



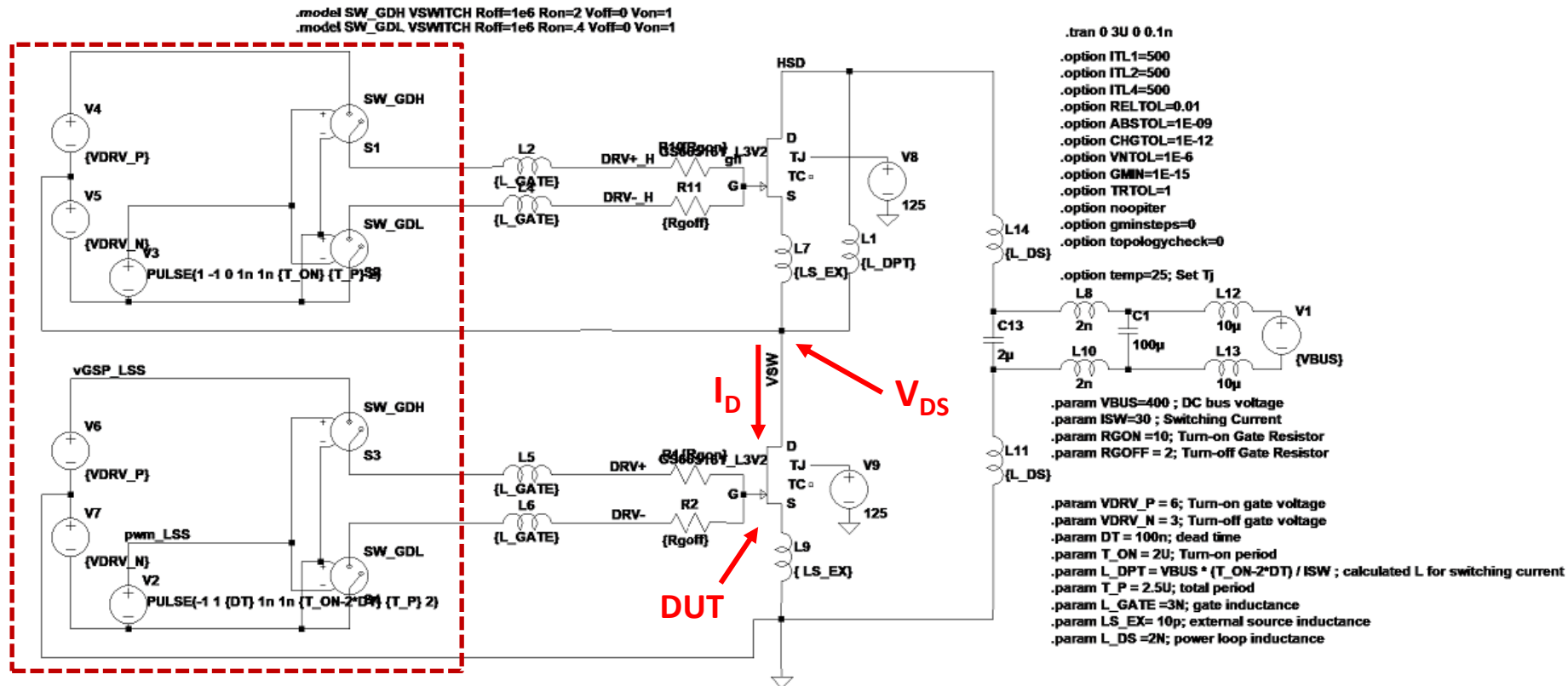
Application Brief

GaN Switching Loss Simulation using LTSpice

July 20, 2021

- GaN Systems provides Pspice/LTSpice simulation models for GaN Enhancement mode HEMT.
- In this presentation, a half bridge double pulse test circuit in LTSpice is introduced and used as the test bench to evaluate switching performance under different electrical parameters.
- Switching losses were simulated and compared with Lab measurement

## GAN SYSTEMS SWITCHING LOSS DOUBLE PULSE TEST BENCH



HS/LS Gate driver circuit

## Set up the simulation parameters:

**.option temp=25 ; Junction temperature setting, adjust between 25 and 150C**

**.param VBUS = 400; DC bus voltage**  
**.param ISW = 30; Switching Current**  
**.param RGON =10; Turn-on Gate Resistor**  
**.param RGOFF = 2; Turn-off Gate Resistor**  
**.param VDRV\_P = 6; Turn-on gate voltage**  
**.param VDRV\_N = 3; Turn-off negative gate voltage**

**Switching test parameters**

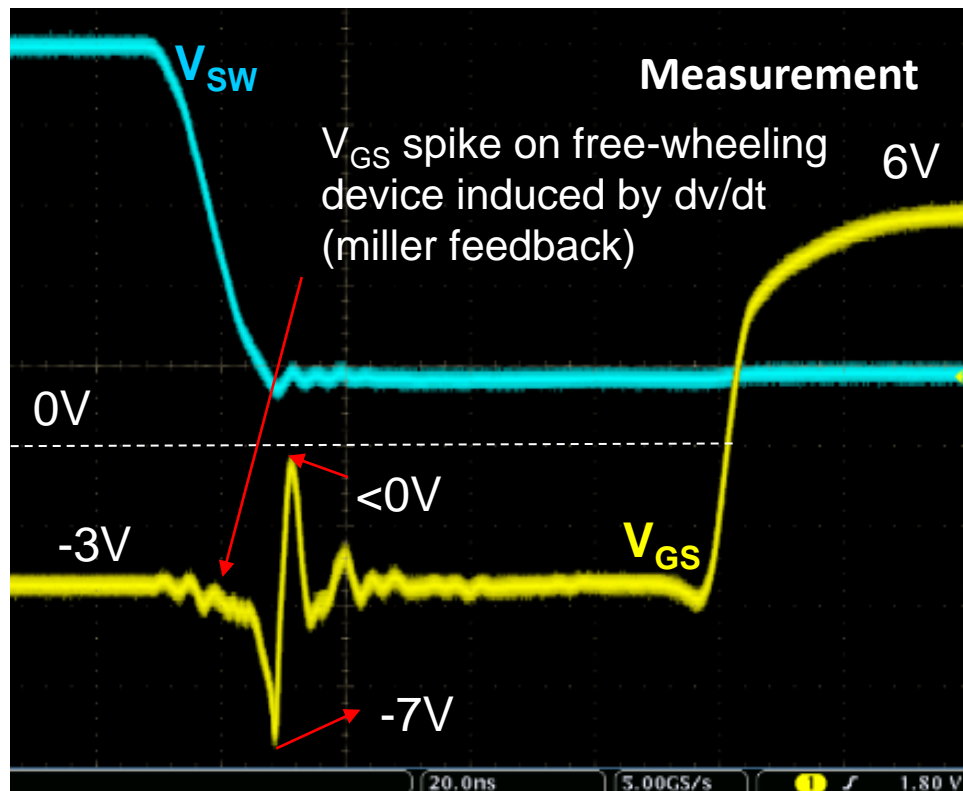
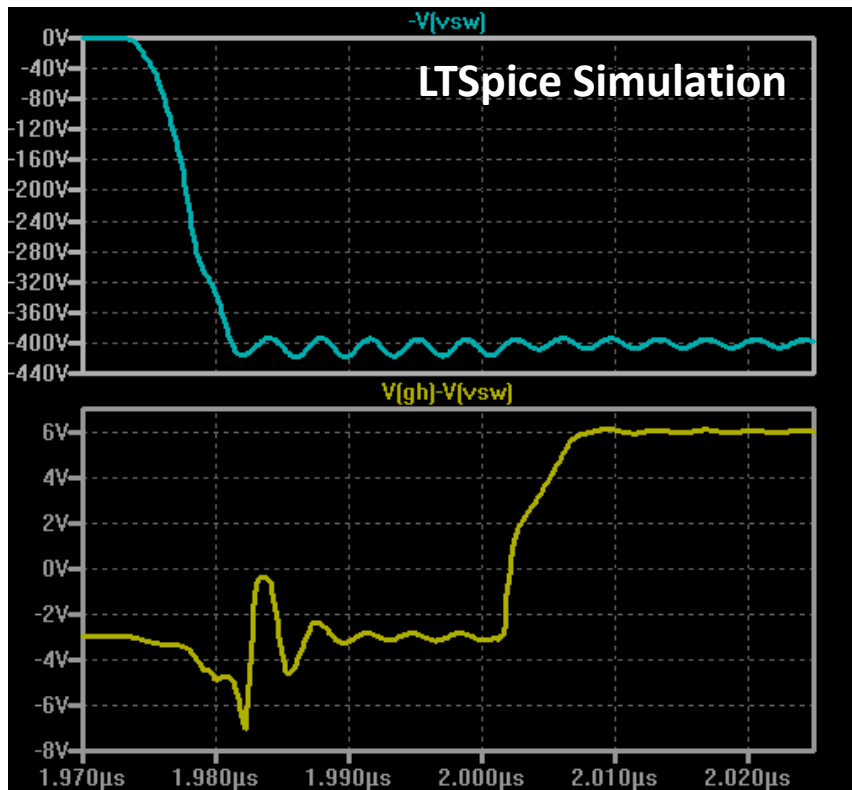
**.param DT = 100n; dead time**  
**.param T\_ON = 2U; Turn-on period**  
**.param L\_DPT = VBUS \* (T\_ON-2\*DT) / ISW ; calculated L for switching current setting**

**.param L\_GATE =3N; gate inductance**  
**.param LS\_EX= 10p; external source inductance**  
**.param L\_DS =3N; power loop inductance**

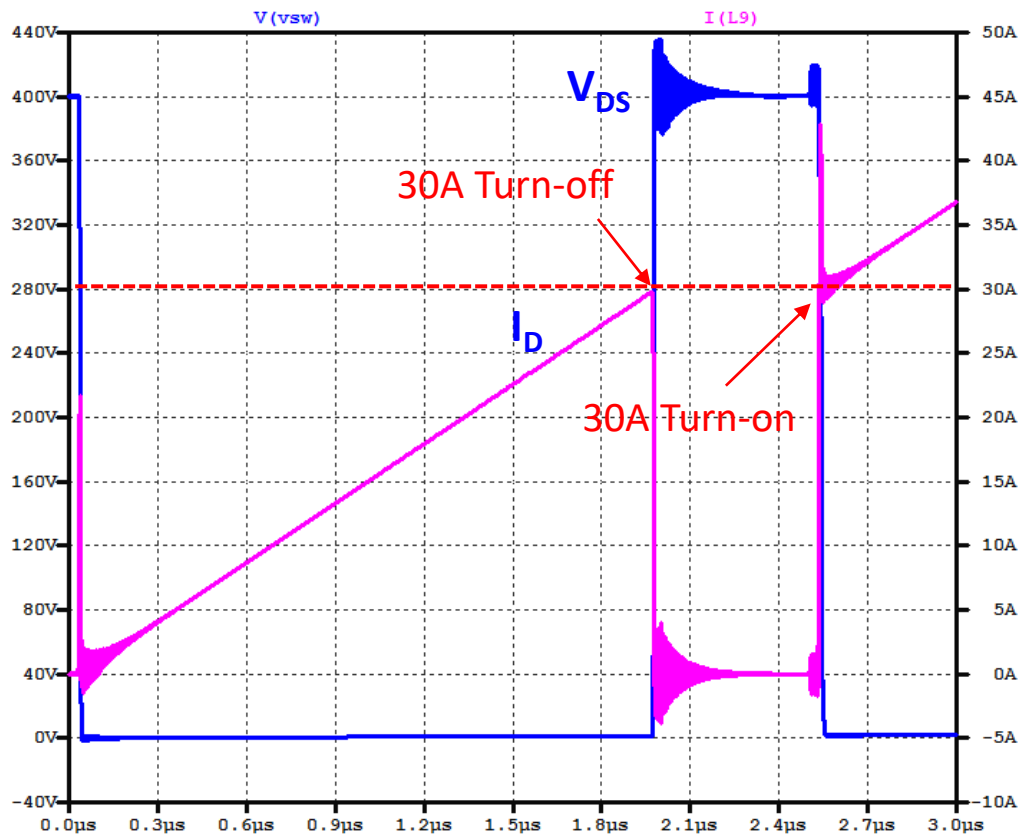
**Parasitic Inductances**

# Gate waveforms (Simulated vs Measured)

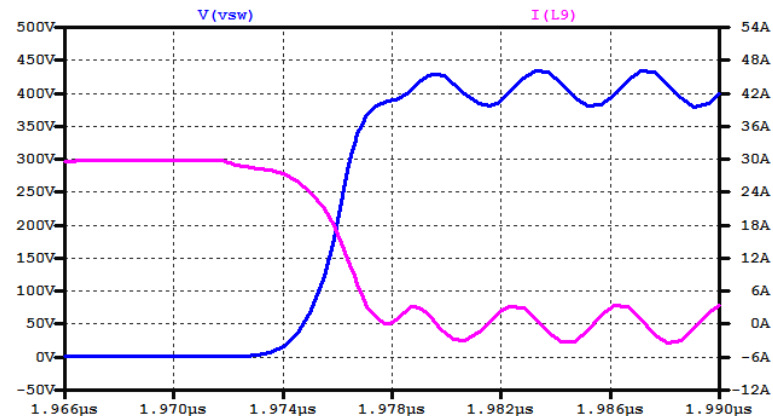
- Good correlation between simulated and measured waveforms.
- Parasitics:  $L_{DS} = 3\text{nH}$ ,  $L_{GATE} = 3\text{nH}$



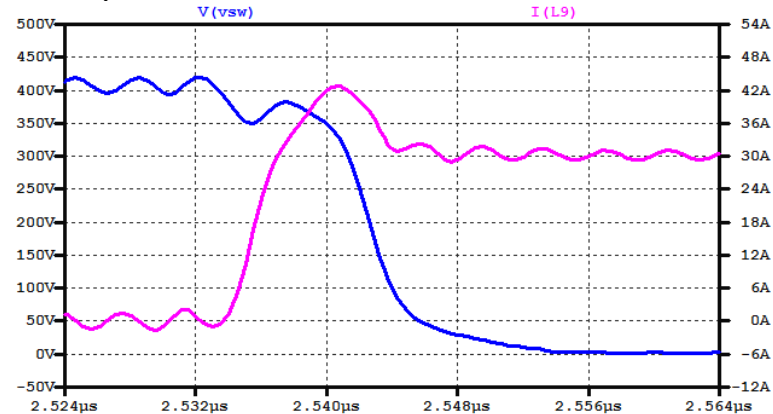
## Double Pulse Simulation Results (400V/30A)



## 400V/30A Hard switch-off

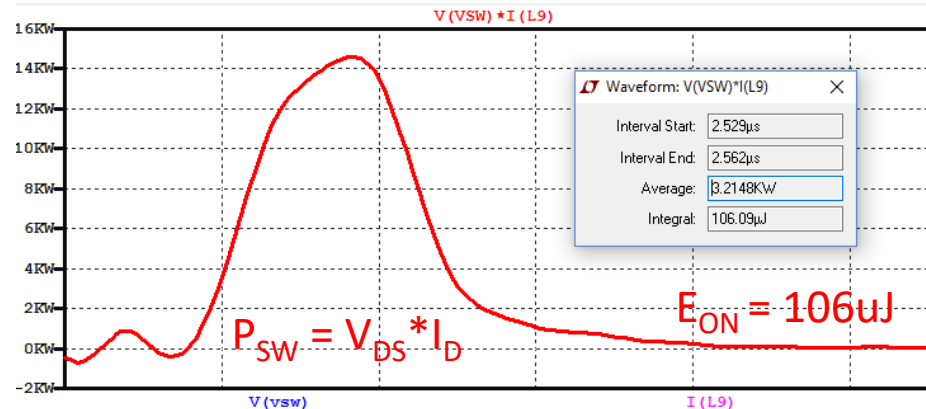


## 400V/30A Hard switch-on

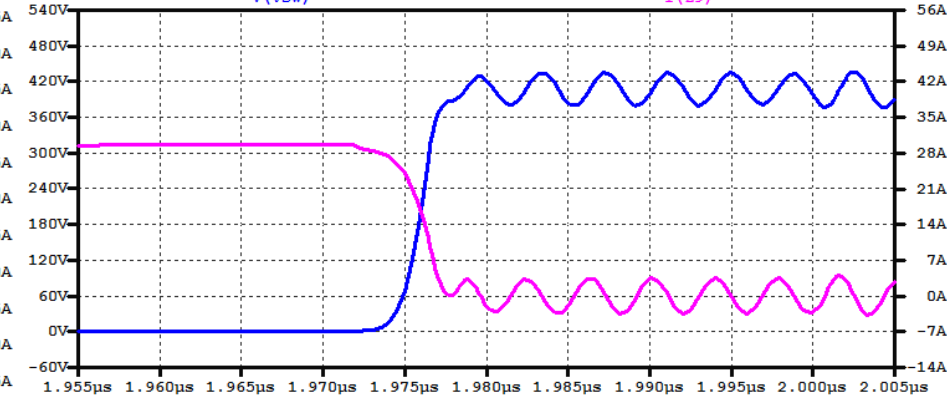
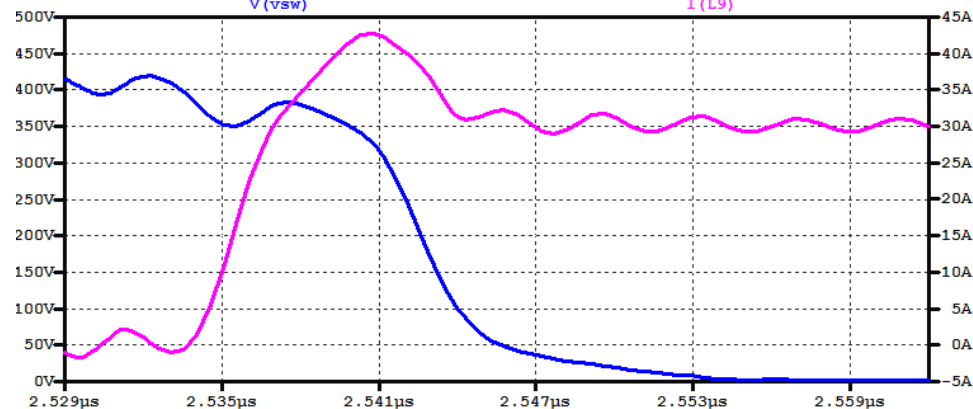
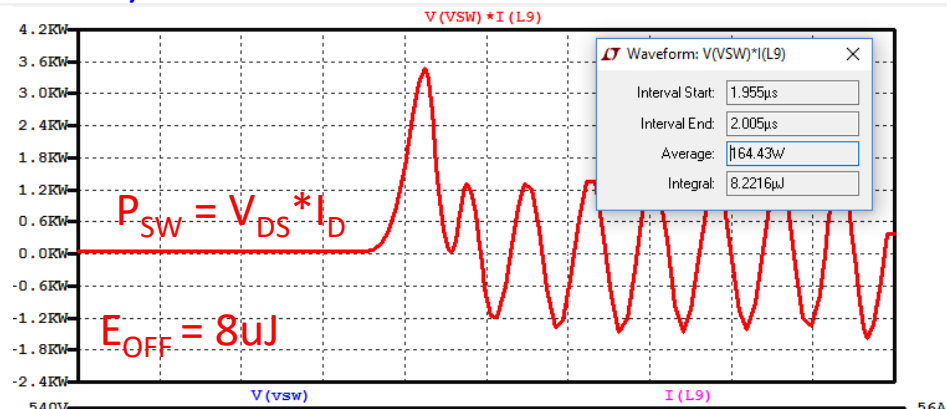


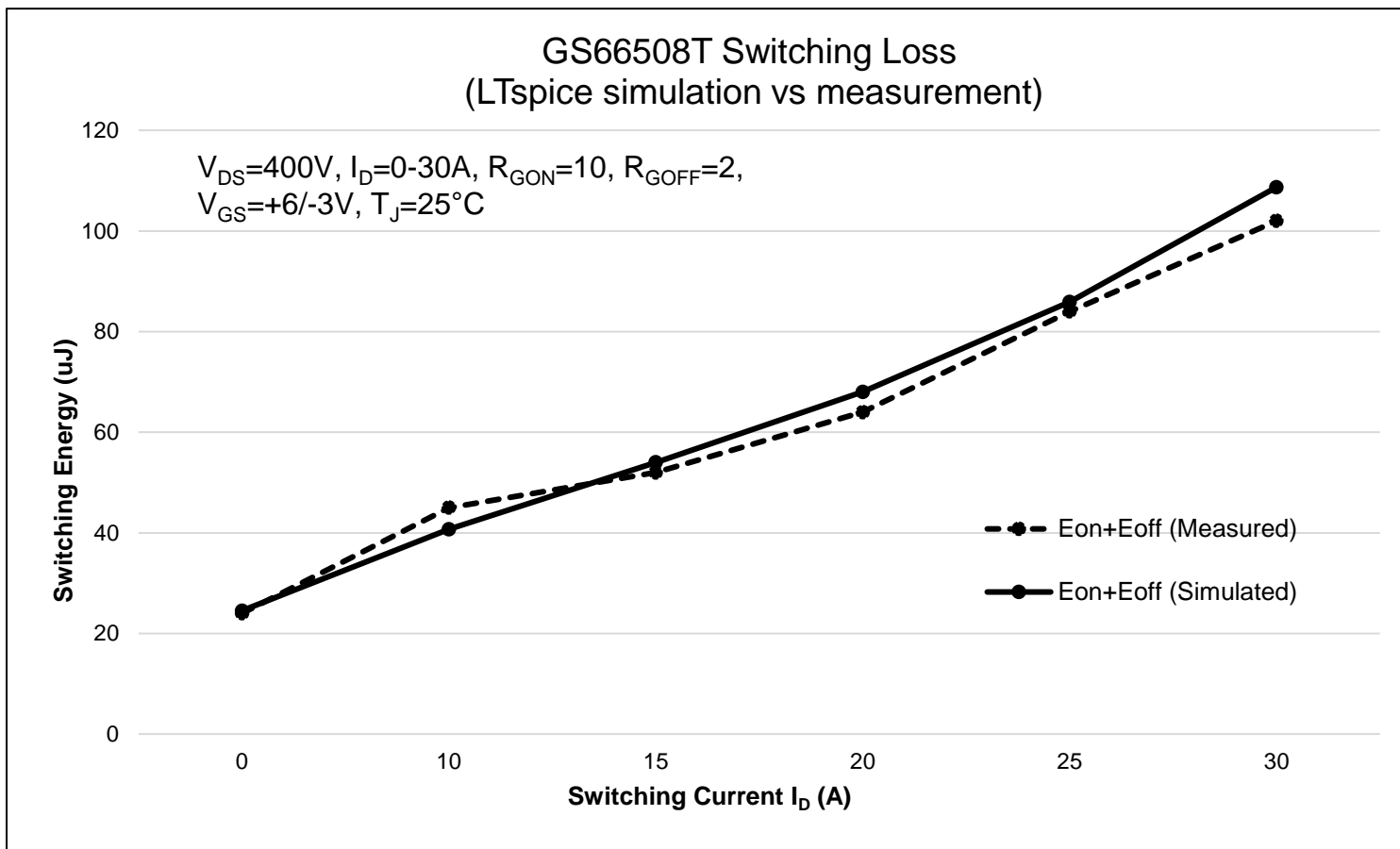
## Switching Loss Calculation using LTSpice

### 400V/30A Turn-on



### 400V/30A Turn-off

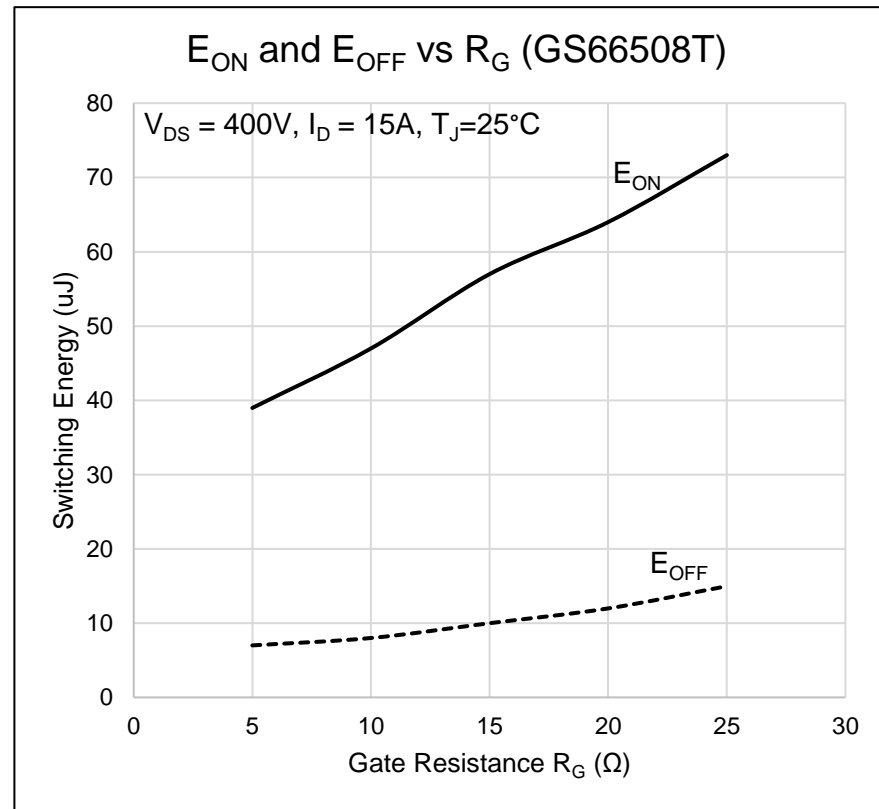
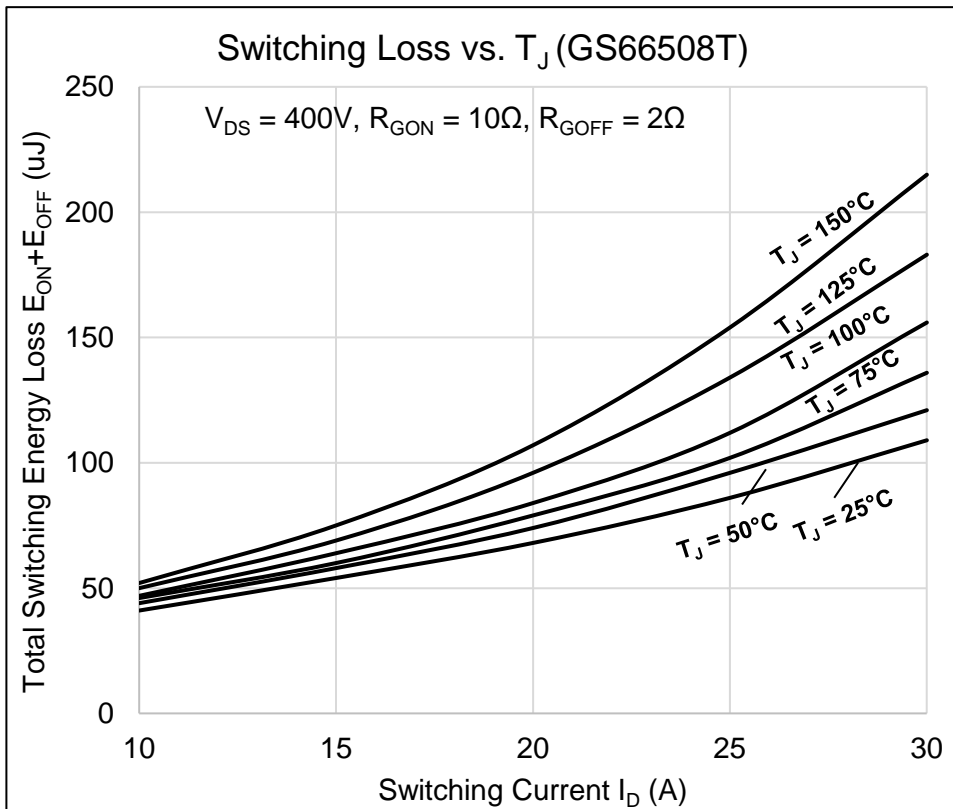






- Turn-on loss increases with  $T_J$  due to the reduced trans-conductance at higher temperature
- Turn-off for GaN is small and less temperature dependent

- Switching Loss increases with  $R_G$ .



- The GaN E-HEMT switching losses were simulated in LTSpice using a half bridge double pulse test circuit.
- The simulation results were verified against lab measurements. Although the real world measurement can be affected by many factors, a reasonably good agreement was achieved between the simulation model and measurement data.
- This LTSpice test circuit is a convenient tool for end users to set up a simulation platform and familiarize themselves with with GaN E-HEMT switching characteristics.
- It can also be used to easily evaluate the effects of different electrical parameters on GaN E-HEMT switching performance.

[Click to download LTSpice Simulation File](#)

[Click to download the LTSpice Model User Guide](#)



Product and application support at

[gansystems.com](http://gansystems.com)