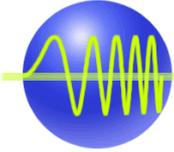


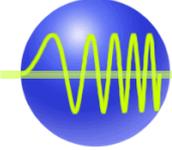
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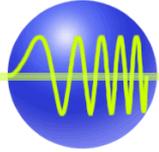
Flexible Digital Power Management System for Small Satellites

Anand Ramamurthy William Edmonson Subhashish Bhattacharya

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Advanced Space Technologies Research & Engineering Center
North Carolina State University

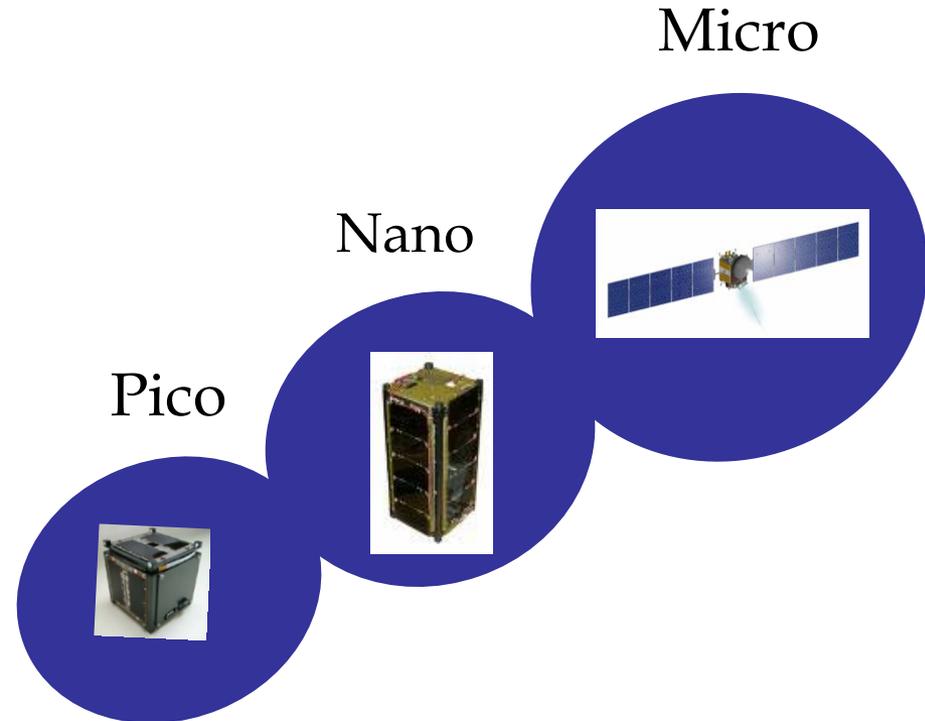


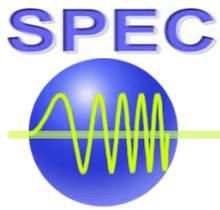
- Main Features
- Power System Architecture
- Hardware Design
- Software Design
- Summary



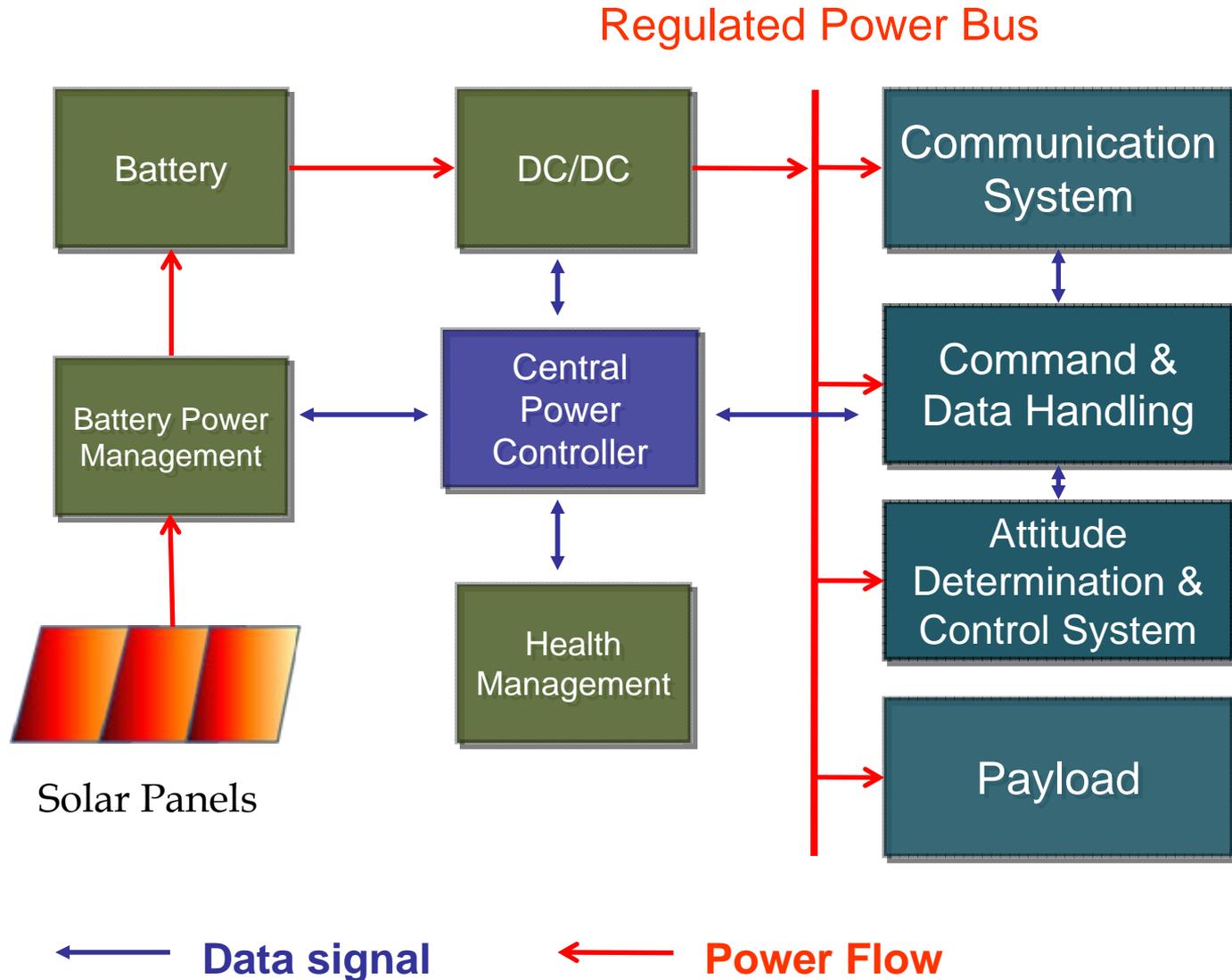
Main Features

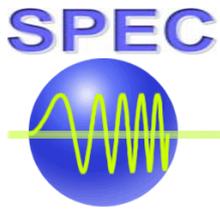
- Complete **digital** solution results in reduced space, size, component count and increased reliability.
- Flexible, scalable, modular Power Management System architecture.
- “Plug and Play” feature for Solar Cells, Battery and Loads.
- Fault tolerant operation, reliability and redundancy for supplying critical loads.
- Monitoring, diagnostics of dc power distribution system and intelligent load-shedding.
- EPS can be controlled from ground station.



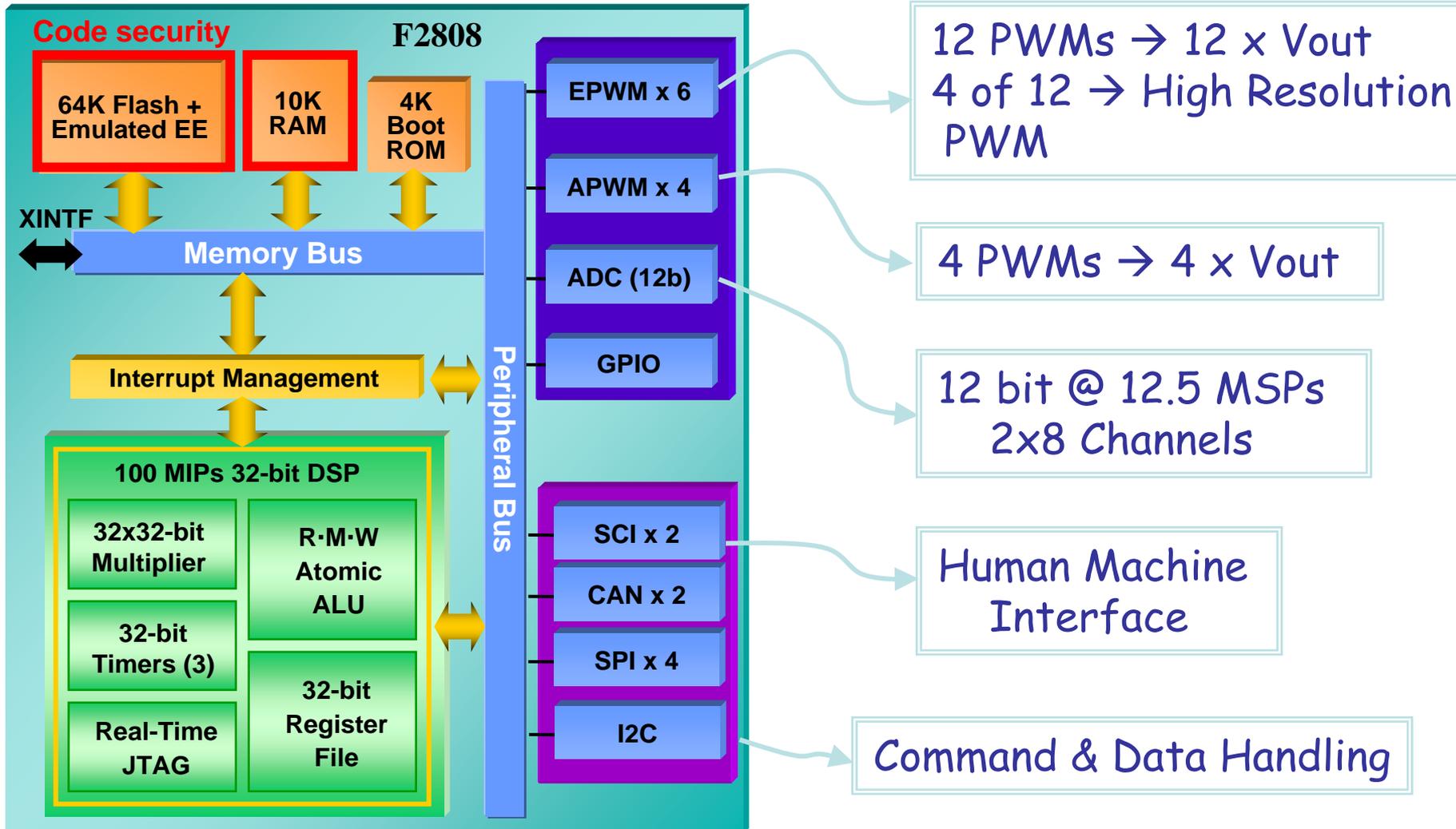


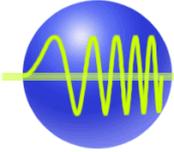
Power System Architecture





Central Power Controller, TMS320F2808 from Texas Instruments



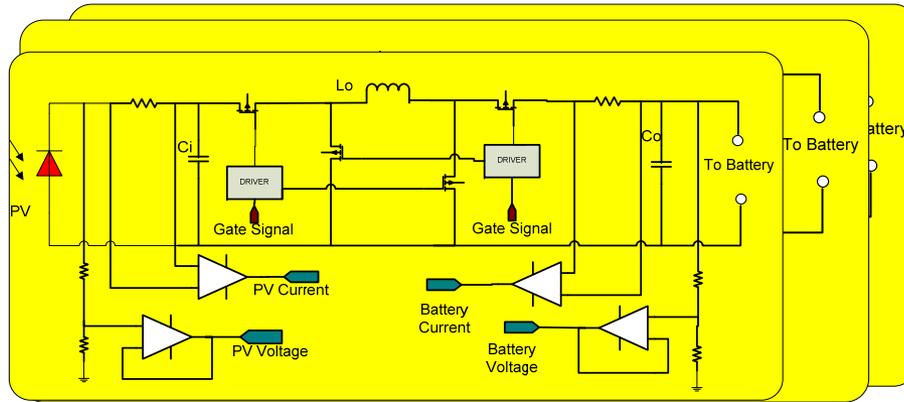


Battery Charging Modules (BCM)

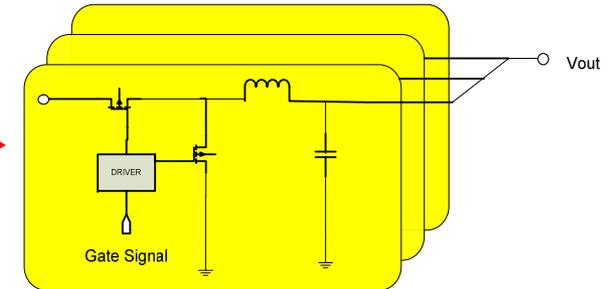
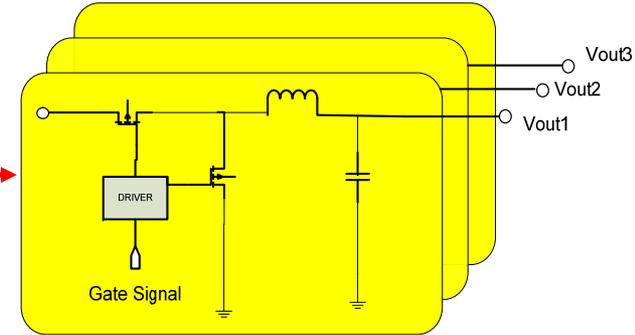
Multiple Digital DC/DC

Multi-Phase DC/DC

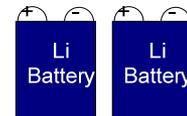
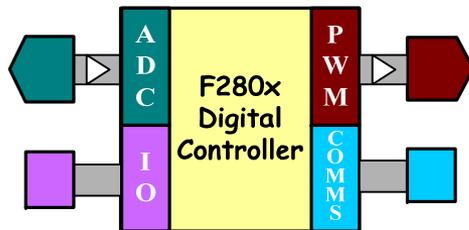
...
BCM2
BCM1



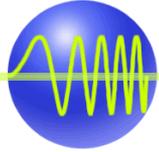
Synchronous Buck Boost Power Stage



Central Power Controller

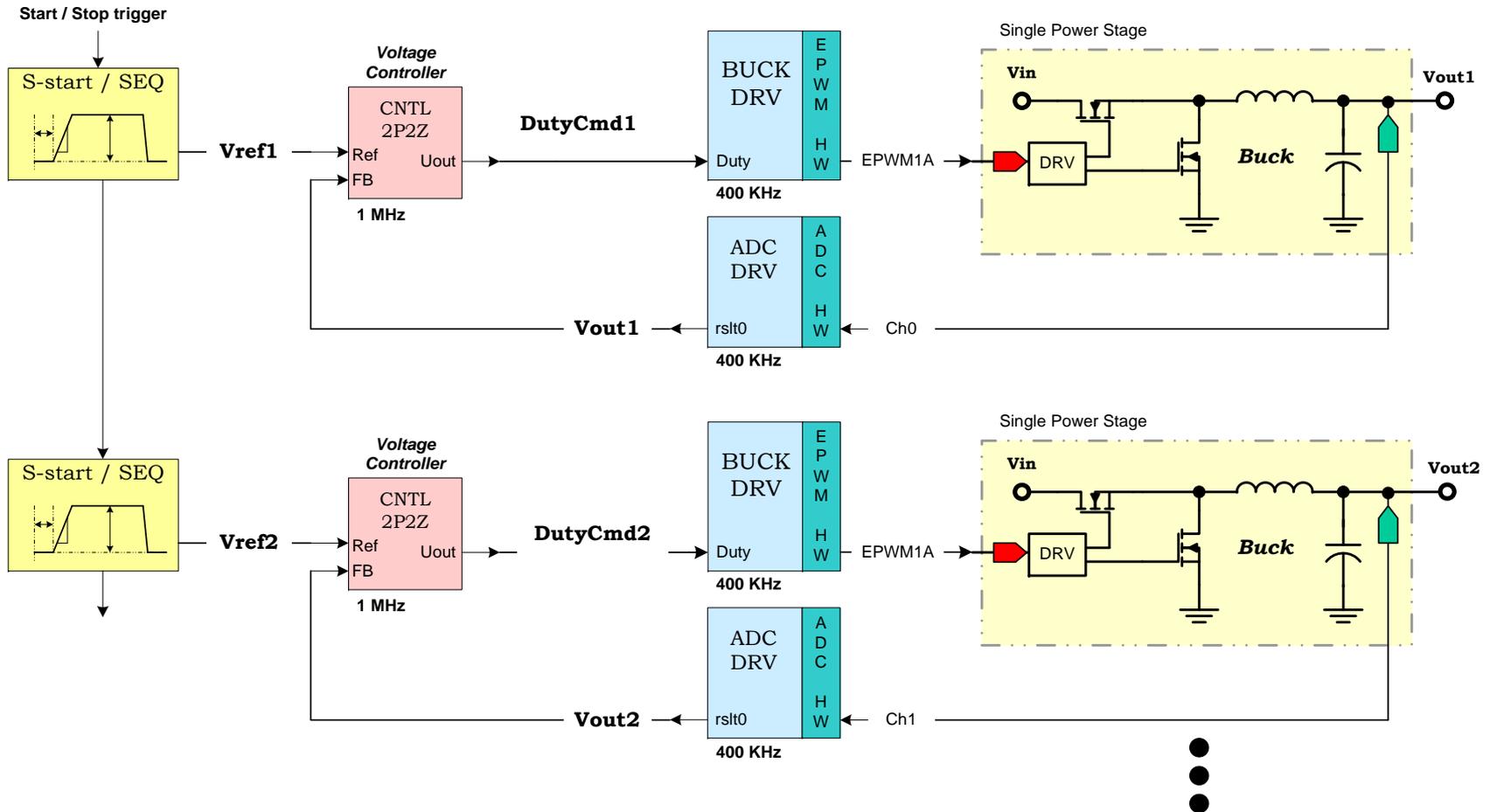


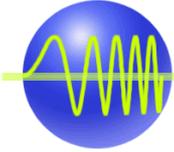
Batteries



Software Control Flow

Point of Load DC/DC Controller

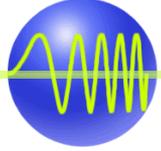




Summary

- Complete Digital Power Management makes the entire system flexible.
- Plug and Play PV array interface, PVs of different voltages can be connected to the Buck Boost Converter.
- Self Tuning Maximum power point tracking for utilizing maximum power.
- Battery storage can be expanded and made redundant, the end of charge voltage can be programmed to accommodate different types of commercial Lithium Ion Cells.
- Programmable Point of Load DC voltages, High Frequency operation, multi-phase DC/DC converters for payloads with higher current requirements.
- Over Current/ Under Voltage Protection , Power Sequencing and Load Shedding Digitally Managed.
- Health of the Power Module is constantly monitored and fault management is done accordingly.

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Thank you