

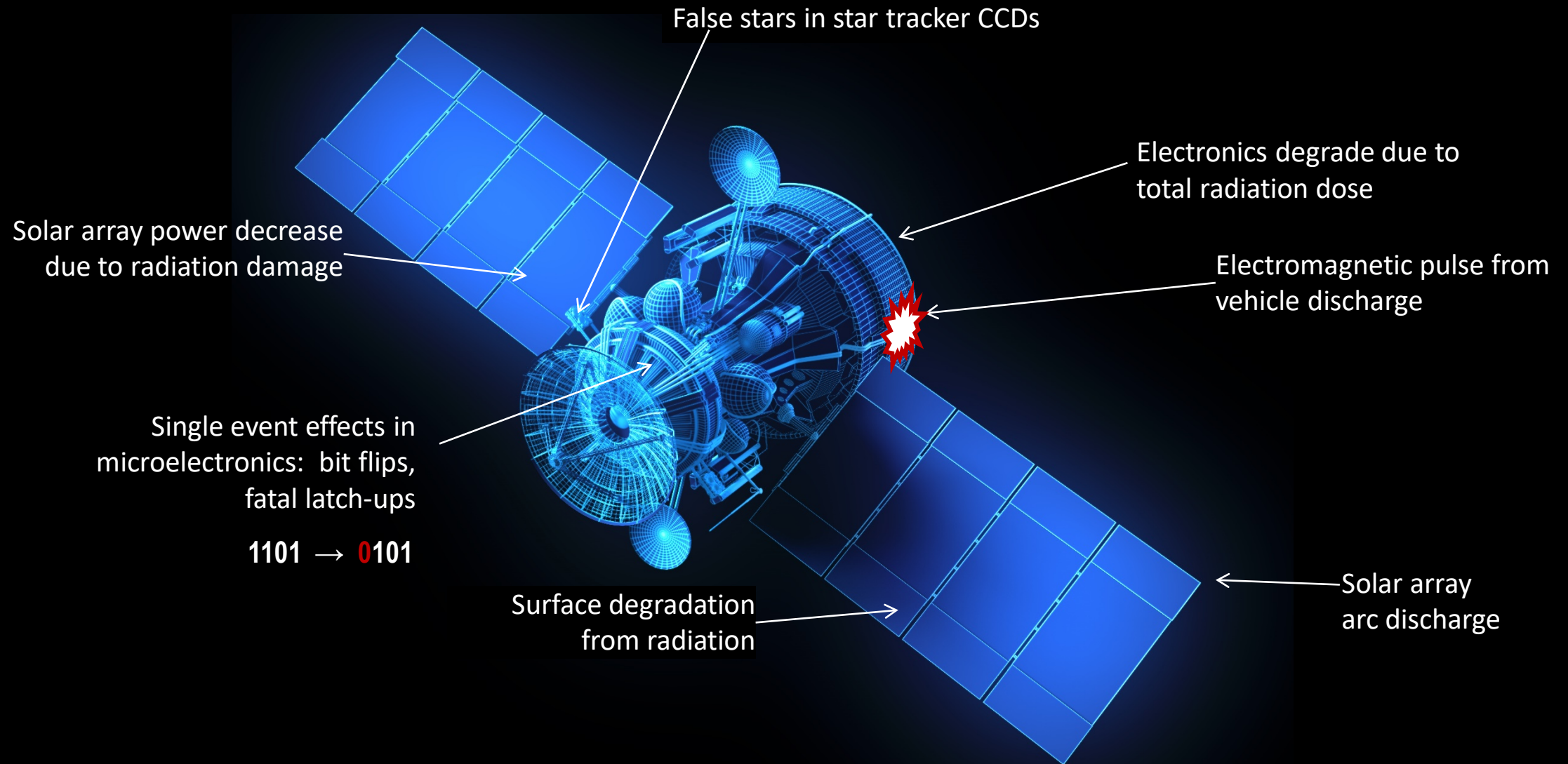


TELEDYNE
DEFENSE ELECTRONICS
Everywhere you look™



Teledyne e2v HiRel
Space Sensor Product Line ↻ April 2021

Radiation Effects on Spacecraft



Micro Dosimeter for Space

- **Problem:**

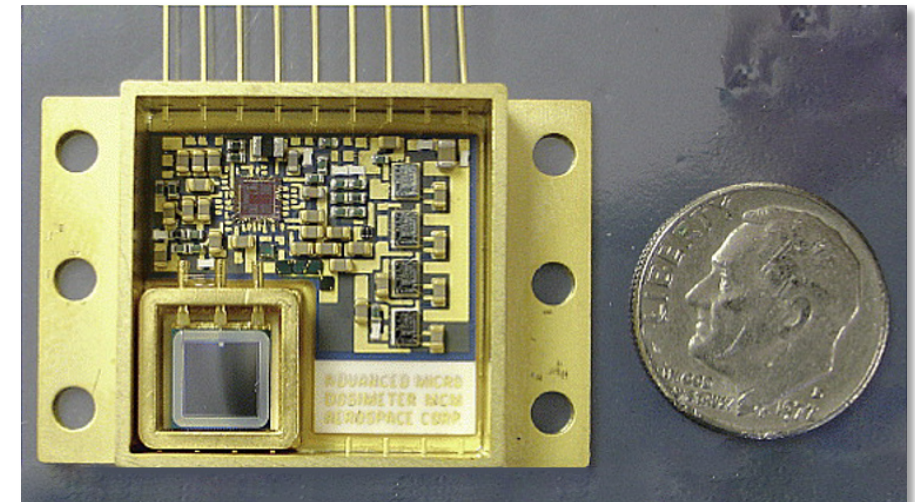
- Electronics degrade with accumulation of radiation dose

- **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:**

- Feeds 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...

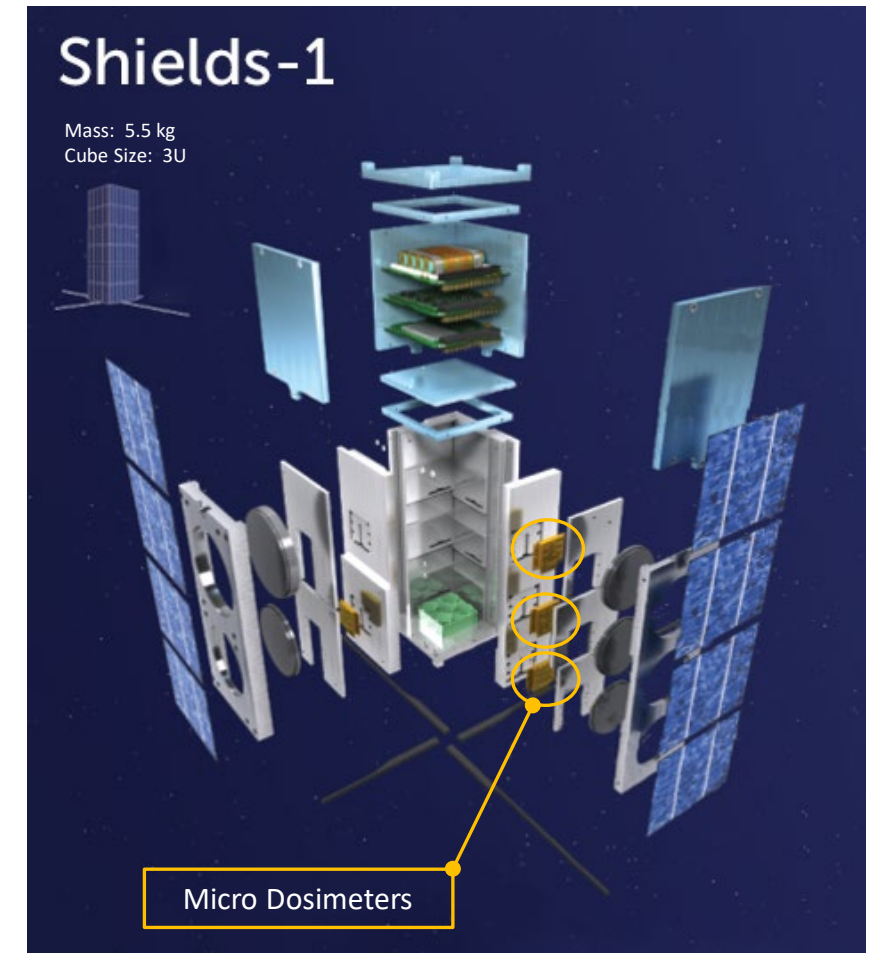


Image credit: NASA

Dosimeter Variants

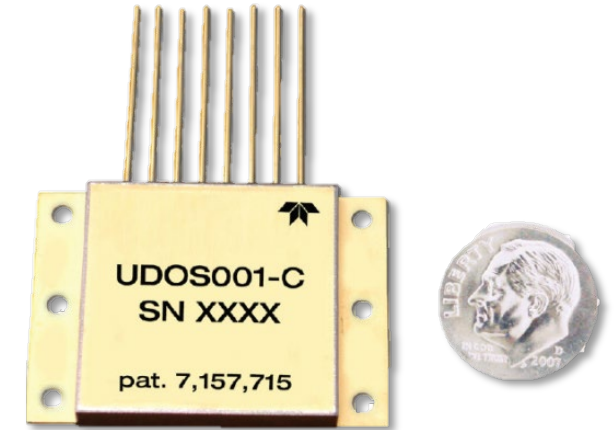
- Standard Dosimeter MedLET μ DOS-001

- 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: -30°C 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: μ DOS-007 also available - as above but with extended -30°C to 70°C temperature range



TELEDYNE e2v HiREL ELECTRONICS Micro Dosimeter

μ DOS001 Micro Dosimeter

Product Specification



Description

The Micro Dosimeter (PN UDOS001) is a compact hybrid microcircuit which directly measures total ionizing dose (TID) absorbed by an internal silicon test mass. The test mass simulates silicon die of integrated circuits on-board a host spacecraft in critical mission payloads and subsystems. By accurately measuring the energy absorbed from electrons, protons, and gamma rays, an estimate of the dose absorbed by other electronic devices on the same vehicle can be made. The Micro Dosimeter can operate from a wide range of power supply voltages. The accumulated dose is presented to three cascaded dc linear outputs and one pseudo-logarithmic output giving a dose resolution of 14 μradSi and a measurement range up to 40 kradSi. These outputs are intended to be directly connected to most analog-to-digital converters (ADCs) or spacecraft housekeeping analog inputs (0 - 5V range), which makes minimal demands on the host vehicle.

Part Number	Description
UDOS001-C	Micro Dosimeter - Commercial
UDOS001-H	Micro Dosimeter - Class H Equivalent Screening

Better than Industry Standards

- First compact microcircuit that provides a repeatable measurement of radiation dose over a wide range of energies
- Uses a patented integrator architecture to produce a fast energy response
- High reliability hermetic packaging

Features/Benefits

- Enables routine monitoring of spacecraft radiation environment
- Custom microchip in a small footprint package which results in significantly lower weight and power than alternative devices
- Can be mounted in multiple locations on spacecraft
- Correlates environmental models and ray-tracing analysis with real-in-flight measurements
- Provides total mission dose to aid in diagnosis of spacecraft anomalies that result from changes in environmental fluxes
- Dosimeters can be integrated to standard spacecraft housekeeping systems
- Measures up to 40 kradSi
- Mechanical dimensions: 1.4" x 1.0" x 0.040"
- 20 grams in weight
- 10 mA from 13 Vdc to 40 Vdc input
- Simple linear analog output
- Commercial Class H equivalent screening available

Classification Description

- Commercial - Electrical Test Only
- Class H - MIL-PRF-38534 Equivalent Screening

Location of Detector



Pin 1

Location of Detector

Page 1 of 5

[Download datasheet](#)



Frequently Asked Questions



Frequently Asked Questions

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.



Frequently Asked Questions

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.

