Powering the future: The promise of Infineon CoolGaN™

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## Agenda

1. Introduction
2. Past barriers to GaN adoption:
   - 600 V CoolGaN™ technology
   - Infrastructure: EiceDRIVER™ driver ICs
   - Robustness: CoolGaN™ Reliability
3. CoolGaN™ value proposition
4. CoolGaN™ momentum
Introduction
Infineon GaN
Our differentiating core competencies

Benchmark in manufacturing
› GaN manufacturing embedded into high volume Si lines in Villach
› Typical Infineon quality standards are applied
› Dual source offering with partner Panasonic

Unique power technology portfolio
› Expertise in all leading power technologies (Si, SiC, GaN)
› Extensive GaN knowhow from both Infineon and International Rectifier
› Large GaN patent portfolio

Application-dedicated products
› GaN product portfolio optimized for specific application requirements
› Application specific reliability testing
› GaN products are offered in SMD packages

Extensive system expertise
› Extensive application / system understanding
› Global design support
› Focus on system performance /cost ratio
CoolGaN™ development and manufacturing: a global endeavor
Past barriers to GaN adoption
600 V CoolGaN™ technology

Unique normOFF concept solution and the best fit for longest lifetime

Features:
› P-GaN resistive gate, hole injection when gate voltage is superior to forward voltage
› P-GaN drain contact to suppress current collapse
High-Voltage GaN e-mode HEMTs best driven by dedicated GaN Driver IC

Infineon, Panasonic: High-Voltage GaN

Self-clamping ohmic gate contact:
› Ohmic gate-contact internally clamps $V_{GS}$ to safe range
  - High gate current for fast turn-on possible
  - Robust gate-drive topology

High-Voltage GaN Driving

Dedicated High-Voltage GaN Driver-IC required for:
› Best Robustness
› Best Efficiency
› Least R&D Effort
Infineon applies 4 inputs to the qualification plan including failure models to predict the **lifetime** and **failure rate** in the field.
New failure mechanisms for GaN: Repetitive Switching SOA

Soft switching (e.g., LLC) operates the device in a region where switching SOA is NOT an issue. For any application with primarily soft switching there is no need to consider switching SOA.

Hard switching operates the device in a region where switching SOA might be an issue: need to consult the repetitive switching SOA curve.
Ease of use: Repetitive Switching SOA curves

- GaN devices can exhibit hard switching SOA failure mode while silicon FET’s do not.
- CoolGaN™ datasheets include curves expressing device limits.
- This failure mode does not occur during soft switching.
Robustness: GaN Device breaks down at higher voltage than Si FET’s

...and is more robust in lightning strike/surge test

› GaN can withstand much higher voltage stress than silicon

› …but lifetime at such high voltage is limited
Value proposition
GaN for power factor correction (PFC)

GaN enables hard switching in half bridge topologies

CCM FullBridge TOTEMPOLE

- Enables the usage of a more compact topology
- Feasible and super efficient
- Very cost effective

TOTEM POLE topologies allows:

- Simpler designs
- Highest efficiency
- Smaller footprint
- System costs reduction
Value proposition
GaN for DCDC converters

CoolGaN™

Advantages

› 10 times lower charges than Si ($Q_{oss}$, $Q_g$, $Q_{rr}$)
› Higher frequency operation
› Higher efficiency
› Smaller designs for the same $P_{out}$
› More power for the same footprint
› Lower system costs

GaN: Enabler for higher power density
CoolGaN™ target applications

- Servers
- Telecom
- Wireless charging
- Audio
- Adapters

Exploring...
CoolGaN™ momentum
Infineon offers a complete system solution

**CoolMOS™**
- IPW60R017C7
- IPT60R028G7

**CoolGaN™**
- IGO60R070D1

**OptiMOS™5**
- 40 – 150V SS08

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**ICE3PCS01G**

**ICE2HS01G**

*GaN EiceDRIVER™ ICs are single-channel products*
CoolGaN™ 600 V + GaN EiceDRIVER™
In volume production now!

The most **reliable** GaN solution delivering **highest performance** amongst all available GaN devices

**Manufacturing expertise** throughout the entire supply chain

**Global application design support**

**Broad portfolio** including drivers

**Volume** capability

**Attractive price** projection
**CoolGaN™ demonstrators**

**PFC for Server SMPS & Telecom Rectifiers – 99.3% peak efficiency**

**2.5 kW TotemPole PFC:** 70 mΩ/600 V in DSOBSC
(Ordercode: EVAL_2500_PFC_GAN_A)

![Buy on-line](image)

**Lab evaluation board – high frequency (>1 MHz) half-Bridge platform**

**Functional board** with 2x 1EDF5673K in LGA package, 2x IGOT60R070D1 (DSO-20-87 top side cooling packages)
(Ordercode: EVAL_1EDF_G1_HB_GAN)

![Buy on-line](image)

**LLC for Telecom Rectifiers – ~160W/in³ @ >98% peak efficiency**

**3.6 kW LLC**, 52 V V_{out}: 70 mΩ/600 V in TOLL (prim. side)
350 kHz
(Ordercode: EVAL_3K6W_LLCE_GAN)

![Available to order](image)
### Collaterals and brochures
- Product briefs
- Selection guides
- Application brochures
- Presentations
- Press releases, ads

### Technical material
- Application notes
- Technical articles
- Simulation models
- Datasheets, MCDS files
- PCB design data

### Evaluation boards
- Evaluation boards
- Demoboards
- Reference designs

### Videos
- Technical videos
- Product information videos

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