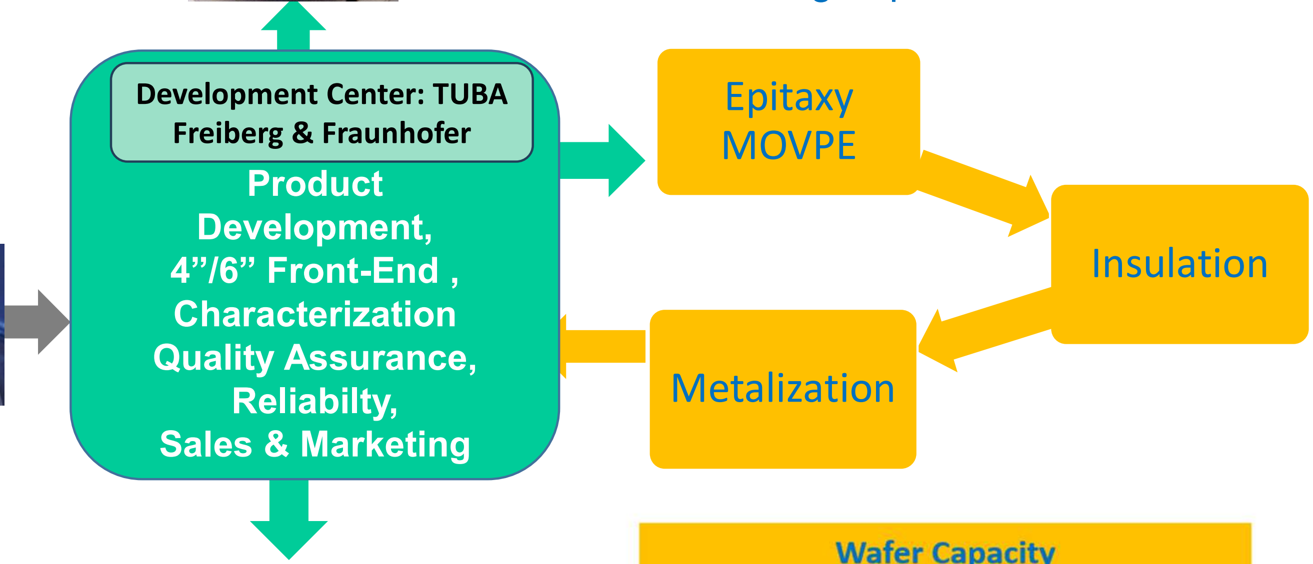


Business Model

3-5 PE High Power Semiconductor Manufacturer



Outsourcing MOVPE & Wafer Structuring to partner **AZURSPACE**



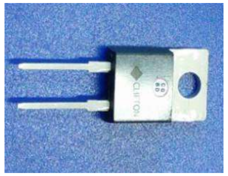
Development Center: TUBA Freiberg & Fraunhofer

Product Development, 4”/6” Front-End , Characterization Quality Assurance, Reliabilty, Sales & Marketing

Epitaxy MOVPE

Insulation

Metalization



Wafer Capacity	
4" Epitaxy Wafer	500,000 w/year
6" Epitaxy Wafer	300,000 w/year

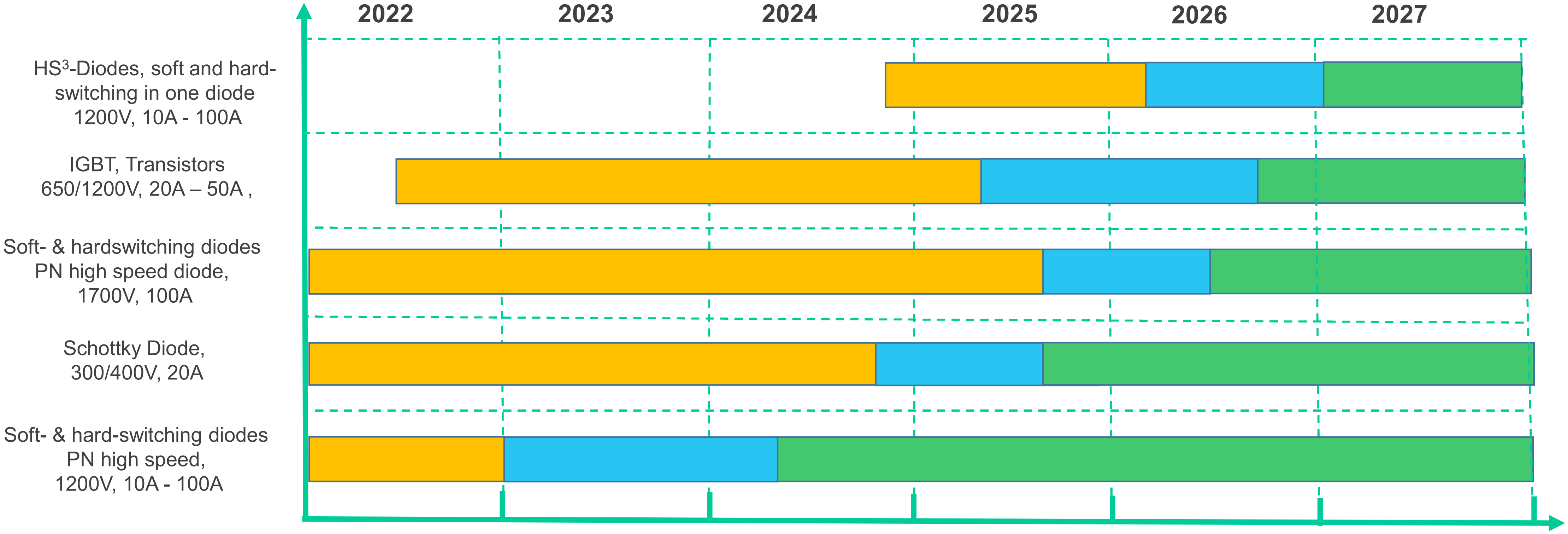
AZUR SPACE Solar Power GmbH, Heilbronn

Fab-Lite Concept together with strong Partners

GaAs Substrate	Wafer Foundry	GaAs Power Semiconductor Company
Freiberger Compound Materials  	AZUR SPACE A 5N PLUS COMPANY 	3|5 power electronics • Focus on R&D and product development Step 1: standard diode module Step 2: HBT transistors, IGBT's • Development Center TUBAF & FhG • Product qualification & reliability • Technical product marketing • Sales & Marketing
Second largest supplier ww of top-grade GaAs, InP and GaN wafers. (location Freiberg) *Independent from China in 2 y. because Al refineries will collect Ga as a waste product during their production*	AZUR SPACE Solar Power European leader and a global player in development and production of multi-junction solar cells for space PV (location Heilbronn) *GaAs foundries as 2nd source are available in Germany, Europe, Taiwan and Malayisa*	GaAs has been used for low-voltage applications with high yield for several decades. *Business model without building new wafer fabs with low investment scalable*

Roadmap & Patents

Roadmap



- 6” wafer from 2026 depending on volume of wafers
- On customer request mask customizing possible
- Continuous development of further high-power diodes
- First round reliability tests completed

🟨 R&D

🟦 Pre-Production

🟩 Production

G2S™

Patents

	Patent Subject	File No. of German Patent Office	Europe	Japan	China	USA
			Patent Filings already registered in			
1	III-V(GaAs)-PIN-Diode	🟧 AKZ 10 2016 013 541.7	🟧 X	🟧 X	🟧 X	X
2	III-V(GaAs)-PIN-Diode plus N+ Substrate	🟧 AKZ 10 2016 013 540.9	🟧 X	🟧 X	X	🟧 X
3	Staked GaAs Schottky-Diode	🟧 AKZ 10 2016 013 542.5	🟧 X	🟧 X	🟧 X	🟧 X
4	III-V(GaAs) PIN-Diode with special Defect Layer	🟧 AKZ 10 2017 002 935.0	🟧 X	X	🟧 X	🟧 X
5	Staked III-V Diode	🟧 AKZ 10 2018 000395.8	🟧 X	🟧 X	🟧 X	🟧 X
6	Diode with Defect Layer	🟧 AKZ 10 2017 002 936.9	🟧 X	X	🟧 X	🟧 X
7	GaAs Layer Structure p+; p and n-Layer	🟧 AKZ 10 2016 015 056.4	🟧 X	🟧 X	🟧 X	🟧 X
8	Liquid Phase Epitaxy Jig	🟧 AKZ 10 2017 009 110.2				
9	Liquid Phase Epitaxy Jig with feed line	🟧 AKZ 10 2017 003 638.1				
10	GaAs IGBT >1000V	🟧 AKZ 10 2016 015 475.6	🟧 X	🟧 X	🟧 X	🟧 X
11	Staked GaAs Diode	AKZ 10 2017 011 878.7	🟧 X	🟧 X	🟧 X	🟧 X
12	III-V(GaAs)-PIN-Diode	🟧 AKZ 10 2018 002 895.0	🟧 X	X	X	🟧 X
13	Scribing Frame	🟧 AKZ 10 2017 011 878.7	🟧 X	X	🟧 X	🟧 X
14	Staked high blocking III-V Diode	🟧 AKZ 10 2019 001 459.6	🟧 X	🟧 X	🟧 X	🟧 X
15	Staked high blocking InGaAs Diode	AKZ 10 2019 003 068.0	🟧 X		X	🟧 X
16	Staked III-V Diode	AKZ 10 2021 000 609.7	🟧 X	🟧 X	🟧 X	X
17	Staked III-V Diode	AKZ 10 2021 000 611.9	X	X	X	🟧 X
18	Staked III-V Diode	AKZ 10 2021 000 610.0	X	🟧 X	X	🟧 X
19	Package with water cooling	AKZ 10 2021 001 968.7	🟧 X	🟧 X	🟧 X	🟧 X

X = Patent filed

🟧 **Patent granted**

Proof-of-Concept

Proof of Concepts from different users

Wireless Charging System tested SiC diodes replace by G2S-diodes	20% lower power loss compared to SiC diodes
GaAs Power Rectifier Diode Module for Ultra-Fast EV Charging by	1,6% higher system efficiency vs SiC diodes, considerable module cost reduction
G2S soft-switching diodes used in 10kW LLC Converter	**Performance with GaAs is very close to that of SiC at lower cost**
GaAs soft-switching diodes used in Phase Shift Full Bridge Converter	**GaAs and SiC have very similar performance, especially as load current/ power increases. At higher power GaAs is better compared to SiC**
G2S hard-switching diodes used in Power Factor Correction Apps (PFC)	**Out of the evaluation report: …That GaAs Diode ….. perform better than the SiC Schottky diode under all power levels under study.**
IGBT Bridge Rectifier and Free Wheeling Diode	1.33% higher efficiency compared to Si
Ultra-fast EV batterie storage / charging systems with G2S diodes in IGBT modules	Switch-on and reverse recovery losses savings against Si Diodes
Test of G2S diodes in 1200V, 225A Standard IGBT Module	Total module switching losses are 22% lower at nominal operating point and 34% lower at typical operation of 100A

Advanced characteristics leading to higher energy savings & reduced costs

Proof of Concept

Wireless Charging System

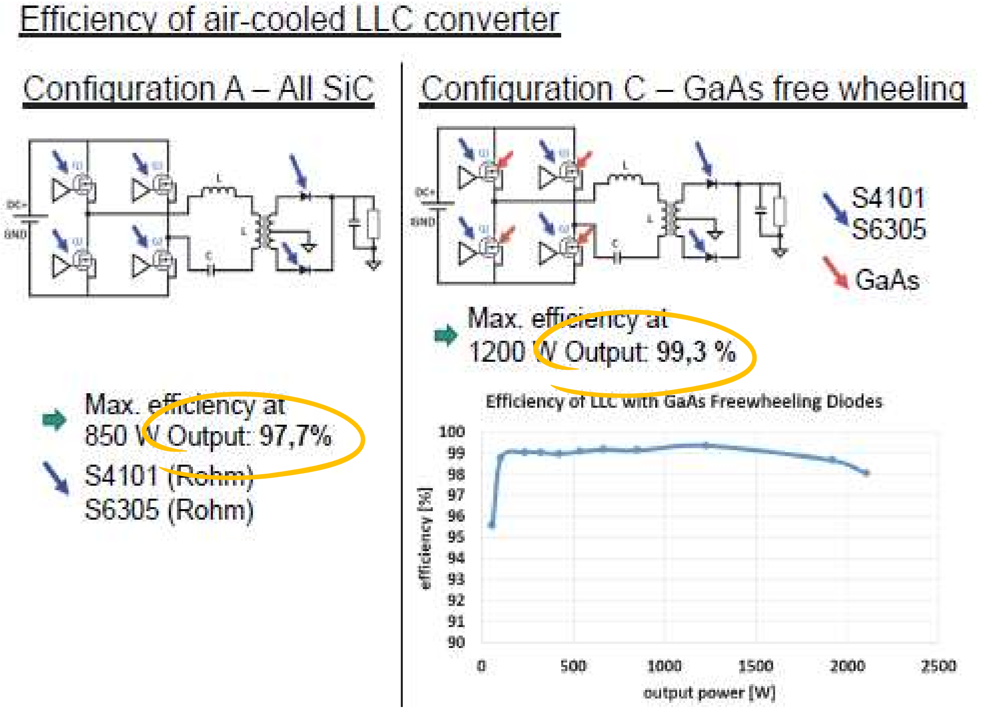
- Performance comparison of SiC & GaAs diodes applied in a wireless charging solution. B2U-rectification at constant output voltage & sinusoidal input current.

  System performance: 3.3 kW,
  primary-side power control,
  measured at 9.1A, 142 kHz and
  356 V output voltage

- 20% lower loss performance with GaAs pin-diode compared to SiC Schottky diode.

20% lower power loss compared to SiC diodes

GaAs Power Rectifier Diode Module for Ultra-Fast EV Charging



Efficiency of air-cooled LLC converter

Configuration A – All SiC

➡ Max. efficiency at 850 W Output: 97,7%

↘ S4101 (Rohm)
S6305 (Rohm)

Configuration C – GaAs free wheeling

↘ S4101
S6305

↘ GaAs

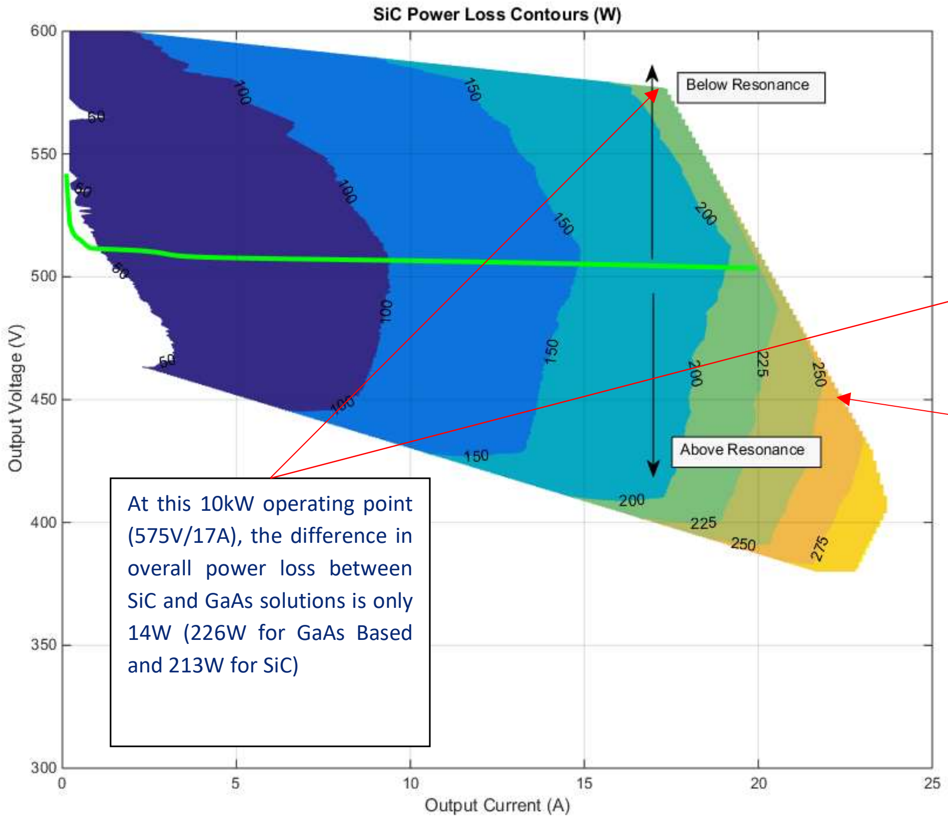
➡ Max. efficiency at 1200 W Output: 99,3 %

Efficiency of LLC with GaAs Freewheeling Diodes

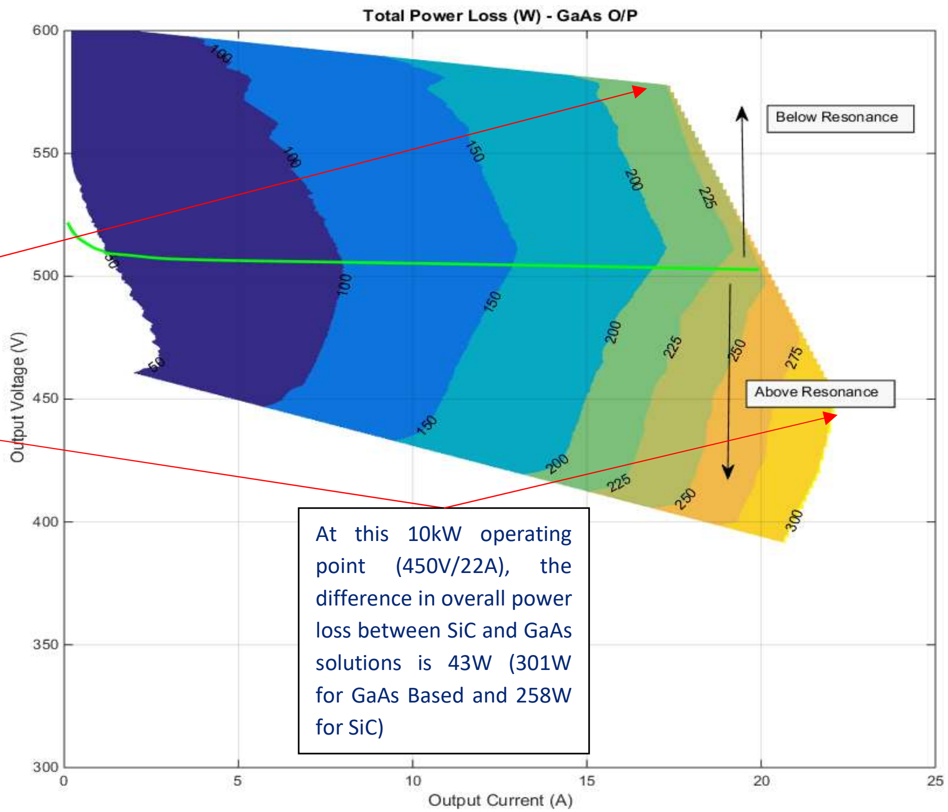
1,6% higher system efficiency vs SiC diodes

GaAs soft-switching diodes used in 10kW LLC Converter

LLC converter is a one of the two most used switching topologies for EV loading stations



At this 10kW operating point (575V/17A), the difference in overall power loss between SiC and GaAs solutions is only 14W (226W for GaAs Based and 213W for SiC)



At this 10kW operating point (450V/22A), the difference in overall power loss between SiC and GaAs solutions is 43W (301W for GaAs Based and 258W for SiC)

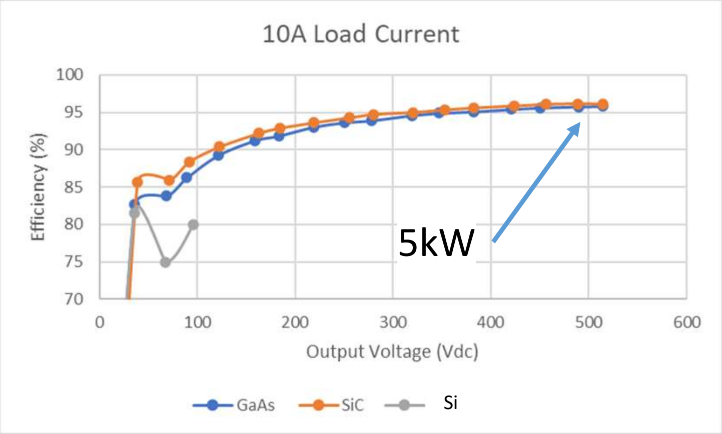
SiC

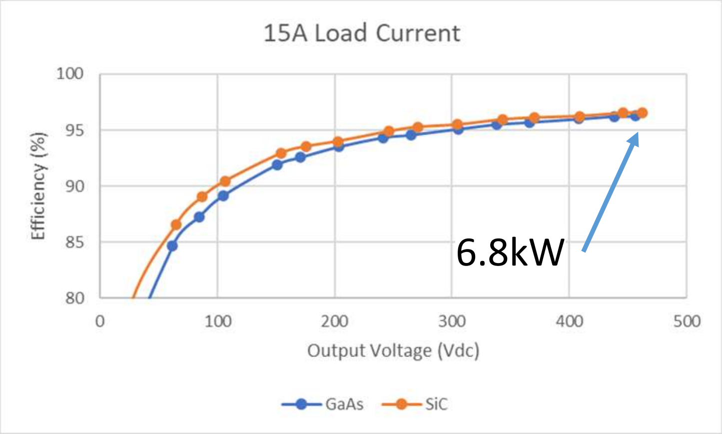
Performance with GaAs is very close to that of SiC at lower cost

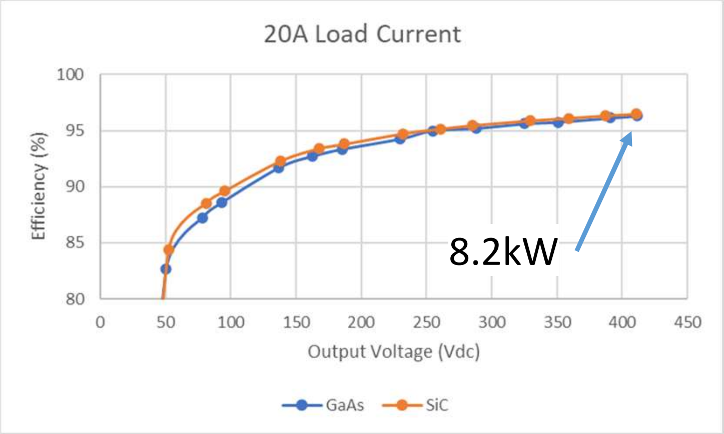
GaAs

GaAs soft-switching diodes used in Phase Shift Full Bridge Converter

Phase Shift Full Bridge converter is a one of the two most used switching topologies for EV loading stations







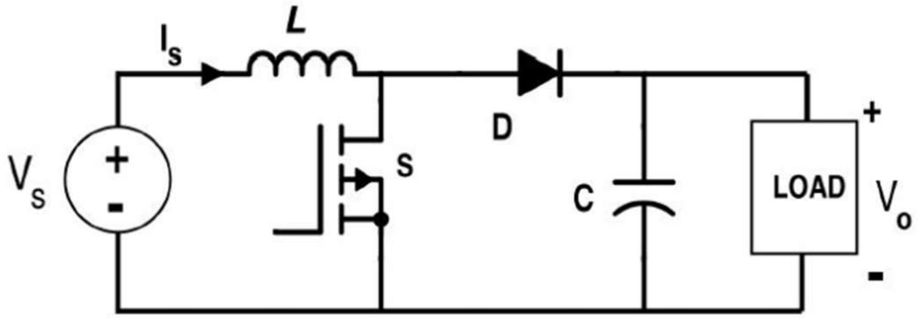
Hyperfast Silicon performance is very poor and this technology is not viable for use at this power level due to Trr induced losses. Limited data capture was possible due to very high clamp losses.

GaAs and SiC have very similar performance , especially as load current/ power increases. At higher power GaAs may be better compared to SiC

GaAs hard-switching diodes used in Power Factor Correction Apps (PFC)

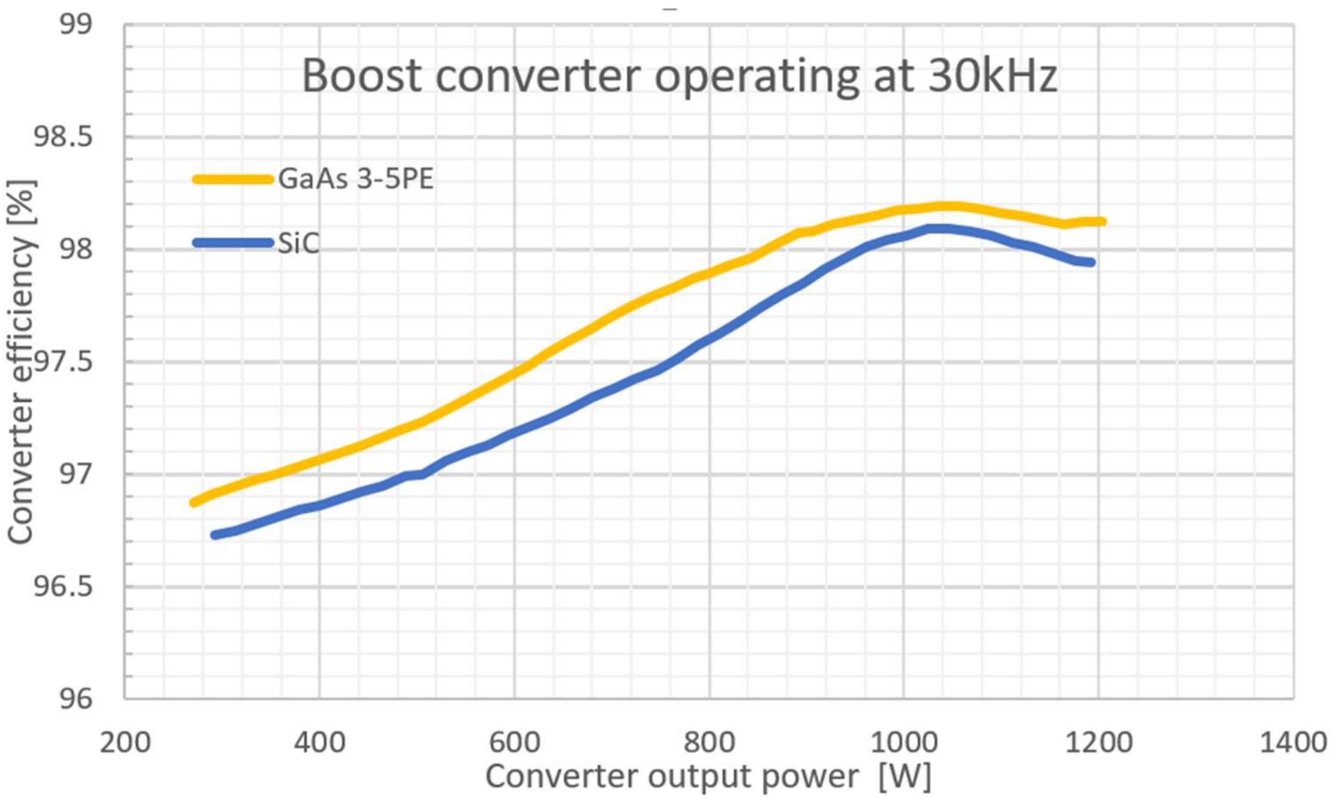
PFC is the most used applications in power electronics. A large discrete power semiconductor manufacturer intensively investigated our GaAs diodes with 4 different types of GaAs diodes with its SiC diodes in PFC application.

Circuit:



- Vs = 370 V, EA-PSI9750-06 power supply
- Vo = 740 V, Load = EA-EL9750-20 electronic load
- L = 1 mH (25 A max)
- C = 100 µF (900 V max)
- S = WNSCM80120W, PWM driven, Vg = 20 V (on state), Vg = -5 V (off state)
- D = all of the diodes mentioned above

GaAs hard-switching diodes used in Power Factor Correction Apps (PFC)

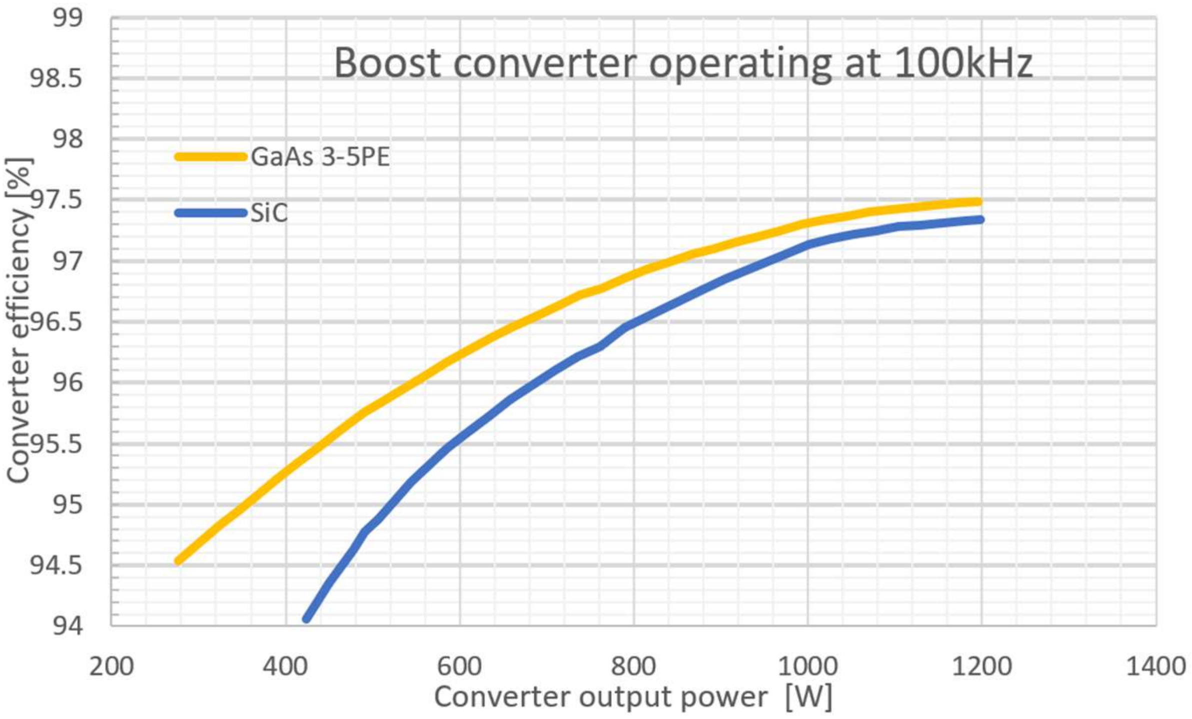


At 30 kHz switching frequency the boost converter operates in discontinuous mode up to approximately 800W output power level. Above that level the converter operates in continuous

At 30k all G2S Diode Profiles are better in all measuring points than SiC diodes.

GaAs hard-switching diodes used in Power Factor Correction Apps (PFC)

The 3-5PE G2S hard switching diode is optimized for PFC and in all measuring points better than SiC diodes.



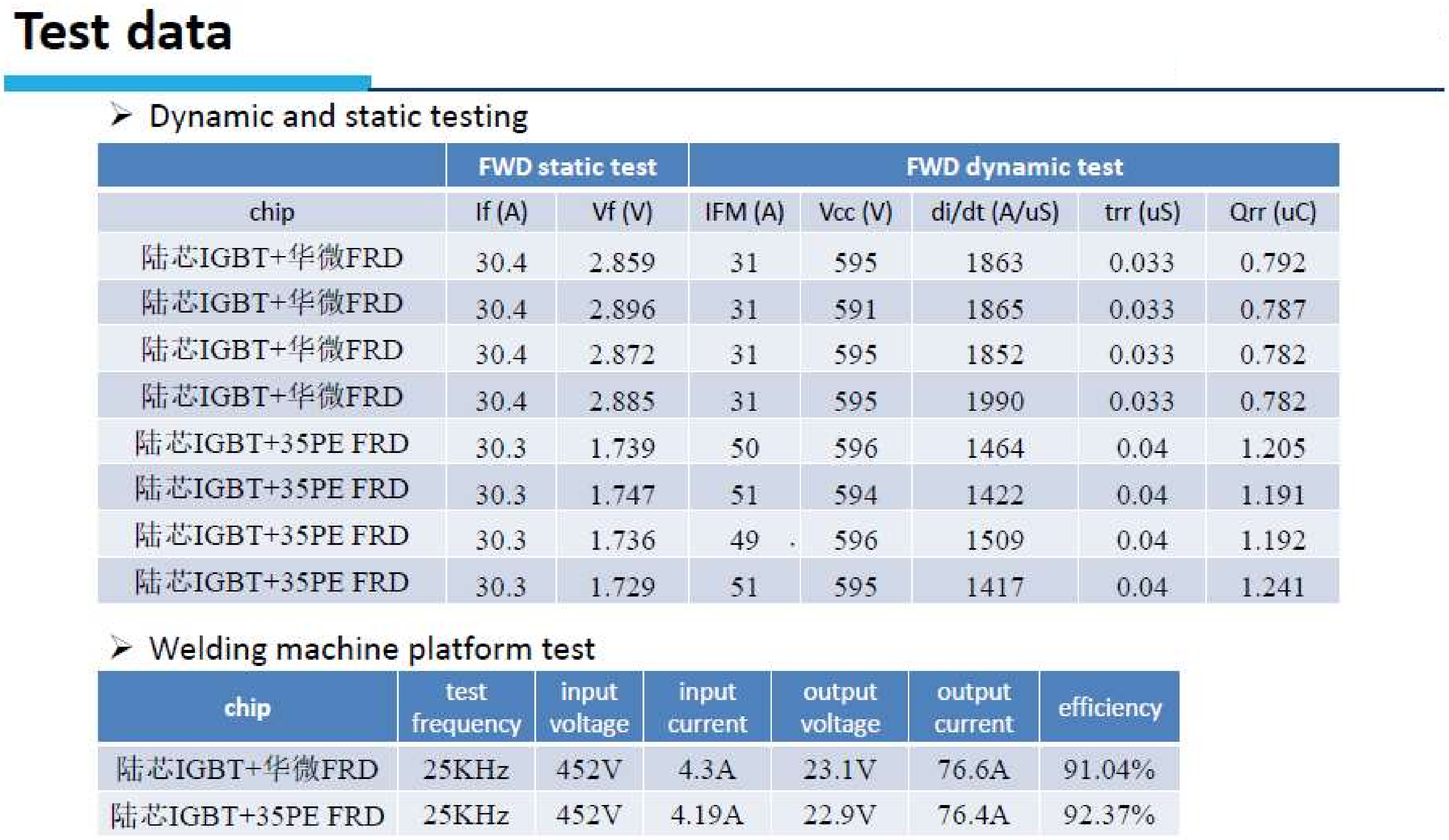
At 100 kHz switching frequency the boost converter operates in discontinuous mode up to approximately 250W output power level. Above that level the converter operates in continuous mode.

Out of the evaluation report:

…That G2S Diode ….. perform better than the SiC Schottky diode under all power levels under study.

Additional Customer also evaluated our G2S diodes and „performance is as good as SiC diodes, in terms of efficiency it will be better than SiC diodes“. Customers wants to switch to G2S.

Bridge Rectifier and Free Wheeling Diode



Test data

- Dynamic and static testing

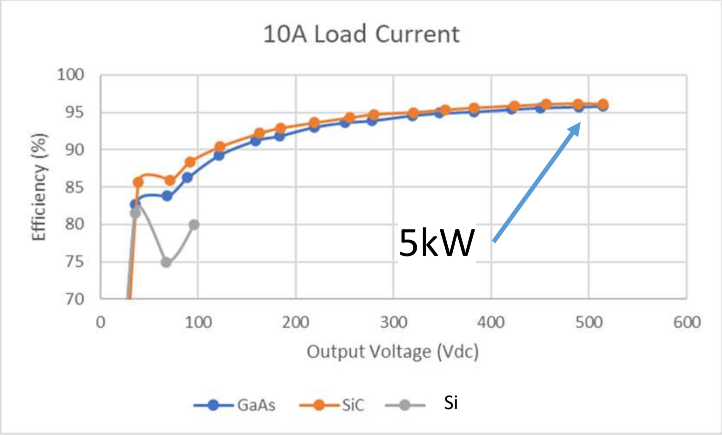
	FWD static test		FWD dynamic test				
chip	If (A)	Vf (V)	IFM (A)	Vcc (V)	di/dt (A/uS)	trr (uS)	Qrr (uC)
陆芯IGBT+华微FRD	30.4	2.859	31	595	1863	0.033	0.792
陆芯IGBT+华微FRD	30.4	2.896	31	591	1865	0.033	0.787
陆芯IGBT+华微FRD	30.4	2.872	31	595	1852	0.033	0.782
陆芯IGBT+华微FRD	30.4	2.885	31	595	1990	0.033	0.782
陆芯IGBT+35PE FRD	30.3	1.739	50	596	1464	0.04	1.205
陆芯IGBT+35PE FRD	30.3	1.747	51	594	1422	0.04	1.191
陆芯IGBT+35PE FRD	30.3	1.736	49	596	1509	0.04	1.192
陆芯IGBT+35PE FRD	30.3	1.729	51	595	1417	0.04	1.241

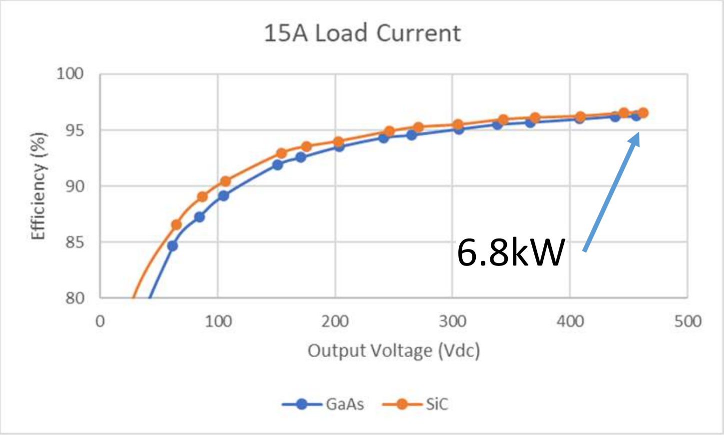
- Welding machine platform test

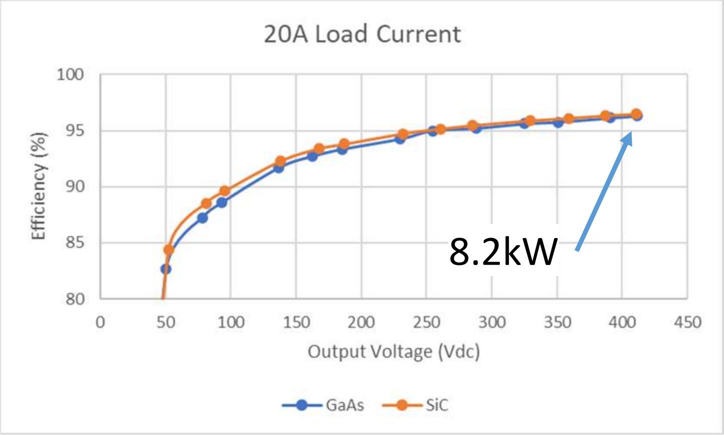
chip	test frequency	input voltage	input current	output voltage	output current	efficiency
陆芯IGBT+华微FRD	25KHz	452V	4.3A	23.1V	76.6A	91.04%
陆芯IGBT+35PE FRD	25KHz	452V	4.19A	22.9V	76.4A	92.37%

GaAs soft-switching diodes used in Phase Shift Full Bridge Converter

Phase Shift Full Bridge converter is a one of the two most used switching topologies for EV loading stations







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GaAs and SiC have very similar performance , especially as load current/ power increases. At higher power GaAs may be better compared to SiC

G2S soft-switching diodes used in Phase Shift Full Bridge Converter

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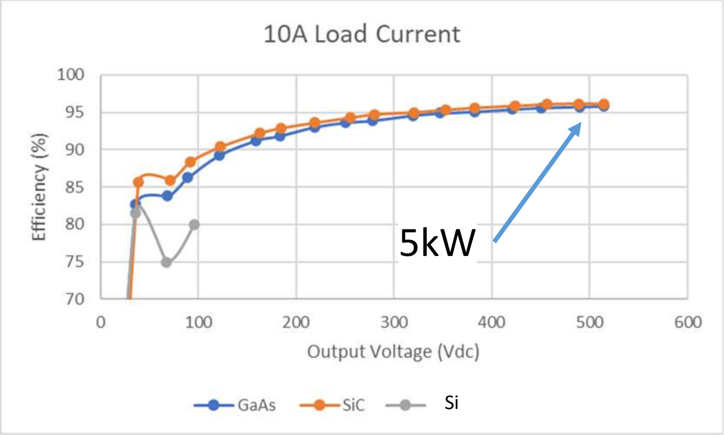

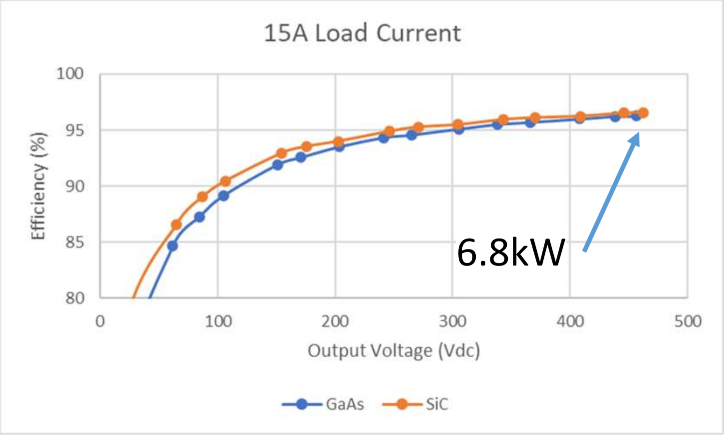

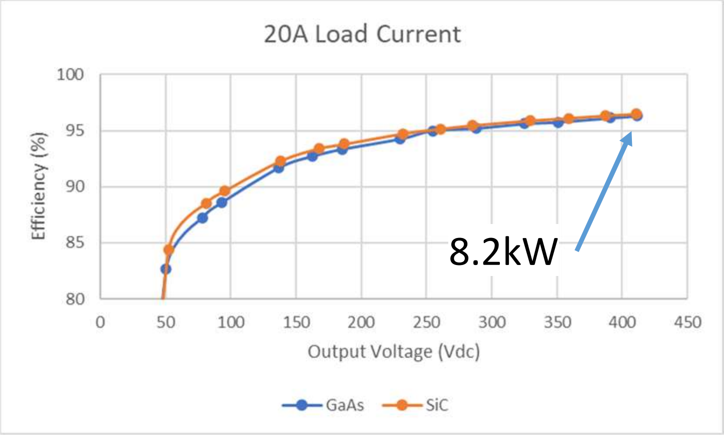

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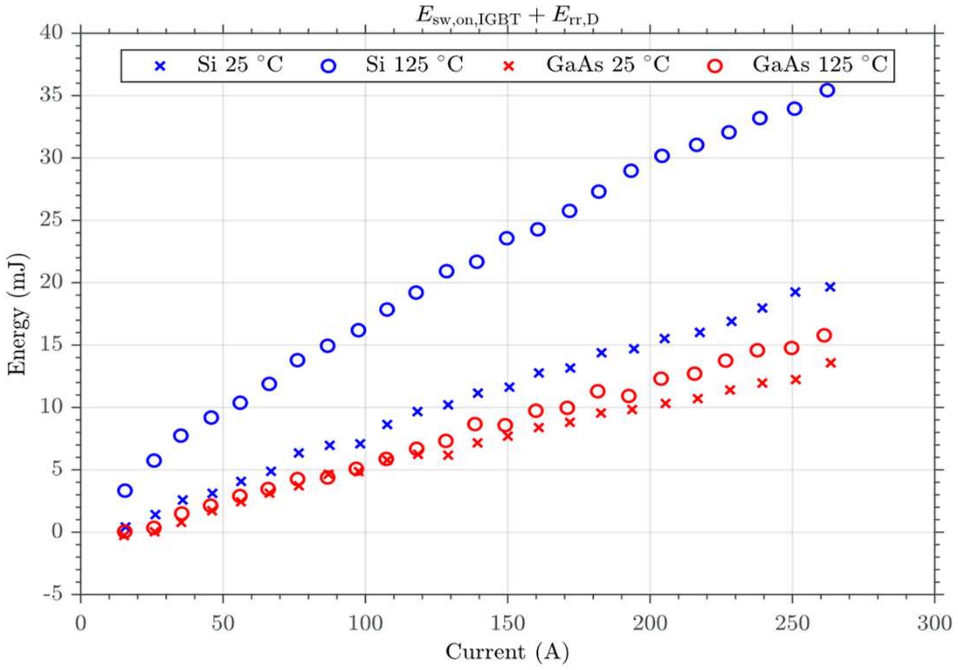
GaAs diodes in ultra-fast EV batterie storage / charging systems

Application ultra-fast EV charging system in conjunction with battery energy storage systems:

- Switching topology: Auxiliary Resonant Commuted Pole Inverter
- 1.2kV Si diodes replaced by 1.2kV G2S Diodes
- Tests performed at different currents and chip temperatures
- Tests have been made at **University of Applied Sciences Georg Simon Ohm Nueremberg**, Germany

Loss savings: sum of switch-on and reverse recovery losses:

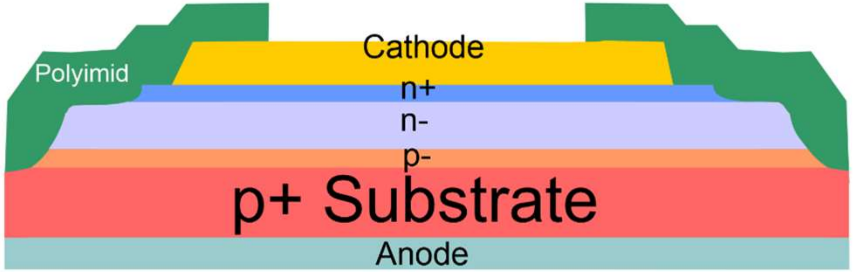


Significant reduction of losses (factor 3.5 (55A) and 2.0 (250A)) are possible by replacing the diodes, especially at higher chip temperatures to be expected in periodic operation

G2S for Power Modules

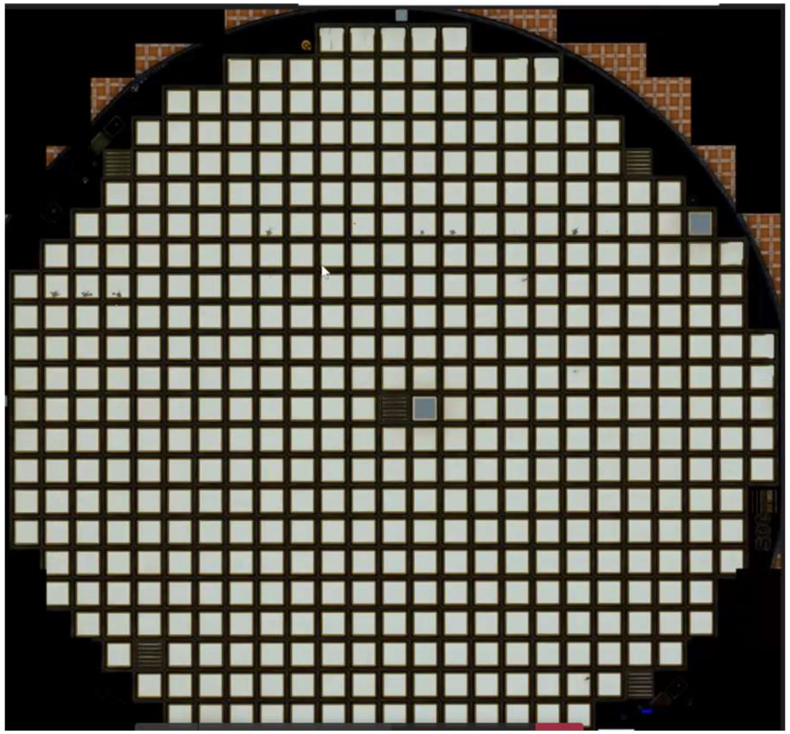
G2S Diodes für Power Modules

Crossection of the G2S pin Diodes



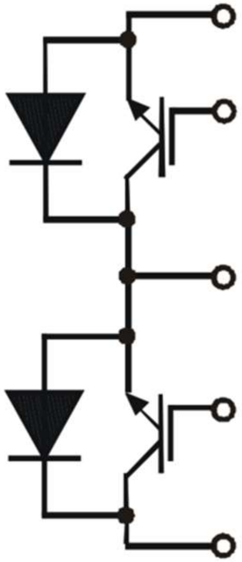
G2S Diode metallization options

	Discret	Modul Typ1	Modul Typ2
Anode	Ag	Ag	Al
Kathode	Ag	Ag	Ag



4 inch wafer Topview, 60A 1200V Devices

G2S diodes in 1200V, 220A Standard IGBT Module



Total module switching losses (Eon+Eoff+Err) are >20% lower at norminal operating point compared to Si-Diodes. At typical operation of 100A the swiching losses are >**30% lower**

Cost structure

Die Size of SiC & GaAs

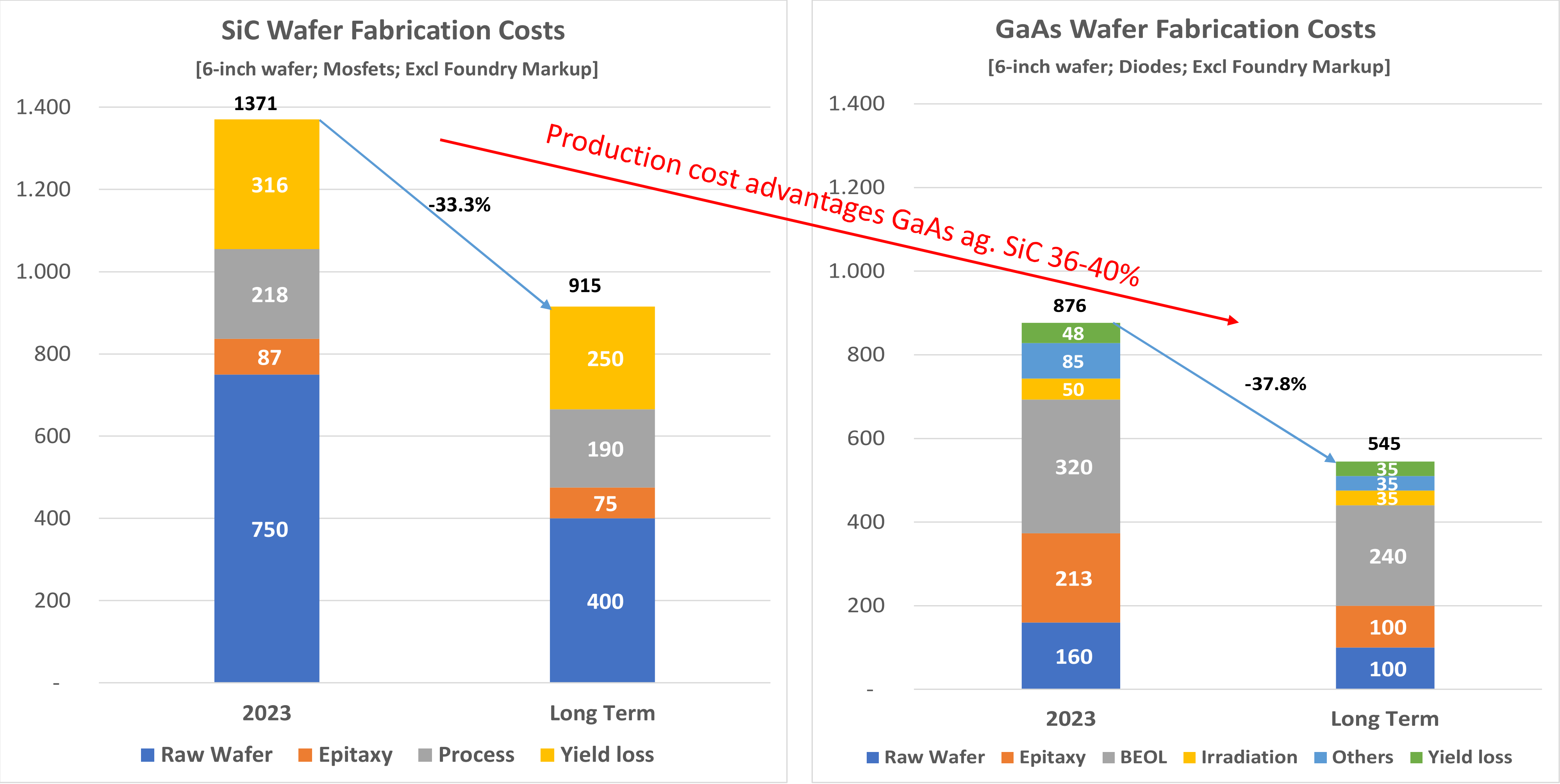
Cost advantage no. 1:

- Die size of GaAs is 35% up to 50% smaller than SiC this means on a 6 inch wafer are as many dies as on a 8 inch SiC wafer.
- 8 inch substrate wafers are already available. 8 inch development funded project started.

Wolfspeed bare Dies compared to GaAs Dies

		SiC die size Wolfspeed		GaAs die size 35PE		Die Size Factor
	Current (A)	Die Size (mm)	Die area (mm^2)	Die Size (mm)	Die area (mm^2)	GaAs smaller than SiC
Wolfspeed bare Dies						
CPW4-1200-S010B	10	2,26 * 2,26	5,1076	1,54 * 2,14	3,2956	1,5
CPW4-1200-S015B	15	2,7 * 2,7	7,2900	2,58 * 1,72	4,4376	1,6
CPW4-1200-S020B	20	3,075 * 3,075	9,4556	2,58 * 2,08	5,3664	1,8
EPW4-1200-S020A	30			3,58 * 2,08	7,4464	
CPW5-1200-Z050B	50	4,9 * 4,9	24,0100	3,34 * 3,34	11,1556	2,2
	60			3,58* 3,58	12,96	>2,2

GaAs Production Cost advantage against SiC Production Costs



SiC Wafer Fabrication Costs

[6-inch wafer; Mosfets; Excl Foundry Markup]

GaAs Wafer Fabrication Costs

[6-inch wafer; Diodes; Excl Foundry Markup]

Production cost advantages GaAs ag. SiC 36-40%

38% manufacturing cost advantage GaAs power diodes compared to SiC diodes in addition die size of GaAs is a factor 2 smaller

SiC Reliability issues

Realibility Cosmic Radiation

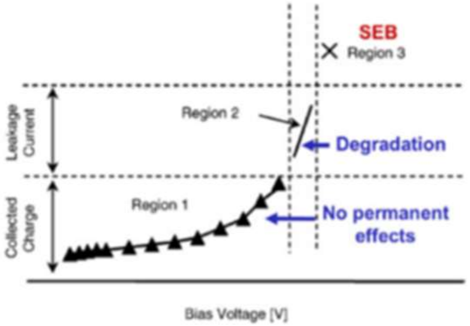


Figure 1. SiC Schottky diode responses to heavy-ion irradiation range from no permanent effect to leakage current degradation to sudden catastrophic single-event burnout (SEB) depending on the reverse bias voltage (V_R) during irradiation.

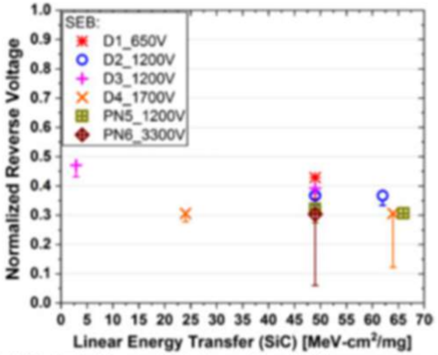
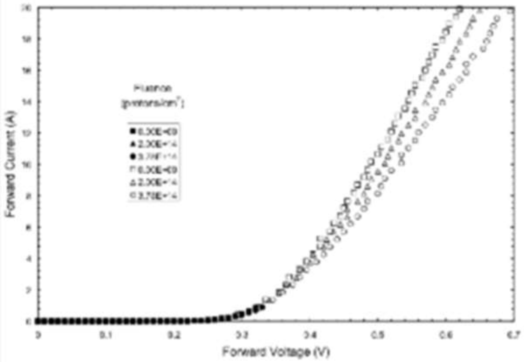
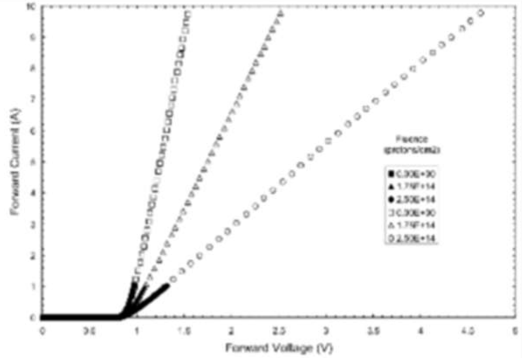


Figure 3. SiC diode V_R at which immediate SEB occurs, normalized to measured breakdown voltage, as a function of LET. Error bars extend down to the highest voltage evaluated at which immediate SEB did not occur.

[6, 7]

Si [8]	**GaAs** [3]	**SiC** [8]
 Fig. 2 Forward bias I-V characteristics vs. 203 MeV proton fluence for selected fluences for 60V/20A Si Schottky barrier diode.	„outstanding and unseen robustness in terms of cosmic radiation robustness“	 Fig. 1 Forward bias I-V characteristics vs. 203 MeV proton fluence for selected fluences for 1200V/10A SiC Schottky barrier diode.

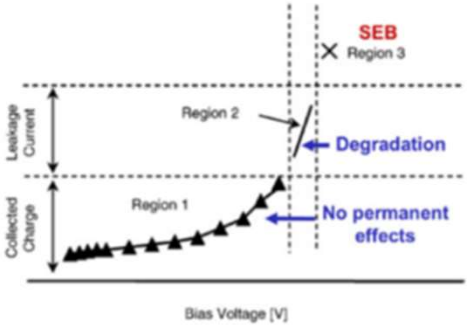
[3] customer report

[6] S. Kuboyama et. al. “Anomalous Charge Collection in Silicon Carbide Schottky Barrier Diodes and Resulting Permanent Damage and Single-Event Burnout” IEEE Transactions on Nuclear Science, vol. 53, no. 6, pp. 3343-3348, Dec. 2006,

[7] J.M. Lauenstein et al. „Space Radiation Effects on SiC Power Device Reliability” 2021 IEEE International Reliability Physics Symposium (IRPS), Monterey, CA, USA, 2021, pp. 1-8

[8] R. D. Harris, "SiC vs. Si for High Radiation Environments," 2007 IEEE Radiation Effects Data Workshop, Honolulu, HI, USA, 2007, pp. 63-67,

Realibility Cosmic Radiation



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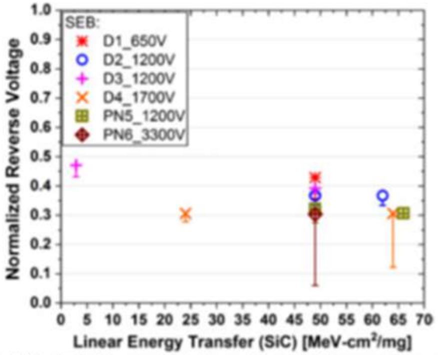

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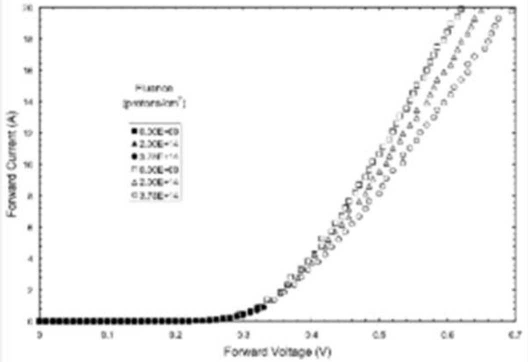
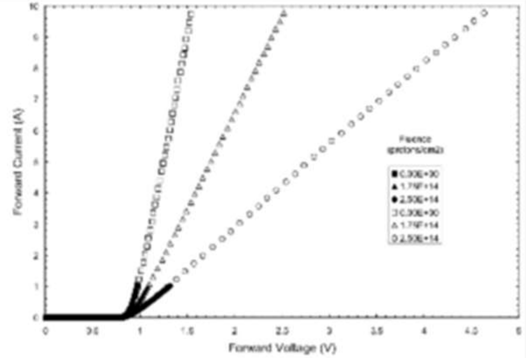
 Fig. 2 Forward bias I-V characteristics vs. 203 MeV proton fluence for selected fluences for 60V/20A Si Schottky barrier diode.	„outstanding and unseen robustness in terms of cosmic radiation robustness“	 Fig. 1 Forward bias I-V characteristics vs. 203 MeV proton fluence for selected fluences for 1200V/10A SiC Schottky barrier diode.

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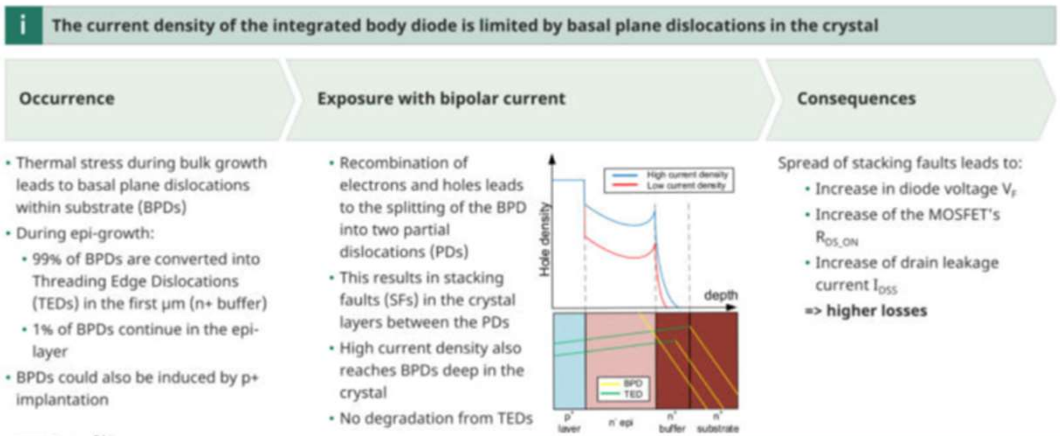
Realibility SiC Bipolar Degradation



The current density of the integrated body diode is limited by basal plane dislocations in the crystal

Occurrence

- Thermal stress during bulk growth leads to basal plane dislocations within substrate (BPDs)
- During epi-growth:
  - 99% of BPDs are converted into Threading Edge Dislocations (TEDs) in the first µm (n+ buffer)
  - 1% of BPDs continue in the epi-layer
- BPDs could also be induced by p+ implantation

Exposure with bipolar current

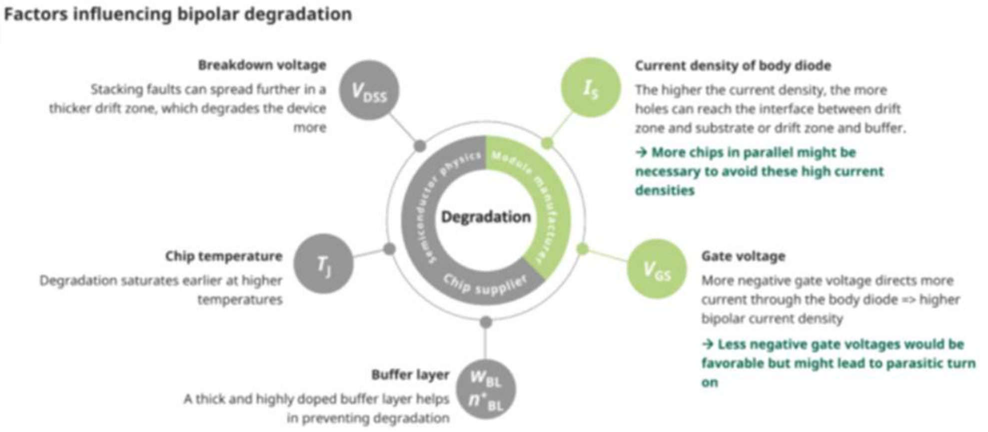
- Recombination of electrons and holes leads to the splitting of the BPD into two partial dislocations (PDs)
- This results in stacking faults (SFs) in the crystal layers between the PDs
- High current density also reaches BPDs deep in the crystal
- No degradation from TEDs

Consequences

Spread of stacking faults leads to:

- Increase in diode voltage V_F
- Increase of the MOSFET's R_{DS_ON}
- Increase of drain leakage current I_{DSS}

=> higher losses



Factors influencing bipolar degradation

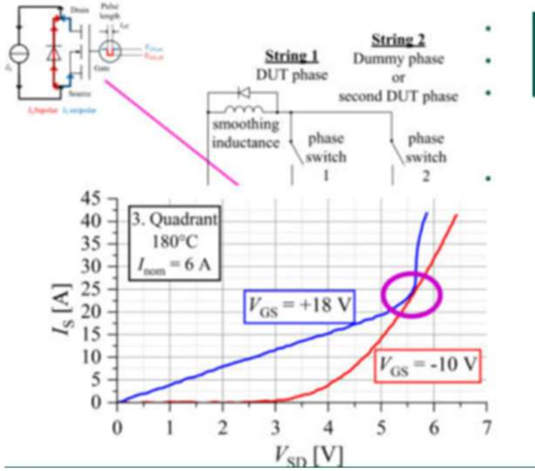
Breakdown voltage
Stacking faults can spread further in a thicker drift zone, which degrades the device more

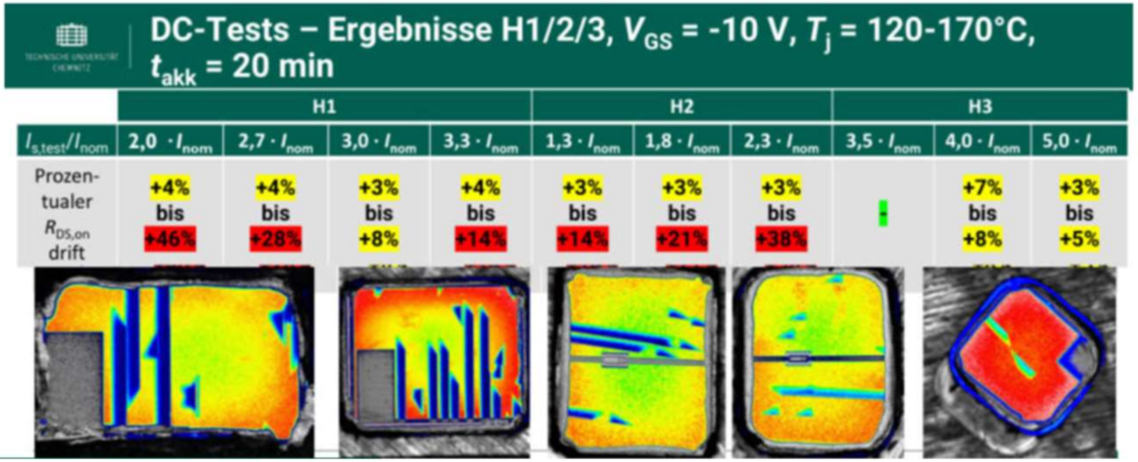
Current density of body diode
The higher the current density, the more holes can reach the interface between drift zone and substrate or drift zone and buffer.
→ More chips in parallel might be necessary to avoid these high current densities

Chip temperature
Degradation saturates earlier at higher temperatures

Gate voltage
More negative gate voltage directs more current through the body diode => higher bipolar current density
→ Less negative gate voltages would be favorable but might lead to parasitic turn on

Buffer layer
A thick and highly doped buffer layer helps in preventing degradation



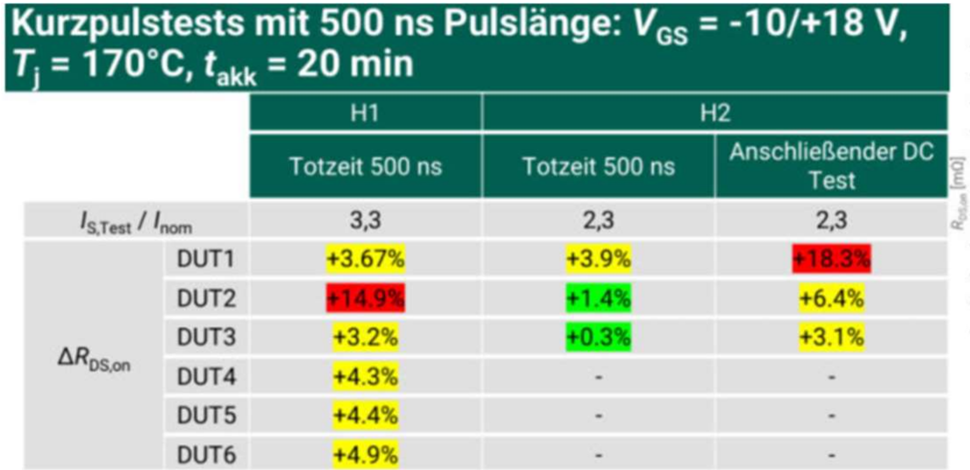


DC-Tests – Ergebnisse H1/2/3, V_{GS} = -10 V, T_j = 120-170°C, t_{akk} = 20 min

	H1				H2			H3		
$I_{s,test}/I_{nom}$	$2{,}0 \cdot I_{nom}$	$2{,}7 \cdot I_{nom}$	$3{,}0 \cdot I_{nom}$	$3{,}3 \cdot I_{nom}$	$1{,}3 \cdot I_{nom}$	$1{,}8 \cdot I_{nom}$	$2{,}3 \cdot I_{nom}$	$3{,}5 \cdot I_{nom}$	$4{,}0 \cdot I_{nom}$	$5{,}0 \cdot I_{nom}$
Prozentualer $R_{DS,on}$ drift	+4% bis +46%	+4% bis +28%	+3% bis +8%	+4% bis +14%	+3% bis +14%	+3% bis +21%	+3% bis +38%	-	+7% bis +8%	+3% bis +5%

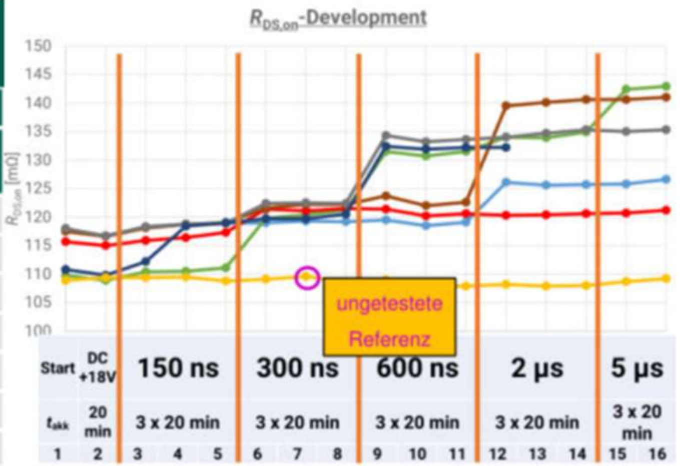
Cristal defects grow, starting from the substrates, through the epitaxial layers and destroy large amount of the active areas leading to significant increase of the on-state resistance and leakage current.

Realibility SiC Bipolar Degredation



Kurzpulstests mit 500 ns Pulslänge: V_{GS} = -10/+18 V, T_j = 170°C, t_{akk} = 20 min

		H1	H2	
		Totzeit 500 ns	Totzeit 500 ns	Anschließender DC Test
$I_{S,Test} / I_{nom}$		3,3	2,3	2,3
$\Delta R_{DS,on}$	DUT1	+3.67%	+3.9%	+18.3%
	DUT2	+14.9%	+1.4%	+6.4%
	DUT3	+3.2%	+0.3%	+3.1%
	DUT4	+4.3%	-	-
	DUT5	+4.4%	-	-
	DUT6	+4.9%	-	-



Bipolar degradation occurs even with short dead times of 500 ns.

Continuing defect growth is observed in the DC test.

Bipolar degradation occurs gradually, depending on the pulse length, even with short pulse lengths.

[1] O. Siwak et al. „SiC MOSFET im Antriebsumrichter für E-Fahrzeuge –eine eierlegende Wollmilchsau??" Proceedings Halbleiterkolloquium Freiburg 2024

[9] C. Herrmann et al. „Bipolardegradation bei SiC MOSFETs während kurzer Totzeiten" Proceedings Halbleiterkolloquium Freiburg 2024