

Effects of Parasitic Capacitances on Gallium Nitride HFETs

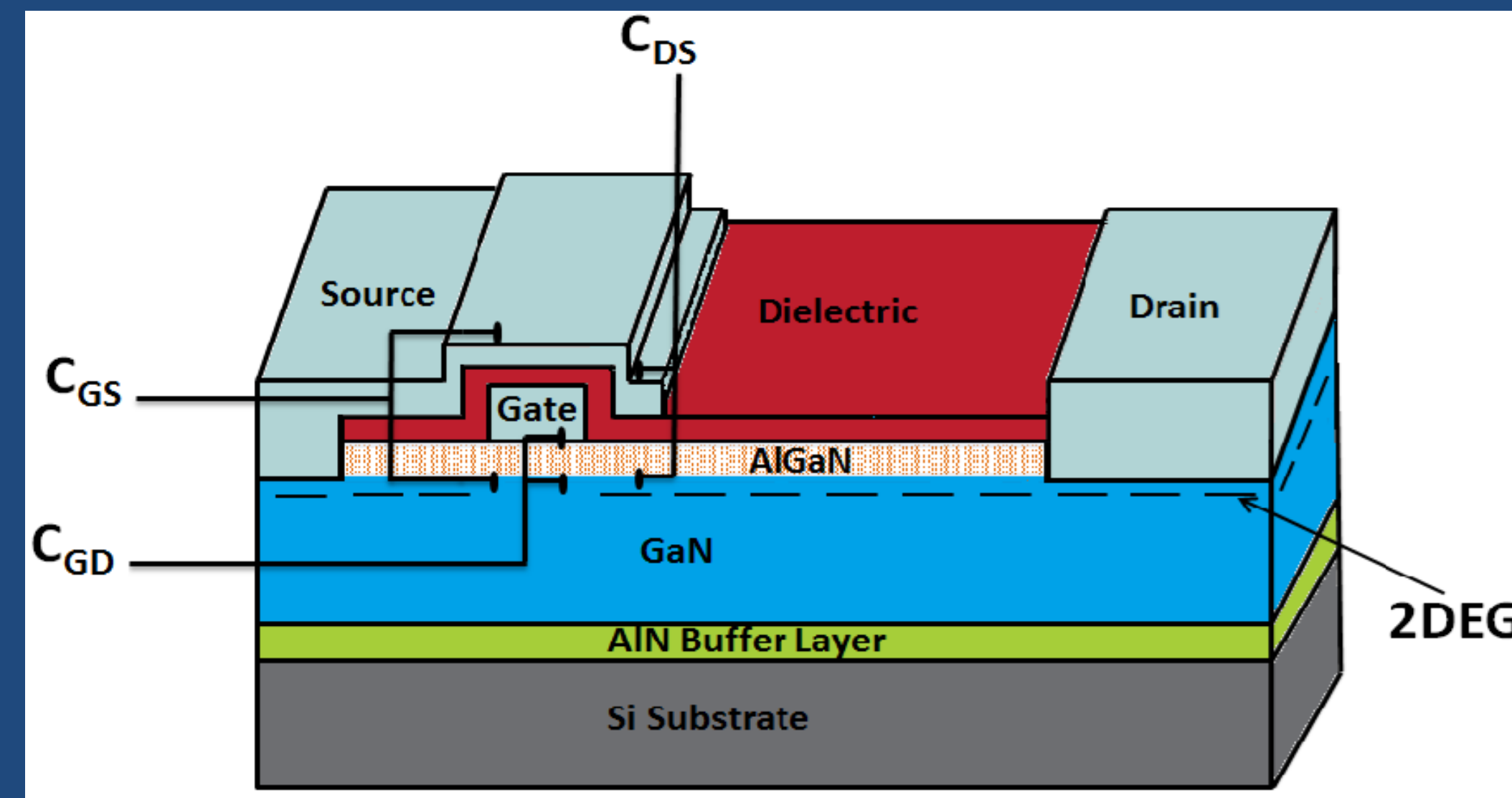
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Objective

- The parasitic capacitances of GaN HFETs from Efficient Power Conversion Corporation (EPC) have been evaluated in order to assess the impact that each capacitance has on the switching performance of the GaN devices.
- The analysis was completed for the EPC2007 (100V device) and the EPC 2010 (200V device).
- This required developing and validating equivalent GaN HFET device models in SaberRD (Synopsys) and implementing the models in a switching test circuit under the influence of variable parasitic capacitance conditions.
- The data presented here can facilitate optimizing the area and hence capacitance of GaN devices for future generation power electronics.

The EPC* GaN HFET



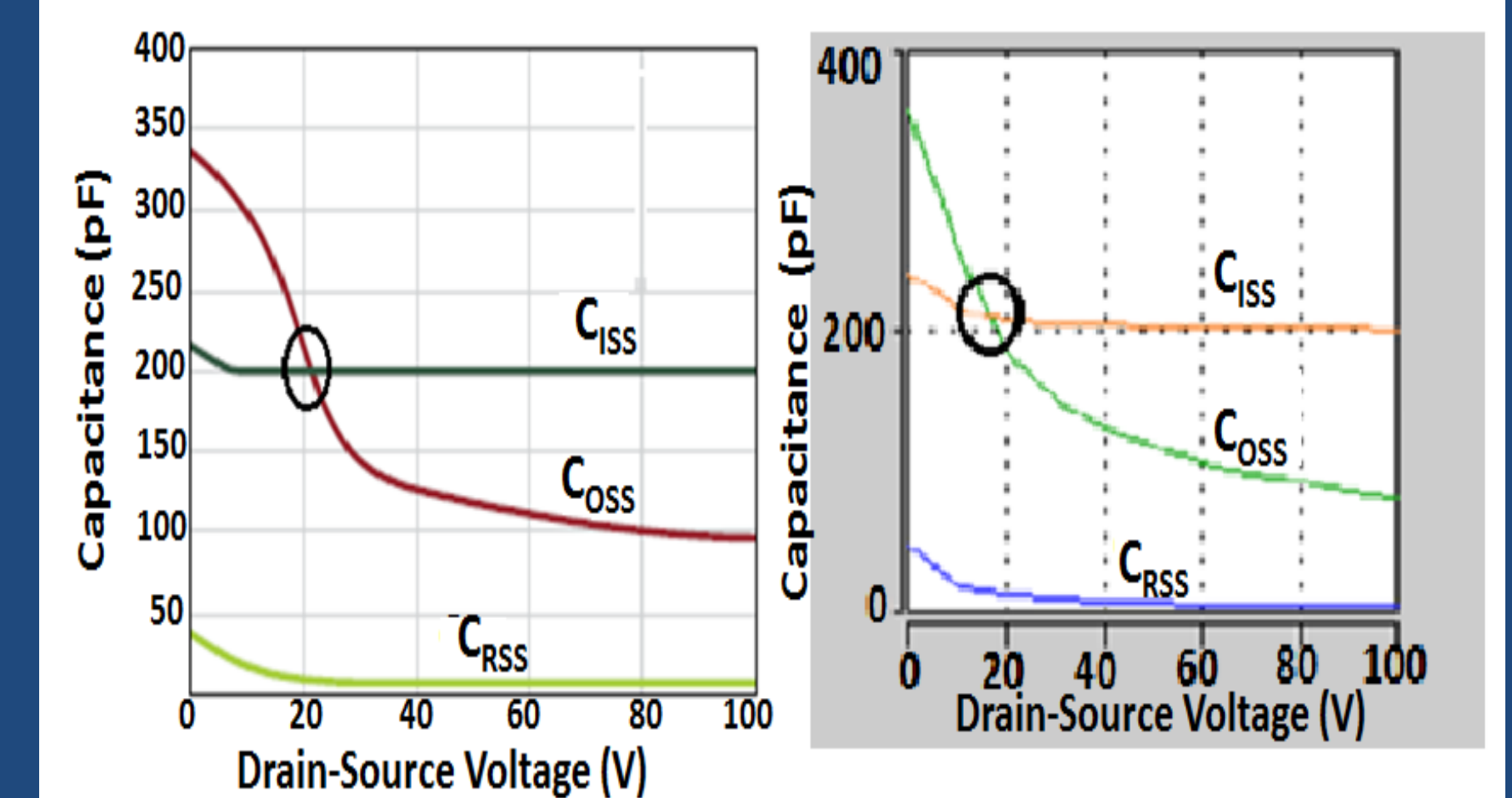
- Lateral, effectively planar structure enables high frequency (~MHz) operation.
- C_{GS} is effective capacitance of device from "channel" to the field plate on top of gate terminal.
- C_{DS} is between drain terminal (continuation of source contact across gate) and the field plate.
- C_{GD} is located in a small portion of the gate terminal.

*Efficient Power Conversion Corporation

Modeled C-V Characteristics

EPC2007 Datasheet

EPC2007 Model

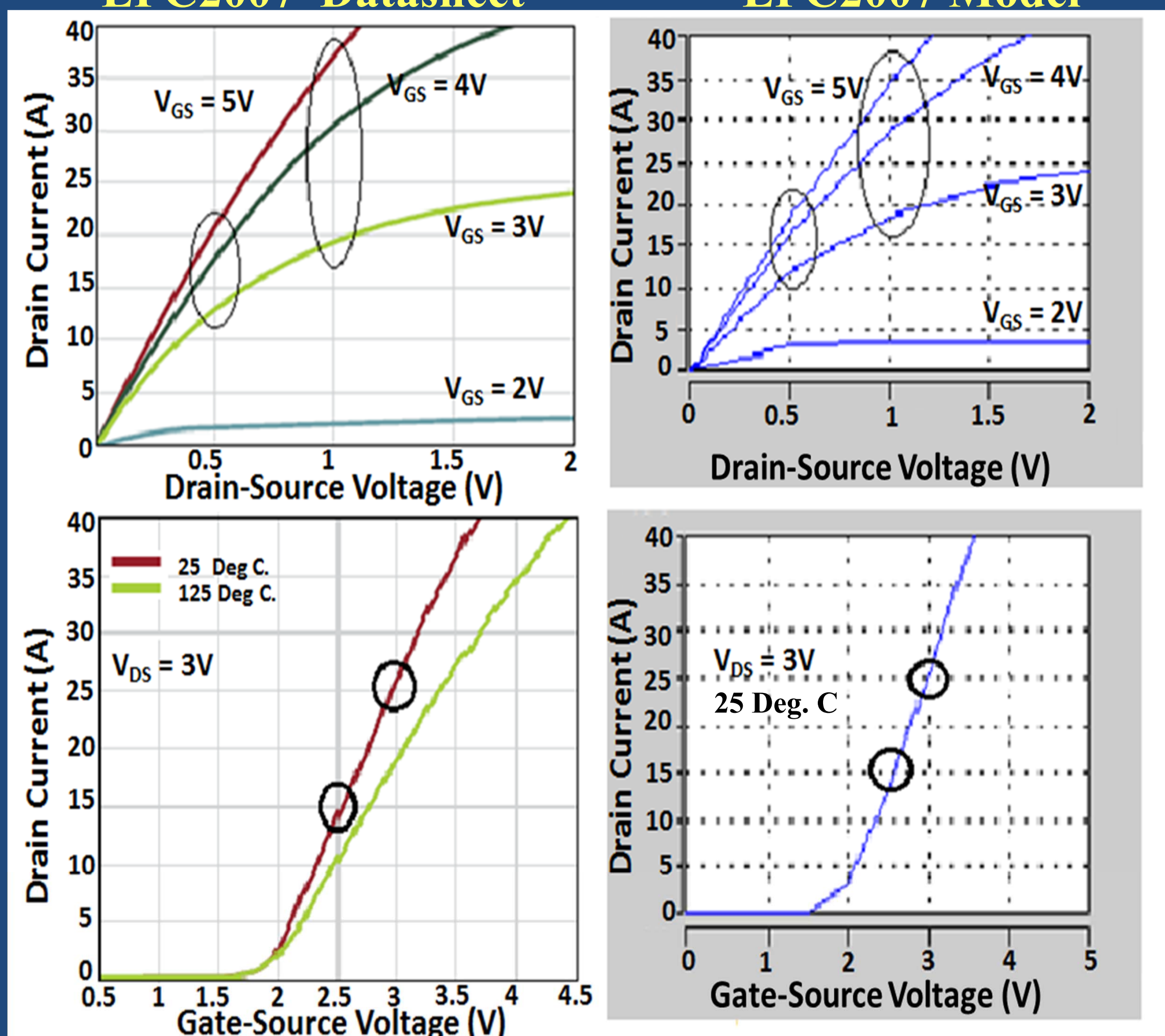


- $C_{RSS} = C_{GD}$
- $C_{OSS} = C_{GD} + C_{DS}$
- $C_{ISS} = C_{GD} + C_{GS}$

Modeled I-V Characteristics

EPC2007 Datasheet

EPC2007 Model



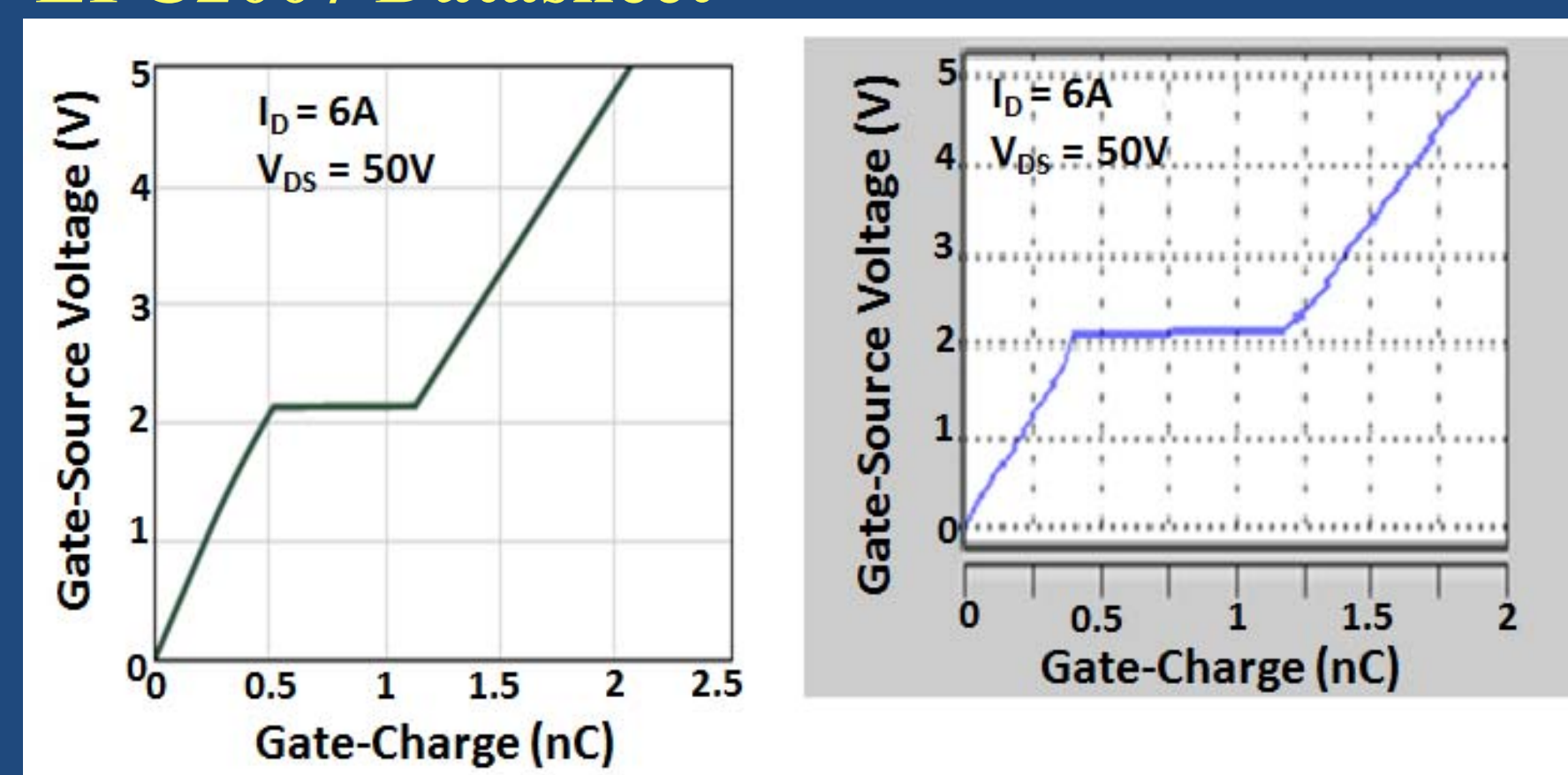
Top: Modeled I-V output characteristics
Bottom: Modeled I-V transfer characteristics

Model Validation

Gate Charge Characteristics

EPC2007 Datasheet

EPC 2007 Simulation

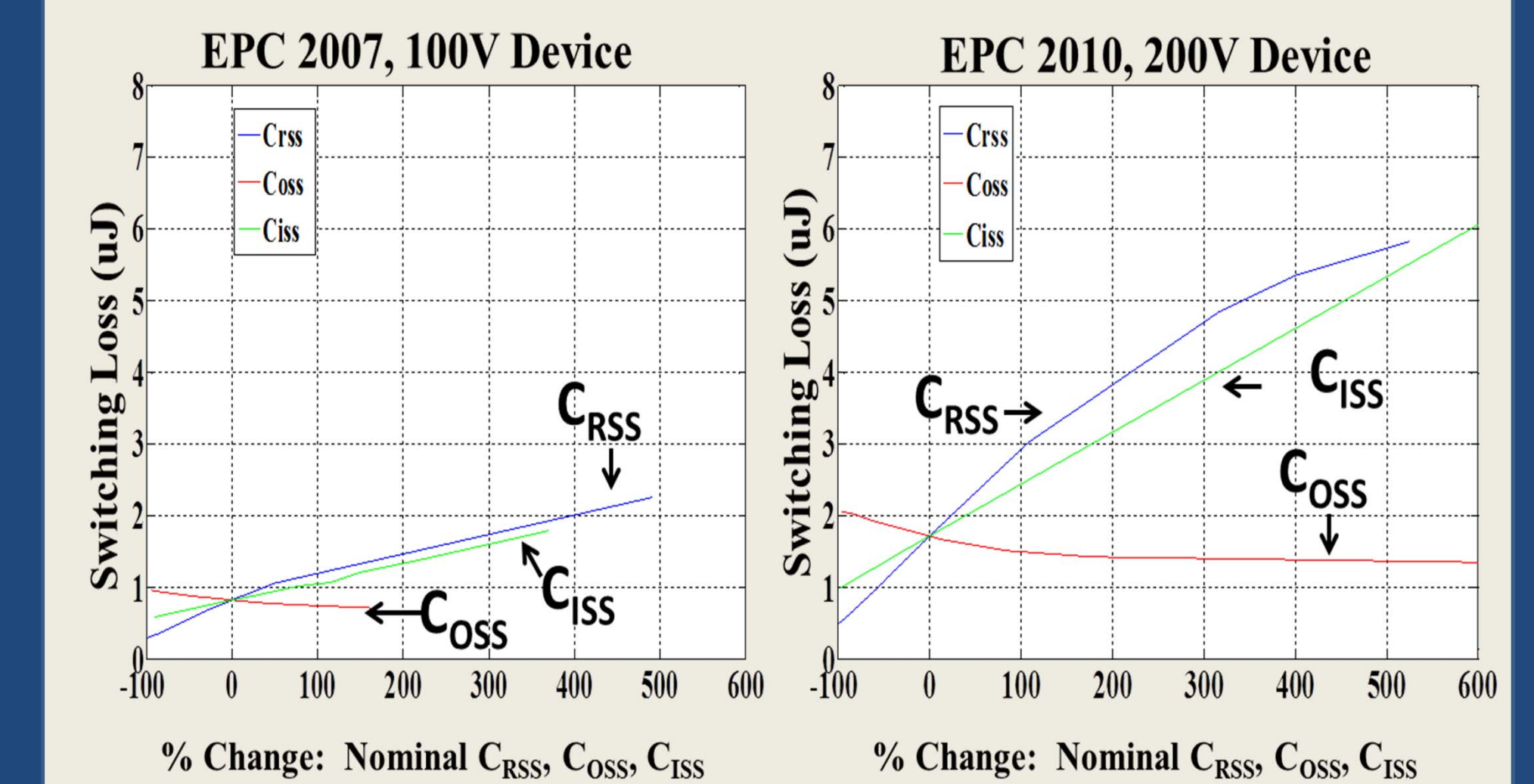


Comparison of Extracted Parameters

	EPC 2007 Datasheet	EPC 2007 Model
$R_{DS(ON)}$	24 mΩ	22.3 mΩ
V_{TH}	1.4V	1.62V

Results

Turn Off Loss vs Parasitic Capacitances



Device	Turn-on Energy Loss	Turn-off Energy Loss
EPC2007 (100 V device)	2.91 μJ	0.824 μJ
EPC2010 (200 V device)	3.16 μJ	1.72 μJ

- C_{GD} (C_{RSS}) contributed the most significant effect when transitioning from the 100V device to the 200V device.
- C_{DS} ($C_{OSS} - C_{RSS}$) can have certain beneficial aspects for the turn-off of GaN HFETs.