Silicon Carbide Schottky Barrier Diodes

Application Note

Scope

Explaining the features and benefits of Sanan Semiconductor SiC Schottky Barrier Diodes (SBDs). Application advantages compared to traditional Si Diodes and to competitor products.

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1. Introduction to SiC

SiC (silicon carbide) has gained increasing importance in both industrial and automotive applications. This wide band-gap semiconductor material has unique properties well-fitting high temperature, high power, and/or high radiation conditions where a conventional semiconductor material like silicon (Si) cannot perform adequately or reliably [1]. SiC has different polytypes and the 4H-SiC is ideal for producing power devices. At present 4H-SiC monocrystalline wafers between 4 and 6 inches are massively produced. Another emerging semiconductor material is gallium nitride (GaN), whose unique properties will play a key role in future applications requiring high-frequency and high-temperature devices.

Table 1 compares the electrical properties of SiC with Si and GaN. Compared to Si, SiC shows several advantages:

- SiC has a 3 times larger band-gap, which thus results in a 3 times larger energy required to move an electron from the valence to the conduction band. Consequently, SiC can handle 10 times larger voltages without breaking down. SiC devices can therefore be designed with thinner layers to achieve the same breakdown voltage.
- SiC's higher saturated drift velocity enables charge carriers to move faster in response to an electric field, reducing switching times and thus reducing switching losses. This characteristic is especially beneficial in high-frequency and high-power applications.
- SiC possesses 3 times higher thermal conductivity, which allows to dissipate heat more effectively and to design smaller heat sinks and cooling systems.

GaN also presents excellent properties, making it a suitable candidate for various innovative applications, but not in the scope of this application note.

Property	Si	SiC (4H-SiC)	GaN
Crystal Structure	Diamond	Hexagonal	Hexagonal
Band Gap EG (eV)	1.1	3.2	3.4
Breakdown Field E_B ($MVcm^{-1}$)	0.3	3.0	3.0
Saturated Drift Velocity V_s ($10^7 cm\ s^{-1}$)	1.0	2.0	2.7
Thermal Conductivity k ($Wcm^{-1}K^{-1}$)	1.5	4.9	1.5

Table 1. Electrical properties comparison between relevant materials in the power semiconductor world [2].

2. Sanan SiC SBDs

Sanan Semiconductor as part of Sanan Optoelectronics has gradually deployed wide band-gap semiconductors, including a product portfolio of SiC for supporting the design of high-voltage, high-current, and high-temperature systems. SiC technology is especially shaping the power industry through advancements in terms of energy efficiency, power efficiency, and power density. Based on 20 years of excellent compound semiconductor manufacturing experience, we offer SiC devices with low failure rates targeting a wide range of applications, such as automotive, renewable energy, and industrial power supply.

In particular, Sanan Semiconductor has a proven portfolio of SiC Schottky Barrier Diodes (SBDs), with more than 100M units shipped annually. As shown in Table 2, we offer 650V, 1200V and 1700V SiC SBDs with a wide range of current ratings. Moreover, our products cover consumer, industrial, and automotive grades and several package topologies are available.

Grade	Voltage	Generation	Package	Current
IND	650 V	Gen-3	TO220-2L	4A/6A/8A/10A/12A/16A/20A
IND	650 V	Gen-3	TO252-2L	2A/4A/6A/8A/10A/20A
IND	650 V	Gen-3	TO263-2L	6A/10A
IND	650 V	Gen-3	DFN8*8-4L	6A/8A/12A
IND	650 V	Gen-3	TO220N-2L	8A/10A/
IND	650 V	Gen-3	TO247-2L	16A/20A/30A/40A/50A
IND	650 V	Gen-3	TO247-3L	16A/20A/30A/40A
IND	650 V	Gen-3	TO3PF	20A
IND	650 V	Gen-3	Bare Die	2A/4A/6A/8A/10A/12A/16A/ 20A/30A/40A/50A
ATV	650 V	Gen-3	SMBF	1A
ATV	650 V	Gen-3	Bare Die	1A/8A/10A/12A/20A/40A
ATV	650 V	Gen-3	TO220-2L	20A
ATV	650 V	Gen-3	TO247-2L	20A
ATV	650 V	Gen-3	TO247-3L	16A/20A/40A
ATV	650 V	Gen-3	TO263-2L	20A
CONS	650 V	Gen-4	TO-220-2L	4A/6A/10A
CONS	650 V	Gen-4	TO-252-2L	4A/6A/8A
CONS	650 V	Gen-4	TO-220N-2L	6A
IND	650 V	Gen-4	Bare Die	4A/6A/8A/10A
ATV	650 V	Gen-4	Bare Die	10A
IND	1200 V	Gen-3	TO220-2L	2A/5A/10A/15A
IND	1200 V	Gen-3	TO252-2L	2A/3A/5A/10A
IND	1200 V	Gen-3	TO263-2L	10A
IND	1200 V	Gen-3	TO247-2L	10A/15A/20A/27A/30A/40A/ 50A/60A
IND	1200 V	Gen-3	TO247-3L	10A/20A/30A/40A/60A

IND	1200 V	Gen-3	Bare Die	2A/3A/5A/10A/15A/20A/27A /30A/40A/50A/60A
ATV	1200 V	Gen-3	SMBF	1A
ATV	1200 V	Gen-3	Bare Die	1A/5A/20A
ATV	1200 V	Gen-3	TO247-2L	20A
ATV	1200 V	Gen-3	TO252-2L	5A
ATV	1200 V	Gen-3	TO220-2L	20A
IND	1200 V	Gen-5	Bare Die	10A/15A/20A/30A/40A
IND	1200 V	Gen-5	TO220-2L	10A
IND	1200 V	Gen-5	TO247-2L	15A/20A/30A/40A
IND	1700 V	Gen-5	Bare Die	25 A
IND	1700 V	Gen-5	TO-247-2L	25 A

Table 2. Sanan portfolio related to the Gen-3, Gen-4, and Gen-5 SiC SBDs currently available in the market [3].

3. SiC SBD Gen-3

Figure 3.1 shows the principle structure of the Gen-3 SiC SBD, which is the latest generation of SiC diodes offered by Sanan Semiconductors. The device incorporates a metal-semiconductor junction, known as the Schottky barrier, instead of a traditional P-N junction characterizing standard Si diodes. The Schottky barrier is formed between the Schottky metal and a lightly doped N-type epitaxy. The substrate is characterized by a highly doped N-type SiC wafer, which provides mechanical stability. When a forward voltage is applied, the electrons are the majority charge carriers, resulting in a unipolar current. Additionally, due to the presence of several p+ islands in the active area, the device behaves as a pn diode during surge operation and an additional current flow is produced. This design prevents high voltage drops in surge operation, which would bring the destruction of the diode.

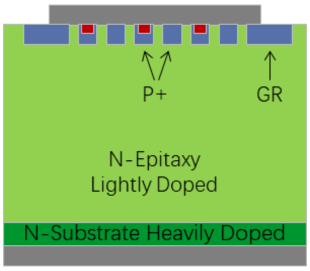


Figure 3.1: Cross-sectional view of the Gen-3 SiC SBD.

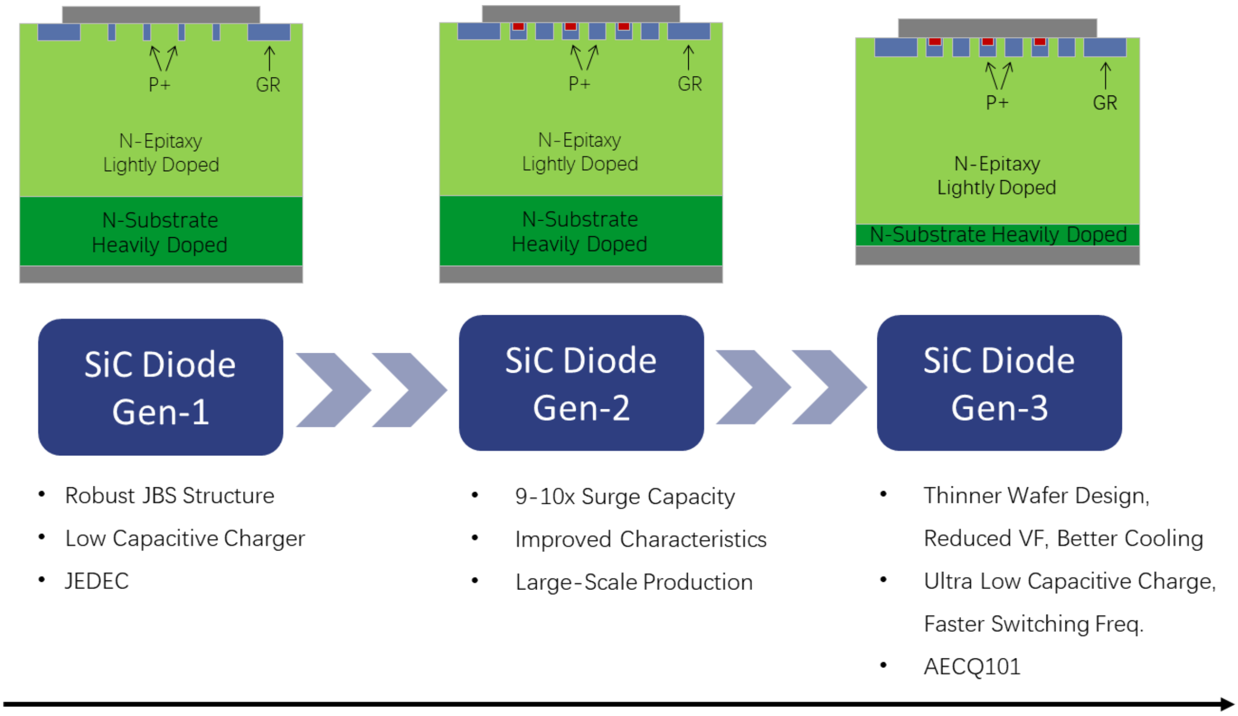


Figure 3.2: Enhancement of Sanan SiC SBD technology throughout the years.

The evolution of Sanan SiC SBD technology over the years is shown in Figure 3.2. Compared to the first released version, the Gen-3 SiC SBD offers an improved surge capacity, and a thinner substrate resulting in a lower forward voltage drop, lower power losses, and thus better electrical performances. Moreover, this technology is characterized by ultra-low values in terms of capacitive charge, which allows the diode to switch on and switch off quickly. A high switching speed minimizes the switching losses and guarantees an efficient operation at high frequencies. Our SiC SBDs Generation-3 are also in compliance with AECQ101 thus certifying the required reliability and safety levels for automotive applications.

3.1 Forward Characteristics: A Comparison between Gen-3 and Gen-2

The Gen-3 thinner wafer design reduces the device series resistance, thus reducing the forward voltage. Figure 3.3 compares the forward characteristics between a Gen-3 and a Gen-2 SiC SBD both rated at 1200V/20A. The reported graphs are related to a junction temperature of 25°C and 175°C, respectively. Similar to Si fast recovery diodes (FRDs), the knee voltage of SiC SBDs is slightly lower than 1 V and is determined by the height of the Schottky barrier. Compared to Gen-2, the Gen-3 innovative design significantly reduces the forward voltage V_F. This is especially evident in Figure 3 when considering high values of forward current I_F. For example, when considering a current equal to 40 A, the Gen-3 design introduces a V_F reduction of 12% and 18% at 25°C and 175°C, respectively. Gen-3 products are especially ideal for applications where power losses and system efficiency are critical design factors.

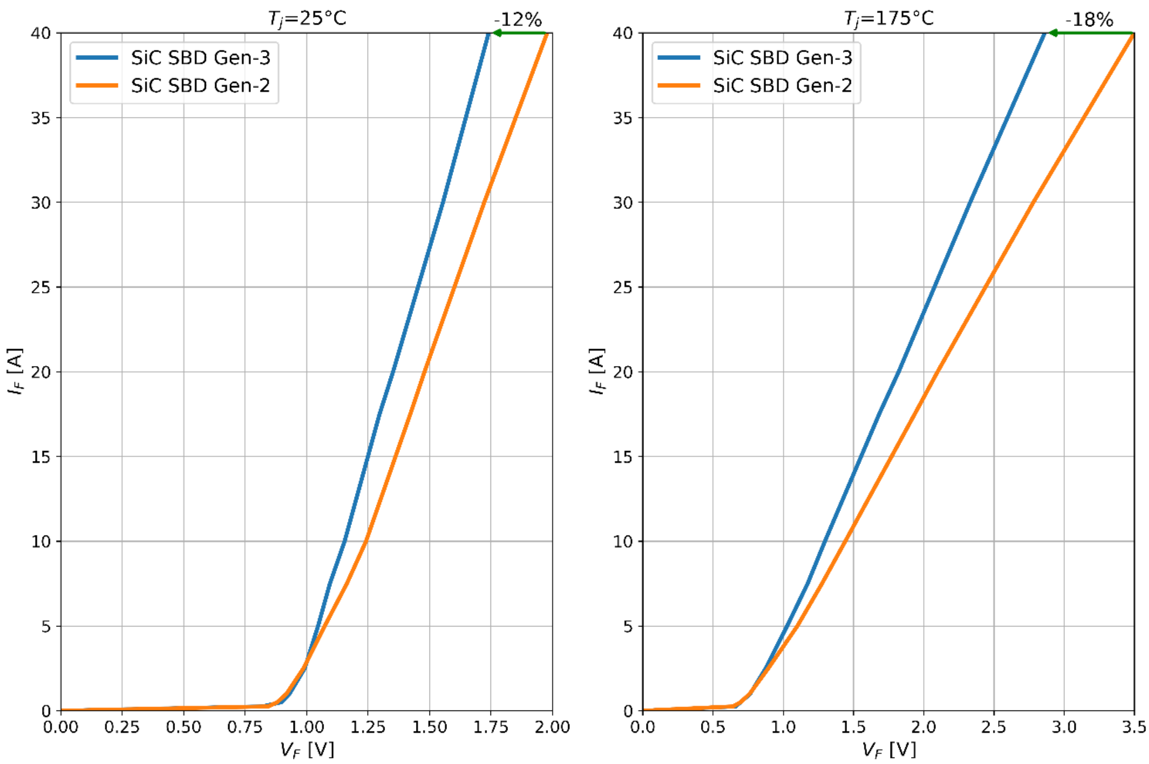


Figure 3.3: Forward characteristics of Gen-3 and Gen-2 SiC SBDs (1200V/20A class).

3.2 Gen-4 and Gen-5 SiC SBDs

The Gen-3 SiC SBD guarantees an excellent overall performance in terms of forward voltage, capacitive charge, and surge current. As shown in Figure 3.4, we also offer two flavors of Gen-3 products, which are referred to as Gen-4 and Gen-5. Gen-4 is the "Low-V_F Series" optimized for lower forward voltage, while Gen-5 is the "High-Surge Series" designed for higher surge current. These additional technology flavors are part of Sanan's strategy to provide application-optimized solutions to meet customers' specific needs.

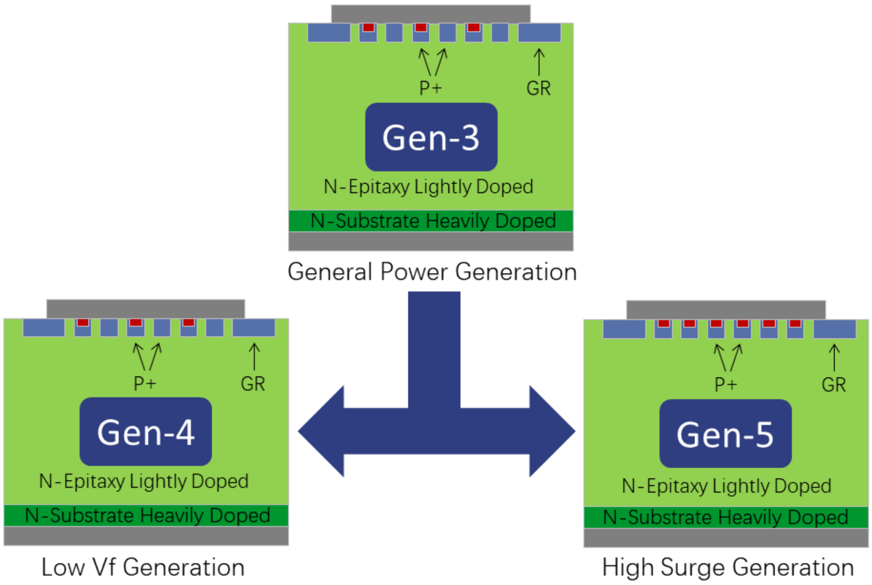


Figure 3.4: Gen-4 and Gen-5 SiC SBD as customized flavors of Gen-3.

More in detail, Sanan SiC SBD Gen-4 technology provides ultra-low values in terms of forward voltage V_F. Figure 6 shows the experimental measurements of V_F for an applied forward current equal to 10 A. The displayed results compare a Gen-3 and a Gen-4 SiC SBD rated at 650 V, 10 A. The Gen-4 device shows a reduction in the average V_F equal to 0.2V and 0.8V at 25 and 175°C, respectively. Keeping a low V_F at high temperatures offers several advantages, such as reduced power losses, enhanced efficiency, and reliable operation in challenging thermal conditions.

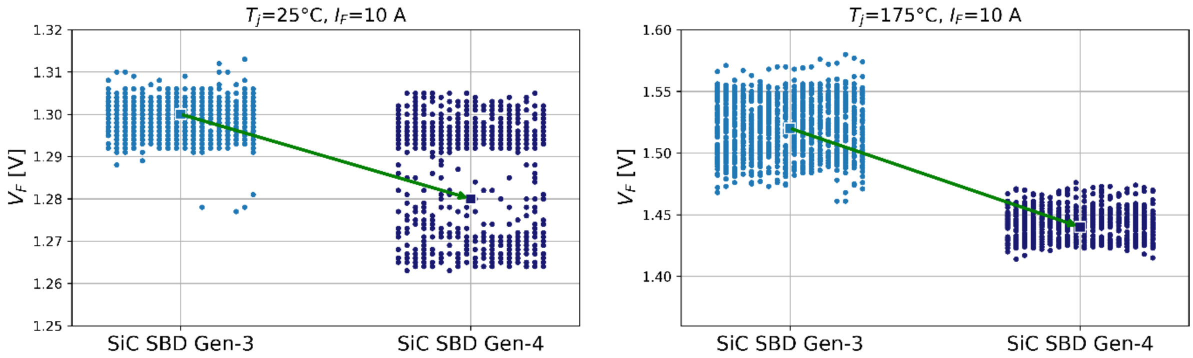


Figure 3.5: Comparison between a Gen-3 and a Gen-4 SiC SBD rated at 650V/10A: Gen-4 provides ultra-low values in terms of forward voltage, especially at high temperatures.

Another key aspect for a diode is its behavior during surge operation. The performance of a SiC SBD in this working condition is well described by the surge non-repetitive forward current, I_{FSM}, which is the maximum peak current of a half sine wave that the diode can reliably handle in the forward direction. The experimental measurements in Figure 3.6 show that the Gen-5 SiC SBD is characterized by significantly higher values of I_{FSM}, which is here specified for a case temperature T_C of 25°C and a time period equal to 10 ms. While Gen-3 offers I_{FSM} values in the order of 300 A, Gen-5 can handle peak currents higher than 400 A. Gen-5 SiC SBDs can effectively absorb bursts of huge energy, thus being less susceptible to damage. This characteristic is especially beneficial in applications where robust operation during transient voltage spikes is critical. Figure 3.6 also shows that Gen-5 is characterized by higher values of avalanche energy E_{AS} compared to Gen-3. Therefore, Gen-5 SiC SBD can handle larger energy spikes without failing, thus reflecting better performance and greater resilience in surge operation.

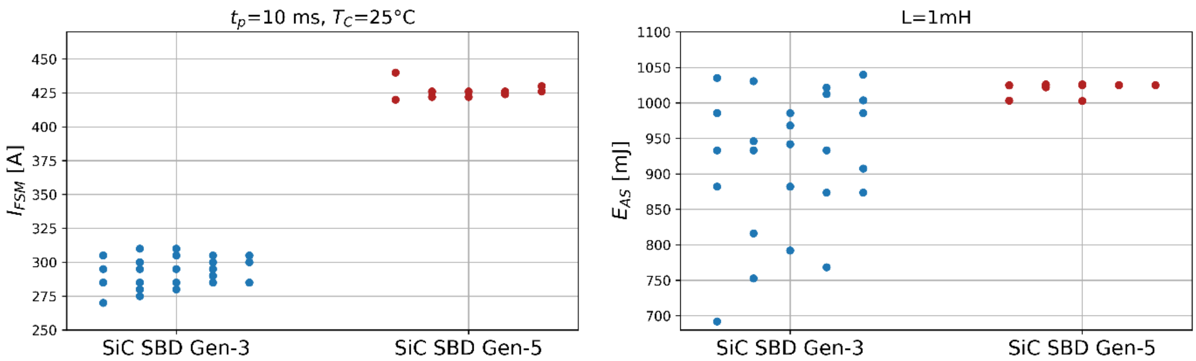


Figure 3.6: Gen-5 provides higher I_{FSM} and E_{AS} compared to Gen-3 (both devices rated at 1200V/30A).

4. A comparison with Si FRDs

This section describes the features and advantages of SiC SBDs over Si FRDs and presents experimental results in a Boost Converter with PFC. Through a comparative analysis, the benefits of SiC SBDs are highlighted for improved performance and effectiveness in power conversion systems.

4.1 Recovery characteristics

Si fast recovery diodes (FRDs) are commonly used in several applications in the field of power electronics. Their cost-effectiveness and fast recovery times make them suitable for various electrical systems. Nevertheless, Si FRDs are bipolar devices dependent on minority carriers (holes), which are stored in the drift layer during forward conduction. Therefore, during the device turn-off, a large transient current needs to flow in the backward direction to remove the stored holes. The peak of the negative current can reach values close to the current in the conduction state, thus generating high power losses both in the diode and in the complementary switch. Moreover, the turn-off behavior is strongly dependent on the forward current level, the junction temperature, and the dI/dt slope.

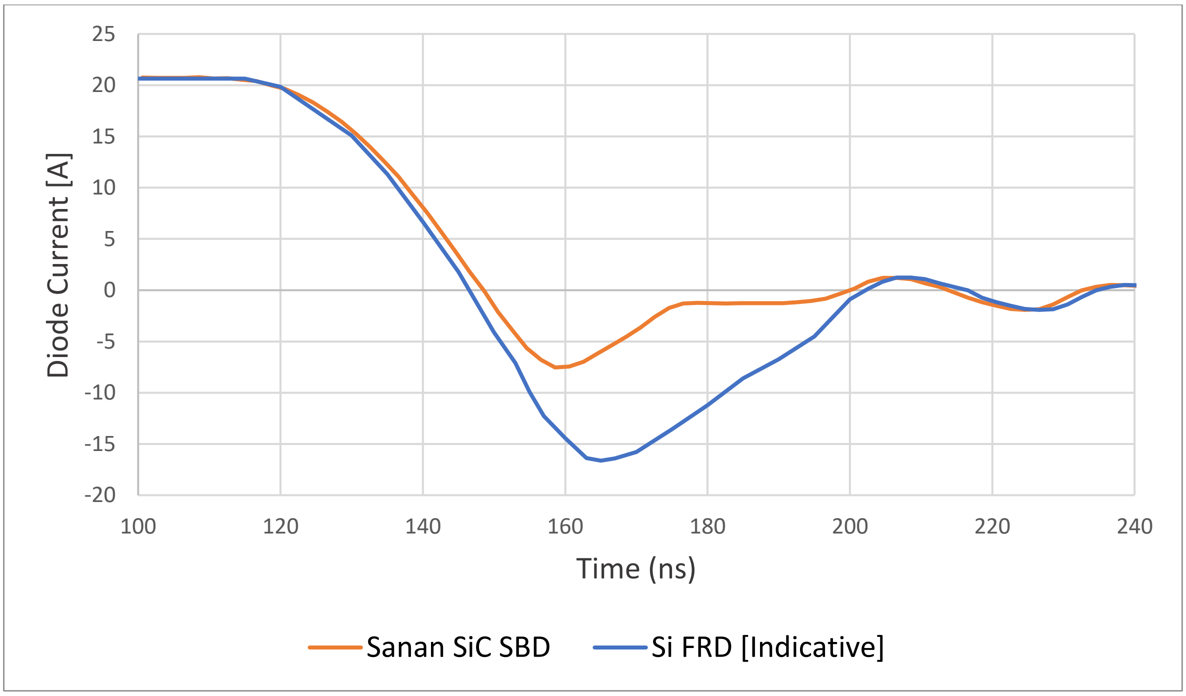


Figure 4.1: Comparison between the recovery curve of a 650V/20A Sanan SiC SBD and an indicative Si FRD at a comparable rating.

On the other hand, SiC SBD conduction is only due to majority carriers (electrons) and holes do not have to be extracted during the turn-off. The switching behavior is then free from reverse recovery and only a small current in the reverse direction appears due to the junction capacitance. Moreover, the capacitive nature of the recovery current brings to constant turn-off characteristics. Figure 4.1 shows that the recovery current is significantly reduced when using a SiC SBD in comparison to a Si FRD, while Figure 4.2 highlights the weak dependence of the turn-off waveforms from the switched current. More in detail, the reverse recovery peaks negligibly increase with the current class, because the junction capacitance increases with the chip area, and thus a higher charge has to be removed.

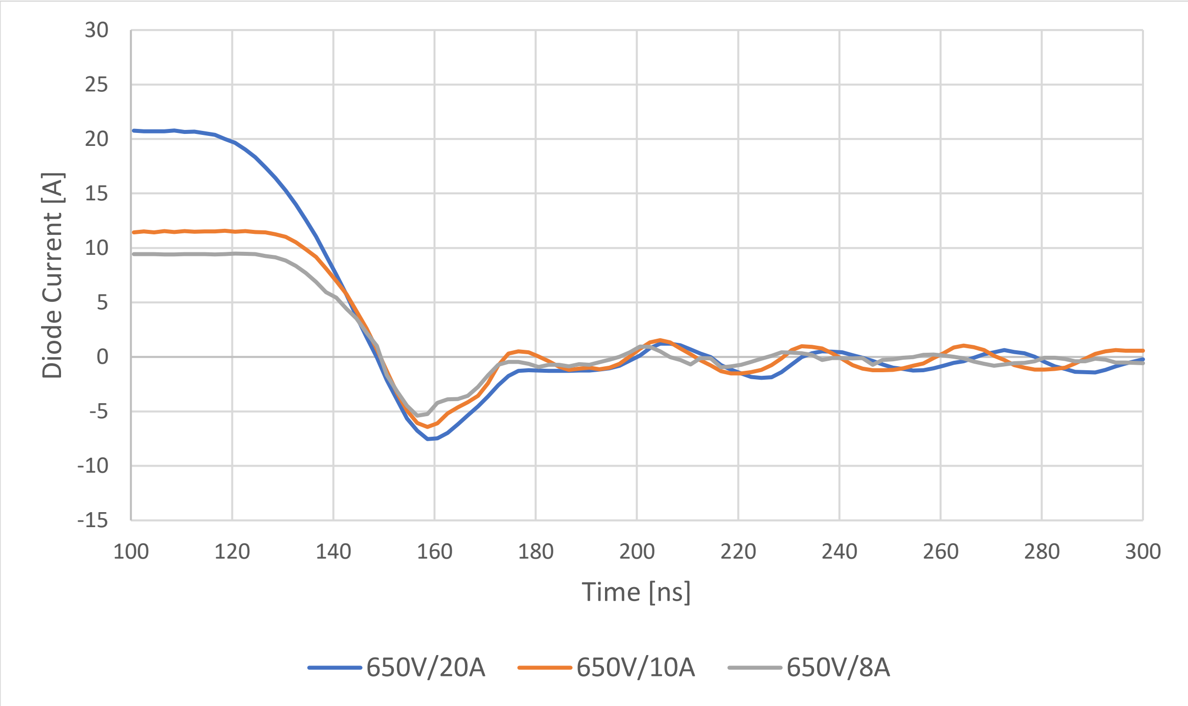


Figure 4.2: Turn-off characteristics comparison for different current classes (Sanan SiC SBDs rated at 650V/20A, 650V/10A, 650V/8A). The reverse recovery peak is negligibly affected by the current class.

4.2 Performance evaluation in a Boost Converter with PFC

The benefits of SiC SBDs have been widely reported in the literature. The lack of reverse recovery losses is a key factor for high-efficiency and high-frequency power converters. Another critical advantage of SiC Diodes is the absence of forward recovery [4], preventing voltage overshoots which result in additional power losses in Si Diodes. The benefits of using SiC SBDs are especially evident when considering applications working in continuous conduction mode (CCM). Figure 4.3 shows the circuit topology of a typical Boost converter with power factor correction (PFC). This subsection provides the experimental results of a 550 W Boost converter with PFC in CCM, where the performance of the converter is compared when using a SiC SBD and a Si FRD.

Table 3 summarizes the parameters of the devices utilized in the converter. An ICE2PCS02G [6] controller manages the switching operations of a 650V super junction MOSFET [7] to provide an output power of 550 W at a DC voltage level of 386V. The converter performance is evaluated when using a commercial 600V/15A Si FRD [8] and a 650V/10A SiC SBD as a boost diode. More in detail, a TO220-2 package characterizes both diodes and the SiC SBD belongs to the Gen-2 Sanan production line.

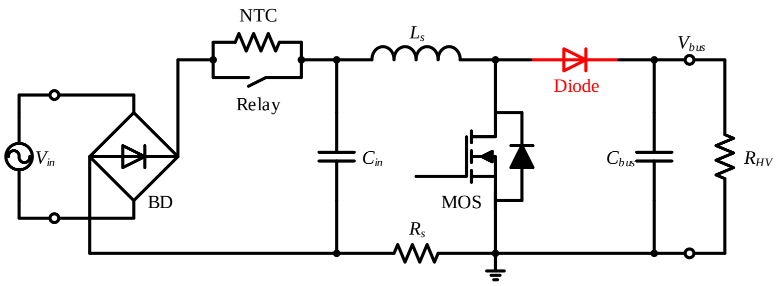


Figure 4.3: Boost PFC topology setup to compare the performance impact of a SiC SBD and a Si FRD.

Boost PFC Specifications	
NTC/Relay	5D-15 / HF32FV-G
CCM-PFC Controller	ICE2PCS02G
MOSFET	650V / 160mΩ, TO-220F
Diode	Si FRD: 600V / 15A, TO220-2 Sanan SiC SBD: 650V / 10A, TO220-2
L_s	730µH
R_s	0.1Ω / 5W
C_{bus}	220µF / 450V x 2, CapXon HP VENT
f_s	65kHz
V_{in} / V_{bus}	220Vac / 386Vdc
R_{HV}	63220E-1200-800 CC 0~1.43A

Table 3. Parameters of the devices utilized in the experimental setup of the Boost converter with PFC.

Figure 4.4 shows the efficiency values at different output power levels. Sanan SiC SBD brings lower power losses, and thus higher efficiency values. The usage of SiC diode technology results in up to 0.5 p.p. improvement in efficiency at the PFC system level and in a loss reduction in the complementary MOSFET. Lower power losses are also connected to lower thermal dissipation. Figure 4.5 shows the thermal distribution on the physical board after a 30-minute run time at the nominal power and considering an ambient temperature of 25°C. As previously discussed, a lower temperature characterizes both the SiC SBD and the associated power MOSFET.

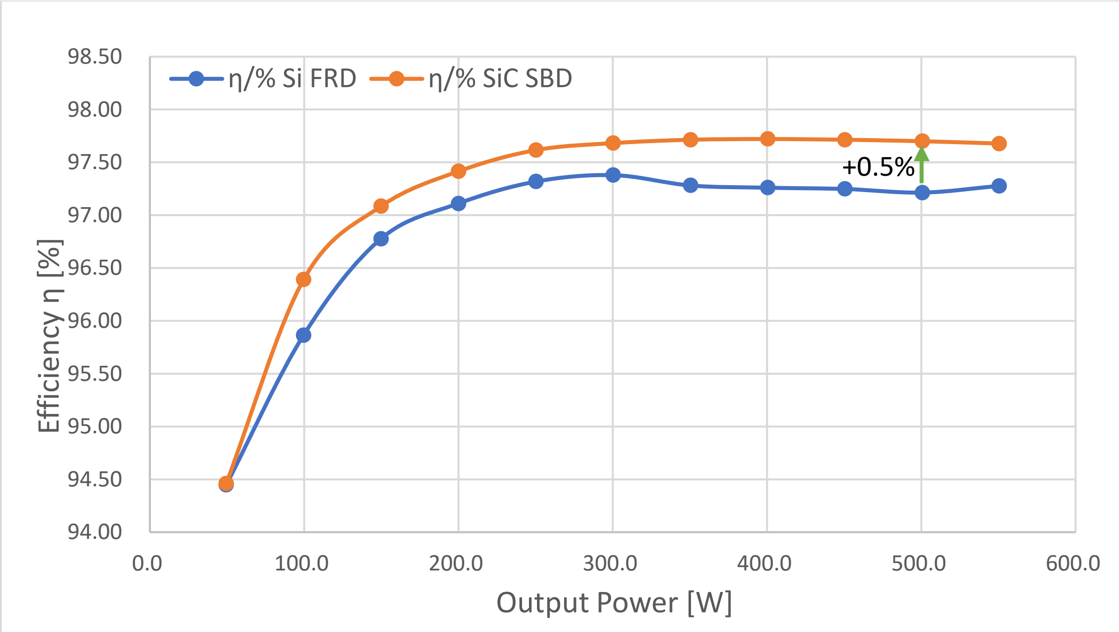
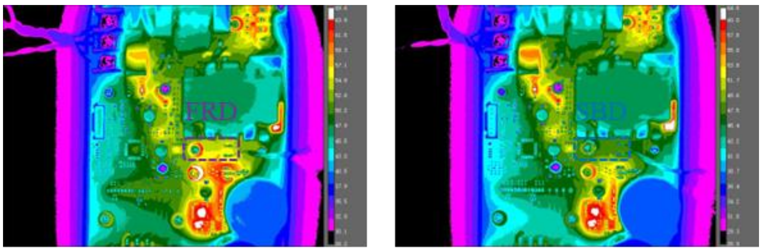


Figure 4.4: Efficiency comparison when using Sanan Gen-2 SiC SBD and a commercial Si FRD in a Boost PFC converter.



T_{FRD} = 62.4°C;
T_{MOS} = 69.6°C

T_{SBD} = 50.8°C;
T_{MOS} = 57.5°C

Figure 4.5: Thermal distribution after 30 minutes at the nominal power when using a commercial Si FRD and Sanan SiC SBD, respectively.

5. Sanan SiC SBDs in the semiconductor market

This section provides a comprehensive evaluation of the performance of Sanan SiC SBDs in comparison with competitors devices. This analysis involves the assessment of 3 key aspects: electrical characteristics from the datasheet, simulation results, and experimental results.

5.1 Electrical characteristics comparison

Table 4 provides a comprehensive overview of some key electrical properties associated with five distinctive SiC SBDs rated at 650V/10A. Last-generation devices from five competitor companies are compared with Sanan Gen-3 and Gen-4 SiC diodes. The devices from the first 3 competitors (Comp. #1, Comp. #2, Comp. #3) were chosen because of the availability of their diode PLECS models for system simulation. Sanan devices have an overall good performance, showing comparable values of stored capacitive charge Q_C, reflecting the turn-off losses related to the necessary charge to be stored in the junction capacitance before the device can start blocking. Moreover, Sanan devices exhibit remarkable results under high-temperature conditions. When considering a test temperature of 175°C, extremely low values of reverse leakage current I_R and forward voltage V_F characterize Gen-3 and Gen-4, respectively. Sanan Gen-4 SiC SBD also shows the lowest figure of merit (FOM) at 175°C, thus bringing significant benefits in high-temperature applications.

Datasheet parameter	Sanan Gen-3	Sanan Gen-4	Comp. #1	Comp. #2	Comp. #3	Comp. #4	Comp. #5
V_F [10A, 25°C, Typ.]	1.30V	1.28V	1.25V	1.27V	1.5V	1.5V	1.5V
V_F [10A, 175°C, Typ.]	1.55V	1.40V	1.75V	1.37V	1.75V	1.7V	1.85V
Q_C [400V]	29nC	28nC	25nC	34nC	23nC	36nC	30nC
*FOM (nC*V) [25°C]*	37.7	35.8	31.3	43.2	34.5	54	45
*FOM (nC*V) [175°C]*	44.9	39.2	43.8	46.6	40.3	61.2	55.5
I_R [650V, 25°C, Typ.]	1µA	5µA	1µA	2µA	10µA	20µA	<1µA
I_R [650V, 175°C, Typ.]	3µA	30µA	194µA	15µA	150µA	30µA	25 µA

Table 4: Comparison of datasheet parameters related to Sanan Gen-3, Sanan Gen-4, and five SiC SBDs from competitor companies. All the devices are rated at 650V/10A in a TO-220 package. The figure of merit (FOM) at 25°C and 175°C is computed by multiplying Q_C and V_F.

5.2 Simulation results in a Boost Converter with PFC

Figure 5.1 shows a simulation model of a 2.4 kW grid-connected Boost converter with PFC. This model was built in PLECS [5] and simulates the electrical power circuit, the control with a standard IC (ICE1PCS01 [9] from Infineon), and the thermal behavior of the semiconductor devices in the converter. After passing the input EMI filter, the AC single phase-line voltage (220 V_{rms}, 50 Hz) is rectified by a diode bridge composed of diodes D1, D2, D3, and D4. These rectifying diodes are modeled according to the datasheet of SE80PWB from Vishay [10]. The power correction circuit in boost topology is characterized by a commercial SiC MOSFET power switch, and Sanan Gen-3 SiC SBD rated at 650V/120mΩ and 650V/10A, respectively. Moreover, the PFC inductor is modeled from a real inductor by considering an inductance value equal to 624 µH, and a 41mΩ equivalent DC resistance.

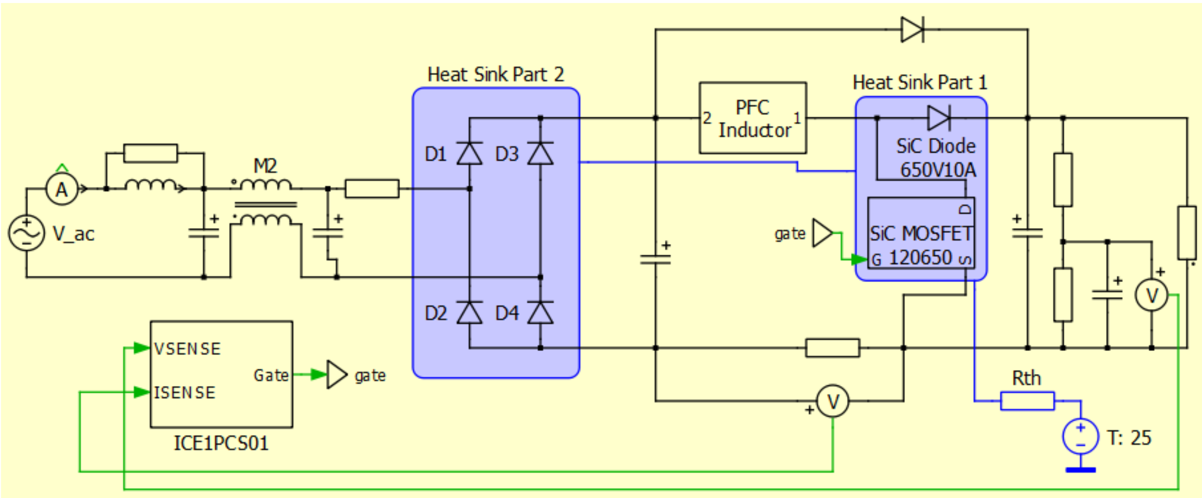


Figure 5.1: 2.4 kW Switch Mode Power Supply with Power Factor Correction.

Figure 5.2 presents the converter efficiency results when considering 3 different switching frequencies: 80 kHz, 100 kHz, and 132 kHz. The converter performance is evaluated in PLECS by considering the power losses from the bridge rectifier, the PFC inductor, the MOSFET power switch, and the boost diode. In the same simulation setup, Figure 5.3 shows the comparison of the efficiency-output power curves at 132 kHz when using different SiC SBDs as a boost diode. More in detail, the performance of the first 3 competitor devices presented in Table 4 (Comp. #1-Comp. #3) is compared with Sanan SiC SBD Gen-3 and Gen-4. These devices from competitor companies were chosen for the comparison because the PLECS model of these products was made available online by the manufacturers. Sanan SiC diodes show comparable performance to competitors at low-power levels, while remarkable efficiency results are reached when approaching the nominal power. Indeed, Gen-3 and Gen-4 SiC SBDs are specifically engineered to minimize conduction losses under high temperatures and currents, thus enhancing efficiency in high power conditions. More in detail, Sanan Gen-4 SiC SBD offers the highest efficiency among the compared diodes in the power range between 2100 and 2400 W.

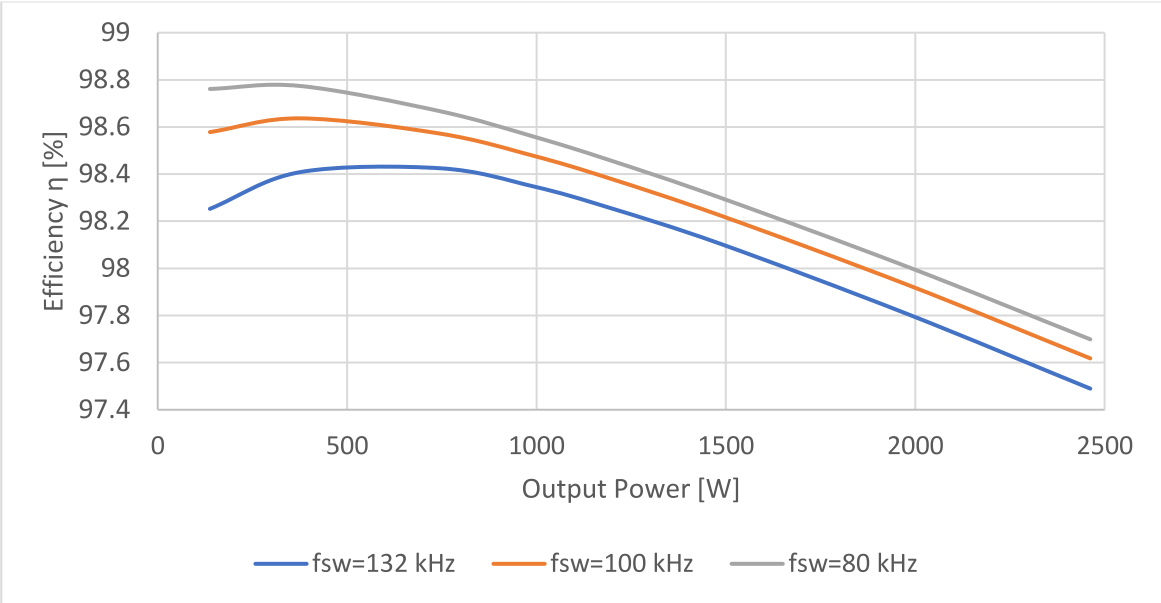


Figure 5.2: Efficiency comparison at three different switching frequencies for a classical Boost PFC in PLECS. Sanan Gen-3 SiC SBD 650V/10A is used as a Boost diode.

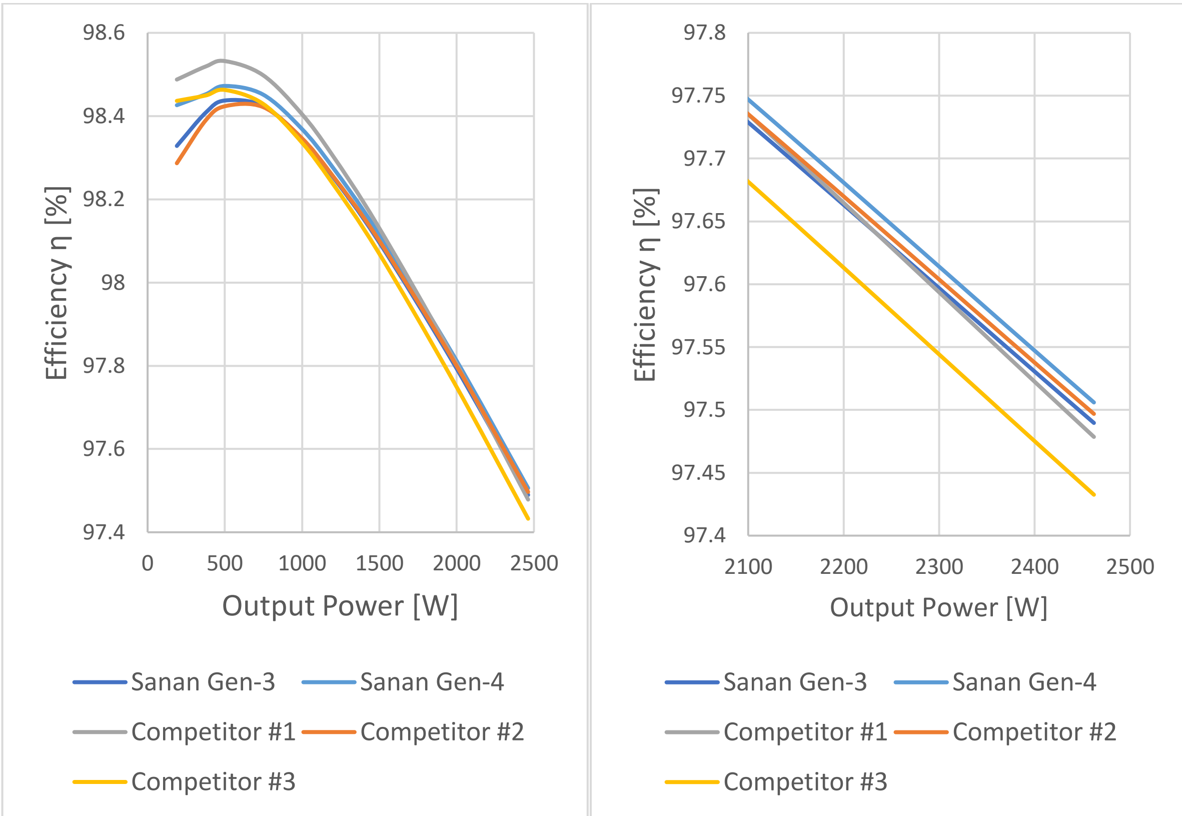


Figure 5.3: Performance comparison between Sanan Gen-3, Sanan Gen-4, and 3 competitor devices at a switching frequency of 132 kHz. The zoom in the 2100-2500 W region highlights the excellent performance of Sanan Gen-4 and Gen-3 devices, especially when approaching the nominal power.

5.3 Experimental results

A 2.4 kW Boost PFC has been used as a converter application to test the dynamic performance of Sanan Gen-3 and Gen-4 SiC diodes. Figure 5.4 shows the circuit topology of the testing platform, while Table 5 provides the parameters of the devices utilized in the overall converter.

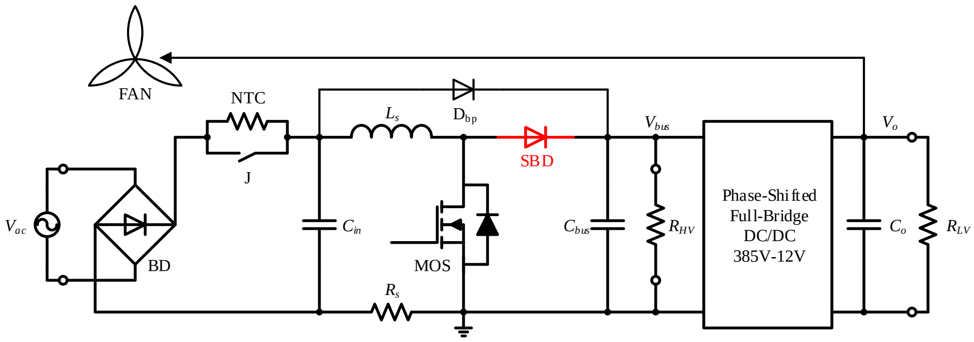


Figure 5.4: Circuit topology related to the experimental setup of a 2.4 kW Boost PFC power supply to test the performance of Sanan Gen-3 and Gen-4 SiC SBDs.

Boost PFC specifications			
BD	1000V/25A, GBJ2508	f_s	~132kHz
NTC/J	5D-15/BJ-SS-112DMF	V_{ac}	220Vac
C_{in}	1µF/500VDC, MPP85	V_{bus}	385Vdc
D_{bp}	1000V/3A, 1N5408	R_{HV}	63220E-1200-800
MOS	650V/89mΩ x 2, TO247-3, NCE65TF099T	V_o	12Vdc
SBD	650V/8A, TO220	R_{LV}	63004-150-60
R_s	0.39Ω // 0.39Ω	C_o	3300µF/16V x 5
L_s	640µH, 1.5mm x 66 turns	C_{bus}	330µF/450V x 2

Table 5: Specifications of the devices utilized in the converter.

The AC single phase-line voltage (220 V_{rms}, 50 Hz) is rectified by a glass passivated bridge rectifier rated at 1000V/25A. More in detail, two super junction MOSFETs in series rated at 650V/89mΩ are used to control the current flow through the inductor and the load by an ICE2PCS01 PFC controller. The load is characterized by two voltage levels at 385 V and 12 V, where the low-level voltage is obtained by DC/DC conversion. Figure 5.5 compares the converter performance at 132 kHz-switching frequency when using Sanan Gen-3 and Gen-4 SiC SBDs as a boost diode. The presented curves highlight a higher conversion efficiency of Gen-4, with a 0.1 p.p. increase at the nominal load compared to Gen-3.

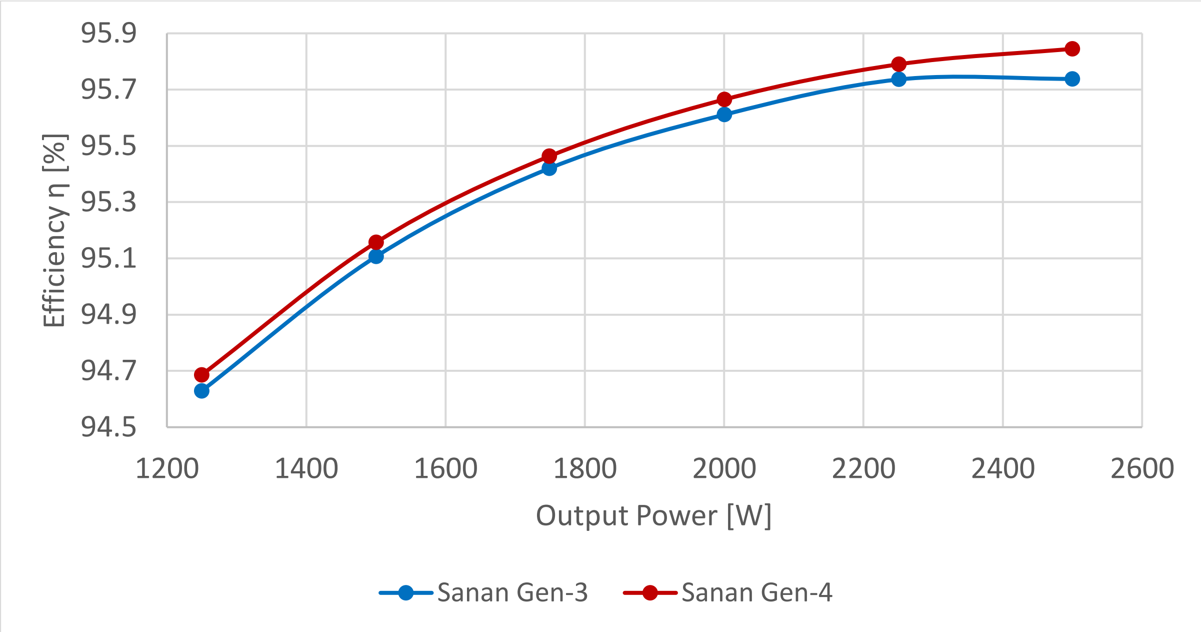


Figure 5.5: Boost PFC efficiency comparison when using Sanan Gen-3 and Gen-4 SiC SBDs both rated at 650V/8A (TO-220).

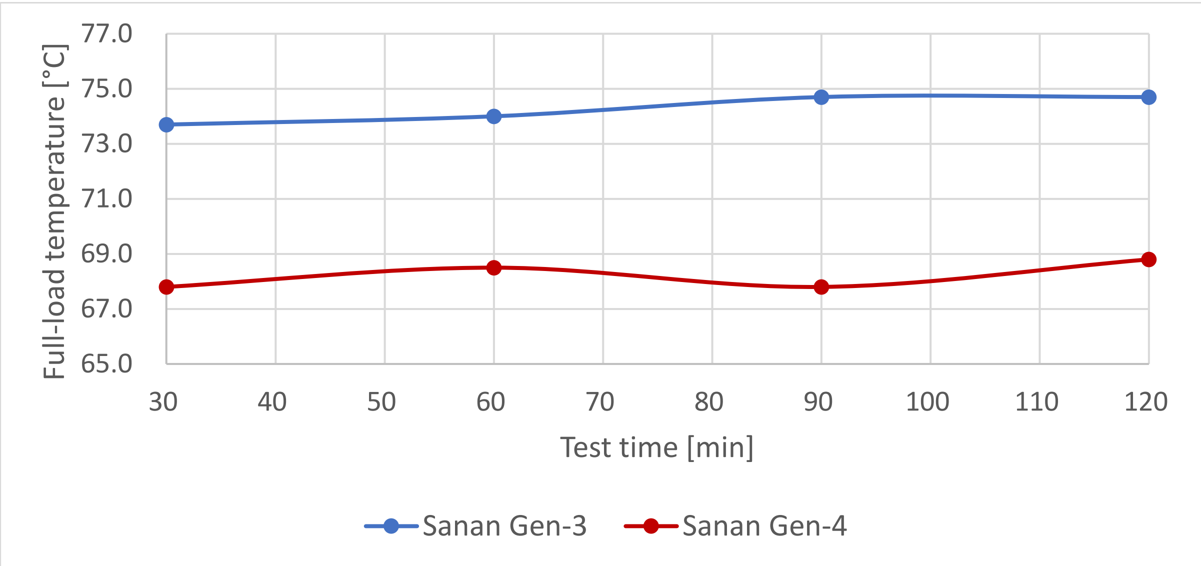


Figure 5.6: Temperature measured on the Boost diode at the nominal load in a 120-minute test time.

Moreover, Figure 5.6 and 5.7 show the dynamic results related to the SiC diode temperature and the converter efficiency, respectively. The presented curves refer to a 120-minute test time at the nominal load, and highlight a substantial decrease in the full-load temperature and the conversion efficiency when using Sanan Gen-4 SiC SBD. These experimental results confirm the simulation results in Section 5.2 and make the Gen-4 product line an excellent candidate for high-efficiency applications. However, low power losses also characterize Gen-3 SiC SBDs, which provide a more comprehensive performance. Indeed, Table 6 compares key parameters from Gen-3 and Gen-4 datasheets, and highlights the better performance of Gen-3 when considering the behavior in surge operation (I_{FSM}) and the reverse current (I_R).

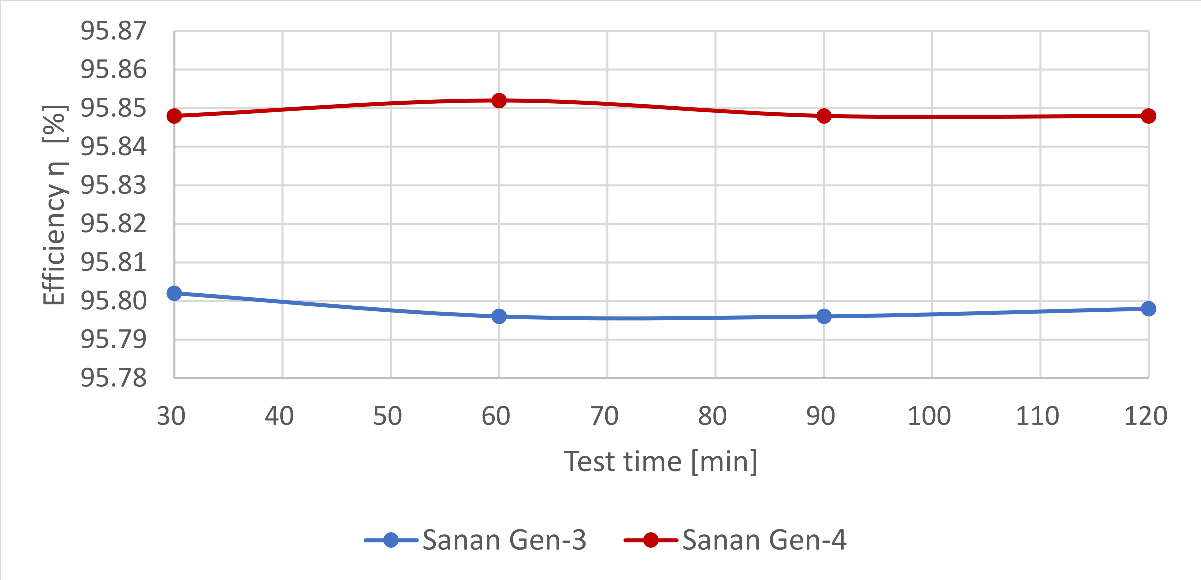


Figure 5.7: Conversion efficiency results during a 120-minute test time at the nominal load when using Gen-3 and Gen-4 SiC SBDs.

Datasheet Parameter	Sanan Gen-3	Sanan Gen-4
V_F [8A, 25°C, Typ.]	1.30V	1.27V
V_F [8A, 175°C, Typ.]	1.55V	1.40V
I_{FSM} [25°C, t_p=10ms, half sine pulse]	65A	42A
I_R [650V, 25°C, Typ.]	1µA	4µA
I_R [650V, 175°C, Typ.]	2µA	15µA

Table 6: Datasheet comparison between Sanan Gen-3 and Gen-4 SiC diodes (650V/8A, TO-220).

6. Summary and Conclusions

This application note provides a detailed overview of the third-generation Silicon Carbide Schottky Barrier Diodes (Gen-3 SiC SBD) developed by Sanan Semiconductor. Gen-4 and Gen-5 SiC SBDs have also been described as customized flavors of Gen-3 to meet application-specific needs in automotive and industrial applications. While Gen-3 offers a more comprehensive performance, Gen-4 and Gen-5 are designed for applications requiring high efficiency and high surge current, respectively. This document also highlights the superior characteristics of Sanan SiC SBDs compared to Si Diodes. Experimental results in a 550 W Boost PFC converter are presented to confirm the enhanced performance of our SiC SBDs. More in detail, SiC SBDs offer the following improvements:

- No reverse recovery during turn-off (capacitive switching),
- Turn-off behavior independence from forward current, junction temperature, and dI/dt,
- Reduced losses in the complementary SiC MOSFET.

Moreover, simulation results and experimental testing in a 2.4 kW Boost PFC converter were conducted to compare Sanan SiC SBDs with the latest generation of SiC diodes from competitors in the market. Sanan SiC SBDs exhibit excellent efficiency in high temperature and high switching conditions. Gen-4 SiC SBDs especially overperform due to remarkably low forward voltage and power losses.

In the present decade the new generation of semiconductor devices will have a key role in creating highly efficient and performing systems. Sanan Semiconductor aims to be a key player in the semiconductor market by providing innovative solutions and reliable products to help solve worldwide challenges, such as sustainability and decarbonization. To do that, our products are not only limited to SiC diodes but to SiC MOSFETs and SiC Substrates and Epitaxies as well. To know more on Sanan Semiconductor products, visit our virtual product center at:

Sanan semiconductor (sanan-semiconductor.com).

7. References

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