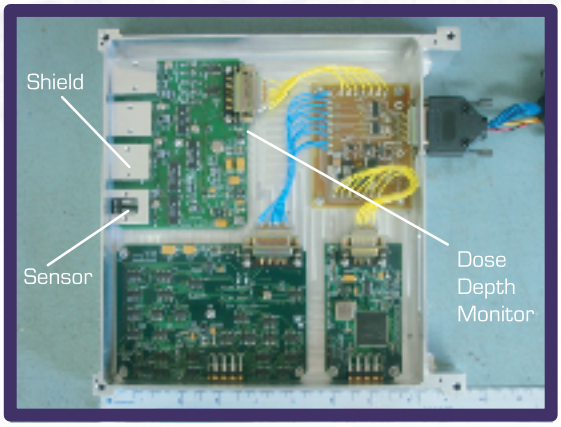
Dose Depth Monitor

SPACE DOSIMETRY

The most significant radiation hazards to spacecraft electronics are degradation effects and failures due to total dose and single event effects (SEEs). The level of radiation experienced by satellite and spacecraft electronics varies considerably, according to the shielding provided by the spacecraft and the payload enclosures. An instrument which gives data on the total dose as a function of shielding thickness is more valuable than a single dose measurement. Such an instrument is known as a Dose Depth Monitor (DDM).

The Dose Depth Monitor has been designed to measure the total dose at four shield thicknesses typical of different positions in the payload. These shields are provided by Thomson Nielsen. The monitor consists of four dual MOSFET sensors, each with a different thickness of shield material.

Although MOSFET dosimeters have been used for several years in satellites, one severe limitation has been the fact that the parameter, which is a function of radiation dose (threshold voltage), is also a strong function of temperature. As a result, the temperature must be measured accurately and accounted for in calculating total dose. Thomson Nielsen's patented dual MOSFETs overcome this drawback by using two MOSFETs on the same die. One is made more sensitive to radiation by having a higher positive gate bias than the other. Total dose is proportional to the differential threshold voltage from such devices. This technique reduces the temperature effect on threshold voltage from ~ 2 mV / ºC to < 0.1 mV / ºC.



This picture shows the DDM with shields in the top left corner of a Satellite tray. These monitors are based on space qualified instruments developed for space technology research vehicle (STRV) satellite[1].

For more information on "off-the-shelf" or custom monitors using our unique radiation detection technologies, contact us at: www.thomson-elec.com.

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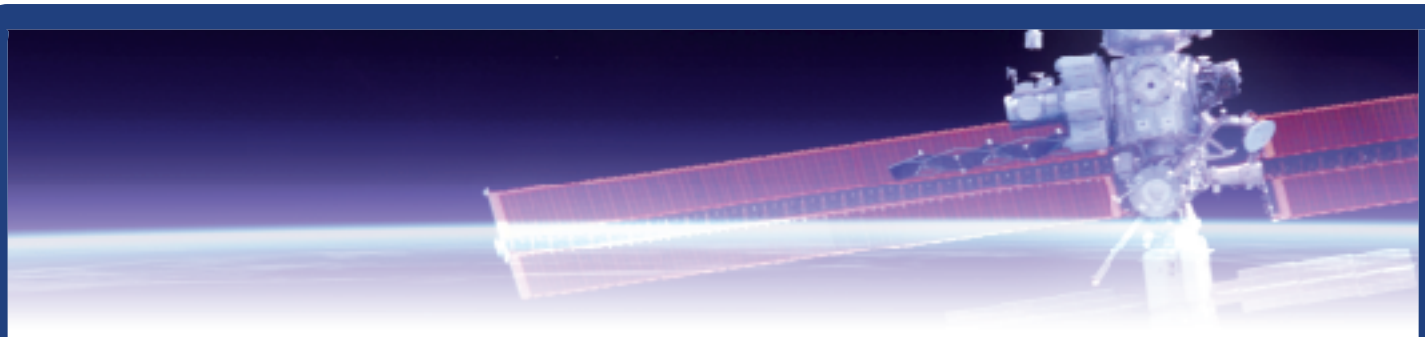

SPACE DOSIMETRY

Radiation Characterization

Since the target dose to be monitored by the four MOSFET sensors will be mission dependent, MOSFETs with different sensitivities and bias voltages are available. It is essential to choose the appropriate sensitivity and bias voltage that will monitor the dose range required without sacrificing resolution. MOSFETs are packaged in 8 pin dip packages and can be mounted in right angle sockets or directly to a board. More MOSFET data is available in Thomson Nielsen Technical Note No.4.

MOSFET dosimeters have been characterized using Co60 radiation for their response as a function of total dose under various bias conditions. This is combined with orbital radiation data and aluminum shield data to choose the best sensor and bias combination(s).

System Specifications

Dimensions
4.5" [11.43cm] x 3.65" [9.28cm] (with connector), height is dependent on sensor orientation and shield configuration. Overall height at DB connector is 0.65" [1.65cm].

Voltage
20V minimum, 40V maximum

Power (typical SPI configuration)
16mA @ 24V = 0.384w

Mass
74 Grams (does not include shields (4 = 66Grams) or extra packaging and mounting hardware).

Interface:
SPI (24 bit on board A/D) or Direct Logic input control with multiplexed analog output voltage.

REFERENCES : [1] IEEE trans paper on STRV

Flown on Bion 10 & 11, MIR, International Space Station NASA & Russian Space Agencies in cooperation with the Canadian Space Agency.

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