GaN bidirectional switch innovation and related applications

Dr. Edward A. Jones, Lead Principal Engineer, Infineon Technologies

Bodo's Wide Bandgap Event 2025

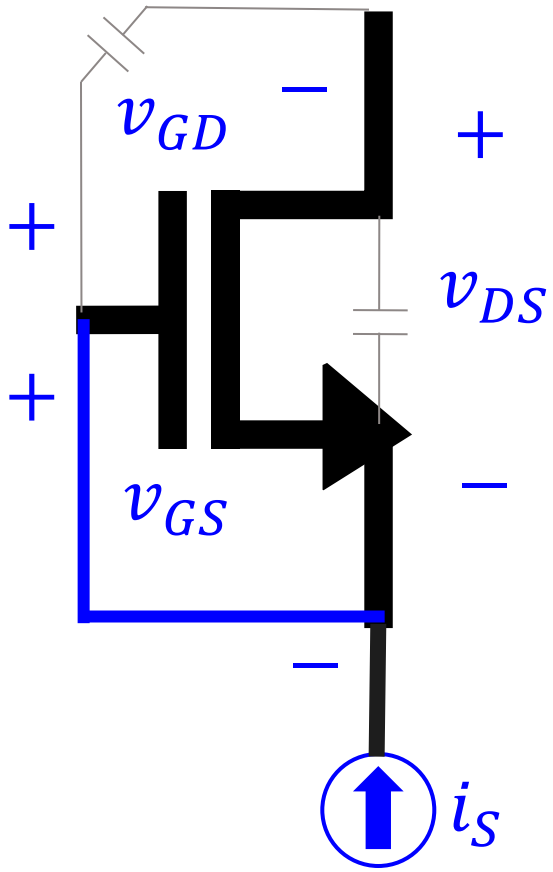
Making WBG Designs Happen

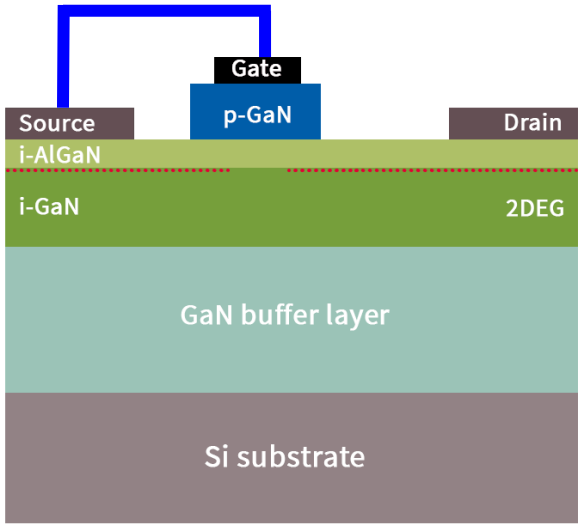
GaN

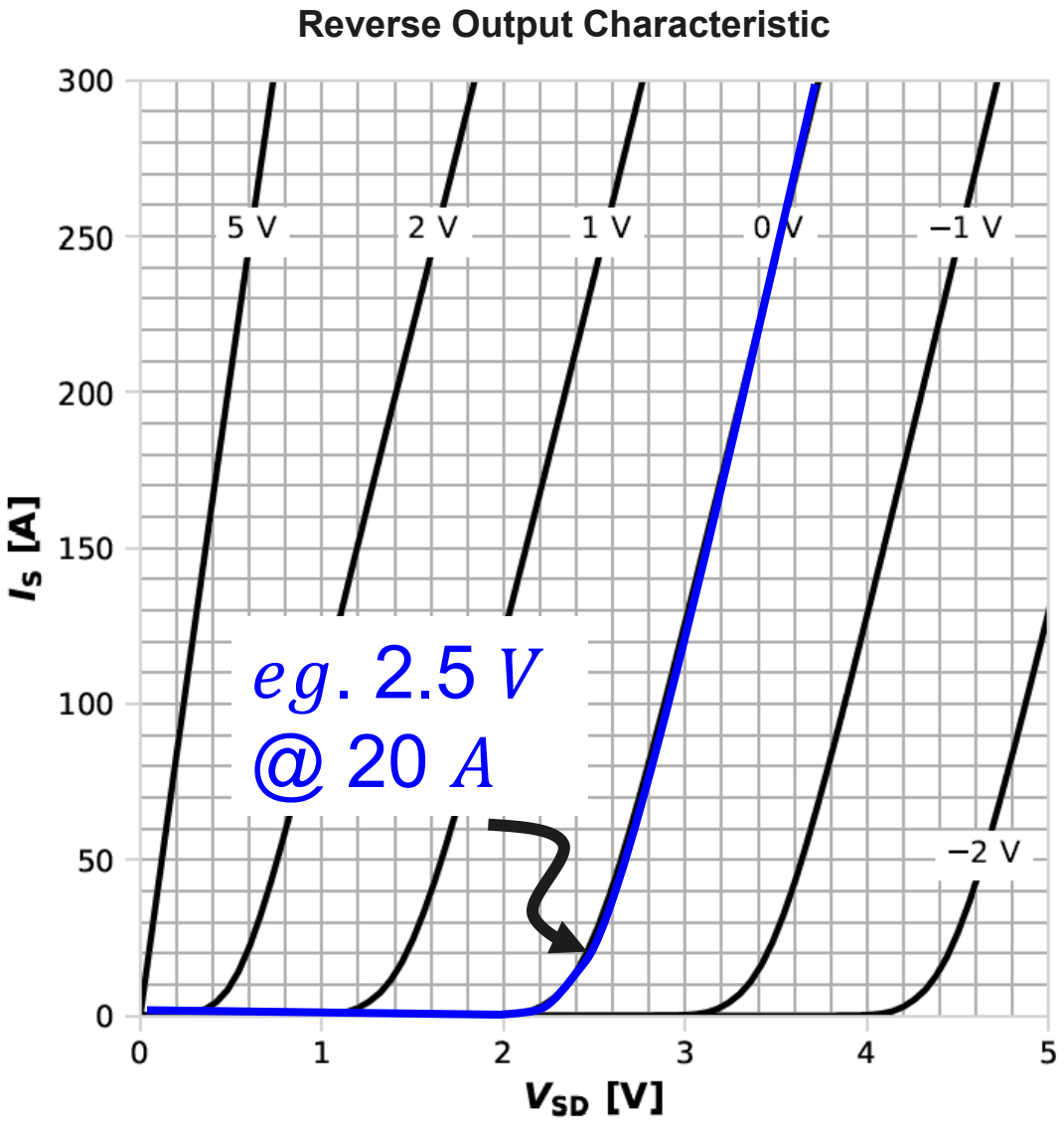
Understanding reverse conduction (body diode) behavior in GaN

$$v_{SD} = v_{GD}$$

$$V_{SD} \approx V_{PL}$$







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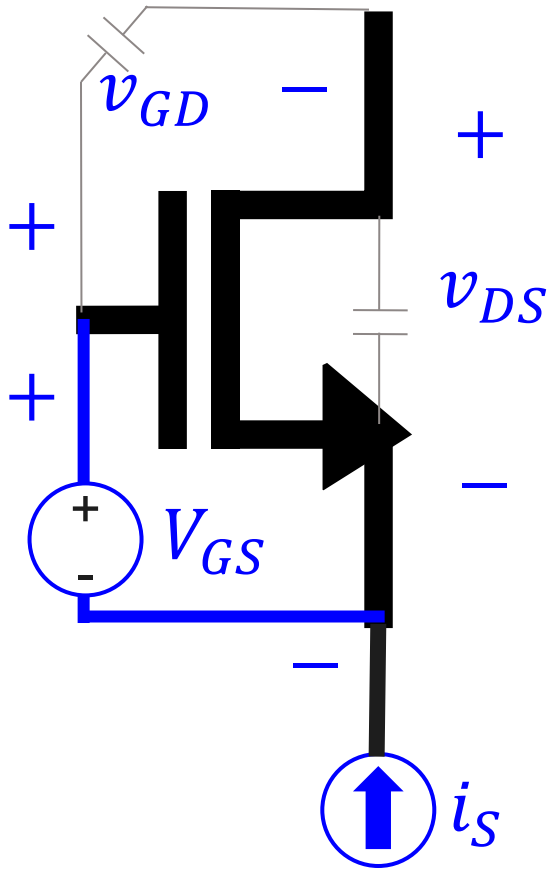
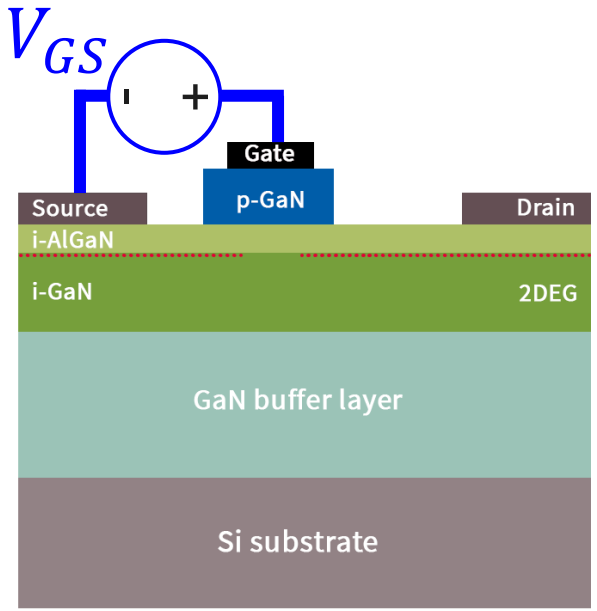
Understanding reverse conduction (body diode) behavior in GaN

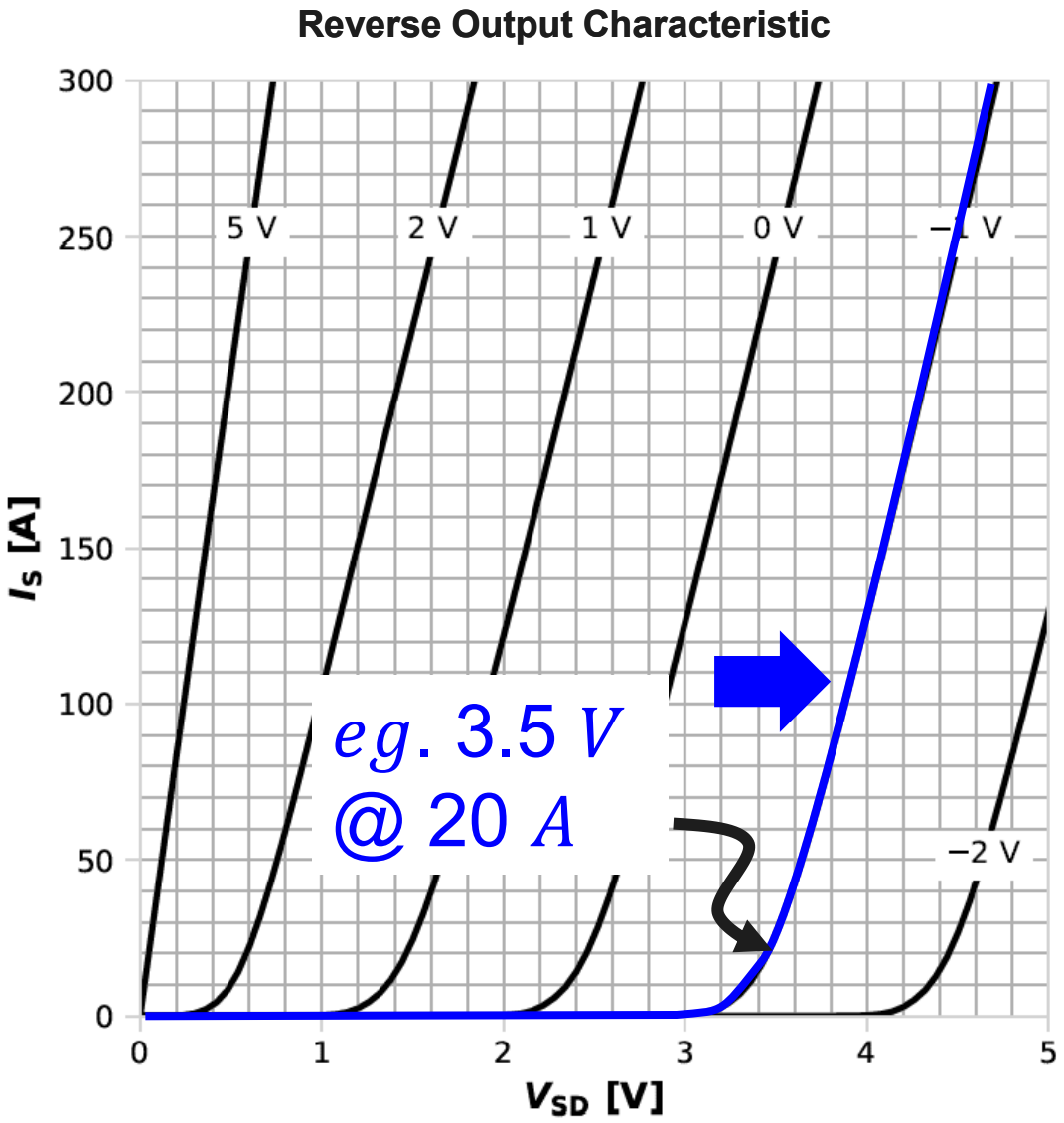


$$v_{SD} = v_{GD} - V_{GS}$$

$$(e.g.\ V_{GS} = -1\ V)$$

$$V_{SD} \approx V_{PL} + 1$$





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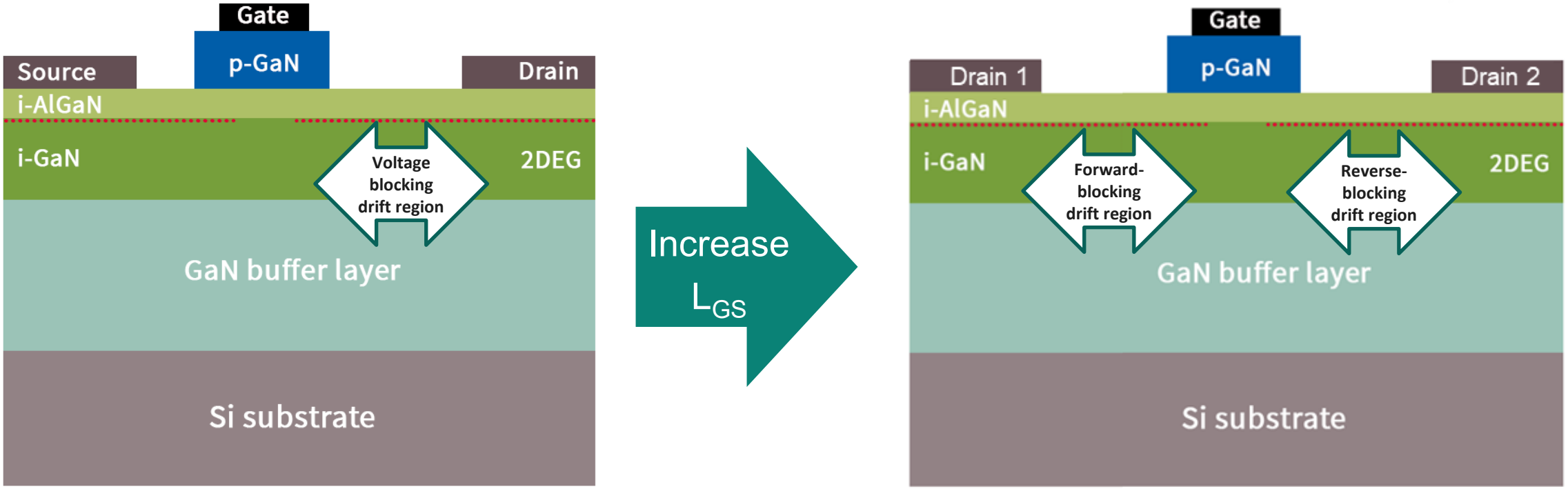
The common-source GaN BDS for low voltage static applications



Typically ~2x less total chip area than back-to-back GaN HEMTs, even more compared to Si MOSFETs

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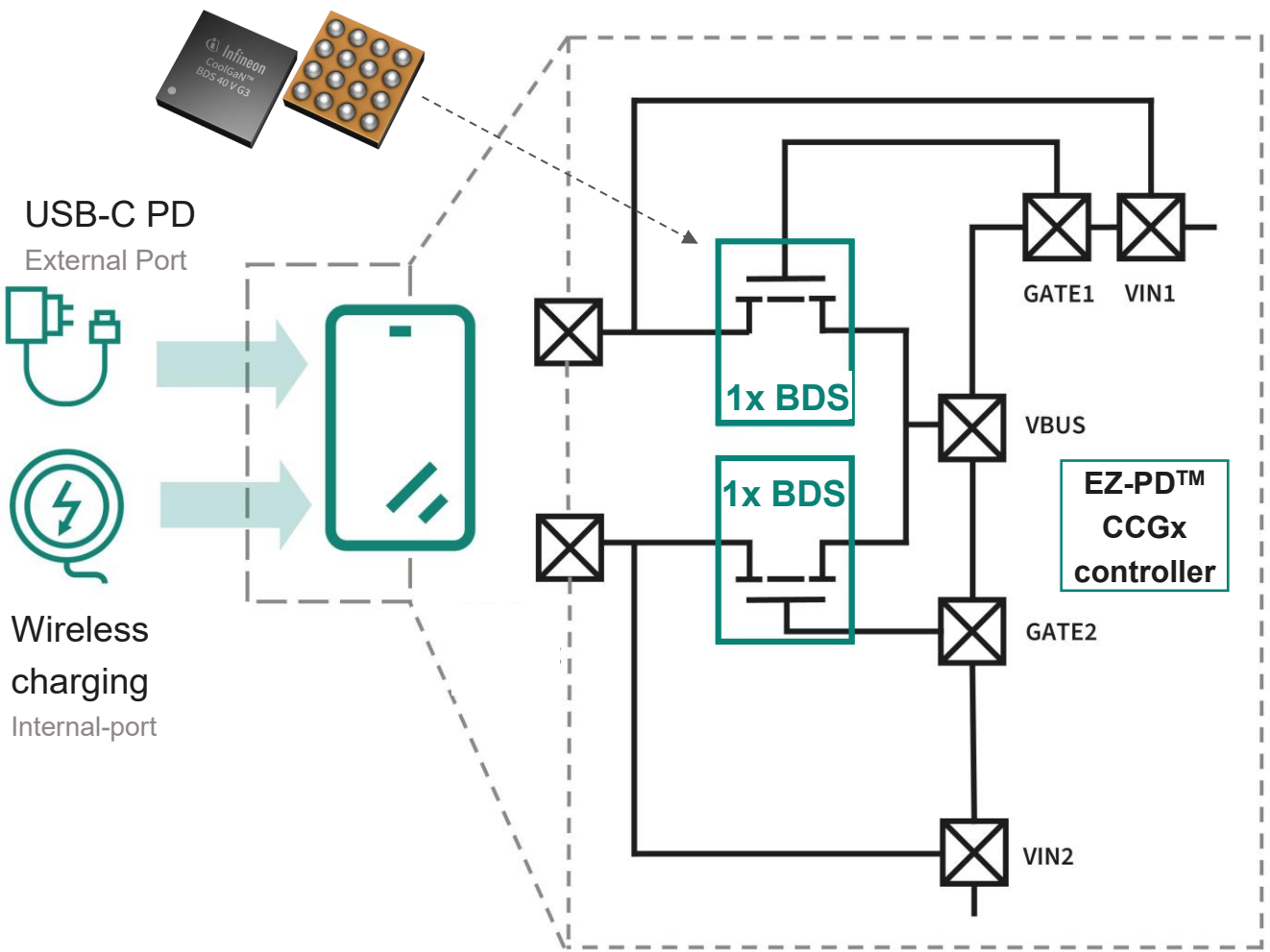
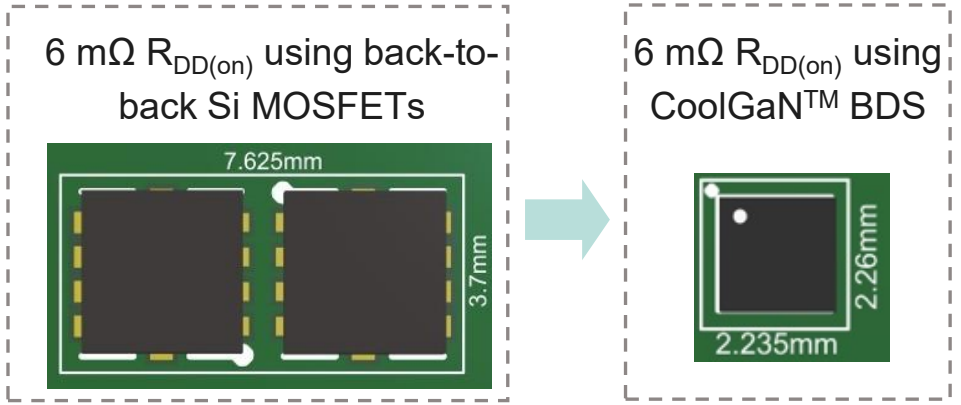
Application highlight:
40 V CoolGaN™ BDS for static battery protection (OVP) in a smart-phone





Customer use case: 82% PCB area reduction!

Functionality:

- Bidirectional current flow during ON state
- Bidirectional current and voltage blocking during OFF state (OVP protection)

- External port needs BDS: OVP USB port overvoltage protection up to 40 V (48 Vpk), after TVS diodes
- BDS used for selection of port: Power source selector (Mux) between USB and wireless charging

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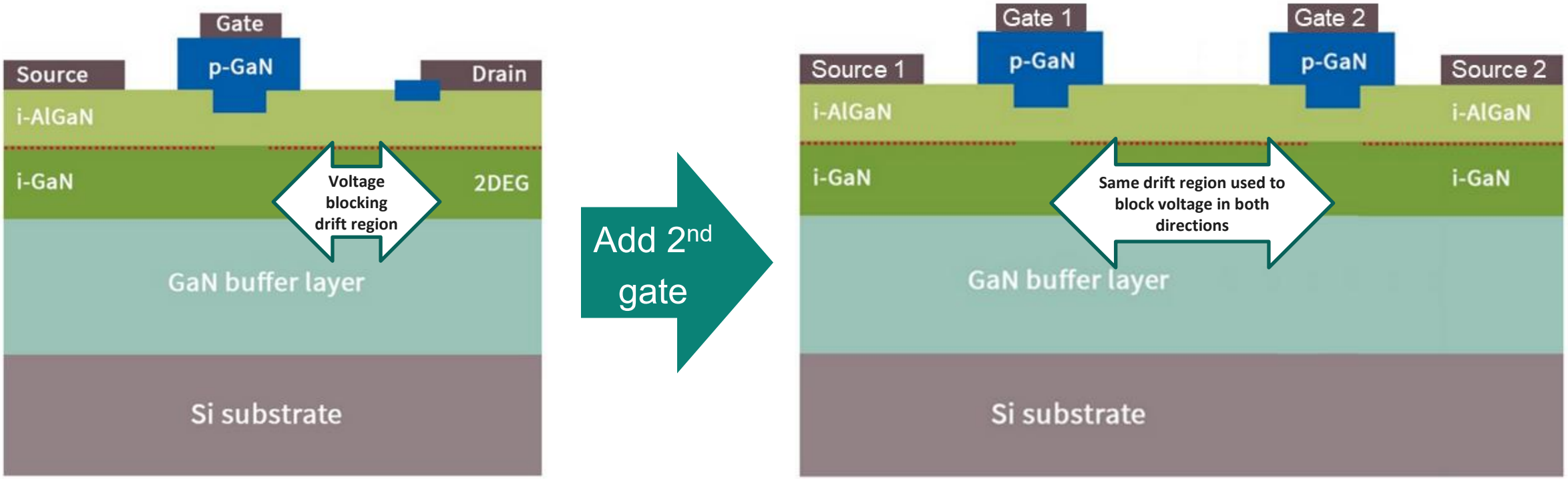
The common-drain GaN BDS for higher voltage switching applications



Typically 3~4x less total chip area than back-to-back GaN HEMTs, even more compared to Si MOSFETs

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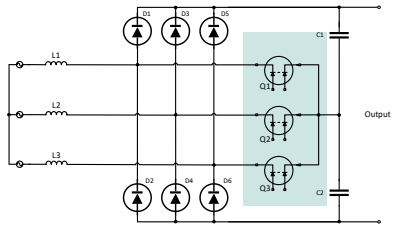
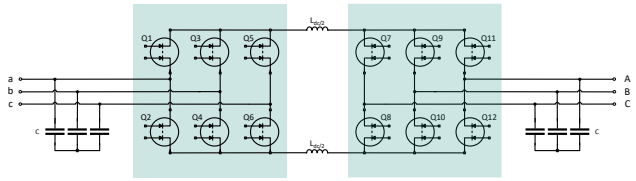
650 V CoolGaN™ BDS replacing back-to-back MOSFETs and enables new topologies (or re-enables old topologies)

Replacement of back-to-back switches in AC-DC applications



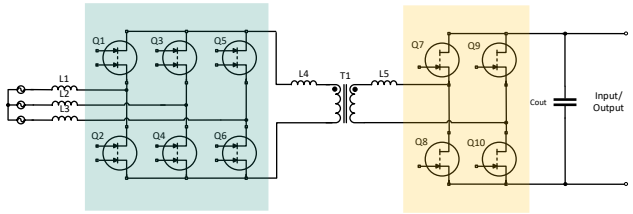
AI servers, adapters, lighting, and more

Current Source Inverters (CSI)



Motor drives

Single-stage AC power conversion



Solar, OBC, and more

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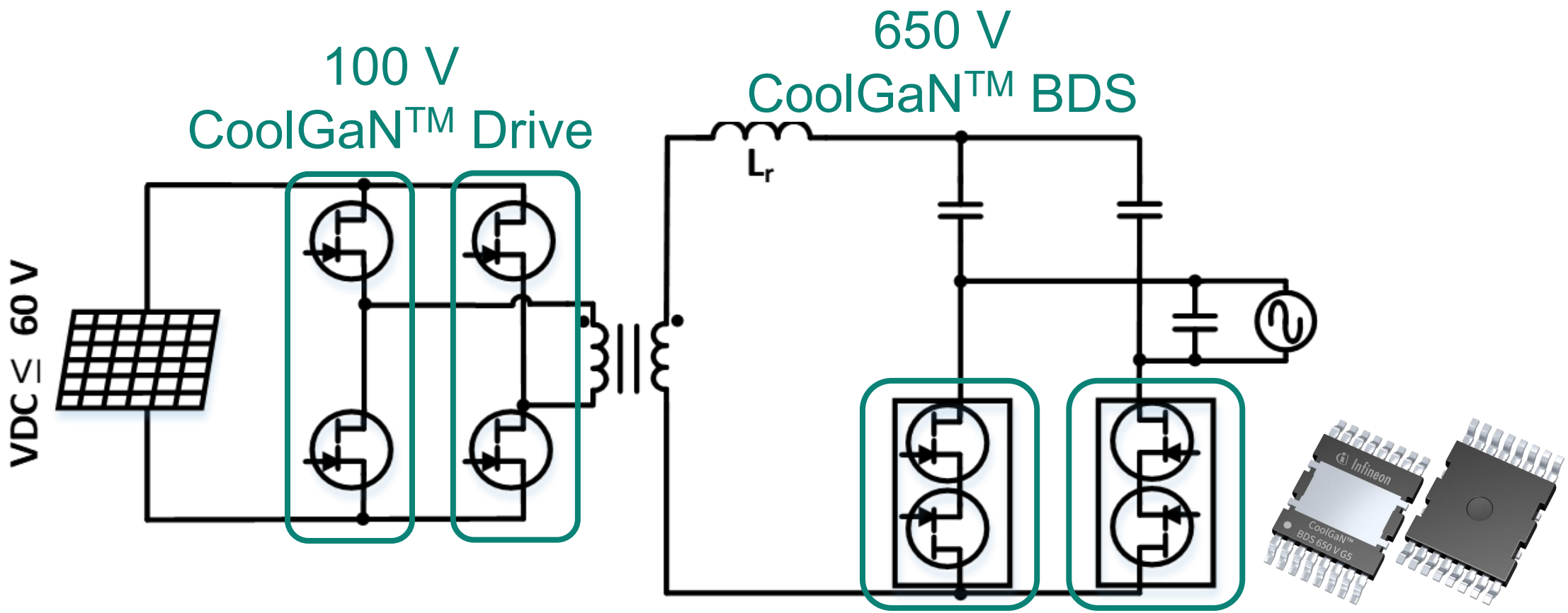
Application highlight:
CoolGaN™ BDS and CoolGaN™ Drive in photovoltatic micro-inverters



Higher power density

Higher efficiency

Lower system cost

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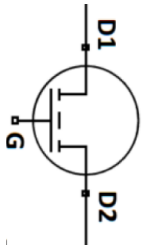
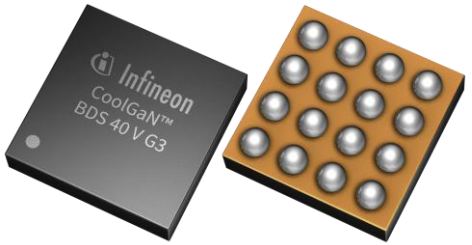
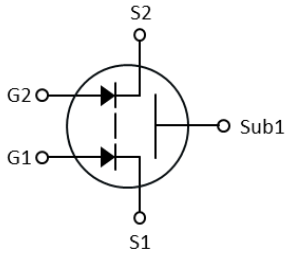
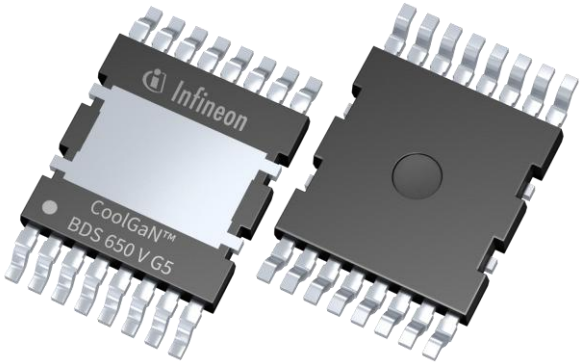
Summary

- New CoolGaN™ BDS already in mass production with two distinct technologies and use-cases:
  - 40 V static BDS for battery protection in consumer electronics
  - 650 V switching BDS for PV, OBC, AI data centers, etc.
- Game-changing improvements at the system level:
  - Power density
  - Efficiency
  - BOM cost
- What will be the next killer-app for bidirectional GaN?
- Who will dream it up?
- Exciting days ahead!









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