# Extending GaN Integration to Higher Power and Faster Speeds

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Efficient Power Conversion

# Speaker Biography

Alex Lidow is CEO and co-founder of Efficient Power Conversion Corporation (EPC). Prior to founding EPC, Dr. Lidow was CEO of International Rectifier Corporation. A co-inventor of the HEXFET power MOSFET, Dr. Lidow holds many patents in power semiconductor technology and has authored numerous publications on related subjects, including co-authoring the first textbook on GaN transistors, GaN Transistors for Efficient Power Conversion, now in its third edition published by John Wiley and Sons. Lidow earned his Bachelor of Science degree from Caltech and his Ph.D. from Stanford.

# GaN Integration

- What problems are we trying to solve?
- What's New?
- What to expect going forward.

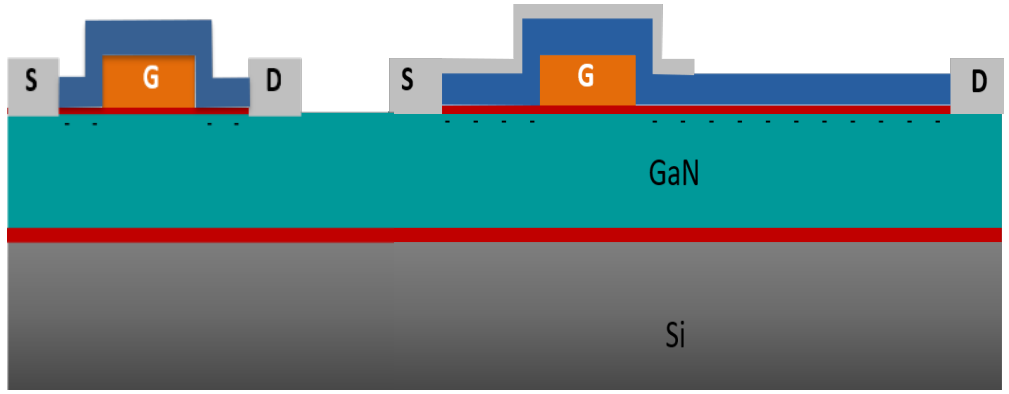
## What Problems are We Trying to Solve?

- Efficiency
- Size and Weight
- Cost
- EMI

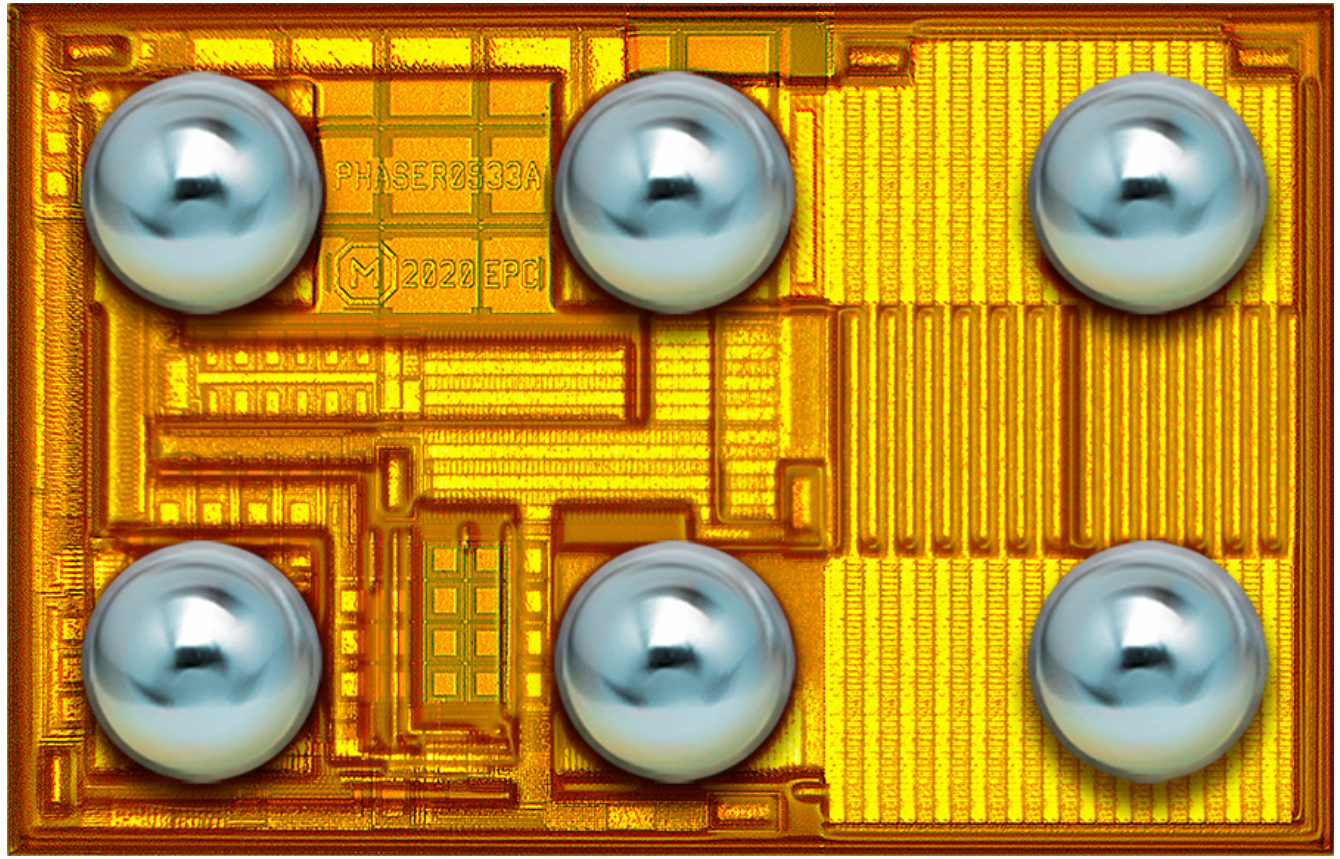
# eGaN FET Plus Driver Integration

**Low Side**
Fixed Ref
Low Voltage
Logic/Analog
GaN Devices

Power
eGaN Device

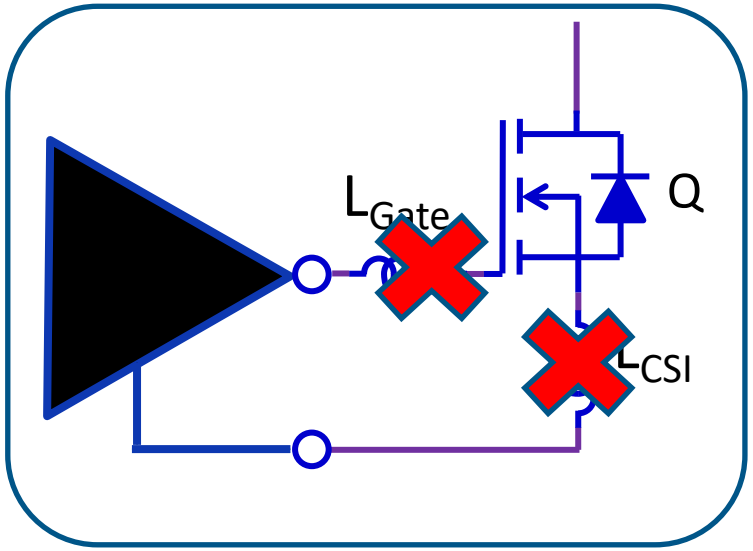


# eGaN® FET Plus Driver

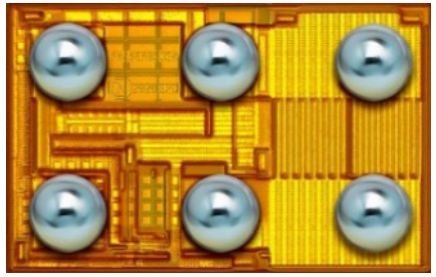



Application that benefits the most:

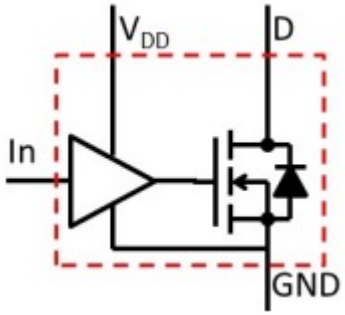
- Lidar



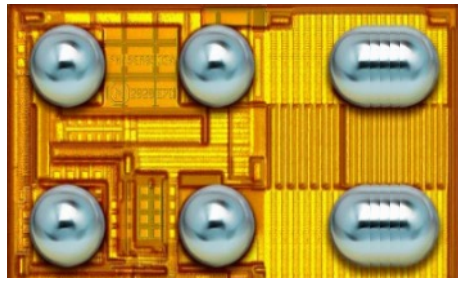
# eToF – Higher Current, Higher Voltage

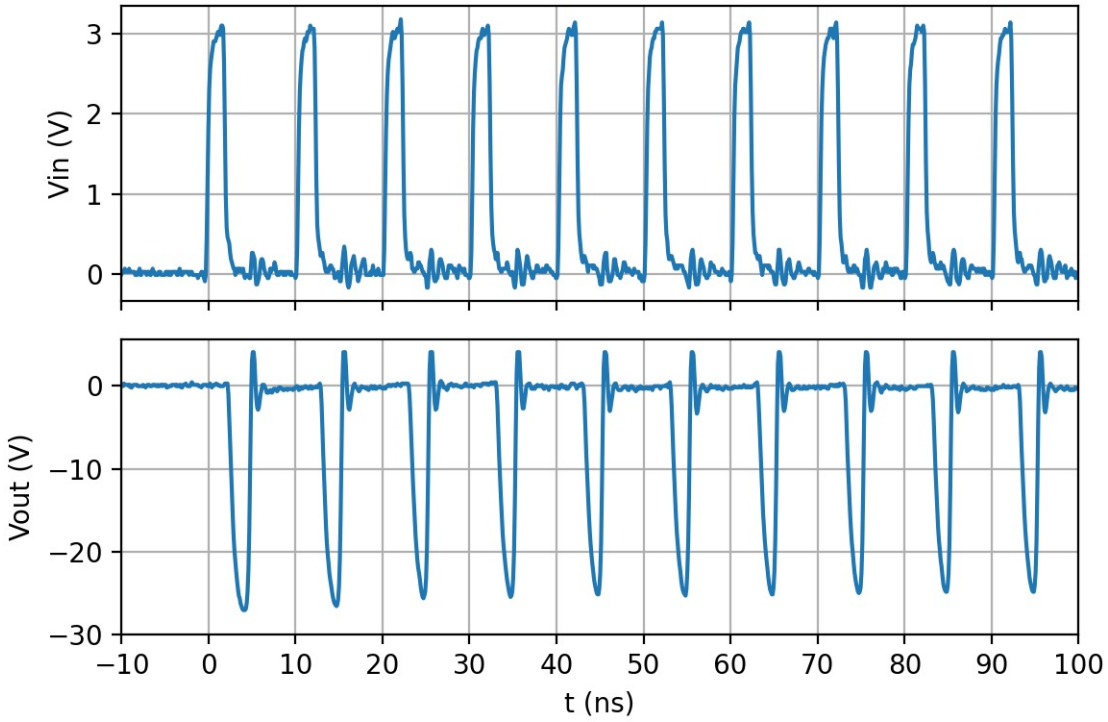


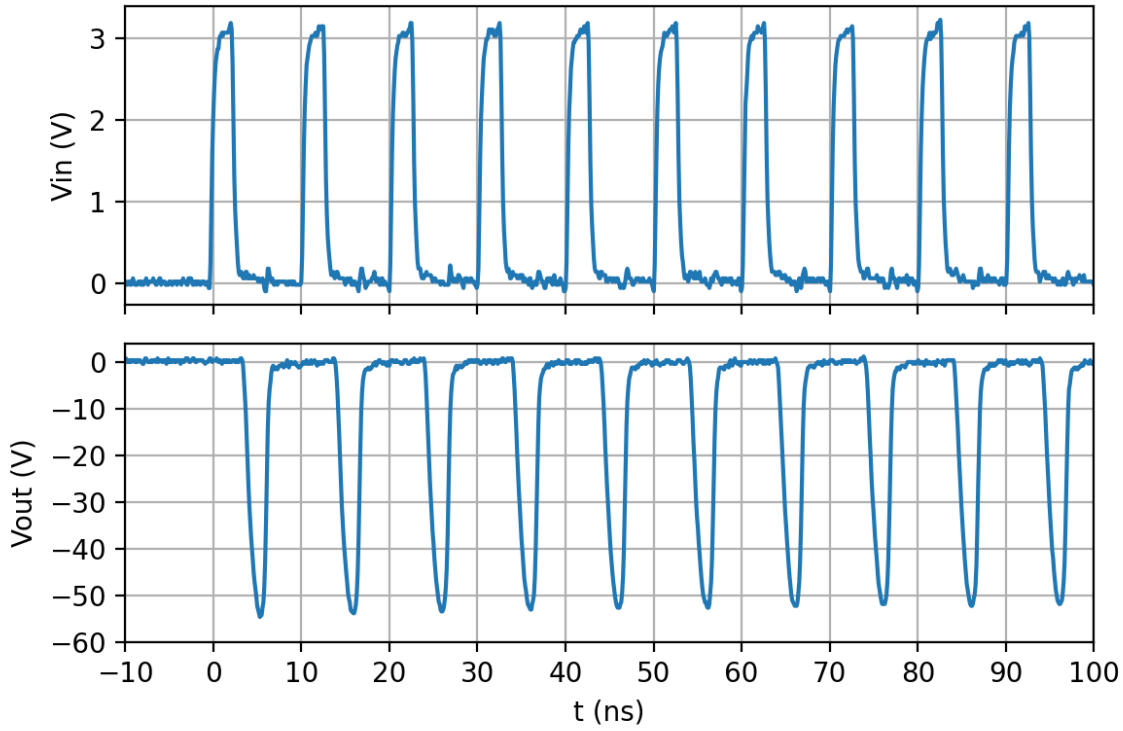
**EPC21601**
**40 V, 10 A**
**pulsewidth=2ns**




**EPC21701**
**80 V 18 A**
**pulsewidth=2.5ns**





# eGaN Power Stage Integration

## Integrated Half-Bridge

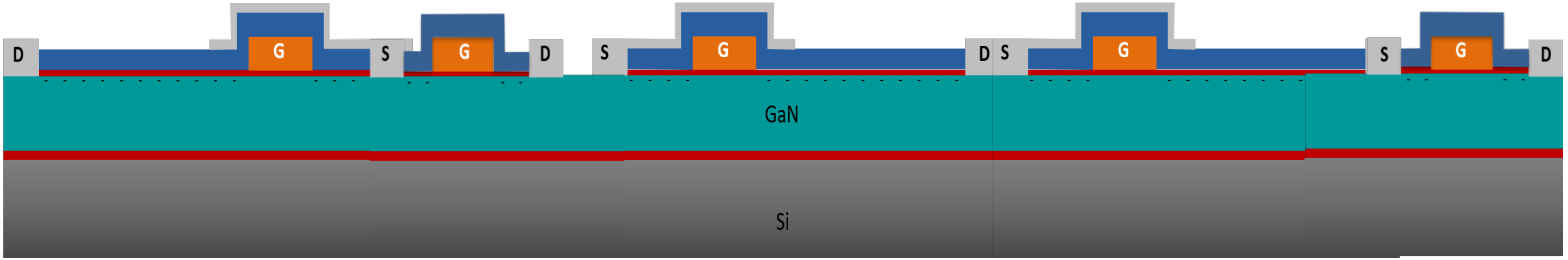
High Voltage Level-Shifting and Analog GaN Devices

**Low Side** Fixed Ref Low Voltage Logic/Analog GaN Devices

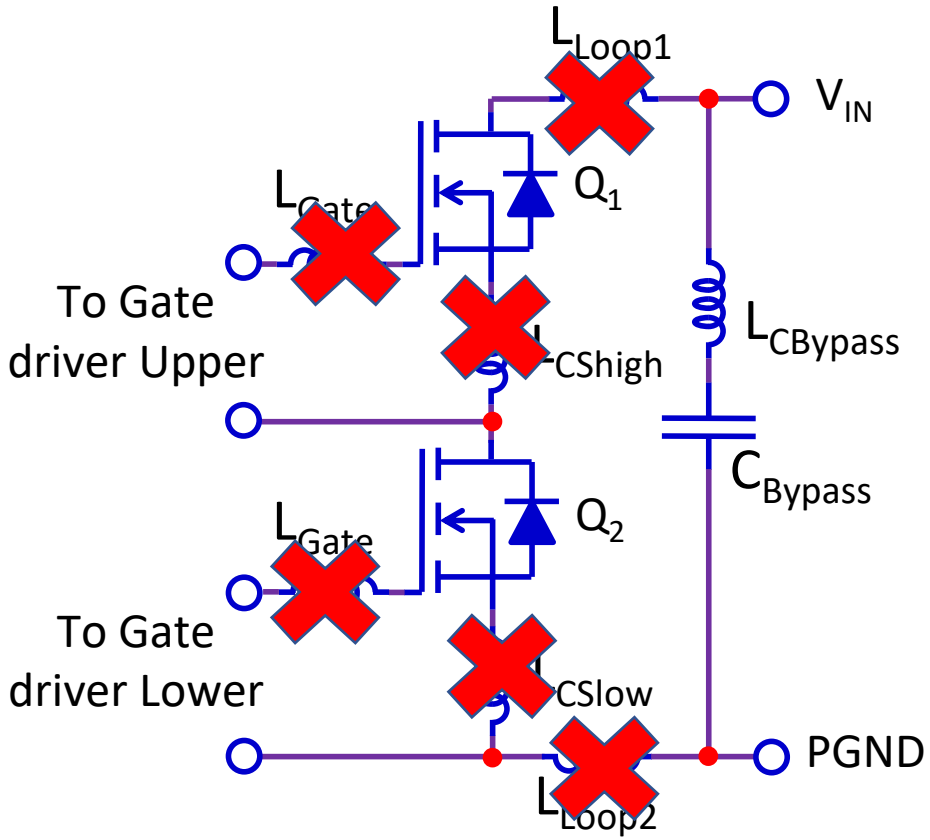
**Low Side** Power eGaN Device

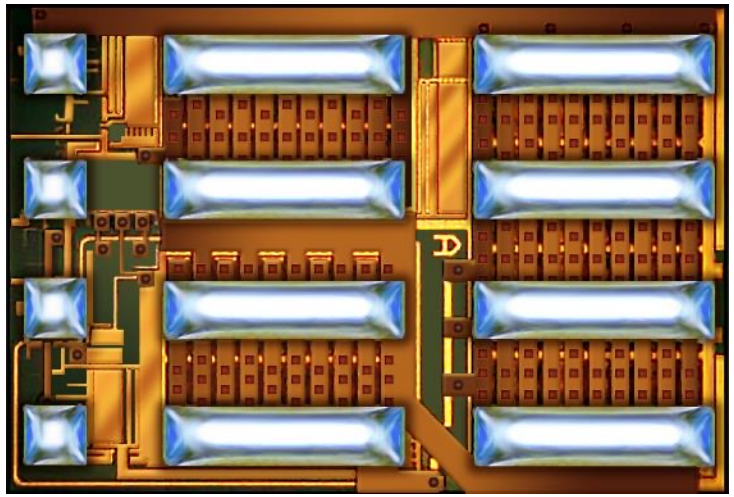
**High Side** Power eGaN Device

**High Side** Floating Low Voltage Logic/Analog GaN Devices



# The Integrated Power Stage



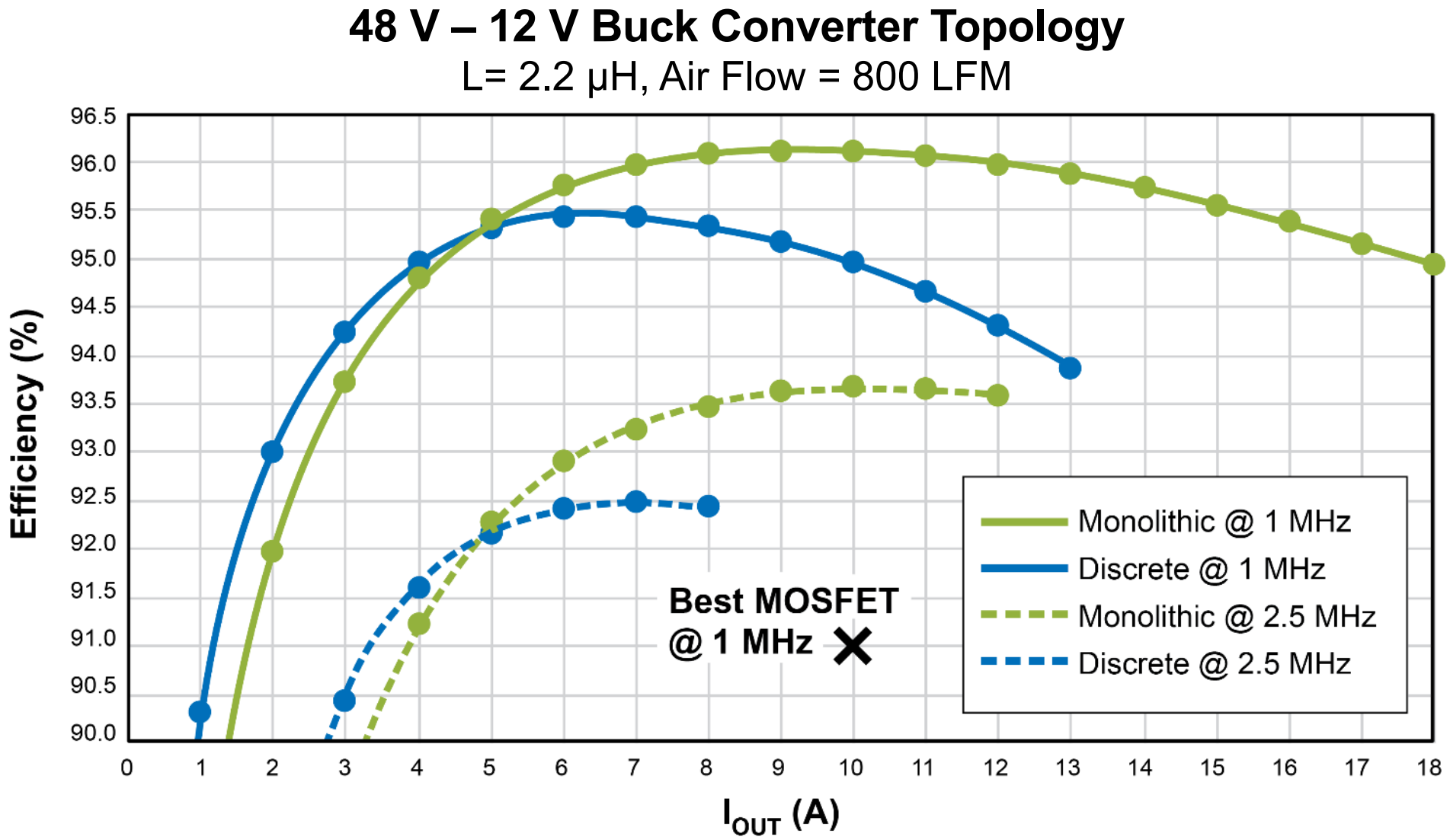



Applications that benefit the most:

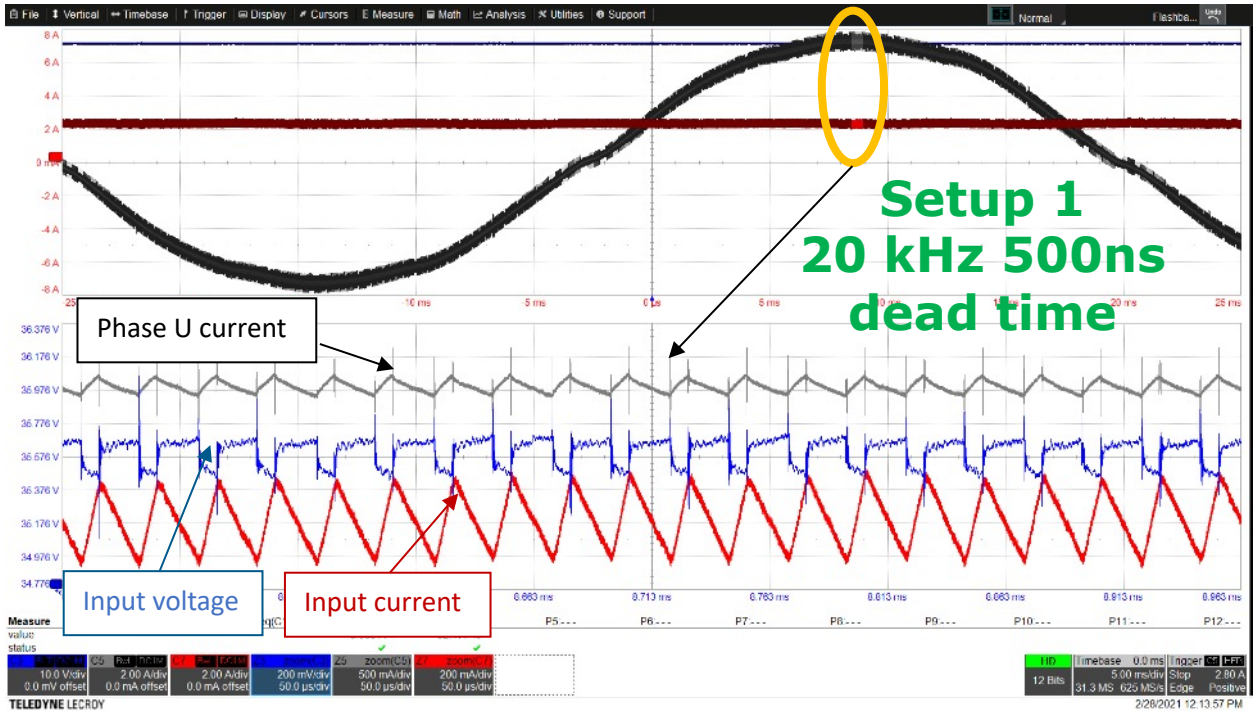
- DC-DC
- Motor Drives

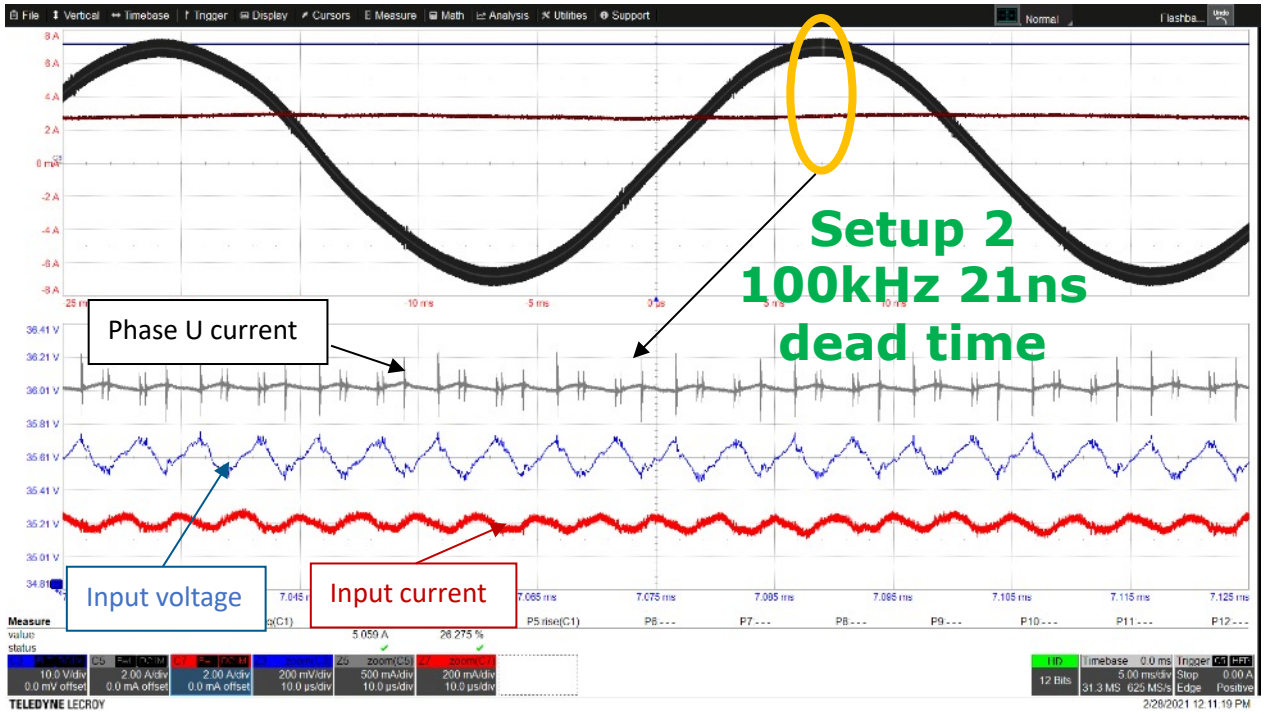
- 35% smaller
- 50% fewer components
- Less design time:
  - Logic In – Power Out
- Better efficiency

# Better Efficiency – Over 96%

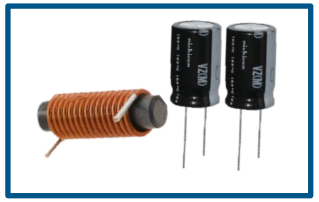


# Higher Frequency Motor Drive with ePower™ Stage

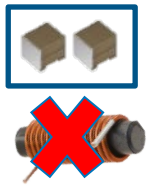



**36Vdc – 5Arms motor phase current**

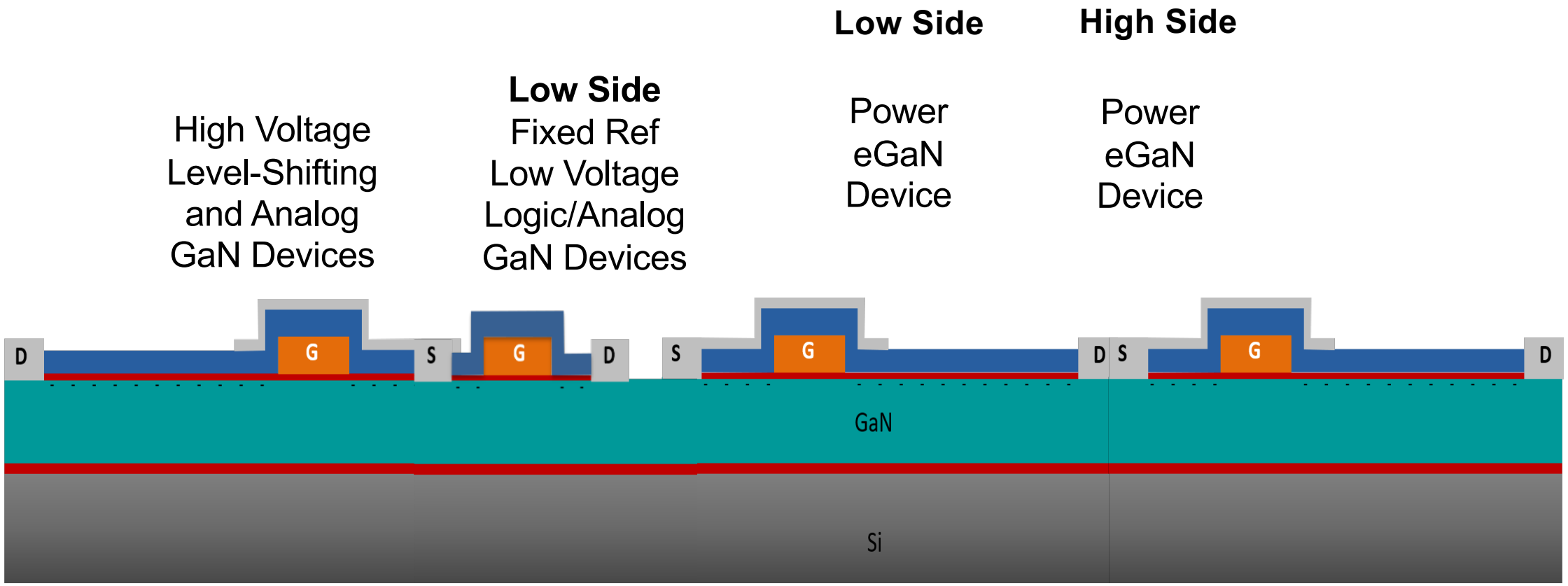


Original LC
input filter
**2.7µH + 660µF**



Ceramic
capacitors
**44µF**

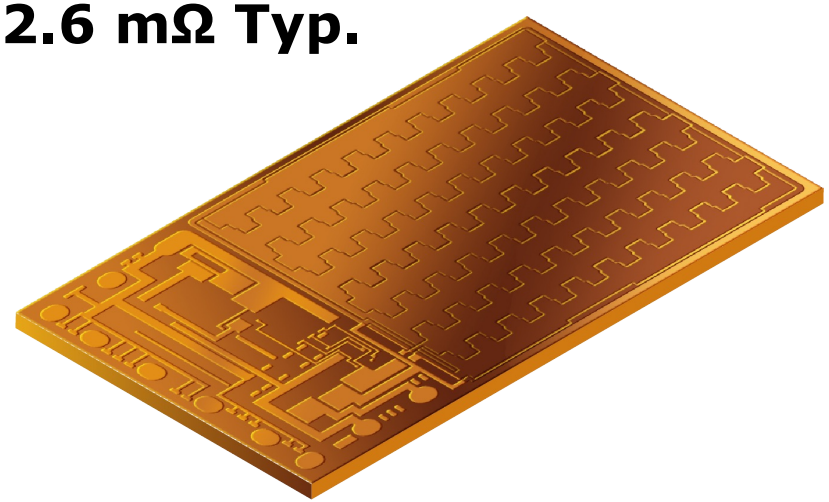
# GaN (Dis) Integration



# ePower™ Chipset – Leading Edge FET Performance

## EPC23101

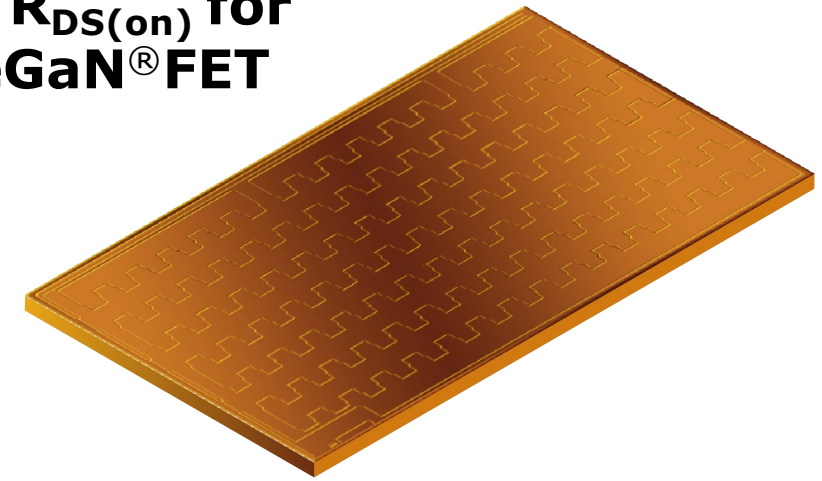
**HSFET is 2.6 mΩ Typ.**



**Optimized for Lower Switching Losses**

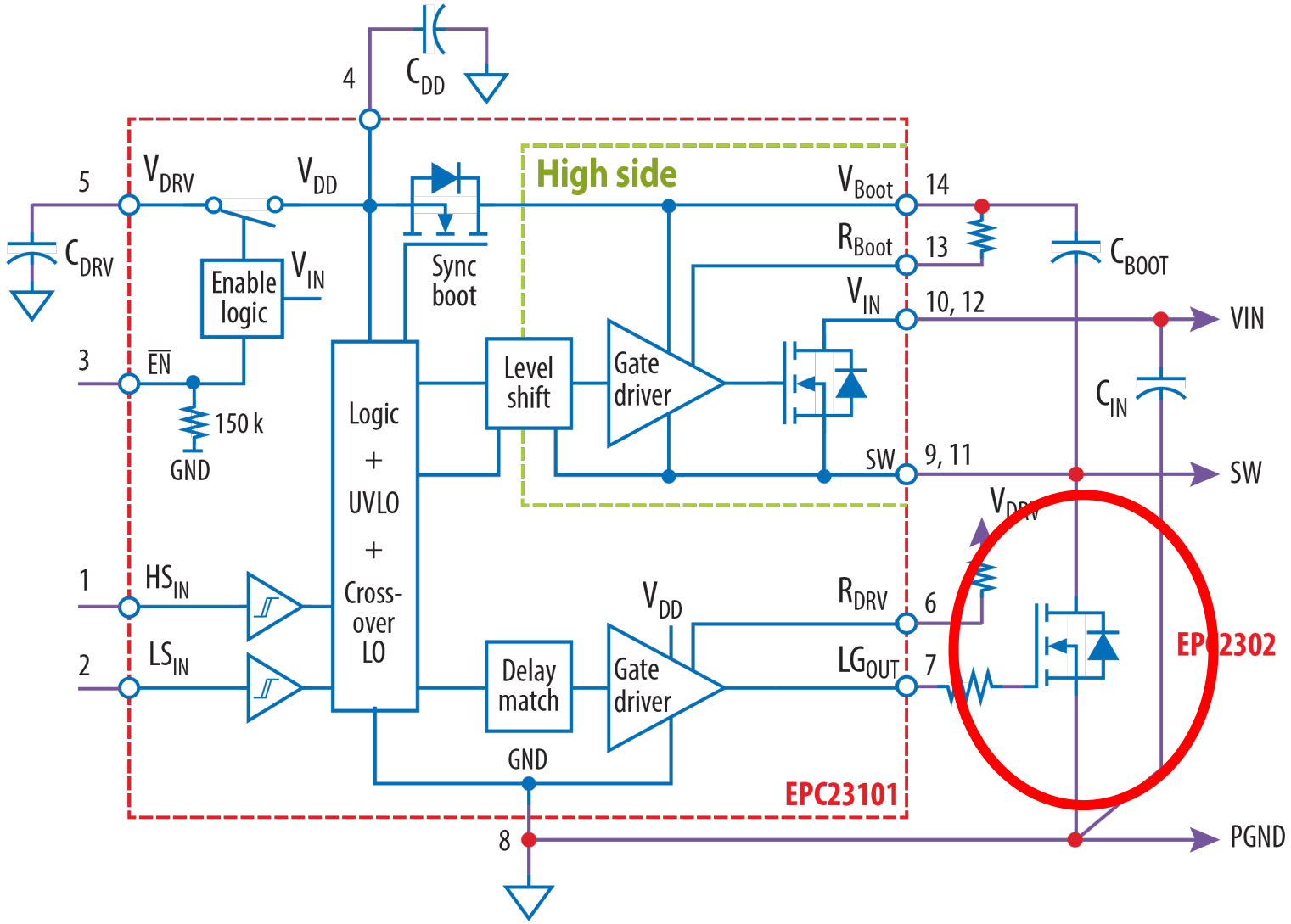
## EPC2302

**LSFET is 1.4 mΩ Typ.**
**Lowest $R_{DS(on)}$ for 100 V eGaN®FET**



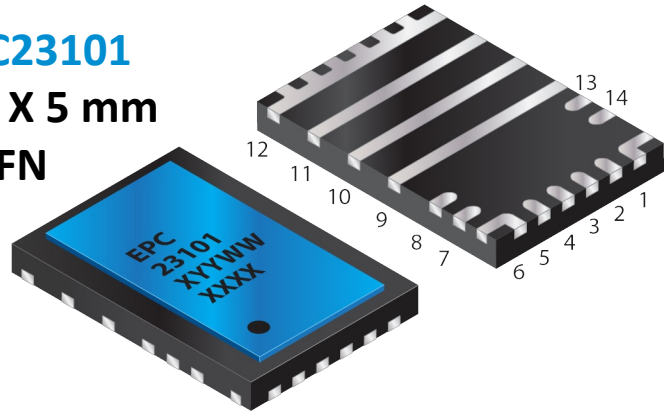
**Optimized for Lower Conduction Losses**

# ePower™ Chipset Block Diagram

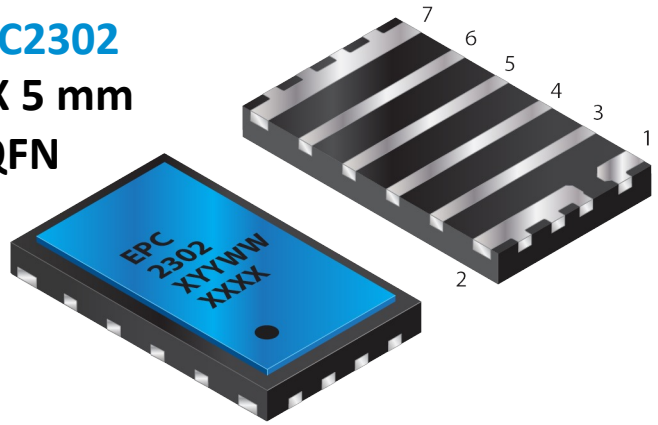


# ePower™ Chipset – Package Features

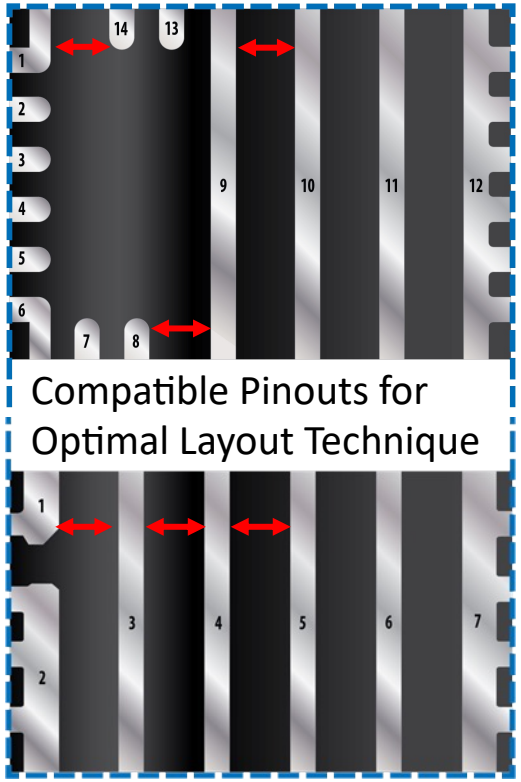
**EPC23101**
**3.5 X 5 mm**
**PQFN**



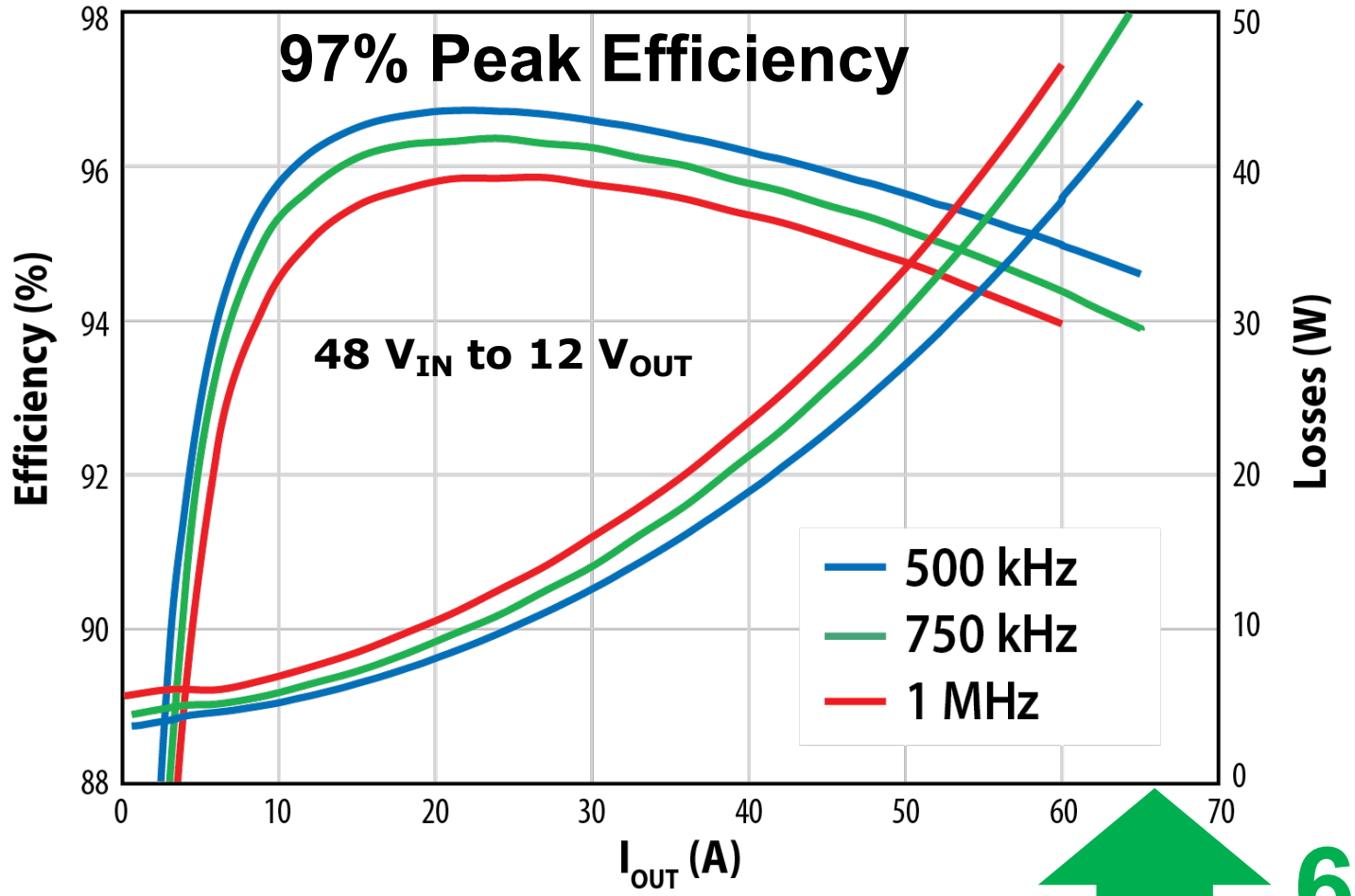

**EPC2302**
**3 X 5 mm**
**PQFN**




**High Voltage to Low Voltage Pads**
**0.6 mm Spacings meet IPC Rules**



# ePower Stage Now Up to 65 A




**Buck Converter**

*$V_{IN}$ = 48 V, $V_{OUT}$ = 12 V,*

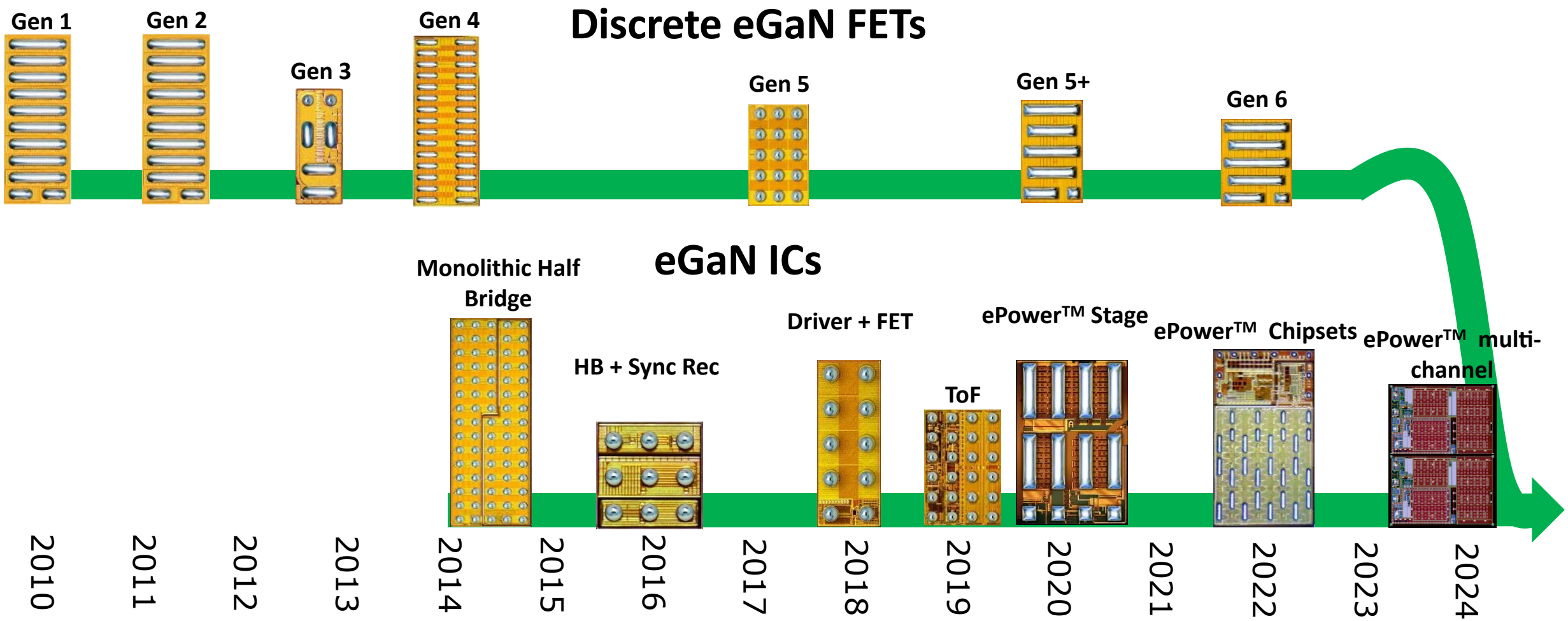
*PWM Freq = 0.5/0.75/1 MHz,*

*L = 2.2 µH, DCR = 0.7 mΩ,*

*DT = 10 ns*

**65 A**

# The Journey Continues…



# GaN Integration – Benefits

- Higher Efficiency
- Lower EMI
- Lower Component Count
- Shortened Design Time To Market
- Saved Precious PCB Area
- Reduced Cost