CoolGaN<sup>™</sup> innovations: solutions creating value in power electronics Oliver Bleck, Director GaN Business Development, Infineon Technologies AG

Bodo's Wide Bandgap Event 2024 Making WBG Designs Happen

GaN



# Infineon leading 4 product areas and 3 material platforms



### Leadership in power systems across all materials and technologies

# **Gallium nitride**

Transistor – Driver



Silicon carbide Diode – MOSFET

SiC

Silicon Diode – MOSFET – IGBT – Driver – Controller





# **CoolGaN™ product families and features**



### Since completion of GaN Systems acquisition

Infineon increased its CoolGaN<sup>TM</sup> product families from **2 to 5 product families**; including **40+ new products,** more R<sub>DS(on)</sub> choices, more voltage nodes, more integrated function options



# Infineon's CoolGaN<sup>™</sup> Transistors

# High voltage

- Up to 700 V with widest selection of R<sub>DS(on)</sub> and package options to maximize system performance and minimize cost
- Dual flow portfolio for customers to maintain existing designs and have mutiple supply chain options

### Medium voltage

- From 60 V to 200 V in very small, cost-effective PQFN packages
- Solutions, with options for dual-side cooling package, provide higher power density and higher power rating for optimal performance



# CoolGaN<sup>™</sup> Bidirectional Switch where one device replaces four switches



Die area





# **Two Si MOSFET switches**

**One Si MOSFET switch** 

- Bi-directional (back-to-back)



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 $R_{DS(on)} = 10 \text{ m}\Omega \text{ (example)}$ 



**One bidirectional switch (BDS)** 



# CoolGaN<sup>™</sup> BDS 40 V G3 has value in many applications with a battery



# Servers

- Motherboard
- Add-on cards
- UPS / Battery back-up (BBU) unit
- OR-ing FETs



### **Consumer device protection and USB-OTG**

- Charging OVP protection and USB-OTG for
- Smartphones, notebooks,
- Handheld gaming consoles
- Cameras
- Monitors
- Docks





### Energy storage systems

- Residential battery storage
- Industrial battery storage



# Battery management system (BMS)

- Power tools
- E-bikes
- E-scooters



# Application example: Smartphone Smaller OVP switch size, lower power loss and lower cost





# Functionality:

- Bidirectional current flow during ON state
- Bidirectional current and voltage blocking during OFF state
- Easy driving using Infineon's EZ-PD™
   CCGx and EZ-PD™ PMGx controllers

### Customer use case: 82% PCB area reduction!





# **CoolGaN™ BDS 650 V G5 has value in many applications**

# **Motor control**

# CSI, T-type



 High switching frequency without dv/dt impact to motor side

# HP SMPS and EV charging

# Vienna PFC/H4 PFC

- Back-to-back replacement
- Increase frequency for high power density

# Renewables

### Heric, Cyclo







- Back-to-back replacement
- Increase frequency for high power density

# **CoolGaN™ Bidirectional Switch solutions**













# CoolGaN<sup>™</sup> Smart Sense 700 V G4

# **Product description**

- Integrated high-accuracy loss-less current sense
- High current sense accuracy
- 200 ns current sense response time
- Standard PDFN package
- Broad range of  $R_{DS(on)}$  options (55 m $\Omega$  360 m $\Omega$ )

- Improved efficiency by removing the sense resistor
- Better thermal management with thermal pad connected to ground
- Better for higher switching frequency to take advantage of kelvin-source pin







# CoolGaN<sup>™</sup> Smart Protect 650 V G5



# **Product description**

- Integrated short-circuit protection
- Miller clamp during turn-off
- Wide gate drive voltage range from 7 V to 20 V
- Standard TOLL & TOLT package
- 25 55 m $\Omega$  in TOLL & TOLT





- Short circuit protection **prevents shoot through**
- Increased efficiency, no negative voltage turn-off
- Preserved ease to parallel multiple transistors
- Compatible with silicon MOSFET driver, for simplified design

# CoolGaN<sup>™</sup> Drive single switch 650 V G5 for low-power applications





- Wide VCC range
- 55 m $\Omega$  500 m $\Omega$  in QFN 5x6 and 6x8

- Improved efficiency by removing the sense resistor
- System cost saving with simplified biasing need
- Meet stringent system standby spec with the ultra low standby power





# CoolGaN<sup>™</sup> Drive single switch 650 V G5 for high-power applications



# **Product description**

- Integrated gate driver & loss-less current sense
- Adjustable turn-on and turn-off dv/dt
- OCP/OTP/SCP
- Fault pin reporting to  $\mu$ C (OCP, SCP, OTP)
- LDO output for signal isolator secondary side biasing
- 25 m $\Omega$  55 m $\Omega$  in TOLL and TOLT

- **Ease of use** with standard industrial packages
- Robust operation with the comprehensive protection feature





# CoolGaN<sup>™</sup> Drive half-bridge 700 V G5



### System benefits

- Improved efficiency by removing the sense resistor
- Heatsink less design
- Meet stringent system standby spec with the ultra low standby power
- **Cost and size savings** via integrated driver & bootstrap diode





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# CoolGaN<sup>™</sup> portfolio provides incremental solutions for high design flexibility - meeting customer demands



CoolGaN <sup>™</sup> Transistor	CoolGaN <sup>™</sup> Smart Sense	CoolGaN <sup>™</sup> Smart Protect	CoolGaN™ Drive
<ul> <li>Does not have protection feature</li> <li>Offers designers the highest freedom to use discrete devices and incorporate control and protection features as needed</li> <li>Can also be compatible for paralleling</li> <li>Higher system BOM cost</li> <li>No pull-down switch</li> </ul>	<ul> <li>Integrated high-accuracy loss- less current sense</li> <li>High current sense accuracy</li> <li>Rapid current sense response time</li> <li>Thermal pad</li> <li>Kelvin sense</li> </ul>	<ul> <li>Compatible with Si MOSFET driving schemes</li> <li>Provides additional protection functionality, including short circuit protection</li> <li>Can also be compatible for paralleling</li> <li>Includes a pull-down switch</li> </ul>	<ul> <li>Gate driver integrated</li> <li>Short-circuit protection feature</li> <li>Over temperature protection</li> <li>Cycle-by-cycle 4 selectable OCP</li> <li>Pull-down switch</li> <li>Tout pin</li> <li>Dv/dt controllable with resistor</li> <li>Provides supply for digital isolator</li> <li>Kelvin sense</li> <li>Can address high-power applications, such as interleaving PFC, DC-DC stage</li> </ul>



# **CoolGaN™** brings value to a broad range of applications



