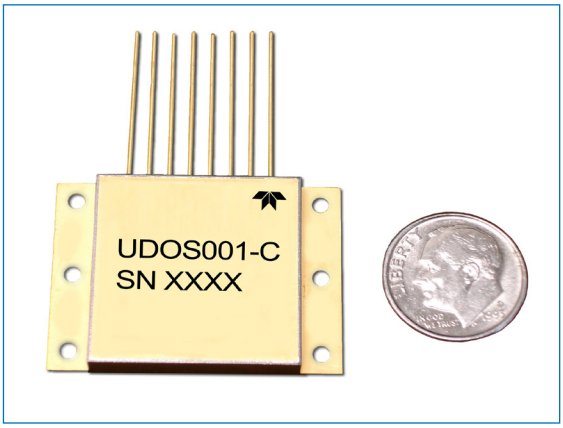
TELEDYNE
MICROELECTRONIC TECHNOLOGIES
Everywhereyoulook™

# µDOS001
## Micro Dosimeter

| PART NUMBER | DESCRIPTION |
|---|---|
| UDOS001-C | Micro Dosimeter - Commercial |
| UDOS001-H | Micro Dosimeter - Class H |
| UDOS001-K | Micro Dosimeter - Class K |




## 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 input voltages. The accumulated dose is presented to three DC linear outputs and one pseudo-logarithmic output giving a dose resolution of 14 uRads and a measurement range up to 40 krads. 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. The Micro Dosimeter incorporates a test function to allow electrical testing of the hybrid without the need for a radiation source.

## FEATURES/BENEFITS

- Enables routine monitoring of spacecraft radiation environment
- Custom microchip in a small footprint package which results in a significantly lower weight and power than alternative devices
- Can be mounted in several locations on spacecraft
- Correlates environmental models and ray-tracing analyses with real in-flight measurements
- Provides total mission dose and dose rate data to aid in diagnosis of spacecraft anomalies that result from changes in environmental fluxes
- Dosimeters connect to standard spacecraft housekeeping systems
- Measures up to 40 krads
- Mechanical dimensions: 1.4” x 1.0” x 0.040”
- 20 grams in weight
- 10 mA from 13V to 40V input
- Simple linear analog output
- Easy to integrate on spacecraft
- Commercial, Class H, and Class K options available

## NOTE

Teledyne 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.

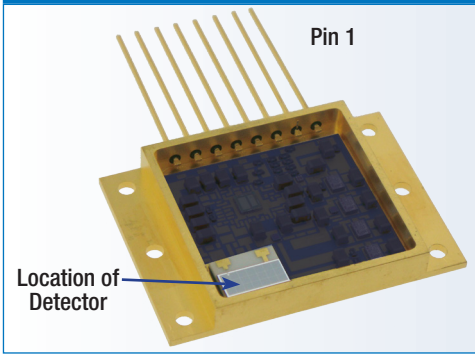
## BETTER THAN INDUSTRY STANDARDS

- First compact microcircuit that provides a repeatable measurement of radiation dose and dose rate over a wide range of energies
- Uses a patented integrator architecture to produce a flat energy response
- High reliability
- Can be tested without a radiation source

## CLASSIFICATION DESCRIPTION

- Commercial - Electrical Test Only
- Class H - MIL-PRF 38534 Class H Screens and Qual
- Class K - MIL-PRF 38534 Class K Screens and Qual

## LOCATION OF DETECTOR



## PRINCIPLE OF OPERATION

The UDOS001 incorporates a silicon detector (3mm x 7mm x 250um) and a pulse-processing architecture that creates a gaussian shaped pulse in response to ionizing radiation. The gaussian pulse is presented to an integrator which integrates the area under the pulse. In this manner pileup effects are minimized. 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 urads, 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 urads per 19.5mV 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.

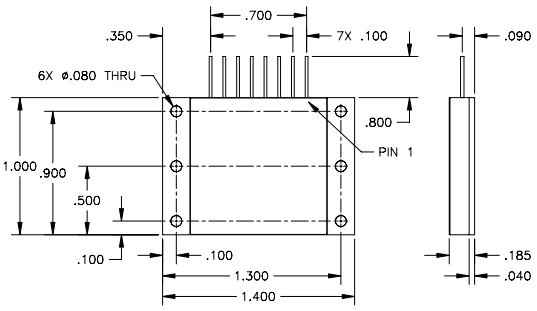
## RATINGS

| Parameters | Symbol | Min | Max | Units |
|---|---|---|---|---|
| Supply Voltage | $V_{cc}$ | 13 | 40 | V |
| Supply Current | $I_{cc}$ | 8 | 12 | mA |
| Dose Rate | | 1 | 10,000 | uRads/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 | uRads/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 | TEST - Test Input Pulser Connection | See Appl Notes |
| 4 | N/C | |
| 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 Krads.

## DAC OUTPUT CONVERSIONS

| DACx | Dose Conversion | Range |
|---|---|---|
| Low (Pin 5) | 14 uRad / 19.5 mV | 0 - 3.6 mRads |
| Medium (Pin 6) | 3.6 mRad / 19.5 mV | 0 - 0.9 Rads |
| High (Pin 7) | 0.9 Rad / 19.5 mV | 0 - 235 Rads |
| Log (Pin 8) | Detailed Table Will Be Provided Upon Request | 0 - 100 kRads |

## 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 inside. If the device is to be connected to a spacecraft unregulated power bus, care must be taken to ensure that the UDOS001 case is mounted so that it is electrically isolated from the spacecraft structure. That way, the wire connected to pin 2 will return current to the spacecraft star ground and no ground loops will be inadvertently created.

### 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.

### TEST Signal

TEST Signal is not needed for normal operation and is intended for test purposes only. In the absence of a radiation source, the UDOS001 can be tested using the TEST input pin 3. The TEST input should be a ramp signal with a negative-going edge (Tfall < 100 nsec) and an amplitude corresponding to a simulated energy deposit in the detector. The conversion is typically 10.5 keV/mV. The rising edge of the TEST input should be slow (Trise > 10 usec) so that opposite polarity signal does not corrupt the integrator output. The TEST input is internally terminated to pin 2 through a 49.9 ohm resistor. The TEST input amplitude must not exceed 1 volt to prevent damage to the device. Because TEST is sensitive to noise, it is best to leave the TEST input disconnected or terminated to ground during the dose measurement.

### Temperature Effects

Although the UDOS001 is operational over the range specified above, low dose rate accuracy may require operation at or below 25°C. The UDOS001 contains a silicon detector whose current noise is a function of temperature. Operation beyond the specified temperature limits (but within the storage limits) will not cause permanent damage, but the quiescent DAC outputs will be non-zero and will change at a finite rate due to the counting of noise charge. This represents an error in the measured dose rate. Users may choose to measure this effect in the lab and subtract it from operational data. However, applications where the expected dose rate is very low should consider keeping the dosimeter biased cold.

### DAC/Log Output Resets

When any of the DAC or Log outputs reaches its maximum value of 5-volts, the counter is incremented and the output rolls-over and begins stepping from 0-volts. This happens frequently for the Low range and less frequently for the High and Log ranges. 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.

# Teledyne Sales Contacts

## NORTH AMERICA

### Inside Sales, South

Shannon Giddens
Tel: 310.577.3882
Email: sgiddens@teledyne.com

### Eastern

Harry Kellzi
Tel: 310.574.2097
Mobile: 310.990.9178
Email: hkellzi@teledyne.com

### Western

Al Gaertner
Tel: 310.574.2066
Mobile: 805.444.3161
Email: agaertner@teledyne.com

## EUROPE

Olivier Dilun
Tel: 33 (0) 1 6405 8118
Email: odilun@teledyne.com

France, Greece, Italy, Portugal, Russia, Scandinavia, Spain, Turkey, Eastern Europe

Gordon Fagg
Tel: 44 (0) 1202 570940
Email: gfagg@teledyne.com

Australia, Austria, Benelux, Germany, Ireland, Israel, South Africa, Switzerland, United Kingdom

## ASIA

Harry Kellzi
Tel: 310.574.2097
Mobile: 310.990.9178
Email: hkellzi@teledyne.com

TELEDYNE
MICROELECTRONIC TECHNOLOGIES
Everywhereyoulook™

12964 Panama Street | Los Angeles, CA 90066 | 310.822.8229 | 800.518.1015
microelectronics@teledyne.com | www.teledynemicro.com