TELEDYNE e2v
HIREL ELECTRONICS
Everywhereyoulook™

µDOS001
Micro Dosimeter
Product Specification

PART NUMBER	DESCRIPTION
UDOS001-C	Micro Dosimeter - Commercial
UDOS001-H	Micro Dosimeter - Class H Equivalent Screening

DESCRIPTION

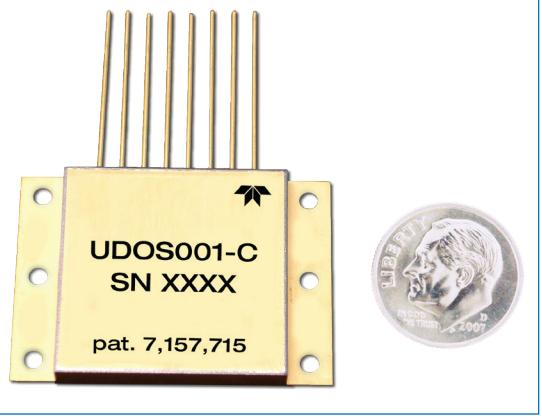
The Micro Dosimeter (P/N UDOS001) is a compact hybrid microcircuit which directly measures total ionizing dose (TID) absorbed by an internal silicon test mass. The test mass simulates silicon die of integrated circuits on-board a host spacecraft in critical mission payloads and subsystems. By accurately 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 µrad(Si) and a measurement range up to 40 krad(Si). 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.

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 analyses 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 krad(Si)
- 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

NOTE

Teledyne e2v HiRel Electronics requests that the Micro Dosimeter 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 Micro Dosimeter data obtained from orbits.



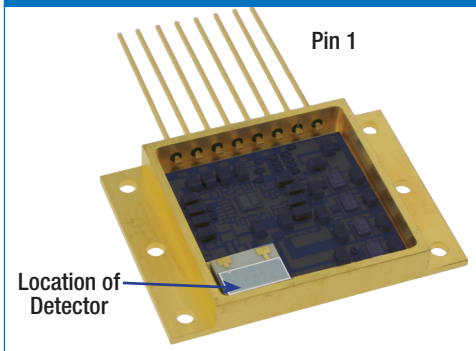
BETTER THAN INDUSTRY STANDARDS

- 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 flat energy response
- High reliability hermetic packaging

CLASSIFICATION DESCRIPTION

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

LOCATION OF DETECTOR



PRINCIPLE OF OPERATION

The UDOS001 incorporates a silicon detector (3 mm x 7 mm x 250 µm) and a pulse-processing architecture that creates a shaped pulse in response to ionizing radiation. This pulse is integrated into an accumulator circuit. The integration continues for each event until a preset limit is reached. When this happens, a Quanta of charge is removed from the integrator equal to a value of 14 µrads, and a counter value is incremented. This counter is divided into sub-groups of 8 bits which are each presented to a D/A converter. The DAC Low range gives dose as 14 µrads per 19.5 mV step, the DAC Medium range is 256 times the Low range, and the High is 256 times the Medium range. The UDOS001 will retain the value of the dose for as long as it is powered. A Pseudo-Log output can be sampled at a very low rate to monitor the total dose over extended periods of time. The other DAC ranges can be sampled at higher rates to obtain useful dose rate measurements.

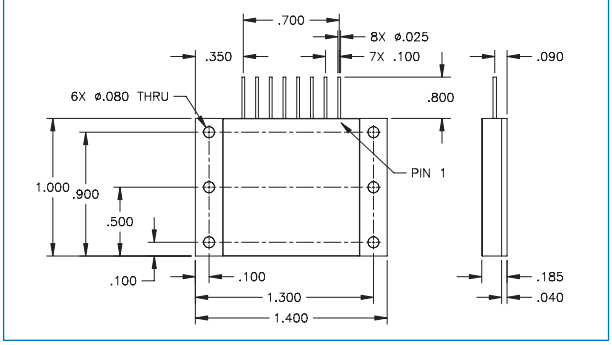
Note: The dosimeter does not measure incident energy directly. The dosimeter measures the amount of energy absorbed in the silicon detector due to the energy loss of the particle as it passes through the detector volume.

Parameters	Symbol	Min	Max	Units
Supply Voltage	V_{cc}	13	40	Vdc
Supply Current	I_{cc}	8	12	mA
Dose Rate		1	10,000	µrad(Si)/sec
Integrated Error		-20	+20	%
Low Energy Threshold	E_t	60	120	keV
Energy Range	E_r	E_t	15	MeV
Dose Sensitivity	S	12	16	µrad(Si)/step
DAC Voltage Step		15	25	mV
DAC Output Voltage Swing		5		V
DAC Output Impedance		8	12	kΩ
Relative Humidity	RH	0	90	%
Operating Temperature	T_o	-30	+40	°C
Storage Temperature	T_s	-40	+ 110	°C

PIN SPECIFICATIONS

Pin	Description	Notes
1	Power	
2	Ground	
3	Reserved - connect to ground during normal operation	
4	N/C - should be formed and mounted	
5	DAC Output - Low Range	Low
6	DAC Output - Medium Range	Medium
7	DAC Output - High Range	High
8	DAC Output - Pseudo-Log	Log

MECHANICAL CONFIGURATION



The UDOS001 drawing shows the hermetic package, mounting flange and 8 external connections. All dimensions given are in inches and tolerances are ±0.005. The package walls are 0.040 inch thick and the cover is 0.010 inch thick.

RADIATION SURVIVABILITY

Xe-beam testing done at Lawrence Berkeley Labs demonstrated latch-up immunity up to 67.8 LET (MeV-cm^2/mg). Harsh proton susceptibility testing was performed using a high energy beam and UDOS001 showed no degradation up to 40 krad(Si).

DACx	Dose Conversion	Range
Low (Pin 5)	14 µrad(Si)/19.5 mV	0 - 3.6 mrad(Si)
Medium (Pin 6)	3.6 mrad(Si)/19.5 mV	0 - 0.9 rad(Si)
High (Pin 7)	0.9 rad(Si)/19.5 mV	0 - 235 rad(Si)
Log (Pin 8)	Detailed Table Will Be Provided Upon Request	0 - 40 krad(Si)

APPLICATION NOTES

Grounding

The UDOS001 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. No ripple from dc converters, on board voltage supply should be clean.

Energy Threshold

The UDOS001 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/Log Output Resets

When any of the DAC or Log 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 Micro Dosimeter 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.

QUALITY FLOW

The Micro Dosimeter hybrids are built using commercial grade and military grade components. All assembled hybrids receive full electrical testing at HIGH, LOW and ROOM operating temperature ranges. Class H-equivalent screening options are available as per the screening tables below:

Class H-equivalent Screening Options

CLASS H	SCREENING
	Active Elements (every wafer lot)
•	100% high magnification visual
•	100% probe at room temperature
	Samples assembled and put through standard environmental screening including burn-in and electrical at min, max and room temp
	Life test
	Scanning Electron Microscope (SEM)
•	Wire bond pull
	Passive elements (capacitors, resistors, inductors – per component manufacturing lot)
•	100% visual
	100% electrical on select parameters at room temp
•	Sample assembled and screened including voltage aging and full electrical at room temp
•	Wire bond pull
	Packages (samples per plating lot, Group D if performed in-line)
•	Physical dimensions
•	Solderability
•	Thermal shock, high temp bake, lead integrity, seal
•	Salt atmosphere (one time)
•	Metal package isolation
	Group C – One Time and for Changes
•	Life Test 1000 hrs, 125°C
•	Internal water vapor, max 5000 ppm water
•	ESD classification testing

CLASS H	SCREENING
	Hybrid Microcircuit 100% Testing
	Non-destructive bond pull
•	Internal visual inspection
•	Temperature cycling 10 times from -65°C to 150°C
•	Constant acceleration 3,000 G
	PIND 1% PDA on 5th run and under 25T total
•	Burn-in 160 hours at 125°C, PDA 10%
•	Burn-in 320 hours at 125°C, PDA 2% second half of burn-in
•	Seal (fine and gross)
•	Electrical test at min, max and room temp
	Radiography
•	External visual
	Conformance Inspection
•	Group A Electrical
	Periodic Testing (Group B in-line or end-of-line)
•	Physical dimensions
•	Resistance to solvents
•	Internal visual and mechanical
•	Destructive wire bond strength after 300°C bake
•	Die shear
•	Solderability
•	**Qualification of Processes and Material - Standard**

Contact Information:

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