



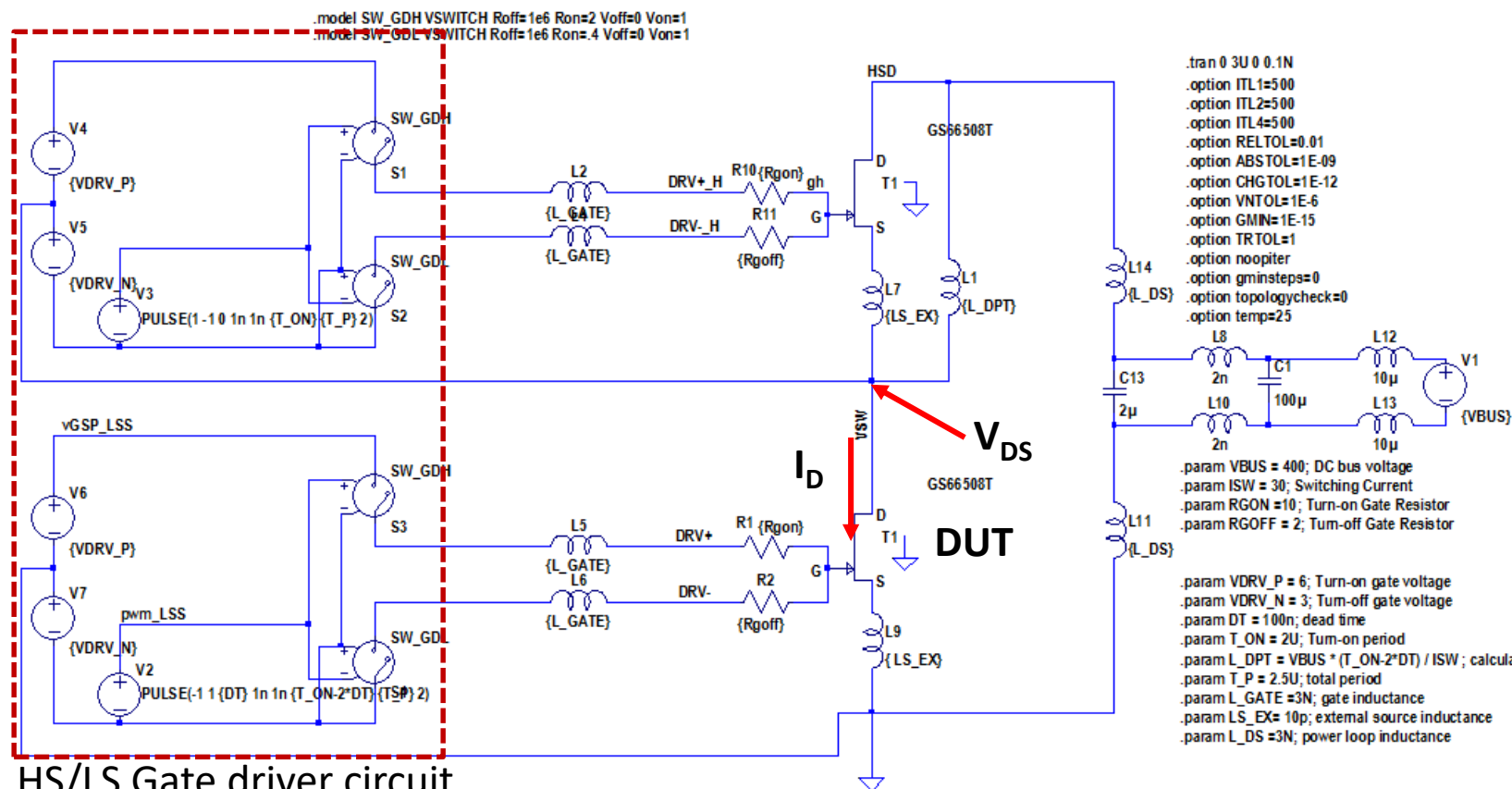
Application Brief

GaN Switching Loss Simulation using LTSpice

Apr 28, 2017

- GaN Systems provides Pspice/LTSpice simulation models for GaN Enhancement mode HEMT.
- In this presentation, a half bridge double pulse test circuit in LTSpice will be 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



## 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

.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 T\_P = 2.5U; total period

.param L\_GATE =3N; gate inductance

.param LS\_EX= 10p; external source inductance

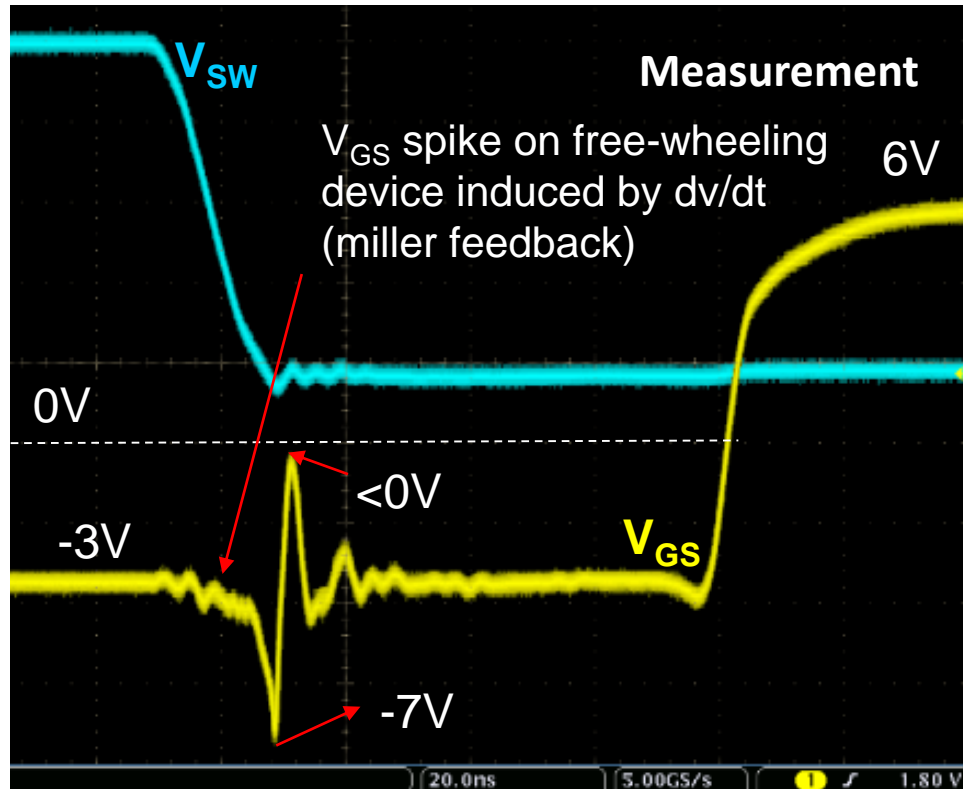
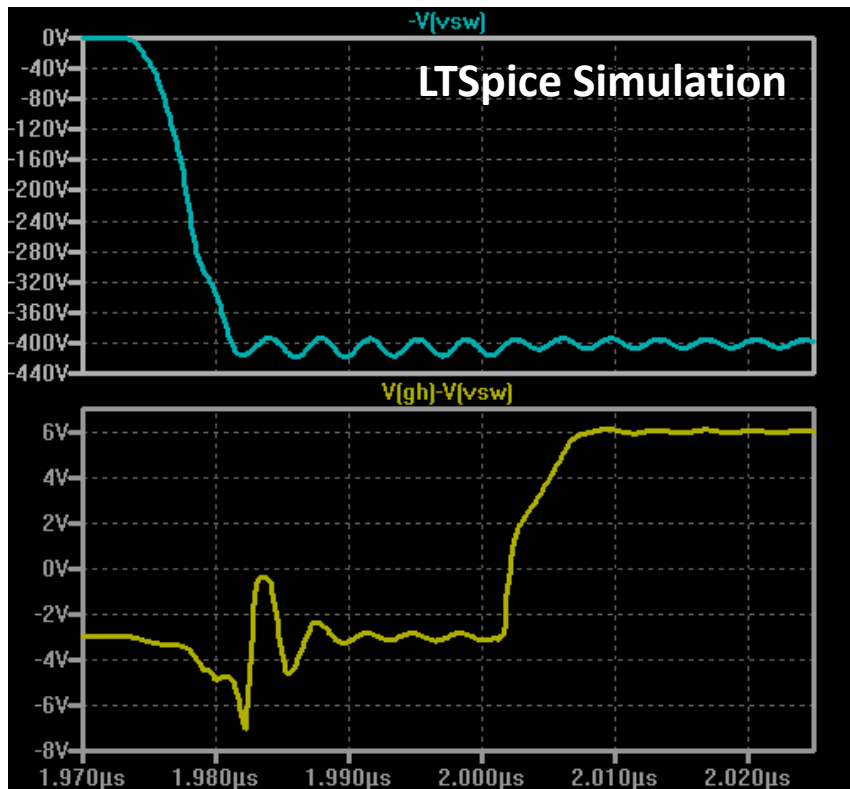
.param L\_DS =3N; power loop inductance

**Switching test parameters**

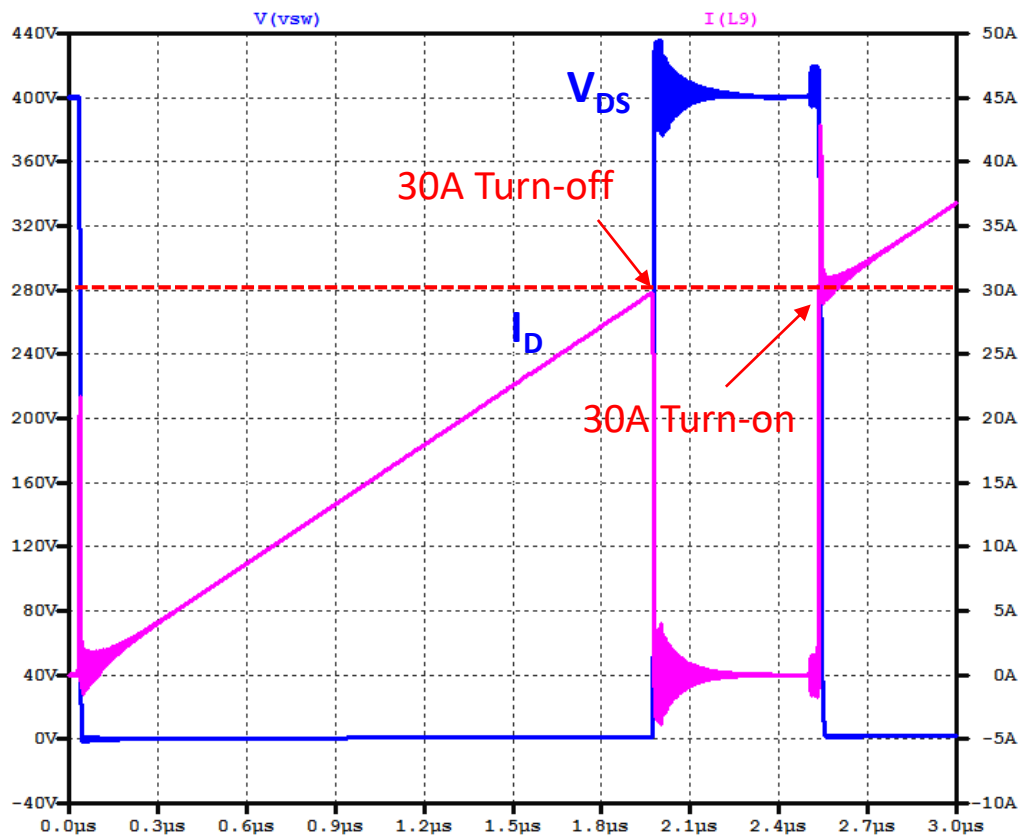
**Parasitic Inductances**

# Gate waveforms (Simulated vs Measured)

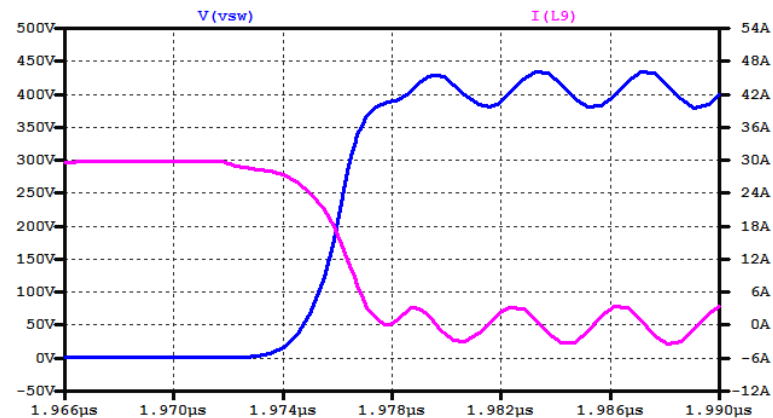
- Good correlation between simulated and measured waveforms.
- Parasitics:  $L_{DS} = 3\text{nH}$ ,  $L_{GATE} = 3\text{nH}$



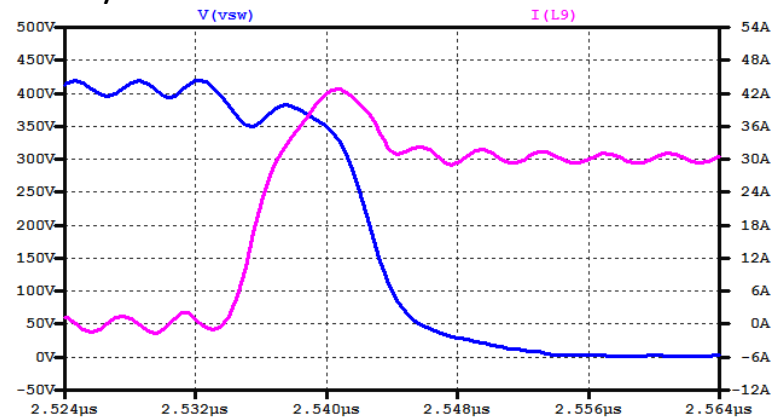
## Double Pulse Simulation Results (400V/30A)



## 400V/30A Hard switch-off



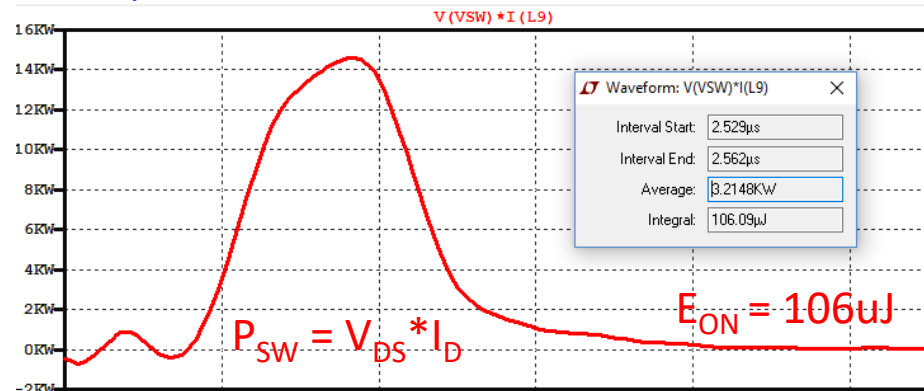
## 400V/30A Hard switch-on



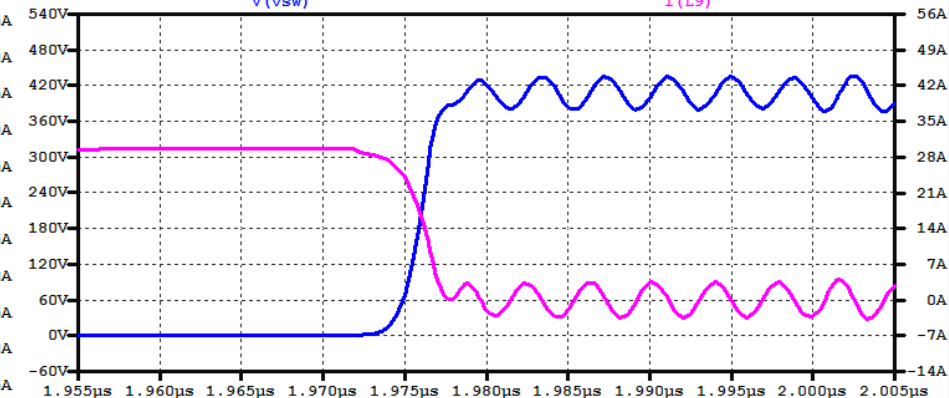
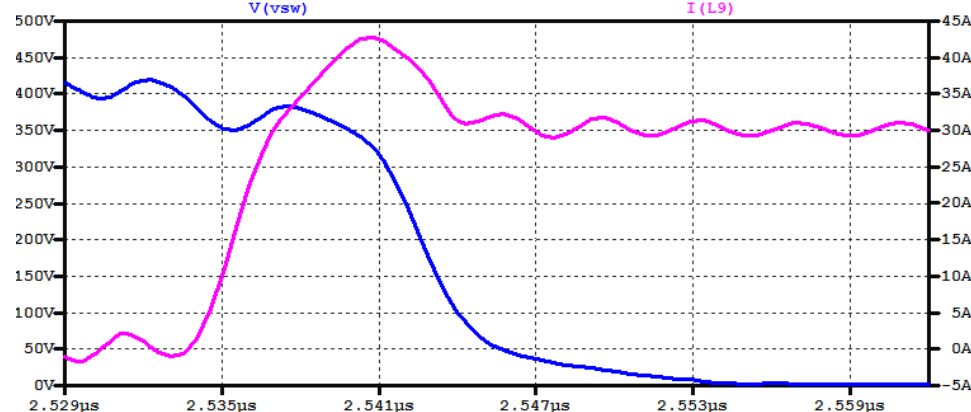
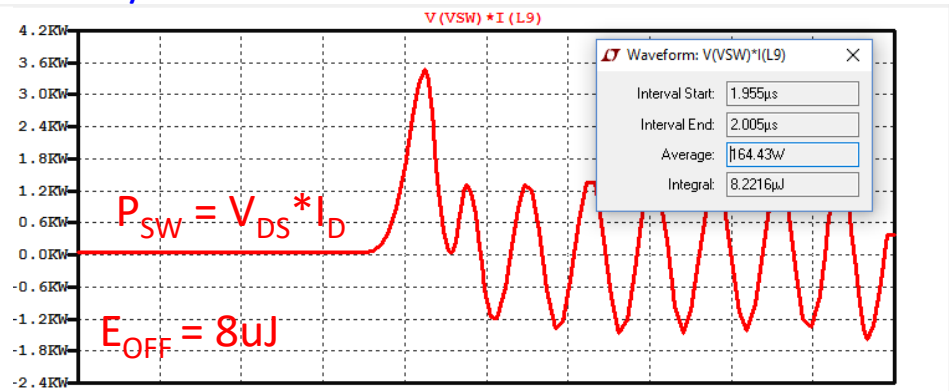


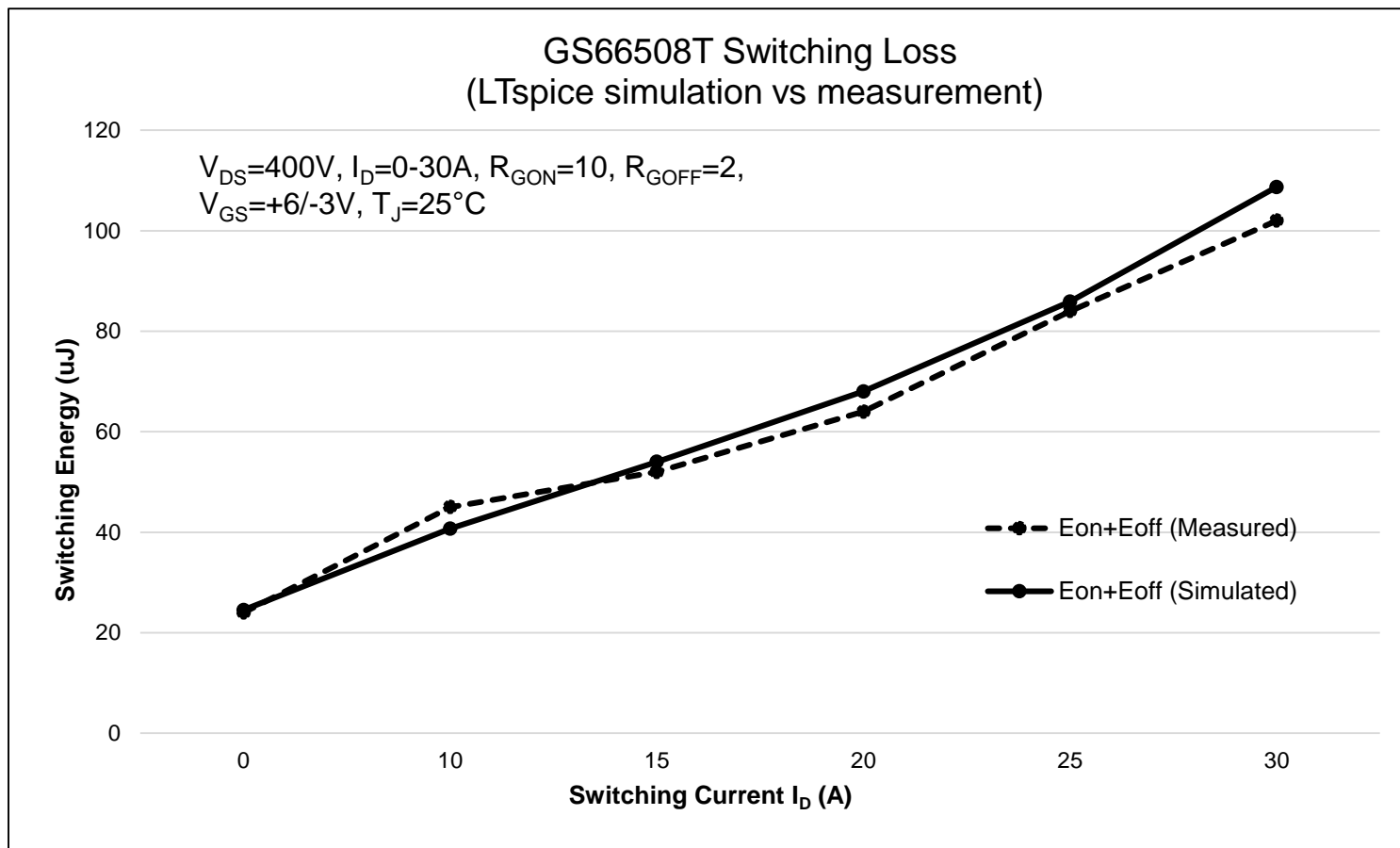
## Switching Loss Calculation using LTSpice

### 400V/30A Turn-on



### 400V/30A Turn-off

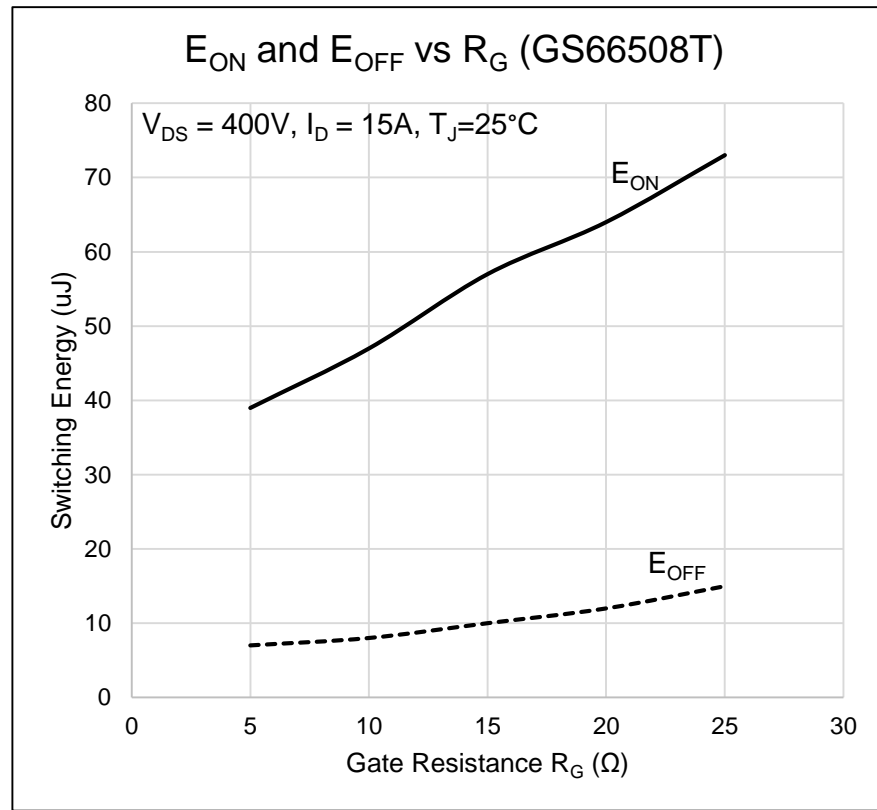
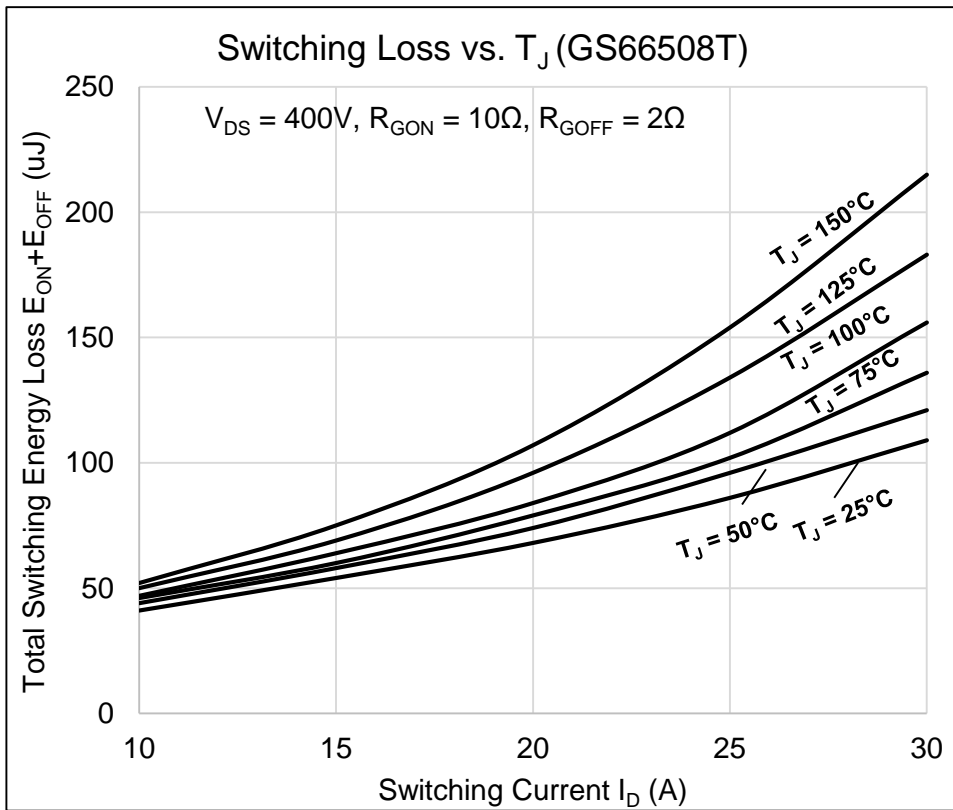






- Turn-on loss increases with  $T_J$  due to the reduced transconductance at higher temperature
- Turn-off for GaN is small and less temperature dependent

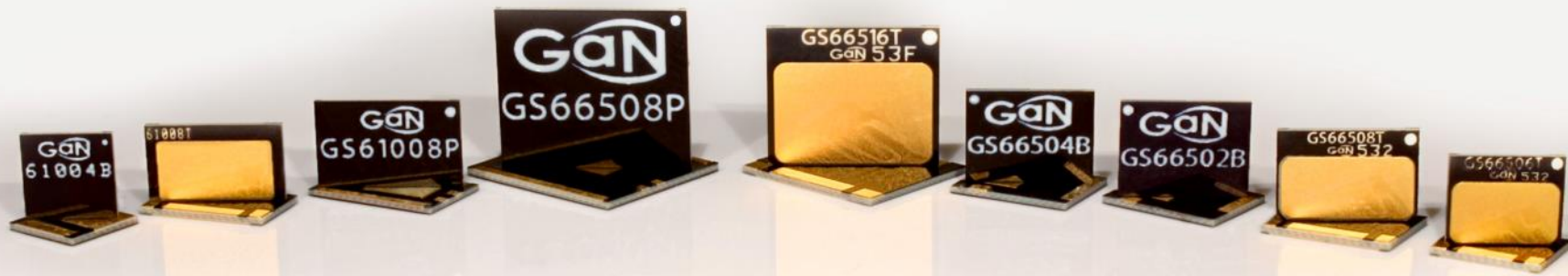
- Switching Loss increases with  $R_G$ .



- GaN E-HEMT switching losses were simulated by using a half bridge double pulse test circuit in LTSpice
- The simulation results were verified by the lab measurement. Although the real world measurement can be affected by many other factors, we have achieved reasonably good agreement between the simulation model and measurement.
- This LTSpice test circuit can be a convenient tool for end users to get started with simulation and be familiar with GaN switching characteristics to assist their design.
- This simulation test bench can also be used to easily evaluate GaN switching performance under different electrical parameters

[Click to download LTSpice simulation file](#)

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