# The adoption of Hybrid switches & GaN technologies for traction inverter

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**Bodo's Wide Bandgap Event 2025**

*Making WBG Designs Happen*

# The adoption of Hybrid switches & GaN technologies for traction inverter

**Thomas Mazeaud, Application Engineer**

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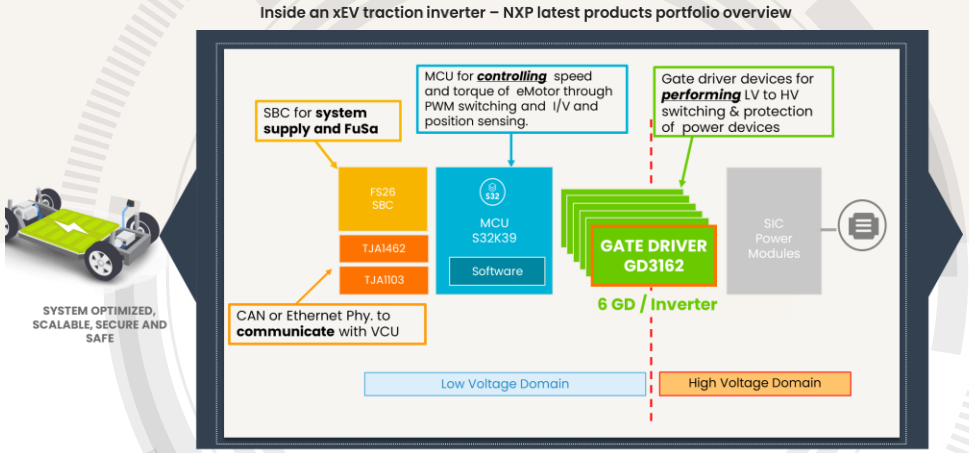
# Key challenges for traction inverter system

**System cost**

**Time to market**
ready for evaluation

**New Power Technologies**




**System performance**

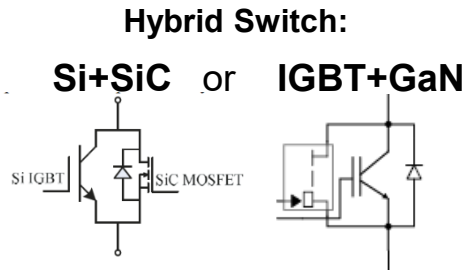
**Innovation**

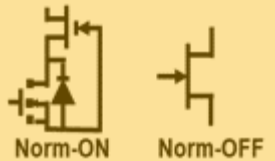
**Safety & reliability**

# Trends in Power Switch Technology







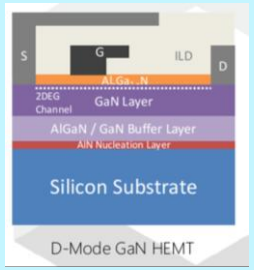

| | | | | |
|---|---|---|---|---|
| Device Cost | $ | $$$ | $$ | $$ |
| Device TTM | In production | In production | By 2026? / >2028? | By 2028? |
| Efficiency impact | - | + | + | ++ |
| BOM cost impact | - | - | + | ++ |
| Challenges | Efficiency | Cost<br>Capacity (today) | Control complexity<br>Adoption vs SiC price | Reliability & Safety<br>Technology for 800V |

# Power GaN for traction inverter [high-current]

## Types of GaN

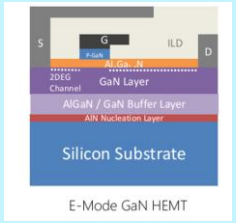
**D-Mode:**

- Direct drive
- Cascode




**E-mode**:

- Ohmic Gate
- Schottky Gate




**Vertical GAN**

## Benefits

- High switching speed
- Low switching losses
- Low gate charge
- Can be implemented on large diameter Si wafers as substrate
- Lower cost to build vs SiC

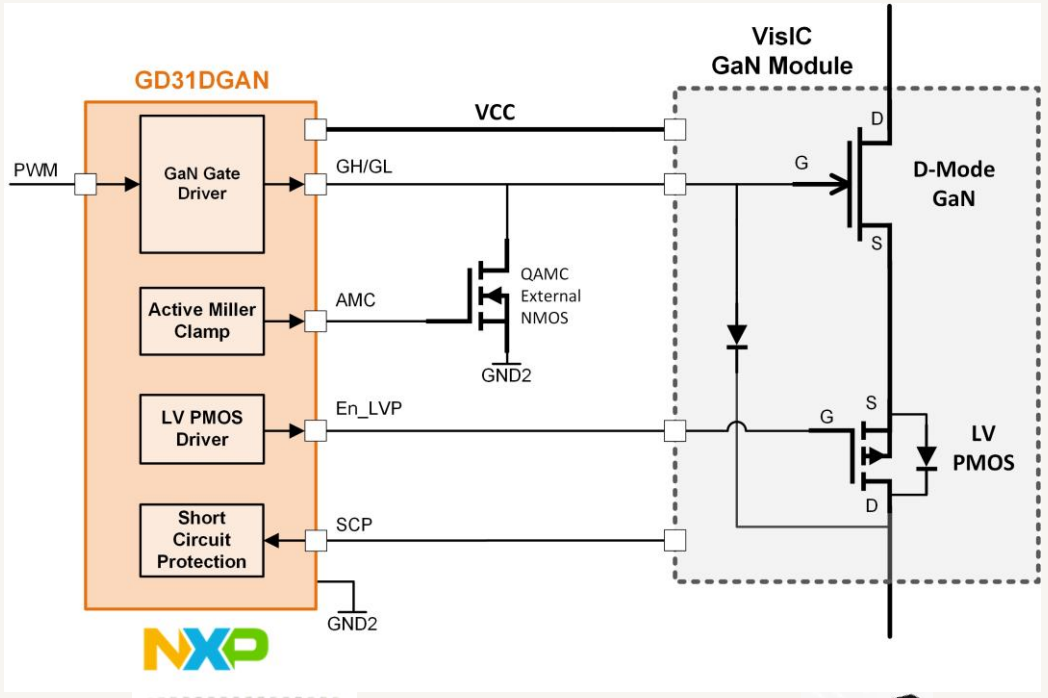
## Challenges

- **D-Mode challenges:**
  - **Normally ON safety management**
- E-Mode challenges:
  - Gate reliability
  - Low gate Vth
- All GAN challenges :
  - High EMI
  - Paralleling for high I
  - Needs fast SC protection

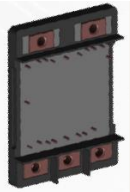
# NXP's GaN HVGD offering enables GaN in inverter applications

**NXP GD31DGAN enables D-mode GaN for traction inverter with safety in mind**

- Safely manage D-mode power up/down
- Tackle safety challenges of D-mode through key features like AMC and series PMOS management
- Fast/Reliable SC detection







# Demonstration platform showcasing a dual traction inverter using Dmode GaN

**3-party collaboration**

- VisIC D3GAN Gen-2 power switch/module
- NXP dedicated GaN driver test chip:  GD31DGAN
- AVL e-drive control software

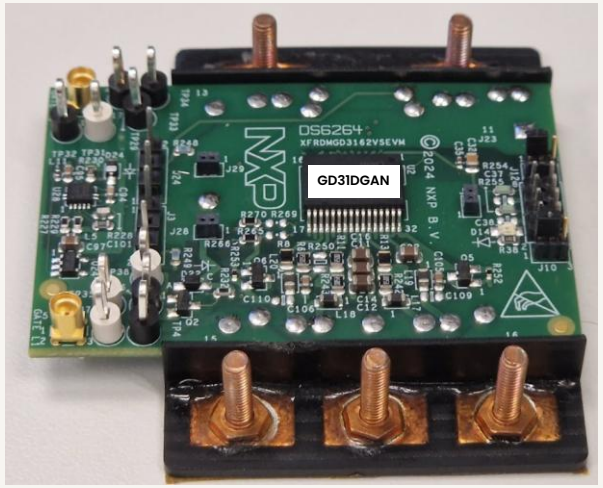
**Dual Traction Inverter Specification:**

- 400V & 2x500A,rms
- Switching Speed up to 15kHz
- Peak Efficiency >99,5%

**Targeted collaboration outcome:**

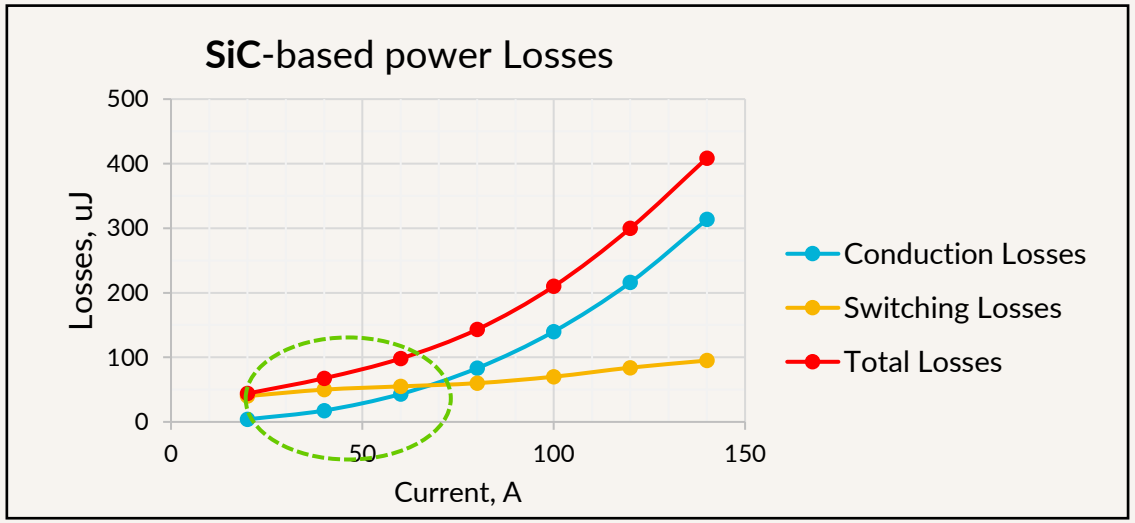
- PoC vehicle driving with GaN inverter
- System level performance data comparison SiC vs GaN

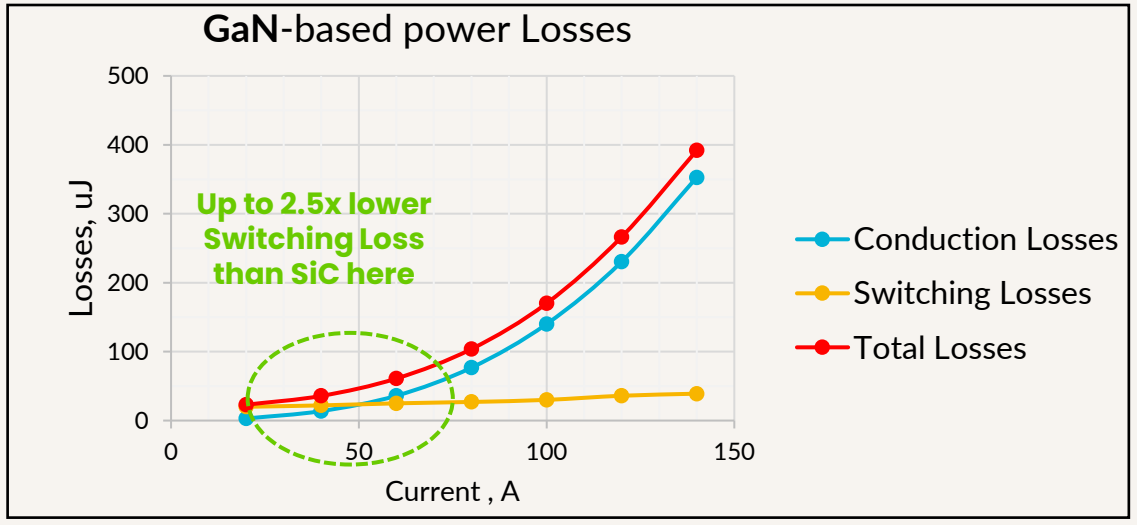
NXP GD31DGaN EVB




AVL inverter

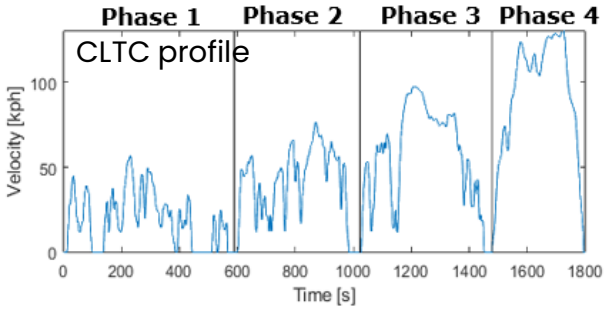
# Evaluation results: GAN vs SiC for inverter application

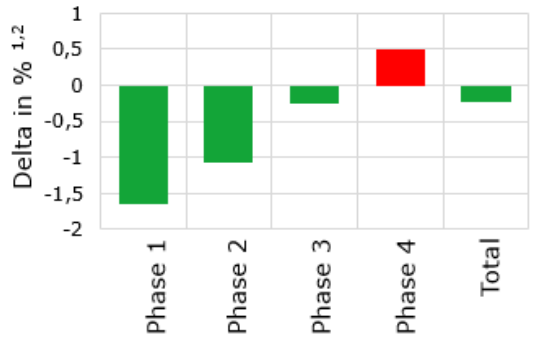



**GaN outperforms SiC in Switching & Total losses at partial load**

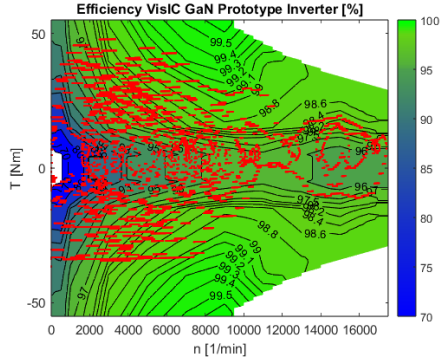
**AVL inverter using Visic GaN Gen1** efficiency testing
@ same e-machine and same speed & load



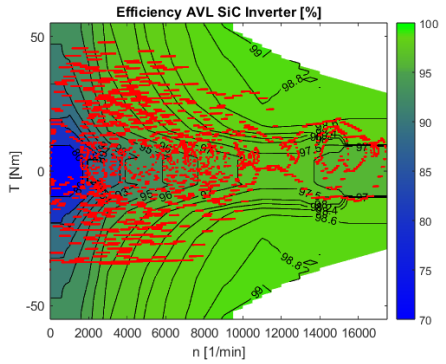




- SiC outperforms GaN
- GaN outperforms SiC

**GaN**




**SiC**



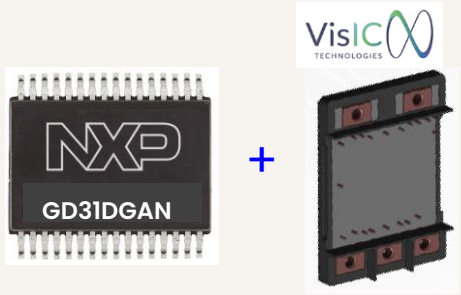

- WLPT measurement

**NXP GD and VisIC GaN delivers better efficiency than SiC, helping drivers go farther on less power**

# Evaluation results: Double pulse testing

## Test configuration

- GD31DGAN + Visic GaN power module
- 400V / 300A @ RT
- Switching energy testing

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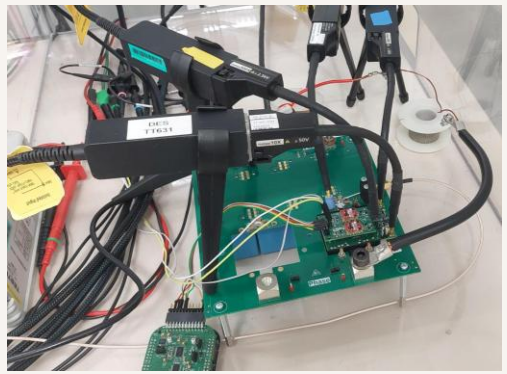

xFRDMGD3162VSEVM board
+ Visic Module

## Tests results: Double-pulse test: 300A / 400 V

# NXP enables the Future of xEV Traction Inverters

**xEV traction inverters face evolving challenges**

- Higher efficiency
- Compactness, thermal management
- Cost optimization

**NXP's HVGDs are designed to meet these needs**

- Support for emerging technologies like Power GaN
- Design with safety in mind for d-mode GAN
- Compatibility with new inverter architectures like 3L inverter

**NXP aims to be the trusted partner for customers exploring**

- Power GAN for traction inverter
- Next trend of inverter architectures
- Hybrid switch adoption

Let's shape the future of electrified mobility—**together**.

# Get in touch

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