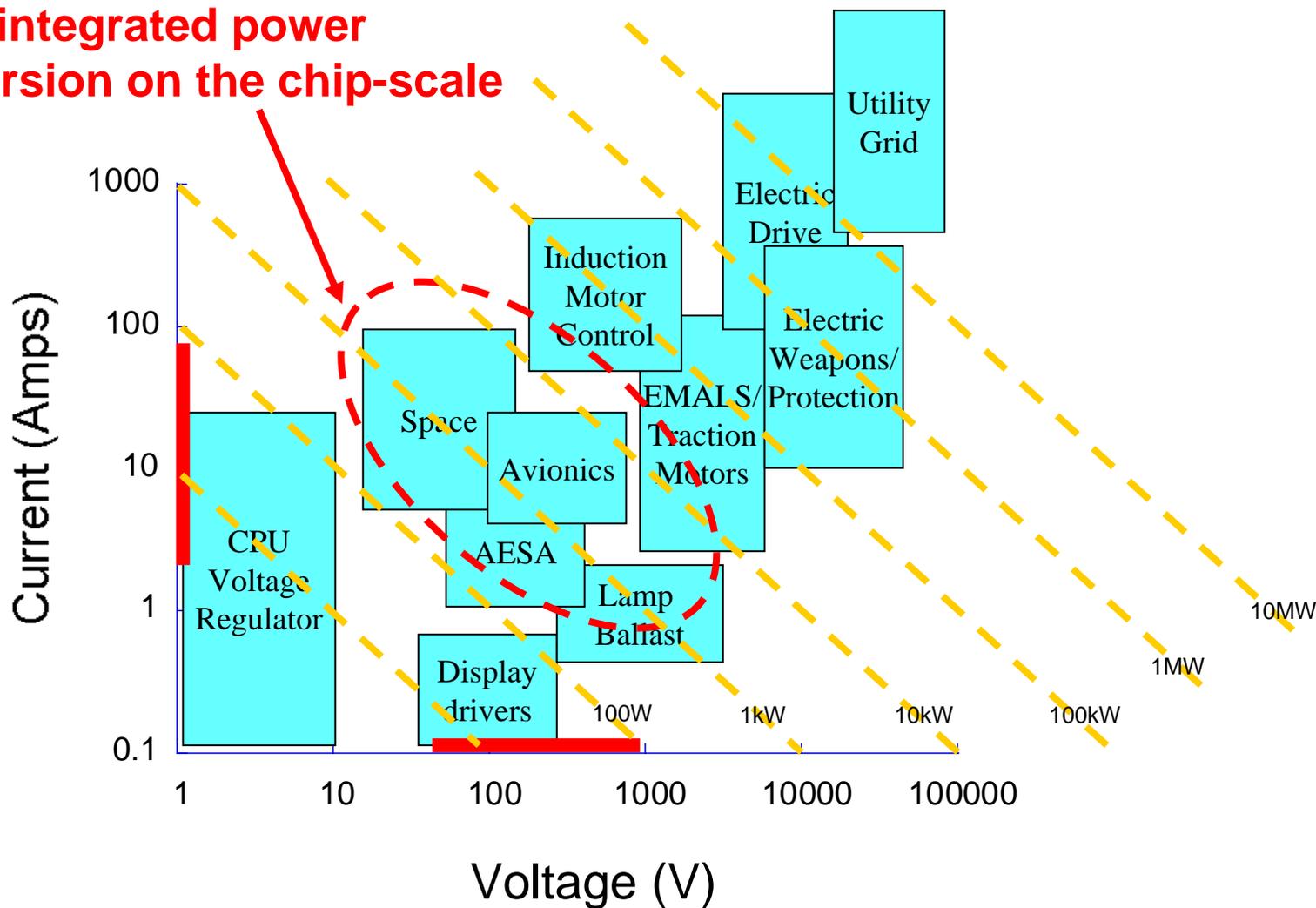




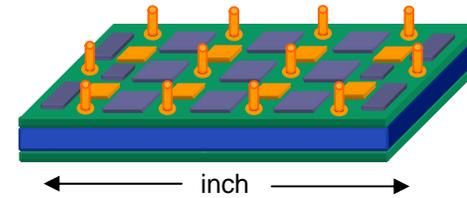
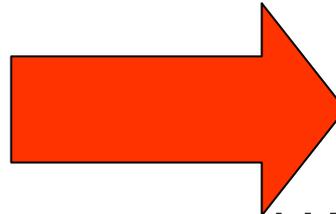
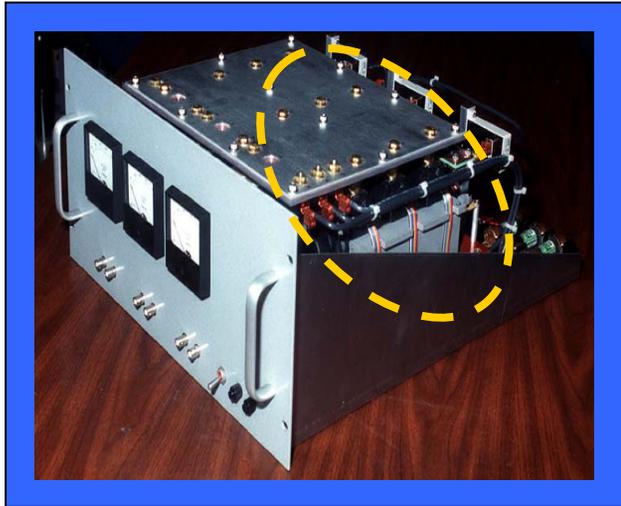
Robust Integrated Circuit Technology for Compact Power and Harsh Environments (RIPE)

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DARPA/MTO

Target: Scalable, ~ kilowatt class integrated power conversion on the chip-scale



Today's Technology



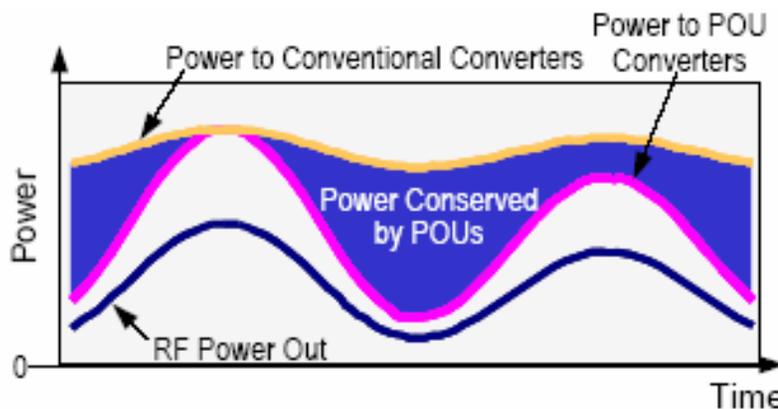
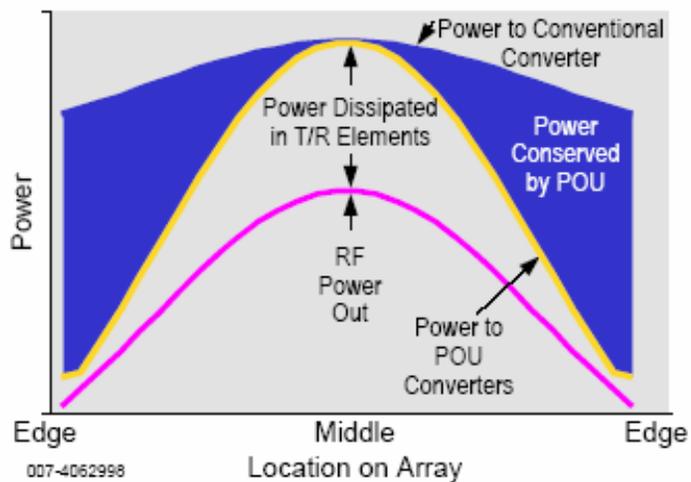
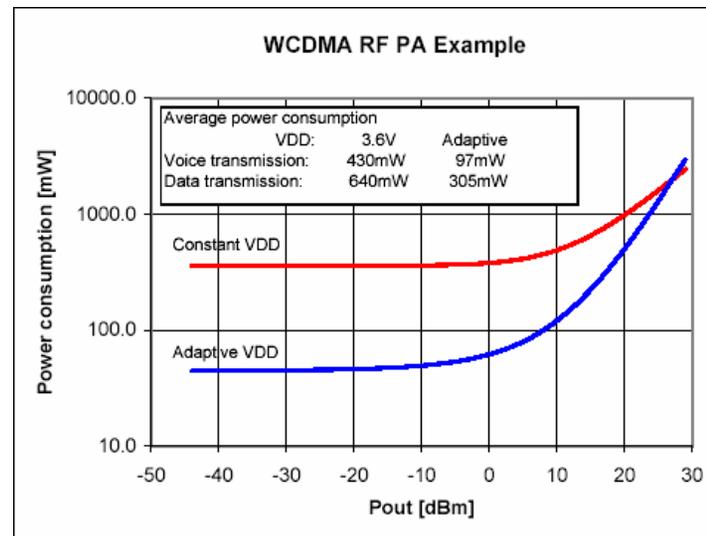
kW Class Power Converter State of Art: Silicon power devices, $\sim 50\text{W}/\text{in}^3$, $\sim 85\%$ efficient, 150 kHz, 125C Operation, separate control electronics

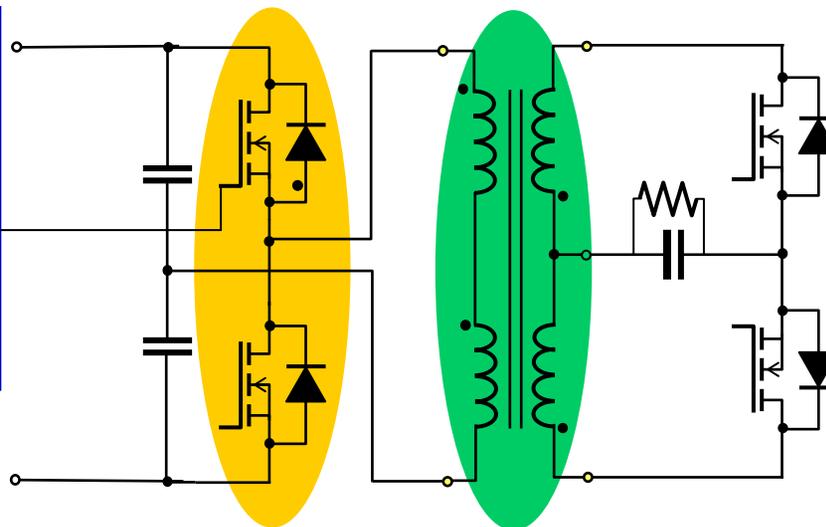
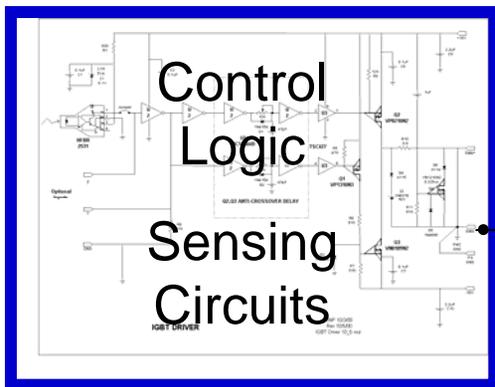
kW Class Integrated Power IC: Silicon-Carbide based, $500\text{W}/\text{in}^3$, 97% efficient, 100 MHz frequency, up to 300C operation, integrated control circuits

Pay-off: 10-100x reductions in size/weight; harsh environment operation; Point-of-load smart power IC's.



Future Space Needs: kiloAmps across ~100m² of aperture, fine grain control





Integrated Electronic Drivers

~100 transistor circuits, ~100V, high current drive to rapidly charge/discharge gates of power switches

Transistor types (MOSFET vs. BJT vs. JFET) for control circuits.

High T operation

Coupled models for circuit simulation

Integrated Power Circuits

Fast response devices for size reduction of magnetics and dynamic voltage/power application

Transistor types (MOS vs. BJT vs. JFET) device matching, ultra low on resistance, minimization of losses, isolation.

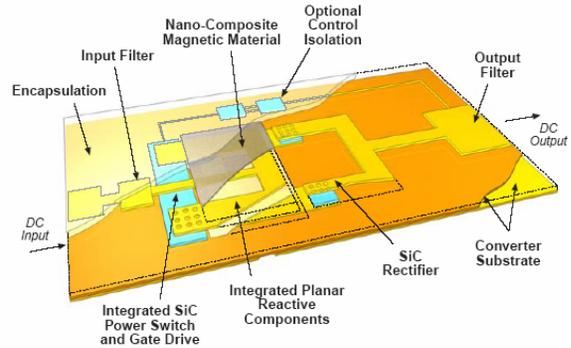
Magnetics

High frequency operation of cores (nano-composites vs. air cores) and associated size reduction

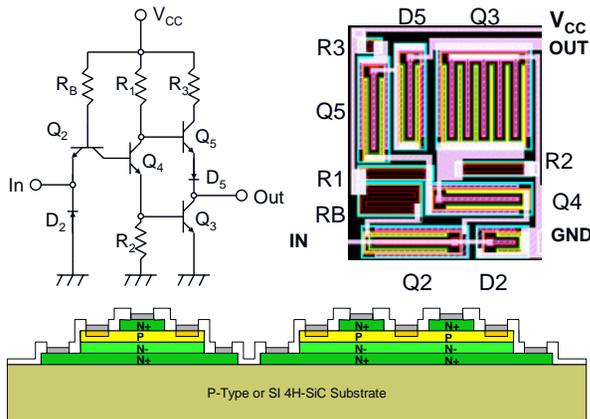
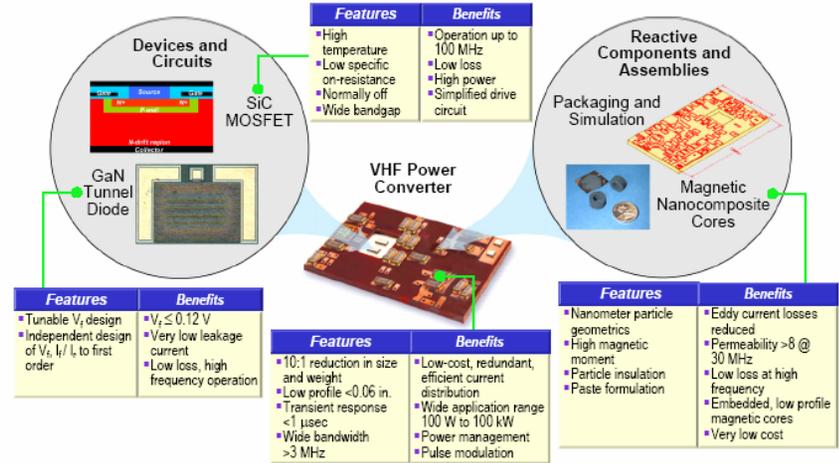
Integration of magnetics into compact RIPE environment

BAA Metrics for kW Class Converter

Metric	Today	18m Phase 1 Go/No Go	36 m Phase 2 Go/No Go	48 months Program end goals
Control logic	Transistor Count	Single device demos	20/chip	100/chip
	Control logic transistor perf.	CMOS	Ft >1GHz, 30V	Ft >5GHz, 50V
	T operation	125 C	175 C	225C
	Converter frequency	.1MHz, (silicon)	10MHz (300V, 2A)	30MHz (500V, 3.5A)
Converter	Converter efficiency	85%	94%	97%
	Volumetric Efficiency	50W/in³	100W/in³	250W/in³
	Circuit Demo		Power half bridge with protection; Op. Amp.; logic gates	Power device full bridge with protection; Integrated Gate Driver Circuits

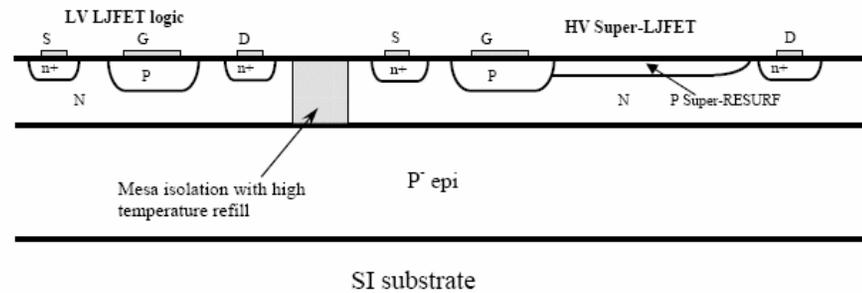


Raytheon



SiC CMOS tech.

United Silicon Carbide, Inc



SiC JFET Device tech.