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RAD/MS-91-2

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Radiation Report on SQXO-2

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A radiation evaluation was performed on SQXO-2 to determine the total dose tolerance of these parts. A brief summary of the test results is provided below. For detailed information, refer to Tables I through III and Figure 1.

The total dose testing was performed using a cobalt-60 gamma ray source. During the radiation testing, five parts were irradiated under bias (see Figure 1 for bias configuration), and one part was used as a control sample. The total dose radiation steps were 5, 10, 20, 30, 50, 75 and 100 krads. After 100 krads, parts were annealed at 25°C for 24 and 168 hours, and then the irradiation was continued to 150 and 200 krads (cumulative). The dose rate was between 0.25 - 2.5 krads/hour, depending on the total dose level (see Table II for radiation schedule). After each radiation exposure and annealing treatment, parts were electrically tested.

The parameter most sensitive to total dose radiation was supply current which increased from an average of 371 uA before radiation exposure, to an average of 1.5 mA at 75 krads. However, the oscillator frequency remained within the specified limits ($\pm 0.02\%$ of 100kHz) for all parts on exposures up to 75 krads. At the next radiation step of 100 krads, two parts (SNs 1 and 3) remained in the high logic state and did not oscillate at all. One other part (SN 0) did not oscillate until 3 seconds after power up. After the 24 hour annealing step, one of the catastrophic failures recovered (SN 1) but required 3 seconds to begin oscillating. The part which had taken 3 seconds to oscillate after power up after 100 krads (SN 0), still required 3 seconds after 24 hours of annealing to begin operating. The next major event happened after 150 krads, when SN 0 failed catastrophically and remained in the high logic state, as well as SNs 1 and 3. After 200 krads accumulated dose, all the parts exposed to radiation were catastrophic failures, all remaining in the high logic state.

Table III provides the mean and standard deviation values for each parameter after different radiation exposures and annealing treatments.

Any further details about this evaluation can be obtained upon request. If you have any questions, please call me at 731-8954.

TABLE I. Part Information

Generic Part Number:	SQXO-2
Manufacturer:	Statek Corp.
Lot Date Codes:	8849, 9036, 9044
Quantity Tested:	6
Serial Numbers of Radiation Samples:	1,3 (LDC 8849); 0 (LDC 9036) 33,34 (LDC 9044)
Serial Numbers of Control Sample:	2 (LDC 8849)
Part Function:	Crystall Oscillator
Part Technology:	Hybrid/Bipolar
Package Style:	TO5

TABLE II. Radiation Schedule

EVENTS	DATE
1) Initial Electrical Measurements	01/26/91
2) 5 krads irradiation @ 250 rads/hr Post 5 krads Electrical Measurements	01/28/91 01/29/91
3) 10 krads irradiation @ 250 rads/hr Post 10 krads Electrical Measurements	01/29/91 01/30/91
4) 20 krads irradiation @ 500 rads/hr Post 20 krads Electrical Measurements	01/31/91 01/31/91
5) 30 krads irradiation @ 500 rads/hr Post 30 krads Electrical Measurements	01/31/91 02/01/91
6) 50 krads irradiation @ 294 rads/hr Post 50 krads Electrical Measurements	02/01/91 02/04/91
7) 75 krads irradiation @ 1250 rads/hr Post 75 krads Electrical Measurements	02/04/91 02/05/91
8) 100 krads irradiation @ 1250 rads/hr Post 100 krads Electrical Measurements	02/05/91 02/06/91
9) 24 hrs annealing Post 24 hr Electrical Measurements	02/06/91 02/07/91
10) 168 hrs annealing Post 168 hr Electrical Measurements	02/07/91 02/13/91
11) 150 krads irradiation @ 2500 rads/hr Post 150 krads Electrical Measurements	02/13/91 02/14/91
12) 200 krads irradiation @ 2500 rads/hr Post 200 krads Electrical Measurements	02/14/91 02/15/91

Notes:

- All parts were radiated under bias at the cobalt-60 gamma ray facility at GSFC.
- All electrical measurements were performed off-site at 25°C.
- Annealing was performed at 25°C under bias.

Table III. Summary of Electrical Measurements
after Total Dose Exposures and Annealing for SQXO-2 1/,2/,3/

Parameters	Initials	Total Dose Exposure (krads)								Anneal		Total Dose (krads)				
		20		50		75		100		168 hrs		150		200		
		mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	
Freq @ 5V kHz		100.0	0	100.0	0	100.0	0	100.0	0	3P/2F		3P/2F		3P/2F		5FAIL
Freq @4.5V kHz		100.0	0	100.0	0	100.0	0	100.0	0	3P/2F		4P/1F		3P/2F		5FAIL
Freq @5.5V kHz		100.0	0	100.0	0	100.0	0	100.0	0	3P/2F		4P/1F		3P/2F		5FAIL
dF(4.5V-5.5V) Hz		0.19	0.12	0.12	0.08	0.21	0.06	0.34	0.07	0.4	.01	0.3	0.1	0.5	.01	5FAIL
ICC1 uA		379	54	693	103	978	242	1.5E3	400	2E3	400	660	211	1.3E3	150	5FAIL
TR ns		24	0.4	21	0.7	26.4	1.0	33.2	2.6	33.3	4.7	29.3	1.9	32	2	5FAIL
TF ns		25	0	21	0.4	25	1.5	32.4	1.9	29.7	3.8	29.8	4.3	29	2	5FAIL
VOH V		5	0	5	0	5	0	5	0	5	0	5	0	5	0	5FAIL
VOL V		0	0	0	0	0	0	0	0	0	0	0	0	0	0	5FAIL

Notes:

1/ The mean and standard deviation values were calculated over the five parts irradiated in this testing. The control sample remained constant throughout the testing and is not included in this table.

2/ Table III provides radiation characteristics of parts at selected total dose exposures and annealing treatments. The data at other radiation exposures and annealing treatments is available and can be obtained upon request.

3/ At 100 krads and above, the mean and standard deviation values were calculated using data on the passing parts only.

Figure 1. Radiation Bias Circuit for SQXO-2

