



# Radiation Micro Dosimeter

Approved for  
Export DAR  
04/27/2010

# Teledyne Microelectronic Technologies

## ◆ Microelectronic Packaging & Products

- COTS to Class K
- More than 250,000 single die to multichip packages per year



## ◆ Technologies

- RF & Microwave
- Optoelectronics
- Secure Communications
- Power and Mixed Signal
- LED Backlights & Light Engines
- Ultra-high Speed Communications



## ◆ Markets

- Defense (Class H certified)
- Avionics
- Space (Class K certified)
- Secure Communications
- Ruggedized Industrial

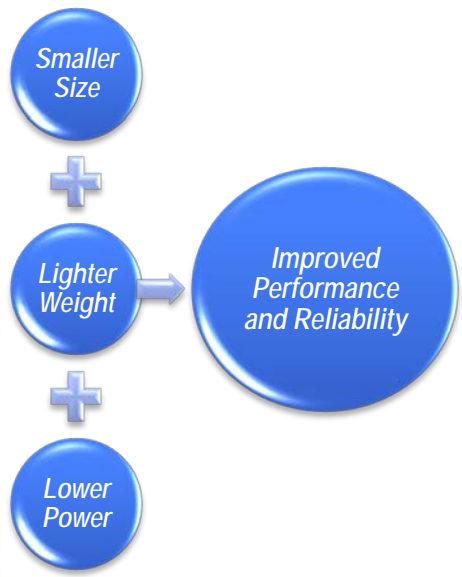


# Teledyne Microelectronic Technologies

- ◆ World Class Facility, established in 1964
  - Los Angeles, California
  - 140,000 ft.<sup>2</sup> total
  - 90,000 ft.<sup>2</sup> manufacturing floor (65,000 ft.<sup>2</sup>. clean room)
- ◆ From prototype to production
  - Enhance design for manufacturability
  - Miniaturize size and reduce weight
  - Improve performance and reliability
  - Comprehensive testing and screening
  - Obsolescence management
- ◆ Microelectronics Trusted Source
  - Packaging, Assembly and Test Services
  - DoD Accredited to
    - Mission Assurance Category 1
    - Trusted Category 1A



# Major Customers & Technologies




- Boeing
- DRS
- Goodrich
- ITT
- L3 Communications
- Maxwell
- Northrop Grumman
- Raytheon
- Semtech
- St. Jude

**Mixed Signal**




- Boeing
- Comtech PST
- ITT
- L3 Communications
- Lockheed Martin
- National Instruments
- Raytheon
- Rockwell Collins
- Semtech

**RF/Microwave**




- Boeing
- Goodrich ISR
- Harris
- Honeywell
- L3 Communications
- Opticomp
- Raytheon
- RIO
- Rockwell Collins

**Optoelectronics**



- Airbus
- BAE Systems
- Boeing
- Borisch
- Curtiss Wright
- Diehl
- GE Aviation
- Hamilton Sundstrand
- Honeywell
- Lockheed Martin

**Power**




- BAE Systems
- Boeing
- ITT
- NSA (MPO)
- Raytheon
- SafeNet
- Sandia
- SPAWAR
- Trimble
- VIASAT

**Secure Communications**




- Aerojet
- Astrium
- Boeing
- Harris
- ITT
- JPL
- L-3 Communications
- Lockheed Martin
- Moog
- Northrop Grumman

**Space**



- Fourth Dimension
- Intervac Photonics
- Kopin
- NVIS
- Red Digital Cinema
- Rockwell
- Schott

**LED Backlights & Illuminators**



# Pioneers in Space

## Spacecraft

- ISSA
- Hubble
- Susei
- MESUR
- Sakigake
- Clementine
- Mars Science Laboratory
- Voyager
- Mars Obsv
- Magellan
- Ulysses
- Cassini
- Mars Global Surveyor
- Viking
- Galileo
- Giotto
- Spacelab
- Huygens

## Satellite

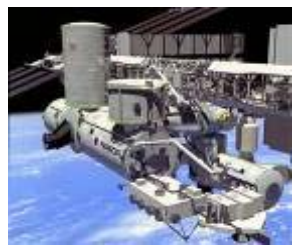
- Tiros
- INTELSAT
- ERS
- SBS
- OAO
- Globalstar
- Satcom4000/5000
- Hubble and JW Space Telescopes
- DOT
- Galaxy
- Westar
- GOES
- Landsat
- HS601/701
- ANIK
- Palapa
- Brazilsat
- DRIRU
- Solarmax
- Spaceway
- GLAST

## Launch & Reentry Vehicles

- Titan
- Centaur
- Shuttle
- Minuteman
- Delta
- Atlas
- Scout
- Trident
- IUS
- MK12A
- MX
- D5

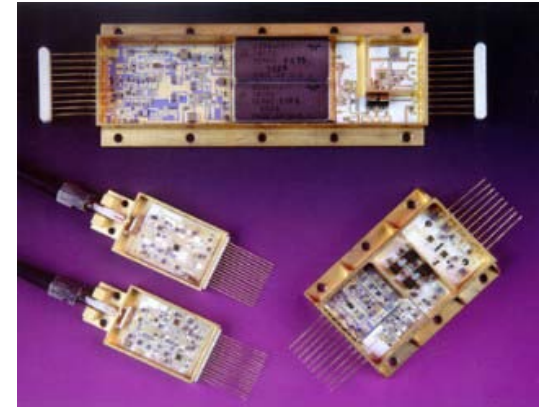
## Military Spacecraft

- DSCS
- GPS
- TDRSS
- SDI
- PMALS
- DMS
- PRISM
- Crosslink
- Milstar
- PMS
- Zodiaque
- Classified



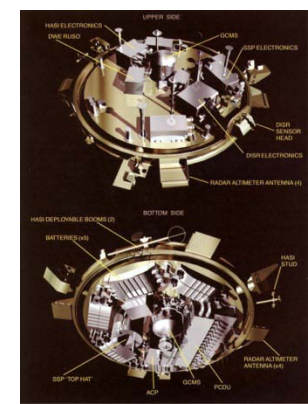
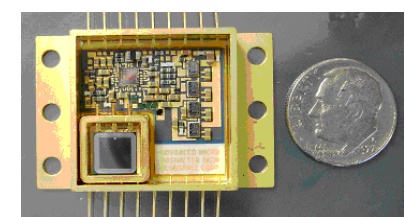
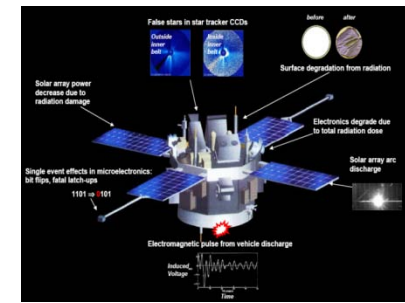
# Space Modules to Class K

- ◆ Radiation Micro-Dosimeter
- ◆ Inertial Navigation
- ◆ Power Management and Control
- ◆ Stepper Motor Control and Stabilization
- ◆ Heater Control
- ◆ Imaging, Camera Pointing and Control
- ◆ Processor and Memory
- ◆ Arcjet Thruster Control
- ◆ TWT Control
- ◆ NTSC Analog Video Modulator/Demodulator
- ◆ FDDI Optical Transmitter/Receiver
- ◆ Radar Altimeter  
Transmitter/Receiver  
Up/Down Converter



# Radiation Micro Dosimeter

- ◆ **Problem:** Electronics degrade with accumulation of radiation dose
- ◆ **Solution:** Teledyne's Radiation Micro-dosimeter
- ◆ Small enough to
  - place at multiple locations
  - surface and payload
- ◆ Real time data
  - alert for hazardous conditions
  - alarm for hostile action
  - anomaly diagnosis
- ◆ Accumulated data
  - improve radiation models & electrical designs
  - lead to improvements in spacecraft design
- ◆ More accurate modeling, reduces need for costly ray-tracing environmental analysis
- ◆ Dose budgets can be developed to establish more accurate estimates of spacecraft life



# Additional Markets

## ◆ Defense Aircraft, Ships & Vehicles

- Provide a radiation monitor to alarm operators of
  - hazardous environmental conditions
  - hostile action
- Optimize future radiation models & electronic designs
- Measure radiation during the disarming and storage of nuclear weapons

## ◆ Nuclear

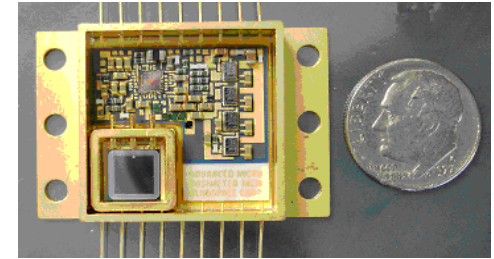
- Determine the radioactivity level in waste
  - Storage
  - Transportation
  - Disposal

## ◆ Medical

- Monitoring the exposure of personnel to ionizing radiation.

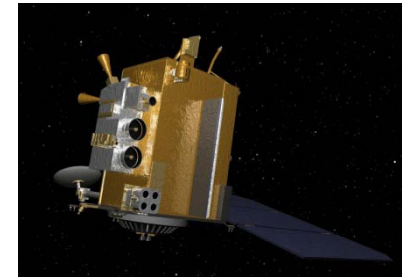
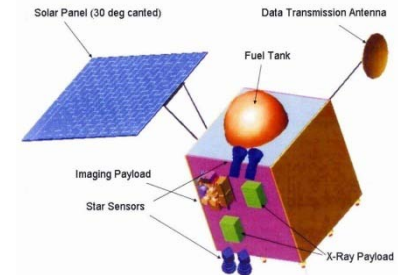
# Radiation Micro Dosimeter Features

- ◆ Size, Weight, And Performance
  - 1.4" x 1.0" x 0.040"
  - 20 grams
  - 10 mA from 13V to 40V input
  - 20 $\mu$ rad to 100Krad
- ◆ Small footprint: can be installed next to sensitive components or areas of concern for radiation exposure
- ◆ Plug & play: connects to standard spacecraft housekeeping, power and communication busses
- ◆ Direct measurement of radiation dose vs alternative indirect measurements
- ◆ Integrates signal prior to threshold detection to improve charge collection accuracy
- ◆ 3 linear DC and 1 pseudo-log output pins
- ◆ 2 U.S. Patents, ITAR Controlled



# Radiation Micro Dosimeter Missions

- ◆ 2008: ISRO Chandrayaan Lunar Orbiter
- ◆ 2009: NASA Lunar Reconnaissance Orbiter
- ◆ 2009: NASA International Space Station
  - MISSE-7B test bed
- ◆ 2009: NRL & Boeing, LEO orbit
- ◆ 2010 planned missions
  - “Deal” mission: first feedback for improving electron and proton environmental models.
  - NASA Radiation Belt Storm Probe (RBSP): inside an instrument called Relativistic Proton Spectrometer.



# Sharing Data Information

- ◆ The Aerospace Corporation requests that Micro Dosimeter data be shared with them
- ◆ The Aerospace Corporation plans to use the data for the purpose of improving space environment models used to predict radiation dose data
- ◆ The goal is to process data from the multitude of Micro Dosimeters in orbit
- ◆ Aerospace will update their models using this information, and will distribute back to the space community
- ◆ Contact information:
  - Sean Reeves, Office of Intellectual Property Mgmt  
P.O. Box 92957-M1/300  
Los Angeles, CA 90009-2957  
310-336-5437, [Sean.reeves@aero.org](mailto:Sean.reeves@aero.org)  
or
  - Dan Mabry, Director Space Instrumentation  
M2/269, 310-336-7335, [Dan.J.Mabry@aero.org](mailto:Dan.J.Mabry@aero.org)

# Frequently Asked Questions

## General Performance:

- ◆ **Q:** *What kind of radiation does the Dosimeter measure?*  
**A:** Electrons, Protons, Gamma Rays
- ◆ **Q:** *How much radiation does it measure?*  
**A:** 20uRads to 100kRads, broadest range in the market
- ◆ **Q:** *What is the survivability (max. radiation exposure)?*  
**A:** 100kRads
- ◆ **Q:** *Why is the operating temperature only -30 to +40°C?*  
**A:** This is standard range for space level components
- ◆ **Q:** *Are evaluation boards available?*  
**A:** They may be available in the future (6 – 8 months)

# Frequently Asked Questions

## Electrical:

- ◆ **Q:** *How much do I have to regulate the power supply?*  
**A:** Unregulated power between 13V and 40V is acceptable
- ◆ **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:** As long as voltage is within 13V and 40V it is okay
- ◆ **Q:** *What is the output voltage 0 to 5V; can it be converted to current?*  
**A:** We do not measure the output impedance

# 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 or Class K. (Typ. 3000 Gs.)

# Frequently Asked Questions

## Reliability:

- ◆ **Q:** *Does temperature affect accuracy of the device?*  
**A:** The device will meet all performance specifications within the operating range on the datasheet
- ◆ **Q:** *Are there any ROHS prohibited materials in the device?*  
**A:** All materials in the device are compliant to MIL-PRF-38534 Class H or Class K. A quotation can be provided if a more extensive analysis is required