



NASA Marshall Space Flight Center

Engineering Systems Department

Environments Group



Space Environmental Effects and Spacecraft EMC

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Spacecraft EMC

- Radiated Emissions
- Radiated Susceptibility
- Conducted Emissions
- Conducted Susceptibility
- Bonding
- Grounding
- Cabling/wiring
- Systems ESD
- Corona



Spacecraft Environments

- Thermal
- Plasma
- Meteoroids/Orbital Debris
- Ionizing Radiation
- Geomagnetic Fields
- Solar



Environmental Influences

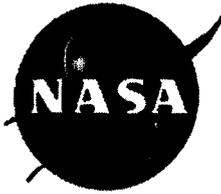
- Geomagnetic field interactions with large spacecraft
 - $\underline{v} \times \underline{B}$ causes voltage potentials in spacecraft structure
 - Special attention to grounding and cabling required to prevent interference
- Micrometeoroid/orbital debris impacts
 - Impact can cause localized plasma “cloud” which could induce arcing of nearby charged surfaces



Environmental Influences

(continued)

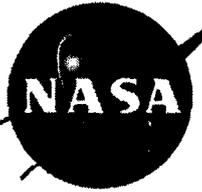
- Spacecraft interactions with plasma environment
 - Spacecraft immersed in plasma accumulates charge on exposed surfaces
 - Use of dielectrics
 - Ram/wake effect
 - Solar array collection
 - thrusters



Environmental Influences

(continued)

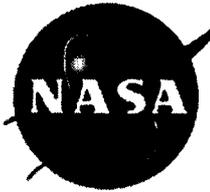
- Spacecraft interactions with plasma environment
 - Photoelectric effect
 - Charge control device impact
 - Solar array arcing
 - List of anomalies
 - Prevention



Environmental Influences

(continued)

- Spacecraft interactions with radiation environment
 - Deep dielectric charging
 - List of anomalies
 - Grounding of radiation shields
 - Arcing to cables



Environmental Influences (continued)

- Thermal
 - MLI bonding
 - Structural bonding
 - Reusable bonds



Environmental Influences

(continued)

- 1-g testing vs. orbital environment
 - GP-B
 - Wake Shield
 - g-Limit



Environmental Influences

(continued)

- “Traditional anomalies”
 - GRO
 - STS-88
 - NOAA-11