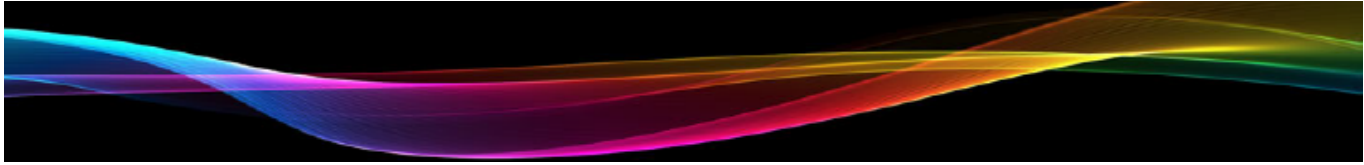# NuDOS Microdosimeter

Product Specification

Features

- Measure ionized dose of electron, proton and gamma rays

- Small footprint package and lower weight

- Measures > 40 krads

- 5 V single rail operation

- Operating Current: 10 mA max

- Simple linear analog output

- Commercial and Class H equivalent screening

- Shielded on five sides by 3 mm of Kovar

- 8-bit DAC: 14 µrad resolution

Applications

- Space situational awareness
- Space-weather sensing
- Simple analog telemetry interface
- A&D, Industrial, Medical, Security radiation measurements

Description

Three new variants to the standard micro-dosimeter provide low, medium, and high energy range coverage to discriminate radiation effects associated with exposed materials and components having varying degrees of shielding in a spacecraft system. The detector can be left open to space, lightly shielded by a thin foil, or heavily shielded with custom covers. A system of several dosimeters can be arranged to provide some spectral information about the environment. The electronics require a 5-volt input for simple integration within most electronic systems on a space vehicle.

All three microdosimeter variants use the same principle of operation. A silicon detector serves as a test mass. The detector is reverse biased to create a volume that is depleted of free charge. Radiation causes ionization in the active volume, resulting in a net current that flows into a low noise preamplifier within a device.
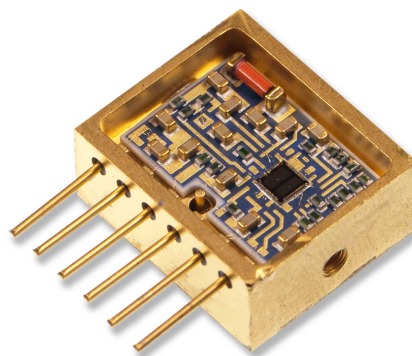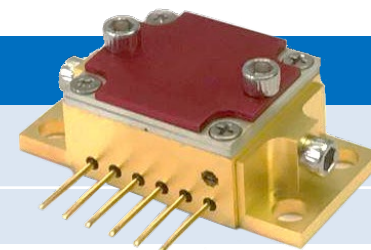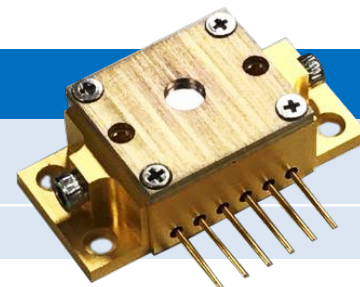

NuDOS Microdosimeter

Ordering Information

Part Number	Description
2307640-1	NuDOS001-H Low-LET Microdosimeter - Cass H Equivalent Screening
2307640-2	NuDOS001-C Low-LET Microdosimeter - Commercial
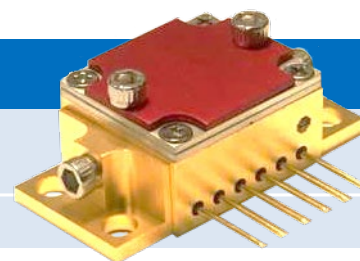
Part Number	Description
2307665-1	NuDOS002-H Med-LET Microdosimeter - Class H Equivalent Screening
2307665-2	NuDOS002-C Med-LET Microdosimeter - Commercial

Part Number	Description
2307670-1	NuDOS003-H Hi-LET Microdosimeter - Class H Equivalent Screening
2307670-2	NuDOS003-C Hi-LET Micrdosimeter - Commercial

Description

The NuDOS microdosimeters are compact hybrid microcircuits which directly measure total ionizing dose (TID) that is absorbed by an internal sensor. The sensor measures the incident radiation that is at that location on the satellite and also seen by the on-board electronics in critical mission payloads and subsystems. The sensor is shielded on five sides by 3 mm of Kovar with the active surface exposed. This reduces error associated with side penetrating particles. The sensor can be left open to space, lightly shielded by a thin foil, or heavily shielded with a custom cover. A system of dosimeters can be arranged to provide some spectral information about the environment.

The electronics require a 5-volt input for simple integration. A separate pin is provided for the detector bias to allow for a higher bias voltage. 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 payload and subsystem can be made. The accumulated dose is presented to two cascaded dc linear outputs giving a dose resolution of 14 µrads and a measurement range up to 0.9 rads. A test input (TESTIN) pin is provided to test the dosimeter electronics in the absence of radiation. A function generator can be used to create a saw-tooth waveform to simulate the detector response.

Ratings

Parameters	Symbol	Min	Max	Units
Operating Voltage	V_{CC}	4.75	5.25	Vdc
Operating Current	I_{CC}	5	10	mA
Detector Bias Voltage	V_{DET}	5	10	Vdc
Dose Rate		1	10,000	µrad/sec
Integrated Error		-20	+20	%
Low-LET Energy Threshold	$E_{t\text{-}LOW}$	40	60	keV
Med-LET Energy Threshold	$E_{t\text{-}MED}$	90	110	keV
Hi-LET Energy Threshold	$E_{t\text{-}HI}$	800	1,200	keV
Energy Range	E_r	E_t	15	MeV
DAC$_{LOW}$ Sensitivity Range	S_{LOW}	12	16	µrad/step
DAC Voltage Step		15	25	mV
DAC Output Voltage Swing		0	5	V
DAC Output Impedance		8	12	kΩ
Operating Temperature	T_O	-30	+50**	°C
Storage Temperature	T_S	-50	+125	°C

**Testing may be run at alternate temperatures per PO request – performance is not guaranteed

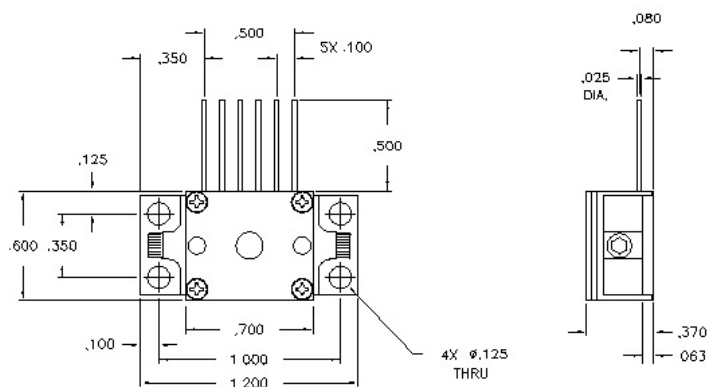## Pin Specifications

Pin	Description	Notes
1	+5 V input	
2	Ground	
3	Detector Bias	5-volts to 10-volts
4	Test Signal Input	TESTIN
5	DAC$_{MED}$ Output	0 to 5-volts in 19.5 mV steps
6	DAC$_{LOW}$ Output	0 to 5-volts in 19.5 mV steps

DAC Output Conversions

DACx	Dose Conversion	Range
Low (Pin 6)	14 µrad/19.5 mV	0 – 3.6 mrad(Si)
Med (Pin 5)	3.6 mrad/19.5 mV	0 – 0.9 rad(Si)

Mechanical Configuration

Package Dimensions (inches)

Application Information

Grounding
The NuDOS case is electrically connected to pin 2 inside the hybrid in order to minimize electromagnetic interference on the sensitive detector electronics. Isolate the dosimeter case from structural chassis to avoid ground loops.

Supply Voltage
Ensure voltage input is stable and maintains the required voltage level. Ripple from dc converters and line noise from other sources should be kept below 100 mVrms.

Energy Threshold
The NuDOS typically will integrate the dose absorbed by the silicon detector for energy deposits in the nominal range of 100 keV to 15 MeV.

Calibration
Each dosimeter can be exposed to a known "fixed" source level of ionizing dose by the end user to calibrate the dosage input to DAC output. Positioning of the dosimeter and area shielding can be used for directional mapping of radiation events.

DAC Output Resets
When any of the DAC outputs reaches its maximum value of 5-volts, the output is reset to 0-volts and the next higher DAC is incremented by 1 step. If the device reaches its maximum dose (i.e., the internal dose counter reaches its maximum), the NuDOS will reset all outputs and continue stepping in response to radiation. The outputs should be buffered or connected to a high impedance ADC. During operation, the outputs should be sampled at the same time to avoid TID ambiguity.

Notes

Trademarks are the property of their respective owners.

Product Specification The data sheet contains final data. In the event Teledyne e2v HiRel Electronics decides to change the specifications, Teledyne e2v HiRel will notify customers of the intended changes by issuing a PCN (Product Change Notification) form.

Data
Teledyne e2v HiRel requests that the microdosimeter data be made available to The Aerospace Corporation for the purpose of improving space environment models used to predict radiation dose with the multitude of microdosimeter data obtained from orbits.

Teledyne e2v HiRel Electronics
765 Sycamore Drive
Milpitas, CA 95035 USA

+1 (408) 737 0992   **www.tdehirel.com**

Email us: **hirel@teledyne.com**

TELEDYNE e2v
HIREL ELECTRONICS
Everywhere**you**look™

A Teledyne Defense Electronics Company