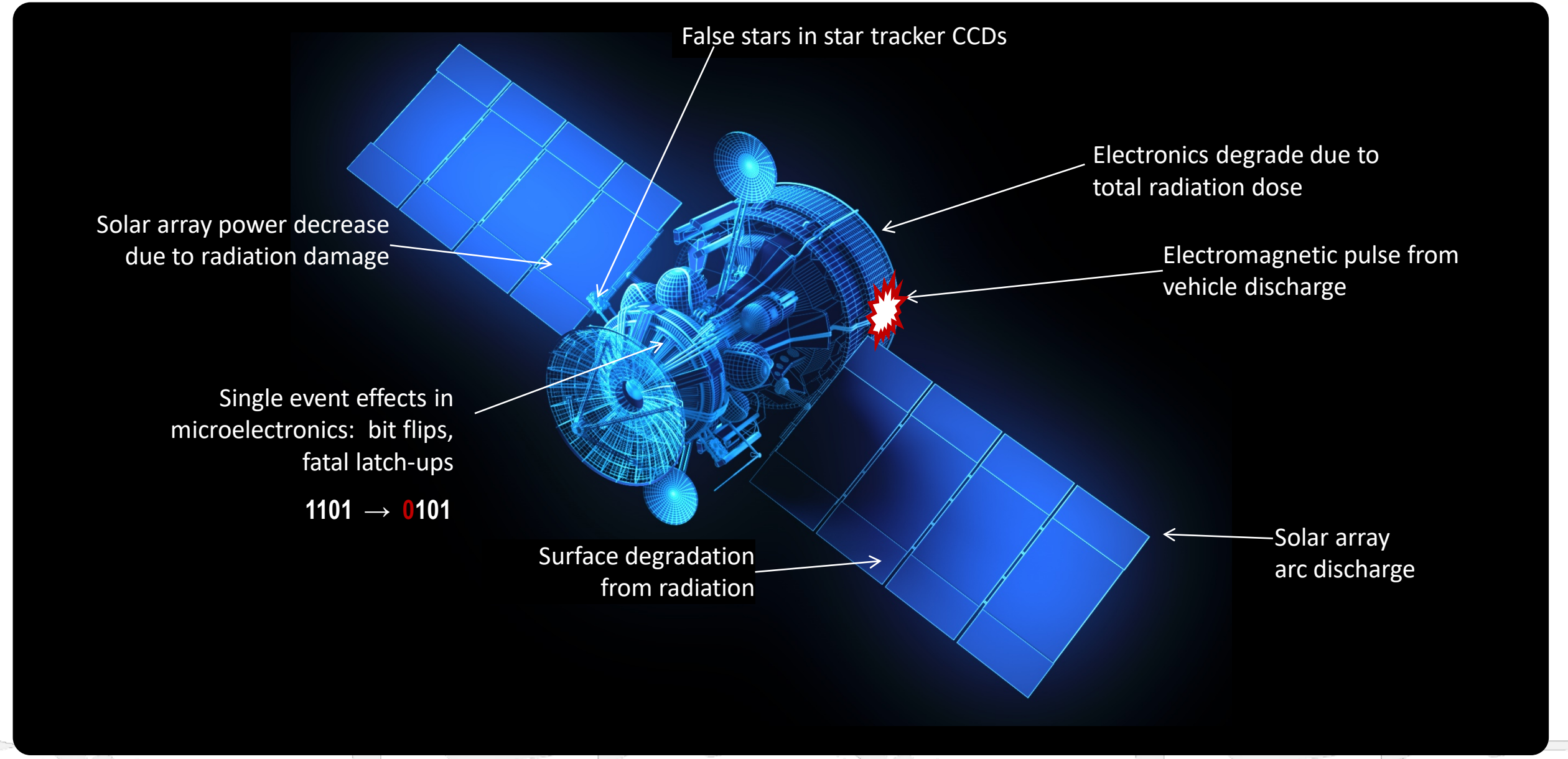
TELEDYNE
DEFENSE ELECTRONICS
Everywhereyoulook™

Teledyne e2v HiRel
Space Sensor Product Line

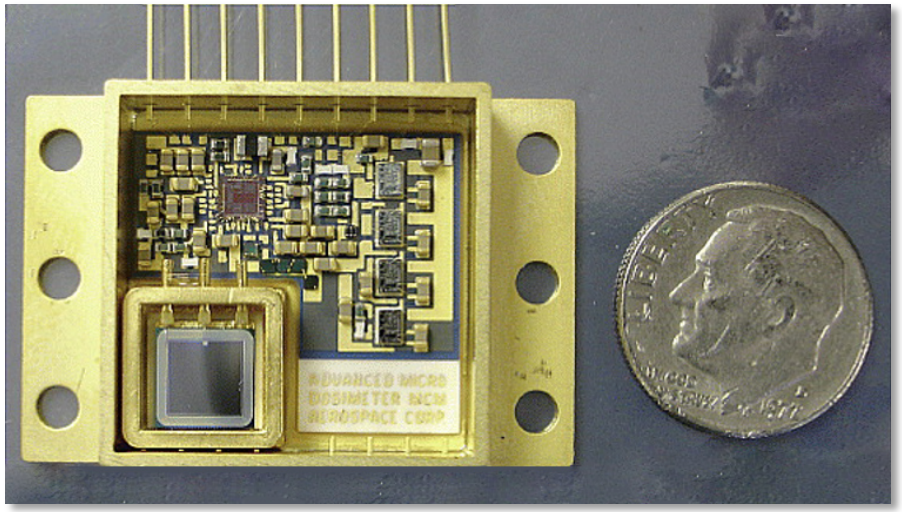
April 2021

Radiation Effects on Spacecraft



Micro Dosimeter for Space

- **Problem**:
  - Electronics degrade with accumulation of radiation dose
- **Solution**:
  - Teledyne's radiation Micro Dosimeter is tailored to problems of satellite anomaly attribution
  - Small enough to place at multiple locations near sensitive avionics
- **Situation Awareness:**
  - **F**eeds Real time data to operator
  - Alerts for hazardous conditions (radiation events)
  - Alarms for hostile action
  - Anomaly diagnosis in REAL TIME
  - Allows operator to power down until condition passes



Dosimeter Missions

- 2009: NASA Lunar Reconnaissance Orbiter: Lunar Orbit
- 2009: NASA International Space Station: LEO
  - MISSE-7B test bed
- 2009: NRL & Boeing, LEO
- 2011: Rapid Pathfinder “Deal” mission in Polar Orbit
  - First feedback for improving electron and proton environmental models
- 2012: NASA Van Allen Probes: GTO
  - Dosimeters in the Relativistic Proton Spectrometer (RPS)
  - Inner Van Allen belt environment
- 2013: Miniature Array of Radiation Sensors (MARS): LEO
  - International Space Station
- 2013: ARMAS (NASA Hi Altitude Aircraft)
  - NASA Dryden DC-8; Altitude 1 – 12 km
  - 29 Successful flight missions
- 2014: SMC AeroCube6: LEO
- 2016: 18 Air Force/SMSC
  - Hosted Payload/47+ Dosimeters
  - IridiumNEXT Constellation/SpaceX Falcon 9: LEO

Lunar Reconnaissance Orbiter Image credit: NASA

Dosimeter Missions

- 2015-18: NASA Langley
  - Shields-1 Cubesat – 18 Dosimeters
  - Potential Manifest:
    - Commercial GTO/US/Late 2015: GTO
    - Commercial SHERPA or DARPA/US/Late 2015: Polar LEO
    - Worldview-4/Atlas V/Mid 2016: HEO
    - ICESAT-2/Delta II /2017: Polar LEO
    - Exploration Mission -1/SLS/2018: HEO
- 2017: AFRL Kirtland AFB
  - Radiation Hazard and Awareness Sensor (RHAS)
  - GEO Satellite
- 2017: NASA Ames
  - BioSentinel/4 Dosimeters: Mars orbit
- …And many more…

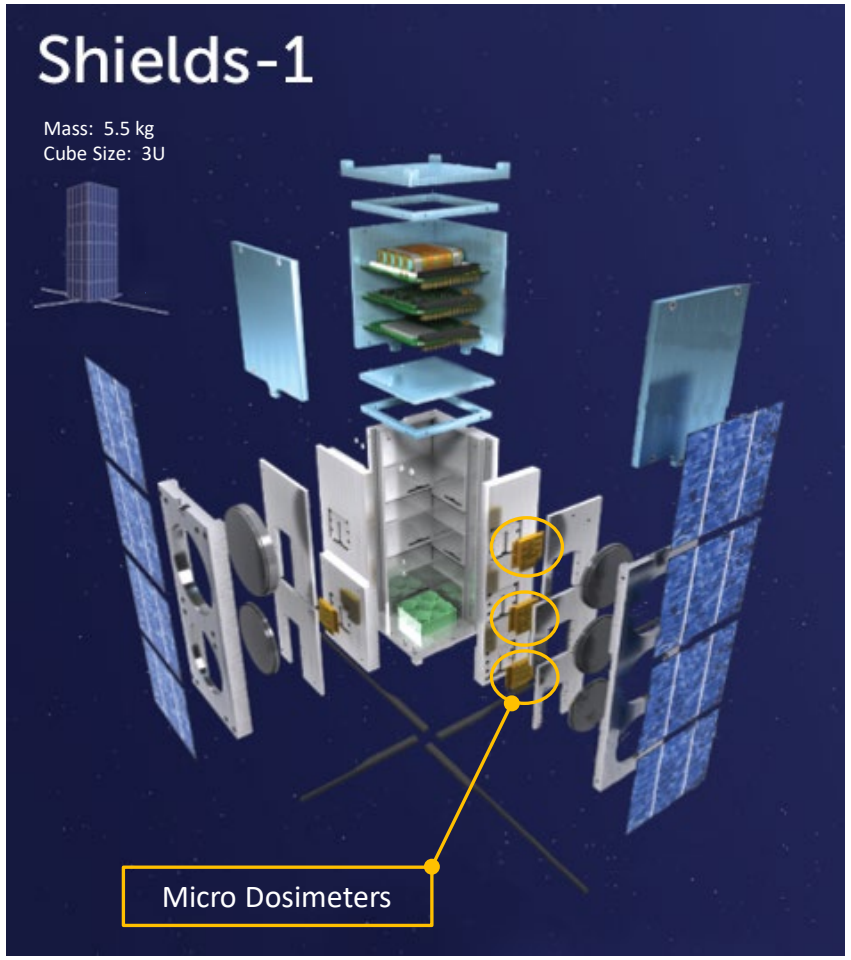
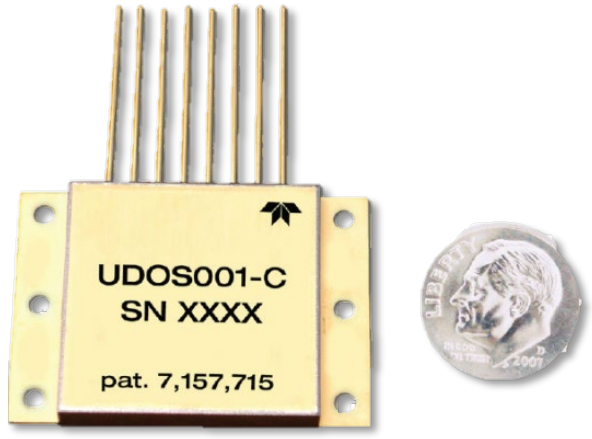
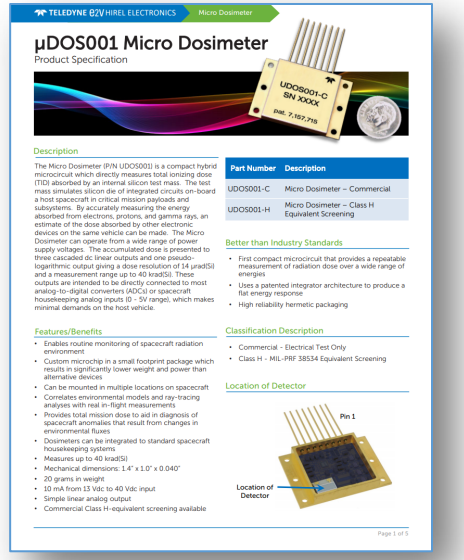


Image credit: NASA

Dosimeter Variants

- Standard Dosimeter MedLET µDOS-001
  - Directly measures total ionizing dose (TID)
  - Measurement range up to 40 krad
  - Responds to Electrons and Protons
  - Electron incident energy threshold is ~400 keV
  - Proton incident energy threshold is ~12 MeV
  - Internal energy threshold is ~100 keV
    - This is the energy that is needed to be absorbed by the detector to trigger
  - Mechanical dimensions: 1.4” x 1” x 0.2”
  - 20 grams in weight
  - 10 mA from 13 Vdc to 40 Vdc input
  - Operating Temperature: -30ºC to 40°C
  - Commercial and Class H equivalent screening available
- Features/Benefits
  - Provides total mission dose to aid in diagnosis of spacecraft anomalies that result from changes in environmental fluxes
  - It can be integrated to standard spacecraft housekeeping systems
- Note: µDOS-007 also available - as above but with extended -30°C to 70°C temperature range





Download datasheet

Frequently Asked Questions

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General Performance:

Q: What kind of radiation does the Dosimeter measure?

A: Electrons, Protons, Beta, Gamma Ray, X-Ray

Q: How much radiation does it measure?

A: 14 uRads to 40 kRads

Q: What is the survivability (max. radiation exposure)?

A: 40 kRads

Frequently Asked Questions

Electrical:

Q: How much do I have to regulate the power supply?

A: Acceptable input voltage range is +13 V to +40 V however the supply voltage should be stable and power line noise kept to less than 100 mVrms. Recommended voltage is +15V to allow for system voltage margin and optimum power dissipation.

Q: Do I need current limiting in my circuit?

A: No current limiting is necessary for power input

Q: What is the linearity of input vs. output?

A: +/- 20% is the spec. Average is 2.2%

Q: What if my voltage regulation exceeds +/-5%?

A: Power supply ripple greater than 100 mVrms can potentially induce noise counts in the integrator circuit.

Q: How do we measure the output?

A: The measured radiation dose is represented by cascaded 5 V DAC's. The first three DAC's output voltage should be measured, and their readings combined to determine the accumulated dose. The DACLOG output is a pseudo-logarithmic output that covers the entire dynamic range of the dosimeter. A DACLOG conversion table is available upon request.

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Mechanical:

Q: How do I mount the device?

A: 6 mounting holes are provided. Mounting/location must ensure the temperature of the device will not exceed specifications

Q: Is thermal grease required for mounting?

A: Not required, power dissipation is very low

Q: Does torque have any affect on the device?

A: Torque has no effect if within the screw specification

Q: What affect does vibration and shock have on the device (will it survive Launch and Pyro shock – or separation)?

A: It will withstand shock & vibration as required in MIL-PRF 38534 Class H

Reliability:

Q: Does temperature affect accuracy of the device?

A: Yes. The temperature coefficient is nominally 0.3 %/°C. For optimum accuracy temperature should be monitored close to the dosimeter and readings adjusted as necessary.