



# GaN Power Devices for Electric Vehicles

## 适用于新能源汽车的氮化镓功率器件



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# VisIC公司

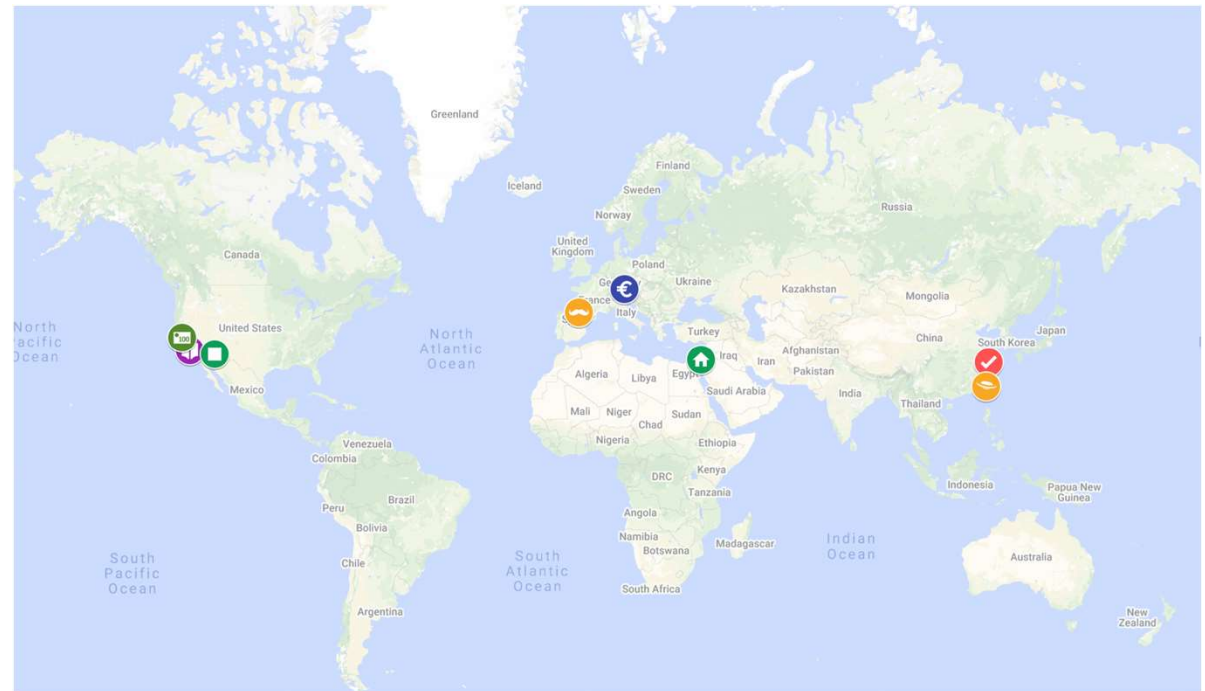


- VisIC Technologies Ltd 在2010年成立于以色列
  - 2020年在上海设立了独资子公司 微思芯电子技术（上海）有限公司

## Locations

- Visic Technologies HQ
- VisIC Shanghai China Support
- VisIC Reliability & Qualification
- VisIC Munich Europe Sales
- VisIC Hsinchu Operation
- VisIC Sales APAC US
- VP OPS
- VP Packaging

	1,084 sq.m.; RD, SM, GA
	110 sq.m. .SM, App support
	Individual contributor
	Individual contributor
	90 sq.m. OPS
	Individual contributor
	Individual contributor
	Individual contributor



# VisIC 研发重点

VisIC研发的D-mode Direct Drive GaN (D<sup>3</sup>GaN) 氮化镓技术平台拥有符合E-Drive应用的高功率，高性能，高可靠性

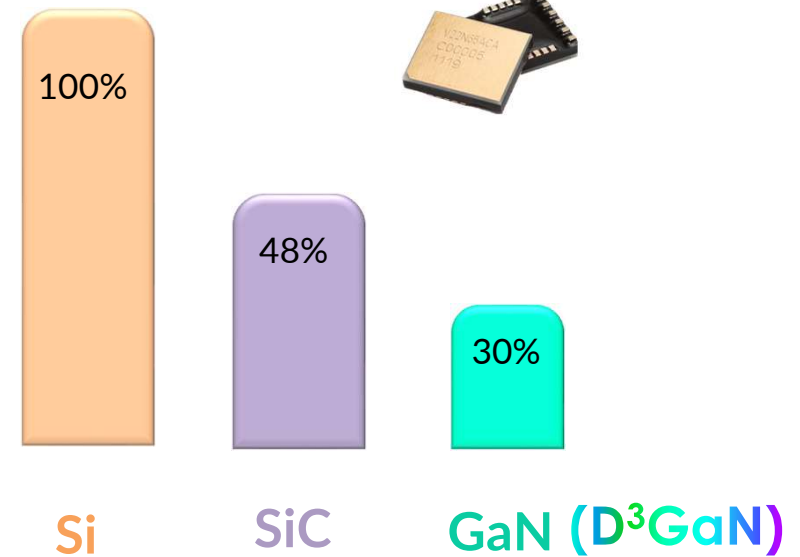
## Cost

VisIC's GaN semiconductors allow automotive OEM to lower EV production cost

## Performance

D<sup>3</sup>GaN is 4.5 times lower power switching losses than SiC → higher efficiency in inverters

## WLTP工况下损耗对比



Conditions:

150 kW peak/ 100kW nom

Load current: 500A peak, 300A nom

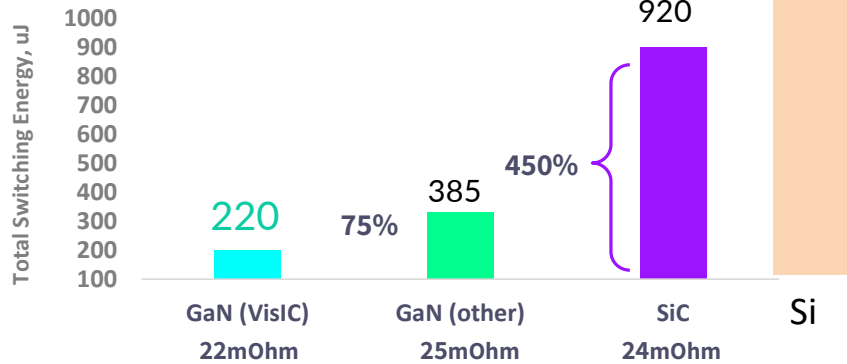
Semiconductor values are based on actual test data

# VisIC性能的优势

开关损耗比较:

low losses = high efficiency

Switching losses comparison @  
50Amp, 650V



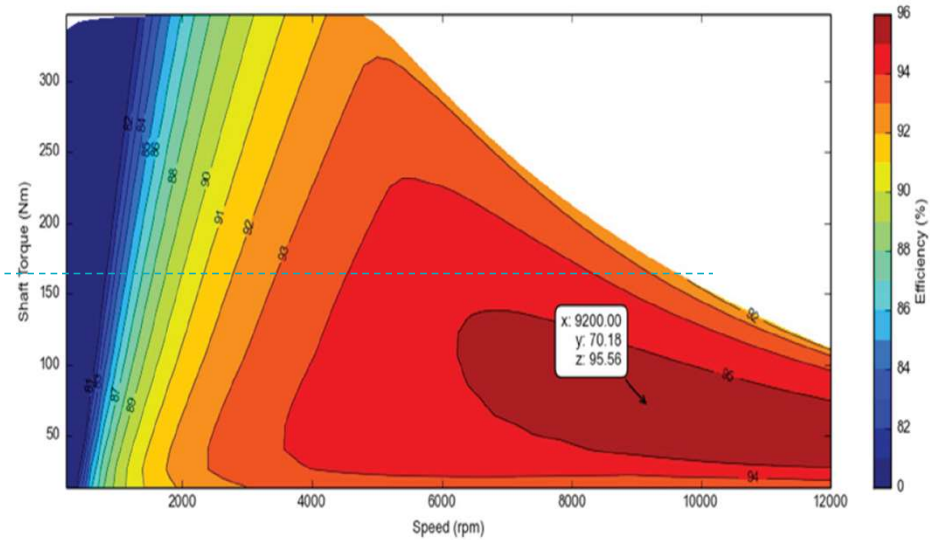
X 4.5 less losses comparing to competitors

开关损耗是衡量功率器件  
在逆变器应用中  
关键的性能指标



Conduction  
Losses  
Dominant

Switching  
Losses  
Dominant

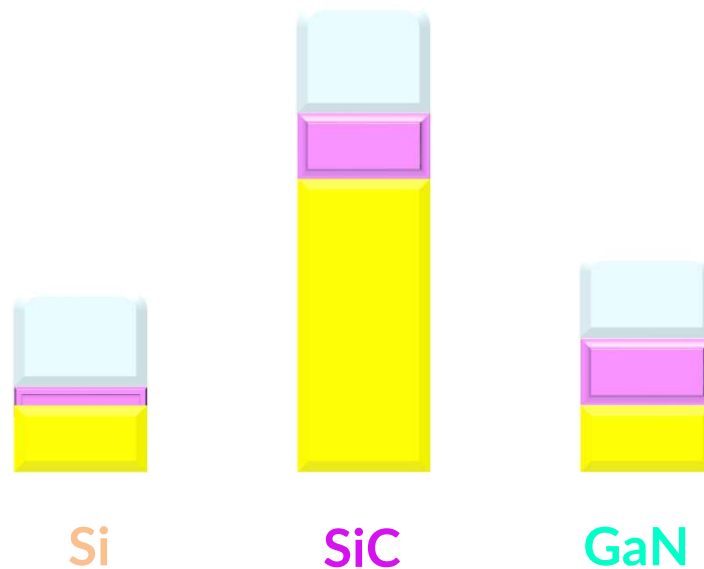
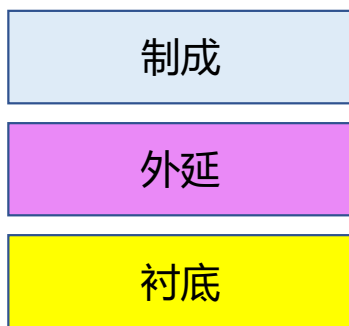


State of the art efficiency map of EM

<https://www.motor-design.com/white-paper-ev-trade-off-analysis/>

# GaN的成本优势

## 半导体器件成本分析

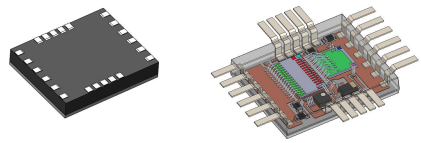


大批量生产时，GaN 器件的成本将与硅器件相当

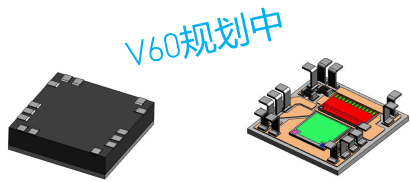
# VisIC GaN产品系列

我们提供分立封装元器件，裸芯片，以及模块级别的GaN产品

## 分立封装器件



22 mOhm 650V 100A

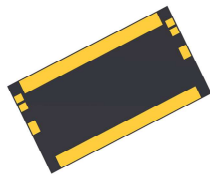


60 mOhm 650V 60A

## 裸芯片

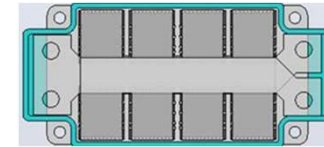
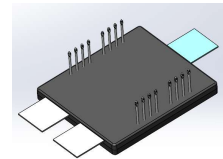


V18 mOhm 650V 100A



7 mOhm 650V 200A

## 模块



600A<sub>rms</sub> / 650V 半桥

300A<sub>rms</sub> / 650V 半桥

及三相全桥

# 产品在新能源汽车的应用

OBC



电机逆变器



**V22** is optimized for **PFC** up to 7.2kW:

- Single die per switch supports PFC half-bridge
- High switching frequencies are supported

**V60** concept optimized for 7.2kW **DC2DC**

- Single die per switch supports DC2DC full-bridge
- Smaller package size allows system size reduction

*Combination of V22 in PFC and V60 in DC2DC allows best system performance and cost solution*

**V22** for inverters up to **50-80kW**:

- Flexible solution with discrete devices
  - Optimization per power (fine granularity)
- Highest efficiency and cost optimization

**V8** for inverters > **100kW**

- Reduced number of components paralleled
- Available as modules and bare dice
- Modules with V8 (e.g. half-bridge module) for motor integration



# On-Board-Charger(OBC)参考设计



硅基OBC的成本，氮化镓的性能

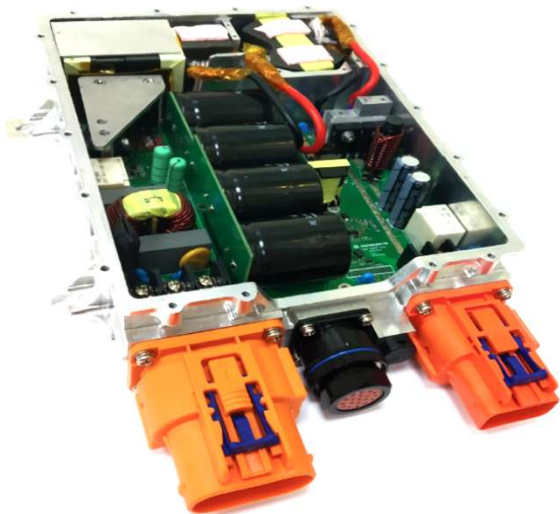
最小最轻的6.7kW / 2.3L OBC

3kW/L = 最高的OBC功率密度

只需要6颗 V22 氮化镓器件

~**3X** Power density  
~**1/2X** Weight

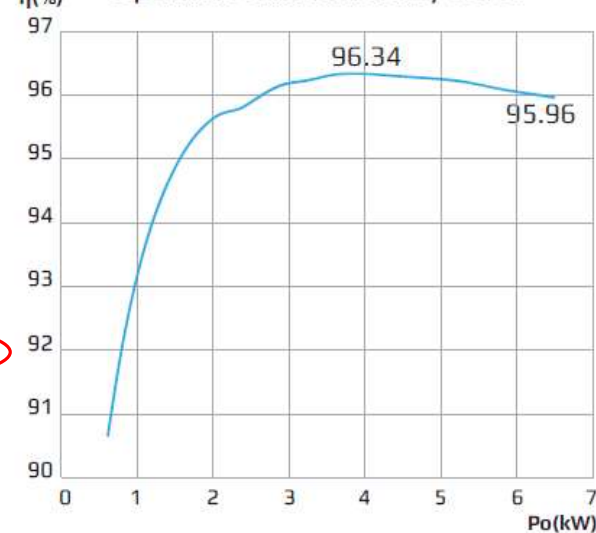
## 6.6kW VisiC's GaN OBC



GaN vs Si Comparison

	VisiC 22mOhm GaN	SI MOSFET
Dimensions, mm	2300 x 170W x 60H	4500 x 200W x 70H
Weight, kg	4.5	10
Power, kW	6.6	6.6
Efficiency, %	>96%	93% - 94%
Power density, kW/L	2.8	1.04
HV transistors count	6	10

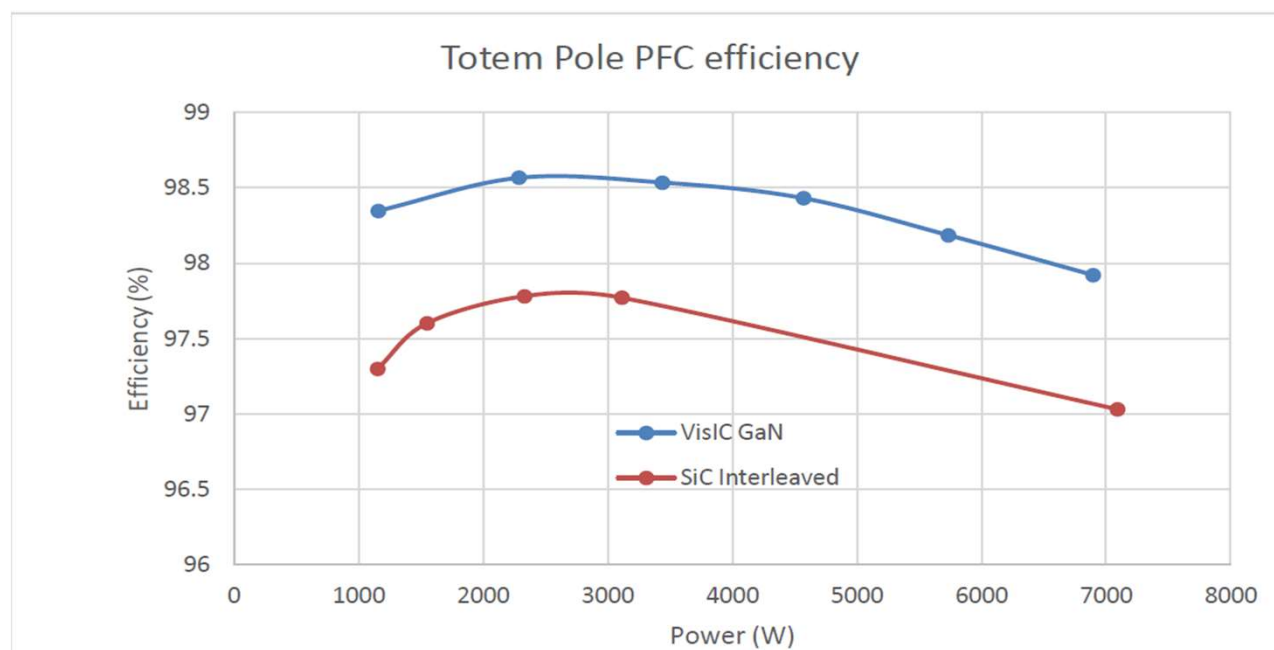
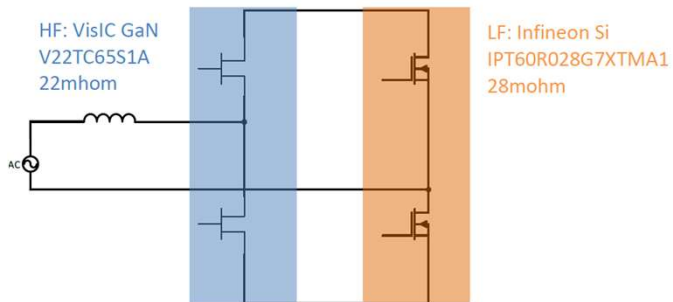
Optimal Point Efficiency Curve





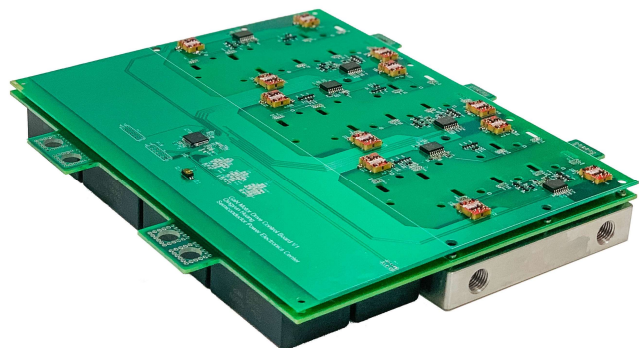
# 最高效的7.2kW双向图腾柱PFC参考设计

- Test Results of Interleaved vs Single Phase for 7.2kW power



Test Condition:  
GaN Single Phase Totem Pole PFC switching at 140KHz  
SiC Interleaved Totem Pole PFC switching at 60KHz

# 100kW电机驱动逆变器参考设计



- 第一代的100kW氮化镓电机驱动逆变器样机
  - 800V power-bus
  - $120A_{RMS}$  per phase
- 50kW/Liter, 40kW/kg
- 使用现成的小体积电容电杆
- 集成有数字控制板
- 可以方便的改动设计来支持不同的功率



Inverter Dimensions:  
26.9Lx21.4Wx3.5H cm, 2.5kg

# 已开展和欧美汽车产商及部件供应商深度合作



SCIENCE & INNOVATION

ENERGY ECONOMY

SECURITY & SAFETY

SAVE ENERGY, SAVE MONEY

Department of Energy

## Department of Energy Announces Eight New Projects Through BIRD Energy Partnership with Israel

- VisIC Technologies Ltd. (Nes Ziona, Israel) and Vepco Technologies (Chino, CA) will develop an 80kW Gallium Nitride (GaN) based dual motor drive power inverter for both plug-in and battery electric vehicles.

THANK YOU FOR ATTENTION

