



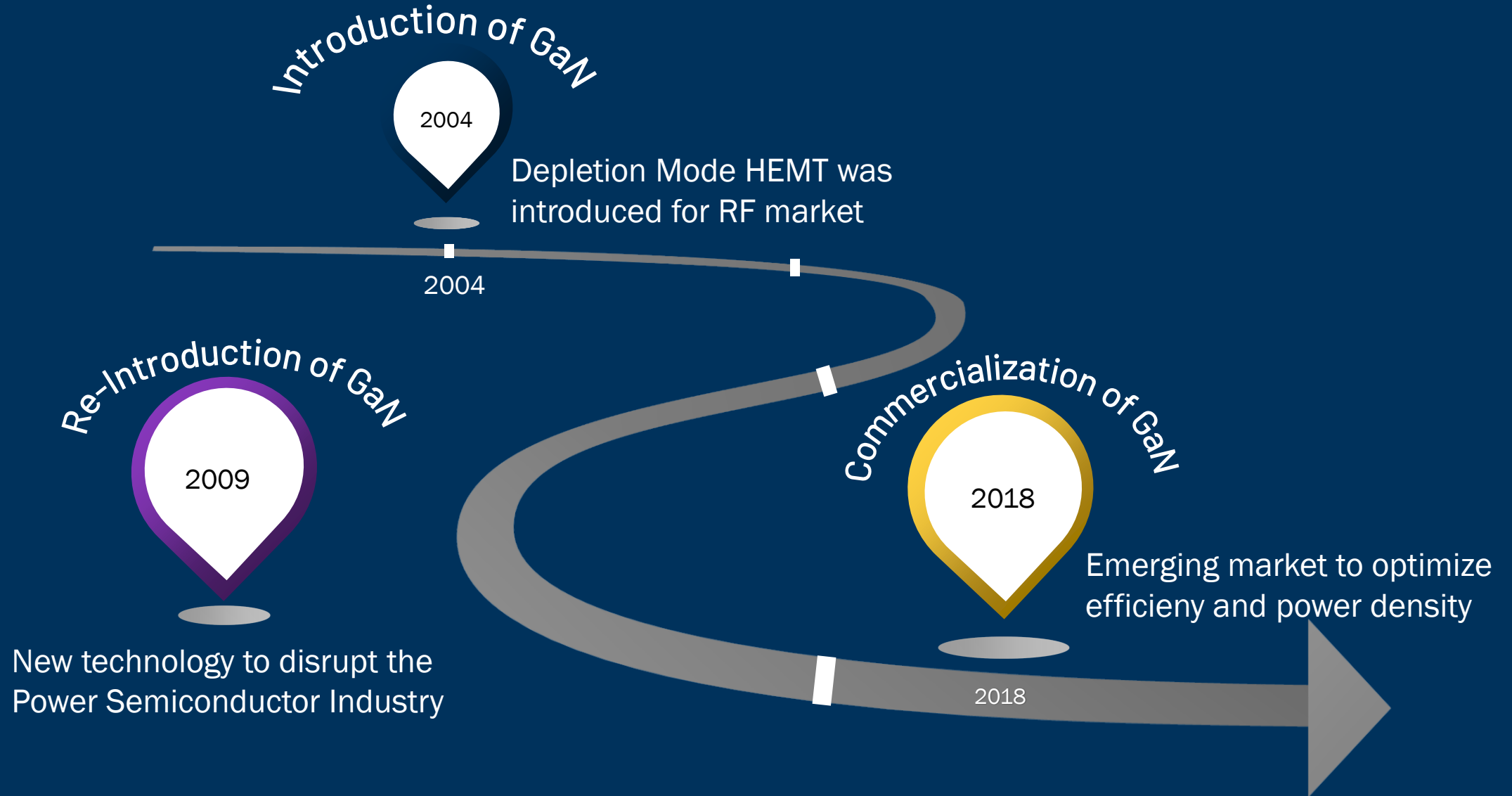
Unleash the Benefits of GaN Technology with Advanced GaN Controllers and Gate Drivers

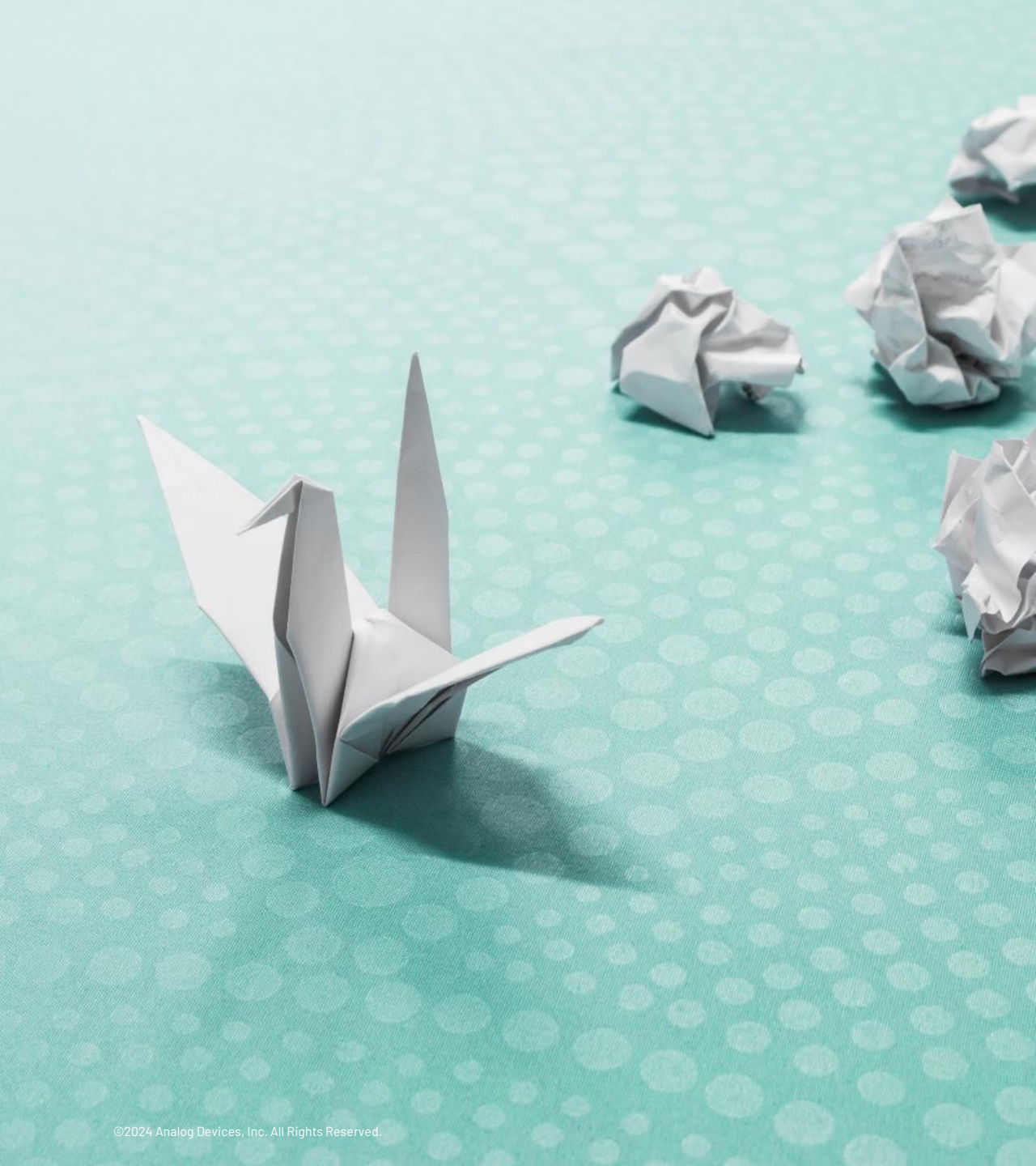
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Agenda

- A brief history of the GaN technology
- Benefits and potential for using GaN technology
- Power device overview and its competitive zone
- Using MOSFET driver/controller for GaN
- Challenges of GaN technology
- Leveraging GaN technology to maximize efficiency for DC-DC power conversion
- Leveraging GaN technology to maximize BLDC operation
- Introduction to LT8418 – 100V Gate Driver and its features sets
- Introduction to LT7890/91 – 100V Controllers
- Summary
- Q&A

Brief History of GaN Technology

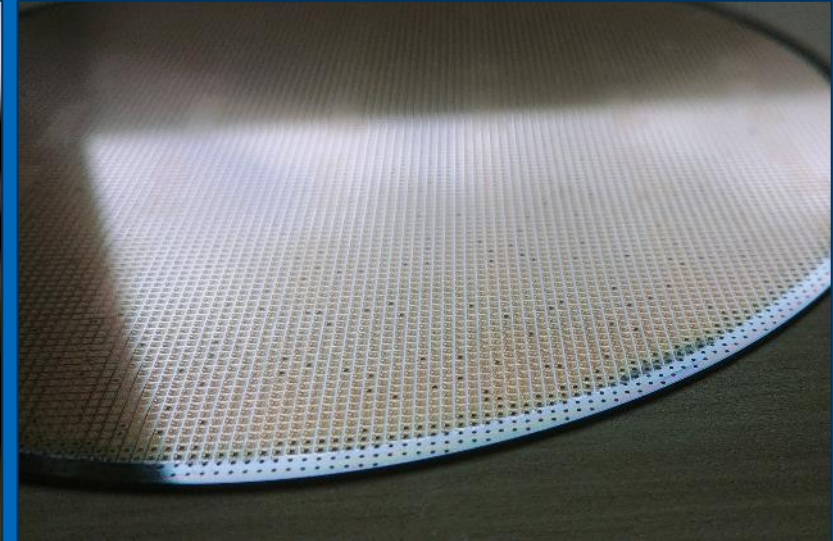
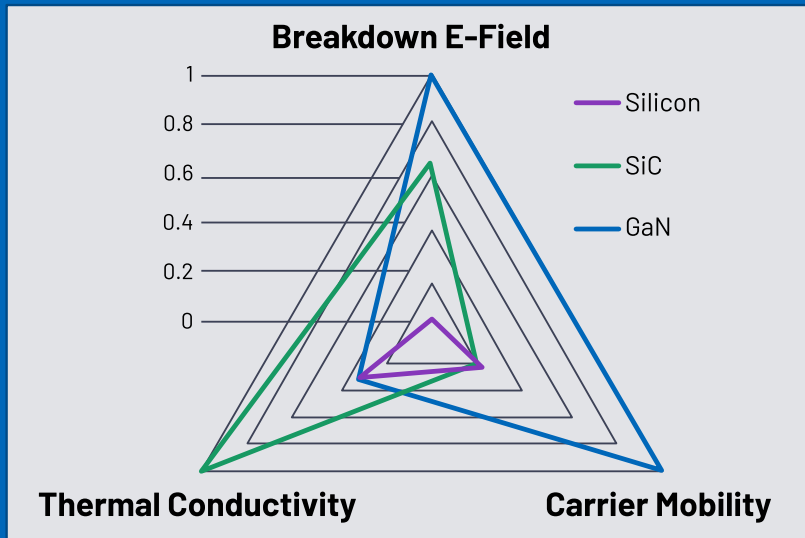




GaN Benefits

- Lower switching losses & increased efficiency
- Simpler system design for power conversion from high voltage rail to low voltage rail
- Miniaturization of passive components
- Eliminates the reverse recovery phase with the absence of a built-in reverse body diode

The Potential for GaN



Features

- Compound semi
- Wide band gap
- High breakdown voltage

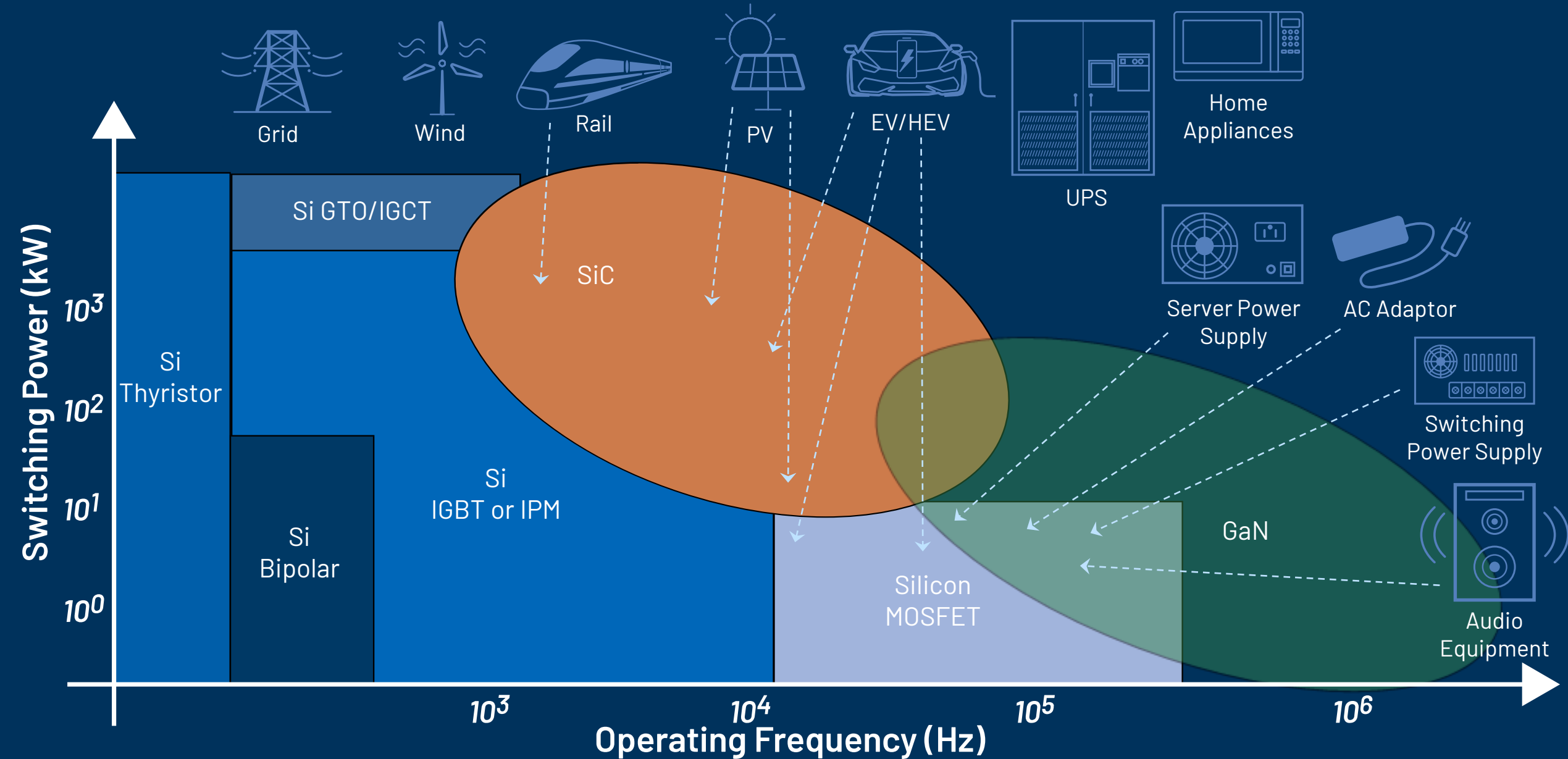
Established markets

- Power amplifiers
- Opto-electronics
- Consumer power (HV)

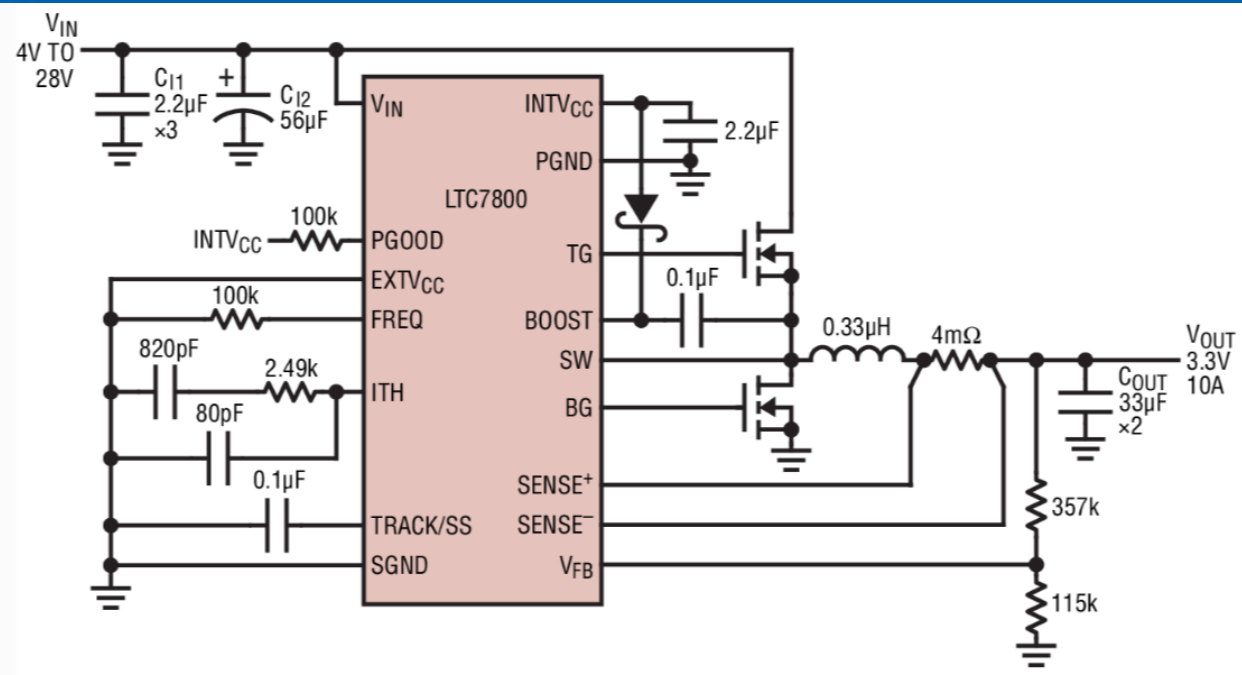
Future in Power

- Silicon process integration
- Lower switching losses
- Higher power

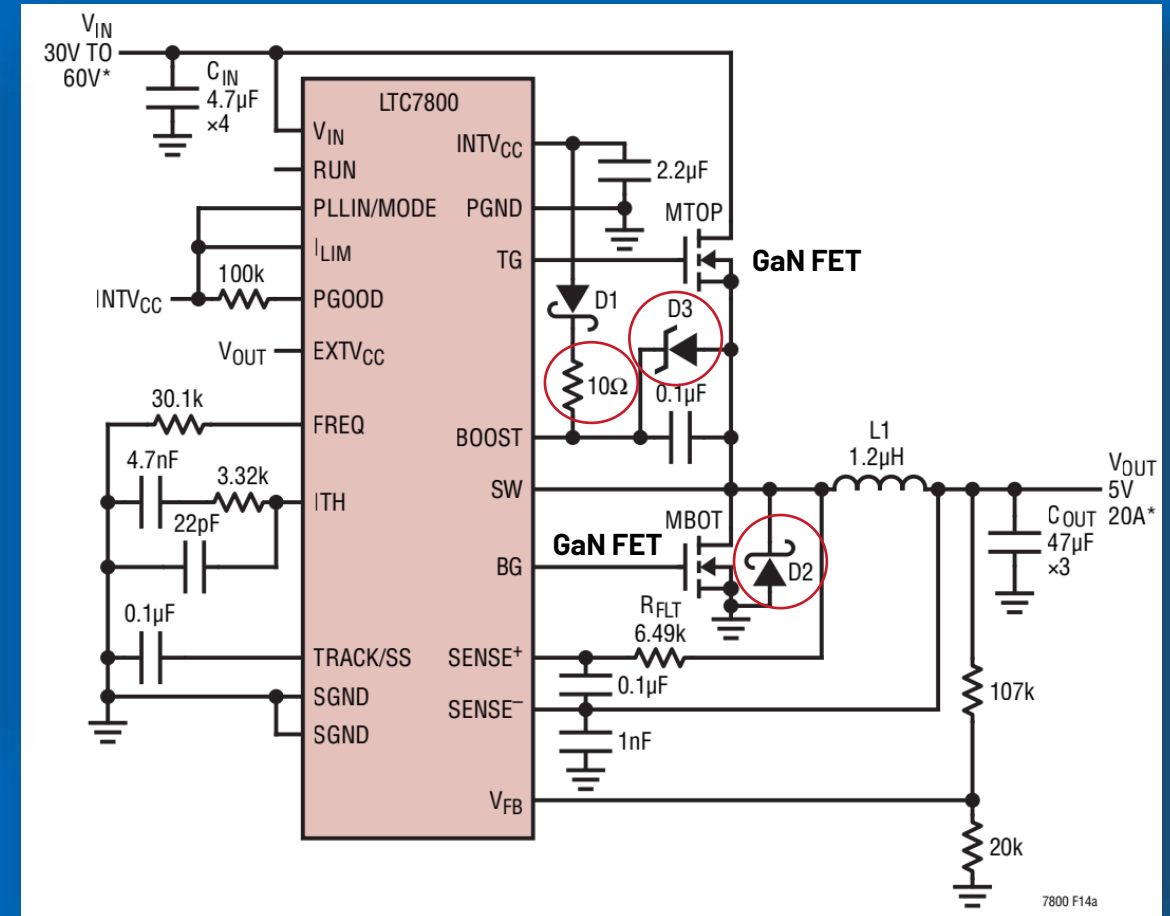
Power Device Competitive Zone



Using a MOSFET Controller for GaN FET



- R: in series with the boost diode to limit current
- D3: Zener diode
- D2: Schottky diode



GaN Challenges

- Tighter control of the VGS is needed
- Voltage drop across the GaN FET during reverse conduction can be higher
- Careful component layout is required
- Higher Gate leakage current compared to Si based FETs

Leveraging GaN solution to Maximize Efficiency DC-DC Power Conversion

Minimize conduction loss

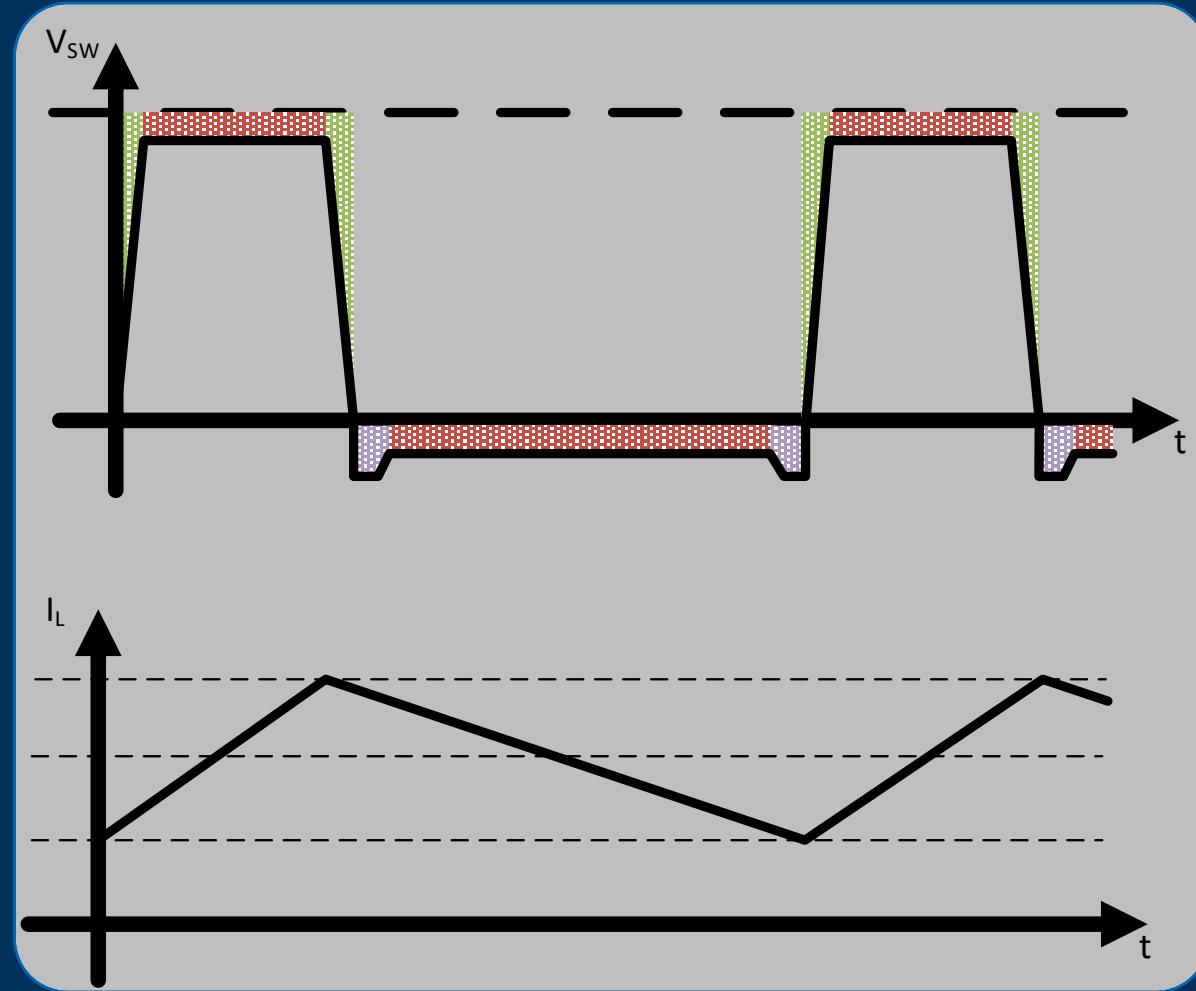
- Lower R_{ON} of the GaN FET reduces conduction loss

Minimize switching loss

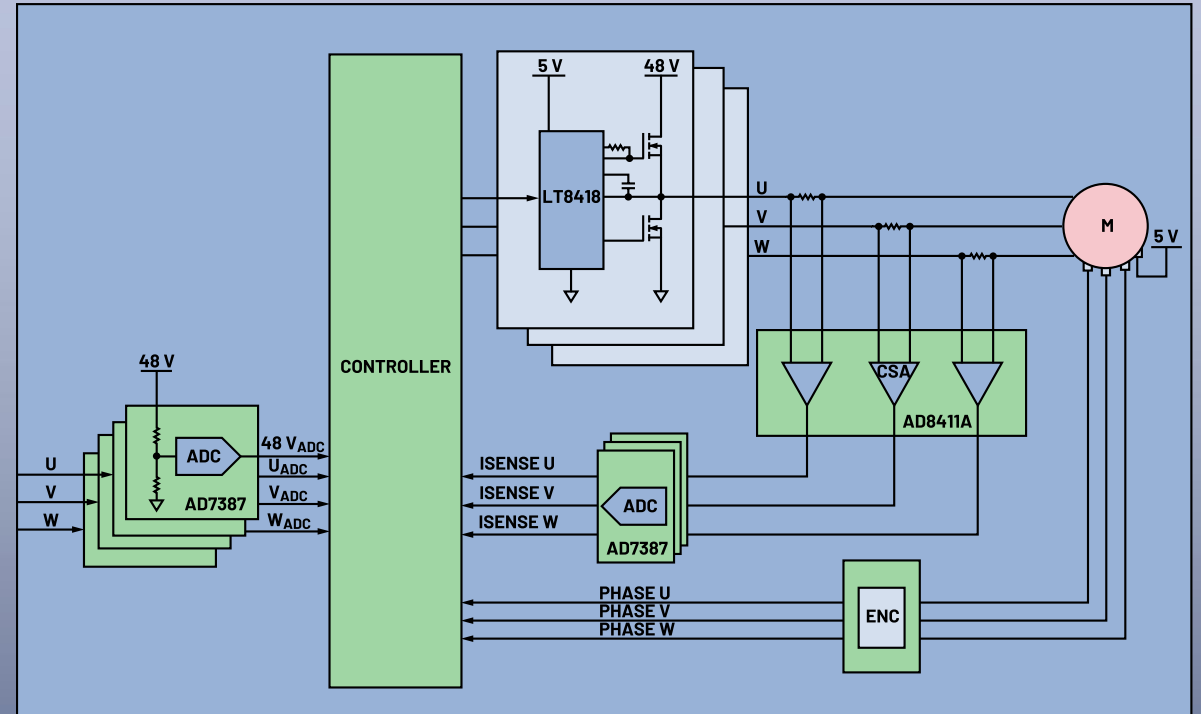
- GaN FET have significantly lower total gate charge than comparable Si MOSFET
- Strong Pull up and Pull-down current for the Gate Driver

Minimize dead times losses

- GaN FET: Higher power loss when the GaN FET has reverse current flow and the gate driver is not driving the gate $\rightarrow I_{REVERSE} * R_{ON}$



Leverage ADI gate driver for GaN HEMT to optimize BLDC control



400 KHz Switching for BLDC motors allows

- Improved efficiency
- Reduce noise and vibration
- High power density
- Faster response time

Robustness against high voltage variations

- Separate Pull-up and Pull-down gate control to fine tune
- Robustness against high voltage variations



GaN Gate Driver

LT8418

analog.com

Flexible

Robust

Control

Compact



LT8418

100 V Half-Bridge GaN Driver with Smart Integrated
Bootstrap Switch

LT8418 100V Half-Bridge GaN Driver

Features

Flexible

- Split gate drivers for adjustable turn on/off behavior
- 4A peak source, 8A peak sink current capability

Control

- Low propagation delay: 10ns typical
- Tight propagation delay matching: 1.5ns typical
- High dv/dt immunity: up to 50V/ns

Robust

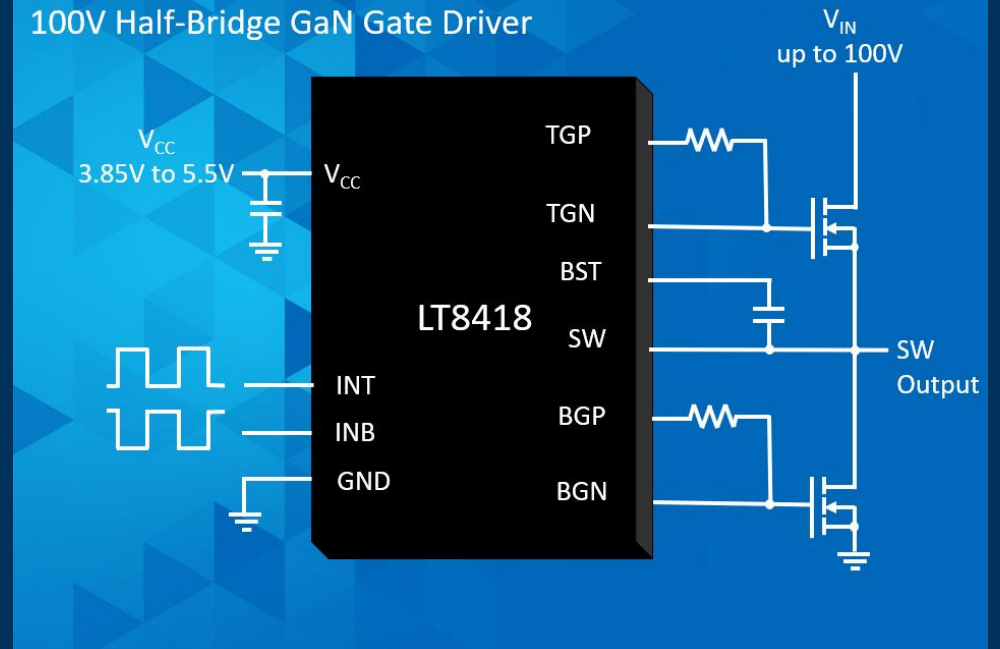
- Smart integrated bootstrap switch
- Under-voltage and over-voltage lockout

Applications

- Class-D audio amplifier 100V
- Data center power
- High frequency DC-DC converters

LT8418

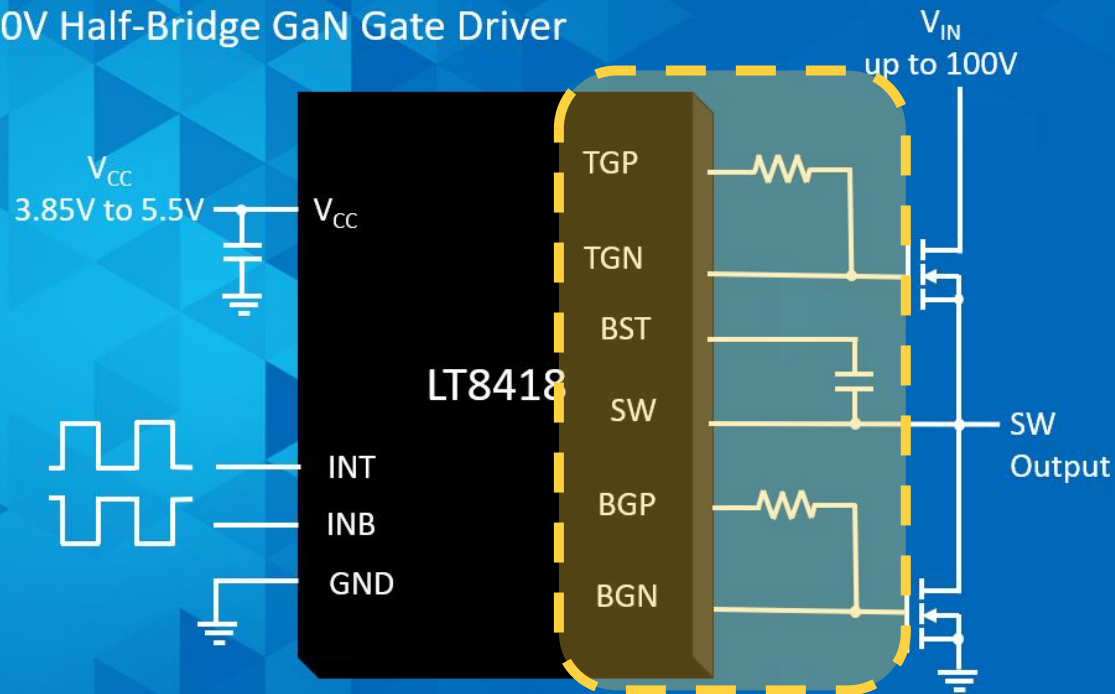
100V Half-Bridge GaN Gate Driver



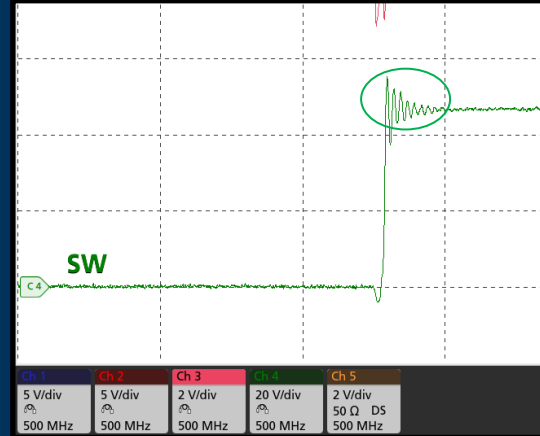
LT8418 100V Half-Bridge GaN Driver

LT8418

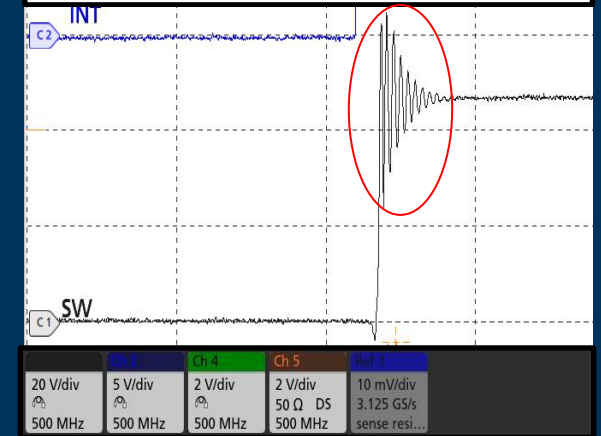
100V Half-Bridge GaN Gate Driver



$V_{IN} = 48V$
 $V_{OUT} = 24V$
 $I_{OUT} = 5A$
 $F_{SW} = 1MHz$
 $RTG = 5.6\Omega$
 $RBG = 2\Omega$



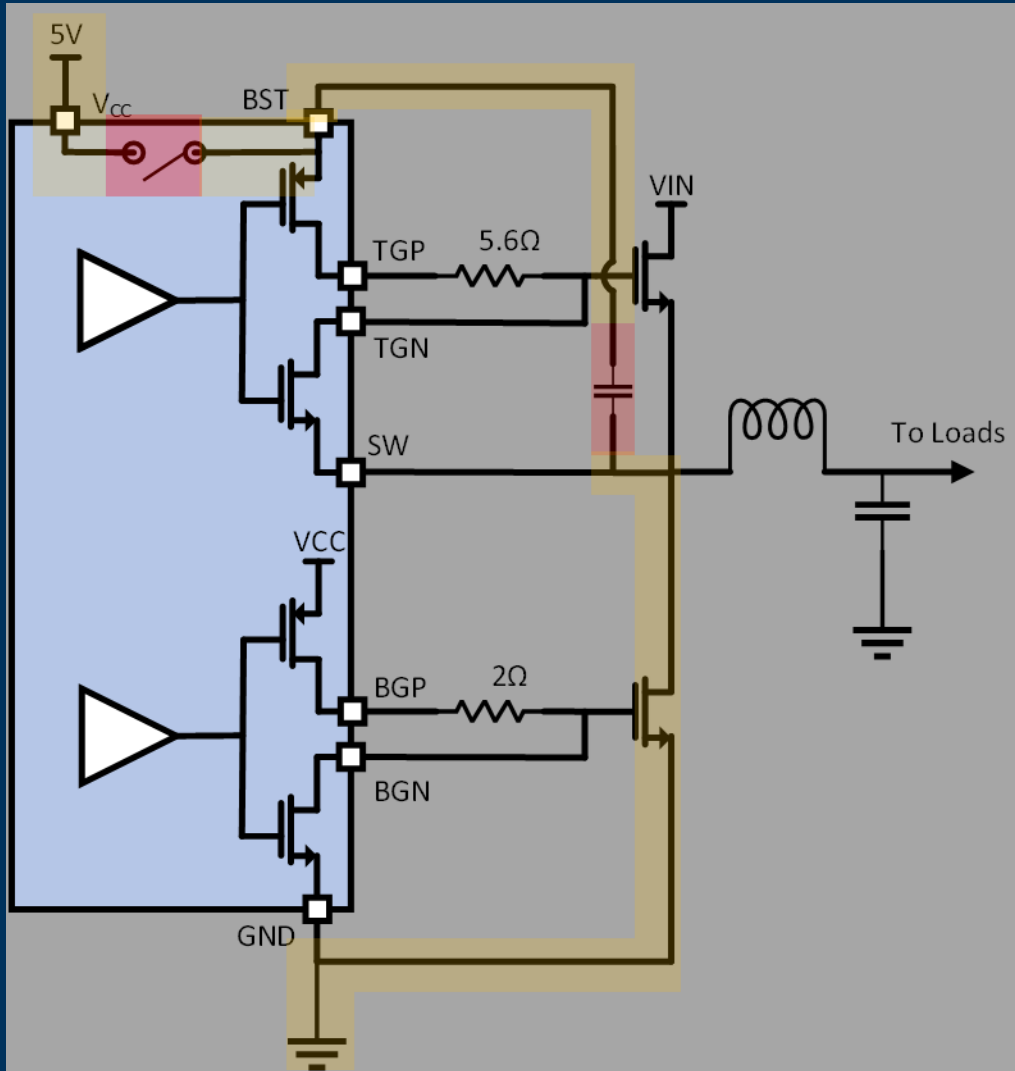
$V_{IN} = 48V$
 $V_{OUT} = 24V$
 $I_{OUT} = 4A$
 $F_{SW} = 1MHz$
 $RTG = 3.9\Omega$
 $RBG = 2\Omega$



Flexible

Split gate drivers for adjustable turn on/off behavior
 4A peak source, 8A peak sink current capability

LT8418 100V Half-Bridge GaN Driver



Smart Bootstrap Switch

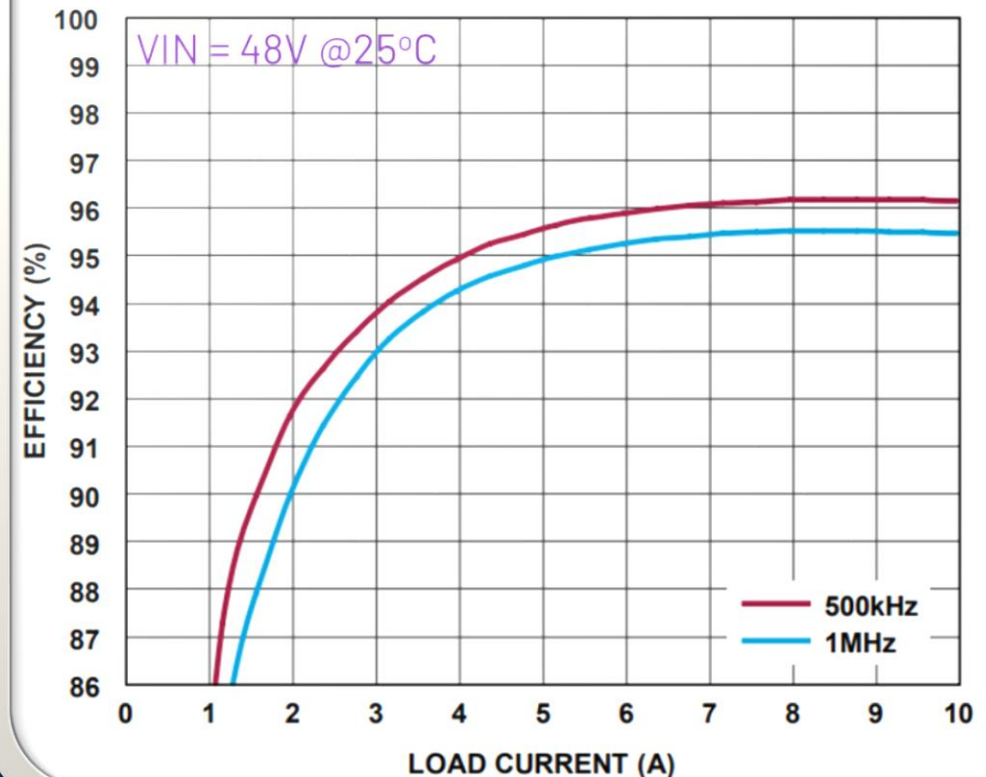
- SW node can go few volts below GND (-2V to -3V)
- Smart bootstrap SW prevents the bootstrap capacitor from being overcharged to enhance reliability of the GaN HEMT.

LT8418 Power Conversion from High Voltage Rail to Low Voltage Rail

- Peak efficiency for 48V to 24V:
 - Above 97% for both 500 KHz and 1MHz
- Peak efficiency for 48V to 12V:
 - Above 96% for 500 KHz
 - Above 95% for 1 MHz

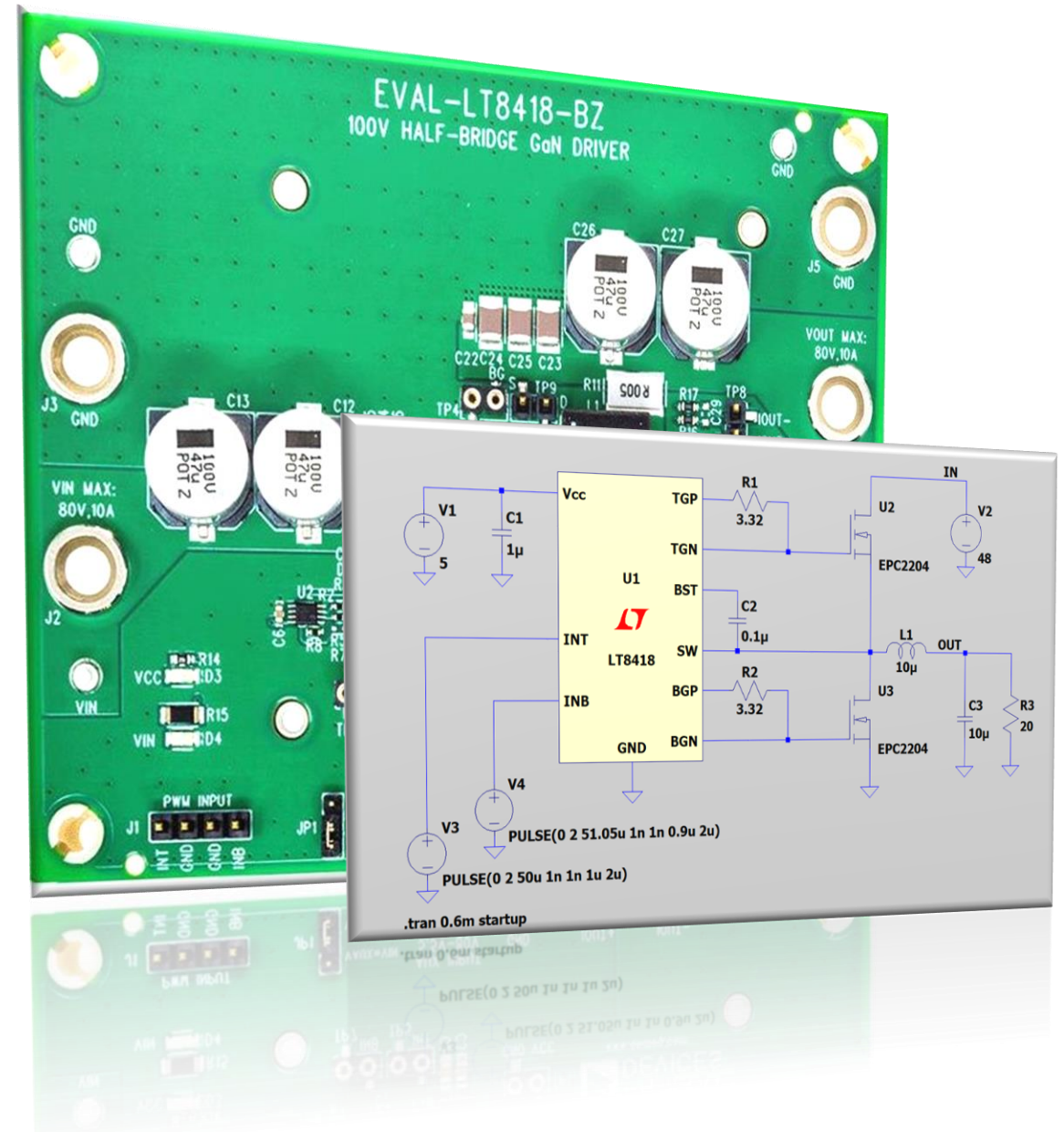
Efficiency vs. Load Current 24V_{OUT}

Efficiency vs. Load Current 12V_{OUT}



LT8418 EVAL KIT

LTSpice Simulation Model





GaN Controller

LTC7890 and LTC7891

analog.com

Robust

Smart

Control

Simple



LTC7890

Low I_Q , Dual, 2-Phase Synchronous Step-Down Controller for GaN FETs



LTC7891

100 V, Low I_Q , Synchronous Step-Down Controller for GaN FETs



LTC7890/1 GaN FET Step-Down Controllers

Features

Robust

- Precise gate drive voltage
- High switching frequency up to 3MHz

Smart

- Smart integrated bootstrap switch
- Smart near-zero dead time

Control

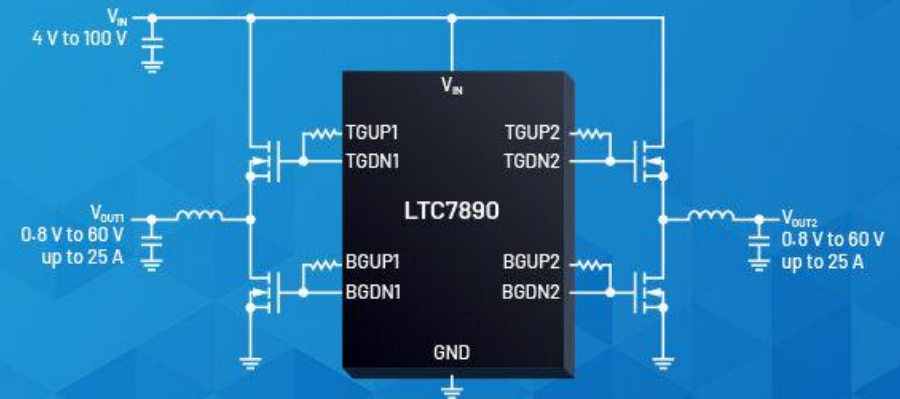
- Split gate drive for pull-up and pull-down
- Dead time control with resistor

Applications

- Data center power
- Lidar devices for automotive, VR/AR, robotics
- Telecommunication
- Medical applications

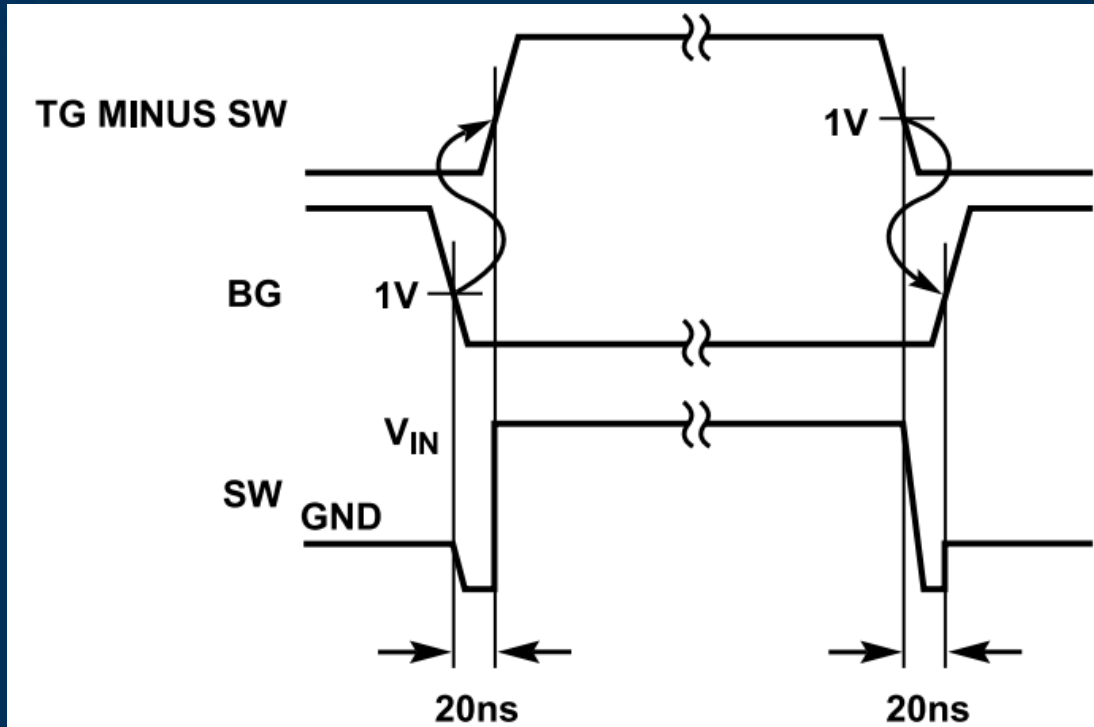
LTC7890

Dual Synchronous Step-Down DC-to-DC Controller for GaNFETs

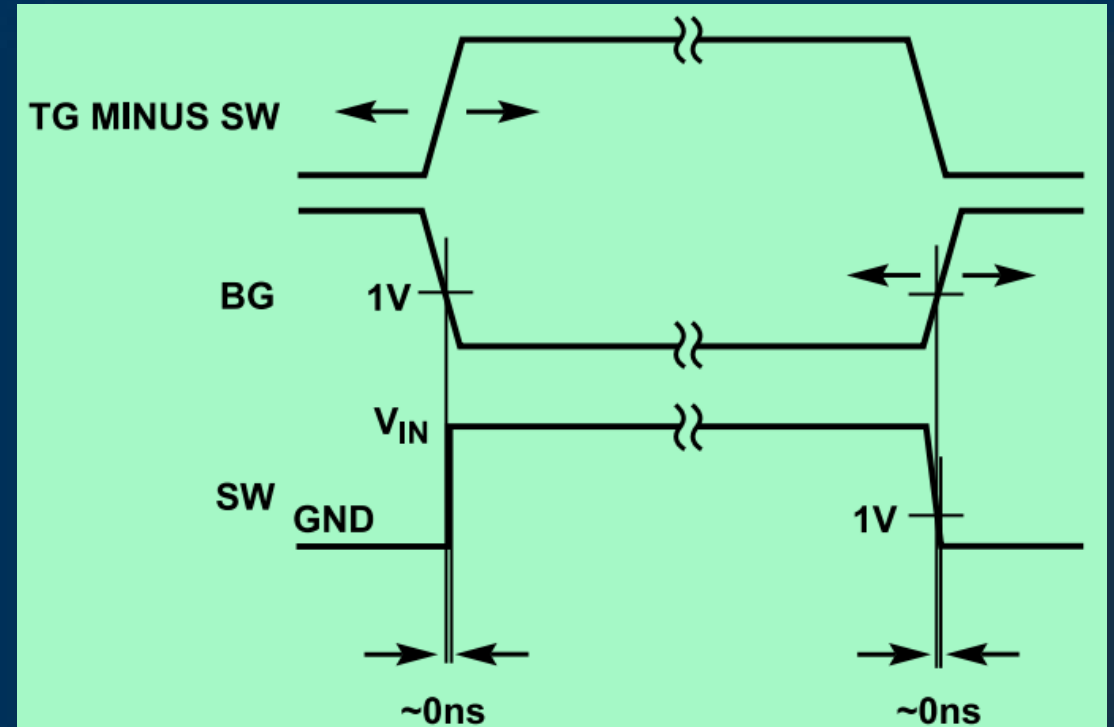


LTC7890/1 Smart Near-Zero Dead Time

Adaptive Dead Time Control

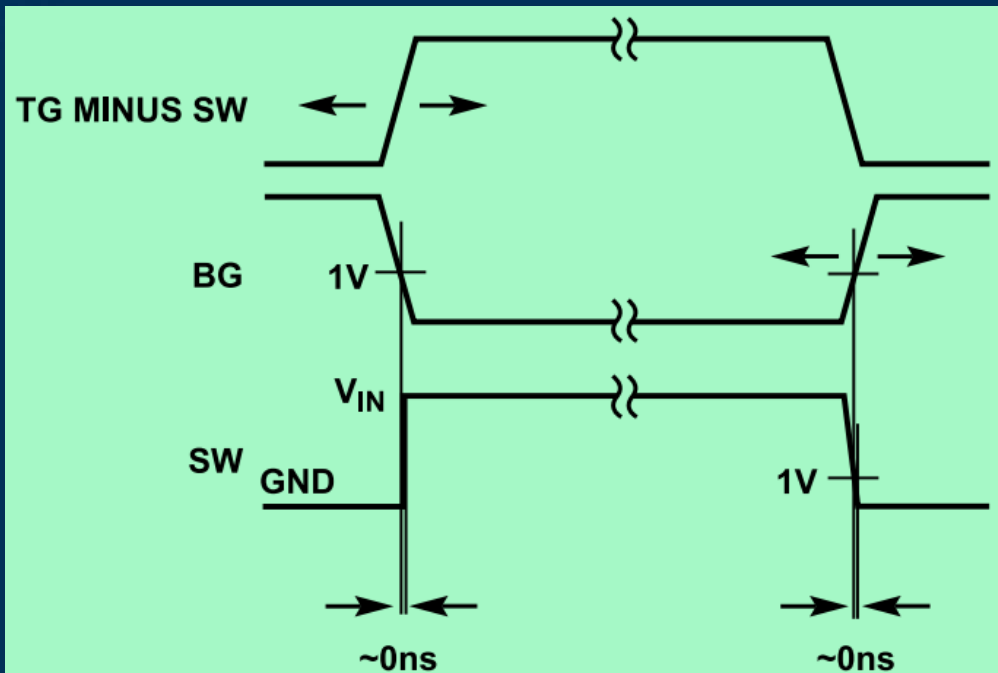


Smart Near-Zero Dead Time Control



LTC7890/1 Smart Near-Zero Dead Time

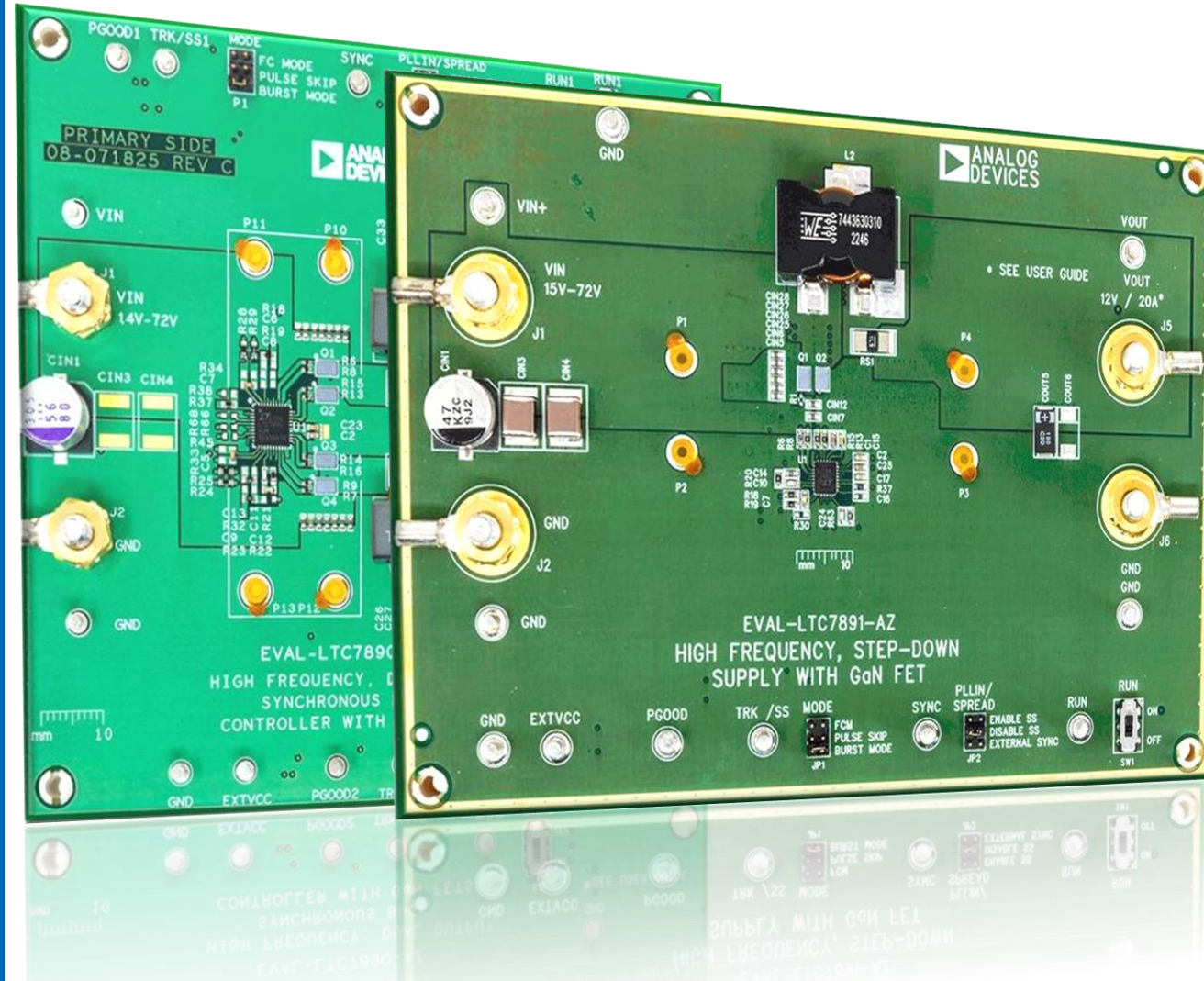
Smart Near-Zero Dead Time Control



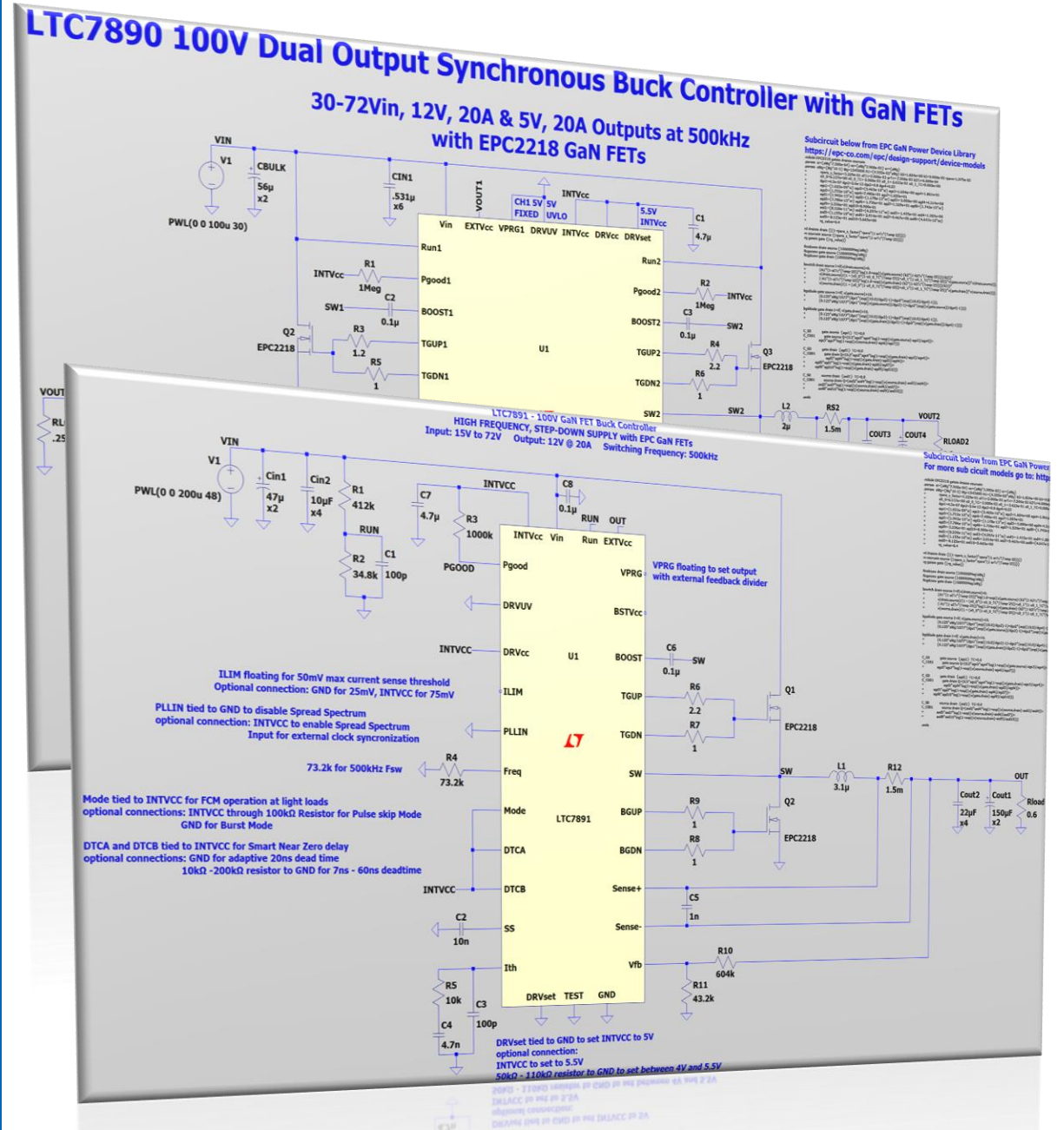
Smart Near-Zero Dead Time Control

- Rising edge of BG and SW is defined as the moment its voltage rises to $\sim 1\text{V}$
- Reduces dead time to near-zero to lower power loss during both FETs being off state
- Increases overall efficiency and maximizes GaN performance

LTC7890/1 EVAL KIT



LTC7890/1 LTSpice Simulation Model



Summary

- GaN provides exceptional performance for high voltage and high-speed switching application.
- A lot of the challenges of using GaN FETs can be mitigated by using ADI's robust and flexible GaN Gate Driver, and GaN controller solutions.
- The LT8418 – 100V GaN FET Driver can support many applications and topologies for reliable GaN FET control
- The LTC7890 and LTC7891 – 100V GaN FET controller is a smart and robust solution for high voltage to low voltage step down conversion

THANKYOU

Q & A

AHEAD OF WHAT'S POSSIBLE

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