Package Integration for High Efficiency and High Power Density

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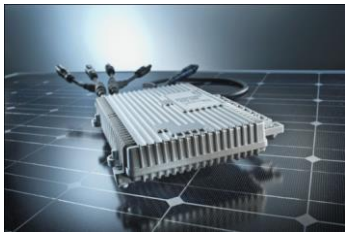
Outline

- Isolation Applications
- Transformer Integration for Isolated DC/DC
- Magnetics Integration for On-Chip Transforms
- Magnetics Integration Through PCB: uModules
- PCB Magnetics Integration Using Ferrite Plates
- PCB Embedded Magnetics
- PCB Embedded Magnetic Layers
- Package Power Density & Efficiency Comparisons
- Conclusion

Isolation Necessary For Many Power Supply Applications

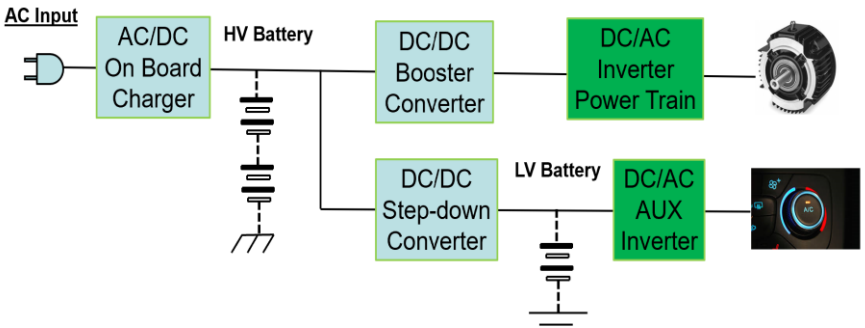
PV Inverters



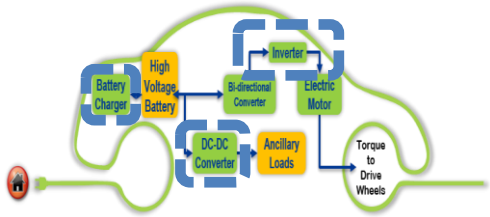
AC/DC Power Supply

LED Driver

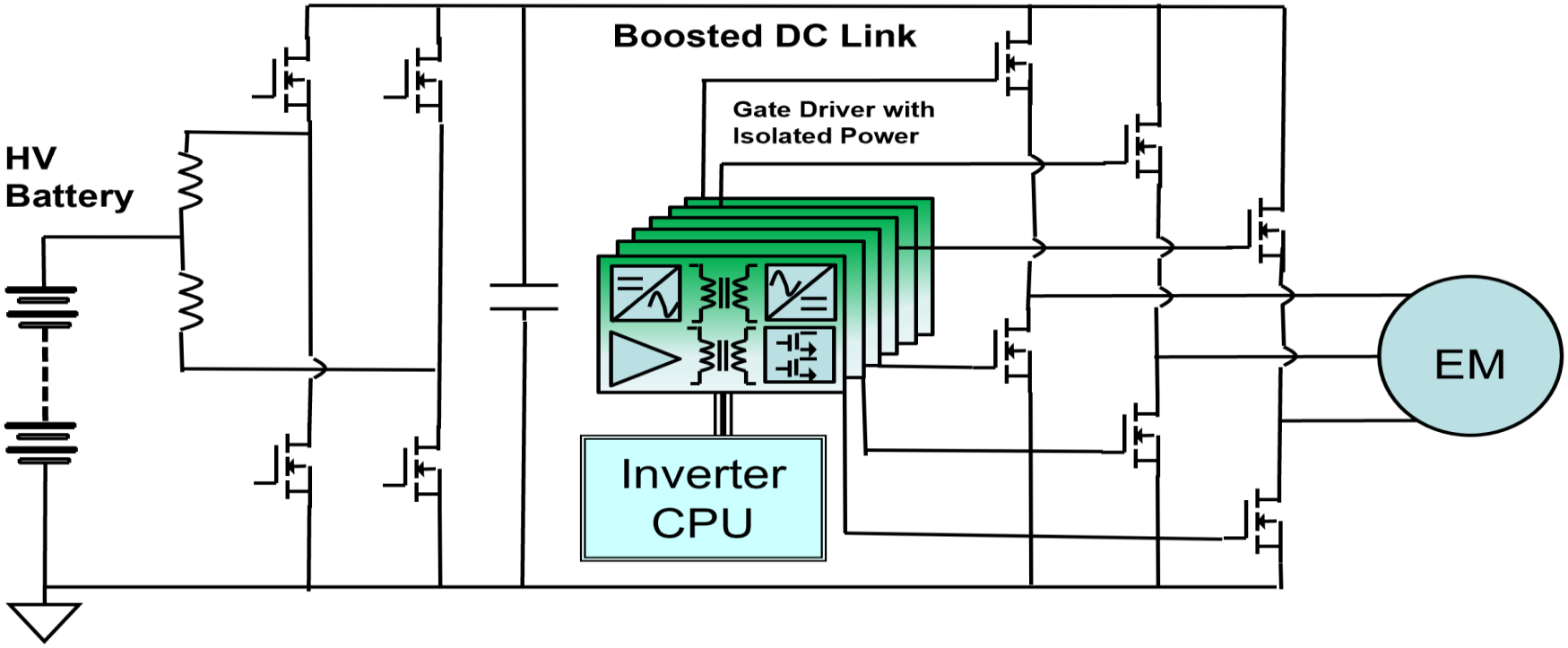
Motor Control
Sensing & Gate Drive



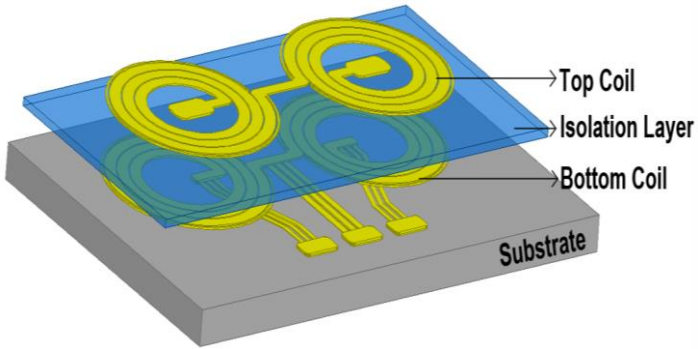
eV

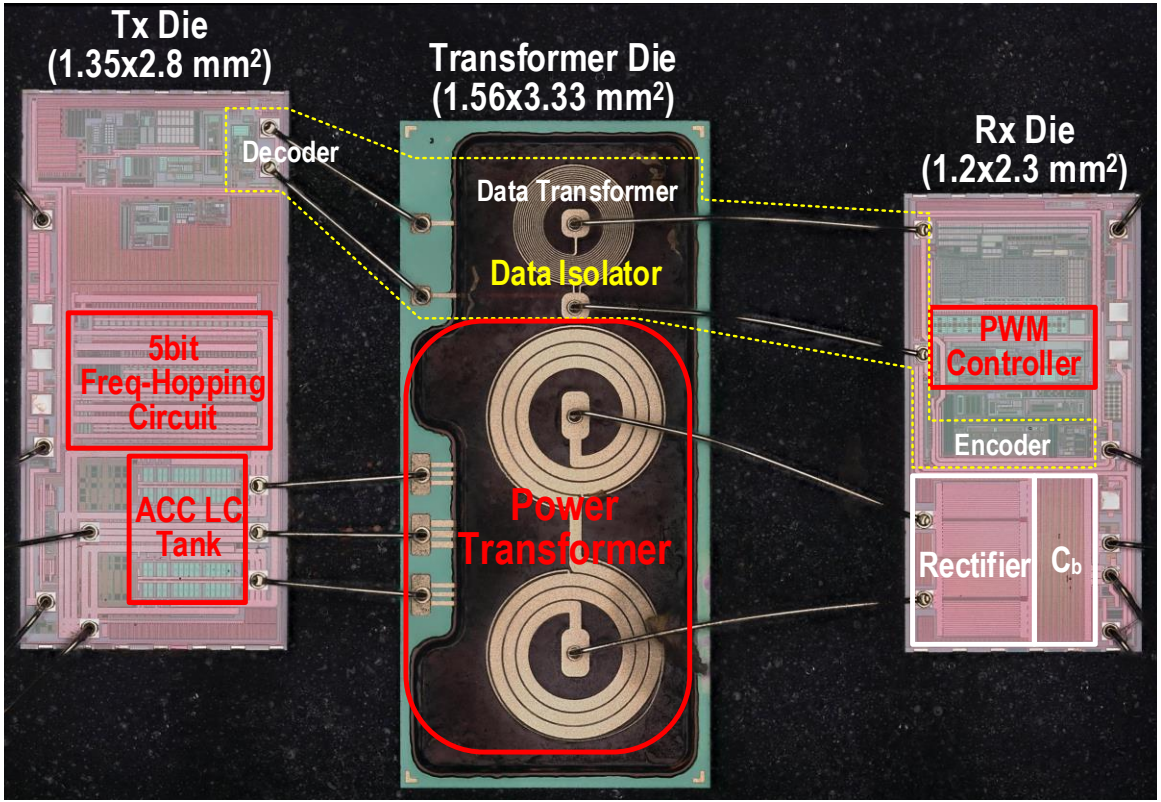


Isolated DC/DC Converters for EV Power Train

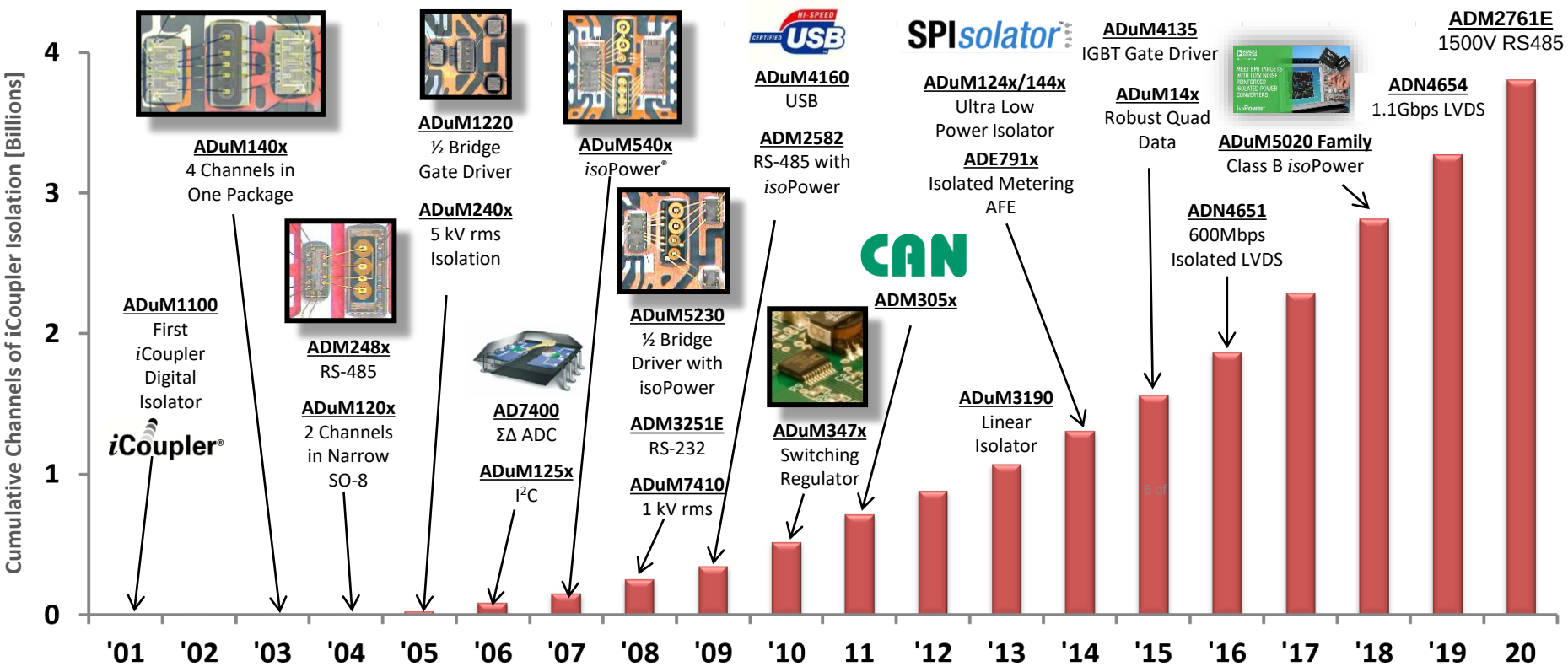


Isolation Transformers Provide Signal and Power Isolation

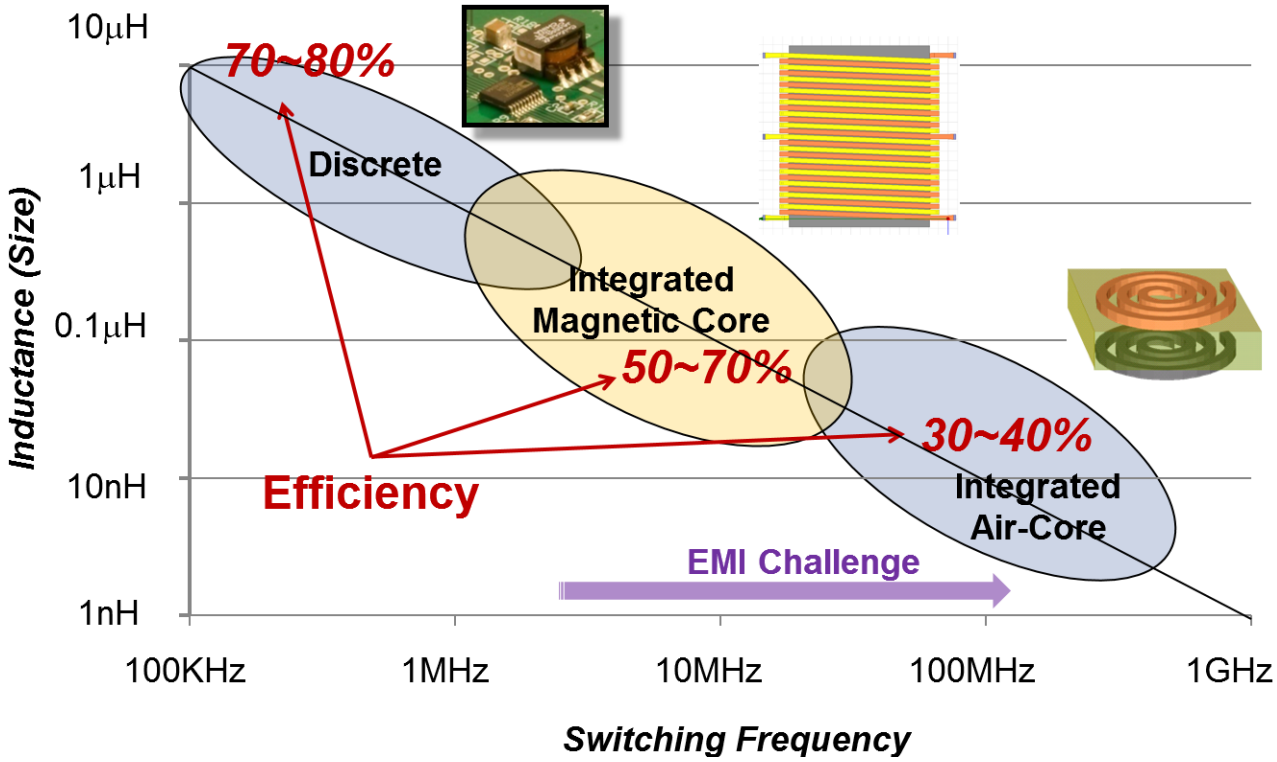


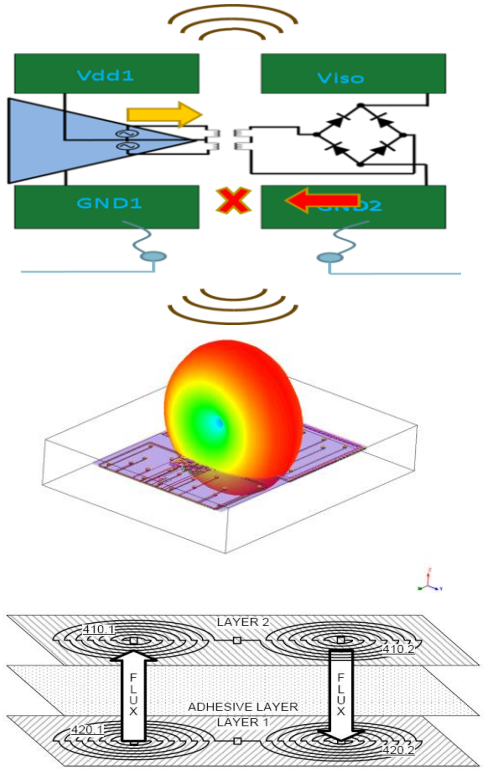


Broad Adoption of Micro-Transformers Based Signal and Power Isolation: >3.8 Billion Micro-Transformers Shipped

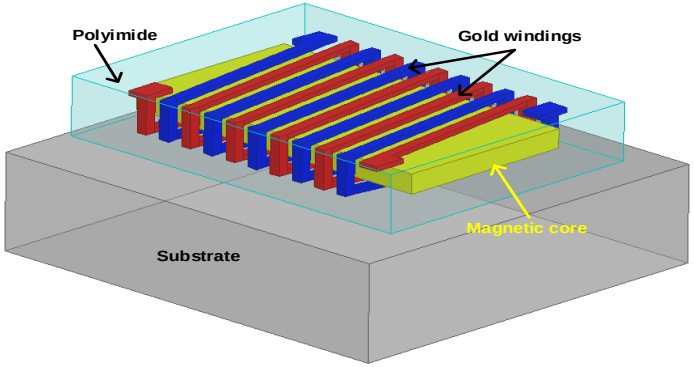


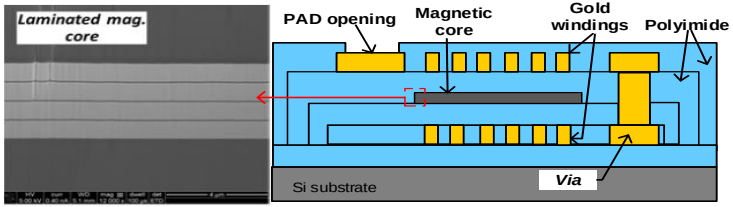
How to Improve Efficiency and Reduce EMI

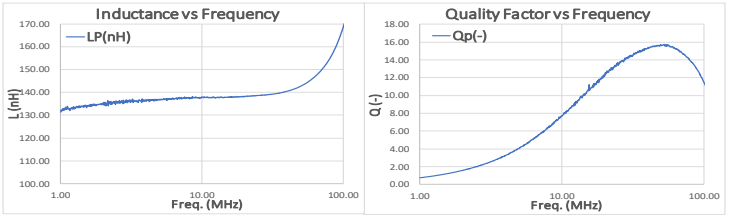


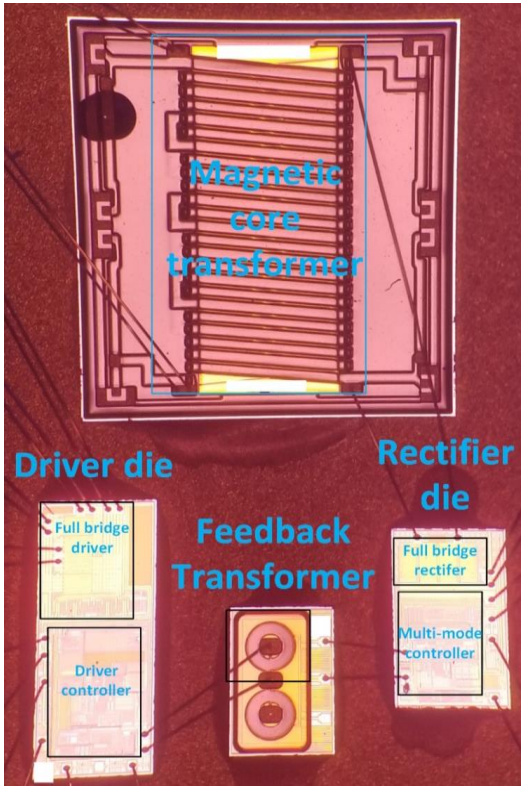


Magnetic Core Transformer Improves Efficiency and Reduces EMI

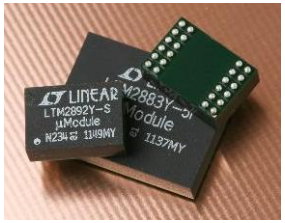




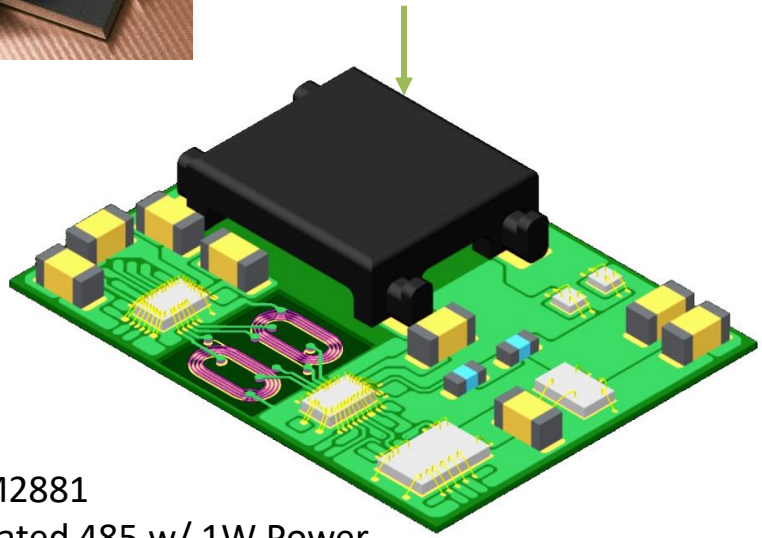




uModule Integration 1W-2.5W Converters

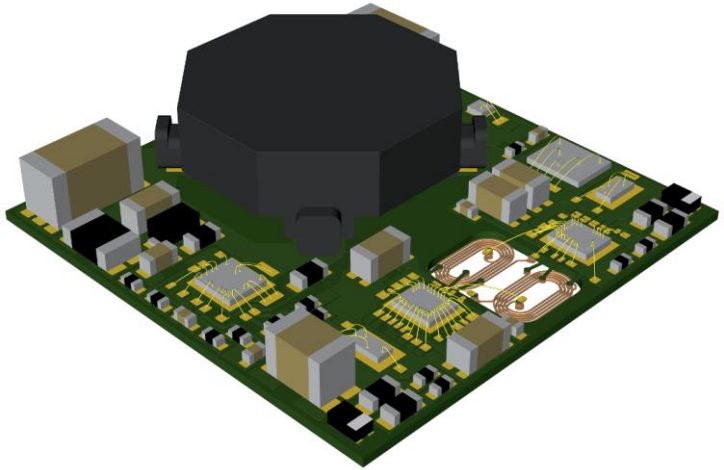


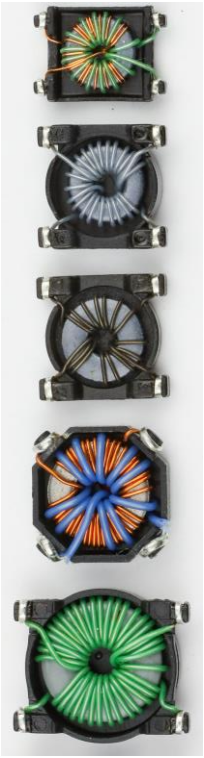
Transformer
8.3mm x 5.9mm x 2mm
49mm^2



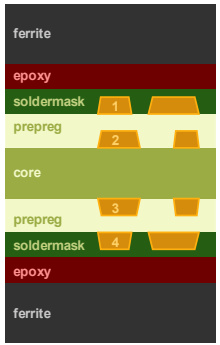
LTM2881
Isolated 485 w/ 1W Power
15mm x 11.25mm x 3.2mm

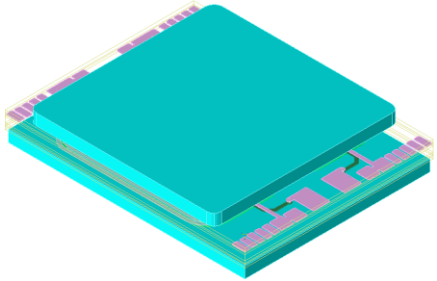
LTM2884
Isolated USB w/2.5W Power
15mmx15mmx4mm

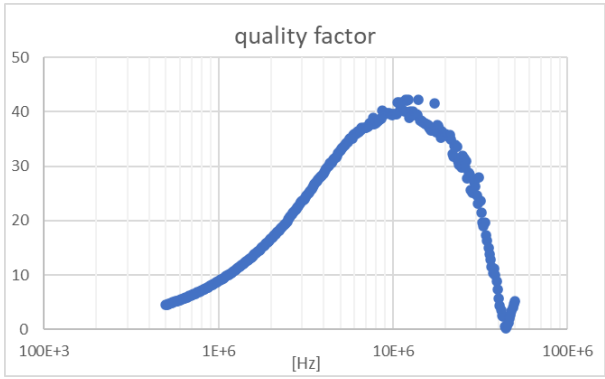


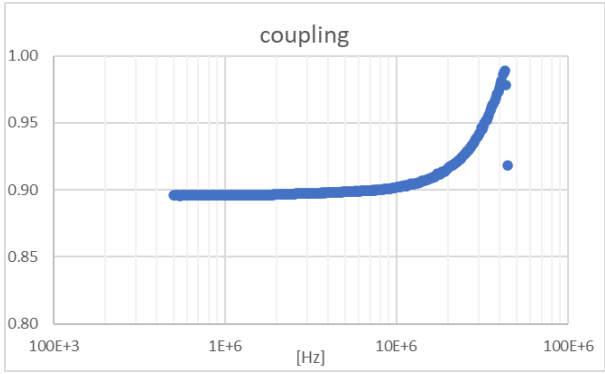


uModule Integration with Ferrite Plates

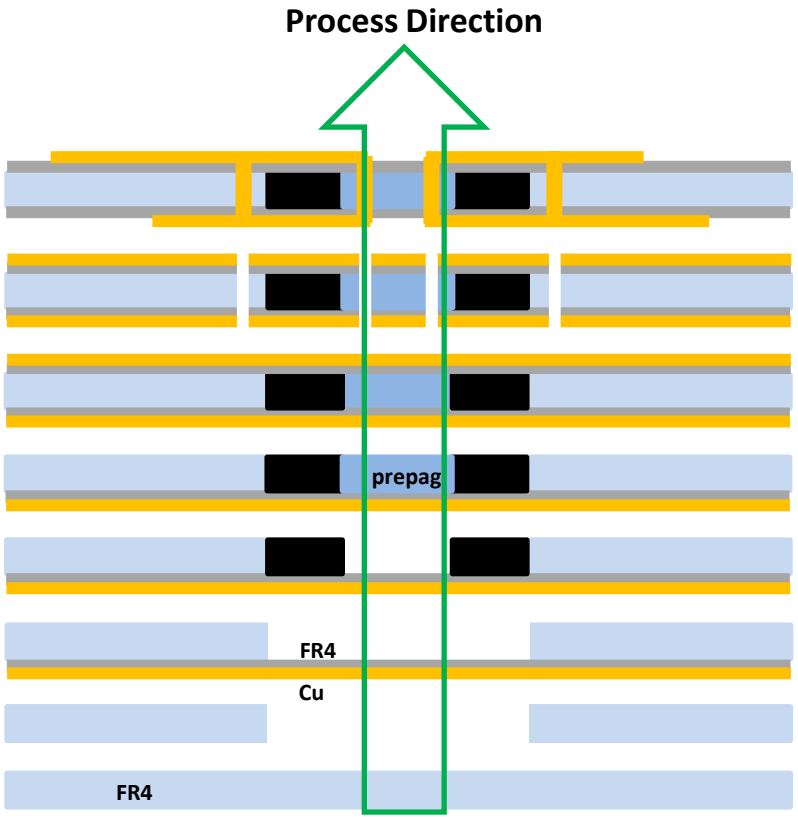








PCB Embedded Magnetics



8: electro plate via and edge Cu to form patterns

7: drill holes for vias

6: glue down top FR4 and Cu sheets

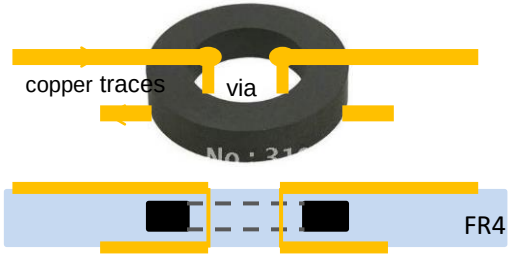
5: fill in prepag (FR4 without resin)

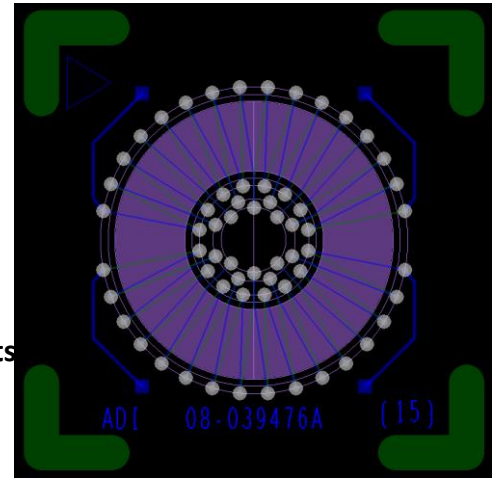
4: drop in toroidal ferrite

3: glue down bottom FR4 and Cu sheets

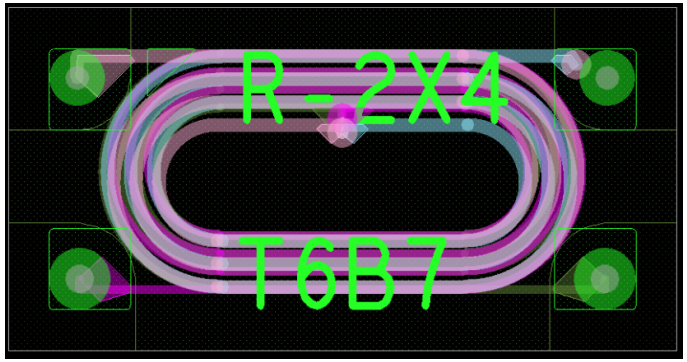
2: Route/drill hole

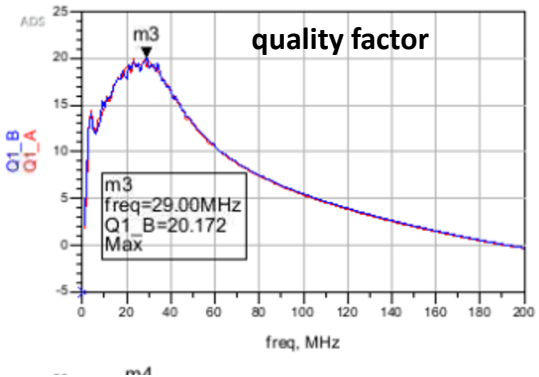
1: FR4 Base layer

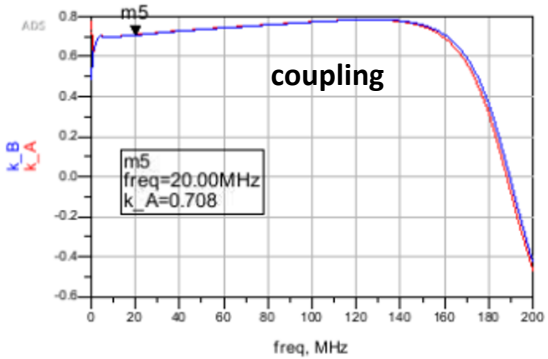


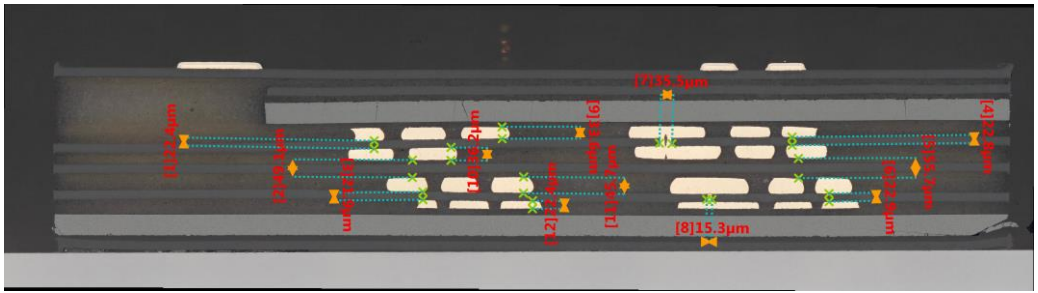


PCB Embedded Magnetic Layers

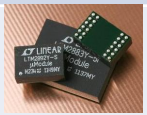
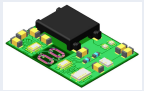
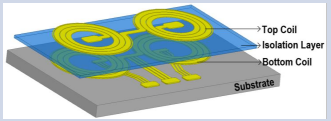
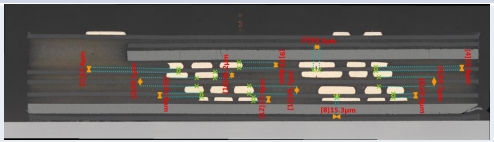
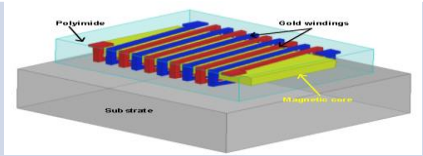








Package Power Density, Device Area Power Density and Efficiency

		Package Power Density (W/cm^3)	Device Area Power Density (W/cm^2)	Efficiency
PCB Magnetics with Ferrite Plates		**12**	**10**	**72%**
LTM2884-PCB Magnetics	 	**2.2**	**2.4**	**66%**
On-chip Air-core		**3**	**15.4**	**34%**
PCB Embedded Magnetic Layers		**4.8**	**15**	**52%**
Integrated Magnetics		**3.8**	**12**	**50%**

Conclusion

- PCB Magnetics Has Advantages in Efficiency with Thick Magnetics and Thick Winding
- Thick Ferrite Plates Enable Compact Package Integration Achieving High Power Density and High Efficiency

Acknowledgements: Contributions from iCoupler® group & ADLK FAB ipassive team in ADI, especially Giovanni Frattini