GaN Integrated Circuits and the Next Generation of Power Conversion Systems

Efficient Power Conversion
GaN IC Device Structure

High Voltage Level-Shifting and Analog GaN Devices

Low Side Fixed Ref Low Voltage Logic/Analog GaN Devices

Integrated Half-Bridge

Low Side Power eGaN Device

High Side Power eGaN Device

High Side Floating Low Voltage Logic/Analog GaN Devices
Introducing the Integrated Power Stage

Preliminary information and specifications. Subject to change without notice.
We make it EASY

50% Easier to Design

✓ **LOGIC IN POWER OUT**, no need to design sensitive gate drive and high dv/dt circuits
✓ **EASIER TO LAYOUT**, less parasitic, less routing, high dv/dt signals now confined inside the chip
We make it SIMPLE

Discrete eGaNs (6+6 Bumps) + Gate Driver (12 Bumps) → Single Chip with 12 Bumps

50% Less to Assemble

✓ LESS SOLDER BUMPS, 24+ Bumps to 12 with larger pitch
✓ LESS CHIPS, one integrated chip vs 3 discrete chips + other components
33% Smaller in Size on PCB

- Total size = 20mm² vs 30mm² not including Synchronous Bootstrap + Input Caps
- Total number of components = 6 vs 13
We make it FAST

V_{IN} = 48 V, V_{OUT} = 12 V, I_{OUT} = 10 A, f_{SW} = 500kHz, L = 2.2 \mu H

- **1MHz+** PWM Switching Frequency
- **1ns** Tuned Switching Time at Rated Load
We make it **EFFICIENT**

- **95%** Efficiency for 48V to 12V Converter
- **40%** lower losses than MOSFETs

Buck Converter Efficiency
for L=2.2uH

\[ V_{in} = 48V \]
\[ V_{out} = 12V \text{ (duty = 25%)} \]

PWM Freq = 1MHz

DT=10ns

**EPC2151 on EPC90119**

**EPC2152 on EPC90120**

Best MOSFET efficiency
Typical Application: DC/DC Converters

**Synchronous Buck Converter**
- Vin = 12V to 60V
- Isw = 10A+
- Switching Frequency = 1MHz+
- Duty Cycle = 2% minimum @1MHz
- Deadtime = 10ns typical

**LLC Resonant Converter**
- Vin = 12V to 60V
- Isw = 10A+
- Switching Frequency = 1MHz+
- Duty Cycle = 50%
- Deadtime = 10ns typical
Typical Application: BLDC Motor Drive

- HV PSU
- 3V3
- 12V
- Voltage sense
- Current sense amplifiers
- Optional Sinewave Filter
- PMSM
- EN
- To/From Controller Interface board
- Inverter Board
- Vc
- Va
- Vb
- GND
- V_{IN} up to 80 V

Typical Application: BLDC Motor Drive

- EPC – The Leader in GaN Technology
- www.epc-co.com
Why eGaN ICs for Motor Drives

- More output at smaller size
- Faster response
- Lower torque ripple
- Lower EMI
Monolithic HB + Drivers: What’s Next

Additional functions

• Over Temperature Protection
• Over Current Protection
• Complementary logic and dead time control
Why GaN ICs?

• Easier Design
• Smaller Size
• More Efficient
• Lower EMI
• Fast-moving roadmap
The end of the road for silicon…

but a clear road ahead for GaN FETs and ICs!