Silicon-carbide diodes

http://www.st.com/sicdiodes

SiC RECTIFIERS

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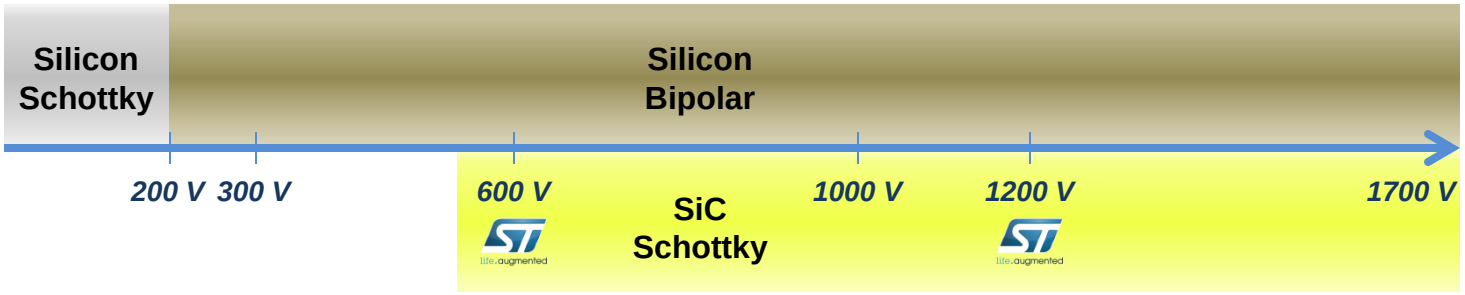
Why silicon-carbide (SiC) Schottky diodes?

- Outstanding electrical characteristics of SiC:
  - SiC: E_{BR} = 200 V/µm
  - Si: E_{BR} = 20 V/µm

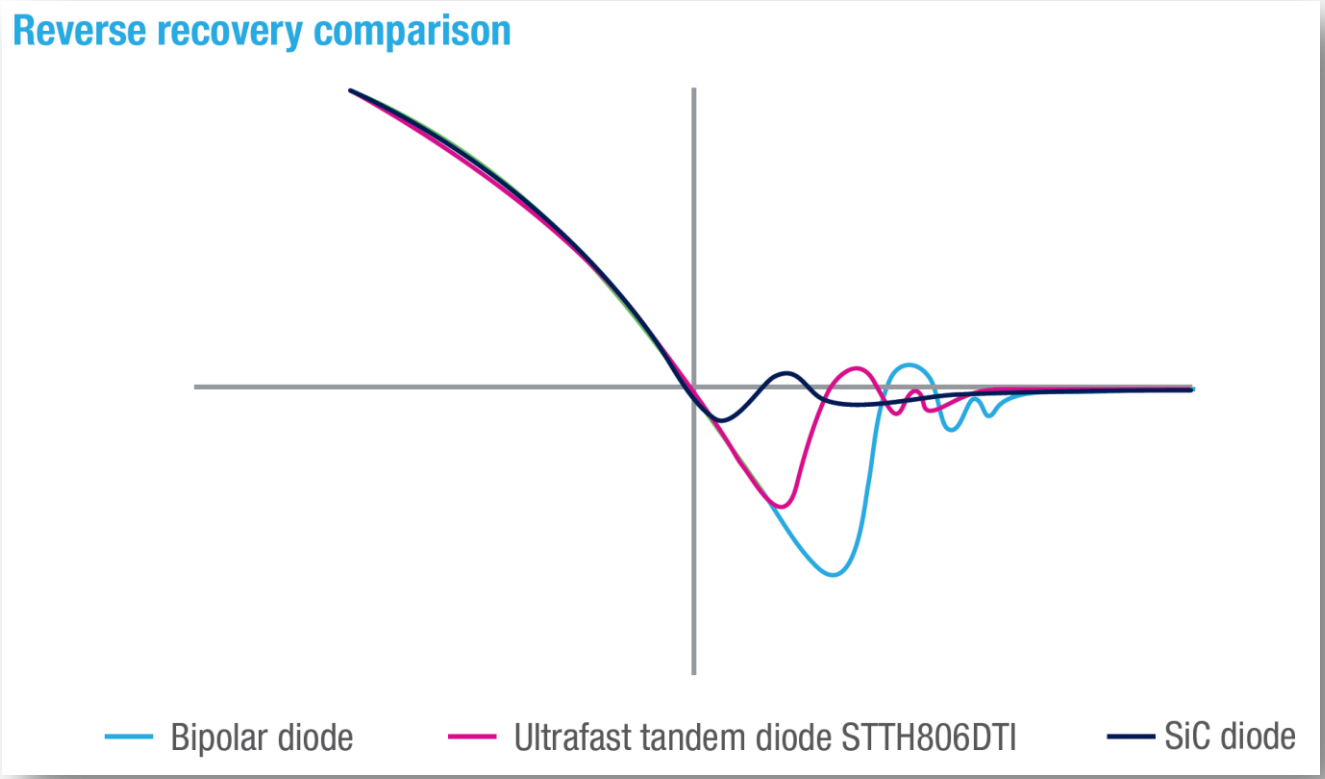
➔ Need less thickness and resistivity to sustain the same breakdown voltage

➔ Silicon Schottky diodes are limited to ~200 V



Best-in-class switching performance

- Advantage of SiC material:
  - Best-in-class switching performance thanks to the Schottky structure giving best possible efficiency



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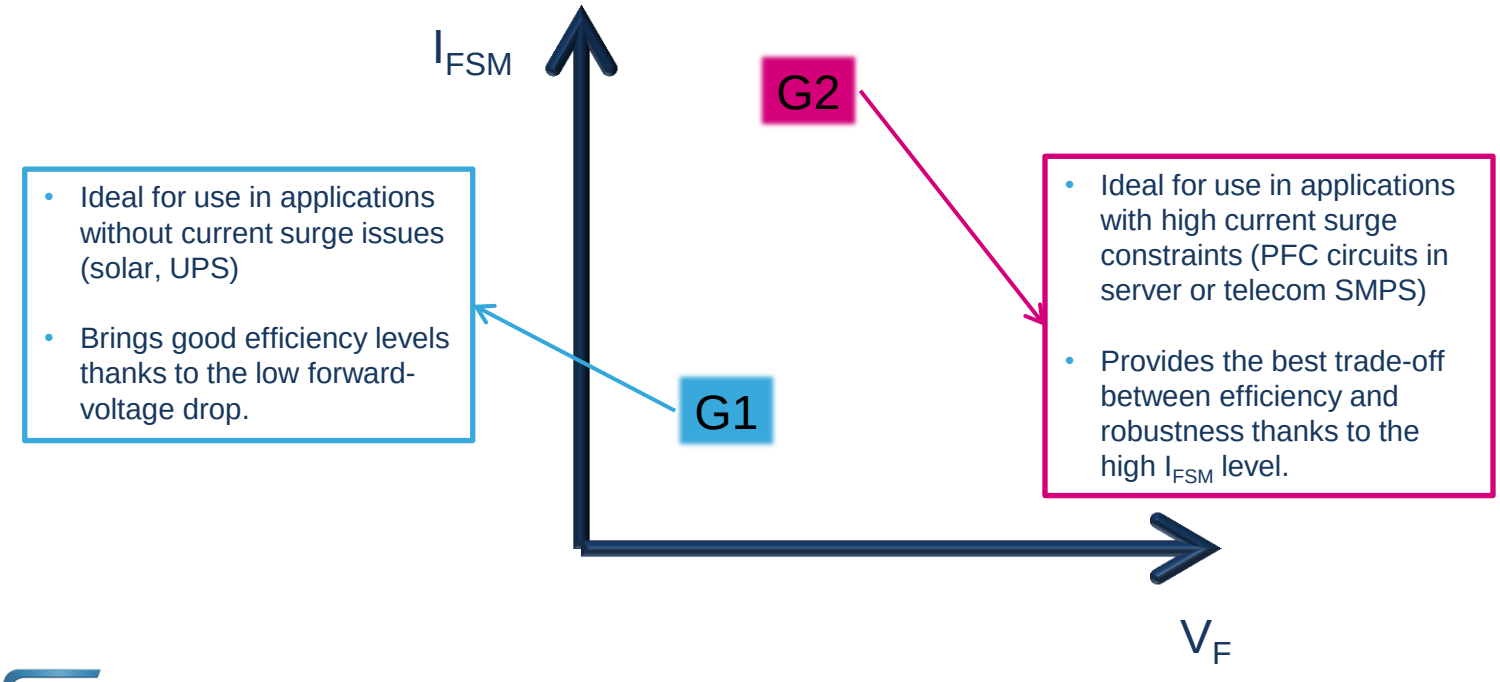
Why two generations?

- Differences between 600V G1 and 650V G2 SiC diodes
  - Higher reverse voltage with G2: more design-margin
  - Different positioning between surge robustness (linked to I_{FSM}) and forward conduction power losses (linked to V_F)



SiC diode part numbering

STPSC	(i)i	g	vv	aa	bb
ST power Schottky SiC diode	Current	Generation	Voltage	Topology	Package

(i)i – Current

4 A
6 A
8 A
10 A
12 A
16 A
20 A

g – Generation

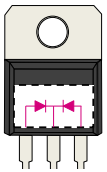
- **blank** – Gen 1
- **H** – Gen 2

vv – Voltage

- **06** – 600 V
- **065** – 650 V
- **12** – 1200 V

aa – Topology

- **blank** – Single diode
- **C** – Dual diodes Common cathode

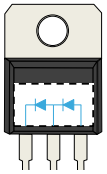


bb – Package

DPAK……B
D²PAK…… G
TO-220AB……T
TO-220AB Ins….TI
TO-220AC Ins….DI
TO-247……W

TH13

G2 dual diodes in series (2 x 650 V)



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SiC power Schottky diode range

	TO-247	TO-220AC	TO-220AB	TO-220AC insulated	TO-220AB insulated	D²PAK	DPAK
600 V G1							
4 A		STPSC406D					STPSC406B-TR
6 A		STPSC606D				STPSC606G-TR	
8 A		STPSC806D				STPSC806G-TR	
10 A		STPSC1006D				STPSC1006G-TR	
12 A		STPSC1206D					
2 x 10 A	STPSC2006CW						
650 V G2							
4 A		STPSC4H065D		STPSC4H065DI			STPSC4H065B-TR
6 A		STPSC6H065D		STPSC6H065DI		STPSC6H065G-TR	STPSC6H065B-TR
8 A		STPSC8H065D		STPSC8H065DI		STPSC8H065G-TR	STPSC8H065B-TR
10 A		STPSC10H065D		STPSC10H065DI		STPSC10H065G-TR	STPSC10H065B-TR
2 x 4 A			STPSC8H065CT				
2 x 6 A			STPSC12H065CT				
2 x 8 A			STPSC16H065CT				
2 x 10 A	STPSC20H065CW		STPSC20H065CT				
2 x 650 V G2							
6 A					STPSC6TH13TI		
8 A					STPSC8TH13TI		
10 A					STPSC10TH13TI		
1200 V							
6 A							STPSC6H12B-TR1

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Applications & topologies

- Applications

PC power

Server power

EV charging stations

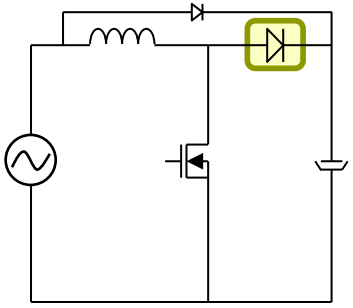
Telecom power

UPS

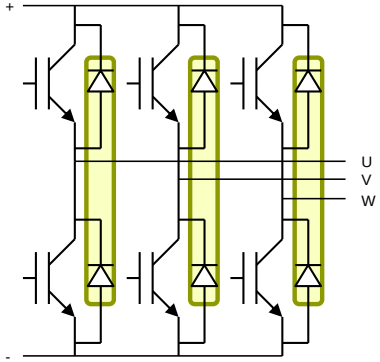
Solar inverters

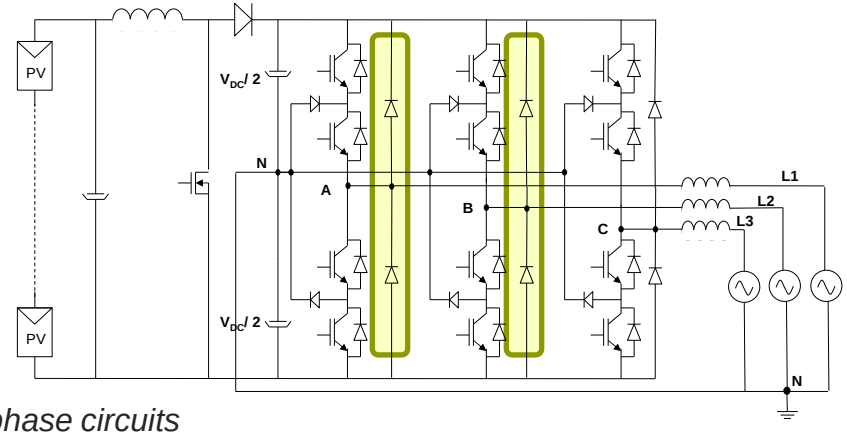
Motor drives

- Typical topologies



Boost





3-phase circuits

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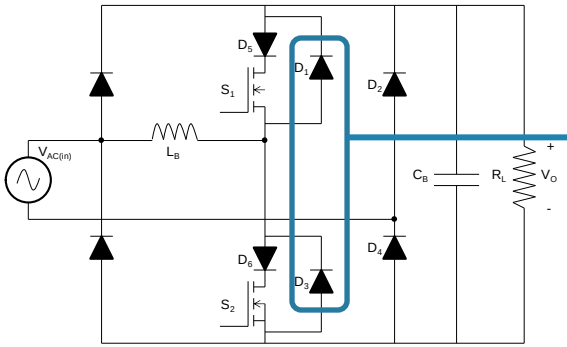
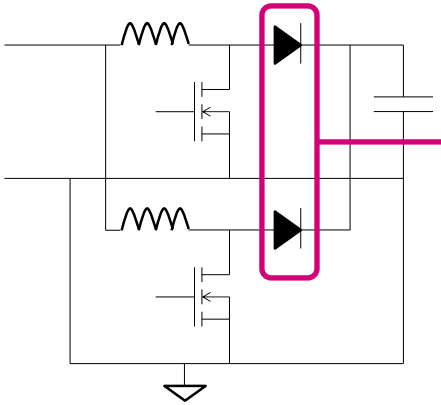
Dual diodes topologies

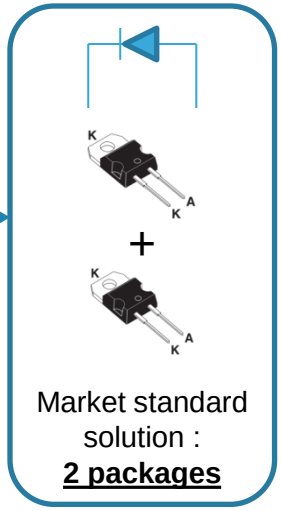
- Comparison with current solutions:

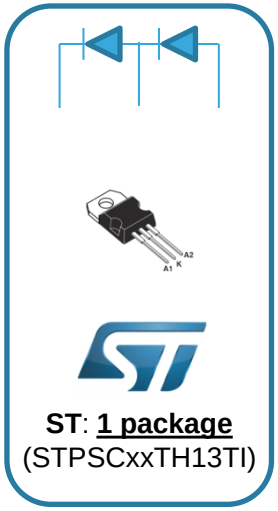


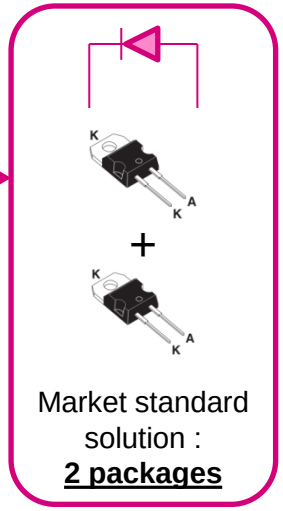
Example: bridgeless topology

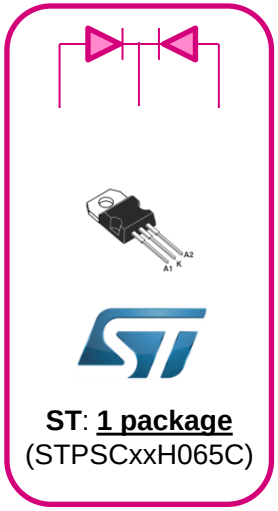


Example: interleaved topology









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Benefits

High forward surge capability (G2)

High robustness → Good reliability of the power converter

Easy design
→ Good time to market
Possibility to reduce diode caliber
→ BOM cost reduction

Soft switching behaviour

Low EMC impact
→ easy design/certification
→ Good time to market

High power integration (dual-diodes)

BOM cost reduction
High added value of the power converter
Gain on PCB and mounting cost

Low forward conduction losses / low switching losses

- High efficiency → high added value of the power converter
- Possibility to reduce size and cost of the power converter

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To know more

- Visit our webpage : http://www.st.com/sicdiodes
- Read our application note AN4242 “New generation 650 V SiC diodes”
- http://www.st.com/st-web-ui/static/active/en/resource/technical/document/application_note/DM00075656.pdf

AN4242

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AN4242
Application note

New generation of 650 V SiC diodes

Introduction

For many years ST has been a worldwide leader in high voltage rectifiers dedicated to energy conversion. During the last decade, electronic systems have followed a continuous trend towards higher power density and more energy savings driven by governments' environmental awareness. Power-supply designers are permanently confronted with stringent efficiency regulations (Energy Star, 80Plus, European Efficiency…). They are forced to consider the use of new power converter topologies and more efficient electronic components such as high-voltage silicon-carbide (SiC) Schottky rectifiers. To help them face this challenge, ST developed in 2008 a first family of 600 V SiC diodes. After having sold millions of pieces, ST's reliability and know-how is confirmed on these new components using wide band gap materials.

In hard-switching applications such as high end server and telecom power supplies, SiC Schottky diodes show significant power losses reduction and are commonly used. A growing use of these rectifiers in also expected in solar inverters, motor drives, UPS and HEV a

Figure 12. Electro-thermal model of the 6 A /650 V SiC G2 (STPSC6H065D) from STMicroelectronics

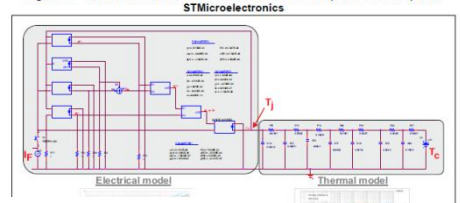


Figure 1. Switching behavior comparison between Si and SiC diodes for T_j=75 °C and T_j=125 °C

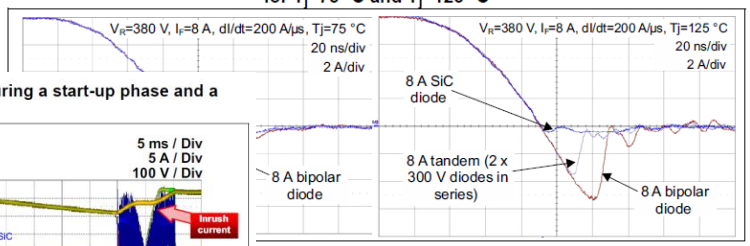
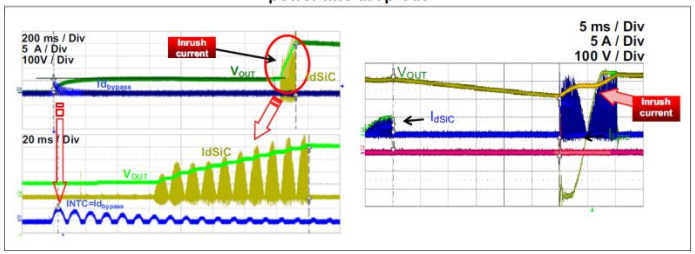


Figure 8. Inrush current proportional to dV_{out}/dt during a start-up phase and a power line drop-out



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