



纳微 Navitas

Let's go GaNFast™

纳微集成氮化镓电源解决方案及应用

Rome.Luo 罗明 · 高级现场应用经理

Integrated GaN Power Solution and Application

Ming (Rome) LUO, Senior Field Application Manager

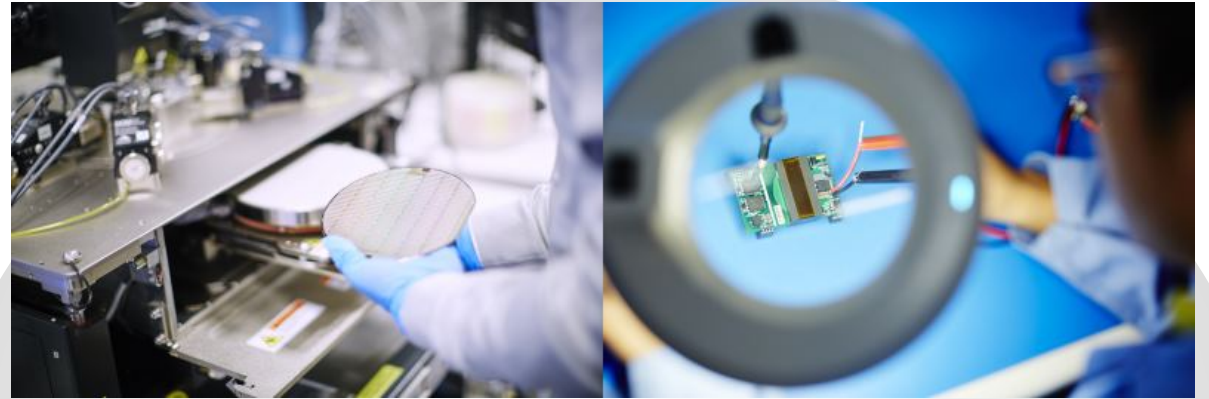
2020 · 06 · 23

- ✓ Navitas 半导体公司介绍
- ✓ Navitas 集成氮化镓产品介绍（选型/注意事项/Layout）
- ✓ Navitas 氮化镓和Si方案性能和体积对比
- ✓ Navitas 氮化镓方案特点
- ✓ Navitas 氮化镓商用案例及其在工业领域的应用



Navitas 半导体公司介绍

- 2014年成立
 - ✓ 总部：美国加州洛杉矶EI Segundo
 - ✓ 中国CN：深圳、杭州、上海
- 世界级管理团队
 - ✓ 现有80多位员工
 - ✓ 预计120+人/2020年底
- Navitas：拉丁文即“能量”
 - ✓ 为电力电子行业注入新能量
- 全世界首家应用氮化镓的功率芯片
 - ✓ 获JEDEC认证
 - ✓ 量产并快速增量
- 世界级制造商合作伙伴
 - ✓ 晶圆厂：台积电 (TSMC)
 - ✓ 封装厂：安靠科技 (Amkor Technology)



navitas
noun | en·er·gy



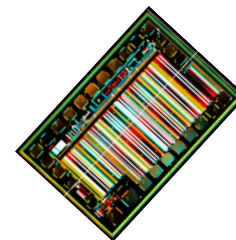


• 全球60多名工程师

- ✓ 专注于美国和中国的顶尖人才
- ✓ 中国团队15名，70%以上拥有博士或硕士学位

• 美国核心团队由30名设计和应用工程师组成

- ✓ 70%以上拥有博士或硕士学位
- ✓ 设计 - 在硅和GaN的模拟和功率方面具有深厚专业知识
- ✓ 应用 - 在谐振设计，高频磁性，EMI方面具有深厚专业知识
- ✓ 汇聚来自顶尖电力电子大学的毕业生，并进行积极招聘计划





超过200项已授权专利

第一款商用平面MOSFET的共同发明人

超过20个主题演讲

第一个级联GaN功率FET的共同开发者

经历过20个世代 功率半导体的行业成长

每年创造超过\$40亿美元的功率半导体收入

第一款用于稳压器，半桥驱动器和LED驱动器的高压功率IC的发明者

5,000多种电源产品投放市场

超过200篇技术论文

第一个P沟道功率MOSFET的共同发明人

全球第一集成驱动器+功率FET的发明者

第一代GaN功率IC的发明者



Navitas集成氮化镓产品介绍



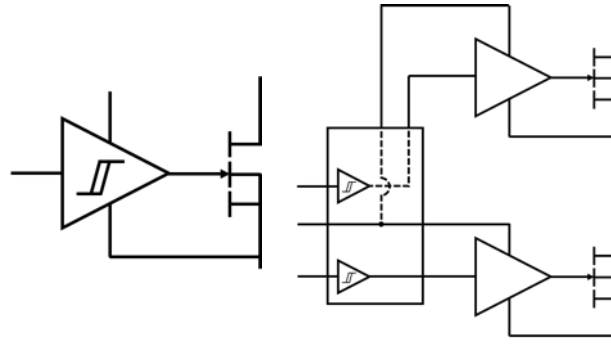
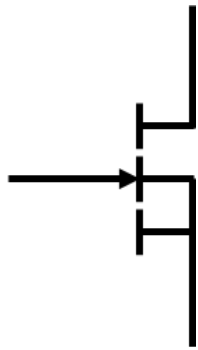
全世界首款GaN 功率IC



最快，最高效的GaN功率管

首个及最快速集成的GaN 门极驱动器

全世界**第一款**



专有设计

- 速度高于硅器件20倍以上
- 速度高于cascaded GaN 5倍以上

专有单路设计 及 专有半桥设计

- 速度高于所有门极驱动器3倍以上
- 获颁或正在申请的专利超过100项

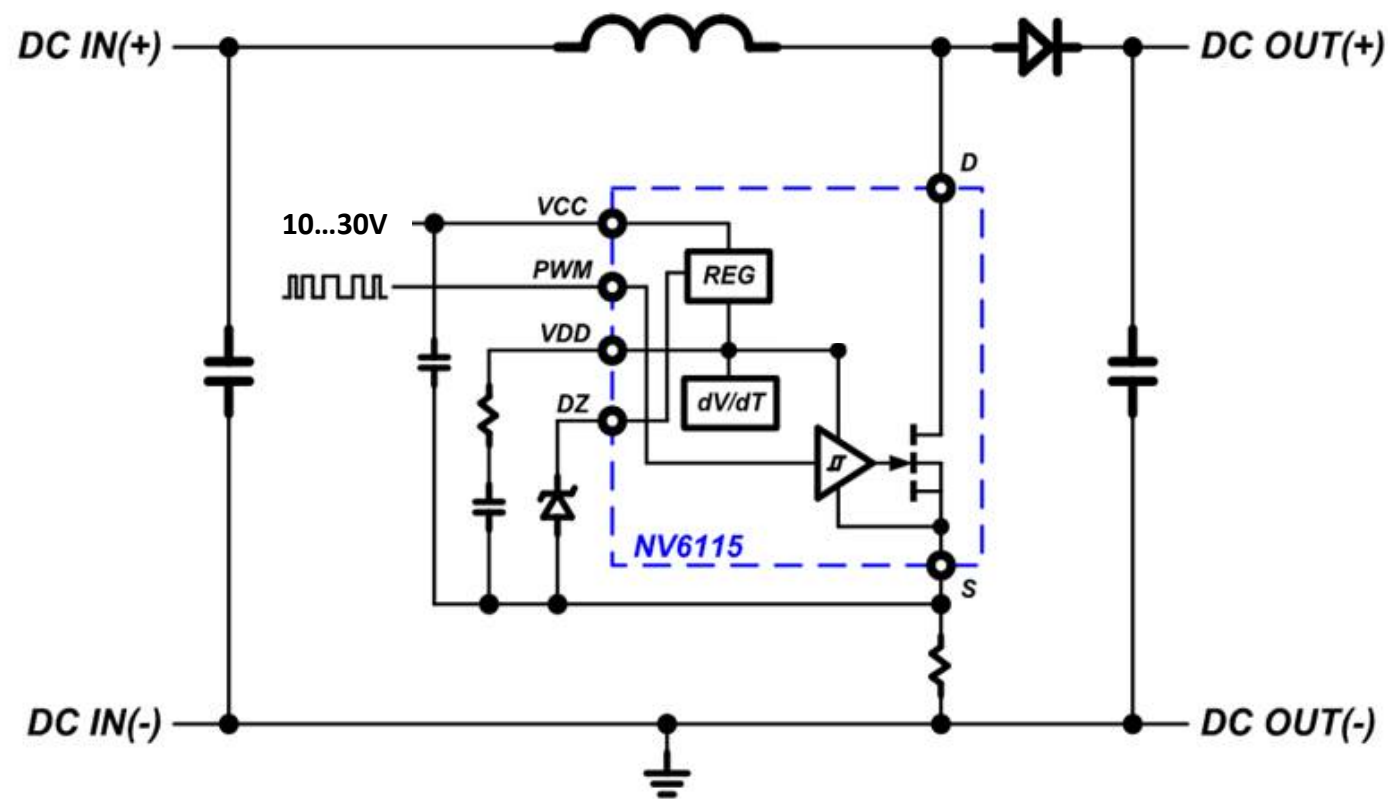
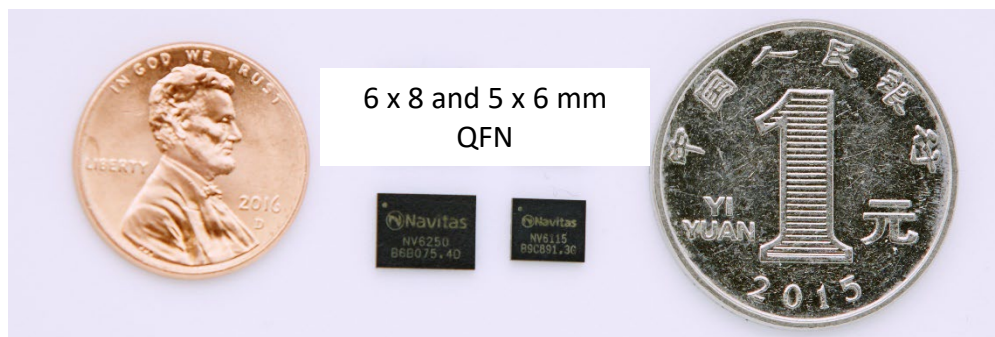
支持高达40MHz开关频率，5倍以上功率密度，系统成本降低20%

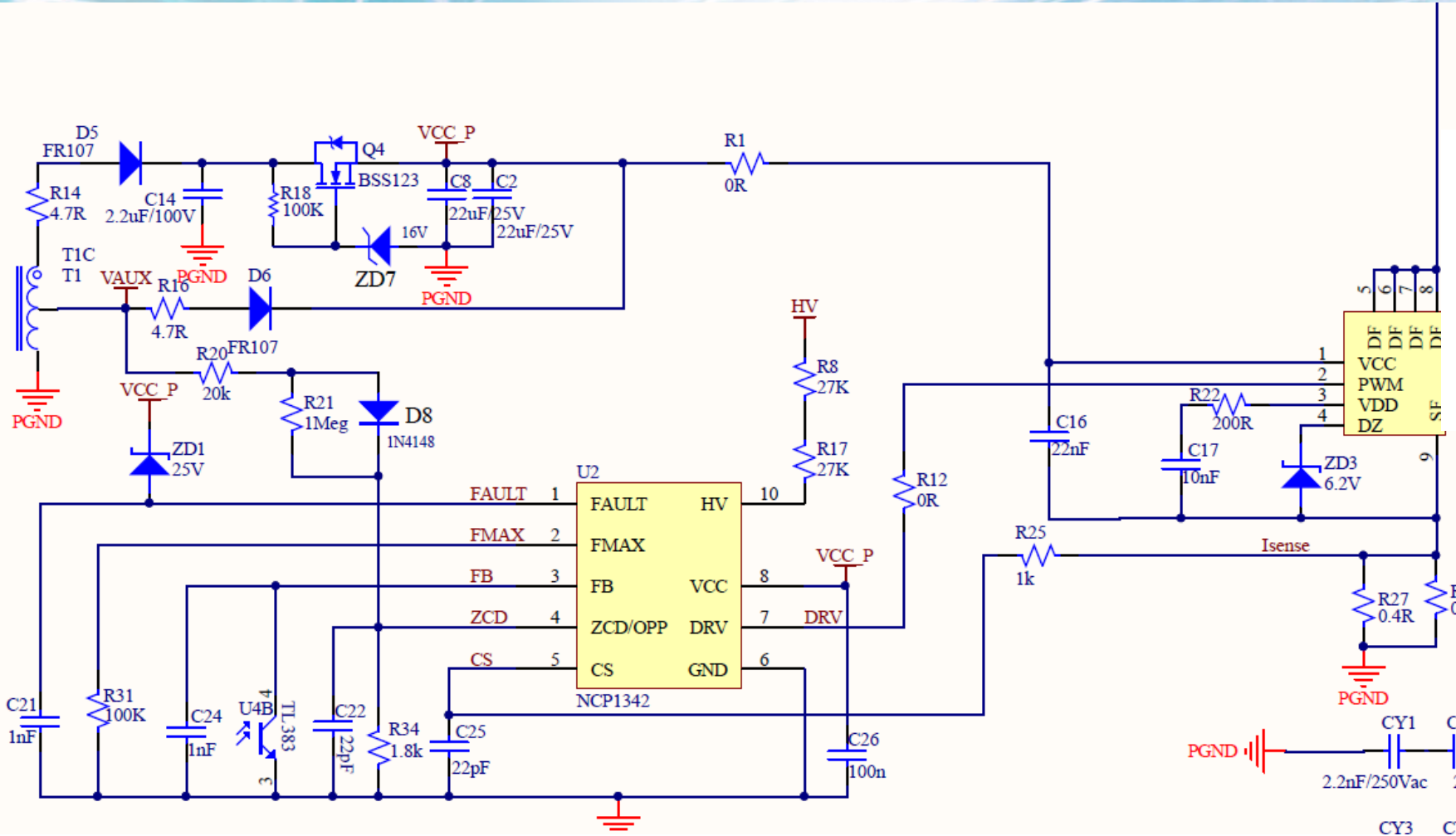
- 单片集成, **650V**

- ✓ GaN FET 功率场效应管
- ✓ GaN Driver 驱动器
- ✓ GaN Logic 逻辑电路

- “**Digital In, Power Out**”

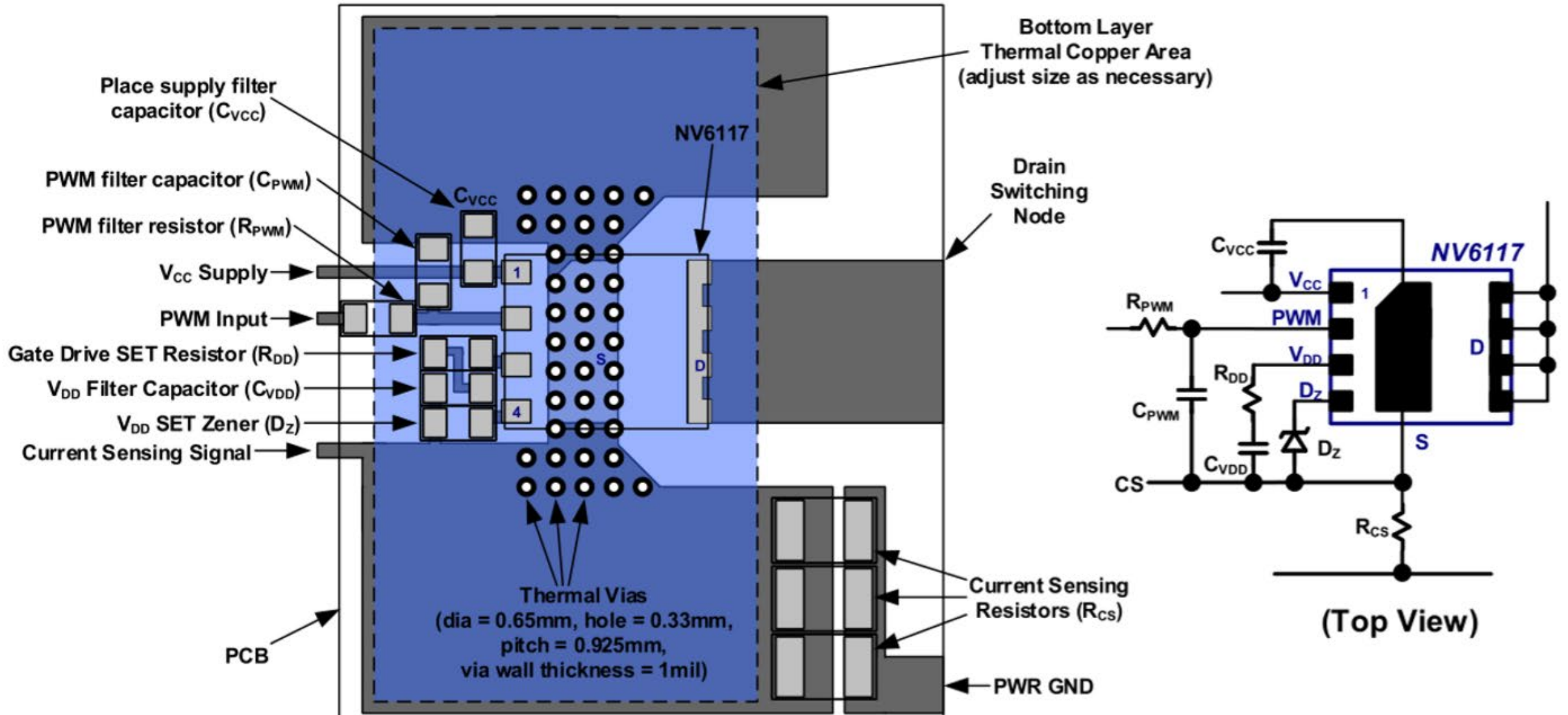
- ✓ 数字输入, 功率输出





SYM	DESCRIPTION	MIN	TYP
C_{VCC}	Maximum V_{CC} supply capacitor		0.1
C_{VDD}	V_{DD} supply capacitor		0.01
R_{DD}	Gate drive turn-on current set resistor	10	25
R_{PWM}	PWM filter resistor		100
C_{PWM}	PWM filter capacitor		100

- flyback with NV6115

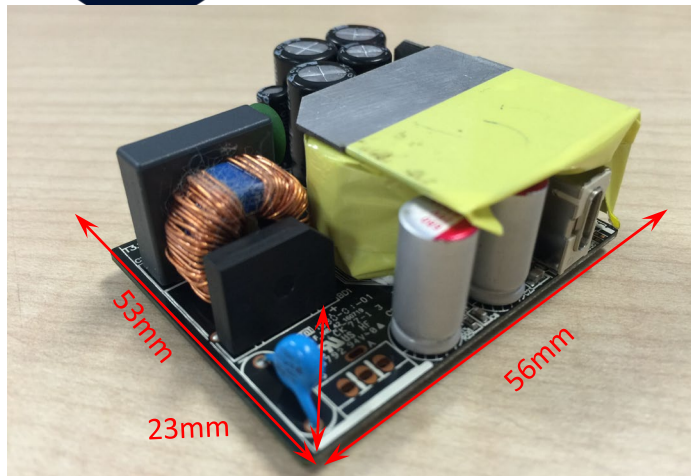


GaNFast Family	NVPN#	Package QFN, L*W [mm]	Rdson(typ), [mOhm]	Typical Application
Single	NV6113	5*6	300	Boost PFC, Totem-Pole PFC, LLC, LCC, Inverter, ACF, HFQR
	NV6115		170	
	NV6117		120	
	NV6123	6*8	300	
	NV6125		170	
	NV6127		120	
Asymmetrical Half-Bridge	NV6252	6*8	600 + 300	Active Clamp Flyback

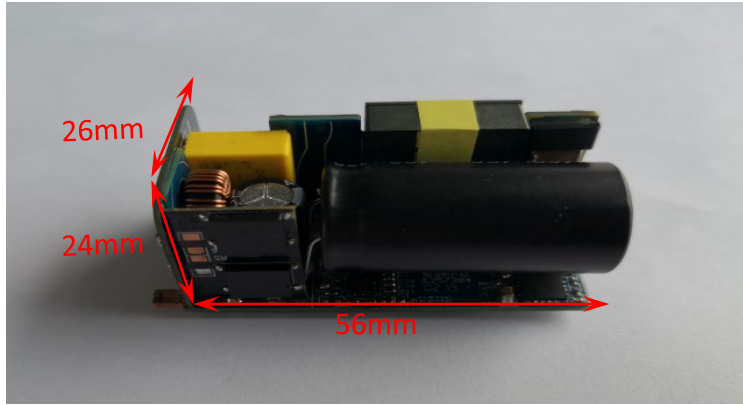


Navitas氮化镓和Si方案体积对比

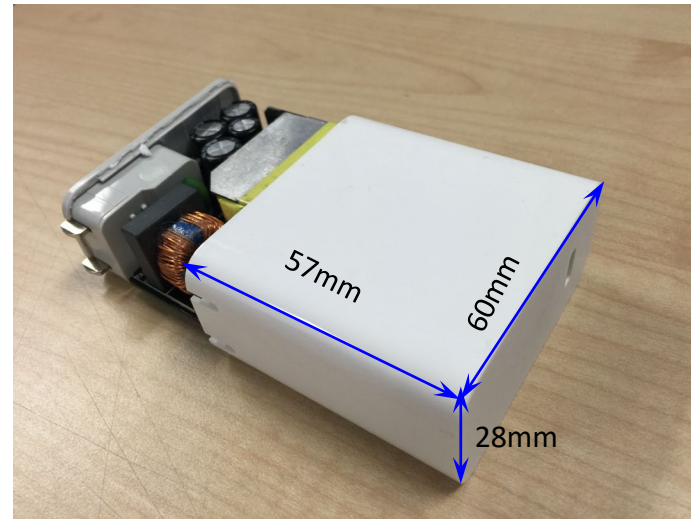
纳微集成氮化镓与Si方案对比---高频小型化 **GaNFast™**



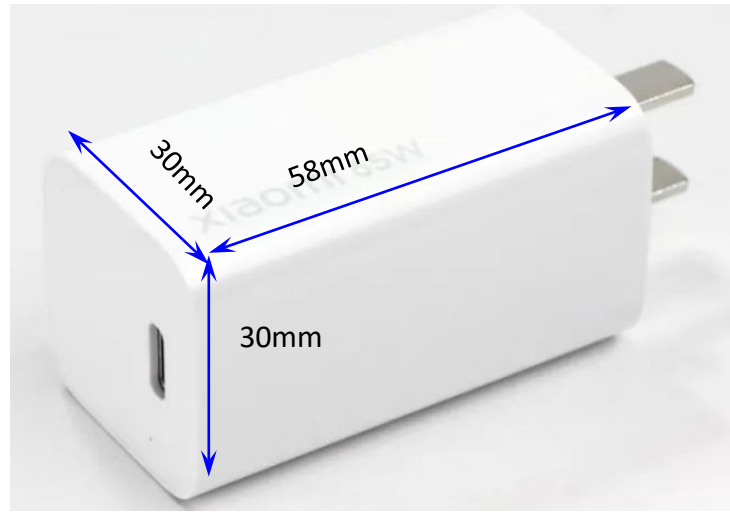
• 传统Si方案 (PCBA)



• 基于Navitas 氮化镓GaN方案 (PCBA)



• 传统Si方案 (case)



• 基于Navitas 氮化镓GaN方案 (case)

体积对比			
	传统Si方案	氮化镓GaN方案	体积比 = GaN/Si
PCBA	56*53*23 =68.3CC	26*24*56 =34.9CC	51.1%
Case size	60*57*28 =95.8CC	30*30*58 =52.2CC	54.4%

Navitas纳微氮化镓方案:

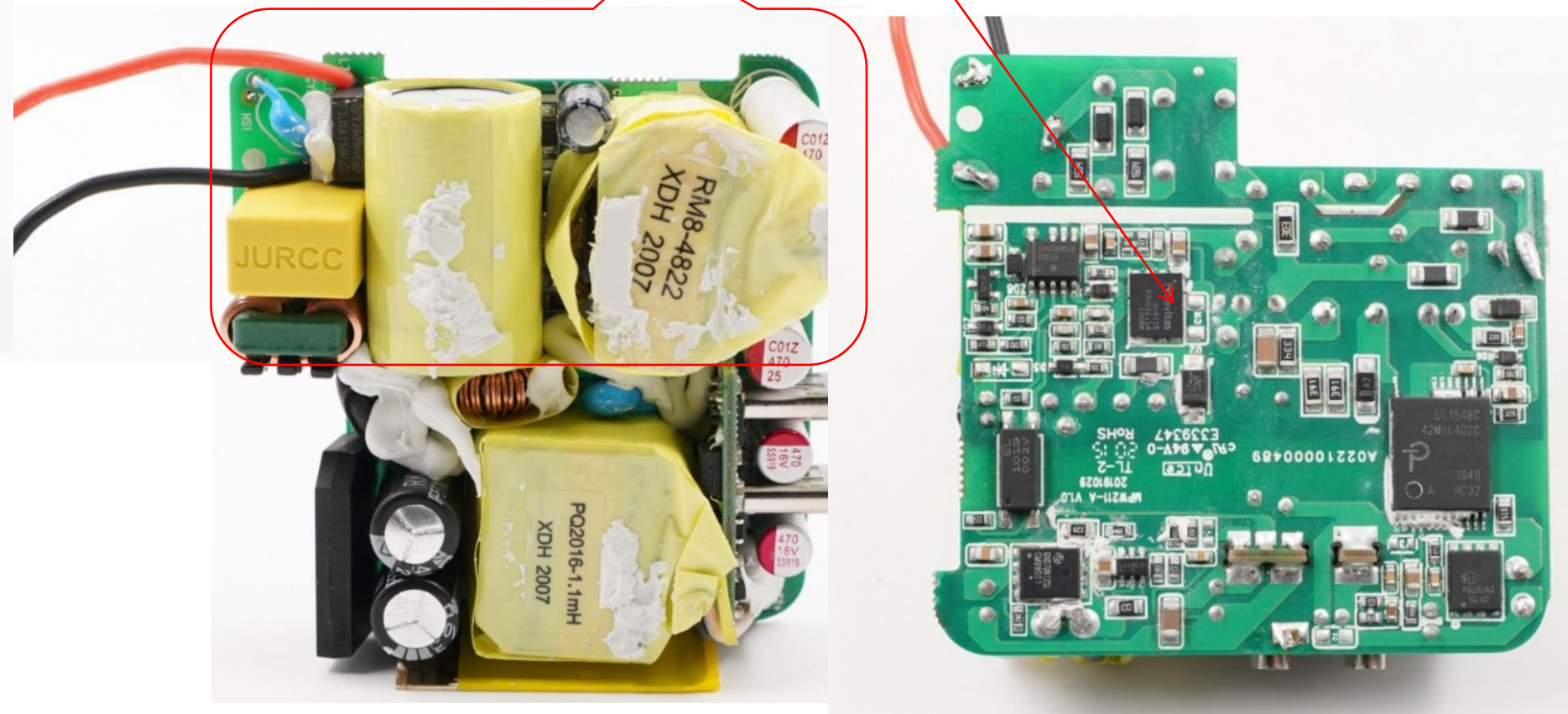
- 充分利用氮化镓器件的高频特性
- 实现更高的效率
- 更小的体积

纳微集成氮化镓与Si方案对比---高频小型化

<http://www.chongdiantou.com/wp/archives/53401.html>



60W with Navitas NV6115 & RM8 (高频方案)



18W with Si PQ2016

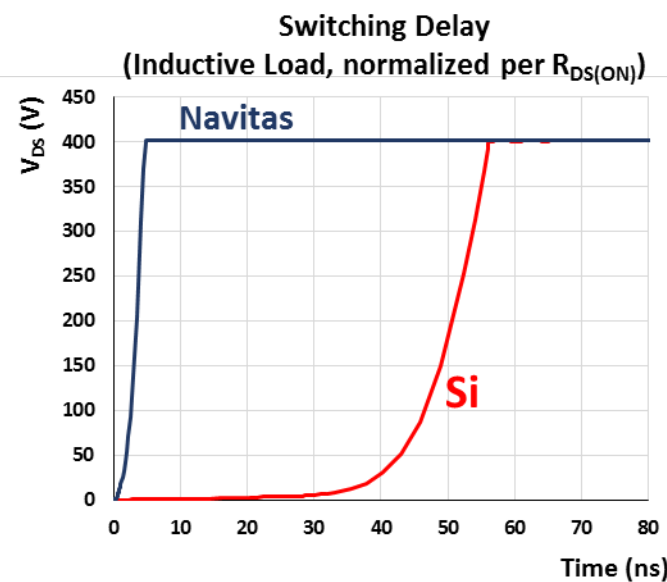
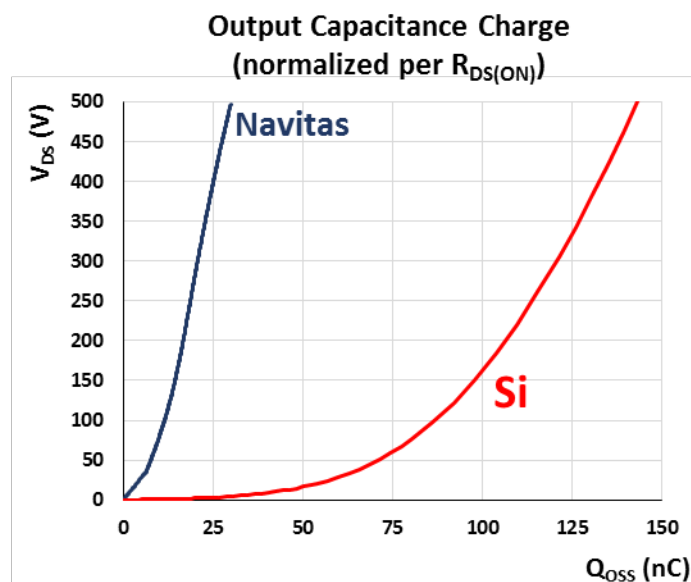
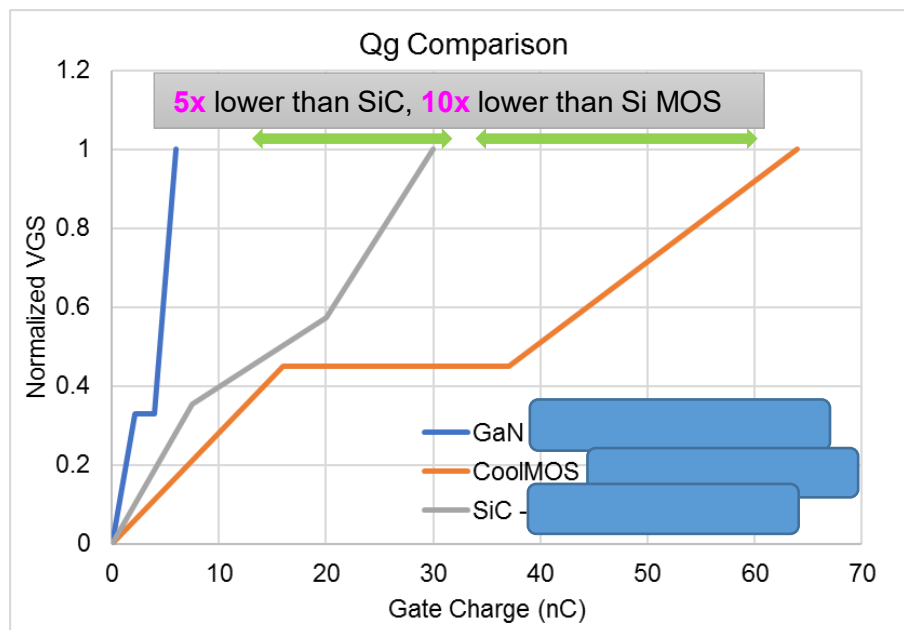
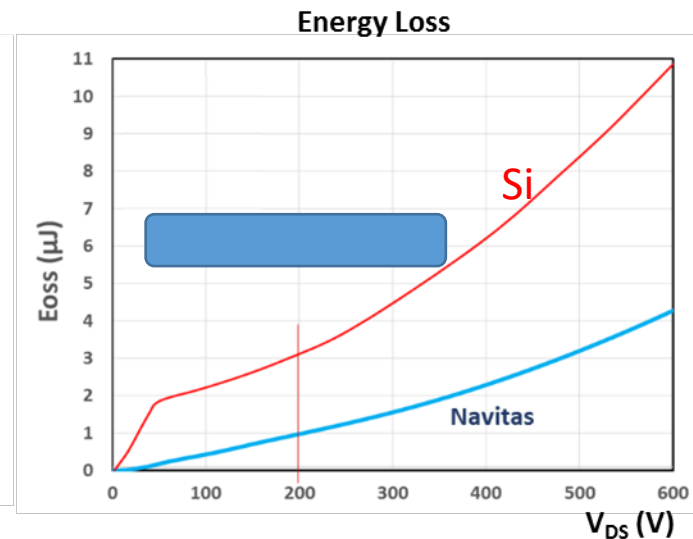
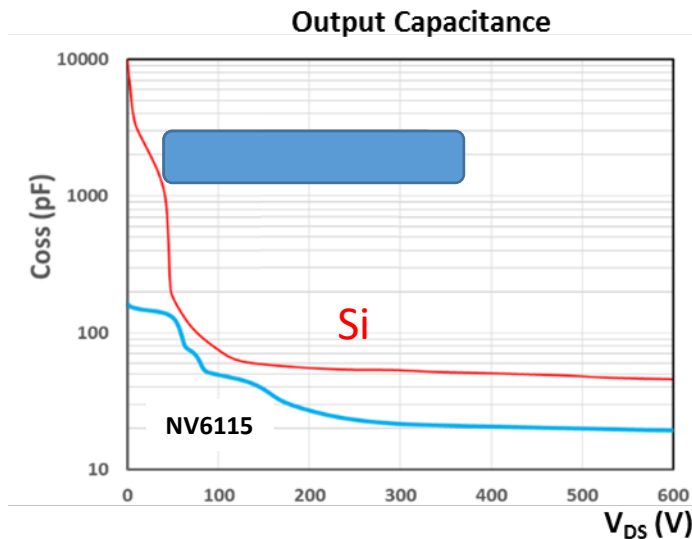
输入端外壳标注产品的参数信息
 型号: WCH003dq 90315
 输入: 100-240V 50/60Hz 2A
 双口输出:
 USB-C1: 5V3A、9V2A
 USB-C2: 5V3A、9V3A、15V3A、20V2.5A
 单口输出:
 USB-C1: 5V3A、9V2A
 USB-C2: 5V3A、9V3A、15V3A、20V3A
 产品已经通过了ETL认证、墨西哥NOM认证、巴西NYCE认证、FCC认证。

- 68W=50W C1+ 18WC2

纳微集成氮化镓小型化原因

• eMode

- 低 $R_{ds(on)}$
- 没有反向恢复损耗
- Q_g 低, 驱动损耗低
- C_{oss} 小, 容性损耗低
- 开关速度快

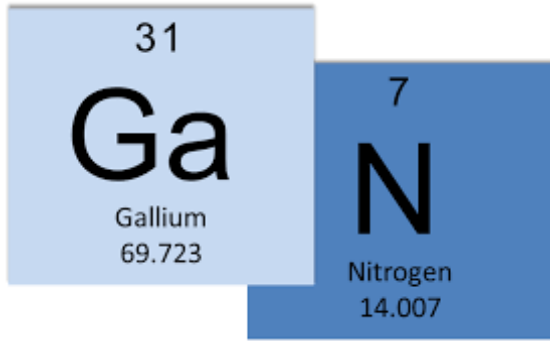




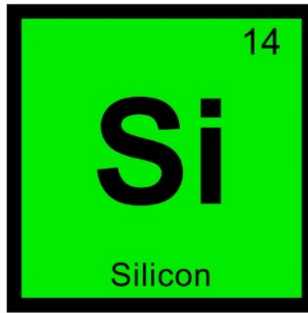
Navitas氮化镓方案特点



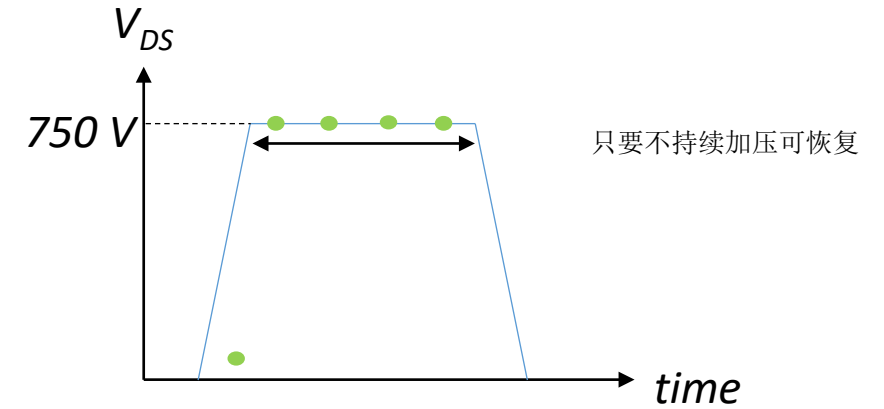
纳微集成氮化镓方案特点01---可靠性



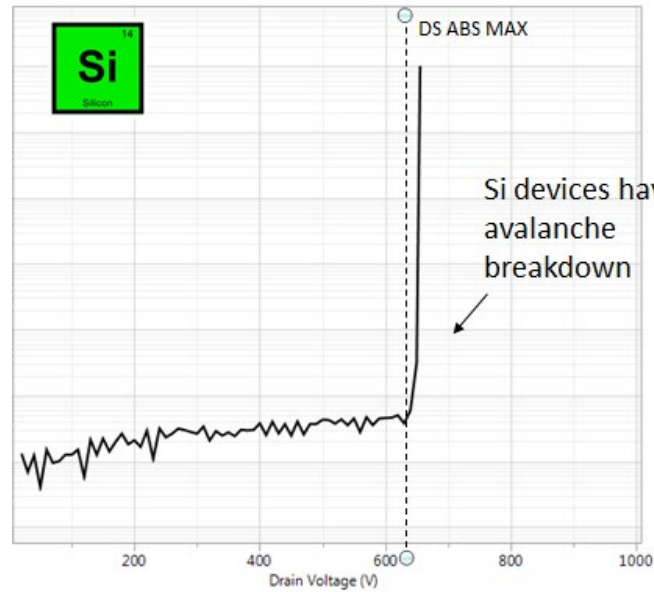
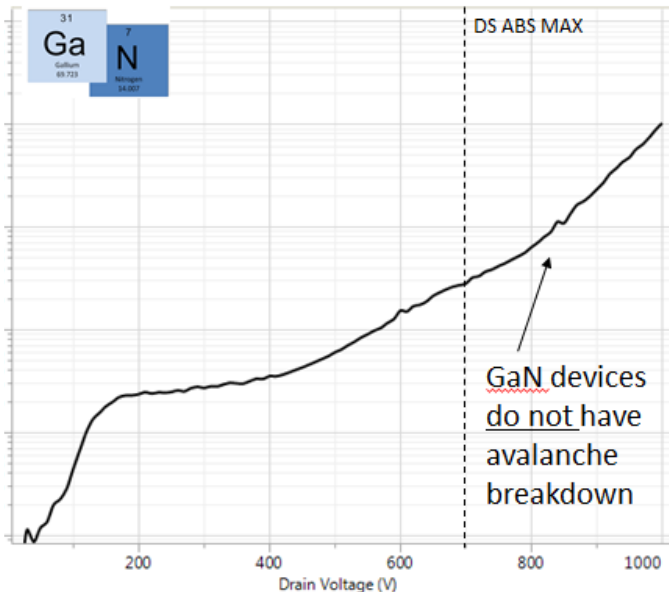
vs



带隙: GaN (**3.4 eV**) vs. Si (**1.1 eV**) → GaN具有更大的临界电场, 使其能够在很小的间隔内承受很高的电压



- Navitas 纳微 **100% Final Test** 最终测试



- GAN VS Si Breakdown voltage

Navitas
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650V GaNFast Power IC Qualification Report

Summary / Conclusion:
Navitas 650V GaNFast Power ICs in 5x8 QFN package have passed reliability requirements per JEDEC standard.

Family	Part #s Qualified	Test Vehicles
650V eGaN GaNFast power ICs with integrated monolithic gate drive technology in 5x8 QFN package (M5G1).	NV6110 ¹ , NV6115, NV6117 ²	NV6111 ¹ , NV6105 ¹ , NV6112 ¹ , NV6117 ²

Please contact Navitas@navitassemi.com for any questions on this report or for further assistance.

Name	Title	Email	Phone number
Stephen Gandhi	Sr. Director, Reliability and Quality	stephen.gandhi@navitassemi.com	+1-844-654-2842

¹ NV6110 and NV6115 have the same fab process, die size, package and core transistor. NV6110 has additional monolithic driver.
² NV6117 and NV6115 have the same fab process, die size, package, core transistor and monolithic driver. NV6117 has additional monolithic gate drive.
³ NV6117 and NV6115 have the same fab process, package, and core design. NV6115 is smaller in die size compared to NV6117.
⁴ NV6110 and NV6113 have the same fab process, package, and core design. NV6113 is smaller in die size compared to NV6110.

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Accelerated Environmental Stress Test Summary

Test #	Reference	Test Conditions	Duration	Lot#	Sample Size / Lot	Total # of Failures	# of Test Vehicles
PC 1	JEDEC22-A111, A112, A113, A114, A115, A116, A117, A118, A119, A120, A121, A122, A123, A124, A125, A126, A127, A128, A129, A130, A131, A132, A133, A134, A135, A136, A137, A138, A139, A140, A141, A142, A143, A144, A145, A146, A147, A148, A149, A150, A151, A152, A153, A154, A155, A156, A157, A158, A159, A160, A161, A162, A163, A164, A165, A166, A167, A168, A169, A170, A171, A172, A173, A174, A175, A176, A177, A178, A179, A180, A181, A182, A183, A184, A185, A186, A187, A188, A189, A190, A191, A192, A193, A194, A195, A196, A197, A198, A199, A200, A201, A202, A203, A204, A205, A206, A207, A208, A209, A210, A211, A212, A213, A214, A215, A216, A217, A218, A219, A220, A221, A222, A223, A224, A225, A226, A227, A228, A229, A230, A231, A232, A233, A234, A235, A236, A237, A238, A239, A240, A241, A242, A243, A244, A245, A246, A247, A248, A249, A250, A251, A252, A253, A254, A255, A256, A257, A258, A259, A260, A261, A262, A263, A264, A265, A266, A267, A268, A269, A270, A271, A272, A273, A274, 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纳微集成氮化镓方案特点02---高度集成



- 纳微半导体的单芯片功率IC是驱动器及氮化镓功率管整合，可以有效去除门极最大偏差电压。

✓ 消除栅极过冲和下冲

- R_G 值是跟门极最大偏差电压 有直接关系，理想 R_G 必须：

$$R_G \geq \sqrt{\frac{4(LG+LS)}{C_{GS}}}$$

- 芯片上的零电感确保无关断损耗
 - ✓ 提升系统稳定，频率可以比较快
 - ✓ 有较减少线路面积。

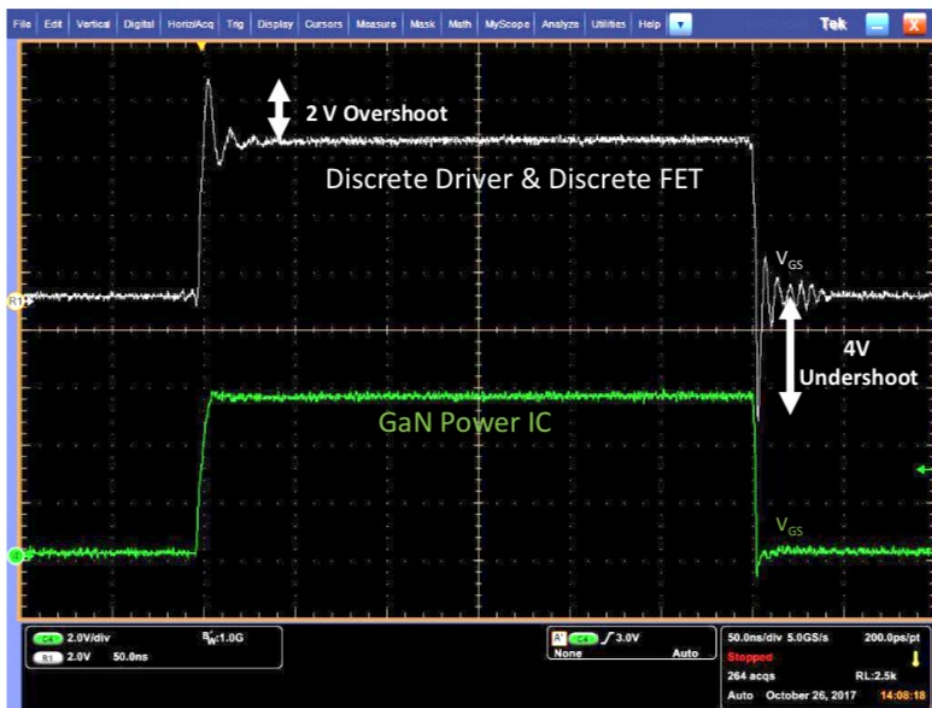


图3：门极电压（集成VS分离）

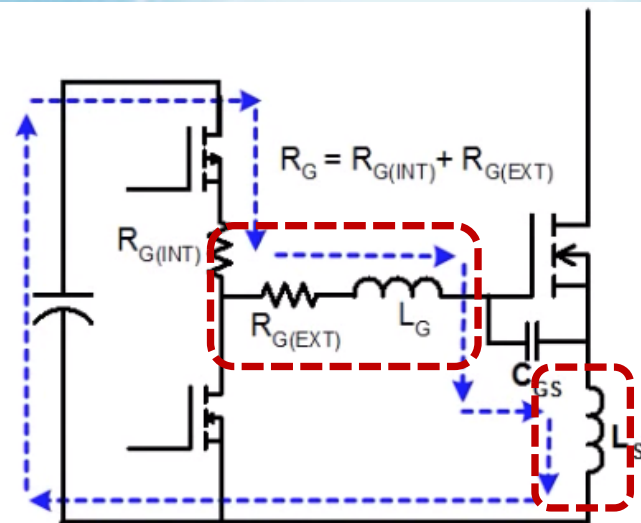


图1：分离式方案

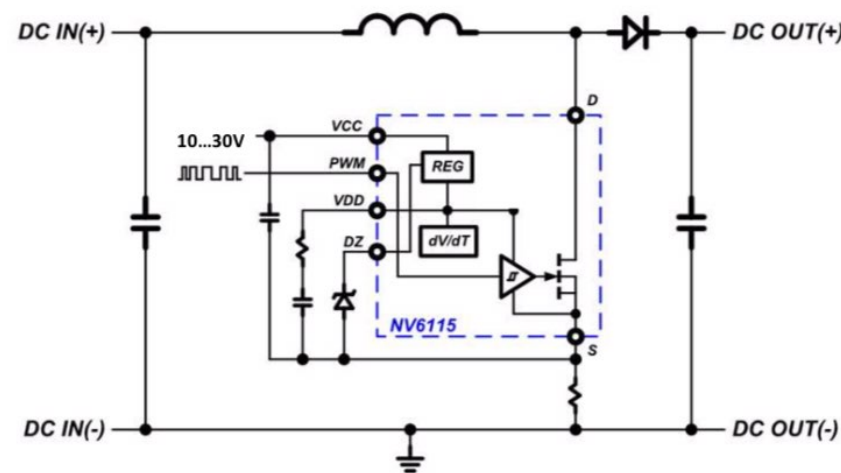


图2：纳微半导体单芯片功率IC

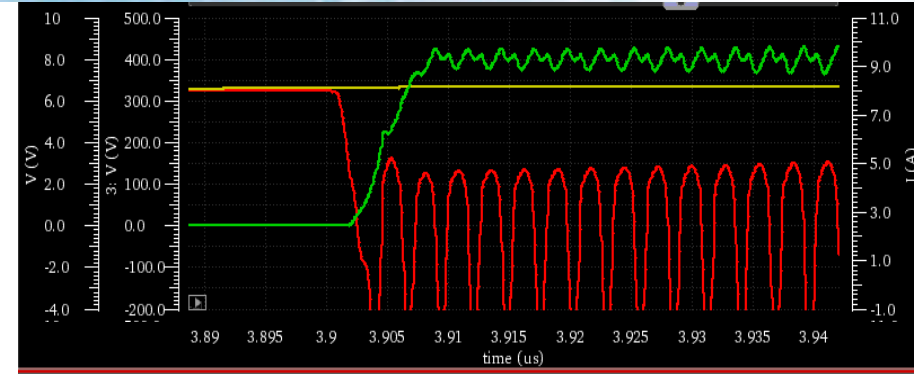


纳微集成氮化镓方案特点02---高度集成



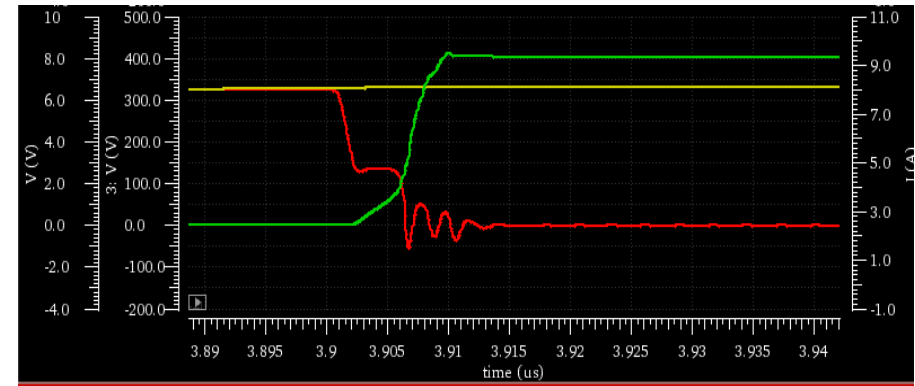
1. 直接外部驱动:

震荡



2. 外部驱动 + R_G :

震荡可控
速度慢
开关损耗加大



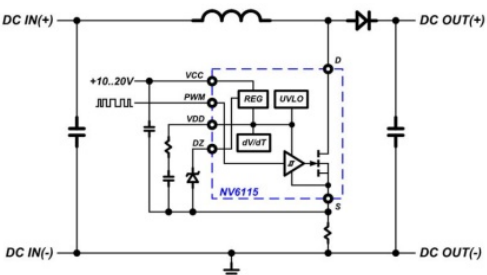
3. 集成驱动:

无震荡
10x 快
极低损耗





纳微集成氮化镓方案特点02---高度集成

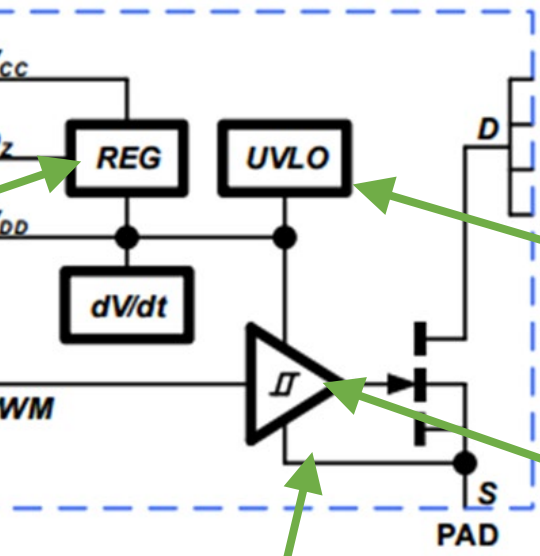


集成驱动 → 设计简单、可靠

大范围 V_{CC} (10-30V)

调节器确保 V_{GS} 在SOA 安全作业区中

PWM Hysteresis 磁滞可抑制噪声



总体布局灵活性和简单

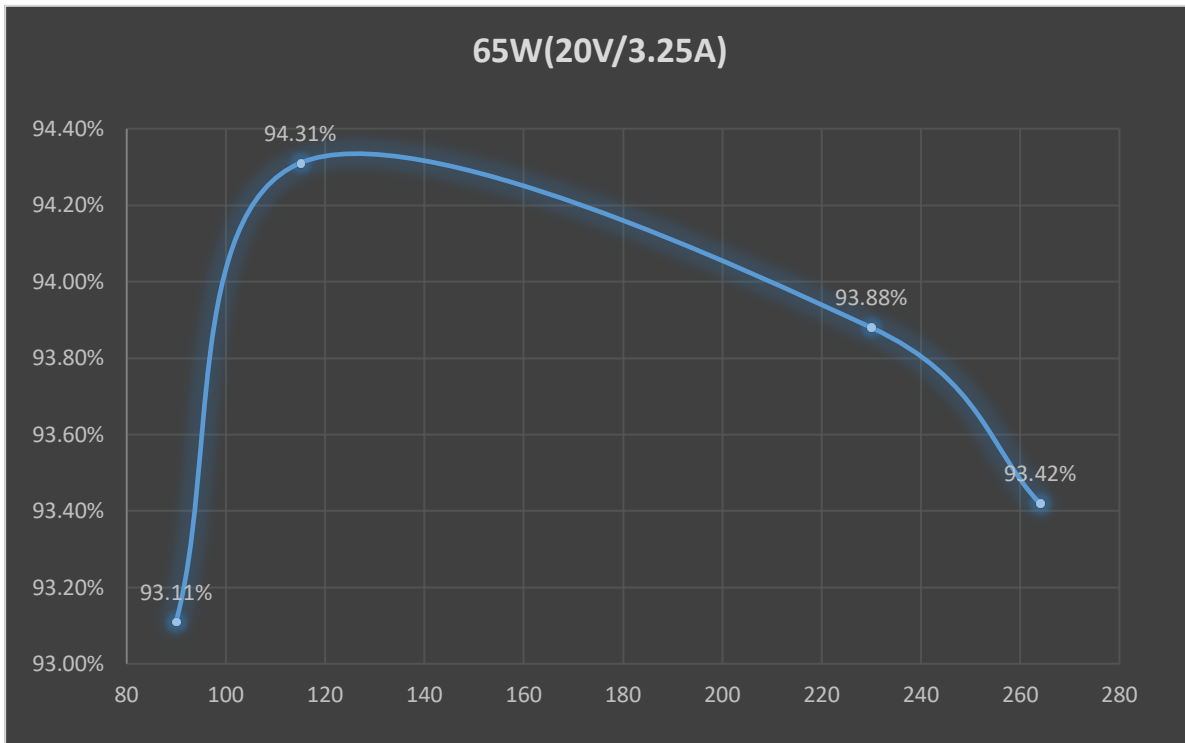
欠压锁定可在没有完整电源时保护驱动器和FET

栅极免受外部噪声影响 (Not pinned out of package)

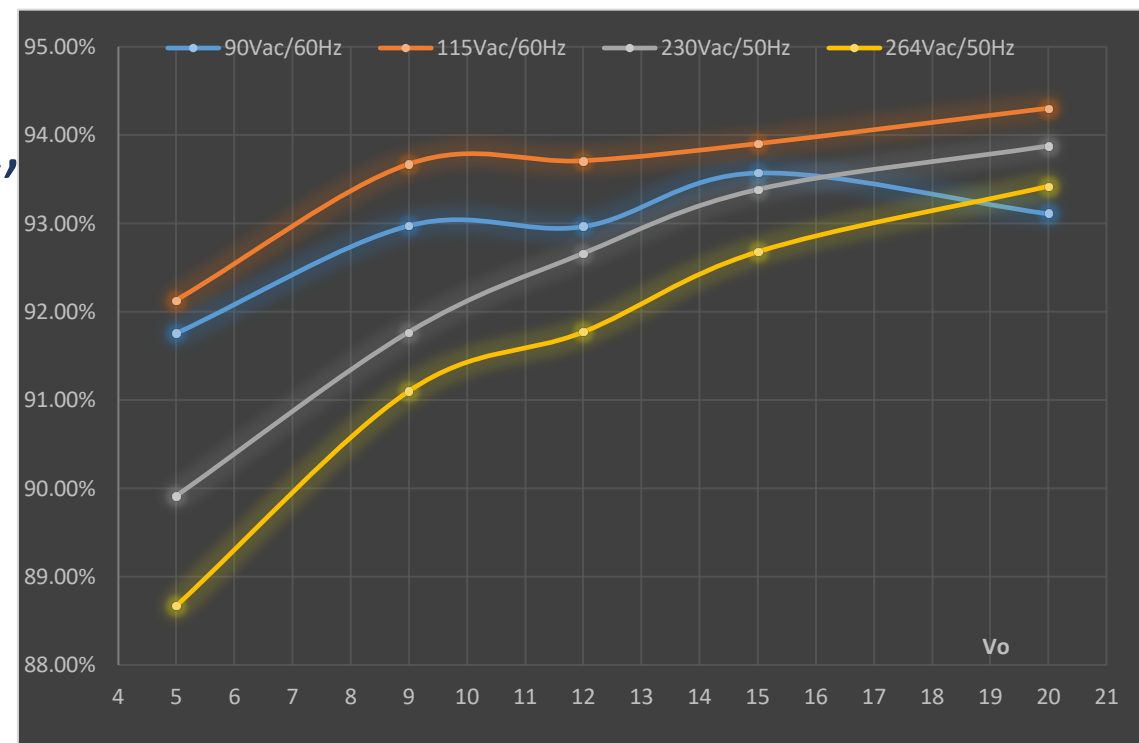
门极回路中无电感或振铃



纳微集成氮化镓方案特点03---高效率



3A,



PCBA : 46 x 26 x 25.5 mm³ (30.5CC)

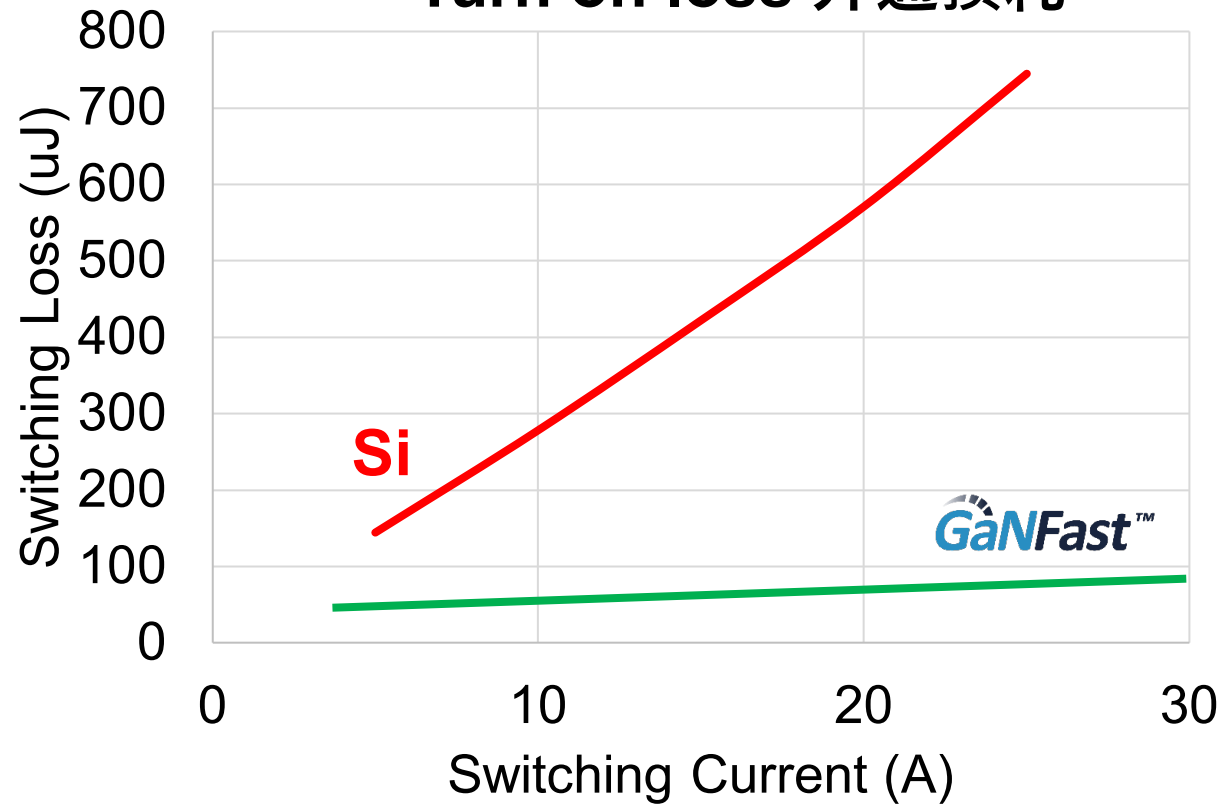
Cased w/ foldable plug: 57 x 30.3 x 30.3 mm³ (52.5CC)



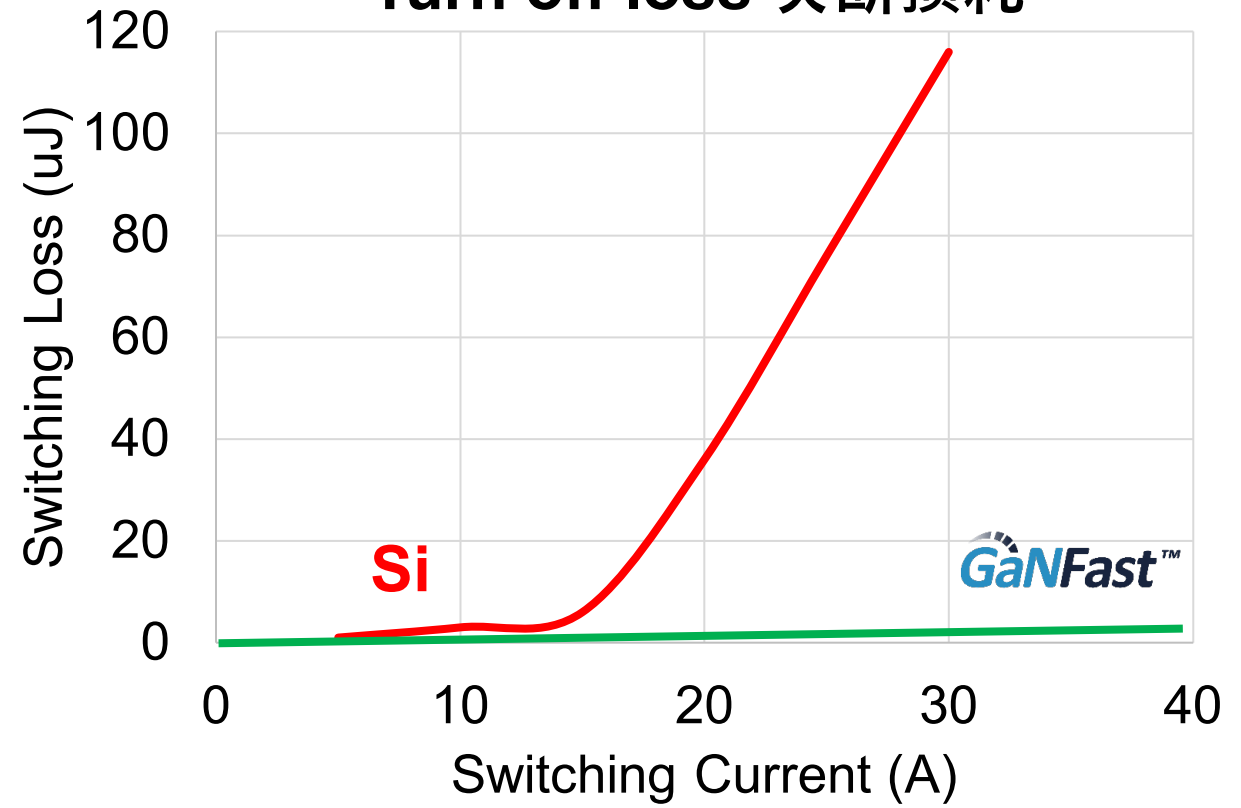
纳微集成氮化镓方案特点04---高效率



Turn on loss 开通损耗



Turn off loss 关断损耗

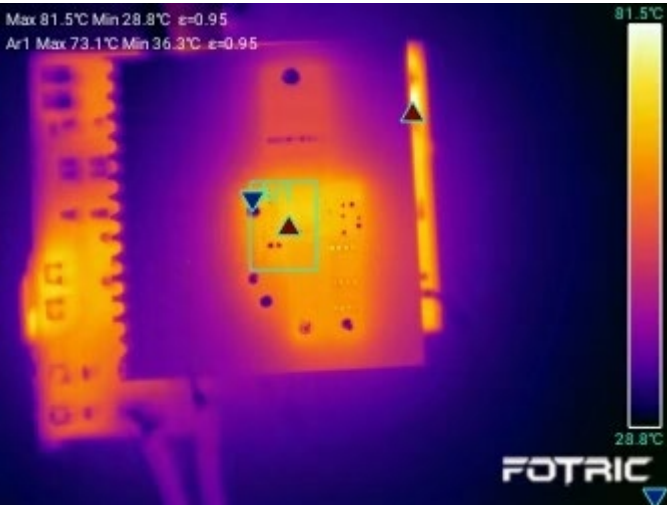
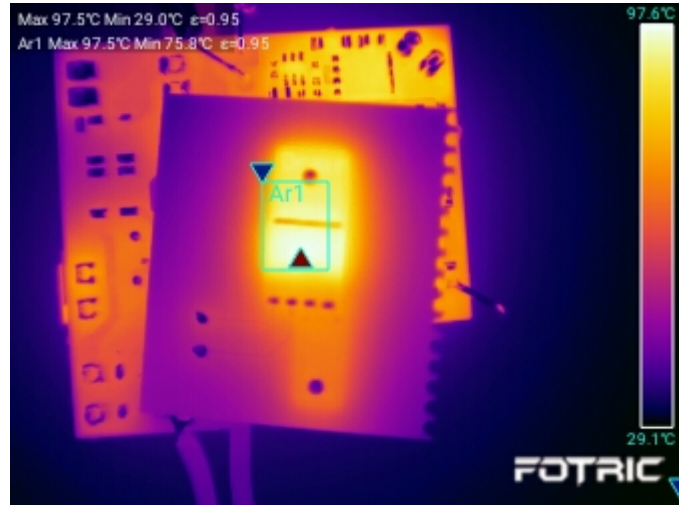


- ✓ Save 85% 的开通损耗
- ✓ Save 95% 的关断损耗



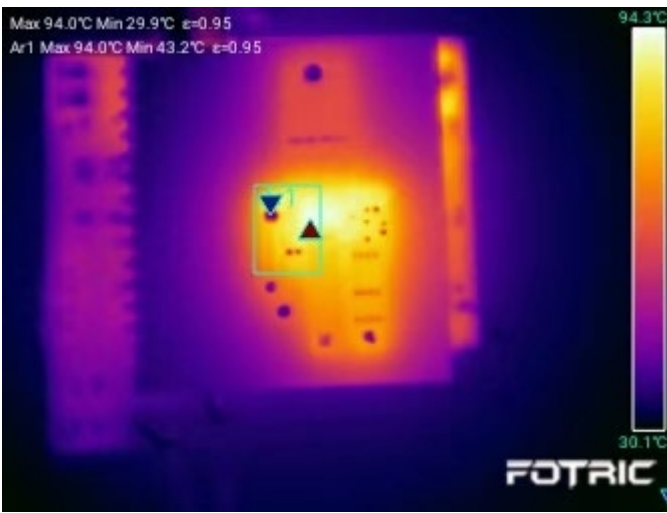
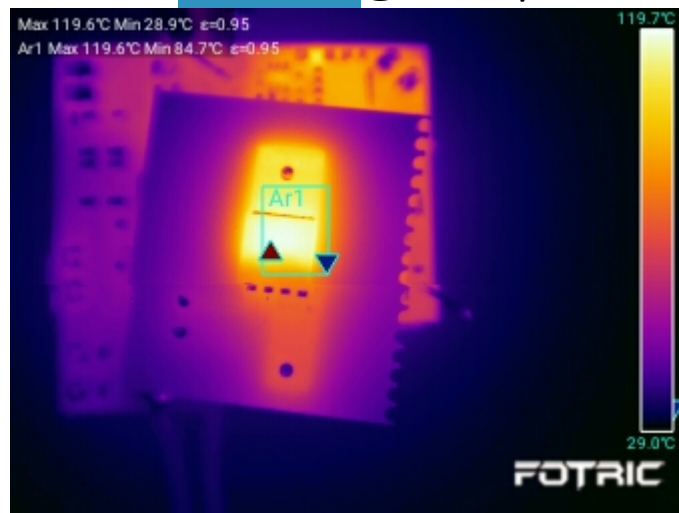
纳微集成氮化镓方案特点05---温度特性 **GaNFast™**

在相同配置下65W / 3.25A板



• 97.5°C **CoolMOS**@90Vac/50Hz

• 73.1°C **Navitas GaN**@90Vac/50Hz

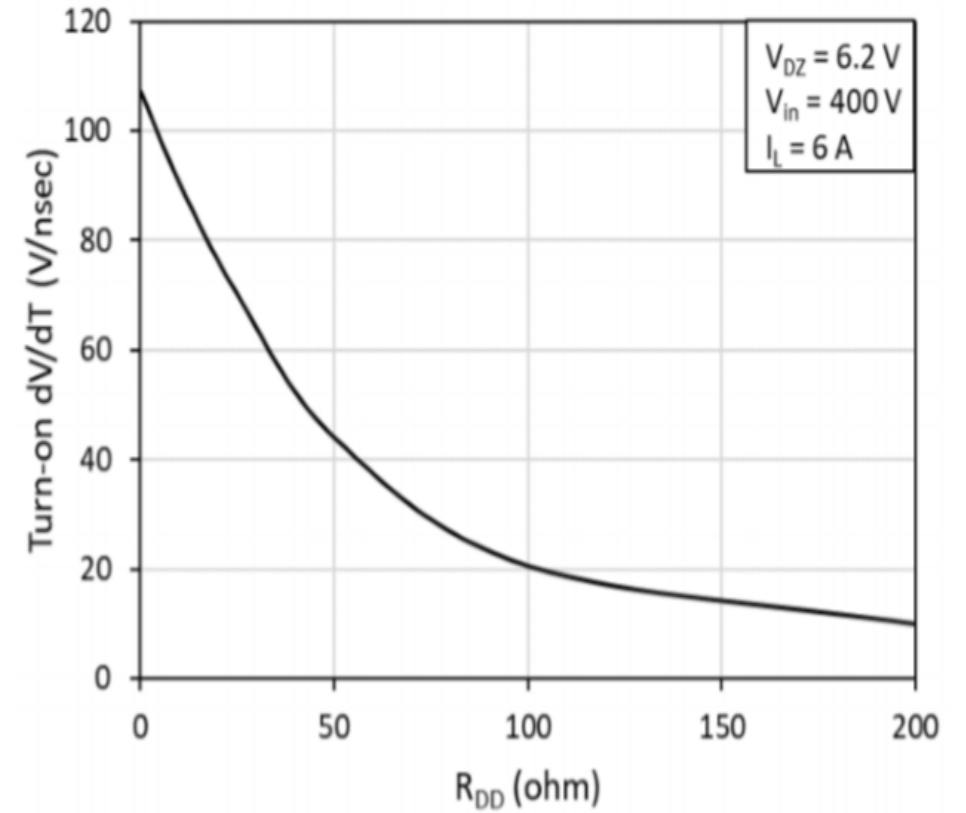
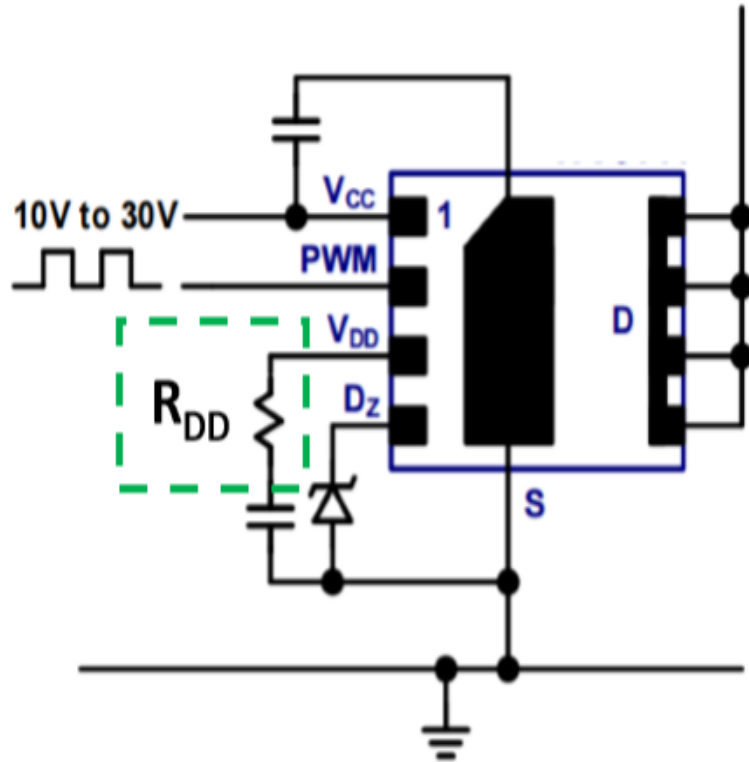


• 119.6°C **CoolMOS**@230Vac/50Hz

• 94.0°C **Navitas GaN** @230Vac/50Hz

	CoolMOS 方案	Navitas GaN 方案	Note
器件	650V 130m ohm	NV6127 650V	
内阻 Rdson [mohm]	130	120	类似规格
封装 Package	QFN8*8	QFN6*8	纳微有较小的体积
90Vac / 50Hz	97.5°C	73.1°C	Delta = 24.4°C
230Vac / 50Hz	119.6°C	94°C	Delta = 25.6°C

纳微集成氮化镓方案特点06---EMI可调 **InfFast™**





关于纳微氮化镓的那些事之07—ID更随性

GaNFast™



65W 2C1A



65W 1C1A



65W 1C



100W 2C2A



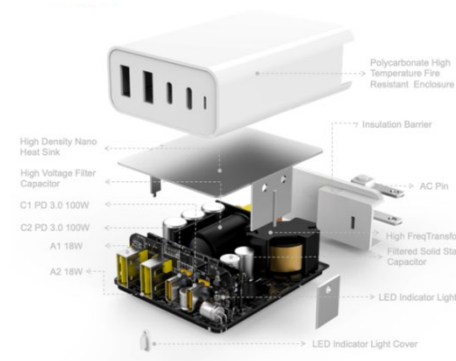
65W 2C1A



45W 1C



130W 2C1A



65W 2C



Navitas Public Information



30W 1A+1C



Navitas氮化镓商用案例



充电器/适配器 商用案例01---Xiaomi



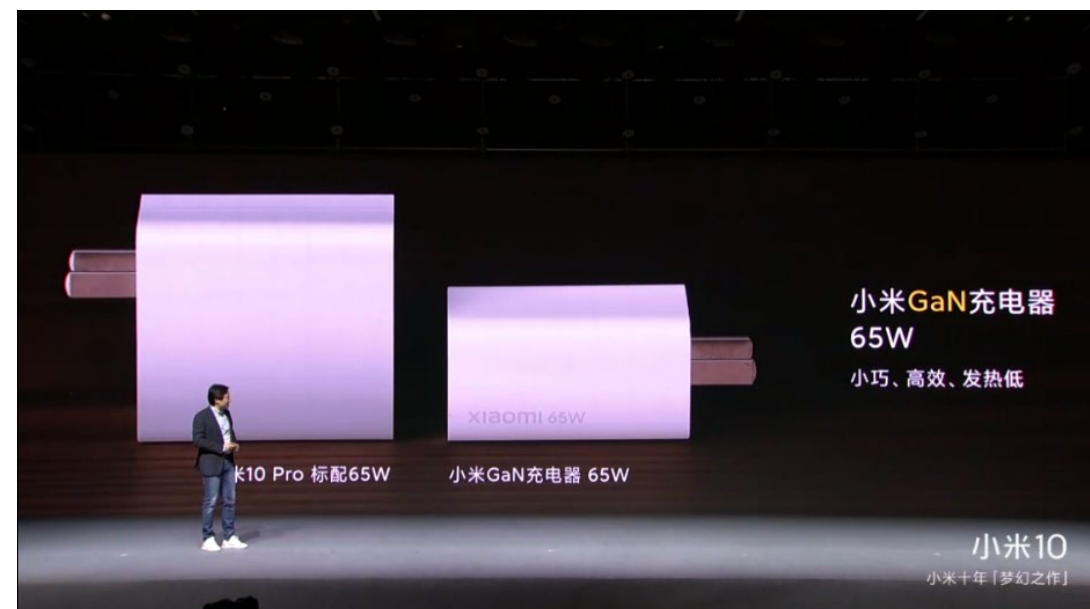
65W-1C
53cc



Mi 10, 10 Pro



Xiaomi CEO: "How tiny is this GaN charger?"



Xiaomi CEO: "This GaN charger is extremely small & efficient?"

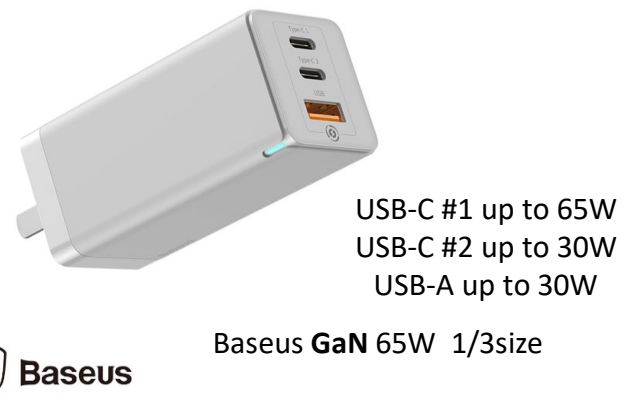


充电器/适配器 商用案例02---Thinkplus





商用03: 全世界最小的充电器们



HyperJuice 100W:
2C+2A,
C1, C2: A1, A2:
150 cc
**World's smallest 100W
4-output**



Baseus120W: 2C+A
USB-C1, -C2 , A
154 cc
**World's smallest 120W
3-output**



AUKEY Omnia 100W 1C, 2C
(104cc, 112cc)
World's smallest 100W



World's Fastest Laptop:
Asus ProArt StudioBook One
NVIDIA Quadro RTX™ 6000
World's Smallest 300W Adapter

纳微氮化镓方案---不限于充电器/适配器 **Fast™**

- ✓ 5倍速的充电速度
- ✓ 5倍节能
- ✓ 5倍的功率密度
- ✓ 降低成本高达2倍

2kW
-20kW

500W
-2kW

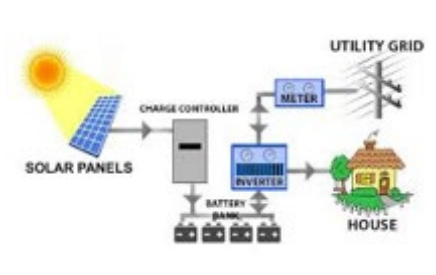
250W

150W

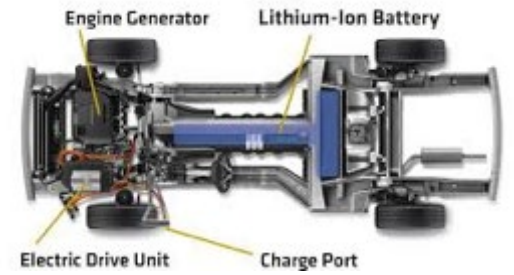
75W

50W

25W



Energy Storage
TAM: >\$1B/yr



Electric Vehicles
TAM: >\$2B/yr



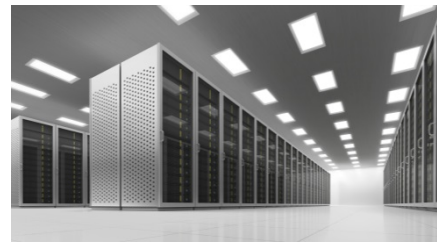
High Density Adapters & Fast Chargers
TAM: >\$2B/yr



Hi-Efficiency Solar
TAM: >\$1B/yr



5G Base stations
TAM: >\$500M



Datacenter
TAM: >\$500M

工业级市场扩张 >\$5B/yr
opportunity.



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