

# High Performance 3D Integrated Synchronous Buck Converters

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# Market demands

- **Power density (Higher power in smaller space)**
- **Less time-to-design / greater ease of use**
- **Greater integration with more outputs and fewer components**
- **Dynamic control & faster transient response switchers**
- **Greater precision / accuracy**
- **Lower energy (more efficient) solutions**

**Power packaging and integration plays an increasingly important role.**

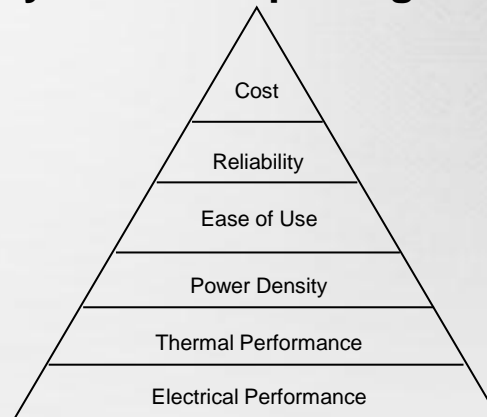
# Value proposition for 3D integration

## Advantages :

- 3D stacking enables miniaturization and drives power density
- Integration enables ease of use with reduced PCB layout complexity and ease of SMT
- Integration enables improved efficiency, faster switching and reduced ripple / EMI

## Challenges :

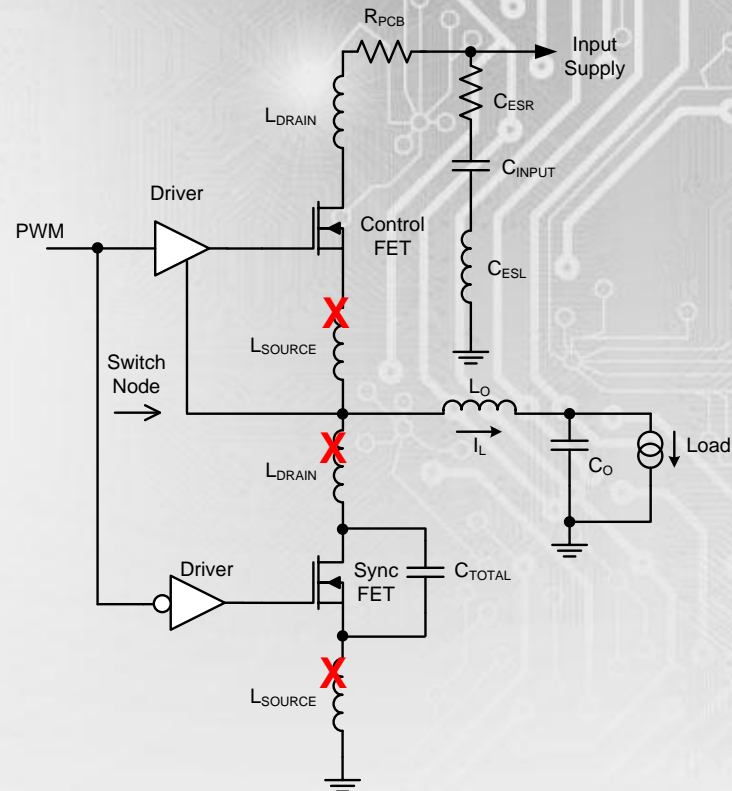
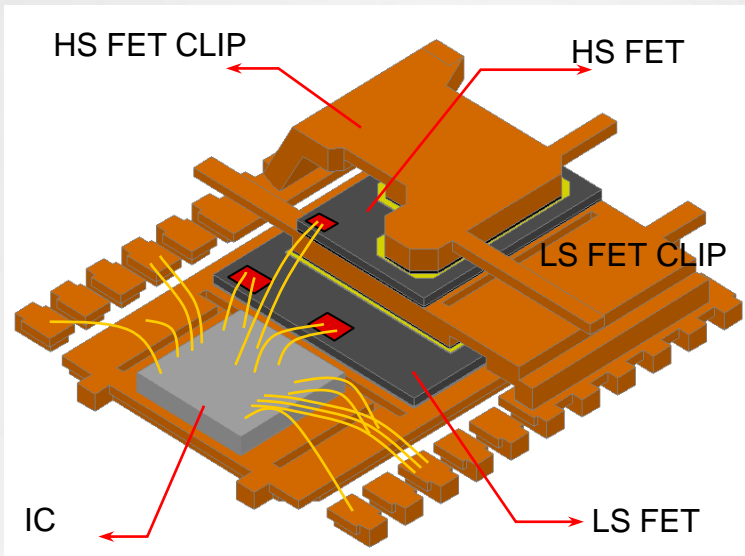
- Thermal management – understanding the system
- Package complexity / reliability – manufacturing excellence and innovative design
- Cost – innovative assembly flows and package structures



# Power density: PowerStack™

## Reduction of package parasitics

- Stacked NexFET™ , ~ 2X greater power density
- Low resistance Cu clips, ~ 30% lower power loss
- Ability to optimize and deliver higher efficiency

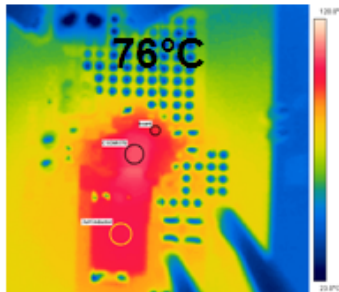
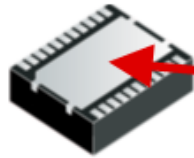


# Power density: PowerStack™

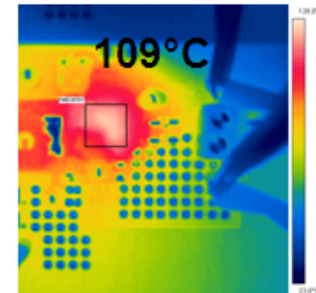
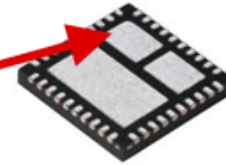
## Improved thermal management and PCB layout

- Single grounded DAP

### Reduced Inductance Package



### Std Side By Side Package



Larger Ground Pad Enable  
More Vias in Low Noise  
Location

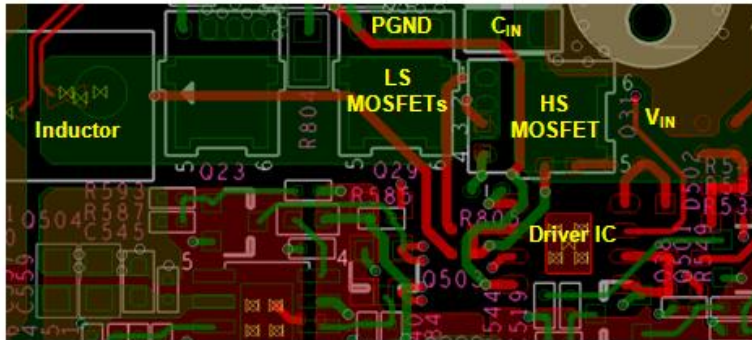
Up to 30°C Lower with a  
Optimized Solution

# Power density: PowerStack™

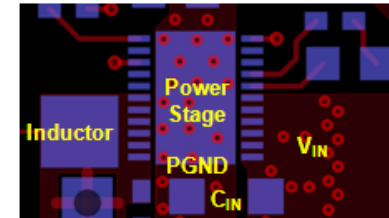
## Improved thermal management and PCB layout

- Simple PCB layout for optimized performance

Traditional Complex Discrete Layout



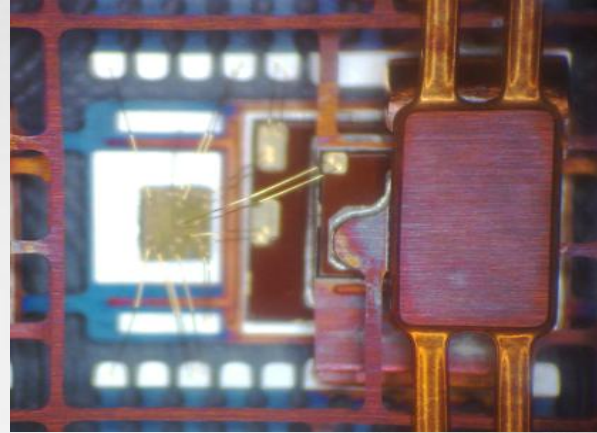
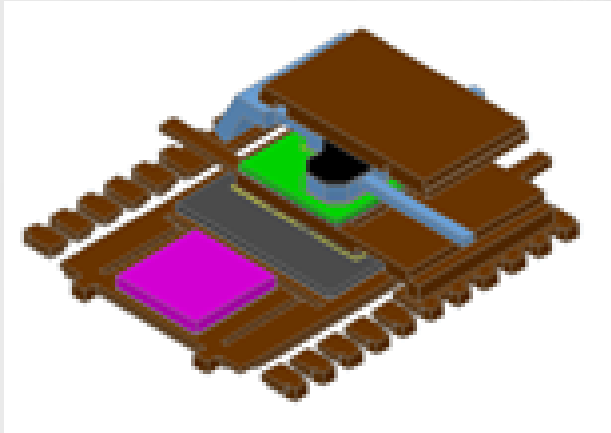
Simple Integrated PowerStage Layout



Integrated: simple layout, optimized for size and performance

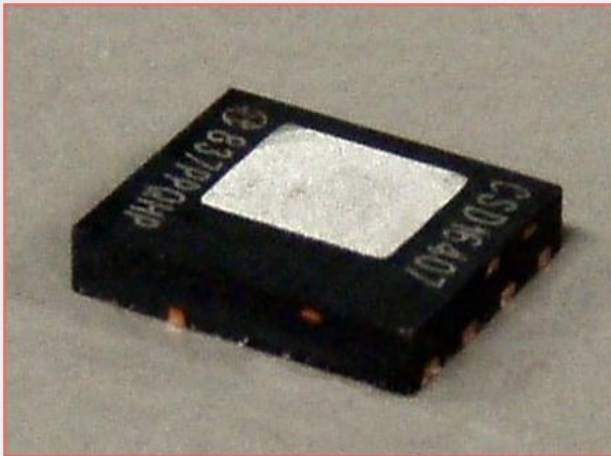
Package impact can be equivalent to 2 generations on silicon improvement!

# Improved performance with 3D integration

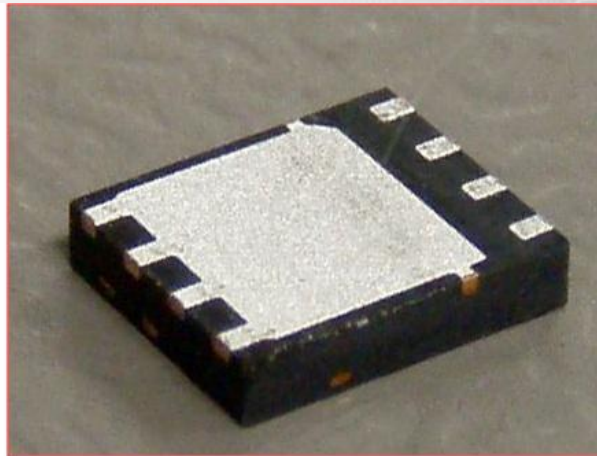


## DualCool™: Key improvements

- Enables top side Cooling
- 30% higher power dissipation
- Higher current capability

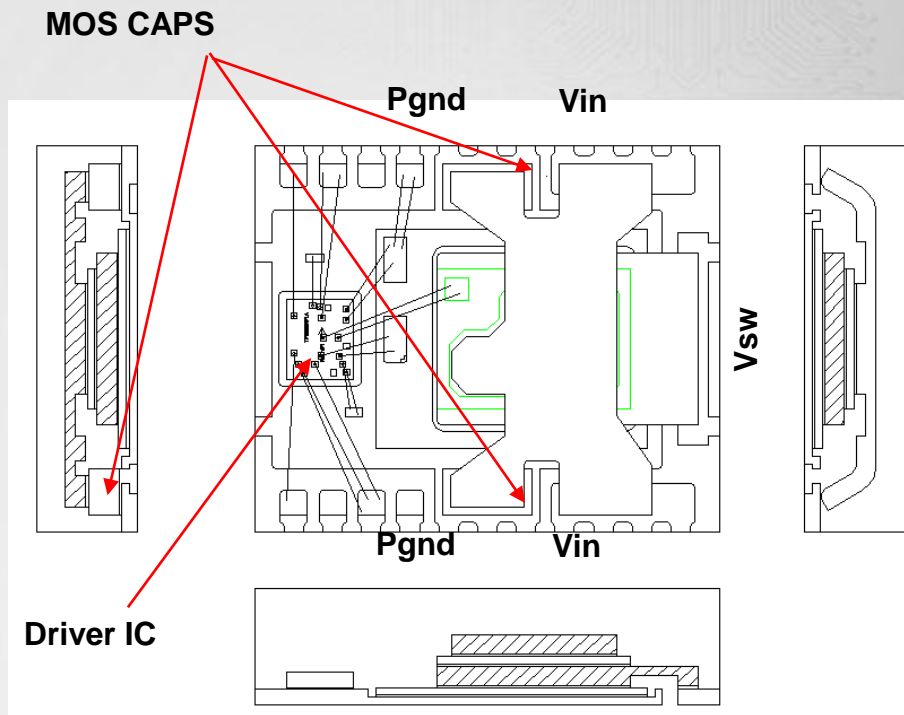


Top view



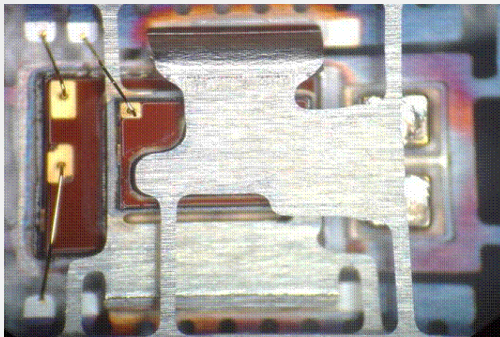
Bottom view

# Improved performance with 3D integration



## Integrated passives: Key improvements

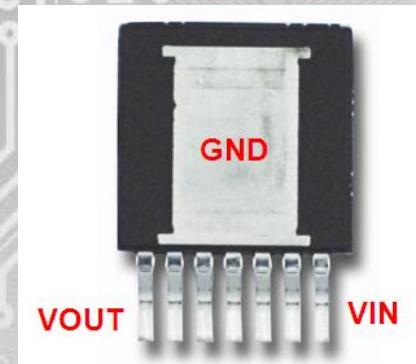
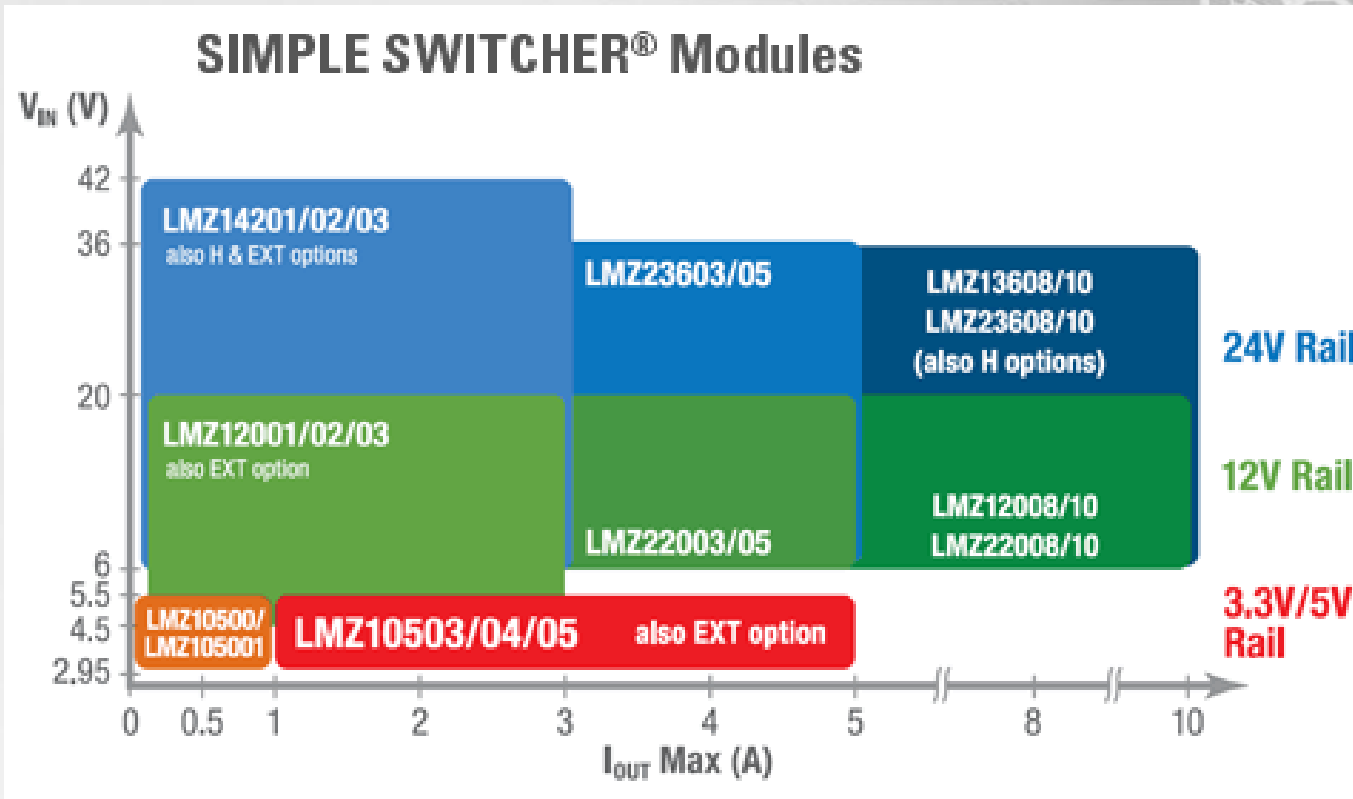
- Integrated  $V_{in}$  capacitors
- Ringing reduced by 40%





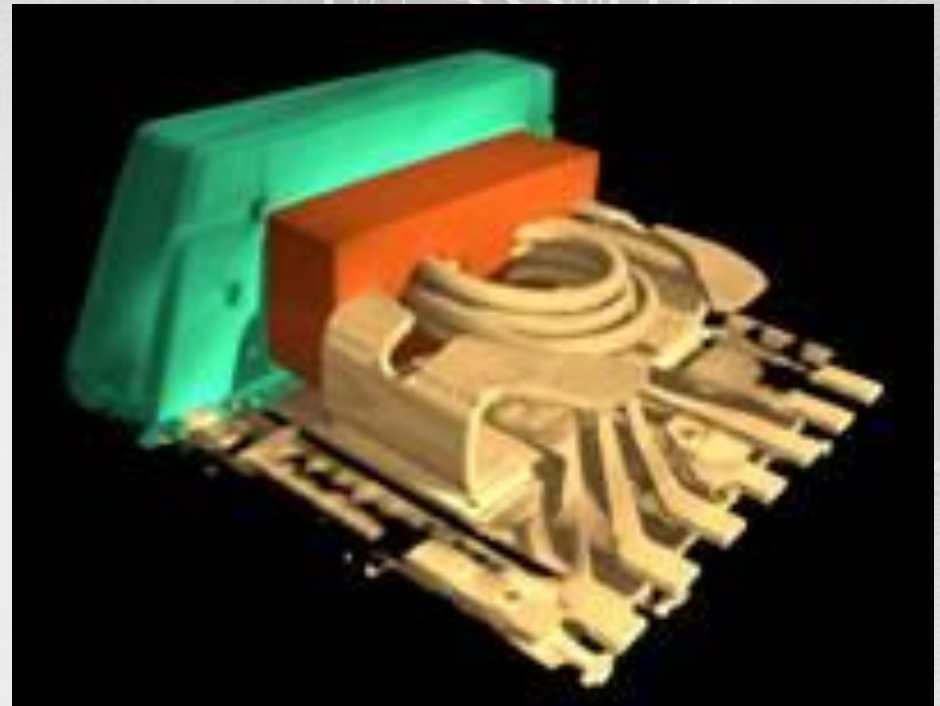
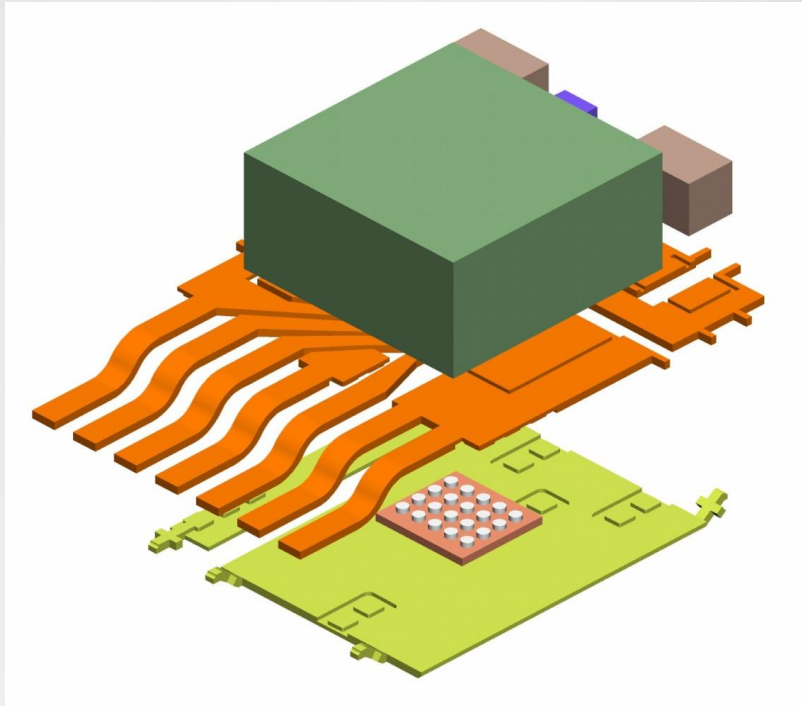
# Ease of Use – SIMPLE SWITCHER® Power Modules

Industry's first TO-263 style integrated module



# Ease of Use – SIMPLE SWITCHER® Power Modules

Industry's first TO-263 style integrated module with dual leadframe



# SIMPLE SWITCHER® Power Module – value advantage

## Ease-of Use Packaging

- Single exposed pad with IC leads
- Easy prototyping and manufacturing

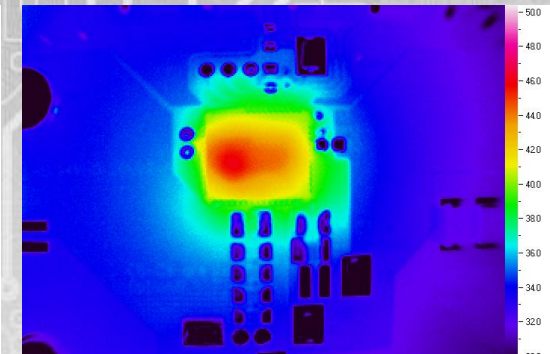
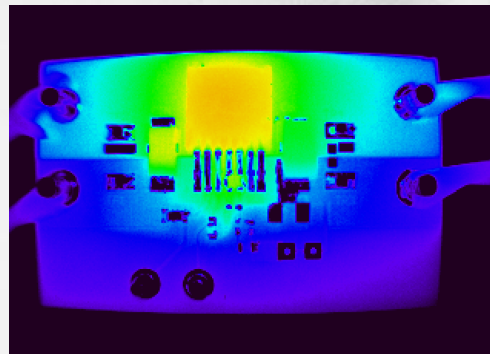


SIMPLE SWITCHER®

Competitors

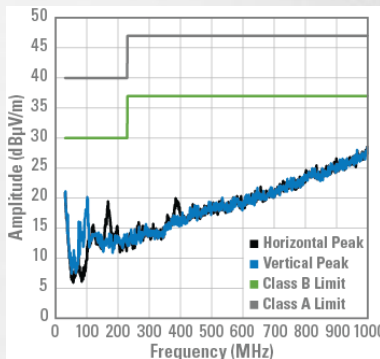
## Heat Dissipation

- Best-in-class thermal performance
- No airflow required



## Low EMI with Shielded Inductor

- Ideal for noise-sensitive applications



LMZ22010 Radiated Emissions

# Conclusions

❑ **3D integration in Power Packaging is a critical element to creating a strong value proposition**

- **Reduced parasitics and noise**
- **Improved power density and thermals**
- **Significant ease of use**
- **Superior solution reliability and cost**

❑ **Future integration**

- **High voltage**
- **Isolation**
- **High accuracy current sensing**
- **Integrated magnetics**

