

## Environmental Impacts on BMS Design and Architecture

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# Environmental Impacts on BMS Design and Architecture

- + Temperature
- + Radiation
- + Vibration and Shock
- + Vacuum
- + Materials
- + Energy Potentials
- + Energy Flow

# Temperature

- + Temperature effects
  - + Operational Temperature of components
  - + Cooling effects
    - + Avionic Cooling –Convection and Conduction
    - + Space Cooling - Conduction

# Radiation

- + Radiation as an affect on electronics
  - + Duration due to long term exposure ( KRAD)
  - + Disruption or errors induced from Single event (LET)
  - + Management of the Errors/Disruption
  - + Latch-up vs Damage
  
- + Radiation Induced affects to conductors

# Vibration and Shock

- + Component mounting
- + Package selection
- + Additional component constraints
- + PCB attachment

# Vacuum

- + Affects
- + Corona
- + Larger creepage and clearance
- + Tin Whiskers
- + Thermal management of components
- + Molecules
- + Particles

# Materials

- + Outgassing – NASA List
- + Solder
- + PCB copper finish - plating
- + Component placement at PCB assembly
- + Connector material
- + Component Pin plating

# Energy potential

- + Track size and spacing
- + Internal layers and outer
- + Component pin spacing at higher voltages
- + PCB coatings and mounting locations
- + Grounding vs Return



# Energy Flow

## + Controls

- + MOSFETS

- + SicFETS

- + GaN FETS

- + Solid State relays

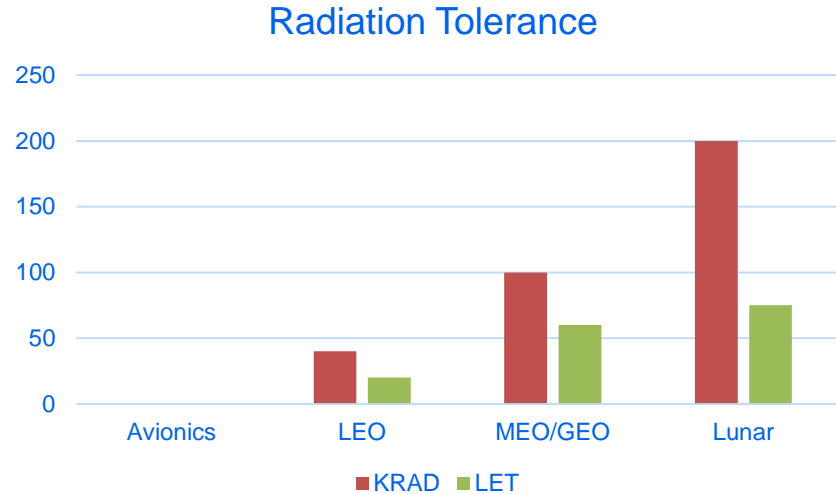
- + Cooling affects to internal power conductors

- + Power SMD component heating



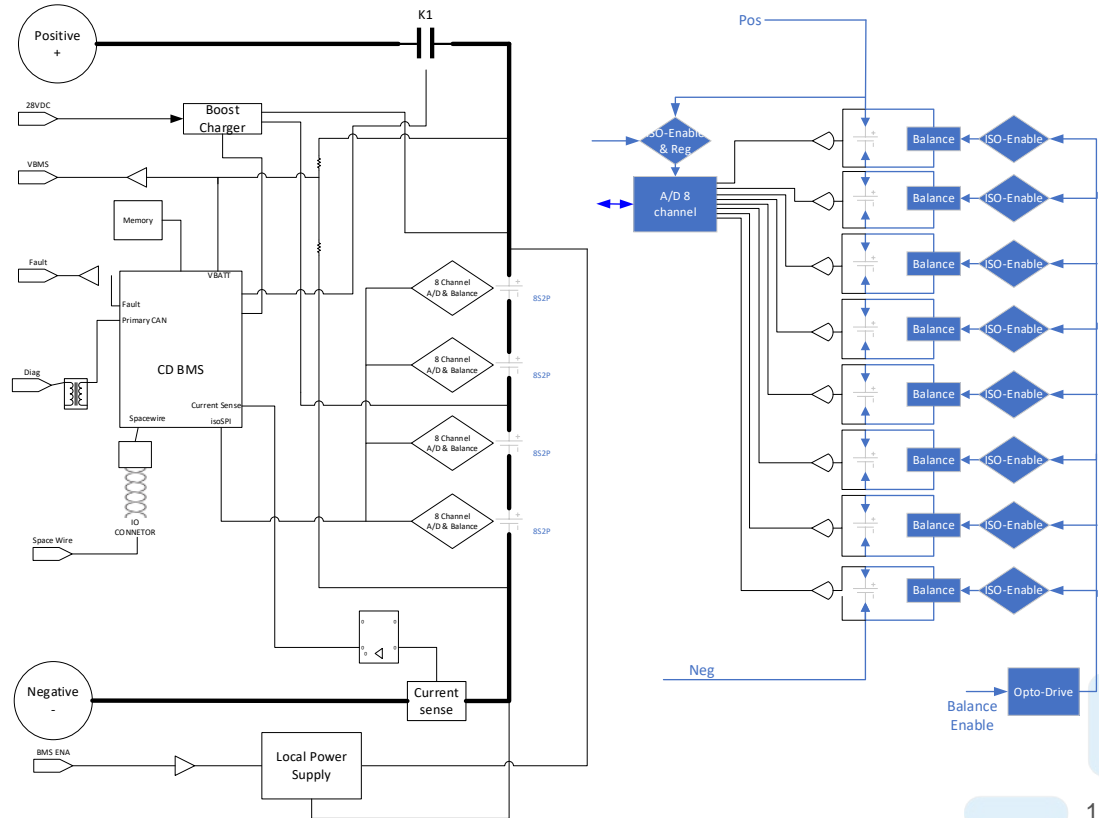
# LEO Application

- + Types –
  - + Analog
  - + digital
  - + functions
- + Blocks
- + Radiation levels
  - + No Cell monitor IC;s available in Radiation Tolerant



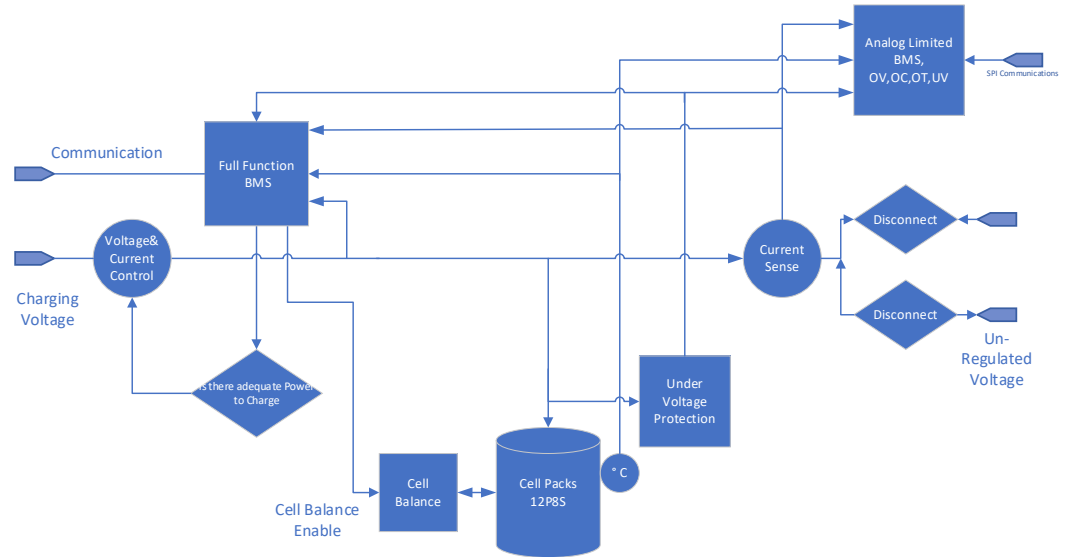
# MEO/GEO Applications

- + Types –
  - + Analog
  - + digital
  - + functions (monitoring , control)
- + Blocks
- + Radiation levels



# Lunar Applications

- + Types –
  - + Analog
  - + digital/storage
  - + functions (monitoring , control)
- + Blocks
- + Radiation levels
- + Particulate



# Future Directions

- + Industry drive integration for
  - + Avionics ,
  - + Expanded rad hard parts
  - + new players
- + Looking to the future will we have more integrated controllers?

# Summary

Power is the HEART of all we do in Space.  
It enables Human survival as we move outside the  
Earth's Eco system.

Battery Systems and Management of Battery System  
enable these ventures that Enlighten knowledge and  
fuel exploration.

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