第三代半导体市场及
安森美半导体宽禁带(WBG)方案

安森美半导体
ON Semiconductor®

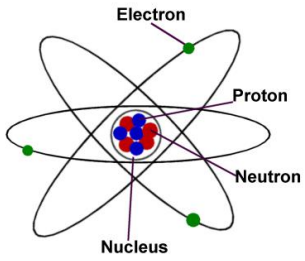
Public Information

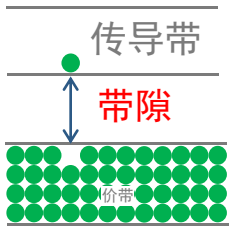
宽禁带材料

带隙 = 移动外壳电子所需的能量

材料	符号	带隙能量(eV)
锗	Ge	0.7
硅	**Si**	**1.1**
砷化镓	GaAs	1.4
碳化硅	**SiC**	**3.3**
氧化锌	ZnO	3.4
氮化镓	**GaN**	**3.4**
金刚石	C	5.5

宽禁带





电子从价带移动到传导带所需的能量

- **碳化硅比硅**
  - 高10倍介电击穿场强
  - 快2倍电子饱和速率
  - 高3倍能量带隙
  - 高3倍热导率

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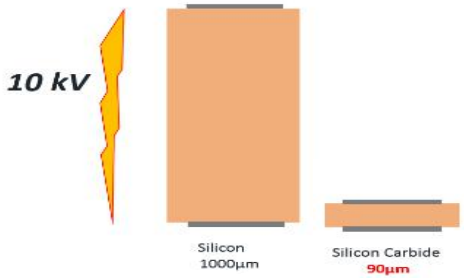
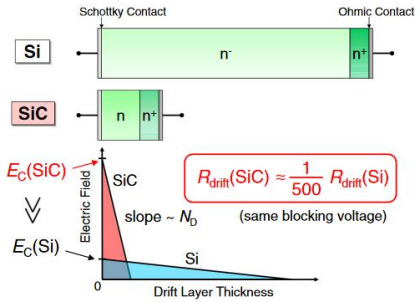
宽禁带材料

高10倍介电场强

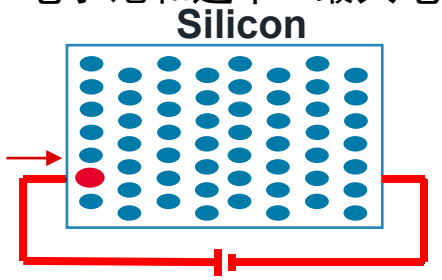
- SiC 厚度可更好地减小RSP
- 降低电阻和热阻= 低功耗

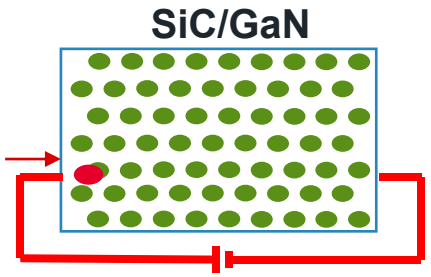




快2倍电子饱和速率

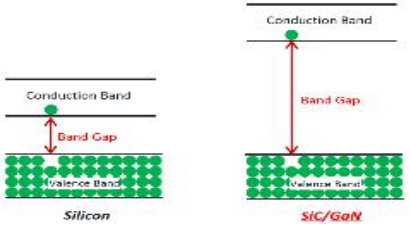
- 可实现更快的开关速度
- 电子饱和速率= 最大电子速度

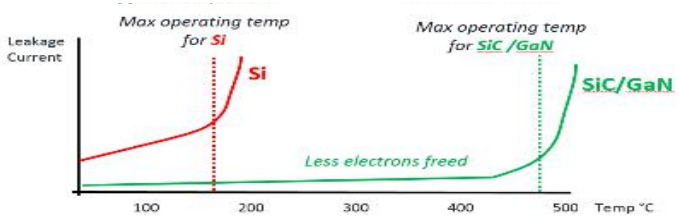




更好的热性能

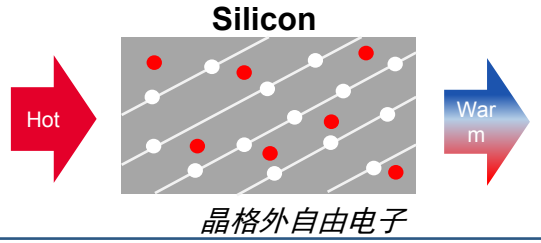
- 在宽温度范围内提供稳定的/低漏电流
- “自由”电子所需的更高能量

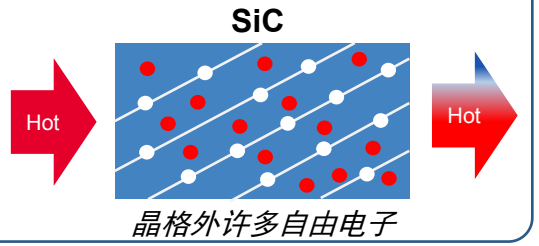




高3倍热导率

- SiC的高散热导致较低的工作温度和热应力
- SiC支持更快的传输激发的电子(热)





Source: Yole 2016, IHS

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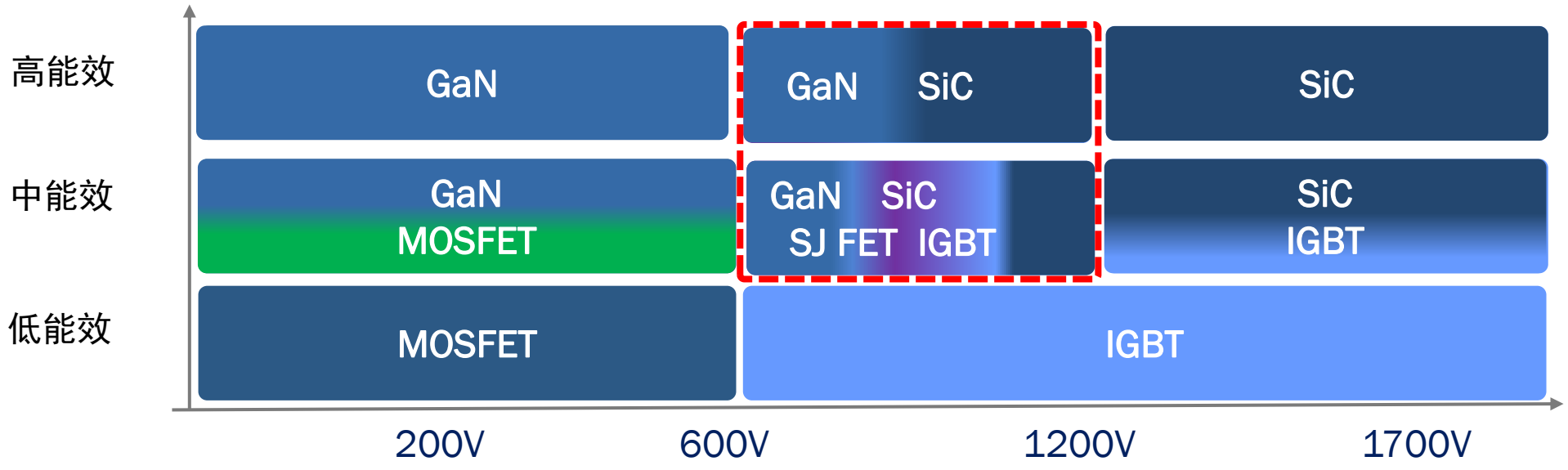
宽禁带产品定位



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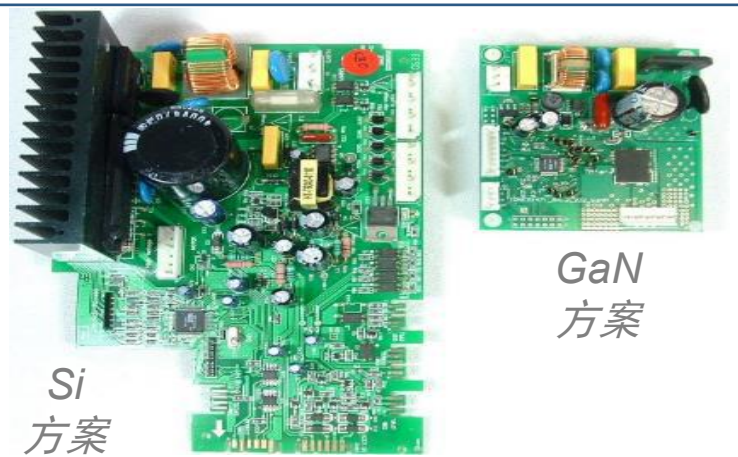
宽禁带产品优势

大功率电源（PSU）

低功耗电机驱动



更强
更环保
更快

笔记本电脑电源

太阳能逆变器

更小
更轻
更便宜
更好散热

*Illustrative representation

安森美半导体
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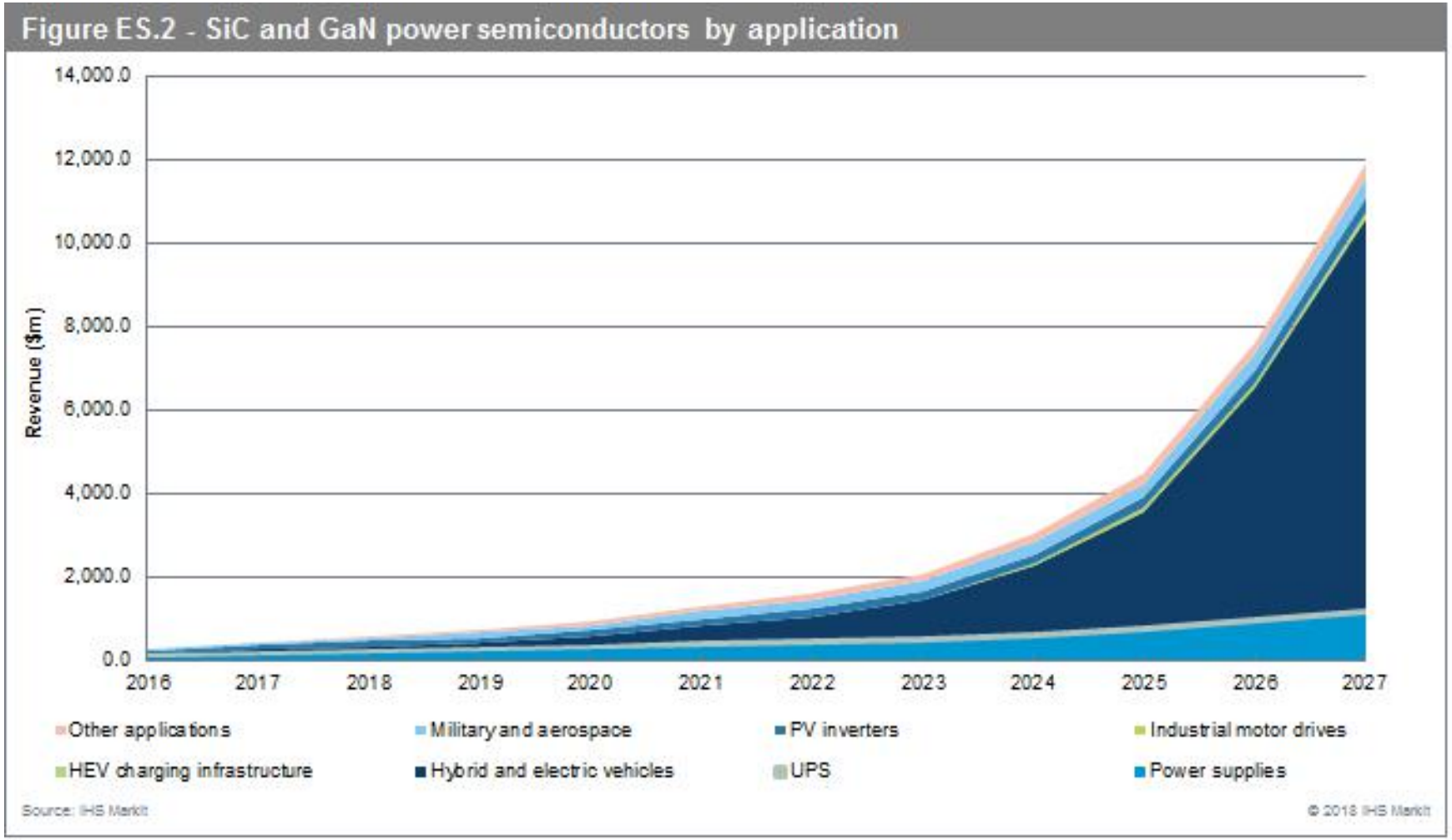
SiC和GaN市场按应用领域划分



安森美半导体
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SiC设计和工厂

研发（R&D） 工厂支持速度(4” 设计)

瑞典Kista

- 4” 极其适合快速原型
- 器件仿真/布局
- 快速、具性价比的4” 原型

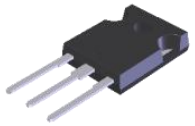
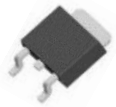
ON工厂支持成本(6” 制造)

韩国富川

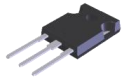
安森美半导体是首家6” 制造商

- 6” 适合量产
- 同类最佳的制造工具
- 瞬时可靠性反馈

WBG产品 – SiC二极管1200V

I (A)	VF (V)	Die	TO-247-3L	TO-247-2L	TO-220-2L	D2PAK	DPAK
							
50	1.45	PCFFS50120AF		FFSH50120A			
40		PCFFS40120AF	FFSH40120ADN	FFSH40120A			
30		PCFFS30120AF	FFSH30120ADN	FFSH30120A			
20		PCFFS20120AF	FFSH20120ADN	FFSH20120A	FFSP20120A	FFSB20120A Now / Sep.	
15		PCFFS15120AF	FFSH15120ADN	FFSH15120A	FFSP15120A		
10		PCFFS10120AF	FFSH10120ADN	FFSH10120A	FFSP10120A	FFSB10120A Now / Sep.	FFSD10120A
8		PCFFS08120AF			FFSP08120A		FFSD08120A
5		PCFFS05120AF			FFSP05120A		

WBG产品 – SiC二极管650V

I (A)	VF (V)	Die	TO-247-3L	TO-247-2L	TO-220-2L	TO-220FP-2L	D2PAK	DPAK	PQFN 88
									
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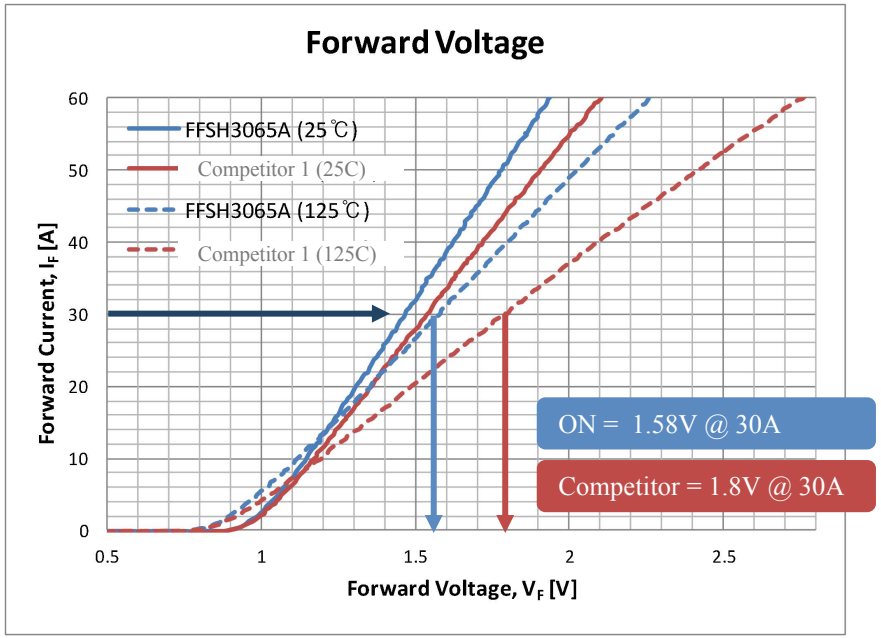
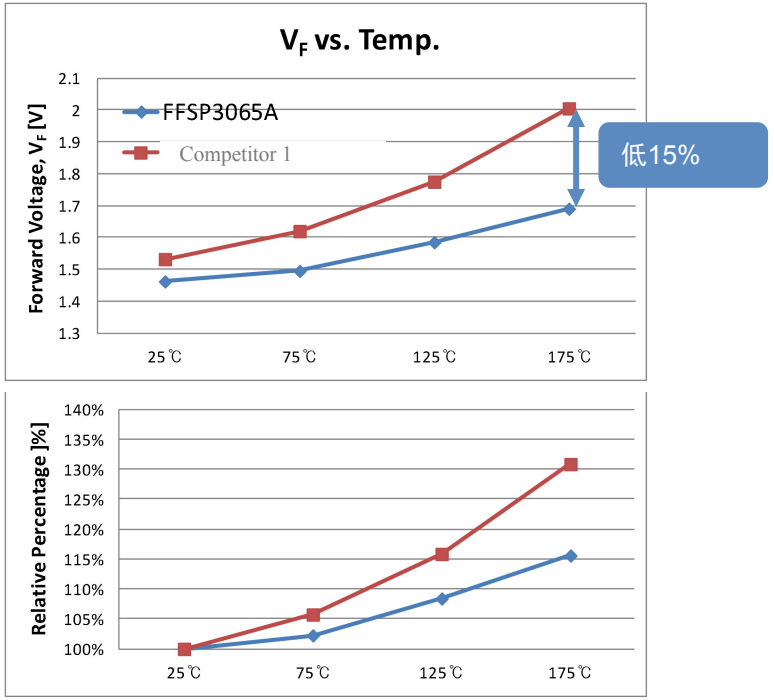
40		PCFFS4065AF	FFSH4065ADN	FFSH4065A					
30		PCFFS3065AF	FFSH3065ADN	FFSH3065A	FFSP3065A				
20			FFSH2065ADN	FFSH2065A	FFSP2065A	FFSPF2065A			
16			FFSH1665ADN	FFSH1665A	FFSP1665A				
12					FFSP1265A		FFSB1265A		FFSM1265A
10					FFSP1065A	FFSPF1065A	FFSB1065A	FFSD1065A	FFSM1065A
8					FFSP0865A	FFSPF0865A	FFSB0865A	FFSD0865A	FFSM0865A
6					FFSP0665A	FFSPF0665A	FFSB0665A	FFSD0665A	FFSM0665A
4					FFSP0465A Now / Nov.		FFSB0465A Now / Nov.	FFSD0465A Now / Nov.	FFSM0465A Now / Nov.

安森美半导体SiC二极管对比最强的竞争器件

- 比同类最佳的竞争器件更低的V_F



- 在工作温度范围内显著降低 V_F



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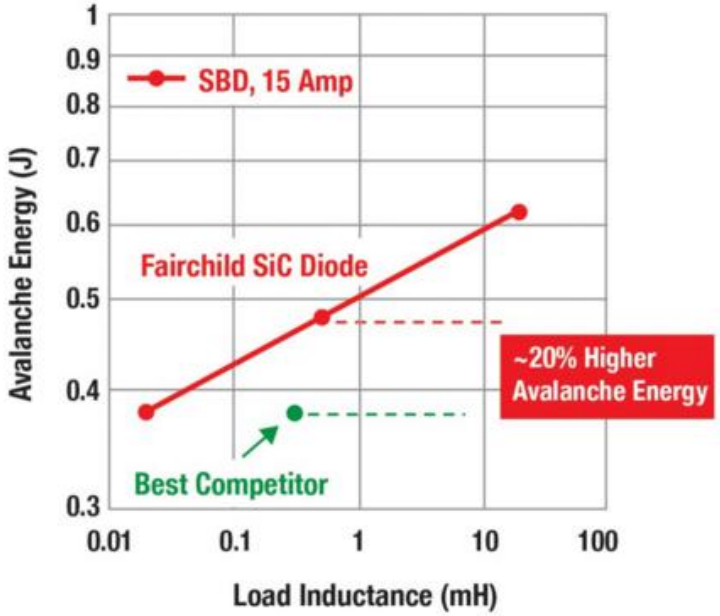
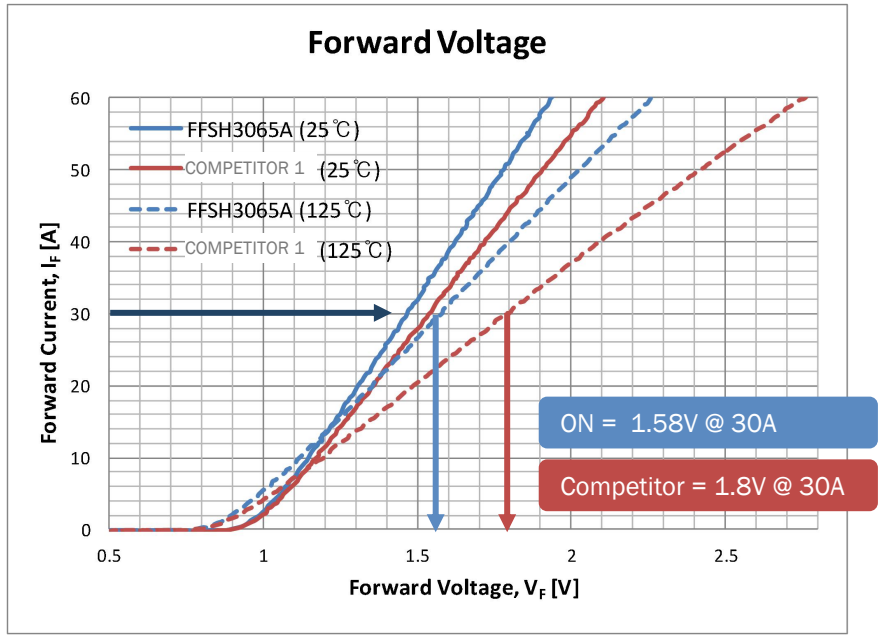
SiC二极管 - 低Vf

- 极佳的强固性
  - 雪崩能量
  - 浪涌电流额定值



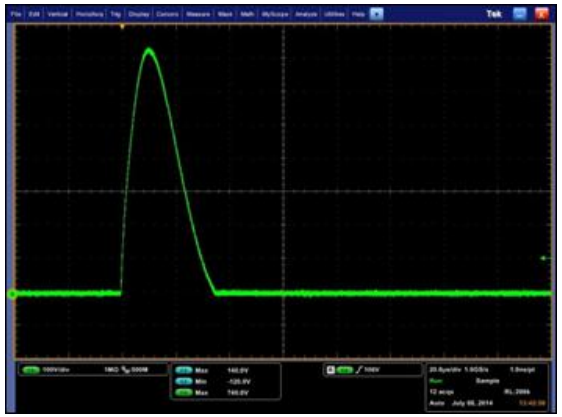
- 比最强的竞争器件更低的V_F



SiC二极管– 浪涌能力

- 浪涌能力(如1200V, 15A)

8.2 ms

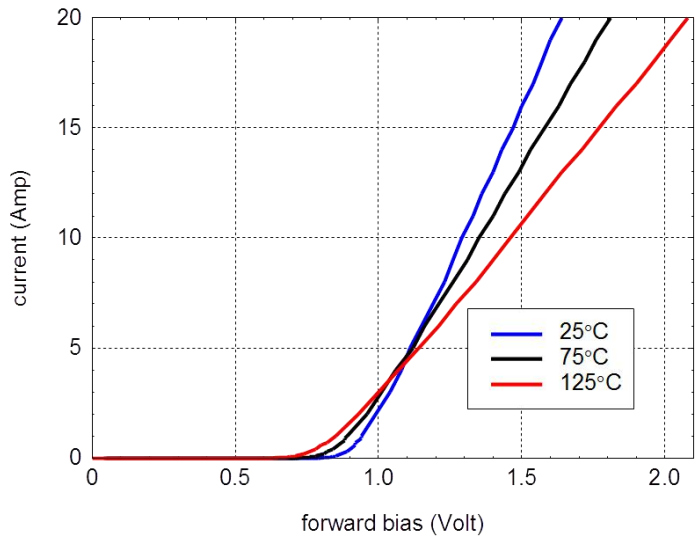


33 μs

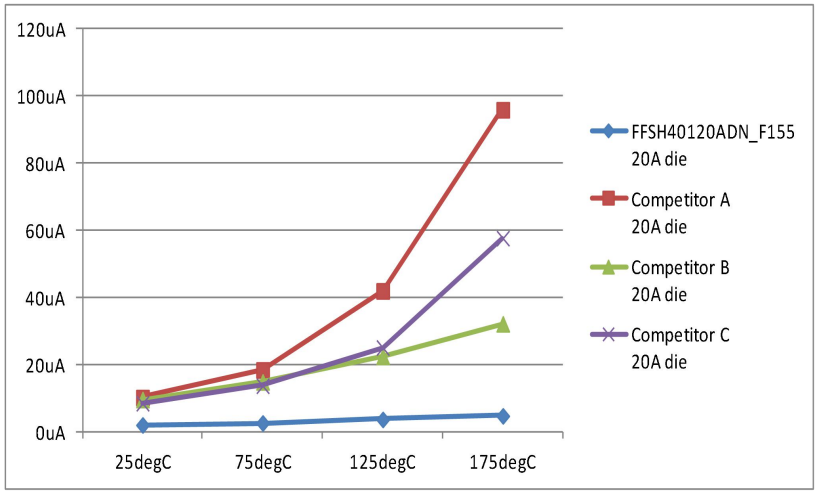
- 8.2 ms 脉冲158 A (>10倍 额定值)非破坏性的浪涌电流
- 这电流的一小部分将会使一个平行平面肖特基二极管发生故障
- 33 μs 脉冲740 A更高的浪涌电流

安森美半导体SiC二极管 – 漏电流

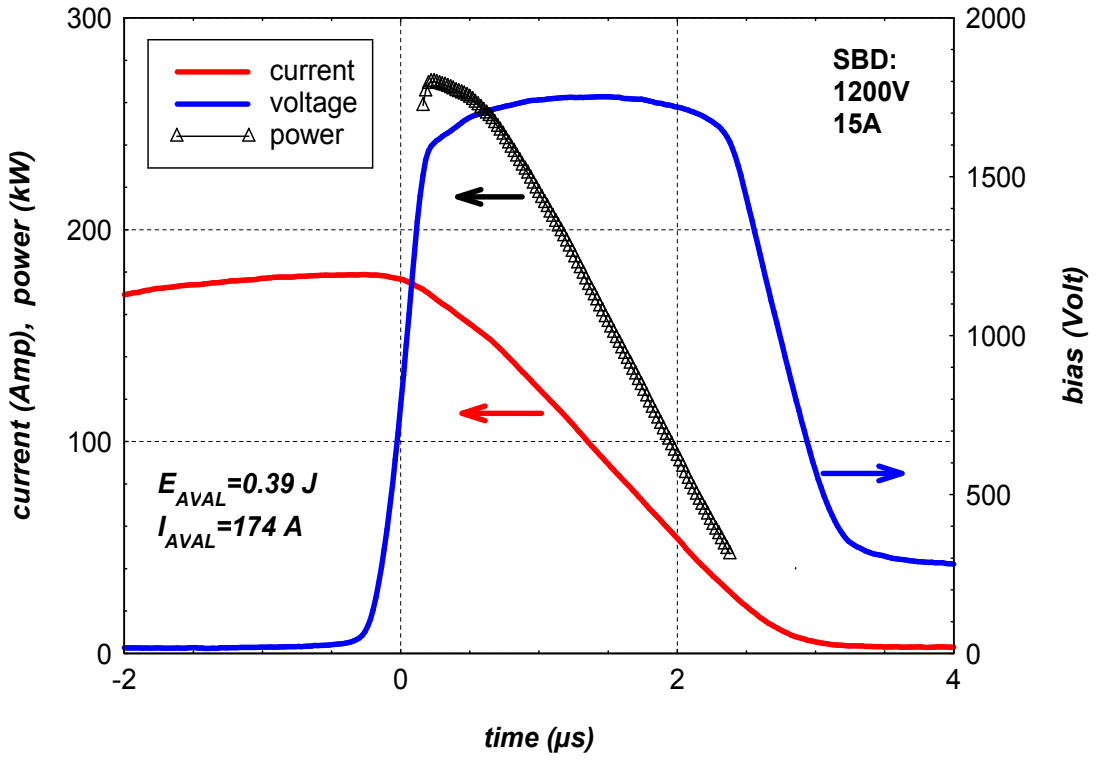
Vf 与电流的关系



漏电流与温度的关系



安森美半导体SiC二极管– 雪崩



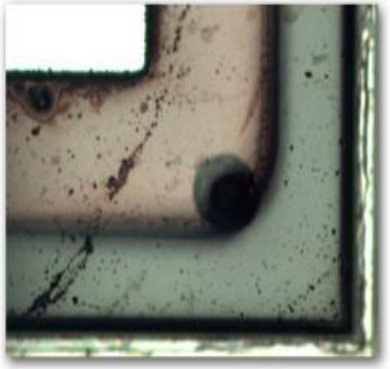
1200V 15A SiC 二极管

雪崩电流接近200 A (3500 A/cm²)

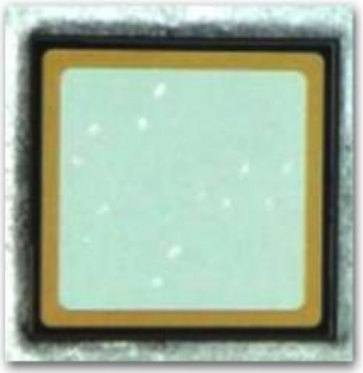
SiC二极管 – 最佳可靠性

测试条件: H3TRB 测试(高温度/湿度/偏置), 85C/85% RH, V_{CE}=960V

Corrosion failure after 168 hours
Competitor 1



Corrosion failure after 168 hours
Competitor 2



No failure after 168 hours
安森美半导体

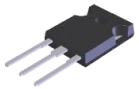
- 竞争器件: 1200V, 8A
  - 168hr: BV发生故障
- ON: 1200V, 10A
  - 1000hr: 通过而未发生故障

WBG MOSFET

Public Information

安森美半导体SiC MOSFET 1200V

＊ 以下产品计划仅为目标时间表，安森美半导体可能不会事先通知就更改裸片设计

ID @25C (A)	$R_{DS(ON)}$ TYP (mΩ)	TO-247-3	TO-247-4	D2PAK-7L
				
40	80	NTHL080N120SC1 Now / Q4’18	NTH4L080N120SC1 Now / Q4’18	NTBG080N120SC1 Now / Q1’19

样品/发布

SiC MOSFET 门极驱动器 – NCP51705

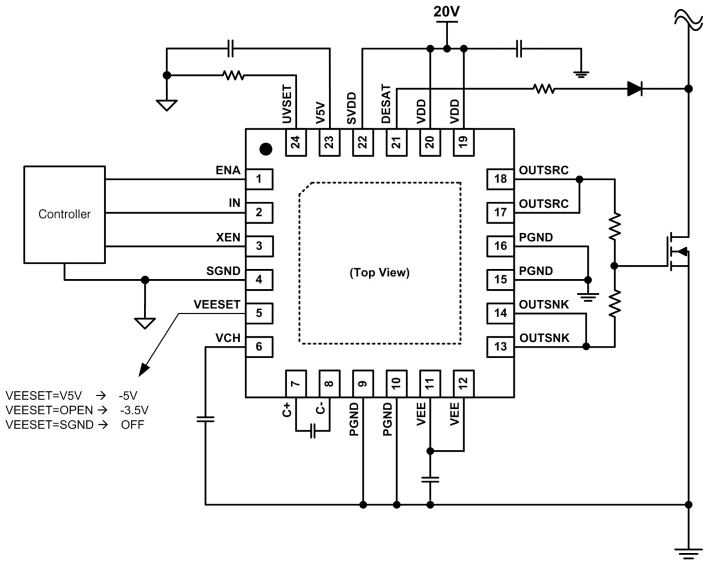
特性

- High peak output current - 6A
- Extended positive voltage rating for SiC MOSFETs
- Integrated negative charge pump (adjustable to -5V)
- Adjustable UVLO levels
- Vcc supply for digital isolators
- DESAT detection for short circuit protection
- Thermal shutdown function
- Inverting/Non-inverting Input

优势

- Optimized to drive all SiC MOSFETs
- Tunable for design
- Simplified BOM and no need for extra DC/DC
- Negative voltage drive for fast turn-off
- Very small package

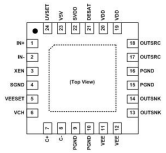
Targeted for automotive qualification



市场及应用

- Industrial Inverters, Motor drives
- High Performance PFC, AC/DC & DC/DC Converters

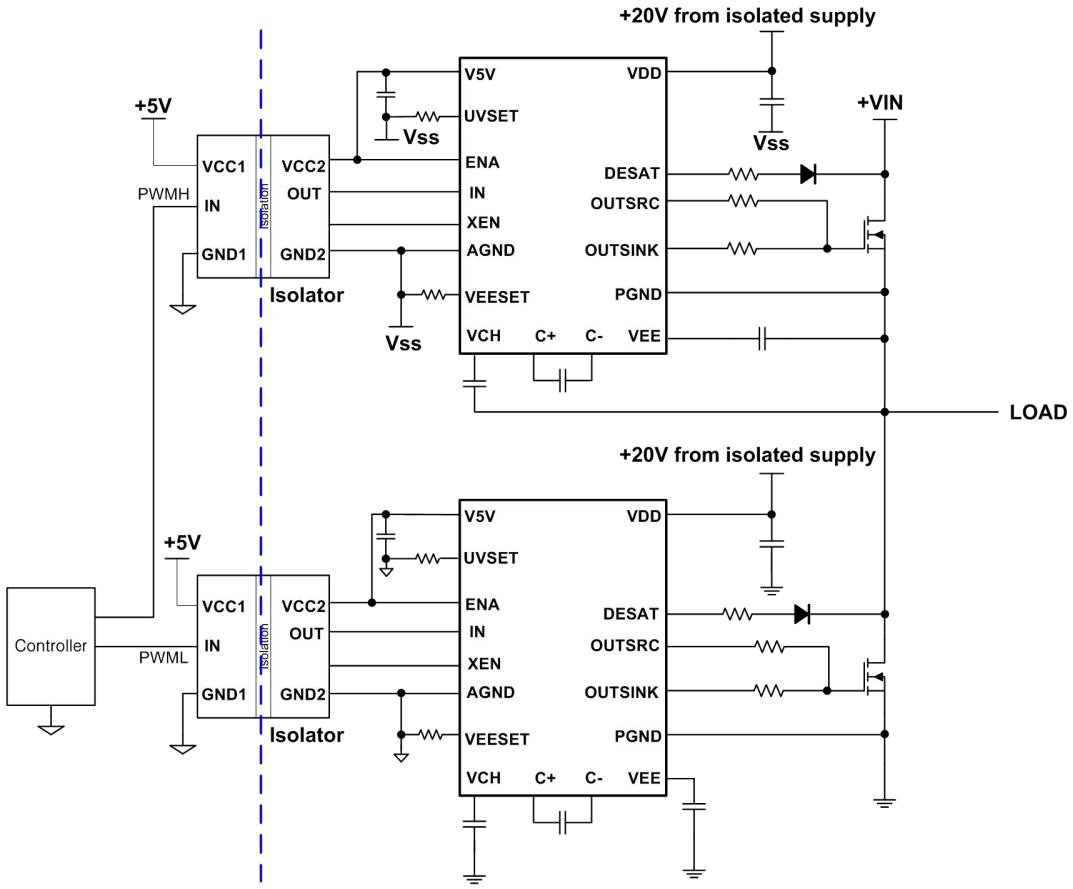
订购及封装信息



- QFN24 4mm x 4mm

SiC MOSFET 门极驱动器 – NCP51705

- 典型的半桥隔离型门极驱动器



SiC MOSFET 门极驱动器要点

- 类似于传统的硅MOSFET驱动器, 在开关时提供高峰值电流， 以对C_{GS}和C_{GD}电容快速充放电
- 为实现最低的$R_{DS(ON)}$, 在导通时间内提供20V至22V 门极驱动幅值
- 为实现最快的关断速度 和在关态期间不受dV/dt 影响,在关断期内驱动器应将门极拉至约-5V
- 通过使用低电感封装来减轻源电感的负反馈效应-以后也要考虑共同封装

关键要点

- ✓ 安森美半导体在全球电源半导体市场排名第二
- ✓ 最可靠的SiC 产品，适当的成本
- ✓ SiC二极管业务增长最快
- ✓ 将于2018年推出首款1200V SiC MOSFET
- ✓ 将于2019年推出首款650V GaN MOSFET

谢谢！

有关安森美半导体宽禁带的更多信息，请访问网站：
www.onsemi.cn

详细信息请联系您的销售代表或授权代理商

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Internal Use Only